The City of Quincy Greenhouse Gas Mitigation Plan 2019

Prepared for the City of Quincy

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Photo courtesy of Blum Shapiro

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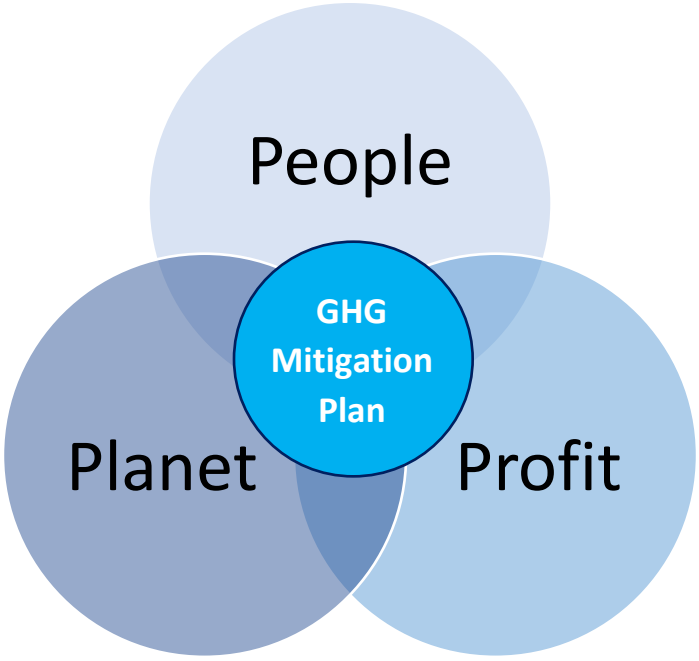
Executive Summary

Since 1792, the City of Quincy has held the core value of improving the lives of its residents. Recently, Quincy residents have been experiencing the negative effects of climate change through erratic temperatures, devastating floods, and extreme weather events. With climate change playing a larger role in the lives of its citizens, Quincy's core value must now consider the importance of community-wide climate action.

Quincy contributes to climate change by emitting greenhouse gases, the majority of which are generated from the City's electricity and natural gas consumption, personal vehicle transportation, and landfill waste. Substantially reducing these emissions will require a plethora of integrated climate action planning measures, such as increasing the electricity grid's renewable energy mix, reducing the use of oil and natural gas for heating, enhancing building energy efficiency, minimizing waste sent to landfill, and mode-shifting to alternate modes of transport such as cycling, walking, and public transit. If the City takes action to reduce its greenhouse gas emissions, it will not only minimize its negative impact on the climate, but it will enhance the lives of its residents, whether through reduced traffic, lower energy costs, or improved public health.

Quincy's municipal government has both the power and the responsibility to effect this transformational, city-wide change. Immediate, bold, and equitable local solutions are needed to address the community's growing climate concerns while simultaneously meeting the City's developmental needs.

This Greenhouse Gas Mitigation Plan presents the first-steps on how Quincy can reduce its impact on climate change while improving its residents' quality of life. It provides a foundational roadmap on how the City can develop a Climate Action Plan which will initiate the transition to a low-carbon future. By following the recommendations in this Mitigation Plan, the City can enable and inspire community-wide climate action that will benefit not only current residents, but future generations to come.



Objective

The Quincy Greenhouse Gas (GHG) Mitigation Plan is a framework for understanding how the City of Quincy can take the first steps to pursue climate action while laying the foundation to promote dramatic emission reductions in the future. This Plan can serve as a resource for Quincy to adapt into a future community-wide Climate Action Plan or Carbon Neutrality Plan. This Plan synthesizes information from the 2018 Community-Wide Greenhouse Gas Inventory, feedback from stakeholders, and research on relevant municipal mitigation measures. Building off this knowledge, this Plan is an exercise in understanding what emissions reduction strategies are currently feasible in Quincy and what enabling actions are needed to promote a culture-shift to a prosperous, low-carbon reality.

The main objective of the Greenhouse Gas Mitigation Plan is to provide a first-steps, foundational roadmap on how Quincy can reduce its impact on climate change while improving the lives of its residents.

Quincy's Energy and Sustainability Director Shelly Dein requested that Harvard University Extension School graduate student Vanessa Goh complete a city-wide greenhouse gas inventory in 2019. The GHG Mitigation Plan translates those results and offers the City guidance on how to focus its mitigation efforts.

The City of Quincy and Climate Change

Global climate change is one of the defining issues of our time. GHG emissions from human activities are the main contributor to this change, with 70% of the world's energy-related GHG emissions stemming from cities.[1] Though climate change is a global issue, its effects will be felt locally. In the United States, the Northeast will experience the impacts of climate change through increased temperatures, precipitation, rising sea levels, and extreme weather events.[2]

As a densely-populated coastal community in the Northeast region, the City of Quincy is particularly vulnerable to the effects of climate change. With 27 miles of coastline and three compact peninsulas, the City is susceptible to coastal flooding due to storm surge and sea level rise. In March of 2018, the City suffered one of its worst natural disasters in the form of a brutal Nor'easter that flooded dozens of homes, left thousands without power, and caused over $10 million in City infrastructure and property damage. A State of Emergency was declared as the resulting tide, the 3rd highest in Massachusetts history, caused more than 500 residents to be evacuated.[3] But the damage didn't stop there; Quincy also experienced multiple weeks of below zero temperatures, flooding of neighborhoods and businesses, irregularly high winter temperatures, and two additional Nor'easters in the same year.

The City has responded to the effects of climate change in various ways. In 2015, the City completed a Climate Vulnerability Assessment and adopted the 5-year update of its Hazard Mitigation Plan (HMP) in 2019. The HMP recognized that climate change presents a huge economic risk that will affect weather patterns, flooding extent, habitat and species distribution, and City disaster recovery efforts. The City is continuing to use the Commonwealth's Municipal Vulnerability Preparedness (MVP)

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[1] World Resource Institute, Global Protocol for Community-Scale Greenhouse Gas Emission Inventories, 2014.
[2] U.S. Global Change Research Program, 2014.
[3] Quincy Sun, 2018.

program to address the impacts of climate change and pursue mitigation strategies identified in the 2019 HMP.

Though Quincy's thorough climate preparedness planning has been a highly visible endeavor, the necessity of GHG mitigation planning has not received equal consideration. In 2018, the International Panel on Climate Change (IPCC) issued a special report that called for limiting global warming to 1.5°C above pre-industrial levels in order to avoid the worst impacts of global climate change. Past this level of warming, severe and irreversible changes will occur to global systems. To achieve this, the Panel called for a rapid and far-reaching sustainable transition in land, energy, buildings, transport, and cities that drastically reduces GHG emissions. Following IPCC recommendations, many countries, states, cities, and businesses have set emission reduction targets and developed comprehensive emission mitigation plans. Massachusetts set a reduction goal of reducing GHG emissions by 80% from 1990 levels by 2050 and developed a Clean Energy and Climate Plan in 2010.

As cities produce the majority of GHG emissions and house the majority of the world's population, they are uniquely positioned to address the issue of climate change. Cities such as Cambridge, Boston, and Somerville have all set ambitious Net Zero emissions targets and have created Climate Action Plans. In 2016, the Metropolitan Mayors Coalition, of which Quincy is a member, created the Metropolitan Mayors Climate Mitigation Agreement which committed the metropolitan region to Net Zero/Carbon-Free status by 2050. This agreement also committed each signee to develop a local climate mitigation plan by 2020.

Despite this, Quincy has not established any City-wide emission reduction targets, nor captured or accounted for emission reductions in previous sustainability measures. Because of this, Quincy does not have a complete understanding of its contribution to climate change and cannot track its emissions reduction progress or effectively plan for climate action. Considering the recent devastating impacts of climate change on its shores, the current development boom, and the growing cultural momentum towards climate action, Quincy should develop a climate plan to address its role in contributing to and combating climate change.

The Greenhouse Gas Mitigation Plan

A Climate Action Plan is a comprehensive roadmap that outlines the specific activities an entity will undertake to reduce greenhouse gas emissions. Climate Action Plans build upon the information gathered by GHG inventories and generally focus on those activities that can achieve the relatively greatest emission reductions in the most cost-effective manner. They are essential in understanding a city's contribution to climate change and outlining its long-term plan to reduce GHG emissions.

This Greenhouse Gas Mitigation Plan will serve as a resource that the City of Quincy can adapt into a future Climate Action Plan. This Plan was created using the results of the 2018 Quincy Greenhouse Gas Inventory, feedback from stakeholders, and research on successful mitigation measures in other local Climate Action Plans. The Quincy Greenhouse Gas Mitigation Plan is a framework for understanding how the City of Quincy can take the first steps to pursue climate action while laying the foundation to promote dramatic emission reductions in the future. As this plan presents the basic "first-steps" in climate action and is not a comprehensive, long-term plan, it is referred to as a Greenhouse Gas Mitigation Plan and not a true Climate Action Plan.

Because of the diversity of the Commonwealth's topography and microclimates, the effects of a changing climate on Massachusetts communities are complex and will differ from community to community. Additionally, because Massachusetts communities themselves are different, strategies for reducing GHG emissions will also vary. This Mitigation Plan acts in concert with the 2018 Community-wide GHG Inventory in order to present Quincy with resources on how to begin targeted climate action planning. The main goals of the GHG Mitigation Plan as well as examples from the Plan are outlined below.

Table 1. Greenhouse Gas Mitigation Plan Goals

1. **Review previous GHG mitigation actions**
    - Green Community designation, transit-oriented development zoning, solar installations
2. **Identify and prioritize strategies for emissions reduction**
    - Green Building Standard, parking requirements, fuel switching
3. **Outline how to incentivize mitigation efforts and engage relevant market sectors in reduction actions**
    - Zoning code, incentive programs, ordinances, collaboration, education and outreach
4. **Provide information to enable effective decision making**
    - Data on emission reduction potential, examples of successful community initiatives, co-benefits of measures
5. **Create a roadmap for basic climate action in order to reduce the City's contribution to climate change and improve the lives of its residents**
    - Outline next steps on how to demonstrate municipal climate leadership, create a community-wide Climate Action Plan, and engage citizens

Opportunities and Risks

As the threat of climate change materializes and surrounding cities increase their mitigation efforts, the City of Quincy has an environmental, financial, and reputational interest in managing its emissions and creating a sustainable community. The benefits of developing an GHG Mitigation Plan directly align with the City's interests and include:

- **Environmental**: Quincy's activities not only produce global GHG emissions but also disrupt local ecosystem services by impacting the quality of the air, water, and natural habitats. Additionally, coastal flooding, erratic temperatures, and extreme weather events will continue to impact Quincy as the effects of climate change intensify. By primarily focusing on preparing for these

events, Quincy is failing to address its contribution to these issues. The GHG Mitigation Plan will help Quincy reduce its negative impact on the local environment and the global climate.

- **Financial**: Climate planning can quantify the relationship between efficiency improvements and emission reductions. Identifying and mitigating emission-heavy activities can ultimately result in decreased spending, resource consumption, and work-hours spent on inefficient processes. It is in Quincy's best interest financially to be proactive instead of reactive when it comes to climate action, especially as energy demand and prices continue to rise. Therefore, climate planning is an essential part of financial planning; it demonstrates that the City is fiscally responsible and devoted to the long-term prosperity of its residents.

- **Risk Management:** As demand for comprehensive climate planning grows on an international level, mandatory state or federal emissions management programs may be established in the future. Preparing for such programs now will aid in Quincy's responsiveness to new regulations and relieve the future reporting burden.

- **Community**: There is a growing movement of Quincy residents calling for climate action and increased municipal transparency. Additionally, existing local issues such as traffic congestion, unhealthy buildings, and inefficient spending can all be addressed through a climate mitigation plan. Creating a sustainable community by reducing emissions and promoting efficiency will increase the health, happiness, and prosperity of residents. Such leadership will not only increase municipal employee engagement and retention, but also enhance Quincy's competitiveness and attract new talent and businesses to the City.

- **Collaboration**: Establishing climate goals allows for cross-pollination of best practices with surrounding cities and organizations. Pursuing strategies that positively impact the lives of Quincy's neighbors can improve relations and enhance cooperation. The majority of goods, services, and emissions cross city borders. Solutions must do the same.

- **Reputational:** Climate planning provides local governments with a pathway to recognize, publicize, and promote their environmental stewardship as well as educate the general public on their efforts. Additionally, Quincy will need to act locally to meet its public commitment on helping the region achieve net zero emissions by 2050.

Key Stakeholders

Shelly Dein, the Director for Energy and Sustainability, is the primary sponsor for this Plan. As a city-wide climate action plan will affect many levels of city government as well as community members, additional stakeholders are listed below.

Table 2. GHG Mitigation Plan Stakeholders

City Stakeholders - Internal	
Name	**Title**
Shelly Dein	Director of Energy and Sustainability
James Fatseas	Director of Planning and Community Development
Chris Cassani	Director of Traffic Parking, Alarm, and Lighting
John Sullivan	Director of Waste and Recycling
Thomas P. Koch	Mayor
City Council Members	
City Stakeholders - External	
Quincy Residents and Employees	
Quincy Climate Action Network	
Metropolitan Area Planning Council	

Plan Guidance

This Plan is divided into five sections: the 2018 GHG Inventory Summary, Recommended Emissions Mitigation Strategies, Prioritized Reduction Strategies, Roadmap for Climate Action Planning, and Future Recommendations. The recommended mitigation strategies in this Plan are divided into four sections: Buildings and Energy, Transportation, Waste, and Governance and Leadership. Each section presents on overview of the sector and emission sources, previous emissions reduction measures, recommended mitigation strategies, and performance metrics. Exact costs and benefits are not quantified but instead assigned to the applicable stakeholder. The Prioritized Reduction Strategies section provides a matrix that organizes strategies in terms of emissions reduction potential and ability to execute. The Roadmap for Climate Action Planning provides a guide on how the City can take the next steps to utilize this report and 2018 GHG Inventory to create a city-wide Climate Action Plan. Future Recommendations list other mitigation strategies the City can consider in a future Climate Action Plan.

As climate action and emissions reduction planning is a new concept for the City, many of these measures lay the foundation to unlock future states of emissions reductions and do not directly reduce GHG emissions themselves (i.e. reducing parking requirements, emphasizing mixed-use development, completing a Mobility Study, etc.). These measures are considered supportive or “Indirect” strategies and do not have a specific quantity of reduced emissions attributed to them. However, these measures provide the necessary groundwork for the City to pursue more stringent emissions reduction strategies in the future.

Quincy Community Profile

Quincy is the eighth largest city in Massachusetts with a population of 94,580 occupying 26.9 square miles according to 2018 data.[4] Established in 1792, Quincy is currently governed by a Mayor and a nine-member City Council. The City has 27 miles of coastline and encompasses two peninsulas as well as a maritime industrial working port of regional significance. Quincy has 3,600 acres of open space (21% of

[4] US Census, 2013-2017 ACS 5-Year Estimates.

total City area) and also contains part of the Blue Hills Reservation which is managed by the State Department of Conservation and Recreation.[5]

Quincy has characteristics of a suburban bedroom community while retaining strong commercial and shopping areas. The City's three traditional commercial districts include North Quincy, Wollaston, and Quincy Center. In 2018, the City contained 42,889 housing units.[6] Of the 40,167 occupied units, 48% were owner-occupied and 52% were rented.

The City is in the final phases of transforming from a manufacturing economy into a knowledge economy. In 2018, Quincy had 3,613 business employing 50,198 individuals.[7] When measured by the number of jobs, the top industry sectors were financial (22%), education and health services (21%), and professional and business services (14%). Quincy is also a city of commuters, with 85% of employed residents commuting to workplaces located outside the City daily, and 84% of jobs located in the City filled by people who live elsewhere.

Table 3. 2018 City of Quincy Profile

Population	**94,580**
Square Miles	26.9 square miles • Land: 16.8 square miles • Water: 10.1 square miles
County, State	Norfolk County, MA
Zip Codes	02169, 02170, 02171
Total Housing Units	42,889 housing units • Occupied: 40,167 • Vacant: 2,722
Composition of Economy	• Financial (22%) • Education and Health Services (21%) • Professional and Business Services (14%) • Other (43%)
Number of Jobs	50,198
Climate Zone	5A
Heating Degree Days[8]	5,552
Cooling Degree Days	1,111

[5] City of Quincy 2019 Report. Retrieved from: https://www.quincyma.gov/civicax/filebank/blobdload.aspx?t=36502.95&BlobID=34117

[6] US Census, 2013-2017 ACS 5-Year Estimates.

[7] Massachusetts Executive Office of Labor and Workforce Development (EOLWD), 2019. Retrieved from: http://lmi2.detma.org/lmi/lmi_es_a.asp#IND_LOCATION

[8] Degree days are defined as the number of degrees by which the average daily temperature is higher than 65°F (cooling degree days) or lower than 65°F (heating degree days). Degree days reflect changes in climate and are used as a proxy for the energy demand for heating or cooling buildings.

Figure 1. City of Quincy Map[9]

Services

Electricity and gas services are provided by the investor-owned utility National Grid. Drinking water and wastewater disposal services are provided by the Massachusetts Water Resources Authority (MWRA). The City is responsible for water distribution, sewer and drain line management. The City provides residential waste collection for one-to-eight family dwellings and condominiums through Capitol Waste Services while larger multifamily dwellings and commercial properties are serviced by private haulers. Public transportation including rapid transit rail, commuter rail, and bus transit is provided by the Massachusetts Bay Transportation Authority (MBTA). The Marina Bay Commuter Ferry service is the result of a partnership between Quincy, the Town of Winthrop, and the Commonwealth of Massachusetts. The Ferry itself is owned and operated by the Town of Winthrop.

[9] Provided by City of Quincy, 2019

Table 4. Quincy Services and Providers

Quincy Service	Service Provider
Electric and Gas	National Grid
Water and Sewer	Massachusetts Water Resources Authority
Residential Waste (1-8 family dwellings)	The City of Quincy/Capitol Waste Services
Commercial Waste (including 9+ family dwellings)	Private Haulers
Public Transportation (bus and rail)	Massachusetts Bay Transportation Authority
Public School Bus Service	City of Quincy
Commuter Ferry	Town of Winthrop

Growth Projections

Quincy is experiencing a development boom, with much growth occurring within infill and redevelopment sites near the Quincy Center, North Quincy, and Wollaston T stations. Nearly 4,000 housing units were built or permitted across the City over the last four years.[10] Housing units are projected to grow by 7-9% and population by 5-7% between 2020-2030.[11] In stronger growth projects, this would equate to a population of over 106,800 by 2030. Quincy's growth is slightly higher than the general Boston Metropolitan Region, which has a 2020-2030 projected household growth of 6-8% and population growth of 3-5%, but more aligned with the US national household and population growth of and 10% and 7%, respectively.[12][13]

[10] City of Quincy 2019 Report. Retrieved from: https://www.quincyma.gov/civicax/filebank/blobdload.aspx?t=36502.95&BlobID=34117

[11] MAPC, 2014. Retrieved from: https://www.mapc.org/learn/projections/

[12] MAPC, 2014. Retrieved from: https://www.mapc.org/learn/projections/

[13] Harvard Joint Center for Housing Studies, 2018. Retrieved from: https://www.jchs.harvard.edu/sites/default/files/Harvard_JCHS_McCue_Household_Projections_Rev010319.pdf

Quincy Greenhouse Gas Emissions Inventory

2018 Inventory Results

The 2018 Community-wide GHG Inventory estimates the total amount of emissions generated from activities within the City of Quincy boundary. The inventory represents emissions from the residential, commercial, industrial, transportation, and waste management sectors for the base calendar year of 2018. This inventory did not include emissions from agriculture, forestry, or industrial processes and product use.

The results of the community-wide inventory demonstrate that activities in Quincy generated approximately 777,198 metric tons of carbon dioxide equivalent (CO2e) in 2018.

Figure 2. Quincy's Total 2018 GHG Emissions by Sub-Sector (MT CO2e)

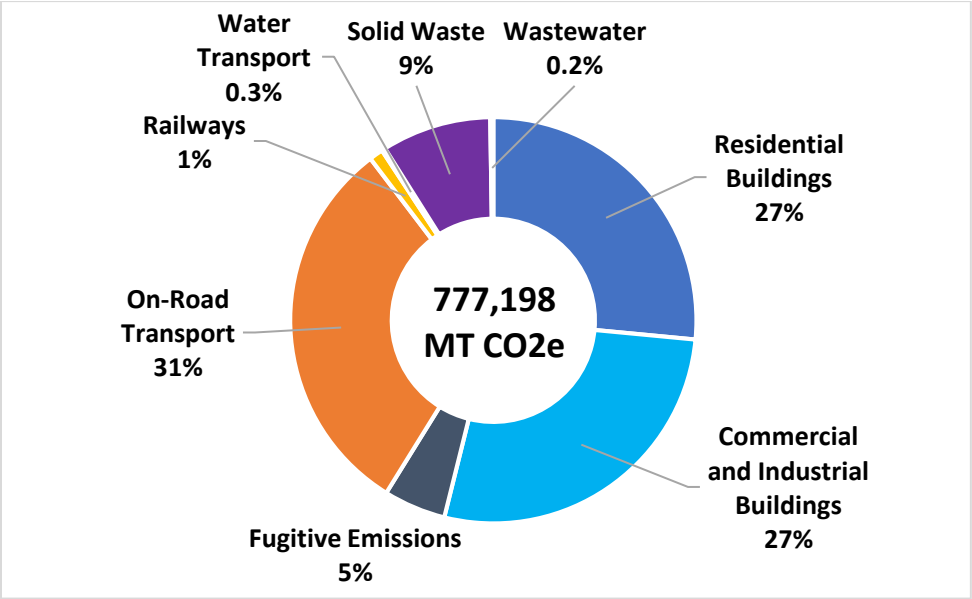


Table 5. Quincy's Total 2018 GHG Emissions

Sector	Subsector	Emissions (MT CO2e)	% of Total Emissions	Total Emissions (MT CO2e)	% of Total Emissions
Stationary Energy	Residential Buildings	206,061	27%	457,276	**59%**
	Commercial and Industrial Buildings	212,743	27%		
	Fugitive Emissions from Natural Gas Systems	38,472	5%		
Transportation	On-Road	239,522	31%	250,351	**32%**
	Railways	8,603	1%		
	Water Transport	2,226	0.3%		
Waste	Solid Waste Disposal	67,691	9%	69,571	**9%**
	Wastewater Treatment and Discharge	1,880	0.2%		
TOTAL				**777,198**	

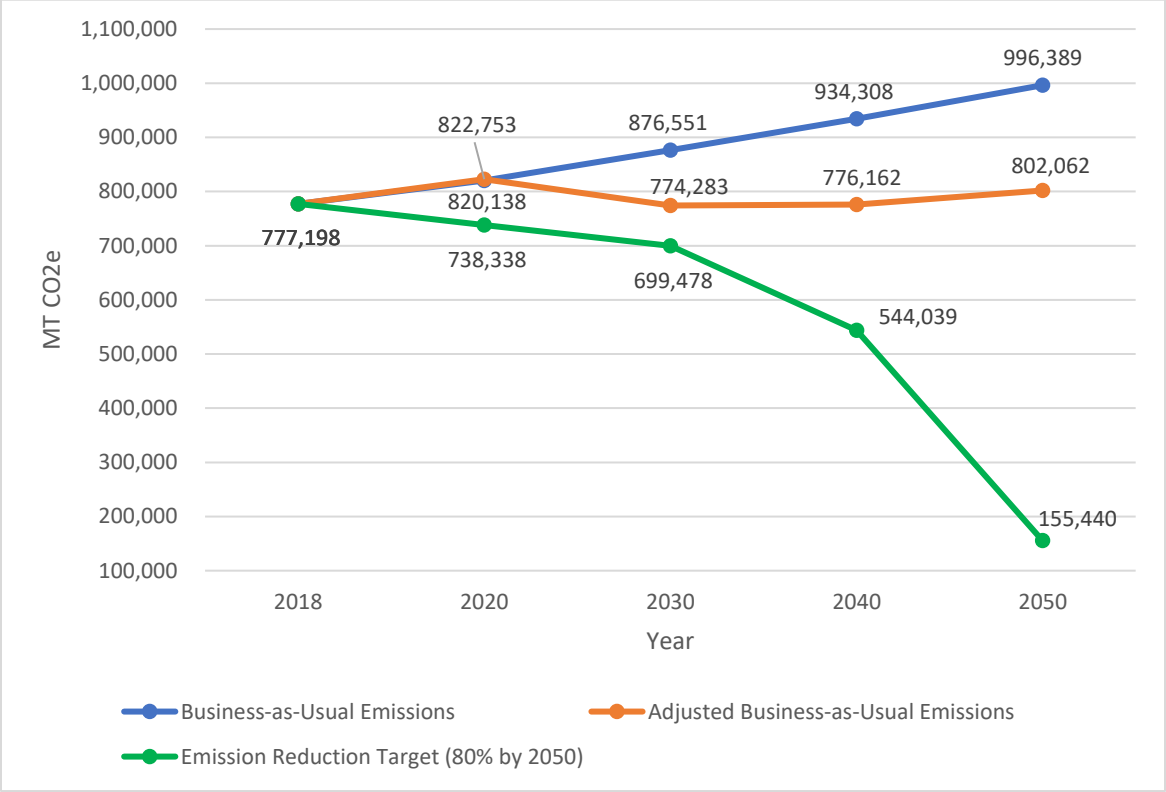
The Stationary Energy sector produced the majority of emissions (59%) primarily due to the consumption of electricity and natural gas in buildings. On-road transportation activities, such as passenger and commercial vehicle travel, generated the most emissions of any sub-sector (31%). Waste sector emissions were mainly generated by landfilling and produced only 9% of total emissions.

Recommended Reduction Target and Emissions Forecasts

To align the City's climate efforts with state goals, Quincy should initially set an emissions reduction target of 80% from 2018 levels by 2050. Quincy should heavily consider setting a net-zero target by 2050 in order to comply with the Metro Mayors Climate Mitigation Agreement.

The below forecasts display emissions trends in a business-as-usual (BAU) and adjusted BAU (ABAU) scenario. The BAU scenario only considers population, household, and employment growth when forecasting future emissions. The ABAU scenario considers the impacts of implementing known federal and state emissions policies, such as the Renewable Portfolio Standard and the Massachusetts Low Emissions Vehicle program. Additionally, the Emission Reduction Target scenario forecasts a potential pathway for meeting an 80% reduction by 2050.

Figure 3. Quincy Emissions Forecast (2018-2050)

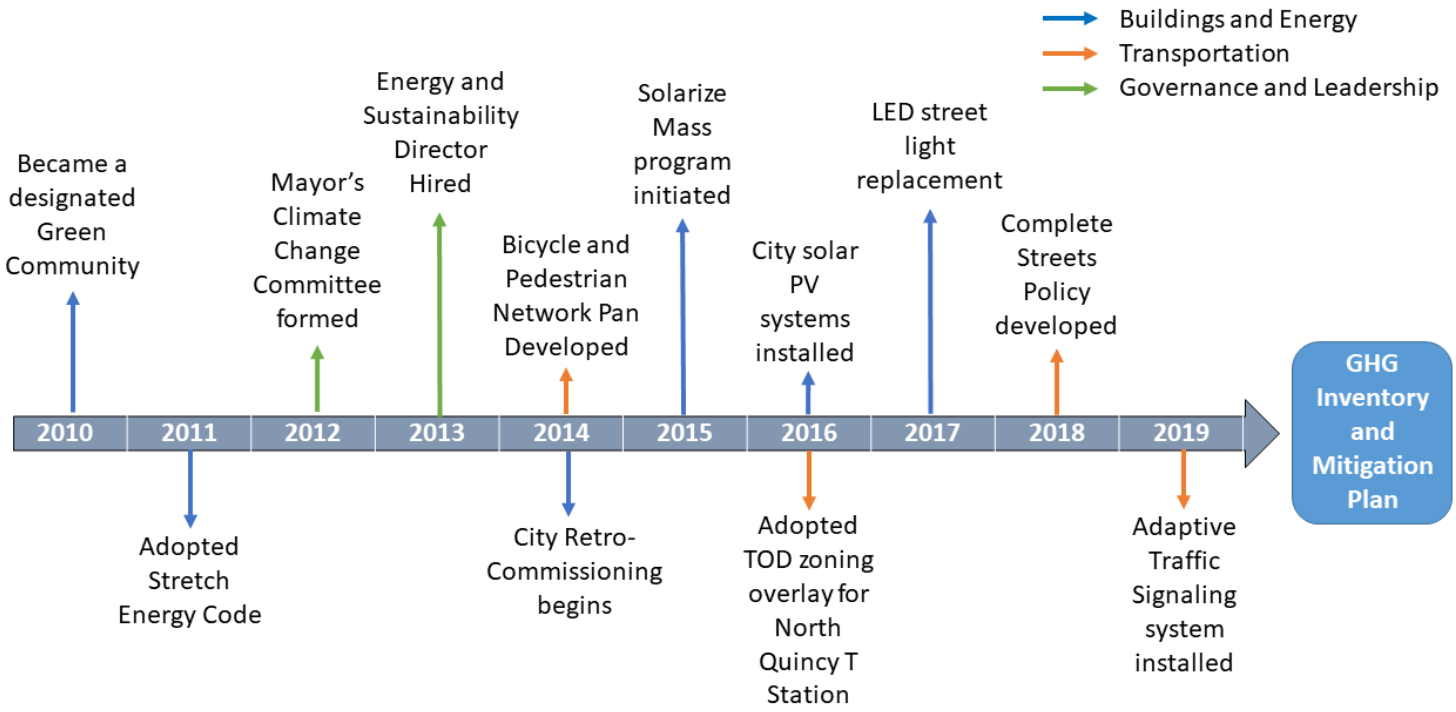


These forecasts indicate that while external policies will have a significant impact on emissions generated in the future, they will not be enough to reach the recommended emissions reduction target. Therefore, ambitious local-level strategies are needed in order to implement significant emissions reductions.

Timeline of Quincy's Previous Mitigation Measures

Below is a brief timeline of Quincy's previous emission mitigation measures. Though emissions reduction may have not been the primary goal of these measures, all have had an impact on City GHG emissions. These measures are categorized and expanded upon in the applicable "Previous Mitigation Measures" sections in the report.

Figure 4. Time of Quincy's Previous Mitigation Measures



Recommended Emissions Mitigation Strategies

The recommended emissions mitigation strategies fall under three categories: buildings and energy, transportation, and waste. Table 6 lists the recommended mitigation strategies, their targeted activities, and if they directly or indirectly reduce emissions.

Table 6. Recommended Emission Mitigation Strategies

	Mitigation Strategy	Targeted Activity	Direct or Indirect Emissions Reduction
Buildings and Energy	Green Municipal Aggregation	Residential and small business electricity consumption	D
	Green Building Standard	Large new construction and major rehabilitation energy consumption	D
	Energy Disclosure Ordinance and Performance Standards	Large existing building energy consumption	I/D
	Heating Fuel Switching	Buildings using heating oil or natural gas	D
Transportation	Mobility Study	Comprehensive transportation planning	I
	Parking Requirements	Reduce vehicle use in new developments	I
	Sidewalk Snow Removal Program	Encourages sidewalk use, reduces personal vehicle travel	I
	MBTA Bus Prioritization	Encourages bus use, reduces personal vehicle travel	I
	Electric Vehicle Charging Stations	Encourages EV adoption, reduces vehicle GHG emissions	I
	Transportation Demand Management	Encourages alternate modes of transport	I
	Permanent Ferry Service	Encourages ferry use, reduces personal vehicle travel	I
Waste	Composting Program	Residential organic waste generation	D
	Waste Inspector	Reduce recycling contamination and landfill emissions	I
	Consumption-Based Emissions Inventory	Comprehensive waste evaluation	I
Governance and Leadership	Municipal Government Climate Change Commitment	Lead by Example	I
	Local Government Emissions Inventory and Mitigation Plan	Lead by Example	I
	Climate Action Task Force	Lead by Example / Education and Outreach	I
	Climate Action Communications and Education	Education and Outreach	I
	External Green Revolving Loan Fund	Outreach and Legislation	I

Buildings and Energy

Overview

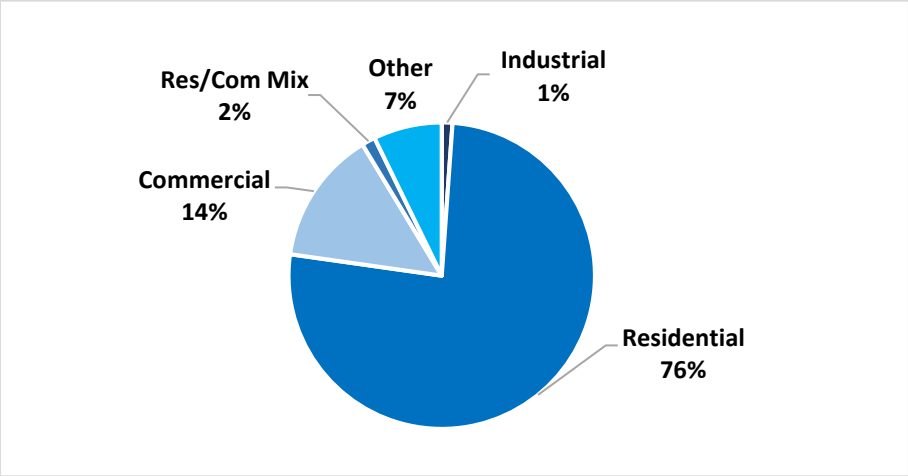
Quincy contains a mix of residential, commercial, and industrial buildings that use grid-supplied electricity and natural gas. The City is heavily residential, with 40,167 occupied housing units divided into owner-occupied (48%) and rented (52%).[14] Like the majority of Massachusetts building stock, most residential properties in Quincy were constructed over 50 years ago.[15] However, Quincy has been experiencing a construction boom, with nearly 4,000 housing units built or permitted across the City over the last four years.[16] Quincy has also experienced a great deal of commercial and mixed-use development around the Quincy Center and North Quincy MBTA stations. An Urban Renewal Plan is in development for the Wollaston MBTA station area. Quincy's total gross building area is 14% commercial with only 1% industrial.

Table 7. Quincy Building Mix from 2017 MAPC Land Parcel Database

Property Type	Gross Building Area (square feet)	% Total Gross Building Area	Finished Building Area (square feet)	% Total Finished Building Area
Residential	79,862,042	76.1%	46,347,778	68.9%
Commercial	14,805,427	14.1%	12,442,621	18.5%
Industrial	1,181,834	1.1%	1,148,404	1.7%
Mixed Use (Residential/Commercial)	1,492,842	1.4%	1,053,468	1.6%
Other*	7,583,957	7.2%	6,307,232	9.4%

*Other includes Exempt Properties, such as Educational Institutions, Hospitals, and Religious Centers.

Figure 5. Quincy Gross Building Floor Area Breakdown

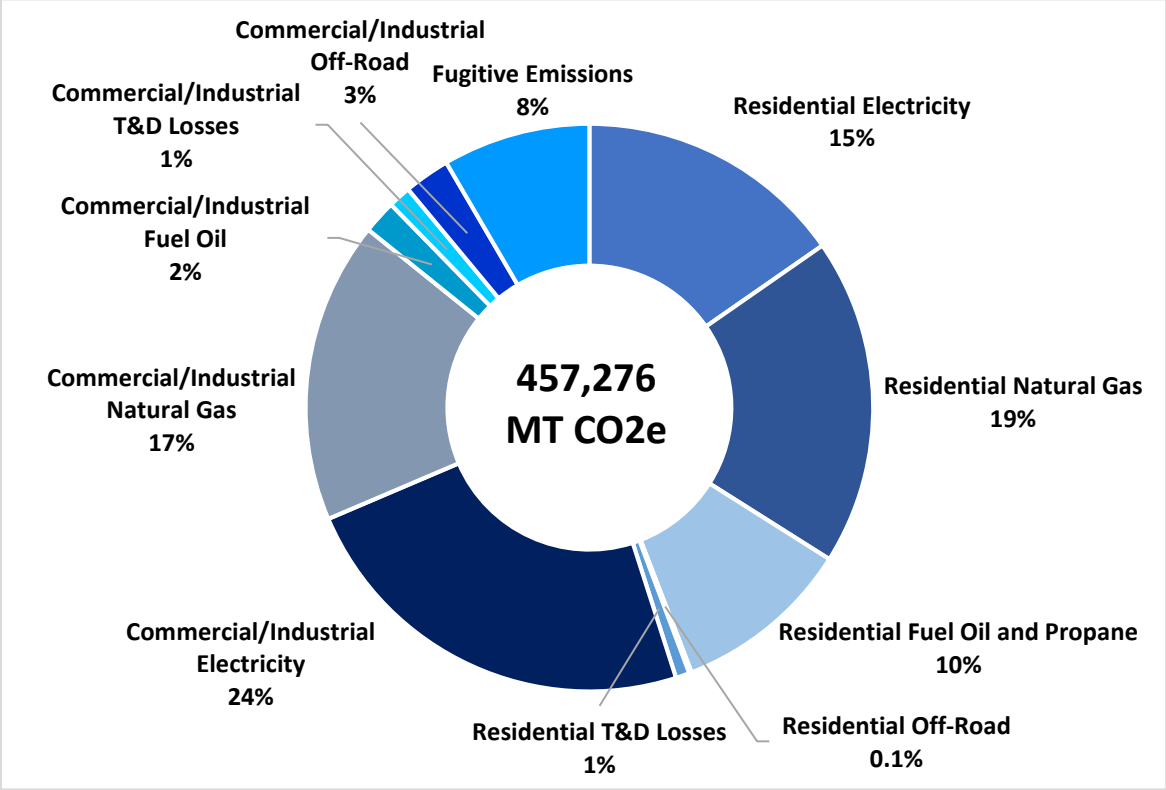


[14] US Census, 2013-2017 ACS 5-year Estimates.
[15] MAPC 2017 Land Parcel Database
[16] City of Quincy 2019 Report. Retrieved from: https://www.quincyma.gov/civicax/filebank/blobdload.aspx?t=36502.95&BlobID=34117

Emissions

Quincy's Stationary Energy sector generates 59% of total City emissions, more than the transportation and waste sectors combined. This is due to the City's large consumption of electricity, natural gas, and oil. Electricity is used primarily for cooling, lighting, and plug loads while oil and natural gas are used primarily for space and hot water heating. Electricity and natural gas are provided by National Grid while oil is provided by private suppliers.

Figure 6. Stationary Energy GHG Emissions by Activity



Approximately half of city-wide emissions are generated from electricity and natural gas consumption. This can be partially attributed to Quincy's use of natural gas to satisfy its large heating demand (96% of Quincy's residential natural gas is used for heating purposes). Additionally, even though heating oil is only used for heating in 20% of residential buildings, it contributes to over 20% of total residential emissions due to its high emissions factor. Because of this, focusing on strategies that reduce the excessive use of these energy sources is essential to realizing large emissions reductions.

Table 8. Costs and Benefits of Addressing Building and Energy Emissions

Costs of Inaction	Benefits of Action
• Increased energy and fuel prices • Increased costs to maintain aging, inefficient building infrastructure • Expensive future retrofits • Increased local pollution from burning fuels on-site (oil, natural gas, etc.) • Increased health issues from old and inefficient buildings • Increased resource consumption (energy, water, materials, etc.) • Decreased building resilience and autonomy • Lock-in of future building emissions • Increased financial and health disparity for low-income populations	• Reduced energy and operation costs due to higher efficiency • Healthier, more efficient buildings • Less equipment turnover/replacement • Increased cost savings from decreased resource consumption • Decreased local pollution and health issues • Increased building resiliency against climate change • Increased socioeconomic equity for low-income populations

Previous Mitigation Measures

Quincy became a Massachusetts Green Community in 2011. The Green Community program provides grants, technical assistance, and local support to help municipalities reduce energy use and costs by implementing clean energy projects in municipal buildings, facilities, and schools. Through this program, Quincy pledged to reduce municipal energy use by 20% over 5 years and received grants for LED street light replacement, retro-commissioning, and Energy Management System installations. The City estimated a municipal energy reduction of 15% since joining the program. The 2017 LED lighting replacement alone reduces the City electricity consumption by over 2 million kWh annually.

In Massachusetts, municipalities do not have the legal authority to set their own municipal energy codes. Massachusetts utilizes the International Energy Conservation Code (IECC) as its base building code which sets the standard for building and energy codes in communities across the Commonwealth. However, municipalities may choose to adopt a more stringent version of the state's base energy code, referred to as the "Stretch Code". Stretch Code adoption is mandatory for designation as a Green Community under the Green Communities Act. Quincy adopted the Stretch Energy Code in 2010. Additionally, the City of Quincy has registered municipal employees to be eligible to vote on IECC revisions. As the IECC is updated every three years, Quincy will be able to vote for the strengthening of building energy standards for the upcoming 2021 update. Advancing the energy code by improving efficiency standards in the IECC will ultimately enable Quincy to reduce building emissions.

Quincy has installed 2 MW of solar on 13 municipal buildings. The City has also partnered with multiple developers who have installed seven large solar arrays in Southeastern Massachusetts. Depending on the site, the electric meters are either in the City's name or a portion of the electricity generated is allocated to the City. If the meter is under Quincy's name, it receives net metering credits on its electricity bill and pays the developer a portion of the value of electricity generated. In other

cases, the City only receives a portion of the net metering credits generated on site. Both scenarios represent a cost-savings for the City where they receive reduced-price electricity and support local solar production (the developer maintains the Renewable Energy Credits (RECs) in all scenarios). The City recently received a grant to assist in soliciting a new round of municipal solar installations. However, the Solar Massachusetts Renewable Target (SMART) program places a cap on the capacity of large solar arrays National Grid is obligated to incorporate and Quincy will be placed on the waiting list.

In 2015, the City participated in the Solarize Mass program which encourages the adoption of small-scale solar electricity systems by residents through a grassroots educational campaign and a tiered pricing structure. The program resulted in contracts for 110 solar systems or approximately 600 kW of solar on Quincy homes and businesses. Notably, the 9th Edition of the Massachusetts State Building Stretch Energy Code, which became effective January 2018, requires a "Solar-Ready Zone" be provided on construction of new detached one and two-family dwellings and townhouses as well as low-rise commercial buildings and additions less than four stories above grade.[17] A Solar-Ready Zone designates and reserves sections of the roof or building overhang for the future installation of a solar photovoltaic or solar thermal system. As municipalities cannot "override" state code, Quincy may find it difficult to enact more stringent solar-ready laws or ordinances requiring solar installations on new developments in the future.

The City's current retro-commissioning program has identified opportunities for increased efficiency in public buildings. The Thomas Crane Public Library, Point Webster Middle School and Clifford Marshall Elementary are currently undergoing a retro-commissioning process. Additionally, the City's Department of Public Works meets with National Grid on a weekly basis to coordinate construction work or street improvements that may affect natural gas infrastructure. These frequent communications have allowed better coordination on addressing gas leaks and streamlining construction processes.

Strategies to Reduce Emissions

	Mitigation Strategy	Emissions Target	Direct or Indirect Emissions Reduction
Buildings and Energy	Green Municipal Aggregation	Residential and small business electricity consumption	D
	Green Building Standard	Large new construction and major rehabilitation energy consumption	D
	Energy Disclosure Ordinance and Performance Standards	Large existing building energy consumption	I/D
	Heating Fuel Switching	Buildings using heating oil or natural gas	D

A majority of building emissions do not fall under the City's direct control. The Commonwealth sets ceilings for building and energy codes while residents and businesses have the freedom to choose the most cost-effective energy options. The City will need to develop a multi-pronged building emission

[17] US DOE, SunShot, 2018. Retrieved from: http://bcapcodes.org/wp-content/uploads/2017/03/MODULE-3-PART-3_slides_66-on_Architectural-Integration-into-Building-Design-10-09-17.pdf

mitigation approach that targets both new construction and existing buildings through a combination of mandatory and voluntary initiatives. As heating fuels generate a large portion of emissions (residential natural gas use for heating generates roughly 10% of city-wide emissions), incentivizing the switch to highly efficient electric systems is essential to drastically reducing emissions. Additionally, promoting a greener electrical grid will ensure Quincy's operations are served by a higher percentage of zero-emission renewable energy sources. Ultimately, the City should create a foundation of measures that enables residents to drive future emission reductions. Basic steps for effectively reducing building emissions along with examples of City strategies are included in Table 9 below.

Table 9. Steps to Reduce Building Emissions

1. **Ensure all new developments meet high efficiency standards and are electrified**
    - Green building standard, banning natural gas hookups
2. **Reduce energy waste from existing buildings through retrofitting**
    - Energy disclosure ordinance, energy performance standard, electric heat pumps, biodiesel
3. **Practice energy efficient behaviors**
    - Resident and business outreach and education
4. **Supplement any remaining energy consumption with renewable strategies**
    - Green municipal aggregation, solar installations

Green Municipal Aggregation

Massachusetts state law allows a city or town to choose the electricity supplier for residents and businesses within that municipality. Municipalities can aggregate the electric loads of the consumers within their boundaries in order to negotiate more favorable terms with a power supplier. This is called municipal or community choice aggregation and allows for important energy decisions to be made at the local level rather than by an investor-owned utility or a for-profit competitive electricity supplier. Green Municipal Aggregation (GMA) is a model that adds more renewable energy to residents' electricity at a competitive price. When a community decides to enact GMA, it goes out to bid for an electricity supplier to secure a long-term price and a cleaner electricity supply. That supplier then replaces the utility's Basic Service and offers a more stable price on residents' regular electricity bill. With the help of Good Energy, Quincy is currently developing a Green Municipal Aggregation plan for its residents and small businesses.

The Massachusetts Renewable Portfolio Standard (RPS) requires regulated distribution companies and competitive suppliers to provide customers with a minimum percentage of renewable energy content. In 2019, all electricity suppliers are required to source at least 14% of their electric load from Class I RECs. One Class I REC is equivalent to one MWh of electricity. The required RPS percentage increases by 1% every year until 2020, 2% until 2030, and then back down to 1% in subsequent years. Quincy is reviewing a GMA plan that offers a default electricity supply option of 10% more Class I RECs

than is required by the state's RPS. The program would become the default for residents and business who are customers of National Grid. These automatically enrolled customers can opt-out at any time. As many large business and customers have third-party suppliers, they must opt-in to participate.

GMA empowers cities and towns to choose an electricity supply that is significantly greener than their utility's default offering, while also delivering price stability and potential cost-savings to residents and small businesses. The voluntarily purchasing Class 1 RECs creates additionality, or the increased demand for renewables with verifiable emission reductions over and above the state's required minimum amount. Therefore, GMA is limiting the supply of RECs for major utilities to meet their RPS mandate and encouraging development of new, in-region renewables (primarily wind and solar) that contribute to a faster transition to clean energy. Various types of community choice aggregation plans have been adopted by local Massachusetts cities and towns including Somerville, Cambridge, Arlington, Brookline, Dedham, Sudbury, and Winchester.

GMA will serve Basic Customers who are not enrolled with a competitive power supplier. If 10% of this total electric load is now generated by renewable sources, this will reduce electricity emissions by 11,527 MT CO2e, or 7%. This represent a total city-wide emission reduction of 1.5%. This is assuming all residential customers are enrolled and only 42% of all commercial/industrial customers are enrolled.

Green Municipal Aggregation					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Direct: 11,527 MT CO2e	Electricity Consumption	Existing Residential and Small Commercial	MWh from renewable sources, # of customers enrolled	Costs: The City Savings: Customers	Voluntary

Green Building Standard

Energy efficiency in new construction is the most cost-effective way for buildings in Massachusetts to reduce emissions by 2050.[18] Quincy has been experiencing a construction boom, with total housing units projected to grow between 7-9% by 2030. It is important for the City to act now to avoid emissions lock-in from the construction of buildings that are not built sustainably.

To address this, the City can amend the municipal zoning code to require all new large-scale building projects and substantially rehabilitated buildings to meet certified green building standards such as LEED or Passive House. The City can begin by targeting large developments, such as new construction and major rehabilitation projects more than 50,000 gross square feet. These developments could be required to meet LEED certified standards, for example, but would not have to apply for certification. This process would include submitting a completed LEED Project Checklist accompanied by an affidavit by a LEED Accredited Professional or by appropriate consultants stating that the project has been designed to achieve the LEED requirements. The standard can be expanded to include other building

[18] Massachusetts Executive Office of Energy and Environmental Affairs, 2015. Retrieved from: https://www.mass.gov/files/documents/2017/12/06/Clean%20Energy%20and%20Climate%20Plan%20for%202020.pdf

types and sizes in the future. Requiring such a standard for large buildings could reduce total building emissions by 3% by 2030.

The benefits of green buildings include reduced operating and maintenance costs, shorter payback periods, and increased asset value. Additionally, green buildings can improve indoor air quality, reduce health issues and workplace absenteeism.[19] LEED projects usually improve energy performance by a minimum of 10% and result in equivalent emissions reduction from new construction projects.[20] Both Boston and Cambridge have integrated green building standards into their zoning codes for large new construction or rehabilitation projects. Cambridge also requires larger buildings to meet stricter LEED certified levels, such as Silver or Gold.

Green Building Standard					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Direct: 15,687 MT CO2e by 2030 over Business-as-Usual projections*	Energy consumption in buildings	New Large Construction Commercial	# of LEED compliant buildings, Energy reduction (kWh, therms)	Costs: Developers Savings: Building Owners and Tenants	Mandatory

*Using MAPC employment and population growth rate as proxies for large building (over 50,000 SF) growth and a 10% emissions reduction

Energy Disclosure Ordinance and Performance Standards

City energy use information provided by National Grid aggregates the City's total energy consumption and does not delineate energy use by property. Energy information can be requested from each individual building owner or tenant in order to accurately profile emissions sources, but this is an extremely inefficient process. It is difficult for the City to target the largest emitters when information on individual building energy use is not publicly available. This lack of information also increases the difficulty for players in the real estate market to properly value energy efficient buildings. Regulating the existing buildings sector has been challenging for many cities as existing developments are not subject to building code updates unless they undergo significant modifications.

Energy use benchmarking and disclosure can aid in effective community energy planning and lead to improved energy performance in buildings. Energy disclosure places the information in the marketplace, where various users such as potential property buyers, tenants, realtors, and energy service providers can use the data and create value for higher energy performing properties. This motivates building and business owners to reduce energy use while simultaneously helping local governments identify and target the largest emitters.

To promote energy benchmarking, the City can enact an Energy Disclosure Ordinance that requires large buildings to evaluate and report their annual energy consumption to the City. This Ordinance can target large buildings (e.g. >25,000 square feet) and multifamily residential properties (e.g. >40 units). The ENERGY STAR Portfolio Manager tool can be used to track this data. Cambridge has

[19] USGBC, 2019. Retrieved from: https://new.usgbc.org/press/benefits-of-green-building
[20] Ali Amiri, Juudit Ottelin and Jaana Sorvari, "Are LEED-Certified Buildings Energy-Efficient in Practice?", 2019.

enacted a Building Energy Use Disclosure Ordinance which requires owners of large buildings to track and report energy and water usage to the City, who then publicly discloses the information.

Additionally, Quincy should consider a future provision in which the ordinance requires a building energy or emissions performance standard. Such standards ensure that buildings make steady progress on emissions reductions while giving flexibility to building owners to develop solutions that are cost effective and specific to the occupational needs of the buildings. Closely following Boston's Building Energy Reporting and Disclosure Ordinance, Quincy could require properties covered by the Ordinance to conduct an ASHRAE energy assessment or reduce energy consumption by 15% every 10 years. Buildings that are certified to a green building standard such as LEED are exempt from this requirement as they already meet high-efficiency standards. Alternatively, to limit the interference with the existing Stretch Energy Code, the City could frame a performance standard as an emissions standard rather than an energy standard. As the City does not want to discourage developers by subjecting them to multiple additional requirements, it is recommended to pilot the Building Energy Disclosure Ordinance over a period of 5-10 years before adding the performance standard requirement.

An Energy Disclosure Ordinance will enable to Quincy to identify large sources of emissions and properly incentivize reductions while motivating property owners to implement energy efficiency and sustainability measures to reduce operating costs or increase the attractiveness of their property. A Disclosure Ordinance will lay the foundation to allow for targeted mitigation measures such as an energy or emissions-based performance standard, which can effectively achieve large-scale emissions reductions. A Building Performance Standard enacted for existing 2018 buildings over 25,000 square feet could reduce total existing building emissions by 6%.

GHG Reduction	Activity Targeted	Sub-Sector	Performance Metrics	Primary Costs/Savings	Mandatory or Voluntary
Energy Disclosure Ordinance					
Indirect	Energy consumption in buildings	Existing Large Commercial and Residential	# of buildings reporting, Changes in energy consumption	Costs: Building Owners/Tenants Savings: Building Owners/Tenants	Mandatory
Building Performance Standard					
Direct: 26,229 MT CO2e*	Energy consumption in buildings	Existing Large Commercial and Residential	kWh or therms reduced from baseline, Average % energy reduction	Costs: Building Owners/Tenants Savings: Building Owners/Tenants	Mandatory

*All 2018 buildings >25,000 SF reduce energy by 15%

Fuel Switching

In Massachusetts, space heating is the largest component of an average household's energy consumption.[21] Heating is commonly provided by one of three heat sources: natural gas, electricity, or oil. Table 10 provides a breakdown of house heating fuel use in Quincy.

Table 10. Quincy Residential Heating Fuels (2013-2017 ACS 5-Year Estimate)

House Heating Fuel	Housing Units	% share
Utility Gas	20,479	51.0%
Electricity	10,583	26.3%
Fuel oil, kerosene, etc.	7,813	19.5%
Bottled, tank, or LP gas	941	2.3%
Solar	62	0.2%
Wood	20	0.05%
Coal or coke	0	0.0%
All other fuels	102	0.3%
No fuel used	167	0.4%

Massachusetts has some of the oldest natural gas main infrastructure in the nation. The average natural gas piping is over 60 years old, with 30% of this infrastructure consists of leak-prone pipe, primarily made of cast-iron.[22] Due to its potency, natural gas leaks result in much higher quantities of CO2e emissions than natural gas combustion. Fugitive emissions due to Quincy's natural gas consumption release 8% of total building emissions and 5% of city-wide emissions. Natural gas leaks from inside Quincy's borders alone could heat 187 homes annually.[23]

Fuel oil is used by as a space heating source by 19.5% of all housing in Quincy. Heating oil is the second largest heating fuel source for owner-occupied housing units (25% of units) while it is the third largest for renter-occupied housing units (14% of units). Overall, residential oil heating generates 23% of all residential building emissions and 10% of overall Stationary Energy emissions. Oil heat is the least efficient, most expensive, and most polluting form of home heating.

Fuel switching from oil or natural gas to electric heating can substantially reduce GHG emissions and well as local pollutants. Some of the most efficient heating systems, such as heat pumps, run on electricity and do not involve the pollution-heavy combustion of fossil fuels on site.[24] However, fuel switching, especially to highly efficient electric systems, may be cost-prohibitive for some homes. Therefore, a multi-pronged approach to move away from fuel oil and natural gas towards efficient heating systems is necessary to realize large emissions reductions.

[21] Massachusetts Energy Policy Planning and Analysis Division, 2019. Retrieved from: https://www.mass.gov/info-details/household-heating-costs
[22] MAPC, HEET, 2019. Retrieved from: http://fixourpipes.org/
[23] See 2018 Community-wide GHG Inventory
[24] Massachusetts Clean Energy Center, 2019. Retrieved from: https://www.masscec.com/blog/2019/03/19/case-clean-heating-and-cooling

Biodiesel Promotion

Biodiesel is a type of diesel fuel manufactured from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel can be blended with petroleum heating oil in order to fuel an oil-based heating system. B20, a 20% blend of biodiesel, is the highest biofuel concentration that can be used that does not necessitate any modifications to the existing heating system. Biodiesel also helps the heating system run more cleanly and efficiently, reducing service-related costs and local pollutants. A provision in the Massachusetts 2008 Clean Energy Biofuels Act required a minimum of 5% biofuel (B5) in all home heating fuel sold in the Commonwealth. However, the law was never implemented by government officials and the amount of Quincy households using a B5 blend is unknown.[25]

Switching to biodiesel is beneficial for properties with heating equipment that may not be suited for electrification, renter-occupied units with no control over the heating system, and single-family home owners who cannot afford to electrify their systems. However, certain sources of biodiesel need to be prioritized, such as waste cooking oil instead of soy or palm oil, to minimize life cycle impacts.[26]

In order to promote the switch to biodiesel, Quincy could create an educational outreach campaign on the benefits of biodiesel heating. As 25% of older, owner-occupied housing units in Quincy use heating oil, Quincy could utilize assessor property data to identify and target these homes for their outreach campaign.[27] This could include mailing educational pamphlets, hosting information seminars, and collaborating with neighborhood associations or community centers to promote biodiesel benefits. Educational materials could also include information on the financial and health benefits of switching to electric heat pumps or more efficient electric systems. Additionally, the City could promote a biodiesel program by partnering with the non-profit Green Energy Consumers Alliance and endorsing their Heating Oil Service program. Green Energy Consumers Alliance pairs members with an oil dealer in their network that will charge a discounted price per gallon on biofuel. Through this program, members are expected to save an average of 15 cents per gallon when compared to the state average price for traditional heating oil.[28]

Fuel switching from distillate oil No.2 to B20 could reduce oil heating emissions from residential buildings by approximately 20% or 8,864 MT CO2e. This would reduce total residential emissions by 4% and is equivalent to negating all rail transport emissions in Quincy. Inventory protocols require biogenic CO2 emissions to be counted separately from a city's total fossil fuel-based emissions. This is attributed to biomass's ability to naturally release CO2 during decomposition, meaning no "additional" carbon is being added to the atmosphere when biofuels are combusted. Conversely, untouched fossil fuels would have never "naturally" release CO2 emissions. Therefore, biofuel emissions are not directly comparable to fossil fuel emissions and can drastically reduce GHG emissions according to some accounting methods. However, it is important to understand the debate around biofuels, the various methods of

[25] Massachusetts Energy Marketers Association, 2018. Retrieved from: https://www.biodiesel.org/docs/default-source/fact-sheets/bioheat-faq.pdf?sfvrsn=445539e8_2
[26] Union of Concerned Scientists, 2014. Retrieved from: https://blog.ucsusa.org/jeremy-martin/biodiesel-update-now-with-more-soy-360
[27] US Census Bureau, 2013-2017 ACS, 5-year Estimates
[28] Green Energy Consumers Alliance, 2019. Retrieved from: https://www.greenenergyconsumers.org/heatingoil/considerbiodiesel

accounting for their emissions, and the lifecycle impacts in production before fully committing to their promotion.

Biodiesel					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Direct: 8,864 MT CO2e	Heating Oil Consumption	Existing Residential	# of homes using biodiesel, Gallons biodiesel purchased	Costs: Residents Savings: Residents	Voluntary

Banning New Natural Gas Hookups

Ultimately, Quincy must shift towards electrification in order to reduce fossil fuel consumption and minimize emissions. Benefits of electrification include improved grid flexibility, reduced fuel price risk, improved local air quality, and enhanced electric vehicle charging and energy storage capabilities.[29] In most new construction, complete electrification will reduce costs compared to building a gas-heated home, with lifecycle cost savings (upfront cost plus operating costs) of $130 to $540 per year.[30] Additionally, by pairing it with a GMA program, electrification will allow customers to take advantage of a cleaner electricity supply. The emissions benefits would also increase as the electric grid becomes cleaner through the RPS mandate.

Though combusting natural gas produces less GHG emissions than other fossil fuel energy sources, natural gas use does not promote the drastic emissions reductions necessary in Quincy. When accounting for fugitive gas leaks, natural gas use in Quincy generates more emissions than electricity consumption. Fugitive emission leaks release 5% of the City's total GHG emissions. Natural gas leaks from inside Quincy's borders alone could heat 187 homes annually.

Banning natural gas hookups in new construction will encourage new developments to utilize electric heating systems and reduce the use of natural gas. This will help prevent unnecessary future retrofits and set the stage for an electrified future when technologies are cheaper and more readily accessible. The ban will enable Quincy's building mix to transition away from fossil fuels and reduce future heating-based emissions. Exceptions to the ban could be allowed, such as gas piping for backup electric generators, propane for outdoor heating and cooking, and commercial cooking equipment. Brookline is pursuing a similar ban and estimates it will cut 15% of the City's GHG emissions over the next 30 years.[31] Banning natural gas hookups and using electric heat pumps instead could reduce Quincy's new construction heating emissions by 61%.

[29] Lawrence Berkeley Lab, 2018. Retrieved from: http://ipu.msu.edu/wp-content/uploads/2018/04/LBNL-Electrification-of-Buildings-2018.pdf
[30] NRDC, 2019. Retrieved from: https://www.nrdc.org/experts/pierre-delforge/new-study-confirms-benefits-electrifying-ca-buildings
[31] WBUR, 2019. Retrieved from: https://www.wbur.org/earthwhile/2019/09/26/brookline-natural-gas-ban

Banning Natural Gas Hookups					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Direct: 5,777 MT CO2e by 2030 over Business-As-Usual projections*	Natural Gas Consumption for heating, cooking, etc.	New Construction	# of electrified buildings, Therm intensity reduction	Cost: Developers, Residents Savings: Residents	Mandatory

*Only considers switching to electric heat pumps and not electric hot water heating.

Electric Heat Pumps

Electric heat pumps are highly efficient systems that can provide both heating and cooling to a space. Instead of using energy to generate heat, heat pumps use electricity to transfer heat from one place to another. Heat pumps are much more efficient than typical furnaces and can deliver two-to-four times as much heat energy as they consume in electrical energy.[32] According to the Northeast Energy Efficiency Partnerships, air source heat pumps installed in the Northeast offered $459 in annual savings when compared to electric resistance heaters, and $948 annually compared to oil furnaces.[33] Additionally, cold climate air source heat pumps can reduce heating energy use by 40% in homes using heating oil and can continue to heat effectively even when outdoor temperatures drop below freezing.[34] Through their high efficiency, and paired with GMA and the increasing RPS, electric heat pumps can drastically reduce GHG emissions in Quincy.

Depending on the existing heating system, physical characteristics of the home, and availability of financing mechanisms, heat pumps are more feasible for some buildings than others. Heating an average Massachusetts home with natural gas can be cheaper than using an electric heat pump, so fuel switching may not be financially viable for some.[35] However, switching from oil or electric resistance systems to electric heat pumps is generally much more cost effective. Converting an oil-based system to an electric heat pump system can reduce home heating emissions by 77%. Additionally, if all residential heating oil systems in Quincy switched to electric heat pumps, it would reduce residential emissions by 17% and city-wide emissions by 4%.

Though heat pumps generate lower emissions compared to other options, their costly installation can be a barrier for adoption regardless of reduced operating expenses. For example, if the existing oil heating system does not contain ductwork, installing a heat pump with its extensive duct system may cost between $10-20k or more.[36] Fortunately, there are funding opportunities that can potentially aid in

[32] Lawrence Berkeley Lab, 2018. Retrieved from: http://ipu.msu.edu/wp-content/uploads/2018/04/LBNL-Electrification-of-Buildings-2018.pdf
[33] Energy Sage, 2019. Retrieved from: https://www.energysage.com/green-heating-and-cooling/air-source-heat-pumps/costs-and-benefits-air-source-heat-pumps/
[34] US Office of Energy Efficiency and Renewable Energy, 2017. Retrieved from: https://www.energy.gov/eere/buildings/articles/cold-climate-air-source-heat-pumps-innovative-technology-stay-warm-winter
[35] Massachusetts Energy Policy Planning and Analysis Division, 2019. Retrieved from: https://www.mass.gov/info-details/household-heating-costs
[36] Cooler Concord, 2019. http://coolerconcord.org/home-heating/air-source-heat-pumps/

reducing these costs, such as MassSave rebates, MassCEC Whole-Home Air Source Heat Pump Pilot, MassSave HEAT loan, and DOER Alternative Energy Credits.

To enhance the financial viability and promote the use of electric heat pumps, Quincy should apply to the MassCEC's HeatSmart Mass Program.[37] HeatSmart Mass is a community-based outreach and education program that encourages the adoption of clean heating and cooling technologies in residential and small-scale commercial applications. Through the program, the City would use a competitive solicitation process that aggregates homeowner buying power to lower installation prices and encourage heat pump adoption. In addition to this program, the City should promote the existing incentives listed above and evaluate other incentives it can offer, such as reduced or waived permitting fees and streamlined permitting.

Electric Heat Pumps					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Direct: 34,301 MT CO2e (Residential Only)*	Building heating and cooling	Residential and Small Commercial	Participation rates, # of heat pumps installed, Amount of rebates/incentives provided	Cost: The City, Residents Savings: Residents	Voluntary

*Considering all residential oil heating switches to electric air source heat pumps. Reduces residential emissions by 17% and total city-wide emissions by 4%

[37] Massachusetts Clean Energy Center, 2019. Retrieved from: https://www.masscec.com/heatsmart-mass-0

Transportation

Overview

Quincy is connected to the Greater Boston area by U.S. Route 1, Route 3A and Interstate 93. The City currently contains 248 miles of road, 320 miles of sidewalk, and less than three miles of designated bikes lanes. The City is served by the MBTA's regional subways system and includes four subway or "T" stations, including North Quincy Station, Wollaston Station, Quincy Center Station, and Quincy Adams Station. The MBTA's rapid transit rail line (the Red Line) serves all four T stations while the Commuter Rail line operates out of Quincy Center. A large portion of Quincy residents reside within one mile of a T station. Quincy is also served by the MBTA bus system and houses 82 buses in the MBTA's southern bus garage. The Marina Bay Ferry provides seasonal service to Quincy's Squantum Point Park, Boston, and Winthrop. Quincy also offers significant port facilities for other private craft on the Town and Fore Rivers, Quincy Bay, and Marina Bay.

In 2018, there were approximately 52,989 passenger vehicles and 2,080 commercial vehicles registered in Quincy.[38] Approximately 131 passenger vehicles were all-electric or plug-in hybrids.[39] Quincy is a city of commuters, with 86% or 46,070 employed residents commuting to workplaces located outside city limits.[40] Only 7,753 residents who live in Quincy work in the City, even though the area supports 50,000 workers.[41] Quincy's commuting patterns, along with the rapid population growth of the Greater Boston area, has contributed to some of the worst rush-hour traffic in the nation.[42]

Cambridge and Somerville are two cities that, like Quincy, are Inner Core communities located adjacent to the City of Boston and served by the Red Line. Therefore, it is helpful to compare their commuting methods and frequencies to Quincy. Though Cambridge and Somerville's public transit rates are similar to Quincy, Quincy's rate of single occupancy vehicle commuting is much higher while its biking and walking rates are much lower.

Table 11. Quincy Commuting Statistics (2013-2017 ACS 5-Year Estimates)

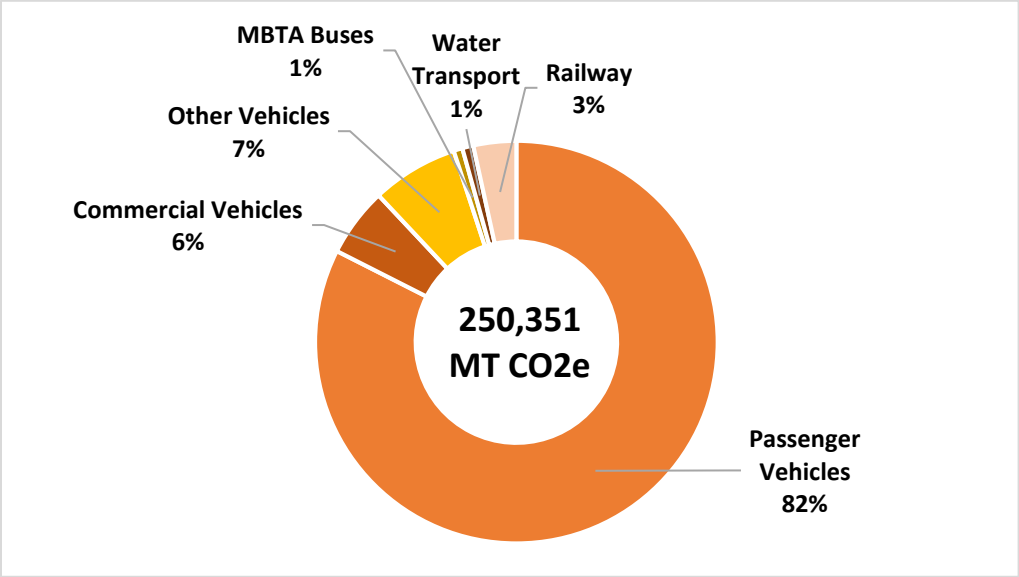
	Drove Alone	Carpooled	Public Transport	Walked	Biked	Taxicab, motorcycle, other	Worked from home	Worked Outside City of Residence[43]	Worked Inside City of Residence
Quincy	**57%**	**9.0%**	**28.1%**	**2.8%**	**0.4%**	**0.9%**	**1.8%**	**85.6%**	**14.4%**
Cambridge	27.8%	3.2%	29.8%	24.1%	7.0%	1.0%	7.1%	70.9%	29.1%
Somerville	38%	6.8%	32.6%	11.4%	6.9%	0.9%	4.4%	95.3%	6.7%
Massachusetts	70.7%	7.5%	10.2%	4.8%	0.8%	1.1%	4.9%	N/A	N/A

[38] US Census Bureau, ACS 2018 and MAPC, MAVC 2014
[39] MAPC, MAVC 2014 and Center for Sustainable Energy, MOR-EV 2019
[40] US Census, OnTheMap, 2019. Retrieved from: https://onthemap.ces.census.gov/
[41] Massachusetts EOLWD, 2019. Retrieved from: http://lmi2.detma.org/lmi/lmi_es_a.asp#IND_LOCATION
[42] WBUR, 2019. Retrieved from: https://www.wbur.org/bostonomix/2019/06/24/bus-lanes-faster-boston-commutes
[43] US Census Bureau, LOEDS Data

Emissions

Quincy's transportation emissions are generated from passenger, commercial, public transit, and waterborne vehicles. These vehicles use a variety of fuels, such as gasoline, diesel, and electricity. 32% of city-wide emissions are produced by the transportation sector. The majority of emissions originate from passenger vehicles which produce 82% of total transportation emissions.

Figure 7. Quincy Transportation Emissions by Activity (MT CO2e)



Passenger vehicles produce 27% of total City-wide emissions while all other transport activities only generate 6% of total emissions. This is reflected in Quincy's commuting patterns, as 86% of employed residents work outside the City with 57% of employees choosing to drive alone.[44] Additionally, only 15% of the jobs offered in Quincy are filled by Quincy residents.[45] The MBTA bus system only generates 0.2% of total city-wide emissions, emphasizing the need for vehicle commuters to switch to buses in order to drastically reduce emissions.

"The largest challenge in mode-shifting and increasing low-emission forms of transport is finding the proper incentives for commuters so that they choose mass transit over their own vehicle"
— Chris Cassani, Traffic, Parking, Alarm, and Lighting Director, City of Quincy

[44] US Census, OnTheMap, 2019. Retrieved from: https://onthemap.ces.census.gov/
[45] Massachusetts EOLWD, 2019. Retrieved from: http://lmi2.detma.org/lmi/lmi_es_a.asp#IND_LOCATION

Table 12. Costs and Benefits of Addressing Transportation Emissions

Costs of Inaction	Benefits of Action
• Increased costs of transport fuels • Health issues from decreased air quality due to vehicle pollution • Loss of productivity and work hours due to traffic • Loss of tax revenue from excessive parking/poor land use planning • Higher costs to rebuild poorly planned transportation corridors • Less funding for public transportation due to lower ridership • Decreased transportation infrastructure resiliency • Increased financial disparity for those who cannot afford vehicles	• Decreased spending on transport fuels • Improved health due to decreased vehicle pollution • Increased productivity due to reduced traffic time • Increased tax revenue from more effective use of space • Increased transportation infrastructure resiliency • Improve health due to frequent use of alternative modes of transport (walking, biking, etc.) • Increased health and wealth for those without access to vehicles

Previous Mitigation Measures

Transit Oriented Development (TOD) encourages the creation of compact, walkable, pedestrian-oriented, mixed-use communities around high-quality transit systems. As cities can influence land use regulations, TOD is an effective way at encouraging alternative modes of transport and reducing passenger vehicle emissions. TOD principles are currently being utilized around the Quincy Center and North Quincy MBTA stations. Quincy adopted a TOD zoning overlay district for North Quincy T station in 2016 but did not incorporate the larger North Quincy business district. Though Quincy Center does not have a TOD overlay, its updating zoning and urban renewal plan emphasize TOD concepts such as mixed-use, high-density developments, flexible parking requirements, and enhanced pedestrian access. Additionally, the City is developing an urban renewal district plan for the Wollaston area and T station which will incorporate TOD concepts. The City should continue in its current steps to support mixed-use TOD as well as pursue more ambitious measures, such as allowing for expedited permitting, as TOD is a major solution to reducing transportation emissions.

In 2018, the City adopted a Complete Streets Policy which aims as a guide towards improving infrastructure to provide safe and accessible travel options for people of all ages, abilities, and modes of travel, including walking, bicycling, driving and using public transit.[46] This policy will ideally help Quincy design roadways with all users in mind, making non-motorized transportation more convenient, attractive, and safe. Quincy also submitted a 5-year Complete Streets plan to receive $300,000 in MassDOT Complete Streets funding by identifying priority areas for transportation improvements through both professional assessments and public forums. However, as Quincy contains a vast transportation network, it cannot rely purely on the Complete Streets funding to make all the necessary improvements.

[46] City of Quincy, Complete Streets Policy, 2018. Retrieved from: https://drive.google.com/file/d/0B53HRfHg0rBiRnZjUEdGSEtVam5EVFl1VkdMOUlDVk5ocExV/view

In 2014, the Mayor's Bicycle Commission and Planning Department and the Metropolitan Area Planning Council (MAPC) completed the City of Quincy Bicycle and Pedestrian Network Plan. The Plan aimed to develop a bicycle and pedestrian network consisting of region-wide on- and off-road connections and institutionalize the implementation of pedestrian and bicycle accommodation at the local level. The Mayor's Bicycle Commission has been working with the Department of Public Works and the Traffic, Parking, Alarm and Lighting Department to implement recommendations found in the plan. In 2018, Quincy partnered with Lime Bikes, a dockless bike-sharing program that brought 300 bikes into the City.

The City has installed a traffic tracking system at 21 intersections. This camera system detects through-put for vehicles, bicycles, and pedestrians. Additionally, the City has recently deployed adaptive smart traffic signaling systems at 25 intersections primarily in and around Quincy Center. The system can adjust signal timing in real-time based on demand in order to optimize intersection traffic and reduce idling. The City is currently working on expanding this system to other major intersections.

To facilitate private vehicle owners to use EVs, the City has installed two public EV charging stations and is in the process of constructing a new Quincy Center parking garage with approximately six EV charging stations. In 2019, Massachusetts adopted a new provision in the state building code that requires a single EV-ready space in any new commercial construction with over fifteen parking spaces.[47] Unfortunately, the City's limited jurisdiction over state code impedes its ability to implement stricter EV parking policies.

Strategies to Reduce Emissions

	Mitigation Strategy	Target Activity	Direct or Indirect Emissions Reduction
Transportation	Mobility Study	Comprehensive transportation planning	I
	Parking Requirements	Reduce vehicle use in new developments	I
	Sidewalk Snow Removal Program	Encourages sidewalk use, reduces personal vehicle travel	I
	MBTA Bus Prioritization	Encourages bus use, reduces personal vehicle travel	I
	Electric Vehicle Charging Stations	Encourages EV adoption, reduces vehicle GHG emissions	I
	Transportation Demand Management	Encourages alternate modes of transport	I
	Permanent Ferry Service	Encourages ferry use, reduces personal vehicle travel	D

In order to address current and future transportation challenges, the City must take a multi-pronged approach. Effective City transportation emission mitigation strategies, such as mixed-use zoning and

[47] Sierra Club, 2019. Retrieved from: https://www.sierraclub.org/massachusetts/blog/2019/03/new-building-code-improvements-for-electric-vehicle-infrastructure-are

reducing parking, incorporate land-use planning to encourage mode-shifting rather than trying to influence vehicle use directly. The prioritization and enhancement of alternate mobility options can be evaluated through a community Mobility Study while collaboration with the MBTA can help to improve public transport options out of the City's direct control. Additionally, a combination of negative incentives (e.g., reduced parking availability) and positive incentives (e.g., improving sidewalks) can help promote the transition away from single-occupancy vehicles. Ultimately, the electrification of the transportation system is necessary to realize major transport fuel emissions reductions. Steps to reduce transportation emissions along with examples of City strategies are included in Table 13.

However, many of the problems of the Massachusetts transportation system are not driven by transportation-based decisions, but instead by land-use and development patterns.[48] Quincy's residential developments are distributed across a large quantity of land, lowering population density and increasing passenger vehicle transit. Quincy needs to accelerate the adoption of land-use regulations that promote high-density, mixed-use, transit-oriented developments and the use of active and shared transportation modes. These land-use regulations will encourage the use of alternative modes of transport, shorten overall vehicle trips, and create jobs within Quincy to reduce external commuting. Prioritizing these developments in conjunction with enhancing pedestrian and bicycle networks will promote mode-shifting from single-occupancy vehicles to low-emission alternatives.

Table 13. Steps to Reduce Transportation Emissions

1. **Reduce private vehicle miles traveled**
    - Minimized parking
2. **Enhance public transportation options and reliability**
    - MBTA bus prioritization, ferry service
3. **Enhance pedestrian and bicycle networks**
    - Mobility Study, sidewalk snow removal program
4. **Provide local amenities and employment opportunities**
    - Land use planning
5. **Promote dense, mixed-use developments in proximity to transit options**
    - Land use planning
6. **Electrify vehicle transport systems**
    - EV charging stations

Mobility Study

Compared to other local communities, Quincy has a relatively low proportion of commuters biking and walking to work (see Table 11). Quincy's lack of bike lanes, high-speed traffic, and inadequate sidewalk infrastructure are prohibitive to accessing a safe bicycling and walking environment. Transforming the functionality of existing streets and rights-of-way to better serve pedestrians and cyclists is critical in increasing zero-emission modes of transport. Identifying alternative solutions, such

[48] Commission on the Future of Transportation, 2018. Retrieved from: https://www.mass.gov/files/documents/2019/01/10/FOTCVolume1.pdf

as moving bike lanes off the road or creating shared-use paths for bicyclists and pedestrians, can increase the accessibility and safety of alternative transportation modes.

Quincy has taken steps to address its transportation issues, such adopting a Complete Streets policy and creating a Bicycle and Pedestrian Network Plan, but they have not completed a comprehensive transportation plan. A Mobility Study would be the first step in holistically addressing current and future transportation issues, developing a framework for mobility improvements, and ultimately mode-shifting to low-emission transportation options. A Mobility Study is a method of evaluating street improvements to expand access, increase safety, ensure reliability, and improve overall conditions for people walking, biking, and driving. A Mobility Study will fully assess existing transportation options while evaluating the impacts of future development on Quincy' transportation network. The Study will identify priority areas to improve mobility options through professional assessments and public forums. Community participation is fundamental to the Study and special attention should be paid to under-served populations who more frequently use alternative modes of transport.

A Mobility Study can also provide the necessary data to enact other transportation strategies, such as parking minimums, EV promotion, and bus prioritization. The Study can include a parking space inventory to evaluate utilization rates as well as a review of existing EV charging infrastructure to identify areas of network expansion. The Study should also review potential funding sources, partnership opportunities, and quantified emissions reductions from mode-shifting to low-emission options. Additionally, the Study should incorporate and build on previous community engagement and planning studies, such as the Complete Streets and Bicycle and Pedestrian Network Plan, to lay the foundation for identifying and prioritizing mobility projects. The Study can evaluate and integrate these plans into other city planning efforts, such as the revitalization of Quincy Center, to assess how these improvements can be unified to enhance mobility across the community. A Mobility Study completed by a Seattle community helped inform future transportation project scoping efforts and provided guidance on identifying funding and partnership opportunities.[49]

A Mobility Study provides the foundation for future transportation emissions reductions by taking a birds-eye-view of mobility issues. By identifying multi-modal interconnections and streamlining existing planning efforts, the Study will ensure that future transportation strategies can be incorporated into the larger framework of holistic mobility solutions.

Mobility Study					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Alternative Modes of Transportation	Transportation	# of community members engaged, # of identified transport solutions	Costs: The City	N/A

[49] Seattle Department of Transportation, 2017. Retrieved from: https://www.seattle.gov/Documents/Departments/SDOT/TransportationPlanning/GMS_Report_FINAL_10-25-2017_Small.pdf

Parking Requirements

In many cities, developers are required to include a minimum number of parking spaces depending on the development type and size. In most cases, minimum parking requirements go beyond what is strictly needed to ensure that residents have adequate parking. Mandating construction of more parking spaces than the market would build artificially pushes the price of parking down, typically to zero, and encourages vehicle use.[50] This in turn increases rates of vehicle ownership, congestion, and emissions.[51]

Quincy typically grants parking relief to TOD developments so they can build to a lower parking requirement. As spillover of parking into residential neighborhoods is a primary concern, Quincy does not issue parking permits to TOD housing residents to prevent those developments from attracting car-owning tenants. Additionally, Quincy requires vehicles to obtain residential permits in order to use all-day street parking around T stations. These permits have been effective in minimizing daytime parking overcrowding from non-residents. However, overnight resident on-street parking demand is still quite high across the City.

The high demand for on-street parking can potentially be explained by MAPC's Perfect Fit Parking Study. [52] This Study determined that 30% of multifamily development parking spaces in the Inner Core area, which includes Boston and its 20 surrounding cities and towns, were not being utilized. From the Quincy multifamily developments surveyed by MAPC, only 81% of provided off-street parking spaces were being utilized. Residents may be using on-street parking instead of their off-street spaces, or there may be an abundance of off-street spaces that are not being utilized by the residents entitled to them. The MAPC Parking Study found that not only was the overbuilding of parking in residential developments wasting tremendous amounts of money and useful space, but the provision of abundant parking was counterproductive to local transportation goals. Transit-proximate developments that provided easy parking were attracting car-owning occupants who were less inclined to use the available transit and more likely to use their personal vehicles.

Parking strategies that could improve Quincy's transit-friendly development and reduce emissions are summarized in Table 14 and explained in detail below.

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[50] Berkeley Institute of Urban and Regional Development, 2012. Retrieved from: https://iurd.berkeley.edu/wp/2012-04.pdf

[51] Local Housing Solutions, 2019. Retrieved from: https://www.localhousingsolutions.org/act/housing-policy-library/reduced-parking-requirements-overview/reduced-parking-requirements/

[52] MAPC, 2019. Retrieved from: https://perfectfitparking.mapc.org/assets/documents/Final%20Perfect%20Fit%20Report.pdf

Table 14. Parking Policy Examples

1. Reduce or eliminate parking requirements for smaller commercial spaces
2. Reduce or eliminate parking requirements for residential properties within 0.5 miles of a T station or frequent transit service (bus service every 15 minutes or less)
3. Establish low maximum parking requirements near T stations or frequent transit service (0.75-1 spaces per unit)
4. Reduce parking requirements based off of WalkScore (e.g. a score of 80 or above equates to a 5-10% off parking requirement)
5. Allow for transferable parking entitlements and shared parking allowances in dense, mixed-use areas

Parking Minimums and Maximums

A common strategy to address personal vehicle use is to reduce or eliminate minimum parking requirements in new developments, especially near public transit. Removing minimum parking requirements in zoning does not eliminate parking supply, it simply allows developers to decide how many spaces to build based on market demand. Additionally, as the assessed value of parking lots is low, the property tax revenue gained is much smaller than what could be collected from other types of developments. Removing parking minimums increases city tax revenue, reduces personal vehicle use, encourages alternative modes of transport, and allows for other space uses such as housing, bicycle storage, and open space. However, parking regulations work best when enacted in concert with other policies, such as the enhancement of alternative transit options.

Generally, minimum parking requirements in Quincy are 1.75 spaces per dwelling unit for multifamily residences, one space per 200 square feet for retail, and one space per 300 square feet for offices. Specific zoning districts have different parking requirements, such as the Quincy Center Special Districts and the North Quincy TOD overlay, which allow for reduced parking by encouraging mixed-use development in areas accessible to public transit. The City of Cambridge has reduced parking requirements to a minimum of one space per dwelling unit or as low as 0.4 per unit in special zoning districts close to T stations. Somerville is currently overhauling their zoning code to remove parking requirements for smaller commercial spaces and for developments within 0.5 miles of a train station. In Framingham, ground floor commercial uses are exempt from parking requirements.

Potential solutions for reducing parking minimums in Quincy include:

1. Reduce or eliminate parking requirements for smaller commercial spaces
2. Reduce or eliminate parking requirements for residential properties within 0.5 miles of a T station or frequent transit service (bus service every 15 minutes or less)
3. Reduce parking requirements based off of WalkScore (e.g. a score of 80 or above equates to a 5-10% off parking requirement)

Removing or reducing parking requirements for commercial spaces may increase the ease of opening new businesses. WalkScore evaluates the walkability and transportation options in an area. Basing parking requirements off WalkScore ensures that the development has access to local resources and alternative modes of transportation before parking minimums are reduced.

Additionally, parking maximums can be utilized in order to restrict the total number of spaces that can be constructed rather than establish a minimum number that must be provided. Maximum limits can improve the urban environment by preserving open space, limiting impervious surfaces, reducing congestion, and promoting transportation choices. From the developer's perspective, maximum limits minimize costs for parking construction and increase leasable space within a given floor-to-area ratio. However, it is crucial for any city employing maximum requirements to also provide accessible and frequent public transportation options. An example of such a policy includes establishing a low maximum parking requirement near T stations or frequent transit service, such as 0.75-1 spaces per unit. Cambridge established parking maximums in special districts as low as 0.75 spaces per unit which have helped reduce personal vehicle use.

Parking Minimums and Maximums					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Vehicle use in new developments	Residential and Commercial Transportation	Average parking spaces/unit, Vehicles/household	Savings: Developers	Mandatory

Shared Parking and Transferable Entitlements

Adding transferable parking entitlements can enhance the flexibility of maximum parking requirements. In such a program, the allowed number of parking spaces for a particular development are considered an "entitlement" that can be transferred or sold to another development if they are unused. This policy enables cities to control the parking supply without restricting developments that would not be feasible without additional parking. Projects that require more parking can proceed, while those that need less parking can benefit by selling their entitlements.[53]

For mixed-use areas, transferable entitlements can also be paired with shared parking allowances. Such modifications allow parking requirements to be met by shared uses from different developments. For example, an office that has peak parking demand during the daytime hours can share the same pool of parking spaces with an apartment building whose demand peaks at night. By allowing for shared parking, planners can decrease the total number of spaces required for mixed-use developments or single-use developments in mixed-use areas. This will increase the ease of implementing parking restrictions and contribute to the reduction of vehicle emissions without inconveniencing developers or tenants. Quincy should allow for both transferable parking entitlements and shared parking allowances in dense, mixed-use areas.

[53] Forinash, Millard-Ball, Dougherty and Tumlin. Retrieved from: https://pdfs.semanticscholar.org/9aca/93497f2f31589bc1ef46f2faddbfbf601b9f.pdf

Shared Parking and Transferable Entitlements					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Vehicle use in new developments	Residential and Commercial Transportation	Average parking spaces/unit or square footage of development, Vehicles/household	Savings: Developers	Voluntary

Sidewalk Snow Removal Program

Approximately 2.8% of commuters in Quincy walk to work and 0.4% bike—much lower than similar communities' rates (see Table 11). Though this is primarily due to a large amount of jobs being located outside the City, a contributing factor may be the lack of enforced sidewalk snow removal for a significant portion of the year. Quincy's Municipal Code requires store owners or tenants to remove snow from the sidewalk bordering their properties, but residents are exempt from this requirement. Because of this, as well as a general lack of proper snow clearing enforcement, Quincy workers have cited issues with walking to T stations for their morning commute.[54] Additionally, local students find it difficult to navigate the snow-covered sidewalks when walking to school. Residents must either walk in the streets, drive to T stations, or drive their children to school. The lack of enforced snow removal reduces pedestrian accessibility, increases vehicle emissions, and intensifies physical hazards to vulnerable residents.

Some cities have addressed sidewalk snow by requiring residents to clear their sidewalks in threat of a fine. However, such a measure could negatively impact those unable to participate such as the elderly or disabled, single parents working multiple jobs, or those without the means to pay for a snow removal service. To address this issue, Quincy could implement a city-operated sidewalk snow removal program. The City could identify priority routes that experience high pedestrian traffic—including routes to T stations, bus stops, and schools—and target them for city-supplied snow-removal services. The clearing could be triggered by a certain total snow depth (e.g., three-to-four inches or more) and must be completed within 8 hours of snowfall. The previously recommended Mobility Plan could evaluate how snow obstructs pedestrian traffic and identify priority sidewalks and intersections for snow removal. The effectiveness of a snow removal program could be evaluated through the City's traffic tracking system which monitors pedestrian traffic through major intersections.

The City of Rochester in New York implemented a similar program in which the City clears sidewalks when snow depth reaches four inches or more. Duluth, Minnesota clears 100 miles of priority sidewalk routes, including routes to schools, high-pedestrian traffic locations, and public-transit locations. Syracuse, New York will begin to plow 20 miles of priority sidewalks after each snow event that accumulates totals of three inches or more in the next year.[55] By treating sidewalks as a necessity for proper transport, a City-run sidewalk snow removal program would directly reduce unnecessary vehicle miles traveled (VMTs), enhance equity, and improve sidewalk accessibility for all residents.

[54] QCAN Meeting 10/9/2019
[55] CityLab, 2019. Retrieved from: https://www.citylab.com/perspective/2019/01/snow-removal-laws-shoveling-city-sidewalks-rules-syracuse/579886/

Sidewalk Snow Removal Program					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Vehicle use during periods of snowfall	Residential Transportation	Miles of sidewalk cleared, Pedestrian and bicycling frequency, Commuter mode-shifting	Costs: The City Savings: Residents	Mandatory

Transportation Demand Management

Transportation Demand Management (TDM) refers to a package of policies and programs that enable the transportation system to function more effectively and efficiently by shifting passengers from single-occupancy vehicle travel. Specifically, TDM encourages using alternative travel modes (bicycling, walking, and public transit); promoting alternatives to SOV travel (teleworking and ridesharing); increasing the number of passengers in vehicles (carpooling and vanpooling); and eliminating the need for some trips altogether (compressed work week). [56]

Through a zoning amendment, Quincy could require that large project developers must provide a Transportation Access Plan as condition of obtaining a building or occupancy permit. The Plan must provide TDM measures for occupants, such as subsidized MBTA pass programs, free shuttle services, a car share program, and bicycle storage facilities. The Transportation Access Plan can be point based, much like the LEED system, where the developer must meet a certain threshold before obtaining a permit. Boston's Transportation Access Plan Agreement (TAPA) follows a similar structure in which the developer negotiates a TDM plan with Boston's Zoning Board.[57]

Cost-benefit analyses often show that implementing TDM strategies is less expensive than expanding roads and parking facilities. [58] Various studies have demonstrated that employer-based TDMs strategies can reduce employee vehicle trips from 8-30%.[59] TDM measures can also help businesses attract and retain employees, increase productivity, and reduce overhead costs, attracting more tenants to these developments. Depending on the strategies implemented, TDM options could significantly reduce single-occupancy vehicle travel.

[56] MAPC, 2015. Retrieved from: http://www.mapc.org/wp-content/uploads/2017/10/TDM-FINAL-REPORT-7_15_0.pdf
[57] City of Boston, 2019. Retrieved from: https://www.boston.gov/departments/transportation/transportation-zoning-board-appeal-guidelines
[58] SANDAG, 2012. Retrieved from: https://www.icommutesd.com/documents/TDMStudy_May2012_webversion_000.pdf
[59] Michigan Sustainable Communities, 2013. Retrieved from: https://smartgrowthamerica.org/app/legacy/documents/state-of-the-practice-tdm.pdf

Transportation Demand Management					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Vehicle use in new developments	Residential and Commercial Transportation	# of employees utilizing TDM measures, Passenger mode-shifting	Costs: Developers Savings: Tenants, Employees	Mandatory

MBTA Collaboration

The MBTA provides bus, train, and commuter rail services to Quincy. As passenger vehicles in Quincy generate 27% of city-wide emissions while MBTA buses only generate 0.2%, mode-shifting to public buses is essential in order to drastically reduce GHG emissions. However, the MBTA's general lack of investment and delayed maintenance of transit infrastructure in Quincy has made it difficult to promote this shift. To assist in Quincy's effort to reduce transport emissions, the MBTA needs to improve its services and become a reliable and attractive resource for Quincy residents. Quincy will need to collaborate with the MBTA to ensure future public transit developments conform to the City's unique needs. The City's input on infrastructure improvement, schedule changes, available capacity, and electrification can help push the MBTA towards a system that is more appealing to residents. This will decrease local vehicle use while simultaneously increasing the MBTA's revenue.

As the Red and Commuter Rail lines are on established tracks that also serve other communities, advocating for changes to those services will be much more difficult than prioritizing buses that primarily serve Quincy. There are 17 MBTA bus routes that provide service to thousands of residents and cover over 2,000 roundtrip miles in Quincy daily. Unfortunately, the Greater Boston area is currently experiencing the worst rush-hour traffic in the nation, and bus route times have increased by 17% between 2006 and 2018.[60] Additionally, Quincy is served by older, emissions-heavy diesel buses as the MBTA's hybrid buses cannot fit in Quincy's bus garage.[61] Therefore, prioritizing MBTA bus service and vehicle enhancement is critical in promoting mode-shifting to public transport and reducing emissions.

Besides the bus prioritization program described below, Quincy should also encourage the MBTA to install schedules, countdown clocks, benches, shelters, and other amenities at key bus stops. These additions are shown to reduce the perception of time spent waiting for the bus and increase accessibility for those without smartphones. [62] Additionally, providing EV charging equipment at MBTA parking facilities can promote the switch to vehicle electrification in Quincy.

Bus Prioritization

Quincy monitors and manages traffic flows through a traffic tracking system and adaptive signaling system installed at major intersections. MBTA buses contain internal location-tracking technology that could be integrated with Quincy's traffic systems in order to offer priority transit to

[60] MBUR, 2019. Retrieved from: https://www.wbur.org/bostonomix/2019/06/24/bus-lanes-faster-boston-commutes
[61] MBTA, 2019. Retrieved from: http://www.transithistory.org/roster/
[62] Wired, 2016. Retrieved from: https://www.wired.com/2016/08/taking-fooorever-get-countdown-clocks-nycs-subway/

buses. Utilizing both systems to coordinate traffic lights with bus routes at key intersections, such as entering and leaving Quincy Center station, can potentially reduce transit times and idling. Partnering with the MBTA to pilot a transit prioritization program at Quincy Center station could be the first step in enhancing bus service throughout Quincy.

Concurrently, bus rapid transit lanes or priority bus lanes at a few key street sections in Quincy could reduce trip times for the majority of bus routes. As many of Quincy's congested streets have dedicated street parking, the City could explore transforming parking on one side of the street into a bus-only lane during high-traffic times (e.g. 7-9 AM or 4-6 PM). This change would allow for a drastic reduction in bus travel time and idling, would not permanently remove street parking, and could have minimal negative impact on regular vehicle traffic. A pilot program could ideally be conducted on Hancock Street/Quincy Avenue outside of Quincy Center Station.

Utilizing bus rapid transit lanes in conjunction with transit prioritization at intersections could drastically decrease bus travel times and increase ride quality. Such a program could potentially result in shorter bus commuting times compared to passenger vehicles. Additionally, decreased travel time with the same quantity of buses could result in increased bus frequency during commuting hours. As commute times decrease and services increase, bus prioritization will motivate residents to mode-shift towards bus use and reduce vehicle miles. Increasing bus ridership by 300-500 residents could decrease emissions by 1,000-2,000 MT CO2e annually.

Several Boston-area communities have piloted bus-only lanes and signal prioritization in recent years, including Arlington, Cambridge, Watertown and Everett. Through such programs, Arlington reduced its bus commute time by 10 minutes and Cambridge and Watertown decreased timing variance by 69%.[63] These improvements have made buses faster, more reliable, and improved public perception of public transportation.[64]

Transit Signal Prioritization and Bus Rapid Transit					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Vehicle use primarily for commuting	Public Transportation	MBTA ridership, Bus commute times, Miles of bus lanes created, Passenger mode-shifting	Costs: MBTA, the City Savings: MBTA, Commuters	Voluntary

Electric Vehicle Charging Stations

According to data from the Massachusetts Vehicle Census (MAVC) and the Massachusetts Offers Rebates for Electric Vehicles program (MOR-EV), there were an estimated 131 EVs registered in Quincy in 2018. The City has currently installed two EV charging stations at a new school and is in the process of

[63] Wicked Local, 2019. Retrieved from: https://arlington.wickedlocal.com/news/20190704/bus-pilots-bring-faster-commutes-public-enthusiasm-to-arlington-cambridge-everett-watertown
[64] MBUR, 2019. Retrieved from: https://www.wbur.org/bostonomix/2019/06/24/bus-lanes-faster-boston-commutes

constructing a new downtown parking garage with approximately six public EV charging stations. According to PlugShare, there are four privately installed charging stations in Quincy that are available to the public.[65]

The majority of EVs owners charge their vehicles through home-charging stations in off-street parking or workplace charging stations when they are available. As many residents utilize street parking or live in multifamily buildings without EV charging, only a limited portion of vehicle owners in Quincy have this capability. Therefore, public charging stations are necessary to encourage additional EV adoption. Though the City is pushing to provide more EV charging stations on public property, they will not be able to provide charging in all the necessary locations to significantly increase EV adoption. The City needs to collaborate with large businesses to develop community-wide EV infrastructure in order to enhance vehicle electrification.

To this end, the City could implement an outreach program and develop rebates for business to install publicly-available charging stations.[66] The City could target and offer rebates to businesses with frequent vehicle traffic or high parking demands (as demonstrated in a Mobility Study). The City could require businesses to provide monthly energy consumption data for all charging stations in order to track usage and effectiveness. The rebate could require businesses to apply for the Massachusetts Workplace Electric Vehicle Supply Equipment (EVSE) Grant which provides 60% of the cost of Level 1 or Level 2 workplace EVSE, up to $50,000. Eligible applicants include employers with 15 or more employees in a non-residential place of business.

When outreaching to businesses, Quincy can emphasize the value proposition of installing EV charging infrastructure. Offering EV charging generates additional revenue for retailers as EV drivers are shown to have higher dwell times than other customers.[67] Installing chargers can also add businesses to special maps that EV drivers utilize to find charging stations. This is an easy and inexpensive form of advertising to a specific, typically higher-earning and extremely loyal customer base. Free EV charging opportunities also act as an attractive benefit to employees and visibly demonstrates a company's climate commitment.

EV Charging Stations					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Electric vehicle use	Transportation	# of charging stations installed, kWh provided, Local EV ownership	Costs: The City, Businesses Savings: Businesses, EV Owners	Voluntary

[65] PlugShare, 2019. Retrieved from: https://www.plugshare.com/location/12611
[66] City of Pasadena, 2019. Retrieved from: https://ww5.cityofpasadena.net/water-and-power/commercialchargerrebate/
[67] The Climate Group, 2018. Retrieved from: https://www.theclimategroup.org/sites/default/files/downloads/ev_charging_faq_.pdf

Permanent Ferry Service

The Marina Bay Ferry is a unique partnership between the City of Quincy, the Town of Winthrop and the Commonwealth of Massachusetts to provide seasonal water transportation from Squantum Point Park to Central Wharf, Seaport Fan Pier, and the Town of Winthrop. The 73-passenger "Valkyrie" is owned and operated by the Town of Winthrop. In 2018, 4,500 passengers road the ferry in the spring and fall, resulting in 133 metric tons of CO2e. Of total ferry emissions, 22 metric tons of CO2e were attributed to trips from Quincy—less than 0.01% of Quincy's overall transport emissions.

Residents are supportive of access to year-round ferry service which reduces travel times and increases commuting reliability. As total ferry emissions are much smaller than emissions from vehicles holding the same number of occupants, increasing ferry commuting can reduce Quincy's transportation emissions.

Year-round ferry service would increase total emissions to 453 metric tons of CO2e a year, or 75 metric tons CO2e attributable to Quincy. If the primary goal is to reduce overall emissions, 28 Quincy round-trip vehicle commuters would need to switch to ferry transport daily to start realizing transportation emissions reductions. This is assuming the average commuter using the ferry service is traveling to downtown Boston. If 100-200 single-occupancy vehicle commuters switched to ferry service, it would reduce annual emissions from 200-500 metric tons of CO2e.

Permanent Ferry Service					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Vehicle use primarily for commuting	Public Transportation	Ferry Ridership	Costs: The City Savings: Residents	Voluntary

Waste

Overview

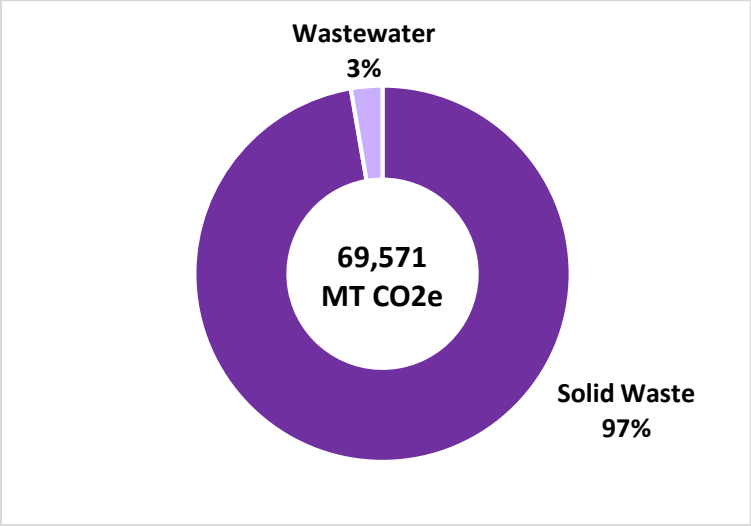
Solid waste in Quincy primarily consists of municipal solid waste. The City provides residential waste and recycling collection for one-to-eight-family dwellings and condominiums through Capitol Waste Services while larger multifamily dwellings and commercial properties are serviced by private haulers. All waste collected by the City is sent to the Covanta SEMASS waste-to-energy plant while recycling is processed and sold at a recycling center in Avon. Commercial and industrial wastes were assumed to be sent to both landfills and waste-to-energy plants. Wastewater is handled by the Metropolitan Water Resources Authority (MWRA). All wastewater in sent to Deer Island Treatment Plant in Winthrop, Massachusetts.

Emissions

Residential units served by the City generated 27,966 metric tons of trash and 4,492 metric tons of recycling in 2018. Residential waste disposal emissions were accounted for in the grid emissions factor as all trash is sent to a waste-to-energy plant. The commercial and industrial sectors generated an estimated 65,305 metric tons of trash and 20,224 metric tons of recycling. Commercial and industrial waste generated 67,691 metric tons of CO2e due to landfilling, or 8.7% of total City emissions.

The City generated 5,493 million gallons of wastewater in 2018. Methane generation from wastewater treatment is used to power MWRA facilities and is not included in Quincy's GHG inventory. The discharge of wastewater generated 1,880 metric tons of CO2e. As wastewater represents <0.3% of the City's total emissions, strategies for wastewater reduction were not included in this plan. However, it should be noted that water conservation is still a significant issue and should be integrated in a community-wide sustainability plan.

Figure 8. Quincy Total Waste Emissions by Activity (MT CO2e)



The majority of solid-waste emissions stem from the inclusion of organic matter in the landfilled waste stream. Therefore, reducing the amount of organic matter waste or the total waste sent to landfill will result in large waste emission reductions.

"The most effective way to increase recycling is to distribute two large carts to every household: one recycling and one trash. This, coupled with education and, most importantly, enforcement with consequences, would be the most effective strategy."
– John Sullivan, Director of Operations, Waste and Recycling Division

Table 15. Costs and Benefits of Addressing Waste Emissions

Costs of Inaction	Benefits of Action
• Higher disposal and rejection rates for trash and recycling • Increased future costs for contaminated recycling streams due to China's recycling ban • Increased costs for resource consumption • Decreased ecosystem health from littering	• Reduced disposal and rejection fees • Decreased landfill waste • Decreased litter and environmental pollution • Increased awareness of resource consumption • Promotion of a circular economy

Previous Mitigation Measures

Quincy residents have two options for acquiring recycling bins: purchasing a trash bin and adhering a recycling sticker or a purchasing a smaller blue recycling bin. As the blue recycling bins are smaller than the trash bins, much of the recycling overflow is placed in the trash. The Waste and Recycling Department recently developed a pricing and logistics plan to provide larger recycling bins to residents to increase recycling rates. The City was also awarded a MassDEP Recycle IQ grant which they will use to develop a multi-platformed public relations program to increase recycling and reduce contamination. The City expects to utilize the grant to begin comprehensive recycling planning in early 2020. Additionally, the Mayor's Composting Task Force—a group comprised of City officials, interested residents, and Quincy Climate Action Network members—regularly meets to develop community composting solutions.

Strategies to Reduce Emissions

	Mitigation Strategy	Target Activity	Direct or Indirect Emissions Reduction
Waste	Composting Program	Residential organic waste generation	D
	Waste Inspector	Reduce recycling contamination and landfill emissions	I
	Consumption-Based Emissions Inventory	Comprehensive waste evaluation	I

Though increasing composting and recycling will reduce the City's contributions to global emissions, the GPC protocol used for Quincy's 2018 GHG Inventory only accounts for emissions due to waste disposal and not from the production, transportation, or reuse of goods. As all of Quincy's residential waste is sent to waste-to-energy plants, the emissions from these plants are included in the grid emission factor. As organic matter typically has a high water content and takes more energy to burn, reducing the amount of organic matter sent to waste-to-energy plants will slightly decrease the grid emissions factor. However, this decrease cannot be quantified in the GHG Inventory. Therefore, any emissions reduction from residential recycling or composting will be reflected in a lower emissions factor provided by external sources but will not be directly reflected in Quincy's GHG Inventory. Such waste emissions accounting issues can be addressed through a consumption-based emissions inventory as explained in the recommended strategies below.

Unlike residential waste, a portion of commercial and industrial waste generated Quincy is presumably sent to landfill. As the breakdown of organic matter is the primary source of landfill emissions, reducing the amount of such matter in the commercial and industrial waste stream will substantially reduce the City's total waste emissions. If commercial and industrial customers increase their rates of composting and recycling, the subsequent emission reductions will be reflected in the waste portion of Quincy's emissions inventory.

In summary, the importance of enacting comprehensive recycling and composting programs should not be diminished as these will drastically reduce life cycle emissions, even if not directly accounted for in Quincy's current GHG inventory.

Composting Program

When organic matter, such as food waste and paper, decomposes in the absence of oxygen, it produces methane. This is a common occurrence in landfills—the destination of approximately 36% of the Commonwealth's waste.[68] The breakdown of organic matter in landfills has become third-largest source of human-related methane emissions in the US. [69] Composting is an effective way to reduce landfill emissions. Rather than generating methane, the composting process converts organic material into stable soil carbon, while retaining water and nutrients of the original waste matter. The result is carbon sequestration as well as production of a valuable fertilizer. Composting can also decrease the amount of contaminated recycling and reduce the amount of energy required to incinerate waste in waste-to-energy plants. If the commercial and industrial sector composted 10% of its municipal solid waste, this could reduce emissions by 9,032 metric tons of CO2e, or 13% of total waste emissions.

The Mayor's Composting Task Force is currently investigating the feasibility of a city-wide composting program. The City is examining proposals from several professional composting companies to potentially provide curbside pickup of food waste and is looking into establishing composting operations in the Department of Public Works yard. As the host entity, the City would pay lower tipping as a result of the reduction in overall trash weight fees while the composting company would have ready access to carbon-rich yard waste. The Composting Task Force should prioritize the completion of a waste characterization study in order to quantify the City's composting potential and increase the accuracy of emissions calculations.

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[68] MassDEP 2017 Solid Waste Update

[69] USA EPA, 2019. https://www.epa.gov/lmop/basic-information-about-landfill-gas

Composting Program					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Direct: 9,032 MT CO2e (Commercial/Industrial Only)*	Residential Waste	Solid Waste	Composting rate, Volume of rejected recycling	Costs: The City Savings: The City, Residents	Voluntary

*Considering the C/I sector composts 10% of total waste and reduces food waste in the MSW waste stream by 10%

Waste Inspector

In 2018, Quincy had a recycling rate of 14%. In comparison, Boston has a recycling rate of 25% while the national average is 34%.[70] Recycling reduces upstream emissions by minimizing the amount of raw materials used to generate new products. Recycling of certain materials also reduces downstream incineration emissions or landfill methane emissions. Unfortunately, a large amount of recycled materials is commonly rejected from recycling facilities as it is contaminated with other kinds of waste. This can cause the municipality to pay increased rejection and landfilling fees.

Quincy plans to hire a recycling coordinator to inspect residential recycling containers for contamination. If contamination is found, the inspectors will leave educational notices on the levels of contamination. Data on the recycling content can be logged and repeat violators could potentially be fined. The program can also promote targeted outreach efforts which may help educate the few residents who may be causing large amounts of recycling contamination. The City of Providence in Rhode Island implemented a similar inspection program which drastically increased the quality of their recycling waste streams and minimized their rejection fees.[71]

Waste Inspector					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Residential Recycling	Solid Waste	Recycling rate, Volume of rejected recycling	Costs: The City Savings: The City, Residents	Mandatory

Consumption-Based Emissions Inventory

Quincy's current emissions inventory only accounts for emissions due to the landfilling of waste. It does not consider the broader emissions impact of Quincy's material consumption, such as from the production, purchasing, and transporting of goods. A consumption-based emissions inventory would provide a holistic picture of the City's waste-related emissions by accounting for the life cycle emissions of goods and services consumed within the community. By utilizing this method and connecting local activities to the global supply chain, cities find that their consumption-based emissions are typically 60%

[70] Waste Dive, 2019. Retrieved from: https://www.wastedive.com/news/boston-zero-waste-2050-organics-textiles/557168/

[71] Providence Journal, 2019. Retrieved from: https://www.providencejournal.com/news/20190208/trash-police-city-says-goal-of-recycling-checks-is-improvement-not-punishment--video-audio

larger than their geographic emissions.[72] There are multiple modeling tools that can be used to complete such an inventory, such as CoolCalifornia.org and the Consumption Based Emissions Inventory Guidebook.

A consumption-based emissions inventory would help Quincy illustrate the strong link between consumption and climate change while providing them with a platform to address community resource use in their climate planning efforts. This type of analysis allows cities to design local programs that target emission-intensive consumption categories and lifecycle phases (e.g. production, use) while supporting a cultural shift to low-emission consumption activities.

Consumption-Based Inventory					
GHG Reduction	**Activity Targeted**	**Sub-Sector**	**Performance Metrics**	**Primary Costs/Savings**	**Mandatory or Voluntary**
Indirect	Waste Generation	Solid Waste	Weight of waste surveyed, MT CO2e/person	Costs: The City	N/A

[72] City of Somerville, 2018. Retrieved from: https://www.somervillema.gov/sites/default/files/somerville-climate-forward-plan.pdf

Governance and Leadership

Overview

Though climate change adaptation is a highly visible issue in Quincy, climate change mitigation has not received equal consideration. However, the City has recently taken action to integrate climate and sustainability into its operations. In 2013, the City hired its first Energy and Sustainability Director to drive energy optimization and climate action at the municipal level. The Director leads the Mayor's Climate Change Committee who advocates for sustainable practices and develops climate legislation for the City. The Climate Change Committee primarily consists of members from the Quincy Climate Action Network, a group of Quincy residents utilizing volunteer man-hours to help enact climate programs and create policies for the City.

"There are many large emissions sources that are not within the City's control. It takes significant rethinking for people to understand their potential climate impact. Therefore, the challenge is to education, incentivize, and encourage residents and business to make changes by disseminating relevant information in actionable steps. The City can only lead by example if people are informed of what the City is doing and are impressed by it." -- Shelly Dein, Energy and Sustainability Director, City of Quincy

Governance and Leadership Strategies

	Mitigation Strategy	Target Activity
Governance and Leadership	Municipal Government Climate Change Commitment	Lead by Example
	Local Government Emissions Inventory and Mitigation Plan	Lead by Example
	Climate Action Task Force	Lead by Example / Education and Outreach
	Climate Action Campaign and Communications Plan	Education and Outreach
	External Green Revolving Loan Fund	Outreach and Legislation

There are three major pathways for local governments to promote sustainability and prepare for climate change: legislation, lead by example, and education. To fully utilize this multi-modal approach, Quincy's government should develop an internal culture of sustainability while empowering its residents to pursue climate action strategies. The City should first establish an internal consensus on climate change and address their own organizational emissions by completing a local government GHG inventory and mitigation plan. Subsequently, they should form a Climate Action Task Force to determine the extent of actions that need to be pursued to reduce community-wide emissions. As the municipal government does not have control over the community's largest emissions sources, the main challenge lies in educating residents and business-owners on the severity of the problem and introducing them to the wealth of opportunities. To build support for local climate solutions, Quincy's leaders must effectively engage citizens and stakeholders through a climate awareness campaign that considers the diverse social, economic, and political backgrounds of their community. By fully recognizing the value of

enhanced climate communication and transparency, Quincy can effectively lead by example and develop a collaborative culture of climate action.

Table 16. Local Government Steps to Reduce GHG Emissions

1. **Enact Climate Legislation**
    - Mandatory and voluntary policies and incentives (Green Building Standard, reduced parking minimums, composting, etc.)
    - External Green Revolving Loan Fund
2. **Lead by Example**
    - Internal Commitment to Climate Action
    - Local Government GHG Inventory and Mitigation Plan
    - Internal City strategies (Sustainable Design Requirements, Green Fleet Policy, Sustainable Procurement Policy, etc.)
    - Climate Action Task Force
    - Internal Green Revolving Loan Fund
3. **Education and Outreach**
    - Climate Action Awareness Campaign
    - Climate Action Communication Plan
    - City website and other public promotion of climate action
    - Community workshops, seminars, and roundtables to inform Climate Action Plan

Municipal Government Climate Change Commitment

In order to publicly demonstrate their commitment to climate action, the Quincy City Council should pass a resolution affirming the goals of the Paris Climate Agreement. The primary goal of the Paris Agreement is to hold the global average temperature increase to below 2 degrees Celsius by drastically reducing anthropogenic GHG emissions. Though President Trump pulled out of the Paris Agreement in 2017, 287 US cities and counties remained committed.[73] In 2016, Quincy informally signed on to the Metropolitan Mayors Climate Mitigation Commitment which was inspired by the Paris Agreement but makes no explicit temperature commitment. Therefore, the City Council should demonstrate their climate leadership through a publicized resolution affirming the goals of the Paris Climate Agreement. Additionally, the City should sign the "We Are Still In" declaration; a joint statement of support for the Paris Agreement signed by US governments, academia, and the private sector.[74]

Mayor Koch should also consider joining a municipal climate alliance organization, such as the Global Covenant of Mayors for Climate and Energy (GoCM). The GCoM is the largest global alliance for city climate leadership, built upon the commitment of over 10,000 cities and local governments. The

[73]We Are Still In, 2019. https://www.wearestillin.com/
[74] We Are Still In, 2019. https://www.wearestillin.com/

GCoM allows for the sharing of best practices as well as resources on city climate action planning. The GoCM requires its members to complete a city-wide GHG inventory using the Global Protocol for Community-Scale GHG Emission Inventories (Quincy's 2018 GHG inventory already meets this requirement). Other Massachusetts cities and towns such as Boston, Somerville, Cambridge, Brookline, Arlington, Medford and Acton have joined the GCoM. Joining the GoCM sends a signal to residents that the City is committed to climate action while encouraging surrounding communities to also pursue climate commitments.

Local Government Emissions Inventory and Mitigation Plan

The City should complete a local government operations GHG inventory in order to understand emission sources from municipal operations. The local government inventory will allow the City to set an emissions reduction target, develop an internal culture of climate action, and follow lead by example principles. It is recommended the City use the Local Government Operations Protocol developed by the ICLEI, California Air Resources Board, California Climate Action Registry, and The Climate Resgistry to report their emissions.

The local government inventory will most likely reveal that municipal operations only generate 5-10% of total community-wide emissions.[75] Though the local government's emissions reduction potential in relation to total emissions may be small, the opportunity to lead by example is substantial. Developing a comprehensive local government GHG mitigation plan will aid in creating an internal culture of climate action while enhancing the municipality's credibility. Examples of internal lead by example climate policies are included in Table 17.

Table 17. Internal Lead by Example Climate Action Policies

Sustainable Design Requirements	A municipal Sustainable Design Requirement would mandate all new municipal buildings to be built to LEED or Net-Zero standards. Such a requirement could act as pilot for a community-wide Green Building Standard. The City could also require participation in a staff training program that promotes optimal energy efficient operations and sustainable management of all municipal buildings.
Sustainable Procurement Policy	Implementing sustainable procurement guidelines for major purchasing decisions can help the City improve their operational sustainability through the products and services it acquires. This policy would require tailoring bid specification documents to reference sustainable third-party certifications, utilizing vendor sustainability questionnaires, and requiring vendors to track and report their environmental impacts. Bidders would be required to submit documentation on the sustainability attributes of their products or services and would be awarded points accordingly during the bid evaluation process. This policy enables the City to gain experience with sustainable products and services that are available from local businesses. It can also save the City money by favoring products that are more resource efficient, last longer, and have lower maintenance and disposal costs.
Green Fleet Policy	The City could require that all new vehicles requested by municipal departments follow a Green Fleet Policy. The policy could require that each request utilize the US

[75] ICLEI, GPC

	EPA Green Vehicle Guide to identify multiple vehicle options with information on fuel economy and emissions. This would allow the City to consider both economic and environmental attributes and align vehicle purchasing with emissions reduction goals. The Policy would promote the purchasing of EVs, hybrids, or alternative-fuel vehicles for the City's fleet. The implementation of such a policy can result in more immediate benefits for fleet vehicles that are replaced frequently, such as police vehicles which are replaced every 3-4 years.
Internal Green Revolving Loan Fund	A Green Revolving Loan Fund is an internal capital pool that is dedicated to funding energy efficiency, renewable energy, or sustainability projects that generate cost savings. A portion of the savings are used to replenish the fund (i.e. revolved) allowing for reinvestment in future projects of similar value. This establishes an ongoing funding vehicle that helps drive energy efficiency and sustainability over time, while generating cost savings and ensuring capital is available for important projects.[76] There are various methodologies for tracking the energy and financial savings from such green projects.[77] EPA's Portfolio Manager is a common tool used to establish energy baselines, identify and prioritize projects, and track avoided costs. For projects with more complex performance variables, a third-party can be used to calculate savings estimates. Alternatively, the City can avoid the internal logistics of a green revolving fund by enrolling in an energy performance contract with an Energy Service Company (ESCO). The ESCO would fund green projects upfront and pay themselves back through the guaranteed savings.

Climate Action Task Force

This GHG Mitigation Plan is an exercise in identifying first-step mitigation strategies the City can currently pursue to reduce emissions. It is meant to serve as a resource for Quincy to adapt into a future comprehensive Climate Action Plan. Establishing a Climate Action Task Force is necessary to determine the extent of actions that need to be pursued to substantially reduce community-wide emissions and ultimately develop a Climate Action Plan. The Task Force can consist of City Department representatives, Climate Change Committee members, and qualified residents. The Task Force, with the help of QCAN, can be responsible for the community engagement process and help promote public climate planning consultation and deliberation through workshops, roundtables, and seminars. The Task Force can conduct a gap analysis of codes and bylaws for climate action goals, conduct feasibility analyses for certain mitigation measures, and identify areas of integration into existing City planning goals. Additionally, the Task Force should collaborate on the Quincy 400 community visioning initiative by helping the advisory committees integrate climate and emissions impacts during the visioning process. Finally, the Task Force will develop a timeline for a net-zero emissions target, periodically update the GHG inventory, and advise the City on climate progress.

[76] US DOE, 2019. Retrieved from: https://betterbuildingsinitiative.energy.gov/toolkits/green-revolving-funds
[77] US DOE, 2011. https://www1.eere.energy.gov/wip/solutioncenter/pdfs/bestpracticesforestablishingmunicipalfundsforenergyefficiencyprojects.pdf

Climate Action Campaign and Communications Plan

The City can only promote community-wide culture change when its goals and actions are properly communicated to its residents. Quincy can accomplish this by creating a long-term, multi-lingual, city-wide awareness campaign that frames climate action in the context of broad community concerns and motivates residents to act. A primary tool Quincy can utilize in this campaign is their City website. Currently, the website lacks any information on climate or sustainability activities in Quincy. A section on sustainability should be created to exhibit progress on the City's climate goals, recognize notable climate accomplishments, and provide relevant resources on how residents can take actionable steps to reduce their carbon footprint. The City can also enhance communications through press releases and publications for local news outlets, social media and email messaging to stakeholder groups, and collaboration with local community organizations such as QCAN. For additional municipal campaign strategies, the City can reference "How to Harness the Power of Your Community to Address Climate Change: A Local Official's Guide" or Boston's Community Engagement Strategy.[78] [79]

As climate change is an abstract concept for some, explaining climate issues through relatable messaging is essential for generating buy-in from residents who may not be otherwise engaged. Developing a climate communications plan on how to translate emission impacts—such as relating them to every-day concepts like traffic, air quality, and utility bills—may be beneficial to enhancing community engagement. The City should reference the research-proven practices for successful climate communication from the "Let's Talk Communities & Climate: Communication Guidance for City and Community Leaders" report.[80] Basic tips from this guide are included in Table 18 below.

Table 18. Climate Communication Tips

1. Connect on common values such as health, quality of life, community well-being, and economic vitality.
2. Underscore the effect climate change has on the outlined common values.
3. Emphasize local solutions and how they can enhance personal benefits and quality of life.
4. Inspire and empower instead of "doom and gloom".

External Green Revolving Loan Fund

It is often difficult for local governments, business, and residents to attract private investment for climate mitigation projects. The perceived high risk of investing in new technologies or business models, small-scale projects with high transaction costs, and a lack of precedents to promote investor

[78] Institute for Local Government and CARB, 2010. Retrieved from: https://www.ca-ilg.org/sites/main/files/file-attachments/cc_and_public_participation.pdf
[79] City of Boston. Retrieved from: https://www.cityofboston.gov/Images_Documents/Community%20Engagement%20Strategy%20DRAFT_tcm3-15941.pdf
[80] ICLEI, 2016. Retrieved from: http://icleiusa.org/wp-content/uploads/2015/06/EcoAmerica-Lets-Talk-Communities-and-Climate.pdf

confidence all inhibit access to capital.[81] Establishing an external green revolving loan fund can reduce the need for private investment and sends a signal to residents, businesses, and investors that the City is committed to supporting sustainable projects. Additionally, a green fund can help de-risk finance from more conventional sources and increase investor certainty.

Green revolving loan funds can be structured in various ways depending on the city's needs. Additionally, sources of seed capital are diverse and can include general funds, administrative budgets, asset sales, or endowments. Following the Toronto Atmospheric Fund's Green Condo Loan model, Quincy could establish an external revolving loan fund for developers of commercial or residential projects that reduce GHG emissions. The loan would be equal to the incremental costs of incorporating above-code efficiency measures and would be repaid by the building owner over a set period of time. The building owner would benefit from lower operating costs and the revolving loan fund would be replenished through these incurred energy and cost savings. After the set time period of payment, the cost savings accrue to the building owner or tenant, a value that increases as utility costs increase. This mechanism ensures the sale price of the building units would not reflect the incremental cost, and the total cost of ownership would be lower overall. Buildings utilizing this funding structure through the Toronto Atmospheric Fund's Green Condo Loan spend significantly less on utility costs than conventional buildings.[82]

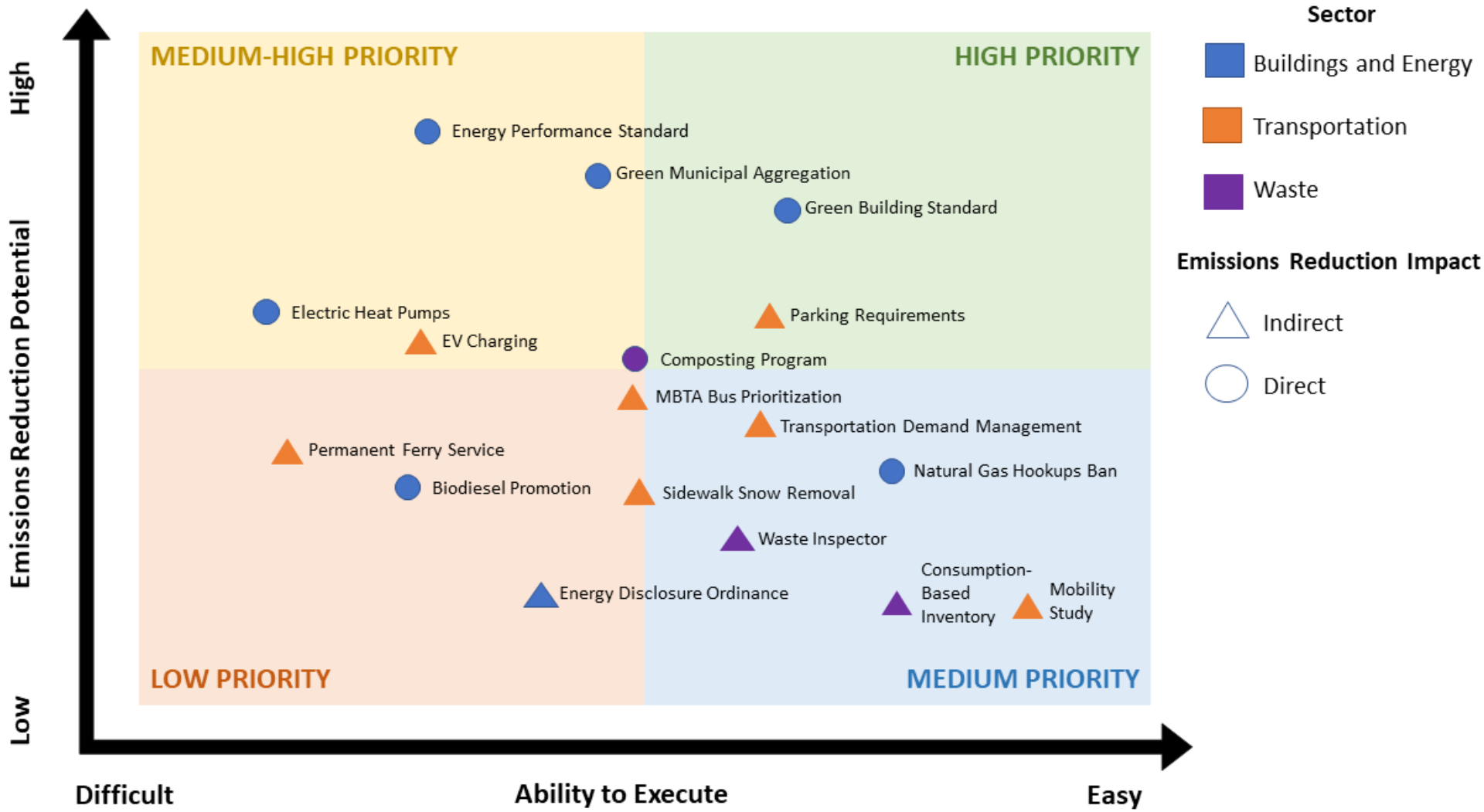
Prioritized Reduction Strategies

A multitude of factors must be considered when prioritizing GHG mitigation strategies: costs, amount of emissions reduced, ease of implementation, time needed to implement, co-benefits, etc. Therefore, the recommended mitigation strategies have been mapped in a Prioritization Matrix (see Figure 9). This Matrix considers both the emissions reduction potential and the ability to execute a specific measure. The emissions reduction potential is a relative measure of whether the proposed initiative will have a high or low impact on City emissions. The ability to executes measures the City's ability to implement the initiative in question, based on its current internal capabilities, and the nature of the initiative (for instance, whether the City has control over the emissions sources or not). Governance and Leadership strategies are not included in the Matrix as they encourage the implementation of mapped strategies. A full list of recommended strategies and detailed metrics are included in Table 19.

[81] C40 Cities, 2016. Retrieved from: http://c40-production-images.s3.amazonaws.com/other_uploads/images/887_C40_Good_Practice_Guide_-_City_Climate_Funds.original.pdf?1479934289

[82] TAF, 2015. Retrieved from: https://taf.ca/toronto-atmospheric-fund-financing-facilitates-better-than-code-windmill-developments-condo/

Figure 9. Mitigation Strategy Prioritization Matrix



It should be noted that these measures, though effective, will not be sufficient to meet an emissions reduction target of 80% by 2050. Additional measures should be identified in a city-wide Climate Action Plan.

Table 19. Index of Emissions Mitigation Measures

Mitigation Strategy	GHG Reduction Impact*	Activity Targeted	Sub-Sector	Performance Metrics	Primary Costs/Savings	Mandatory or Voluntary
Green Municipal Aggregation	High/Direct: 11,527 MT CO2e	Electricity Consumption	Existing Residential and Small Commercial	MWh from renewable sources, # of customers enrolled	Costs: The City Savings: Customers	Voluntary
Green Building Standard	High/Direct: 15,687 MT CO2e by 2030 over Business-as-Usual projections	Energy consumption in buildings	New Large Construction Commercial	# of LEED compliant buildings, Energy reduction (kWh, therms)	Costs: Developers Savings: Building Owners and Tenants	Mandatory
Energy Disclosure Ordinance	Low/Indirect	Energy consumption in buildings	Existing Large Commercial and Residential	# of buildings reporting, Changes in energy consumption	Costs: Building Owners/Tenants Savings: Building Owners/Tenants	Mandatory
Building Performance Standard	High/Direct: 26,229 MT CO2e	Energy consumption in buildings	Existing Large Commercial and Residential	kWh or therms reduced from baseline, Average % energy reduction	Costs: Building Owners/Tenants Savings: Building Owners/Tenants	Mandatory
Biodiesel	Medium/Direct: 8,864 MT CO2e	Heating oil consumption	Existing Residential	# of homes using biodiesel, Gallons biodiesel purchased	Costs: Residents Savings: Residents	Voluntary
Banning Natural Gas Hookups	Medium/Direct: 5,777 MT CO2e by 2030 over Business-As-Usual projections	Natural gas consumption for heating, cooking, etc.	New Construction	# of electrified buildings, Therm intensity reduction	Cost: Developers, Residents Savings: Residents	Mandatory
Electric Heat Pumps	High/Direct: 34,301 MT CO2e (Residential Only)	Building heating and cooling	Residential and Small Commercial	Participation rates, # of heat pumps installed, Amount of rebates/incentives provided	Cost: The City, Residents Savings: Residents	Voluntary

Mobility Study	Low/Indirect	Alternative modes of transportation	Transportation	# of community members engaged, # of identified transport solutions	Costs: The City	N/A
Parking Minimums and Maximums	Medium/Indirect	Vehicle use in new developments	Residential and Commercial Transportation	Average parking spaces/unit, Vehicles/household	Savings: Developers	Mandatory
Shared Parking and Transferable Entitlements	Medium/Indirect	Vehicle use in new developments	Residential and Commercial Transportation	Average parking spaces/unit or square footage of development, Vehicles/household	Savings: Developers	Voluntary
Sidewalk Snow Removal Program	Low/Indirect	Vehicle use during periods of snowfall	Residential Transportation	Miles of sidewalk cleared, Pedestrian and bicycling frequency, Commuter mode-shifting	Costs: The City Savings: Residents	Mandatory
Transportation Demand Management	Medium/Indirect	Vehicle use in new developments	Residential and Commercial Transportation	# of employees utilizing TDM measures, Passenger mode-shifting	Costs: Developers Savings: Tenants, Employees	Mandatory
Bus Prioritization	Medium/Indirect	Vehicle use primarily for commuting	Public Transportation	MBTA ridership, Bus commute times, Miles of bus lanes created, Passenger mode-shifting	Costs: MBTA, the City Savings: MBTA, Commuters	Voluntary
Electric Vehicle Charging Stations	Medium/Indirect	Electric vehicle use	Transportation	# of charging stations installed, kWh provided, Local EV ownership	Costs: The City, Businesses Savings: Businesses, EV Owners	Voluntary
Permanent Ferry Service	Medium/Indirect	Vehicle use primarily for commuting	Public Transportation	Ferry Ridership	Costs: The City Savings: Residents	Voluntary

Composting Program	Direct: 9,032 MT CO2e (Commercial/Industrial Only)	Residential Waste	Solid Waste	Composting rate, Volume of rejected recycling	Costs: The City Savings: The City, Residents	Voluntary
Waste Inspector	Low/Indirect	Residential recycling	Solid Waste	Recycling rate, Volume of rejected recycling	Costs: The City Savings: The City, Residents	Mandatory
Consumption-Based Emissions Inventory	Low/Indirect	Waste generation	Solid Waste	Weight of waste surveyed, MT CO2e/person	Costs: The City	N/A
*Please see emissions reduction assumptions in the relevant recommendation sections as not all listed emissions reduction quantities are directly comparable						

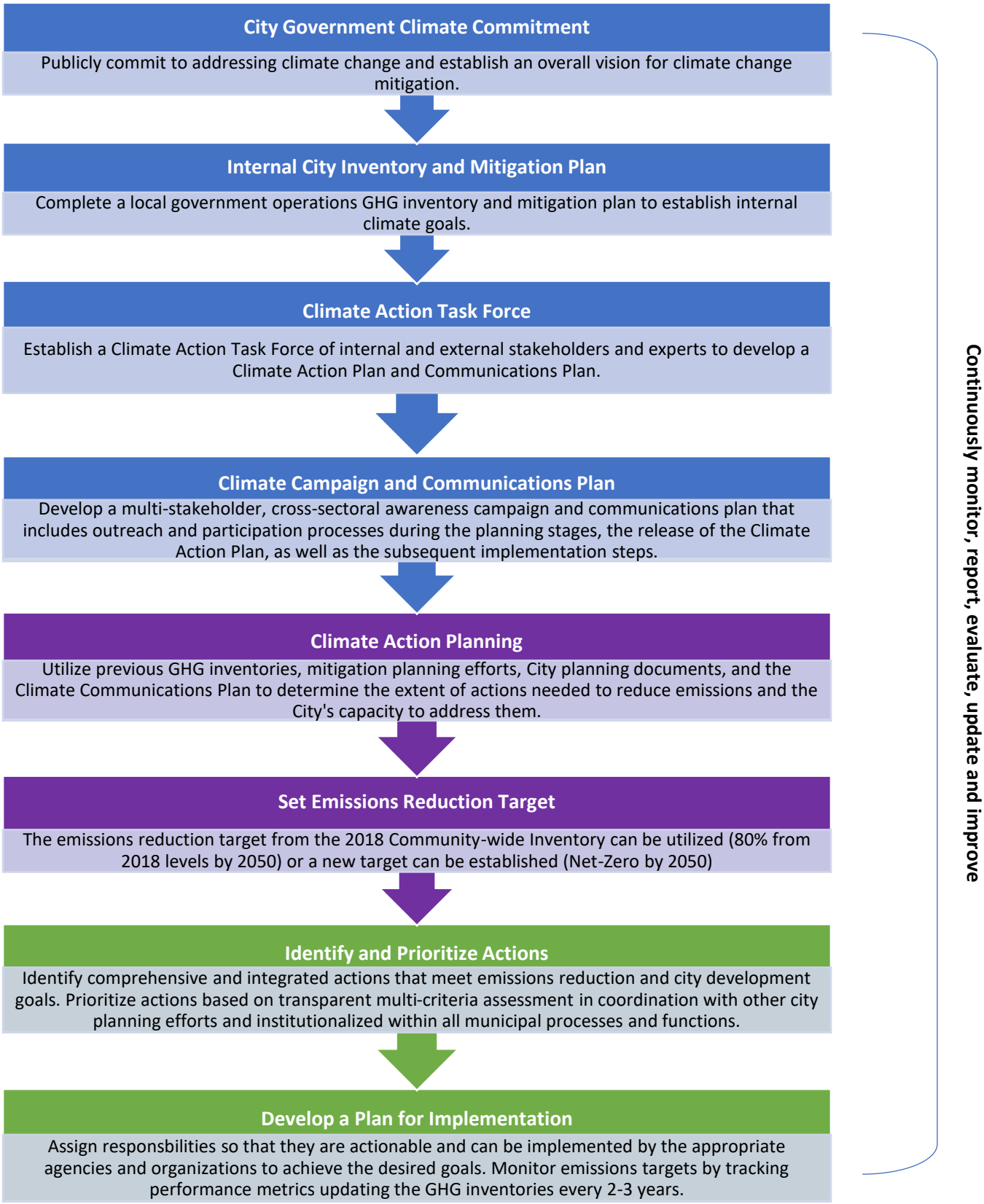
Roadmap for Climate Action Planning

A Climate Action Plan is a comprehensive roadmap that outlines the specific activities that an entity will undertake to reduce greenhouse gas emissions. Rather than being an isolated process, climate action planning is integrated with and directly linked to other socio-economic, spatial, disaster risk reduction, and environmental planning processes at the municipal, regional, and national level. Achieving such integration involves sharing information and knowledge across different sectors and stakeholders while promoting the inclusion of climate mitigation goals, policies, and initiatives across the community. The current GHG Mitigation Plan lays the foundation for developing a thorough Climate Action Plan, but there are many additional steps in the climate planning process that must be considered.

Figure 10 provides a basic roadmap on how Quincy can follow the climate action planning process.[83] This roadmap demonstrates how the current GHG Mitigation Plan recommendations and strategies are an essential part of the process and will reduce the overall planning burden. Additionally, the MAPC is developing a Net Zero Action Playbook for cities and towns in the Boston Metro Region. This strategic playbook will incorporate actions municipalities can take to address emissions from buildings, energy, and transportation while incorporating equity considerations. This playbook will be released in 2020 and should be utilized in Quincy's future climate action planning process.

[83] UN Habitat, 2015. Retrieved from: http://e-lib.iclei.org/wp-content/uploads/2016/02/Guiding-Principles-for-City-Climate-Action-Planning.pdf

Figure 10. Quincy Climate Action Planning Process



Future Recommendations

The previous recommendations act as first-step, foundational actions Quincy can pursue to address climate change. Enacting these strategies will result in significant emission reductions, but additional actions are needed to meet a future 80% or net-zero emissions target by 2050. When developing a city-wide Climate Action Plan, Quincy should consider the additional long-term strategies:

Weatherization and Envelope Improvements
Quincy will need to target energy use for both residential and commercial heating and cooling in order to achieve significant emission reductions. Building weatherization and envelope improvements increase indoor comfort year-round and reduce the use of HVAC systems. Strategies include air sealing, wall and floor insulation, window and door upgrades, and pipe and/or duct insulation. These improvements will help customers reduce emissions in the thermal sector beyond what is feasible from heating equipment turnover. Mass Save offers 75-100% off approved residential insulation improvement costs in addition to having air leaks sealed at no-cost. Additionally, the Massachusetts Housing and Community Development Department offers a Low-Income Weatherization Assistance Program (WAP) that provides eligible households with full-scale weatherization services.
Deep Energy Retrofits
A Deep Energy Retrofit is a construction and rehabilitation method that aims to reduce building energy use by 50% or more. DERs save more energy, money, and materials than demolishing and constructing new buildings while simultaneously improving the efficiency, functionality, and comfort of the building. Core DER technologies include adding insulation, upgrading windows, replacing doors, increasing air tightness, improving the vapor barrier, addressing thermal bridges, installing high-performing HVAC and hot water heating systems, and upgrading lighting technologies. The key factor of DERs is that none of these measures are considered in isolation; they are assessed as interacting components of a larger energy system. DERs can range from $50,000-$180,000 depending on the household.[84] The promotion and incentivization of DERs will be necessary for Quincy to reduce emissions from its existing building stock.
Expedited Permitting
To encourage the adoption of low-emission building construction or retrofitting, the City could expedite the review, permitting, and inspection process for projects targeting higher levels of energy reduction than mandated target goals or incorporating renewable energy systems. Streamlining project review through simplified administrative procedures will incentivize developers to follow sustainable building practices.
Curbside EV Charging

[84] Cluett & Amann, 2014

Many residents do not have access to off-street EV charging stations. In order to promote EVs, Quincy will need to evaluate the feasibility of installing curbside charging stations across the City. Strategies could include utilizing street light and/or utility pole charging stations. Such a program would incentivize those without private parking spaces to transition to EVs.

Electric School Buses

In addition to a Green Fleet Policy, the City could pilot an electric school bus program for their K-12 students. Electric buses offer a number of health benefits for drivers and riders. With zero tailpipe emissions, electric school buses protect students from diesel exhaust, improve air quality, and produce less noise while operating. Though school buses generate less than 0.1% of City transport emissions, this measure would act as a highly visible lead by example policy to encourage transport electrification within the City.

Net-Zero Building Standard

Achieving a city-wide net-zero emissions target will require buildings to produce to zero emissions. The City could institute a policy that requires new and renovated municipal buildings to be powered and heated entirely with renewable energy. This could set the precedent for a city-wide net-zero building standard that could replace a green building standard requirement.

Natural Gas Leaks

In 2018, natural gas leaks with Quincy's borders released 120,700 therms or 5% of total city-wide emissions. Though Quincy claims to have a constructive working relationship with National Grid on these issues, updated leak data is needed to evaluate National Grid's progress on leak repair. If leaks are still a substantial issue in Quincy's infrastructure, the City will need to evaluate the effectiveness of its communication strategy with National Grid and assess how it can better promote the prioritization of leak repair.

Promoting Mass Save

In order to reduce emissions from existing buildings, Quincy will need the support of low- or no-cost energy programs that target residential and commercial consumers. The Mass Save program offers rebates and incentives for residents and businesses to save energy and money. These services are managed and delivered by utilities with funding from customers' energy bills. Mass Save offerings include no-cost home energy assessments, heat pump rebates, smart thermostat discounts, weatherization incentives, and 0% loan financing options. Promoting Mass Save program offerings can aid in the cost-effective adoption of energy-efficient building upgrades and aid in an equitable transition to a low-carbon economy.

Electric MBTA Buses
Currently, the MBTA's hybrid buses do not fit in Quincy's bus garage. Additionally, the MBTA only just began to pilot battery-electric buses in 2019. Quincy should continue to work with the MBTA to promote the transition to electric buses. The City will also need to advocate for a new bus garage that supports battery-electric buses in order to bring this low-emissions mode of transit into Quincy.
Massachusetts C-PACE Program
Quincy will need to develop multiple financing mechanisms in order to promote a shift to low-emission building practices. Commercial Property Assessed Clean Energy (C-PACE) is a financing mechanism used by local governments that allows commercial, industrial, and multi-family property owners to finance energy efficiency and renewable energy improvements through a property tax payment. The repayment of qualified energy improvements is done via a voluntary property tax assessment collected by local governments. This approach enables owners to undertake more comprehensive energy upgrades with longer payback periods of up to 20 years. At property sale, repayment responsibility transfers to the next owner if the original investment amount has not been repaid. The financing for PACE projects may be provided by municipal bonds or third-party capital secured by the property assessment payments. MassDevelopment and the Massachusetts Department of Energy Resources are currently developing a C-PACE program and financing is expected to be available in early 2020.[85] Once financing is available, Quincy may opt into PACE by a majority vote of the City Council.
Carbon Offsets
Ultimately, Quincy will not be able to directly reduce all of its emissions to meet a zero-emissions goal in the foreseeable future. Not all cars will be electrified, equipment will still utilize fossil fuels, and, per current policy, only 55% of grid energy will come from renewables by 2050. After Quincy enacts all feasible mitigation strategies, the remaining GHG emissions, or residual emissions, will have to be addressed by the purchasing of carbon offsets. A carbon offset represents a quantity of verified carbon dioxide equivalent that is permanently reduced, avoided, or removed from the atmosphere through an action taken by the creator of the offset. Ideally, offset projects should be created locally so communities can benefit from reduced local pollution. Any purchased offsets should meet rigorous standards such as those from the American Carbon Registry or Climate Action Reserve. Carbon offsets are considered a last resort and should not be used in lieu of other direct emission reduction strategies.

[85] Mass Development. 2019. Retrieved from: https://www.massdevelopment.com/what-we-offer/key-initiatives/pace/

Conclusion

Quincy is no stranger to climate change. Coastal flooding, erratic temperatures, and extreme weather events will continue to impact the City for years to come. Additionally, existing day-to-day issues such as traffic congestion, unhealthy buildings, and inefficient spending will be exacerbated if the City fails to address their GHG emissions.

Climate action planning holistically addresses these issues by reducing the City's contribution climate change while improving its residents' quality of life. By addressing emissions from local buildings, transportation, and waste, the GHG Mitigation Plan presents strategies that will not only reduce climate impacts, but will further Quincy's economic, social, and environmental goals. The Plan also demonstrates that sectoral actions alone are not sufficient to drastically reduce emissions. Such actions cannot be considered in isolation and must be prioritized using a multitude of factors such as costs, environmental impacts, co-benefits, and ease of implementation. Quincy's local government is key in this process and must commit to long-term, integrated climate action planning in order to support and coordinate mitigation efforts across all city departments, businesses, and neighborhoods. Additionally, Quincy's government must reach outside the City to engage with state decisionmakers, collaborate with regional partners, and push for comprehensive climate legislation nationally.

A limitation of global warming to below 2°C requires a fundamental restructuring of important areas in the economy and society. Such a challenge will require connecting divided communities to promote large-scale cooperation and collaboration. It will require empathy, deep listening, and long-term thinking. And it will require local governments to effect change instead of letting change happen to them. The City of Quincy has a choice at this juncture: it can do nothing, or it can take action to create a more a prosperous, equitable, and sustainable community for generations to come.

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Appendix