TOWN OF HINGHAM

CLIMATE ACTION PLAN

Hingham
Climate Action
Planning Committee

Hingham
Climate Action
Planning Committee

July 19, 2023

Hingham Town Hall
210 Central Street
Hingham, MA 02043

RE: Hingham Climate Action Plan

Dear Residents, Businesses, and Leadership of the Town of Hingham:

On behalf of the Hingham Climate Action Planning Committee ("CAPC") and all of the participants that contributed through the public processes to arrive at this point, it is our great honor to present the attached Town of Hingham Climate Action Plan ("Plan"). The Plan provides a path forward for achieving net zero carbon emissions by 2040. We considered numerous factors, including social equity and environmental justice. The recommendations and tasks delineated in this Plan have been developed specifically for Hingham based on extensive input from residents, businesses, and leaders of the Hingham community, in consideration of Hingham's specific goals to achieve net zero and its current sources of carbon emissions.

In April 2021 the Town of Hingham voted to create the CAPC, charging it with evaluating a wide range of carbon emission reduction strategies and proposing measures to achieve a zero sum of carbon emissions by the year 2040 or another target date deemed feasible. The CAPC, with the assistance of Energyzt Advisors, LLC, an energy consulting firm whose engagement with Hingham was generously funded by the Hingham Municipal Lighting Plant, spent over a year fulfilling this mission, with countless hours contributed by public participants who attended public town hall meetings, participated in regular committee meetings, provided comments on surveys, helped formulate input from community organizations on how to respond, and otherwise provided support and insight into the process.

The issuance of this Plan is particularly timely. In October 2021, a bomb cyclone nor'easter tore through Hingham with 90+ mile-per-hour gusts causing devastation that made national news. On January 29, 2022, another bomb cyclone dropped nearly two feet of snow in Hingham in a snow that broke records throughout Eastern Massachusetts and capped a 15-year period of producing the most snow in the Commonwealth's recorded history. That summer a level three "critical drought" declaration was made for Hingham and the entire Southeast Region in Massachusetts as the Town baked in unyielding heat for much of the summer with little to no precipitation. In December 2022, yet another bomb cyclone brought devastating weather across 1,000 miles of the U.S.; though Hingham was spared the worst of the storm, our town endured 65 mile-per-hour gusts and localized flooding. And in 2023 millions throughout the Northeast, including residents of Hingham, endured air polluted from over 20 million acres of wildfires throughout Canada (not to mention the planet enduring in July the hottest week ever recorded).

Hingham experiences severe weather. As a coastal New England town, it will always experience severe weather and its adverse impacts. What is troubling is not isolated severity but frequency of that growing severity, which is increasing across all seasons, and is projected to continue to do so in the decades to come as the planet continues to warm under the greenhouse effect from carbon emissions. Frequent weather events and ongoing changes to the climate endanger lives and strain residential, business, and municipal coffers as each event demands increased time, money, and risk tied to preparation and recovery. State and federal programs are offering money to towns to mitigate such costs, especially for towns that show efforts to address the underlying problem.

The news of the climate crisis is scary and overwhelming. You may ask yourself, "But what can I do?" The answer is, "A lot." Organized government action is important, but the vast majority of Hingham's emissions come from us as individual residents. A significant part of the solution to this problem lies in daily household decisions. The ways we choose to heat and cool our homes, the cars we drive, and our consumption habits can fuel the crisis—or mitigate it.

While the Town has a strong role to play, residents should reckon with our individual responsibility in mitigating the climate crisis. This document invites you to consider how you can be part of the solution. It gives specific, actionable guidance as to how you can prevent further damage to our environment. We invite you to read this document and consider the specific changes—both large and small—that you can make.

Given the localized impacts of this global problem, Hingham, like everywhere else, must decide how it can: (1) reduce carbon emissions and mitigate its climate impact and (2) adapt to the “new normal” of weather severity. This Climate Action Plan is Hingham’s answer to the first challenge. The Town has separately undertaken vulnerability preparedness planning to adapt to climate change, and we encourage you to review Hingham’s efforts, which can be found at https://hingham-ma.gov/306/Climate-Change.

The daunting scope of behavioral change to transition away from fossil fuels, and the overall carbon reduction required can breed cynicism and despair, which often lead to paralysis and inaction. However, the only way to tackle a problem of this scale is through diligent, thoughtful, and concerted action at both the macro (state, national, and global) and micro (regional and municipal) levels. Whether individually or as members of community advocacy groups, Hingham citizens have asserted their commitment to fighting climate change and fostering sustainability by approving related ballot initiatives and Town Meeting warrant articles with overwhelming majorities. They have created a clear mandate for the Hingham community to take the actions necessary to achieve net zero carbon emission by 2040.

This Plan requires integration throughout all facets of the Hingham community. Together we can realize the solution for the problem to which we collectively contribute.

Hingham
Climate Action
Planning Committee

Sincerely,

Brad E. Moyer, Chair
And the Climate Action Planning Committee Members*:

Alyson Anderson	Carlos A.F. Da Silva	Henry (Bob) Hidell
Thomas Morahan	Elliott Place	Beth Porter
Kathy Reardon	Gary Tondorf-Dick	Nancy Wiley
	Maria Zade	

** The successor body to the CAPC, the Hingham Climate Action Commission, created by Hingham Town Meeting 2023, will oversee implementation of the Climate Action Plan*

Hingham Climate Action Planning Committee

ACKNOWLEDGEMENTS

This Climate Action Plan could not have been created without the efforts of, and generous support from, the groups and individuals listed below. The Climate Action Planning Committee, and indeed all of Hingham, are fortunate to have so many willing to give their time and energy to the betterment of Hingham. Specifically, there are many Hingham citizens who participated in various engagement sessions, responded to surveys, volunteered their time in public outreach, and attended open meetings organized around development of this plan. The list below is representative, but not comprehensive:

Select Board of Hingham
William Ramsey
Joe Fisher
Liz Klein

Advisory Committee
Brenda Black and Joe Griffin, who regularly attended meetings and reported back to their Advisory Committee colleagues

Community Organizations
All citizen-run organizations, such as:

Hingham Drives Electric
Hingham Net Zero
South Shore 350

Climate Action Planning Committee
Brad E. Moyer, Chair, Energy Action Committee
Maria Zade, Cleaner Greener Hingham
Alyson Anderson, School Committee
Thomas Morahan, Hingham Municipal Lighting Plant
Gary Tondorf-Dick, Planning Board

Funding provided by:
HMLP

Town Administration
Tom Mayo, Town Administrator
Art Robert, Asst. Town Admin., Ops.
Michelle Monsegur, Asst. Town Admin., Fin.

Town Staff
Virginia LeClair, Sustainability Coordinator
Consultant

Hingham Municipal Lighting Plant
Brianna Bennett, Sustainability Coordinator

Town Committees and Representatives
All entities who provided input, including:
Cleaner Greener Hingham
Conservation Commission
Energy Action Committee
Planning Board
School Committee

Henry (Bob) Hidell, Conservation Commission
Nancy Wiley, Development & Industrial Commission
Kathy Reardon, Select Board Appointee
Elliott Place, Select Board Appointee
Beth Porter, Moderator Appointee
Carlos A.F. Da Silva, Moderator Appointee

Consultant:
Tanya Bodell
John Malloy, Jr.
ENERGYZT

Hingham Climate Action Planning Committee

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ACRONYMS, TERMS AND DEFINITIONS

Acronym	Definition
CAPC	Climate Action Planning Committee
CO2, CO2e	Carbon Dioxide and Carbon Dioxide equivalents usually measured in tons
DER	Distributed Energy Resource; may include solar, batteries or other power generation resources located behind the retail meter, e.g., residential solar panels
DOE	U.S. Department of Energy, a federal agency
DOER	Massachusetts Department of Energy Resources, a state agency responsible for energy oversight
DR	Demand Response, reducing or shifting electricity usage during certain time periods
EE	Energy Efficiency, the focus on reducing wasteful energy usage through lower energy intensity technology and behaviors (e.g., switching to LED lightbulbs or Energy Star appliances)
ENE	Energy New England, the wholesale aggregator that supplies electricity to HMLP
EPA	U.S. Environmental Protection Agency, a federal agency
FCM	Forward Capacity Market, the competitive market that ISO-NE uses to purchase demand response and generation capacity for New England

Acronym	Definition
GHG	Greenhouse Gases - gases in the atmosphere which trap heat and thus lead to global warming. There are seven greenhouse gases; the main ones are carbon dioxide, methane, nitrous oxide and water vapor.
HEIRP	Hingham Electrical Infrastructure Reliability Project, a proposed HMLP project to construct and operate a new transmission line and substation
HMLP	Hingham Municipal Lighting Plant, the electric utility servicing Hingham
ISO-NE	Independent System Operator of New England, the entity that operates the regional wholesale electricity market
kWh	Kilowatt-hour Equal to 1,000 Watt-hours, a unit of electrical energy
LEED	Leadership in Energy and Environmental Design—a set of protocols that set standards for the design, construction, and maintenance of sustainable buildings and infrastructure
MassCEC	Massachusetts Clean Energy Council, a non-profit primarily funded by state budget
MassDEP	Massachusetts Department of Environmental Protection, a state agency

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Acronym	Definition
MassSave	An Investor-Owned Utility program in Massachusetts focused on education, outreach, and subsidies to utility customers to adopt energy saving investments such as insulation, window/door replacement, and switch to heat pumps.
MBTA	Massachusetts Bay Transportation Authority, a state agency responsible for public transportation
MW	Megawatt, a unit of electrical capacity, equal to 1,000 Kilowatts or 1 million Watts, associated with maximum generation or demand
MWh	Megawatt-hour Equal to 1,000 kWh, a unit of electrical energy. MWh is a unit of electrical energy equal to the electricity used by ~ 330 average homes in one hour.
NEPPA	Northeast Public Power Association, a non-profit organization of public power providers such as HMLP
Net Metering	Program in which the utility purchases excess solar power from residential and business buildings
Net Zero	A condition in which total carbon emissions (carbon footprint) attributed to an entity or organization are equal to the total carbon captured or sequestered and attributed to that entity or organization.
PAYT/SMART	Pay-As-You-Throw / Save Money and Reduce Trash, programs that incentivize waste reduction
PMOs	Personal Mobility Options, alternative means for individuals to travel individually or in small groups using autonomous driving vehicles, share rides, mobility pods, or other means

Acronym	Definition
R-Value	The ability of a material to resist heat transfer. The lower the R-value, the greater the heat transfer, loss or gain
REC	Renewable Energy Credit, a separately traded property right that allows the holder to claim renewable characteristics associated with its electricity
RETF	Renewable Energy Trust Fund, a funding mechanism established in Massachusetts in 1997, revised in 2008 in the Green Communities Act.
RGGI	Regional Greenhouse Gas Initiative, the voluntary greenhouse gas credit trading program that caps carbon emissions at the generation level across 11 plus states.
SMART 2.0	Solar MAssachusetts Renewable Target program that currently supports solar in Massachusetts with incentive credits
TOD	Transit-Oriented District, areas that co-locate residential and business units near public transportation depots
Ton	2,000 pounds, also called “short ton,” used to measure carbon emissions
Tonne	A metric measure of weight equal to 1.10231 short tons used to measure carbon emissions
V2G	Vehicle-to-Grid, a bidirectional charging technology that enables energy to be pushed back to the power grid from the battery of an electric vehicle, thereby supporting electric distribution and wholesale electricity markets such as demand response and ancillary services
WRI	World Resources Institute

Hingham Climate Action Planning Committee

EXECUTIVE SUMMARY

A successful plan for community-wide action must come from a successful stakeholder process of engagement and input. For more than a year, the Climate Action Planning Committee engaged in such a process, bringing together the opinions of multiple participants through surveys, meetings, live outreach, and written publications. Throughout the process, considerations of social equity and environmental justice were discussed and incorporated. The process itself and recommendations focus on 1) transparency and inclusion, 2) education and outreach, and 3) historic preservation. This Climate Action Plan ("Plan") is the result of that process – a documentation of the consensus built through conversation and discussion.

Section 1 offers an introduction to what prompted development of a Plan, followed by an overview of the plan in Section 2. **Section 2** begins with a call to action--what you can do to help implement the Plan (Figure ES-1). This type of matrix is repeated in the body of the Plan for each of the core components.

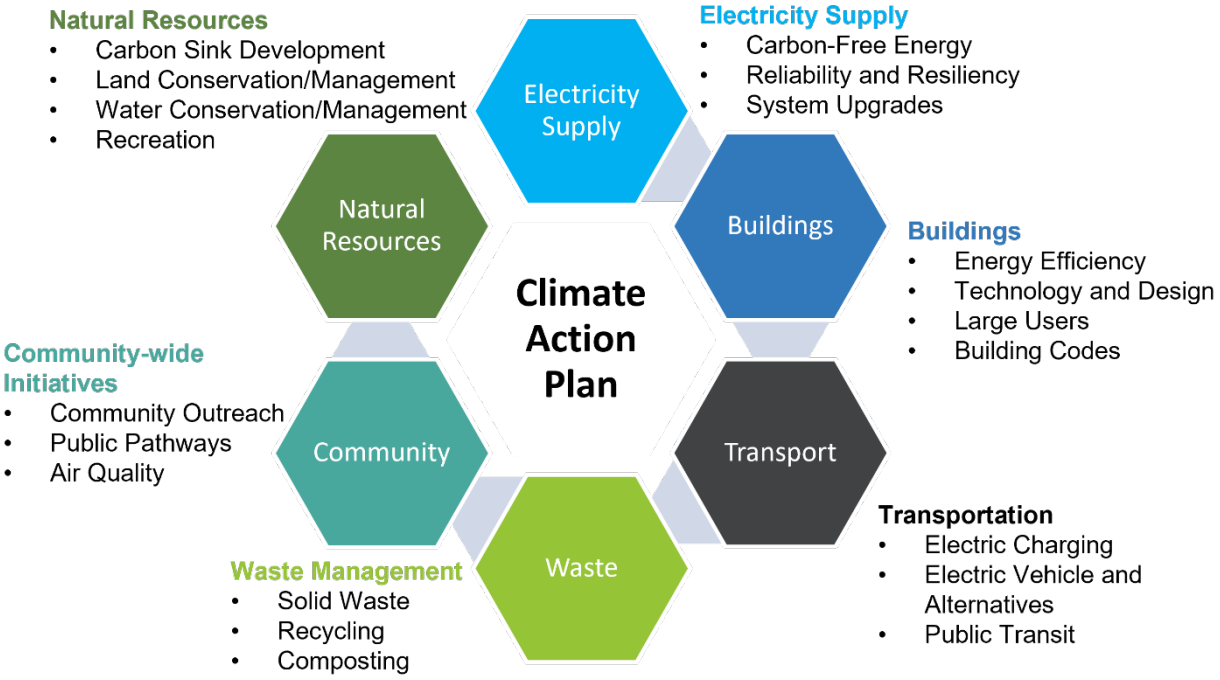
Figure ES-1: What You Can Do to Help Implement the Plan

 Residents	• Read the plan and become familiar with what you can do as a resident of Hingham • Follow the progress on achieving the goals and tasks in this Plan and hold responsible parties tasked with implementing the Plan • Be aware of warrant articles tied to this Plan and inform voters on how to proceed
 Businesses	• Read the plan and become familiar with what you can do as a business in Hingham • Join other businesses in realizing economies of scale to implement recommendations • Ensure implementation of this Plan provides a business-friendly environment
 Government	• Take the lead on education and implementation of this Plan • Ensure responsible parties are specified and held accountable • Establish appropriate funding processes to implement recommendations • Track and monitor progress, with regular updates to the town
 Schools	• Publicize the Plan to students, parents and teachers so they are educated • Encourage student groups and activities that enable and implement relevant tasks • Find ways for the schools to modify operations to be consistent with the Plan • Provide a curriculum to inform students on sustainability and how to measure and reduce their environmental impact
 Innovators	• Understand decarbonization opportunities in Hingham and elsewhere • Identify the technologies, business models and missing links to implementation • Develop solutions to provide efficient and cost-effective means of achieving decarbonization

Sections 3 through 8 provide additional insight into how to address each of the core sources of Hingham's carbon emissions. Those six core component parts also provide a framework consistent

with the categories other Massachusetts municipalities have identified and are addressing in their climate action plans (see Figure ES-2).

Figure ES-2: Core Components of Hingham's Climate Action Plan



Each section delves into the current state of Hingham's core sources of carbon emissions and provides an overview of the recommended actions to reduce those emissions. Those recommended actions are detailed further in Appendix A, which provides a series of tables that present specific tasks, timeframe, metrics, and responsibility. Those tables may be used going forward to provide an annual update and dashboard against which Hingham's decarbonization progress can be tracked.

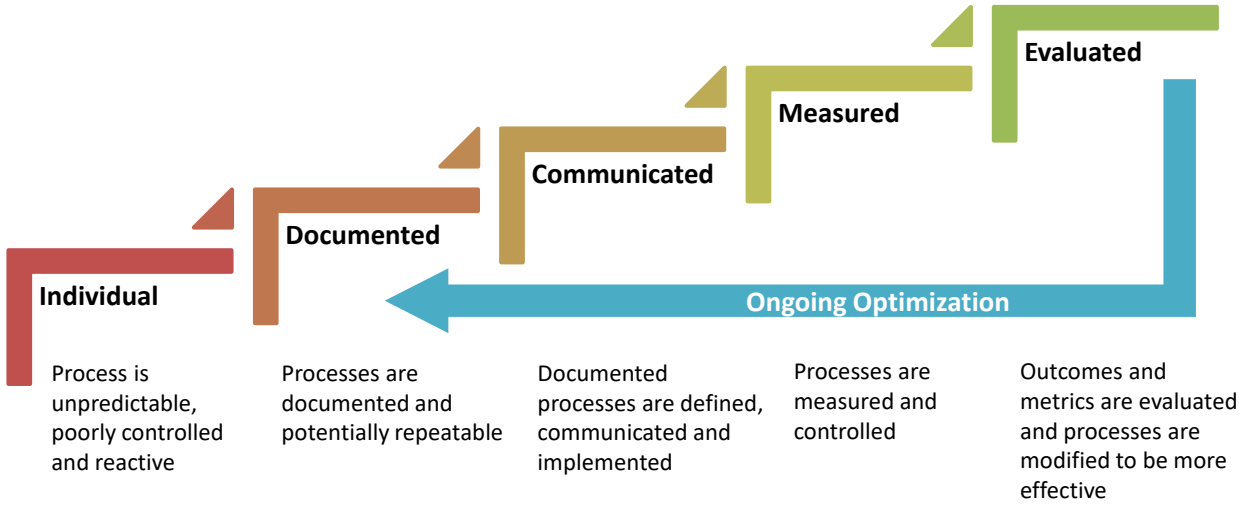
The Plan also identifies the parties that will play leadership roles going forward to guide the collective in implementing the Plan. **Section 9** presents recommendations on the role that key stakeholders play in implementation, including:

- Town leadership
- Hingham Municipal Lighting Plant
- Town Committees
- Businesses and Large Consumers of Energy
- Residents
- Public Interest Groups
- Hingham School District
- Government

With so many parties playing a role in implementation, the section on roles and responsibilities ends with a discussion on collaboration and coordination.

Section 10 describes how to optimize the implementation process. Achieving net zero is a matter of establishing a process and constantly improving on that process based on tracking key variables and metrics within the broader context of local, industry and policy trends. Process optimization requires a continuous feedback loop of communication, assessment, and revision (Figure ES-3).

Figure ES-3: Optimized Implementation of the Climate Action Plan



As complete as the Plan may be, and as optimized as implementation may become, the process will not be complete until decarbonization is realized and permanently in place, currently anticipated to occur no sooner than 2040.

The document itself therefore becomes a part of the process – a guide that will be revised and updated as conditions change and new solutions become technically, financially, socially, and politically feasible. As the Conclusion notes in **Section 11**, this Plan simply provides the start of a program for moving down the path towards decarbonization based on information and conditions known today. Over time, as conditions change, new technologies appear, and policies are revised, subsequent revisions to this Plan will provide updates on what has been accomplished and what more is required. With the Plan in place, it is now time to begin.

Hingham Climate Action Planning Committee

1. INTRODUCTION

A climate action plan is more than a simple report or document; it is a process. And that process begins with outreach and discussions to bring residents and town leaders to consensus on what the right path forward should be. This document provides the recommendations and insights garnered through a year-long process of the Climate Action Planning Committee to develop a Climate Action Plan for the Town of Hingham.

At the start, it is important to note that HMLP has played and will continue to play a critical role in developing, updating, and implementing the Plan, including funding for the Consultant, Energyzt, who guided development of the Plan. However, it is the collective will of Hingham residents and businesses that established Hingham's goal to establish a Climate Action Plan to reach Net Zero. It is these individuals and organizations, together with Hingham's leaders, who will need to bring this plan to fruition.

Hingham already has established two goals that are critical to this Plan:

1) **Carbon-Free Energy Goals:** In 2017, the Hingham Municipal Lighting Plant ("HMLP") Board voted to add 100% carbon-free energy to HMLP's mission.

2) **Net Zero Goal:** The 2021 Town Meeting mandated development of a Climate Action Plan with the aim of achieving net zero carbon emissions by 2040.[1]

HMLP

HMLP funded the development of the Climate Action Plan with $80,000 from its green fund. As the sole electricity provider to Hingham, HMLP plays a critical role in decarbonizing the community and already is promoting electrification through its **Electrify Hingham** program, which includes information and rebates for:

1) Weatherization
2) Heat Pumps
3) Electric Vehicles
4) Solar & Batteries
5) Appliances
6) LED Lighting

[1] Article 14 approved at Hingham Town Meeting on May 4, 2021 specifically allows for establishment of a Climate Action Planning Committee to establish a Climate Action Plan ("CAP"). In the Comment section, establishment of the Climate Action Planning Committee affirms "the development of a CAP for the Town, including the goal of 'net zero' carbon emissions by the targeted date." In the Recommended section, the Climate Action Planning Committee is charged with "establishing a Climate Action Plan, which will evaluate a wide range of carbon emission reduction strategies and propose measures within the Town of Hingham to achieve a zero sum of carbon emissions produced and taken out of the atmosphere ("net zero") by the year 2040 or another target deemed feasible." The Warrant is provided here: https://www.hingham-ma.gov/DocumentCenter/View/11974/2021-Warrant-PDF; a record of the approval is provided here: https://www.hingham-ma.gov/912/2021-Town-Meeting-Results

Hingham Climate Action Planning Committee

There are multiple ways to achieve Hingham's net zero goals by 2040. Each path includes its own set of costs, benefits, and investment decisions. Members of the Climate Action Planning Committee, HMLP, the Town of Hingham, and the public engaged in numerous discussions regarding what path would be feasible for the community to pursue.

As with plotting any path, there are many ways to get to the same endpoint. This plan charts a course built on consensus that focuses on feasibility, minimizes risks while maximizing returns, identifies alternatives, and maps out the milestones and landmarks to achieve Hingham's net zero goals.

The next section provides a summary of the current source of Hingham's carbon emissions and an overview of the Climate Action Plan developed to reduce those emissions. Each section thereafter describes the high-level categories of actions required to address carbon emitted by each source introduced in the overview, with a summary of what members of the Hingham Community can do and specific action items included in the appendices. The final section provides a recommendation for the path ahead and how to optimize the process for achieving Hingham's Net Zero goals.

It is important to note that Sections 2 through 8 each begin with a matrix that explains what YOU can do. You may be a resident or business in Hingham, part of government leadership or involved with the schools. Perhaps you are an innovator or someone involved in one of Hingham's many public interest groups. If you are focused on action, that first table suggests how you may move forward and help to implement the Plan's carbon reduction recommendations.

HINGHAM NET ZERO

Hingham Net Zero, as one of Hingham's many public interest groups, was founded by residents of Hingham for education and advocacy to:

1. Raise awareness of the need for climate action.
2. Support the Town's efforts to reduce emissions.
3. Work to reduce carbon emissions across the town as quickly as possible.

The appendices provide additional detail. Appendix A includes the specific action items, including timeframes for implementation. Appendix B provides a town-wide carbon emissions inventory and illustration of a path towards decarbonization. Appendix C provides a summary of the survey results, and Appendix D lists the public meetings and public engagement opportunities that this Committee sponsored over the course of the engagement. Appendix E provides examples of potential funding resources that are available in 2023 for Hingham to pursue, recognizing that

grant programs and funding sources are constantly changing and will need to be pursued both opportunistically and strategically.

2. OVERVIEW OF THE PLAN

What you can do to help:

 Residents	• Read the Plan and become familiar with what you can do as a resident of Hingham • Assess your own carbon footprint using an online carbon emission calculator, e.g. Carbon Footprint Calculator | Climate Change | US EPA, and create your own plan • Follow the progress on achieving the goals and tasks in the Plan and hold assigned parties responsible for implementation • Be aware of warrant articles tied to the Plan
 Businesses	• Read the plan and become familiar with what you can do as a business in Hingham • Transition sales and support to EVs, electrified HVAC (Heat Pumps), and electric appliances (electric induction stoves, dryers, yard tools, etc.) • Join other businesses in realizing economies of scale to implement recommendations • Ensure implementation of this Plan maintains Hingham's business-friendly environment
 Government	• Take the lead on education and implementation of the Plan • Ensure responsible parties are specified and held accountable • Establish appropriate funding processes to implement recommendations • Track and monitor progress, with regular updates to the Town
 Schools	• Publicize the Plan to students, parents and teachers so they are educated • Encourage student groups and activities that enable and implement relevant tasks • Find ways for the schools to modify operations to be consistent with the Plan • Provide a curriculum to inform students on sustainability and how to measure and reduce their environmental impact • Include climate, environmental and energy economics classes as electives • Host inspirational speakers focused on protecting the environment • Support the high school club Green Team efforts
 Innovators	• Understand opportunities in Hingham and elsewhere related to decarbonization • Identify the technologies, business models and missing links to implementation • Develop solutions to provide efficient and cost-effective means of achieving decarbonization

There are a number of frameworks for understanding how carbon emissions are generated and how to reduce them. The GHG Protocols were established by the World Resources Institute

("WRI") in the early 2000s.[2] The GHG Protocols categorize carbon emissions into the following categories:

Scope 1: Direct greenhouse gas emissions generated within the boundaries of a community through combustion of fossil fuels or processing of carbon-intensive inputs that result in the release of carbon into the atmosphere.

Scope 2: Indirect greenhouse gas emissions occurring as a consequence of the procurement of electricity, heat, cooling, and steam for use within the community boundary, where combustion of fossil fuels and release of carbon emissions is performed by others outside of the community.

Scope 3: Indirect greenhouse gas emissions generated by others outside of the city boundary as a result of activities that occur within the city boundary.

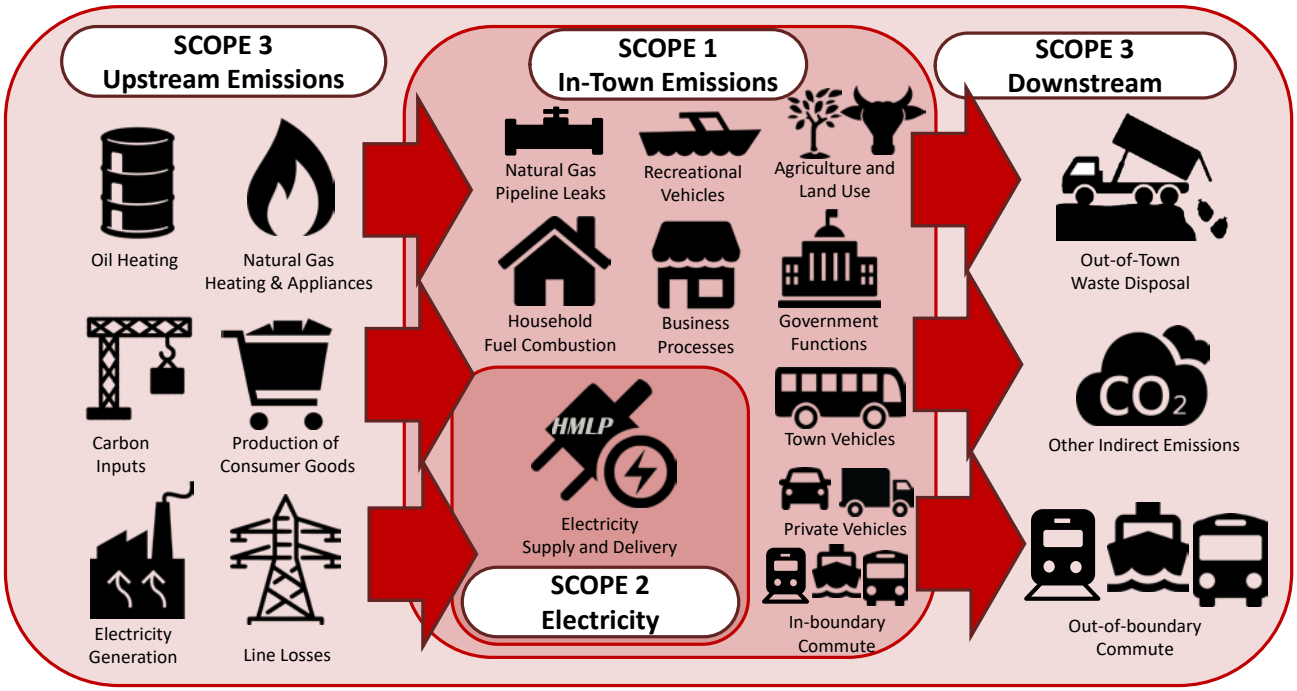
Scope 4: Offsets or carbon-reducing activities outside of the emissions-generating activities.[3]

Figure 1 illustrates each source of emissions that can be addressed by a community to reduce emissions based on the WRI GHG Protocols.

[2] WRI, Global Protocol for Community-Scale Greenhouse Gas Inventories: An Accounting and Reporting Standard for Cities, Version 1.1,

[3] Scope 4 emissions were not a part of the original GHG protocol emissions categories, but are gaining traction as a means of offsetting any remaining carbon emissions that cannot be reduced or eliminated through direct intervention or alternatives.

Figure 1: Illustration of Community-Scale GHG Inventory Categories[4]



The WRI GHG Protocols for cities focus on understanding what carbon emissions are created within the border of the city, along with the upstream and downstream emissions associated with the activities of residents, businesses, government, and visitors. Carbon emissions are divided into the same three categories described above, with some refinement focused on city operations:

- **Scope 1:** Includes fuel combustion within the boundary due to heating, cooling and appliance usage, along with transportation. Land-use and incoming waste also contribute to a community's emissions.

- **Scope 2:** Grid-supplied energy delivered into the Town represents Scope 2 emissions, although carbon emissions from electricity generation within the town would be considered Scope 1 emissions.

- **Scope 3**: Includes emissions generated upstream from deliveries into Hingham such as public modes of transportation, as well as downstream emissions from transportation

[4] Developed to be Hingham-specific with the benefit of the World Resources Institute GHG Protocol for Cities, https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities as documented in: Global Protocol for Community-Scale Greenhouse Gas Inventories, An Accounting and Reporting Standard for Cities, Version 1.1., p. 11, https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf

sources that leave Hingham, waste that leaves Hingham, and leaks or losses due to energy transportation outside of the Town's boundary.

These sources of carbon emissions, which include what is brought into the Town and what is taken out of the Town (i.e., Scope 3 emissions), need to be acknowledged. This Plan targets a reduction in carbon emissions where the Hingham community can control whether or not carbon is emitted or absorbed. For purposes of this Plan, the goal of achieving net zero is to reduce carbon emissions that are in the control of the community to as close to zero as possible, including credits and offsets (Scope 4 emissions) that counter the emissions that cannot be completely reduced.

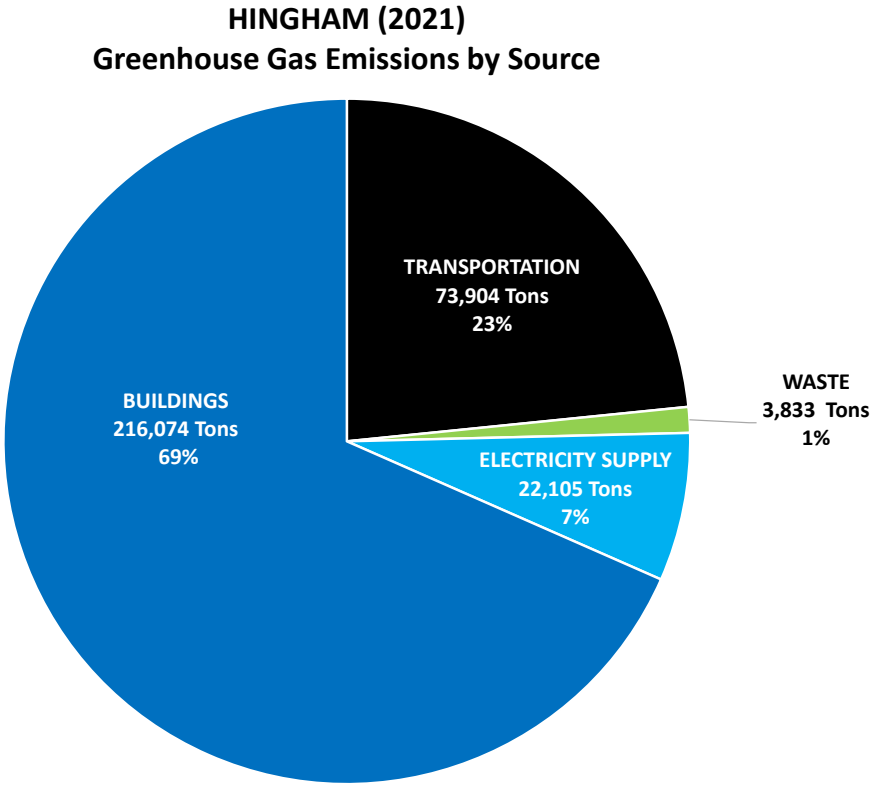
To understand the starting point for Hingham, the GHG Protocols for Cities was applied to Hingham-specific data as described in Appendix B to calculate Hingham's carbon emissions. **Figure 2** summarizes the result of this analysis.

SCOPE 4 EMISSIONS REGIONAL GREENHOUSE GAS INITIATIVE

Massachusetts is one of 11 states that participate in RGGI (pronounced "Reggie") – an intergovernmental organization established to create a market-based carbon credit trading program. By purchasing and retiring carbon credits, HMLP can offset the Town's carbon emissions and incentivize greater carbon mitigation efforts.

By far, the largest source of carbon emissions in Hingham comes from fossil fuels used for heating buildings. The next largest source of carbon emissions comes from transportation – primarily the use of internal combustion engines that consume gasoline and petrochemicals. This is followed by Hingham's electricity supply. Waste, which includes carbon emissions associated with solid waste that decomposes outside of Hingham (i.e., Scope 3 emissions) produces a small portion of Hingham's total emissions.

Figure 2: Hingham Greenhouse Gas Emissions (2021)

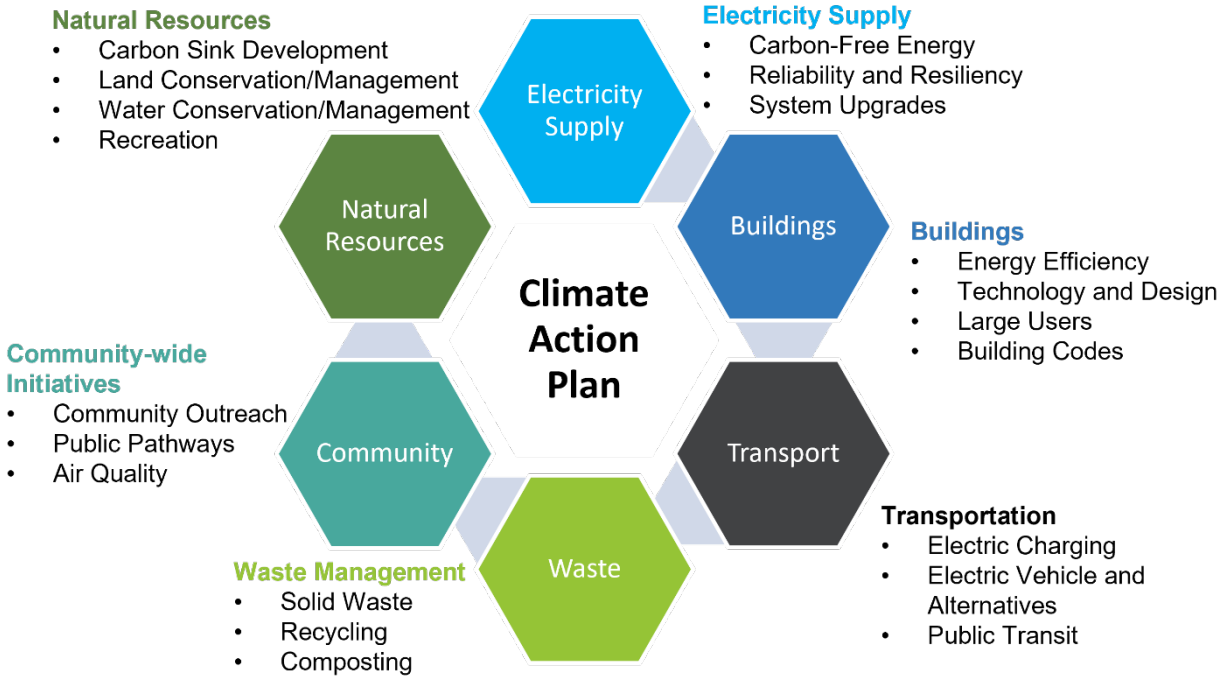


Hingham Climate Action Plan Core Components:

A review of twenty-five other Massachusetts municipal climate action plans confirmed the core components for targeting emissions and their sources in the Scope categories above (see Figure 1). In addition, actions surrounding community and natural resources are included as means of reducing carbon emissions through education, outreach, and public investment, while conserving existing carbon sinks. The Plan therefore focuses on the following six components (**Figure 3**):

1) Electricity Supply
2) Buildings
3) Transportation
4) Waste Management
5) Community
6) Natural Resources

Figure 3: Core Components of Hingham's Climate Action Plan



This Plan addresses each of these component parts in more detail, delving into key areas of implementation. The following sections provide a high-level summary of the decarbonization challenge specific to Hingham and a summary of the recommendations. For those interested in understanding who can do what to achieve the recommendations in the Plan, each section includes a high-level summary of specific actions that can be taken by Hingham's residents, businesses, governing bodies, schools, and innovators. Appendix A provides specific action items with identification of who should take the lead to implement each of the component parts of the Plan.

3. ELECTRICITY SUPPLY

What you can do to help:

 Residents	• Review HMLP's energy portfolio to understand the sources of your electricity • Support HMLP's move towards 100% carbon-free energy • Identify and invest in personal renewable resource assets and available HMLP, MassSave, and other incentives • Consider ways to enhance your resilience during extreme weather conditions • Use electricity responsibly by reducing consumption, especially during peak periods
 Businesses	• Invest in carbon-free energy resources for commercial buildings when feasible • Access economically viable measures to improve your reliability and resilience • Conduct a personal carbon inventory and understand your carbon risks • Develop an action plan for your business to achieve net zero carbon emissions
 Government	• Take action to support HMLP's efforts to achieve 100% carbon-free energy • Educate Hingham residents and businesses on ways to achieve net zero • Coordinate decarbonization efforts among local, state, and federal entities • Establish local personnel and processes responsible for obtaining grant funding
 Schools	• Investigate opportunities to install carbon-free energy assets for electricity • Explore economically viable resilience measures such as energy storage • Consider microgrid equipment and technology for backup power • Create a curriculum around the economics of carbon-free energy resources • Prioritize strategies to reduce energy consumption and achieve net zero goals • Install solar energy arrays on rooftops that can host them
 Innovators	• Troubleshoot the existing shortfalls of carbon-free energy options • Augment commercial energy storage technologies and optimize system capabilities • Launch innovative business models to make carbon-free energy attainable for all • Design utility models to accelerate grid capabilities for electrification adoption

HMLP is a municipal utility that manages the distribution of electricity in Hingham for all of its users, including residents, businesses, and municipal customers. As indicated in its mission statement, HMLP strives to "provide reliable electric services to the Town of Hingham while keeping rates reasonable, service quality high, and operations environmentally sustainable, including a commitment to 100% carbon-free energy."[5]

To meet its objectives, HMLP purchases competitively priced carbon-free energy on the market when it is available and sells the renewable energy credits ("RECs") it receives for those purchases.

[5] HMLP Website, https://www.hmlp.com/about-hingham-municipal-lighting-plant/

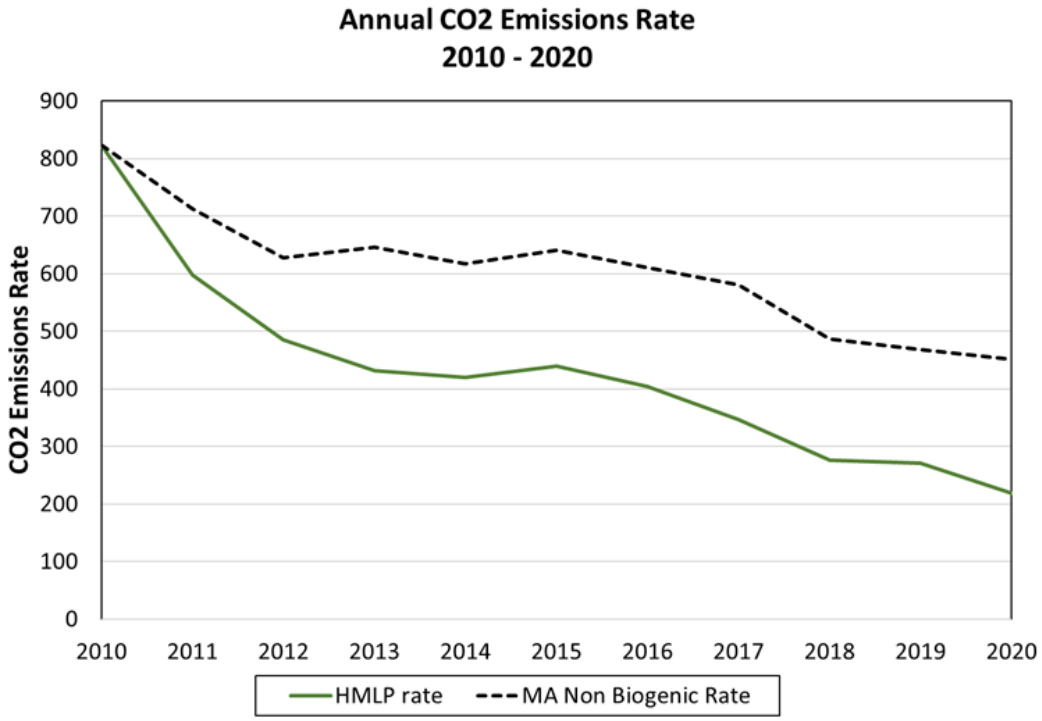
HMLP reinvests the funds it receives from REC sales into local, distributed energy projects. In 2022, the Hingham Light Board voted to begin selling all of the RECs after evaluating pathways to achieve a carbon-free power supply and adopting a roadmap to convert HMLP's portfolio as quickly and responsibly as possible.[6] Carbon emissions from Hingham's electricity supply are less than 10 percent of total emissions compared with other sectors like buildings, transportation, and waste.

HMLP has launched an Electrify Hingham Initiative to promote electrification for all of its customers and identify decarbonization opportunities, including local, state, and federal incentives. The list of activities that HMLP engages in to achieve carbon reductions at an affordable cost for Hingham ratepayers is extensive and dynamic – constantly adjusting to available funds and market conditions. Although different aspects of HMLP's programs are addressed in this section, additional electrification opportunities are described in their relevant sections (e.g., buildings, transportation, and natural resources). Related to Hingham's electricity supply, Electrify Hingham promotes the development of distributed energy resources ("DERs"), such as solar or battery storage, a load management/demand response program, and energy conservation in the face of system load growth.

As a result of HMLP's efforts, Hingham's annual carbon dioxide ("CO2") emissions rate for electricity has declined by a faster rate than the state's CO2 emissions rate (**Figure 4**).

[6] HMLP Website, https://www.hmlp.com/light-board-policies/

Figure 4: HMLP Carbon Emissions versus Massachusetts[7]



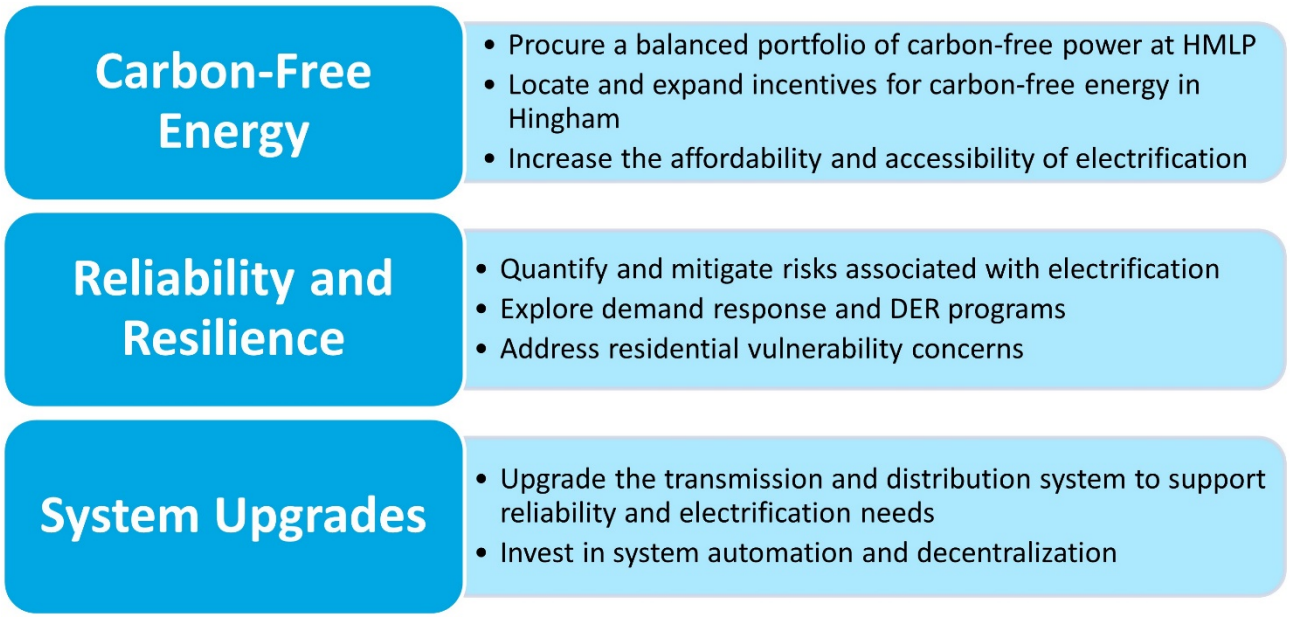
The ongoing efforts to decarbonize HMLP's power supply and prepare for a net zero distribution system are critical components of the Plan. Municipal utilities like HMLP may operate with more autonomy than investor-owned utilities because they are Town-owned assets that work in close proximity to their customers. HMLP's decision-making autonomy empowers it to collaborate on the climate action planning process, such as initially funding the development of the Plan and taking a leadership role to implement many of its recommendations. There are numerous pathways that the Town, HMLP, and all of the Plan stakeholders can pursue, but the relationship with and input from HMLP remains critical to the success of the Plan.

Figure 5 summarizes the Plan's recommendations associated with Hingham's electricity supply. The recommendations focus on the decarbonization of power sources while maintaining reliability and resilience. The electrification of buildings and transportation (discussed in later sections) is an

[7] HMLP Data. HMLP is required to submit an estimate of carbon emissions associated with its electricity supply on an annual basis to the Massachusetts Department of Environmental Protection Bureau of Air & Waste in a form titled "AQ 32 Mandatory Greenhouse Gas Emissions Reporting Form for Retail Sellers of Electricity." The filing for 2020 serves as the basis for the carbon inventory associated with electricity supply. CO2 Emissions Rate is measured at lbs./MWh.

important step towards transitioning away from fossil fuels, but the electricity supply must also be sourced from carbon-free resources in order to build net zero systems.

Figure 5: Electricity Supply Decarbonization Recommendation Categories



The following sections describe these efforts in more detail, including the current status and recommendations regarding:

1) **Carbon-Free Energy:** Increase carbon-free energy and electrification for Hingham with decentralized, distributed energy resources ("DER"), carbon-free energy power procurement, and initiatives such as Electrify Hingham.

2) **Reliability & Resilience:** Fortify system reliability and resilience by strategically investing in demand response programs and community resources.

3) **System Upgrades:** Upgrade the physical transmission and distribution system to enable electrification of load and invest in tools to manage the system.

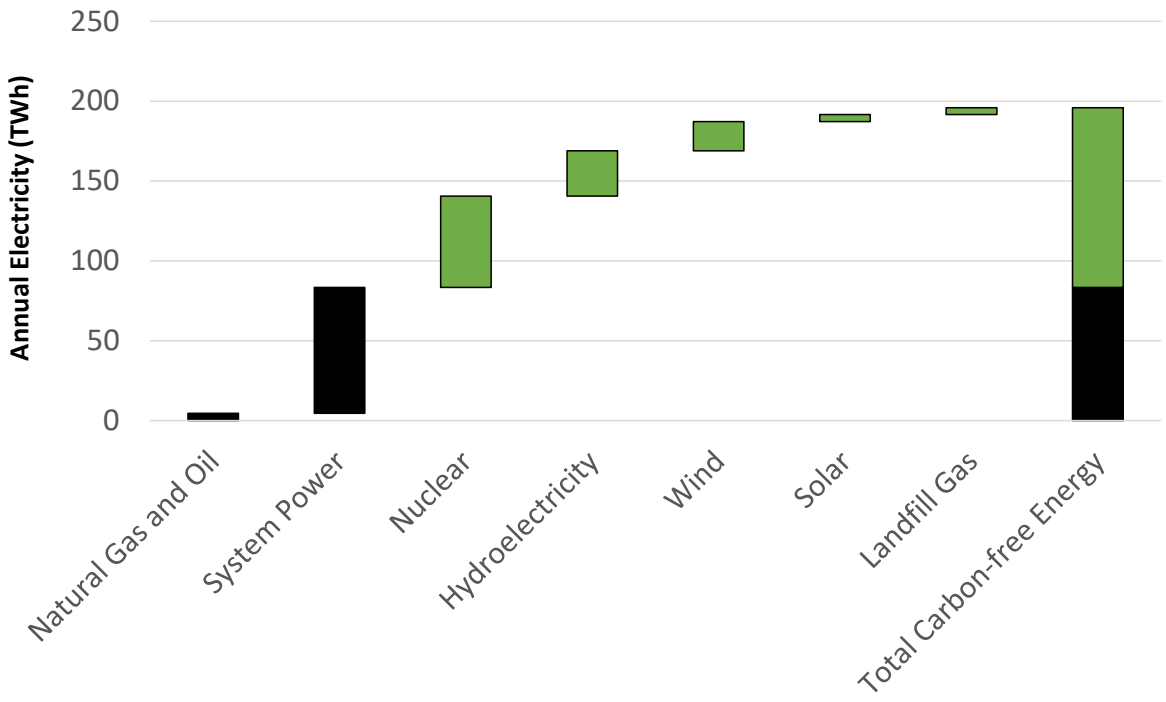
The next three sections provide a more detailed overview. Detailed action items (Appendix A) include new actions and continuation of existing efforts already underway to increase reliance on carbon-free resources, improve reliability and resilience, and ensure that the system is ready to meet Hingham's needs into the future.

3.1. CARBON-FREE ENERGY

The cornerstone of the Plan is HMLP's efforts to decarbonize its power supply and enable end-users to decarbonize theirs. When electricity is carbon-free, the electrification of buildings and transportation can occur without adverse impacts to the environment.

Fortunately, HMLP already has committed to seeking carbon-free energy for its power supply and the process of moving to net zero is underway. In 2021, 57 percent of Hingham's power supply was considered carbon-free (**Figure 6**).

Figure 6: HMLP Electricity Supply Portfolio 2021[8]



Two aspects of HMLP's current services are worth note:

[8] Energyzt analysis of HLMP data.

1) **Power Procurements:** Electric utilities such as HMLP do not traditionally produce their own electricity or own generation assets. To provide electricity to Hingham, HMLP signs contracts to purchase power from different generation facilities. HMLP purchases power for Hingham through competitive power contracts secured by Energy New England ("ENE"). HMLP is a part owner of ENE and works with them to secure competitive power contracts when available. HMLP is not responsible for shutting down or converting existing plants to clean energy resources, and instead has the flexibility to consider alternative purchase arrangements.

2) **Diverse Portfolio Management:** To meet its decarbonization goals, HMLP maintains a diverse mix of renewable and non-carbon resources in its portfolio such as wind, solar, nuclear, and hydropower. A diverse power portfolio reduces dependence on a single source of energy and protects against price volatility in any one sector. Given the goal of decarbonization, the emphasis should continue to be procurement of carbon-free energy.

NEGAWATTS = ENERGY SAVED

The first step in any carbon reduction initiative is to reduce the wasteful use of energy. A "negawatt" is a reduction in energy versus "megawatts" (a standard measure of energy production and consumption). Studies have shown that energy efficiency and demand response are the most cost-effective approaches for decarbonization given the current waste in the system. Every reduction in electricity watts, natural gas British thermal units, gallon of gasoline, or barrel of oil reduces associated carbon emissions and makes it less costly to convert to carbon-free sources. A dollar saved is a dollar earned, and energy you save can also earn money.

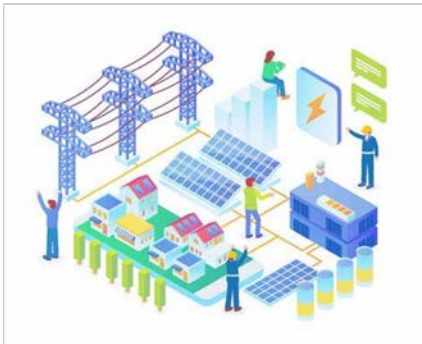
Residents, businesses, and the Town can also participate in generating their own renewable energy. Local generation assets are called distributed energy resources ("DER") and may include systems such as a rooftop solar array or battery storage. When a customer installs DER, they can consume the power generated on-site instead of relying on the electrical grid. If the customer produces more energy than they consume, they can sell the excess back to HMLP in a process called net-metering. Net-metering is when a renewable generation asset, such as solar, provides a surplus of power back to the grid. The customer receives a credit on their electric bill for the power sent back. Net-metering policies are evolving as more people consider installing their own energy assets and the structure of the policies, such as the amount that is credited, currently varies town-by-town. A key action item in the Plan is to maintain an effective net-metering program that

supports and encourages electricity users in Hingham to install DER on their property and sell any excess production back to HMLP.

To fully decarbonize the electric grid and pave the way for widespread electrification, all of Hingham's stakeholders must be a part of the conversation. HMLP launched the Electrify Hingham Initiative in 2022 to open lines of communication, promote energy conservation, and support technology accessibility. Electrify Hingham focuses on education and incentives to guide HMLP ratepayers in the transition away from fossil fuels and recognizes HMLP's role as a steward for responsible, strategic electrification. The program presents pathways for efficient buildings, electric transportation, DER development, and establishing partnerships. In addition to continuing this program, the Plan recommends creating a broader education program for citizens to understand how they can reach net zero carbon emissions, of which electrification is a subset.

It is critical to compile funds that can support net zero goals and the development of carbon-free energy assets. In 2019, HMLP's Light Board began selling some of its RECs to generate funds for green capital projects. That year, over $1.3 million was set aside.[9] HMLP has currently earmarked the funds for a large solar array at its office building and another array at the Hingham landfill. To identify future solar projects, HMLP formed a municipal solar working group that is focused on

[9] HMLP, Financial Report 2020, https://www.hmlp.com/wp-content/uploads/simple-file-list/FinancialReport2020.pdf



VIRTUAL POWER PLANTS

As electricity consumers in Hingham become "prosumers" and produce their own power with solar arrays, acquire electric vehicles with two-way charging/discharge, and install their own energy storage systems, these dispersed distribution energy resources ("DERs") may be combined into a virtual power plant. Utilities can aggregate DER resources to avoid peak demand events when electricity is most expensive and receive payments for offsetting load through ISO-NE capacity markets.

accessing potential sites, making proposals to the Town, and accelerating projects. As a result, the power supply serving Hingham is expected to become more decentralized and carbon-free.

3.2. RELIABILITY AND RESILIENCE

A robust system is one which is reliable and resilient. A reliable electric system provides consistent power to users with minimized disruptions,[10] while a resilient system is able to withstand or recover from unexpected disruptions. Both of these elements play a key part in the transition to net zero carbon emissions. Promoting electrification means that Hingham stakeholders are going to rely on the electric grid more and more. The power system must inspire confidence that it will be predictable and adaptable to meet Hingham's needs. Likewise, there are steps that all of Hingham's stakeholders can take to ensure that their power remains reliable and resilient.

It is important to know that the lights will turn on when you flip the switch. A reliable system takes steps to protect itself against prolonged power outages and avoid situations where power delivery can become compromised. As Hingham electrifies its buildings and transportation systems, more people will become dependent on the grid to deliver power on a consistent, uninterrupted basis. HMLP is responsible for delivering power to all electricity users in Hingham, but HMLP's transmission assets and operations extend outside of Hingham's borders. Nearly all of Hingham's power supply comes from external sources through power purchase agreements. Reliability requires ensuring that sufficient supply is procured, and adequate

[10] Consistent power delivery is dependent on both power generation and transmission. HMLP is principally focused on transmission as a power distributor. Power generated within Hingham principally comes from solar arrays and backup systems (e.g., generators)

delivery equipment is installed to deliver power consistently to consumers in Hingham.

The increased electrical load from electrification is also going to place stress on the system that could potentially reduce reliability. The combination of reliance on a subset of wholesale electricity market resources, net metering purchases, and electrification of the system could combine to have an adverse impact on reliability. Therefore, the Plan recommends that attention be paid to reliability. To this end, recommendations explicitly request that HMLP monitor, quantify, and mitigate any distribution system risks associated with electrification, and consider using active demand response programs and virtual power plant programs (see sidebar on previous page) to reduce peak demand on the system.

Resilience reflects how quickly a system recovers from an unexpected or disruptive event such as a natural disaster, cyber-attack, and other emergencies. A resilient electric system is able to respond quickly to power outages or avoid them altogether. The Town can act to be more resilient by educating residents on emergency preparation and installing backup power supplies. While Hingham undertakes decarbonization and HMLP focuses on the reliability and preparation of its system, it also is important to make proactive investments that minimize the impact in instances when the system is unable to deliver power.

Hingham can build a resilient system by spearheading investments in decentralized, carbon-free energy assets and ensuring accessibility to everyone. The Plan recommends that the Town and HMLP consider opportunities such as community solar and whether a cost-effective model can be applied to Hingham. Community solar is when a solar array is built and members of the community can sign-up to purchase power from the array. These systems provide access to solar power to customers who may not be able to install solar on their own properties due to upfront cost, homeownership status, available space, or other factors. The challenges of executing a successful

DEMAND RESPONSE SYSTEMS

A demand response system seeks to shift the usage of electricity away from the peak usage time, which is the most expensive demand to meet. It is also the time when HMLP's electricity includes the highest percentage of generation powered by fossil fuels. A demand response program can help consumers shift their usage to a different time of day or eliminate the use entirely. Demand response programs may include techniques such as communicating with customers when a peak is expected and asking for cooperation; incentivizing adoption of battery storage and behavior to bank cheaper energy and use it during peak times; offering consumers devices which will allow the utility to control peak usage by appliances such as hot water heaters and compensating consumers for participation; and many similar strategies.

community solar project among other DER opportunities would need to be reviewed by the Town and HMLP.

Also, the Plan recommends that the Town take steps to recognize and support citizens who may be more impacted by extended power outages, such as those who rely on electricity-powered medical devices.

By capitalizing on advancing technology, government incentives, and carbon-free resources that HMLP and others within Hingham may locate within the borders of the Town, decarbonization efforts can be used to improve resilience as well as the environment.

3.3. SYSTEM UPGRADES

The distribution system servicing the Town of Hingham was created during a carbon-based energy world. As a result, transition to carbon-free resources and electrification may impose new stresses on the distribution system.

HMLP already is engaged in a project to upgrade the transmission system delivering power over a high voltage line into Hingham. The Hingham Electrical Infrastructure Reliability Project ("HEIRP") is an on-going project to construct and operate an additional transmission line and substation in Hingham to address critical reliability needs and support the Town's climate change initiatives.

The Plan recognizes that Hingham's electric grid will need investment to adapt to the new realities of an electrified system that includes greater integration of DER. To this end, the Plan focuses its recommended action items on:

1) **Upgrades:** Encouraging HMLP to monitor and upgrade its transmission and distribution systems to allow for increasing electrification, greater total energy consumption, and potentially higher winter peaks associated with installation of heat pumps.

2) **System Automation:** Cost-effective investment in system automation to control decentralized energy resources and optimize system operations to carry greater load with fewer losses.

HMLP will continue to play a critical role in helping the Town of Hingham to achieve its net zero goals. The specific action items that have been developed in conjunction with HMLP ensure continued reliance on HMLP to implement the carbon-free energy goals of the Climate Action Plan.

4. BUILDINGS

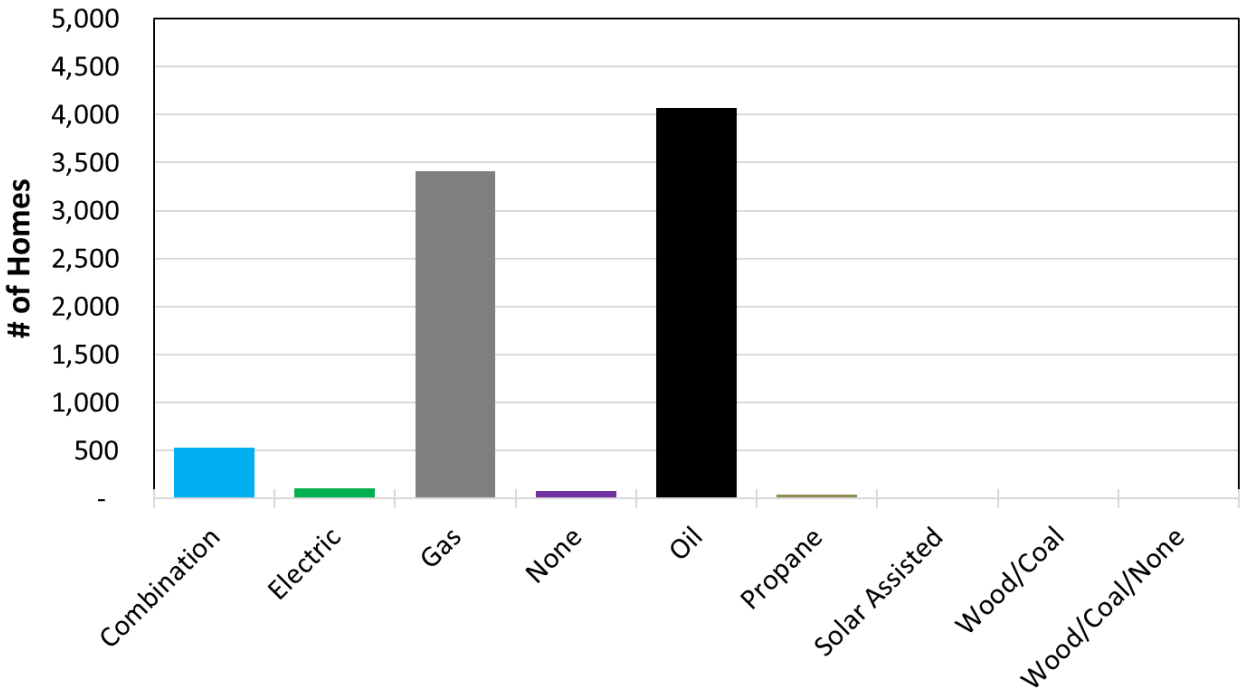
What you can do to help:

 Residents	• Deploy energy-saving measures and smart technology to reduce energy consumption • Enroll in energy efficiency and demand response programs offered by HMLP • Convert to an efficient, electric (or carbon-free) HVAC system • Assess efficiency and electrification incentives from MassSave, HMLP, and others • Estimate your potential savings in converting from fossil fuel systems to electric heat pumps, factoring in both initial and life-of-system costs
 Businesses	• Deploy energy-saving measures and smart technology to reduce energy consumption • Enroll in energy efficiency and demand response programs offered by HMLP • Invest in more energy efficient, lower carbon-emitting HVAC options • Utilize PACE program funding to invest in efficiency and clean energy
 Government	• Continue to engage in the MassCEC Green Communities Program and other state/federal grant programs for energy efficiency • Invest Green Communities and state monies into energy efficiency improvements • Where possible, convert to electric heat pumps and LEED building upgrades • Encourage compliance with building codes that stretch beyond current efficiency/insulation requirements • Analyze embodied energy footprint of existing buildings slated for demolition; new buildings will require a redundant embodied energy to construct • Create and authorize a Hingham Buildings and Site Management Commission to develop conservation and preservation measures to steward Hingham building resources and address deferred maintenance patterns resulting in capital projects • Update Hingham Zoning and Subdivision Control Bylaws with a lot coverage bylaw to protect the balance of open space and carbon sink, protection of trees, reduction in heat islands, reduced pavement and building footprint, conservation and expansion
 Schools	• Identify ways to implement energy efficiency and HVAC regulation and communicate with the town's grant writer to pursue funding • Install automation (e.g., temperature control, lights, motion sensors) in buildings • Explore replacement of existing fossil-fuel heating with heat pumps, use LED lighting, and invest in other cost-effective energy efficiency opportunities • Aim to minimize essential and operational energy usage at the school buildings • Identify areas where carports with solar panels may be located • Educate students on engineering concepts underlying energy efficiency
 Innovators	• Address technology shortfalls in evolving to efficient, net zero buildings • Develop mass market-available solutions for interfacing heat pumps with existing HVAC infrastructure (air handlers in ducted systems, hot water-based radiator systems) to facilitate cost-effective, cosmetically neutral conversions of residential HVAC to electric heat pumps • Create business models to finance energy efficiency investments

Buildings make up 68% of Hingham's total carbon emissions, the most significant emissions source evaluated by the Plan. Energy consumption, materials, and waste are some of the most common sources of emissions in buildings. Residents, businesses, and the Town must consider how they can decarbonize their respective buildings and institute energy efficiency.[11] It will be essential to deploy various measures to address the embodied and emitted carbon from buildings.

Since Hingham is moving towards a 100% carbon-free power supply, the electrification of buildings and their operations becomes an ample opportunity to move towards net zero. Heating and cooling functions are one element of a building's operations that consume significant energy. HVAC systems may use oil, natural gas, propane, wood, or electricity as fuel sources. Nearly half of the homes in Hingham rely on oil for its heating fuel and 40 percent rely on natural gas. Only 108 homes were reliant on electricity as of 2021 (**Figure 7**). The status of home heating in Hingham illustrates massive potential carbon savings if residents switch from carbon-intensive fuels such as oil to electricity.

Figure 7: Home Heating Fuels[12]



[11] While embodied carbon in buildings is not measured as part of Hingham's carbon inventory, new building projects should be cognizant of carbon used to construct buildings and transport their materials. LEED certification is one way to acknowledge embodied carbon, and so pursuing LEED certification is a recommendation of this Plan.
[12] Hingham Data, analysis is based off data for 8,232 homes in Hingham

The bifurcation of Hingham into oil versus natural gas heating tends to be geographic. Only half of the Town has access to National Grid's natural gas distribution system. The rest generally rely on oil heat. Hingham buildings that depend on oil disproportionally impact Hingham's carbon emissions. Moving to an electric or geothermal heat source could create significant carbon reductions.

Before discussing technology conversions, the Plan focuses on reducing energy usage and creating opportunities for flexible demand. Energy efficiency is the first step in decarbonization because it reduces overall energy demand. Reducing energy consumption makes "negawatts" that offset the amount of carbon-free energy that needs to be generated or procured by HMLP. Creating negawatts is a cost-effective strategy that offsets the amount of carbon-free power required to support net zero buildings and a decarbonized build environment.

To this end, the Plan recommends measures focused on energy efficiency awareness, high-performance technology (e.g., HVAC equipment), collaborating with Hingham's largest energy users, and considering adoption of the Commonwealth's specialized opt-in stretch code as it relates to Hingham's buildings (**Figure 8**).

Figure 8: Building Decarbonization Recommendation Categories

Energy Efficiency	• Increase awareness and opportunities to reduce energy consumption • Lead/join regional effort to compile list of contractors • Promote programs such as Electrify Hingham, PACE financing and Mass Save
Technology and Design	• Promote/accommodate efficient heat pumps • Educate Hingham residents on efficient alternatives with Electrify Hingham • Institute new incentive opportunities for technological advancement
Large Users	• Establish commercial team to work with largest users to improve efficiency • Encourage installation of automation and distributed energy resources • Develop demand-side management program
Building Code	• Adopt the Massachusetts Opt-in specialized stretch code • Identify/address opportunities for historical homes/districts • Consider future limitations on new fossil fuel hookups

Converting buildings from fossil fuel energy to decarbonized sources is a significant lift. Technology to do so cost-effectively continues to improve. Initially, education and incentives will be key to success, followed by a more comprehensive effort to publicize, market, and implement conversions of long-lived heating equipment and building systems over time. Each of the areas

described above receives an overview below, with more detailed action items provided in Appendix A.

4.1. ENERGY EFFICIENCY

The first step in decarbonization is reducing energy usage. Reducing energy use serves two purposes:

1) Reduce reliance of fossil fuels; and

2) Make electrification more affordable.

Using existing technologies and incentives to reduce demand for energy is the first step in any decarbonization program. Both residents and business / non-profit entities should begin by arranging for a comprehensive energy efficiency audit through MassSave (if using gas heating equipment) or HMLP (for all others). These audits will specify areas of concern and make recommendations that will reduce the building's consumption of energy. Rebates and federal tax credits are available to support this.

HMLP's energy efficiency programs help customers reduce their energy usage and demand. HMLP has direct access to Hingham's citizens that rely on heating oil, through their electricity usage. It is important to ensure that HMLP can offer their electricity customers that use heating oil information about energy efficiency opportunities as well as more efficient electrical alternatives. For example, a common recommendation for efficient, electrical alternatives is to consider heat pump installations. Below is a guide for how one may approach a recommendation for heat pump installation through either MassSave or HMLP:

GREEN COMMUNITIES
Massachusetts
DEPARTMENT OF ENERGY RESOURCES

Hingham has received the following grants for energy efficiency as part of the Green Communities Program:

- **Efficient Pumps and Ventilation:** In 2018, the Town received $142,232 to fund energy conservation measures tied to improving demand control ventilation, variable frequency drives and lighting in the Broad Cove Sewer Pumping Station, South Elementary School and High School.

- **LED Lighting:** In 2022, Hingham received a grant of $185,475 to fund energy conservation measures including installation of LED lighting and administrative assistance in municipal facilities including the High School and Town Hall.

Massachusetts is considering a new version of the program tentatively called "Climate Leaders" that would further reward climate vanguards such as the Town of Hingham.

Hingham Climate Action Planning Committee

Heat Pump Retrofits for Every Hingham Building

How do you heat your building?

Oil, Propane, Electric, Other (HMLP Program)	Natural Gas (Mass Save Program)
Schedule no-cost energy assessment at HMLP.com/assessment	Schedule no-cost energy assessment with Mass Save, 866-527-7283
Complete recommended weatherization, insulation, air-sealing, etc.	Complete recommended weatherization, insulation, air-sealing, etc.
Plan to apply for HMLP weatherization rebate: 50% up to $1000	Plan to apply for Mass Save weatherization rebate: 75% to 100%
Contact three heat pump installers: Abode Participating Contractor List	Contact three heat pump installers: Mass Save Heat Pump Installer Network
Get three quotes for equipment found on the NEEP Cold Climate Heat Pump List	Get three quotes for equipment on Mass Save's Heat Pump Qualified Product List
Schedule appt. to review system design and equipment ratings with Abode Energy	Schedule appt. to review system design and equipment ratings with Mass Save

Complete the installation and quality assurance forms

Submit HMLP rebate application: up to $5500 for whole-house retrofit	Submit Mass Save rebate application: up to $10,00 for whole-house retrofit

Plan to take advantage of available federal income tax credits for weatherization and heat pumps

Scan QR code to schedule with Abode Energy

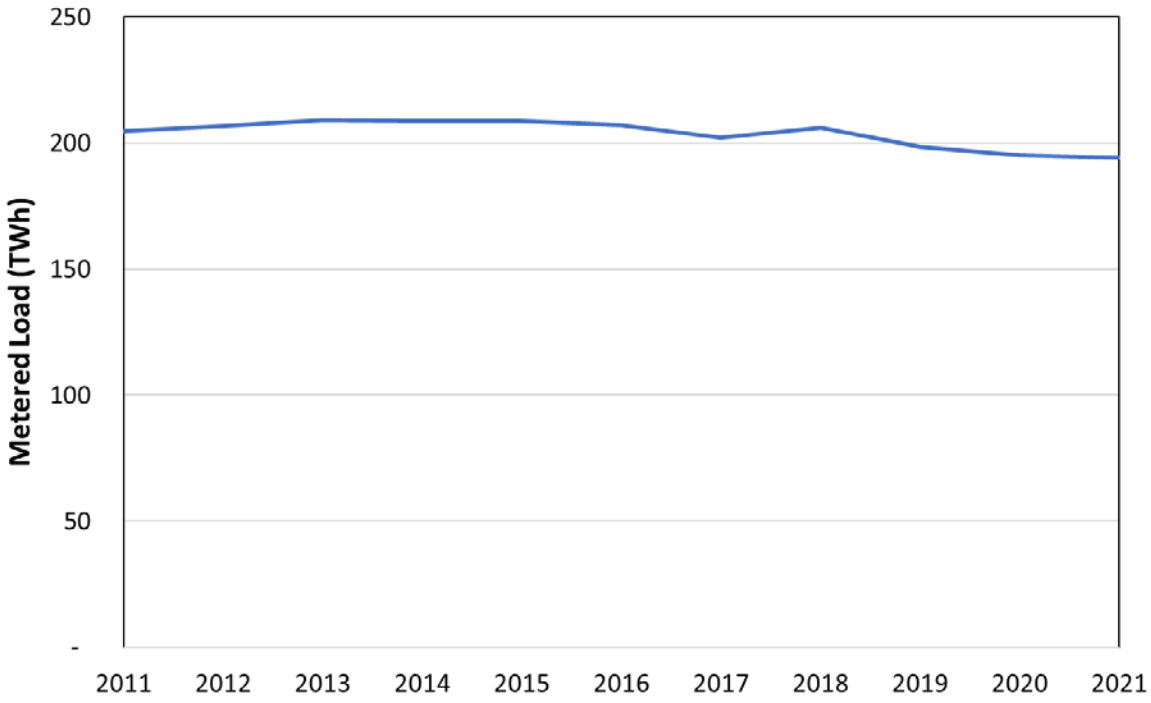
Free heating & cooling consultations at any step in the process! Sign up for step-by-step assistance.

Scan QR code to schedule with Mass Save

Around fifteen years ago, Hingham retained a consultant to identify ways the Town could reduce its municipal government electricity consumption. The Town also has been engaged in various energy efficiency investments through the Massachusetts Green Communities program, investing in more efficient operating equipment with funding from the Massachusetts Green Communities (see sidebar above).

Over the past decade, the impact of energy efficiency efforts has been a success. While Hingham's population has increased by 10 percent[13] and housing units have increased by 2.25 percent,[14] total energy usage has declined slightly from just over 200 TWh per year to below 200 TWh per year (**Figure 9**).

Figure 9: Hingham Historical Metered Electricity Load (2011 – 2021)[15]



There continues to be room for improvement. Residents and businesses can realize energy cost savings through investments in energy efficiency and smarter energy use. This Plan recommends

[13] See U.S. Census data for Hingham in 2010 and 2020, https://www.census.gov/quickfacts/fact/table/hinghamtownplymouthcountymassachusetts,MA/HSD410220
[14] Hingham Housing Data Profile, http://www.housing.ma/hingham/profile
[15] Energyzt analysis of HMLP data; data was not available for 2014.

continuation and expansion of HMLP's existing programs, legislative support for maintenance and expansion of existing energy efficiency programs, and consumer education on energy efficient alternatives and decarbonization opportunities.

When evaluating energy efficiency in your home, the following elements should be considered (and ideally in conjunction with an HMLP or MassSave energy audit):

ELEMENTS OF AN ENERGY EFFICIENT HOME

- Thermal envelope
- Building materials
- Insulation
- Air and vapor retarders / barriers
- Windows and doors, heat transfer, and conduction
- Radiation
- Convection
- Controlled ventilation

Thermal Envelope

The thermal envelope consists of everything that serves to shield the living space from the outdoor environment. It includes the basement, wall and roof assemblies, insulation, air and vapor retarders and barriers, windows, skylights, doors, weather stripping and caulking.

Building Materials

Most homes in Hingham—antique (post-and-beam), contemporary (balloon framing), and modern (platform framing)—are built of wood inclusive of framing, sheathing, and a weather-proof envelope specific to the architectural period style. Some homes are built of brick and/or stone masonry. Siding systems are primarily of cedar clapboards and shingles with brick end walls in Federal homes and roofing systems are wood shingles, asphalt shingles, slate, copper, or coated metal.

Insulation

An energy efficient home will feature higher insulation R-values to reduce heat transfer.

Heat rises, and the best place to start in insulating a house is in the attic. Organic spray foam closed cell insulation that does not produce heat as it cures is the best insulation and air and vapor barrier system. Foundation walls and slabs should be insulated as well as the living space walls. The insulation system should be close fitting without gaps and any compaction of material thickness.

WHAT IS AN R-VALUE?

An R-value is the ability of a material to resist heat transfer. The lower the R-value, the greater the heat transfer, loss or gain. An energy-efficient wall and system will have an R-value of at least R-30 and R-50-70 in the attic framing or attic floor.

Energy audits available to Hingham residents through either HMLP or MassSave can assist the homeowner in assessing the existing insulation and heat transfer conditions in the house envelope. Additionally, a blower door test can evaluate the convective heat infiltration gains and losses in a building envelope to assess the tightness of the envelope.

Air and Vapor Retarders / Barriers

A vapor retarder/barrier is a material or structural element that can be used to inhibit the movement of water vapor, while an air retarder / barrier can inhibit airflow, into and out of a house's envelope. The design of air and vapor retarder / barrier is dependent on the climate and the existing or chosen construction materials and design of the house. It is important that any water vapor that does manage to get into the walls, sills, basements or attics be allowed to escape to prevent mold and decay.

Water vapor condensation is a major threat of decay to the structure and envelope of a house, no matter the climate. In cold climates, pressure differences can drive warm, moist indoor air into exterior walls and attics and roof framing cavities. In warm climates, the cycle reverses itself. As the warm humid outdoor air enters the walls and encounters cooler wall cavities, it condenses into liquid water. This is referred to as dew point, when the moisture falls out of the air. This dew point moisture, if not ventilated, will cause decay in untreated wood and organic components of houses.

Regardless of climate, water vapor migration should be minimized by using a carefully designed thermal envelope and sound construction quality control practices. Systems that control air and water vapor movement in homes rely on nearly airtight installation of sheet materials on the interior as the main air and vapor barrier. Fully plastered house walls provide an excellent air and vapor barrier. Wallpaper coverings and paint can increase the integrity of this air and vapor barrier. For exterior cedar shingles, using a Tyvek or Peel and Stick blue membrane barrier under a rain screen with Cedar Breather ventilation underlayment and clapboards can provide a breathable air and vapor barrier.

Windows and Doors, Heat Transfer, and Conduction

The typical home in a cold climate such as Hingham loses 20%-25% of its heat through the windows and doors. Making your house more energy-efficient and keeping the patina and architectural character that beautiful, old single-pane windows offer are not mutually exclusive. Restoring old and antique windows is the preferable option. Antique windows constructed from dense, old-growth wood can last for centuries if restored to good working condition and functionality. The quality of wood casings and sash and the glass patina is more durable and long lasting when maintained. In existing houses, the window casing openings are often out of square and plumb given the age and natural settling of the envelope.

MINIMIZING HEAT TRANSFER

Heat is the transfer of energy from a warmer object to a cooler object. A difference of temperature between two objects is needed for heat transfer to take place. The goal for energy conservation in windows and doors is to reduce the temperature difference between the inside and outside, thereby reducing the transfer of heat energy during the warm and cold seasons.

New windows are often made of less durable wood and won't fit as tightly as the existing sash. Restoring the existing wood sash, providing exterior storm windows and an interior removable storm window to create an effective captive air space pocket are the best architectural and most energy-efficient option.

Conduction is the transfer of energy from one molecule to another by direct contact. In a single pane window, the interior temperature intersects with the exterior temperature similar to a teaspoon in a cup of coffee. The R-value of a single window pane is 1.0. The introduction of a thermopane window with two planes of glass with a gas (Argon) in the interstitial air space reduces this heat transfer. The resultant R-value is 2.0. The use of petrochemical seals in these thermopane glass assemblies results in gradual escape of the argon gas over a period of 10 plus years due to the seal's degradation by the sun's ultraviolet rays.

Vacuum insulated glass by Nippon Sheet Glass in Japan (known as Pilkington Nippon Spacia vacuum insulating glass in the U.S.) has an R-value of R-4-4.5. This vacuum insulating glass is expected to last at least 50 years. It has no petrochemical seals, and the interstitial vacuum space glass construction is sealed with glass fillet welds, preventing petrochemical seal degradation by the sun's UV rays. Installing this vacuum insulating glass will increase the R-value of a tightly fitting window to at least R-14.

The conventional wood exterior storm window and the triple track aluminum combination windows provide a captive air space on the window system. This captive air space reduces the

conduction temperature and heat transfer. These triple track aluminum storm window systems are readily available, come in numerous sizes, are reasonably priced, and are fairly energy efficient.

Triple pane windows with two interstitial spaces filled with argon gas or vacuum are often considered for the New England climate. The additional interstitial space increases the R-Value incrementally and reduces radiational energy transfer with the addition of Low-Emittance coatings. These window types are more costly and have a thickness that requires careful window frame detail in integrating into a residential wall system.

Radiation

Radiation is the transfer of heat by electromagnetic waves, mainly infrared radiation (e.g., sunlight through a window). Unlike conduction or convection, heat transfer by radiation does not need any matter to help with the heat transfer. The application of UV retardant films on the glass window surface can reduce infrared radiation heat transfer.

Low-Emissivity, Low-Emissivity or Low-Emittance glass, contains a microscopic coating that makes a window more thermally efficient. The coating is thin, non-toxic and virtually colorless.

Convection

Convection is the movement of heat by a fluid such as water or air. The fluid, either liquid or gas, moves from one location to another, transferring heat along with it. This movement of a mass of heated water or air is called a current.

Convection problems at windows and doors result in a draft of air leaking either into or through the loose-fitting windows and doors. Repairing loose window putty glazing in existing 70–350-year-old high quality wood sash is superior to replacing existing wood windows with new windows of farm-growth finger jointed pine, aluminum or vinyl materials. Many new vinyl and aluminum replacement windows are poorly sealed and allow increased convection draft infiltration.

In terms of windows, the most critical point to make is that old, wooden windows, when maintained and, if necessary, augmented with simple storm windows, are much more energy efficient and better for the environment than replacement windows.

The conventional wood exterior storm window and the triple track aluminum combination storm window effectively protect and seal the window system from the exterior weather environment as these outer storm windows provide a cover to the exterior window wood sash and casing trim, and also provide a captive air space on the window system. These triple track aluminum storm window systems are readily available, come in numerous sizes, are reasonably priced, and are fairly energy efficient.

This captive air space reduces the conduction temperature and heat transfer. This will eliminate the formation of condensation and wood decay on an exposed single or thermopane insulated inner wood sash without an exterior storm window. The R-value of a window assembly with a tight-fitting wood storm window or triple track storm windows and a single or thermopane insulated window sash is R-3.5.

Reducing convection by installing weather stripping at doors and windows and caulking at fixed joints in the floor, wall and roof perimeter envelope joints and openings is an effective way to seal air leaks in the building envelope. This can result in a significant reduction in heating and cooling costs.

Controlled Ventilation

An energy-efficient house is tightly sealed, and thus it needs to be ventilated in a controlled manner. Controlled mechanical ventilation prevents health risks from indoor air pollution, provides more comfortable indoor air quality, and reduces air-borne moisture infiltration and condensation, thereby preventing damage to the wood framed envelope.

Natural draft combustion devices such as furnaces and gas fired ranges need to be provided with an independent source of combustion air to mitigate any toxic fumes and also prevent depressurization of a sealed house. Sealed combustion devices such as fireplaces, stoves, heating and hot water heaters, using only outdoor air and ventilation of combustion gases, are important for occupant health and safety.

Heat recovery ventilators (“HRV”) or energy recovery ventilators (“ERV”) are recommended for use for controlled ventilation in airtight homes. These devices are very effective in salvaging and reusing waste heat energy and preheating fresh outside combustion and ventilation air.

4.2. TECHNOLOGY AND DESIGN

Hingham’s path to carbon reduction and ultimately to our 2040 net zero carbon target will include a transition period for the deployment of carbon-reducing technology in new construction and in the renovation and modernization of existing housing, commercial, and public structures. The transition will involve incorporating advanced building materials and advanced HVAC technologies in new construction and renovation, as well as public education on the new technology and its application.

HEATING AND COOLING HOMES AND BUSINESSES

Heating, cooling, and appliances tend to be the largest energy users within our buildings,

accounting for at least 80% of global energy use in the built environment.[16] As noted in Section 4.1, our first step in decarbonization should be making the building envelopes themselves more energy efficient. Energy efficiency measures will immediately reduce the carbon footprint of a building regardless of its mechanical systems. After that, however, the most substantial contribution an individual home or business can make is transitioning off of a fossil fuel heating and cooling (HVAC) system. The Commonwealth, federal government, and various green building councils widely recognize heat pump-based HVAC systems as the best solution to achieve this. As such, the Plan recommends prioritizing heat pump technology in Hingham's buildings as a current best practice for achieving net zero. The Plan also recommends that the Town stay apprised of innovations that can further advance the Town's goals in a landscape of ever-evolving technology.

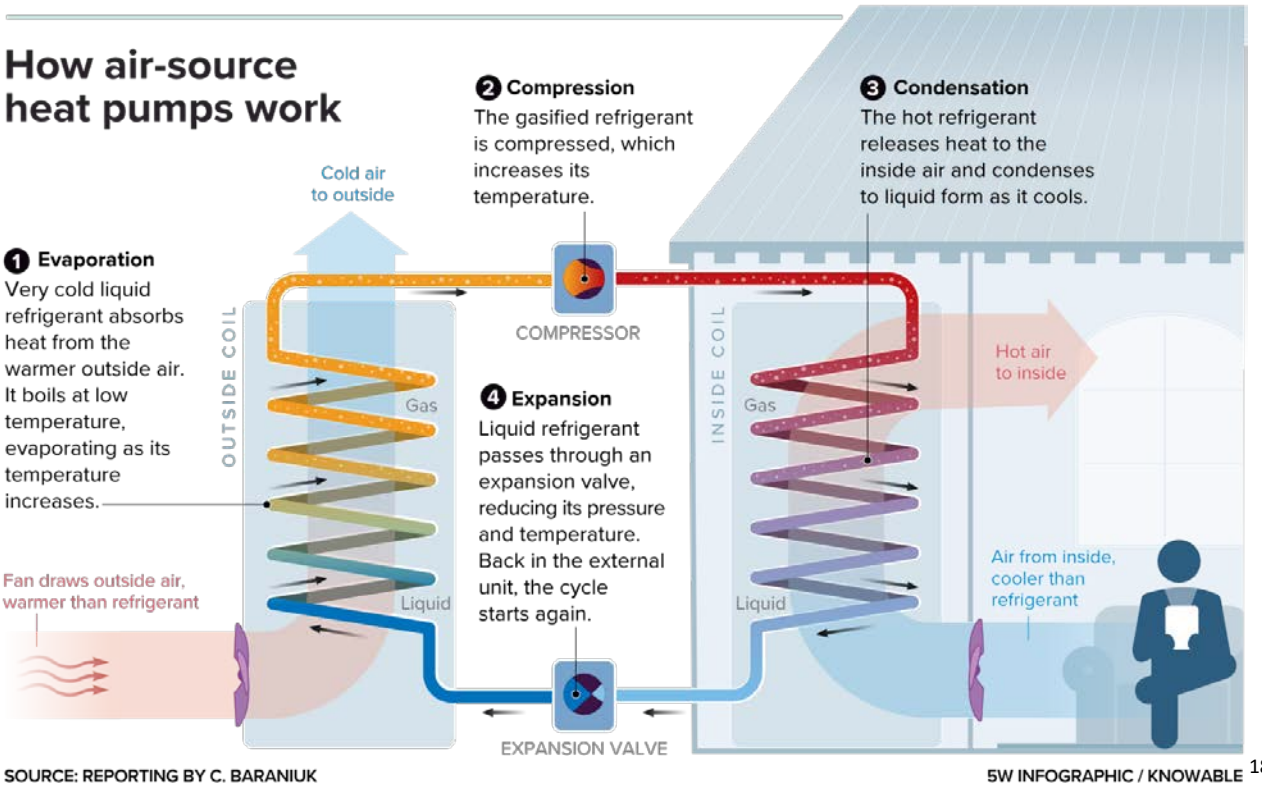
The Commonwealth has identified electric heat pumps in its 2050 Climate Roadmap as a versatile solution for significantly reducing the energy footprint of buildings.[17] Heat pumps can heat, cool, and dehumidify a building by using a small amount of electrical energy to transfer heat energy from one location to another. By accelerating the decarbonization of buildings through installation of heat pumps, Hingham's homes, businesses, and nonprofits can rapidly transition away from fossil fuels and energy-intensive HVAC systems.

Heat pump technology is not new, but well-established and understood. For example, a refrigerator is a heat pump which moves heat from inside the refrigerator to outside of it, causing the contents to be cooled.

There are several kinds of heat pump designs available on the market for different HVAC applications. Air source heat pumps are the technology most commonly used in homes. Ground source heat pumps and variable refrigerant flow technologies can be cost effective in larger installations, and other variations of the technology are useful under differing conditions.

All heat pumps operate on the same principle: they use a circulating refrigerant to move heat from the outdoors to the indoors during heating season, and from indoors to outdoors in the cooling season. The heating cycle of an air source heat pump is illustrated below. For the cooling cycle, the equipment simply reverses the flow of its refrigerant, and pumps heat from inside to outside instead of outside to inside.

[16] International Energy Agency. 2019 Global Status Report for Buildings and Construction. https://www.iea.org/reports/global-status-report-for-buildings-and-construction-2019
[17] Massachusetts Clean Energy and Climate Plan for 2025 and 2030. https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download



[18]

Two decades ago, heat pumps were not feasible as a stand-alone solution for Massachusetts winters, but this is no longer the case. Today, cold-climate heat pumps can provide heat down to minus 20 degrees Fahrenheit without a significant decline in effectiveness. Consumers can verify that a heat pump they are considering is cold-climate certified by using tools such as the NEEP Cold Climate Air Source Heat Pump List.[19]

There are many advantages to heat pumps as an alternative to oil and gas heating systems:

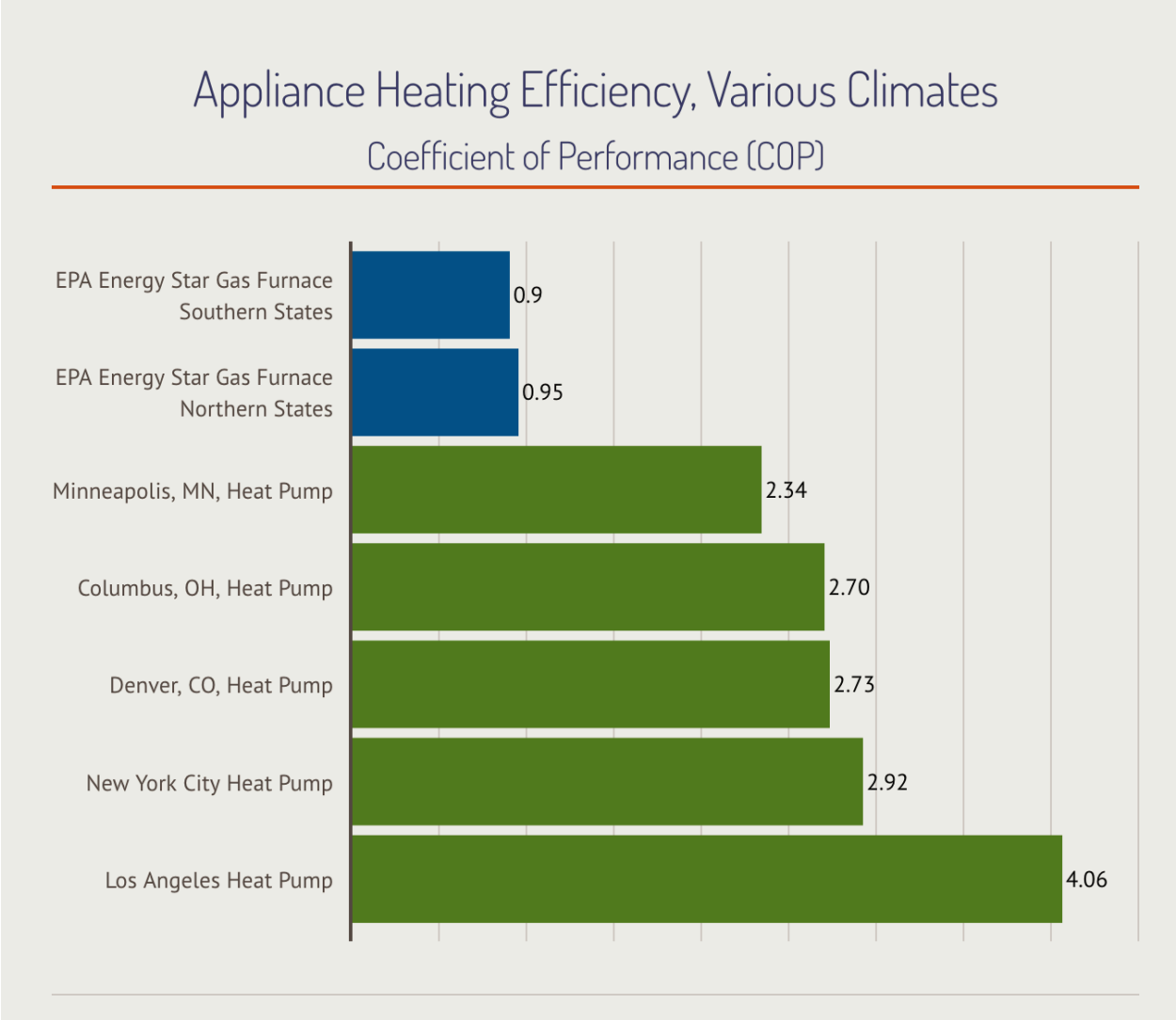
1) ***Carbon-Free Electricity****:* Gas and oil are fossil-fuel resources that will always be carbon-emitting. By contrast, heat pumps rely on electricity. Because they are as much as four times as efficient as burning fossil fuels, heat pumps dramatically lower carbon emissions, even if they are powered by electricity generated 100% by fossil fuels. Hingham's electricity, supplied by HMLP, includes carbon-free generation resources. As HMLP moves toward 100% carbon-free power, all-electric buildings in Hingham using heat pumps will have their carbon emissions reduced. Buildings can also use solar arrays to supply carbon-free power to their heat pumps to achieve carbon-reduction

[18] Published under the Creative Commons license
[19] NEEP's Cold Climate Air Source Heat Pump List. https://ashp.neep.org/#!/

targets.

2) ***All-in-One Comfort****:* Heat pumps answer all HVAC needs in one package. One system can provide heating, air conditioning, advanced air filtration, and dehumidification to a building. These systems are customizable to the needs of the building and can be installed with or without ductwork.

3) ***Cost Competitive & Cost Saving****:* In most instances, heat pumps save people money on utility bills compared to heating with propane, oil, or electric resistance. These systems are also cost-competitive with natural gas, especially in territories like Hingham with historically lower electric rates. Additional savings can be recognized when comparing the cost of installing an all-in-one heat pump system to installing separate equipment for heating and air conditioning. There are various rebates and federal tax credits available to mitigate the upfront costs of installing heat pumps.



[20]

CUTTING THE CARBON COST OF APPLIANCES

Residents and businesses can further lower their carbon footprint by choosing electric appliances. Simply replacing a gas-fired or oil-burning appliance with an electric one is a step in the right direction, as Hingham's electricity has a lower carbon cost than either gas or oil. Older versions of electric appliances are available, but innovations such as induction cooktops, heat pump water heaters, and heat pump clothes dryers can increase the energy efficiency and lower the operating

[20] Rocky Mountain Institute, "It's Time to Incentivize Residential Heat Pumps," June 8, 2020, *https://rmi.org/its-time-to-incentivize-residential-heat-pumps/*

costs of regular household activities. There are also many incentives available for switching to all-electric appliances.

CHALLENGES TO IMPLEMENTING NEW TECHNOLOGIES

While replacing HVAC and other appliances presents an enormous opportunity to reduce Hingham's carbon footprint, there are challenges which must be overcome.

- **Antique Homes**: Hingham has many historical and antique homes that were built to support the heating solutions of another era. Technology has evolved dramatically in the last two decades, and many modern solutions (i.e., HVAC with heat pumps) require special consideration, precision, and design. It is recommended that the Town identify resources to support the retro-fitting of older structures.
- **Emergency Buying**: Replacing familiar equipment such as an HVAC system with something new requires learning about new technology in advance and making decisions about what is best for the consumer's situation before an emergency arises. Consumers need to be knowledgeable and prepared with a plan to convert fossil fuel systems to heat pumps. Too often, when an oil or gas system fails, the only option will appear to be to replace it with the same technology. HMLP, in partnership with the town and community groups, can undertake to promote HMLP's Electrify Hingham program to help residents and business owners prepare to make the most efficient choices for their building(s).
- **Electrical Upgrades**: For homes, businesses, and nonprofits, new electrification technology may necessitate the upgrade of the electrical panel or other aspects of the building's electrical system. If so, contractors estimating installation costs should factor required electrical upgrades into the total cost of the project.
- **System Design:** Technologies like HVAC systems must be appropriately designed to meet occupant needs in new construction and building retrofits. With heat pumps, some of the largest design considerations are control mechanisms, sizing and design, engineering, and installation. Technological best practices for successfully installing heat pumps include:
    - Determining the building's heating load and sizing the pump(s) accordingly.
    - Designing and engineering the interface of the heat pump to the existing or new air distribution system or the existing or new hydronic heating system.
    - Correctly sizing the electrical load and distribution system, including demands from lighting, appliances, cook tops, heat pumps, solar assets, EV charging, etc.

  Consumers should seek advice from experts to assist in this process. Hingham residents qualify for free heat pump coaching from Abode Energy Management, available from HMLP.com.

MAKE A PLAN

Because switching to a new HVAC system is not a cut-and-dried process, it is most important that

consumers who want to lower their carbon emissions investigate their options and make a plan to switch away from fossil-fuel burning systems before a system failure makes it difficult.

Consumers can begin their transition away from carbon emissions by scheduling a no-cost energy assessment with MassSave (for natural gas customers) or HMLP (for all others) and implementing the suggestions in their customized assessment report. Consumers should always exercise buyer discretion and stay apprised of available technologies and recommendations.

Education programs through various outlets such as Town departments, HMLP, nonprofits, and state organizations can support consumers in decarbonization and in the transition to electric, efficient buildings. Local entities can also stay apprised of new innovations like demand response, software management, or other evolutions in technology to help Hingham consumers connect with the latest, best available resources.

4.3. LARGE USERS

Large energy users often are some of the most cost-effective targets for decarbonization. Many of those entities, which include industrial and commercial companies, golf courses, managed communities, and municipal government may want to decarbonize and most certainly want to save money. Federal and state programs target these types of large customers with incentives and rebates to encourage decarbonization investments. Helping these community members to reach net zero can address a large portion of Hingham's total carbon emissions with limited transaction costs.

Hingham is primarily residential, but there are a limited number of areas focused on business, industry and industrial parks concentrated in the lower south-west portion of the Town's borders. In addition, there are a number of thriving industrial parks, office parks, business districts and commercial businesses, including the downtown area, waterfront, and Derby Street shops. In total, Hingham hosts around 3,100 businesses that employ 14,174 people.[21] Those businesses are primarily commercial businesses.

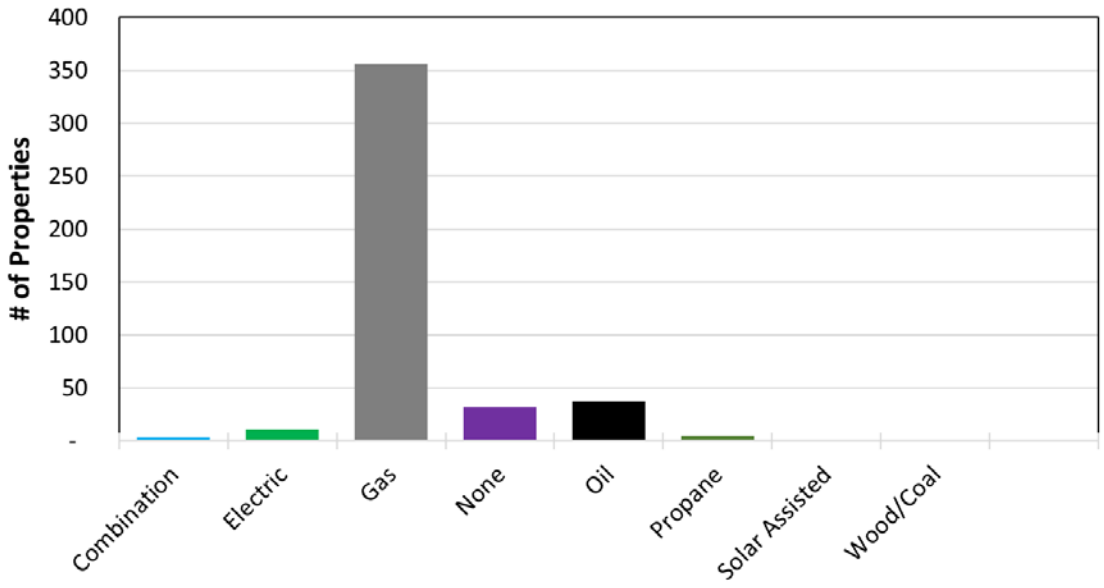
Hingham is actively promoting expansion of the Town's commercial and industrial resources. The Development and Industrial Commission was established in the early 1960's and revitalized in 1997 under MGL Chapter 40, Section 8A for the promotion and development of the industrial resources of the municipality. Its charter states that the commission,

[21] US Chamber of Commerce, https://www.chamberofcommerce.com/united-states/massachusetts/hingham/

> . . . shall conduct research into industrial conditions, investigate and assist in the establishment of educational or commercial projects, including projects involving private enterprise, for the purpose of expanding or strengthening the local economy, and shall seek to co-ordinate the activities of unofficial bodies organized for said purposes.[22]

Expanding the commercial and industrial base could serve to increase carbon emissions. On the other hand, these large users are relatively small in number compared to residential energy users. However, the larger users are concentrated, have bigger building envelopes, and require more electricity for purposes of inputs to production and climate control. For example, the 632 non-residential customers represent only 13 percent of National Grid's customers in Hingham but consume around 43 percent of total natural gas consumption.[23] Most of the large commercial and industrial properties are connected to National Grid's natural gas system (**Figure 10**).

Figure 10: Hingham Heating Fuel for Commercial and Industrial Customers (2021)[24]



There is an opportunity to incorporate efficiency and carbon-free planning by owners of the large commercial and industrial user buildings when they renovate the tenant occupied spaces upon tenant turnover. Development of carbon-free heating, ventilation and air conditioning energy

[22] Hingham Website, https://www.hingham-ma.gov/496/Development-Industrial-Commission
[23] Aggregated natural gas usage data provided by National Grid.
[24] Energyzt analysis of HMLP data.

systems should focus on the primary system infrastructure updates and the tenant operated distribution systems. Most of these systems are operated on natural gas for fuel and air ducting systems for distribution. The envelopes of the existing buildings could employ white solar reflecting roof membranes to reduce heat island effect; solar panel installation ready roof systems; MA Stretch Code compliant insulation, air and vapor membrane; and ventilation balance system updates.

The geographically-concentrated set of large users that represent a significant portion of total natural gas create an ideal target for decarbonization, even with the predominant use of natural gas as the heating source. The Town should consider augmenting and expanding its interactions with large users to create a commercial/industrial team that explicitly targets this group to discuss incentives for implementation of:

- Hingham's decarbonization goals
- Energy efficiency education and incentives
- PACE financing for upfront investments
- Demand response programs offered by HMLP
- Energy generation assets, such as solar for roofs and carports
- Backup generation and energy storage
- Installation and maintenance of electric vehicle charging stations

Some of these large energy users are national companies that may have their own net zero goals, offering synergies through public-private partnerships and ongoing collaboration.

4.4. BUILDING CODES

As part of the Green Communities program, Hingham was required to adopt a state-issued stretch code as aspects of its building code. At the time, the stretch code may not have been such a stretch as industry standards had caught up to the requirements. Hingham will be required to meet the Commonwealth's minimum code requirements.

At the end of 2022, the Commonwealth also approved a new specialized net zero opt-in stretch code. The Plan's action items recommend that the Town examine potential adoption of the specialized stretch code, identify and address opportunities for historical homes and historical districts, and examine potential Town-wide limitations on new fossil fuel hookups.

Addressing and publicizing how historical homes can partake in decarbonization efforts is particularly important for Hingham. Nearly one-quarter of the housing units in Hingham were built before 1939[25] and Hingham Main Street is lined with beautifully historic homes (see sidebar). Although building codes can and should be designed to target new construction, older homes could benefit from education and incentives to achieve cost savings moving forward.

THE MOST BEAUTIFUL MAIN STREET IN AMERICA

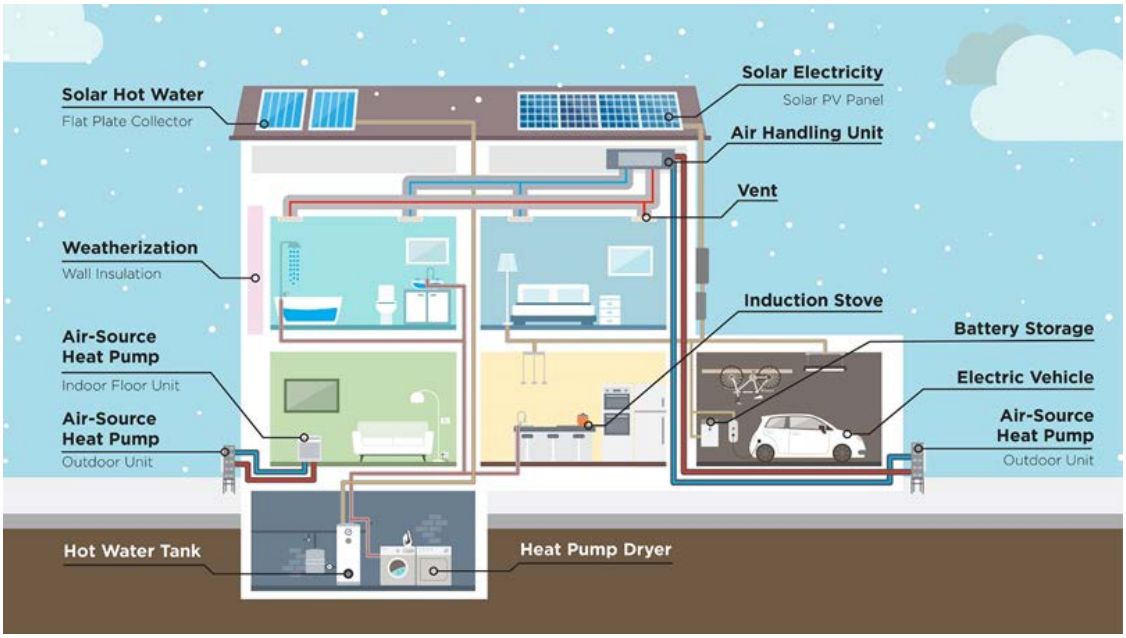
In January 1942, First Lady Eleanor Roosevelt visited Hingham to complete a photo documentary co-authored with Hingham resident Frances Cooke Macgregor titled, "This is America."

The First Lady reputedly enjoyed the mix of architecture and described Hingham Main Street as the most beautiful Main Street in America.

Even without a new building code, there are a number of ways that historical buildings can become cleaner, greener, and smarter. There are also valid public sources providing information on how to do this. For example, improving the energy efficiency of the existing historical building envelope can be achieved with insulation, air and vapor barriers, reducing porosity of the envelope, and generally tightening up the airflow into and out of the building consistent with the original architecture. At a minimum, Hingham should aim to educate the public by referencing publicly-available sources on how to reduce heat loss. **Figure 11** illustrates components of a low-carbon residence, including distributed energy resources (DERs) such as rooftop solar and batteries.

[25] Housing Hingham MA, http://www.housing.ma/hingham/profile

Figure 11: Example of a Clean Energy Home[26]



In Massachusetts, funding is available through multiple outlets for commercial, non-profit, and industrial users to transition their building(s) to net zero. Large users may be able to access funds to support their project through the Property Assessed Clean Energy (PACE) financing program, Mass Save HEAT loan (0% financing), Mass Save retrofit or new construction programs, investment tax credits, and HMLP rebates. Residential customers are not eligible at this time for PACE. However, state entities and utilities from across MA are discussing alternative residential financing opportunities .

[26] MassCEC, p. 3, https://goclean.masscec.com/downloads/MassCEC-Introduction-to-the-clean-energy-home-guide.pdf

5. TRANSPORTATION

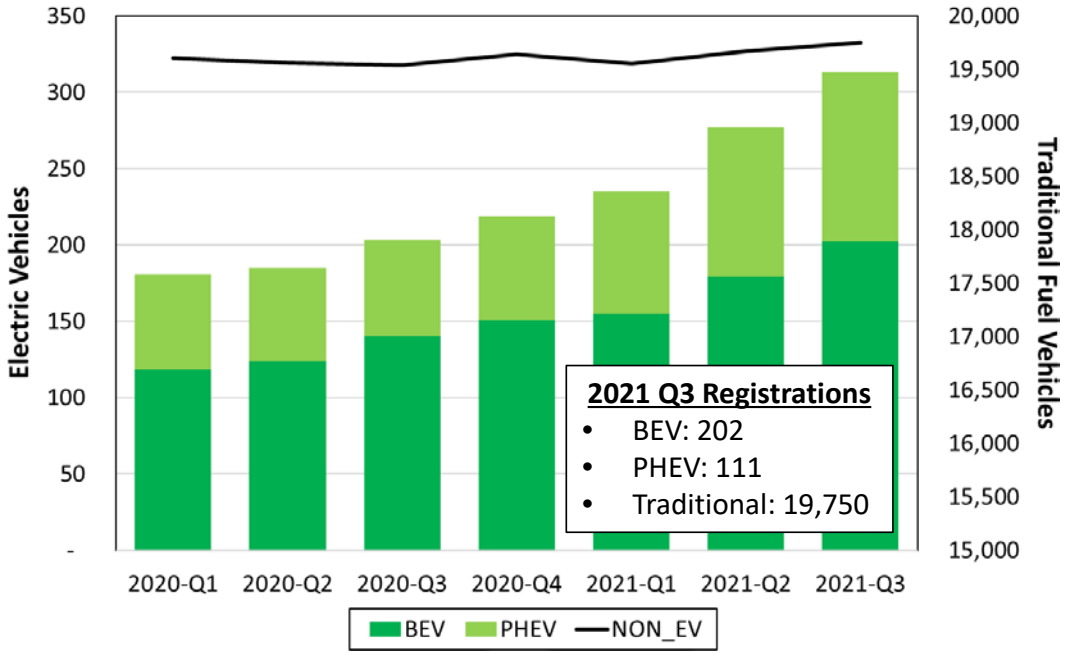
What you can do to help:

 Residents	• Provide educational resources. Explore the economics and feasibility of converting to electric and clean energy vehicles, and convert when feasible, and if you are an EV owner, share calculations and experience with neighbors and friends • Explore the use of hybrid vehicles in the interim. • Support installation of charging stations and carbon-free energy fueling stations • Make use of MBTA and other public transportation whenever feasible • Minimize automobile trips by bicycling, walking, combining errands, ride-sharing, or ordering online. Turn-off fossil-fueled vehicles while waiting rather than idling
 Businesses	• Consider converting vehicle fleets to alternative fuel, hybrid and electric • Install EV charging stations in business, Commuter Rail, Commuter Board, MBTA bus stop (at old rail station), multi-unit housing, and shopping parking areas • Explore possible business sponsorship of electric trolley system • Allow employees to telecommute when feasible
 Government	• Convert vehicle fleet to alternative fuel and electric • Procure funding for EV charging stations and install at parking lots for town buildings and town sports fields; charge an appropriate market price to collect fees for maintenance and replacement costs • Explore public transit and personal mobility options, including the procurement of an electric bus trolley to make a loop connecting destinations throughout Town • Monitor grant programs for fleet conversion, installation of EV charging stations, and other opportunities. • Monitor incentive programs for emissions, idle reduction, etc.
 Schools	• Monitor the economics and obtain funding for electric school buses • Install EV charging stations in school parking lots for students, parents and teachers, as well as for electric school buses used to transport students from other schools • Educate students on how to assess the economics of public transportation and EVs and PHEVs instead of fossil-fuel powered automobiles • Encourage bicycling and walking to school when and where safe
 Innovators	• Continue to improve the economics of EV charging stations and business models so that they are commercially feasible without subsidies • Expand the manufacturing of electric school buses to move down the cost curve to become on par with the cost of diesel buses • Innovate around personal mobility technologies, including autonomous vehicles

Transportation generates the second largest source of emissions – primarily as a result of combusting gasoline and diesel fuel through internal combustion engines. Roughly one-quarter of total carbon emissions come from vehicles that are registered in and operate around town.

However, Hingham drivers are increasingly purchasing plug-in hybrid electric vehicles ("PHEVs") and battery electric vehicles ("BEVs"). Out of roughly 20,000 registered light-duty vehicles, a bit more than 300 are identified as electric.[27] Year-over-year growth was 50% between the third quarter of 2020 and third quarter of 2021 (**Figure 12**).

Figure 12: Hingham Electric Vehicle Light Duty Vehicles as of 2021[28]



As market offerings continue to proliferate over the next ten years, the Committee anticipates that electric vehicle purchases will increase exponentially. The largest automakers in the world are rolling out a plethora of new electric models, and start-ups are raising billions of dollars in public equity markets to offer niche solutions for trucks, vans, and commercial vehicles. The Environmental Protection Agency is granting $5 billion to subsidize electric school buses under the Infrastructure Investment and Jobs Act. the federal Inflation Reduction Act provides billions of dollars to effectuate a transition to alternative transportation fuels, including continuation of tax incentives for electric vehicles and establishment of widespread charging stations.

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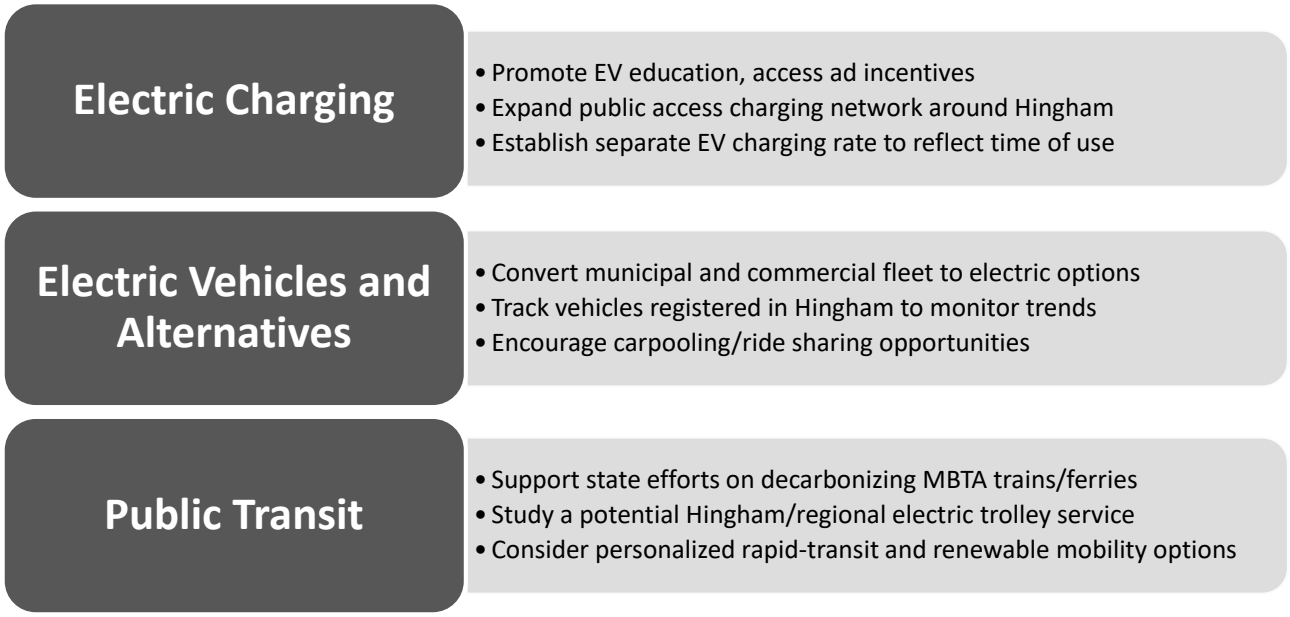
[27] There currently is no easy way to establish the number of electric vehicles based in Hingham and data is representational versus definitive. This will become more difficult as mainstream mass-market brands start to roll out their electric vehicle offerings. Going forward, the Commonwealth and Town could require registrants to specify on their registrations whether the vehicle is a BEV, PHEV or alternative fuel vehicle to allow for better tracking and monitoring.

[28] Energyzt analysis of vehicle registration data sourced from National Grid via IHS-Polk.

By 2035, the Commonwealth of Massachusetts requires 100 percent of new vehicles sold in Massachusetts to be electric.[29] Although internal combustion engines will continue to be purchased and operated in Hingham, they are set to phase out over time in keeping with Hingham's net zero goals. This Plan recognizes these broader trends and organizes its recommendations and actions around these areas (**Figure 13**).

Figure 13: Transportation Decarbonization Recommendations Overview



As already mentioned, a decarbonized and well-maintained electrical system is crucial to enabling the electrification of transportation in Hingham. A brief overview is provided in the following sections, with detailed action items in Appendix A.

5.1. ELECTRIC CHARGING

In many cases, conversion to electric vehicles already makes economic sense. Educating consumers will be important to ensure Hingham's citizens can make informed decisions. To this end, the Town should capitalize on educational efforts already underway through Electrify Hingham and Hingham Drives Electric (see sidebar) to enable electrification.

The Town of Hingham also can enable electrification of the community's fleet by pursuing the

[29] Joseph Choi, "Massachusetts to require 100 percent of car sales to be electric by 2035," The Hill, January 5, 2021, https://thehill.com/policy/energy-environment/532684-massachusetts-to-require-100-percent-of-car-sales-to-be/

following activities:

- **Provide Information and Links to Valid Information Providers:** Provide information and links to valid information providers, such as Hingham Drives Electric (see sidebar), so that Hingham citizens can make informed investment decisions in their next automobile lease or purchase. Such information includes location of charging stations, process for installing charging stations at homes and businesses, and estimated savings for electric vehicles versus internal combustion engines. Utility rates factor into EV economics, and towns with municipal light plants such as Hingham tend to have lower rates, making electricity-based vehicles more attractive.

- **Educate:** Consumers of electric vehicles should understand the geopolitical implications of the mining of natural resources to make electric batteries for electric vehicles, and the resulting embodied carbon footprint in producing EVs (as well as any other vehicles). The manufacturers can and should be developing technologies that do no harm to the environment and do no harm to developing nations.

Hingham Drives Electric

Hingham Drives Electric is a program funded by HMLP to educate and encourage residents to explore electric vehicles. It is run by a team of EV specialists from ENE. The site provides multiple tools and resources that residents can use to compare the total cost of electric vehicles to their gasoline alternatives.

http://hinghamdriveselectric.org/

- **Interim Solutions**: Consumers of alternative fuel vehicles should pursue hybrid and plug-in hybrid vehicles**,** as well as conversion of internal combustion engine vehicles to hybrid, plug-in hybrid, where all battery electric vehicles are not feasible.

- **Install Charging Stations:** As the Town's fleet electrifies, ensure adequate charging installations by encouraging: private providers to locate in the Town; as-of-right siting in commercial and multi-unit housing parking areas; and equity and charging access considerations tied to potential requirements for multi-unit housing units (e.g., apartment and condominium complexes), public housing, new developments, service stations, dealerships, and large commercial spaces. All charging should occur in compliance with all life safety codes. Increasing the ability to charge in Hingham drives economic dollars to Hingham's stores and commercial areas.

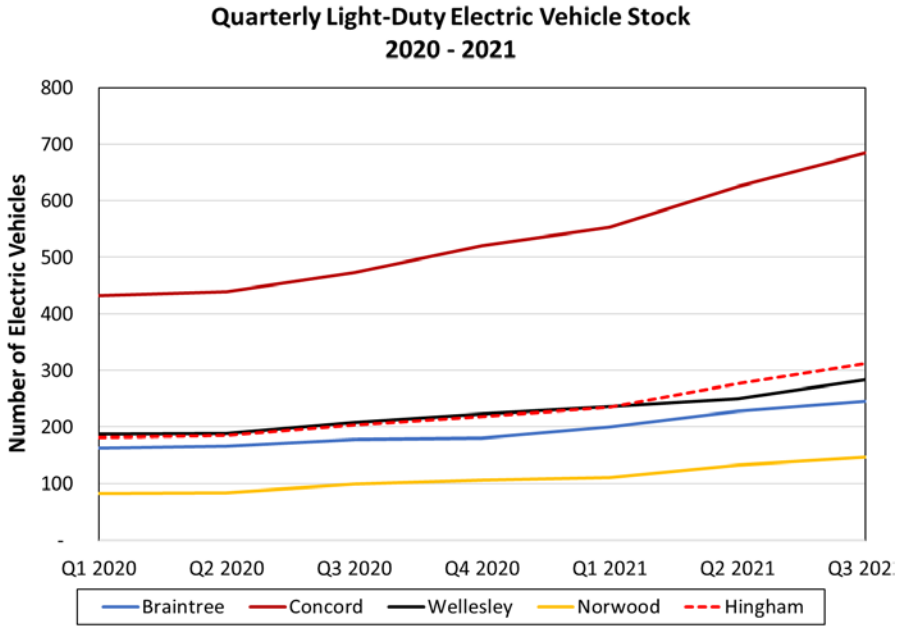
- **Establish Variable EV Rates for Electricity:** Encourage HMLP to establish variable electric vehicle rates for all charging stations in Hingham (including home installations) that sends a time-of-use signal through to the electric vehicle charging programs. Such signals equitably incentivize electric vehicle owners to charge in response to time-of-use pricing during off-peak hours when electricity is readily available, reducing stress on the system.

- **Promote Residential Carbon-Free DERs (e.g., solar and batteries) for Charging Vehicles**: Distributed energy resources ("DERs") are useful not only for HVAC electrical needs (powering heat pumps) but also to directly charge personal EVs (several systems are already on the market). This could also reduce high-peak demand on Town electricity and possibly provide DERs to feed electricity back into the Town system when not being used at home.

- **Incentivize:** Provide information on electric vehicle incentives from federal, state and local programs. Adopting average vehicle miles traveled in Massachusetts and applicable electricity rates, the website should include a calculation that compares the economics of electric vehicles in Hingham to a traditional vehicle over the lifecycle of the car.

The goal should be to produce a noticeable increase in electric vehicle uptake versus other towns – an uptick that only recently started to happen (**Figure 14**).

Figure 14: Comparison of Hingham EV Growth Rates to Similar Towns[30]



5.2. ELECTRIC VEHICLES AND ALTERNATIVES

Technology is changing quickly and the federal government has created incentives for alternative fuels. Such incentives are unlikely to make a significant difference over the next decade as electric vehicles are the focus of automobile manufacturers and state policy. That said, there are a number of automobile alternatives that Hingham should consider and, if it makes sense, promote:

- **Convert Municipal Fleet:** With respect to decarbonizing transportation, it is important that the municipal government lead by example. Local, state, and federal funding is available to

[30] Energyzt analysis of vehicle registration data sourced from National Grid via IHS-Polk.

both install charging stations and subsidize the purchase of municipal fleet electric vehicles, interim hybrid, and plug-in hybrids. As of 2023, the Inflation Reduction Act allows for non-profits such as the Town of Hingham to receive "tax credits" in the form of direct payments. Hingham should capitalize on the incentives available to convert its municipal fleets to electric vehicles if it is economic to do so. Even without special incentives, electric vehicles are becoming increasingly competitive against internal combustion engines that have higher maintenance costs and rely on volatile oil prices.

- **Prepare to Convert to Electric School Buses:** Although the initial round of EPA electric school bus conversion money was not likely to be awarded to Hingham, other funding options are available. In addition, $5 billion in subsidies over the next five years will expand electric school bus manufacturing capabilities and drive costs down the commercialization cost curve. State net zero policies also could result in funded or unfunded mandates within the next decade. Hingham should monitor broader trends on cost, production, and subsidies, and be prepared to convert its school bus fleet to go electric. Although initial EPA funding may not target Towns such as Hingham, there may be funding for innovative demonstration projects that would allow Hingham to receive funding while obtaining data and information on how electric buses may work within its school system.

- **Encourage Carpooling/Ride Sharing:** Carpooling and ride sharing is a long-standing means of removing vehicles from the roads. The Town should be aware of how carpooling is incentivized in other areas, ride sharing is enabled, and highlight ways for residents of Hingham to share rides to reduce emissions.

V2G = VEHICLE-TO-GRID

V2G is a set of incentives and systems that allow electric vehicles to interact with their interconnected power systems. Although the technology already exists to provide V2G services, market-based incentives and signals have not yet been fully developed.

As electric vehicles become a greater portion of the fleet, HMLP can play a role by establishing a set of electric rates and programs specific to electric vehicles. For example:

- **Time-of-use Pricing:** The state of New York requires its utilities to send a price signal that reflects the hourly price on the power system in order to create incentives for electric vehicles to charge outside of peak hours when low-cost electricity is more readily available.

- **Demand Response:** National Grid has a program that pays EV owners $50 to enroll plus $20 annually that sends a signal to pause charging during peak demand events on hot summer days and automatically resume charging afterwards.

- **Track Vehicle Adoption and Public Reporting:** In order to monitor the success of its efforts and the need for infrastructure installation and upgrades, the Town of Hingham should begin a formal effort to explicitly track which registered vehicles are alternative fuel vehicles. Similarly, HMLP should monitor and track which homes have home charging stations and whether those chargers are Level-1, Level-2, or advanced fast-charge equipment. This information should be put into an easy-to-read chart or charts that highlight progress that the entire community is making with respect to automobile decisions and total carbon emissions saved.

5.3. PUBLIC TRANSIT

Hingham is home to multiple modes of public transportation that can move citizens and visitors around the state and therefore connect to the rest of the country and the world. Current modes of public transportation include:

- **MBTA Commuter Rail:** The diesel-fueled, double-decker purple commuter trains run from Boston South Station through the south shore and Hingham to the Greenbush Station in Scituate. Stops include West Hingham Station and Nantasket Junction.

- **MBTA Commuter Boat:** The MBTA operates a ferry that relies on maritime fuel oil out of the Hingham Shipyard that delivers passengers to Logan Airport, Hull, and Boston (Rowes Wharf and Long Wharf).

- **MBTA Buses:** The MBTA also operates Line 220 that connects the Hingham depot along Route 3A to downtown Quincy via a diesel-fueled fleet of buses, and the 714 bus line from Hingham to Hull and back.

The MBTA public transportation system therefore, at present, contributes Scope 3 emissions to Hingham's inventory. To eliminate the MBTA's carbon contributions to Hingham, the Town and citizens should work with the MBTA to encourage and support decarbonization by moving to electric or alternative fuels.

Even in the absence of conversion to a decarbonized fuel source, greater adoption of public transportation options versus personalized vehicle commuting still decreases Hingham's carbon emissions.

In addition, Hingham should explore local public transit opportunities to connect the residents of the Town to the MBTA Public Transit Systems. Explore the procurement of an electric bus trolley to make a loop connecting destinations in South Hingham, Linden Ponds, Derby Shoppes, Queen Anne's Corner, Rockland Park and Ride Plymouth and Brockton Bus Line to Boston and Cape Cod, Hingham Center,

Town Hall, Downtown Hingham, West Hingham Commuter Rail, North Hingham, Nantasket Station Commuter rail, Shipyard, Commuter Boat, Beal Street, Summer Street, North Street, Thaxter Apartments, and the Library. Such local transit opportunities could include:

- Electric trolley service
- Senior transportation alternatives
- Internal Town transportation system
- Personal rapid-transit mobility options

Such services could reduce the need for residents to get into their cars to run neighborhood errands, increase mobility options for those who do not drive, and connect otherwise disparate parts of the community. Public transportation removes automobiles from roads, reducing total carbon emissions through scale transportation. However, the MBTA's reliance on diesel-fueled vehicles contributes to carbon emissions. For these reasons, the Plan both recommends promoting public transportation and supporting decarbonization of that transportation resource.

To this end, Hingham should support Commonwealth efforts to convert its public transportation solutions to decarbonized alternatives. Such conversions not only reduce Hingham's Scope 3 carbon emissions, but also they would save Hingham's air and environment from particulate matter and diesel exhaust fumes.

Any analysis should include potential offsetting revenues that could be obtained through a vehicle to grid program that could offer capacity into ISO-NE wholesale electricity markets as demand response units.

6. WASTE

What you can do to help:

 Residents	• Reduce consumption of disposable items and invest in reusable items • Support the reuse economy by choosing used and recycled products and options (including the Hingham Swap Shop, "Buy Nothing" sites, etc.) • Ensure that recycles are properly cleaned and sorted • Use reusable bags for shopping and avoid single-use plastics • Compost organic materials and use the end-product of composting in yards • Respond to incentives in a Hingham PAYT/SMART program to reduce waste
 Businesses	• Identify ways to reduce waste in production and service processes • Support bans on single-use plastics regardless of implementation in Hingham • Respond to incentives in a Hingham PAYT/SMART program to reduce waste • Redistribute edible, excess food and compost food waste • Increase accessibility to water bottle refill stations or provide other alternatives to single-use plastic water bottles
 Government	• Implement PAYT/SMART program and update associated bylaws accordingly • Implement community-wide composting programs • Consider warrant articles for bans against single-use plastic • Expand accessibility to recycling, composting, and water bottle refill stations
 Schools	• Find ways to reduce waste inside and out of the classroom • Ensure that all schools are actively and properly recycling • Increase accessibility to cafeteria and classroom recycling, composting, and water bottle refill stations • Encourage engagement and participation in town efforts to research and implement carbon reduction programs • Educate students on where our waste goes and why it creates carbon emissions • Install dishwashers in school cafeterias in order to reduce single-use items
 Innovators	• Create low-cost, biodegradable alternatives to single-use plastic • Invent and distribute cost-effective local waste-to-energy conversion technologies • Develop materials and products that can be recycled and use recycled materials as an input to production

When we reduce waste, we reduce carbon sent into the atmosphere. Therefore, reducing, reusing, recycling, and composting are linked to achieving our carbon-reduction goals.

The Town of Hingham no longer operates its own landfill. Instead, waste is processed at the Transfer Station and sent to a location outside of the border of the Town, generating Scope 3 emissions for which action can be taken, and therefore is addressed in this Plan.

Waste generates a significant amount of carbon and methane emissions. According to the EPA, municipal solid waste ("MSW") landfills are the 3rd largest source of human-related methane emissions in the U.S.[31] Landfill gas, a byproduct of the decomposition of organic materials in landfills, is composed of 50% methane and 50% CO2; methane is 28 to 35 times more effective than CO2 at trapping heat in the atmosphere.[32]

In Massachusetts, an estimated 40% of the waste stream could be removed from landfills and incinerators through recycling and composting.[33] Massachusetts is moving forward with reducing parts of the waste stream through its ban of textiles and mattresses in November 2022. Furthermore, also as of November 2022, any business generating over one-half ton of food waste is required to have it composted.

Hingham provides recycling services at the Transfer Station. In addition to mattress recycling, the Hingham Transfer Station also accepts other bulk items during designated days, including automotive batteries, computers and home electronics, large and small appliances, furniture, and hazardous materials such as paint, oil and propane tanks.[34] It is important for these efforts to be continued and an increase of education and marketing to ensure Hingham citizens use these recycling services.

Composting is another function that Hingham has begun to support on the residential level. Expanding composting to be a centrally organized activity would contribute to removing organic material from the waste stream.

Figure 15 summarizes the focus of reducing carbon emissions by reducing waste. Broad recommendations emphasize efforts to minimize solid waste, increased recycling, and expand composting support. (Each of these categories is discussed in more detail below and in the action items delineated in Appendix A.)

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[31] While this Plan does not make a specific recommendation with regard to GHG emissions from septic system use, nor has it measured (or is able to measure) such GHG emissions, nonetheless the Town should consider investigating and implementing advanced technologies and/or other measures to reduce GHG emissions from on-site septic system use when available

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

[33] Ryan Proulx, et. al, "Need to Enforce: Waste Bans in Massachusetts," September 2022, https://publicinterestnetwork.org/wp-content/uploads/2022/09/The-Need-To-Enforce_-Waste-Ban-Regulations-in-Massachusetts-9.7.22-2.pdf

[34] MassDEP, Recycle Smart, Hingham Transfer Station, https://recyclesmartma.org/location/hingham-transfer-station/

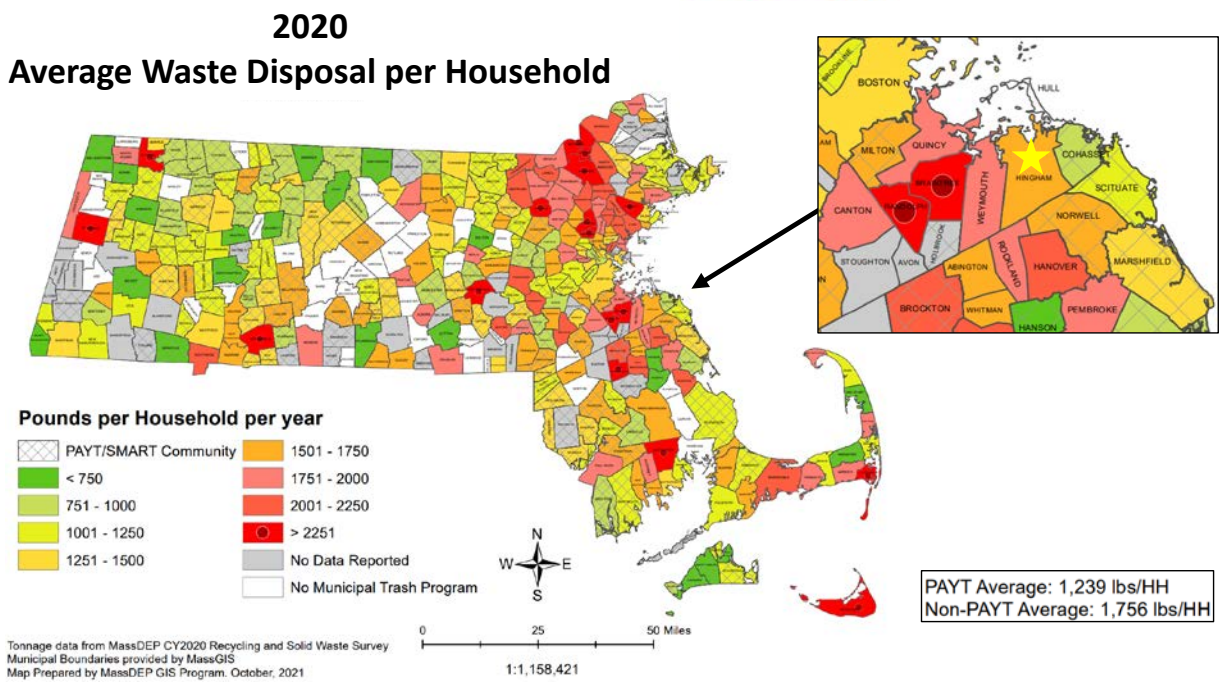
Figure 15: Waste Minimization Recommendations Overview

6.1. SOLID WASTE

Compared to other towns in Massachusetts, Hingham falls into the middle of the range with respect to average waste disposal per household. Hingham disposes of an average of 1,501 to 1,750 pounds per household per year.

Throughout Massachusetts, various towns and communities have adopted pay-as-you-throw (PAYT) programs that impose a higher cost for disposing of waste. An analysis of such programs indicates that those towns with PAYT reduce waste. Towns with such programs have been shown to produce less waste per household versus towns that do not have PAYT programs. In 2020, the average trash generated in PAYT municipalities was 29% less or 517 pounds per household (**Figure 16**). Eleven of Hingham's 19 benchmark towns currently have a PAYT/SMART program.

Figure 16: Hingham's Average Waste Disposal per Household vs. Other Towns



The benefits to waste reduction are why both federal and state agencies recommend implementation of this type of program.[35] The EPA notes that PAYT programs achieve three objectives: [36]

1. **Environmental Sustainability:** By reducing waste and increasing recycling, fewer natural resources need to be extracted and landfill greenhouse gas emissions are reduced.

2. **Economic Sustainability:** Reducing waste that has to be incinerated or buried in landfills reduces costs to the towns that are struggling with soaring municipal solid waste management expenses.

3. **Equity:** The variable rate program is inherently fair by charging consumers based on the trash they produce. When the cost of managing solid waste is a flat rate, those who recycle and minimize their waste subsidize their neighbor's wasteful actions.

Currently, 155 MA municipalities (44%) have adopted a PAYT/SMART program. Neighboring South

[35] Massachusetts Department of Environmental Protection, "Pay-As-You-Throw (PAYT)/Save-Money-And-Reduce-Trash (SMART)," https://www.mass.gov/lists/pay-as-you-throw-paytsave-money-and-reduce-trash-smart
[36] EPA, https://archive.epa.gov/wastes/conserve/tools/payt/web/html/index.html

Shore towns of Cohasset, Marshfield, Norwell and Scituate have implemented similar programs.[37]

Hingham does not have a pay-as-you-throw (PAYT) program. Recommendations therefore include adopting a PAYT program for the Town of Hingham transfer station and regulating private haulers to be consistent with public rules, engaging in efforts to eliminate single-use plastic, and diverting bulk waste to recycling centers that are better able to reuse major components of large disposal items.

6.2. RECYCLING

Recycling is a means of reducing the amount of waste that lands in landfills. EPA estimates indicate that avoided emissions from recycling versus landfilled materials are 2.89 metric tons of CO2 equivalent per short ton.

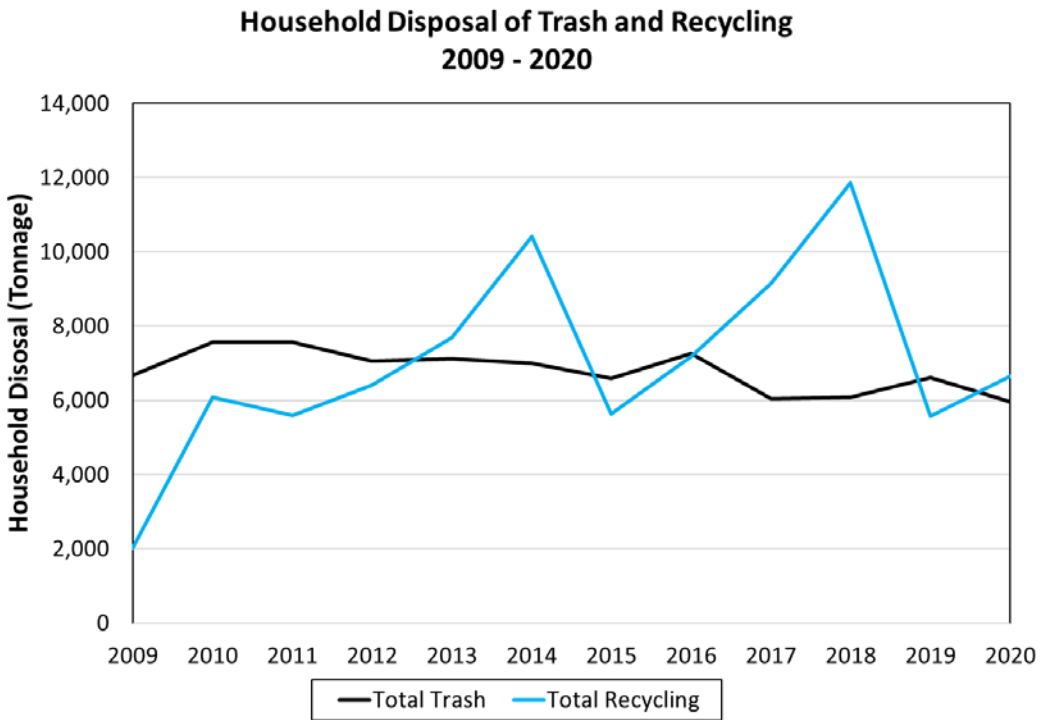
Hingham is a member of the South Shore Recycling Cooperative and enables residents to contribute waste products that can be recycled at various collection sites. Private companies that service Hingham residents may or may not adhere to recycling requirements. It would be appropriate to align and enforce private company offerings to public sector options so as to support every resident and business in Hingham in their efforts to reduce waste. Alternatively, the Town could undertake waste collection so as to remove multiple haulers and the resultant Scope 1 emissions.

With proper verification and authorization from the Hingham Department of Public Works that requires proof of residency, residents may also deposit hazardous waste at 10-12 South Shore Recycling Cooperative sites throughout the south shore.

As a result of these existing efforts, Hingham has experienced an upward trend in recycling that is substantially greater than the downward trend in waste disposal (**Figure 17**).

[37] Cohasset, Scituate, Marshfield, and Norwell all have PAYT programs either at curbside, at drop-off, or both, https://www.mass.gov/lists/recycling-solid-waste-data-for-massachusetts-cities-towns

Figure 17: Hingham Household Disposal of Trash and Recycling (2009 – 2020)



Recommendations serve to continue and expand existing efforts to reduce waste and increase recycling. These recommendations include extending transfer station hours, providing dedicated personnel to recycling, adding differentiated recycling bins in public spaces and public buildings, and increasing water filling stations in public places.

6.3. COMPOSTING

Composting is a fan-favorite for parts of Hingham, and those who compost are passionate about the benefits. Almost anyone can compost. Small apartment units can use a kitchen-sized composting unit whereas larger residences may have a large rotating container or pile in the yard. That said, town-wide collection and processing through a centralized function enables every citizen to compost, which can reduce waste and unnecessary stress on the transfer station functions. Such services also could be useful for restaurants and commercial establishments that generate large amounts of reusable waste that remains out of landfills and may even reduce carbon emissions if the composted materials promote new greenery.

Composting begins at home as well as in the schools. Although anyone can compost with commercially-available options as small as a bin that sits in the kitchen, there may be economies of scale for a larger, centralized solution to composting. Specifically, municipal programs may include curb-side collection and centralized digesters with redistribution. If a community-wide program is not feasible, a subscription-based service where members receive the organic material for use in their yards could be a starting point. To this end, Cleaner Greener Hingham has been a key promoter of composting (see side bar).

Cleaner Greener Hingham is a Town-chartered committee of citizen volunteers who study waste within the Town, with an eye to finding environmentally sustainable solutions. In 2021, the Town of Hingham in partnership with Cleaner Greener Hingham announced a new Home Composting Program and offered free composting bins. Cleaner Greener Hingham's website offers video tutorials on composting.

Recommendations include expanding existing efforts to establish town-wide composting for businesses and residents, exploring the potential decarbonization benefits associated with curb-side composting collection and education, anaerobic digesters, and waste-to-energy power supply alternatives.

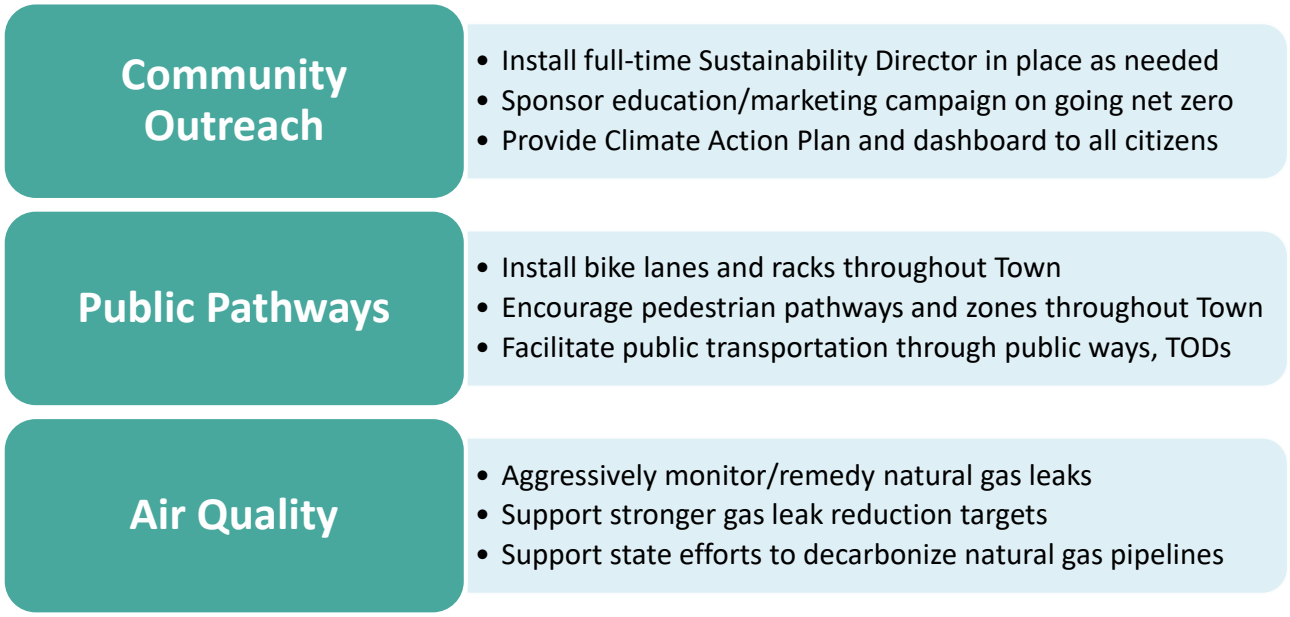
7. COMMUNITY

What you can do to help:

 Residents	• Educate yourself, family and friends on the Plan and updates using regular dashboards developed and issued by the Town • Participate on Town committees that are supporting implementation of the plan and/or join interest grounds that encourage steps towards net zero carbon emissions • Support and use bike lanes, pedestrian walkways, public transit and other ways to keep cars off the roads • Demand action from the local utility to minimize natural gas leaks
 Businesses	• Stay up-to-date on decarbonization technologies, options and progress • Work with utilities to find low-impact energy alternatives to minimize reliance on natural gas • Develop and promote TODs and other mixed-use areas that maximize foot traffic
 Government	• Fund and hire a full-time Sustainability Director on an ongoing basis to oversee Plan implementation and other strategic initiatives • Fund a full-time grant writer to pursue funding opportunities for energy decarbonization, energy efficiency, and initiatives in this Climate Action Plan, as well as other potential grants for the Town • Install bike racks at municipal buildings and build bike paths/pedestrian walkways to facilitate community flow around Town • Collect data and create a regularly updated carbon inventory and dashboard to monitor and publicize progress on carbon emissions reduction
 Schools	• Promote bike paths and pedestrian pathways to and from the schools from town centers and heavy residential areas so that students can transport themselves to and from school • Install bike racks at school buildings and facilities • Publicize progress on Climate Action Plan and carbon emissions through school programs and student/parent outreach • Educate about the importance of choosing public transportation and carpooling
 Innovators	• Develop meaningful ways to convey information on carbon reduction initiatives • Facilitate carbon inventories and tracking tools • Develop clean energy alternatives to natural gas that can either bypass or use existing natural gas pipeline infrastructure

Hingham is a community where people live, work and play. Increasing connectivity and connection across the Town is an important part of fostering that sense of community. The community itself can reduce carbon emissions by bringing the Town's citizens together (**Figure 18**).

Figure 18: Community Recommendations Overview



Each of these are described in more detail below, with detailed action items listed in Appendix A.

7.1. COMMUNITY OUTREACH

Community outreach is required to bring the entire community together. Implementation requires participation by nearly everyone in town. To support education, coordination, and collaboration among everyone who should be involved to achieve Hingham's net zero goals, this Plan recommends installing a full-time Sustainability Director, sponsoring education and marketing campaigns on how to reach net zero, and establishing a Plan dashboard that can be distributed on a regular basis to all citizens, showing steps to take and benchmarks reached.

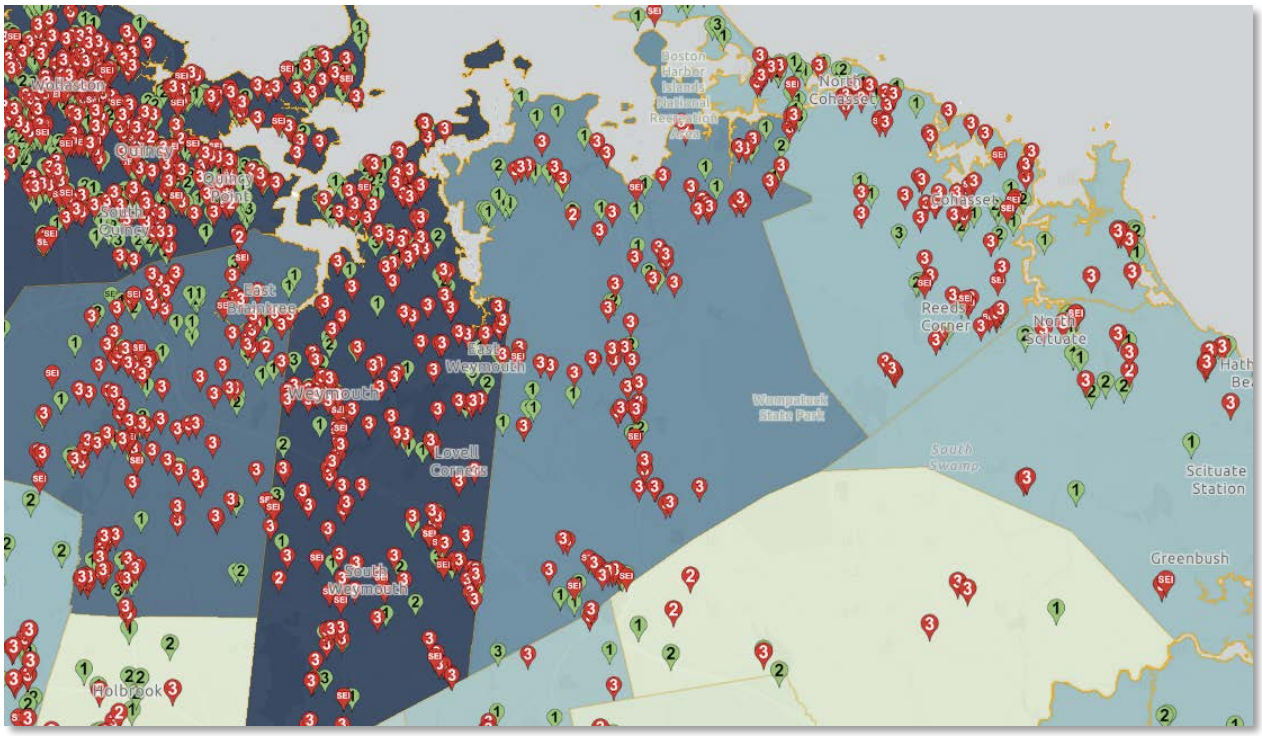
7.2. PUBLIC PATHWAYS

Public pathways are both a means of connecting the community and reducing carbon emissions. By making it easier for Hingham citizens and businesses to move away from automobiles, a broader swath of the town can be active physically, biking and walking, while also achieving net zero. To this end, the Plan recommends facilitating bike and pedestrian pathways throughout town, installing bike racks at public locations throughout town, and facilitating public transportation with public ways and transit-oriented districts ("TODs").

7.3. AIR QUALITY

Hingham experiences methane releases as a result of natural gas leaks. At the end of every year, Massachusetts gas distribution utilities are required to file annual service quality reports to the Department of Public Utilities (DPU). Since at least 2015, the number of gas leaks in Hingham has been flagged as an issue.[38]

Figure 19: Map of Natural Gas Leaks (2021)[39]



Natural gas leaks are graded by the utilities as follows:

- **Grade 1** leaks are hazardous and must be repaired immediately.
- **Grade 2** leaks are non-hazardous, but could become hazardous in the near future and must be repaired within 1 year.
- **Grade 3** leaks are non-hazardous and are expected to remain non-hazardous. Grade 3 leaks are required to be repaired or eliminated within 8 years.

Natural gas leaks emit methane into the atmosphere. Although repairing gas leaks is the responsibility of Natural Grid, which distributes natural gas supply to Hingham users, stopping gas leaks must be part of a Climate Action Plan to reduce emissions. As such, recommendations include aggressively monitoring/remedying natural gas leaks, supporting stronger gas leak reduction targets, and supporting state efforts to decarbonize natural gas pipelines. In addition, any Hingham review of adding or replacing an existing natural gas line should include a review of the status to repair the existing natural gas lines within the town that are leaking.

[38] Patch.com, "Map Reveals 199 Natural Gas Leaks in Hingham,"August 24, 2015, https://patch.com/massachusetts/hingham/map-reveals-199-natural-gas-leaks-hingham-0
[39] Heet.org, https://heet.org/gas-leaks/gas-leak-maps/

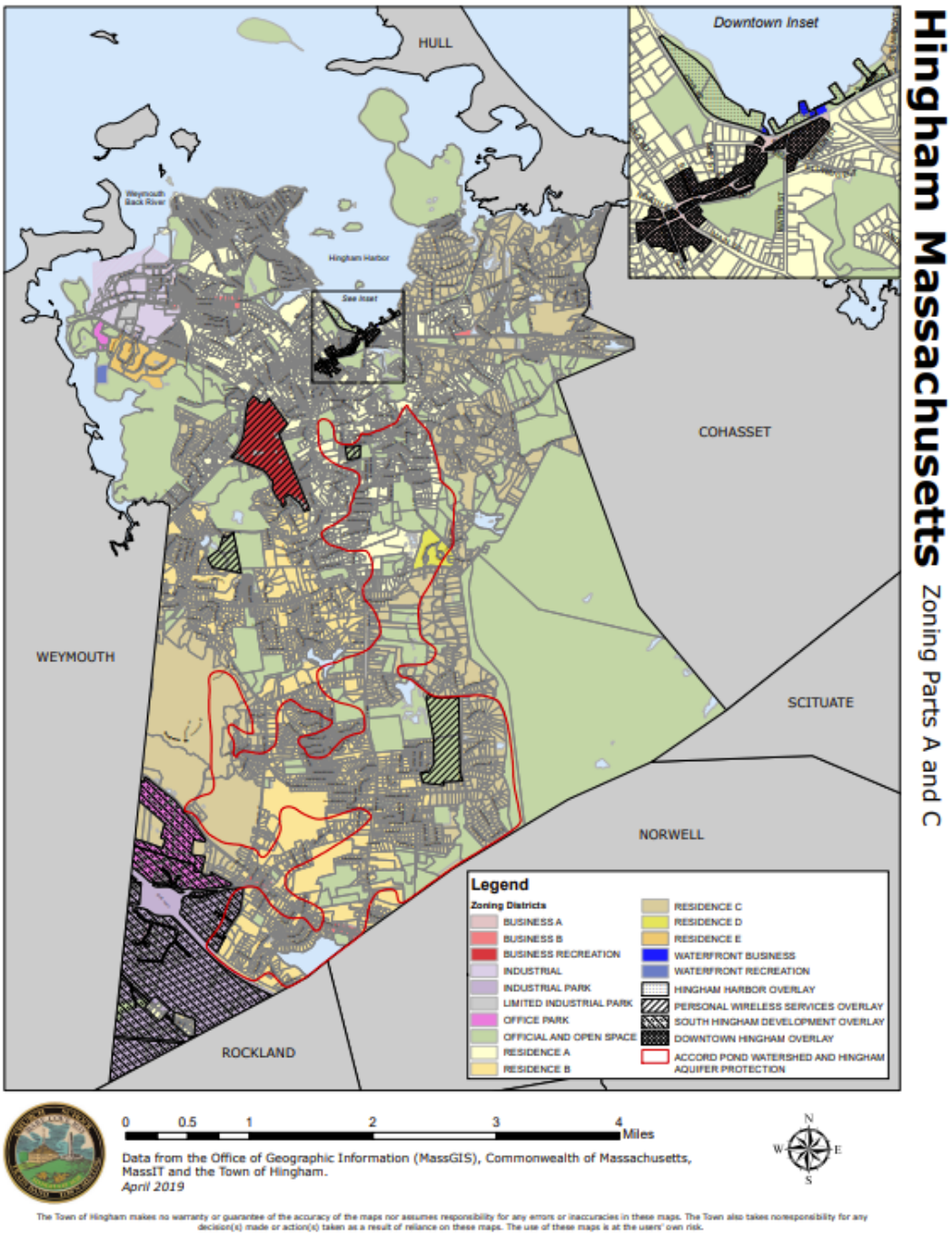
8. NATURAL RESOURCES

What you can do to help:

 Residents	• Reduce water consumption through smarter water use and technology • Convert landscaping to native plants that thrive naturally without watering with low or no fertilizer • Convert landscaping tools to electric and/or hire landscape maintenance firms that use electric tools • Engage in and fund conservation activities that enhance natural resources • Convert boat engines to electric where economically and technically feasible
 Businesses	• Reduce water consumption through water management practices and technology • Convert business landscaping to native plants and minimize use of fertilizers and water • Develop land and operate industrial/commercial spaces to minimize emissions • Convert landscaping tools to electric
 Government	• Educate citizens on water conservation, native plants to promote local carbon sink preservation and enhancement • Reduce water consumption through water management practices and technology • Convert municipal landscaping to native plants and minimize fertilizer • Strengthen zoning and planning codes to protect naturally occurring carbon sinks, including updating Conservation Commission ordinances to protect natural resources beyond strict wetland restrictions and recommend restrictions on fertilizers to prevent nitrogen runoff and pollution • Incentivize use of battery-operated landscaping tools, and consider ways to limit use of gas-powered tools
 Schools	• Reduce water consumption through smarter water use • Convert landscaping around school buildings to native plants • Favor organic produce for the cafeteria to minimize need for fertilizer • Educate students about water ecosystems, conservation, carbon sinks, and water conservation
 Innovators	• Develop more efficient organic or low fertilizer use agricultural practices • Identify technology that minimizes water usage in manufacturing processes and waste disposal • Develop negative and net zero materials for more cost-effective pricing

The Town of Hingham has a long history which is coveted and protected with six historic districts that help the Town to maintain its unique character. Similarly, Hingham boasts significant natural resources, including protected green space, coastline, watersheds, and waterways. These natural resources create carbon sinks that absorb carbon and allow for environmental exchanges that better the environment to the benefit of residents, businesses, and visitors.

Figure 20: Hingham Zoning Parts A and C[40]



[40] Town of Hingham, Zoning Map, https://www.hingham-ma.gov/351/Zoning-Board-of-Appeals, https://www.hingham-ma.gov/DocumentCenter/View/2123/Hingham-Zoning-Map-Parts-A-and-C-PDF?bidId=

Figure 20 provides the Hingham Zoning Map that illustrates the significant amount of official and open spaces throughout the community (in light green). Residential areas (yellows and tans) are the second largest set of zones, making the average total density across the Town equal to 910 persons per square mile.

The Town of Hingham covers an area of 25 square miles, of which 22.6 square miles is land and almost 10 percent is water. Hingham is proud of its location on the water, including 21 miles of shoreline and construction of a new harbor park, which further expands the public use of Hingham Harbor. The acquisition of the South Shore Country Club by the municipality provides additional recreation opportunities for residents while preserving the suburban character of this historic seaside community. Recreational areas include Bare Cove Park, which has biking and walking trails around its 500 acres along Back River, World's End, which is a 250 acre peninsula overlooking Hingham Harbor with beautiful views of Boston, and Wompatuck State Park, which includes 3,000 acres of woodland are and the largest public campground in the metropolitan Boston area.

In contrast to a sustainability plan focused on long-term conservation, this section focuses solely on ways that Hingham can capitalize on natural resources to promote decarbonization. In recognition of the role that Hingham's green spaces and ocean exchanges play, this Plan includes recommendations regarding development, maintenance, and protection of natural resources that contribute to carbon absorption (**Figure 21**).

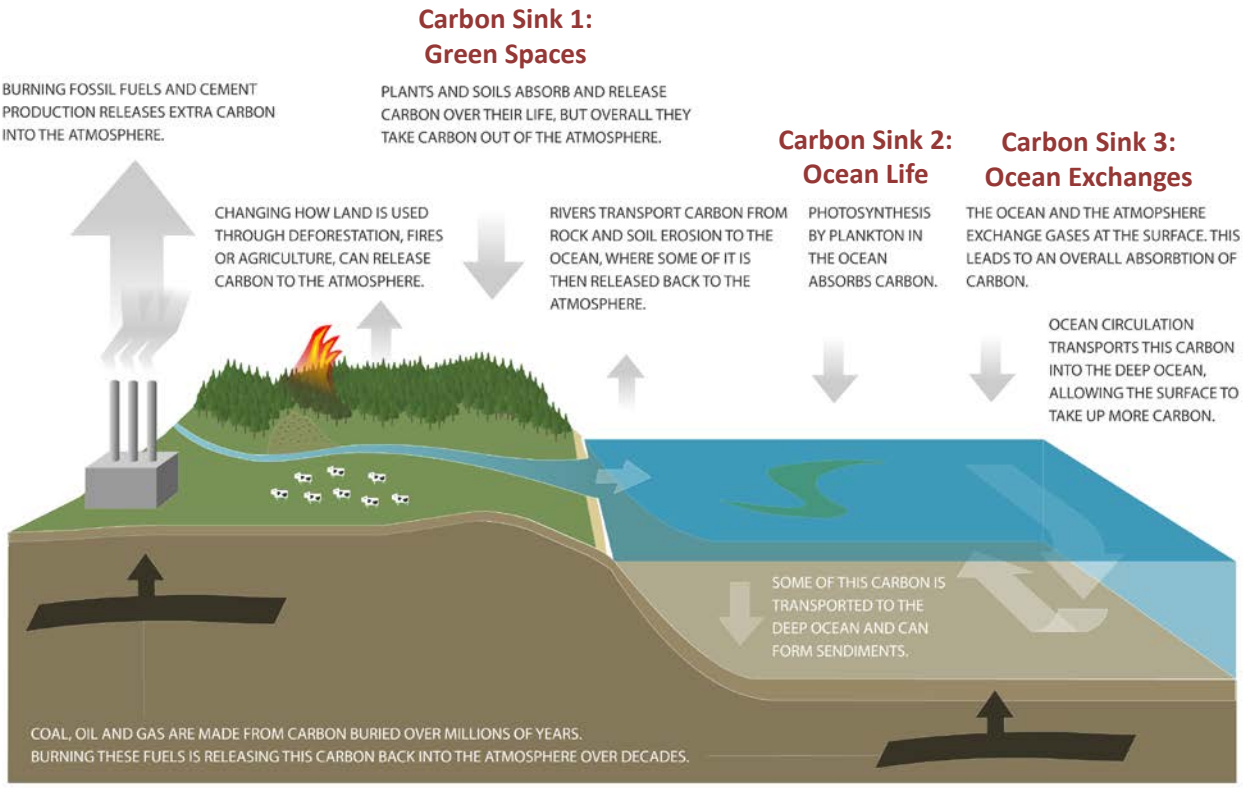
Figure 21: Conservation and Creation

Carbon Sink Development	•Educate residents and businesses to enhance/create carbon sinks •Encourage land development in a way to decrease carbon output and increase carbon absorption •Strengthen zoning and planning codes to protect naturally occurring carbon sinks
Land Conservation / Management	•Engage in tree maintenance and planting programs favoring native plants •Preserve/Conserve open space, land, forests and grasslands •Promote electric landscaping tools
Water Conservation / Management	•Promote low-fertilizer agricultural practices on Town properties •Favor native and drought-resistant plants in landscaping •Reduce water consumption through water management practices and technology
Recreation	•Reduce carbon emissions in recreational areas (land and sea) •Enable electric motor alternatives at recreational areas •Promote carbon-negative materials

8.1. CARBON SINK DEVELOPMENT

Hingham has a number of naturally occurring carbon sinks. These areas, which include woodlands, waterways, marshlands, and harbors, allow for carbon to be absorbed from the atmosphere and processed through nature's naturally occurring functions (**Figure 22**).

Figure 22: Illustration of Carbon Sinks[41]



Carbon sinks can operate on an expansive level (e.g., Amazon forest) and on a micro-level (e.g., natural landscaping in a front yard). Although Hingham has a wealth of large carbon sinks that require protection, residents and businesses can create their own carbon sinks through sustainable landscaping practices.

Recommendations include educating citizens about how to protect, enhance and create carbon sinks that include native plants and minimize water usage. When developing Hingham land and waterways, consider how to do it in a way that decreases carbon output and increases carbon

[41] https://niwa.co.nz/atmosphere/faq/what-is-a-carbon-sink

absorption. The Town also can promote zero carbon emissions landscaping tools such as electrified mowers and leaf blowers that take advantage of HMLP's carbon-free electricity supply and reduce gasoline exhaust.

8.2. LAND CONSERVATION / MANAGEMENT

Hingham includes 6.25 square miles (i.e., 4,000 acres) of open space that is protected and overseen by various entities:[42]

- **The Hingham Conservation Commission** is responsible for the protection and management of the Town's conservation land – around 1,000 acres. This commission also manages the administration of the Massachusetts Wetlands Protection Act and related town bylaws.
- **Hingham Land Conservation Trust** acquires, maintains and preserves exceptional landscapes in Hingham and advocates for local land protection efforts. In addition to a number of smaller conservation parcels, they own three major properties: Jacobs Meadow, Eel River Woods and Whortleberry Hollow.
- **Trustees of Reservations** manages World's End (251 acres), Weir River Farm (75 acres), and the Whitney & Thayer Woods (824 acres co-managed with Cohasset).
- **The Commonwealth** is the largest protector of land in Hingham, overseeing the conservation and use of Wompatuck State Park (3,500 acres primarily in Hingham), Stodder's Neck (39 acres), and five Hingham Harbor islands including Langlee, Ragged, Sarah, Button and Bumpkin (44 acres).

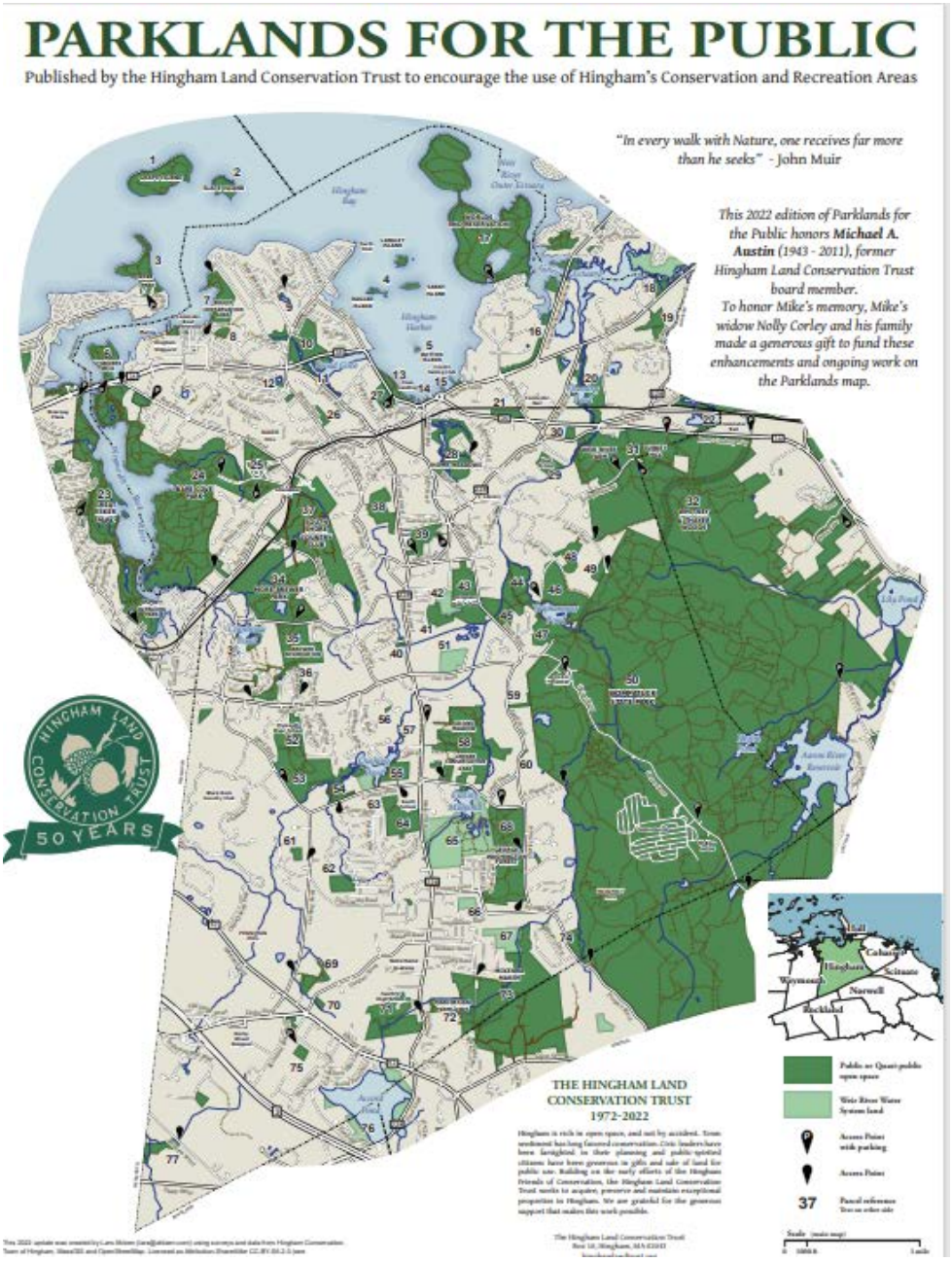
TREE CITY USA.

In 2020, the National Arbor Day Foundation named Hingham "Tree City USA" for the 32nd year, in recognition of the Town's commitment to tree care and planting. In that year, the Town's Tree and Park Division maintained:

- More than 1,000 acres of open space
- Over 10,000 public shade trees
- 45 tree plantings
- 193 tree removals
- 1,657 trees pruned

[42] Town of Hingham Website, https://www.hingham-ma.gov/307/Conservation-Property

Figure 23: Conservation Lands in Hingham[43]



With slightly more than one-quarter of the land in Hingham currently protected through

[43]Hingham Land Trust, "Parklands for the Public," 2022, https://hinghamlandtrust.org/wp-content/uploads/2022/05/Parklands-Map-2022.pdf

conservation and public management, recommendations focus on preserving and conserving existing open spaces, land, forests and grasslands; expanding protected green spaces that serve as carbon sinks; and engaging in tree maintenance and planting programs.

8.3. WATER CONSERVATION / MANAGEMENT

Water conservation contributes to achieving Hingham's net zero goals in two ways:

1) **Decreasing Water Treatment Emissions:** Reducing water usage decreases the energy required to treat and deliver that water for end-use.

2) **Protecting Carbon Sinks:** Conserving Hingham's waterways and ensuring healthy ecosystems preserves some of Hingham's largest natural carbon collection absorption assets.

Hingham's potable water supply, which is managed by the Weir River Water System, takes advantage of the community's natural water resources located within the Town's boundaries to store, treat, and deliver water to end-users. That said, water treatment, pumps, and delivery consume a significant amount of electricity, and therefore contribute to carbon emissions.

WEIR RIVER WATER SYSTEM

The Weir River Water System provides water treatment, supply, and delivery services to water users in the Town of Hingham. Operations of the water system is outsourced under contract by Veolia, who is overseen by the Hingham Water Commission and the Weir River Water System Citizens Advisory Board.

Although the primary source of energy – electricity – will be decarbonized as part of achieving HMLP's decarbonization goals, conservation reduces energy demand and increases system efficiency. Reduced demand for water saves users across the entire system money by deferring capital investment required to expand the system's capacity and associated rate increases. Therefore, recommendations include tasking the Water Commission and Citizen's Advisory Board with identifying and pursuing water conservation and reduction measures to implement through the Weir River Water System.

Hingham's location on the ocean also includes a number of rivers and estuaries such that 15.58 percent of the community is water. The estuaries within Hingham are particularly important as they transition between freshwater rivers and their entry into the ocean. Called the "breeding grounds" for the oceans, many sea species use estuaries to reproduce and some animals remain their entire lives within those brackish waters.

Protecting these delicate ecosystems along with the shallow waters of Hingham Harbor requires

reducing run-off, managing storm water flows, and restoring wetlands. This is an area where the Town can lead by example while enabling individual choices that meet a minimum level of care. For example, the Town of Hingham could reduce the use of nitrogen fertilizers on Town properties, update bylaws and regulations to protect Hingham's wetlands, and manage storm water flows. Relying on native landscaping also reduces carbon emissions by minimizing the need for fossil-fueled yard equipment.

A focus on educating, implementing and supporting native plants and naturally occurring drought-tolerant landscaping would support both of these initiatives. At a minimum, the Plan recommends that the Town of Hingham adopt native and drought-tolerant landscaping for all municipal grounds and landscaping to lead by example. The Weir River Water System also should take the lead on distributing educational and promotional materials that support conversion to native landscaping choices as a means of reducing water consumption and water bills. Correspondingly, rates should reflect essential and non-essential water use charges, with the latter being significantly higher, with targeted usage by customer included on invoicing to reflect lot size and housing occupancy.[44]

By focusing on water conservation and the actions that decrease water usage, Hingham can restore natural habitats, conserve freshwater, ensure the health of the town's streams and rivers, control invasive species, and reduce water bills while helping to achieve the community's net zero carbon emissions goals.

8.4. RECREATION

In addition to protecting conservation lands and waters as carbon sinks, it is also important to protect recreation activities in these and other areas. Recreation is a lifestyle for Hingham residents who make use of the state and local parks, conservation lands, waterways, and harbors.

Recommendations aim to reduce carbon emissions in recreational areas, encourage electric motor alternatives at recreational areas, and promote carbon-negative materials.

[44] This already is being done in dry ecosystems such as California and billing systems are able to customize targets and usage for each customer.

9. IMPLEMENTATION

This Plan should be considered a living document. It is a program for moving down the path towards decarbonization based on information and conditions known today. Over time, however, conditions will change, new technologies will appear, and policy requirements must be able to adapt. This section presents recommendations on how implementation of the Plan could proceed, focusing on the role that each stakeholder in Hingham could play.

9.1. LEADERSHIP

Ultimately, how to proceed and who will be responsible lies with Town leadership. To this end, the Select Board has the ultimate responsibility for ensuring implementation of the Plan. It is expected that the Select Board would work closely with the Town Administrator and staff to ensure adequate resources are procured, appropriate staff and contractors are retained, relevant committees are empowered, and action items are executed.

9.2. HINGHAM MUNICIPAL LIGHTING PLANT

HMLP is the cornerstone of Hingham's Net Zero plans. HMLP should identify how it may achieve its net zero objectives with the new provisions concerning direct payments for clean energy projects and be required to provide at least quarterly updates to the teams responsible for implementing the plan. HMLP also may be in the best position to provide education and offer programs to Hingham residents that promote electrification and installation of on-site, carbon-free electricity resources and energy storage capability. The full extent of HMLP's role will be defined during implementation of the Plan.

9.3. TOWN COMMITTEES

There are a number of Town Committees that may have responsibility over aspects of this Climate Action Plan. The composition of the Climate Action Planning Committee illustrates the multi-disciplined nature of the issue and what is required to implement this plan. With the issuance of the final Climate Action Plan, the charter of the Climate Action Planning Committee ends. Town Meeting 2023 established the Hingham Climate Action Commission ("CAC") with the charge of supporting, overseeing, and reporting on the Town's implementation of the Climate Action Plan and any updates and amendments thereto over time. The CAC will work with the Town, other Committees, HMLP, and public interest groups to coordinate execution of action items and provide regular updates to the Select Board and Town.

9.4. HINGHAM SCHOOL DISTRICT

Hingham Schools not only provide a means of hosting in-town solar, energy storage, and charging stations, they also can educate the next generation on how to live a sustainable life. Key areas where the schools can participate in helping Hingham go net zero include:

- Include environmental and energy economics classes as electives
- Host inspirational speakers focused on protecting the environment
- Support the High School Green Team club efforts
- Install water bottle fillers
- Avoid single-use plastics
- Build new schools according to stretch code requirements, including LEED certification
- Install solar energy arrays on rooftops that can host them
- Identify areas where carports with solar panels may be installed to offset school electrical load
- Consider microgrid equipment and technology for backup power
- Explore conversion to electric school buses as they become more cost-effective

9.5. BUSINESSES

Businesses and large consumers of energy are an important part of the decarbonization plan. Part of the Plan includes educating large users about the options available to them, specifically:

- Becoming informed about ways to reduce carbon emissions
- Choosing to set net zero goals
- Reducing waste through low-impact packaging choices
- Increasing recycling and composting
- Investing in energy efficient options
- Participating in HMLP demand response and net metering programs
- Choosing electric input options instead of fossil-fuel inputs
- Converting to electric heat pumps instead of less efficient fossil fuel heating/cooling
- Converting business fleets to electric vehicles
- Encouraging and hosting carbon-free electricity resources and electric storage backup generation options

There are sustainable, cost-effective ways to become more efficient.

9.6. RESIDENTS

This Plan acknowledges the supporting role that residents of the Town play in bringing net zero decarbonization goals to reality. Daily household decisions tied to composting, waste reduction, heating sources, and carbon-free energy investment all contribute to achieving the actions

identified in this Plan. To this end, residents play a critical role through:

- Becoming informed about ways to reduce carbon emissions
- Avoiding single-use plastics
- Reducing waste through low-impact packaging choices, recycling and composting
- Minimizing plastic packaging, containers, and bags
- Choosing cost-effective home electrification options over fossil fuel resources
  - Electric vehicles
  - Electric yard mowers, blowers, and trimmers
  - Electric snow blowers
- Choosing electric appliances instead of natural gas (e.g., dryers, ovens, stoves)
- Converting to electric heat pumps instead of less efficient fossil fuel heating/cooling
- Purchasing an electric or alternative fuel vehicle instead of internal combustion engines
- Considering electric storage backup generation options
- Proposing and signing citizen petitions in support of action items in this Plan

9.7. INTEREST GROUPS

As highlighted throughout this Plan, Hingham benefits from a multitude of non-profit and volunteer interest groups that are specific to the Town as well as regional. Each group tends to have their own focus, which can be directly focused on reaching net zero carbon emissions (e.g., Hingham Net Zero), very specific (e.g., Hingham Drives Electric) or much broader (e.g., Sustainable South Shore/South Shore 350). Representatives from these groups are members of the Climate Action Planning Committee, attended meetings, and invited representatives from the Committee to present on the Plan's progress.

This Plan anticipates that these groups will continue to be involved and play a crucial role in implementation of this Plan. Specifically, they could be a critical part of the implementation of this Plan through:

- Citizen education
- Leadership support
- Highlighting success stories
- Organizing implementation efforts
- Providing social pressure in their areas of focus
- Proposing citizen petitions in support of action items in this Plan

It is the hope that this Plan can help to serve as a guide and focus community group efforts so that we are all moving in the same direction with purposefully set goals and action items.

9.8. FEDERAL AND STATE GOVERNMENT

Both the federal government and the Commonwealth of Massachusetts offer a number of subsidies, grants, and other funding opportunities. In addition to credits that are directly paid through the Inflation Reduction Act, funding has been made available for distribution to the Commonwealth through the Infrastructure and Jobs Investment Act. Combined, there are trillions of dollars of funding available to towns such as Hingham that are innovative and willing to move forward with clean energy resources and alternative fuels. Under the Inflation Reduction Act, tax credits are now directly available to non-taxing paying entities. Pursuing these funding opportunities and grants requires someone being responsible for grant identification and writing, as well as operational execution to receive the funding. Appendix E includes a list of potential grant and funding opportunities currently available, and this appendix should be updated on a regular basis to reflect the dynamic nature of decarbonization initiatives and clean energy funding.

9.9. COORDINATION, COLLABORATION AND DIRECTION

With all of these individuals and groups playing a role, it is important to have coordination, collaboration and direction. This alone could be a full-time job, and a position that municipalities as well as businesses focused on their own sustainability efforts have created for this purpose.

Hingham has developed a role for specifically this purpose:

- **Coordinate Implementation of the Climate Action Plan:** Reach across leadership, Town Committees, and multiple public interest groups to coordinate and direct efforts to execute the tasks identified in this Plan.

- **Prioritize Action Items:** Prioritize action items to focus on cost-effective, quick-hit, easy-to-implement action items to obtain quick wins and immediate carbon reductions.

- **Secure Grant Money:** Identify potential entities and funding available to offset the costs of implementing action items in this Plan.

- **Find Cost Offsets and Self-Fund Opportunities:** Find grants and other means of offsetting the cost of a full-time Sustainability Director within the Town.

Ideally, this position will be able to “pay for itself” as well as realize cost savings.

10. TRACKING AND METRICS

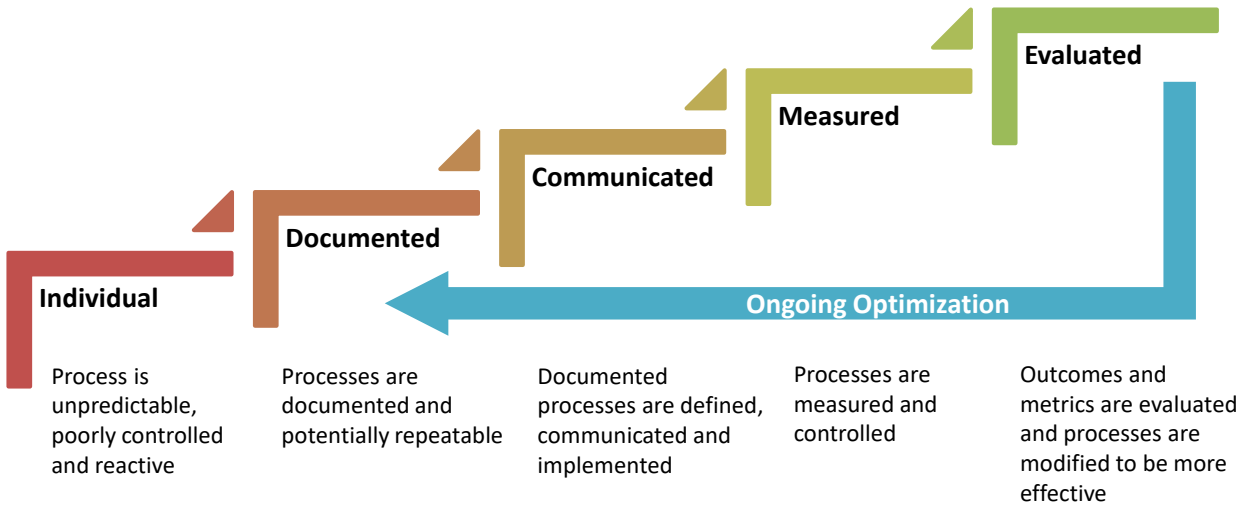
Achieving net zero is a matter of establishing a process and constantly improving on that process based on tracking key variables and metrics within the broader context of local, industry and policy trends. Process optimization requires a continuous feedback loop.

To date, Hingham's net zero and decarbonization efforts have been carried by public interest groups and Town Committees. Their efforts have been laudable, and those groups, such as Hingham Net Zero, advocated for a documented Climate Action Plan.

Following on these excellent individual efforts, documentation is the second level of process improvement, followed by communication. This Climate Action Plan establishes the documentation of recommendations following nearly a year of ongoing discussions and communications. Going forward, communication will continue to be critical to implementation, including educating and informing Town staff, residents, and businesses regarding actions that can and are being taken to reduce Hingham's carbon emissions.

The fourth step in process improvement requires tracking and measuring progress. This information then needs to be assessed and the Plan modified, documented, and communicated to continue the positive process optimization feedback loop (**Figure 24**). Individuals continue to play a role, but within the optimization cycle.

Figure 24: Optimized Implementation of the Climate Action Plan



Optimizing the process for Hingham to achieve net zero by 2040 is no different. To this end, the greenhouse gas inventory established through this process must be updated on a regular basis –

ideally every year. New solutions and grant funding should be tracked, monitored, and acted upon when economic and feasible to do so. The Climate Action Plan should be updated on a regular basis as well, removing action items that have been achieved and either modifying or adding in new tasks to continue to achieve decarbonization.

11. CONCLUSION

A Climate Action Plan is more than a document – it is a process. The past year has been a wealth of discussion, collaboration, and realization that Hingham can start taking clear steps now to achieve its net zero goals by 2040. This Plan provides the initial steps on how to proceed. The benefit of our collective research and discussion is presented as support for the detailed recommendations listed in Appendix A. This document simply records the outcome and sets a path forward to achieve the goal of net zero by 2040.

With this Plan in place, it is now time to start the journey.

Hingham
Climate Action
Planning Committee

APPENDIX A
Action Items

Hingham Climate Action Planning Committee

ELECTRICITY SUPPLY

Implementation Steps	Timeframe	Metrics	Responsible Party
3.1 CARBON-FREE ENERGY			
3.1.1 Support efforts to acquire all energy from carbon-free sources, including education about specific actions that can be taken to reach net zero.	Ongoing	Carbon content of power supply	Town Residents Businesses
3.1.2 Follow state guidelines and meet state mandates for its power supply.	Ongoing	Percentage of carbon-free energy	HMLP
3.1.3 Maintain goal to achieve a fully decarbonized power supply.	Ongoing	Carbon content of power supply	HMLP
3.1.4 Continue to allow net metering for HMLP customers who choose to install DERs on their property.	Ongoing	Number of net metering program participants	HMLP
3.1.5 Review HMLP's existing net metering program structure for potential economic and social value.	Near-term	Number of net metering program participants	HMLP
3.1.6 Continue HMLP's solar committee to identify renewable energy projects within the town and whether they are economically, socially, and environmentally viable.	Ongoing	Number of potential projects examined and viability	Town HMLP
3.1.7 Develop community solar projects that are economically, socially, and environmentally viable.	Long-term	Number of viable projects implemented	Town HMLP
3.1.8 Explore covered parking with solar arrays in open lots owned by Town.	Medium-term	MW of solar carports	HMLP
3.1.9 Review relationship between DER installations and property taxes.	Near-term	Timeliness of review	Town
3.1.10 Encourage covered parking (solar arrays) in open lots owned by third parties.	Medium-term	MW of solar carports	Third-parties HMLP
3.1.11 Monitor tax credit programs supporting carbon-free resources and determine whether they are viable for Hingham.	Ongoing	Regular updates to Select Board	HMLP
3.1.10 Educate residents and businesses in Hingham about their clean energy supply options, new federal incentives, and explain how to implement carbon-free resources on their property.	Near-term	Number of notices; number of DER installations	Town Residents Businesses HLMP
3.1.11 Educate consumers on electrification opportunities and why they contribute to decarbonization given HMLP's power supply.	Near-term	Number of conversions to electric	HMLP Non-profits

Implementation Steps	Timeframe	Metrics	Responsible Party
3.2 RELIABILITY AND RESILIENCE			
3.2.1 Track electrification (e.g., home heating, EVs, DER) for Hingham buildings and report at Town Meeting at least annually	Near-term and ongoing	Number of and accuracy of annual reports	Town HMLP
3.2.2 Quantify risks associated with electrification.	Ongoing	Annual risk assessments	HMLP
3.2.3 Consider time-of-use (TOU) rates for electric vehicles and DERs to incentivize charging/output during optimal hours.	Near-term	Timeliness of TOU tariff review	HMLP
3.2.4 Implement demand response program to include some combination of peak shaving/reliability technologies.	Near-term	Timeliness of DR program	HMLP
3.2.5 To scale-up demand response program, explore incentives for batteries, hot water heaters, automatic thermostats, EV charging, and other DERs.	Medium-term	Number of resources enrolled in DR program	HMLP
3.2.6 Monitor distribution system's available capacity for distributed energy resources (e.g., solar and batteries).	Ongoing	Total kW installed and circuit capacity remaining	HMLP
3.2.7 Move forward on DER projects that are economically beneficial to HMLP and its ratepayers.	Ongoing	Total kW installed from projects HMLP implements	HMLP
3.2.8 Move forward on DER projects that are economically beneficial to the Town and improve reliability and resilience.	Medium-term	kW installed from municipal DER projects	Town HMLP
3.2.9 Identify potential DERs and resilience opportunities on other Town buildings.	Medium-term	kW installed	Town HMLP
3.2.10 If economically viable, support the Town in implementing resilience opportunities (e.g., localized power during grid failure) on municipal buildings.	Medium-term	Number of reliable/resilient buildings	Town HMLP
3.2.11 Offer residents a registrar to self-identify reliance on power-dependent medical devices and other life-impacting needs for electricity.	Near-term	Activated registry	HMLP
3.2.12 Provide vulnerable residents with information on backup power supply options.	Medium-term	Number and quality of outreach	HMLP
3.3. SYSTEM UPGRADES			
3.3.1 Implement software and operational infrastructure to capitalize upon increase in DERs to create virtual power plants.	Long-term	Number of DERs managed by HMLP and hours used	HMLP

Implementation Steps	Timeframe	Metrics	Responsible Party
3.3.2 Review underground wiring opportunities, including cost, dangers, and safety impact.	Near-term	Number of opportunities reviewed	HMLP
3.3.3 Pursue underground distribution line opportunities when economically viable, safe, and determined to improve reliability associated with decarbonization efforts with funding responsibility to be determined through the usual process.	Medium to long-term	Miles converted to underground	HMLP
3.3.4 Upgrade the distribution system to allow for DERs and electrification.	Long-term and ongoing	Number of reliability events	HMLP
3.3.5 When existing metering technology is ready to be replaced, transition Hingham to updated metering infrastructure (e.g., Advanced Metering Infrastructure and/or TOU Meters).	Longer-term and ongoing	Number of AMI meters	HMLP
3.3.6 Support the Hingham Electrical Infrastructure Reliability Project (“HEIRP”) at future Town Meeting and in general.	Near-term	Town approvals and siting	Residents Town
3.3.7 Complete the HEIRP including the construction and operation of new transmission line and substation.	Near-term	Project Operation Date	HMLP

Hingham Climate Action Planning Committee

BUILDINGS

Implementation Steps	Timeframe	Metrics	Responsible Party
4.1 ENERGY EFFICIENCY			
4.1.1 Raise awareness on how Hingham residents and businesses can reduce their existing load through: - MassSave energy assessments (natural gas) - Energy New England (oil) - HMLP programs (electricity) Such awareness should include (1) rebates available for upgrades to air and water heat pumps, windows, doors, insulation, and air and vapor barrier systems, and (2) a schedule timeline for appliances and solar heating upgrades to help residents prepare for procurement and installation Awareness should equally address adaptation (lifestyle changes).	Near-term	Number of requested assessments	Town Residents Businesses Non-profits HMLP
4.1.2 Create a teaching model to help residents and businesses (1) conserve energy consumption and (2) plan, design, budget and implement carbon-free energy resources. Such a model should educate citizens on ways to be more efficient, including: - Weatherization - Insulation subsidies/loans - Programmable thermostats - Air and vapor barriers - LED lightbulbs - Appliance replacements	Near-term	Number and extent of outreach	Non-profits State
4.1.3 Lead/join local/regional efforts to compile information on contractors proficient in: - Energy conservation - Heat pump installation and operations - Solar energy systems - Electric backup power (e.g., batteries) Effort should also identify home audit, design, architectural, engineering and contractor-based consulting services qualified to assess potential envelope, applicable heating/cooling systems, tree siting for maximum passive solar benefit, vehicles, etc., like the Mass Save Audit	Near-term	Participation of contractors	Town / Sustainability Director
4.1.4 Collect and post information resources on a town-sponsored website (e.g., HMLP, Abode, Energy Sage, MassCEC, Inform HOAs).	Medium-term	Number of clicks	Town / Sustainability Director

Implementation Steps	Timeframe	Metrics	Responsible Party
4.1.5 Create model home case studies, a building pilot demonstration and a teaching pilot program in a traditional, historic and contemporary home (both written and video recorded, akin to "This Old House" programming).	Medium-term	Timing and size of pilot project	HCAC Coordinating with Town Administration and Other Town Personnel
4.1.6 Identify potential equity issues associated with town-funded support (e.g., should larger homes receive the benefits of incentives or should there be a sliding scale by home size/income).	Medium-term	Timing and level of discussion	Town Non-profits HMLP
4.1.7 Advocate for PACE program financing programs for Residential Customers.	Long-term	Number of discussions with legislators	Town HMLP Committees
4.2 TECHNOLOGY AND DESIGN			
4.2.1 Promote high efficiency heat pumps to displace oil and natural gas-fired boiler systems.	Ongoing	Number of conversions to heat pumps	HMLP
4.2.2 Educate customers on technology and product development for heat pumps to be integrated into water circulation heating and domestic hot water.	Ongoing	Number and extent of outreach	Private Contractors
4.2.3 Promote Clean Energy Homes - Energy Star Electric Appliances - Electric / Induction Stoves.	Ongoing	Number and extent of outreach	Town Non-profits HMLP
4.2.4 Collaborate with permit/ building inspector on how to promote more efficient HVAC options during renovations: - Flyer in building permit - Contractor outreach program - Require contractor to provide alternatives with bids	Near-term and ongoing	Timeliness of program and number of flyers sent	Committees Town Building Inspector
4.2.5 Promote the decentralized solar generation capacity of homes and buildings to contribute to the electric grid and reduce dependency on a centralized grid and HMLP distribution overhead infrastructure, including new buildings in Town being made solar ready	Ongoing	Number of solar installations / solar-ready retrofits	Town Non-profits HMLP
4.2.6 Develop detailed implementation plans for the Climate Action Plan and Hingham Master Plan to enable Zoning Bylaw and Building Code updates to reflect the Climate Action Plan and Master Plan goals and objectives. Include LEED and Building Wellness Code updates	Medium-term	Creation of implementation plan(s)	HCAC Town Committees Planning Board
4.2.7 Monitor National Grid natural gas decarbonization roadmap and implementation progress and leak mitigation.	Ongoing	Number of updates	Mass DPU National Grid Select Board
4.3 LARGE USERS			

Implementation Steps	Timeframe	Metrics	Responsible Party
4.3.1 Establish commercial team to work with large customers to educate on programs and program benefits, including automation and distributed energy resources. Include condominium, multi-family, commercial property owners and managers and require all heating and air conditioning contractors to provide carbon-free energy systems specifications in all bids to replace or make major repairs or changes to heating and air conditioning systems and other gas, propane, or oil fueled systems and appliances	Medium-term	Number of consultations	Town Non-profits HMLP
4.3.2 Support implementation of PACE program financing programs.	Industrial/Commercial: Near-term and ongoing	Number of PACE loans	Town HMLP
4.3.3 Create and sign up large customers to participate in an aggregated demand response program.	Near-term development with medium-term implementation	Total MW offered into the FCM	HMLP
4.3.4 Create clean peak program similar to investor-owned utilities to compensate for demand response from large energy storage units.	Medium-term	Total MW of energy storage used in demand response	HMLP
4.3.5 Educate and promote net metering program for large users who implement solar energy arrays on their buildings.	Ongoing	Total MW purchased under Net Metering	HMLP
4.4 BUILDING CODE			
4.4.1 Research and review Massachusetts stretch codes to determine whether they can be implemented in Hingham: - Updated Green Communities requirements - Massachusetts stretch codes	Near-term	Decision on whether or not to implement	Town
4.4.2 Explore adoption of the new MA Net Zero Opt-in Specialized Code and if it is feasible, go through the process for Hingham to review and approve adoption.	Near-term	Implementation	Town
4.4.3 Provide list of R-values and link to stretch code requirements to permit requests.	Near-term	Number of requested permits receiving	Town
4.4.4 Educate/promote Passive House/LEED-certified buildings for new construction.	Medium-term	Number and extent of outreach	Town Non-profits HMLP

Implementation Steps	Timeframe	Metrics	Responsible Party
4.4.5 Require commercial and multi-unit building owners to notify potential renters of insulation R-values in rentable space.	Medium-term	Renter notification collateral	Town
4.4.6 Explore community interest in limiting new fossil-fuel hookups.	Medium-term	Number of public hearings / public survey	Town Non-profits Committees
4.4.7 Require multi-unit buildings to provide: - Electric vehicle charging - Minimum number of charging stations - Submetering	Long-Term	Number of units providing	Town
4.4.8 Expedite approvals for heat pumps, insulation, solar, backup-power and batteries.	Near-term	Number of approvals	Town

TRANSPORTATION

Implementation Steps	Timeframe	Metrics	Responsible Party
5.1 ELECTRIC CHARGING			
5.1.1 Promote Hinghamdriveselectric.org for residents and businesses to obtain information on electric vehicles.	Near-term	EV growth in Hingham versus state-wide	Town, HMLP
5.1.2 Increase EV charging stations in business, municipal, and public parking lots; charge appropriately to recover costs.	Near-term	Number of charging stations	Town, HMLP, Private Companies
5.1.3 Install EV charging stations in school parking lots for teachers, parents and students.	Near-term	Number of charging stations	Town, HMLP, Schools
5.1.4 Encourage EV charging stations and hookups in multi-unit housing and shopping lots.	Medium-term	Number of charging stations	Town, HMLP, Private Owners
5.1.5 Establish separate EV charging rate to reflect time of use to incentives charging during most efficient times.	Near-term	Implementation of EV Rate	HMLP
5.2 ELECTRIC VEHICLES AND ALTERNATIVES			
5.2.1 Convert municipal fleet to electric and other non-fossil-fuel vehicles where economically and technologically feasible.	Medium-term	Percentage of fleet to EV conversions	Town and departments
5.2.2 Do a demonstration project with at least one electric school bus to gather information.	Medium-term	Timing of bus demonstration	Schools, HMLP
5.2.3 Convert school buses to electric and other non-fossil fuels if it is economically feasible and install associated charging infrastructure.	Medium- to Long-term	Number of buses converted	Schools, HMLP
5.2.4 Provide tax incentives for higher MPG vehicles by charging higher excise taxes for less efficient vehicles.	Medium-term	Incentives and taxed vehicles (number and dollars)	Town Assessor's Office
5.2.5 Encourage carpooling/ride sharing with incentives, bicycling, and walking.	Medium-term	Incentives (number and dollars)	Town
5.2.6 Educate on electric boating engine options and provide fast-charge electric charging options at docks.	Longer-term	Number of electric boats, charging stations	Harbor Master, Non-profits
5.2.7 Track electric vehicles (car and boats) registered in Hingham to understand trends and adoption rates.	Near-term	Number of registered electric vehicles	Town Assessor's Office
5.3 PUBLIC TRANSIT			

Implementation Steps	Timeframe	Metrics	Responsible Party
5.3.1 Encourage use of public transit options.	Near-term	Growth in public transit use	MBTA
5.3.2 Support state efforts on electrification / decarbonization of MBTA: - Buses - Trains - Ferries	Medium-term	Conversion of MBTA to alternatives	Town Residents Businesses
5.3.3 Study a potential Hingham-based electric trolley/bus service that meets identified public needs to connect key Town destinations and the MBTA System, in order to promote economic growth and equitable accessibility.	Medium-term with Longer-term implementation	Timeliness of study	Town
5.3.4. Research/Understand carbon-free personal mobility options (e.g., solar, ride-sharing, elderly transportation options) and develop a plan for meeting identified needs for segments of the community.	Medium-term	Timeliness of study	Town Non-profits

Hingham Climate Action Planning Committee

WASTE

Implementation Steps	Timeframe	Metrics	Responsible Party
6.1 SOLID WASTE			
6.1.1 Adopt PAYT/SMART Program to create incentives to reduce waste (including bylaw change allowing Town to charge for household waste): - Residents - Businesses - Private Haulers	Medium-term	Reduction in Waste; bylaw change	DPW
6.1.2 Require all private haulers to provide recycling to Hingham customers, Including creating a bylaw requiring all trash companies to offer recycling pick up if needed. Consider creating a bylaw that all trash companies entering the Town must have trucks that meet EPA emission standards or better	Near-term	Reduction in waste bylaw change; confirm percentage of compliance Private Haulers	DPW / Board of Health
6.1.3 Reduce/limit/ban single-use plastic and non-refillable containers, such as passing bylaws restricting drinks sold in single use plastic containers and modifying relevant health codes to allow customers to bring their own reusable containers for certain food item.	Near-term	Elimination of single-use plastic	CGH / DPW / Board of Health
6.1.4 If economically feasible, eliminate plastic from school cafeteria plates and cutlery – convert to compostable wood/paper products that the Transfer Station is able to compost.	Near-term	Amount of plastic saved	Schools
6.1.5 Institute fee for bulk waste as part of PAYT/SMART Program indicated in 6.1.1.	Near-term	Reduction in bulk waste	DPW
6.1.6 Divert textiles, mattresses (2022 mattress waste ban), hazardous waste from landfill to recycling alternatives.	On-going	Tonnage of diverted bulk waste	DPW
6.1.7 Establish polystyrene foam ordinance to ban as food packaging in the largest retailers.	Medium-term	Passage of ordinance at Town Meeting	CGH/Business Associations
6.1.8 Publicize system technology borrowing opportunities (e.g., equipment, small appliances, and tools) at the Hingham Public Library.	Medium-term	Number of items borrowed	Hingham Public Library
6.1.9 Continue to employ waste to energy options for distributed energy resources.	On-going	Renewable generation of energy	DWP, HMLP
6.2 RECYCLING			
6.2.1 Increase education for homeowners, schools and businesses regarding recycling options and fund staff to empty these bins frequently.	On-going	Number and extent of outreach	CGH / DPW / Schools

Implementation Steps	Timeframe	Metrics	Responsible Party
6.2.2 Add more recycling bins at fields, parks, schools, municipal buildings, and other public spaces.	On-going	Increased recycling rates; litter reduction	DPW
6.2.3 Increase water filling stations in town buildings, fields, and other public areas.	Medium-term	Fewer water bottles in recycling	Hingham Water
6.2.4 Increase textile recycling at Transfer Station and other Town locations.	On-going	Fewer textiles in waste stream	DPW, Schools, Businesses and other locations
6.2.5 Promote Hingham Exchange program.	Medium-term	Reduction in textiles in trash	CGH
6.3 COMPOSTING			
6.3.1 Establish community-wide composting program for municipal and school buildings: - Clearly define what is compostable- - Establish composting bins in schools and municipal buildings - Create program for collection and distribution of post-processed compost	Medium-term	Reduced tipping fees / Reduced waste tonnage	Sustainability Coordinator / DPW director
6.3.2 Educate businesses and residents on: - Benefits of composting - Clearly define what is compostable - Explore curb-side composting collection options - Create drop-off for compostable materials (decentralized composting program with curb-side residential pick-up)	Near-term	Number and extent of outreach	DPW / Sustainability Coordinator
6.3.3 Explore potential siting and operations of an anerobic digester, including participating in multi-community digesters.	Long-term	Participation in community digester	Town / DPW
6.3.4 Find ways to reduce food waste and redistribute excess food in accordance with food laws.	Medium-term	Amount of food waste	Businesses

Hingham Climate Action Planning Committee

COMMUNITY

Implementation Steps	Timeframe	Metrics	Responsible Party
7.1 COMMUNITY OUTREACH			
7.1.1 Establish a full-time Sustainability Director to coordinate implementation of the Plan recommendations and obtain grants/funding to do so.	Near-term	Approved Budget and Timing of Hire	Town
7.1.2 Maintain the Climate Action Commission (CAC) to monitor, track, provide updates, and advise on the Plan implementation and progress.	Long-term	Hingham achieving net zero	Select Board and Town Meeting
7.1.3 Sponsor an education and marketing program to inform residents and businesses of incentives to install energy efficiency and adopt carbon-free energy solutions.	Medium-term	Marketing Plan	CAC, Sustainability Director, Town
7.1.4 Promote net zero carbon emission opportunities for the Town, residents, and businesses.	Long-term	Realization of Net Zero Goals	CAC, HMLP, HNZ, Sustainability Director
7.1.5 Make copies of the Plan and associated dashboards readily available in digital and hardcopy	Near-term	Number of copies/ clicks	Town
7.1.6 Favor Town vendors who have their own Net Zero and/or sustainability plan	Medium-term	RFPs with extra points	Town
7.1.7 Regularly update the carbon inventory and track progress through an easy-to-absorb dashboards	Medium-term	Number of reports	Sustainability Director
7.1.8 Continue ongoing communications with community groups to seek equitable outcomes on all Plan recommendations	Near-term	Number and extent of outreach	Town, Sustainability Director
7.2 PUBLIC PATHWAYS			
7.2.1 Develop a plan to connect schools, parks, the harbor, and commercial centers with bike paths, sidewalks, and possibly an electric trolley.	Near-term	Plan publication	Town, Planning Board
7.2.2 Facilitate community movements throughout town via clean resources with installation of: - Bike paths - Bike racks - Pedestrian walkways	Medium to long-term	Number of new pathways	Town, Planning Board
7.2.3 Connect areas of natural resources to/from public transit and public centers.	Medium-term	Number of new pathways	Town, Planning Board

Implementation Steps	Timeframe	Metrics	Responsible Party
7.2.4 Explore Transit Oriented Districts (TODs) as a solution to facilitate proximity to public transportation centers to minimize vehicle traffic. Existing example of TOD is the Hingham Shipyard. The Town is also exploring the possibility of increasing the density of existing districts that would comply with the MBTA Communities Multi-family Zoning Requirements (i.e. ½ mile from public transit options). See https://www.hingham-ma.gov/1013/MBTA-Communities for more information.	Medium-term	Number and location of TODs	Town, Planning Board
7.3 AIR QUALITY			
7.3.1 Monitor National Grid natural gas leak data for improvements/degradation	Ongoing	Number / volume of gas leaks	Town, Sustainability Director
7.3.2 Require aggressive program to: - Encourage local utility to stop natural gas pipeline leaks - Adopt gas leak reduction targets (e.g., AGA voluntary guidelines)	Ongoing	Number / volume of gas leaks	Town
7.3.3 Support state efforts to decarbonize the natural gas system	Ongoing	Comply with State	Town
7.3.4 Identify areas where Hingham energy consumers can benefit from incentives to move off natural gas and oil.	Medium-term	Number of areas and incentives	CAC, HMLP, Sustainability Director
7.3.5 Promote electrification of heating supply to decrease reliance on natural gas and oil.	Long-term	100% carbon-free heating achieved	CAC, HMLP, Sustainability Director

Hingham Climate Action Planning Committee

NATURAL RESOURCES

Implementation Steps	Timeframe	Metrics	Responsible Party
8.1 CARBON SINK DEVELOPMENT			
8.1.1 Educate residents, businesses and the Town Administration about carbon sinks.	Near-term	Number of meetings, local & State publications	Conservation Commissions, Land Trusts, Watershed Organizations
8.1.2 Protect lands that serve as carbon sinks.	Near to Mid-term	#Acres protected Zoning By-law	Conservation Commission, Planning Board, Open Space Acquisition Committee
8.1.3 Provide education on the benefits of landscaping with native plants and sustainable choices.	Near-term	Workshops, local & State publications	Garden Clubs, Land Trusts, Watershed Orgs, Conservation Commission
8.1.4 Continue to protect wetlands with upgraded bylaws to match state and federal regulations, and to exercise the option to exceed these regulations when allowable and reasonable.	Near to mid-term	Acres of additional wetlands protected	Conservation Commission
8.2 LAND CONSERVATION / MANAGEMENT			

Implementation Steps	Timeframe	Metrics	Responsible Party
8.2.1 Engage in tree maintenance and planting program, including: - Two for one tree planting policy - Zoning bylaw for tree removal Examples include the following: ATM 2022 amended the Site Plan Review Design and Performance Standards for the Preservation of Existing Vegetation, including Protected Trees. The Zoning By-Law now requires mitigation plantings in an amount equivalent to 50% of the caliper inches of removed trees. See Section I-I,6.d. of the 2022 Hingham Zoning By-Law The Conservation Commission adopted a Tree Removal and Replacement policy that requires a minimum of 1:1 and as much as 3:1 replacement depending on where the tree to be removed is located within its jurisdictional areas. See https://www.hingham-ma.gov/DocumentCenter/View/8602/Tree-Removal-and-Replacement-Policy-PDF.	Near-term	Number of trees saved or planted, Zoning By-Law	Tree Preservation Study Committee, Tree and Park (DPW), Planning Board, Conservation Commission
8.2.2 Seek out and recommend acquisition or preservation of open space, land, forests and grasslands in Hingham. [Open Space Acquisition Committee] Provide funding for land acquisition or protection. [Community Preservation] Protect and manage acquired or protected open space, land, forests and grasslands in Hingham. [Private land trusts]	Near to Mid-term	# Additional acres of conservation land or conservation protection easements	Open Space Acquisition Committee Community Preservation Committee Private land trusts; Conservation Commission
8.2.3 Expand protected green spaces that serve as naturally occurring carbon sinks.	On-going	# Acres of additional protected carbon sink areas, including coastal. By-law amendments.	Open Space Acquisition Comm., Community Preservation Comm.; Private Land Trusts, Conservation Comm.

Implementation Steps	Timeframe	Metrics	Responsible Party
8.2.4 Promote zero carbon emissions landscaping equipment for both the Town and residential users	Near to Mid-term	Workshops with suppliers, local & State publications	Hingham DPW (town use), Climate Change orgs Hingham Net Zero, Sustainable South Shore,
8.3 WATER CONSERVATION/ MANAGEMENT			
8.3.1 Replace non-native plants with native plant landscaping at Town-owned properties to reduce water and fossil fuel use.	Near to Mid-term	# Town areas where non-natives are replaced	Hingham DPW (Tree & Park) Hingham Beautification Committee Con. Comm advise if needed
8.3.2 Investigate and pursue alternatives to high nitrogen fertilizer use on Town properties to improve water quality and reduce nitrous oxide emissions. Continue to prohibit the use of de-icing chemicals, fertilizers, pesticides, & herbicides etc. in perpetuity on large redevelopment projects where appropriate.	Near term	Report from Rec. Commission & others re nitrogen fertilizer use. Less eutrophication in ponds and rivers.	Recreation Commission DPW (Tree & Park), School Dept, Con Comm
8.3.3 Educate water users on water conservation practices and benefits.	Near Term	Meetings, Workshops, Publications,	Weir River Water Commission & WRWS Citizens Advisory Board. Climate Action orgs, Land Trusts, Local Media
8.3.4 Generate user-specific targets for water usage and report with water department bills, both residential and business.	Near Term	Impact of water usage targets in gallons saved	WRW Commission & Citizens Advisory Board.
8.3.5 Create tiered pricing for water usage to differential between essential and non-essential usage and disincentivize the latter.	Near Term	Impact in gallons saved	WRW Commission & Citizens Advisory Board.
8.4 RECREATION			

Implementation Steps	Timeframe	Metrics	Responsible Party
8.4.1 Find ways to reduce carbon emissions in recreational areas (land and sea) by promoting electric alternatives.	Medium- to Long-Term	Number of electric vehicles including boat engines and bikes.	On water: Harbormaster & Harbor Development Committee. On land: Recreation Commission
8.4.2 Allow and facilitate the location and installation of fast charging stations at recreational parking areas.	Medium-term	Number of charging stations	HMLP & Harbor Development and Recreation Commissions.
8.4.3 Promote use of carbon-negative materials and recycled inputs at recreational areas (e.g., picnic tables, chairs, playgrounds).	On-going	Number of areas with carbon-negative and/or recycled equipment	Recreation Commission, Con. Comm., Harbor Development Comm., Bare Cove Park Comm.

Hingham
Climate Action
Planning Committee

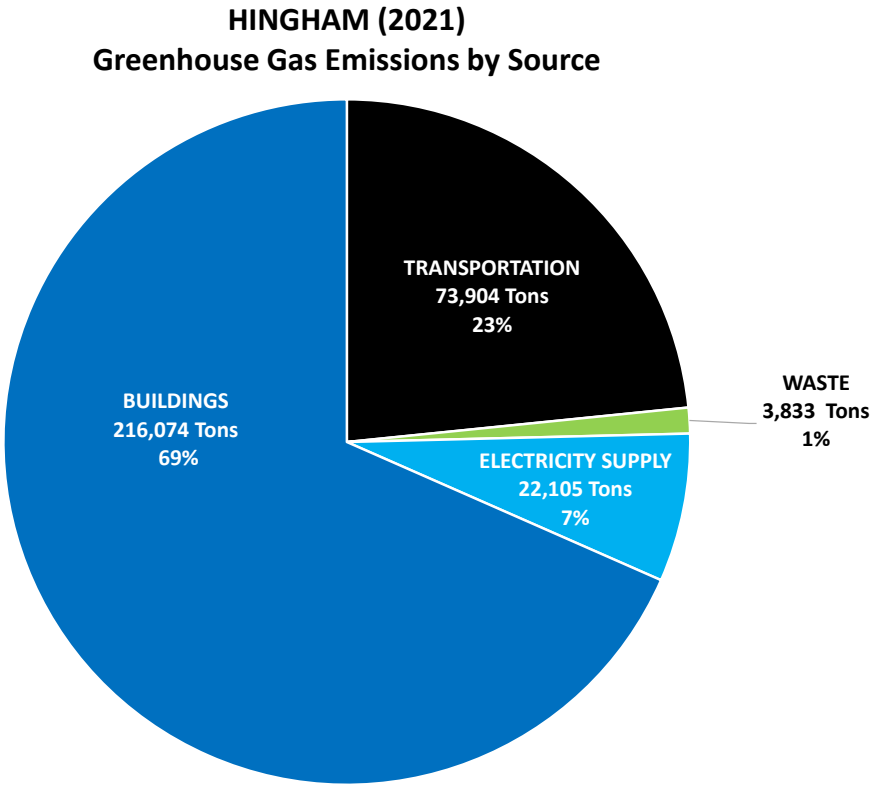
APPENDIX B
Carbon Emissions Inventory

Hingham Climate Action Planning Committee

APPENDIX B
Carbon Emissions Inventory

This appendix provides an overview of Hingham's estimated carbon emissions and the process used to develop these estimates using 2021 as the base year. **Figure B-1** provides a high-level summary of Hingham's community-wide carbon emissions calculated using Hingham-specific data and a methodology based on the GHG Protocols developed by the World Resources Institute ("WRI").

Figure B-1: Hingham Greenhouse Gas Inventory (2021)



As a general rule, the methodology used to provide an inventory of carbon emissions is based on the GHG Protocols for cities established by WRI in the early 2000s, updated for more recent

revisions.[1]

The following sections describe the methodology and data sources used to estimate carbon emissions associated with each category. With respect to data sources, Hingham-specific data was used whenever possible, cross-checked with 1) public data for the Commonwealth of Massachusetts and the United States; and 2) carbon inventories calculated for other municipalities in Massachusetts, adjusted for population.

As with any calculation, better data will produce more accurate results. With respect to Hingham-specific information, some of this data is collected and maintained as a matter of municipal and state efforts, but there is room for improvement. Existing data limitations can be remedied as part of the data collection recommendations included in the Plan (see Appendix A). For this purpose, each section includes recommendations for future data collection that can hone the estimation methodology and create more accurate values to be refined as part of the implementation of Hingham's Climate Action Plan.

B.1. Electricity Supply

Hingham Municipal Lighting Plant ("HMLP") supplies electricity to the Town of Hingham, its residents, and businesses. HMLP procures electricity from power purchase agreements and spot market purchases from the New England wholesale market for electricity ("ISO-NE"). Power purchases from renewable resources such as wind, solar, and hydroelectric projects generally come with Renewable Energy Credits ("RECs") as part of the power purchase agreement. HMLP can purchase or sell RECs as needed to meet its renewable energy targets.

HMLP provided a spreadsheet with a break-out of the source of its historical power purchases. **Figure B-2** reproduces the data provided and HMLP's estimated carbon emissions associated with its power supply.

[1]Developed to be Hingham-specific with the benefit of the World Resources Institute GHG Protocol for Cities, https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities as documented in: Global Protocol for Community-Scale Greenhouse Gas Inventories, An Accounting and Reporting Standard for Cities, Version 1.1., p. 11, https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf

Figure B-2: HMLP Power Supply and Estimated Carbon Emissions (2015 - 2020)

Generation by Fuel Type (MWh)	2015	2016	2017	2018	2019	2020
Total Non-Fossil Fuel (Excl. Nuclear & Landfill)	23,504	28,946	30,556	32,735	43,518	43,242
Nuclear	55,676	60,184	57,142	58,502	61,260	55,849
System Power Under Contract	113,826	100,285	100,313	102,421	86,650	85,751
Landfill Gas	2,983	7,946	5,877	3,798	3,943	4,309
Fossil Fuel	12,680	9,568	8,111	8,560	3,052	5,935
Total	**208,670**	**206,928**	**201,998**	**206,015**	**198,423**	**195,086**

GHG Emissions by Type (Short Tons of CO2e)	2015	2016	2017	2018	2019	2020
MA Non Biogenic	45,903	41,882	34,945	28,459	26,892	28,584
MA Biogenic	7,818	7,472	6,567	1,054	460	94
Regional Non Biogenic	39,591	35,507	29,281	26,058	24,191	20,363
Regional Biogenic	10,256	9,939	8,616	6,910	5,976	4,110
Total - MA	**53,721**	**49,354**	**41,512**	**29,513**	**27,352**	**28,678**
Total - Regional	**49,847**	**45,446**	**37,897**	**32,968**	**30,167**	**24,473**

Most of HMLP's energy supply comes from "System Power Under Contract." System power reflects the ISO-NE power supply deducting for power explicitly contracted from power generators by utilities, retailers, or end-users.[2] HMLP applies two methodologies to estimate carbon emissions:

1) **MA Standard:** MA Non Biogenic applies standard carbon emissions intensity and heat rates by fossil fuel type for the state's generation mix.

2) **Regional:** Regional Non Biogenic applies values reflecting New England's average carbon intensity by fuel type.

HMLP reports these values in its annual filings to the Massachusetts Department of Environmental Protection Bureau of Air & Waste in a form titled "AQ 32 Mandatory Greenhouse Gas Emissions Reporting Form for Retail Sellers of Electricity."

Annual versions of estimated carbon emissions associated with HMLP's supply of electricity generally are produced in the summer. For purposes of the carbon inventory, the carbon emissions calculations produced by HMLP were accepted as provided for 2020 and adjusted by a factor to reflect the change in Hingham load for 2021 versus 2020 (**Figure B-3**).

[2] ISO-NE uses the NEPOOL Generation Information System ("GIS") to determine the characteristics of its power supply through separately tracked and traded GIS certificates. End-users who purchase energy with specific characteristics retire those certificates. The remaining certificates in the GIS reflect the characteristics in the residual system mix. https://nepoolgis.com/

Figure B-3: Carbon Emissions Reported (Short Tons of CO2e) in 2020 versus Estimated Values

Electricity	2020 HMLP Reported	2021 (estimated)
MA Biogenic and Non Biogenic	28,678	28,798
Regional Biogenic and Non Biogenic	24,473	24,576

For the carbon inventory, the regional values are used as those are more reflective of the geography of the power resources from which HMLP purchases its energy. This 2021 estimate can be updated in the tracking tool once HMLP finalizes its submission to the state. Given that these carbon emissions are reported to the state in accordance with the state's methodology, the carbon inventory adopts them for this purpose.[3]

HMLP recognizes that while it purchases 57 percent of its energy from non-fossil fuel sources, the state does not recognize that energy as renewable unless the RECs are retired. HMLP has made a decision to sell those RECs to the large utility companies and use those funds to invest in clean energy investments within Hingham (including funding of this Plan). Therefore, HMLP does not have the right to claim that the energy it purchases is renewable as that right has been sold to another utility. To claim that their renewable energy purchases are renewable, the RECs would have to be retired.

The Next Generation Roadmap legislation in the Commonwealth requires that municipalities meet a goal of 50 percent non-emitting energy in their portfolio by 2030, 75 percent by 2040, and net zero by 2050. HMLP could at any point begin retiring class 1 RECs to meet those goals. For purposes of its submissions filed with the state, however, HMLP calculates carbon emissions based on the generation source of the electricity and does not add back carbon emissions associated with pooled power based on RECs that are sold. This approach may be refined going forward, but is consistent with what REC retirements would generate.

As Electrify Hingham gathers momentum and investment in distributed energy resources are more fully integrated into HMLP's distribution system, additional data may be required to keep track of renewable energy being injected back into the grid purchased by HMLP under its net metering program. Information on energy storage and community solar also may need to be incorporated

[3] Carbon emissions are allocated to each sector based on the HMLP rate designation. For consistency, the municipal sector share of emissions is estimated based on property data on building square footage for the town versus other sectors in the rate class. Going forward, this estimation approach could be refined using a bottoms-up approach developed for reporting emissions as part of the Green Communities program.

into the calculation. Establishing a program to gather that data and incorporate it into the carbon inventory could become increasingly important, especially if the RECs are sold back to Hingham as part of the net metering program.

Going forward, the Town of Hingham and/or HMLP also may engage in Scope 4 emissions offsets, including carbon emission reduction credits. As Scope 4 emissions offsets are utilized to meet Hingham's net zero goals, those credits should be inventoried, reported regularly, and incorporated into future carbon inventories.

Figure B-4 summarizes the sources of data used and future data sources that could become more relevant for the carbon inventory going forward.

Figure B-4: Electricity Supply Carbon Inventory Data Sources

Data	Existing Data Sources	Future Data Sources to Use
Electrical energy supply sources by power purchase agreements	Hingham Municipal Lighting Plant	Same, potentially adjusted for REC retirements versus sales
ISO-NE power pool purchases	Estimated carbon intensity of electrical energy from the ISO-NE power pool	ISO-NE power supply carbon intensity data by hourly dispatch
Distributed energy resources	Not applicable	Renewable energy produced in Hingham and sold under net metering agreements
Offset for REC sales	Not accounted for	REC inventory, transactions, and retirements
Offset for carbon credits	Not applicable	Carbon credit transactions

B.2. Buildings

Buildings are the largest source of Hingham's carbon emissions. These emissions generally are produced by combustion fossil fuels such as natural gas and oil for heating and hot water heaters. To date, there are relatively few reported installations of heat pumps in Hingham households[4].

[4] We note that embodied carbon in buildings is not measured as part of Hingham's carbon inventory due to various challenges even in making estimates, let alone accurate measurements. However, new building projects should be cognizant of carbon used to construct buildings and transport their materials.

Estimating carbon emissions from buildings is straightforward for natural gas-fired buildings based on natural gas delivery data provided by National Grid. In contrast, oil is delivered to Hingham residents by multiple oil delivery services. Most of those companies either did not have the data readily available or were not willing to provide it. Without access to this data, carbon emissions associated with heating oil deliveries into Hingham is required.

The process adopted for estimating building emissions is summarized below:[5]

1) **Natural Gas:** Use natural gas delivery data by customer type provided by National Grid to calculate carbon-emissions for buildings that combust natural gas for heating, hot water heaters, and natural gas-fired appliances.

2) **Fuel Oil:** The Massachusetts Department of Energy Resources (DOER) publishes an annual forecast of estimated heating oil usage per square foot. This value can be adopted and applied to the square footage of buildings in Hingham that rely on heating oil to generate an estimate of annual usage and associated carbon emissions. The methodology adopted for the carbon inventory assumes 0.335 gallons/square foot annually to total square footage of oil-heated buildings in Hingham based on the Massachusetts DOER forecast for 2021 that indicates an average oil usage of 637 gallons per winter for an average Massachusetts home of 1,903 square feet.[6] This metric implies that the average home in Hingham consumes 775 gallons per year.[7]

3) **Allocate by Sector:** Allocate emissions based on square footage of properties by fuel type and sector (i.e., Residential, Commercial, Industrial, Municipal). Apply sector square footage by heating type to fuel consumption estimates to generate consumption by sector. Multiply consumption by the average carbon content to

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[5] This Plan incorporates by reference the "Hingham CAP Carbon Inventory Calculations" spreadsheet used to generate and calculate the estimates described in this Appendix B.

[6] Massachusetts DOER, https://www.mass.gov/info-details/massachusetts-household-heating-costs. The average Hingham home is approximately 2,700 square feet based on data from the Hingham Assessor's Office.

[7] This value was confirmed by cross-checking against a number of other third-party sources including:
New England: US EIA, https://www.eia.gov/consumption/residential/data/2015/ c&e/pdf/ce6.1.pdf
Massachusetts oil heat suppliers:
Scott Williams Oil https://www.scottwilliamsoil.com/how-much-heating-oilwill-i-burn-this-winter/
Live 95.9, https://live959.com/how-many-gallons-of-oil-does-anaverage-massachusetts-home-use-in-a-day/
Payless for Oil, https://paylessforoil.com/how-much-oil/

calculate total carbon emissions by sector.[8]

Hingham has a larger proportion of homes fueled by oil (around half) compared to the rest of the Commonwealth (23.5 percent).[9] Hingham homes also are larger, on average, than the rest of the Commonwealth. Oil has a higher carbon content than natural gas, and the average efficiency of oil boilers tends to be lower than natural gas boilers. As a result, residential properties heated by oil consume more than the statewide average and are a significant contributor of carbon emissions.

Over time, as buildings convert to more efficient boilers and heating systems, total natural gas delivered can be expected to decrease. This decrease will be countered by the development of new buildings that could increase demand for fossil fuels.

Although this methodology could continue to be used going forward, it will be important to continue to have access to National Grid natural gas delivery data and the Assessors' data on buildings and heating systems in those buildings. As heating systems transform, there may be a lag in the data, which could overstate carbon emissions inventories in any given year. To further refine the estimate, data could be collected from oil delivery companies on a going forward basis or through surveys of homeowners that have oil heating.

Figure B-5 lists the data used in this calculation and potential data that could be used going forward.

[8] As Hingham's municipal carbon emissions is collected as part of the Green Communities program, the more detailed estimate can be cross-checked against this "top-down" estimation method or even substituted for this calculation going forward.
[9] Massachusetts Government, https://www.mass.gov/service-details/how-massachusetts-households-heat-their-homes

Figure B-5: Building Carbon Inventory Data Sources

Data	Existing Data Sources	Future Data Sources to Use
Natural Gas Usage	National Grid	Same
Oil Deliveries	Estimated using Massachusetts DOER projected estimates per square foot	Actual oil deliveries reported by heating oil companies that service Hingham
Oil Usage	See Oil Deliveries	Survey of homeowners with oil heating systems
Fuel Consumption Intensities	U.S. EIA https://www.eia.gov/consumption/commercial/data/2012/c&e/pdf/e2.pdf	Same
Emission Factors	U.S. EPA https://www.epa.gov/climateleadership/ghg-emission-factors-hub	Same
Cross-checks	State-based data reported by U.S. EIA Delivery Rule of Thumb	State-based data on average usage per person, per building, and/or per square footage

B.3. Transportation

Transportation is the second largest source of Hingham's carbon emissions. Calculating carbon emissions from transportation in Hingham includes two components to be consistent with the GHG Protocols for Cities:

1) **Vehicles Owned and Registered in Hingham:** Estimated mileage for vehicles owned and registered in Hingham (56,648 tons CO2e); and

2) **Commuters:** Carbon emissions associated with commuting in and out of Hingham, including personal vehicles and public transportation (17,256 tons CO2e).

For the first category – vehicles owned and registered in Hingham – the calculation relies on vehicle data provided by the Town Assessors Office and HMLP, which comes from National Grid's purchase of data from IHS-Polk. Assessor data includes total registrations, while IHS-Polk data

differentiates between Battery Electric Vehicles ("EVs"), Plug-in Hybrid Electric Vehicles ("HEVs"), and non-electric vehicle registration for the ZIP codes associated with municipal light plant communities such as Hingham (**Figure B-6**). Electric vehicles are roughly 1.6% of the total – in line with state-wide estimates of the percentage of electric vehicles.

Figure B-6: Light-Duty Vehicles in Operation for Hingham (2020 – 2021)[10]

MLP	Town	EV_TYPE	2020-Q1	2020-Q2	2020-Q3	2020-Q4	2021-Q1	2021-Q2	2021-Q3
HMLP	Hingham	BEV	118	124	140	151	155	179	202
HMLP	Hingham	PHEV	63	61	63	68	80	98	111
HMLP	Hingham	NON_EV	19,607	19,559	19,540	19,639	19,553	19,671	19,750
HMLP	**Hingham Total**		**19,788**	**19,744**	**19,743**	**19,858**	**19,788**	**19,948**	**20,063**

Hingham-specific data was used as the basis for carbon emissions emitted by in-Town vehicles as follows:

1) **Number of Vehicles by Type:** Tally total vehicles based on data provided by the Assessor's office and allocated to BEVs, PHEVs, and non-electric vehicles according to the National Grid/IHS-Polk Data.

2) **Average Mileage Driven per Vehicles:** Estimate average mileage driven per vehicle from the Metropolitan Area Planning Council / Massachusetts Registry of Motor Vehicles – Massachusetts Vehicle Census.

3) **Average Miles per Gallon:** Estimate average miles per gallon based on the U.S. Department of Transportation's average miles per gallon for non-EVs in the United States. For municipal vehicles, actual MPG data was applied using the details provided on the vehicle type and year class.

4) **Calculate Total Gallons:** Using miles driven divided by average miles per gallon per vehicle, calculate total gallons of transportation fuel used per year.

5) **Calculate Total Carbon Emissions:**[11] Calculate total carbon by multiplying the carbon content of gasoline per gallon to total gallons of transportation fuel used in 2021. Separate

[10] National Grid purchases this data from IHS-Polk (https://ihsmarkit.com/products/automotive-market-data-analysis.html). National Grid makes no claims as to the accuracy of the data. The figures do not include medium or heavy-duty vehicles.

[11] Carbon content of gasoline is used versus trying to break out gallons into gasoline versus diesel as information on diesel engines is not readily available.

data for average municipal MPG usage versus estimated community-wide vehicle MPG usage.

The Hingham Assessor's office receives information on make, model and year for each vehicle registered in Hingham. Going forward, this data could be compiled and maintained to provide greater accuracy by type of vehicle and miles per gallon. Surveys of Hingham vehicle owners could be used to achieve greater accuracy in estimating the miles driven per year (**Figure B-7**).

Figure B-7: Transportation Carbon Inventory Data Sources – Registered Vehicles

Data	Existing Data Sources	Future Data Sources to Use
Registered Vehicles	Assessor's Office provides total number of registered vehicles—year, class, and vehicle type provided for municipal fleet	The Assessor's Office receives data on make, model and year. This data is reported to the state DMV. Going forward, this data could be compiled and maintained.
Battery Electric Vehicles	National Grid / IHS-Polk	Same; could refine with Assessor data going forward
Plug-in Hybrid Electric Vehicles	National Grid / IHS-Polk	Same; could refine with Assessor data going forward
Home Charging Stations	Not used	HMLP could track installations and operations of Electric Charging stations in residences that require a hookup and an inspection
Average Vehicles Miles Traveled	Metropolitan Area Planning Council / Massachusetts Registry of Motor Vehicles – Massachusetts Vehicle Census, https://www.mapc.org/learn/data/	Same Could be refined with survey data, which will be easier to track as EVs become more common
Average Miles per Gallon	U.S. Department of Transportation, https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles	Same Could be refined with Assessor Data on Make/Model/Year
Carbon Content of Gasoline	U.S. Environmental Protection Agency, https://www.epa.gov/climateleadership/ghg-emission-factors-hub	Same.

Commuters are a separate source of transportation carbon emissions. Commuters emit within the borders of the Town of Hingham via self-driven vehicles, ride-shares, buses, commuter rail, ferry boats, and more. Under the GHG Protocols, emissions from commuters driving within the borders of Hingham are considered Scope 1 emissions, while emissions outside of Hingham going to and from commuter destinations are considered Scope 3 emissions.

The basis for the commuter emissions is based on a state-wide survey of commuters and mode of

transportation by town. This survey provides a basis for estimating the impact of commuters to and from Hingham on carbon emissions. One limitation of the survey is a lack of breakdown on public transportation. To further refine estimates, an additional region-wide survey on commuters by mode of public transportation was used. The values were updated to remove public transportation modes that are not available for travel to or from Hingham (i.e., Streetcar, Trolley, and Subway), and adjusted to reflect patterns in Hingham using ridership data.[12]

In order to understand distances traveled by commuters, a report from the Town of Hingham on Transportation and Circulation was used. The report provides information on the number of commuters by town for out-of-town commuters working in Hingham, as well as the number of commuters by destination for Hingham residents.

Combining information on distances traveled and modes of transportation, an annual mileage estimate could be generated for each mode of transportation. Emission factors from the U.S. EPA are then applied, which are provided in emissions per mile by modes of transportation.

To allocate emissions from commuters inside the borders of Hingham versus outside the borders, the Greenhouse Gas Protocol "Induced Activity" method was applied. Under this approach, 50% of transboundary trips that originate or terminate in the town are accounted for. Therefore, emissions were updated to reflect only half of the miles traveled for each commuting mode. The value for Hingham is deducted from transportation emissions to preclude double-counting.

The final step allocates total commuting emissions to Scope 1 (occurring in the Town) and Scope 3 (occurring outside of the Town). For this, we apply a 50-50 factor so that half of the total commuting emissions occur within Hingham and half occur outside of Hingham. This allocation does not make a difference for purposes of the total emissions estimate, but does distinguish between carbon emissions from commuting that occurs within Hingham's borders versus upstream or downstream.

Figure B-8 summarizes the data sources used in the carbon inventory and potential refinements that could be made going forward.

[12] For example, regional estimates for ferry commuting were adjusted to 54 percent versus 2 percent for the region; bus commuting was adjusted to 2 percent versus region-wide estimates of 29 percent. Given that both ferries and buses use diesel, the reallocation has a negligible impact on total carbon emissions.

Figure B-8: Transportation Carbon Inventory Data Sources - Commuters

Data	Existing Data Sources	Future Data Sources to Use
Number of Commuters	State-wide survey	Same
Mode of Commute	State-wide survey	Same
Modes of Public Transportation	U.S. Survey - Regional	Same
Commuting Distances	Town of Hingham – Transportation and Circulation Report	Same
Carbon intensity of Commuter Mode	U.S. Environmental Protection Agency, https://www.epa.gov/climateleadership/ghg-emission-factors-hub	Same, unless MA decarbonization changes public transportation fuels from diesel to electric
Portion of Commuting Miles by Type applied to Hingham	50% based on GHG Protocol standard assumption	Could be refined with a future survey
Portion applied to Scope 1 versus Scope 3	Based on rough estimate of commuter time in Hingham versus surrounding towns	Same

B.4. Waste

Estimation of emissions associated with waste is a straight-forward exercise using information collected by the state by town. For this purpose, waste includes the different components of solid waste that is delivered to the Department of Public Works Transfer Station (estimated to generate 3,833 tons CO2e). This waste is delivered to a location beyond the borders of Hingham, making them Scope 3 emissions.

Hingham, as with other municipalities, tracks total waste delivered to the DPW and reports to the state, which makes the data publicly available.[13] Each type of waste has an associated carbon intensity provided as a standard estimate by the U.S. EPA. Total carbon emissions for solid waste are calculated by applying the annual tonnage of waste by category by the carbon intensity for that type of waste.

In Hingham, residents and businesses deliver waste to the DPW directly and indirectly through

[13] Commonwealth of Massachusetts, Recycling & Solid Waste Data for Massachusetts Cities & Towns | Mass.gov

private haulers. It is possible that private haulers deliver waste to other locations, which would not be included in Hingham's reported data. Conversations with private haulers indicated that most, if not all, deliver to the local DPW. Industrial and commercial waste may be different, but there currently is no basis for knowing how or where that waste would be delivered. Going forward, that information could be captured via surveys of Hingham businesses directly as part of a licensing process or through the South Shore Chamber of Commerce.

Municipal versus community-wide waste emissions are estimated by allocating a portion of waste from the DPW to municipal facilities. To do so, industry estimates on waste generation in offices on a square footage basis are multiplied by municipal building square footage. EPA estimates on the types of waste and recycling rates are used to separate solid waste from recycled waste. These totals are subtracted from the data sourced through the Town Transfer Station and assumed to be municipally-sourced.

Figure B-9 summarizes the data used to calculate carbon emissions from waste and ways to refine that data going forward.

Figure B-9: Waste Carbon Inventory Data Sources

Data	Existing Data Sources	Future Data Sources to Use
Total solid waste delivered to DPW by type	Town of Hingham DPW data reported to the state and made publicly-available	Same
Total solid waste delivered outside of DPW by private haulers	Unknown	Annual surveys of private haulers regarding total tonnage delivered to a DPW station other than Hingham
Waste generation estimates by various industries	https://www.wastecare.com/usefulinfo/Waste_Generated_by_Industry.htm	Waste hauler totals from Municipal facilities
Common wastes and materials	https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/paper-and-paperboard-material-specific-data	Waste hauler totals from municipal facilities – solid waste versus recyclables
Carbon intensity by type of solid waste	U.S. Environmental Protection Agency, https://www.epa.gov/climateleadership/ghg-emission-factors-hub	Same

In the GHG Protocols, carbon emissions associated with wastewater are included in the waste category. Wastewater has a standard metric for carbon emissions which includes electricity and energy used to process the waste, as well as decomposition emissions associated with the waste ponds. Most of the carbon emissions associated with wastewater is tied to energy consumed during the treatment process, which already is captured in the electricity supply and buildings calculations, and would be less than 1 percent of Hingham's estimated carbon emissions using the GHG Protocol standards. A very small subset is tied to decomposition within the waste ponds. This additional source of carbon emissions is not accounted for in the carbon inventory given its negligible value.

B.5. Agriculture and Industrial

Although the GHG Protocols includes a methodology for estimating carbon emissions associated with agriculture and industrial processes, those sectors are not included as separate categories in the carbon inventory for Hingham.

With respect to agriculture and industrial processes, most of the Scope 1 (direct) and Scope 2 (electricity) emissions are accounted for in the categories above. As to Scope 3 emissions associated with the upstream and downstream processes, general estimates are available under the GHG Protocols, but those estimates are developed for Europe and are not necessarily applicable to Hingham, introducing a new source of uncertainty. Furthermore, the Climate Action Planning Committee does not make any recommendations with respect to specific actions that could be undertaken by those two sectors to offset their Scope 3 carbon emissions. To the extent such goals and sustainability reporting are required going forward, Scope 3 emissions for Hingham's industries could be estimated and included in future inventories.

B.6. Cross-Checks Against Other Massachusetts Municipalities

To ensure the accuracy of the final calculations, a comparison of the Hingham GHG Inventory was compared to the GHG Inventory produced in the climate action and sustainability plans of other towns in Massachusetts. A comparison of the GHG Inventory for Hingham compared to other Towns is illustrated below (**Figure B-10**).

Figure B-10: Comparison of Hingham GHG Inventory to Selected Towns

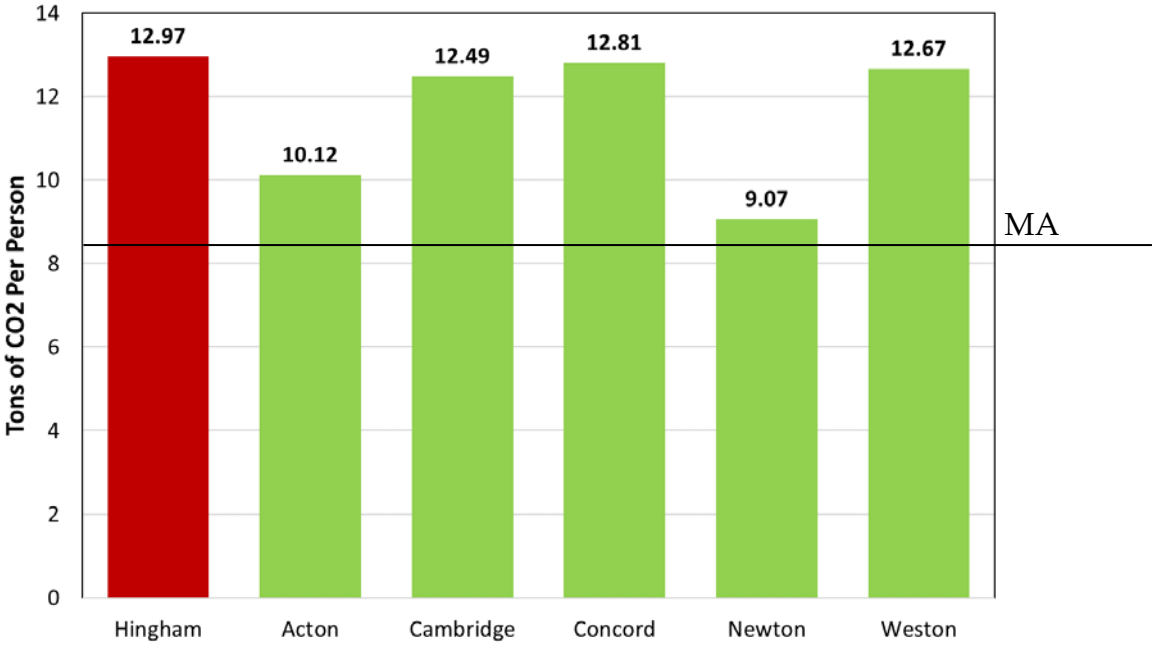
Sector	Hingham	Cambridge	Concord	Newton	Weston
Buildings	68%	82%	60%	64%	68%
Transportation	23%	11%	36%	25%	30%
Waste	1%	7%	3%	1%	2%
Electricity Supply	7%				
Energy System Losses				10%	
Total	**100%**	**100%**	**99%***	**100%**	**100%**

* May not equal 100% due to rounding.

As shown in this chart, Hingham's GHG inventory is in line with other towns on a percentage basis. Although each town deploys different methodologies, categories, and data sources, this comparison confirms the general accuracy of the methodology employed for Hingham with respect to similarly situated towns.

Another way to check the estimate is to compare Hingham's average per capita carbon emissions to other towns (**Figure B-11**).

Figure B-11: Comparison of Hingham Per Capita Intensity to Other Towns[14]



In 2019, the Commonwealth of Massachusetts averaged around 9.2 metric tons of energy-based carbon emissions per person annually, falling to 7.4 metric tons per person in 2020.[15] Hingham averaged around 13 tons per person in 2021, a per capita carbon intensity consistent with similarly situated towns in Massachusetts, but higher than the state-wide average.

B.7. More Detailed Break-Out

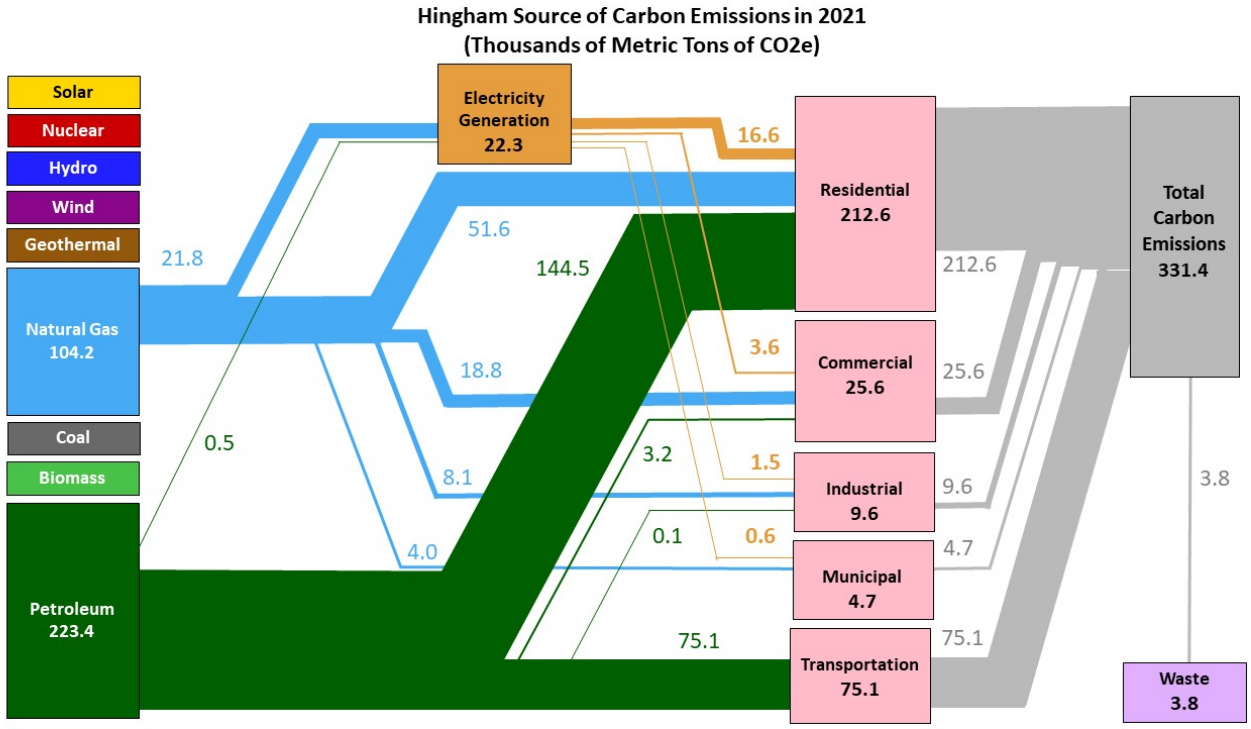
The adopted methodology takes a top-down approach to estimating the carbon emissions associated with the entire Hingham community. The sources of these emissions include the Town of Hingham's municipal government, businesses, and residents. In some cases, the data is provided at a level granular enough to break out the use of these carbon emissions; in other cases, the

[14] These town estimates are based on various years: Cambridge (2012), Concord (2016), Newton (2013), Weston (2018), but provide a rough comparison. The Hingham estimates are from 2021.
[15] Calculated using the EIA per capita carbon emissions, adjusted from metric tonnes to short tons using the factor of 1.10231131. See Table 4, https://www.eia.gov/environment/emissions/state/

break-out requires another estimation methodology.

A Sankey diagram is a useful way to visualize the sources and sinks generating Hingham's carbon emissions (**Figure B-12**). Given that Hingham is a primarily residential community, it should be no surprise that the majority of carbon emissions come from residential buildings, followed by automobiles. Commercial buildings contribute the next largest portion of carbon emissions due to the consumption of electricity and natural gas. Industrial and waste combined represent less than 5 percent of the total.

Figure B-12: Town of Hingham Sources and Sinks for Carbon Emissions (2021)



Estimated carbon emissions in Hingham tend to be more building-intensive than the Commonwealth of Massachusetts as a whole. Homes are larger and older than many of the residential accommodations in the state. Hingham also has a larger proportion of homes fueled by heating oil. In absolute terms, this translates into higher carbon intensity.

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APPENDIX C
Summary of Community Survey Results

During the months of April through September 2022, the Hingham Climate Action Planning Committee posted and publicized an online survey targeting the entire community of Hingham. The survey was advertised on the Town webpage, at public events, and during public meetings. The survey program was set to only allow for one response per IP Address so as to limit duplication of respondents. This appendix summarizes the results of the survey.

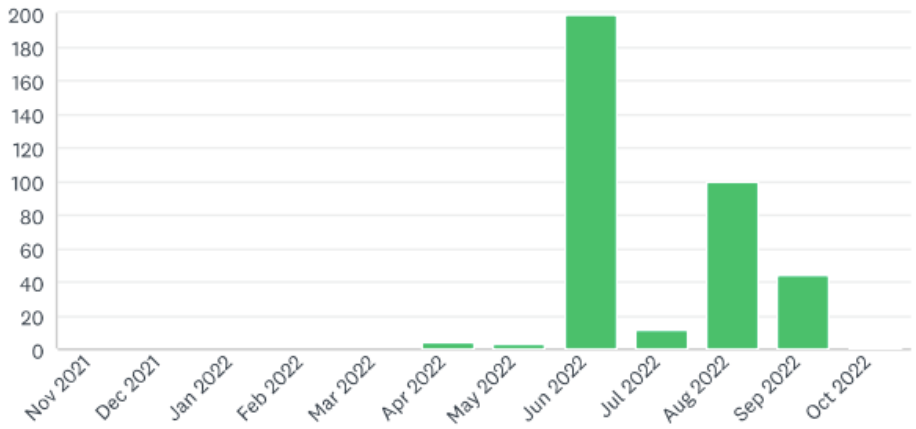
C.1. Survey Response

TOTAL RESPONSES	COMPLETION RATE	TYPICAL TIME SPENT
362	100%	4m:53s

Trends

Responses (by month)

First: 4/24/2022 Zoom: Nov 2021 to Oct 2022

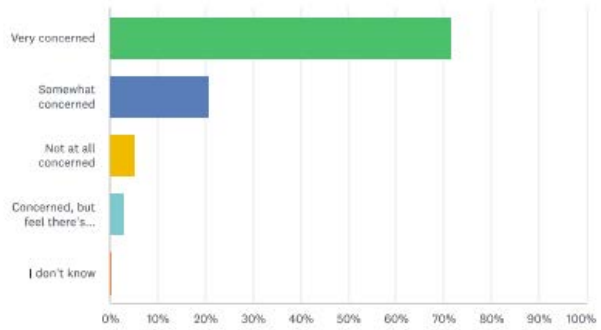


C.2. Survey Questions and Results

Question 1

How concerned are you about climate change?

Answered: 361 Skipped: 1

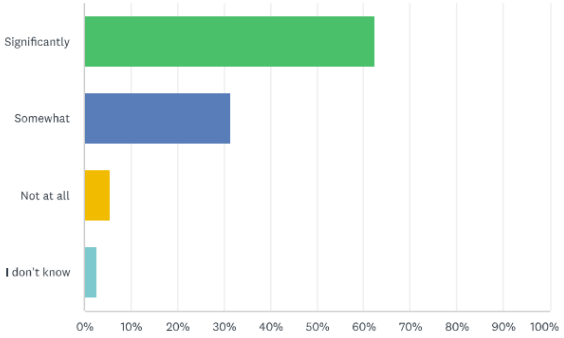


ANSWER CHOICES	RESPONSES	
Very concerned	71.47%	258
Somewhat concerned	20.78%	75
Not at all concerned	5.26%	19
Concerned, but feel there's nothing I can do	2.77%	10
I don't know	0.28%	1
Total Respondents: 361		

Question 2

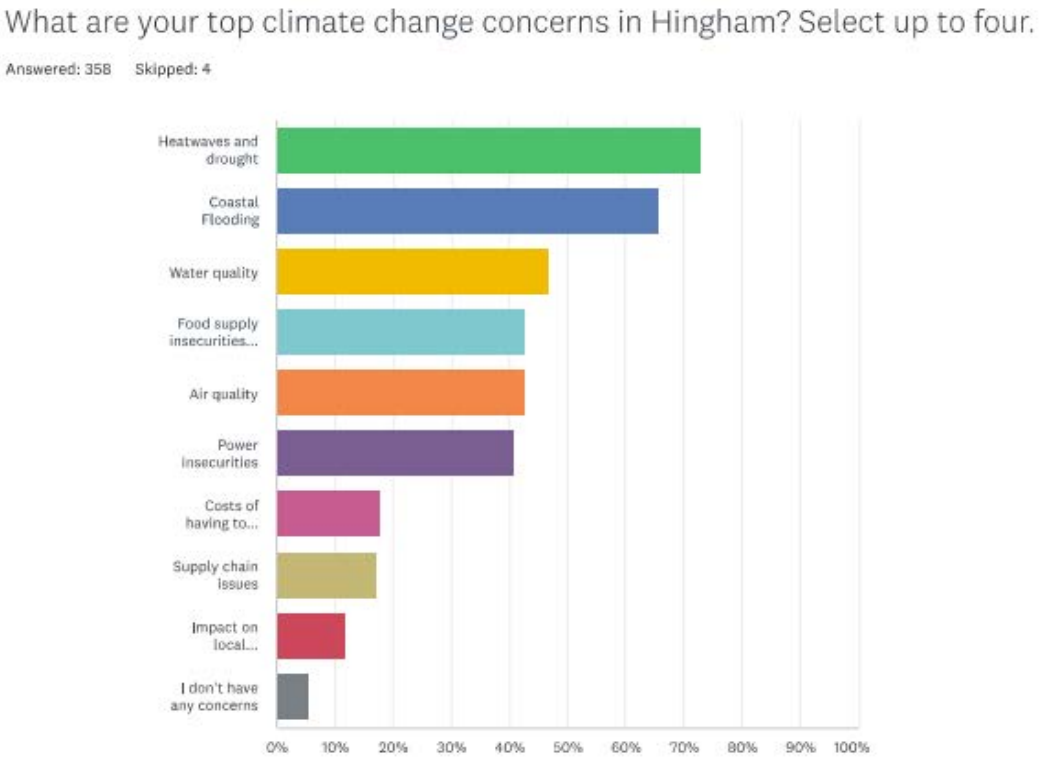
How much do you think climate change will impact you and/or your families?

Answered: 361 Skipped: 1



ANSWER CHOICES	RESPONSES	
Significantly	62.33%	225
Somewhat	31.30%	113
Not at all	5.26%	19
I don't know	2.49%	9
Total Respondents: 361		

Question 3



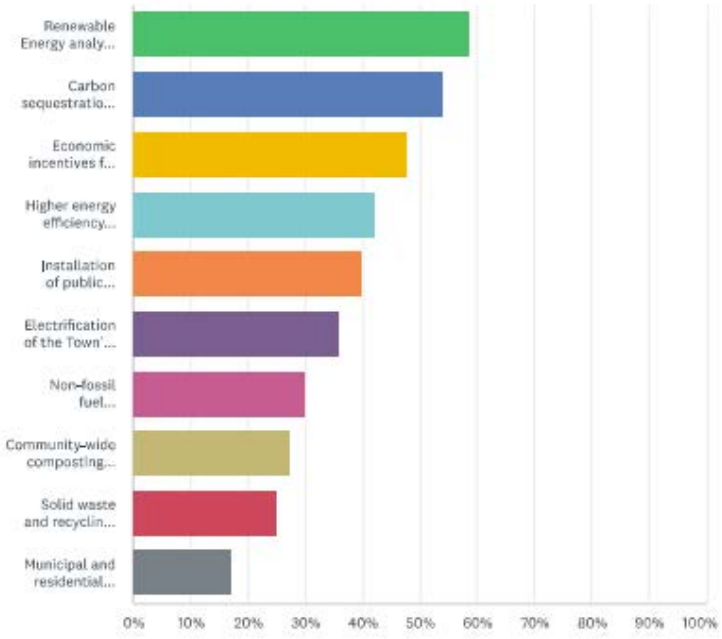
ANSWER CHOICES	RESPONSES	
Heatwaves and drought	72.91%	261
Coastal Flooding	65.36%	234
Water quality	46.65%	167
Food supply insecurities and rising costs	42.74%	153
Air quality	42.74%	153
Power insecurities	40.78%	146
Costs of having to modify my home	17.60%	63
Supply chain issues	17.04%	61
Impact on local businesses	11.73%	42
I don't have any concerns	5.31%	19

Total Respondents: 358

Question 4

The Hingham Climate Action Plan will include strategies to reduce greenhouse gas emissions in order to reach net zero carbon emissions in Hingham. Please choose the top four areas you would like to see covered in the plan.

Answered: 358 Skipped: 4



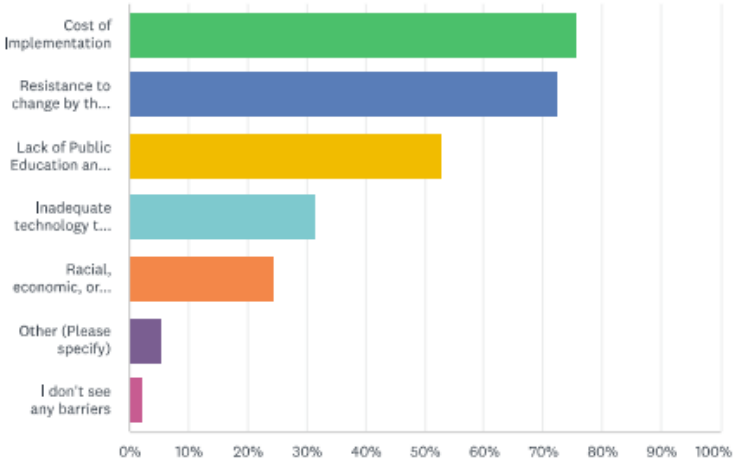
ANSWER CHOICES	RESPONSES	
Renewable Energy analysis and assessment	58.66%	210
Carbon sequestration (conservation of green spaces, planting and preservation of trees)	53.91%	193
Economic incentives for residents to modify homes	47.77%	171
Higher energy efficiency building standards	42.18%	151
Installation of public electric vehicle charging stations	39.94%	143
Electrification of the Town's vehicle fleet	35.75%	128
Non-fossil fuel transportation options (e.g. bike lanes)	29.89%	107
Community-wide composting program	27.37%	98
Solid waste and recycling education	24.86%	89
Municipal and residential battery storage	17.04%	61

Total Respondents: 358

Question 5

What are the barriers to addressing climate change in Hingham? Select all that apply.

Answered: 361 Skipped: 1



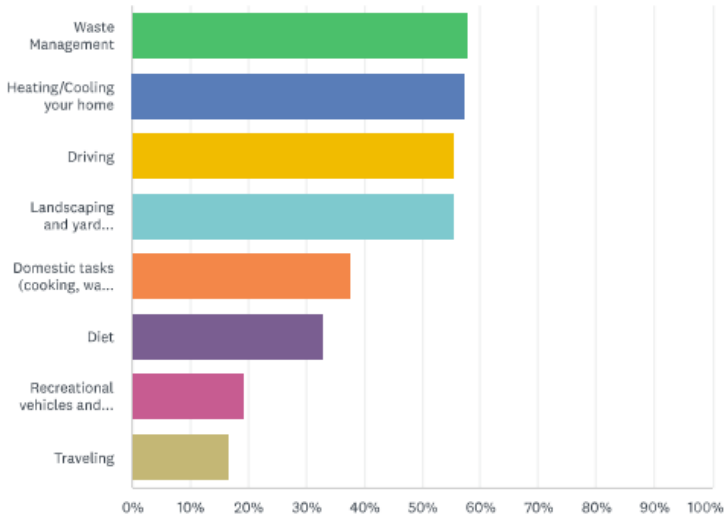
ANSWER CHOICES	RESPONSES	
Cost of Implementation	75.62%	273
Resistance to change by the public/private/corporate/industrial sector	72.30%	261
Lack of Public Education and Information	52.63%	190
Inadequate technology to address climate change	31.30%	113
Racial, economic, or other inequalities	24.38%	88
Other (Please specify)	5.26%	19
I don't see any barriers	2.22%	8

Total Respondents: 361

Question 6

Which part of your carbon footprint (amount of carbon you personally emit) are you most willing to change? Select up to four.

Answered: 344 Skipped: 18



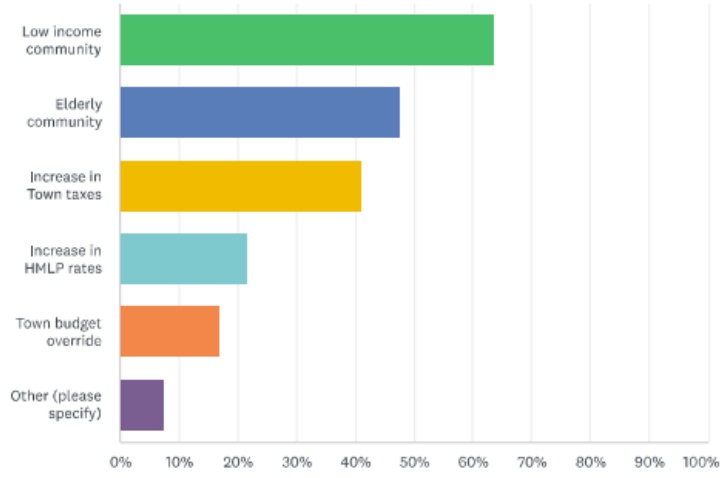
ANSWER CHOICES	RESPONSES	
Waste Management	57.85%	199
Heating/Cooling your home	57.27%	197
Driving	55.52%	191
Landscaping and yard maintenance	55.52%	191
Domestic tasks (cooking, water heating, drying clothes, etc)	37.50%	129
Diet	32.85%	113
Recreational vehicles and boats	19.19%	66
Traveling	16.57%	57

Total Respondents: 344

Question 7

What equity issues should we be mindful of when creating the plan? Select up to two.

Answered: 361 Skipped: 1



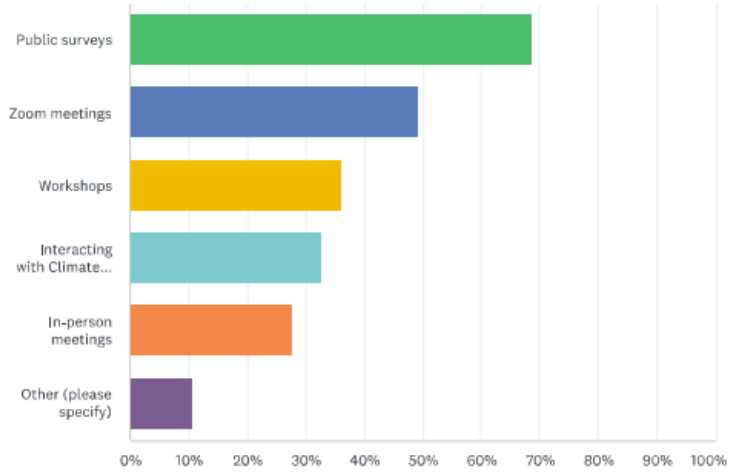
ANSWER CHOICES		RESPONSES	
Low income community		63.43%	229
Elderly community		47.65%	172
Increase in Town taxes		41.00%	148
Increase in HMLP rates		21.61%	78
Town budget override		16.90%	61
Other (please specify)	Responses	7.48%	27

Total Respondents: 361

Question 8

How would you like to be involved in climate action planning in Hingham? Select all that apply.

Answered: 361 Skipped: 1



ANSWER CHOICES		RESPONSES	
Public surveys		68.70%	248
Zoom meetings		49.03%	177
Workshops		35.73%	129
Interacting with Climate Action Planning Committee (CAPC) at events		32.41%	117
In-person meetings		27.70%	100
Other (please specify)	Responses	10.53%	38

Total Respondents: 361

Question 9

Do you have any other comments or suggestions?

Specific answers are available through the Town of Hingham.

Question 10

If you would like to receive updates on the plan and information about future events, please include your contact information below. For privacy purposes this information will not be shared or sold to third parties.

Answered: 178 Skipped: 184

ANSWER CHOICES		RESPONSES	
Name	Responses	95.51%	170
Company	Responses	0.00%	0
Address	Responses	92.13%	164
Address 2	Responses	0.00%	0
City/Town	Responses	94.38%	168
State/Province	Responses	94.94%	169
ZIP/Postal Code	Responses	93.82%	167
Country	Responses	82.58%	147
Email Address	Responses	92.70%	165
Phone Number	Responses	65.73%	117

Survey End

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APPENDIX D
List of Public Meetings and Community Engagement

Hingham
Climate Action
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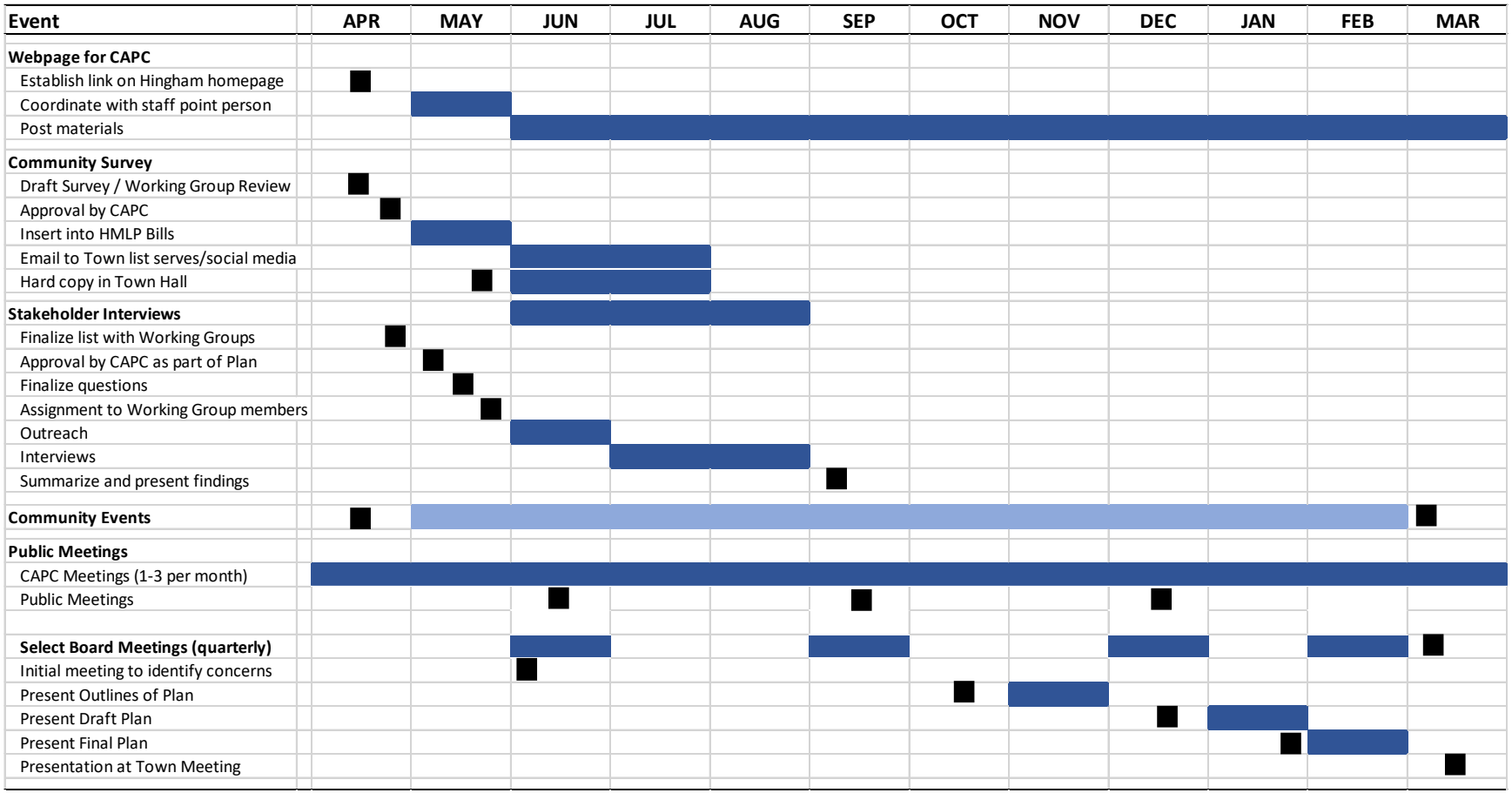
D.1. Schedule of Public Outreach (2022-2023)



Hingham Climate Action Planning Committee

D.2. List of Public Meetings and Outreach

CAPC MEETINGS

2023

- January 11, 2023
- January 26, 2023
- February 16, 2023
- March 16, 2023
- March 29, 2023
- May 3, 2023
- May 17, 2023
- June 15, 2023
- June 28, 2023
- July 19, 2023

2022

- January 26, 2022
- February 9, 2022
- March 2, 2022
- March 8, 2022
- March 24, 2022
- April 6, 2022
- April 27, 2022
- May 25, 2022
- June 1, 2022
- June 29, 2022
- July 13, 2022
- August 3, 2022
- August 17, 2022
- August 31, 2022
- September 14, 2022
- September 20, 2022
- September 28, 2022
- October 12, 2022
- October 26, 2022
- November 10, 2022
- December 1, 2022
- December 7, 2022
- December 14, 2022

2021

- December 22, 2021
- December 1, 2021
- November 18, 2021
- November 3, 2021
- October 27, 2021
- October 13, 2021
- September 22, 2021

PUBLIC ENGAGEMENT MEETINGS

- December 7, 2022
- September 20, 2022
- June 15, 2022

PRESENTATIONS TO SELECT BOARD

- October 18, 2022
- June 28, 2022
- July 25, 2023

PRESENTATIONS TO TOWN BODIES

- Energy Action Committee: February 21, 2023
- School Committee: March 27, 2023
- Planning Board and the Development & Industrial Commission: June 5, 2023

PRESENTATIONS TO SUSTAINABLE SOUTH SHORE

- November 28, 2022
- May 31, 2022

PUBLIC EVENTS

- South Shore Eco Fest, April 29, 2022
- Hingham's Farmer's Market, August 13, 2022

PUBLIC ARTICLES

- John Borger, *The Anchor*, "Meet Hingham's Climate Action Planning Committee," September 9, 2022, https://www.hinghamanchor.com/meet-hinghams-climate-action-planning-committee/

- Carol Britton Meyer, *The Anchor*, "Citizen Involvement Key to Climate Action Plan's Success," October 19, 2022, https://www.hinghamanchor.com/citizen-involvement-key-to-climate-action-plans-success/

- Joel Barnes, *The Patriot Ledger*, "From Solar Power to Water Use, Hingham Is Looking Toward the Future of Climate Change," December 11, 2022, https://www.patriotledger.com/story/news/2022/12/11/from-fossil-fuels-to-electricity-hingham-looks-to-future-of-climate-change/69705543007/

VIDEO: https://youtu.be/fQ-PChBF6IU

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APPENDIX E
Examples of Grants and Funding Opportunities

Hingham Climate Action Planning Committee

Examples of Grants and Funding Opportunities

Grants and funding opportunities are constantly changing, and this appendix should serve as an example of potential funding available and as a basis for researching future grant opportunities going forward.

Category	Program	Agency	Program Goals
Electricity	MAPC Technical Assistance Program	MAPC	Ongoing support for technical services associated with implementing clean energy and decarbonization investments
	Transmission Facilitation Program (TFP)	U.S. Department of Energy	Facilitate upgrades to transmission facilities
	Grid Resilience and Innovation Partnerships Program (GRIP)	U.S. Department of Energy	Grid Resilience Utility and Industry Grants, including smart grid grants and grid innovation programs
	Inflation Reduction Act	U.S. Department of Energy	Clean energy, climate mitigation and resilience, agriculture on conservation related investment programs
Buildings	MAPC Technical Assistance Program	MAPC	Ongoing support for energy efficiency investments
	DOER Green Communities	DOER	Helps municipalities reduce energy use and costs by implementing clean energy projects in municipal buildings, facilities and schools
Transportation	MPO Community Connections Program	MPO	Provides first and last mile solutions for community transportation, bike supportive infrastructure, bike share stations, vehicles, bike parking, shelters and lanes
	Complete Streets Program	MassDOT	Provides safe accessible options for all travel modes – walking, biking, transit, and vehicles.

Category	Program	Agency	Program Goals
	MassEVIP Fleets Incentives	MassDEP	Helps eligible public entities acquire electric vehicles for their fleets
	MAPC Technical Assistance Program	MAPC	
	Shared Streets and Spaces Program	MassDOT	Provides funding to municipalities to quickly implement improvements to plazas, sidewalks, curbs, streets, bus stops, parking areas and other public spaces to promote public health, safe mobility and strengthened commerce.
	MassEVIP	Massachusetts	Funding opportunity for municipalities to fund public and fleet charging stations
	MORE-EV	Massachusetts	Funding opportunity for residents, businesses and non-profits to install public and fleet vehicle charging stations
	Electric School Bus Program	EPA	Distribute $5 billion in funding to subsidize electric school buses
Recycling	SMRP - Small Initiative Program	MassDEP	Support local recycling, composting, organics, reuse, source reduction policy development and enforcement
	SMRP -Recycling Dividends Program	MassDEP	Payments to municipalities that have implemented specific programs and policies to reuse, recycle and reduce waste
Natural Resources	MVP Program - Planning GrantAction Grant		Supports communities as they build resilience to climate change
	DCR Grants (e.g., Mass Trails, LAND Grant, PARC grant, etc.)	Division of Conservation and Recreation	Acquisition of conservation and recreation land, as well as development and recreation of parks