

Town of Andover

Climate Action & Sustainability Plan



September 2023

Table of Contents

04	Acknowledgements
06	Foreword
08	Letter from the Steering Group
09	Introduction
16	Climate Action at the State Level
17	Andover's Climate Action Goals
18	Plan Development
20	Overview of the Plan
26	Buildings
39	Energy

Cover page image: "Climate Change Vision," artwork by Sean Kim, Pike School

60	Mobility
69	Public Health & Safety
80	Natural Resources
106	Waste
118	Implementation Roadmap
124	Conclusion
126	Glossary & Abbreviations

Land Acknowledgement

We open by respectfully acknowledging that we collectively gather on the territory of many Indigenous peoples, who have stewarded this land for hundreds of generations.

With gratitude to the Andover Center for History & Culture for their guidance, we acknowledge the harmful effect colonization and violent systemic and cultural inequities have had on our understanding of Indigenous identity and terminology.

Andover was home to the Pennacook people as early as 6000 BCE, and we honor their past, present, and emerging leaders.

Land Acknowledgments are a small, but essential, step towards building a culture of respect, truth, and accountability.

Acknowledgements

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Kate Margolese, Andover WECAN

Mary Pritchard, Andover WECAN

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Town Hall in Snow. Photo by Kate Margolese

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Foreword



A Message from Town Manager, Andrew Flanagan

I am proud to release Andover's first Climate Action and Sustainability Plan. The Plan reflects three years of data gathering through a greenhouse gas emission inventory process; many regional and community dialogues that began during the Climate Summit; and through a detailed strategic planning process conducted during the last year.

At every phase of this process, the Town benefited greatly from the contributions of a committed Steering Committee comprised of talented volunteers from our community, and from the capabilities of our consultant, Weston & Sampson. This group worked tirelessly to conduct one-on-one interviews with area companies, host workshops, compile case studies from prior successful efforts, and to organize and analyze hundreds of comments submitted by municipal staff, students and residents through a comprehensive survey. The engagement process resulted in 1,000 touchpoints. I also want to thank Joyce Losick-Yang, Andover's Director of Sustainability & Energy, for her diligence, dogged commitment to sustainability, and her skillful ability to build community through this ambitious undertaking.

The result of this exhaustive process is a comprehensive plan that outlines 16 high-impact strategies and 35 corresponding actions, tailored to the needs of our community, that can help cut greenhouse gas emissions and make our community safer.

The actions outlined in the Plan are necessary to help us meet the moment. Never before have we faced a set of challenges as far-reaching and complex as climate change. This Plan is Andover's roadmap to a more sustainable future, for this generation and those to follow. The Plan does nothing by itself. Action is needed, and the implementation details within the Plan outline ways that our community can mobilize the resources required to achieve measurable progress. The Plan also sets ambitious and quantitative goals that will help us chart our impact from now until 2050.

I applaud the Andover community's commitment to confronting climate change – and I know that deep and broad support within this community will be critical as we seek to implement this Plan. The youth of Merrimack Valley released a joint statement at the Climate Summit to demand “social justice in the realm of climate change, providing every member of communities equal and adequate opportunities to their future”. At our Annual Town Meeting in 2023, the Andover Sustainability Resolution passed nearly unanimously, and asked that the Town's climate mobilization efforts “do not unfairly burden those who are economically or socially disadvantaged and that benefits of a realized, sustainable future accrue to all.” Equity is a guiding principle of the Plan, and equity considerations are woven throughout our actions.

Because of the magnitude of the work ahead of us, I recognize that the Plan must remain a living document. Meeting the goals will require the community to stay nimble, to pivot when we encounter hurdles and to incorporate new solutions and innovations when they arise. At every turn in the road ahead, I commit to deliver the high quality services our community deserves, and to be a true partner on this journey.



Our personal protective equipment for the long emergency ahead depends on recognizing our interconnection. Emotional intelligence, practices to stretch the window of tolerance, the ability to sit with uncertainty, the dexterity to balance hope and fear, a commitment to not narratively foreclose the future, the belief that our actions are meaningful, an embracing of ambivalence, and a connection to a strong community that acts together to care for itself—all of these skills appear in the tool kit for surviving and thriving in the years to come.

— *Britt Wray, PhD, Generation Dread: Finding Purpose in an Age of Climate Crisis, Alfred A. Knopf, Canada, Kindle, 233. Provided by Committee Member, Dennis Richards*

Letter from the Committee

Dear Neighbor,

We stand at a pivotal moment in history. We are witnessing record heat, deadly wildfires, torrential rains and floods, all effects that climate change is bringing to our planet, to our home. A call to action is paramount! For this reason, we are grateful that in 2023, the residents and town leaders of Andover have come together to set our town on a sustainable path to the future through the creation of the Climate Action and Sustainability Plan (CASP). We are committed to the success of the strategies and actions outlined in the CASP.

The CASP was built on years of commitment to environmental values and solutions. Community and town leaders and staff worked together to collect the data appropriate to Andover and to consider the most effective options for the 35 actions outlined in the plan. We are grateful for their dedicated work and expertise. We are especially grateful to Andover's Director of Sustainability, Dr. Joyce Losick-Yang, for leading us with her determination, expertise, and consensus building skills. We applaud the work that has been done over the years to make Andover a Green Community. We also acknowledge the important contributions made by community boards, businesses, committees, civic organizations, faith communities, advocates, and residents. Momentum for the CASP was accelerated with the overwhelming passage of the Andover Sustainability Resolution at Town Meeting 2023 and its vision to reimagine Andover's future. Community support for climate action has been turned into an ambitious, achievable climate action document to achieve net zero by 2050.

The response to the climate crisis has given us the opportunity to unite the town around a common goal, creating stronger connections between neighbors as we work to implement this action plan.

We see a bright future if we all pull in the same direction together. In reducing our carbon emissions, Andover will have cleaner air, improved public health, and overall quality of life. Our buildings will be healthier and more efficient. We will think about transportation and mobility in new ways and find better solutions for our waste. We will increase biodiversity through the protection and restoration of our open spaces and forests and the planting of native trees and plants. We will focus on and support our youth and the mental health challenges caused by climate anxiety. These behavioral shifts in how we live and think will result in a healthier and more resilient community.

The Climate Action and Sustainability Plan offers answers to "What can we do?" with a roadmap of actions that will deliver a cleaner, brighter, and more equitable future across economic, racial, and cultural differences. We ask you, our neighbors, to look for ways you can participate in this town-wide effort.

This is an effort that will touch each of us and require all of us!

Sincerely,

CASP Steering Committee

Mary Pritchard
Diane Shen
Jacqueline Salit
Dennis Richards

Kate Margolese
Candy Dann
Jonathan Unger
Mark Spencer

Introduction

Andover's first Climate Action and Sustainability Plan is informed by our residents and businesses, our shared values, and science. This plan builds upon significant climate work in town and **shares how we as a community can equitably reduce our greenhouse gas emissions and live in a more sustainable community.** Andover is home to more than 36,000 residents and a wide range of businesses from local shops and restaurants to multinational corporations. As a desirable place to live and work, we need to be prepared for the changing climate and actively work to reduce our greenhouse gas emissions. With Andover's unique attributes including the large commercial and industrial sectors, valuable natural resources, and passionate residents, the community has both challenges and opportunities for climate adaptation and mitigation that differ from its neighbors.

This Climate Action and Sustainability Plan will serve as a comprehensive roadmap for taking climate action and building resilience, while aligning with regional and statewide efforts. Achieving net-zero emissions and preparing for the future will require a collaborative effort from the municipality, residents, businesses, and community groups.



Step it Up Andover. Photo by Kate Margoless



Mission Statement

The Town of Andover will meet the State's net-zero emissions mandate by 2050 along with the interim targets for 2030 and 2040. We envision a community that equitably supports economic, social and sustainable growth. We welcome new neighbors and businesses and embrace the cultural richness of Andover's history and its people.

By making transformative changes in reducing energy use, promoting renewable energy adoption, implementing sustainable and health-conscious construction practices for new and existing buildings, advocating for electrical vehicle adoption, as well as shaping a respectful relationship with our environment and natural resources, Andover will reduce greenhouse gas emissions while promoting sustainable growth. Through improved infrastructure, zoning, policies, education, and communication, the town will enjoy a more resilient future.

Guiding Principles

Andover's climate adaptation and mitigation actions will be guided by four key principles. These principles are resilience, equity, justice, and collaboration.



Resilience

Resilience is defined as the capacity of individuals, communities, businesses, institutions, and governments to adapt to changing conditions and to prepare for, withstand, and rapidly recover from disruptions to everyday life, such as hazard events.¹ Climate change remains shrouded in uncertainties, making climate resilience an exceptionally important concept to consider when developing a path forward for the Andover Community. Hazard events are likely to become more frequent and more severe (Refer to **Climate Hazards & Impacts**). The Town of Andover should aim to not only survive these events but thrive even in the face of uncertainty. Integrating resilience into climate action strategies can help the Town be better prepared for changing conditions.



Equity

As the Town of Andover considers climate adaptation and mitigation strategies, it must also consider equity. Equity is the consistent and systematic fair, just, and impartial treatment of all individuals.¹ Climate adaptation and mitigation strategies must serve and protect all members of the Andover community, especially those who have been historically underserved or underrepresented. Andover must strive to cultivate an atmosphere of inclusion and representation, and to implement practices that support equitable participation in local planning. Implementation of climate actions and resilience strategies should also be done in an equitable manner so that all Andover residents—regardless of their race, ethnicity, color, gender, age, sexuality, national origin, ability, or income—can experience the benefits and avoid additional burdens in the transition to a more sustainable Andover.



Justice

Justice, specifically environmental justice (EJ), is the principle that all people have a right to be protected from environmental hazards and to live in and enjoy a clean and healthful environment. EJ is the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits.² Environmental justice will be achieved when no group endures disproportionate impacts from climate change or environmental hazards when compared to other groups. Climate change is already having disproportionate impacts on those who have contributed to its causes the least. The Town of Andover aims to dismantle this injustice and prevent it from persisting within the community. Keeping environmental justice at the forefront of discussions surrounding climate adaptation and mitigation strategies will ensure that all needs of the community are met in an equitable way. Andover has one Environmental Justice Population designated by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) in which the minority population is 49.3% of the neighborhood (by census block groups).³

¹ Definition from the Federal Emergency Management Agency

² Definition from the Massachusetts Executive Office of Energy and Environmental Affairs

³ Massachusetts 2022 Environmental Justice Populations <https://www.mass.gov/info-details/massgis-data-2020-environmental-justice-populations>



Ballardvale Dam on The Shawsheen River. June 23, 2023. Photo by Jon Unger



Collaboration

Achieving decarbonization, resilience, equity, and justice cannot be accomplished in isolation. Implementing resilient, equitable, and just climate adaptation and mitigation strategies will take the combined efforts of Town departments, community groups, businesses, non-profits, and individuals. Not only will it be important to collaborate within the Town of Andover, but it will also be important to coordinate efforts with neighboring towns and communities, and align with statewide efforts. Increased collaboration increases the chances of successful and effective implementation of climate adaptation and mitigation strategies.

The development of the Climate Action and Sustainability Plan coincided with the development of the Master Plan and the Community Health Plan, both of which support climate adaptation and mitigation efforts for a more sustainable Andover. The Master Plan includes an Environmental Sustainability section with goals regarding sustainable development, alternative and electric transportation, and residential and commercial climate action that are closely aligned with actions described in this plan. The Community Health Plan includes priorities and objectives related to building a sense of community and improving access to health resources, housing, and alternative transportation. The Town's Active Transportation Plan is also underway and will develop a long-term vision and plan for enhancing pedestrian/bicycling movement throughout town. This will include safety and infrastructure improvements, Complete Streets funding opportunities, reduced reliance on vehicles, and an improved sense of community.

Continued collaboration is needed to implement the actions and recommendations in all of these plans to make Andover a more sustainable community to live and work in.

Greenhouse Gas Emissions

Carbon dioxide, methane, nitrous oxide, and fluorinated gases are considered greenhouse gases (GHGs). Although these gases are released naturally, human-caused activities (i.e., burning fossil fuels to power buildings, vehicles, etc.) are greatly contributing to global warming because these gases trap heat. The rate at which GHG emissions are being produced has accelerated and is leading to long-term shifts in temperatures and weather patterns.

To understand Andover's contributions to climate change, a baseline greenhouse gas emissions inventory was conducted. This is the first step in tracking progress toward emissions reductions and net-zero goals. By using science-based data we can make more informed decisions and better prioritize high impact actions to mitigate climate change.

The emissions baseline was developed for 2017, consistent with other communities including Arlington, Natick, and Melrose. This year was selected because it is fairly recent, but independent of the 2018 Columbia Gas incident and COVID-19. Additional inventories will be conducted in future years and compared with the baseline to assess progress toward reducing these emissions.

The inventory was conducted following the guidance provided with the Metropolitan Area Planning Council's (MAPC) GHG Inventory Tool and used a combination of municipal data and publicly available data from entities such as Mass Save, MAPC, U.S. Census, etc. The inventory includes:



Stationary:

Electricity and fossil fuel usage from all buildings in Andover plus off-road equipment fuel usage



Transportation:

All vehicles registered in Andover plus the portion of Massachusetts Bay Transit Authority (MBTA) systems used in Andover



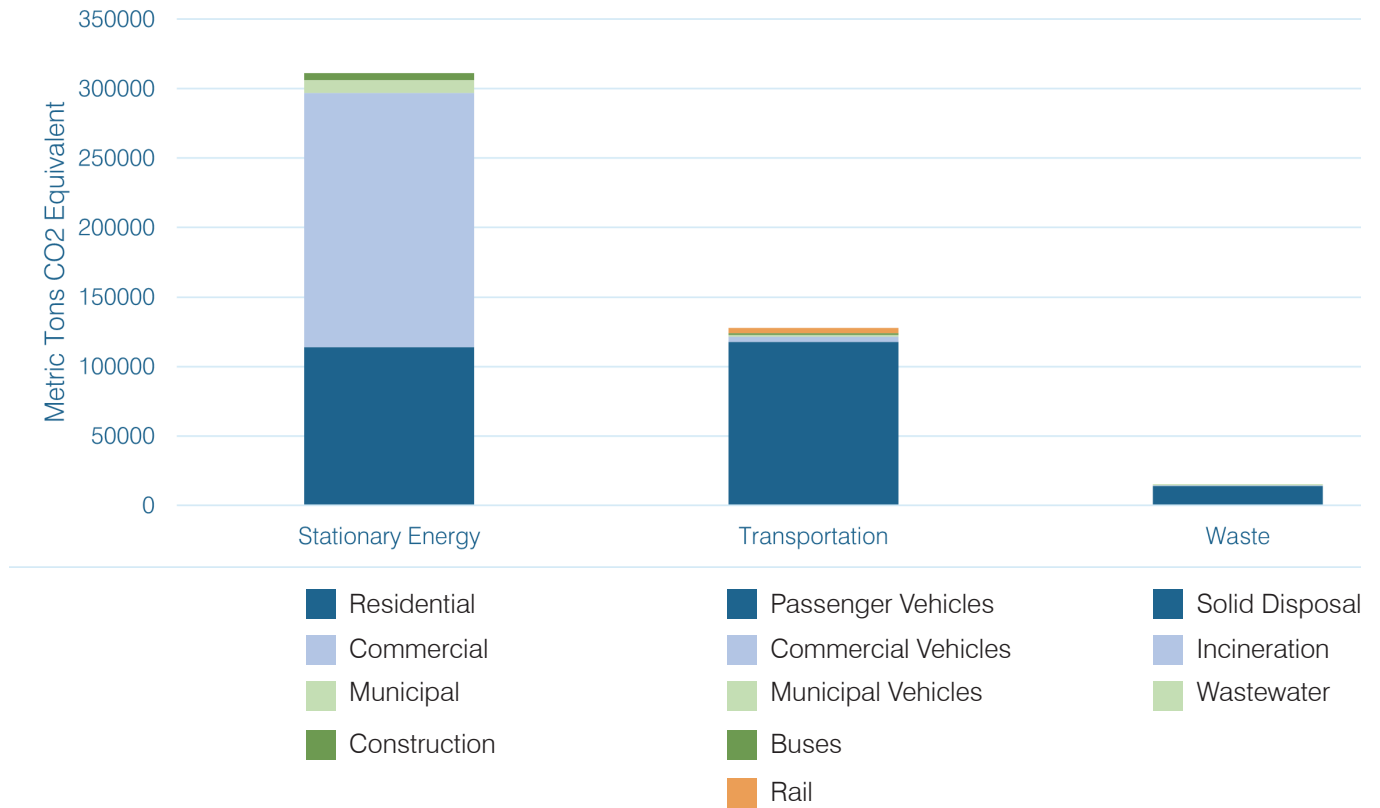
Waste:

All waste and wastewater disposed by Andover



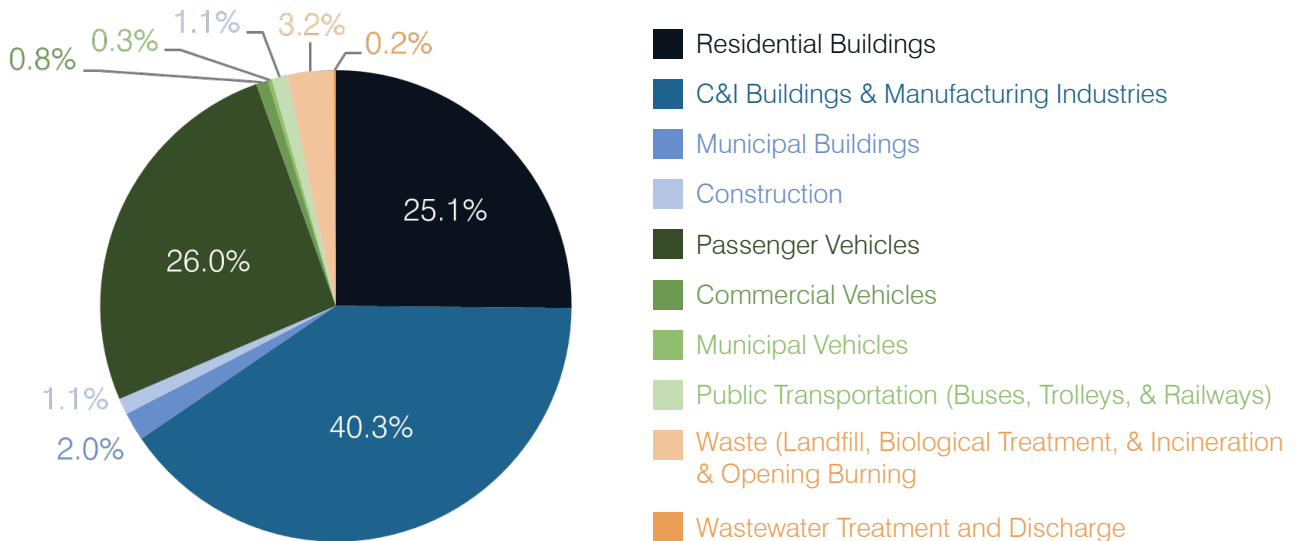
The community as a whole, including residents, businesses, and the municipality, were responsible for emitting **453,779 metric tons of carbon dioxide equivalent (MTCO₂e) in 2017.**

Baseline Greenhouse Gas Emissions Inventory (2017)

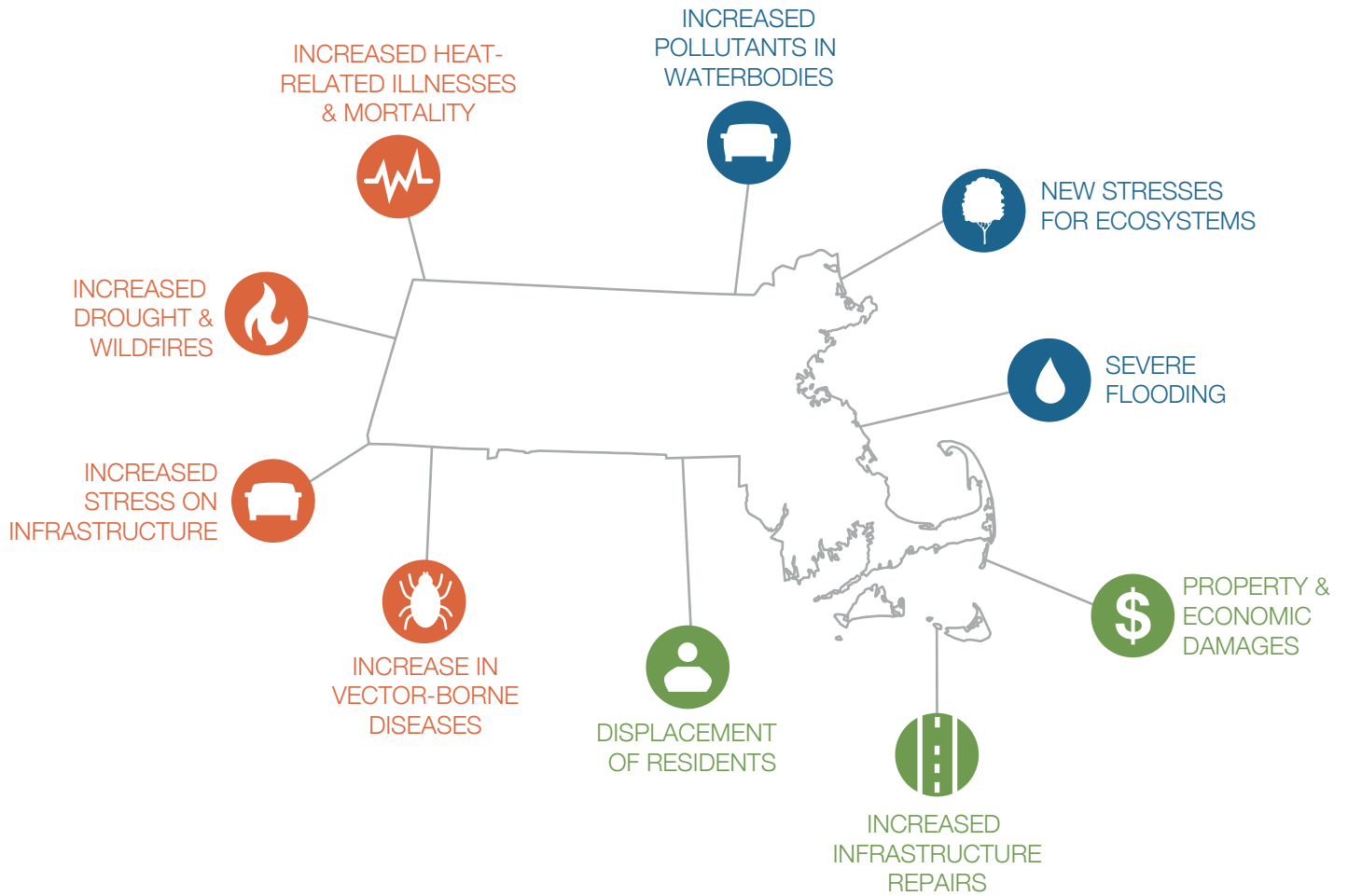


The three largest portions of Andover’s emissions include commercial/industrial buildings (40.3%), residential buildings (25.1%), and passenger vehicles (26.0%). The emissions associated with municipal buildings and vehicles represent only a small fraction of the total emissions at 2.3%. Given this distribution, actions that help residents and businesses transition to more sustainable alternatives can have considerable emissions reductions, while the Town can lead by example in decarbonizing its own operations.

GHG Emissions by Type



Climate Hazards & Impacts



By the end of the century, Andover and the surrounding region will experience between 28 and 46 days per year with temperatures over 90 degrees Fahrenheit. Compared to an average of only had 7 days between 1971 to 2000.

Total annual precipitation at century's end is projected to increase by as much as 18% above the 1971-2000 baseline of 45 inches.

Source: ResilientMA <https://resilientma-mapcenter-mass-eoeea.hub.arcgis.com/>

The Municipal Vulnerability Preparedness (MVP) Community Resilience Building process identified flooding, nor'easters, and extreme temperatures as the Town's top climate hazards of concern.

Impacts from Climate Hazards

Infrastructure:

Infrastructure including buildings, bridges, culverts, dams, sewer systems, water systems, storm drain lines, and power and communication networks are all vulnerable to extreme storm events, especially aging infrastructure. Additional maintenance and repair may be needed as normal climate conditions change.

Natural Resources:

The changing climate is expected to lead to increased growth of invasive species, reduction in biodiversity, and ecosystem disturbance.

Protecting existing natural resources continues to become more important as we rely on them for ecosystems services such as flood reduction, carbon sequestration, water and air purification, shade, etc.

Public Health and Safety:

Physical and behavioral health, including mental health, is likely to be impacted by climate change. Examples of the impacts include increased injuries and deaths including heat-related illnesses, increased health costs, increased vector- and water-borne diseases, reduced air quality, reduced recreation opportunities, limited access to emergency services and evacuation, respiratory diseases and asthma, increased allergens, reduced water and food quality, reduced air quality, etc.

Financial:

Cost of recovering from storm events, such as property damage and lost income, can be a burden to residents, businesses, and the Town. In addition to storm events, some sectors, such as agriculture and others that are highly dependent on natural resources, may be significantly impacted by other, less pronounced changes in climate (e.g., shifts in growing seasons and successful crop types), therefore leading to cascading impact. Learn more about climate impacts in Andover from the **MVP Community Resilience Building Report**, Hazard Mitigation Plan (expected 2024) and from state resources such as **ResilientMA** and in the **Massachusetts Climate Change Assessment**.



Flooding

Andover residents and businesses have long been impacted by flooding. More recently, severe flooding was experienced in the spring of 2006 (Mother's Day Flood) and 2010. During the 2010 event, major roads were flooded, a sewer pump station failed, schools were closed, homes and businesses were damaged, and residents were evacuated including 115 older adults living at Atria Marland Place. Many locations were impacted by both the 2006 and 2010 events including the residents of Washington Park Condominiums.

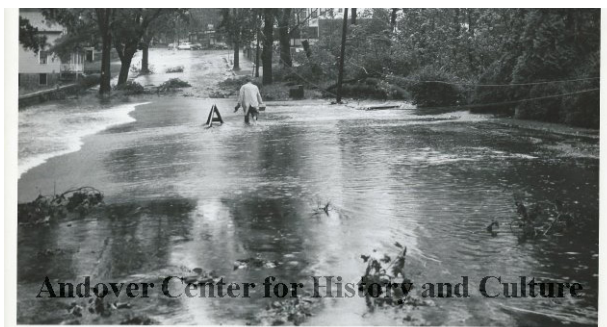
Source: March 17, 2010. Flooding Displaces Hundreds. Andover Townsman.

https://www.andovertownsman.com/news/flooding-displaces-hundreds/article_dbc18892-e2e4-5e38-b825-5f069abc9daa.html



Extreme Heat

In the last several years, the Town has used municipal buildings as cooling centers during extreme heat events including the Memorial Hall Library in 2019 and the Robb Center in 2022.



Flooding and damaged powerlines from Hurricane Edna in 1954 taken by Donald Look. Flooded area of Central Street looking toward Elm Street-Main Street Andover. Photo from the Andover Center for History & Culture

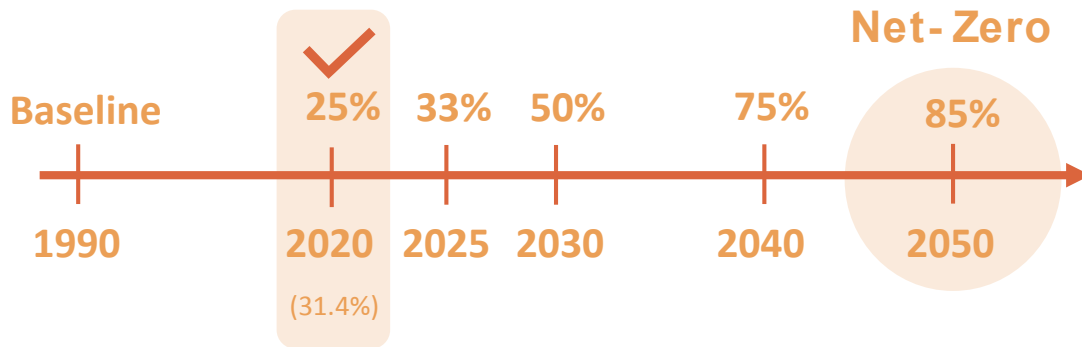


1936 Shawsheen flood. View of York Street with man in row boat. Photo from the Andover Center for History & Culture

Climate Action at the State Level

The Commonwealth of Massachusetts is taking action to address climate change impacts and contributions on numerous fronts, detailed in the **MA Decarbonization Roadmap** (2020) and the passing of the **Climate Act of 2021**, also known as An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy. The Climate Act of 2021 required the adoption of statewide goals to reduce greenhouse gas (GHG) emissions and sector-specific sublimits to progress toward interim emissions reduction goals, with the goal of achieving net-zero emissions by 2050.

The Commonwealth defines net-zero as “a level of statewide greenhouse gas emissions that is equal in quantity to the amount of carbon dioxide or its equivalent that is removed from the atmosphere and stored annually by, or attributable to, the Commonwealth; provided, however, that in no event shall the level of emissions be greater than a level that is 85 percent below the 1990 level.”¹



The **Clean Energy and Climate Plan for 2025 and 2030**, published in June of 2022, built upon the modeling and analysis of the Decarbonization Roadmap with a greater focus on climate action through 2030. This plan outlines specific strategies, policies, and implementation goals and benchmarks for the Commonwealth to reduce emissions in a cost-effective and equitable manner, with a focus on efforts now through 2030 to achieve a 50% reduction of GHG emissions from the 1990 baseline.²

Given the commonwealth’s ability to develop wide-reaching policy and facilitate the transition of larger scale infrastructure, this allows Andover to focus efforts locally while also experiencing benefits of state-wide action. One example of this relationship is the recent updates to the Stretch Energy Code, led by the Department of Energy Resources (DOER). As a stretch code community already, Andover’s new buildings and qualified retrofits are subject to the new requirements for installation and/or prewiring of net-zero enabling technologies. This statewide action is helping communities decarbonize the building stock, therefore making progress on both statewide and Andover specific GHG emissions reduction goals.

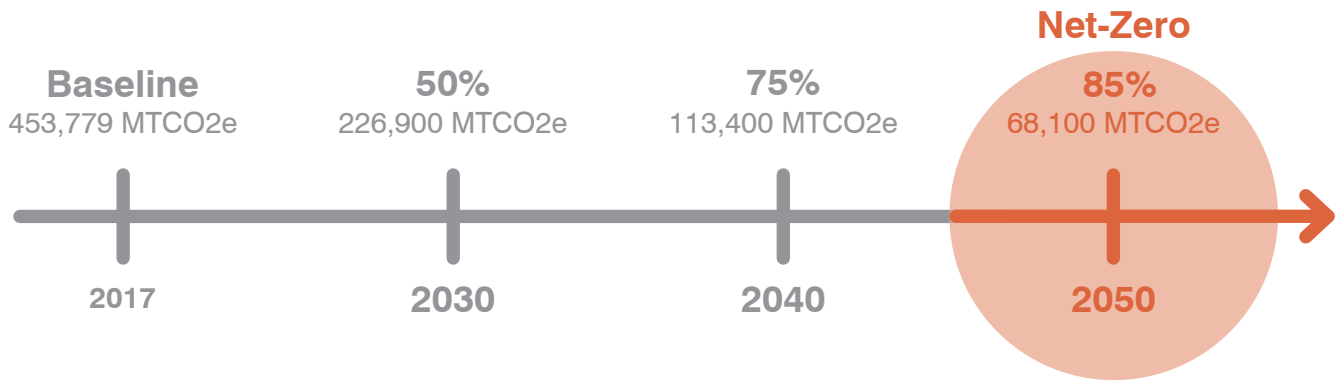
¹ **Determination of Statewide Emissions Limit for 2050.** April 22, 2020.

² **Massachusetts Clean Energy and Climate Plan for 2025 and 2030.** June 30, 2022.

Andover's Climate Action Goals

In alignment with the goals adopted by the Commonwealth of Massachusetts to achieve net-zero by 2050, Andover has undertaken its own roadmap to incorporate the unique attributes of the town through this transition.

Andover aims to achieve net-zero emissions by 2050 which includes an 85% emissions reduction from the 2017 baseline. Interim goals include a 50% reduction and 75% reduction of emissions from the 2017 baseline by 2030 and 2040, respectively. The remaining 15% of emissions that may be unavoidable will be accounted for with natural carbon sequestration from lands such as forests and wetlands and additional carbon capture and storage with emerging technologies.



With an understanding of where Andover's emissions are coming from, 2030 and 2050 targets for measuring progress have been set to guide emissions reductions and resiliency improvements. These targets are action specific and summarized by sector in the Implementation Plan section.



Andover WECAN educating community members on climate action at Andover Thrives Community Day. Photographer: Kate Margolese



Andover staff and volunteers meet up at the Municipal Services Facility to make sure rain barrels are intact prior to distributing them to residents. Photographer: Amy Latva-Kokko

Plan Development

Andover has been taking action to reduce greenhouse gas emissions and improve sustainability and resilience in the last several years. By hiring a Sustainability Director in 2019, Andover improved its capacity to facilitate sustainable and resilient programs and policy initiatives. To further these efforts, the Climate Action and Sustainability Plan is designed to serve as a roadmap for meeting net-zero goals and better preparing the community for the future.

The development of this plan had nearly 1,000 touchpoints with community and municipal stakeholders. Over 450 residents, students, and businesses responded to the Climate Action and Sustainability Plan survey. This survey gathered information regarding concerns about climate change, current climate adaptation and mitigation strategies used, and barriers for further implementation.



Four public meetings (two virtual, two in-person) were held during the course of the project to gather input on goal setting, engagement planning, action development, and implementation details. Municipal staff were also engaged virtually and during an in-person session to learn about the need for climate adaptation and mitigation, and how their department can be involved in facilitating action implementation.

The Climate Action Planning Steering Group, consisting of volunteer residents, regularly provided guidance throughout the project.

The actions proposed in this plan leverage existing efforts and identify new opportunities to improve resilience and reduce emissions within the Town government and the community. Actions were developed using a four-step approach which included:

1. Identification of past and on-going climate action and resilience efforts
2. Compilation of actions from community engagement (e.g., Climate Summit and Interactive Community Forum) and best practices used by other communities
3. Revision and prioritization of actions
4. Development of detailed plans for implementing actions

The plan is organized into sectors, strategies, and actions. Descriptions of each sector provide context as to why the strategies and actions within it are important for achieving net-zero emissions and building resilience.

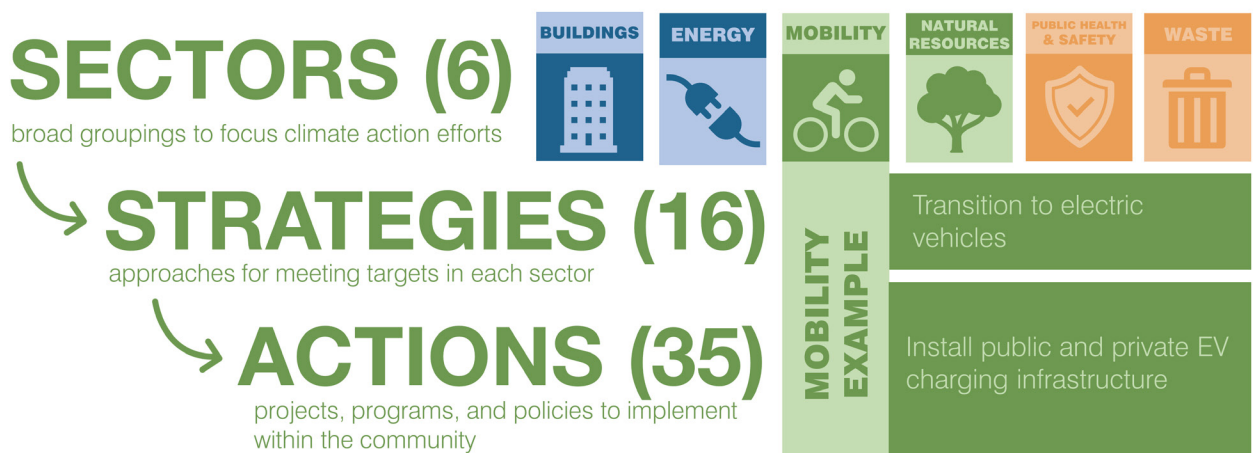


The Interactive Community Forum was held on April 10th, 2023 to gather input on actions.

Overview of the Plan

The Climate Action and Sustainability Plan identifies 35 actions that the Town can implement to reduce greenhouse gas emissions and building climate resilience to foster a more sustainable future for all community members.

Each of the 35 actions have a two-page implementation plan that details the action leader, supporting partners, key steps for implementation, ease of implementation, measures of success, timeframe, cost, possible funding sources, resilience considerations, co-benefits and equity considerations. This information provides a foundation for making progress toward each action.



Buildings

B-1 Construct Net-Zero, Low Embodied Carbon New Buildings

- B-1-1. Adopt the Specialized Stretch Energy Code
- B-1-2. Reduce embodied carbon in new buildings

B-2 Retrofit Existing Buildings to Use Less Energy & Renewable Energy

- B-2-1. Facilitate a residential electrification and energy efficiency program
- B-2-2. Facilitate a commercial and municipal electrification and energy efficiency program
- B-2-3. Develop a residential climate resilience strategy



Energy

E-1 Reduce Energy Use

- E-1-1. Educate commercial entities and municipal stakeholders on energy reduction
- E-1-2. Educate residents on energy reduction
- E-1-3. Partner with utilities to address gas leaks in supply infrastructure.

E-2 Transition to Renewable Energy

- E-2-1. Implement Municipal Aggregation (also known as Andover Community Power)
- E-2-2. Offer training programs for residents on solar and energy storage options.
- E-2-3. Increase the amount of voluntary MA Class I Renewable Energy Certificates for municipal electricity procurement contracts.

E-3 Emphasize Energy Education from Kindergarten through the Trades

- E-3-1. Increase clean energy and climate change educational programming into K-12 school curriculum.
- E-3-2. Clean Energy Workforce and Apprenticeship Initiative

E-4 Enhance Energy Resilience

- E-4-1. Evaluate municipal facilities energy supplies and add power redundancy.



Mobility

M-1 Enable and Promote Alternative Transportation

- M-1-1. Implement Active Transportation Plan

M-2 Transition to Electric Vehicles

- M-2-1. Install EV charging infrastructure
- M-2-2. Transition public fleets to EVs



Public Health & Safety

PH-1

Protect residents, workers, and visitors in the event of natural disasters or public health crises

- PH-1-1. Explore meaningful ways to increase emergency communication with the community
- PH-1-2. Develop neighborhood resilience hubs to coordinate and maintain resident well-being

PH-2

Enhance municipal and community preparedness to respond to climate impacts

- PH-2-1. Develop public health approach to build mental wellness and resilience
- PH-2-2. Identify and assess hazardous material storage locations at risk from flooding



Natural Resources

NR-1

Enhance and protect the tree canopy

- NR-1-1. Develop a program to maintain and improve the municipal tree canopy.

NR-2

Advance the smart and efficient use of water

- NR-2-1. Identify and repair water distribution system leaks.
- NR-2-2. Promote residential water conservation practices

NR-3

Promote and Protect Andover's biodiversity and natural resources

- NR-3-1. Lead by example with municipal adoption of sustainable landscaping practices
- NR-3-2. Facilitate the use of sustainable landscaping practices in Andover
- NR-3-3. Provide education on the protection of biodiverse ecosystems in the community

NR-4

Minimize stormwater run-off

- NR-4-1. Minimize impervious surfaces throughout Andover
- NR-4-2. Install nature-based solutions pilot projects in areas vulnerable to flooding

NR-5

Prioritize wetlands in enhancing Andover's resilience to climate change

- NR-5-1. Make Andover's wetlands more resilient
- NR-5-2. Promote community awareness of wetlands importance



Mentor Susan Valenti and Intern Davena Halak with an Environmental Sustainability Internship Course (ESIC) poster. Photo provided by Melanie Cutler

Waste

W-1

Reduce and Divert Waste

- W-1-1. Enhance and update the trash and recycling collection program
- W-1-2. Develop an organics composting program
- W-1-3. Establish a Recycle and Reuse Drop-Off Site
- W-1-4. Ensure parallel trash and recycling collection service for multifamily residential



Composting area. Photo by Kate Margolese



"Bag Monster." Photo by Amy Smith

Sector

Strategy

Action

Information on the sector, strategy, and action is listed at the top of the page



Action Description

Information about the action is described in narrative text



Key Steps for Implementation

Steps to achieve the action are listed chronologically



Action Lead

Information about department and organization involvement is listed in these rows



Supporting Partners



Ease of Implementation

- Department has authority to carry out
- Requires Select Board approval
- Requires Town Meeting vote



Measures of Success

Metrics that could be used to evaluate success are listed here

One of these boxes are checked, to indicate what is required

💡 Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*

A legend is included to define key categories



Action Initiation Timeframe



Resilience Considerations

Action initiation timeframe is shown on a sliding scale



Co-Benefits & Equity Considerations

Resilience considerations, and co-benefits and equity considerations, are described in text



Cost

Cost is summarized in dollar signs



Possible Funding Sources

Possible funding sources are listed in text

Buildings

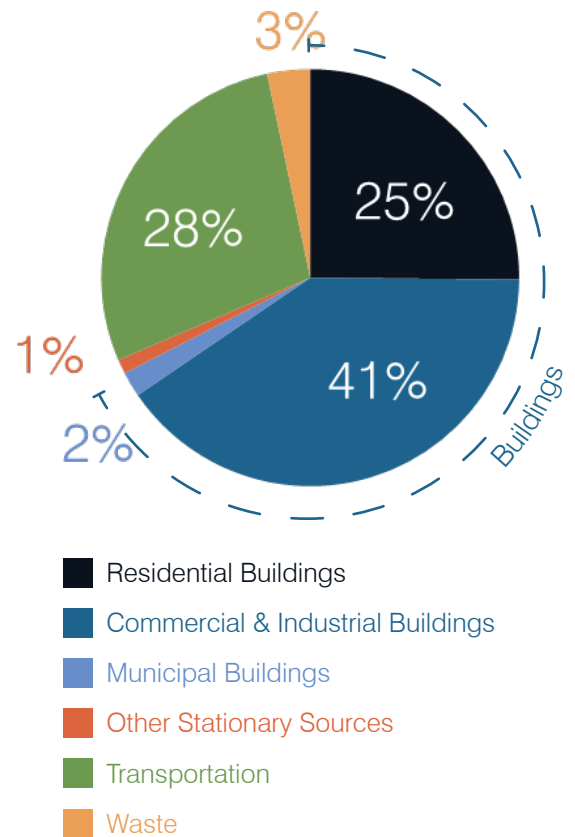
Climate resilient, net-zero buildings are essential for creating a more sustainable future. In Andover, buildings and the energy used to power operations occurring inside of them make up 67.4% of the total GHG emissions.

These GHG emissions can be reduced by combining energy efficiency with net-zero enabling technology. Energy efficiency improvements including weatherization, insulation, smart thermostats, lighting upgrades and controls, appliance upgrades, etc. can reduce energy consumption of buildings, therefore reducing greenhouse gas emissions. Incentives and rebates are available from a variety of organizations including Mass Save to help residents and businesses cost effectively implement energy retrofits. In 2021, Andover residents received \$1,116,839 in electric incentives, and Andover's commercial and industrial entities received another \$1,311,111 in electric incentives.¹ Emissions can also be reduced by transitioning heating, cooling, and other equipment that uses fossil fuels like natural gas or oil, to efficient, all-electric technologies such as air- and ground-source heat pumps. Electrification of building systems enables buildings to become net-zero as the electricity grid becomes more saturated with renewable energy sources.

The emissions included in the GHG inventory are also known as operational carbon emissions. Embodied carbon is defined by the Carbon Leadership Forum as, "the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials."² Andover does not yet measure its embodied carbon and aims to take initial steps to measure, bring awareness to, and reduce embodied carbon emissions. Material choices during the design process and improved building maintenance and repair or reuse are some examples of how embodied carbon emissions can be reduced.

Buildings of the future are being designed and constructed now so in order to meet net-zero goals in 2050, Andover's new buildings should be high performance, low embodied carbon, and net-zero ready to avoid the need to retrofit these buildings in the future.

Building Greenhouse Gas Emissions



1 Mass Save Data <https://www.masssavedata.com/Public/GeographicSavings?view=U>

2 Carbon Leadership Forum <https://carbonleadershipforum.org/embodied-carbon-101/>



Building strategies for Andover include:

B-1. Construct Net-Zero, Low Embodied Carbon New Buildings

B-2. Retrofit Existing Buildings to Use Less Energy and Renewable Energy



Building Measures of Success:

The following metrics can be used to quantitatively track progress during action implementation. Additional examples of measures of success are detailed throughout.

Action ID	Topic	Metric	2030 Target	2050 Target
B-1-1	New Buildings	% all electric new buildings	100%	100%
B-2-1	Existing Buildings	No. weatherizations installed/year	300	all homes insulated
B-2-1	Existing Buildings	No. heat pumps installed/year	200	all homes have heat pumps
B-2-1	Existing Buildings	% reduction in gas consumption	3%	80%
B-2-2	Existing Buildings	No. all-electric municipal buildings	2	8
B-2-2	Existing Buildings	% reduction in gas consumption	10%	50%



All homes will need to transition away from fossil fuel heating and cooling systems and improve energy efficiency. By engaging organizations that own or manage affordable housing, apartment complexes, and condominiums, the Town can advocate for deep energy retrofits and net-zero enabling technology to ensure everyone moves forward in the electrification transition. Additional resources and funding opportunities also exist for these types of housing and for low-income individuals and households, such as the **Mass Save Income Based Offers** like **Enhanced Residential Program** and **Income Eligible Program**.

Case Study

Buildings

All-Electric Efficient Air Source Heat Pumps

Environmental and health concerns over the continued use of fossil fuels, prompted us to choose to electrify as much of our home as we could. As our well maintained natural gas boilers began to age out, it was the perfect time to transition to **all-electric efficient air source heat pumps**.

Our first step was to increase the efficiency of our home through air sealing and insulating our building envelope. We installed ducts in our basement which service the HVAC needs of the first floor, and we installed floor mounted mini split units in the four main rooms of our second floor.

The first floor consists of one zone, and the second floor mini splits each act as its own individually controlled zone. There are times when we only need to cool or warm one or two rooms, and there are times when all units are working simultaneously. There is plenty of flexibility and the system has worked quite comfortably for us.

We decided to keep one of the two natural gas boilers as a “backup.” We have not really needed it. On the night when it was -12° F in the winter of 2023, our system worked fine, although not as efficiently as it would at 0° F and above. We ran the hydronic boiler just that one night, more to make sure that it would work than because the heat pump couldn't keep up. We chose a heat pump system that is specifically designed for the climate that we live in.

Some considerations from our experience:

- Your home or building will have its own needs, and you and your contractor can best determine what kind of system would work most suitably for you.
- Try to receive estimates from multiple contractors who are geographically reasonably close by and ask lots of questions. Your contractor should be aware of any rebates or tax incentives that your HVAC system might be eligible for.

- Jonathan Unger, Andover Resident

Buildings



B-1. Construct Net-Zero, Low Embodied Carbon New Buildings

B-1-1. Adopt the Specialized Stretch Energy Code



Action Description

The Specialized Stretch Energy Code is a set of regulations in Massachusetts that requires buildings to meet specific energy efficiency standards. The code requires that buildings with fossil fuel systems be pre-wired for future electric systems, and for smaller buildings to accommodate solar photovoltaic systems. Additionally, multifamily buildings over 12,000 sq. ft. must meet Passive House standards or net-zero home performance scores. The code is an above-code appendix to the state's base building energy code and is designed to result in cost-effective construction that is energy-efficient. New commercial and residential buildings and qualified renovations are required to comply with the specialized stretch energy code. This code builds upon the current stretch code (in effect as of January 1, 2023, and July 1, 2023). While this action has limited potential to reduce emissions associated with existing buildings, it can establish a standard for any future buildings constructed in Andover to be net-zero or net-zero ready. This is important because it is more difficult to retrofit buildings than to build new ones with net-zero enabling technology and adequate electrical service, especially as we approach 2050.



Key Steps for Implementation

- Internal and external training for building inspectors and related departments.
- Public education and meetings with developers, architects, and tradespeople.
- Select Board and Town Manager approval.
- Town Meeting vote.



Action Lead

Sustainability Department



Supporting Partners

- Community Development & Planning - Buildings
- Facilities Department
- Planning & Economic Development
- Andover WECAN
- Andover Green Advisory Board
- Memorial Public Library
- Developers, realtors, architects



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Reduction in fossil fuel use in buildings with significant renovations.
2. Number of new net-zero buildings constructed as a percent of all new buildings.

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Action Initiation Timeframe



Resilience Considerations

Passive House design can increase resilience by creating eco-friendly and energy-efficient structures that maintain consistent indoor temperatures and excellent air quality.¹ Passive House buildings can withstand severe climate events and power outages, making them resilient structures. Net-zero buildings can generate their own energy from renewable sources, such as solar and wind power, which can increase their independence and reduce their vulnerability to power outages and disruptions when paired with energy storage devices.²



Co-Benefits & Equity Considerations

1. The Specialized Stretch Energy Code would apply equally to all residential construction including low- and moderate-income construction. There are funds to support all-electric low- and moderate-income construction from the state and federal governments. The cost of implementation may dissuade property owners from retrofitting existing buildings.
2. The Specialized code includes provisions for improved indoor air quality, which can have positive impacts on public health.
3. The Specialized code can result in lower energy bills for residents of new buildings constructed under the code.
4. Buildings constructed under the Specialized code may have higher property values due to their energy efficiency and reduced greenhouse gas emissions.



Cost

\$



Possible Funding Sources

External municipal funding sources are not needed. Incentives, rebates, and technical assistance are available through Mass Save for residential and commercial net-zero enabling technology and energy efficiency measures.

1 <https://www.buildings.com/resiliency-sustainability/article/33001322/how-passive-house-design-encourages-resilience>
 2 <https://www.energy.gov/eere/buildings/zero-energy-buildings-resource-hub>

Buildings



B-1. Construct Net-Zero, Low Embodied Carbon New Buildings

B-1-2. Reduce embodied carbon in new buildings



Action Description

Reducing embodied carbon in new buildings is an important step towards achieving a more sustainable future. Embodied carbon refers to the greenhouse gas emissions associated with the construction and end-of-life of a building, including the CO₂ emitted from extraction and manufacturing processes to create construction materials, the transport of materials and equipment to a project site, installation and construction activities, building maintenance, demolition, and material disposal. Fortunately, there are several ways to reduce embodied carbon in new buildings. These include expanding adaptive reuse, repurposing existing assets or materials, using low carbon materials, and using electric construction equipment. Andover can begin this process of tracking and reducing embodied carbon by leading by example with municipal buildings and preparing educational materials for promoting awareness of the need to reduce embodied carbon in new buildings. Embodied carbon is not captured in Andover's GHG inventory and therefore this action does not directly reduce emissions from the baseline but is part of the larger climate change mitigation effort. Embodied carbon is a considerable source of emissions and this action is included to address this source.



Key Steps for Implementation

- Establish an embodied carbon baseline.
- Promote the use of low carbon materials in new buildings and renovations.
- Develop a checklist for permit applications or other educational materials.
- Possibly require lifecycle analysis for all new buildings over 20,000 ft² and municipal buildings.
- Develop an educational series for local architects, builders, and developers.



Action Lead

Sustainability Department



Supporting Partners

- Community Development & Planning - Buildings
- Facilities Department
- Planning & Economic Development
- Andover WECAN
- Andover Green Advisory Board
- Memorial Public Library
- Developers, Realtors



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Buildings



B-2. Retrofit Existing Buildings to Use Less Energy & Renewable Energy

B-2-1. Facilitate a residential electrification and energy efficiency program



Action Description

Facilitating a residential electrification and energy efficiency program involves a whole-home systems approach to optimize energy efficiency. This includes considering all the variables, details, and interactions that affect energy use in a home, such as appliances and home electronics, insulation, and air sealing. Upgrades to more energy-efficient appliances and retrofits to existing household equipment can further reduce residential energy demand. Appropriate policy interventions and programs can be designed to promote sustainable changes in behavior and encourage investments in structural improvements. Andover can support residents transitioning their home heating and cooling systems to efficient all-electric air-source heat pumps, ground-source/geothermal heat pumps, solar hot water, and/or heat pump water heaters and make deep energy efficiency retrofits through educational materials, training, and outreach regarding rebates and incentives.



Key Steps for Implementation

- Research past education and installation campaigns such as Massachusetts Clean Energy Center (MassCEC) HeatSmart program, which was a volunteer-led community-based outreach and group purchasing campaign. Refer to the Solarize-HeatSmart Toolkit for resources including training webinars. Note: The procurement laws that the Town is subject to may be a barrier for certain types of Town-sponsored bulk purchasing campaign.
- Collaborate with community groups such as Andover WECAN to further pursue the Heat Pump Coaching Program to train residents and conduct outreach.
- Compile existing resources related to costs and available rebates and incentives into an easily accessible format for distribution.
- Target homeowners that already expect to replace their heating and/or cooling equipment in the next five years to help them make informed decisions and target owners of apartment and condominium complexes where individuals have less control.
- Work with the Andover Housing Authority, Andover Community Trust, and Mass Save Community First Partnership to promote heat pumps and energy efficiency within affordable housing.



Action Lead

Sustainability Department



Supporting Partners

- Andover WECAN
- Heat Smart Alliance
- Mass Save Community First Partnership
- Andover Housing Authority
- Andover Community Trust

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Increased number of weatherization, insulation, and air sealing installed.
2. Increased number of heat pumps installed.
3. Reduced residential natural gas and oil usage



Action Initiation Timeframe



Resilience Considerations

Facilitating a residential electrification and energy efficiency program has several benefits for climate resilience. When new heating and cooling equipment is installed, it should be done so in a way that it is protected from climate hazards such as flooding, extreme heat, and wind. These modifications can increase the resilience and reliability of the electric grid, which is essential during extreme weather events.



Co-Benefits & Equity Considerations

1. Expands access to affordable clean energy and energy efficiency, which helps to reduce monthly energy bills for pollution-burdened communities.
2. Low-income households may not be able to afford the upfront costs of electrification and energy efficiency upgrades.
3. Renters and other groups may face barriers to participating in electrification and energy efficiency programs.
4. Electrification and energy efficiency upgrades can have health and safety benefits, such as reducing indoor air pollution and improving ventilation.



Cost

\$\$: Funds to develop a program and resources for supporting the community.



Possible Funding Sources

1. Mass Save Incentives and **Income Based Offers**
2. **Mass Save HEAT Loan**
3. **Mass Save Enhanced Barrier Mitigation Incentives** (to address knob and tube wiring and removal of vermiculite)

Buildings



B-2. Retrofit Existing Buildings to Use Less Energy & Renewable Energy

B-2-2. Facilitate a commercial and municipal electrification and energy efficiency program



Action Description

Facilitating a commercial and municipal electrification and energy efficiency program can have numerous benefits for communities. Implementing energy efficiency measures can reduce fuel import dependence, lower energy costs, and contribute to emissions reductions. Electrification can offer inherent advantages of controllability, precision, versatility, efficiency, and environmental benefits compared to other energy sources. Andover can help businesses and commercial property owners improve energy efficiency and electrify operations to transition away from fossil fuel usage and reduce energy demand by facilitating business-to-business learning and education through outreach and training.



Key Steps for Implementation

- Opt into the Property Assessed Clean Energy (PACE) programs. MassDevelopment staff can guide Andover through the process and provide a copy of the resolution model.
- Facilitate round table discussions by defining key stakeholders, identifying interest in topics, and identifying speakers or resources.
- Study geothermal opportunities and notify groups involved with current pilot projects of Andover's interest, for example, the Home Energy Efficiency Team (HEET) is creating a database of public interest in geothermal networks across the state to share with utilities, legislators and regulators. Notify them here: **Want geo service on your street? (arcgis.com)**
- Continue to seek state and federal funding for municipal energy efficiency and electrification projects, prioritizing projects that can occur during regular maintenance or upgrade schedules.



Action Lead

Sustainability Department



Supporting Partners

- Community Development & Planning
- Facilities Department
- Andover WECAN
- Rotary Club
- Chamber of Commerce



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- PACE requires Select Board approval



Measures of Success

1. Number of all-electric municipal buildings
2. Percent reduction in energy consumption

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Action Initiation Timeframe



Resilience Considerations

To facilitate a commercial and municipal electrification and energy efficiency program, climate resilience considerations should be taken into account. This includes employing climate resilience and carbon footprint considerations, building capacity to strengthen the foundation for low emission energy, and incorporating forward-looking climate change data in the design of capital projects. Energy efficiency retrofits can help mitigate increased peak electric demand.



Co-Benefits & Equity Considerations

1. Reduced utility bills from energy efficiency improvements.
2. Opportunities for marketing sustainable practices or retaining and recruiting employees that value sustainability.
3. By reducing greenhouse gas emissions, energy efficiency can also help improve air quality and reduce the negative health impacts associated with air pollution
4. Energy efficiency programs can support economic development by creating jobs and stimulating local economies.
5. Energy efficiency improvements can create a more comfortable and productive work environment, which can lead to increased worker productivity.
6. Energy efficiency improvements can also improve building comfort and health by reducing drafts, improving ventilation, and reducing the risk of mold and other indoor air quality issues.



Cost

\$\$\$\$\$: *Municipal energy efficiency and electrification*



Possible Funding Sources

1. **PACE** offers financing with terms up to 20 years. Savings from the upgrades can be used to repay the betterment over time which can be collected quarterly, semi-annually or annually. Additionally, at property sale, the assessment and lien are transferred to future property owners, who also benefit from the installed upgrades and will realize energy savings.
2. **Mass Save** incentives, programs, and technical support for businesses.
3. **National Grid** rebates, incentives and programs.
4. Department of Energy Resources **Green Communities Grants** (Municipal).
5. **Massachusetts School Building Authority** grant programs (Municipal).



B-2-3. Develop a residential climate resilience strategy



Action Description

Developing a residential climate resilience strategy is essential to ensure that homes and communities are prepared for the impacts of climate change. A residential climate resilience strategy should include a combination of ‘grey’ building solutions with ‘green’ nature-based solutions. The strategy should prioritize the integration of “soft” resiliency strategies, such as green infrastructure, and “hard” resiliency strategies, such as built or engineered solutions. The strategy should also support social cohesion, community ties, information flow, and the empowerment of individuals and communities.¹



Key Steps for Implementation

- Develop a residential climate resilience educational campaign to provide information on the impacts of climate change, how it might affect residential properties, and strategies residents can implement to protect themselves.
- Develop zoning to protect buildings from loss and damage by researching resilient zoning used by other communities, collaborating with other departments, drafting the zoning language, and following the zoning bylaw process including a Town Meeting vote. Consider strengthening floodplain overlay district requirements as **recommended by MAPC**.
- Research the opportunity to reduce flood insurance payments for residents through the FEMA National Flood Insurance Program **Community Rating System** (CRS) and apply if deemed to be a good candidate. This program awards credit points for a variety of public information and floodplain management activities completed within the community, as described in the **guidance document**. Discounts on flood insurance premiums are based on the CRS class and credit points obtained.



Action Lead

Sustainability Department



Supporting Partners

- Community Development & Planning - Buildings
- Andover WECAN
- Andover Green Advisory Board
- Conservation Commission

¹ <https://www.mdpi.com/2071-1050/11/10/2888>

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Zoning changes require Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Number or dollar value of flood insurance claims after a significant storm event.
2. FEMA Community Rating System class and discount achieved.
3. Number of residents engaged with outreach and education.



Action Initiation Timeframe



Resilience Considerations

Resilient residential buildings are designed to withstand environmental stressors and disasters, ensuring longevity, innovation, and adaptability. To make buildings resilient to climate change, it is important to consider strategies such as building resilience to heatwaves, floods, and cold.



Co-Benefits & Equity Considerations

Developing and implementing a strategy to improve climate resilience has numerous co-benefits including possibly reduced property damage, costs, and injury or loss of life. Education and outreach should include vulnerable populations such as older adults or people with disabilities and the property owners where they reside to understand their needs for improving resilience and how that can be incorporated into the strategy.



Cost

\$



Possible Funding Sources

1. **State Municipal Vulnerability Preparedness (MVP) program**
2. **Federal Emergency Management Agency Hazard Mitigation Assistance Grants**

Energy

To meet net-zero and resilience goals, Andover must reduce energy consumption, promote renewable energy adoption, and improve energy system resilience. Reducing energy is a critical first step. By reducing energy use, less energy needs to be created. New energy infrastructure creates greenhouse gases— whether that’s building new wind turbines or building and running a power plant.

Transitioning from fossil-fuel based energy to electricity allows for the possibility of net-zero energy use. Over time the electricity grid is becoming more saturated with renewable energy and therefore the GHG emissions associated with using electricity are decreasing. Electricity can be less carbon-intensive than fossil fuels like coal, oil, and natural gas.

The Town, residents, and businesses have begun this energy transformation. The town is leading by example in both reducing its energy use and transitioning to electricity. All of Andover’s streetlights use energy-saving LED lighting. In addition, the Town is prioritizing renewable electricity for all-electric school buildings and energy intensive processes such as water treatment.

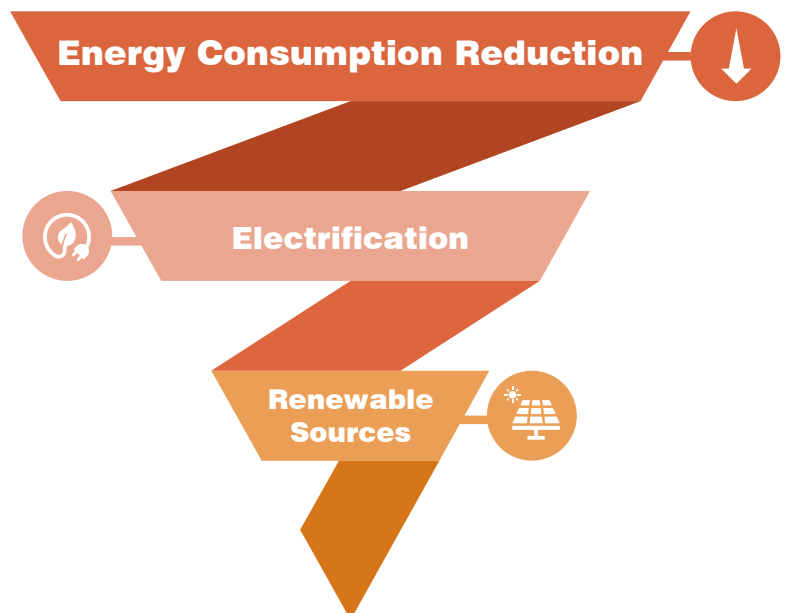
The energy related actions detailed in this plan take an educational approach to motivate residents and businesses to take action. Past education and outreach campaigns have been successful, such as the Solarize MA program in which 78 solar systems, with a total capacity of 653.75 kW, were contracted and installed in Andover in 2014. Solar photovoltaic systems are just one of the energy strategies Andover can utilize.

The Town will build community support for energy projects by providing resources about cost savings and technologies, and also by bringing together people that have already implemented new energy solutions. With resident-to-resident and business-to-business opportunities for learning, we can move forward in the energy transition together.



The Town of Andover was awarded \$15,000 through the Municipal Energy Technical Assistance Grant Program to conduct an energy resiliency assessment of the Town of Andover’s Shawsheen Village Pump Station (SVPS). The scope includes:

- Existing conditions assessment and site visit
- Evaluation of flow monitoring data and energy usage
- Report development





Energy strategies for Andover include:

- E-1. Reduce Energy Use
- E-2. Transition to Renewable Energy
- E-3. Emphasize Energy Education From K Through the Trades
- E-4. Enhance Energy Resilience



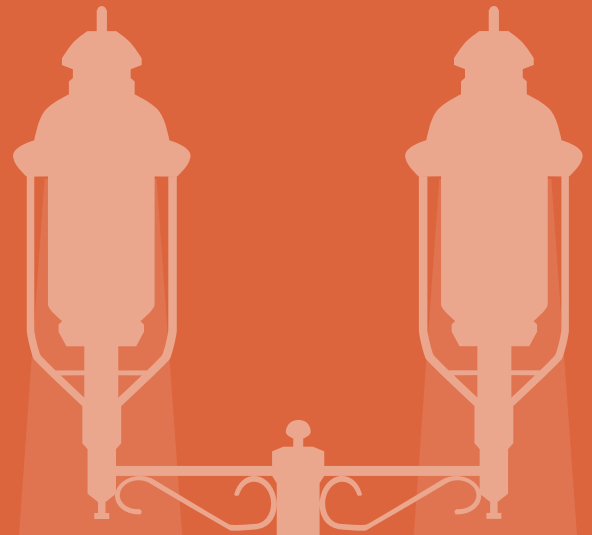
Energy Measures of Success:

The following metrics can be used to quantitatively track progress during action implementation. Additional examples of measures of success are detailed throughout.

Action ID	Topic	Metric	2030 Target	2050 Target
E-1-1	Reduce Energy	No. large business participants	3	6
E-1-1	Reduce Energy	No. business participants	3	6
E-2-1	Renewable Energy	% of eligible accounts enrolled	100%	100%
E-2-1	Renewable Energy	% opt-in for 100% renewable option	50%	100%
E-2-2	Renewable Energy	MW installed solar capacity (cumulative)	18 MW(DC)	40 MW(DC)
E-2-3	Renewable Energy	% MA Class I RECs in supplied energy	60%	100%
E-3-1	K-12 Curriculum	% student exposed to curriculum or programming	5%	75%
E-3-2	Clean Energy Workforce	No. apprentices participating in Andover projects (cumulative)	30	100
E-4-1	Municipal Building Resilience	No. accessible buildings serving as warming or cooling centers	4	6

Case Study

Energy



The Town has converted 100% of town-owned streetlights to light emitting diodes (LEDs) which include 1,800 streetlights.

This is expected to yield a 50-80% reduction in energy usage from the previous technology and significant utility and maintenance savings annually. Between the purchase of our lights and the retrofit to LED, the Town stands to save roughly \$100,000 per year in maintenance and energy use. LED lights are more expensive, but can last 20 years, so the investment will be paid back by these savings and reduced maintenance costs in under 5 years.

In addition to the extended lifecycle and lower replacement costs, LEDs result in reduced greenhouse gas emissions because they use less energy. They also help reduce light pollution at night and provide improved and more uniform light quality. LEDs make colors look brighter and more “true” to natural color. Due to the improved color rendition, things appear brighter and sharper under LEDs which is why police and other safety personnel prefer LEDs.

STREET LIGHTS



E-1. Reduce Energy Use

E-1-1. Educate commercial entities and municipal stakeholders on energy reduction



Action Description

Energy efficiency can reduce GHG emissions both through lowered energy demand at residences and businesses and by reducing the need for creating new energy infrastructure. All energy infrastructure, whether fossil-fuel based or renewable, creates greenhouse gas emissions in its construction.

Energy efficiency also can reduce reliance on foreign fuels and in turn lessen exposure to energy price volatility.

Reducing peak energy demand will be critical to balance electricity supply and demand.



Key Steps for Implementation

- Facilitate business-to-business discussions regarding best practices on peak energy demand reduction and other energy related topics to enable sharing successful strategies, technologies, and resources such as National Grid’s Connected Solutions program. Identify interested businesses, topics of interest, and possible speakers or resources.
- Connect businesses with National Grid and Eversource energy efficiency account representatives. Larger commercial and industrial businesses may already be in contact with their representatives. The Town can help connect businesses that do not have a representative or do not know who their representative is.
- Educate municipal employees on energy reduction strategies related to their operations to improve efficiency and reduce peak energy demand.
- Investigate technology that could support municipal staff and operations in energy reduction such as additional controls or energy storage.



Action Lead

Sustainability Department



Supporting Partners

- Utility energy efficiency account representative
- Facilities Department
- Public Works Department
- Andover WECAN
- Andover Green Advisory Board
- Chamber of Commerce
- Rotary Club



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Number of large businesses participating.
2. Demand reductions.
3. Number of projects initiated based on outreach.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

During peak demand periods, demand load reductions can alleviate energy supply and grid constraints, thereby decreasing the risk of power system failures.



Co-Benefits & Equity Considerations

1. Businesses generating their own energy using alternative sources, such as solar panels, can help to reduce peak demand charges from the utility.
2. Demand response programs can help electricity providers save money through reductions in peak demand and the ability to defer construction of new infrastructure.
3. Small businesses may have limited financial resources to make energy efficiency improvements and reduce peak demand.



Cost

\$



Possible Funding Sources

1. **National Grid Connected Solutions** programs for demand reduction
2. **Mass Save**

E-1. Reduce Energy Use

E-1-2. Educate residents on energy reduction



Action Description

Andover can take several steps to educate residents on energy reduction. One approach is to encourage residents to adopt pledges to reduce energy use and providing financial and technical assistance for residential energy audits and retrofits. Simple, well-structured, and well-communicated energy-saving advice can motivate citizens to act.

Reducing energy consumption in residential buildings is an important step towards reducing stress on the grid and can have considerable cost savings. One way to achieve this is by investing in energy-efficient appliances and products, such as energy-saving bulbs and smart appliances. Another way is to optimize home energy efficiency through a whole-home systems approach, which considers all the variables, details, and interactions that affect energy use in a home. This includes passive design concepts.

By reducing energy consumption in residential buildings, we can save money, increase energy security, reduce pollution, and minimize the natural resources used to power our homes. Energy efficiency can reduce GHG emissions both through lowered energy demand and by reducing the need for creating new energy infrastructure. All energy infrastructure, whether fossil-fuel based or renewable, creates greenhouse gas emissions in its construction.



Key Steps for Implementation

- Develop a residential energy reduction campaign which provides examples of energy reduction strategies and resources for financial and technical support, such as Mass Save.
- Connect residents with other residents that have already begun to implement energy efficiency strategies in their homes to enable information sharing. Some examples include lawn signs to inform neighbors, events with community groups and green teams, etc.



Action Lead

Sustainability Department



Supporting Partners

- Utility companies
- Andover WECAN
- Andover Green Advisory Board
- Mass Save



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Demand reductions when taking into account transition to electric vehicles and appliances.
2. Number of projects initiated based on outreach.
3. Increase in dollars saved through **Mass Save Electric Incentives**.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

During peak demand periods, demand load reductions can alleviate energy supply and grid constraints, thereby decreasing the risk of power system failures.



Co-Benefits & Equity Considerations

1. Residents can reduce their electricity bills.
2. Residents generating their own energy using alternative sources, such as solar panels, can reduce utility bills.
3. Low-income households may experience barriers to installing energy efficiency measures due to lack of awareness, access, or ability to pay for the upfront cost of upgrades



Cost

\$



Possible Funding Sources

1. **National Grid Income Eligible Services Program**
2. **National Grid Connected Solutions** programs for demand reduction
3. **Mass Save**



E-1. Reduce Energy Use

E-1-3. Partner with utilities to address gas leaks in supply infrastructure.



Action Description

Natural gas is sent to our homes and buildings through underground pipes. In Massachusetts, some of these pipes are over 100 years old and leaking. Gas leaks include the release of methane, which is a potent greenhouse gas with a global warming potential 27-30 times higher than that of carbon dioxide. (footnote 1). Reducing the methane emissions associated with gas leaks can have a considerable impact in mitigating climate change. In addition, fixing gas leaks pays for itself as we are paying for and wasting the gas leaking.

In Andover, the emissions from gas leaks equate to 28,642 MTCO₂e or 6.3% of the total baseline emissions! [need to source this!!!] Not only are gas leaks a substantial contributor to our GHG emissions, they are also a safety and public health hazard.

Home Energy Efficiency Team (HEET) has created a gas leaks map. By understanding where the leaks are and which are emitting the most, we can focus efforts to get the worse gas leaks fixed first.



Key Steps for Implementation

- Collaborate with HEET, other groups, or other communities already advocating for gas leak detection and correction to identify methods of partnership with utilities that have been successful. An example of HEET's efforts through existing partnership was described in a **WGBH News article**.
- Research methods to further promote gas leak repairs such as the City of Boston **Ordinance Regarding Management and Elimination of Natural Gas Leaks**.



Action Lead

Sustainability Department



Supporting Partners

- Emergency Management
- Home Energy Efficiency Team (HEET)
- Gas Transition Allies
- MA Department of Public Utilities



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Reduced number of gas leaks based on data reported annually to the Department of Public Utilities, summarized by the **Home Energy Efficiency Team**.
2. Percent of gas distribution pipes modernized.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

Designing a resilient gas supply infrastructure poses several challenges. Electrification and diverse clean fuels should be explicitly prioritized as part of these resilience strategies.



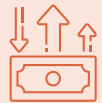
Co-Benefits & Equity Considerations

1. Reduce pollution.
2. Improve local environmental quality.
3. Improve public health.



Cost

\$



Possible Funding Sources

Utilities would be responsible for funding improvements to supply infrastructure



E-2. Transition to Renewable Energy

E-2-1. Implement Municipal Aggregation (also known as Andover Community Power)



Action Description

Municipal aggregation is a process by which towns and cities purchase electricity supply in bulk from an alternative supplier while still receiving transmission and distribution service from their existing utility provider. The main benefit of municipal aggregation is that it allows communities to have more local control over their electricity sources, more green power than is offered by the default utility, and/or lower electricity prices. It also encourages the development of renewable energy sources and supports green jobs. Andover Community Power is a program that will be offered by the Town to provide residents and businesses more electricity supply options. The program is a Town-vetted alternative to National Grid's default supply and other third-party electricity suppliers. The program has been under review by the Department of Public Utilities since July 2021. Refer to the ACP website for more information: <https://acp.andoverma.gov/>.



Key Steps for Implementation

- Upon approval by the DPU, Andover will monitor the market and identify the appropriate time to run a competitive bid for electricity supply.
- Upon selection of an electricity supplier, Andover will implement an extensive education and outreach campaign to make residents and businesses aware of the upcoming program launch and their choice to participate in the program or leave before it starts (opt out).
- Residents and businesses will be strongly encouraged to choose the "Andover Ultimate" product with 100% renewable energy (MA Class I Renewable Energy Certificates (RECs)).



Action Lead

Sustainability Department



Supporting Partners

- Andover WECAN
- Town Manager
- Rotary Club
- Realtors
- Community Groups
- Faith Groups
- Memorial Public Library



Ease of Implementation

- Already passed at Town Meeting
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*

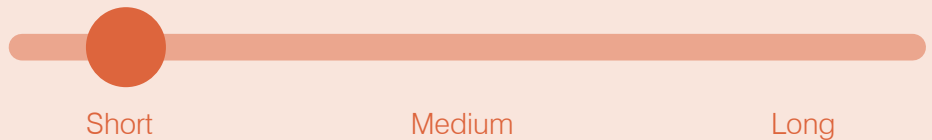


Measures of Success

1. Number of accounts enrolled.
2. Number of accounts enrolled in the 100% renewable option: goal 100% by 2035.



Action Initiation Timeframe



Resilience Considerations

It is important to create a program that meets the needs of the community, that the program is financially sustainable, and that the program is structured to provide reliable and resilient electricity supply.



Co-Benefits & Equity Considerations

1. Residents and businesses can benefit from reduced electricity costs and stable rates. While the program cannot guarantee savings to customers in the future, the Town of Andover is committed to working to provide stable and affordable electricity rates through the ACP program.
2. By using the bulk purchasing power of the community, renewable energy is more accessible to all, including low-income households and renters.
3. All of Andover's community members participating in the program will have access to the same benefits.



Cost

\$



Possible Funding Sources

No funding sources should be needed



E-2. Transition to Renewable Energy

E-2-2. Offer training programs for residents on solar and energy storage options.



Action Description

Solar energy is a sustainable and clean source of energy that can benefit residential customers. However, one of the main challenges of solar energy is its intermittency, which means that it is not always available when needed. Energy storage can help address this issue by allowing solar energy to be stored when it is generated and used when it is needed. Storage can also help smooth out variations in how solar energy flows on the grid, which can be affected by season, time of day, clouds, dust, haze, or obstructions like shadows, rain, snow, and dirt. Andover can provide residents with the knowledge and tools to procure solar and energy storage technology for their homes through educational materials, training, and outreach building upon past efforts and learning from campaigns in other communities.



Key Steps for Implementation

- Research past education and installation campaigns and models from other cities and towns (e.g. **SolarizeMA Toolkit and past marketing plan for Andover, MetroWest Clean Energy**).
- Collaborate with community groups such as Andover WECAN to pursue a resident-to-resident coaching program similar to what is in development for heat pumps.
- Compile existing resources related to costs and available rebates and incentives into an easily accessible format for distribution.
- Connect with homeowners that have expressed interest in solar. Work with Andover Housing Authority, Andover Community Trust and other community groups to identify opportunities for solar panels, community solar and energy storage.
- Investigate the feasibility of community-generated solar on Town property



Action Lead

Sustainability Department



Supporting Partners

- Community Development & Planning
- local solar companies
- Andover WECAN



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Increased megawatts of installed solar capacity in Andover.
2. Number of homes with solar.
3. Number of people engaged during outreach and education.
4. Number of households with battery storage.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

Solar and energy storage can play an important role in increasing the resilience of the electricity grid and the communities served by the grid, while also mitigating climate risks and contributing to energy security and productivity.



Co-Benefits & Equity Considerations

1. Solar and energy storage systems may be cost-prohibitive for some members of the community and the Town can work with community groups to identify funding sources or additional methods for providing access to renewable energy such as with community solar.
2. Community solar projects provide an alternative to rooftop photovoltaic systems for people who are unable to install solar panels on their roofs because they don't own their homes, have insufficient solar resources or roof conditions to support a rooftop PV system due to shading, roof size, or other factors, or for financial/other reasons.



Cost

\$: education & outreach



Possible Funding Sources

1. **Department of Energy Resources Solar Massachusetts Renewable Target (SMART)** program.
2. **National Grid Connected Solutions** for energy storage.



E-2. Transition to Renewable Energy

E-2-3. Increase the amount of voluntary MA Class I Renewable Energy Certificates for municipal electricity procurement contracts.



Action Description

MA Class I Renewable Energy Certificates are a type of certificate that serves as proof of purchase for the attributes of renewable energy generation. They are used to implement the Massachusetts Renewable Energy Portfolio Standard (RPS), which requires retail electricity suppliers to obtain a percentage of the electricity they serve to their customers from qualifying renewable energy facilities. Increasing the portion of Andover's electricity that comes from renewable energy sources can help reduce GHG emissions. Renewable Energy Certificates or Credits (RECs) are issued for every megawatt-hour of renewable electricity produced and can be purchased by entities, such as the Town of Andover, to claim this renewable electricity. This is a system used to account for the flow of renewable energy throughout the electricity grid. Starting in December 2023, Town and School electricity will contain 15% additional MA Class I RECs beyond the minimum required by the State, increasing Andover's use of renewable energy. The Town has committed to matching the additional MA Class I RECs in the Andover Community Power.



Key Steps for Implementation

- Assess current municipal electricity contracts.
- As contracts are up for renewal include at least an additional 15% MA Class I RECs beyond the minimum required by the state.
- Continue to increase RECs as needed to achieve 100% renewable energy sources by 2040



Action Lead

Sustainability Department



Supporting Partners

- Facilities Department
- Community Development & Planning



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

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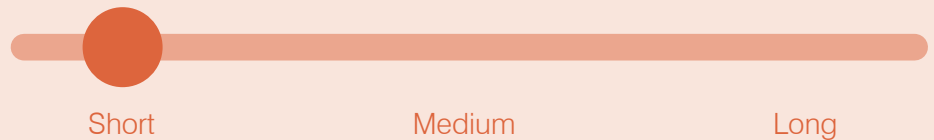


Measures of Success

1. Percent of total electricity that comes from renewable sources via RECs.



Action Initiation Timeframe



Resilience Considerations

Renewable energy generation can build climate resilience by diversifying the sources of electricity. This is important in the clean energy transition, especially as the electricity demands, weather patterns, and frequency of storm events change.



Co-Benefits & Equity Considerations

1. Renewable energy generation can have significant health co-benefits, including reducing premature mortalities due to air pollution.
2. Renewable energy generation can create economic development and jobs in manufacturing, installation, and more.



Cost

- Voluntary MA Class I RECs vary in costs depending on the market and the amount of energy consumed. In the most recent contract, the additional cost for 15% additional MA Class I RECs beyond the required state minimum of 24% for 2024 was \$0.03/kWh, a roughly \$77,000 cost increase in the year. This is roughly 3% of the town's electric costs of \$2.9 million annually.
- Voluntary Class I RECs act to hasten the transition of the electricity grid to clean energy. Absent any voluntary Class I REC purchases beyond requirement, Massachusetts Clean Energy Standard is projected to result in a power grid that is serviced entirely by renewable energy by 2040. When the State reaches that point, the Town's voluntary Class I REC purchase will cease because there would be no additionality in the purchase of additional Class I RECs.



Possible Funding Sources

No funding sources are expected to be needed



E-3. Emphasize Energy Education from Kindergarten through the Trades

E-3-1. Increase clean energy and climate change educational programming into K-12 school curriculum.



Action Description

Climate change is one of the most pressing issues of our time, and it is essential that we educate our youth about its causes, effects, and potential solutions. Incorporating clean energy and climate change educational programming into K-12 school curricula is a crucial step in this direction. Including climate change education in K-12 curriculum has numerous benefits, including encouragement of behavior change and the adoption of sustainable practices, enhanced science literacy and understanding of ecological concepts, and improved ability to adapt to climate change by providing students with the tools to calculate risks, prepare for climate crises, and recover from their effects. By increasing clean energy and climate change educational programming in K-12 school curricula, we can help our youth understand the importance of taking action to mitigate climate change and create a more sustainable future.



Key Steps for Implementation

- Assess what is currently being taught in public schools with regard to climate change and what opportunities students have for hands-on learning outside the classroom (e.g., green teams, clubs, internships, etc.).
- Research the climate change education legislation that has been developed including three bills that were introduced in the Massachusetts House of Representatives in February 2023.¹
- Educate Andover residents and demonstrate support of this legislation
- Collaborate with entities across Andover to expand hands-on learning opportunities and programs (e.g., field trips, internships, projects, etc.).



Action Lead

School Committee/School Administration



Supporting Partners

- PTA Groups
- Andover High School's ESIC Program
- Girls and Boys Scouts
- Sustainability Department
- Andover Youth Services



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval
- Requires state approval for formal curriculum changes

¹ National Center for Science Education. March 17, 2023. Climate change education legislation in Massachusetts. <https://ncse.org/climate-change-education-legislation-massachusetts>

E-3. Emphasize Energy Education from Kindergarten through the Trades

E-3-2. Clean Energy Workforce and Apprenticeship Initiative



Action Description

The transition to clean energy and electrification requires a skilled workforce that can design, install, and maintain renewable energy systems. Workforce development programs can play a crucial role in providing education and training to prepare individuals for these jobs. The Town can support the development of clean energy careers through partnerships with local education institutions and hands-on learning opportunities.



Key Steps for Implementation

- Follow the workforce development efforts of the **Merrimack Valley Clean Energy & Energy Efficiency Programs**, established based on the settlement of the gas explosions. One of the **advisory committee's 2023 goals** includes evaluating possible workforce development programs. Research other clean energy workforce development programs and resources such as those available through **MassCEC**.
- Collaborate with local vocational schools such as the Greater Lawrence Technical School and the Essex North Shore Agricultural and Technical School.
- Identify opportunities for student projects at municipal facilities in Town.



Action Lead

Sustainability Department



Supporting Partners

- Facilities Department
- local vocational schools
- Andover Community Trust



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



E-4. Enhance Energy Resilience

E-4-1. Evaluate municipal facilities energy supplies and add backup power redundancy.



Action Description

Municipal facilities, such as water and wastewater utilities, data centers, and critical facilities, require a continuous and reliable power supply to operate effectively. However, power outages can occur due to various reasons, including natural disasters, cyberattacks, and equipment failures. To ensure power resilience, it is essential to evaluate the energy supplies of these facilities and add power redundancy. Having backup generators, portable generators, and redundant electricity supply can prepare these facilities for power outages and emergency situations. By implementing these measures, municipal facilities can ensure a reliable and resilient power supply, even during emergencies.



Key Steps for Implementation

- Determine which buildings have backup power supply and which do not and assess the redundancy of the electric supply (i.e., electricity from one or multiple substation) for critical facilities.
- Identify buildings that must remain functional in times of emergency
- Secure funding to install generator connections that are located above design flood elevations and protected from flooding or other climate hazards.
- Install emergency generators and portable generator connections.
- Backup power should be located in stable locations (i.e., not in a basement in a floodplain).



Action Lead

Facilities Department



Supporting Partners

- Public Works Department
- Sustainability Department



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Increase in the number of facilities with backup power.
2. No major disruptions to power at municipal facilities during times of emergency.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

Having redundant power sources at municipal buildings will help the community return to normalcy faster following a hazard event or crisis. Any redundant power sources should be protected from climate hazards and confirmed to have enough power for a multi-day power outage.



Co-Benefits & Equity Considerations

1. Municipal facilities can serve as warming, cooling, or emergency shelters. These locations should be accessible for people with disabilities.



Cost

\$\$\$



Possible Funding Sources

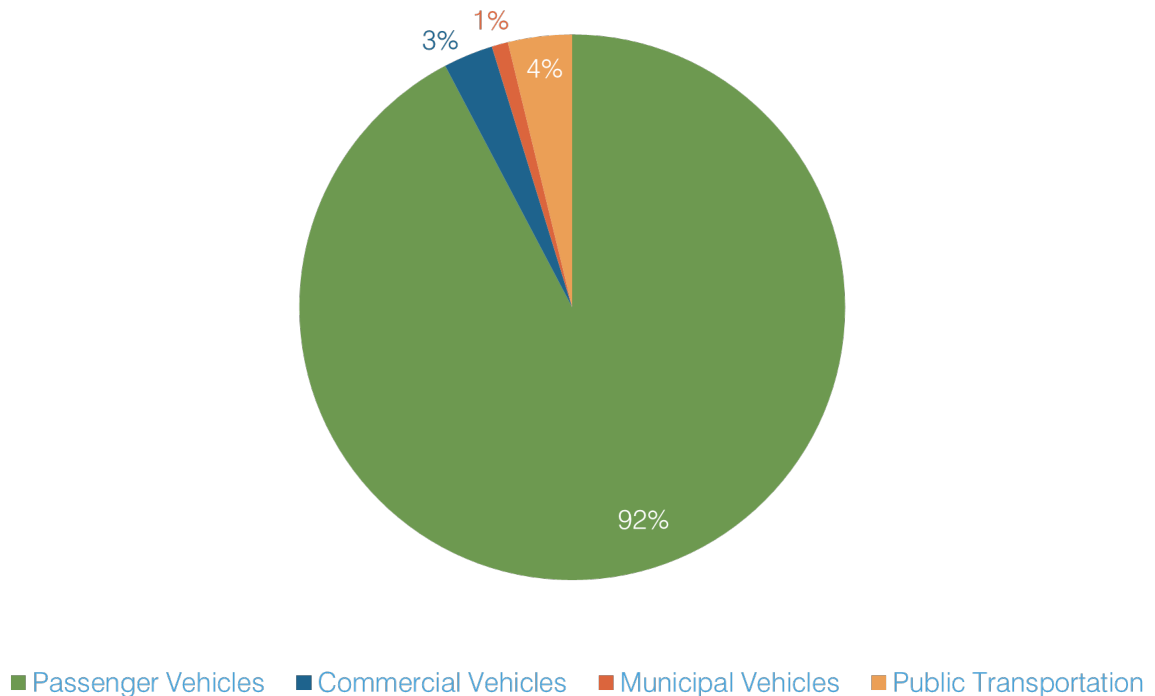
Municipal Energy Technical Assistance (META) Grant Program provides grants up to \$15,000 to provide municipalities with aid in negotiation, development and/or management of clean energy projects.

Mobility

Climate resilient and sustainable mobility is a concept that aims to reduce the impact of transportation on the environment while ensuring that transportation remains accessible and efficient. It involves a shift towards zero-carbon and low-carbon modes of transportation, such as walking, cycling, and public transit, as well as the use of cleaner fuels and more efficient vehicles. The benefits include enhanced recreation opportunities, public health improvements, cost savings on fuel and vehicles, as well as reduced carbon emissions and air pollution. Shifting to clean mobility will also serve as an engine for job creation and diversification with expected increases in both electric vehicle and battery recycling and manufacturing facilities, as well as bike or scooter servicing centers. Climate resilient and sustainable mobility also involves planning and designing transportation systems that are resilient to the impacts of climate change to get people where they need to be with reduced disruption.

Transportation is a major contributor to greenhouse gas emissions. Decreasing the number of miles driven and number of vehicles on the road while transitioning those vehicles to electric can have a large impact in reducing greenhouse gas emissions. GHG emissions associated with passenger vehicles account for 26% of Andover's total emissions and equate to 117,826 MTCO₂e per year. This makes up 92% of the total transportation related emissions, with commercial vehicles, municipal vehicles, and public transportation making up the remaining 8% of the transportation sector. If all gasoline and diesel usage by vehicles was eliminated, Andover's total emissions could be reduced by 124,051 MTCO₂e per year. This assumes there are no additional emissions associated with electricity usage because by 2050 ideally the electricity will be 100% renewably sourced (for more information on emissions reduction calculations refer to Appendix A). Included in this possible reduction is 1,236 MTCO₂e associated with the transition of municipal vehicles to electric vehicles. The Town recognizes there are challenges for transitioning many vehicle types to electric, but the technology and available vehicle types are evolving and will continue to evolve by 2050.

Transportation Emissions Breakdown:



Andover residents are actively transitioning to electric vehicles. The 2023 vehicle excise tax cycle identified 500 electric vehicles and 234 plug-in hybrid vehicles registered in Andover. However, this represents only 2.6% of vehicles registered in Andover. The survey conducted as part of the plan development revealed that of the 28 respondents that had an electric vehicle, 93% of them charge their vehicle at home. All 28 respondents were homeowners and no renters reported having an electric vehicle. While the Town can take meaningful action towards increasing EV charging infrastructure, there is still work to be done for multifamily housing complexes and private homes without the ability to install their own EV charging infrastructure. The Town is trying to bridge this gap with publicly available charging stations and education about shifting transportation modes. The Town recognizes that there are barriers to walking, biking, and taking public transportation, such as safety concerns, limited ability, time, and convenience, and is developing an Active Transportation Plan to devise a path forward.

Vehicle Type	Quantity
Battery Electric Vehicles (BEV)	500
Plug-In Hybrid Electric Vehicles (PHEV)	234
TOTAL BEV and PHEV	734
TOTAL REGISTERED VEHICLES	28,362
% BEV+PHEV	2.6%
Other Hybrid (Unspecified, Strong, or Mild)	1,024
%BEV+PHEV+ Other Hybrid	6.2%



Mobility strategies for Andover include:

M-1. Enable and Promote Alternative Transportation

M-2. Transition to Electric Vehicles



Mobility Measures of Success:

The following metrics can be used to quantitatively track progress during action implementation. Additional examples of measures of success are detailed throughout.

Action ID	Topic	Metric	2030 Target	2050 Target
M-1-1	Alternative Transportation	% trips on foot or by bike	3%	10%
M-1-1	Alternative Transportation	Reduced no. vehicles miles traveled per household		
M-2-1	Electric Vehicles	No. apartment and condo complexes with EV charging stations	5%	50%
M-2-1	Electric Vehicles	No. workplaces with EV charging stations	5%	50%
M-2-2	Electric Vehicles	% light-duty and medium-duty EVs in municipal fleet	10%	100%

Case Study

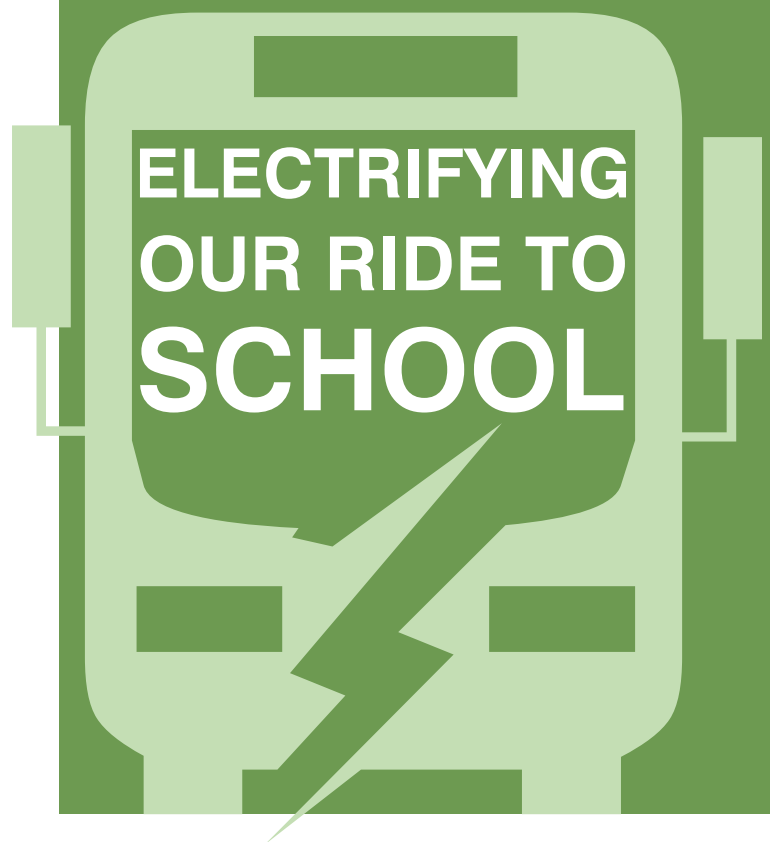
Mobility

More than 10% of all students in Andover Public Schools ride an electric school bus!

Trombly Motor Coach Services, based in Dracut, MA, provides transportation services to Andover Public Schools. Thanks to a grant from the federal government, Trombly's parent company introduced ten new electric school buses to its fleet, and five of those buses now carry Andover students to and from school. Each electric bus cost approximately \$350,000 – more than three times a conventional diesel bus. Charging stations require an additional investment of about \$60,000 each. However, there is no incremental cost to Andover Public Schools for implementing its electric buses; the federal grant offset any increase in transportation cost due to the conversion which allowed Trombly to provide the new buses to Andover at the same rate as the older diesel buses. The electric buses have a range of 138 miles on a full charge.

In addition to eliminating carbon emissions, students and drivers love the new electric buses because they're quiet, there's no smell of diesel exhaust, they don't vibrate, and the regenerative braking makes the buses more responsive and easier to maneuver and stop.

Dr. Parvey, Superintendent of Andover Public Schools, praised the new buses, adding "We are very proud to lead the conversion to a safer, carbon-free transportation system which will benefit not only our students and families but also the Andover community and our partners at Trombly too. As we plan and work to create a zero-emission future, this is a significant step toward achieving our goal."





M-1. Enable and Promote Alternative Transportation

M-1-1. Implement Active Transportation Plan



Action Description

Implementing the Active Transportation Plan is crucial for lowering transportation emissions. The Active Transportation Plan provides a foundation for policies, procedures, investments, and improvements to the active transportation infrastructure. Implementing policies, programs, and facilities such as bikeways, trails, and sidewalks supports the use of active transportation to serve mobility needs in an efficient and sustainable manner. By adopting recommendations of the Active Transportation Plan, we can create a healthier, more active, and more sustainable future for ourselves and for generations to come. Wherever possible we want to shift miles driven in a car to alternative forms of transportation including public transportation, biking, walking, and rolling.



Key Steps for Implementation

● Implementation steps will be determined during and following the development of the Active Transportation Plan. Collecting data on the number of cars, bikes, and pedestrians traversing the town will be helpful for measuring success.



Action Lead

Community Development & Planning



Supporting Partners

- Department of Public Works
- Sustainability Department
- Facilities
- Walk Bike Andover
- Andover Trails
- Open Space Task Force



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

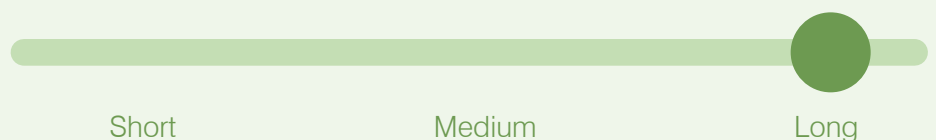


Measures of Success

1. Number of additional miles of bike lanes or pedestrian walkways.
2. Percent of all trips on foot or bike
3. Decreased vehicle miles traveled



Action Initiation Timeframe



Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Resilience Considerations

The development of the Active Transportation Plan with a focus on climate resilience is an important step towards creating sustainable communities. As climate change continues to exacerbate natural disasters, it is crucial to invest in transportation infrastructure that can withstand these challenges. The plan should include smart and sustainable street design, transit-oriented development, parking management, and sustainable transportation planning.



Co-Benefits & Equity Considerations

1. The Active Transportation Plan should ensure that resources are distributed equitably across all communities.
2. Public transportation should be increased and made accessible to everyone.
3. Active transportation can increase physical activity levels, which can lead to improved health outcomes such as reduced risk of chronic diseases like obesity, diabetes, and heart disease.¹
4. Opportunities to improve the safety and comfort of Andover's streets for all users will be incorporated into the Active Transportation Plan.



Cost

\$\$\$\$: *Depending on implementation actions.*



Possible Funding Sources

- 1. Community Transit Grant Program**
- 2. Complete Streets Funding Program**
- 3. Community Connections Funding Program**

¹ <https://pubmed.ncbi.nlm.nih.gov/20637168/>



M-2. Transition to Electric Vehicles

M-2-1. Install EV charging infrastructure



Action Description

The transition to electric vehicles is crucial for reducing emissions and combating climate change. Municipalities play an important role in the transition to electric vehicles (EVs) by installing public EV charging infrastructure and promoting the need for EV charging infrastructure at businesses, apartments, and condos. In order for everyone to be able to transition to electric vehicles, there needs to be a charging infrastructure for EV owners who do not have access to off-street parking, cannot afford to install their own charger or are limited as renters or shared-owners. In addition, providing reliable, convenient, and fast charging stations can attract visitors to businesses in Andover. Andover should install public EV charging infrastructure to accommodate the increase in visiting electric vehicles. Andover has already started adding EV charging infrastructure to municipal lots and is planning additional ways to expand the network.



Key Steps for Implementation

- Conduct a study to determine the areas where EV charging infrastructure would be highly utilized by drivers who don't have access to off-street parking near their home or cannot afford to install a charger. This study should also include an assessment of apartments, condominiums, and other home types that may have barriers to installing EV charging.
- Assess the need for additional EV charging infrastructure based on annually determining the rate of EV adoption by residents. Install additional EV chargers when demand outstrips availability based on charging infrastructure occupancy data.
- Develop and annually update an EV charging infrastructure development guide for multifamily housing in Andover, including but not limited to listing available rebates and incentives, upfront and ongoing cost breakdowns, and percentage of EVs registered in town.
- Encourage new commercial and industrial developers to install workplace charging infrastructure for their employees.



Action Lead

Facilities Department



Supporting Partners

- Apartment building owners, condo associations
- Department of Public Works
- Community Development & Planning
- Andover Green Advisory Board
- Andover WECAN
- Chamber of Commerce
- Economic Development Council
- The Planning Board and Zoning Board of Appeals

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

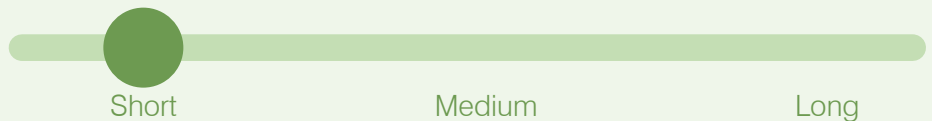


Measures of Success

1. Installation of EV charging stations at apartment and condo complexes in Andover.
2. Increased use of electric vehicles in Andover by residents living in apartments and condos in Andover.
3. Installation of EV charging stations at commercial and industrial workplaces in Andover.



Action Initiation Timeframe



Resilience Considerations

Electric vehicles can improve climate resilience in several ways. They emit fewer greenhouse gases and air pollutants than gasoline or diesel cars. This means that they can help reduce the amount of carbon emissions released into the atmosphere, which is a major contributor to climate change. Electric vehicles can help reduce the reliance on fossil fuels, which are a finite resource and contribute to climate change. Electric vehicles can help improve air quality, which can have a positive impact on public health.¹



Co-Benefits & Equity Considerations

1. Electric vehicles can help reduce noise pollution and particulate matter from combustion engines, which can have a positive impact on the environment and human health.
2. Electric vehicles may not be accessible to everyone because of price, although they are becoming more affordable as technology changes and as more EVs enter the used car market.



Cost

\$\$\$



Possible Funding Sources

1. National Grid EV Charging Program
2. MassEVIP Workplace & Fleet Charging Incentives
3. MassEVIP Multi-Unit Dwelling & Educational Campus Charging Incentives
4. MassEVIP Direct Current Fast Charging Incentives

¹ <https://www.eea.europa.eu/articles/electric-vehicles-a-smart>



M-2. Transition to Electric Vehicles

M-2-2. Transition public fleets to EVs



Action Description

Transitioning municipal fleets to electric vehicles (EVs) requires a solid strategy. The first step is to analyze the utilization of all current vehicles by examining driving data. Local governments like Andover can directly impact the EV market by committing to electrification and investing in new fleet technology. Ongoing declines in battery costs, wider availability of electric car models, uptake of EVs by fleet operators, and enthusiasm of electric car buyers provide a favorable environment for transitioning the municipal fleet to EVs. As vehicles need to be replaced, they should be replaced with electric vehicles when possible.



Key Steps for Implementation

- Identify municipal fleet useful life and opportunities to replace fossil fuel vehicles with electric vehicles.
- Consult Town Staff to ensure that an electric vehicle will meet their needs.
- Identify where electric vehicles can be purchased for the best price.



Action Lead

Facilities Department



Supporting Partners

- Department of Public Works
- Police and Fire Departments



Ease of Implementation

- Approval at Town Meeting
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Increase in number of electric vehicles in the Town of Andover's community fleet



Action Initiation Timeframe



Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Resilience Considerations

Transitioning municipal fleets to electric vehicles (EVs) is a crucial step in building climate resilience and mitigating emissions. EVs are responsible for considerably lower emissions over their lifetime than conventional vehicles. This is especially true in regions with cleaner electricity generation. Using more energy-efficient vehicles like EVs can help improve fuel economy, lower fuel costs, and reduce emissions, which can contribute to our energy security.¹



Co-Benefits & Equity Considerations

1. EVs can save money over their useful life, as they require less maintenance and have lower operating costs than traditional vehicles.
2. EVs produce zero tailpipe emissions, which can help reduce air pollution.
3. EVs produce less noise pollution than traditional vehicles, which can lead to quieter streets.
4. Municipal fleets transitioning to EVs can set an example for residents and encourage accelerated adoption of EVs.



Cost

\$\$\$\$



Possible Funding Sources

1. **National Grid EV Charging Program**
2. **MassEVIP Workplace & Fleet Charging Incentives**

¹ https://afdc.energy.gov/fuels/electricity_benefits.html

Public Health & Safety

Public health, resilience, and sustainability are interconnected concepts that are critical for the well-being of individuals and communities. Climate change brings a suite of uncertainties. Preparing and protecting the public for different types of hazards or crises is an important task to mitigate the impacts of events caused by climate change. This plan and others, including the **Community Health Improvement Plan** and **Arbovirus Response Plan**, demonstrate how the Town is actively preparing.

Climate change has significant impacts on public health. Extreme weather events such as heatwaves, storms, and floods can lead to death and illness. Climate change also disrupts food systems, increases the spread of food-, water-, and vector-borne diseases, and affects mental health. In addition, climate change undermines many of the social determinants of good health, such as livelihoods, equality, and access to health care and social support structures. Climate change affects the social and environmental determinants of health, including clean air, safe drinking water, sufficient food, and secure shelter. Vulnerable populations, such as those with limited economic resources and those living in certain locations, are at higher risk. Climate change is also one of many compounding factors that can influence mental health. The public health community has an important perspective to share about climate change, which can make the problem more personally relevant, significant, and understandable to members of the public.

Community preparedness is an essential aspect of disaster management. It involves the collective efforts of community members to prepare for potential disasters and emergencies. The goal of community preparedness is to ensure that individuals and communities are equipped with the necessary training, education, and resources to prepare in advance against the threat of a possible local disaster. According to **Ready.gov**, studies have shown that individuals who believe they are prepared for disasters often are not as prepared as they think, while others admit they have not developed any type of personal preparedness plan. Therefore, community preparedness aims to maximize residents' awareness of the importance of proactive planning and encourage participation in disaster preparedness activities. This can be achieved by partnering with local resources, establishing effective community emergency response teams, and developing community disaster preparedness plans.



Andover's 2023 Community Health Improvement Plan identifies goals and objectives for three priority areas including Mental Health Across the Lifespan, Affordable Housing, and Diversity, Equity, and Sense of Community. This plan echoes and amplifies those sentiments.

How does climate change effect mental health?

The Centers for Disease Control and Prevention (CDC) has identified the following effects to mental health related to climate change:

- Trauma, grief, or sleep disorders after extreme weather
- Stress or depression due to changes in food access and livelihoods
- Mood disorders or aggressive behavior in areas with rising surface temperatures
- Feelings of helplessness or anxiety about the future

Source: How Climate Change Can Affect Your Mental Health. May 10, 2022. [How Climate Change Can Affect Your Mental Health | Blogs | CDC](#)



Public Health and Safety strategies for Andover include:

PH-1: Protect residents, workers, and visitors in the event of natural disasters or public health crises

PH-2: Enhance municipal and community preparedness to respond to climate impacts



Public Health and Safety Measures of Success:

The following metrics can be used to quantitatively track progress during action implementation. Additional examples of measures of success are detailed throughout.

Action ID	Topic	Metric	2030 Target	2050 Target
PH-1-1	Public Safety	Increased enrollment in communication pathways	10%	75%
PH-1-2	Resilience Hubs	Percent of population located within 2 miles of a hub	5%	50%
PH-2-1	Climate Impact	No. people engaged on behavioral health programs		
PH-2-2	Climate impact	Incidents involving release of hazardous materials during floods		0



UMass Amherst's Industrial Assessment Center faculty and students visit Andover's Water Treatment Plant for a comprehensive tour and energy assessment. Photo by Joyce Losick-Yang.



March 2010 flood event along North May Street. Photo by Kate Margolese.

Case Study

Public Health & Safety

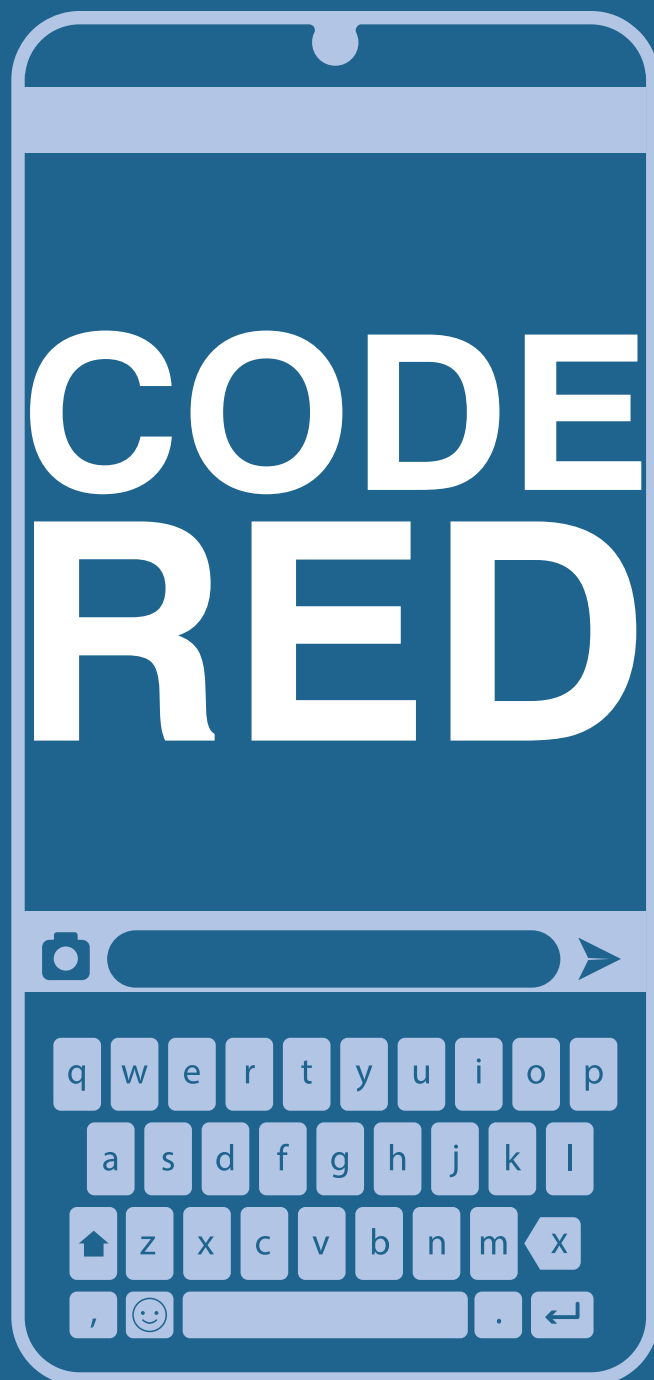
Have you heard the news?

Since 2014, the Town of Andover has been using the CodeRED Emergency Notification System to alert residents and businesses of emergency situations. It enables the Town to provide mass notification quickly and easily through phone calls, text messages, and emails.

As the Town experiences the impacts of climate change, access to information can help improve public health and safety. In 2019, mosquitos in Andover were positive for Eastern Equine Encephalitis (EEE) and the state designated the Town as a high risk for EEE. During this time, CodeRED was used to disseminate information about the risk and mitigation efforts. CodeRED is also used regularly to provide information about disruptions to municipal services from severe weather events. With more frequent and serve storms expected due to climate change, advanced notice of these events can help the community prepare.

CodeRED is a free program and participants can opt out at any time. If you are not already registered, you can do so here: **Register for CodeRED Online**

If you were previously being called through our old Reverse 911 system, you will need to re-register with the new CodeRED system. For those who are hearing impaired, the sign up form offers a TDD only option for tone delivery of emergency messages. Messages delivered to phone numbers marked TDD will only be delivered in a TDD/TTY format. Residents without internet access may visit town offices and fill out a CodeRED registration form in-person.



Public Health & Safety

PH-1: Protect residents, workers, and visitors in the event of natural disasters or public health crises



PH-1-1. Explore meaningful ways to increase emergency communication with the community



Action Description

Resilient communication is a crucial aspect of community resilience. There are several strategies Andover can use to communicate with the public effectively. Effective communications strategies for municipalities include the use of social media, reverse calling systems, digital billboards, and the Town's website. Social media platforms such as Facebook, Twitter, and Instagram can be used to disseminate information, respond to resident queries and concerns, and shape content that residents will want to engage with. It is important to determine which method is the most effective means of timely communication for the majority of citizens.



Key Steps for Implementation

- Compile available data on usage of current communication systems and develop a public survey, advertise, and distribute survey via multiple pathways, including social media, website, and print.
- Analyze survey result to determine if the survey captured a representative sample and identify the three most common methods and any gaps in communications.
- Expand the reach of the communication methods with an outreach campaign.
- Research and implement additional communication strategies to address gaps, if needed.



Action Lead

Emergency Management



Supporting Partners

- Community Development & Planning - Health
- Police and Fire
- Information Technology
- Faith Communities
- PTA Groups
- Adjacent Communities
- Library



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. High number of survey respondents.
2. Increased engagement numbers on the website and social media.
3. Increased enrollment in communication pathways (i.e., subscribed to CodeRED, emails, etc.).

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Action Initiation Timeframe



Resilience Considerations

Climate resilient communication is crucial for communities to prepare for and cope with the impacts of climate change. As we work to avert the worst potential impacts of climate change, we must also become more resilient to those impacts that are now unavoidable. Citizens are more prepared when they have easy access to the information they need during a hazard event or crisis. To achieve a climate resilient community, increasing climate information and technical capacity for flexible and dynamic systems are needed. This needs to be coupled with greater consideration of the socio-ecological resilience and context-specific values of marginalized communities and meaningful engagement with the most vulnerable in decision making.



Co-Benefits & Equity Considerations

1. These impacts often disproportionately affect low-income communities and communities of color, reinforcing the need for equitable and proactive resilience planning and resource allocation.
2. Not all citizens may have easy access to internet, television, or text messaging.
3. Building proactive resilience and engaging with the many aspects of climate change and future uncertainties involved requires working with traditionally marginalized groups, including women, youth, Indigenous Peoples, local communities, and ethnic minorities.
4. Make sure that youth, seniors, people with disabilities, and people who work in flood-prone areas are being reached in more than one way.



Cost

\$



Possible Funding Sources

1. **Department of Homeland Security Regional Catastrophic Preparedness Grant Program (RCPGP)**, refer to **Grants.gov** for currently available federal grants and to the **Massachusetts Emergency Management Agency** for additional guidance and funding on the topic of emergency management and communications

Public Health & Safety

PH-1: Protect residents, workers, and visitors in the event of natural disasters or public health crises

PH-1-2. Develop neighborhood resilience hubs to coordinate and maintain resident well-being



Action Description

Developing neighborhood resilience hubs is a strategy that can help coordinate and maintain resident well-being. Resilience hubs are community-serving facilities that are designed to enhance community resilience while reducing greenhouse gas emissions and improving local quality of life. These hubs are typically housed in trusted, community-managed facilities such as a church or civic center and are designed to coordinate culturally sensitive, multilingual services to better meet the needs of diverse groups of community members. They can provide a safe place for temporary shelter and relief during days of extreme heat or operate as centers for distributing necessities such as food and multilingual information after disaster events such as floods. By engaging residents in the process of designing community resilience hubs, communities can define their needs and priorities for their neighborhood, promoting equity and community and economic development.¹ The Memorial Hall Library is an example of a suitable resilience hub.



Key Steps for Implementation

- Increase public education and outreach efforts regarding emergency planning and preparedness.
- Connect the public with emergency services.
- Identify socially vulnerable populations in Andover and connect those with special needs to emergency services.
- Investigate the need for an additional ambulance for the anticipated increase in incidences to better serve the public.
- Host public hazard expos or other community engagement events.
- Facilitate emergency drills via public schools.



Action Lead

Police and Fire



Supporting Partners

- Facilities
- Emergency Management
- MEMA
- MA Dept. of Public Health
- Library
- Faith Communities
- Better Business Bureau
- Andover Youth Services

¹ <http://resilience-hub.org/>

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Increased connectivity between emergency services and vulnerable populations.
2. Public survey to assess preparedness.



Action Initiation Timeframe



Resilience Considerations

Communities become more resilient to disasters when citizens are more prepared and informed. When citizens are prepared, it is less likely that there will be loss of life or damage to property. Resilience hubs are a promising approach to building local community power and leadership, strengthening relationships between governments and the people they serve, and addressing existing health inequities that disasters highlight and exacerbate.



Co-Benefits & Equity Considerations

1. Site considerations might include accessibility and physical safety.
2. Resilience hubs should be designed to coordinate culturally sensitive, multilingual services to better meet the needs of diverse groups of community members.



Cost

\$



Possible Funding Sources

1. **FEMA BRIC funding for Capability & Capacity Building**
2. **Municipal Vulnerability Preparedness (MVP) program**

Public Health & Safety

PH-2: Enhance municipal and community preparedness to respond to climate impacts

PH-2-1. Develop public health approach to build mental wellness and resilience



Action Description

Developing a public health approach to build mental wellness and resilience is crucial in promoting overall well-being. According to the World Health Organization, mental health is a state of well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community. It is a basic human right and a crucial component of health and well-being. Building resilience and promoting mental wellness can prevent the onset of mental health problems and potentially lessen the severity of existing mental health problems.¹ The 118th Congress recently introduced the Community Mental Wellness and Resilience Act to provide funding to address this issue.² To prepare for climate impacts and help address climate related mental health, Andover can establish programs to facilitate community connectedness and communication of important information to all residents including youth, who are particularly concerned about climate change. This action is aligned with the Community Health Improvement Plan Goal 1, Objective 1.1, to increase the availability and reach of diverse, age-appropriate training and education for residents, municipal and school staff, and care givers to address all aspects of mental health needs by the end of FY 2024



Key Steps for Implementation

- Develop a peer recovery support services programs to provide non-clinical services that include peer support services and engagement, recovery housing, recovery community centers, peer bridger programs, peer-run crisis respites, warm lines, and recovery programs in high schools and colleges.
- Study how to engage citizens to use municipal resources such as the cooling and warming centers.
- Engage community members.
- Identify required staff and resources required.



Action Lead

Community Development & Planning – Health Department



Supporting Partners

- Andover Youth Services
- PTA Groups
- Andover Public Schools

1 <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response>

2 https://www.markey.senate.gov/imo/media/doc/one-pager_cmwra_-_050423pdf.pdf

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Engage with at least 100 students and other members of the community focused on behavioral support programs relating to climate anxiety, disaster resilience and community resources by 2024.
2. Identify at least one evidence-based strategy or program that can meaningfully enhance community resilience or behavioral wellness and obtain the resources to take action by 2026.



Action Initiation Timeframe



Resilience Considerations

To build community resilience, there is tremendous potential to work together in a coordinated and comprehensive manner. Developing age and culturally appropriate community strategies to engage all adults and youth in enhancing and sustaining mental wellness and resilience is a key step in promoting mental health.¹



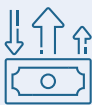
Co-Benefits & Equity Considerations

1. A public health approach can help address persistent health disparities rooted in systemic racism and improve individual and community health.
2. Social connections serve as important protection against poor health and well-being and aid in coping with toxic stress that damages health.
3. People of all ages will be able to access municipal programs and resources, including youth.



Cost

\$\$



Possible Funding Sources

1. **FEMA BRIC funding for Capability & Capacity Building**
2. **FEMA Small Business Program**
3. **Health and Public Safety Workforce Resiliency Training Grant**

¹ <https://psvchnews.psvchiatrvonline.org/doi/10.1176/appi.bn.2023.02.2.23>

Public Health & Safety

PH-2: Enhance municipal and community preparedness to respond to climate impacts

PH-2-2. Identify and assess hazardous material storage locations at risk from flooding

	Action Description	<p>Identifying and assessing hazardous material storage locations at risk from flooding is crucial to prevent environmental contamination and health risks. Storage facilities protect hazardous waste by storing them in tanks, but if these facilities are located in flood-prone areas, the risk of contamination increases. Floods can cause tanks to rupture, leading to the release of hazardous materials into the environment. The toxic waste threat is increasing with climate change as flood events become most substantive and frequent. It is essential to identify and assess hazardous material storage locations at risk from flooding to prevent environmental contamination and health risks.</p>
	Key Steps for Implementation	<ul style="list-style-type: none"> ● Conduct a risk assessment to measure the potential loss of life, personal injury, and economic and property damage resulting from identified hazards. ● Develop mitigation strategies to reduce the risk of flooding at hazardous material storage locations. This can include relocating storage facilities, implementing flood protection measures, and developing emergency response plans. ● Establish a maintenance and training program. ● Create an educational program to inform the community on storing hazardous household products such as paints, solvents, pesticides, etc.
	Action Lead	<p>Fire Department</p>
	Supporting Partners	<ul style="list-style-type: none"> • Department of Public Works • Sustainability Department • Facilities Department • Community Development & Planning - Health • Community Development & Planning - Conservation • Emergency Management • Better Business Bureau
	Ease of Implementation	<ul style="list-style-type: none"> <input type="checkbox"/> Requires Town Meeting vote <input checked="" type="checkbox"/> Department has authority to carry out <input type="checkbox"/> Requires Select Board approval
	Measures of Success	<ol style="list-style-type: none"> 1. Less or no incidents involving hazardous materials during flooding events. 2. Successful deployment of flood control measures during flooding events

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Action Initiation Timeframe



Resilience Considerations

Flood control measures at hazardous material locations will increase resilience by decreasing the possibility of accidents or contamination.



Co-Benefits & Equity Considerations

1. Flood control measures may provide protection to the facilities in addition to the hazardous materials contained within them.



Cost

\$\$\$



Possible Funding Sources

1. **Hazard Mitigation Assistance Grants**
2. MEMA's **Hazardous Materials Emergency Preparedness (HMEP) Grant**

Natural Resources

Protecting natural resources such as forests, water, and wetlands is a crucial part of climate adaptation and mitigation. Shade trees help to mitigate extreme heat and wetlands help to mitigate flooding from rainfall or storm events. Both have the ability to sequester carbon dioxide. Potable water should be conserved and used responsibly in order to ensure its continued supply in the future and to reduce the demand from the water treatment plant, which is one of the most energy intensive municipal operations. In 2022, Andover's residential water usage was 80 gallons per person per day which is high compared to other communities. Preserving biodiversity helps to maintain healthy ecosystems and prevent further acceleration of climate change. Allowing resources and systems to function naturally and without human disturbance can help reduce GHG emissions and build resilience. When natural resources need to be managed, such as stormwater runoff, nature-based solutions that aim to protect and restore ecological systems should be used.

The community benefits from natural resources like the 2,200 acres of Conservation Commission protected land across the community.¹ Andover has approximately 5,921 acres of forests and 2,523 acres of wetlands that provide important ecosystem services including carbon sequestration.² The 11,521 street trees included in Andover's tree inventory sequester 885 MTCO₂ each year.³



Nature-Based Solutions (NBS) are adaptation measures focused on the protection, restoration, and/or management of ecological systems to safeguard public health, provide clean air and water, increase natural hazard resilience, and sequester carbon. Incorporating NBS in local planning and design projects produces long-term solutions that benefit human and natural systems.



NBS offer numerous co-benefits that address challenges faced by communities:

- Climate Resilience
- Cost-Effective Alternatives
- Supporting Ecosystem Services
- Spurring Economic Activity
- Enriching Human Health And Well-Being

Source: **Nature-Based Solutions Toolkit**
https://resilientma.mass.gov/mvp/content.html?toolkit=nature_based

¹ As of 2021 from <https://andoverma.gov/156/Conservation>

² Dewitz, J., and U.S. Geological Survey, 2021, National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021): U.S. Geological Survey data release, [doi:10.5066/P9KZCM54](https://doi.org/10.5066/P9KZCM54). Land cover types included deciduous forest, evergreen forest, and mixed forest, woody wetlands and emergent herbaceous wetlands.

³ <https://andoverma.treekeepersoftware.com/index.cfm?deviceWidth=1920>



Natural Resource strategies for Andover include:

NR-1: Enhance and protect the tree canopy

NR-2. Advance the smart and efficient use of water by all community members

NR-3. Promote and Protect Andover's biodiversity and natural resources

NR-4. Minimize stormwater run-off

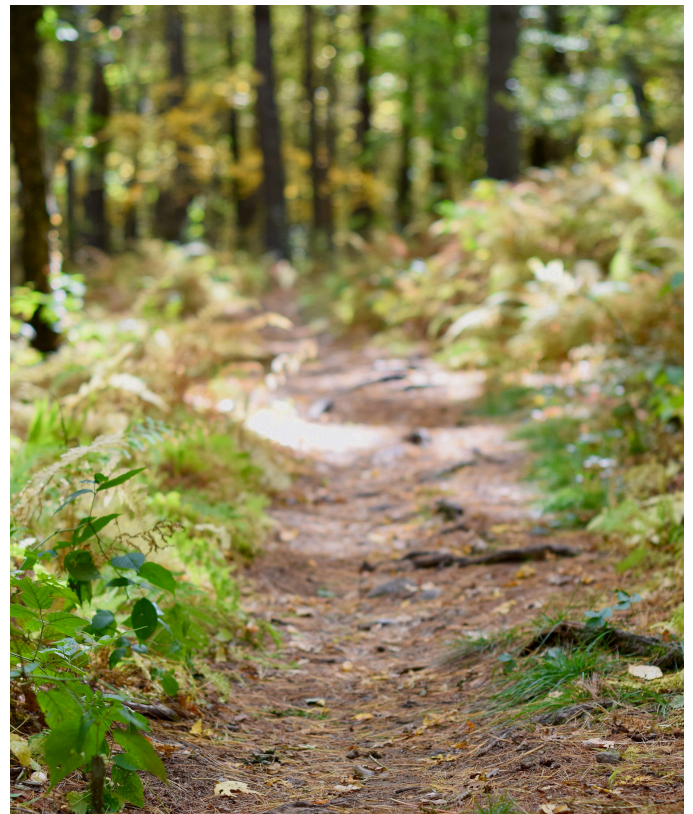
NR-5. Prioritize the role of wetlands in enhancing Andover's resilience to climate change



The Environmental Sustainability Internship Course (ESIC) is a unique approach to experiential and project-based learning at Andover High School in Andover, MA. Each student is matched with a community mentor to work on a project to improve environmental sustainability in Andover. While all of the projects have a basis in sustainability, each internship is a unique experience based on the student's and mentor's connections, skills, and interests. All internships focus on job skills, leadership, project management, and environmental sustainability.



Playstead in Andover. Photo by Kate Margolese



Hiking Trail. Photo by Kate Margolese



Natural Resource Measures of Success:

The following metrics can be used to quantitatively track progress during action implementation. Additional examples of measures of success are detailed throughout.

Action ID	Topic	Metric	2030 Target	2050 Target
NR-1-1	Tree Canopies	% tree cover in town	68%	70%
NR-1-2	Urban Heat	% impacted areas with newly planted trees	3%	15%
NR-2-1	Water Conservation	% reduction in leak volume	10%	50%
NR-2-2	Water Conservation	% reduction in residential water usage	18.75%	25%
NR-3-1	Nature Resource Protection	% electric landscaping equipment	30%	75%
NR-3-1	Nature Resource Protection	No. town properties practicing low impact landscaping	2	10
NR-3-2	Nature Resource Protection	% residential/commercial low impact landscapes	5%	50%
NR-3-3	Biodiversity Education	No. public events	4	12
NR-4-2	Stormwater Management	No. nature-based solutions implemented to reduce climate impacts	2	5
NR-5-1	Wetlands	% acreage increase in protected wetlands	5%	10%
NR-5-2	Wetlands	No. public events	2	4

Case Study

Natural Resources



In June 2022, a small group of dedicated volunteers came together to promote native plantings and healthy habitats for pollinators throughout our community. Andover Pollinator Pathway's mission is to foster connections between the many natural spaces in town and residential gardens to form a pathway for pollinators. The goal is to create a more robust, resilient ecosystem with a greater diversity of native species to support pollinators. Residents can join by following these five practices:

- Plant native plants, including trees, shrubs, grasses, and flowers.
- Reduce the use of chemical fertilizers, herbicides, and pesticides in favor of safer alternatives.
- Control invasive plants
- Reduce lawn size in favor of native plantings
- Leave leaves in the landscape in the fall

Andover Pollinator Pathway has dedicated gardeners who do yard visits to help residents get started on creating their own pollinator garden using the five practices listed. They provide residents with lists of native plants and local nurseries carrying these native pollinator plants. They have set up **a webpage on the national Pollinator Pathway site** and, to date, have over 30 yards on their interactive google map. In addition, they have over 110 names on the mailing list who receive newsletters.

Andover Pollinator Pathway also sponsors a Speaker Series with Memorial Hall Library to educate Andover residents about best practices including transitioning lawns into healthy ecosystems, soil health and organic land management, demonstrations on winter seed starting, and growing native plants for spring plant sales. They invite Andover residents to nurture backyard biodiversity by learning more about the benefits of native plants and pollinators.

Natural Resources



NR-1: Enhance and protect the tree canopy

NR-1-1. Develop a program to maintain and improve the municipal tree canopy.



Action Description

Maintaining and improving the municipal tree canopy is essential for the health and well-being of Andover. Trees help reduce runoff, erosion, and stormwater, and they provide many other benefits such as reducing heat islands, increasing property values, and improving air quality. To achieve these benefits, Andover can develop a forestry program that preserves, plants, and manages local forests and trees for public benefits and quality of life. As global warming increases, extreme heat waves and invasive species can degrade the existing tree canopy. A municipal forestry program can provide technical, educational, and financial assistance to help town staff triage and prioritize needs and provide training to field staff on topics of pruning, planting, or identification of tree defects. The Town is currently developing a Tree Management Plan.



Key Steps for Implementation

- Support the Tree Committee in developing a tree bylaw, as required by Select Board Tree Replacement Policy (will require town meeting vote).
- Assess the current status of the tree canopy in Andover
- Identify areas with needs for additional trees.
- Complete the Tree Management Plan.
- Determine available funding and seek additional funding if necessary.
- Work in conjunction with Public Works and the community to execute plantings.
- Calculate the total carbon sequestration potential of all trees.



Action Lead

Department of Public Works



Supporting Partners

- Tree Committee
- Community Development & Planning
- Conservation Commission
- Andover High School's environmental club
- Merrimack Valley Planning Commission
- Sustainability Department



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Sustained or increased percentage of tree cover in the town.

Natural Resources



NR-1: Enhance and protect the tree canopy

NR-1-2. Identify areas vulnerable to extreme heat impacts and coordinate tree planting efforts



Action Description

Trees can help reduce urban heat by shading building surfaces, deflecting radiation from the sun, and releasing moisture into the atmosphere. Trees and vegetation lower surface and air temperatures by providing shade and through evapotranspiration.¹ The use of trees and vegetation in the urban environment brings benefits beyond mitigating urban heat islands including reducing electricity demand for air conditioning, not only sparing money and emissions, but helping avoid potentially catastrophic power failures during heat waves.



Key Steps for Implementation

- Identify areas that are vulnerable to extreme heat impacts. This could include citizen science projects similar to those **conducted in Boston**.
- Encourage the inclusion of trees early in concept and site design processes.
- Secure funding for additional shade tree cover.
- Enlist community support to execute plantings.



Action Lead

Department of Public Works



Supporting Partners

- Community Development & Planning
- Conservation Commission
- Andover High School's environmental club and ESIC course
- Merrimack Valley Planning Commission
- Sustainability Department
- Andover Green Advisory Board



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Increased tree coverage in identified areas.
2. Decreased instances of extreme heat impacts in newly planted areas.



Action Initiation Timeframe



¹ <https://www.epa.gov/heatlands/using-trees-and-vegetation-reduce-heat-islands>

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Resilience Considerations

Reducing extreme urban heat effects will be important as the community continues to navigate climate change and its impacts. Trees provide shade and are effective at mitigating the impacts of urban heat. Areas that lack tree cover can be vulnerable to extreme heat impacts.



Co-Benefits & Equity Considerations

1. Improved aesthetics.
2. Planting trees in these areas can help reduce the health risks of a warming climate and make the effort more equitable.
3. Urban tree canopy has greater cooling effects in socially vulnerable neighborhoods, making it an effective strategy to combat extreme heat events that are becoming a significant climate-driven threat to public health.



Cost

\$\$\$



Possible Funding Sources

1. **Healthy Communities Grant Program for New England**
2. **Municipal Vulnerability Preparedness Grants from EEA**
3. **Urban and Community Forestry Challenge Grants**
4. **Urban & Community Forestry Inflation Reduction Act Grants**
5. **Massachusetts Collaborative for Private Forestland – Regional Conservation Partnership Program**

Natural Resources



NR-2. Advance the smart and efficient use of water

NR-2-1. Identify and repair water distribution system leaks.



Action Description

Identifying and repairing water distribution leaks can make a town more sustainable in several ways. First, it can help conserve water, which is becoming an increasingly scarce resource. Second, it can reduce the amount of energy required to pump and treat water, which can help lower greenhouse gas emissions. Third, it can save money for both the town and its residents by reducing water bills. By implementing leak detection programs, utilizing green energy systems, and repairing leaks as soon as they are detected, Andover can improve our water supply networks and become more sustainable. Andover currently responds to public property leaks to repair them immediately; however private property repairs are not addressed as quickly.



Key Steps for Implementation

- Develop a standard for strict deadlines for private property repairs and penalties for noncompliance.
- Revise future contracts for professional services for leak detection to also include immediate repair once found.
- Develop a program for the municipality to support repairs of private property leaks.



Action Lead

Department of Public Works



Supporting Partners

- Facilities Dept.
- Andover Green Advisory Board



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Will need to pass at Select Board Meeting



Measures of Success

1. Leak should not persist year over year. There should be a clear reduction in leak volume in aquifer storage and recovery (ASR).



Action Initiation Timeframe



Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Resilience Considerations

By reducing water distribution leaks, utilities can better manage water resources during extreme weather events, reduce water loss, save money, and improve infrastructure. These measures can help build a more resilient water supply system that can withstand the impacts of climate change.



Co-Benefits & Equity Considerations

1. Reduced wastewater discharges through indoor water savings, which can improve water quality and aquatic habitat.
2. Reduced need for water supply expansion.
3. Investments in water infrastructure can yield additional benefits for water security and resilience for surrounding communities.
4. Community access to safe, affordable, and reliable water services, regardless of income, race, or other factors.
5. Leakage reduction measures should be designed to ensure that the benefits are distributed equitably across the community.



Cost

\$\$\$\$



Possible Funding Sources

1. **MassDEP Water Resources Grants & Financial Assistance**
2. **HUD Community Development Block Grant (CDBG)**
3. **Water Infrastructure Finance and Innovation Act (WIFIA)**

Natural Resources



NR-2. Advance the smart and efficient use of water

NR-2-2. Promote residential water conservation practices



Action Description

Promoting residential water conservation practices is crucial for ensuring the availability of clean water for future generations. Water conservation involves the efficient utilization of water while cutting down its wastage. There are several ways to conserve water at home, indoors and outdoors. Indoor ways include fixing leaks, using low-flow showerheads and faucets, and installing water-efficient appliances. Outdoor ways include planting native species, converting space to non-lawn alternatives, and watering outdoors only when needed. Rainwater runoff can be captured with rain barrels or underground cisterns and used for irrigation. Water conservation can save energy and money, extend the life of septic systems, and prevent water pollution in nearby lakes, rivers, and local watersheds. By promoting residential water conservation practices, we can ensure that supplies of fresh water will be available for everyone, today and tomorrow.



Key Steps for Implementation

- Offer water efficiency classes to employees and residents so they can learn techniques to incorporate water-efficient practices into their daily lives.
- Update the website with helpful information regarding water conservation.
- Work with local home improvement stores to sell or advertise rain barrels.
- Host a bi-annual water conservation workshop for the community.
- Provide clear communications about upcoming restrictions on water use.
- Designate or hire staff to monitor and enforce any new regulations.
- Fund the installation of advanced metering infrastructure (AMI) and automatic meter reading (AMR) metering technology.
- Pass by-law implementing water restrictions in accordance with terms set forth in WMA Registration and Permit issued to town, including enforcement mechanism and penalties for noncompliance. During drought emergencies, the town implements restrictions through the Water Use Restriction Bylaw which was adopted in 2002.
- Investigate opportunities for incentivizing residential and commercial water use reductions



Action Lead

Department of Public Works



Supporting Partners

- Community Development & Planning
- Facilities Department
- Sustainability Department
- Andover Green Advisory Board
- Better Business Bureau
- Faith Communities
- PTA Groups
- Girls and Boys Scouts
- Greater Lawrence Technical School

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

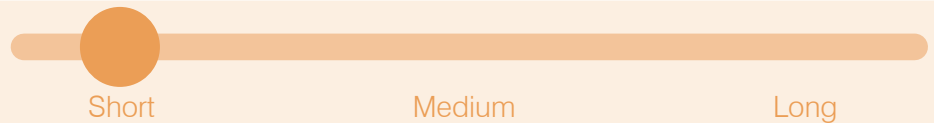


Measures of Success

1. Increased use of rain barrels, rain gardens, or other green infrastructure or water storage methods.
2. Decline in the average residential water bill.
3. Reduction in water pumped from WTP during summer months.
4. If AMR system is implemented, there would be no peak usage during early morning/evening hours on restricted days, and/or no usage on irrigation meters during this period.



Action Initiation Timeframe



Resilience Considerations

Drinking water sources should be conserved as much as possible. There is uncertainty surrounding how climate change will impact freshwater resources, and therefore learning water conservation habits now will be beneficial in the long-term.



Co-Benefits & Equity Considerations

1. Ensuring all people have access to clean, safe, affordable water service is one of the three pillars for advancing water equity. Residential water surveys and evaluations targeted at high water users can benefit equity and fairness.
2. Residential water conservation practices can result in water use savings of 20% to 40%.¹
3. Increased water efficiency and reuse, alongside integrated land use and water planning, can maintain a healthy environment, promote sustainable development, and reduce demand for water supply expansion projects.



Cost

\$: However, if an AMI/AMR system is implemented, the cost would be greater than \$2M



Possible Funding Sources

1. **Department of Housing and Urban Development Green and Resilient Retrofit Program (GRRP)**
2. **Mass Save Program**
3. **State Revolving Fund (for AMI/ARM, but very competitive)**

¹ <https://www.oas.org/dsd/publications/unit/oea59e/ch31.htm>

Natural Resources



NR-3. Promote and Protect Andover’s biodiversity and natural resources

NR-3-1. Lead by example with municipal adoption of sustainable landscaping practices



Action Description

Andover can lead by example with sustainable landscaping practices by implementing eco-friendly landscaping practices, prioritizing the use of native species plants, and using electric equipment to reduce air pollution, conserve water, and manage waste. By implementing these practices, Andover can save money and resources while demonstrating for residents and businesses what best practices are for sustainable landscapes.



Key Steps for Implementation

- Review current town landscaping practices to identify which species use the most water and require the most maintenance and make more sustainable selections for future landscaping. Identify opportunities to reduce the use of pesticides, herbicides, or chemical fertilizers and replace with organic methods to increase water holding capacity and drought/flood tolerance.
- Assess the inventory of Town owned landscape equipment to identify equipment near the end of its lifespan and develop a replacement plan tied to the capital budget for electric equipment.
- Create internal educational materials for hired landscaping staff and decision makers.
- Demonstrate transparent and participatory leadership on adoption to the community through local newspaper articles and on the Town’s website.



Action Lead

Facilities Department
Department of Public Works



Supporting Partners

- Community Development & Planning - Health
- Division of Planning & Economic Development
- Sustainability Department
- Merrimack Valley Planning Commission
- Andover High School’s ESIC Program



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Increase in use of native plant species in landscaping.
2. Purchase and use of electric landscaping equipment.
3. Increase in use of low impact development techniques on municipal properties.

Natural Resources



NR-3. Promote and Protect Andover's biodiversity and natural resources

NR-3-2. Facilitate the use of sustainable landscaping practices in Andover



Action Description

Sustainable landscaping practices aim to create an environmentally friendly and climate-appropriate landscape that requires minimal resource inputs such as fertilizer, pesticides, gasoline, time, and water. These practices include using native plants, reducing water usage, composting locally grown crops and kitchen waste, and limiting the amount of irrigated turf to high traffic areas.¹ Andover can play an active role in supporting residents and businesses with more sustainable landscaping practices through the development of educational materials and ordinances. As an example, York County Pennsylvania has a Sustainable Landscaping Model Ordinance that encourages sustainable landscape practices in common areas of major residential developments. The ordinance provides guidelines for the use of native plants, soil amendments, and other sustainable landscaping practices.²



Key Steps for Implementation

- Host public meetings and workshops for residents and landscaping companies about the importance of sustainable landscaping.
- Develop take-home educational materials for residents and landscaping companies.
- Develop a model ordinance for sustainable landscaping for new development and parcels over 1 acre.



Action Lead

Community Development & Planning



Supporting Partners

- Local landscaping companies
- residents
- DPW
- **Massachusetts Horticulture Society**
- **American Society of Landscape Architects**
- **Grow Native Massachusetts**
- **Native Plant Trust**
- Shawsheen Watershed Group
- Conservation Commission
- Andover Green Advisory Board
- Andover Village Improvement Society
- Open Space Task Force
- Garden Clubs
- Pollinator Pathways

1 <https://www.mass.gov/doc/more-than-just-a-yard-ecological-landscaping-tools-1/download>

2 <https://www.ycpc.org/DocumentCenter/View/303/Model-Sustainable-Landscaping-Ordinance-Final-01-27-2014-PDF>

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Development of the ordinance will require Select Board vote. Education materials only require staff time.



Measures of Success

1. Higher percentage of properties utilizing sustainable landscaping techniques.
2. Increase in presence of native plant species.
3. Increase in use of electric landscaping equipment.
4. Passing of model ordinance.



Action Initiation Timeframe



Resilience Considerations

Sustainable landscaping practices promote the use of native plant species which help promote biodiversity in the area. Sustainable practices may also include limiting impervious coverage which is beneficial for stormwater runoff mitigation. Sustainable landscaping practices also conserve water, create habitat, sequester carbon, and control erosion.



Co-Benefits & Equity Considerations

1. Some sustainable landscaping practices may reduce maintenance costs for homeowners, which can be especially beneficial for low-income communities.
2. Increase in native plant species helps local wildlife thrive.
3. Habitat generation.
4. Sustainable landscaping can reduce the costs for irrigation, fertilizer, and pesticides.
5. Water conservation.



Cost

\$



Possible Funding Sources

1. **Healthy Communities Grant Program for New England**
2. **Urban and Community Forestry Challenge Grants**
3. Consider partnering with local organizations, businesses, and universities for support on pilot projects for low-income residents.

Natural Resources



NR-3. Promote and Protect Andover's biodiversity and natural resources

NR-3-3. Provide education on the protection of biodiverse ecosystems in the community



Action Description

Many residents and businesses may not know the importance of biodiverse ecosystems in their community. The benefits of biodiverse ecosystems include sustaining natural systems to improve resilience and carbon sequestration. Andover can promote Ecoliteracy and provide educational programs on the protection of biodiversity through community-based conservation approaches. These approaches involve initiatives aimed at conserving biodiversity while also letting local people benefit from the resources. Educational materials can include examples for protection and conservation of natural areas and wildlife, as well as important cultural and indigenous knowledge and resources.



Key Steps for Implementation

- Develop and distribute educational materials for residents.
- Work with the school district to include the importance of biodiversity in the curriculum or other learning opportunities.
- Develop a biodiversity index benchmark for existing biodiversity in Andover to monitor over time.



Action Lead

Community Development & Planning - Conservation



Supporting Partners

- Andover Public Schools
- Andover Pollinator Pathways
- Girls and Boys Scouts
- Open Space Task Force
- Andover High School's ESIC Program
- Senior Center
- Memorial Hall Library



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Development and continued monitoring of biodiversity to include species richness and evenness. Species richness is the total number of distinct species, while evenness is a measure of how evenly distributed the individuals are among the species.¹

¹ <https://www.nrcs.usda.gov/publications/ceap-wildlife-2016-BiodiversityMetrics-MultiScaleAnalysis.pdf>

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

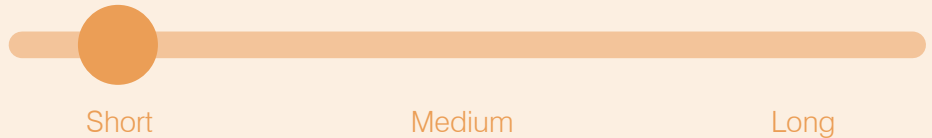
Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Action Initiation Timeframe



Resilience Considerations

For an ecosystem to function, it needs various, diverse interconnected components. The loss of biodiversity weakens ecosystems and reduces their resilience to climate change.



Co-Benefits & Equity Considerations

1. Biodiversity is fundamental for the provision of ecosystem services, which we depend on for food, air, and water security, and multiple other natural benefits.
2. Biodiversity provides numerous ecosystem services that are crucial to human well-being at present and in the future.
3. Equity-centered ecosystem restoration, which approaches restoration through an equity lens in addition to sound ecological principles, is more likely to improve ecological outcomes and promote environmental and social justice.



Cost

\$



Possible Funding Sources

1. **Urban and Community Forestry Challenge Grants**
2. Consider partnering with local organizations, businesses, and universities for support on pilot projects for low-income residents.

Natural Resources



NR-4. Minimize stormwater run-off

NR-4-1. Minimize impervious surfaces throughout Andover



Action Description

Impervious surfaces reduce infiltration and groundwater recharge, increase surface runoff, alter the pathways by which water reaches streams, and can lead to localized flooding, among other environmental consequences. Andover can develop bylaws and best practice education programs to minimize impervious surfaces and promote low-impact development. Targeted places to reduce the amount of impervious surfaces include buildings, roads, parking lots, and other structures for new construction and redevelopment projects, and municipal properties. Regulations regarding impervious coverage could be located in the zoning by-law or the Stormwater Management and Erosion Control bylaw.



Key Steps for Implementation

- Creating education and information materials to be provided when new permits are requested.
- Educate the public and developers about the benefits of reducing impervious coverage.
- Develop revisions to the bylaws.
- Educate the Select Board about the benefits of reducing impervious coverage
- Adopt and implement new regulations.
- Create an incentive program at the municipal level that encourages property owners to reduce impervious surfaces and install low-impact development (LID)/green stormwater infrastructure (GSI) elements.
- Implement a community-based plan designed to summarize strategies for reducing existing and future impervious surface coverage and increasing stormwater.



Action Lead

Community Development & Planning



Supporting Partners

- Department of Public Works
- Sustainability Department
- Facilities Department
- Andover Green Advisory Board
- Andover Village Improvement Society
- Open Space Task Force
- Shawsheen Watershed Group

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- This action requires the adoption of new legislation by the Select Board

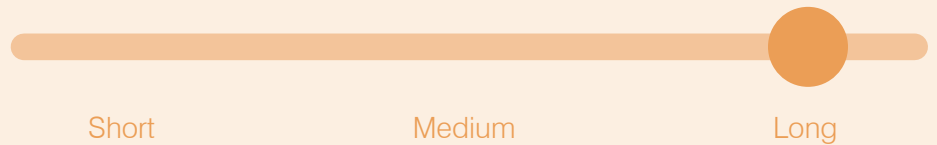


Measures of Success

1. Adoption of new regulations regarding impervious coverage.
2. Increased use of pervious surfaces by developers and homeowners.
3. Decrease in stormwater runoff.
4. Decrease in urban heat effect.



Action Initiation Timeframe



Resilience Considerations

Reducing impervious surfaces can provide several resilience benefits. By minimizing areas such as streets, parking lots, and driveways, stormwater runoff is reduced, which enhances flood control, reduces erosion, and increases infiltration. Impervious surface reduction can help improve urban heat island (UHI) by reducing the amount of heat absorbed by built surfaces during the daytime.



Co-Benefits & Equity Considerations

1. Increased greenspace can facilitate recreational and community activities that enhance the quality of life of residents/employees.
2. Reduced runoff volume improves water quality for downstream communities by reducing pollutant loads and combined sewer overflows.
3. People of color, families with children, and low-income communities are most likely to be impacted by impervious surfaces.
4. This program should raise awareness of green infrastructure benefits, include residents in the design and decision-making process, and lessen the burden of environmental hazards on low-income communities.



Cost

\$\$



Possible Funding Sources

1. **Section 319 Nonpoint Source Competitive Grants Program**
2. **604(b) Grant Program: Water Quality Management Planning from MassDEP**
3. **Healthy Communities Grant Program for New England**

Natural Resources



NR-4. Minimize stormwater run-off

NR-4-2. Install nature-based solutions pilot projects in areas vulnerable to flooding



Action Description

Nature-based solutions (NBS), including green stormwater infrastructure, can be an effective way to minimize stormwater runoff and mitigate flood risks. NBS are actions that protect, sustainably manage, and restore natural and modified ecosystems to address societal challenges. They can help to reduce flood risk, combat climate change, improve water quality, protect property, restore and protect wetlands, stabilize shorelines, and reduce urban heat. Based on vegetated surfaces, NBS provide opportunities for water interception, evapotranspiration, infiltration, and filtration, and thus, can help to reduce the negative impacts of floods, such as erosion, sedimentation, and loss of vegetation cover. NBS can be an ideal solution for Andover which is both sustainable and resilient. Ideally, the Town will implement a series of NBS pilot projects. These projects can be performed by the Town, by community groups with support from the Town, or by local schools. The Town previously implemented a 0.5 acre green infrastructure project.



Key Steps for Implementation

- Identify areas of frequent flooding by developing a town or watershed wide flood model which includes future climate projections. Using this model, identify target areas for nature-based solutions and green infrastructure.
- Alternatively, the Town can crowdsource locations from the community through a campaign. It should be noted that this method does not include future climate changes.
- Select pilot projects locations and identify funding and partners.
- Obtain buy-in from community members.
- Design and construct NBS pilot projects.
- Maintain and study improvements of NBS.



Action Lead

Facilities Department
Department of Public Works



Supporting Partners

- Sustainability Department
- Community Development & Planning - Conservation
- Andover Public Schools



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Installation of nature-based solutions.
2. Reduced flooding and/or heat in identified areas.
3. Increase in use or desire for nature-based solutions.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

Nature-based solutions contribute greatly to community resilience and flood mitigation. They often offer better long-term solutions for flood mitigation than gray infrastructure.



Co-Benefits & Equity Considerations

1. NBS can provide a wide range of co-benefits such as water and air quality improvements, wildlife habitat, carbon sequestration, and flood risk reduction.
2. Healthy natural and managed ecosystems produce a diverse range of services on which human well-being depends, such as food, fiber, clean water, and cultural and recreational opportunities.
3. NBS can help restore watershed and ecosystem health, increase biodiversity, and manage floods, droughts, and extreme weather events.
4. Equity considerations are important in assessing the co-benefits of NBS across elements of socio-cultural and environmental systems.
5. NBS can also provide opportunities for community engagement and empowerment, which can help build social capital and increase community resilience.



Cost

\$\$\$



Possible Funding Sources

1. **Section 319 Nonpoint Source Competitive Grants Program**
2. **604(b) Grant Program: Water Quality Management Planning from MassDEP**
3. **Healthy Communities Grant Program for New England**
4. **Urban and Community Forestry Challenge Grants**
5. **Hazard Mitigation Grants**

Natural Resources



NR-5. Prioritize wetlands in enhancing Andover's resilience to climate change

NR-5-1. Make Andover's wetlands more resilient



Action Description

Wetlands are biodiversity hotspots, providing important habitats for many species of plants and animals. They also play an integral role in shaping the ecology and function of the watershed by providing flooding and erosion protection and improving water quality, as well as offering opportunities for recreation. Last but not least, wetlands can provide carbon storage, slowing the progression of climate change. We need to protect, create, expand, and connect wetlands by identifying strategic areas for expansion and migration, including the adoption of local regulations that prioritize the protection and restoration of wetlands. This can also include shorelines like riverfronts, streambanks, and ponds.



Key Steps for Implementation

- Perform a study to identify areas for wetland migration and expansion through new nature-based solutions.
- Enlist the assistance of local non-profits, land trusts, and conservation organizations to increase community awareness and garner support for wetlands protection.
- Identify wetland areas that could be set aside as passive recreational areas, and others that need to be protected and restored to improve wildlife habitats and riverine health
- Characterize the destruction and risk of wetlands.
- Add resilience language to the **General Bylaw for Wetland Protection** and gain needed approvals.
- Incentivize landowners to identify new wetlands on private properties.
- Calculate the carbon sequestration potential of wetlands. The **MA Healthy Soils Action Plan** estimates wetlands have an average soil organic carbon stock of 321 metric tons/acre.



Action Lead

Community Development & Planning - Conservation



Supporting Partners

- Local non-profits/land trusts including but not limited to Andover Village Improvement Society (AVIS), Shawsheen River Watershed Association, Merrimack River Watershed Council, Essex Greenbelt Association
- state agencies
- federal agencies
- Sustainability Department



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- This action requires the adoption of new legislation by Planning Board and the Select Board

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*

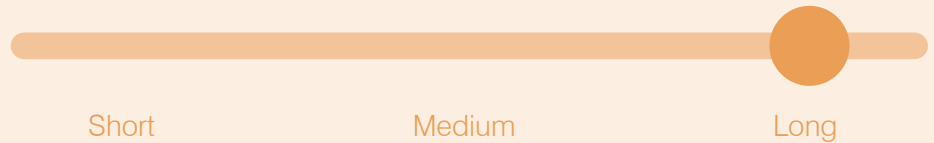


Measures of Success

1. No net loss of wetlands.
2. Increased percentage of land set aside in land trusts.
3. Increase in protected wetlands.
4. Passing an amendment to add resilience to the Wetlands Protection Bylaw.



Action Initiation Timeframe



Resilience Considerations

Wetlands play an important role in community resilience. They mitigate flooding and stormwater runoff by storing and slowing floodwaters and allowing them to passively permeate into the groundwater table. Climate change may bring more frequent storms with higher rates of precipitation, making functioning wetlands a crucial part of community resilience.



Co-Benefits & Equity Considerations

1. Protecting watersheds and communities with nature-based solutions, including but not limited to increasing riparian buffers can help vulnerable communities that are disproportionately affected by climate change.
2. Wetlands provide several benefits for humans, including reducing flood damage, improving water quality, and providing habitat for wildlife.
3. Protecting and restoring wetlands can help mitigate climate change by sequestering carbon and reducing greenhouse gas emissions.
4. Wetlands can provide recreational opportunities and support local economies.
5. Land acquisitions to protect and conserve wetlands can occur through either the purchase or donation of land. It is important to consider the equity implications of these acquisitions, as they may displace low-income or minority communities.



Cost

\$



Possible Funding Sources

1. **National Coastal Wetlands Conservation Grants**
2. **Wetland Program Development Grants**
3. **MassWildlife Habitat Management Grant Program**

Natural Resources

NR-5. Prioritize wetlands in enhancing Andover's resilience to climate change



NR-5-2. Promote community awareness of wetlands importance



Action Description

Wetlands play a key role in community resilience that often goes unrecognized by members of the community. Building community awareness of the importance of wetlands is an important part of sustainable wetland planning and management. One way to promote community awareness is to educate people about the benefits of wetlands, such as their role in improving water quality, providing wildlife habitat, and reducing rainstorm damage. Another way is to encourage people to participate and volunteer in wetland conservation efforts. Additionally, providing important contact information for local bodies responsible for wildlife rescue, wetland rehabilitation and conservation work, and research organizations can be useful. Finally, learning about the wetlands and the ecosystem benefits they provide can be an effective way to encourage people to value and prioritize wetlands.



Key Steps for Implementation

- Develop public outreach and education materials promoting the importance of wetlands.
- Host a community wetlands workshop that explains the importance of wetlands.
- Develop educational signage to be displayed adjacent to wetlands and in other natural areas.



Action Lead

Community Development & Planning - Conservation



Supporting Partners

- Memorial Hall Library
- local non-profits and land trusts
- AVIS
- Andover Trails



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval



Measures of Success

1. Attendance at educational opportunities provided by the Town.
2. Increased community desire for wetlands protection.



Action Initiation Timeframe



Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Resilience Considerations

The more educated the public, the more likely wetlands are to be protected, and the better they will function in terms of community resilience. If a community takes care and protects their wetlands, they will benefit from improved water quality, improved flood mitigation, more passive recreation space, and improved aesthetics of the community.



Co-Benefits & Equity Considerations

1. Nature tourism: Wetlands can provide opportunities for nature tourism, such as birdwatching and wildlife viewing.
2. Educational opportunities for youth.
3. It is important to consider the location of wetlands and transportation resources when designing educational programs to ensure that all communities have access to information, events and resources.
4. Land acquisitions to protect and conserve wetlands need to consider the equity implications of these acquisitions, as they may displace low-income or minority communities.



Cost

\$



Possible Funding Sources

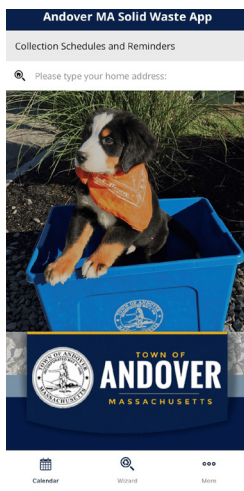
- 1. National Coastal Wetlands Conservation Grants**
- 2. Wetland Program Development Grants**
- 3. MassWildlife Habitat Management Grant Program**

Waste

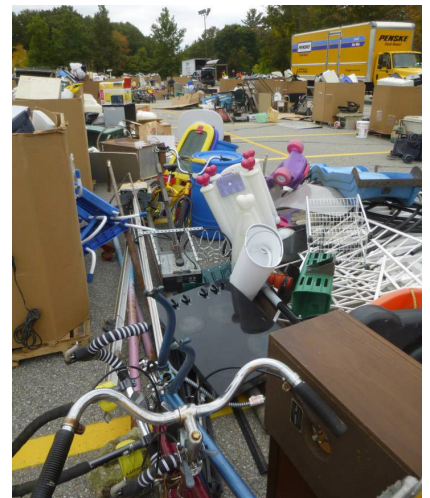
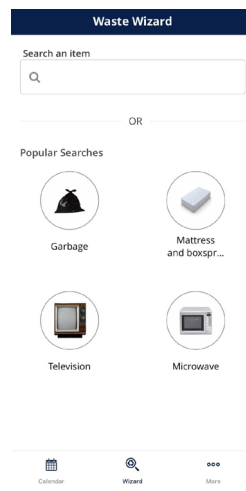
Most of Andover’s solid waste goes to an incinerator but, at times, such as when the facility has reduced capacity due to maintenance, the waste is shipped to regional landfills. Solid waste contributes to greenhouse gas emissions during anaerobic decay of waste in landfills and during combustion at incineration facilities. According to the Massachusetts Department of Environmental Protection (MassDEP) Solid Waste Master Plan, Waste reduction can lead to significant greenhouse gas emission reductions, particularly when viewed from a lifecycle perspective. Based on the EPA Waste Reduction Model (WARM), if Massachusetts achieves the 2030 waste reduction goals, it could prevent over 1,700,000 metric tons of carbon dioxide (CO₂) equivalent from entering the atmosphere. This reduction is equivalent to removing annual emissions from over 370,000 passenger vehicles or conserving nearly 200 million gallons of gasoline.¹

Solid waste makes up 3.2%, or 14,354 MTCO₂e, of Andover’s total baseline GHG emissions. Waste prevention, reuse, recycling, and composting can divert waste and therefore reduce emissions associated with waste disposal. Composting can help to convert food waste into productive soils that can then be used for another cycle of growing plants. Composting allows organic material to be digested in a manner that avoids the production of methane, which is a potent greenhouse gas with a global warming potential 28 times higher than that of carbon dioxide.

The Town currently provides several methods for waste disposal in addition to the curbside trash, recycling, and seasonal leaf collection program. The Bald Hill Compost facility accepts grass clippings, leaves, green garden waste, and woody yard waste. It is open seasonally and requires a permit for residents. Residents can also pick up finished compost at the site for personal use. The Town also has historically held an annual drive-through donation, reuse, and recycling event known as Zero Waste Day, in addition to offering household hazardous waste and electronics recycling one-day collections.



Andover’s Solid Waste App



*Zero Waste Day in April 2014.
Photo from the Zero Waste Day
Andover Facebook page*

¹ <https://www.mass.gov/doc/2030-solid-waste-master-plan-working-together-toward-zero-waste>, page 10

In 2023, Zero Waste Day was held on June 3rd and collected a variety of items including:

For Reuse:

- Toys and hobbies
- Camping and travel gear
- Clothing and shoes
- Books, CDs, DVDs
- Bicycles
- Furniture
- Home goods
- Household and building materials

For recycling:

- Tires
- Textiles
- Electronics and appliances
- Scrap metal
- Dehumidifiers



Mass Save offered \$30 rebates for dehumidifiers.

By keeping these items out of landfills and incinerators, Andover is reducing GHG emissions associated with solid waste disposal.

By identifying opportunities for source reduction and developing infrastructure for improved collection of food wastes, recyclable materials, large or bulky items, and hazardous materials, Andover can reduce waste-related contributions to climate change. There are financial and resiliency reasons to reduce the Town's generation of solid waste in addition to the need to reduce GHG emissions. The resiliency concerns arise because the regional waste disposal capacity has significantly declined in the past decades and is at a point where a large storm event would cause a regional disruption in the solid waste disposal system throughout New England and would likely require shipping waste to landfills out-of-state. The critical shortage of disposal capacity also is likely to lead to significant cost increases at landfills and incinerators in the future.

Other municipalities have reduced their solid waste generation through a combination of effective measures such as convenient and comprehensive diversion programs (including curbside food waste collection, mattress collection, weekly recycling, scrap metal drop-off areas) and trash limits through the distribution of standardized trash containers and various types of fees to fund the enhanced programs. It is clear from the data collected by MassDEP, that those municipalities with enhanced diversion programs have succeeded in reducing their trash tonnage. MassDEP collects data on the tons of solid waste generated and paid for by a municipality and the number of households that are served by that program. By looking at the municipalities across the state with the lowest trash levels being considered the best, Andover is in the bottom 5% in terms of tons per household served. Andover should enhance its collection program, challenge residents to reduce the waste generation by 50% or more, and fund any additional cost with new fees such that the cost does not reduce funding for other critical town needs.



Waste strategies for Andover include:

W-1. Reduce and Divert Waste



Waste Measures of Success:

The following metrics can be used to quantitatively track progress during action implementation. Additional examples of measures of success are detailed throughout.

Action ID	Topic	Metric	2030 Target	2050 Target
W-1-1	Trash and Recycling Program	% reduction in tonnage	50%	90%
W-1-2	Composting	% household participation	10%	50%
W-1-3	Dropoff Site	% reduction of improperly disposed reusable or recyclable material		100%
W-1-4	Trash and Recycling Program	% households served		100%



Bald Hill Compost Site. June 23, 2023. Photo by Jon Unger

Case Study

Waste



DIVERTING FOOD WASTES FROM ANDOVER SCHOOLS

The U.S. Environmental Protection Agency (EPA) **reported in 2021** that the annual food loss and waste in the United States is equivalent to 170 million metric tons of greenhouse gas emissions. This amount does not include methane from decomposition of organic food matters in landfills. It is striking that 50% of the overall food loss and waste in the U.S. occurs during the consumption stage of the food chain, and the amount of food wasted by restaurants, cafeterias and households can feed all food insecure Americans.

Preventing food wastes can improve food security in communities, leading to a healthier population. That is why committed parents working with the Andover Public Schools implemented a food rescue program in 2017. Parent volunteers worked with school officials to set up share tables to recover uneaten school lunch items and transporting the collected food to local food pantries. The group was also instrumental in setting up in-school composting programs to process food wastes. Their work was **highlighted by the EPA** in 2018 as one of 13 winners in a national recognition program.



W-1. Reduce and Divert Waste

W-1-1. Enhance and update the trash and recycling collection program



Action Description

Andover must enhance and update the trash and recycling collection program to reduce waste sent to landfills and incinerators, conserve natural resources, prevent pollution, reduce greenhouse gases, and avoid future cost increases. The urgency to reduce waste across the state is due to the reduced disposal capacity at landfills and an aging set of solid waste incinerators. In contrast, there are increased opportunities for reuse, recycling, composting, and donating items. Reflecting these realities, the Massachusetts Solid Waste Master Plan has set a waste reduction goal for 2050 to reduce disposal by about 5.1 million tons by 2050, from a 2018 baseline of 5.7 million tons to 570,000 tons by 2050, a 90 percent reduction in tons disposed.¹ By updating the trash collection program, Andover can facilitate the collection of recyclable materials. This would reduce the amount of trash generated and minimize future cost increases.



Key Steps for Implementation

- Develop political support.
- Define a new collection program.
- Create a new bid document that includes new collection program features.
- Select contractor.
- Publicize and educate the community on the new program.
- Distribute barrels.



Action Lead

Department of Public Works



Supporting Partners

- Trash and Recycling Vendors
- Sustainability Department
- Andover Green Advisory Board



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

¹ <https://www.mass.gov/doc/2030-solid-waste-master-plan-working-together-toward-zero-waste/download>, page 10.

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Reduced trash tonnage per household.
2. 50% reduction in tonnage by 2030.
3. 90% reduction in tonnage by 2050.



Action Initiation Timeframe



Short

Medium

Long



Resilience Considerations

By reducing Andover waste, the town would help enhance the resilience of the state to respond to large storm events that cause an increase in solid waste disposal.



Co-Benefits & Equity Considerations

1. Reducing waste protects the environment and reduces expenses for disposal.
2. Recycling and reusing waste lessens the need to extract resources and lowers the potential for contamination.¹
3. Sustainable waste management practices can help businesses and communities create economic and social benefits.
4. Sustainable waste reduction efforts should aim to benefit all members of society, regardless of their socioeconomic status.
5. Sustainable waste reduction efforts should aim to educate and engage all members of society, not just those who are already environmentally conscious. This can help to ensure that everyone has the knowledge and tools they need to participate in sustainable waste reduction efforts.
6. Policies that require individuals to pay for waste disposal could disproportionately affect low-income households and programs to address that cost impact should be considered as part of the fee structure.



Cost

\$: *Cost would likely increase for weekly collection. Savings would accrue from reduced waste generation and from solid waste fees.*



Possible Funding Sources

1. **Sustainable Materials Recovery Program (SMRP) Municipal Grant**
2. **Consumer Recycling Education and Outreach Grant Program**
3. **MassDEP Reduce, Reuse, Repair Micro-Grant**

¹ <https://www.epa.gov/recycle/reducing-and-reusing-basics>



W-1. Reduce and Divert Waste

W-1-2. Develop an organics composting program



Action Description

Developing an organic composting program is a great way to recycle organic waste and create a nutrient-rich soil amendment or mulch. Composting is a controlled, aerobic process that involves microorganisms breaking down organic materials such as food scraps and yard trimmings. The end product is compost, which can be used to enrich soil and plants. Composting is a resourceful way to manage waste more sustainably, reduce the volume of materials that might otherwise be disposed of in landfills or trash incinerators, and prevent powerful greenhouse gases from being emitted into the atmosphere. To facilitate composting throughout Andover, the Town should provide multiple options including backyard compost bin distribution, an optional town-wide curbside collection of food waste (because an optional program is likely to have less contamination), and continuation of the Bald Hill drop-off site.



Key Steps for Implementation

- Before starting the initiative, it is important to get the buy-in from key stakeholders and provide educational materials to develop political support.
- Define new compost collection program options.
- Expand and promote the existing backyard compost bin program.
- Create new bid document for services and select contractor for curbside compost collection.
- Publicize widely.
- Distribute curbside compost collection barrels.
- Review lessons learned from previous public school composting program and consider reimplementing



Action Lead

Department of Public Works



Supporting Partners

- MassDEP Municipal Assistance Coordinator
- Andover Public Schools
- Andover Green Advisory Board
- Girls and Boys Scouts
- Andover Youth Services



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. 50% participation rate.
2. Waste reduction of 15% within 2 years of implementation.



Action Initiation Timeframe



Resilience Considerations

Community composting can support local food production and food security, create and sustain local jobs, and build healthy soil.



Co-Benefits & Equity Considerations

3. Higher quality compost could be available at Bald Hill if the organic material collected are composted here. Must be accessible to everyone in the community who desires to participate.
4. Composting enriches the soil with nutrients, which reduces the need for fertilizers and pesticides. Fertilizers and pesticides require fossil fuels for their production and shipping, and some of them are potentially harmful to our health.
5. Composting can create green jobs and support local economies.



Cost

\$: This cost assumes any additional costs for curbside collection are incorporated into an overall waste management fee.



Possible Funding Sources

1. **MassDEP Waste & Recycling Grants & Assistance**
2. **Climate Pollution Reduction Grants** through EPA



W-1. Reduce and Divert Waste

W-1-3. Establish a Recycle and Reuse Drop-Off Site



Action Description

Establishing a recycling and reuse drop-off site is an important step towards better waste management. When establishing a recycling and reuse drop-off site, there are several key considerations such as location, design, equipment, staffing, education and outreach, and regulations. The process of reusing starts with the assumption that the used materials that flow through our lives can be a resource rather than refuse.¹ Andover residents currently have no place to easily dispose of several categories of reusable or recyclable materials such as tires, scrap metal, paint, motor oil, and mercury-containing items. A recycle and reuse drop-off site would reduce waste disposed of as trash. Recycling and reuse limits the need to extract new resources, which reduces greenhouse gas emissions and helps to mitigate climate change.



Key Steps for Implementation

- Develop political support and educational materials.
- Define items to be collected.
- Identify site or negotiate site access.
- Layout site.
- Determine whether to be privately operated or town operated.
- Develop bid documents and select vendor.
- Publicize widely.
- An alternative to establishing a site in Andover is to negotiate with North Andover to utilize their drop off site.



Action Lead

Department of Public Works



Supporting Partners

- MassDEP Municipal Assistance Coordinator
- Andover Public Schools
- Andover Green Advisory Board
- Girls and Boys Scouts
- Andover Youth Services



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval

¹ https://pubs.nmsu.edu/_g/G314/index.html

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*

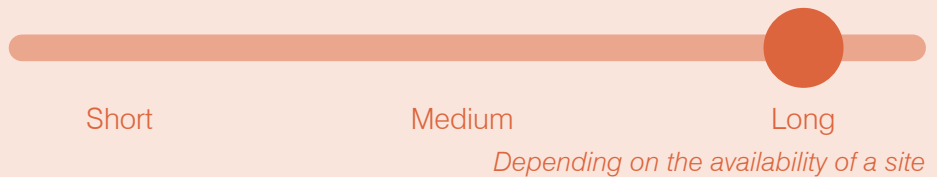


Measures of Success

1. Start of operations within 7 years.
2. Active use of the site by Andover residents.
3. Increase in number of users and amount of material collected.



Action Initiation Timeframe



Co-Benefits & Equity Considerations

4. Recycling reduces the use of natural resources by reusing materials, which conserves natural resources such as timber, water, and minerals.
5. Recycling indirectly reduces stress and creates a positive environment.¹
6. Increased donations to non-profits.
7. Must be easily accessible to the entire community.
8. This could offer drop-off access to those who are not currently served by the Town's trash collection program.



Cost

\$\$



Possible Funding Sources

1. **Sustainable Materials Recovery Program (SMRP) Municipal Grant**
2. **Consumer Recycling Education and Outreach Grant Program**
3. **MassDEP Reduce, Reuse, Repair Micro-Grant**

¹ <https://community.thriveglobal.com/recycling-is-good-for-the-environment-but-did-you-know-it-can-also-improve-your-mental-health/>



W-1. Reduce and Divert Waste

W-1-4. Ensure parallel trash and recycling collection service for multifamily residential



Action Description

Andover residents living in apartments or condominiums with more than six units are not served by the Town's trash and recycling program. Only some of these residences currently have access to recycling. The MassDEP regulates disposal of materials across the Commonwealth. MassDEP has identified a list of items that should be recycled or reused rather than landfilled or incinerated, known as **Waste Disposal Bans**. The Town has the ability to increase access to recycling services for apartment and condominium residents and better comply with state regulations by revising the Board of Health (BOH) regulations. The BOH has authority to adopt private hauler regulations requiring that all private haulers seeking a permit to operate in Andover must offer recycling services at no additional cost and demonstrate their compliance with the Waste Disposal Bans.



Key Steps for Implementation

- Develop political support with BOH.
- Request assistance from MassDEP.
- Develop draft regulations based on MassDEP resources and submit to BOH.
- Publicize to private haulers.
- Enforce the following year by requiring data reporting on tonnages collected in Andover by each company and a list of any entities not complying with the waste sorting requirements.
- Educate residents served by private haulers, using the MassDEP Solid Waste Master Plan as a resource.



Action Lead

Community Development & Planning - Health



Supporting Partners

- MassDEP Municipal Assistance Coordinator
- Sustainability Department



Ease of Implementation

- Requires Town Meeting vote
- Department has authority to carry out
- Requires Select Board approval
- Would require new legislation and regulation from the Board of Health

Legend

Action Initiation Timeframe

Short: 0-2 years
 Medium: 3-6 years
 Long: 7+ years

Cost*

\$: less than 10k \$\$\$\$: 500k-2mill
 \$\$: 10-50k \$\$\$\$\$: 2 mill+
 \$\$\$: 50-500k

**Cost associated with the actions refers to how much it is expected to cost the Town to implement. This does not include costs for individuals or businesses which may vary.*



Measures of Success

1. Number of complexes that begin to implement a recycling program (baseline currently unknown).
2. Tons of recyclable materials collected by private haulers.



Action Initiation Timeframe



Co-Benefits & Equity Considerations

1. Renters and condominium owners will have greater access to recycling services and may have an increased sense of belonging when given equal access to similar waste diversion as Town serviced residents.



Cost

\$



Possible Funding Sources

1. **Consumer Recycling Education and Outreach Grant Program**

Implementation Roadmap

							Implementation Partners									
Action Details							Municipal Departments									
Sector	Strategy	Action	Timeline for Initiation	Cost for the Town	GHG or Resilience	Sustainability	Facilities	Community Development & Planning	Emergency Management	Police & Fire	Public Works	Schools	Library	Residents	Businesses	
Buildings	B-1. Construct Net-Zero, Low Embodied Carbon New Buildings	B-1-1. Adopt the Specialized Stretch Energy Code	3-6 years	\$	GHG	X	X	X					X	X	X	
		B-1-2. Reduce embodied carbon in new buildings	3-6 years	\$\$\$	GHG	X	X	X					X	X	X	
	B-2. Retrofit Existing Buildings to Use Less Energy and Renewable Energy	B-2-1. Facilitate a residential electrification and energy efficiency program	3-6 years	\$\$	GHG	X									X	X
		B-2-2. Facilitate a commercial and municipal electrification and energy efficiency program	3-6 years	\$\$\$\$\$	GHG	X	X	X								X
		B-2-3. Develop a residential climate resilience strategy	3-6 years	\$	Resilience	X		X							X	
	Energy	E-1. Reduce Energy Use	E-1-1. Educate commercial entities and municipal stakeholders on energy reduction	0-2 years	\$	GHG	X	X				X				X
E-1-2. Educate residents on energy reduction			0-2 years	\$	GHG	X								X		
E-1-3. Partner with utilities to address gas leaks in supply infrastructure			3-6 years	\$	GHG	X			X							
E-2. Transition to Renewable Energy		E-2-1. Implement Municipal Aggregation (also known as Andover Community Power)	0-2 years	\$	GHG	X								X	X	X
		E-2-2. Offer training programs for residents on solar and energy storage options.	3-6 years	\$	GHG	X		X							X	
		E-2-3. Increase the amount of voluntary MA Class I Renewable Energy Certificates for municipal electricity procurement contracts.	0-2 years	\$\$\$	GHG	X	X	X								

Sector	Strategy	Action Details	Timeline for Initiation	Cost for the Town	GHG or Resilience	Implementation Partners									
						Municipal Departments							Residents	Businesses	
						Sustainability	Facilities	Community Development & Planning	Emergency Management	Police & Fire	Public Works	Schools			Library
Energy	E-3. Emphasize Energy Education from Kindergarten through the Trades	E-3-1. Increase clean energy and climate change educational programming into K-12 school curriculum.	3-6 years	\$\$	GHG & Resilience	X						X	X		
		E-3-2. Clean Energy Workforce and Apprenticeship Initiative	7+ years	\$\$\$	GHG & Resilience	X	X					X	X	X	
	E-4. Enhance Energy Resilience	E-4-1. Evaluate municipal facilities energy supplies and add power redundancy.	0-2 years	\$\$\$	Resilience	X	X				X				
Mobility	M-1. Enable and Promote Alternative Transportation	M-1-1. Implement Active Transportation Plan	7+ years	\$\$\$\$	GHG	X	X	X			X		X	X	
		M-2. Transition to Electric Vehicles	M-2-1. Install EV charging infrastructure	0-2 years	\$\$\$	GHG	X	X	X			X		X	X
		M-2-2. Transition public fleets to EVs	3-6 years	\$\$\$\$	GHG	X	X			X	X				
Public Health and Safety	PH-1: Protect residents, workers, and visitors in the event of natural disasters or public health crises	PH-1-1. Explore meaningful ways to increase emergency communication with the community	3-6 years	\$	Resilience	X		X	X	X		X	X	X	
		PH-1-2. Develop neighborhood resilience hubs to coordinate and maintain resident well-being	0-2 years	\$	Resilience	X	X	X	X	X	X	X	X	X	

Action Details						Implementation Partners									
Sector	Strategy	Action	Timeline for Initiation	Cost for the Town	GHG or Resilience	Municipal Departments							Residents	Businesses	
						Sustainability	Facilities	Community Development & Planning	Emergency Management	Police & Fire	Public Works	Schools			Library
Public Health and Safety	PH-2: Enhance municipal and community preparedness to respond to climate impacts	PH-2-1. Develop public health approach to build mental wellness and resilience	7+ years	\$\$	Resilience	X		X				X		X	
		PH-2-2. Identify and assess hazardous material storage locations at risk from flooding	3-6 years	\$\$\$	Resilience	X	X	X	X	X	X			X	X
Natural Resources	NR-1: Enhance and protect the tree canopy	NR-1-1. Develop a program to maintain and improve the municipal tree canopy.	0-2 years	\$	GHG & Resilience	X		X				X	X	X	
		NR-1-2. Identify areas vulnerable to extreme heat impacts and coordinate tree planting efforts	3-6 years	\$\$\$	GHG & Resilience	X		X				X		X	X
	NR-2: Advance the smart and efficient use of water	NR-2-1. Identify and repair water distribution system leaks.	3-6 years	\$\$\$\$	GHG & Resilience	X	X					X		X	X
		NR-2-2. Promote residential water conservation practices	0-2 years	\$	GHG & Resilience	X	X	X				X	X	X	
	NR-3: Promote and Protect Andover's biodiversity and natural resources	NR-3-1. Lead by example with municipal adoption of sustainable landscaping practices	3-6 years	\$\$	GHG & Resilience	X	X	X				X	X		
		NR-3-2. Facilitate the use of sustainable landscaping practices in Andover	3-6 years	\$	GHG & Resilience	X		X				X		X	X
		NR-3-3. Provide education on the protection of biodiverse ecosystems in the community	0-2 years	\$	Resilience	X		X					X	X	X
	NR-4: Minimize stormwater run-off	NR-4-1. Minimize impervious surfaces throughout Andover	7+ years	\$\$	Resilience	X	X	X				X		X	X
		NR-4-2. Install nature-based solutions pilot projects in areas vulnerable to flooding	7+ years	\$\$\$	Resilience	X	X	X				X	X	X	X

Action Details						Implementation Partners									
Sector	Strategy	Action	Timeline for Initiation	Cost for the Town	GHG or Resilience	Municipal Departments									
						Sustainability	Facilities	Community Development & Planning	Emergency Management	Police & Fire	Public Works	Schools	Library	Residents	Businesses
Natural Resources	NR-5. Prioritize wetlands in enhancing Andover's resilience to climate change	NR-5-1. Make Andover's wetlands more resilient	7+ years	\$	GHG & Resilience	X		X						X	
		NR-5-2. Promote community awareness of wetlands importance	0-2 years	\$	GHG & Resilience	X		X					X	X	X
Waste	W-1. Reduce and Divert Waste	W-1-1. Enhance and update the trash and recycling collection program	3-6 years	\$	GHG	X								X	X
		W-1-2. Develop an organics composting program	3-6 years	\$	GHG	X								X	X
		W-1-3. Establish a Recycle and Reuse Drop-Off Site	7+ years	\$\$	GHG	X								X	X
		W-1-4. Ensure parallel trash and recycling collection service for multifamily residential	3-6 years	\$	GHG	X		X			X			X	

Bold **X** denotes the lead municipal department.



Along the Shawsheen River near Dundee Park, June 2023, Photo by Jon Unger

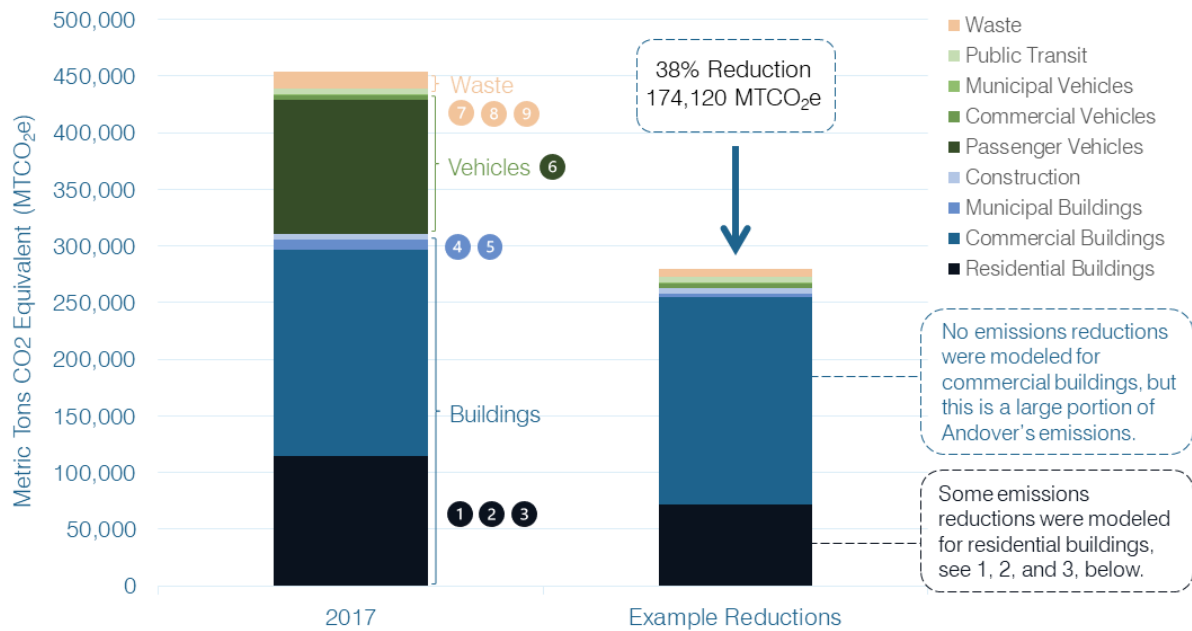


Shawsheen Square in 2006 Mother's Day Flood. Photo from the collections of the Andover Center for History and Culture



Electric Vehicle Charging Station at 89 Main Street.

This graph shows example greenhouse gas emissions reductions from a sample of actions across sectors.



1

If residential energy efficiency improvements were made to reduce energy consumption by 10%, this would reduce Andover's emissions by 8,769 MTCO₂e per year.

2

If 4,360 homes switched from a natural gas boiler to an air source heat pump, Andover's emissions would be reduced by an estimated 11,772 MTCO₂e per year.

3

If all residential electricity was assumed to be 100% Class I RECs, Andover's emissions would reduce by 21,812 MTCO₂ (excluding electricity reduced due to energy efficiency).

4

If all municipal natural gas usage was eliminated Andover's emissions would be reduced by 5,326 MTCO₂e.

5

If the water treatment plant electricity usage was reduced by 10% with residential and commercial water conservation measures and energy efficiency upgrades, there would be a reduction of 105 MTCO₂e.

6

If all gasoline and diesel usage from passenger vehicles was eliminated emissions would be reduced by 117,817 MTCO₂e.

7

If Andover's tons of waste were reduced by 50%, emissions would be reduced by 6,924 MTCO₂e

8

If an organics composting program was developed and all possible food waste was composted, 1,357 MTCO₂e could be reduced.

9

If the Board of Health requires private waste haulers to provide the same level of recycling services to multifamily residential, 229 MTCO₂e could be reduced.

Additional examples include:

10

If 4,360 homes in Andover had solar panels on their roofs, 6,785 MTCO₂e would be avoided. See Appendix X for more information about the assumptions and calculations.

11

Specialized Stretch Code: If by 2050, there was an additional 14,551,117 square feet of residential and commercial space in Andover and 80% of this did not use natural gas, an estimated 35,630 MTCO₂e would be avoided in one year.

Related Strategies & Actions:

1 2 B-2-1

3 E-1-1

4 B-2-2

5 NR-2

6 M-2

7 W-1-1

8 W-1-2

9 W-1-4

10 E-1-2

11 B-1-1



Additional information about the GHG emissions reduction calculations can be found in Appendix A.

Conclusion

The transition to net-zero is a necessary step in the fight against climate change, but also a challenging one.

The Town of Andover recognizes that bold action is needed to meet the goals and targets outlined in this plan. While the actions and details to get started on implementation pertain to the municipality, many of the 35 actions cannot be executed without residents and businesses doing their part. The Town can embark on projects, establish programs, and create policies to make headway toward net-zero, but lifestyle changes, building retrofits, and new business practices are necessary too.

While there is massive transformation needed, we can expect many positive outcomes including cleaner air and water, a healthier community, and new job opportunities in clean energy and other sustainable industries. By empowering residents and businesses with the knowledge, tools, and resources to make decisions with climate in mind, we can secure a more sustainable future.

Pushing the envelope

The Town's Capital Improvement Program plans and budgets several years out but in each iteration departmental requests typically far exceeded the resources available. While the Town has financial and staff constraints to execute climate actions on top of existing operations, climate action and sustainability have been deemed a priority, yet we need to be creative and resourceful to meet net-zero goals. This includes continuing to take advantage of state and federal funding opportunities and expanding staff capacity.



View from the bridge on Stevens Street over the Shawsheen River, June 2023, Photo by Jon Unger

How you can help in the transition

There are a range of things that residents and businesses can do to start or continue taking climate action. Some examples include:

Start with small changes

- Utilizing the free Mass Save energy audits to identify energy efficiency measures that can help you reduce your energy and save money on your utility bills.
- Walk, bike, or use public transportation once per week instead of driving when it's convenient, if you have the ability
- Water your lawn, or portions of it, less often

Make sustainable swaps when you're in need of a replacement or upgrade

- When in need of a new vehicle, opt for a plug-in hybrid or an electric vehicle
- When in need of a new heating or cooling system, opt for an all-electric efficient heat pump, rather than a direct replacement of fossil fuel systems
- When in need of a new appliance like a stove or water heater, opt for an electric version

Share your knowledge with others and stay informed

- Already have an EV, heat pump, solar, etc.? Share your experience with your friends and neighbors!
- Stay in the know! Subscribe to **2050, Andover's Sustainability e-newsletter**.

Advocate beyond Andover

- Make your voice heard by advocating for additional climate action at the state and federal levels by joining advocacy groups like Andover WECAN, contacting elected officials, participating in public events, and supporting upcoming legislation.



Induction cooking. Photo by Kate Margolese



Town Meeting. Photo by Kate Margolese

Glossary and Abbreviations

The following definitions are consistent with those in the Massachusetts Decarbonization Roadmap, unless otherwise noted.

Adaptation (to climate change): Actions taken at the individual, local, regional, and national levels to reduce risks from today's changed climate conditions and to prepare for impacts from additional changes projected for the future. *Definition from the US Global Climate Change Research Program and consistent with the Massachusetts Climate Assessment*

Anthropogenic: Made by people or resulting from human activities; usually used in the context of emissions that are produced as a result of human activities.

Building Envelope: The physical separator between the indoor and outdoor environments that limits heat transfer.

Capacity: The maximum amount of energy that can be produced at a given time. Often used to characterize the amount of electricity generation infrastructure (reported in Watts), but can also be used to describe the storage of a battery, the amount of transmission, or the output of a heat pump (Btu)

Carbon Capture and Storage (CCS): The process of capturing waste carbon dioxide (CO₂), transporting it to a storage site, and depositing it where it will not enter the atmosphere.

Carbon Dioxide (CO₂): A naturally occurring gas, and also a byproduct of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal human caused greenhouse gas that affects the Earth's radiative balance.

Carbon Dioxide Equivalent (CO₂e): A unit of measurement that allows the effect of different greenhouse gases and other factors to be compared using carbon dioxide as a standard unit for reference. CO₂e are commonly expressed as "metric tons of carbon dioxide equivalents (MT CO₂ e)."

Carbon Sequestration: The process of removing carbon from the atmosphere and storing it in a reservoir. From the point of view of biology, it includes the direct sequestration through a change in land use like afforestation. From the point of view of physics, it includes the split and removal of carbon dioxide to store it underground for a long period of time in gas and oil reservoirs, coal mines, and depleted saline aquifers. *Definition from the Climate Reality Project*

Carbon Sink: A biological system or other natural environment, such as a forest or a body of water, that absorbs more carbon dioxide from the atmosphere than it releases.

Climate Change: A change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period.

Climate Equity: Recognizing and addressing the unequal burdens made worse by climate change, while ensuring that all people share the benefits of climate protection efforts. Achieving equity means that all people—regardless of their race, color, gender, age, sexuality, national origin, ability, or income—live in safe, healthy, fair communities. *Definition from the Environmental Protection Agency (EPA)*

Co-Benefits: The positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare.

Decarbonization: The process by which countries or other entities aim to achieve a low-carbon economy, or by which individuals aim to reduce their consumption of carbon.

Distribution: The process and system of moving electricity from the transmission system to individual consumers.

Direct Emissions: Greenhouse gas emissions from sources that are attributed to the reporting entity.

Emissions: The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.

Embodied Carbon: In the building industry, embodied carbon refers to the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials. In contrast, operational carbon refers to the greenhouse gas emissions due to building energy consumption. *Definition from the Carbon Leadership Forum*

Energy Efficiency: Using less energy to provide the same service (lighting, mobility, cooling/heating, etc).

Environmental Justice (EJ): the principle that all people have a right to be protected from environmental hazards and to live in and enjoy a clean and healthful environment. EJ is the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits. *Definition from the Massachusetts Executive Office of Energy and Environmental Affairs*

Equity: See Definition for Climate Equity



Above the Ballardvale Dam on The Shawsheen River, June 2023, Photo by Jon Unger



The Shawsheen River near Balmoral, June 2023, Photo by Jon Unger

Flexible Loads: Energy using devices where their energy demands can be shifted according to user needs and/or requirement of power balance.

Fossil Fuel: A general term for organic materials formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years.

Generation: The production of electric power from a primary energy resource: natural gas, wind, solar. Typically reported in Watt-hours.

Global Warming Potential (GWP): A measure allowing comparisons of different gases across a common unit.

Greenhouse Gas (GHG): Any gas that absorbs infrared radiation in the atmosphere.
Indirect Emissions: GHG emissions that are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity.

Inventory: A comprehensive, quantified list of an entity's or jurisdiction's GHG emissions and sources.

Load: The amount of energy demanded by a particular energy service or the aggregation of services such as electricity demand.

Methane (CH₄): A colorless, odorless flammable gas that is the main constituent of natural gas. It is the simplest member of the alkane series of hydrocarbons.

Metric Ton: Common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs. or 1.1 short tons.

Mitigation (of climate change): A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Municipal Solid Waste (MSW): Residential solid waste and some non-hazardous commercial, institutional, and industrial wastes.

Natural Gas: A naturally occurring mixture of principally methane and small fractions of hydrocarbon and non-hydrocarbon gases found in porous geologic formations beneath the Earth's surface, often in association with petroleum (oil).

Natural Hazard: Sources of harm or difficulty created by meteorological, environmental, or geological events. *Definition from FEMA and consistent with the Massachusetts Climate Assessment*

Net-Zero Emissions: The balancing of gross emissions with removals of greenhouse gases from the atmosphere.

Net-Zero Enabling Technology: Technologies that either 1) significantly increase energy efficiency, 2) allow for a structure to avoid onsite combustion of fossil fuels or to source renewable energy, or 3) store energy generated from renewable sources onsite. *Definition from the Metropolitan Area Planning Council (MAPC)*

Nitrous Oxide (N₂O): One of the six primary GHGs, typically generated as a result of soil cultivation practices, particularly the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

Reforestation: Planting of forests on lands that have previously contained forests but that have been converted to some other use.

Renewable Energy: Energy obtained from natural sources that are considered endless due to the immense amount of energy they contain, or due to their capacity to regenerate themselves in a natural way. Renewable energies are divided into: eolic (wind), geothermic, hydroelectric, tidal energy, solar, wave energy, biomass, and biofuels. *Definition from the Climate Reality Project*

Resilience: the capacity of individuals, communities, businesses, institutions, and governments to adapt to changing conditions and to prepare for, withstand, and rapidly recover from disruptions to everyday life, such as hazard events. *Definition from FEMA and consistent with the Massachusetts Climate Assessment*

Sequestration: The uptake of carbon containing substances, in particular carbon dioxide, in terrestrial or marine reservoirs.

Sink: Any process, activity or mechanism that removes a greenhouse gas from the atmosphere.
Transmission: The bulk movement of electrical energy from a generating source and site to a substation or intermediate location.

Vulnerability: Tendency or predisposition to be affected in a negative manner. The level of susceptibility of a system, or its inability to face the negative effects of climate change such as the volatility of weather and the extremes. Vulnerability is a function of a system's character, magnitude, and exposure to climatic variation rate, as well as its sensitivity and adaptation capacity. *Definition from the Climate Reality Project*



Andover Town Green in winter. Photo by Kate Margolese



A snowy road in Andover. Photo by Kate Margolese