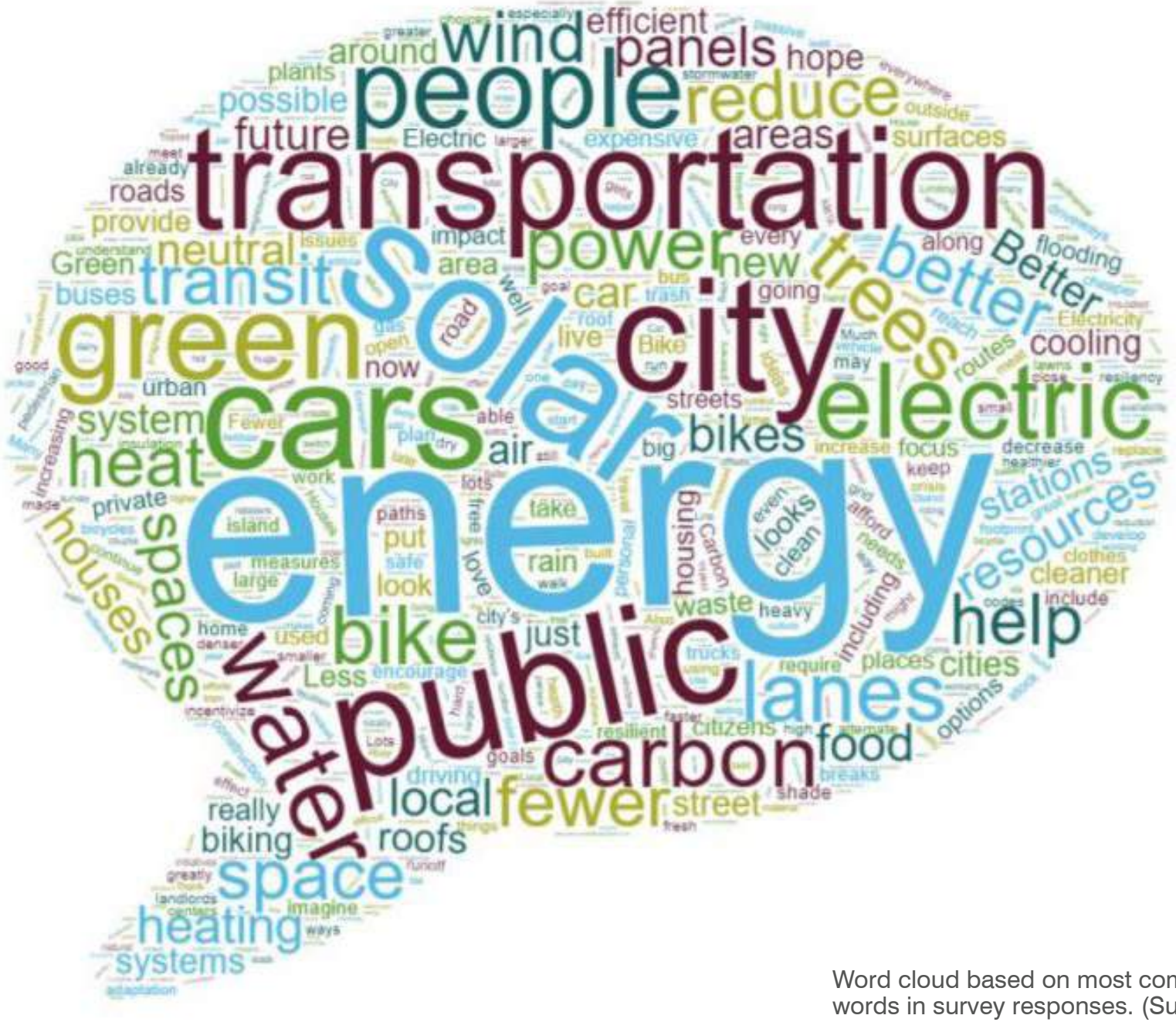
CITY OF SOMERVILLE
OFFICE OF SUSTAINIBILTY &
ENVIRONMENT

MAYOR JOSEPH A. CURTATONE

SOMERVILLE CLIMATE FORWARD

Somerville's Community Climate Change Plan

NOVEMBER 2018



Word cloud based on most common words in survey responses. (Summer 2018) Somerville Climate Forward

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LETTER FROM MAYOR JOSEPH A. CURTATONE

Climate change is one of the most pressing challenges of our time. It also presents a tremendous opportunity to think differently about how we plan and live in cities. By taking action to slow climate change and to prepare for its impacts, we can forge a better future for our children, make Somerville healthier and safer, stimulate the local economy by driving demand for local clean energy and transportation solutions, and make our community stronger and more resilient. In Somerville, we can lead by showing that bold transformations are possible. Climate change is a complex, collective action problem. But in Somerville, we don't shy away from a challenge, we roll up our sleeves and find solutions. Somerville Climate Forward is full of solutions that will help us work collectively to become a carbon-neutral and resilient City.

In true Somerville fashion, we used a data-driven approach to develop the actions in Somerville Climate Forward. This plan is the culmination of years of work to fully understand what climate change means here in Somerville. The Climate Change Vulnerability Assessment informed us of our most pressing needs to make our community more resilient to climate impacts; our greenhouse gas inventories tell us how we, as a community and city government, contribute to global greenhouse gas emissions and where we need to cut back the most; and the Pathways to Carbon Neutrality Study showed us what it would take to achieve carbon neutrality by 2050. Armed with this data, we were able to push our action planning further and prioritize a short list of actions that are detailed and implementable. Not all of the actions in this plan will be easy, but I know that Somerville is up to the challenge.

Now more than ever, we need bold local solutions and transformational change that are only possible through collective action. Solving the problem of climate change will require transformations of our transportation, energy, and economic systems that have been driven by fossil fuels for generations. It is important for us all to find ways to reduce emissions every day, whether that is by choosing to take a bus instead of a car or using less energy at home. But government plays a critical role in facilitating the systems-level changes that make it easier for everyone to make more sustainable choices. Whether that is bringing the Green Line to Somerville to make it easier to forego a car or implementing the community choice electricity program to bring down the cost of renewable electricity.

It is also vital that we do this equitably. Climate action cannot leave people behind. On both the global and local scale, those who have contributed least to climate change will be the most impacted and often have the fewest opportunities to benefit from climate action. If we are to succeed in our goals, everyone needs to be able to participate in climate action, not just those with the most resources. This is why we have identified equity considerations for each action in this plan, and will continue to look for ways to implement this plan so that it benefits everyone in our community and does not increase burdens on those in our community who are already struggling.

This plan alone will not prevent global climate change, but if cities around the world take bold action to transform into carbon neutral and resilient cities, we can create a better future for all. Let's be bold together and move Somerville forward.

THIS PLAN IS THE RESULT OF THE HARD WORK AND COLLABORATION OF MANY.

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SustainaVille
creating a resilient & carbon neutral somerville

INTRODUCTION

WHAT IS SOMERVILLE CLIMATE FORWARD?

Somerville Climate Forward, Somerville's first comprehensive climate change plan, is a set of implementable actions that will reduce Somerville's contribution to climate change and prepare the City for the unavoidable impacts of climate change.

This plan includes policies, programs, and strategies that work to accomplish the following:

- **Reduce** Somerville's contribution to climate change and work towards carbon neutrality (mitigation).
- **Prepare** Somerville for the unavoidable impacts of climate change (adaptation).
- **Fairly distribute** the opportunities created by climate action and work to alleviate the unequal burdens of climate change (equity).

This plan is the framework for how we will collectively take action on climate change in Somerville over the next 5-10 years.

These actions build on the work that is already being done across the City to advance sustainability and climate resilience. The plan represents the next step of a multi-year planning process that began with Mayor Joseph Curtatone's commitment to making Somerville carbon neutral, or having a net-zero release of GHG emissions, by 2050, and has included development of the City's first Greenhouse Gas (GHG) Inventory (2016), the Carbon Neutral Pathways Assessment (2017), and the Somerville Climate Change Vulnerability Assessment (2017).

Somerville Climate Forward identifies opportunities for near-term action across different sectors, including buildings, mobility, natural environment, community, and leadership.

This plan is the framework for how we will collectively take action on climate change in Somerville over the next 5-10 years. These actions won't get us all the way to carbon neutrality, but they are the critical first steps on the pathway to meeting our long-term goals.

Photo Credit: City of Somerville

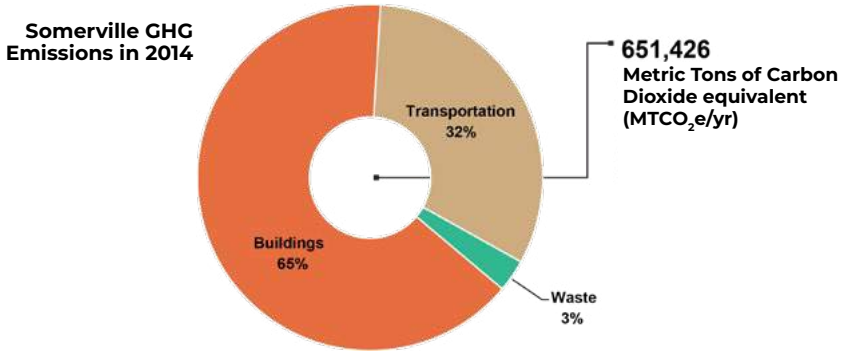
WHY WE NEED TO ACT NOW

Climate change is one of the most serious challenges of our time, and there is no doubt that our dependence on fossil fuels is to blame. The good news is that because we know what the problem is, we also know what we need to do to solve it. It won't be easy, but preventing climate change from causing catastrophic impacts is achievable if we take action together.

Climate change presents an urgent agenda for cities, as it is a cumulative process that is already impacting day-to-day life. The longer we take to reduce emissions, the more severe the impacts will be, making it more difficult and expensive to prepare and rebound from these impacts. Even more, Somerville and our region have among the highest energy costs in the country, and our dependence on fossil fuels also creates uncertainty for our economy and security. The time to act is now.

An implementation-driven approach to addressing climate change will allow the City to simultaneously prepare for impacts, while taking action to reduce the GHG emissions that cause climate change. Early actions on reducing or mitigating GHG emissions are important to lower the cumulative emissions released into the atmosphere. Early actions are also important for strategies where implementation of GHG reducing programs will take decades. For example, switching heating systems in all Somerville buildings from natural gas or oil to electric or renewable systems will take significant, sustained effort over decades.

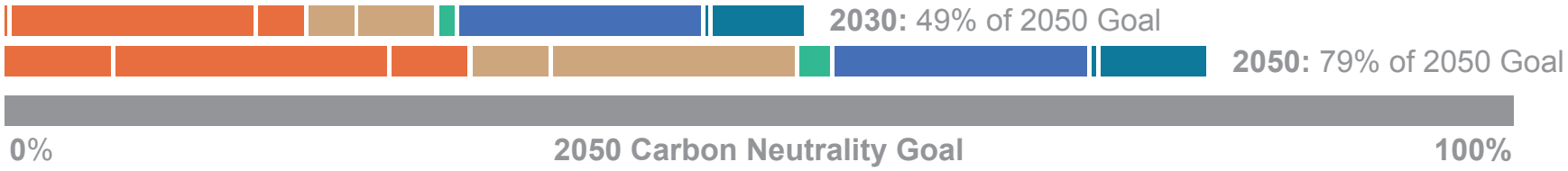
We as cities have a responsibility to do this now. Cities are responsible for 70% of global GHG emissions and will be forced to contend with the localized impacts of climate change. Somerville is part of a growing cohort of cities committed to climate action.



Source: AECOM for Somerville Climate Forward

In 2014, Mayor Joseph Curtatone committed to achieving carbon neutrality in Somerville by 2050. And as chairman of the Metro Mayors Coalition, he led the 15 municipalities that comprise the coalition in pledging to make the Boston region carbon neutral by 2050. He has also signed onto the Global Covenant of Mayors for Climate & Energy and Climate Mayors, committing to upholding the goals of the Paris Climate Agreement. In 2017, the Board of Aldermen passed a resolution to affirm the goals of the Paris Climate Agreement. Somerville's leaders and community are ready to take action. This plan is an important step towards making those goals a reality.

If we fully implement the actions in this plan, how close will we get to carbon neutrality?



Source: AECOM for Somerville Climate Forward

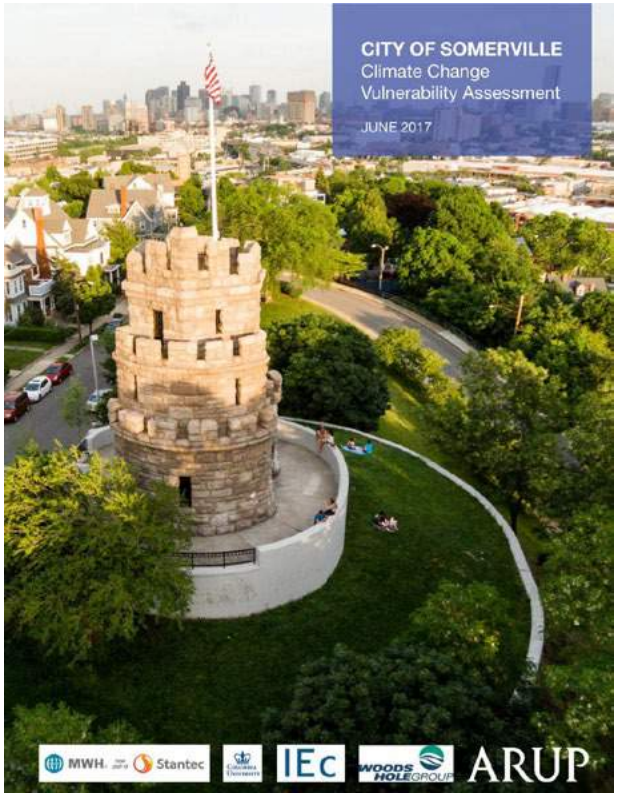
WHAT WE KNOW ABOUT CLIMATE CHANGE IN SOMERVILLE

The City's climate change analysis provides us a strong, science-based foundation on which to create an action plan.

The 2017 Somerville Climate Change Vulnerability Assessment identifies our top risks in an environment that has changed due to man-made climate change.

In many ways climate change will intensify impacts that Somerville is already experiencing, such as heat waves and flooding from intense rainstorms. Over the last year, respondents to the Somerville Climate Forward survey noted that they have observed longer and warmer summers in Somerville, as well as an increase in extreme weather, particularly intense rainstorms.

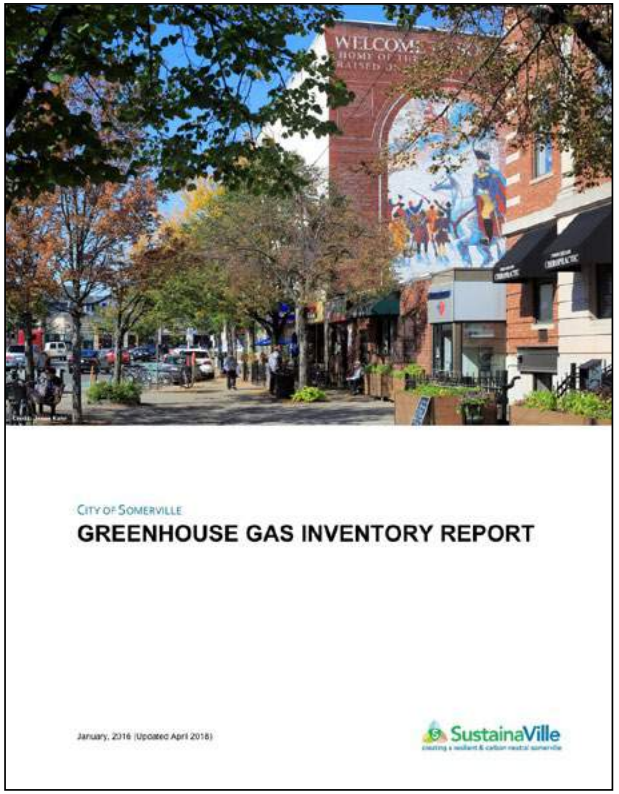
Climate change will also present new impacts from sea level rise and storm surge along the Mystic River, which the City has not experienced in the past. Somerville's Climate Change Vulnerability Assessment prompted the City to include actions that reduce climate change risks to the most vulnerable people, infrastructure assets, and natural resources as part of this plan. We will need to adapt to these new and evolving risks, while also finding solutions to minimize our contribution to climate change.



The 2016 Greenhouse Gas inventory was Somerville's first rigorous analysis of the source of our climate-change causing emissions.

Approximately two thirds of Somerville's GHG emissions come from buildings, one third from transportation, and 3% from waste disposal. To reach our goal of being carbon neutral by 2050, we will have to eliminate nearly all of our emissions from buildings, energy, transportation, and waste.

As a follow-on to the GHG inventories, the Carbon Neutrality Pathway Assessment identified a few key priorities for reducing emissions: switching to 100% renewable electricity, switching from fossil fuels to electric or renewable systems in vehicles and for heating, and improving energy efficiency in new and existing buildings. When we implement the actions in this plan, we are beginning the big transformations that need to take place in order to achieve carbon neutrality.



WE HAVE ALREADY STARTED

In the past several years, Somerville has already initiated many efforts to reduce City and community emissions and to prepare for climate change impacts. For example:

- Somerville is a designated Massachusetts Green Community and has reduced municipal energy use by 15% in four years.
- Somerville Energy Efficiency Now (SEEN) launched in fall 2015 to increase resident and landlord adoption of energy efficiency measures that are incentivized through State programs.
- The HeatSmart/CoolSmart campaign in 2017-18 increased awareness of efficient air-source heat pumps, with systems installed in over 60 homes.
- The City of Somerville was awarded SolSmart Gold by the US Department of Energy in 2017, the first municipality in Massachusetts to receive that designation. This followed the successful 2016 Solarize Somerville campaign, which led to the installation of over 100 solar arrays on Somerville homes.
- Somerville has been an ardent advocate for the Green Line Extension and is contributing $50 million to the project, which will be critical for reducing personal vehicle trips and transportation emissions.
- The City's Pavement and Sidewalk Management Program, with a recurring $1 million/year in targeted improvements, is gradually upgrading pedestriam areas for people of all physical abilities.
- The City has worked hard to make biking safer through street design, bike lanes, and education, and has been named a Gold level Bicycle Friendly Community by the Bicycle League of America.
- Somerville became a Massachusetts Municipal Vulnerability Preparedness (MVP) Program designated community and received a $350,000 MVP action grant in 2018 to plan for built and natural stormwater management solutions.
- The City is carrying out a $40 million project - with a 2016 $13 million grant from the Commonwealth of Massachusetts - to support sewer and water infrastructure upgrades in Union Square in order to alleviate strains on the existing stormwater infrastructure. Recently redesigned public parks have also been designed to slow and store stormwater on site.
- The City increased the use of electric vehicles in the municipal fleet, and installed seven public electric vehicle charging stations with free power.
- The City of Somerville maintains over 12,000 public trees and in 2018 received the Tree City USA Growth Award for demonstrating environmental improvement and higher level of tree care.

With this plan, the City of Somerville will continue to consider climate change in decision making and will strive to make climate change a key consideration in all major planning, policy, and programs decisions.

Photo credit: Mike Powers

HOW THIS PLAN WAS DEVELOPED

The Somerville community has a long-standing and passionate interest in climate change, with numerous community groups working on issues related to climate change mitigation and adaptation. Somerville Climate Forward has been developed with significant participation of residents, community organizations, regional partners, and City government departments. Over 180 people responded to the Somerville Climate Forward survey or spoke with City staff at outreach events, sharing observations of how the climate in Somerville is changing, how they respond to extreme weather, and what they would like to see in a carbon neutral and climate resilient future. In addition, over 75 residents and stakeholders joined City staff on nine action area-focused working groups to provide advice and guidance throughout the plan development process. Ideas and recommendations raised in survey responses and by the working groups helped to inform the actions that are detailed in this plan. The Commission on Energy Use and Climate Change (CEUCC) provided project guidance.

The actions in Somerville Climate Forward leverage existing efforts and identify new opportunities to increase resilience and reduce emissions within City government and the community. They were developed and prioritized in a four-step approach, which included:

1) Research of best-practice solutions implemented in other cities – both national and international;

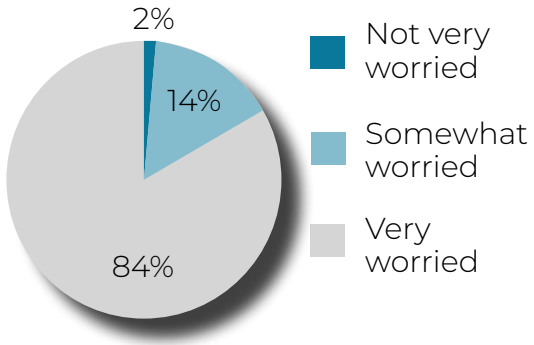
2) Evaluation of potential solutions through initial screening of their potential impact;

3) Prioritization of solutions using a structured framework that assessed benefits and feasibility of the proposed actions, e.g. How great is the financial cost? Are there programs or funds that could support it?

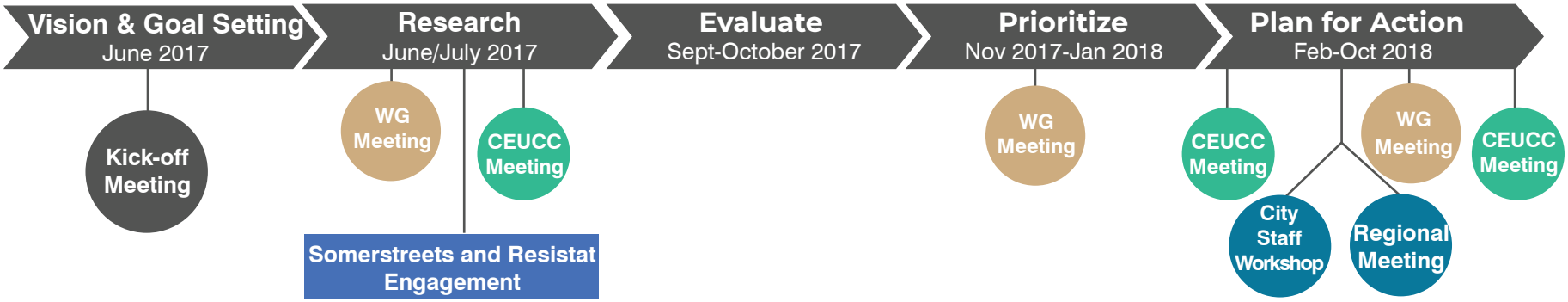
4) Development of detailed plans, including implementation strategy, for each action.

Somerville Climate Forward is different from other climate action plans because the planning process was designed to result in an implementable plan. Hundreds of possible solutions were considered, and through an iterative process, were narrowed down to 22 priority actions.

How worried are you about climate change?



Source: Office of Sustainability & Environment Survey, 2017



INTRODUCTION

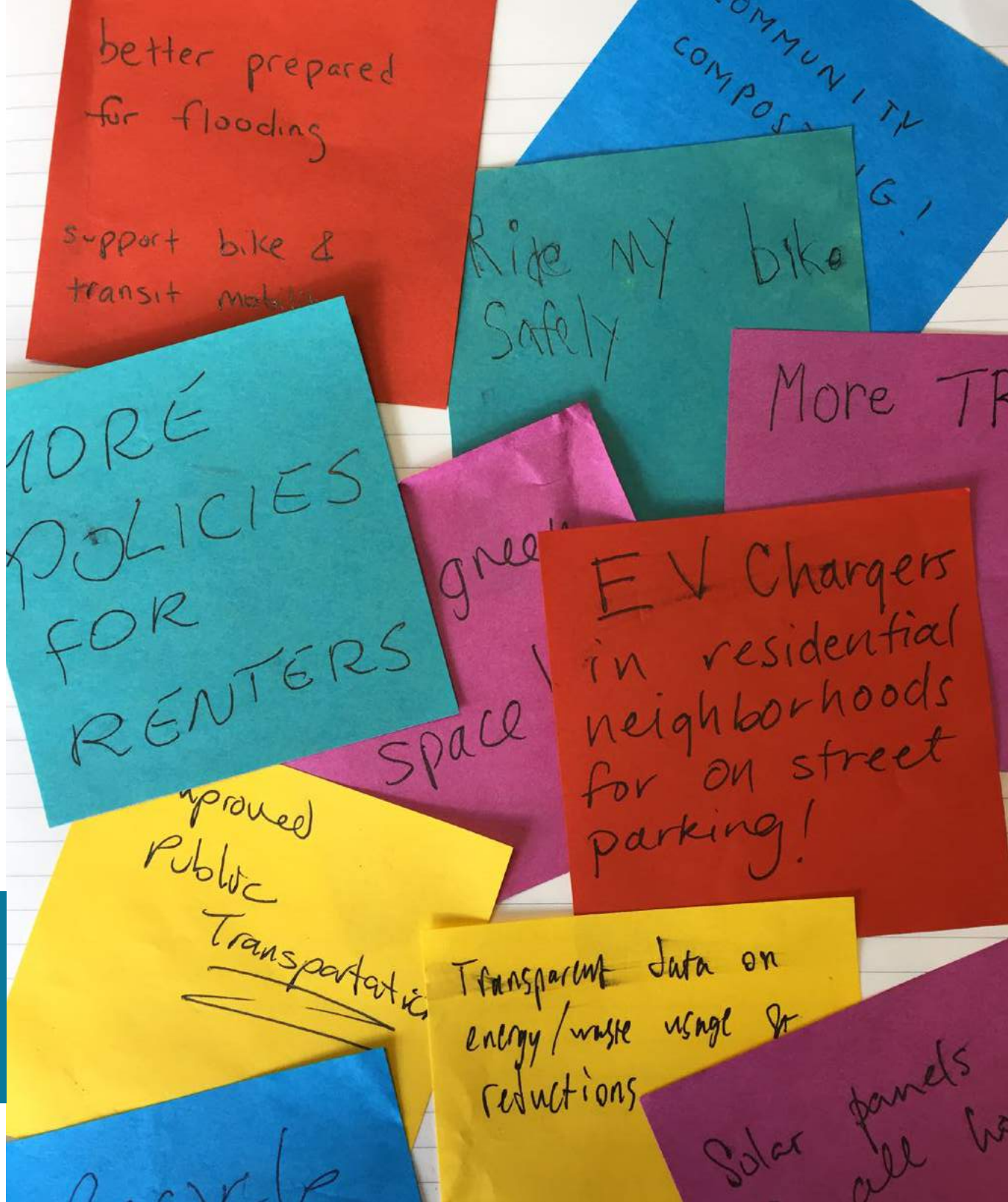
With the issuance of Somerville Climate Forward, the City presents a robust and implementable climate change action plan. Presented in this report are:

- **VISION AND GOALS**
- **THE 13 ACTION AREAS AND 22 PRIORITY ACTIONS**
- **IMPLEMENTATION TIMEFRAME**

The priority action areas were selected based on their ability to solve a key issue identified by either the Climate Change Vulnerability Assessment or the Pathways to Carbon Neutrality Study. The specific priority action was selected based on the impact it can have, the co-benefits it can provide, the feasibility of implementing it in Somerville, and by asking working groups, technical experts, City staff, and regional partners: what do we need to do to get started addressing this problem?

The focus of this plan is to make a difference now. The actions are intended to be initiated within 5 years. Some of the actions will take longer to complete than others. In five years, the plan will be revisited in order to reassess priorities and identify new action areas.

Collectively, the priority actions represent the most important next steps for Somerville to take in order to have the biggest impact on mitigating and preparing for climate change.



YOU'RE PART OF THIS TOO!

Achieving our climate goals will require all hands on deck. Everyone has a role to play in making a carbon neutral and climate resilient future a reality. No matter how small, all of our actions add up to more than the sum of the parts.

Here are a few ideas to get you started:

1) Talk to your family and friends about climate change and why taking action matters to you.

2) Make a preparedness kit for extreme weather and make a plan with your family or roommates.

3) Find ways to reduce energy usage at home. Start with a no-cost MassSave Home Energy Assessment. Contact Somerville's Housing Division for information on home energy and environmental programs.

4) If you own your home, consider installing an air source heat pump, updating your insulation, or putting solar on your roof.

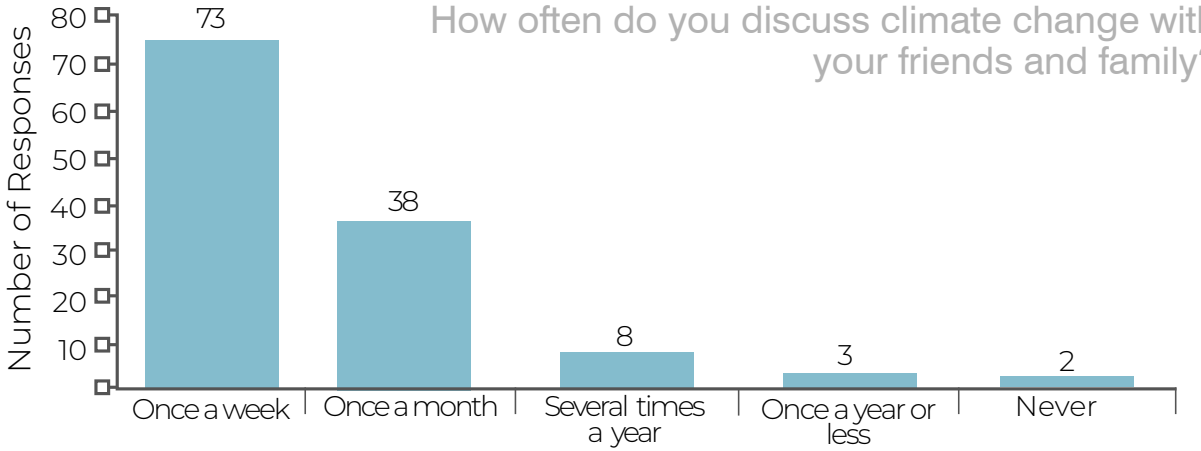
5) If you rent or own, consider opting-up to 100% renewable electricity through the Somerville CCE program.

6) Ride the bus, walk, take the T, bike. Choose to go car free.

7) Calculate your household's carbon footprint and choose one way to cut back.

8) Reduce your water usage or install a rain barrel to capture stormwater runoff.

9) Advocate for climate action.



Source: Office of Sustainability & Environment Survey, 2017

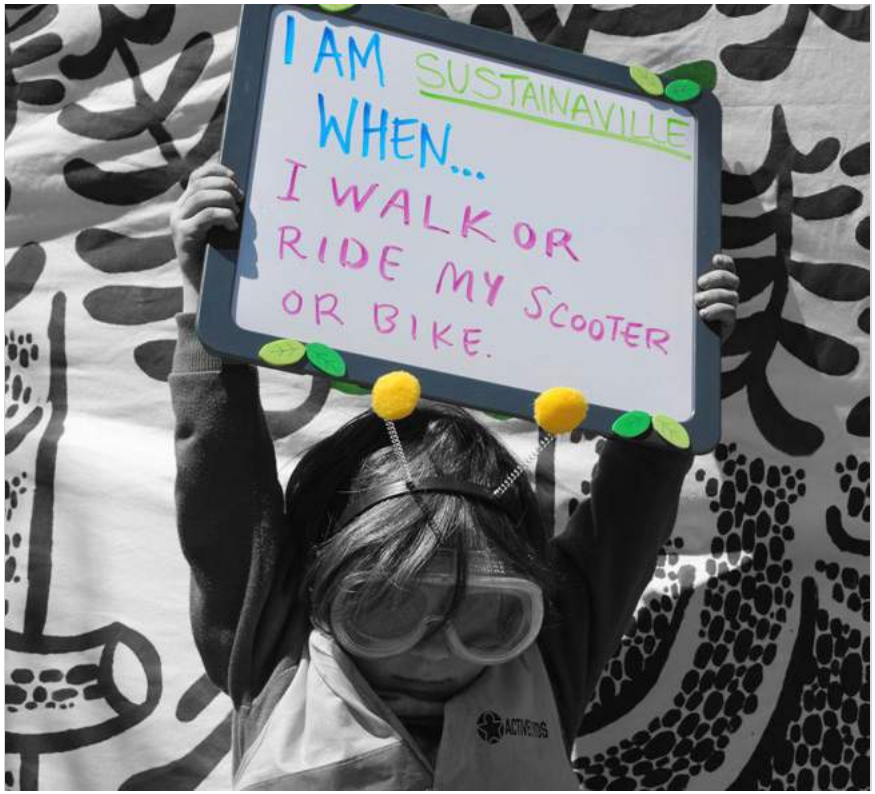
Photo credit: Mike Powers

SOMERVILLE CLIMATE FORWARD VISION

Our vision for a climate forward Somerville is a **thriving**, **equitable**, **carbon neutral**, and **resilient** city that is prepared for climate change while doing its share to mitigate it.

Thriving

Equitable



Thriving - Somerville will continue to be an exceptional place to live, work, play, and raise a family.

Equitable - The benefits and opportunities created by climate action will be fairly distributed to all, and resource allocation is prioritized to alleviate the unequal burdens of climate change in the community.

Somerville's actions on climate change must strive to achieve all four of these elements in order to ensure that Somerville remains a diverse, creative, and exceptional place to live.

Carbon Neutral

Resilient

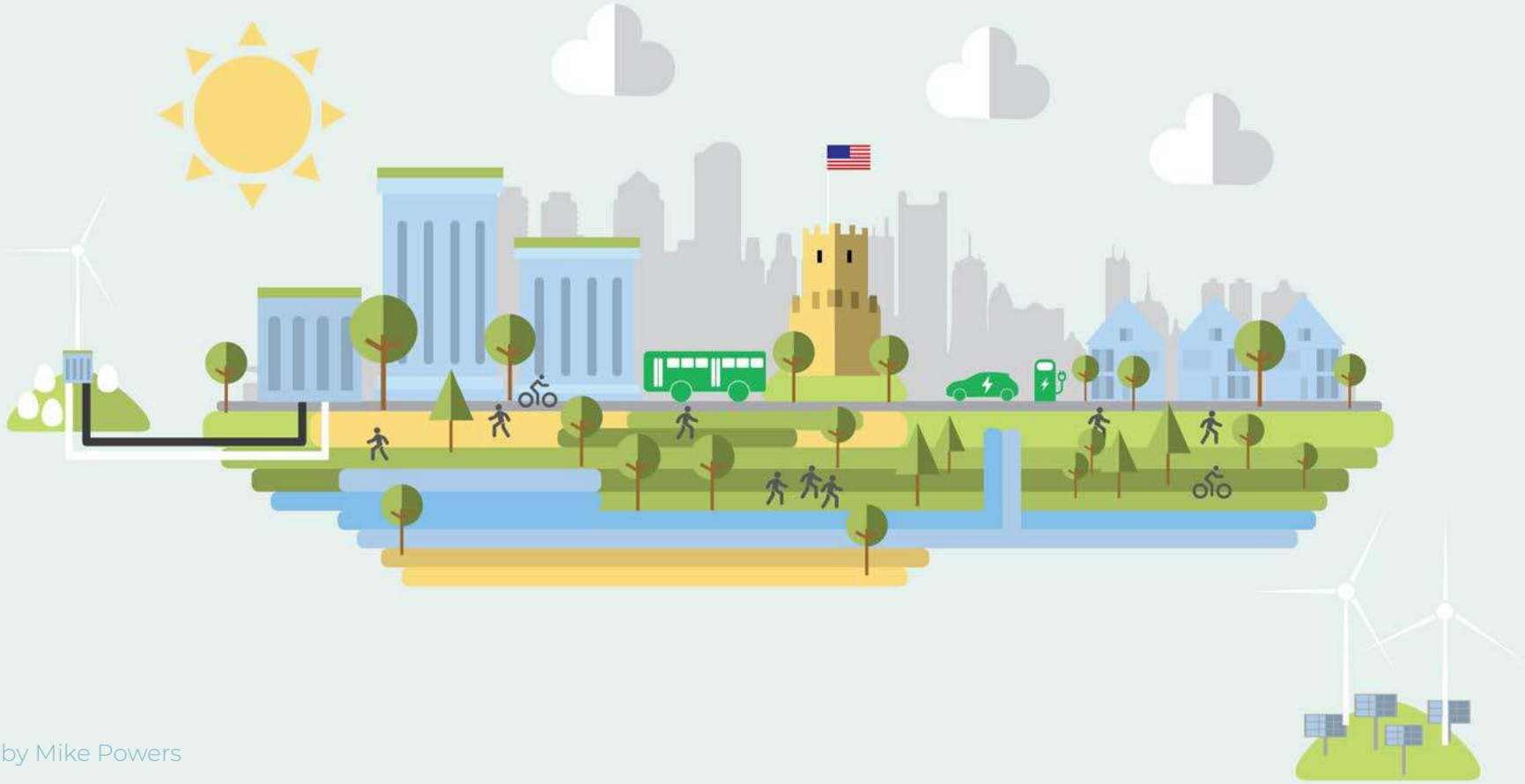
Carbon Neutral - Somerville will be a net-zero emitter of greenhouse gases, and any emission sources that cannot be fully eliminated will be reduced through carbon offset programs.

Resilient- Somerville will adapt in order to prepare for the chronic and acute impacts of climate change.

LONG RANGE GOALS

Somerville Climate Forward's long range goals are aligned with the priorities identified in the City's climate analysis studies (GHG Inventories, the Carbon Neutrality Pathways Assessment, and the Climate Change Vulnerability Assessment), and they are built on the foundation of the community vision and goals in SomerVision, the City's comprehensive plan. The goals describe what outcomes need to be achieved in order to fully realize the Somerville Climate Forward vision.

Somerville Climate Forward is structured to provide integrated, actionable solutions that work towards the goals. Implementing the plan will require a joint effort from the City, key stakeholders, and residents. To help establish working relationships among these groups, the vision and long range goals were reviewed and discussed at the first public meeting held in June 2017 and then further developed with the Somerville Climate Forward working groups. Reaching these goals will be a long and iterative process. This plan is an important step on that journey, but future planning and additional actions will be needed to achieve these goals in Somerville.



Graphic by Mike Powers

Buildings and Energy - Somerville's buildings and homes are built and retrofitted to be net-zero carbon, healthy, resilient, and affordable. 100% of Somerville's electricity is from renewable sources.

Mobility - Everyone has accessible and affordable zero-carbon ways to commute and get around Somerville that are resilient to climate impacts.

Environment - Somerville's built and natural systems work together to provide resilience to climate change and expand social and environmental benefits to all. Infrastructure is reliable and adaptable to changes in the climate and to Somerville's evolving needs. Everyone in Somerville is a responsible consumer and minimizes waste by reducing, reusing, and recycling as much as possible.

Community - Residents, businesses, and institutions are prepared for the acute and prolonged stresses and risks from climate change, and they are able to meet their basic needs, including having access to safe and healthy housing, food, air, water, and open space. Everyone within the Somerville community is knowledgeable about climate change and is empowered and supported to take action and participate in local decision making, regardless of age, education level, cultural background, or language. Somerville has a sustainable economy that builds on opportunities created by climate action and is resilient to negative impacts from climate change.

Leadership - The City of Somerville is proactive about preparing for climate change and leads by example, while supporting non-governmental providers of vital services. Somerville is a regional leader that sparks action in other communities and in the Commonwealth.

THE PLAN
AT A GLANCE

Somerville Climate Forward prioritizes 13 action areas supported by key priority actions that set Somerville on a path to be a resilient, carbon neutral city. Somerville Climate Forward is the framework for how we will collectively take action on climate change in Somerville over the next 5-10 years.

This plan includes policies, programs, and strategies that work to accomplish the following:

- Reduce Somerville's contribution to climate change and work towards carbon neutrality (mitigation).
- Prepare Somerville for the unavoidable impacts of climate change (adaptation).
- Fairly distribute the opportunities created by climate action and work to alleviate the unequal burdens of climate change (equity).

The priority action areas were selected based on their ability to solve a key issue identified by either the Climate Change Vulnerability Assessment or the Pathways to Carbon Neutrality Study. Each specific priority action was selected based on the impact it can have, the co-benefits it can provide, the feasibility of implementing it in Somerville, and by asking working groups, technical experts, City staff, and regional partners: what do we need to do to get started addressing this problem? Collectively, the priority actions represent the most important next steps for Somerville to take in order to have the biggest impact on mitigating and preparing for climate change.

Somerville Climate Forward prioritizes **13** action areas supported by **22** key priority actions.

BUILDINGS

1. Net-zero and resilient new buildings standards

- Explore the feasibility of a local net-zero energy or net-zero emissions-based performance standard.
- Adopt flood and extreme heat resilience standards for new construction.

2. Improved energy performance in existing buildings

- Enable a rental energy disclosure requirement through the creation of a rental licensing program.
- Continue and expand thermal electrification programs (HeatSmart/ CoolSmart).

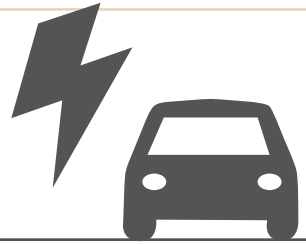
MOBILITY

3. Equitable low-carbon mobility

- Improve bus reliability and trip times.
- Improve and expand bicycle infrastructure.
- Assess parking policy and parking supply to meet low-carbon mobility needs.

4. Rapid transition to electric vehicles

- Develop electric vehicle charging infrastructure strategy.



ENVIRONMENT

5. Stormwater management

- Update stormwater management policies and develop design guidelines.
- Investigate a stormwater enterprise fund to improve stormwater management.

6. Expanded tree canopy

- Formalize and implement a modern urban forestry management plan including best practices and resilient species list.
- Develop guidance and training for community stewardship of trees.

7. Reduced consumption and waste

- Complete a consumption based greenhouse gas inventory and conduct community outreach on climate impacts of consumption.

COMMUNITY

8. Healthy and resilient community

- Establish a preparedness education program and an emergency alert system that help protect the community from flooding and extreme heat events.

9. Pathway to 100% renewable energy

- Extend the community choice electricity aggregation program and increase share of renewable energy.

10. Culture of climate action

- Organize community climate action and preparedness leadership program to educate the public and increase participation in climate programs.

LEADERSHIP

11. City government leading by example

- Set progressive net-zero building standards for new municipal buildings and those undergoing major renovation; set renewable electricity standards for all existing and new municipal buildings.

12. State advocacy for carbon neutrality

- Advocate for building and energy codes that achieve net-zero energy performance.
- Advocate for faster de-carbonization of electricity.
- Advocate for more stringent regulation of utility gas leaks.

13. Regional collaboration for coastal resilience

- Create a Mystic River Regional Coalition of neighboring municipalities to develop cohesive regional strategy and to push State action.
- Assess potential intervention options to address flood risk along Mystic River.

PRIORITY ACTIONS

The next section of the plan explains the priority actions in detail and identifies an implementation approach for each priority action. Each priority action addresses a critical mitigation or adaptation goal for Somerville, provides additional benefits, and is feasible to implement in Somerville. The priority actions were selected through an iterative process with the working groups and city staff. Together, the 22 actions comprise a suite of activities that will help Somerville take the next steps toward achieving our long-term climate goals.

Each priority action plan has the following information:

- Overview of Somerville's approach to the problem
- Precedents from other communities
- Benefits, including non-climate related benefits and the impact of the action on reducing GHG emissions and adapting to climate change
- A plan for implementation
- Cost information
- Performance metrics to help us track progress over time.

In addition to priority actions, related actions have also been identified. These actions represent additional steps that can be taken to support the overall objective of the priority action, but are not the most critical action for Somerville to take first. The purpose of identifying the related actions is to make sure that windows of opportunity to pursue these actions are not missed should they arise during the implementation of this plan. Some related actions might move in priority over time and additional related actions might be identified. Progress on both priority and related actions will be shared periodically through implementation progress reports.

Each priority action addresses a critical mitigation or adaptation goal for Somerville, provides additional benefits, and is feasible to implement in Somerville.

Photo credit: Mike Powers

1 ACTION AREA: NET-ZERO AND RESILIENT NEW BUILDINGS STANDARDS

PRIORITY ACTION: EXPLORE THE FEASIBILITY OF A LOCAL NET-ZERO ENERGY OR NET-ZERO EMISSIONS PERFORMANCE STANDARD FOR NEW DEVELOPMENT AND SIGNIFICANT MODIFICATIONS TO EXISTING DEVELOPMENT.

In order to meet Somerville's carbon reduction goals, all new buildings must be designed and built to produce virtually no GHG emissions. In Massachusetts, however, municipalities do not have the legal authority to set their own municipal energy codes, so Somerville must look for other ways to regulate emissions that will result from new development. The City will take a multi-pronged approach in this action, including incentivizing new development to pursue net-zero building design, following the lead of other MA cities in defining new building performance standards, leading by example in new municipal buildings, and advocating for changes to the State building code.

In Massachusetts, the State has purview over the building code, and cities are extremely limited in their ability to pass local ordinances requiring development to exceed the State code. The State allows municipalities to adopt a more stringent version of its base code, which is referred to as the "stretch code". Somerville adopted the State's stretch code in 2011; however, in effect, it falls well short of producing net-zero buildings. These buildings (also referred to as zero net energy, or ZNE) can include those that achieve net-zero energy use through on-site renewable energy sources, like solar panels or ground source heat pumps, as well as those that achieve net-zero emissions through investment in a carbon offset program, such as a community solar project that can serve buildings with poor on-site solar access. For purposes of this Action Area, the term net-zero buildings includes both of these options because they each have a role to play in Somerville's future development.

Taking action in this area is important because:

- The building energy sector in Somerville contributes approximately two-thirds of total communitywide emissions
- New development in the City is anticipated to occur at an annual growth rate of over 1% in both the residential and commercial sectors based on the projected increase in number of residents and local employment, respectively[1]
- Future development will need to achieve net-zero performance standards for the City to meet its carbon neutrality target

It is important for the City to act now to avoid emissions lock-in from continued construction of buildings that do not achieve net-zero standards (i.e., the construction of buildings that will continue to generate emissions into the future, until demolished or retrofitted to achieve net-zero standards).

[1] Somerville's population and employment forecasts were collected from the Boston Region Metropolitan Planning Organization's Central Transportation Planning Staff (CTPS) travel model, which was used to develop the transportation sector on-road emissions forecasts.

APPROACH

In light of restrictions to require net-zero new construction through the building code, the City will take the following actions to reduce emissions in new construction, some of which are described in more detail in other Action Areas:

1. Incentivize and facilitate net-zero building construction
2. Explore options to develop net-zero building performance standards
3. Lead by example with net-zero municipal buildings (see Action Area 11)
4. Advocate for changes to the State building code (see Action Area 12)

Somerville has limited control to implement stricter building standards than those defined in the State building code but can encourage high-efficiency construction with development incentives.

Incentivize and Facilitate Net-Zero Buildings

Somerville can encourage net-zero development through development incentives and pilot projects that demonstrate local feasibility for these projects. Cities in Massachusetts have the authority to pass zoning ordinances to regulate the use of land, buildings, and structures to protect the health, safety, and general welfare of their constituents. While the City's zoning code revisions are not allowed to impose stricter requirements than the State building code, they can be designed to offer incentives that encourage voluntary action among developers to exceed State standards. In addition to zoning code changes to facilitate net-zero buildings, the City can also provide other incentives designed to help defray development costs.

The City can consider the following zoning code changes and development incentives:

- Relaxed building height restrictions
- Density or intensity bonuses
- Reduced off-street parking requirements
- Reduced permit fees, development fees, or property taxes; fee delays until issuance of occupancy permits; feedback program
- Expedited permitting
- Industry recognition/awards via competitions

Increasing public awareness of the benefits and feasibility of net-zero buildings will also help increase demand for this design approach. In addition to demonstrating viability and challenges with its own building portfolio (Action Area 11), the City can promote net-zero building projects through technical support from the City's planning and building departments. As an early implementation step, the City can designate a net-zero building ambassador to assist developers in identifying experienced net-zero designers and builders and guide them through the permitting process. This process will help to identify unnecessary barriers to net-zero development, which the City will remove to help facilitate future projects. The City will also document projects that go through this process to expand its database of local case studies of different building types to help guide future projects.

Explore Range of Compliance Solutions

The City has consulted with other local governments, including Cambridge, regarding their actions to develop alternative pathways to net-zero development that do not conflict with the State building code. One option under consideration is to develop performance-based standards that require new construction to achieve net-zero emissions or net-zero energy use. These standards are not prescriptive, meaning that builders and developers can define their own compliance approach as long as the performance standards are achieved. Other local governments are still exploring the viability of this approach as a companion requirement to the State building code. Somerville will also explore this option through collaboration and knowledge-sharing with other cities, and through stakeholder engagement to develop consensus around a specific approach that will work in Somerville.

The City should convene a Net Zero Building Task Force to research net-zero ordinances or policies under consideration in other Massachusetts cities, including net-zero energy or emissions performance standards. The Task Force can discuss the benefits and constraints of the options identified, and define a preferred approach for use in Somerville, including defining what compliance with the standards means. Through the Task Force, the City can define a set of allowable compliance solutions that could include:

1. High energy efficiency design, such as achieving Passive House or other recognized building certification programs
2. Electrification of building systems, including heating, hot water, cooking
3. On-site and/or off-site renewable energy development
4. Purchase of verifiable carbon offsets

The Task Force will also explore the viability of interim steps toward net-zero requirements or performance standards, such as the City's ability to restrict fossil fuel use in new construction. In addition to considering interim targets, the City will determine an appropriate phasing schedule for implementation of the new net-zero building standards. For example, starting with new residential construction of four or fewer units then expanding to other building types and sizes until the standards apply to all new construction. The City will seek guidance on its phasing approach from the Task Force.

It is important to note the overlap and distinction between net-zero energy and net-zero emissions performance standards. Net-zero energy standards are achieved through development of on-site renewable energy to offset building energy demand. As a largely built-out community, this kind of standard could be challenging to achieve in some projects (e.g., poor solar access). Net-zero emissions standards allow a project to offset its energy emissions either on-site or through renewable energy projects developed off-site, such as a community solar project. At this stage, the City will evaluate the feasibility of both options because past efforts to update the building code at the State level have called for net-zero energy standards, and there is value in maintaining consistency with State efforts. At the local level (albeit outside of Massachusetts), cities have been successful in passing stringent building performance standards despite not having purview over the building code because they were framed as emissions standards rather than energy standards (e.g., Vancouver, Canada).

Assembly Row, Somerville

PRECEDENTS

Cambridge, MA has a section on Sustainable Design and Development in its zoning ordinance, which contains specific green building requirements. Cambridge is evaluating further amending this section to include an emissions-based performance standard for new development, specifically to avoid conflicts with the State building code. Somerville can explore a similar amendment as a near-term action with input from Cambridge on the legality of such an amendment. Details on Cambridge's evaluation are not currently available.

Vancouver, Canada is regulated under the Vancouver Charter, a provincial statute that grants the City different powers than other communities have under British Columbia's Municipalities Act. The Charter has allowed the City to make by-laws regulating GHG emissions from buildings. Building on this authority, the City adopted the Zero Emissions Buildings Plan in 2016, which establishes GHG and thermal energy use limits by building type that eventually taper off to zero by a specific timeline. Further, the plan provides recommendations to enable compliance through leading by example, offering incentives for early adoption, and increasing capacity and knowledge about net-zero emissions buildings among industry professionals and the public. While Somerville does not have comparable authority, the Vancouver performance standards provide an example of enacted GHG performance standards.

PLAN FOR IMPLEMENTATION

Implementation partners:	• Office of Strategic Planning & Community Development (OSPCD) - Planning and Zoning • City Inspectional Services Department – Building Division • Neighboring cities (e.g., Cambridge, Boston) • Associations of developers, design professionals, architects, engineers • Academic institutions • Energy consultants • Energy utilities • Energy-focused community organizations (e.g., Conservation Law Foundation, Environment Massachusetts, USGBC Massachusetts Chapter)
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Evaluate possible zoning code changes and other development incentives to encourage, and reduce barriers to net-zero development • Provide technical support to developers and builders, including through net-zero building ambassadors to guide projects through permitting process; identify opportunities to streamline permitting process or otherwise remove administrative barriers to net-zero projects • Develop database of local net-zero case studies as references for future projects • Convene Net Zero Building Task Force to build consensus for more stringent local building standard; invite participation from developers/builders, design professionals, neighboring cities, etc. - Review net zero plans or ordinances from other Massachusetts cities - Define preferred building standard for use in Somerville (e.g., net-zero energy, net-zero emissions), including consideration of interim standards if net-zero is deemed infeasible at present • Determine appropriate phasing of new standards that ultimately lead to net-zero buildings (e.g., non-residential construction of 10,000 sq ft or greater by 2025, non-residential construction of 7,500 sq ft or greater by 2030) • Develop set of allowable compliance solutions
Equity considerations:	If the upfront costs of energy-efficient development are passed on to property owners or tenants, this may disproportionately impact low- and middle-income populations. Financing mechanisms to offset these costs are discussed on page 23. However, residents living in inclusionary units or new affordable housing would benefit if their buildings were net-zero emissions because their energy costs would likely be lower and less variable. The increased cost for affordable housing projects could be a challenge, and incentives to offset costs should be explored so affordable housing development is not stalled because of a net-zero policy.

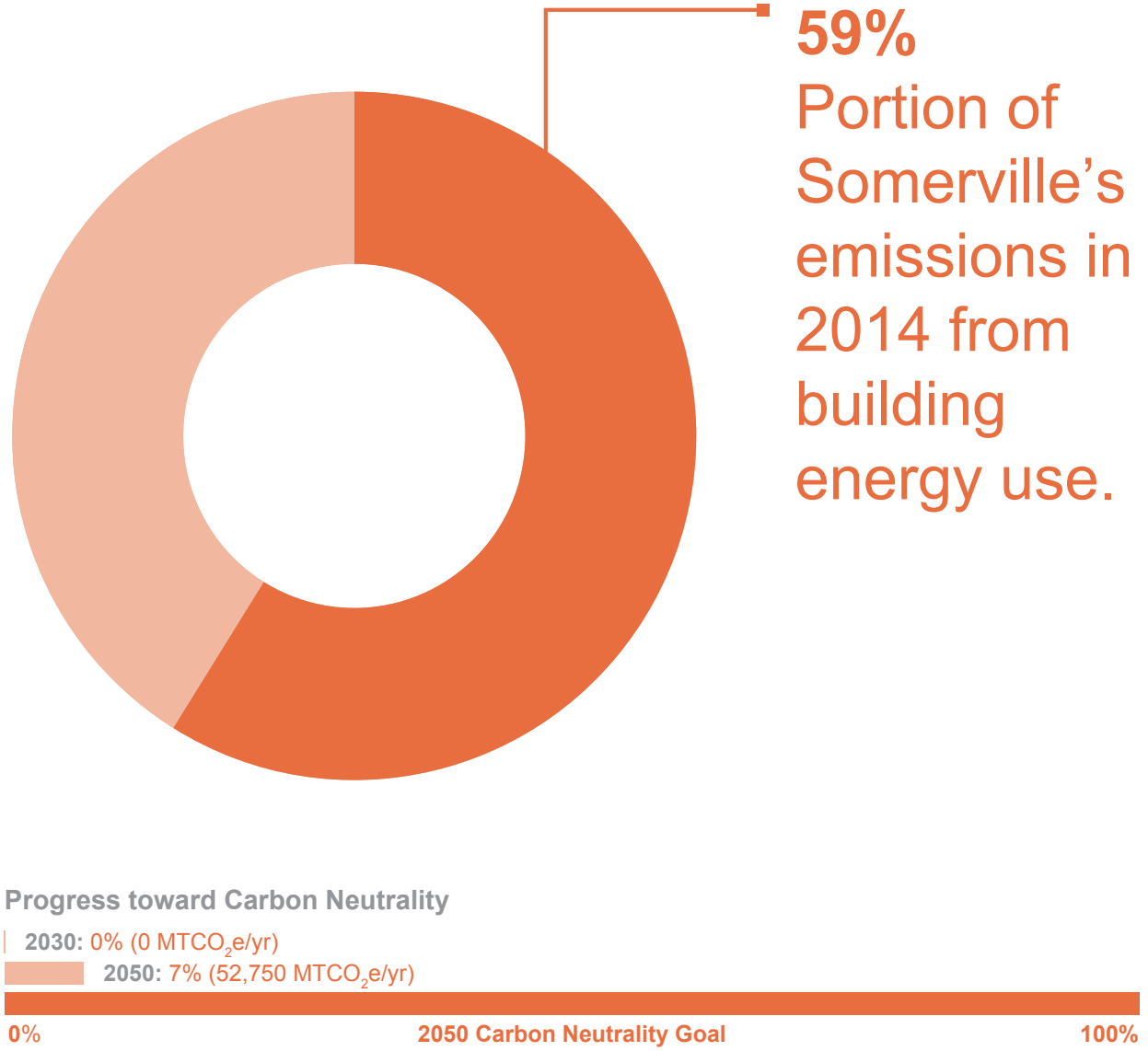
BENEFITS

Qualitative co-benefits:

- Requirements for net-zero buildings present significant opportunities for job creation in the building-scale energy efficiency and renewable energy fields.[2]
- These requirements also improve energy and water conservation and air quality due to potential elimination of on-site fossil fuel use.

Impact of action on GHG mitigation & adaptation:

- Net-zero buildings, when paired with energy storage solutions, can contribute to increased resilience in the face of extreme weather events, such as flooding and heat waves in Somerville. However, electrification of energy end uses combined with the de-carbonization of electricity can increase dependence on the grid, and therefore increase susceptibility to power outages during extreme weather events.
- This action has the potential to provide substantial long-term emissions reduction, if it is implemented early. See the discussion on the next page about avoiding emissions lock-in from new construction.



Note: The GHG reductions shown in this figure assume that net-zero building requirements go into effect in 2030 and apply to all new construction from 2030 to 2050.

[2] Creating the Clean Energy Economy – Analysis of the Net Zero Energy Home Industry. (2013). Retrieved from https://www.iedconline.org/clientuploads/Downloads/edrp/IEDC_Net_Zero_Homes_Industry.pdf

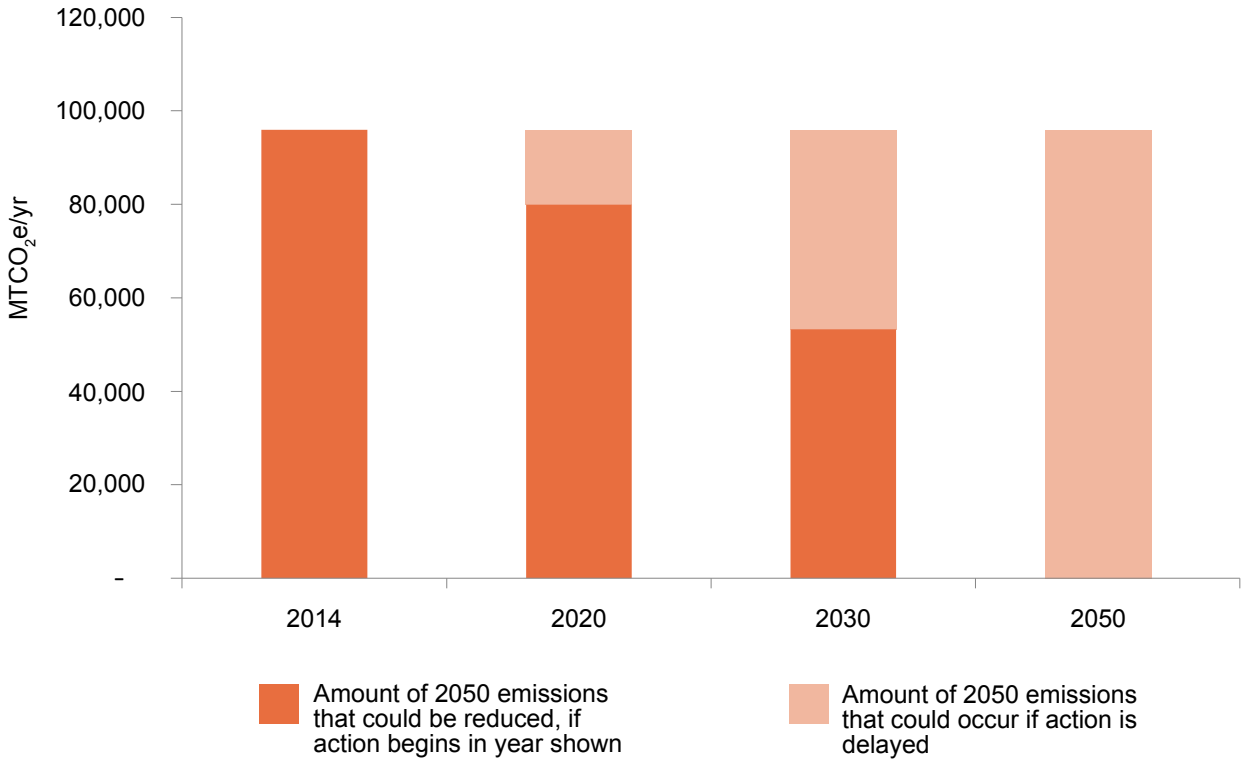
Avoiding emissions lock-in:

If the City's advocacy effort in this action is successful, it will result in avoided energy emissions from new buildings in the community. However, the amount of emissions avoided depends upon how quickly the City's efforts can be realized. Delays in influencing changes to the building code will result in construction of new buildings under the existing building code, which will lock in these future building emissions (i.e., guarantee these emissions will occur) unless the buildings undergo net-zero energy/ emission retrofits in the future.

The figure below illustrates the cost (in terms of emissions incurred) of delay in this action. If a net-zero building standard was enacted in 2014, then the City could have avoided all emissions from new buildings constructed from 2014 to 2050. This would have avoided 95,900 $MTCO_2e/yr$ by 2050, or 13% of the City's carbon neutrality goal.

If the net-zero building standard is delayed until 2020, then the maximum 2050 reduction potential decreases to 79,950 $MTCO_2e/yr$, or 10% of the carbon neutrality goal. This is because buildings constructed between 2014 and 2020 would not be designed to achieve net-zero standards, and will continue to generate emissions through 2050, or until they are renovated to higher standards.

The reduction potential of this action decreases to 52,750 $MTCO_2e/yr$ by 2050, or 7% of the carbon neutrality goal, if action is delayed until 2030, and drops to zero if the building standards do not begin until 2050.



Early action on constructing net-zero buildings helps avoid lock-in of inefficient buildings in the community that will continue to generate emissions after they are constructed.

COST

Avoided Cost

- Avoided costs from net-zero energy/emissions buildings will be commensurate with the magnitude of energy savings likely from such buildings. A study by Efficiency Vermont summarizes energy savings relative to code-compliant buildings as shown below.
- Savings relative to code-compliant buildings:
  - Single family home: 67%
  - Duplex: 61%
  - Quadplex: 57%
  - Open office: 72%
  - Closed office: 74%
  - Office/manufacturing: 65%

Capital Cost/Operational Cost

- The Efficiency Vermont study shows that construction of new residential zero net energy/emissions buildings is a cost effective investment relative to code-compliant buildings from the onset.
- These buildings cost less to own and operate than code buildings from the first year into the long term. Net-zero office/manufacturing buildings are a better investment than code-compliant buildings when incentives and rebates are applied.
- Without incentives or rebates, net-zero energy office/manufacturing construction can have a cost premium of 6–16%, though operating and maintenance costs for the buildings are lower than for code-compliant construction.[3]

Funding Mechanisms

- In-kind contributions from developers: The City can collaborate with developers to explore the viability of "in-kind" developments to demonstrate Passive House or another near-zero emissions approach.
- Revolving energy fund seeded by general funds: The City can establish a fund to provide loans to net-zero projects equal to the incremental costs to construct a net-zero building. The fund is replenished through incurred energy and cost savings for a set amount of time (e.g., 5 years), after which the cost savings accrue to the building owner or tenant.[4]
- "Fee-bate" incentives: The City can develop a cost-neutral building permitting fee program to provide a financial incentive in the form of a rebate to projects that achieve or exceed an emissions or energy performance standard, while projects that do not achieve the standard would pay the fee without rebate

MONITORING PROCESS

Performance Metrics

- Number of net-zero buildings constructed
- kWh of on-site renewable energy generated
- kWh of off-site renewable energy generated (if applicable)
- Type and magnitude of offsets applied (if applicable)

[3] Net Zero Energy Feasibility Study. (2015). Retrieved from https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-net-zero-energy-feasibility-study-final-report-white-paper.pdf

[4] C40: Toronto's Atmospheric Fund Makes Sustainability Affordable. (2011). Retrieved from http://www.c40.org/case_studies/toronto%E2%80%99s-atmospher¬ic-fund-makes-sustainability-affordable

RELATED ACTIONS:

Identify zoning changes to support transition to net-zero and resilient buildings: roof ordinance requiring solar, green, blue or white roof; additional impervious surface requirements; electric vehicle charging infrastructure requirements.

The house at 13 Elmwood Street was renovated in 2012 to become Somerville's first net-zero house with rooftop solar photovoltaics providing all on-site energy.
Photo Credit: Conor Semler 2018

1 ACTION AREA: NET-ZERO AND RESILIENT NEW BUILDINGS STANDARDS

PRIORITY ACTION: ADOPT FLOOD AND EXTREME HEAT RESILIENCE STANDARDS FOR NEW CONSTRUCTION

Adopt flood and extreme heat resilience standards for new construction

Climate change is expected to increase heat and flooding, impacting Somerville buildings and their occupants. While many of Somerville's existing buildings will require retrofits to adapt to changing climate, Somerville can set standards for new development to be resilient to future climate from day one.

Resilient buildings in Somerville should achieve the following:

1. Keep occupants comfortable during heat waves by providing adequate insulation, ventilation, and cooling.
2. Protect against flooding, either urban flooding from precipitation events and/or from coastal storms depending on the location of the development.
3. Be resilient to utility outages that could occur as a result of either extreme heat or large storm events.

In addition to the building design, the site of new construction can be designed to:

1. Manage stormwater onsite and reduce stormwater flows into the City's stormwater infrastructure. This can be achieved through a combination of gray and green infrastructure.
2. Provide shade and localized cooling benefits through appropriate landscape design.

Resilient new construction will help protect the health and safety of building occupants and increase business continuity for businesses located in such buildings after extreme weather events. Further, resilient site design will help to mitigate neighborhood and citywide climate risks.

As the City experiences growth, it is important to seize the opportunity presented by new development to implement flooding and heat resilient standards to minimize risk to buildings, protect residents, and ensure business continuity. However, similar to the challenges with requiring net-zero new buildings, the City cannot enact policies that conflict with the State Building Code. Therefore, a suite of actions is recommended for achieving resilient new construction in Somerville.

The overall benefit of resilience standards is to develop a building that is protected from climate change impacts and designed for a speedy return to normal conditions.

APPROACH

The main strategies identified for implementing higher flood and extreme heat resilience standards for new construction are:

1. Advocate for changes to State regulations
2. Adopt new local regulations through zoning
3. Educate key stakeholders on risks and measures for implementation for the voluntary implementation of resiliency actions
4. Provide incentives for the implementation of resiliency measures. The proposed approach is aimed at new construction to keep both the building and its occupants resilient to extreme heat and flooding events that are likely to be more frequent in the city in the future.

1. Advocate for changes to State Regulations

Changes to the Massachusetts Building Code for higher design standards for flood and heat resiliency would provide mandatory statewide compliance. The City can be instrumental in advocating such changes to State regulations. However, it is a long-term strategy as this involves a complex process with many stakeholders. Recommended changes could include:

- Revisions to the State building code to require vulnerable utilities to be built or relocated considering more stringent flood elevation, such as the FEMA 500-year flood elevation or using projected future flood elevations, if available.
- Revisions to the Energy Strech Code to integrate some of the LEED resilient energy measures, such as requiring that 100% of the normal building occupancy can occupy habitable zones that maintain "livable temperatures" (standard effective temperature between 54°F and 86°F) during a power outage for 7 days in the typical extreme hot and cold weeks of the year.[5]

[5] Wilson, A. (2016). Mainstreaming Resilience: Making Resilient Design Standard Practice. Nesea.org. Retrieved from: http://nesea.org/sites/default/files/session-docs/mainstreaming_reslience_making_resilient_design_part_standard.pdf [Accessed 6 Nov. 2018].7 Somerville Zone Ordinance, Article 8: http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/01/Article-8-%E2%80%93-Overlay-Districts-20180109.pdf

WHAT THE CITY IS ALREADY DOING

The City of Somerville is already requiring developers to complete the **SustainaVille Sustainable and Resilient Buildings Questionnaire** on how new projects will address climate change issues. The City is also a member of the **Metro Mayors Climate Preparedness Task Force** and has been working with the Commonwealth to inform proposed revisions to the Massachusetts State Building Code to integrate revised flood resiliency requirements. This is, however, a longer-term solution that will require time for consensus building.

2. Adopt new local regulations through zoning

For more immediate actions, the City can proceed with integrating climate change strategies in regulations that are under its jurisdiction, such as zoning. The proposed zoning overhaul for Somerville includes a Floodplain Overlay district based on Zone A or Zone AE of the Flood Insurance Rate Map issued by FEMA.[6] This only impacts the small section of the city at risk of projected flooding. One option could be for the City to use the FEMA 500-year floodplain to define its Floodplain Overlay District" as part of its zoning overhaul.

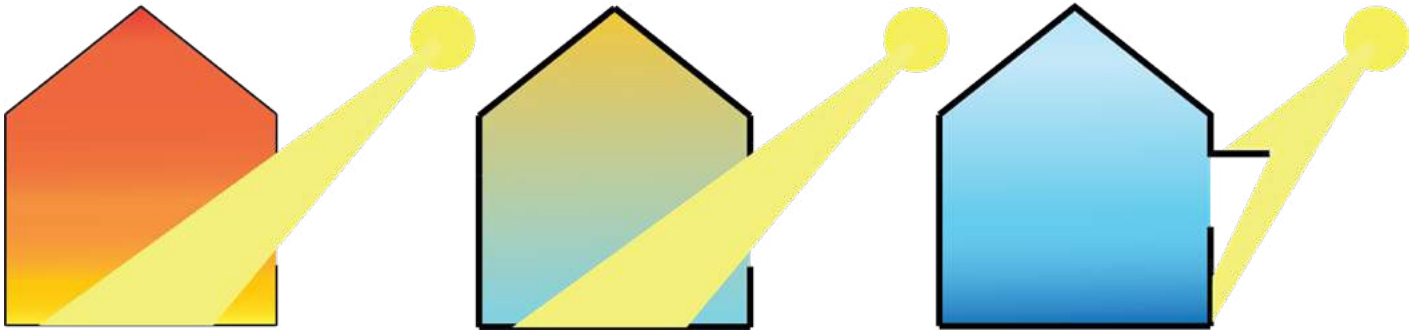
While there are limits to new construction requirements that Somerville can make because of the State Building Code preemption, through zoning, the City has some leverage for new development to implement more resilient design. The City can explore a "resiliency factor" as part of its zoning overhaul, similar to the current proposal for a "green factor", where the developer can decide which features to incorporate to meet a certain score. Measures to be explored can include:

- Achieving LEED Resilient Design pilot credits, which are for Assessment and Planning for Resilience, Design for Enhanced Resilience, and Design for Passive Survivability.[7]
- Designing passive systems for new buildings to ensure passive survivability, adaptation to extreme temperatures over time and reduce energy demand and indoor temperatures.[8] Examples of passive strategies are:
  - Employing continuous insulation throughout the envelope for an airtight building envelope.
  - Limits on heating/cooling loads (both peak and annual)
  - Limit on overall source energy use

Other examples of resiliency measures that could be included in the resiliency factor are:

- Placing the sump pump drainage pipe beneath a slab and recommend using a dual sump pump system with back-up power source.
- Installing roof overhangs that drain directly away from the building foundation.
- Installing French drains around the perimeter of buildings.
- Installing green roofs, blue roofs and/or white roofs.
- Having emergency back-up power for all new high-density residential and commercial buildings and these back-up power sources are located at higher floor elevations. Source of energy for the emergency power to be aligned with emission-based performance for new construction.

BUILDING MODIFICATION IMPACT:



BUILDING WITHOUT MECHINICAL COOLING

BUILDING WITH INCREASED INSULATION

BUILDING WITH INCREASED INSULATION AND SHADE DEVICE

Credit: Kleinfelder for Somerville Climate Forward

[6] City of Somerville. (2018). 8 Overlay Districts. Retrieved from: http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/01/Article-8-%E2%80%93-Overlay-Districts-20180109.pdf [Accessed 6 Nov. 2018].

[7] Usgbc.org. (2018). LEED pilot credits on resilient design adopted | U.S. Green Building Council. Retrieved from: https://www.usgbc.org/articles/leed-pilot-credits-resilient-design-adopted [Accessed 6 Nov. 2018].

[8] Phius.org. (2018). The Principles: Passive House Institute U.S.. Retrieved from: http://www.phius.org/what-is-passive-building/passive-house-principles [Accessed 6 Nov. 2018].

For immediate actions, the City can proceed with integrating climate change strategies in regulations under its jurisdiction, for example zoning.

3. Educating key stakeholders

Shifting new construction to climate resilient design will require building support amongst a diverse set of stakeholders, City departments, developers, realtors, and large land-owners. Action can be taken to increase awareness of the risks of climate change and opportunities to increase resilience through building design. Next steps can include:

- Creating education material that describes design options for protecting against heat and flooding.
- Using the SustainaVille Sustainable and Resilient Buildings Questionnaire to work with developers to adopt higher building standards on a voluntary basis.
- Making future flood elevation information public as it becomes available:
  - As a first step, the City can publish on its website a GIS-based online map that shows current FEMA 100- and 500-year flood zones, as well as future projected flooding from precipitation (where available) and sea level rise for 2070. This will enable developers to more easily assess if the proposed project is within zones already identified to be at-risk.
  - When additional information is available, such as maximum 2070 100-year flood elevation (combining flooding from both precipitation and sea level rise/storm surge) for each parcel, the City can update the above website. Somerville is currently developing a citywide inundation model funded by the State through the Municipal Vulnerability Preparedness Action Grant. The results of this model can then be used to make future flood elevation data be available for each parcel in the City.

4. Providing incentive for implementation of resiliency measures

Providing financial incentives will be critical primarily for smaller property owners and affordable housing developers to maintain equity in resiliency opportunities. The City could consider researching further different approaches:

- Providing development incentives, such as density increases for complying buildings.
- Explore possible partnerships to offer financial incentives to smaller property owners and affordable housing developers for implementing resilience features, such as green, blue or white roofs.

PLAN FOR IMPLEMENTATION	
Implementation lead:	Office of Strategic Planning and Community Development (OSPCD)
Implementation partners:	• Office of Sustainability and Environment • Capital Projects and Planning • Finance Department • Board of Aldermen • Property owners • Private developers • Fair Housing Commission • Somerville Redevelopment Authority
Implementation steps in the context of Somerville:	• Advocate for State regulations to be updated for better integration of climate change requirements • Integrate resiliency measures in zoning • Educate key stakeholders on climate change risks and recommend that higher standards be adopted on a voluntary basis • Provide financial incentives
Implementation schedule:	Short Term (0-3 years): • Integrate adaptation and resiliency measures in the City zoning code revisions by revising boundaries of the Floodplain Overlay District(s) • Implement education programs for implementing resiliency measures on a voluntary basis. • Assess if a "resiliency factor" similar to the proposed "green factor" could be integrated in the zoning recommendation to provide implementation of actionable measures/ strategies for resiliency. Long Term (7-10 years): • Provide development and/or financial incentives for the implementation of resiliency measures • Advocate for the State Building Code to factor in climate change
Equity considerations:	• Equity is important to address in new development including residential development and small businesses for whom higher resiliency requirements might pose a financial burden. There needs to be a balance between flood protection and other required improvements and understanding cost implications for maintaining access to fair and affordable housing. There should not be a choice that needs to be made between affordable housing and adaptation improvements. Consequently, resiliency strategies need to be developed in parallel with financial incentives.

PRECEDENTS

Changes in regulations to integrate/ factor in climate change:

In 2017, the City of Boston approved the "Climate Resiliency - Review Policy Update" replacing the prior Climate Change Resiliency and Preparedness Policy and related Checklist. The new policy reflects the findings and recommendations of the Boston Research Advisory Group and Climate Ready Boston and Mayor Martin J. Walsh's Carbon Neutral 2050 goal.[9] The article requires developers to identify potential climate and environmental changes, as well as how these changes will affect the project's sustainability and building inhabitants' safety. The City of Somerville could update its existing questionnaire to be more specific to risks as more site-specific information is available, such as maximum projected flood elevation for each parcel based on combined flooding from precipitation and sea level rise/storm surge.

The City of Norfolk, Virginia adopted a zoning ordinance to enhance flood resilience of new development. The ordinance establishes a Coastal Resilience Overlay (CRO) zone, where new development and redevelopment will have to comply with new flood resilience requirements, and an Upland Resilience Overlay (URO), designed to encourage new development in areas of the City with lower risk of flooding.

[9] Bostonplans.org. (2018). Article 37 Green Building Guidelines | Boston Planning & Development Agency. [online] Available at: http://www.bostonplans.org/planning/planning-initiatives/article-37-green-building-guidelines.

The zoning ordinance includes the following innovative practices for fostering more flood resilient urban development:

- Freeboard - The ordinance requires that construction in the 100-year floodplain be elevated at least 3 feet above the 100-year base flood elevation, and construction in the 500-year (0.2% chance) floodplain, to be elevated or floodproofed to 1.5 feet above the 500-year flood elevation.
- Coastal Resilience Overlay - In the CRO zone, additional requirements include the use of permeable surfaces on new parking spaces and stormwater infiltration requirements.
- Resilience Quotient System - The ordinance also adds a new resilience quotient system, where developers earn points for adopting different resilience measures that promote flood risk reduction, stormwater management, and energy resilience, among other practices. New development is required to meet different resilience point values based on the development type (e.g., residential, non-residential, mixed-use) and development size, unless the developer opts to meet specified standards for elevation and drainage.

  To meet the resilience quotient standards, all development, unless exempted, must go through a site plan review process.[10]

  The City of Somerville has developed a "Green Factor" that could be a model for developing a "Resiliency Factor" for achieving higher performance for new buildings.

Provide education material to encourage that higher standards be adopted on a voluntary basis:

Washington Climate Ready D.C. recommends developing a set of flood resilience guidelines for the FEMA 500-year floodplain in addition to those existing for the 100-year floodplain for new development and substantial improvements to existing development. The measures have been adopted on a voluntary basis and are in the process of being integrated in resiliency guidelines for the District.[11]

In Boston, The Spaulding Rehab Hospital building in Charlestown took the initiative to build its facility to higher resiliency standards. The building is raised much higher than required by code; for example, the first floor is 30 inches above the 500-year flood elevation. The building is designed such that the entire first floor of the building can be flooded with only minor damage while enabling the upper floors of the building to remain fully occupied and operational. Somerville could highlight local examples like this where developers chose a resilient design to demonstrate possibilities to other developers and encourage voluntary action.

The City of Cambridge has made available an informational tool called the FloodViewer[12] that can be used by the Cambridge community to assess climate change threats from flooding and to prepare for it by implementing specific strategies. Developers are encouraged to review projected flood elevation for new projects and build / protect to the 2070 10-year flood elevation (precipitation or sea level rise/storm surge, whichever is higher) and recover to the 2070 100-year flood elevation (precipitation or sea level rise/storm surge, whichever is higher). This provides an example on how more specific data can be used to educate stakeholders to adopt higher standards on a voluntary basis.

[10] Adaptationclearinghouse.org. (2018). Building a Better Norfolk: A Zoning Ordinance of the 21st Century | Adaptation Clearinghouse. [online] Available at: http://www.adaptationclearinghouse.org/resources/building-a-better-norfolk-a-zoning-ordinance-of-the-21st-century.html.
[11] Doee.dc.gov. (2018). [online] Available at: https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/CRDC-Report-FINAL-Web.pdf.
[12] FloodViwer, City of Cambridge. (2018). [online] Available at: https://www.cambridgema.gov/Services/FloodMap

Provide financial incentives:

In 2008, the City of Portland Oregon adopted an Ecoroof Incentive program to address the city's stormwater management problems. The incentive program was active through 2012 and provided an incentive for the installation of green roofs and other innovative roofing methods to better manage stormwater runoff. Through the program, the city offered property owners and developers an ecoroof construction incentive of $5 per square foot in the form of a subsidy. During that time, the Portland Bureau of Environmental Services (BES) granted almost $2 million in incentives that helped fund over 130 projects, creating more than 8 acres of ecoroofs that manage an average of 4.4 million gallons of stormwater each year. The program was administered by the BES.[13] Green roofs contribute to mitigate the urban heat island effect, increase the energy efficiency of buildings, and manage stormwater. The sum of the projects helped Portland to become more resilient.

New York City's CoolRoofs™ Program was launched in 2009. Through the program, building owners have applied approximately 6 million square feet of white, reflective coating on more than 600 building roofs. The program offers cool roof installations at no cost or low cost to select buildings (e.g., community centers, schools, hospitals, cultural buildings) with priority given to non-profits and affordable housing. Building owners are provided discounted rates for the coating, as well as labor, technical assistance, and materials (e.g. paint brushes, rollers, gloves). Private building owners who share the electricity cost savings are also eligible. The program reduces the urban heat-island effect, reduces GHG emissions and provides savings of 10 to 30 percent on cooling costs.[14]

The Portland and New York City programs demonstrate that the incremental implementation of green roofs can have a significant impact.

MONITORING PROCESS

Performance Metrics	Targeted participation rate	Estimated GHG reduction
Buildings that: • Comply with two (2) of the LEED Pilot Credit for Resiliency.[15] • Meet the Passive House Institute US Certification[16], aiming to design for the projected Climate Zone 3, and increase energy resiliency. • Set a building floor elevation above projected flood elevation once the information is available.	• 100% of new buildings could potentially include additional resiliency measures. • Applicable for renovation exceeding a pre-specified minimal square footage.	• GHG reductions are closely tied to the extent of heat reduction and back-up power measures. Passively cooled buildings require less energy, and back-up systems that use renewable energy and/or battery storage to reduce the need for fossil fuel generators.

[13] Adaptationclearinghouse.org. (2018). Case Study: City of Portland, Oregon Ecoroof Incentive | Adaptation Clearinghouse. [online] Available at: http://www.adaptationclearinghouse.org/resources/case-study-city-of-portland-oregon-ecoroof-incentive.html.
[14] Www1.nyc.gov. (2018). NYC CoolRoofs - NYC Business. [online] Available at: https://www1.nyc.gov/nycbusiness/article/nyc-coolroofs.
[15] Usgbc.org. (2018). LEED pilot credits on resilient design adopted | U.S. Green Building Council. [online] Available at: https://www.usgbc.org/articles/leed-pilot-credits-resilient-design-adopted.
[16] Phius.org. (2018). PHIUS+ 2015: Passive Building Standard -- North America : Passive House Institute - United States. [online] Available at: http://www.phius.org/phius-2015-new-passive-building-standard-summary.

BENEFITS

Qualitative co-benefits:

- Resilient buildings provide a safer work environment and are most likely to maintain business continuity during extreme events. Resiliency does not only benefit a specific business but also provides for a resilient Somerville economy.
- Resilient buildings contribute towards a healthier living environment by being resilient to extreme heat and flooding impacts, such as damage from mold.

Impact of action on GHG mitigation & adaptation:

- Resilient buildings designed for some level of energy autonomy to sustain power supply disruption caused by extreme events will also have reduced GHG impact as they are built to higher energy standards.
- Designing resilient passive systems for new buildings will ensure passive survivability, adaptation to extreme temperatures and reduced energy demand for maintaining livable indoor temperatures.
- Resilient buildings meeting Passive House or LEED resilient requirements will have a smaller footprint on the environment.

COST

Avoided Cost	Capital Cost/ Operational Cost	Funding mechanisms
• The total cost for estimated damage (in 2016 dollars) for the projected 2070 100-year coastal storm event has been estimated at $155M for structural and content damage and $217M for commercial structural damage.[17] • The regional impact for the loss of revenue for the same storm is estimated at $105M.	• The recommended systems for increased heat requirements are minor premiums on new buildings for Massachusetts code and will provide significant savings in energy and the impact on the grid during extreme temperature events. For example, a R-40 insulation requirement for specific building components will have a 10% premium compared to what could be a R-25 today, and green roofs (4") have a $15-20/sf premium.[18] • Cost for implementing flood protection for new construction can range from marginal to high according to projected flood elevation. To provide an order of magnitude, it has been estimated that the direct financial return on resilience investments does not appear attractive in low to moderate climate scenarios, but generally turns positive under more severe scenarios of sea level rise and extreme precipitation.[19]	• MVP Action Grants

[17] Somervillema.gov. (2018). Climate Change Vulnerability Assessment. [online] Available at: https://www.somervillema.gov/sites/default/files/6-13-2017_Somerville%20CCVA%20Final%20Report.pdf.
[18] Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).
[19] The discount rate also has a major impact, with many projects showing positive Benefit-Cost Ratios (BCR) with a 2–3% discount rate, but marginal BCRs or less than 1 with rates of 6–7%. Some studies report a positive return on investment, but the methodologies and assumptions are questionable. Financing Climate Resilience: Mobilizing Resources and Incentives to Protect Boston from Climate Risks. UMass Boston. April 2018.

2 ACTION AREA: IMPROVED ENERGY PERFORMANCE IN EXISTING BUILDINGS

PRIORITY ACTION: ENABLE A RENTAL ENERGY DISCLOSURE REQUIREMENT THROUGH THE CREATION OF A RENTAL LICENSING PROGRAM.

The majority of Somerville residents are renters and have little to no control over the energy efficiency or energy systems in their home. Reducing emissions from rental properties is essential to achieving carbon neutrality, but the City of Somerville currently has no ability to regulate this. Establishing a rental licensing program will create the administrative infrastructure required to regulate rental units and to enable a rental energy disclosure requirement.

The existing building stock in Somerville contributes to nearly two-thirds of communitywide emissions, with nearly 20% of total emissions attributed to energy use in rental properties. When examined by fuel type, natural gas consumption makes up 50% of residential energy use, followed by electricity (32%) and heating fuel oil (16%). Regulating the existing buildings sector has been challenging for many cities, as existing development is not subject to building code updates unless it undergoes significant modification. Reliance on voluntary action alone may not result in substantial GHG reductions in this sector. Therefore, a local policy that mandates property owners to evaluate and disclose their energy footprint could be an effective solution as it could motivate property owners to take action to implement energy upgrades as cost savings measures and to make their property more marketable. Furthermore, given that approximately 65% of housing units in Somerville are renter-occupied, Somerville needs an approach that directly targets and benefits rental properties. The first step in creating any targeted rental program or policy is establishing a rental license program, which creates the necessary tools to enforce any rental energy requirement. An energy disclosure mandate would benefit tenants at the point of lease by informing them of the unit's estimated energy costs. Such a disclosure would also hopefully encourage landlords to make upgrades in order to keep their units competitive.

APPROACH

Rental licensing programs can help improve accountability among property owners and be used as an instrument to safeguard the health, safety, and welfare of city residents in general. Other benefits include the creation of an up-to-date log of rental unit addresses, the ability to contact tenants and landlords, and enabling rights of first refusal for tenants.

Developing a citywide rental licensing program in conjunction with energy disclosure requirements can result in seamless integration, but will require additional up-front and ongoing administrative time for the City to create the rental licensing program. This could include permanent staff to handle licensing, renter license inspector certification, ongoing assistance and enforcement, and data tracking. As described in the Precedents section, the City of Boulder, CO has successfully implemented a policy requiring rental properties to achieve a baseline energy efficiency standard. The policy was designed, in part, to help overcome the "split incentive" barrier in which renters do not invest in energy efficiency improvements to a property they do not own and property owners do not receive the financial benefit of efficiency improvements through lower rental unit utility costs.

As a first step, Somerville will need to convene a working group consisting of stakeholders identified below to build consensus for a rental licensing program with an energy disclosure requirement. If the stakeholders determine that such a program is feasible in Somerville, then the City can pursue development of a rental licensing program. While a rental licensing program could have multiple core functionalities, only the one pertinent to energy disclosure is discussed in this section. The City could design its program such that, to maintain a valid rental license, landlords must disclose their property's energy performance to tenants.

Rental properties represent 64% of total residential units in the City, and influencing energy efficiency in existing rental buildings is an important objective to support Somerville's carbon neutrality goal.

The validity of the license period can be determined by understanding the rate of lease turnover in Somerville so as to enable effective enforcement of the disclosure requirement. The City would then define an appropriate mode of disclosure, which could be in the form of a public database, a private transaction in which the information is shared only among the property owner, tenants, and the City, or by other means. The disclosure process could be streamlined by working with the energy utilities such that the information can be requested in a streamlined fashioned, and delivered in a standardized format that contains enough detail to enable informed decision making (e.g., a breakdown of energy consumption by energy end uses as opposed to aggregated data on energy consumption). License inspectors and support staff would then be trained on certification, enforcement, and data tracking. Lastly, as the requirement would be limited to energy disclosure and does not include mandatory upgrades, the City could offer financial and/or technical resources to encourage upgrades to be implemented, since the ultimate objective of this solution is to drive energy improvements in the existing buildings sector.

Existing rental properties in Somerville represent a significant opportunity for energy efficiency improvements, but often face the challenge of "split incentives", where building owners do not receive a financial benefit from efficiency improvements and tenants do not own the building to make such improvements.
Photo Credit: Mike Powers 2018

PRECEDENTS

Boston, MA: The City adopted a rental property inspection program to ensure safe conditions in the City's ever evolving rental property market. The program requires property owners to register their properties with the City, and submit regular inspections. Most properties are inspected every 5 years, rental units belonging to chronic offender landlords are inspected every 3 years, and problem properties are inspected annually. Chronic offenders and problem properties are identified through use of a point-based system that tracks code violations and complaints about the property (e.g., noxious odors/fumes, unsanitary conditions). Implementation of the program's inspection requirements originally occurred upon change in tenancy, and was based upon voluntary reporting of rental unit turnover by property owners. In 2012, the City modified the program to follow the current 5-year inspection cycle.

Boulder, CO: Under the City's SmartRegs program, all long-term licensed rental properties are required to meet or exceed the minimum efficiency standards before they receive their rental licenses. If a rental property doesn't meet the requisite efficiency standards by the end of 2018, the property owner will not receive a rental license or their existing rental license will expire until efficiency upgrades are performed that make the rental property SmartRegs compliant. The City worked with Boulder Area Rental Housing Association members, energy efficiency professionals, and various other stakeholders to define the minimum efficiency standards that would be achievable while balancing the burden for property owners. Residential properties can reach compliance through a prescriptive or performance path. The City also created the EnergySmart program that goes hand in hand with the SmartRegs policy. It offers technical assistance, help with scheduling contractors for energy efficiency improvements, and incentives above and beyond those offered by the utility. The rental licensing office must confirm a rental property is SmartRegs-compliant before the City issues their renters license. If a unit is rented without a license, there are fines in place (first violation is $150–$500, second violation is $300–$750, third violation is $1,000). The City has compiled the compliance data into a public database of rental units in the form of a map that indicates whether a rental property is compliant, noncompliant, or exempt. However, this map does not share the actual efficiency score of the rental property.

Chicago, IL: The Chicago Municipal Code requires that a building or dwelling unit owner must provide a disclosure to prospective tenants whether they will be responsible directly to the utility company for paying the cost of gas or electric heat for that building or unit. The property owner must also provide in writing the annual cost of heating based on the previous 12 months. In addition, at the time any residential dwelling unit or building is offered for sale, the owners / agents must provide information on gas or electric cost for heating that unit or building for the previous 12 months. The owner or agent must also inform the prospective purchaser whether the dwelling unit or building was occupied during the previous 12 months, and if so, for what portion of the time. An energy disclosure application form may be forwarded to the utility company to request the information. The Application for Energy Disclosure is used to request gas or electric disclosures on a particular address and / or unit number. Separate applications are required for gas and electric heat. Building owners must provide an energy disclosure - the cost of monthly heating - to prospective tenants prior to signing lease.

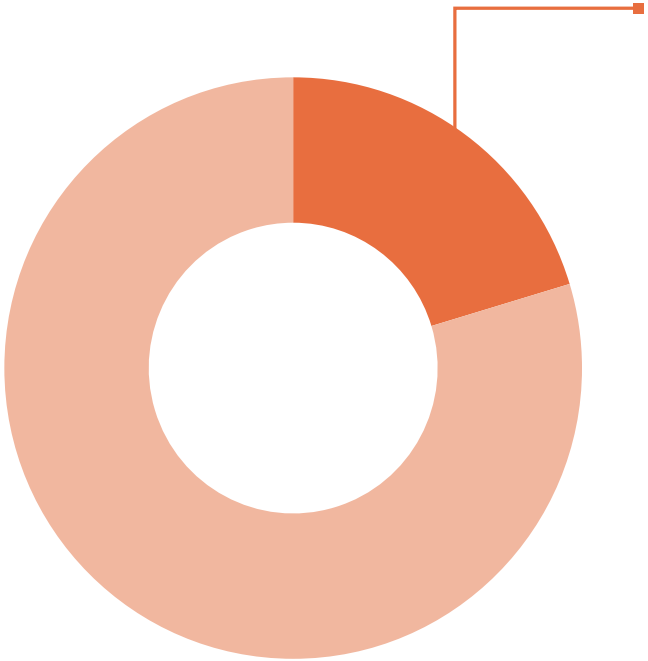
Note: To estimate emissions from rental units, Somerville's 2014 residential energy emissions were divided among rental and ownership units based on housing unit data from the 2014 U.S. Census Bureau American Community Survey 5-Year Estimate. Approximately 64% of total residential units were renter-occupied in Somerville in 2014.

The maximum emissions reduction potential shown for this action represents a 100% reduction in rental unit energy use in 2030 and 2050 under a scenario in which the energy disclosure requirements lead to energy efficiency upgrades in all units, consistent with net-zero building standards.

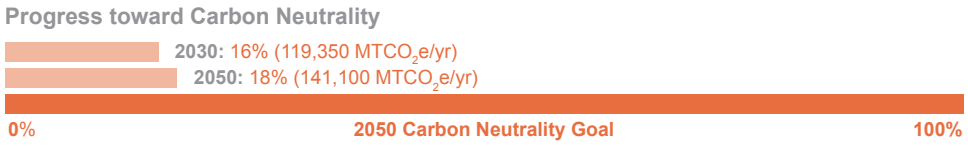
BENEFITS

Qualitative co-benefits:

- Broader economic co-benefits: Requirements for point of lease energy disclosure requirements present significant opportunities for job creation in the inspection, auditing, and data reporting fields.
- Health: A licensing program that requires greater reporting and inspections will bring to light more code violations that affect human health, such as lead exposure and indoor air quality.
- Environmental co-benefits: If mandatory energy disclosure requirements result in energy upgrades, they can lead to energy and water conservation, as well as improved indoor air quality due to potential elimination of on-site fossil fuel use.



20%
Portion of Somerville's emissions in 2014 from rental properties



Impact of action on GHG mitigation & adaptation:

- When paired with energy storage action, net-zero buildings, can contribute to increased resilience in the face of extreme weather events such as flooding and heat waves in Somerville. However, electrification of energy end uses combined with the de-carbonization of electricity can increase dependence on the grid, and therefore increase susceptibility to power outages during extreme weather events.
- This action will target all rental housing in Somerville, though it is difficult to estimate the extent to which energy disclosure requirements will directly result in energy upgrades and GHG reductions. The maximum potential of this action (see note on page 35) could result in reductions totaling:

  - 2030: 119,350 $MTCO_2e/yr$ (16% of carbon neutrality target)

  - 2050: 141,100 $MTCO_2e/yr$ (18% of carbon neutrality target)

PLAN FOR IMPLEMENTATION

Implementation partners:	• Office of Strategic Planning and Community Development, Housing Division • Inspectional Services Department, Building Division • Rental housing associations • Real estate representatives • Energy utilities
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Convene stakeholder group to build consensus for rental licensing program, including how and when to incorporate point-of-lease energy disclosure requirement; If stakeholder group determine that this is feasible, then: • Establish rental licensing program • Identify appropriate interface for disclosure of energy information (either privately to tenant or to public database) • Coordinate with energy utilities to automate process of energy disclosure to tenants • Train inspectors and other program staff on enforcement, administration, and data-tracking • Encourage voluntary compliance with rental license program to increase awareness of future requirements and support resources available Medium Term (4-6 years): • Begin enforcement of rental license requirement • Offer technical and financial resources within rental licensing program to encourage energy upgrades to buildings based on results of disclosed energy consumption information
Equity considerations:	A rental licensing program, even without purview over energy disclosure requirements, is designed to protect the housing interests of renters by creating a system to monitor and enforce the safety of rental units. Efforts should be made to keep any fees associated with the license or energy disclosure low in order to minimize additional financial burdens on households. Ideally, if the program takes on the task of enforcing energy disclosure requirements, it can further benefit rent-burdened residents by providing information on how they can potentially reduce energy costs. However, given the current high competition for rental units, renters may not have the opportunity to alter their housing choices based on energy information, so careful thought should be given to the timing and type of energy data that is shared through the licensing program. Finally, when setting up the program, considerations should be given for ensuring that tenants are not displaced as a result of energy efficiency upgrades. Implementation of a licensing and disclosure program should be carefully designed to address the concerns of elderly and immigrant residents, for whom housing stability is often connected with health and safety.

MONITORING PROGRESS

Performance Metrics

- Compliance rates and violation rates
- kWh of energy saved
- $MTCO_2e$ of GHG emissions reduced
- % on-site renewable energy generated
- Program implementation cost (including energy disclosure costs, as well as other administrative costs)

RELATED ACTIONS

Enable Commercial PACE (C PACE) financing program in Somerville

Large building energy use disclosure ordinance - annual reporting

Continue to promote Mass Saves incentives

COST

Avoided Cost

- While it is difficult to estimate the extent to which energy disclosure requirements by landlords will directly result in energy upgrades and subsequent cost savings, a study of 5 cities in which energy upgrades were mandated by rental licensing program reports annual cost savings ranging from $350 per unit to $770 per unit.

Capital Cost/ Operational Cost

- Administrative costs to the City for setting up a rental licensing program: A study of rental licensing programs in 5 cities that require energy upgrades at point–of- lease reported administrative costs ranging from $9 - $15 per rental unit over a 3 year period.

Funding Mechanisms

- **Property Assessed Clean Energy:** To help offset the upfront capital costs of energy upgrades, enrollment by the City in a Property Assessed Clean Energy (PACE) program could be a potential financing mechanism. Under this type of program, the upfront costs of energy upgrades can be provided from the sale of municipal bonds or through private investment companies, and is repaid through property taxes by the property owner This approach enables owners to undertake more comprehensive energy upgrades with longer payback periods of up to 20 years. At property sale, a lien stays with the property and is transferred to subsequent property owners if the original investment amount has not already been repaid. MassDevelopment launched a Commercial Property Assessed Clean Energy (C PACE) program in collaboration with Massachusetts Department of Energy Resources (DOER). The program will be available to multi-family buildings with five or more units. Somerville can opt into this program though a majority vote of the Board of Aldermen.
- **Utility on-bill financing:** The City could develop financing options such as on-bill financing with Eversource and National Grid, which would directly pass the upgrade cost through to the tenants on their utility bills.
- **Utility incentives:** The City can review incentives, such as rebates offered by Eversource and National Grid to see how much they can offset the up-front costs of potential improvements by landlords.
- **Revolving energy fund seeded by general funds:** The City can establish a revolving loan fund through which it offers energy upgrade loans to interested landlords. The fund would then be replenished through incurred energy and cost savings.[20]

[20] C40: Toronto's Atmospheric Fund Makes Sustainability Affordable. (2011). Retrieved from http://www.c40.org/case_studies/toronto%E2%80%99s-atmospheric-fund-makes-sustainability-affordable

2 ACTION AREA: IMPROVED ENERGY PERFORMANCE IN EXISTING BUILDINGS

PRIORITY ACTION: CONTINUE AND EXPAND THERMAL ELECTRIFICATION PROGRAMS (HEATSMART/ COOLSMART).

Natural gas and oil heating in homes produce one quarter of Somerville's greenhouse gas emissions. In order to reach carbon neutrality, existing homes must transition to efficient heating systems that can be powered by fossil fuel-free electricity. The City can accelerate this transition through education and incentives.

Regulating the existing buildings sector has been challenging for many cities because existing development is not subject to building code updates unless it undergoes significant modification. Therefore, actions that combine outreach with financial and technical incentives to encourage energy upgrades will be an important part of the City's carbon neutrality pathway, along with actions that impose mandatory retrofits to existing buildings.

The City's HeatSmart CoolSmart program is a good example of how incentives can help drive electrification and energy efficiency actions. The program aims to increase the proliferation of air source electric heat pumps as a substitute for conventional electric, natural gas, and fuel oil systems. Approximately 65% of housing units in Somerville are renter-occupied, and turnover in rental housing occupancy is much higher than in owner-occupied housing. Therefore, this program will be promoted to landlords to encourage rental property improvements. This action will also complement others targeting the existing building stock.

SOMERVILLE'S CLIMATE LEADS TO SUBSTANTIAL HEATING DEMAND THROUGHOUT THE YEAR, WHICH IS PRIMARILY MET WITH NATURAL GAS AND HEATING FUEL OIL. THE CITY'S HEATSMART COOLSMART PROGRAM IS DESIGNED TO INCREASE USE OF ELECTRIC HEAT PUMPS THAT CAN BE POWERED WITH CLEAN ELECTRICITY.

APPROACH

The objectives of this action are to:

1. Conduct outreach and increase awareness among Somerville residents and businesses about the benefits of heat pumps
2. Competitively select installers who can provide tailored services to customers
3. Offer rebates and other financing mechanisms to make heat pumps more affordable

1. Conduct Outreach and Raise Awareness

During the 2017/2018 HeatSmart CoolSmart program period, the selected installers completed over 240 site visits, 59 households signed contracts, and two households pursued installations through Somerville's Housing Rehab program. Of the 150 leads from the City's landing page, approximately 75% were for multi-family buildings. Notably, most people who signed up for the program and completed site visits did not follow through with the purchase and installation of the system.

As a next step, the City can study why specific audiences are not participating in the program, such as multi-family building owners, and develop a strategic outreach campaign that addresses the identified barriers for each target audience. The City can also work with recent program participants to develop short case studies that describe project details, including system specifications, before and after energy use and cost information, construction timeline, and lessons learned. To increase adoption, the City could also develop other promotional information, such as a FAQ sheet, to help dispel misconceptions about air source heat pump technology and the regulatory process for this type of building improvement.

2. Select Installers

Similar cold climate heat pump programs are offered across New England and can provide best practices for minimizing program costs. The Efficiency Maine program has been successful in achieving low installed costs by facilitating knowledge sharing among its contractors and working with heat pump manufacturers and wholesalers to provide competitive pricing for program participants.[21] Somerville can identify opportunities to collect and share best practices and lessons-learned from its HeatSmart CoolSmart contractors to increase program quality and decrease costs. The City can also consider negotiating lower equipment costs with heat pump manufacturers or wholesalers.

3. Offer Incentives

Based on the first year of the HeatSmart CoolSmart program, the City found that a $100 incentive per household was not a significant motivating factor for most participants. However, more tailored incentives could be offered to increase adoption. The City can continue to promote existing incentives, such as the DOER Alternative Energy Credits, and evaluate other incentives it can offer, including reduced or waived permitting fees and streamlined permitting. The City could identify high-priority building typologies, resident groups, and businesses it wants to participate in the program, and develop tailored outreach and incentive programs for each group. For example, the City could target property owners with the most financial need or building types that would provide the greatest benefit from participation, such as high GHG reduction potential (e.g., older buildings, multi-family properties).

[21] Northeast/Mid-Atlantic Air-Source Heat Pump Market Strategies Report. (2014). Retrieved from https://neep.org/sites/default/files/resources/NortheastMid-Atlantic%20Air-Source%20Heat%20Pump%20Market%20Strategies%20Report_0.pdf

PRECEDENTS

King County, WA: The County department of Permitting and Environmental Review published a fact sheet about permitting requirements for different types of heat pumps.

Boulder, CO: Boulder developed a renewable thermal strategy for single family homes. Central to the strategy is a model that combines building typology information with empirical assessment data, permit data, and other sources. This dataset allows Boulder to track the expected replacement date for heating systems across all single family building homes, enabling the City to conduct targeted outreach.

BENEFITS

Qualitative co-benefits:

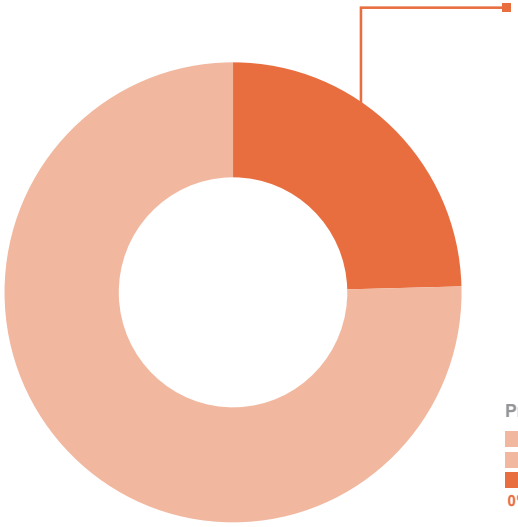
- Uptake of heat pumps through this program contributes directly to local inspection and installation jobs. It will also help build literature on the viability of heat pumps in cold climates, and contribute to further innovation and improvement in this technology.
- The use of heat pumps results in energy savings as well as improved air quality due to elimination of fossil fuel use

Impact of action on GHG mitigation & adaptation:

- Greater access to efficient in-home cooling will be critical in the projected hotter warm-weather months, particularly for residents at risk of heat-related impacts
- As heat pumps require electricity, when paired with rooftop solar and energy storage solutions, they can contribute to increased resilience in the face of extreme weather events such as flooding and heat waves in Somerville. However, electrification of energy end uses combined with the de-carbonization of electricity can increase dependence on the grid, and therefore increase susceptibility to power outages during extreme weather events.
- Heat pumps can reduce heating emissions by half or more compared to oil and electric resistance systems, and approximately 20% compared to natural gas. GHG reductions from heat pumps powered with 100% renewable electricity could total:

  - 2030: 22,500 $MTCO_2e/yr$ (3% of carbon neutrality target)

  - 2050: 36,300 $MTCO_2e/yr$ (5% of carbon neutrality target)



25%
Contribution of residential natural gas and heating oil to 2014 emissions inventory

Note: The emissions reduction potential shown for this action represents installation of electric heat pumps powered by 100% renewable electricity in 2030 and 2050. The calculations assume 50% saturation of heat pump technology in residential and non-residential buildings by 2030 and 100% heat pump use by 2050. The reductions were adjusted to exclude participation from rental properties, which are already addressed in Action 2a. Rental units account for approximately 64% of Somerville's housing units, and for this analysis it was assumed that rental units are responsible for 64% of residential energy use.

RELATED ACTIONS

Assess feasibility of carbon-neutral district energy systems.

For opposite page:

[22] Air-Source Heat Pumps. (2017). Retrieved from http://coolerconcord.org/home-heating/air-source-heat-pumps/

[23] Costs and benefits of air source heat pumps. (2018). Retrieved from https://www.energysage.com/green-heating-and-cooling/air-source-heat-pumps/costs-and-benefits-air-source-heat-pumps/

PLAN FOR IMPLEMENTATION

Implementation partners:	• Office of Strategic Planning and Community Development - Housing Division • Inspectional Services Department • Office of Sustainability and Environment • Rental housing associations • HVAC installation contractors • Energy utilities • Mass Save • Heat pump manufacturers and wholesalers
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Evaluate past participation rates in HeatSmart CoolSmart program, and identify barriers to uptake • Develop promotional materials, including FAQ sheets and case studies, to increase public awareness of program's potential • Develop system to collect/share lessons-learned from and with program contractors • Identify groups of building types for targeted outreach; tailor incentive programs to increase participation Medium Term (4-6 years): • Evaluate opportunities to negotiate lower equipment costs, including through partnership with other local government or organizations
Equity considerations:	• Only homeowners and property owners are able to participate in HeatSmart CoolSmart • Even with incentives, there is still a significant cost to install air source heat pumps

MONITORING PROGRESS

Performance Metrics

- Number of households/ businesses contacted
- Participation rates in program
- Amount of rebates/financial incentives provided
- Number of heating systems converted
- $MTCO_2e$ of GHG emissions reduced (through communitywide inventory)
- Program implementation cost

COST

Avoided Cost

- While it is difficult to estimate the extent to which a technical and financial assistance program on heat pumps will directly result in energy upgrades and subsequent cost savings, a heat pump would have been about 15% cheaper to operate in Massachusetts than an oil boiler or furnace over the last 3 years, and 30% cheaper to operate compared to oil over the last 5 years. The use of solar energy to power heat pumps would further reduce operational costs.

Capital Cost/ Operational Cost

- Central ducted system: $12,000-$20,000 installed cost (before incentives)[22]
- Single mini-split system: $3,500-$5,000 installed cost[23]

Funding Mechanisms

- Rebates: The Massachusetts Clean Energy Center and Mass Save offer rebates for heat pump systems
- Loans: Mass Save offers zero interest heat loans along with their free home assessment services. Synchrony Bank also offers loans depending on credit score. For low- and middle-income families, the Somerville Home Rehab Program offers 0% interest, deferred interest loans.

3 ACTION AREA: EQUITABLE LOW-CARBON MOBILITY

PRIORITY ACTION: IMPROVE BUS RELIABILITY AND TRIP TIMES.
PRIORITY ACTION: IMPROVE AND EXPAND BICYCLE INFRASTRUCTURE.
PRIORITY ACTION: ASSESS PARKING POLICY AND PARKING SUPPLY TO MEET LOW-CARBON MOBILITY NEEDS.

One-third of Somerville's greenhouse gas emissions come from the transportation sector, with nearly all of those emissions coming from personal or commercial car and truck trips. Switching to vehicles using zero or low carbon fuel is one approach to reducing transportation emissions; however that will not address traffic, land-use, and safety issues that come with auto-centric transportation. The City's two-pronged approach aims to reduce the total amount of vehicular miles traveled through land use policies, transit improvements, and investments in active transportation, and then reduce the remaining emissions through advancement of alternative fuel options, including electric vehicles. The City's broader goals for improved community health and safety, a strong local economy, and shared social equity require a balance between these two approaches.

Many Somerville residents either choose not to, or cannot afford to own a car; affordable, safe, and reliable low-carbon alternative transportation options are necessary to reduce transportation emissions in an equitable way. Somerville's priority is creating a robust multi-modal transportation network where single-occupancy cars are not the dominant mode. Reducing car trips and improving multi-modal transportation is a community goal enshrined in SomerVision, Somerville's comprehensive plan, calling for 50% of new trips to be made by transit, biking, or walking. Somerville has been making progress towards this goal by passing a complete streets ordinance, adopting a Vision Zero goal, creating new dedicated bike lanes, launching and expanding a bike share system, and piloting a separated bus lane. The City has also invested in the Green Line Extension, which will provide Somerville with much more light rail transit access, and can be complemented by other non-vehicle modes that serve different riders' needs and can be implemented more quickly. At the same time, there are competing demands for the limited space of the City's streetscape. Perceived parking demands can cause conflict with creating dedicated space for bikes and buses—particularly on major corridors. Additional progress should focus on making biking safer and more accessible, improving bus reliability and routing options, and working with the community towards reconfiguring or removing parking on major corridors to create additional space for low-carbon transportation options.

Multi-modal travel options allow residents and visitors to walk, bike, and ride transit safely and comfortably, increasing equitable accessibility within the community.

APPROACH

The primary elements of facilitating equitable low-carbon transportation in Somerville are to:

- Convert City right-of-ways to dedicated bus and bike lanes,
- Work with the MBTA to improve bus reliability and operational efficiency (i.e., how long does it take to get from point A to point B on the bus) ,
- Improve and expand bicycle infrastructure to make biking a viable and safe option for a greater portion of the Somerville community, and
- Reimagine parking requirements and allocations to meet low-carbon mobility needs.

On- and off-street parking takes up valuable space that could otherwise be dedicated to low-carbon transportation options, such as additional bike lanes or dedicated bus lanes. The City will explore opportunities to remove or redistribute parking within the community to maximize the use of its roadway space parking within the community to maximize the use of its roadway space.

To successfully minimize the amount of space dedicated to parking, the City can develop a comprehensive parking inventory to better understand the existing publicly accessible parking assets in the community. This will support further analysis of where additional off-street parking is actually needed from new development and where the City can reduce existing on-street parking supply to create more space for non-auto-oriented transportation needs, such as protected bike lanes and/or dedicated bus lanes. As non-vehicular mobility increases, demand for parking should decrease to provide additional opportunities for further parking reductions over time.

The City will continue to partner with the MBTA to evaluate pilot projects (e.g., bus lane on Broadway) and permanent opportunities for dedicated bus lanes to increase reliability within the bus network and provide a competitive alternative to the growing use of ride-sharing in the community. On-street parking reductions will help to free-up the space needed to support dedicated bus lanes. The City's partnership with the MBTA will also explore local transit signal prioritization along key bus routes, and opportunities to consolidate multiple bus stops in close proximity to one another and/or minimize route redundancy with the Green Line extension.

Bike lane expansion will focus on improving convenience and safety for this travel mode to increase use among all population groups. Somerville has already installed many "easy" bike lane projects, where lane striping had minimal impact on roadway configuration and other travel uses, and will continue to pursue these opportunities where they exist. Protected bike lanes have also been installed in Cambridge, Boston, and Somerville. Now that the City is looking to further expand its bike infrastructure, there will have to be trade-offs with on-street parking over use of the City's limited roadway space. Consultation with local businesses and residents is important to ensure support for these transformations, including consideration of business delivery needs and impacts on pedestrian networks. Continuation of discounted bike share memberships will also ensure the City's investment in new bike infrastructure is shared equitably.

Reducing on-street parking in certain areas of the city would provide additional space to accomodate new dedicated bike and bus lanes.
Photo Credit: Mike Powers 2018

PEDESTRIAN ACCESSIBILITY AND GREEN LINE EXTENSION ARE ALSO CRITICAL TO CARBON NEUTRALITY

Walking is a critical aspect to low carbon mobility and the City has been continuously working on improving pedestrian accessibility.

- The Sidewalk Management Plan, to be launched in FY20, is a data-driven methodology to prioritize sidewalk and ramp repairs based on their condition and proximity to key pedestrian origins and destinations (e.g. schools, transit stops, open space).
- The Capital Improvement Plan includes a $1 million/year recurring investment for ADA sidewalk, ramp, and signal improvements.
- Shape up Somerville has analyzed walking access to food retailers in Somerville. While all residents live within a 1-mile drive of a full service grocery store, 45% of Somerville residents live farther than a 10 minute walk to a full-service grocery stores. Improving the entire car-free mobility network, including having safe and accessible walking routes, will help increase access to healthy and affordable food for all.

The Green Line and Community Path extensions are essential to reducing our community transportation emissions. The Green Line Extension will expand transit access through much of Somerville and the community path extension will extend a safe and direct walking and cycling corridor across the City.

PLAN FOR IMPLEMENTATION	
Implementation partners:	• Office of Strategic Planning and Community Development (OSPCD) – Transportation & Infrastructure • Traffic & Parking • Department of Public Works • Engineering Department • MBTA • Private developers
Equity considerations:	• Very few youth and older adults bike in Somerville. Women accounted for 39% of cyclists counted in 2017 across the City. However, the percentage of women, younger, and older cyclists all increased at locations along the community path. This indicates that protected bike facilities are more comfortable for a wider range of people. Extending the community path and creating new protected bike lanes could increase cycling rates of currently underrepresented populations. Buses provide essential mobility service to many Somerville residents who have no other transportation options. Improving bus service for those who rely on it will benefit those in most need, while also making the bus a more desirable option for residents who have a choice of transportation options. • Metrics should explicitly look at race, age, and gender.

PLAN FOR IMPLEMENTATION

Implementation steps in the context of Somerville:

Bus

Short-Term (0-3 Years):

- Pilot bus-only lanes on Somerville routes
- Partner with MBTA to implement traffic signal prioritization for key bus routes
- Evaluate bus routes as Green Line Extension comes online to identify opportunities to reroute redundant bus routes, like route 80, and to create better bus connections throughout Somerville and with new transit line

Medium Term (4-6 years):

- Identify opportunities to straighten bus routes and consolidate bus stops to facilitate faster trip times
- Identify opportunities for dedicated bus lanes to minimize car-related traffic congestion for transit users; paint dedicated bus lanes to increase awareness of program and alert drivers to change

Bike

Short Term (0-3 years):

- Continue to expand bicycle network; implement protected bike lane project following route selection with stakeholder groups (e.g., business owners, neighborhood residents)
- Continue neighborways program to expand low-stress bike network on lower-traffic, residential streets with low-cost interventions and more permanent treatments, like curb extensions and raise crosswalks
- Continue to offer discounted bike-share memberships to low-income residents
- Expand Blue Bikes station network and implement Blue Bikes dockless pilot
- Support Green Line and community path extension while under construction

Medium Term (4-6 years):

- Establish formal bike facilities plan

Parking

Short Term (0-3 years):

- Develop citywide parking inventory of publicly accessible spaces; update inventory on 5-year cycle to analyze changes in parking demand
- Evaluate and pilot removal of some on-street parking along major corridors, like Broadway, Holland and Elm Streets, and Somerville Ave. to create dedicated space for bikes and buses

Medium Term (4-6 years):

- Study and implement demand-based, dynamic street parking; focus efforts first on commercial districts and major corridors, where removal of parking and minimizing traffic could most benefit buses, bicyclists, and pedestrians
- Make changes to parking requirements in zoning ordinance:
  - Reduce or eliminate minimum off-street parking requirements
  - Require parking built in commercial areas to be fee-based public parking and reinvest parking revenues in public transportation improvements
- Continue to evaluate community parking needs and remove additional on-street parking, as feasible

PRECEDENTS

Bus Lane Expansion

· Somerville, MA installed a bike and bus lane on Prospect St in 2017 and, on average, reduced trip times by 6 minutes.

· Everett, MA removed one mile of street parking on Broadway, a main corridor, and installed a pop-up dedicated bus lane. This intervention resulted in a reduction in bus trip times by 4-8 minutes. Based on the success, the City made the changes permanent.[24]

Bicycle infrastructure Expansion

· Cambridge, MA installed protected bike lanes in the Harvard Square area in 2017. The improvements were controversial with area businesses and their obstruction of vehicular and pedestrian circulation in some areas. City Council voted in early 2018 to keep the project in place and is considering potential improvements, including priority signals for cyclists, improving pedestrian crossings with mid-block islands or bulbouts, and adding passenger drop-off zones and/or short-term parking during business hours.

Parking Management

· Philadelphia, PA performs a parking inventory in its Center City neighborhood every five years to track parking space utilization. The inventory counts publicly accessible spaces and looks at occupancy rates in parking facilities with 30 or more spaces. Parking demand decreased in this neighborhood from the 2010 to 2015 inventories, even as parking space also decreased. The City attributes decreased demand to an increasing residential population in the neighborhood, its high walkability, and transit options.

BENEFITS

Qualitative co-benefits:

- Reduced traffic congestion.
- Improved health by encouraging more active transportation choices and improved air quality.
- Improved connections between neighborhoods within Somerville and more reliable service to underserved residents.
- Improving bus reliability and trip times will make buses more competitive with driving and rideshare. In addition to being a more attractive transportation choice, improved bus routes will also benefit those who rely on buses to commute or access basic services.

Impact of action on GHG mitigation & adaptation:

- The MBTA is reconstructing the sea wall at the Charlestown Bus yard (located in Somerville), which will better protect the critical facility from coastal flooding and make the entire bus system that serves Somerville more resilient to climate change. In addition to investing in the resilience of the system, the MBTA is also working on modernizing its bus fleet to include lower emission vehicles.
- During extreme heat and storms fewer people bike or walk longer distances. Buses can provide safe and critical transit connections during these events, and can adjust their route if a portion of the route is flooded. Focus 40, the MBTA's strategic plan, is using climate change projections to inform future bus and transit routing, which will further enhance the resilience of the bus system.
- After an extreme storm, in the instance that roads are blocked, or fuel is temporarily unavailable, biking and walking can be the only way of getting around (as demonstrated after Superstorm Sandy in New York). Improved walking and cycling infrastructure will therefore improve Somerville's resilience.
- These actions contribute to the following passenger mode shift-related GHG reduction estimates, but cannot be stated separately from other estimated mode shift changes (e.g., subway, walking):

  - 2030: 25,500 MT CO_2e/yr (3% of carbon neutrality target)

  - 2050: 37,200 MT CO_2e/yr (5% of carbon neutrality target)

[24] When Street Parking Becomes a Pop-Up Bus Lane. (2017). Retrieved from https://www.citylab.com/transportation/2017/02/when-street-parking-becomes-a-pop-up-bus-lane/517404/

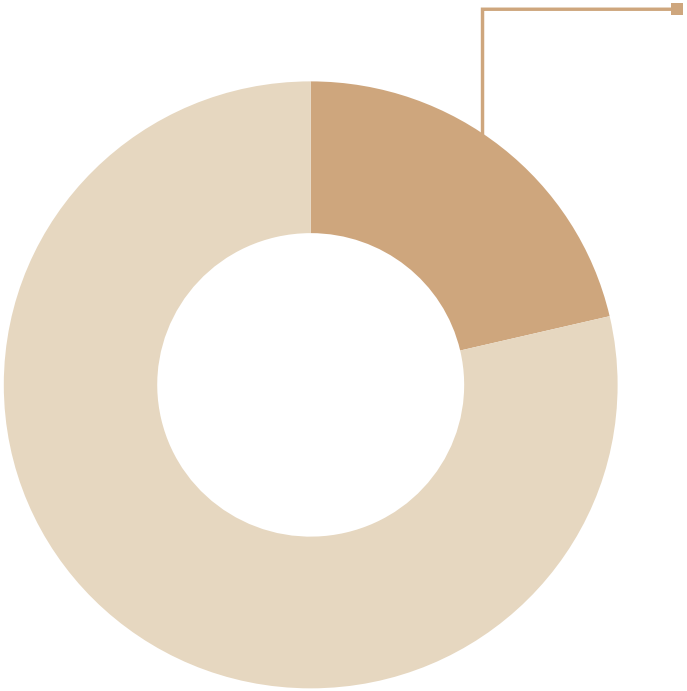
MONITORING PROGRESS

Performance Metrics

- Bus trip times
- Bus on-time performance
- Miles of bus lanes created
- Miles of bike lanes created
- Pedestrian counts
- Bike counts – rising number of underserved cyclists – women, youth, older adults, people of color
- Passenger mode shift by travel option (e.g., bus, bike)
- GHG emissions reduced

Targeted Participation Rate

- To improve participation monitoring, participation rate metrics have been defined to track the City's commute travel model share using US Census ACS outputs. The ACS data does not separate bus ridership from other transit options, so the bus actions defined in this strategy cannot be directly tracked using this data source. However, CTPS may be able to provide City staff with estimated mode share updates in the future for implementation tracking purposes.
- 2014 (baseline) – Public Transportation 30.5%, Bicycle 5.3%
- 2050 – Public Transportation 50.0%, Bicycle 15.0%



21%
Portion of Somerville's emissions in 2014 from on-road transportation

Note: Tracking a community's travel mode share is often a challenging task due to a lack of useful and up-to-date data sources. At this time, the ACS data provides the most pertinent information that is regularly updated. While the data focuses only on commute travel mode (instead of total community travel mode), it can serve as a proxy for how the community as a whole travels until a better data source is available.

COST

Avoided Cost

Bus and Bike Lanes

- From a strictly financial cost-benefit analysis, the bus and bike lane actions are not likely to result in cost savings, except in instances where the improvements allows users to forgo operating expenses associated with personal vehicle use in exchange for active transportation or public transit options.

Parking

- Avoided costs from over-development of parking can be measured in terms of construction costs and the opportunity cost of underutilized land development potential. Structured parking in the Boston area costs approximately $22,368 per space for construction costs only.[25] This does not include the cost of underlying land (which can be highly valuable in urban settings) or ongoing operations and maintenance. Urban on-street and surface parking has lower construction costs, but similar costs for land acquisition and operations and maintenance.

Capital Cost/Operational Cost

Bike Lanes:

- Standard 5' painted lanes in both directions costs approximately $50,000 per mile in material costs.
- Protected lanes with paint and flex posts costs approximately $100,000 per mile in material costs.
- A raised cycle track lane will cost approximately $1,000,000 per mile.

Bus Lanes:

- A standard painted bus lane in each direction costs approximately $800,000 per mile and will need to be repainted every 1-2 years. Less expensive paint could be used for a pilot but would only last for approximately 6 months on a busy street.
- Equipment for transit signal priority costs approximately $75,000-$150,000 per intersection.

Funding Mechanisms

There may be options to fund certain aspects of this strategy (primarily bike lane expansion) through the City's Capital Investment Plan or through the Department of Public Works' annual maintenance fund. In addition, development-based funding options could include:

- Development agreements to provide certain improvements (e.g., protected bike lanes through an urban infill project site)
- Development impact fees/in-lieu fees for negotiation or fund installation of new facilities
- Transportation Infrastructure Improvement District (a type of Tax Increment Financing district)

[25] Transportation Cost and Benefit Analysis II - Parking Costs. (2018). Retrieved from http://www.vtpi.org/tca/tca0504.pdf

RELATED ACTIONS

MBTA COLLABORATION – Continue to work with the MBTA to assess climate vulnerabilities within the public transportation system and identify resilience opportunities. The MBTA will conduct a vulnerability assessment of the Red Line and of the MBTA system's electric power needs in the coming year.

Work with MBTA to add bus shelters at popular stops to support ridership during extreme weather.

4 ACTION AREA: RAPID TRANSITION TO ELECTRIC VEHICLES

PRIORITY ACTION: DEVELOP ELECTRIC VEHICLE CHARGING INFRASTRUCTURE STRATEGY.

Achieving 100% clean electricity in Somerville would have an even greater ability to reduce GHG emissions if used to power an all-electric transportation system. The combination of renewable energy with building and transportation electrification presents the clearest path to the City's carbon neutrality goal. Within this overarching framework, the City's most effective role in accelerating the use of electric vehicles (EV) is to facilitate the development of charging infrastructure community-wide.

As described in Action Area 3, the City's two-pronged approach to reducing transportation emissions is to first reduce vehicle miles traveled in the community, and to then electrify the remaining vehicular travel modes combined with access to 100% clean electricity. Providing opportunities for charging at home and at work, when cars sit idle for hours at a time, is an important outcome of this strategy. Pilot programs and case studies from other cities can be used as a guide in Somerville. Utility companies nationwide, including in Massachusetts, are keenly interested in the trajectory of the EV industry to support long-term planning for electricity supply and distribution grid capacity and reliability. Many, including Eversource, have developed pilot programs to increase EV charging station access, often with a focus on at-home charging stations that can better utilize off-peak energy supplies. Challenges to expanding the charging network, particularly in built-out communities like Somerville, include providing access to home owners without garages or driveways as well as tenants in multi-family properties.

The potential expansion of autonomous vehicle technology could decrease the need for EV charging at home or work, particularly if the future of vehicles is based on a shared economy model with fleet operators owning vehicles for on-demand use by residents and charging provided at centralized hubs. The goal of Action Area 3 would further decrease demand for personal EV charger access as active transportation and public transit offset demand for private vehicle ownership. While the uncertain role of autonomous vehicles and broad travel mode shifts could change the EV charging landscape in the future, there are still many unknowns, so the City's immediate actions are designed to support community adoption of EV technology in the near-term.

Electrification of the community's vehicle fleet, powered by clean electricity, can offset the remaining vehicle emissions after implementation of other equitable low-carbon transportation strategies.

APPROACH

As a first step, Somerville can develop an EV charging infrastructure plan to guide investment and policy decisions that will result in a distributed network of EV chargers. The plan should analyze the numerous technology and ownership options for charging stations, consider location and network density needs, and collect case studies from other jurisdictions that have been successful in removing barriers to broad installation. In the past, the City has installed EV charging stations that are accessible to the public through use of grant funds and been responsible for their maintenance. The EV charging infrastructure plan will explore options for how the private sector can lead the expansion of the EV charging network. The plan should also lay out the policies for EV charging related to zoning, curbside charging, and workplace charging, as outlined below:

- Zoning ordinance changes: The City can update its Zoning Ordinance to identify Level 1 and 2 EV charging stations as a permitted use by right in all zoning districts, and can define where Level 3 charging stations (i.e., DC fast charging)[26] are allowed, taking care to avoid the unintended consequence of incentivizing personal vehicle use to the City's commercial districts that are easily accessible by public transit. The City can also establish EV parking space requirements for new construction.
- Curbside EV charging: The City can research case studies of other curbside EV charging pilot programs in advance of designing its own to increase charging opportunities for residents without a dedicated garage and/or driveway. The City's pilot program should balance the need for more at-home EV charging access with concerns for on-street parking limitations. The EV charging infrastructure plan should also evaluate the technical feasibility for installing street light and/or utility pole charging stations as pursued by other municipalities. This action will also increase at-home charging access, and utilize existing electrical infrastructure to minimize costs associated with trenching, long electrical conduit runs, and electrical upgrades to home power equipment. As with the curbside charging program, the City can evaluate potential impacts to limited on-street parking and test various parking strategies to overcome neighborhood opposition. The plan should also consider potential competing curbside demand for priority bus or bike lanes.
- Workplace EV charging: As with at-home charging, vehicles are typically parked for several hours at places of work where they have sufficient time to achieve a full charge. Work place charging opportunities can also provide increased reliability in recharging options for drivers who want an EV, but lack at-home charging access. The City can prepare a parking space inventory (see Action Area 3) and evaluate utilization rates at parking lots and garages. This evaluation will help to identify opportunity sites with available capacity and proximity to residential neighborhoods for overnight charging. Although perhaps less convenient than traditional at-home charging, this strategy would provide nearby residents with guaranteed charging opportunities at night and employee charging during the day, to maximize return on infrastructure investments. The Zoning Ordinance changes noted above will ensure that new commercial development includes charging facilities.

The City also aspires to provide equitable access to EV technology through installation of charging stations at or near affordable housing properties and through development of an EV car share pilot program with incentives for low-income participants. This would allow all members of the community to share in the benefits of improved air quality associated with increased EV use. At this time, there is no clear funding source to support this type of program. However, Somerville hopes to partner with EV car share companies in the future, and explore opportunities to provide incentives for low-income participants.

[26] A level 1 station takes 17 – 25 hours to fully charge an EV with a 100-mile battery; a level 2 station takes 4 – 5 hours to achieve the same degree of charging; a level 3 station provides an 80% charge in 30 minutes.

PLAN FOR IMPLEMENTATION	
Implementation partners:	• Office of Strategic Planning & Community Development (OSPCD) – Transportation & Infrastructure, Planning & Zoning • Traffic & Parking • Department of Public Works • Eversource • Private companies and developers
Equity considerations:	• High costs associated with purchase/lease of EVs and installation of at-home charging equipment will slow technology adoption for low-income residents. However, the used EV market is expected to grow in coming years. • EVs help improve local air quality and these benefits will be concentrated in affluent neighborhoods without strategic EV deployment options for low-income residents/low-income neighborhoods. However, because 93 and McGrath Highway contribute most to Somerville's poor air quality, a Statewide transition to EVs will be necessary to realize transformational benefits to residents living near the highway

As part of its two-pronged transportation emission strategy, the City will first work to transition community members from personal vehicles to public transit and active transportation options (see Action Area 3), and then facilitate use of electric vehicles powered by clean electricity for the remaining vehicular trips. This EV action applies to private automobiles and public transit vehicles.

Photo Credit: Mike Powers 2018

PLAN FOR IMPLEMENTATION	
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Develop EV Charging Infrastructure strategic plan to guide investment and policy updates related to expansion of communitywide EV charging station network; implement specific strategies, as described below Municipal Code Updates Short Term (0-3 years): • Update zoning ordinance to state that Level 1 and 2 EV charging stations are permitted uses by right in all zoning districts; define areas where Level 3 charging stations are desired • Establish minimum parking requirements for EV charging spaces in new residential and non-residential development • Develop curbside EV charging station pilot program to increase at-home charging opportunities in neighborhoods with constrained properties (i.e., no private garage, driveway) Direct Installation Program Short Term (0-3 years): • Evaluate and prioritize opportunity sites for curbside EV charging stations within residential neighborhoods; based on evaluation results, pursue utility company, grant program, or other incentive/pilot programs for EV charging station expansion • Explore existing technologies and feasibility of street light and/or utility pole EV charging stations to maximize use of existing electrical infrastructure • Establish process for residents and local businesses to suggest locations for new public charging stations • Develop pilot program for residential curbside charging stations to test different charging technologies and parking space access strategies Medium Term (4-6 years): • Evaluate off-street parking utilization (see Action Area 3 for description of citywide parking space inventory) to identify potential sites/facilities for overnight residential EV charging; work with property owners to develop after-hours access requirements for area residents and pursue implementation funding, including Eversource EV Make-Ready Infrastructure Program funds or partnership opportunities Low-Income EV Accessibility Short Term (0-3 years): • Talk to companies that could deliver low-income EV car share program to understand opportunities and constraints in Somerville Medium Term (4-6 years): • Identify funding partnership opportunities to implement EV car share pilot program for low-income residents

PRECEDENTS

Low-Income EV Car Share Program

- Sacramento, CA has initiated a pilot EV car share program for residents in three low-income communities. The Sacramento Metropolitan Air Quality Management District received funding for the program from the California Greenhouse Gas Reduction Fund, and selected Zipcar as the program operator. The program has placed eight battery electric vehicles at three affordable housing communities and the Sacramento Valley Amtrak and Light Rail Train Station. The pilot program will give the first 300 participants a free membership and three free hours of driving for three days a week. The program is available to all 2,000 residents of the low-income communities.

- Los Angeles, CA initiated an EV car share program aimed low-income residents in five communities. The BlueLA Electric Car Sharing Program introduced 100 EVs and 200 charging stations, and offers monthly memberships or rentals by the minute. The rentals are available to anyone, but the City provides incentives for low-income users, including 25% discounts for users paying by the minute and a 40% discount for monthly subscribers. Self-service kiosks will be available 24/7 with up to five associated parking spots, each with an electric charger. The program is designed as a point-to-point system allowing drivers to return cars to any kiosk.

Utility-Sponsored EV Infrastructure Expansion

- Southern California Edison implemented its Charge Ready pilot program to install 1,000 charging ports at 60 locations within its service territory. The utility company invested $22 million to increase charging stations in locations where plug-in EVs would be parked for four or more hours. Nearly 65% of total ports installed were at workplaces, 23% at destination centers, 10% for large fleet operator use, and 3% at multi-family dwellings. The pilot program discovered that parking garage installations were cheaper than surface lot installations because wall-mounted conduits required less site restoration after installation, and multi-family residential installations were challenging since property managers often want distributed deployment of charging facilities on-site, which increases infrastructure expenses.

Zoning for EV Charging Stations

- Methuen, MA has revised its Comprehensive Zoning Ordinance to identify Level 1 and 2 EV charging stations as permitted uses by right within all zoning districts, and identified the districts in which Level 3 charging stations are permitted and restricted. The zoning ordinance also establishes the review process for charging station permits and associated design criteria.

- Berkeley, CA has initiated a Residential Curbside EV Charging pilot program to increase access to at-home charging for homeowners who lack off-street parking. The program considers characteristics of the property to determine the type of charging option, including properties with a garage and/or driveway; properties with no garage or driveway, but space to accommodate a vehicle; or properties with no garage, driveway, or space for front yard vehicle-related paving. The on-street parking space remains open for public use, but not use of the charger. Applicants to this program are responsible for all permitting, construction, and equipment costs.

EV-Ready Community Guides

- Ready Set Charge California: https://www.prospectsv.org/wp-content/uploads/2016/12/Ready-Set-Charge-California-EV-Communities-Guide.pdf

- Plugging In: Readying America's Cities for the Arrival of Electric Vehicles: https://uspirg.org/sites/pirg/files/reports/US%20Plugging%20In%20Feb18%20%281%29.pdf

BENEFITS

Qualitative co-benefits:

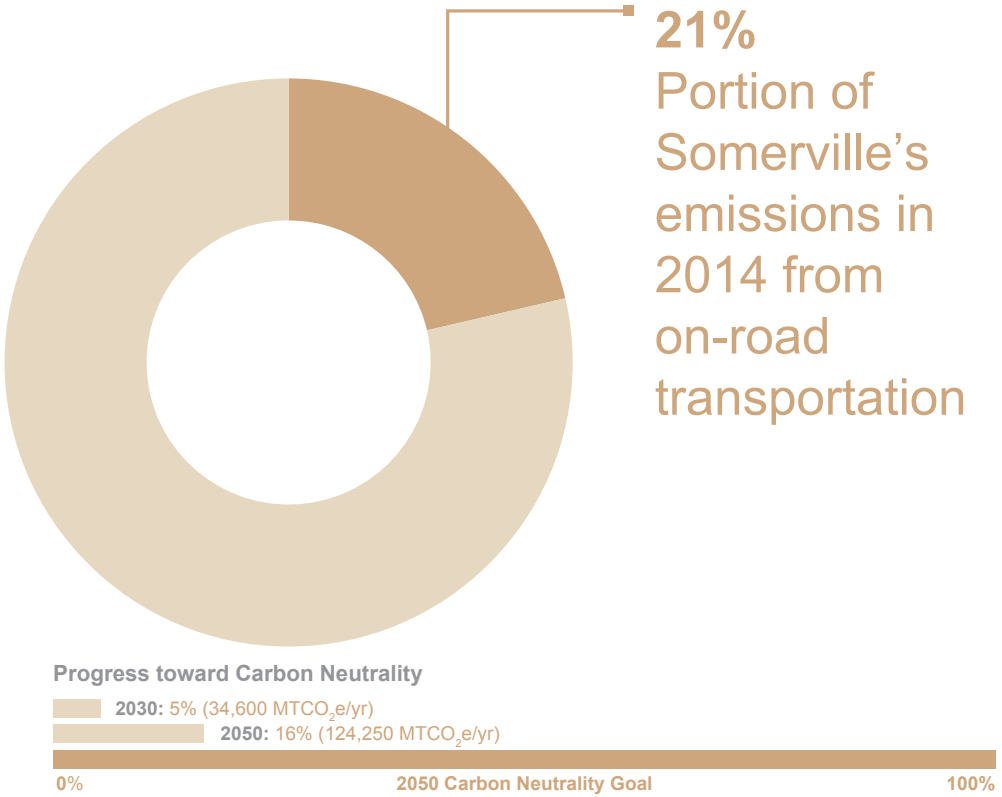
- Social and environmental: Improved health and local air quality from reduced combustion of fossil fuels

Impact of action on GHG mitigation & adaptation:

- Extreme weather events that result in electricity supply disruptions could impact residents' ability to charge their electric vehicles, placing increased temporary strains on the public transit infrastructure.
- Broad adoption of electric vehicles that can be charged with emissions-free electricity is a critical component of Somerville's carbon neutrality strategy once active transportation and public transit mode share opportunities have been maximized. Implementation of this action would result in the following emissions reductions based on the participation rates shown below:

  - 2030: 34,600 MT CO_2e/yr (5% of carbon neutrality target)

  - 2050: 124,250 MT CO_2e/yr (16% of carbon neutrality target)



Note: The emission reduction estimates for this action assume achievement of 100% clean electricity communitywide by 2030.

MONITORING PROGRESS

Performance Metrics

- Number of publicly accessible EV charging stations by type (e.g., Level 1, 2, 3)
- Utilization of publicly accessible EV charging stations measured in number of annual users
- Number of building permits for private EV charging stations
- Local EV ownership counts
- Low-income resident participation rates in EV car share program

Targeted Participation Rate

2030
- Passenger vehicles - 40% electric vehicles
- Buses - 40% electric vehicles

2050
- Passenger vehicles - 100% electric vehicles
- Buses - 100% electric vehicles

COST

Avoided Cost

- Operational Costs of EVs: The cost of fueling EVs in Massachusetts ($1.87 per gallon-equivalent) is lower than that of conventional vehicles ($2.55 per gasoline gallon).[27]

Capital Cost/Operational Cost

City-owned and operated public charging stations

- $15,000 for equipment and installation

Lamp Post/Utility Post Charging Stations

- $3,000-$5,000 – Juice Bar Mini single or double EV charging stations; can be pole mounted with bracket system.

Curbside EV charging stations (in instances where homeowners install a charger in the planting strip and connect to their homes' electric panel)

- $5,000-$20,000 costs reported during the City of Berkeley pilot program; costs include Level 2 charging station, trenching, conduit runs, and application and permitting fees (which totaled $2,500); fees included minor encroachment permit, engineering permit, electrical permit, and plan check

Low-Income EV Car Share Program

- $1.3 million for one year - Sacramento's Our Community Car Share program is funded by California's Greenhouse Gas Reduction Fund for one year, operated by Zipcar, and provides 2,000 residents of low-income communities with free access to EV car rentals; program includes purchase of 8 EVs and installation of 9 charging stations

Funding Mechanisms

EV Charging

Electric vehicle charging infrastructure grant funding is provided competitively through several Commonwealth and regional programs, including:

- MassDEP MassEVIP: Fleets program offers funding for cities/towns, state agencies, and colleges/universities to purchase EVs and Level 2 dual-port charging stations
- MassDEP MassEVIP: Workplace Charging program offers grants to employers with 15+ employees for 50% (up to $25,000) of hardware costs to install Level 1 and Level 2 charging stations
- Regional Greenhouse Gas Initiative auction proceeds

Development-based funding options could include:

- Development agreements to include charging stations for employees/residents, possibly in exchange for a development bonus or off-street parking requirement reduction

EV Purchase/Lease

Funding and incentives for EV purchase or lease is also available from EV manufacturers, auto dealers, State and Federal agencies, and non-profit organizations. Many of the incentives can be combined to reduce the final purchase price:

- Massachusetts DOER MOR-EV program offers rebates up to $2,500 for purchase/lease of zero-emissions or plug-in hybrid vehicles
- Periodic manufacturer-specific rebate/incentive offers or utility company partnerships
- Federal tax credits of $2,500-$7,500 for purchase or lease of electric vehicles
- Drive Green with Mass Energy dealer discounts; vary by dealer and vehicle type (approximately $3,000-$10,000)

[27] Saving on Fuel and Vehicle Costs | Department of Energy. (2018). Retrieved from https://www.energy.gov/eere/electricvehicles/saving-fuel-and-vehicle-costs

RELATED ACTIONS

- Advocate for electrification of MBTA fleet, including buses and the Ride.
- Shared autonomous vehicle pilot: Autonomous vehicle pilots must fit with Somerville's values and transportation goals. As Somerville considers future opportunities to pilot and eventually incorporate shared autonomous vehicles, the City can require that such vehicles operating in Somerville be electric and provide equitable, not exclusive, service.
- Advocate for Corporate Average Fuel Economy (CAFE) standards.

Photo Credit: Mike Powers

5 ACTION AREA: STORMWATER MANAGEMENT

PRIORITY ACTION: UPDATE STORMWATER MANAGEMENT POLICIES AND DEVELOP DESIGN GUIDELINES.

To address precipitation related flooding, there are two key strategies: 1) updating our existing stormwater management policies to include climate change projections in the design criteria for City infrastructure projects and new development, and 2) develop a more equitable funding mechanism to pay for the infrastructure improvements required to minimize the risk of stormwater flooding. By nature of Somerville's location, topography, outdated infrastructure and density, several areas of the City are already at risk of flooding from heavy rainfall events. This risk is likely to be exacerbated by climate change. Design storms are used to assess carrying capacities and level of service associated with drainage systems, as well as to determine flooding overflows associated with stormwater and sewer infrastructure. These design storms along with other specific requirements, such as reducing flooding on private properties and/or limiting nuisance in the public right-of-way, typically constitute drainage design criteria for projects. Establishing drainage design criteria that are based on future design storm projections will provide better guidance for the extent of mitigation measures required to manage stormwater.

Two areas where revised drainage design criteria can be considered are planned public infrastructure upgrades and private development. Currently private development, at a minimum, must not increase the rate or volume of runoff. The City generally requires reduction in rate and volume to the maximum extent considered technically feasible while being consistent with zoning. Current procedures for stormwater management allows developers to determine building geometry consistent with zoning, then the developer proposes a stormwater management system that reduces peak runoff flows. Public infrastructure and construction projects adhere to the same requirements as private development not to increase rate or volume of runoff.

Currently, infrastructure is evaluated for the 10-year and 25-year, 24-hour Northeast Regional Climate Center (NRCC) current rainfall events, not future projections. There are practical and logistical constraints that limit the size of anything being built in Somerville, but in order to make better design and planning decisions with limited funds, it is valuable to know how much stormwater an infrastructure or development property will manage in future climate scenarios. Proposed stormwater design projects by the City and private developers can be evaluated using the 10-year, 24-hour storms and the 25-year, 24-hours storms by 2030 and 2070. Based on the results of such evaluation, the City can consider, for example, using the rainfall depth and intensity associated with the 10-year 24-hour storm of 2070 as the revised criteria for stormwater design and management in both public infrastructure and private development projects. The City's Climate Change Vulnerability Assessment shows that the present 25-year 24-hour storm is likely to be the 10-year 24-hour storm by 2070. There is a significant increase in the level of service between a 10-year 24-hour storm and the 25-year 24-hour storm. It will be important to understand the increased demands on stormwater infrastructure with climate change to understand what additional flood mitigation measures might be needed.

Today, most of Somerville has combined sewer, therefore the current focus of stormwater management is in limiting the quantity of stormwater getting into the City's infrastructure system. However, Somerville is working on separating the stormwater and sewer systems to increase the overall capacity of the system. As sewer separation projects are completed, there will an increasing need to focus on improving the water quality of stormwater runoff that is conveyed through separate stormwater pipes, as it will no longer be conveyed to the Deer Island Wastewater Treatment Facility.

The main goal is to reduce the peak flow of water that enters the City's piped infrastructure, as the system is already under capacity during major precipitation events.

APPROACH

The main goal is to reduce the peak flow of water that enters the City's piped infrastructure, as the system is already under capacity during today's major precipitation events.

The approach has two components:

1. Proceed with studies and modeling to gain a better understanding of the flooding impacts in terms of extent and depth of flooding and determine how they can be mitigated. This can be achieved by:

- Developing a citywide stormwater model to identify areas that will be at greater risk under future storm scenarios. The model can also be used as a tool to identify best solutions to mitigate flooding in the future.
- Evaluating how stormwater infrastructure and private development projects can mitigate flooding by using revised design criteria.
- Evaluating the feasibility of using gray and green infrastructure to meet the revised design criteria in stormwater infrastructure and private development projects.[28]

2. Adopt revised drainage design criteria for stormwater infrastructure and update the City of Somerville Stormwater Management Policy to recommend that private development projects use the revised drainage design criteria as part of their stormwater management plan. This can include:

- Adopting more stringent drainage design criteria for development projects, such as mitigating post development conditions to be no worse than predevelopment conditions under a less intense (or more frequent) storm in the future.
- Recommending using revised drainage design criteria within zoning regulations.
- Encouraging meeting higher drainage design criteria by maximizing the use of green infrastructure solutions, such as integrating rain gardens, porous pavement, green roofs based on their feasibility of implemention in different land use types.

[28] Somerville is including a Green Factor requirement in the current proposed zoning overhaul. The proposed zoning code was submitted to the Board of Aldermen in October 2018. The requirement will provide for the integration of high quality landscape design in future projects. The proposed Green Factor might also contribute to climate resilience but its possible impact has not been quantified at this stage. Retrieved from: http://3pb8cv933tuz26rfz3u13x17-wpengine.netdna-ssl.com/wp-content/uploads/sites/2/2018/02/Article-10-Development-Standards-20180201.pdf

Somerville has received the Municipal Vulnerability Preparedness (MVP) Action Grant from the State to develop a citywide hydrologic/hydraulic model to better quantify flooding impacts in the future. The grant will develop an understanding of the extent to which green infrastructure can reduce flooding in the City, as well as identify specific locations where green infrastructure can be most effective.

PLAN FOR IMPLEMENTATION	
Implementation lead:	Engineering Department
Implementation partners:	• Office of Sustainability and Environment • Department of Public Works • Capital Projects and Planning • Water and Sewer • Office of Strategic Planning & Community Development (OSPCD) - Planning and Zoning • Inspectional Services Department • Mayor's Office • Finance Department • Board of Aldermen • Property owners • Private developers
Implementation steps in the context of Somerville:	• Develop citywide stormwater model to evaluate future flooding impacts and flood mitigation alternatives • Evaluate the feasibility of adopting revised design criteria in public infrastructure and private development projects • Recommend and adopt revised criteria for public infrastructure and private development projects to accommodate future flooding scenarios
Implementation schedule:	Short Term (0-3 years): • Develop a citywide stormwater model • Evaluate the feasibility of adopting revised design criteria in public infrastructure and private development projects • Evaluate optimizing gray/green infrastructure to consider revised design criteria Medium Term (4-6 years): • Present policy and/or zoning recommendations by considering revised design criteria Long Term (7-10 years) • Revisit climate projections and revise criteria based on latest climate science.
Equity considerations:	Precipitation flooding, particularly from more extreme storms in the future, will impact critical support services, including childcare, elderly and public housing facilities, food resources, and religious centers.[29] Precipitation flooding could cause disruptions to transportation and small businesses, resulting in lost wages for hourly workers or business closure if small businesses experience significant damage.

[29] City of Somerville Climate Change Vulnerability Assessment. (2017). Retrieved from: https://www.somervillema.gov/sites/default/files/6-13-2017_Somerville%20CCVA%20Final%20Report.pdf pages 40-43.

PRECEDENTS

The City of Cambridge is considering using the 10-yr 24-hr storm of 2070 as the design criteria for new drainage infrastructure in the City. The City has a "25:2" stormwater management policy for re-development that mandates storing the difference in volume between the 2-year, 24-hour storm event runoff and the 25- year, 24-hour storm event runoff.[30] The City is considering modifying this requirement to include climate change impacts by using the 2070 design storms criteria. Additionally, the City encourages the incorporation of green roofs under Zoning Ordinance, Article 22.[31]

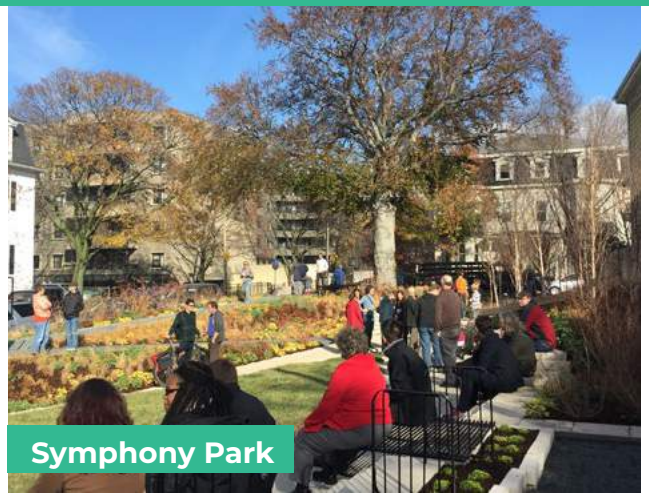
New York City issued in April 2018 the "Climate Resiliency Design Guidelines"[32] that recommends the use appropriate NYC DEP guidelines to develop stormwater management plan using the higher design storm as prescribed in DEP guidelines covering (1) Guidelines for the Design and Construction of Stormwater Management Systems (2) Criteria for Detention Facility Design (3) DEP Site Connection Proposal Application and Guidelines. DEP will continue updating stormwater standards and developing specific tools to evaluate impacts of increased precipitation and drainage strategies for on-site storm water management and the changes will be reflected in future versions of these Guidelines.

[30 & 31] City of Cambridge Community Development Department. (2018). Retrieved from https://www.cambridgema.gov/CDD/Projects/Climate/~/media/29AEEF2F1F5443C1931AB72FA419104B.ashx
[32]NYC Climate Resiliency Design Guidelines. (2018). Retrieved from http://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v2-0.pdf

WHAT THE CITY IS ALREADY DOING

The City has a long history of piloting and then standardizing green infrastructure implementation. For example, the City employed rain gardens and underground storage in the construction of Chuckie Harris Park in 2013, Symphony Park in 2015 and Lincoln Park in 2018. Similar interventions are planned for Nunziato Field.


Chuckie Harris Park


Symphony Park


Lincoln Park

BENEFITS

Qualitative co-benefits: Adopting revised design criteria for stormwater infrastructure in public and private development projects can:

- Promote better quality of life by providing benefits, such as flood damage reduction, maintaining property values, and providing long-term system maintenance.
- Increase economic resiliency by reducing stormwater flooding risks and minimizing structural damage and loss of business continuity.

Impact of action on climate change:

- If all new development and City infrastructure projects were designed with drainage design criteria that consider climate change, there would be significantly less stormwater entering the system. Consequently, Somerville would have a drainage system that is better able to manage larger volumes which would result in less flooding of property and fewer disruptions to daily life and business.

MONITORING PROCESS

Performance Metrics

- Reduction in extent and depth of flooding from precipitation.
- Reduction in number of properties impacted
- Reduction in duration of flooding
- Reduction in insurance claims following extreme precipitation event.

COST

Capital Cost/ Operational Cost

The development of the citywide stormwater model will be a resource used to inform many future improvements to stormwater infrastructure, as well as inform the Stormwater Enterprise Fund solution. A model could cost approximately $100k- $150k. The following steps should be undertaken after a citywide model is developed:

- Evaluate feasibility of adopting revised design criteria in public infrastructure and private development projects ($50k-70k)
- Evaluate feasibility of optimizing use of gray/green infrastructure to meet revised design criteria ($50k-70k)
- Make recommendations for zoning and policy changes ($20k-25k)
- The capital cost for the implementation of stormwater infrastructure designs that are based on revised criteria should be evaluated on a project by project basis.

Funding mechanisms available:

- State Revolving Fund (SRF) Loan Program - The Clean Water SRF Program helps municipalities comply with federal and state water quality requirements by focusing on watershed management priorities, storm water management, and green infrastructure.
- Massachusetts Department of Environmental Protection Water Quality Management Planning Grant

RELATED ACTIONS

Use updated stormwater model to measure effectiveness of strategic de-paving.

WHAT THE CITY IS ALREADY DOING

The **Somerville Ave. Utility and Streetscape Improvements Project**, which is currently underway, addresses legacy stormwater flooding issues in Union Square, and includes significant water and sewer system upgrades, and enhancements to the overall streetscape.

- Underground, the stormwater upgrades will increase capacity and reduce flooding with the installation of a 14-foot wide by 6-foot tall box culvert (a rectangular concrete structure) under Somerville Ave. from Union Square to Medford St., which will remove storm flows from the 100-year old, 72-inch brick combined sewer underneath Somerville Ave. Water main replacements and sewer pipe lining rehabilitation will provide reliable service for many years to come.
- Above ground, streetscape improvements will include enhanced pedestrian, transit rider, cyclist, and traffic facilities; and green stormwater infrastructure.
- 6.5-foot wide bike lanes along either side of the street will be fully separated from the road by a raised curb and offset by a few feet.
- Green stormwater infrastructure will be used to collect and filter runoff from 25% of the project area. This will be accomplished by new planted areas, stormwater infrastructure that will support large tree growth, and permeable surfaces on the bike paths and in some buffer areas. New permeable areas will lead to a reduction of 0.7 acres of impervious hard surface.

5 ACTION AREA: STORMWATER MANAGEMENT

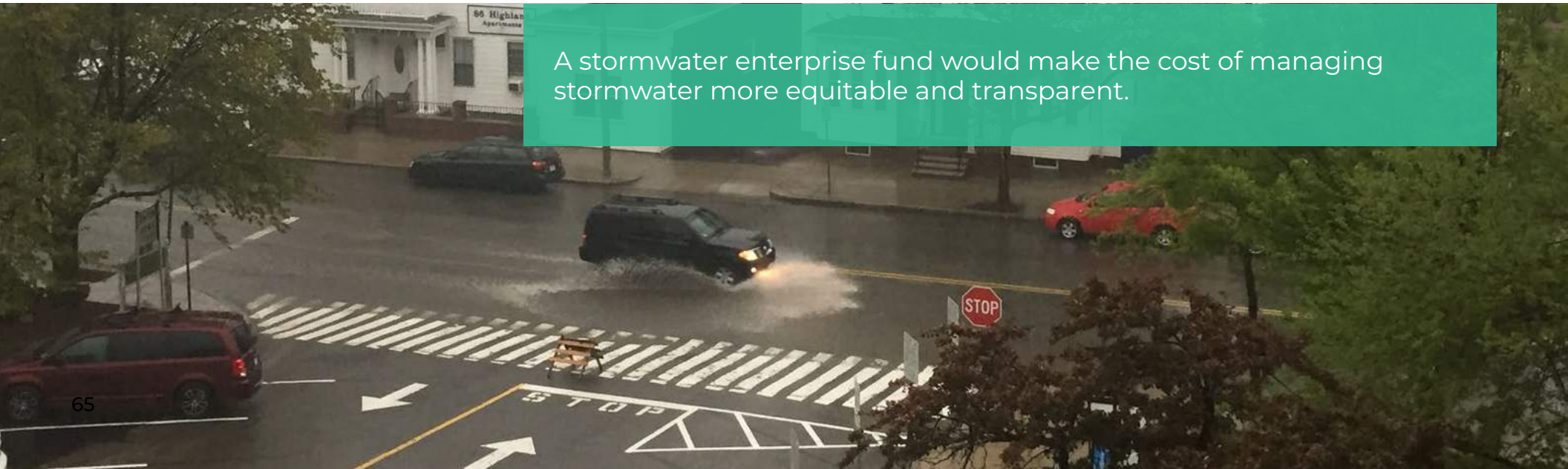
PRIORITY ACTION: INVESTIGATE A STORMWATER ENTERPRISE FUND TO IMPROVE STORMWATER MANAGEMENT

To address precipitation related flooding, there are two key strategies: 1) updating our existing stormwater management policies to include climate change projections in the design criteria for City infrastructure projects and new development, and 2) develop a more equitable funding mechanism to pay for the infrastructure improvements required to minimize the risk of stormwater flooding. Stormwater infrastructure improvements will be a growing need for the City of Somerville in the face of climate change, aging infrastructure, and increased development. Precipitation related flooding was identified as one of the priority focus areas in the City's CCVA.[33] Funding is needed for sewer separation and other capital-intensive projects that will alleviate the impacts of precipitation related flooding. For example, the stormwater system has been overwhelmed during major flooding events such as those that occurred in May 2006, March 2010 and July 2010 storms.

A stormwater enterprise fund, as with other enterprise-type systems, is a fee-for-use approach to infrastructure management. In Somerville, stormwater needs are currently funded through the sewer enterprise fund. Property owners pay into the sewer enterprise fund based on how much wastewater they send to the system. However, the amount of stormwater a property sends to the system is not accounted for in the fees they pay. Creating a dedicated stormwater enterprise fund will create more transparency and equitable distribution of the costs by separating out the stormwater from sewer. Through such a program, properties that send more stormwater into the system would pay more into the stormwater enterprise fund. Under Somerville's current system, properties with large parking lots or large areas of impervious surface, but little wastewater discharge (like big retail stores) are not paying their fair share of the costs to maintain and improve the City's stormwater system. A separate stormwater enterprise fund could collect revenue fairly and generate funds for infrastructure improvements that benefit neighborhoods at risk of flooding.

Based on stakeholder involvement, the program could also be designed to encourage better on-site stormwater management by allowing for reduced fees, or abatements, if property owners make positive changes to their site, like installing green roofs or increasing infiltration.

[33] City of Somerville. (2018). Retrieved from: https://www.somervillema.gov/sites/default/files/6-13-2017_Somerville%20CCVA%20Final%20Report.pdf page vi, Priority



A stormwater enterprise fund would make the cost of managing stormwater more equitable and transparent.

APPROACH

The goal of creating a stormwater enterprise fund is to more equitably fund the infrastructure upgrades and maintenance required to manage Somerville's stormwater, but initial steps must be taken to understand the need and opportunity of creating such a program, and the interests of various stakeholders in working towards this goal. Significant time will be spent investigating the feasibility of a stormwater enterprise fund and engaging with stakeholders to determine key interests and outcomes from such a program. The purpose of the feasibility study will be to assess Somerville's existing stormwater management program, to make recommendations and changes for the future, and to assess the feasibility of funding the program with an enterprise fund and other methods. Some of the questions that the feasibility study would answer are: what are the stormwater related problems, issues, needs, resources and opportunities currently faced by Somerville; what stormwater program priorities should guide the City in the next three to five years; what specific program improvements should be made and what will be the costs; what are the best way(s) to pay for these program improvements; and how should the funding method(s) be implemented.

The first steps of this action are research and engagement based. This approach will work in conjunction with the approach identified in the Priority Action related to updating stormwater management policies and developing design guidelines because the latter will help to better define the issues and constraints related to stormwater flooding and identify what flood mitigation options are technically feasible. This will be critical information for stakeholders to have in order to evaluate policy options.

PLAN FOR IMPLEMENTATION	
Implmentation lead:	Engineering Department
Implementation partners	• Water and Sewer Department • Department of Public Works • Office of Sustainability and Environment • Capital Projects and Planning • Office of Strategic Planning and Community Development • Mayor's Office • Communications Department • Finance Department • Board of Aldermen • Property owners • Private developers • Advocacy Groups • Assessing Department
	(continued next page)

PLAN FOR IMPLEMENTATION (continued)	
Implementation steps in the context of Somerville:	• Stakeholder engagement • Develop scope and conduct feasibility study for establishing a stormwater enterprise fund • If identified as feasible, determine appropriate fee and billing rate structure, as well as incentive mechanisms • Identify implementation procedure by defining the four components: public education and outreach among the City's legislative body; program structure; funding mechanism; and database of policy issues, billing data, inquiry and complaint response, etc.
Implementation schedule:	Short Term (0-3 years): • Interview key stakeholders to inform public involvement approach • Create stormwater taskforce • Complete needs analysis of all stormwater related needs and identify items to be administered by stormwater enterprise fund • Develop framework for enterprise fund • Establish fee structure and abatement mechanisms based on stakeholder input • Finalize policy details and establish internal administrative organization Long Term (7-10 years): • Evaluate program and make adjustments
Equity considerations:	The fundamental objective of a stormwater enterprise fund is attainment of equity. Service fee rate methodologies are designed to attain a fair and reasonable apportionment of cost of providing services and facilities. If designed fairly, a stormwater enterprise fund would not increase costs significantly for a household, but instead would shift the cost to manage stormwater to the property owners who contribute the most. This would likely have little negative impact on overall housing affordability in the city.

Source: Kleinfelder for Somerville Climate Forward

Benefits of community engagement in developing a stormwater enterprise fund include:

- Proactive education of stakeholders about stormwater needs and priorities
- Ability to refine and test the program prior to implementation
- Opportunity to develop innovative and collaborative solutions
- Creation of momentum for a consensus-based solution

PRECEDENTS

Based on a 2016 survey conducted by the researchers at Western Kentucky State University,[34] there are 1,583 stormwater funds/utilities across the country. Of these, more than 58% of the utilities are in 100 metro areas like, Minneapolis, Seattle, and Miami. Sizeable stormwater utility efforts are being undertaken in Los Angeles and Baltimore. Stormwater funds/utilities are becoming more common, especially in progressive cities. Stormwater enterprise funds in other communities have provided the ability to fund capital projects related to flood control and water quality improvements, enhance maintenance and operations of stormwater infrastructure, facilitate regulatory compliance and support ancillary activities related to ecological preservation and stormwater reuse.

A study conducted by EPA[35] in 2015 for eleven case study communities in New England identified the following key lessons from implementing stakeholder engagement process in the development and adoption of stormwater funding mechanisms:

- Identify and involve all key stakeholders.
- Foster deliberation and exchange of ideas among stakeholders with many points of view.
- Start by discussing what the proposed program should accomplish, and only then talk about how to fund it.
- Use several forms of proactive outreach.
- Send example billing ahead of the first bill to help rate payers become aware of new fee, and be responsive and flexible through the first few billing cycles.

Representative Massachusetts Stormwater Fund Programs: Chelmsford, Chicopee, Fall River, Newton, Northampton, Milton, Reading, and Westfield.

BENEFITS

Qualitative co-benefits:

- Recognizes stormwater as a resource that needs to be efficiently used and managed.
- Promotes better quality of life by providing benefits, such as improved community aesthetics, flood damage reduction, maintaining property values, and providing long-term system maintenance.
- Provides ancillary co-benefits, such as improved air quality, positive public health impacts, and might allow for the creation of new jobs associated with developing and maintaining the enterprise fund.
- More equitable distribution of costs for stormwater management.

Impact of action on climate change:

- If implemented, a stormwater enterprise fund could create the financing framework for implementing the infrastructure improvements that are necessary for managing future storms. This would be a critical mechanism for managing future risk and increasing the City's ability to respond to evolving stormwater management needs.

A stormwater enterprise fund would provide an equitable funding mechanism to pay for stormwater infrastructure improvements, making Somerville more resilient

[34] Western Kentucky University Stormwater Utility Survey. (2017). Retrieved from: https://www.wku.edu/seas/documents/wkusswusurvery17.pdf.
[35] EPA. (2015). Retreived from: https://www.epa.gov/sites/production/files/2015-09/documents/eval-sw-funding-new-england.pdf

MONITORING PROGRESS

Performance Metrics

If the enterprise fund is implemented, performance metrics to measure its success may include:

- Clear accounting of costs and benefits of capital projects
- Number of credits or reductions in fees claimed by users on their bills

Targeted participation rate

Citywide

COST

Capital Cost/Operational Cost

The cost for conducting the feasibility study through the implementation of the enterprise fund can range between $200K – 300K.

The operational cost for managing a stormwater enterprise fund would be a modest incremental increase over current water and sewer enterprises.

WHAT THE CITY IS ALREADY DOING

The City has funded and implemented numerous stormwater infrastructure improvement projects. A stormwater enterprise fund could fund similar projects in the future. For example, the **Poplar Street Stormwater Pump Station Project** will fundamentally change the way the City manages the drainage system for 60 percent of Somerville by creating the new opportunity to discharge stormwater to the MBTA drainage system. The City has successfully negotiated the details of a system with the MBTA that maximizes the volume of stormwater sent to the Charles River instead of the capacity-limited MWRA wastewater collection system. **The Spring Hill Sewer Separation Project** includes a number of targeted improvements to the combined sewer system at various locations in the Spring Hill neighborhood to optimize the use of the MBTA stormwater connection. Targeted sewer separation in this area is the next step in realizing the full potential of the Poplar Street Stormwater Pump Station.

ENVIRONMENT

6 ACTION AREA: EXPANDED TREE CANOPY

PRIORITY ACTION: FORMALIZE AND IMPLEMENT A MODERN URBAN FORESTRY MANAGEMENT PLAN TO PRIORITIZE FUTURE TREE PLANTING AND MAINTENANCE INCLUDING BEST PRACTICES AND A RESILIENT SPECIES LIST

PRIORITY ACTION: DEVELOP GUIDANCE AND TRAINING FOR COMMUNITY STEWARDSHIP OF TREES

Maintaining and growing Somerville's urban forest is a priority in the City's Climate Change Vulnerability Assessment because of the role the urban forest plays in mitigating the urban heat island effect and keeping the city cooler as temperatures rise. In addition, Somerville's urban forest offers countless ecological, economic, and health benefits to the community, including removing harmful pollutants from the air and stormwater. [36]

- Trees cool neighborhoods: Neighborhoods that are well-shaded with street trees can be up to 6-10 degrees cooler than neighborhoods without.
- Trees reduce energy usage: Trees properly placed around a house can save up to 30% of energy use and provide for a specific property to be more resilient to extreme heat. Researchers have found that planting deciduous trees or vines to the west is typically most effective for cooling a building, especially if they shade windows and part of the building's roof.[37]

A healthy and thriving urban forest will reduce the urban heat island effect and improve air quality, especially in areas where vegetated cover was previously lacking. In addition, trees increase property values and beautify urban landscapes. Urban forests can help keep cities within a healthy temperature range, although the exact temperature reduction from urban forests is difficult to measure and the extent of the effect varies in space and in time. However, it has been documented that large parks or tracts of urban trees can cool daytime summer air temperatures by as much as 10°F.

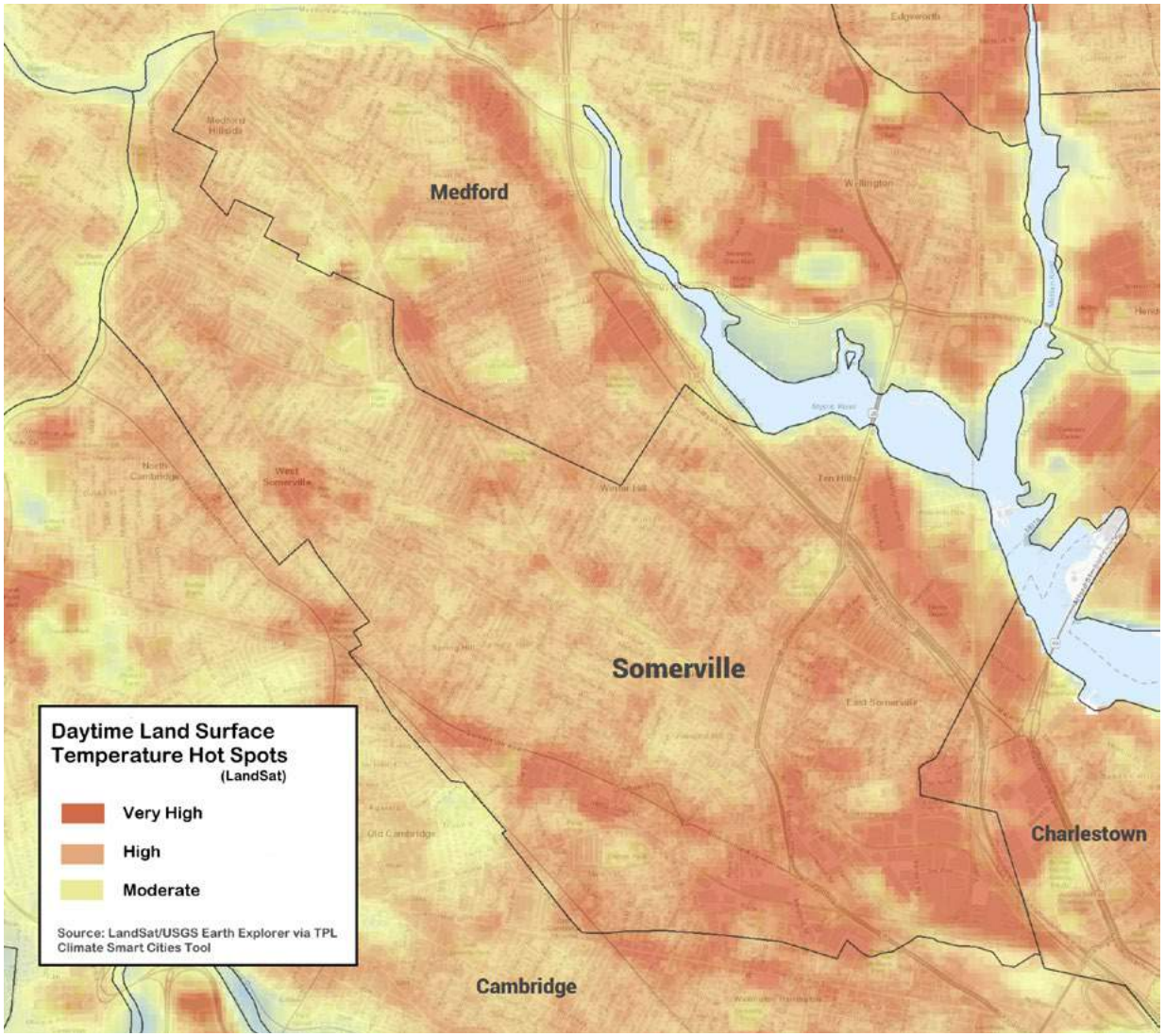
Somerville's urban forest is comprised of publicly owned and maintained trees on public land and privately owned and maintained trees on private property. The City's urban forest is comprised of more than twelve thousand public trees on sidewalks, in parks, and on other public property. Finding appropriate locations for new trees can be a challenge due to Somerville's density and the numerous functions that Somerville's limited public rights-of-way need to serve, including ADA compliant sidewalks, bike lanes, car and bike parking, and utility infrastructure. New approaches will be needed to greatly expand Somerville's urban forest as there is limited space to plant trees in the public right-of-way.

As annual average surface temperature rises, the City will need to consider a revised tree species list anticipating that by 2070, Massachusetts climate might resemble North Carolina's climate today.

[36] Urban Trees and Climate Change. (2018), Retrieved from: http://canopy.org/tree-info/benefits-of-trees/urban-trees-and-climate-change
[37] Using Trees and Vegetation to Reduce Heat Islands. (2018). Retrieved from: https://www.epa.gov/heat-islands/using-trees-and-vegetation-reduce-heat-islands

Climate change will also bring new risks to Somerville's urban forest as temperatures rise. The City will need to consider a revised tree species list anticipating that by 2070, Somerville's climate might resemble today's climate in North Carolina with average low temperate ranging from -10 °F to 10 °F . Many species native to Massachusetts already struggle to thrive in urban conditions and climate change will add additional stress. The City will need to evaluate and revise its preferred tree species list to include additional non-native species that will be more tolerant to warmer temperature and different precipitation patterns.

Communication and community outreach are key. Residents will need to play a large role in the continued maintenance and health of the urban forest.



Urban heat island map for Somerville using the TPL decision support tool analysis to identify and evaluate sites that would most benefit from green infrastructure improvement. (Source: Data from Trust for Public Land Climate Smart Cities https://web.tplgis.org/bostonmetromayorsecure/viewer/#)

APPROACH

A healthy urban forest in Somerville requires a partnership between the City, its key stakeholders and residents. There are two main actions identified through this planning process to grow and maintain a healthy urban forest in a changing climate:

1. Formalize and implement a modern urban forestry management plan. This includes:

- Complete tree Inventory - To start, the City needs a comprehensive tree inventory of all of the public trees in Somerville. This data is important for establishing a baseline and for setting goals for tree canopy expansion. In 2017, the City began creating a new comprehensive inventory of all the trees on public land (public right of way, parks, and city property), and the inventory will be completed in 2018. Keeping the inventory up to date will be useful in determining priority planting locations, as well as maintaining species diversity.

- Develop a modern and robust Urban Forest Management Plan - The City is in the process of developing an urban forest management plan that will guide the expansion and protection of the urban forest. The Urban Forest Management Plan will use the findings from the Climate Change Vulnerability Assessment to provide recommendations in planning for:

  - Factoring in extreme events, e.g. flooding from extreme precipitation, drought, extreme heat, into resilient tree species selection.

  - Warmer average annual climate impacting tree species' selection

  - Pest and disease management strategy adapted to warmer climate and possible introduction of new pests

  - Prioritization of new tree planting in areas with lowest tree canopy to mitigate urban heat island.

- Set tree canopy goals and pursue funding opportunities to support increased planting and maintenance that will be required to meet canopy goals.

- Prioritize planting - Using the Urban Forestry Management Plan as a guide, the City can prioritize planting trees in areas with low tree canopy and select trees based on their resilience to future climate and ability to increase canopy coverage.

- Pilot alternatives - Develop landscaping alternatives to street trees in areas that will not support a tree.

  - Develop a back of sidewalk tree planting program.

  - Along narrow streets or alleyways, consider planting shrubs, vines, etc. and when and where they are appropriate.

  - Develop a planting list and required site conditions.

  - In order to maximize efficient use of limited public space, the City can design a pilot for tree planter curb extensions that could allow tree planting in new locations.

2. Develop guidance and training for community stewardship of trees.

- Zoning - The City of Somerville is currently considering adopting a "green factor" as part of the zoning overhaul. The green factor provides a value-based scoring system to prioritize landscape elements and site design that contributes to the reduction of stormwater runoff, the improvement of urban air quality, mitigation of the urban heat island effect, and improved well-being of residents and visitors. Establishing higher drainage design standard will be aligned with the current proposed approach.
- After the green factor is in effect, the City can evaluate the effectiveness of the green factor based on whether it has resulted in desired tree preservation and planting on new development sites.
- In addition to zoning, the City can evaluate options for ordinances to protect valuable private trees.
- Support public education and increased awareness of the value of the tree canopy and best practices for planting and maintaining trees on private properties.

  - Develop guidance and training for residents to care for trees on private property by creating online and physical brochures and hosting tree care workshops.

  - Promote benefits of trees This could include the promotion of i-Tree tools[38], a state-of-the-art, peer-reviewed software suite that provides urban and rural forestry analysis and benefits assessment tools. By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link forest management activities with environmental quality and community livability. Public education and increased awareness such as offered by i –Tree can educate key stakeholders of value of tree canopy and best practices for planting and maintaining trees on private properties.

[38] i-Tree. (2018). Retrieved from: https://www.itreetools.org/about.php

WHAT THE CITY IS ALREADY DOING

The City of Somerville planted over 100 trees during the 2017 Fall planting season and more than 120 trees during the 2018 Spring planting season. Each year the City includes at least $150,000 in the budget for planting new street trees.

In 2018, the City was awarded a $20,000 grant from the MA Department of Conservation and Recreation to complete an Urban Forest Master Plan.

PLAN FOR IMPLEMENTATION	
Implementation partners:	• Office of Strategic Planning and Community Development- Urban Forestry • Department of Public Works • Engineering • Tree Warden • Office of Sustainability and Environment • Environmental non-profits and community groups
Implementation schedule:	Short-term (0-3 years) • Complete street tree inventory • Complete the Urban Forest Management Plan • Identify factors to prioritize planting and maintenance needs • Evaluate tree planting alternatives • Set tree canopy goals and secure funding to pursue expanding planting agenda • Create materials and outreach strategy for public education on private tree planting and maintenance, for example, communication materials for property owners. Mid-term (4-6 years) • Pilot alternative planting locations • Explore opportunities for integrating tree requirement in regulations • Meet target for trees to be planted and/or net gains • Update communication strategy promoting the benefits of trees
Equity considerations:	An urban forest management plan should seek to advance equity and environmental justice by identifying strategies to improve forest health and canopy cover in low- and moderate- income neighborhoods and neighborhoods that have higher exposure to air pollution. Outreach about the urban forest should be culturally sensitive and should be conducted in multiple languages.

PRECEDENTS

Models for Somerville present a mix of programs that support awareness of healthy urban forests and the provision of direct support for maintenance of urban trees. All stakeholders will be asked to contribute. According to a publication by Clark et al. on a model of urban forest sustainability, it is not possible to separate urban forests from the people who live around them. The paper states that "...sustainable urban forests are not born, they are made. They do not arise at random, but result from a community-wide commitment to their creation and management. Obtaining the commitment of a broad community, of numerous constituencies, cannot be dictated or legislated. It must arise out of compromise and respect."[39]

Tree planting and maintenance: A partnership of Yale University Urban Resources Initiative (URI) with the City of New Haven's Parks, Recreation and Trees Department has established a program to plant street trees for New Haven residents with GreenSkills crews[40]. Residents can use an online form to request trees. The resident commitment entails watering the tree (or trees) planted and informing URI of any problems with the new tree. Each tree needs 25 gallons of water per week during the growing seasons (from bud-break to leaf-drop) for the first three years. The URI is a community not-for-profit affiliated with the Yale School of Forestry and Environmental Studies. A program such as the Yale/New Haven collaboration might be a model for Somerville looking at possible partnership with Tufts University that has a department of Urban and Environmental Policy and Planning and an Environmental Studies Program (ENVS).

The Citizen Forester Program presents a wonderful opportunity for individuals to become skilled at planting, pruning, and maintaining trees in an urban environment. It also provides interested persons with the chance to get involved with local city and county agencies and help their community take care of its public trees. The program was initiated by the Cross Timbers Urban Forestry Council and has been replicated in many cities nationally[41]. In Massachusetts, the DCR's Urban and Community Forestry Program assists communities and nonprofit groups in protecting, growing, and managing community trees and forest ecosystems to improve the environment and enhance livability throughout Massachusetts[42]. For Somerville, the program could be adapted to factor in climate change stresses on the urban forest and provide additional educational information for a resilient urban forest. This program could benefit Somerville, which has a limited staff for the maintenance of an expanding urban forest.

[39] Clark et al, A Model of Urban Forest Sustainability, Journal of Arboriculture, 1997
[40] Urban Resources Initiative. (2018). Retrieved from: https://uri.yale.edu/programs/greenskills
[41] Citizen Forester | Cross Timbers Urban Forestry Council. Retrieved from: http://ctufc.org/citizen-forester
[42] Urban and Community Forestry. (2018). Retrieved from: https://www.mass.gov/service-details/urban-and-community-forestry

BENEFITS

Qualitative co-benefits:

- Trees are most useful as a mitigation strategy when planted in strategic locations around buildings or to shade pavement in parking lots and on streets. Researchers have found that planting deciduous trees or vines to the west is typically most effective for cooling a building, especially if they shade windows and part of the building's roof[43].
- Increased shade on sidewalks and bike lanes could encourage more walking and bicycling at higher temperature by mitigating human discomfort caused by urban heat island[44].

Impact of action on climate change:

- Trees and vegetative cover can lower ambient air temperatures in urban areas through shading, windbreak, and evapotranspiration. The result is lower demand for the energy needed to provide air conditioning in summer months[45]. Increased shade on buildings could lead to more efficient use of air conditioning (A/C). It is worth noting that A/C savings are projected nationally to save more GHG than public transit improvements or widespread wind power[46].

[43] Using Trees and Vegetation to Reduce Heat Islands. (2018). Retrieved from: https://www.epa.gov/heat-islands/using-trees-and-vegetation-reduce-heat-islands
[44] Anderson, R. (2000). Local government and urban heat island mitigation. Retrieved from: https://nature.berkeley.edu/classes/es196/projects/2000final/anderson.pdf
[45] https://www.epa.gov/green-infrastructure/lower-building-energy-demands
[46] Carbon and Tree Facts. (2018). Retrieved from: http://www.arborenvironmentalalliance.com/carbon-tree-facts.asp

MONITORING PROCESS

PERFORMANCE METRICS	Report tree count on a yearly basis. Options: • Number of new trees planted • Number of trees lost • Monitor survival rate of new trees versus percent of trees planted in low canopy areas. • Update tree inventory regularly and track metrics over time, including average tree size
TARGETED PARTICIPATION RATE AND/OR SUCCESSFUL REPORTING METRIC	There is no set tree canopy cover level that would be considered "optimal" everywhere. More important is how best to optimize canopy cover – weighing desired benefits against associated costs. However, it is fair to say that the currently estimated 18% tree canopy in Somerville is in the low range of urban tree canopy and any increase would be an improvement. It is important for the City to adopt its own goals, depending on a number of considerations that are unique to its particular circumstances, including climate, geography, specific environmental concerns, and local preferences. A few initial goals can be to: • Increase canopy coverage in areas with lowest coverage. • Replace trees that are lost due to pests, storm or other physical damage, and from construction in a timely fashion. • Set long-term target for tree canopy expansion.
ESTIMATED GHG REDUCTION	While trees do absorb CO_2, the amount of CO_2 that could be absorbed through Somerville's urban forest is negligible. It would take a forest approximately 270 times the size of Somerville to absorb all of Somerville's nearly 620,000 MT of CO_2 emitted each year. A single tree can absorb CO_2 at a rate of 48 lb. per year (0.025 ton).

COST

Avoided Cost

- Savings include averted energy costs and reduced health care costs from improved air quality. It has been estimated that existing trees in the State of California could reduce by 2.5% the annual air conditioning energy use.[47] There is also a growing body of evidence suggesting that human mental and physical health are linked to the health of the urban forest[48]. A recent study found a 12 percent reduction in all-cause mortality for people living within 800 feet (250 meters) of a high level of greenness.[49]
- Planting appropriate resilient species will extend the life of the urban forest and reduce vulnerability to pests.
- A potential unintended cost of increased tree canopy would be post-storm utility and traffic disruptions from downed limbs. However, this can be minimalized through regular maintenance and education on maintaining healthy trees.

Capital Cost/Operational Cost

- Management plan and public education- Estimated at $45,000.
- On average, it costs approximately $1,000 to plant a tree in the public right of way. This is for tree, site prep, planting, 2 years of maintenance.
- Ongoing maintenance is one of the largest costs for maintaining a healthy urban forest.

Funding mechanisms

- Massachusetts DCR Urban Community Forestry Challenge Grant
- Many grant programs do not pay for maintenance, a critical requirement for maintaining a healthy urban forest.

RELATED ACTIONS

Continue to incorporate green infrastructure in park and public space design.

Establish an adopt-a-tree program

[47] E. Gregory McPherson and James R. Simpson; Potential energy savings in buildings by an urban tree planting programme in California. (2003). Retrieved from: https://www.fs.fed.us/psw/publications/mcpherson/psw_2003_mcpherson005.pdf
[48] Benefits of Trees. (2018). Retrieved from https://www.oufc.org/urban-tree-newa/benefits-of-trees
[49] Green, J. (2017). The Reason to Expand Urban Forests: Our Health. Retrieved from https://dirt.asla.org/2017/10/06/the-public-health-case-for-investing-in-urban-trees

ENVIRONMENT | 7

ACTION AREA: REDUCED CONSUMPTION AND WASTE

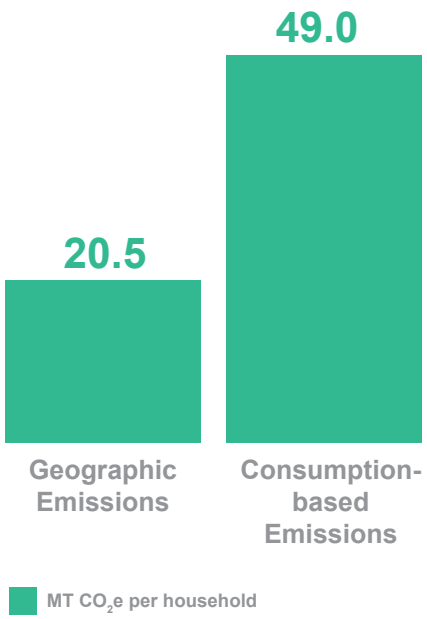
PRIORITY ACTION: COMPLETE A CONSUMPTION-BASED GREENHOUSE GAS INVENTORY AND CONDUCT COMMUNITY OUTREACH ON CLIMATE IMPACTS OF CONSUMPTION.

Emissions from Somerville's disposal of solid waste generated by the community are relatively low, representing only 3% of the total GHG inventory. In the case of Somerville, these emissions are associated with waste incineration, the current management method used to treat disposed waste. However, this percentage does not provide a complete picture of the global emissions impact of the goods and services that are consumed and disposed of in Somerville. Somerville's GHG inventories are developed using the standard Global Protocol for Community-Scale GHG Inventories, which only count emissions generated within the city's boundary, grid-supplied electricity emissions generated outside the city's boundary, and emissions from waste and wastewater treated outside the city's boundary.

While geographic-based emissions inventories like Somerville's are the most common approach in GHG analysis today, cities are increasingly incorporating other types of analysis to provide a more holistic picture of their GHG contributions. One example is the development of a consumption-based inventory that accounts for the life cycle emissions of goods and services consumed within a community. In a consumption-based inventory, emissions are estimated from the entire life-cycle of goods, such as emissions from:

- Extraction and processing of raw materials
- Transportation of raw materials to manufacturing facilities, components throughout the global assembly line, and final products to stores or customers
- Energy used at manufacturing facilities and during product use
- Final product disposal (e.g., recycling, landfill, incineration)

Consumption-based inventories support a holistic understanding of how local activities relate to global emissions within the context of global supply chains.



Somerville's consumption-based emissions are **2.4 times larger** than geographic emissions for the average household.

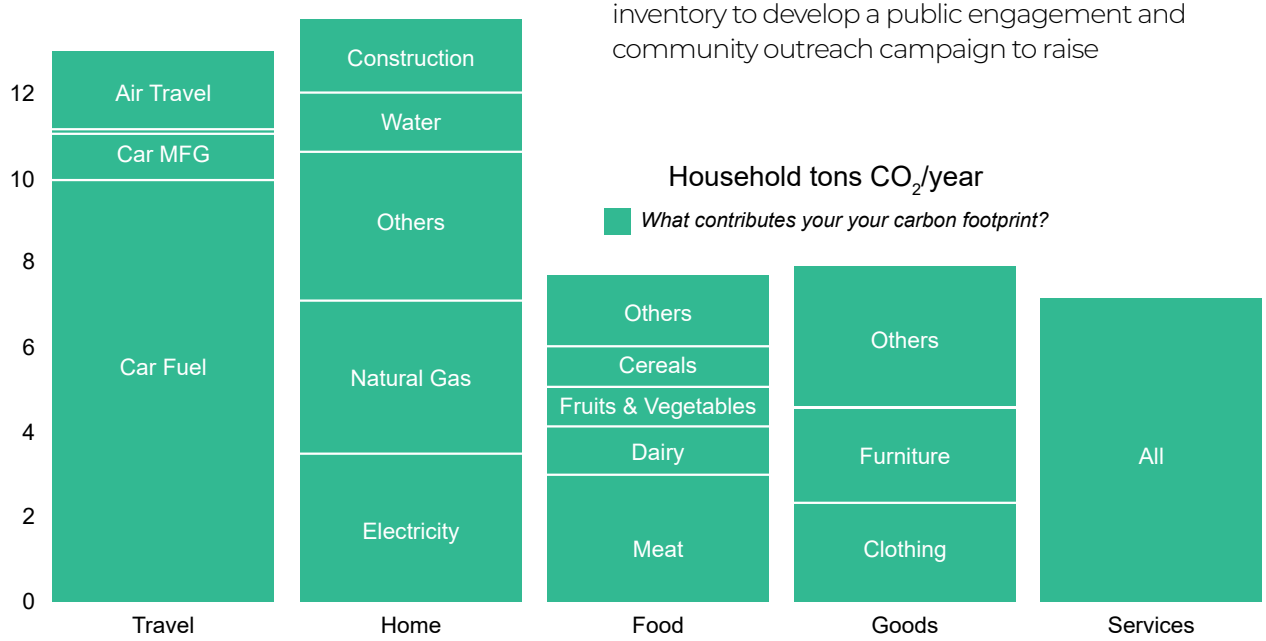
As a relatively wealthy consumer city, Somerville can have a far greater impact on global emissions by changing behaviors that induce emissions through the global supply chain. As an example, a C40 Cities report analyzed emissions inventories from nearly 80 cities and found that the total consumption-based emissions from those cities were 60% larger than their total geographic inventory emissions. It also found that 80% of the cities in the study were consumer cities in which the cities' individual consumption inventories are larger than their geographic inventories. More than half of the cities in the study had consumption inventories twice the size of their geographic inventories, and 20% had consumption inventories that were three times larger.[50] Efforts to increase responsible waste management through recycling should be coupled with education and programs aimed at minimizing consumption that produces excessive waste. The City of Somerville can develop a consumption-based inventory to supplement its geographic sector-based inventory and help communicate local actions to reduce emissions beyond the City's boundary.

An educational campaign about the results of the consumption-based inventory can help target the community's global GHG emissions that are not reflected in the geographic-based inventory.

[50] Average emissions per household in Somerville from CoolCalifornia Calculator for Households & Individuals, retrieved from: www.coolcalifornia.org; total households in Somerville 2014 from U.S. Census Bureau 2010-2014 American Community Survey 5-Year Estimate.

APPROACH

The City will develop a consumption-based inventory that analyzes the life cycle emissions associated with goods and services consumed in the community. CoolCalifornia.org provides an easy-to-use on-line carbon footprint calculator that can be used to approximate such an inventory in a cost-effective manner. The figure below shows the CoolCalifornia results for average emissions per household in Somerville, and demonstrates the range of emissions sources that can be evaluated in a consumption-based inventory. The model was developed using econometric analysis from national household surveys to estimate household consumption by zip code, size, and income bracket. Based on these results, Somerville's consumption-based inventory totals 49.0 $MTCO_2e$/household or 1,557,416 $MTCO_2e$/yr in 2014, compared to 20.5 $MTCO_2e$/household or 651,426 $MTCO_2e$/yr in its geographic-based inventory.[51] A more sophisticated consumption inventory can be developed using an econometric model with inputs and outputs developed specifically for Somerville. Depending on the models used to develop the inventory, the range of consumption categories can be different from those provided in CoolCalifornia, including further disaggregation of categories to provide greater detail.



This calculator also allows the City to evaluate local household carbon footprints by zip code and/or household income brackets to provide more granular results on how income is closely associated with emissions generation. The City will use the results of the consumption-based inventory to develop a public engagement and community outreach campaign to raise awareness on opportunities to reduce global emissions through personal choices, such as reducing meat and dairy consumption or learning how to mend clothing or other personal goods. The City will also consider setting high-level targets for household carbon footprints, and encourage residents to calculate their own personal carbon footprints to better understand how their choices relate to global GHG emissions. The City will continue to monitor progress toward its 2050 carbon neutrality target using a sector-based GHG inventory.

In addition to addressing the community's emissions through actions on conscious consumption, the City will evaluate opportunities to reduce waste emissions in its geographic inventory. Specifically, the City will focus on reducing plastics in the trash stream. Plastics make up only 16% of the waste stream that is incinerated, yet they contribute to 88% of the waste emissions. To reduce the amount of plastics that go to the waste-to-energy facility, the City can work on increasing recycling of recyclable plastics. A first step will be to work on raising participation in its recycling program from multi-family properties and the commercial sector to divert this waste type away from incineration.

[51] Average emissions per household in Somerville from CoolCalifornia Calculator for Households & Individuals, available at: Cool California. (2014). Retrieved from https://coolcalifornia.arb.ca.gov/<www.coolcalifornia.org>; total households in Somerville 2014 from U.S. Census Bureau 2010-2014 American Community Survey 5-Year Estimate.

PLAN FOR IMPLEMENTATION	
Implementation partners:	Office of Sustainability and Environment Department of Public Works MWRA MassDEP
Implementation steps in the context of Somerville:	Short-term (0-3 years) • Develop consumption-based inventory to understand global life cycle emissions associated with good and services used/ consumed in Somerville; estimate inventory based on City's population by household income data to highlight connection between income and GHG emissions • Establish high-level sustainability goals based on consumption inventory results (e.g., per household carbon footprint goals); continue to track progress toward 2050 carbon neutrality target using sector-based GHG inventory • Develop community outreach/engagement campaign to share consumption inventory results and steps to reduce personal/household carbon footprints • Enforce mandatory recycling ordinance participation goals; evaluate baseline achievement for progress tracking Mid-term (4-6 years) • Establish recycling ordinance participation goals and tracking program to monitor large multi-family and commercial recycling rates
Equity considerations:	• One of the main goals of focusing on emissions from consumption is to take a more equitable approach in looking at emissions from goods and services. A consumption based inventory will show that even though emissions might be generated from within Somerville's borders, our consumer choices make us responsible for emissions generated and counted elsewhere. This shifts the perspective that the producer is solely responsible for the emissions and shares that responsibility with the consumer, who is generating demand for that product.

PRECEDENTS

Consumption-based Inventories

- Portland, OR analyzes sector-based and consumption-based inventories in its Climate Action Plan. The use of both inventory types allows the City to present a more complete picture of the emissions for which Portland is responsible, as well as identify opportunities for the reduction of those emissions. The CAP illustrates how emissions from the production and use of goods/products varies, and how strategies can be designed to target the sources of emissions: products with high production-related emissions (e.g., food, construction) benefit from repair and reuse campaigns, while products with high use-related emissions (e.g., vehicles, appliances) benefit from replacement strategies that focus on new, high-efficiency technology options.
- C40 analyzed consumption-based inventories for nearly 80 member cities internationally and compared the results against GPC-compliance sector-based inventories. The results of the analysis show how 'consumer cities' can influence global emissions reductions, particularly those that are attributed to 'producer cities' in a sector-based inventory.
- Vancouver, BC set a goal to reduce the City's overall ecological footprint by 33% below 2006 levels by 2020. To help implement the goal, the City partnered with Evergreen, a nonprofit specializing in public engagement to advance green living, to implement a neighborhood-based outreach campaign. Three neighborhoods were selected to participate with residents tracking food consumption, waste, and transportation for two weeks. The same residents will then repeat the exercise in a year to compare their individual results. A similar pilot project was conducted from 2013-2015 in one neighborhood, and achieved a 12% reduction in the neighborhood's ecological footprint.

MONITORING PROCESS

Performance Metrics

- Average household carbon footprint in Somerville
- Number of households that self-report estimation of their individual carbon footprint
- Recycling plans submitted by multi-family buildings and businesses.

COST

Capital Cost/ Operational Cost

- $50,000 for implementation of Vancouver, Ontario ecological footprint outreach campaign in up to four neighborhoods
- $10,000+ to develop consumption-based inventory, depending on methodological approach (i.e., use of the CoolCalifornia.org calculator is cheaper than approaches that rely on implementing household surveys or macro-economic models)

Funding Mechanisms

- The City receives funding from the grant programs below and will continue to seek annual funding.
- Sustainable Materials Recovery Program Municipal Grants – MassDEP program to improve local recycling, composting, reuse, and household hazardous waste diversion.
- Sustainable Materials Recovery Program Recycling Dividends Program – MassDEP program to distribute recycling program dividends to qualifying communities; payments range from $2,800 to $240,000 depending on households served and program scoring results.
- Sustainable Materials Recovery Program Municipal Technical Assistance Grants – MassDEP program to provide up to 80 hours of technical assistance to help cities develop high-priority recycling, solid waste, or pay-as-you-throw projects; a second technical assistance program is available to increase quality of recycling in a community (i.e., minimize contamination in recycling stream) through the Recycling IQ Kit.

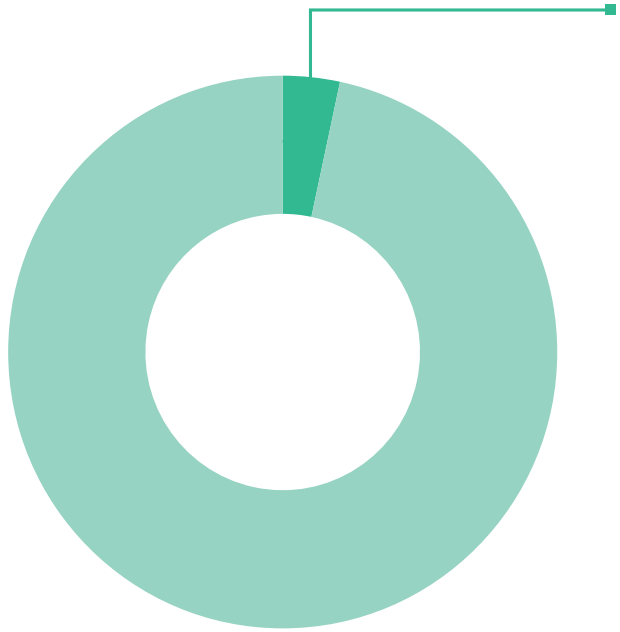
BENEFITS

Qualitative co-benefits:

- Improved air quality from reduction of plastics in incinerated waste stream
- Global emissions reductions from reduced consumption of goods/services associated with the global supply chain
- Increased local understanding of connection between consumption and GHG emissions
- Avoided costs associated with over-production of food products (resulting from food waste), including environmental costs from fertilizer use, potable water use, and agricultural land use

Impact of action on GHG mitigation & adaptation:

- If Somerville is successful in diverting plastics from incineration by 2050, GHG reductions will total approximately 12,300 MT CO_2e/yr or 2% of the City's carbon neutrality goal



3%
Contribution of solid waste to 2014 emissions inventory

WHAT ABOUT COMPOSTING?

Because Somerville's trash is currently disposed of in a waste-to-energy facility, organic waste accounts for only 1% of Somerville's waste emissions, or only 0.0003% of total Somerville emissions. Other cities in the country have higher waste emissions because their trash is sent to a landfill, where methane is released during the waste decomposition process. This means that separating food scraps and disposing of the material separately from Somerville's trash would have a negligible effect on community emissions. In addition, a citywide food scrap collection program would cost as much if not more per ton as trash services. While composting is not a climate priority today, a food waste diversion program could lessen the risk of rising emissions, if waste disposal in a waste-to-energy facility is unavailable in the future. A food waste diversion program that sends waste to anaerobic digesters could provide the fuel for renewable energy generation. However, our region does not yet have robust and economically sustainable anaerobic digestion facilities and infrastructure. The City will continue to monitor the landscape of food waste diversion options in the region to determine if a sustainable and cost-effective program could be created in the future. And while composting might not have a big climate impact, food does account for a significant proportion of household consumption-based emissions. So reducing food waste overall and limiting meat and dairy consumption can help to reduce consumption-related emissions from agriculture outside of Somerville.

8 ACTION AREA: HEALTHY AND RESILIENT COMMUNITY

PRIORITY ACTION: ESTABLISH A PREPAREDNESS EDUCATION PROGRAM AND AN EMERGENCY ALERT SYSTEM THAT HELP PROTECT THE COMMUNITY FROM FLOODING AND EXTREME HEAT EVENTS.

Increasing outreach and public health education on flood vulnerability and extreme heat is a priority for protecting the Somerville community and helping residents and businesses prepare for disruptions caused by dangerous weather events. Communication networks play a critical role in building awareness of risks and connecting community members to support during extreme climate events.

Many Somerville residents are unaware of climate risks and may not be prepared, or might not know how to prepare, for flooding or extended periods of extreme heat. There are several serious public health concerns raised by climate change including: heat-related illness and mortality, exposure to contaminated flood waters and mold resulting from flood impacts, greater exposure to impacts from poor air quality, and an increase in vector-borne diseases. While the risks are widespread, a large portion of Somerville residents are likely to have risk factors that differ depending upon whether they are older, very young, have limited financial resources or education, rent versus own their homes, have health and/or physical challenges, lack consistent access to healthcare, are not proficient in the English language, and/or face other stresses such as the effects of persistent racism in their lives.

RESIDENT EXPERIENCES

Heat event/storm caused power outage in our large walk-in cooler for the pantry. We had to scramble to bring food to other coolers around Somerville/Cambridge. We had to expend resources carting the food to other storage sites. Even then, we lost some food.

I feel the least prepared for the possibility of the loss of property/ expensive repairs after a huge weather event.

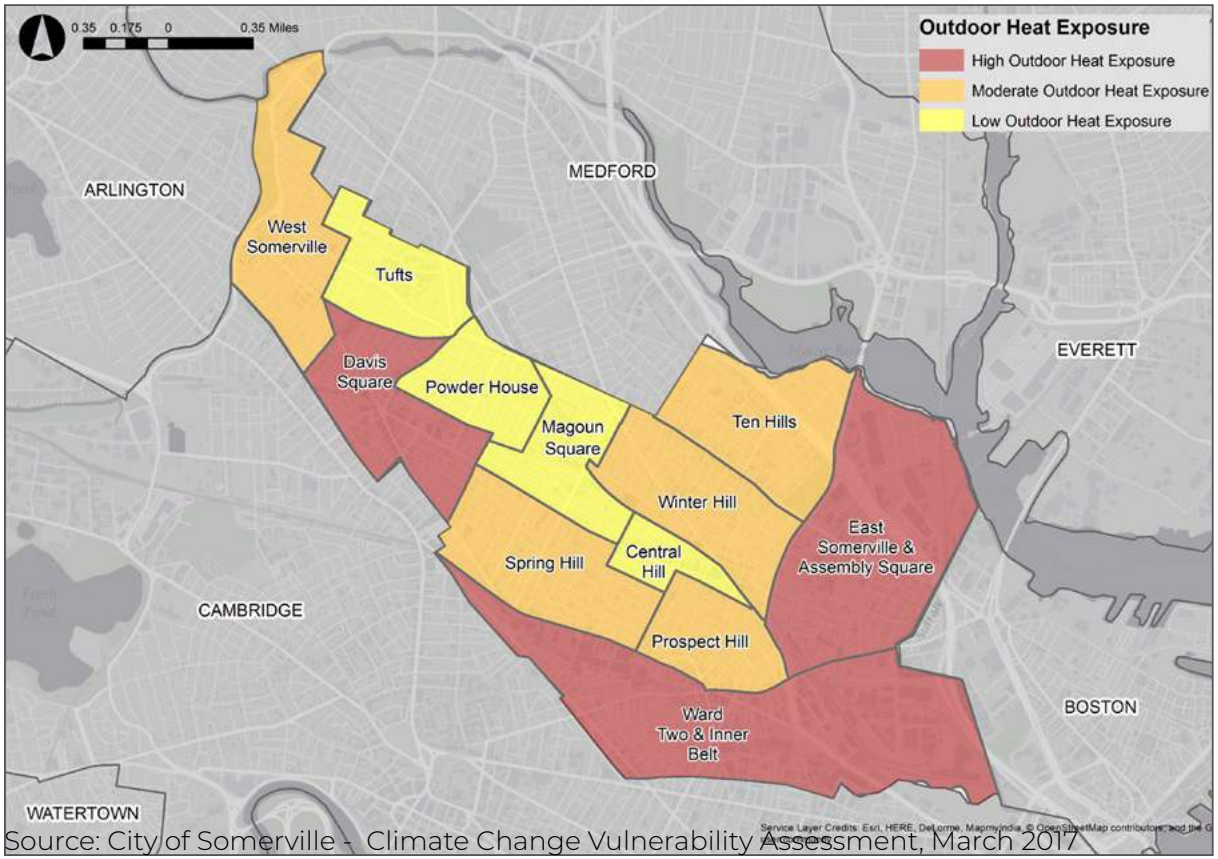
A few years ago an older neighbor was caught in dangerous flash floods in the Medford St. underpass next to Target and was fortunate to be dragged out of his car by someone who saw the danger as the water surrounded the car and made opening the door difficult. I never thought this kind of high danger existed in our streets, but have heard of similar incidents in the past at the Route 28 underpass near Foss Park by Mystic Ave.

I've done almost everything I can to reduce my emissions and create personal resiliency. It gives me peace of mind to have as much as I can in place for myself. And it also makes me available if I had to help out in the community in the future, either with knowledge, experience, or emergency assistance for others. I have the opportunity and the resources, so I feel responsible to make the most of that.

Communication networks play a critical role in supporting community members to build their awareness and receive support in responding to emergencies and reducing the effects of extreme climate events. Many don't realize the risks that they face.

Of most concern in the short-term are extreme heat events that can trigger a variety of heat stress conditions, such as heat stroke in which the body is no longer able to cool down. This condition can cause death or permanent disability if emergency treatment is not given. As illustrated in the Outdoor Heat Exposure map below, specific Somerville neighborhoods are at greater risk for urban heat island effect due to limited vegetation and urbanization patterns. The number of days over 90 °F is projected to nearly triple by 2030. This means there will be more heat waves (three days in a row over 90 °F) and that such heat waves will last for longer periods. Heat waves with high temperatures during the day and nighttime temperatures that do not drop below 75 °F are a greater cause of loss of life than other types of weather events; especially for the very young, elderly, those with cardiorespiratory health conditions, and outdoor workers. Getting to cool areas can prevent heat-related illnesses. Those who show signs of distress need immediate medical assistance.

Other preventive measures and alerts may be necessary during other severe weather events, such as extreme precipitation and severe storms. Key neighborhoods in Somerville are at relatively higher risk of flooding due to the probability of extreme precipitation or extreme storms translating into more extensive and/or greater depths of flooding in those areas. Residents who might require assistance will need to be identified and supported so that they are safe and have access to health services and medications.



Source: City of Somerville - Climate Change Vulnerability Assessment, March 2017

As illustrated in the Relative Urban Heat Island Exposure by Neighborhood Map, specific Somerville neighborhoods are at greater risk for to urban heat island effect due to limited vegetation and urbanization patterns.

APPROACH

The focus of this action is to enhance the existing communication systems to develop a strong and robust network for public health education and rapid response for communicating climate risk related emergencies. Climate risks to be integrated or updated in existing emergency communication are extreme heat, coastal flooding and extreme precipitation flooding. Of urgent need is a program to pre-identify groups and networks who work with those who are more vulnerable due to their location in the city, exposure to one of the identified risks, health conditions, or social isolation. Their safety and wellbeing can be improved by creating a redundant communication system focusing on population groups that might not be reached by the existing emergency alert system.

The steps in creating an enhanced communication system could include the following key measures recommended by the U.S. Environmental Protection Agency (EPA) in their Excessive Heat Event Guidebook.[52]

- Identify facilities and locations with concentrations of high-risk individuals to prioritize actions and inform about notification activities for their respective populations.
- Strengthen the City of Somerville's heat emergency response, potentially including:
  - Automatic notification of partners through reverse 911 that is triggered by the heat index
  - Incorporation of heat-attributable adverse health impacts into activation criteria. Health surveillance data, such as hotline calls, prehospital transports, and community deaths, can be made available very quickly. In addition, systems can be developed that automatically flag these indicators when they increase above expected baseline values.
  - Identification of existing lists and channels of communication. For example, the City can partner with the Council on Aging and Somerville/ Cambridge Elder Services to make sure home-bound seniors are aware of, and safe, during heatwaves.
  - Translations of all alerts into multiple languages.
- Adjust existing emergency preparedness plans to incorporate climate projections and increase resilience of existing City-run shelters, particularly the resilience of backup generation for air-conditioning and food storage in the event of a power outage. Projected local heat, flooding, storm-related hazards, including evacuation and power loss and climate-related vector-borne disease outbreak scenarios should be incorporated into emergency response protocols. Somerville does not currently have a full-time dedicated emergency planner. A dedicated staff person could help build capacity for emergency response.
- Establish systems to alert public health officials about high-risk individuals or those in distress. Once alerted, officials should conduct direct assessments of high-risk individuals to check for signs of excessive heat exposure or flooding. The City could explore a more in-depth proactive measure to establish a voluntary registry for those with physical, mental, and sensory disabilities to preauthorize emergency response personnel to enter their homes during search-and-rescue operations.[53] The Council on Aging has such a system in place that could be expanded.
- Broad public alerts should also be triggered during an extreme heat event (EHE), and include:
  - Coordinated public broadcasts of information about the anticipated timing, severity, and duration of EHE conditions and availability and hours of any public cooling centers
  - Coordinated public distribution and broadcast of heat exposure symptoms and tips on how to stay cool during an EHE
  - Provision of informational phone lines that can be used to report heat-related health concerns
  - Multi-lingual communication systems

- Additional response actions promoted by the EPA during an extreme heat alert include:
  - Designate public buildings or specific private buildings with air conditioning as public cooling shelters and provide transportation
  - Extend hours of operation at community centers with air conditioning
  - Arrange for extra staffing of emergency support services
  - Increase outreach efforts to the homeless and establish provisions for their protective removal to cooling shelters
  - Suspend utility shutoffs
  - Reschedule public events to avoid large outdoor gatherings when possible
- Flood alerts can incorporate some similar elements as well as the following as recommended by the American Public Health Association:[54]
  - Advice to store clean water
  - Options for ensuring necessary supplies of medicines and access to needed healthcare and medical equipment should there be a loss of power or travel difficulties.
  - Resources and safe cleanup guidance after a flood

In advance of climate-related health emergencies, education on public health climate risks to promote action on preventive protective measures can include targeting engagement through:

- Training health and social service providers on climate-related risks and options for client education and outreach and assurance of continuity of healthcare access, medicines, and home medical equipment.
- Establishing means of effective communication for all residents, particularly those with high risk factors, built on participatory-based, social marketing approaches. The approach is to tap on existing programs that work, such as City communications, Council on Aging, Visiting Nurses Association, and SomerViva, and focus the outreach on the specifics health hazards of climate change risks.
- Integrating with creation of the SustainaVille climate leader training and local organization networking to further reach across neighborhoods and population groups, employ services of trusted leaders and effective communication channels, and create consistent and recognizable branding. Over time, SustainaVille community based organization partners can serve as Community Resilience Hubs, offering not only resident training but resources to help residents prepare for and address climate-related emergencies.

Farmers Markets are good places to engage residents in a positive manner. They could be a forum to enhance communication and be part of a strong and robust network for education and rapid response.

For opposite page:
[52] Excessive Heat Events Guidebook EPA 430-B-16-001 | June 2006 Updated Appendix A | March 2016. Retrieved from: https://www.epa.gov/sites/production/files/2016-03/documents/eheguide_final.pdf
[53] Fairchild, Colgrove, and Jones, "The Challenge Of Mandatory Evacuation: Providing For And Deciding For." As cited by Rudolph, L., Harrison, C., Buckley, L. & North, S. (2018). Climate Change, Health, and Equity: A Guide for Local Health Departments. Oakland, CA and Washington D.C., Public Health Institute and American Public Health Association.

For this page:
[54] Climate Change, Health, and Equity: A Guide for Local Health Departments. Oakland, CA and Washington D.C., Public Health Institute and American Public Health Association.

PLAN FOR IMPLEMENTATION	
Implementation leads:	Department of Health and Human Services Communications Department
Implementation partners:	• Mayor's Office • Somerstat • Fire Department and Emergency Services • 311 • SomerViva • Somerville Public Schools • Council on Aging • Cambridge Health Alliance • Homeless Coalition • Office of Sustainability and Environment • Visiting Nurses Association, Somerville/Cambridge Elder Services • Organizations that serve immigrant populations • Social services organizations • DPW and outdoor Workers (outdoor landscapers, construction, utility workers).
Implementation steps and schedule:	Short-term (0-3 years) • Identify and partner with relevant health and social service organizations responsible for emergency communication • Meet with service providers to understand best methods of communication and to identify next steps for implementing communication program. • Develop community alert and response programs • Establish enhanced communication networks focusing on hard-to-reach populations • Establish heat and flood response guidance and train partner organizations and residents. • Incorporate climate-related scenarios into emergency response plans and activities, including alert systems • Train and drill public health officials, providers, and most-at-risk residents • Incorporate emergency outreach efforts into the SustainaVille climate leadership program • Ensure availability of shelters and cooling centers for population most at risk. Medium Term (4-6 years) • Establish neighborhood organization capacity to serve as Climate Resilience Hubs • Develop supporting policies that protect residents • Assess staffing needs for emergency planning and response

PLAN FOR IMPLEMENTATION	
Equity considerations:	Those who are most at risk of climate impacts are populations that already face health and economic disparities. People who already are suffering from existing health issues, or challenges affording basic needs, such as food and housing, typically have fewer resources to draw on in case of an emergency. Therefore, outreach about climate impacts should not assume everyone has an equal ability to prepare or bounce back quickly from an extreme heat or flooding event. Efforts should be made to target residents who might be more at risk and help connect them with resources and support services. Emergency shelters and cooling centers should be adapted to unique cultural, language, health, and personal needs. For example, residents with pets need shelter or cooling center options where they can bring their animals.

WHAT THE CITY IS ALREADY DOING

- The City currently sends out alerts during extreme weather events to let residents know how they can prepare.
- The City has created Emergency Preparedness Plans for various scenarios, including shelter plans.
- The City is prepared to open cooling centers in public buildings, including the Council on Aging, schools, libraries, 165 Broadway, and the public safety building.
- The Fire Department and Health and Human Services are working on vulnerable population plan in case of evacuation.

PRECEDENTS

Community Resiliency Hubs:

The City of Berkeley in California developed the Community Resilience Center (CRC) Program that gives community organizations the tools, resources, and training needed to serve as hubs for assistance and information during and following disasters. Similar to the approach outlined for Somerville, the CRC Program's goal is to enhance the resilience of the people of Berkeley by strengthening the organizations they depend on day-to-day and providing disaster preparedness outreach and training through organizations they know and trust.[55]

Boston is coordinating public health and healthcare infrastructure, communities, and businesses to coordinate emergency planning[56], mitigation, response and recovery. They are identifying and mapping neighborhood organizations that can support residents and share resources during an emergency. In Cambridge, the Margaret Fuller Community Service Center also offers an example of a neighborhood resource that is integrating climate change and health into their planning and services. They are participating in creating a neighborhood video being prepared by the Cambridge Public Health Department (CPHD) on climate change health impacts featuring and tailored to Port area residents, and will hold resident discussion session using such resources. They offer cool places, such as their library, for residents to gather and are identifying how their own facilities, such as day-care and classroom spaces, can be impacted by extreme heat and flood events. They also received a grant from the CPHD's Cambridge Healthy Eating and Active Living program to renovate their flat roof (that currently contributes to the urban heat island effect) into a community rooftop garden that will train residents in gardening and help ensure their food pantry has sustainable access to healthy produce.[57]

Emergency Education Programs / Training:

The City of Portland Oregon has organized an ambitious and popular disaster preparedness and climate resiliency education program called Planning for Resilience and Emergency Preparedness (PREP). Among the courses offered are "Your Resilient Neighborhood focused on citizen stormwater and heat management strategies and Should I Stay or Should I Go?", which is a class examining real time disaster survival, management and recovery scenarios. This is designed to encourage heads of households, institutional leaders, and business owners to develop alternative plans to address specific disaster threats. It provides an efficient way of communicating emergency services to most vulnerable groups by using their leaders to convey the information to them.[58]

Alert Networks: A study suggested that excess mortality during heat waves decreased following implementation of a nationwide heat warning system in Germany.[59] As part of the Resilient Boston plan , the City is leveraging neighborhood-level volunteers to check in on neighbors during heat events and will partner with nonprofits and healthcare providers to register disabled residents who lack cooling capacity in their homes.[60] Eversource has a life support registry. When the power source is threatened (e.g., for an approaching storm), Eversource makes a proactive call to all life support customers to warn them to make alternate plans. Eversource also monitors their circuits and, if they lose power, calls the Police Department to check on them. During activated heat alert periods, Phoenix expands homeless shelter hours into the daytime. Philadelphia and Toronto send field teams to conduct follow-up visits with at-risk individuals identified from hotline calls and, if necessary, transport them to a cooling shelter.

[55] Community Resilience Centers. (2018). Retrieved from: https://www.cityofberkeley.info/CommunityResilienceCenter/
[56] Greenovate Boston Leaders. (2018). Retrieved from: https://www.boston.gov/departments/environment/climate-ready-boston-leaders-program
[57] August 2018 interview with Selvin Chambers, Director, Margaret Fuller House.
[58] Planning for Resilience & Emergency Preparedness | PREP - Neighbor by Neighbor, Block by Block. (2018). Retrieved from: http://www.preporegon.org/
[59] Heudorf U, and Schade M. Heat waves and mortality in Frankfurt am Main, Germany, 2003-2013: what effect do heat-health action plans and the heat warning system have? Z Gerontol Geriatr. 2014 Aug;47(6):475-82.
[60] Resilient Boston - An Equitable and Connected City. (2017). Retrieved from: https://www.boston.gov/sites/default/files/document-file-07-2017/resilient_boston.pdf

BENEFITS:

Qualitative co-benefits:

Environmental: Awareness of public health consequences of climate change can lead to actions that protect the local environment, such as:

- Measures to reduce contributions to outdoor air pollution
- Improvements of indoor environments as cooling measures are adopted and flooding averted and post-remediation enhanced.

Social: Social cohesion can be strengthened as:

- City and partner organizations strengthen relationships
- Neighbors become more aware and support one-another to prepare and address emergencies

Economic: The economic co-benefits of a healthy and resilient community are many, including:

- Healthy and stable workforce
- Reduced business disruption

Impact of action on GHG mitigation & adaptation:

The impact of strategic action on health and resiliency will include lives saved, property loss prevented, a better prepared community, and increased awareness of imperative to act on climate change. The projected impact of implementing this action could address one or several of the following:

- Prevention of increases in asthma and allergies and some of the factors, such as flooding leading to mold growth caused by climate change risks such as flooding and extreme heat.
- Even modest increases in heat are predicted to increase health-related impacts including cardiovascular morbidity and mortality.
- Stomach illnesses can be prevented if contaminated floodwater exposures are reduced and food protected.
- Other health conditions, such as Lyme disease and West Nile virus can be anticipated and cases averted.

[61] Buonocore, et al. Air Quality and Health Co-Benefits of a Carbon Fee-and-Rebate Bill in Massachusetts, Harvard T.H. Chan School of Public HealthApril 27, 2017. Retrieved from: https://1jf7652uqh8csljrqst8yp9l-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/Study-Carbon-Pricing-and-Public-Health.pdf

MONITORING PROCESS

Performance Metrics

The following measures align with activities and can help monitor progress and efficacy:

- Number of social service and health organizations and affiliated providers participating in a climate alert network
- Number of residents reached through communication alert systems
- Number of hard-to-reach residents participating in outreach and education events, and signing up for alerts through the network.
- Residents accessing cooling centers during extreme heat events.

Performance metrics can also be developed using public health indicators for equity and wellness, including disparities in health outcomes and exposures to climate impacts. These can include existing metrics or ones that could be readily available. For example:

- Number of total hospitalizations, and hospitalization and Emergency Department visits for heat-related stress, asthma, and heat attacks during and closely following extreme events. As available, neighborhood rates by race and ethnicity.

Additional measures of successful preparedness and emergency response could include:

- Police and fire calls during extreme climate event.
- Success of evacuations and returns to homes.

Note that while health outcomes cannot be directly tied to the enhanced communication networks, their trends will be important to monitor to identify potential areas of concern and success.

RELATED ACTIONS

- Track and monitor vector-borne diseases.
- Training for the Medical Reserve Corps. The MRC is a volunteer group, and many of the volunteers have a medical background. MRC members could be trained to do public outreach/education for heat and flood emergencies (for example, teaching people about heat exhaustion and the need to stay cool). MRCs could play a role staffing shelters (cooling or otherwise) and assisting people with functional needs. MRCs could also be used to check on elderly residents in a heat emergencies. The 4B Regional unit covers Somerville

  (See: https://mrc.hhs.gov/partnerfldr/Partner).

COST

AVOIDED COST:	Avoided cost range from savings from averted harm to people and indirect benefits from improved conditions. Case studies in the literature point to the importance of the following averted costs regarding protected human life and health: • The costs associated with asthma (associated with flooding and water leaks) are substantial. The American Lung Association estimates that the cost of asthma in the U.S. in 2007 was $19.7 billion for both direct and indirect costs. Furthermore, asthma resulted in 12.8 million missed school days and nearly 10.1 million missed workdays in the US. Massachusetts has higher rates of asthma than the U.S. average. Somerville rates of asthma prevalence are similar to the state average; yet also include more populations at risk of poorly-controlled asthma. • Health-related costs due to heat-related premature death and hospitalization in the Northeast's urban centers are sizeable even at modest levels. • Significant cardiovascular and respiratory health impacts and their costs are associated with air pollution. A recent study by the Harvard School of Public Health on the health impacts in Massachusetts accruing if it were to adopt a carbon fee estimated the co-benefits from reduced GHG use to be $10/ton, increasing by $5 per year until it reaches a plateau of $40 per ton. Cumulative savings over an implementation year of 2017 through 2040: $2.9 billion ($2017 USD) of cumulative health benefits between 2017 and 2040, worth $2.0 billion ($2017 USD) if discounted to 2017 at 3% per year.
CAPITAL COST/ OPERATIONAL COST:	The costs associated with this broad range of strategies may vary widely depending upon how the implementation fully develops. Among categories of costs can be: • Funds added to existing health and wellness programs to extend their outreach to include climate change education. • Additional staff for expanded services. • Additional communication expenditures
FUNDING MECHANISMS:	There is an array of existing programs and grants that might provide funding options: • The Emergency Planning and Community Right-to-Know Act (EPCRA or SARA Title III) requires the formation of Local or Regional Emergency Planning Committees (LEPCs and REPCs). These committees are responsible for protecting their communities from incidents involving hazardous materials but might considered for climate related extreme events. • Apply for the community-driven approach FEMA's Whole Communities Program to help residents, business owners and institutional leaders from "high risk" communities to complete and implement individualized disaster readiness and response plans. • Municipal Vulnerability Preparedness Grant Program (MVP).

9 ACTION AREA: PATHWAY TO 100% RENEWABLE ENERGY

PRIORITY ACTION: EXTEND THE COMMUNITY CHOICE ELECTRICITY AGGREGATION PROGRAM AND INCREASE SHARE OF RENEWABLE ENERGY.

Electricity consumption contributes to approximately 20% of total emissions in Somerville. Full de-carbonization of electricity by 2050 will be crucial, not just to reduce emissions from baseline electricity consumption in Somerville, but also because moving heating systems and vehicles to electricity—or "electrification"—is a key component of the Somerville's pathway to carbon neutrality. Until the New England power grid is fossil fuel free, Somerville can continue its municipal aggregation program to expand the proportion of renewable energy. See Action 12 for details on the Massachusetts Renewable Energy Portfolio Standard (RPS) and details for how it may change.

In the absence of a 100% renewable requirement at the State level, Somerville is well positioned to pursue locally driven efforts to provide clean electricity to its residents and businesses through the aggregation program that was established in 2017 and approved by the Massachusetts Department of Public Utilities.

Somerville has a community choice electricity (CCE) aggregation program currently in place until January 2020, which offers three options for electricity generated from varying proportions of renewable energy sources. The options are called Somerville Basic (which incorporates no additional renewable energy sources beyond minimum state requirements, but at a lower rate than Eversource), Somerville Local Green (which incorporates an additional 5% of local renewable energy generation sources beyond state requirements), and Somerville 100% Local Green (which incorporates 100% local renewable energy generation sources). All customers are automatically enrolled in the Somerville Local Green program unless they opt for one of the other two options, or choose to opt-out of the program and continue with Eversource-supplied electricity. All of the above options with the exception of Somerville 100% Local Green electricity have been more affordable than Eversource's rates. The major benefit of the CCE program is to increase the amount of renewables for most Somerville residents, while keeping costs competitive with Eversource's default rates due to competitive electricity supply rates.

Somerville Community Choice Electricity is an excellent example of how we can have a much bigger impact on climate change if we act together.

APPROACH

This Action Area defines the interim steps that can be taken to incrementally increase the total amount of clean electricity purchased in Somerville. The City will continue to encourage participation in the CCE program's existing renewable electricity tier options, and explore opportunities to increase the number of tiers available within the next iteration of the program (i.e., a CCE program beyond the current version's 2020 time frame) to reduce barriers to participation. In support of these efforts, the City may consider analyzing why individual customers might choose to opt-in to higher-renewable supply options and make complementary building electrification and energy efficiency decisions, as this will help improve the program after January, 2020 when the terms of the current program expire. Possible research and program design considerations are discussed below and further supported by case studies in the Precedents section.

At the end of the current CCE program in January 2020, Somerville can launch a second round CCE program that further advances renewable electricity generation. Prior to designing the program the following elements should be studied and considered.

Percentage of renewable energy sources incorporated: Currently, the supplier of renewable energy for Somerville's program, Green Energy Consumers Alliance, provides 5% renewable energy sources beyond minimum State requirements at a cost below Eversource's rates. It is possible that by 2020 suppliers could incorporate a greater share of renewable energy in their default electricity supply offering, and the City can explore incorporating different tiers of renewable energy percentages beyond the 5% and 100% options. An expanded suite of participation tiers (e.g., 5%, 25%, 50%, 100%) may support incremental improvements in clean electricity use communitywide by giving participants several options. The benefits of increasing the share of renewables in the default offering should be carefully balanced with the cost in order to not over burden households; one solution could be to maintain a low- or no-cost option (e.g., 5%) along with more expensive options.

Specifics on the type and geography of renewable energy sources eligible for inclusion in the CCE: Somerville currently emphasizes the use of local renewable energy sources in all its green electricity options. The renewable energy in the CCE program options comes from Massachusetts Class 1 Renewable Energy Certificates (RECs), which stimulate demand for more local renewable energy projects and green the grid faster. Massachusetts Class 1 RECs tend to be more expensive than other RECs, but they provide a clear local benefit. The City will work with local third-party suppliers to identify renewable electricity sources that best meet the City's goals.

Bulk purchasing in collaboration with multiple cities versus individual city electricity aggregation programs: Somerville's current program only aggregates customers within its geographic boundaries, and does not include other cities. It is possible that collaboration among cities to establish multi-jurisdiction CCE programs might drive down the cost of green electricity, as it guarantees third-party suppliers with a high demand for green electricity. Somerville can explore this option to see if there are benefits of a larger aggregation.

Contract period: Most CCE programs in Massachusetts offer constant rates for green electricity over a 2 to 3 year period after which they are revisited. The City may be able to drive down the cost of green electricity if it committed to an extended service period when negotiating terms with a third-party supplier.

Research on all of these factors should inform modifications to Somerville's CCE program after 2020. In the meantime, Somerville can continue to share information with its residents and local businesses about the 100% green electricity option

WHAT CAN YOU DO?

Sign up for 100% renewable through the Somerville CCE program at:
www.somervillecce.com

Photo Credit: Mike Powers 2018

PLAN FOR IMPLEMENTATION	
Implementation partners:	• Housing Division • Third-party renewable energy suppliers • Other cities in Massachusetts • Metropolitan Area Planning Council • Energy utilities (Eversource and National Grid)
Implementation steps in the context of Somerville:	Short-term (0-3 years) • Research appropriate pricing tiers based on percentage of renewable energy sources incorporated • Research on what mix of local, in-state, and out-of-state renewable energy sources are acceptable for inclusion in CCE portfolio • Collaborate with other cities to investigate bulk purchasing model • Negotiate with third-party suppliers on future contract periods, tiered pricing, and geographic boundaries of renewable energy sources eligible for consideration in CCE portfolio • Develop and implement community outreach program to encourage participation in 100% green electricity option even if it has cost premium compared to other options • Develop and communicate incentives to make 100% green electricity purchases more favorable
Equity considerations:	• The cost of utilities is a concern for many residents in Somerville. CCE helps to stabilize rates over a period of time, making electricity costs more predictable. The current CCE program is saving Somerville residents and businesses money, and future CCE programs should continue to consider cost as an important factor.

BENEFITS

Qualitative co-benefits:

- Broader economic co-benefits: Renewable energy generation is likely to create up to 37,000 new jobs in New England between 2018 and 2030, as long as there is sustained statewide demand. The green electricity market can also provide a price hedge against rising natural gas prices and volatility.
- Environmental co-benefits: Improved air quality due to increased use of renewable fuels and decreased use of fossil fuels in electricity generation.

Impact of action on GHG mitigation & adaptation:

- Diversification of energy generation sources in Massachusetts as a result of incorporating more renewable energy increases the resilience of the overall energy systems.
- Achievement of 100% renewable electricity use in Somerville will result in the following emissions reductions, which are in addition to reductions that will occur from implementation of the State's current RPS requirements:

  -2030: 121,800 MT CO2e/yr (16% of carbon neutrality target)

  -2050: 144,000 MT CO2e/yr (19% of carbon neutrality target)

MONITORING PROCESS

Performance Metrics

- $MTCO_2e$ of GHG emissions reduced
- Number of accounts enrolled in CCE program by tier
- Percent renewable energy in electricity generation portfolio

PRECEDENTS

Percentage of renewable energy sources incorporated: Most "green" CCE programs offered by cities in Massachusetts are similar to Somerville's, offering green electricity that incorporates 5% more renewable energy sources than State requirements (and is more affordable than conventional electricity), or 100% green electricity (which comes at a premium). Some cities have introduced variations in their program. For example, Brookline's default tier incorporates 25% more renewable energy sources beyond State requirements (cheaper than conventional electricity). Arlington offers an additional tier of 50% more renewable energy sources beyond State requirements in addition to the 5% and 100% tiers. Both the 5% and 50% tiers are cheaper than conventional electricity. Other cities, including Berlin and Adams only offer a 100% green electricity option.

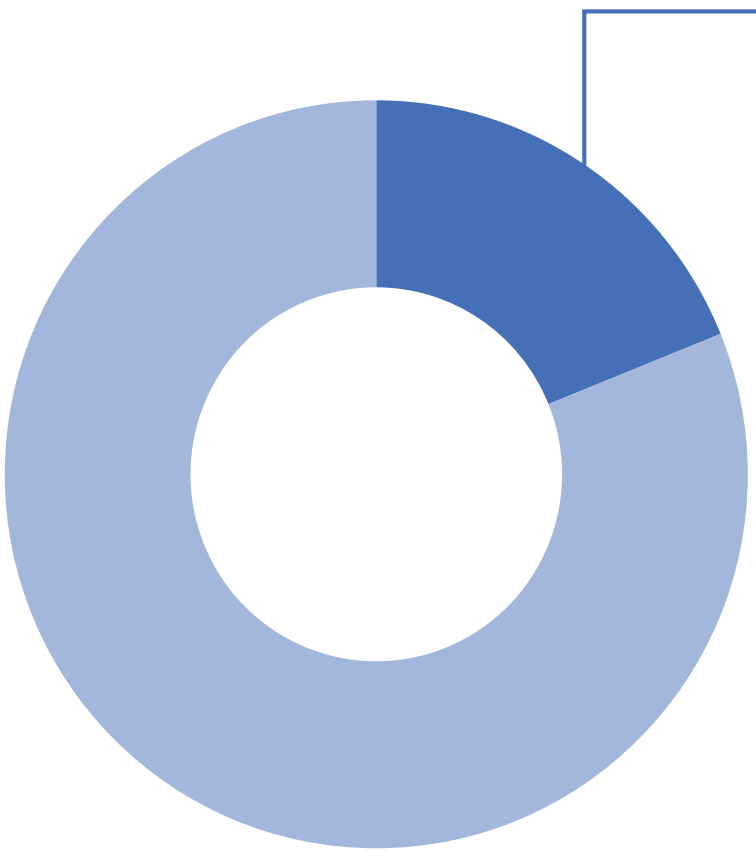
Specifics on the type and geography of renewable energy sources eligible for inclusion in the CCE: Cities vary in their preferences for renewable energy generation sources used in their CCE programs. For example, Cambridge's 25% tier only allows the use of solar energy generated in or around Cambridge. The 100% tier only allows the use of renewable energy sources within New England. Arlington uses local energy generation sources for all its tiers, wherein the term "local" is defined as within the boundaries of the Commonwealth to the extent possible. Berlin, Adams, and many other cities that only offer 100% green electricity typically use renewable energy sources from outside the State, such as wind energy from National Wind. Other cities have used a hybrid option (e.g., in Bellingham's CCE program, the 100% green electricity option includes 20% additional renewable energy sources beyond minimum State requirements from within New England, and the remaining sources from outside New England). Some cities such as Bourne and Brewster have used an incremental approach, in which their 100% green electricity option requires inclusion of in-state renewable energy generation sources in increments of 1% per year (and the rest could be from sources outside the state), thereby creating a demand for new renewable energy sources on an annual basis within the Commonwealth.

Bulk purchasing in collaboration with multiple cities versus individual city CCE programs: While several cities in Massachusetts have implemented individual CCE programs, some cities have created a multi-jurisdiction bulk purchasing model to enable economies of scale. Approximately 23 cities and towns in Massachusetts participate in the Mass Community Electricity Aggregation Program which offers green electricity that incorporates approximately 5% more renewable energy sources above the minimum State requirements. Some cities in this program offer more tiers than others (e.g., Dedham offers tiers of 5% and 100% green electricity).

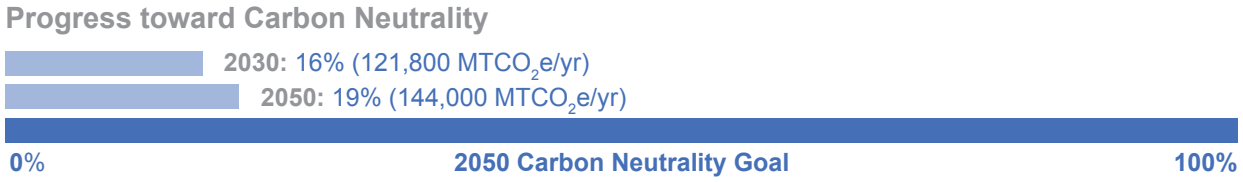
COST

Capital Cost/ Operational Cost

Cost of 100% green electricity: Given the fluctuation in electricity prices, it will be challenging to estimate future rates, as multiple factors impact prices, such as the type of fuel involved, the number of guaranteed customers in the CCE, the period of the CCE contract, and whether the electricity being provided is locally produced, in-state or out of state.



21% Contribution of electricity to 2014 emissions inventory



10 ACTION AREA: CULTURE OF CLIMATE ACTION

PRIORITY ACTION: ORGANIZE COMMUNITY CLIMATE ACTION AND PREPAREDNESS LEADERSHIP PROGRAM TO EDUCATE THE PUBLIC AND INCREASE PARTICIPATION IN CLIMATE PROGRAMS.

For Somerville to succeed in achieving its goal to adapt to and mitigate the risks associated with climate change, widespread community awareness and participation in the actions outlined in Somerville Climate Forward will be required. This action identifies steps that the City and community members can take to share this plan with the broader Somerville community and to increase participation in the actions identified in this plan.

Somerville has had successful community involvement in several recent climate action efforts, including Solarize Somerville, and Somerville Climate Forward reflects this robust community participation, as there has been an engaged climate advocacy community that contributed to the development of the plan. At the same time, there are still many within Somerville that might not be aware of both the risks and opportunities posed by climate change. Immigrants, low-income residents, students and young adults, renters, local business owners, and people of color have not been well represented in Somerville's climate change work to date. In order to make progress towards a resilient and carbon neutral future, climate action will need to become an integral part of the culture of Somerville with the support of all its diverse communities.

With the goal of growing participation and increasing awareness, this action focuses on training community leaders and residents to talk to their own communities and networks about climate change. Moving forward, fulfilling this goal, the Office of Sustainability and Environment can create a SustainaVille Leaders program to train volunteers and community leaders to disseminate information and relay ideas and feedback to the City on community needs and climate programs. The program can build on the National Association of Climate Resilience Planners' framework[62] for community-driven climate action, emphasizing:

- Improved social infrastructure for community participation in decision-making;
- Equitable partnerships between the City government and community-based organizations to build community leadership and facilitate the development and implementation of community driven climate resilience solutions;
- Increased awareness of structural racism and other systemic issues contributing to disproportionate climate vulnerabilities;
- Comprehensive solution sets that address the root causes of climate vulnerability; and
- Increased communication, coordination and collaboration across governmental agencies for effective disaster preparedness and for implementation of policy and systems changes needed to achieve climate resilience.

[62] Rosa Gonzalez, "Community-Driven Climate Resilience Planning: A Framework" (National Association of Climate Resilience Planners, May 2017). Retrieved from: https://kresge.org/sites/default/files/library/community_drive_resilience_planning_from_movement_strategy_center.pdf.

APPROACH

This solution focuses on developing the social infrastructure needed engage residents in the implementation of Somerville Climate Forward. The main components for creating a culture of climate action are:

Start SustainaVille Leaders program – A program of local climate leaders to train volunteers to be leaders in their community on climate action. The structure for trainings can build around Somerville's Climate Forward actions, which should be flexible allowing for residents leadership to address locally-defined issues and strategies. Culturally-tailored materials and workshops on climate change in Somerville will need to be developed to be fully accessible and in appropriate languages. These should be created in partnership with community residents, including youth who are well positioned to educate their peers, families, and neighbors. Initial workshops can be collaboratively designed and piloted by the City and the local climate leaders. The City should expect to share information during trainings while at the same time learning from residents and local leaders. The Boston Climate Ready Program provides a model for establishing a Climate Leaders Program (see Precedents section).

Engaging community groups/networks – The Somerville Office of Sustainability can draw upon strong networks of existing environmental, community, business, and social services to launch the SustainaVille Leaders program. An initial step could entail a scan of existing organizations with relevant missions and/or who represent or serve residents. Initial meetings and interviews with community leaders and residents will help to learn priorities, experiences pertaining to climate (such as history of heat and flooding), local assets, needs, and best ways to further enhance ongoing engagement. Maximizing "in-reach" within their existing social networks rather than "outreach" by an outside organization is an approach that is effective and offers resident ownership. This "in-reach" approach would start by working in true partnership with resident leadership, going to established gathering places to hold discussions (rather than their being expected to come to City meetings), and building outreach and effective and equitable action strategies that intertwine with community goals and existing activities. Community meetings can be organized around members of the Somerville Climate Forward working groups and gradually extend to a broader range of community-based organizations (see partners in implementation below). These proposed community engagement steps are endorsed by the American Public Health Association measures to ensure that climate action optimizes health and equity co-benefits. They are fully outlined in the 2018 "Climate Change, Health, and Equity: A Guide for Local Health Departments" developed by the Public Health Institute Center for Climate Change.[63]

Organizing events on themes/action – Events on climate action themes can be piloted and supported by the City with SustainaVille Leaders and partner organizations growing and expanding efforts with interest and increased community involvement over time. Resources the City can offer can include guidance, sample workshops, training materials, and support for outreach. Broader actions can be fostered as the City mobilizes funders from public and private sources, which can create new opportunities to support local programs and events. Each year the City and its partners can coalesce around a particular theme that strengthens the Somerville Climate Forward Plan. Examples of themes include building awareness of various climate impacts and mitigation measures residents and/or businesses can advance; health and climate focused events that build resilience and preparedness particularly in neighborhoods that may be most impacted by heat and floods; and events focusing on economic advancement that support local residents to develop green businesses and careers. Success of events and actions should be tied back to metrics and/or indicators of progress that resident leaders help the City to define.

[63] Climate Change, Health, and Equity: A Guide For Local Health Departments. (2018). Retrieved from: https://www.apha.org/-/media/files/pdf/topics/climate/climate_health_equity.ashx?la=en&hash=14D2F64530F1505EAE7AB16A9F9827250EAD6C79

PLAN FOR IMPLEMENTATION	
Implementation lead	Office of Sustainability & Environment
Implementation partners:	• Immigrant population groups (e.g. Welcome Project, faith-based organizations, English for Speakers of Other Languages programs, Cambridge Health Alliance Community Health Volunteers) • Youth leadership programs (e.g. schools, afterschool and sports programs, youth media, Teen Empowerment, Groundwork Somerville) • Seniors (e.g. Council on Aging, Somerville Elder Services, senior housing, homecare) • Food & housing assistance programs (e.g.food pantries, public housing tenant associations) • Small business owners • Neighborhood and Advocacy Groups (e.g. Winter Hill Neighborhood Association, Climate Coalition of Somerville) • Playgroups, parent groups etc. • Health and Human Services • SomerViva • Somerville Media Center • Schools, Somerville Family Learning Collaborative • Somerville Housing Authority
Implementation steps in the context of Somerville and Schedule:	Short Term (0-3 years): Engage community groups/networks • Identify appropriate local organizations and networks • Assess the range of priorities, perspectives, and resources • Strengthen linkages between local organization issues/activities and climate change. • Gather feedback to strengthen collaborative climate change planning and monitoring Start SustainaVille Leaders program • Design pilot training modules and materials • Pilot initial trainings with local organization partner(s) • Evaluate and refine trainings Organizing events on themes/action • Identify initial theme(s) • Organize City events/action(s) • Mobilize funding support. • Offer models, guidance, materials, and resources for local organizations to participate and hold their own community-directed events. • Monitor outcomes using indicators of success and associated metrics identified and gathered with community partners. Medium term (4-6 years) • Assess progress, build on and spread successful elements of initial campaign • Develop new campaign themes and associated activities to pilot, test, and spread

PLAN FOR IMPLEMENTATION

Equity considerations:	Those who are most at risk of climate impacts are populations that already face health and economic disparities. They may have several barriers to public participation and to taking action on preparedness and environmental protection. Such population groups have limited time, resources, may speak languages other than English, and are not tied to City processes. Holding meetings at culturally-familiar sites and during events where residents already congregate can support engagement. Priorities identified by such residents should be integrated in community-driven strategies. There are several Climate Justice Frameworks that have been advanced which can provide guidance. The 2017 Guide to Equitable, Community-Driven Climate Preparedness Planning by the Urban Sustainability Directors Network offers one such roadmap.

The Somerville community is already engaged in addressing climate change. Somerville Climate Forward will build on the successes of Sustainaville.

PRECEDENTS

Climate-Ready Boston Leaders Program is designed to "expand education and engagement of Bostonians about climate hazards." The City is doing so by educating residents about the risks to their properties and businesses, and training volunteer to become Climate Ready Leaders supported through Local Climate Resilience Committees in neighborhoods across Boston. Once trained, the "Leaders" host meetings where they share the findings from Climate Ready Boston with friends, colleagues, faith groups, and other communities they belong to. Boston has also moved forward to incorporate efforts that are more driven by local climate justice advocacy perspectives. Having interviewed scores of local organizations, their plan for "Resilient Boston: An Equitable and Connected City"[64] recognizes the value of community-driven approaches and includes measures such as local grants to community-based organizations and strengthening ties between area funders and CBOs to build greater capacity.

In Cambridge, the Mayor's Summer Jobs program hires teens, some of whom have been engaging in climate awareness work. This includes making videos tailored to Cambridge on what is climate change, how residents can help reduce climate impacts, climate change and health, and profiles of residents by discussing climate justice in their neighborhood.

Somerville also has many of its own precedents to build from, including the Somerville Growing Center that brings residents together to engage in environmental education, community gardening, environmental career development, and fostering of relationships among neighbors.

Another example comes from the Somerville Media Center, which has worked with Centro Presente teen programs to engage youth in creating public service announcement videos on various topics. These have been shown to families and the public venues, such as the Somerville Theater in Davis Square. The Somerville Teen Shoveling program is another example of a program that could be enhanced to address climate resiliency education. This program pairs teens and seniors so that the senior may contact their assigned youth to provide shoveling services for a pre-determined fee. Nonprofits extend cross-sector collaborations even further across the City. Groundwork Somerville, for example, builds youth and resident environmental stewardship while supporting green jobs and enhancing a more sustainable environment, food security, and social well-being.

BENEFITS

Qualitative co-benefits: These can range from savings from averted harm to people and properties to indirect benefits from improved conditions. Residents are using the opportunity for positive change in their communities. If actions to prepare for and mitigate climate change are taken, they can result in:

- Healthier communities from increased accesses to active transportation options, improved indoor and outdoor environmental quality, and enhanced household preparedness for extreme weather events.
- Improving housing so that homes and apartments are comfortable even in periods of extreme hot and cold temperatures and protected from flooding impacts, with attention given to availability and affordability – including savings from energy conservation.
- Advanced economic stability through green job promotion and prevention of job disruption and job loss.
- Making neighborhoods more safe as community initiatives strengthen relationships, reduce crime, and prevent the displacement and risk of violence that have accompanied extreme weather events in communities such as New Orleans following hurricane Katrina.

Impact of action on GHG mitigation & adaptation: A culture of climate change is imperative to attaining mitigation and adaption goals. Effective engagement and participation from the primary contributors to GHG emissions identified in Somerville Climate Forward plan, including:

- Residential buildings, where homeowners, landlords, and tenants can act to conserve and switch to greener fuels and appliances.
- On road vehicles, where residents can shift to public or active transit &/or greater fuel efficiency/cleaner fuel vehicles.
- Commercial buildings, for which related strategies can gain employer support for greater efficiencies.

MONITORING PROCESS

Performance Metrics

Process indicators will help monitor successful implementation of coalitions, including:

- Number of individuals and organizations contributing to an assessment of priorities, needs, and assets.
- Number of people participating in the SustainaVille Leaders program and hosting trainings and events.
- Number of SustainaVille Leader training sessions held .
- Resident engagement in Sustainaville events and activities*

*Target rates for participation should be representative of community demographics or greater for vulnerable populations including: at least 15% from households below the poverty line, at least 25% non-white, at least 10% conducted in Spanish or other language, and include youth, isolated seniors, and outdoor workers. Note: Percentages are based on 2015 American Community Service 5-year estimates for Somerville.

It is important that residents help generate the final performance metrics to be used.

COST

Capital cost/ operational cost:

Costs associated with this broad range of strategies may vary widely depending upon how the implementation fully develops. One of the main costs of implementing a successful engagement program is staff time. Additional costs include:

- Mini-grant Funding to CBOs and SustainaVille Leaders (direct funding will likely require outside grant funding).
- Development and printing of communication materials, such as outreach and informational flyers and videos in multiple languages.
- Event costs for planning, promotion, convening, childcare, and food and supplies.
- Research costs to assess resident priorities, needs, and assets.

RELATED ACTIONS

- Provide support to teachers wanting to establish a school education program about local climate impacts, goals, and actions.
- Create sustainable business recognition program.

For opposite page:
[64] Resilient Boston - An Equitable and Connected City. (2017). Retrieved from: https://www.boston.gov/sites/default/files/document-file-07-2017/resilient_boston.pdf

11 ACTION AREA: CITY GOVERNMENT LEADING BY EXAMPLE

PRIORITY ACTION: SET PROGRESSIVE NET-ZERO BUILDING STANDARDS FOR NEW MUNICIPAL BUILDINGS AND THOSE UNDERGOING MAJOR RENOVATION; SET RENEWABLE ELECTRICITY GOALS FOR ALL EXISTING AND NEW MUNICIPAL BUILDINGS.

The building energy sector contributes to approximately two-thirds of Somerville's communitywide emissions. While emissions from municipal operations form a small portion (approximately 2%) of overall communitywide emissions, the municipal buildings sub-sector accounts for most of overall municipal emissions (approximately 75%). By focusing both on transitioning to 100% renewable electricity and creating requirements for new City buildings to be net-zero, Somerville can reduce emissions for existing municipal buildings, while also making sure that new municipal buildings are designed and constructed to meet the City's carbon neutrality goal for 2050. See Action Area 1 for further description of net-zero building performance standards.

Setting a net-zero building performance standard and a renewable electricity goal for municipal buildings is important for the City because:

- These solutions will demonstrate City leadership on climate change.
- The City expects a significant overhaul in municipally-owned buildings in the next few years, and this is the optimal time to drive new, green development in City operations.
- These solutions will reduce operational energy costs of new and renovated buildings and facilities.
- These solutions can serve as a useful precursor to communitywide building performance standards as well as expansion of community choice aggregation being considered by the City (see Action Areas 1 and 9, respectively). In particular, it is important for the City to develop an evidence base to demonstrate the viability of net-zero buildings in Somerville, as the City seeks to pursue similar standards at the community scale without triggering State building energy code violations. Furthermore, as the City is actively encouraging community members to opt into 100% green electricity purchases under its current community choice aggregation program, the City should lead by example and do the same.

APPROACH

To achieve net-zero emissions from City operations by 2050, Somerville will have to take a two pronged approach. First, Somerville can set performance standards for new City buildings to be net-zero emissions, net-zero energy, or "net-zero ready". Second, Somerville can ramp up the purchase of renewable electricity for City use until all local government electricity use is supplied by 100% renewable sources.

When taken together, these actions would result in the electrification of City buildings (i.e., replacement of natural gas and fuel oil with electric equipment/appliances) that are powered by emissions-free electricity to achieve carbon neutrality.

As with the approach to communitywide net-zero building standards, the City can take a flexible approach to defining its new building performance standards, including the following options:

- Net-zero energy: New buildings may have sufficient space and appropriate environmental conditions to provide all building energy demand on-site
- Net-zero emissions: New buildings might lack adequate solar access, for example, and could be designed to minimize total energy use, with separate funding to develop an off-site community solar project to offset the building's remaining energy demand or develop and/or tie-into a district energy system serving multiple buildings
- Net-zero ready: New buildings could be designed as net-zero ready, such that all new building systems and equipment are electric and will result in carbon neutrality when paired with emissions-free electricity

In addition to these potential compliance options, the City may also want to consider the following:

- If the performance standards should include restrictions on fossil fuel use in all new construction (except where specifically exempted based on unique building or facility requirements)
- If the net-zero requirements are best applied at the individual building scale or aggregated across the full City building portfolio
- If on-site renewable energy generation is preferred at the building scale or if district scale solutions or off-site generation options to achieve net-zero emissions are acceptable
- If energy storage will play a significant role in maintaining operational continuity during times of power outage while still maintaining achievement of the net-zero buildings objective

Somerville can reduce emissions in municipal buildings by implementing net-zero building standards and transitioning to 100% renewable electricity.

In net-zero energy buildings, renewable energy is generated on-site to provide for the building's total annual energy demand, including through rooftop solar arrays.

Photo Credit: Mike Powers 2018

Next, the City can conduct a study to better understand its existing building typologies and how retrofits of these buildings can be designed to achieve the net-zero building standard. The study should include building-specific information on baseline energy consumption by fuel type and end use, and consider which existing buildings might have opportunities for on-site renewable energy systems and which are constrained and would need to include renewable energy offset options. The study could also include an outline of the net-zero building standard compliance pathway for each building, including proposed energy efficiency solutions and renewable energy systems or offset options. An emphasis should be placed on reducing heating energy demand and transitioning heating systems to renewable energy, such as waste heat, electricity, and bio-energy resources recovered from local waste (e.g., bio-methane from anaerobic digestion of solid waste or wastewater sludge), where feasible. When complete, this study could serve as a guide for how to transition the entire City building portfolio to carbon neutrality.

As a third step, the City can select a pilot project to test the new building standard, revise it based on project results, and share project outcomes with the community to demonstrate the viability, challenges, and solutions to net-zero buildings in Somerville.

It is also important to recognize that some buildings and facilities might need to be exempt from net-zero building standards altogether (or required to follow the net-zero emissions option). Examples of such buildings include:

- Projects where the useful life of an improvement does not justify the additional expense incurred
- Projects where the use of net-zero will create an impediment to construction due to conflicts with other laws, building code requirements, funding opportunities
- Specialty process equipment that serve critical functions (e.g., fire pumps, traffic control boxes)

As this new performance standard would apply to any building that undergoes significant modification, the definition of significant modification should be made clear at the onset as well. For example, a common threshold used to determine significant modification is 25% or more of the building's square footage will be impacted.

RENEWABLE ELECTRICITY

To achieve carbon neutrality in the municipal building sector, it is the City's goal to procure 100% renewable electricity for municipal operations. As described in Action Area 9, the City currently has the option to participate in a community choice electricity aggregation program (CCE) through 2020 to procure clean electricity for municipal use. However, the City is currently able to secure more favorable rates outside of the CCE program through its own electricity procurement. Similar to the CCE program, the City can purchase renewable energy certificates to offset its energy use with renewables.

The City will first evaluate the cost implications of procuring 100% clean electricity. If this option is found to be cost prohibitive, the City will establish interim clean electricity procurement targets through 2050. The City will also consider renewable energy development opportunities on a case-by-case basis as new municipal building projects (or major renovations) are evaluated. This would support incremental progress toward a 100% clean electricity goal, while the State's RPS requirements offerings catch up to the City's aspirations.

In pursuit of this clean electricity goal, the City can also leverage lessons learned from existing programs, as well as review rates from third-party suppliers and renewable energy developers. The rates will depend on the extent to which renewable energy sources are incorporated (e.g., 5% or 100%), the types of sources (e.g., solar, wind), and their geography (local, in-state, or out-of-state). Purchasing clean electricity from these suppliers will reduce the GHG footprint of both new and existing City buildings and precludes the need for on-site electricity generation.

PLAN FOR IMPLEMENTATION		
Implementation lead:	Capital Projects and Planning	
Implementation partners:	• Office of Sustainability & Environment (OSE) • Purchasing Department • SomerStat • Department of Public Works • School Department	• Libraries • Parks and Recreation • Emergency Management Division (Fire Department) • Eversource and National Grid • Third-party energy suppliers
Implementation schedule:	Short Term (0-3 years): <u>Implementation steps for net-zero municipal building standards</u> • Establish net-zero building performance standard for new municipal buildings and significant renovations that includes compliance options for net-zero energy, net-zero emissions, and net-zero ready buildings • Analyze existing municipal building typologies in Somerville to understand their potential for net-zero building achievement – - Typologies include: schools (65% of municipal building emissions), general administration (including City Hall, public works, community centers; 14%), recreation and emergency services (10%), and libraries (2%) – Analysis to consider: baseline energy consumption by fuel type (e.g., electricity, natural gas) and end use (e.g., heating, cooling, hot water) at building scale • Determine potential net-zero compliance pathway of building typologies (including on-site renewable energy potential or access to district energy) • Determine buildings and facilities that might need to be exempt from net-zero standards • Determine definition of “major renovation” • Identify pilot project on which to test and refine new standards; share project results publicly to increase local knowledge of net-zero building potential in Somerville <u>Implementation steps for renewable electricity goals</u> • Evaluate cost impact of switching to 100% clean electricity • If participation in preceding option is infeasible at this time, establish interim clean electricity targets between now and 2050 carbon neutrality target date • Evaluate on-site renewable energy development options during planning phase of new City buildings or significant renovations • Aggregate municipal accounts to purchase green electricity commensurate with renewable energy goal within established timeframes • Make strategic purchasing decisions and release competitive solicitations for renewable electricity similar to process for third-party electricity supply.	
	(continued next page)	

PLAN FOR IMPLEMENTATION	
Equity considerations:	The City will benefit directly from these solutions by realizing operational cost and energy savings over time. In instances where the City buildings and facilities are directly serving broader community functions (e.g. cooling centers), disadvantaged communities will also benefit from reduced costs and a better quality of life.

PRECEDENTS

Cambridge, MA: The City is developing a zero net energy policy for new municipal buildings. Currently, new municipal buildings are designed to meet the City's short-term communitywide "zero net ready" target, such as the Martin Luther King (MLK) School. With an estimated energy use intensity of 33.4 kBtu/sf/year, 69% below baseline, and over 1,600 solar PV panels, MLK school produces almost half of the energy it consumes, with the potential for the remaining electrical load to be provided by renewable electricity.

Amherst. MA: The City established a zero-energy municipal buildings bylaw for all new municipal buildings and new building additions

Chicago, IL: The City committed to power all municipal facilities with 100% renewable electricity by 2025. The commitment will be met through a combination of acquiring renewable energy credits, utility-supplied renewable energy via Illinois' Renewable Portfolio Standard, and on-site generation. Initial purchases will begin in 2018 and 2019.

Portland, OR: Portland adopted a goal of generating or purchasing 100% of all electricity for City operations from renewable resources by 2030. As per the directive of the City's climate action plan, 15% of the City's electricity use is required to come from on-site generation of renewable energy, like solar and biogas. The remainder of the City's renewable electricity goal can be met by purchasing renewable energy credits. As of December 2016, Portland met this target through a combination of on-site generation and purchases.

Salt Lake City, UT: In 2016, the City adopted a goal to transition to 50% renewable electricity by 2020 and 100% by 2032 for municipal operations. The City intends to meet this target through a mix of on-site renewable energy generation and purchases of RECs from a solar farm in Utah.

BENEFITS

Qualitative co-benefits:

- Broader economic co-benefits: Requirements for net-zero buildings and renewable electricity goals present significant opportunities for job creation in the building scale energy efficiency and renewable energy fields.[65]
- Environmental co-benefits: Energy and water conservation, improved air quality due to potential elimination of on-site fossil fuel use.

Impact of action on GHG mitigation & adaptation:

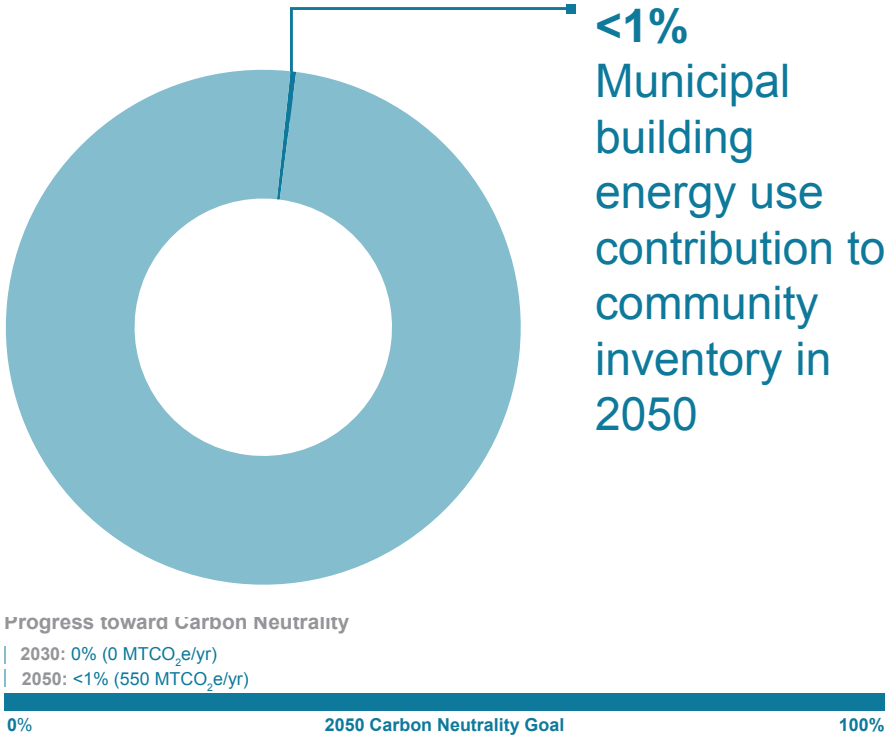
- When paired with energy storage solutions, net-zero buildings can contribute to increased resilience in the face of extreme weather events. However, electrification of energy end uses combined with the de-carbonization of electricity can increase dependence on the electric grid and increase susceptibility to power outages during extreme weather events.
- By 2050, the City's buildings and facilities are estimated to emit approximately 12,250 $MTCO_2e$/yr from both electricity and non-electricity fuel consumption. A combination of net-zero building standards targeting new and existing buildings and a municipal 100% renewable electricity standard would mitigate these emissions entirely.

[65]International Economic Development Council. Creating the Clean Energy Economy – Analysis of the Net Zero Energy Home Industry. (2013). Retrieved from: https://www.iedconline.org/clientuploads/Downloads/edrp/IEDC_Net_Zero_Homes_Industry.pdf

MONITORING PROCESS

Performance Metrics

- kWh of energy saved
- $MTCO_2e$ of GHG emissions reduced
- kWh on-site renewable energy generated
- kWh off-site renewable energy generated (if applicable)
- Type and magnitude of offsets applied (if applicable)
- Number of net-zero City buildings constructed or renovated



COST

Avoided Cost

- Avoided costs from net-zero buildings: Incremental construction costs can be recouped through operational savings. The payback period for net-zero emissions buildings is estimated at 12-15 years.

Capital Cost/Operational Cost

- Capital cost of net-zero buildings: Buildings and facilities designed and built to net-zero emissions performance standards can incur capital costs around 5-12% higher than conventional buildings.[66]
- Cost of renewable electricity goal: Given the fluctuation in electricity prices, it is challenging to estimate rates for clean electricity, as multiple factors impact prices, such as the type of fuel, contract length, and where the electricity is produced.

Funding Mechanisms

- Revolving energy loan fund seeded by general funds: The City can establish a fund for municipal net-zero building projects to provide loans to a City department equal to the incremental costs to construct a net-zero building. The fund is replenished through payments of utility savings for a set amount of time (e.g., 5 years), after which the utility cost savings accrue to the applicable City department.

[66] Net Zero and Living Building Challenge Financial Study: A Cost Comparison Report for Buildings in the District of Columbia. Retrieved from: https://living-future.org/wp-content/uploads/2016/11/NZEB_LBC_-DC_Financial_Study.pdf

12 ACTION AREA: STATE ADVOCACY FOR CARBON NEUTRALITY

PRIORITY ACTION: ADVOCATE FOR BUILDING AND ENERGY CODES THAT ACHIEVE NET-ZERO ENERGY PERFORMANCE.

In parallel to Action Area 1, Somerville can advocate for changes to the Massachusetts Building Code that will require new buildings to be high-performing, and achieve net-zero performance standards (see Action Areas 1 and 11 for a description of these standards). In Massachusetts, the State has purview over the Building Code, and cities are extremely limited in their ability to pass local ordinances requiring development to exceed the State code minimum standards. The State's Board of Building Regulations and Standards (BBRS) updates the Building Code approximately every three years to be consistent with the most recent version of the International Energy Conservation Code (IECC), as per the directive of the 2008 Green Communities Act. The State does allow municipalities to adopt a more stringent version of its base code, which is referred to as the "stretch code". Somerville currently complies with the State's stretch code, but it falls short of the transformative action that will be required to achieve the city's carbon neutrality target.

The building energy sector in Somerville contributes to approximately two-thirds of communitywide emissions, and new development in the city is anticipated to occur at an annual growth rate of over 1% in both the residential and commercial sectors based on the projected increase in number of residents and local employment, respectively.[67] This anticipated new development will need to follow more stringent building standards if the city is to meet its GHG neutrality target. A concerted effort by the City to advocate for a more stringent State Building Code in collaboration with partners will allow the City to adopt new building performance standards that will result in higher energy efficiency and/or renewable energy standards for new development (to be defined as net-zero energy or net-zero emissions performance standards).

APPROACH

Given the challenges associated with receiving exemptions from the State Building Code, advocacy to the State to make changes to legislation may be the most effective long-term strategy to steer new development toward the kind of building performance standards required to achieve the city's carbon neutrality goal; particularly since the State has historically recognized the importance of this kind of transition, and has completed preliminary research on the feasibility of net-zero energy buildings through a task force. An advocacy approach similar to the one taken by municipalities prior to the passage of the Massachusetts Green Communities Act is recommended by the Conservation Law Foundation. If successful, it will result in uniform statewide updates to the Building Code that can include net-zero energy requirements. Action steps will include:

- Building a strong evidence base for why the requested regulatory changes are necessary and beneficial**:** Somerville will convene a regional Net Zero Energy Task Force consisting of various stakeholders to develop local literature on the feasibility of net-zero energy or emissions buildings in Somerville. The City will also lead by example with a net-zero building policy for new municipal buildings. Net-zero municipal buildings can serve as pilot projects to demonstrate the technical and financial viability of such buildings in the community, and provide further evidence to the task force.

[67] Somerville's population and employment forecasts were collected from the Boston Region Metropolitan Planning Organization's Central Transportation Planning Staff (CTPS) travel model, which was also used to develop the transportation sector on-road emissions forecasts.

- Review and support current lobbying and legislative efforts: Once supporting evidence has been compiled, the City will work with its partners to conduct a baseline review of current efforts to bring about legislative change regarding net-zero building standards. This will include a review of legislation already under consideration, as well as the lobbying and advocacy efforts of other organizations. The City will join petitions to demonstrate its support for specific efforts, as warranted.
- Inspire advocacy action from community members: The City will share information about its advocacy efforts so that residents and local organizations are aware of the issue, and can learn how to get involved themselves. The City will also learn from the City of Cambridge's example in coalition building around this topic, and will continue to engage stakeholders through the Net Zero Energy Task Force to develop support for new building standards from the development community, design professionals, and other local governments.

As the BBRS is required to update its building code to be consistent with the IECC, the City will also consider petitioning directly to the International Code Council (ICC) to call for faster upgrades to the IECC. The City is eligible to enroll as a member to advocate for progressive changes to the code. Alternatively, the City can also partner with organizations such as the Metropolitan Area Planning Council or the U.S. Conference of Mayors to submit comments and attend hearings during the code update process.

Community members can make their voices heard through advocacy and engagement actions to help advance legislation that is supportive of the city's carbon neutrality goal.

PLAN FOR IMPLEMENTATION	
Implementation Lead:	• Office of Sustainability and Environment
Implementation Partners:	• Legislative Affairs Office • City Inspectional Services Department – Building Division • Neighboring cities (e.g., Cambridge, Boston) • Metropolitan Area Planning Council • Development and redevelopment authorities • Associations of developers, design professionals, architects, and engineers • Academic institutions • Energy consultants • Energy utilities • Energy focused community organizations (e.g., Conservation Law Foundation, Environment Massachusetts, USGBC Massachusetts Chapter)
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Convene Net Zero Energy Task Force to study the feasibility of net-zero buildings in Somerville • Adopt net-zero building policy for new municipal buildings or significant modification to existing buildings (see Action Area 11) • Implement pilot net-zero development project, and document project lessons • Identify efforts to date that require net-zero energy/emissions performance in new development through legislative change and advocate for action on efforts aligned with City's goals • Share City's advocacy and engagement efforts publicly to increase awareness of this topic with residents/local organizations; encourage grassroots advocacy of State legislative efforts through knowledge-sharing opportunities, including Net Zero Energy Task Force meetings • Build coalition of local support through stakeholder engagement with developers/builders, design professionals, and other local governments
Equity considerations:	• If the upfront costs of net-zero energy/emissions development are passed on to property owners or tenants, this may disproportionately impact low and middle income populations. In the long-term, all populations, including disadvantaged communities will benefit from reduced utility costs and a higher quality of life associated with net-zero energy/emissions buildings. Additional requirements may impact the cost of affordable housing development in the community – incentives to developers should be considered (e.g., density/intensity bonuses, reduced parking requirements).

RELATED ACTIONS:

INTERNATIONAL CODE COUNCIL – As the BBRS is required to update its building code to be consistent with the IECC, the City will also consider petitioning directly to the International Code Council (ICC) to call for faster upgrades to the IECC. The City is eligible to enroll as a member to advocate for progressive changes to the code.

BENEFITS

Qualitative co-benefits:

- Broader economic co-benefits: Requirements for net-zero energy/ emissions buildings present significant opportunities for job creation in the building-scale energy efficiency and renewable energy fields.[68]
- Environmental co-benefits: Energy and water conservation, improved indoor air quality due to potential elimination of on-site fossil fuel use

Impact of action on GHG mitigation & adaptation:

- Net-zero buildings, when paired with energy storage solutions, can contribute to increased resilience in the face of extreme weather events, such as flooding and heat waves. However, electrification of energy end uses (e.g., electric heaters, ovens) combined with the de-carbonization of electricity can increase dependence on the grid, and therefore increase susceptibility to power outages during extreme weather events.
- If the City's advocacy effort is successful, it will result in avoided energy emissions from new buildings in the community. However, the amount of emissions avoided depends upon how quickly the City's efforts can be realized. Delays in influencing changes to the Building Code will result in construction of new buildings under the existing building code, which will lock in these future building emissions (i.e., guarantee these emissions will occur) unless the buildings undergo net-zero building retrofits in the future. See Action Area 1 for information on the GHG reduction potential of communitywide net-zero building standards.

MONITORING PROCESS

Performance Metrics

- Legislation passed to move toward net-zero buildings
- Number of net-zero buildings constructed by type (e.g., single family residential, multi-family residential, office).

[68] International Economic Development Council. Creating the Clean Energy Economy – Analysis of the Net Zero Energy Home Industry. (2013). Retrieved from: https://www.iedconline.org/clientuploads/Downloads/edrp/IEDC_Net_Zero_Homes_Industry.pdf

[69] Efficiency Vermont. Net Zero Energy Feasibility Study. (2015). Retrieved from: https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-net-zero-energy-feasibility-study-final-report-white-paper.pdf

COST

Avoided Cost

Avoided costs from net-zero energy/ emission buildings will be commensurate with the magnitude of energy savings likely from such buildings. The Efficiency Vermont study[69] summarizes energy savings relative to code-compliant buildings as shown below.

- Savings relative to code-compliant buildings:
- Single family home: 67%
- Duplex: 61%
- Quadplex: 57%
- Open office: 72%
- Closed office: 74%
- Office/manufacturing: 65%

Capital Cost/Operational Cost

Cost of Advocacy: research and outreach materials, staff time

Cost of net-zero construction: The Efficiency Vermont study shows that construction of new residential net-zero energy buildings are a cost effective investment relative to code-compliant buildings from the onset. These buildings cost less to own and operate than code-compliant buildings from the first year into the long term. Net-zero office/manufacturing buildings are a better investment than code-compliant buildings when incentives and rebates are applied. Without incentives or rebates, net-zero energy office/ manufacturing construction can have a cost premium of 6–16%, though operating and maintenance costs for the buildings are lower than for code-compliant construction.

12 ACTION AREA: STATE ADVOCACY FOR CARBON NEUTRALITY

PRIORITY ACTION: ADVOCATE FOR FASTER DE-CARBONIZATION OF ELECTRICITY.

The clear path to carbon neutrality for Somerville is through a region-wide electric grid that is fossil fuel free for all the cities and towns it serves. The Massachusetts State Legislature is best positioned to pass legislation that accelerates renewable energy generation in the region. The sooner clean electricity can be provided, the sooner electric vehicles and electric heating systems can be zero-carbon solutions.

The Massachusetts Renewable Energy Portfolio Standard (RPS) requires retail electricity suppliers to obtain a percentage of the electricity they serve to their customers from qualifying renewable energy facilities. The RPS began with a compliance obligation of 1% in 2003, and increased by 0.5% annually until it reached 4% in 2009. In 2009, as a part of the Green Communities Act of 2008, the annual obligation was set to increase by 1% annually. In 2018, the state legislature passed a bill to update the RPS which will increase 2% annually beginning in 2020 and then return to a 1% annual increase after 2029. Under the RPS, the electricity generation portfolio of utilities will accommodate approximately 54% renewable energy sources by 2050.

The building energy sector in Somerville currently contributes to approximately two-thirds of communitywide emissions and electricity use is responsible for approximately 30% of total emissions in the building energy sector. Full de-carbonization of electricity by 2050 will be crucial, not just to reduce emissions from baseline electricity consumption in Somerville, but also because electrification of the city's thermal heating load (Action Areas 1, 2, 9, and 12) and transportation vehicles (Action Area 4) are key components of the carbon neutrality pathway. A concerted effort by the City and partners to advocate for strengthening the RPS in collaboration will allow the City access to carbon free electricity by 2050 in line with its GHG neutrality target.

APPROACH

As with the other State advocacy Priority Actions, successful advocacy efforts require building a strong evidence base for why the requested regulatory changes are necessary and beneficial to communities throughout the State. Somerville has prepared a communitywide GHG inventory and forecasts along with a carbon neutrality analysis, and from that work understands that space and water heating systems will need to be electrified and powered by 100% renewable electricity by 2050. This means that the demand for electricity in the community under a GHG neutrality scenario will increase significantly compared to business-as-usual conditions (i.e., a scenario in which no further actions are taken to reduce the community's GHG emissions). Somerville has identified the RPS as the most expedient legislation priority for carbon-free electricity currently available because it is a proven, well-known program and because it stimulates local economic activity through the development of renewable energy. Other state policies, such as a potential carbon tax or the Clean Energy Standard (which mandates utilities to supply an increasing amount of clean energy on top of what is required by the RPS) would complement a more aggressive RPS.

In the past, several bills have been filed with the State legislature to adjust the RPS requirements to varying degrees, examples of which are summarized in the Precedents section. Organizations including the Northeast Clean Energy Council (NECEC), Synapse Energy Economics, Sustainable Energy Advantage (SEA), Green Energy Consumers Alliance, E4TheFuture, and others have demonstrated the need for enhanced RPS requirements. As part of its advocacy efforts, the City can ally with these types of organizations to push for enhanced RPS renewable energy requirements. The City will also consider being a signatory to petitions demonstrating support for future bills introduced in the legislature that are related to the RPS and align with the City's carbon neutrality goal, and join other cities with similar GHG goals to advocate the State for change through partnership with organizations such as the Metro Mayors Coalition.

Achieving 100% clean electricity communitywide is an essential component of the City's 2050 carbon neutrality strategy.

PRECEDENTS

The following bills related to RPS improvements were introduced to the State legislature in 2017/2018 as a result of past lobbying efforts by the organizations mentioned in this Action Area. This list provides examples of the type and extent of RPS modifications that have been considered in the past. Moving forward, OSE and Legislative Affairs will monitor the introduction of new bills to amend the RPS requirements, and evaluate their potential merit within the framework of Somerville's carbon neutrality goal. In general, the City would consider supporting bills that would require greater renewable energy requirements over a shorter time frame because this type of action supports the City's broad de-carbonization efforts in multiple areas (e.g., building energy fuel switch from natural gas to electricity, transportation vehicle electrification). With this overarching objective in mind, the City can consider which, if any, future bills merit support through becoming a signatory to petitions from lobbying or advocacy groups.

BILL NUMBER	BILL NAME	PROPOSED INCREASE TO SHARE OF RENEWABLE ENERGY SOURCES IN ELECTRICITY GENERATION
H.3634	An Act accelerating the renewable energy portfolio standard	2% every year until 2027 3% every year until 2037 5% every year thereafter
H.1747	An Act to increase renewable energy	40% by 2030
H.2700	An Act to increase the renewable portfolio standard and ensure compliance with the Global Warming Solutions Act	2% every year after 2017
S. 1841	An Act expediting the transition to a renewable energy portfolio	2% every year after 2017
S.1849	An Act Transitioning Massachusetts to 100 Percent Renewable Energy	50% by 2030 80% by 2040 100% by 2050
S.1846	An Act relative to solar power and the green economy	2% every year until 2018 3% every year thereafter
S.1876	An Act relative to Enhancing RPS standards	2% every year after 2017

PLAN FOR IMPLEMENTATION	
Implementation Partners:	• Legislative Affairs Office • Metro Mayors Coalition • Northeast Clean Energy Council (NECEC) • Advancing Commonwealth Energy Storage (ACES) Program • Sustainable Energy Advantage (SEA) • Massachusetts Energy Consumers Alliance • E4TheFuture • Energy utilities • Other local cities
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Summarize the need for improvements to the RPS to help achieve Somerville's GHG reduction target, leveraging the city's GHG inventory and GHG neutrality pathway analysis • Analyze the various bills introduced to State legislature on RPS improvements and determine those best positioned to help achieve the City's carbon neutrality goal; be a signatory to petitions of support for bills aligning with City's priorities . • Join forces with other cities and organizations that are already petitioning for changes to the RPS
Equity Considerations:	A ramp-up of the RPS is not likely to have disproportionate impacts on disadvantaged communities. The abundant projected supply of renewable energy sources will keep the price of electricity stable. In a report prepared for NECEC[70] to analyze potential changes to the State's RPS, the analysis found that increasing RPS requirements from 1% annually to 2% annually would increase residential electricity bills by approximately $0.15 per month through 2030, and increasing requirements to 3% annually would increase residential bills by $2.17 per month. The 2% and 3% RPS scenarios would result in 38% and 51% renewable electricity sales in MA by 2030, respectively; exceeding current RPS requirements that will achieve 25% renewable electricity sales by 2030.[70]

[70] Synapse Energy Economics, Inc. and Sustainable Energy Advantage, LLC. An Analysis of the Massachusetts Renewable Portfolio Standard, Prepared for NECEC in Partnership with Mass Energy, May 2017. Retrieved from: https://www.necec.org/files/necec/PDFS/An%20Analysis%20of%20the%20Massachusetts%20Renewable%20Portfolio%20Standard.pdf


Photo Credit: Mike Powers 2018

RELATED ACTIONS:
Monitor other state legislation that advances carbon-free electricity generation, such as a carbon tax.

BENEFITS

Qualitative co-benefits:

- Broader economic co-benefits: Increasing the RPS can result in up to 37,000 new jobs in New England between 2018 and 2030. Increasing the RPS can provide a price hedge against rising natural gas prices and volatility.
- Environmental co-benefits: Improved air quality due to increased use of renewable fuels and decreased use of fossil fuels in electricity generation.

Impact of action on GHG mitigation & adaptation:

- Diversification of energy generation sources in Massachusetts as a result of incorporating more renewable energy increases the resilience of the overall energy systems. However, electrification of energy end uses in Somerville, combined with the de-carbonization of electricity can increase dependence on the grid and therefore increase susceptibility to power outages during extreme weather events.
- If the City's advocacy effort is successful, this Action Area will result in avoided emissions of approximately 144,000 $MTCO_2e$ per year by 2050. These emissions are associated with electricity consumption, and represent additional emissions reductions from exceeding the State's existing RPS requirements. See Action Area 9 for more information on GHG reductions from 100% clean electricity.

COST

Capital Cost/Operational Cost

- Under a high electrification scenario, for residential ratepayers in Massachusetts, increasing the RPS requirement to 2%per year will likely increase residential bills by an average of $0.15 per month between 2018 and 2030, relative to the baseline.
- Additional analysis will be necessary to understand potential cost implications from a 100% RPS requirement, given the need to provide battery backup energy storage and/or additional renewable generation capacity in that scenario to ensure reliability from intermittent renewable energy sources.

MONITORING PROCESS

Performance Metrics

- $MTCO_2e$ of GHG emissions reduced
- % renewable energy in electricity generation portfolio

12 ACTION AREA: STATE ADVOCACY FOR CARBON NEUTRALITY

PRIORITY ACTION: ADVOCATE FOR MORE STRINGENT REGULATION OF UTILITY GAS LEAKS.

Reducing emissions from natural gas leakage will be crucial to achieving the city's carbon neutrality target. Therefore, it is important for the City to advocate for amendments to State regulations to require utilities to monitor and abate natural gas leakage from transmission and distribution infrastructure.

The leakage of natural gas from transmission and distribution infrastructure in Somerville is a significant source of greenhouse gas (GHG) emissions, accounting for approximately 5.7% of the City's communitywide GHG footprint in 2014, almost twice as much as waste.[71] It is estimated that approximately 2.7%[72] of natural gas consumed by the residential and commercial sectors in Somerville leaks into the atmosphere from transmission and distribution infrastructure. Methane, which is a primary component of natural gas, is 80 times more potent over a 12 year period.[73] Beyond its contribution to climate change, the leakage of natural gas can also result in adverse public health, safety, and environmental impacts (including damage to street trees) at the local scale. In addition, the commodity costs of lost natural gas are directly passed on to commercial and residential rate-payers. Even if the Somerville community were to cut down on natural gas consumption in the buildings sector via large-scale electrification of current natural gas end uses (e.g., space heating, water heating, cooking), this will not to mitigate leakage from existing transmission and distribution infrastructure within and around the city's boundaries. Furthermore, transmission and distribution infrastructure is owned by natural gas utilities serving Somerville (Eversource and National Grid), and the City is limited in its ability to address leaks, as the utilities are primarily regulated by the State and Federal governments. The City Engineering Department already coordinates with Eversource and National Grid during trenching activities to access water and sewer lines, but more can be done by the utilities to pursue proactive leak detection and more proactive replacement.

APPROACH

Somerville will advocate for changes in State regulations that would require utility companies to monitor and reduce natural gas leakages from utility infrastructure. Successful advocacy efforts require building a strong evidence base for why the requested regulatory changes are necessary. Somerville can do its part by establishing a clearer understanding of the magnitude of natural gas leaks occurring from the distribution and transmission infrastructure within the city. As previously noted, the City's GHG inventory currently assumes that approximately 2.7% of natural gas consumed by the community leaks into the atmosphere. This estimate is based on proxy information, and it is recommended that the City keep abreast of best practices in evaluating natural gas leaks at a community level as methods continue to evolve. This will serve to improve accuracy in the city's estimated leakage rates. The City can also evaluate the nature of local environmental, social, and economic impacts of the leakages for a holistic understanding of costs imposed on its community.

Fugitive emissions from natural gas distribution were responsible for approximately 6% of Somerville's 2014 community emissions. It is estimated that nearly 3% of natural gas consumed in the city leaks into the atmosphere.

[71] City of Somerville Greenhouse Gas Emissions Inventory. (2017). Retrieved from: https://www.somervillema.gov/sites/default/files/somerville-greenhouse-gas-inventory-report.pdf

[72] McKain, Kathryn, et al, Methane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts, Proceedings of the National Academy of Sciences of the United States of America, vol. 112, no. 7, pages 1941–1946. Retrieved from: http://www.pnas.org/content/112/7/1941.full

[73] City and County of San Francisco. Methane Math: How Cities can rethink Emissions from Natural Gas. 2017.

A literature review[74] of the existing regulatory framework governing the natural gas industry in Massachusetts shows that utilities currently have no incentive to mitigate leaks in infrastructure as the cost of the lost gas is passed on to rate-payers. While utilities are required to fix certain categories of leaks, this is limited to those that pose an existing or probable hazard to life or property. Furthermore, while utilities have the option to recover costs of capital improvements from rate-payers (and some have launched infrastructure replacement programs), these incentives are not strong enough to drive timely and effective action. The cost recovery programs are often without specific targets, and do not reflect the full benefits of repairs, including GHG mitigation. They are also restrictive in their eligibility requirements. In addition, utilities also do not follow a consistent methodology for monitoring or measuring leaks, nor do they have a performance tracking system in place in cases where they conduct repairs.

It is recommended that the City and its implementation partners develop recommendations for regulatory interventions that will require utilities to:

- Disclose leaks, including number, location, pipeline, component type, and volume via a monitoring and reporting platform
- Establish repair timelines for all leak types, regardless of hazard potential
- Limit cost recovery from rate-payers for leaked gas
- Establish a cap on allowable leaked gas
- Enable more immediate allowances for cost recovery of repairs to leaks
- Expand current targeted infrastructure replacement programs
- Change service quality standards to include leak mitigation as a metric for evaluating service

While natural gas distribution is responsible for almost 6% of community emissions, the infrastructure is primarily located underground, adding to the challenge and cost in mitigating this emissions source. The City will need to partner with utility companies, academic institutions, and community organizations to develop a fuller understanding of local fugitive natural gas emissions and the opportunities to reduce them.

[74] Conservation Law Foundation. Into Thin Air. (2016). Retrieved from: http://www.clf.org/wp-content/uploads/2016/03/CLF-Into-Thin-Air.pdf> and City and County of San Francisco. Methane Math: How Cities can rethink Emissions from Natural Gas. (2017).

PLAN FOR IMPLEMENTATION	
Implementation Partners (see Precedents section for further information on these groups):	• City Legislative Affairs • City Engineering Department • Conservation Law Foundation (CLF) • Community Groups (Mothers Out Front) • University, non-profit, and private sector research partners • Other local governments (e.g., Boston, Cambridge) • Natural gas utilities serving Somerville (i.e., Eversource and National Grid)
Implementation steps in the context of Somerville:	Short Term (0-3 years): • Stay informed about evolving state of modeling and/or measuring natural gas leaks at community level, including best practices from other local governments undertaking climate action initiatives • Based on prevailing methodologies for analysis, identify local impacts of natural gas leaks with support from identified partners • Analyze gaps in current regulatory framework governing natural gas industry, leveraging research conducted by CLF, City of San Francisco, and others • Identify new regulatory interventions that will drive utilities to mitigate leaks • Work with partners to implement State regulatory advocacy campaign, including community outreach to garner support for identified regulatory interventions
Equity Considerations:	• Leaks in infrastructure can cause an increase in ground-level ozone, leading to deterioration of air quality and adverse health impacts. Such impacts can affect disadvantaged populations disproportionately, given underlying socioeconomic factors that are likely to make them more vulnerable. Advocating for more stringent gas leakage monitoring, prevention, and repair standards for utilities, if successful, will mitigate disproportionate impacts to vulnerable populations. • Natural gas utilities currently charge rate-payers for all natural gas transmitted, regardless of whether it leaks or is used. Further, current regulation in Massachusetts allows utilities to recover costs of infrastructure repairs from ratepayers. So, ratepayers currently pay for the leaked natural gas, repairs to prevent leaks, and the negative impacts (e.g., health, environmental) from leaks.[75]

[75] Conservation Law Foundation. Into Thin Air. (2016). Retrieved from: http://www.clf.org/wp-content/uploads/2016/03/CLF-Into-Thin-Air.pdf

PRECEDENTS

- Boston, MA collaborated with the Environmental Defense Fund, Google, and National Grid to conduct a bottom up study of underground natural gas pipeline leaks in Boston using Google Street Map View mapping cars equipped with methane sensing technology. The study was conducted over a 4-month period and detected an average of one leak per mile driven. The study also evaluated natural gas infrastructure and concluded that approximately 45% of the pipes are made of cast iron or other leak-prone material, and more than half of the pipes are over 50 years old, thereby providing insights into where to focus repairs and replacement.
- Maine has established stringent leak classifications and repair regulations that target both hazardous and non-hazardous leaks (whereas similar regulations in other states, including Massachusetts, only target high-consequence leaks). Maine's regulations define three grades of risk ranging from Grade 1 to Grade 3 in decreasing order of consequence. All grades of leakage are required to be repaired by a specific timeline, unless the faulty infrastructure is already scheduled for replacement under an existing capital improvement program. Further, the regulations do not allow utilities to downgrade a leak classification by venting the leaking gas (a practice that reduces risk of explosions by relieving pressure).[76]
- Pennsylvania and Texas have established limits on the amount companies can charge customers for lost gas to no more than 5% of total lost gas.[77] New York established a benchmark and allows utilities to recover revenue if they achieve a lower magnitude of leaked gas than the benchmark, and exerts a penalty that is returned to ratepayers if they exceed the benchmark.[78]

BENEFITS

Qualitative co-benefits:

- Natural gas leaks can cause depletion of oxygen in soil, contributing to the death of urban trees and foliage. Avoided leakages in natural gas transmission and distribution systems can prevent such impacts.[79]
- Leak detection and repair (LDAR) services are a growing industry that can create lucrative, local jobs. A study conducted by the Environmental Defense Fund on the economic benefits of natural gas leak detection and repair shows that more than half of LDAR companies are small businesses, and over a third were founded in the last seven years, showing an emerging industry. The potential for growth in this industry is high, particularly if State and Federal regulations governing natural gas leakage are strengthened.[80]

Impact of action on GHG mitigation & adaptation:

- Although natural gas leaks can occur under any circumstances, their likelihood of occurrence can be particularly high in the aftermath of extreme weather events. If concerted advocacy efforts can result in regulations requiring timely repair and replacement of aging natural gas delivery systems, it will make the energy infrastructure sector in Somerville more resilient to anticipated impacts of climate change.
- If the City's advocacy effort is successful, it will result in conservation of approximately 1 million to 1.3 million therms of natural gas per year (i.e., 2015 leakage estimate through 2050 forecast leakage estimate), which amounts to avoided emissions of approximately 37,200 $MTCO_2e$ to 51,500 $MTCO_2e$ per year (7% of carbon neutrality target).[81]

[76] Conservation Law Foundation. Into Thin Air. (2016). Retrieved from: http://www.clf.org/wp-content/uploads/2016/03/CLF-Into-Thin-Air.pdf

[77] Office of Senator Edward J. Markey. America Pays for Gas Leaks. (2013). Retrieved from: https://www.markey.senate.gov/documents/markey_lost_gas_report.pdf

[78] Conservation Law Foundation. Into Thin Air. (2016). Retrieved from: http://www.clf.org/wp-content/uploads/2016/03/CLF-Into-Thin-Air.pdf

[79] City and County of San Francisco. Methane Math: How Cities can rethink Emissions from Natural Gas. (2017).

[80] Environmental Defense Fund. Find and Fix: Job Creation in the Emerging Methane Leak Detection and Repair Industry. (2017).

[81] City of Somerville Greenhouse Gas Emissions Inventory. (2017). Retrieved from: https://www.somervillema.gov/sites/default/files/somerville-greenhouse-gas-inventory-report.pdf

COST

Avoided Cost

- If the City's advocacy effort is successful, the avoided costs from conserving 1 million to 1.3 million therms of natural gas per year amount to approximately $1.3 - $1.7 Million per year.[82] Note that this estimate only includes the cost of the lost commodity and does not include the avoided cost of emergency response, property damage (including city street trees), fatalities, or injuries from safety incidents.

Capital Cost/Operational Cost

- Replacement of cast iron, unprotected steel, or other distribution lines with polyethylene (PE) plastic pipe or protected steel pipe typically costs between $1 million to $5 million per mile of replaced pipe.[83]

MONITORING PROCESS

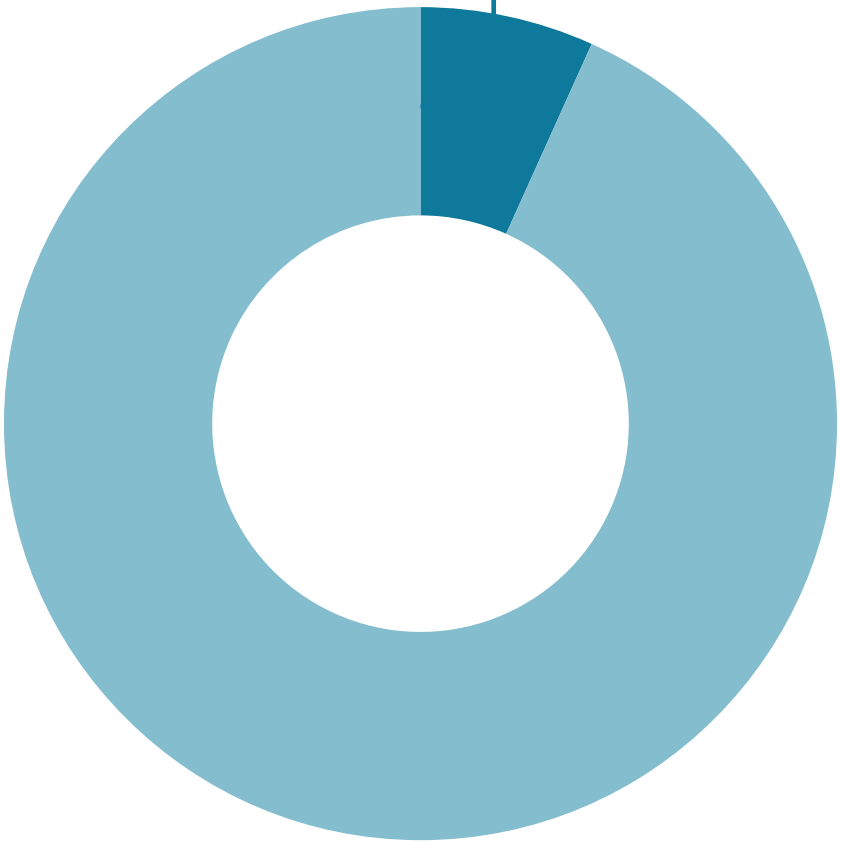
Performance Metrics

If the City's advocacy effort is successful, the following metrics can be used to track utility progress in reducing leakages:

- Funding investment in repairs per year
- Number of leaks detected and repairs made per year
- Therms of natural gas conserved
- Emissions of $MTCO_2e$ avoided
- Avoided costs to rate payers

[82] Energy Information Administration. (2017). Retrieved from: https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_SMA_a.htm

[83] American Gas Association Guidelines for Reducing Natural Gas Emissions from Distribution Systems. (2014). Retrieved from: https://www.energy.gov/sites/prod/files/2015/04/f21/AGA%20Guidelines%20for%20Natural%20Gas%20Emission%20Reduction%20Bd%20Approved%20May%2017%202014.pdf



6%
Fugitive emissions from natural gas distribution in 2014 emissions inventory

Note: The 2050 reduction estimate shown in the figure above represents the high-end of the potential GHG reduction range, which could vary from 37,200 to 51,500 MT CO_2e/yr.

Progress toward Carbon Neutrality

2030: 6% (43,500 $MTCO_2e$/yr)
2050: 7% (51,500 $MTCO_2e$/yr)

0% **2050 Carbon Neutrality Goal** **100%**

13 ACTION AREA: REGIONAL COLLABORATION FOR COASTAL RESILIENCE

PRIORITY ACTION: CREATE A MYSTIC RIVER REGIONAL COALITION OF NEIGHBORING MUNICIPALITIES TO DEVELOP COHESIVE REGIONAL STRATEGY AND TO PUSH STATE ACTION.

PRIORITY ACTION: ASSESS POTENTIAL INTERVENTION OPTIONS TO ADDRESS FLOOD RISK ALONG MYSTIC RIVER.

To address sea level rise and storm surge related flooding, there are two key priority actions:

- A regional coalition of neighboring municipalities and stakeholders in the Mystic River watershed needs to be formed to develop a cohesive regional strategy and to push State action.
- Assess potential intervention options to address flooding risks along the Mystic River.

Climate change is exacerbating existing risks from increasing extreme storms and sea level rise in the Boston metro area.

Somerville is currently protected from storm surge by the Amelia Earhart Dam (AED) that was built in 1966. However, as sea level rise and more extreme storms are projected, it is presumed that the AED may not be able to function as a barrier in the future under extreme storms. The AED is likely to be bypassed (or flanked) by floodwaters via the low-lying areas around it. Flanking can occur as early as 2035[84] and overtopping as early as 2040 under a 500-year flood.[85] With flanking and/or overtopping of the AED, Somerville and neighboring municipalities that are currently protected from storm surge impacts on the Boston Harbor will no longer be protected. This will likely result in significant flood damage to property and infrastructure, as well as impact business continuity in the Boston metro region, including Somerville. Therefore, one of the key priorities is developing conceptual designs of regional resiliency intervention options and assessing to what extent they can either eliminate or reduce the likelihood of flanking and/or overtopping of the AED. The flood reduction benefits of these interventions need to be assessed either separately or in combination. Based on the results of this assessment, Somerville and neighboring municipalities in the Mystic River watershed will have a better idea of the option(s) that could be implemented and the relevant stakeholders in their implementation.

Unlike other climate impacts, such as heat waves that can be mitigated at a local level within Somerville, flooding from sea level rise and storm surge is a region-wide problem that requires multijurisdictional action, beginning with a formal, action-oriented organization of stakeholders. Somerville's two primary coastal flood pathways fall outside of the City's jurisdiction, making collaboration a necessity. Since the governance structure among municipalities in Massachusetts is not county or region-based, regional coalitions need to be formed proactively by municipalities. Such coalitions at a watershed scale can be effective in developing potential solutions to regional issues that may be difficult or may be ineffective if one single municipality were to address it. A coalition focused on flood resilience along the Mystic River can be used to both assess potential interventions and to advocate for specific interventions.

Somerville has strong regional allies to advocate for identifying, integrating, and implementing incremental resiliency improvements in existing and proposed projects around the Mystic River Watershed for enhanced preparedness to projected flooding.

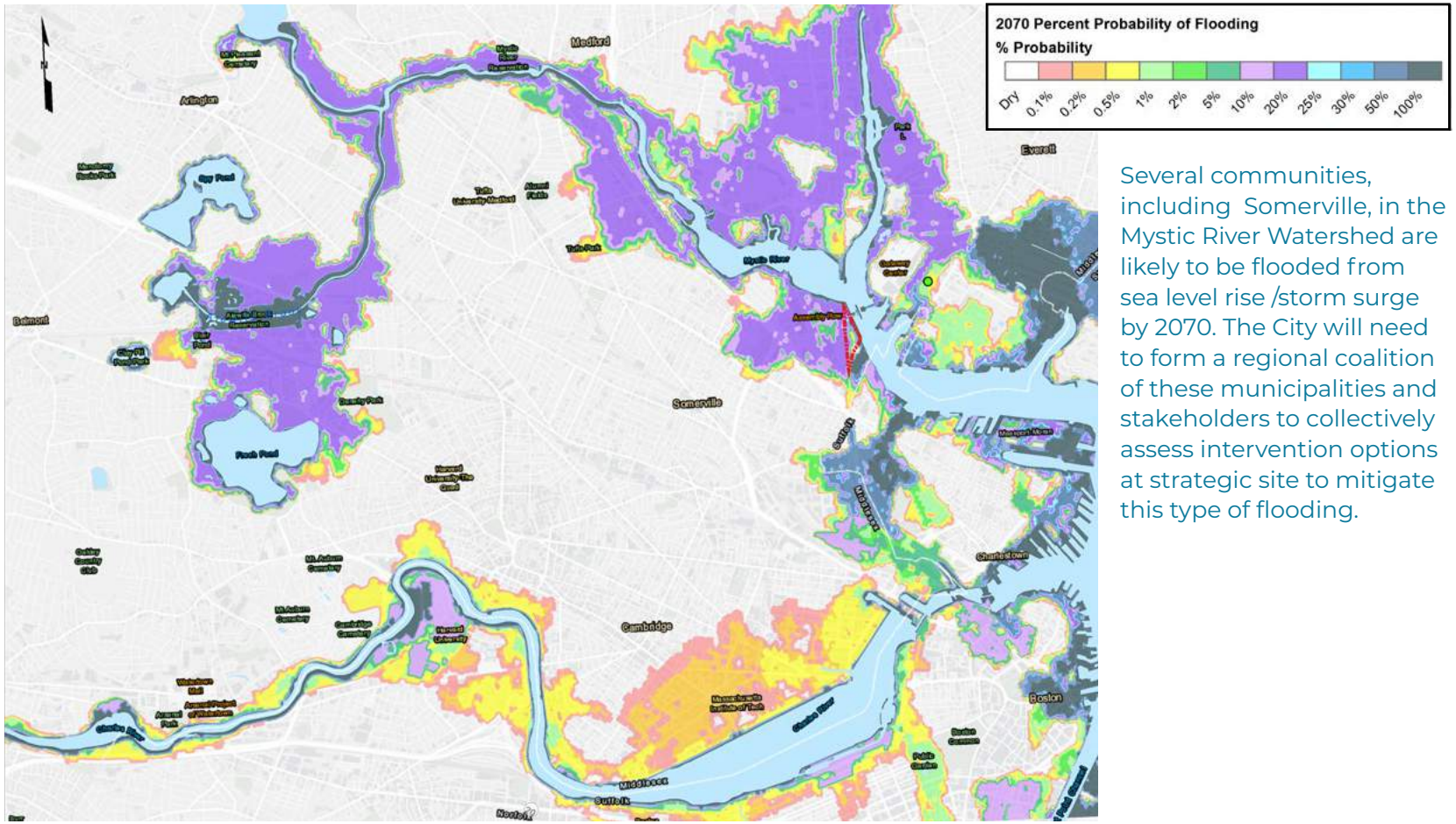
[84] City of Somerville Climate Change Vulnerability Assessment. (2017). Retrieved from: https://www.somervillema.gov/sites/default/files/6-13-2017_Somerville%20CCVA%20Final%20Report.pdf, page 4

[85] City of Cambridge Community Development Department. (2018). Retrieved from: http://www.cambridgema.gov/CDD/Projects/Climate/~/media/F93208C3B12D4AACBD3E-0F3A712F68C7.ashx

APPROACH

Given that Somerville alone cannot manage its coastal flood risk, the main goal is to establish regional coordination in addressing the flooding risk of the Mystic River and its tributaries. Through a watershed level collaboration, Somerville can advocate for adopting a regional resiliency approach to:

- Develop stakeholder engagement to assess solutions affecting neighboring communities
- Identify project sites/parcels abutting AED where interventions, such as berms can be built
- Coordinate with MBTA/MassDOT to use the existing built transportation infrastructure as additional flood barriers
- Prioritize intervention options within the watershed



Several communities, including Somerville, in the Mystic River Watershed are likely to be flooded from sea level rise /storm surge by 2070. The City will need to form a regional coalition of these municipalities and stakeholders to collectively assess intervention options at strategic site to mitigate this type of flooding.

Based on preliminary understanding, strategic interventions for sea level rise and storm surge (SLR/SS) resiliency that need to be advocated by Somerville with the regional coalition can be broadly classified into the following three categories:

- Shoreline solutions that maintain access to open spaces and the River: This can include extending the sea wall along the Charlestown Bus Depot and continuing as a berm that wraps around the Department of Conservation and Recreation (DCR)Draw 7 Park abutting the AED. As an important first step, the Draw 7 Park is currently being designed with resiliency considerations. Recreational areas can be designed to partially flood while preventing water from entering nearby buildings and neighborhoods. This type of solution is expected to have a low cost-benefit ratio, since the cost to design and implement this solution is low and the expected benefits both in terms of flood protection and recreation are high.
- Interventions on private and public property: These can include interventions at strategic low-lying areas around the flanking flood pathways on both the north and south sides of AED, such that flooding risks are eliminated or significantly reduced in surrounding areas and in the upstream communities. Examples of this type of intervention are vegetated berms, elevated walkways or roadways serving as flood barrier, and temporary flood barriers.
- Dam studies and improvements to increase structural resilience or evaluate redundancy options for another dam: These include interventions, such as raising the crest of the AED, assessing structural resilience of the dam, adding pumping capacity, and other upgrades to match the redundancy and preparedness currently in place at the Charles River Dam.

Once these solutions are evaluated individually or in combination, Somerville along with other members of the coalition will understand priorities for implementation within Somerville and by other parties.

PLAN FOR IMPLEMENTATION	
Implementation lead:	City of Somerville, Office of Sustainability and Environment
Implementation partners:	• Neighboring Municipalities • Mystic River Watershed Association • Metropolitan Area Planning Council Metro Mayors Coalition • State Agencies (Massachusetts Emergency Management Agency, Executive Office of Energy and Environmental Affairs) • Massachusetts Department of Conservation and Recreation • Large property owners and private entities with economic interest in the resilience of the Mystic River

PLAN FOR IMPLEMENTATION	
Implementation schedule:	Short Term (0-3 years): • Stakeholder assessment to identify necessary partners for the Mystic River Regional Coalition • Establish the Coalition • Pursue funding opportunities to assess regional intervention options • Assess effectiveness of proposed potential options and identify benefits using criteria, such as: - Reduction in flooding (extent, depth, duration) - Reduced impacts to critical regional infrastructure, critical services and vulnerable population groups - Reduced economic impacts both in terms of structural damage and business continuity Medium Term (4-6 years): • Further develop the design for the most effective intervention(s) and conduct cost benefit analysis of selected option(s) Long Term (7-10 years) • Develop a robust implementation plan for design and construction of the most effective intervention(s)
Equity considerations:	Neighborhoods at risk of flooding within the Mystic River Watershed are home to some of our more vulnerable residents,[86] so it is critical that these vulnerabilities are addressed. Furthermore, a regional approach to addressing flood risk along the Mystic River can create opportunities to advance equity at the regional scale. For housing affordability, transportation, and economic opportunity to improve for Somerville residents, we need a strong region that is equally prepared to respond to climate impacts. A regional approach can help to make sure that all communities are responding to climate risks, not just the best resourced communities.

PRECEDENTS

The Northern California Water Association (NCWA) was established in 2003 to partner with over 200 agricultural representatives, natural resource professionals, wetland managers and local governments throughout the region to improve water quality for Northern California farms, cities and the environment.

The Southeast Florida Regional Climate Change Compact was formalized following the 2009 Southeast Florida Climate Leadership Summit, when elected officials came together to discuss challenges and strategies for responding to the impacts of climate change. The Compact outlines an ongoing collaborative effort among the Compact Counties to foster sustainability and climate resilience at a regional scale.

The Maumee River Basin Partnership of Local Governments (MRBPLG) is a consortium of cities, towns, villages, townships, counties, watershed management groups, and the regional community, which was founded in March 2001 by the City of Fort Wayne, Indiana and the City of Toledo, Ohio. This Partnership stretches across three state boundaries and focuses on a watershed-based approach to water quality management in the Maumee River Basin.

The City of Somerville can take leadership in the proposed Mystic River Regional Coalition in collaborating with other municipalities and watershed organizations within the Mystic River watershed to advocate and push the State to take action on assessing and implementing the most effective resiliency intervention(s) that can have significant flood reduction benefits to multiple communities in the watershed. Strategically designing parks and other open spaces along the Mystic River waterfront would not only increase its resiliency but also enhance its value as a green recreational corridor.

[86] City of Somerville Climate Change Vulnerability Assessment. (2017). Retrieved from: https://www.somervillema.gov/sites/default/files/6-13-2017_Somerville%20CCVA%20Final%20Report.pdf, Figure 35.

Amelia Earhart Dam

Draw Seven State Park

Shoreline solution for flood mitigation implemented at Wilkes-Barre River Common in Wilkes-Barre, PA. Source: Sasaki, 2009.

BENEFITS

Qualitative co-benefits:

- The regional resiliency intervention options in the Mystic River watershed can have significant flood reduction benefits for Somerville and other upstream communities, which can also yield significant economic benefits by both reducing the extent and magnitude of physical flood damage, as well as reducing the economic impacts from disruptions to business continuity in one of the densest areas of the country.
- The implementation of specific actions at the AED would directly benefit Somerville in the short-term while allowing for additional long-term improvements for the region. One of the main benefits would be increased flood resiliency in the Mystic River watershed that would result in the resiliency for communities in the entire region, including the protection of key critical infrastructure assets, such as water, energy, transportation, schools and hospitals.
- The implementation of sustainable / "green" solutions would enhance the Mystic River watershed ecosystem and recreational opportunities for the benefit of the abutting vulnerable populations as well as the city as a whole.

Impact of action on climate change:

- A regional coalition of neighboring municipalities and stakeholders will be effective in developing a cohesive regional strategy to mitigate the effects of sea level rise and storm surge, which are beyond the jurisdiction of one single municipality to solve. Such a coalition will also provide impetus for State action by pursuing funding opportunities to evaluate potential intervention options and selecting the one(s) that would be most effective in mitigating flooding, reducing impacts on critical infrastructure, services and vulnerable population groups, as well as minimize economic impacts including business continuity.

MONITORING PROCESS

Performance Metrics

Although one measure alone may not increase overall resiliency to sea level rise/ storm surge, implementing a redundant and robust system should provide more protection at a regional level and will include many entities to participate. Performance of this methodology can be measured by:

- Creation of a Mystic River Regional Coalition
- Number of participants in regional meetings
- Coastal resilience projects implemented within the watershed

COST

Avoided Cost

- Avoided costs can include a reduction in flood damage costs and extends the design life of existing infrastructure.
- The total structural content damages for residential and commercial properties is estimated at $217M for the 2070 100 year coastal flood event.[87]
- Estimated loss of business revenue for the 2070 100 year coastal flood event is $105M.[87]

Capital Cost/ Operational Cost

Operational costs are estimated to fall below $100,000 per year to continue the regional coordination and enhance regional collaboration. The costs associated with this broad range of strategies for advocacy may vary widely depending upon how the implementation fully develops. Among categories of costs can be:

- Staff and graphic support for stakeholder engagement process
- Additional staff time for expanded regional coordination efforts

Assessment of interventions can be in the range of $250k-$300k for study.

The capital costs for implementing the resulting proposed solutions could vary based on if resiliency solutions are integrated in an existing project or if it is a new project, such as raising the AED dam. Major infrastructure projects can start around $1M but could exceed $100M according to scope and complexity.

Funding mechanisms:

There is an array of existing programs and grants that might provide funding options:

- Coastal Resilience Grant Program provides financial and technical support for local efforts to increase awareness and understanding of climate impacts, identify and map vulnerabilities, conduct adaptation planning, redesign vulnerable public facilities and infrastructure, and implement non-structural (or green infrastructure) approaches that enhance natural resources and provide storm damage protection.
- Flood Hazard Mitigation Program funds to states, territories, tribal governments, and other communities after a disaster to reduce or eliminate future risk to lives and property from natural hazards.
- Hurricane and Storm Damage Reductions Projects from USACE funds efforts to study, design, and construct small coastal storm damage reduction projects in partnership with non-Federal government agencies, such as cities, counties, special authorities, or units of state government. Projects are planned and designed under this authority to provide the same complete storm damage reduction project that would be provided under specific congressional authorizations. The maximum Federal cost for planning, design, and construction of any one project is $10,000,000.

[87] City of Somerville Climate Change Vulnerability Assessment. (2017). Retrieved from; https://www.somervillema.gov/sites/default/files/6-13-2017_Somerville%20CCVA%20Final%20Report.pdf Figures 44 & 45.

RELATED ACTION

CONTINUE TO PURSUE OPPORTUNITIES TO INCORPORATE COASTAL RESILIENCE MEASURES INTO PROJECTS ALONG MYSTIC RIVER AS THEY ARISE.

TIMELINE

IMPLEMENTATION

Somerville Climate Forward is a plan about taking action now. It lays the foundation for tracking progress and celebrating success. The implementation steps associated with the priority actions identified in the previous section were designed to be actionable today, with achievements and milestones mapped out for different points in the future. This reinforces the City's strong commitment towards climate action and reflects input from a diverse group of stakeholders who participated in developing the plan.

The implementation timeline shows which actions are being started immediately and how long the City anticipates it will take to complete the majority of the steps outlined in each priority action. Some actions are discrete projects that will take less time to complete and some are ongoing initiatives that will continue to evolve over the years. There may be additional steps for an action that will help advance its impact which are not included in this simplified timeline.

Progress on all actions will be tracked annually and actions will be evaluated after five years to determine if they have met their goals and to ensure they have not led to unintended consequences. This evaluation will provide an opportunity to adapt and add actions to incorporate the latest climate science, technological developments, policy changes, leadership commitments, and community priorities. After five years, it is expected that many actions will be complete and new priority climate actions will need to be selected.

1. Explore the feasibility of a local net-zero energy or net-zero emissions-based performance standard.
2. Adopt flood and extreme heat resilience standards for new construction.
3. Enable a rental energy disclosure requirement through the creation of a rental licensing program.
4. Continue and expand thermal electrification programs (HeatSmart/CoolSmart).

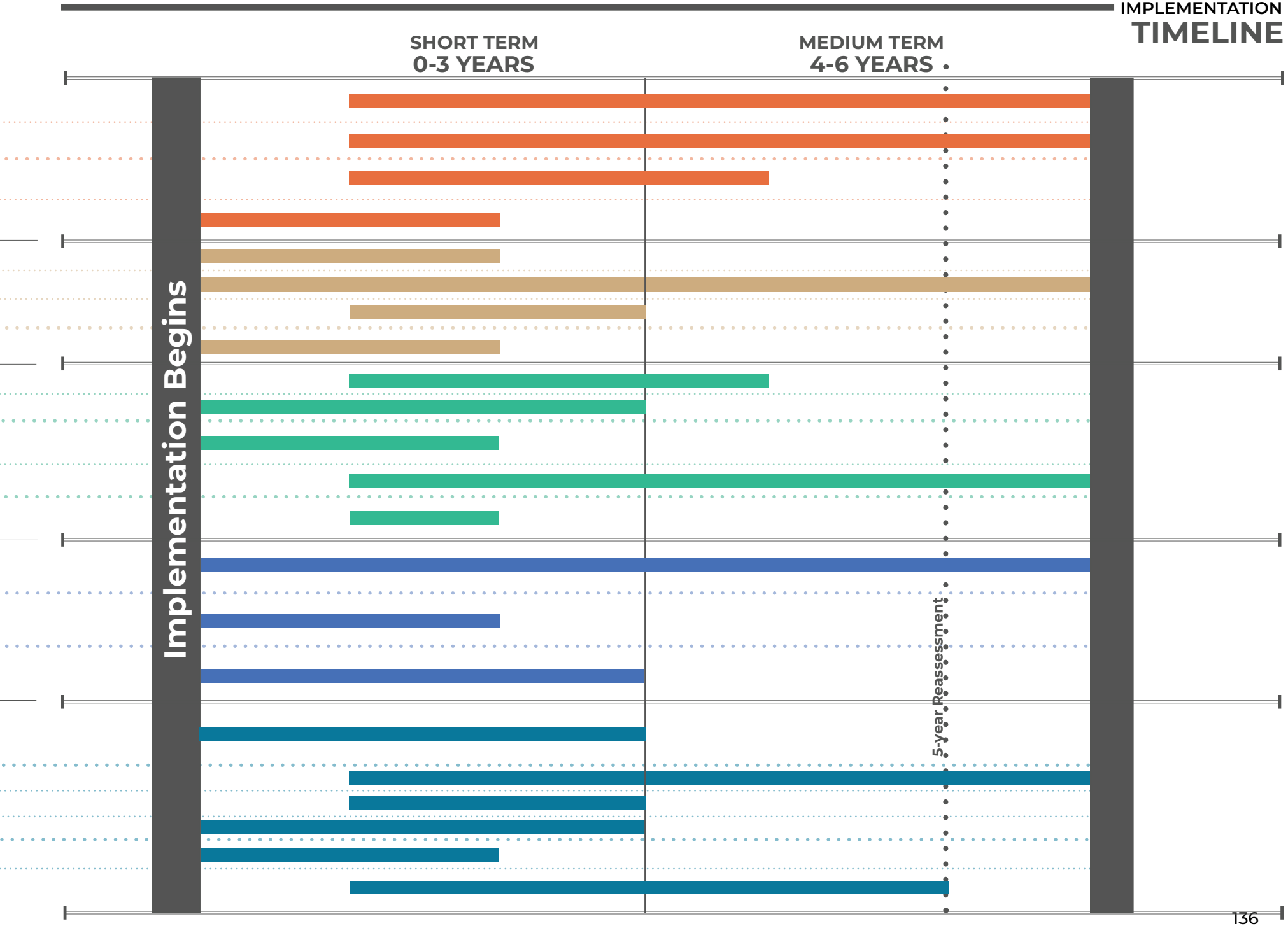
5. Improve bus reliability and trip times.
6. Improve and expand bicycle infrastructure.
7. Assess parking policy and parking supply to meet low-carbon mobility needs.
8. Develop electric vehicle charging infrastructure strategy.

9. Update stormwater management policies and develop design guidelines.
10. Investigate a stormwater enterprise fund to improve stormwater management.
11. Formalize and implement a modern urban forestry management plan including best practices and resilient species list.
12. Develop guidance and training for community stewardship of trees.
13. Complete a consumption based greenhouse gas inventory and conduct community outreach on climate impacts of consumption.

14. Establish a preparedness education program and an emergency alert system that help protect the community from flooding and extreme heat events.
15. Extend the community choice electricity aggregation program and increase share of renewable energy.
16. Organize community climate action and preparedness leadership program to educate public and increase participation in climate programs.

17. Set progressive net-zero building standards for new municipal buildings and those undergoing major renovation; set renewable electricity standards for all existing and new municipal buildings.
18. Advocate for building and energy codes that achieve net-zero energy performance.
19. Advocate for faster de-carbonization of electricity.
20. Advocate for more stringent regulation of utility gas leaks.
21. Create a Mystic River Regional Coalition and to push State action.
22. Assess potential intervention options to address flood risk along Mystic River.

TIMELINE


SHORT TERM
0-3 YEARS
MEDIUM TERM
4-6 YEARS
Implementation Begins
5-year Reassessment

BY IMPACT

IMPLEMENTATION

Somerville Climate Forward is a comprehensive climate action plan that sets forward an agenda of priority actions that can achieve both climate change mitigation and adaptation. The combined effect of these actions will be to reduce local GHG emissions and to adapt to projected flooding and extreme heat events in the future.

The chart to the right illustrates how each of the plan's priority actions address the four impact areas of GHG reduction, flooding, extreme heat, and equity.

As described throughout this plan, the City wants to ensure that the combined benefits of taking action are shared by all residents. Many of the actions outlined in the plan present opportunities to protect and enhance the well-being of Somerville communities. The City is also committed to tracking the success of this plan by its impact on equity in our community. All of the actions in this plan were designed with equity in mind; actions marked with an Equity Impact are expected to have an observable impact on balancing the burdens and opportunities of climate across our community's population.

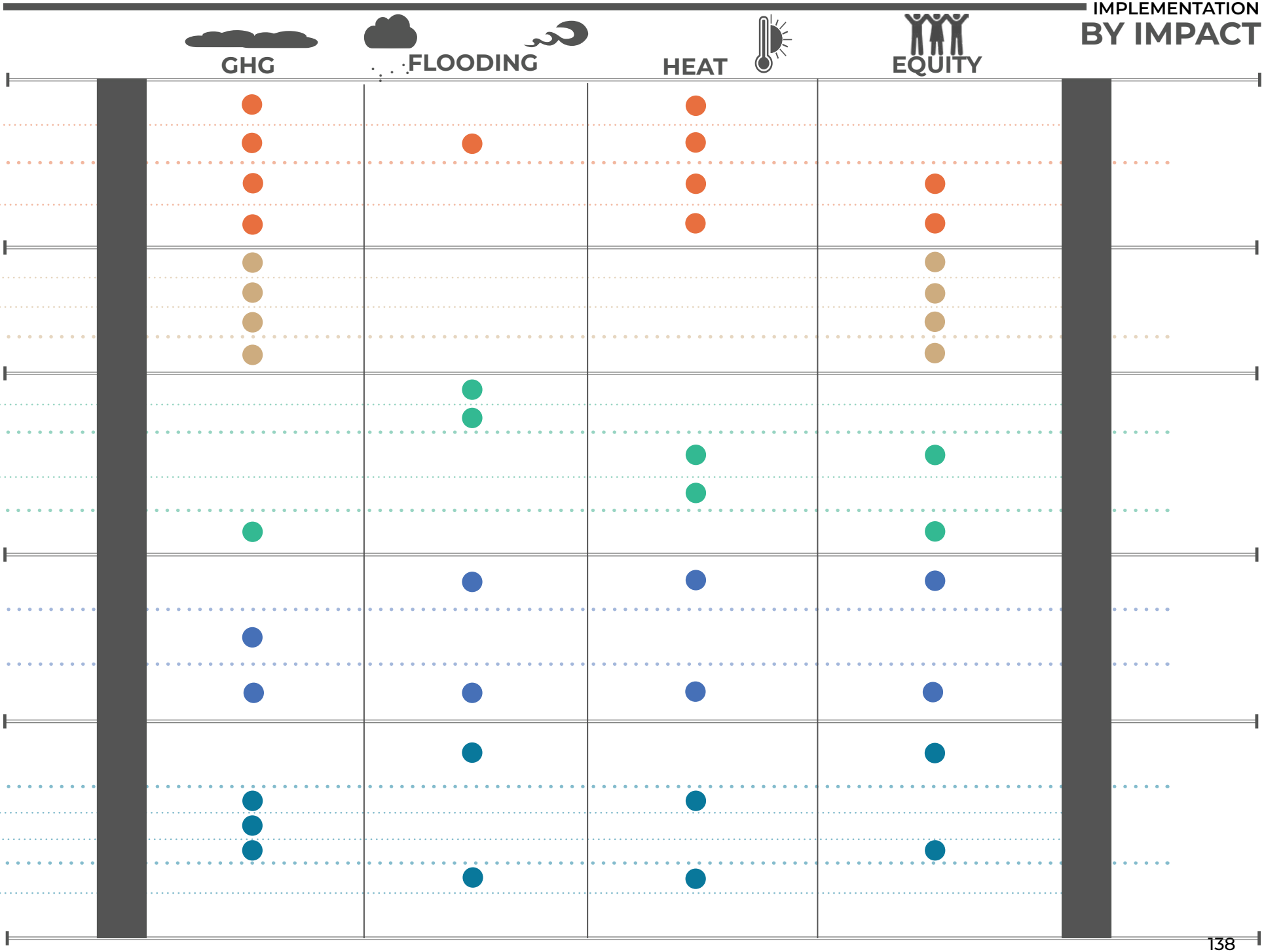
1. Explore the feasibility of a local net-zero energy or net-zero emissions-based performance standard.
2. Adopt flood and extreme heat resilience standards for new construction.
3. Enable a rental energy disclosure requirement through the creation of a rental licensing program.
4. Continue and expand thermal electrification programs (HeatSmart/CoolSmart).

5. Improve bus reliability and trip times.
6. Improve and expand bicycle infrastructure.
7. Assess parking policy and parking supply to meet low-carbon mobility needs.

8. Develop electric vehicle charging infrastructure strategy.
9. Update stormwater management policies and develop design guidelines.
10. Investigate a stormwater enterprise fund to improve stormwater management.
11. Formalize and implement a modern urban forestry management plan including best practices and resilient species list.
12. Develop guidance and training for community stewardship of trees.

13. Complete a consumption based greenhouse gas inventory and conduct community outreach on climate impacts of consumption.
14. Establish a preparedness education program and an emergency alert system that help protect the community from flooding and extreme heat events.
15. Extend the community choice electricity aggregation program and increase share of renewable energy.
16. Organize community climate action and preparedness leadership program to educate public and increase participation in climate programs.

17. Set progressive net-zero building standards for new municipal buildings and those undergoing major renovation; set renewable electricity standards for all existing and new municipal buildings.
18. Advocate for building and energy codes that achieve net-zero energy performance.
19. Advocate for faster de-carbonization of electricity.
20. Advocate for more stringent regulation of utility gas leaks.
21. Create a Mystic River Regional Coalition and to push State action.
22. Assess potential intervention options to address flood risk along Mystic River.


GHG
FLOODING
HEAT
EQUITY

The chart to the right summarizes the total GHG reduction impact of the plan's quantifiable priority actions. The reduction opportunities are primarily from Buildings, Mobility, and Community actions, and target the greatest emissions sources in the city. Action Areas 1 and 2 reduce building energy emissions by improving energy efficiency in existing buildings, promoting fuel switching in building systems to clean electricity, and supporting net-zero new building construction. Combined, these actions provide 30% of the reductions needed to achieve the City's 2050 carbon neutrality goal. Actions 3 and 4 reduce transportation emissions by increasing transit use and active mobility options (e.g., walking, biking) and electrifying vehicles in the community. These actions provide 21% of the reductions needed in 2050. Action 9 reduces emissions by providing access to 100% clean electricity, the effects of which are amplified through the actions to further electrify building systems and vehicles. This action is responsible for 19% of the total reductions needed. The remaining reductions in the plan come from minimizing fugitive natural gas emissions (Action 12), improving waste diversion practices (Action 7), and leading by example in new municipal building design (Action 11). These actions provide an additional 9% of reductions toward the 2050 goal. The sum of all quantifiable actions in the plan can reduce emissions in 2050 by nearly 80%.

1. Explore the feasibility of a local net-zero energy or net-zero emissions-based performance standard.

2. Enable a rental energy disclosure requirement through the creation of a rental licensing program.

Continue and expand thermal electrification programs (HeatSmart/CoolSmart).

3. Improve bus reliability and trip times.
Improve and expand bicycle infrastructure.
Assess parking policy and parking supply to meet low-carbon mobility needs.

4. Develop electric vehicle charging infrastructure strategy.

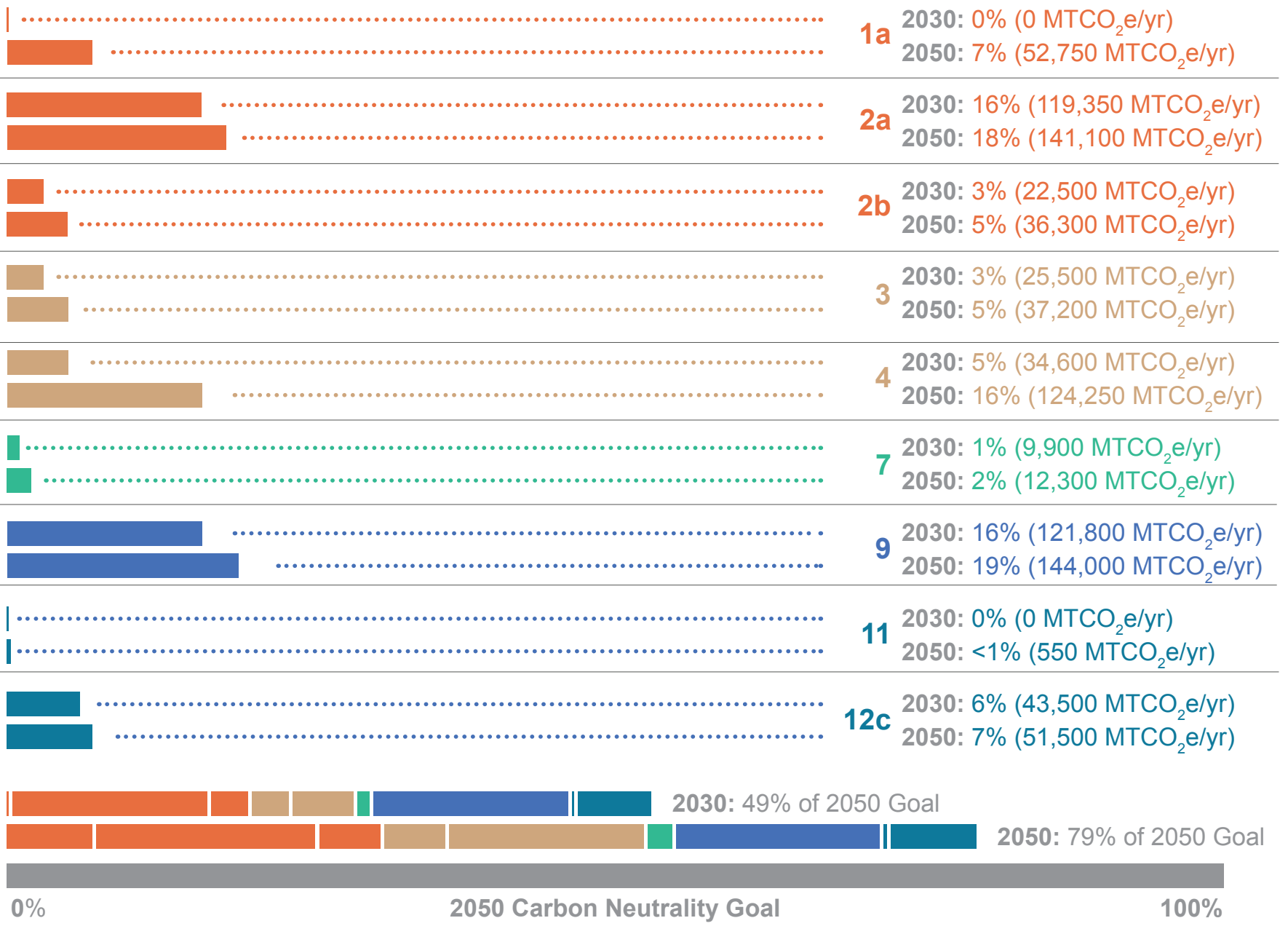
7. Complete a consumption based greenhouse gas inventory and conduct. community outreach on climate impacts of consumption.

9. Extend the community choice electricity aggregation program and increase share of renewable energy.

11. Set progressive net-zero building standards for new municipal buildings and those undergoing major renovation; set renewable electricity standards for all existing and new municipal buildings.

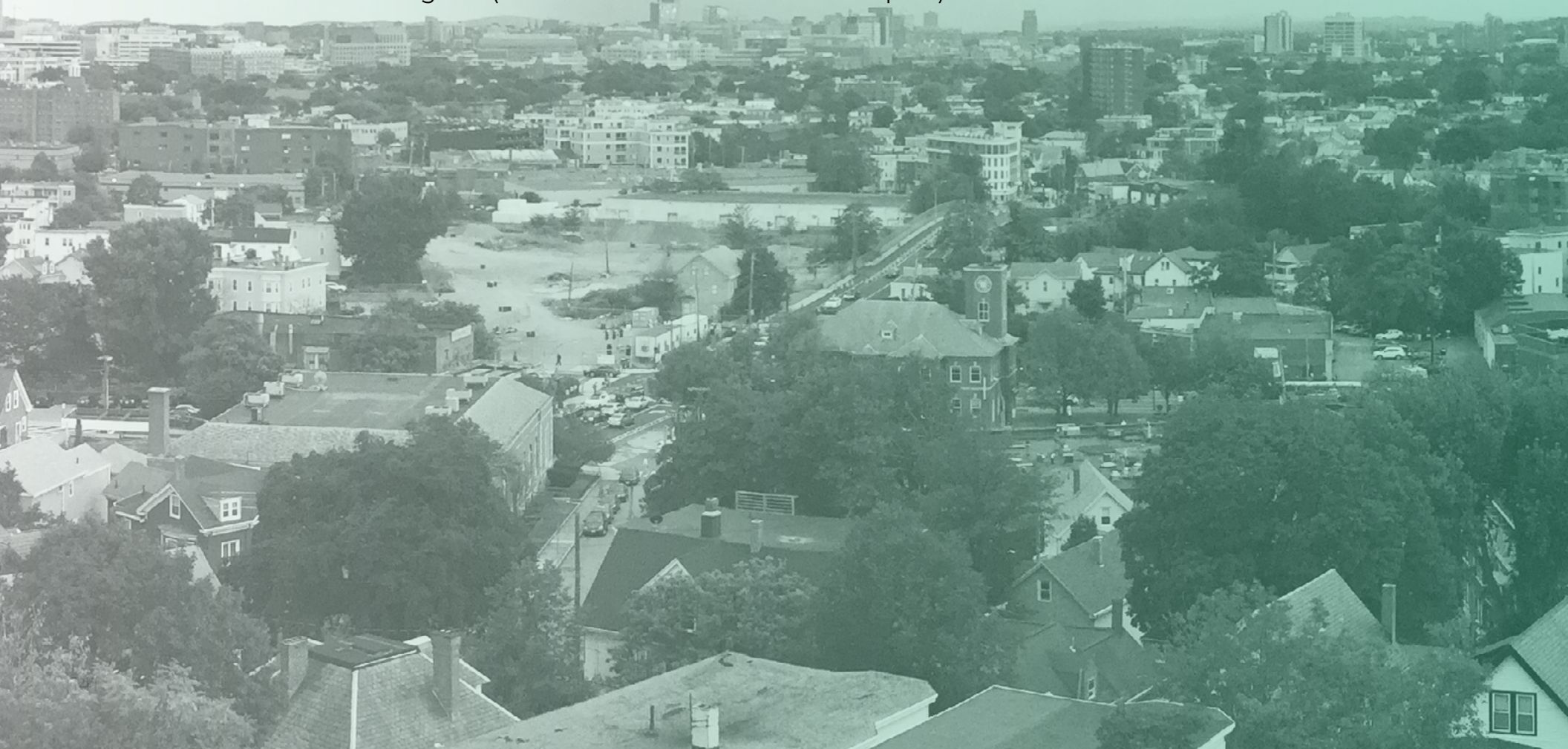
12. Advocate for more stringent regulation of utility gas leaks.

Progress toward Carbon Neutrality



The Office of Sustainability and Environment will be responsible for overseeing implementation of the plan, and for ensuring it stays up-to-date with the latest climate science, technologies, and community trends. Progress on implementation of the priority actions in Somerville Climate Forward and their related steps will be reported annually as part of SustainaVille, the City's platform for reporting on GHG reduction and resiliency initiatives.[88]

Climate change is a global issue that cannot be solved in isolation by the City of Somerville, its residents, or its many engaged stakeholders. Fostering partnerships and strengthening regional collaboration initiatives will play a pivotal role in achieving the ambitious goals established and ensuring the continued success of Somerville Climate Forward. The City will continue to play an active role in regional organizations, such as the Metro Mayors Climate Preparedness Task Force; in State-led resiliency and carbon neutrality initiatives, such as the Green Communities Program; and engaging the community with existing and new programs such as the recommended SustainaVille Leaders Program (detailed in Action Area 10 of this plan).



Although the City cannot take on this charge alone, it can create policies and programs that make it easier for everyone in Somerville to take action. Our success will ultimately be determined by Somerville's residents, businesses, and institutions commitment to this plan. Across our community, small daily choices and behaviors can add up to a big impact. Through simple actions, such as installing home energy retrofits and decisions like walking instead of driving, we can collectively contribute to reduction in GHG emissions and help do our part to improve the resilience of Somerville's built, natural, economic, and social systems. We hope you join us in working to move Somerville forward.

[88] City of Somerville. Sustainaville. (2018). Retrieved from: https://www.somervillema.gov/sustainaville

SustainaVille

creating a resilient & carbon neutral somerville