Energy and Climate

"Plans to protect air and water, wilderness and wildlife are in fact plans to protect [people]."

— Stewart Udall[1]

Introduction

Climate is an increasingly critical topic for municipalities across Massachusetts - both in terms of mitigating greenhouse gas (GHG) emissions and preparing for the impacts of climate change. Massachusetts has a statewide goal of reducing GHG emissions by 80% by 2050 (from a 1990 baseline), and many municipalities are setting local goals to reduce emissions. Climate change will impact public health and safety, as well as economic prosperity and growth across many sectors. Local impacts include coastal flooding due to sea-level rise and storm surge, increasingly intense storms, increased urban flooding, and a larger number of higher heat days. Municipalities have an important role in effectively mitigating and preparing for climate change through land use planning, policy setting, and implementing projects.

Municipalities have an opportunity to lead against climate change and in the reduction of GHG emissions. The City has taken steps to reduce energy and GHG emissions through direct control over municipal energy usage, and indirectly through policies and programs for residents and businesses. Incorporating energy efficiency and renewable energy into municipal planning has several benefits, including:

- Help save money and reduce energy costs
- Stabilize energy prices
- Reduce air pollution
- Reduce greenhouse gas emissions
- Increase energy resilience and energy independence

1 Udall, Stewart. The Quiet Crisis 1963.

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As a dense, urban, coastal city, Revere faces several challenges in terms of climate change impacts, including sea-level rise, storm surge, and coastal flooding, and the urban heat island effect. These risks put a strain on municipal services, strains wastewater systems, damage public property, and impact the health, safety, and welfare of residents and businesses. The City has already taken steps to plan for the impacts of climate change through the State's Municipal Vulnerability Preparedness (MVP) program. Through this process, Revere identified climate vulnerabilities and created an action plan to begin to address priority projects.

This chapter of *Next Stop Revere* addresses two sides of climate, including both mitigation and climate preparedness. This chapter summarizes municipal energy usage, energy across the community, and the City's successes to date related to energy efficiency and renewable energy. It outlines recommended goals and strategies for continued work on energy, both at a municipal and community-wide scale, to mitigate GHG emissions. It also reviews some of the key impacts of climate change on Revere and aligns policy and project recommendations to continue to make Revere a more prepared and resilient place.

The City has already taken steps to plan for the impacts of climate change through the State's Municipal Vulnerability Preparedness (MVP) program.

Historical Context

The City of Revere has formally worked on issues of energy and climate for over a decade. Revere was an early participant in the State's Green Communities program to reduce municipal energy usage and improve sustainability and became a designated Green Community in 2011 (see details below). At the same time, Revere has implemented key energy savings projects in the public schools and other municipal buildings. In addition, Revere is a member of Metro Mayors Coalition (MMC), which is comprised of fifteen cities and towns within the Boston Metro Area. In 2014 the MMC Mayors and Town Managers made a regional commitment to climate preparedness and resilience in the wake of Superstorm Sandy, which impacted cities and towns all along the eastern seaboard. As part of that commitment, the MMC formed the Climate Preparedness Taskforce. In 2016, the MMC made a further commitment to become a net-zero region by 2050. Most recently, Revere participated in the State's Municipal Vulnerability Preparedness program to create a localized plan to address climate impacts.

Energy

MUNICIPAL ENERGY USE

Municipalities have direct control over energy use in their municipal facilities including, buildings, open space and recreational facilities, traffic lights, water and sewer systems, and vehicle fleets. While municipal energy use typically only makes up a small portion of the total energy use within a community, municipal leadership on energy efficiency and renewable energy can be critical to elevating the issue and incentivizing change by leading by example. Energy efficiency efforts can help save the City money by reducing costs from energy usage. Similarly, purchasing renewable energy can help stabilize energy prices and may reduce costs for the City, which can be a significant portion of the municipal budget.

Revere's electricity and natural gas utility provider is National Grid. Over the past eight years, Revere has reduced the most usage in water and sewer and vehicles. In FY2017 (July 2016-June 2017), Revere used 114.879 MMBtus of energy, with 95,168 MMBtus from municipal buildings (including schools), 8,471 MMBtus from street and traffic lights, 10,844 MMBtus from municipal vehicles (gasoline and diesel) and 396 MMBtus from water and sewer.

Green Communities and Municipal Energy Programs

In 2011, the City of Revere was designated a Green Community by the Massachusetts Department of Energy Resources (DOER). In order to receive this designation, the City created a 5-year energy reduction plan (ERP) to reduce municipal energy use by 20% (with a baseline year of FY2008-2009). In addition to the ERP, the Designation requires the community to achieve four criteria, including:

1. Approve zoning for renewable energy generation,
2. Adopt expedited permitting for as-of-right energy facilities,
3. Adopt a fuel-efficient vehicle policy, and
4. Adopt the Massachusetts' Board of Building Regulations and Standards (BBRS) Stretch Code (780 CM 115.AA) which minimizes the full costs of an asset over its life cycle and increase energy efficiency in new construction.

The Green Communities Designation allows the City to be eligible for state grant funding to implement energy conservation measures (ECMs) across City-owned property, buildings, and vehicles. In the 2009 baseline, municipally-owned buildings (including schools) made up 88.2% of the total municipal energy consumption, and vehicles made up 11.1% (the remainder of energy usage is from streetlights, open space, and water/sewer). Of the 88.2% energy use from municipal buildings, the schools make up the largest portion of energy usage, which is typical across Massachusetts.

Revere has taken advantage of the Green Communities state grant three times since designation and received nearly half-a-million dollars in State grant funding.

Award Date	Award Amount	Project Summary
July 2011	$366,600	Grant-funded measures at City Hall, the Senior Center, and the Youth Center. ECMs included an Energy Management System (EMS), weatherization upgrades, HVAC upgrades, and lighting retrofits.
July 2015	$89,460	Grant-funded the purchase of four electric vehicles and installation of EV charging stations
July 2018	$10,00	Grant-funded an additional EV charging station and Energy Conservaton Measure
Total	$466,060	

Figure 1: Green Communities grants since 2011.

In addition to the Energy Conservation Measures funded by the State, the Revere Public Schools District has worked with Ameresco through an Energy Service Performance Contract (ESPC) to invest in energy efficiency and renewable energy in public schools.[2] The ESPC is a "budget neutral" program, which means that Ameresco paid for all upfront costs, and a portion of the annual cost-savings to the City help repay the investment over 15 years.

The $10.3 million project also utilized rebates and incentives from the State and utilities, as well as an Energy Efficiency and Conservation Block Grant (EECBG). Over time, the City will see an estimated annual cost savings of $685,982 due to these upgrades. The projects included:

- New rooftop and 42 kW building-integrated solar PV at Beachmont Elementary School
- Installation of "smart" energy management systems
- Upgrades to the steam traps and radiators at McKinley School
- New transformers at Revere High School which helps reduce electricity loss
- Replacement of the pool cover and dehumidifier at Garfield Elementary School

In addition to Green Communities, Revere is also currently in the process of retrofitting its streetlights to LEDs, which is anticipated to have an annual savings of $150,000. Nearly 200 communities across Massachusetts have participated in an LED streetlight retrofit program through the utilities or State. Revere has several electric vehicle charging stations for municipal vehicle usage, and the City is the process of installing several charging stations for public use.

2 Ameresco (2011). Revere and Ameresco complete solar, energy efficiency, and building management technology measures at city schools. Retrieved February 13, 2019 from https://www.ameresco.com/revere-ameresco-complete-solar-energy-efficiency-building-management-technology-measures-city-schools/; Ameresco (2011). Video: Revere Public Schools. Retrieved February 13, 209 from https://www.ameresco.com/portfolio-item/revere-public-schools/

RENEWABLE ENERGY

Renewable energy installations are increasing in Revere, as more residents and businesses take advantage of the benefits of renewable energy. Between 2010 and 2018, 6,653 kW of solar photovoltaic (PV) has been installed across Revere, according to Mass DOER.[3] The majority of the installations are residential installations with an average size of 8.8 kW (a typical home uses between 5kW and 10kW in electricity).

There were several installations on commercial/office buildings and one retail location.[4] National Grid also installed a utility project for 752 kW on a brownfield site to assist with electricity loading challenges[5] at a local substation.[6] The electricity generated from this project is equivalent to the needs of powering 150 average homes.

The installation of any solar panels on a residential or commercial building in Revere requires a permit and a municipal inspection. The utility companies require certification of both before connecting the solar panel to the grid.

The City has one municipal solar installation at the Beachmont School, which was a solar PV project completed by Ameresco as part of the roof replacement. The 42kW project uses building integrated technology, in which the solar photovoltaic material is incorporated into the roofing material (as opposed to traditional panels which sit above the traditional roof).

In 2019, the City also formalized an agreement with a solar developer, Citizens Energy, to implement a Community Shared Solar Project "Joe-4-Sun" program for the municipality and low-income residents. While the solar arrays themselves are not located in Revere, the City has signed a 20-year agreement that will result in long-term cost savings for the City. The contract enables the City to enroll up to 150 low-income subscribers from Revere.[7]

COMMUNITY ENERGY USE

While leadership in municipal energy use is critical, the energy used in residential, commercial, and industrial sectors comprises a larger portion of Revere's energy usage and GHG emissions.

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3 Massachusetts Department of Energy Resources (2017). Qualified Generations Units. Retrieved February 14, 2019 from https://www.mass.gov/service-details/qualified-generation-units.

4 This includes the Kids Only After School, Black Marble Motorcycles, and GRE Revere TGT LLC.

5 Substations help manage the flow of electricity in the electrical grid, and "loading" refers to balancing the electricity load used during low usage and high usage time periods. Distributed generation of electricity through solar PV can both help with loading, as well as cause challenges.

6 NationalGrid (2019). Revere. Retrieved February 14, 2019 from https://www.nationalgridus.com/new-energy-solutions/Renewables/Massachusetts/Revere

7 City of Revere News. February 12, 2019. "Go Green Save Green." Retrieved from https://www.revere.org/news/post/go-green-save-green

According to the 2016 MassSave[8] data, electricity usage from the residential sector accounts for 52% of usage, while commercial and industrial (C&I) account for 48% of usage. Electricity is measured in "Mega-Watt hours" (MWh). 1 MW is equivalent to 1,000 kilowatts (kW), which is 1,000 watts. So, 1 MW is equal to 1,000,000 watts. 1 MWh would be equivalent to the electricity required to power 10,000 100-watt light bulbs for one hour. Between 2013 and 2016, electricity usage in the residential sector remained fairly flat but commercial and industrial electricity usage increased by approximately 22%, with a large increase between 2015 and 2016.

When looking at energy use in Revere in comparison to its neighboring communities of Chelsea, Everett, and Malden, Revere has lower electricity usage in the C&I sector and an average usage in the residential sector. When comparing across population estimates,[9] the estimated average energy use for residential usage is 1.98 MWhrs per person in Revere compared to 1.69 MWhrs for Chelsea and 2.4 MWhrs for Malden. However, when combining total electricity usage across both residential and C&I sectors, Revere's energy use is less than neighboring communities. This lower level of energy usage is likely due to the limited C&I sector when compared to other communities of similar sizes. Future development patterns are likely to change this mix of energy usage, however it's important that all sectors actively work to reduce their per capita electricity usage and GHG emissions over time, even as more renewable energy is added to the electricity grid due to the state renewable portfolio standard (RPS) and requirements for the utilities.

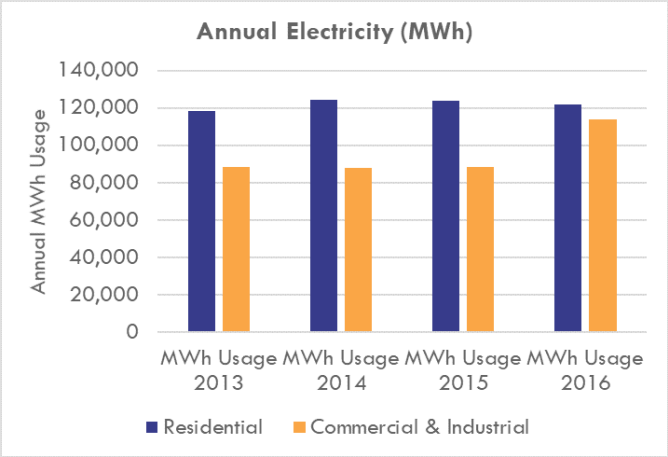

Figure 2: Annual electricity use by sector from 2013 to 2016.

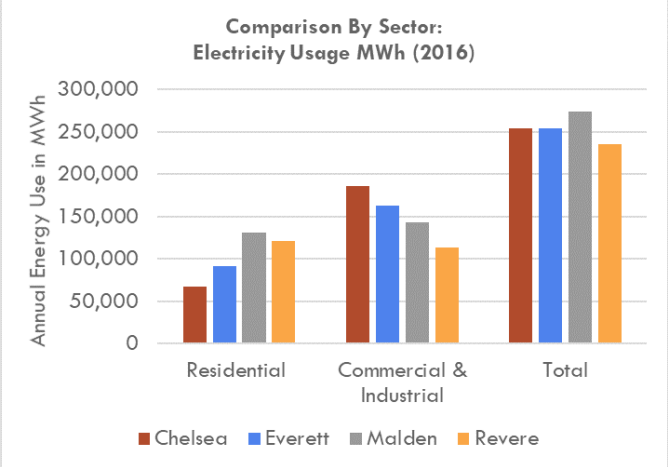

Figure 3: Comparison of annual electricity usage by city by sector.

In addition to capturing electricity data, MassSave also collects utility data for natural gas, which is typically used for the heating, cooling, and provision of hot water in buildings. However, other heating fuels such as propane and oil, which are delivered to building occupants, are not captured in the MassSave dataset. The following graph shows the thermal energy used across the Revere community. Thermal energy is measured in "British Thermal Units" or BTUs.[10] In 2015, Revere's residential sectors made up 60% of the thermal energy use compared to 40% from the C&I sector. Both residential and C&I thermal energy usage increased

9 The estimated population size for Revere is 53,993, Chelsea is 40,227, Everett is 44,636, and Malden is 61,264.

10 A British Thermal Unit or BTU is the unit of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

between 2013- 2015. C&I usage increased by 41% during this period.[11] This increase may be due to population increases, and an increase in the number and types of businesses. Similar to electricity usage, all sectors must work together to reduce their per capita natural gas usage and GHG emissions over time.

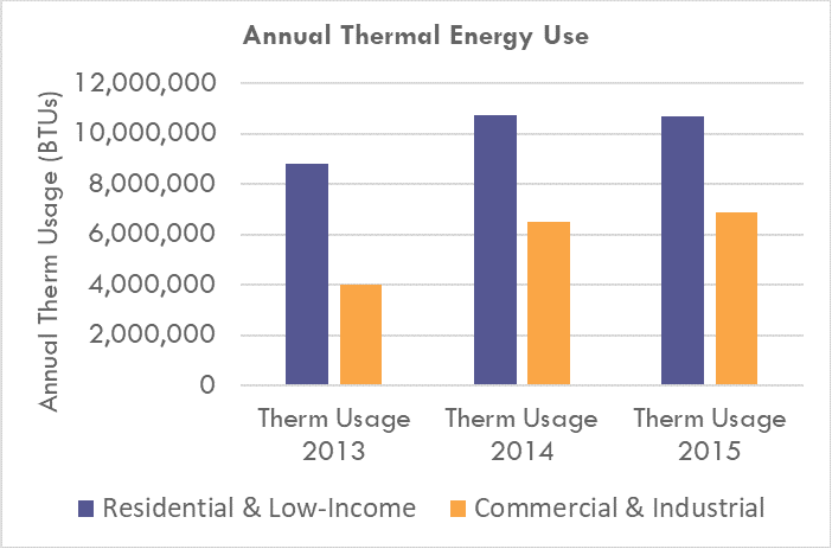

Figure 4: Annual thermal energy use by sector from 2013-2015

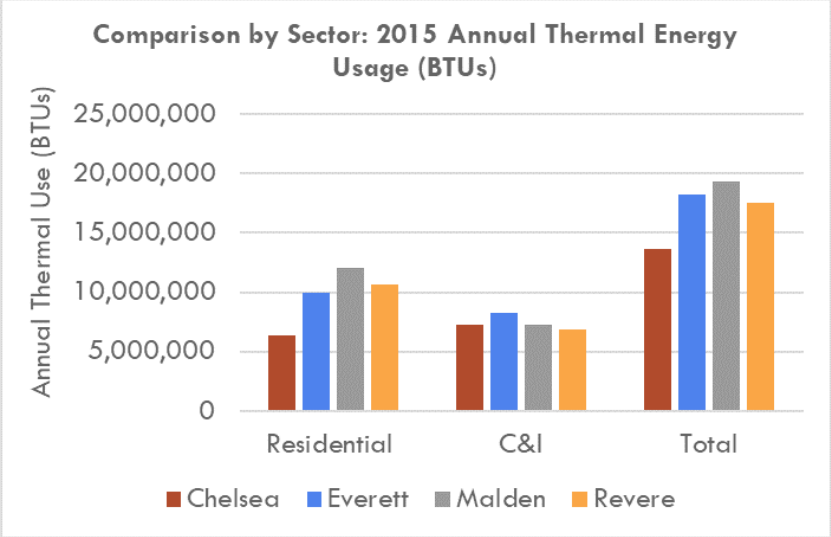

Figure 5: Comparison of annual thermal energy use by city by sector.

When looking at energy use in Revere in comparison to its neighboring communities of Chelsea, Everett, and Malden, Revere has a slightly lower thermal energy usage in the C&I sector and higher usage in the residential sector. When comparing across population estimates, the estimated average energy use for residential usage is 174 BTUs per person in Revere compared to 158 BTUs for Chelsea residents and 223 BTUs for Everett residents. This difference in energy usage may be due to differences in housing types, the number of people living within a single home/ unit, and average age across the communities. However, when combining total thermal energy usage across both residential and C&I sectors, Revere's thermal energy usage is on par with neighboring communities. Additional research through a comprehensive GHG inventory would help determine causes for these trends in energy usage over time, as well as setting baseline benchmarks to be used to set goals to reduce GHG emissions over time.

11 This data set does not take into consideration weather normalization, which incorporates the number of heating degree days. The number of heating degree days may impact the amount of thermal energy used in any given year.

Climate Change

Massachusetts is already experiencing the impacts of climate change - including sea-level rise (SLR), increased storm surge and coastal flooding, increased precipitation, periods of increased drought, and higher summer temperatures and heatwaves.[12] In addition, ocean and coastal ecosystems are impacted by climate change, including increasing ocean temperatures and acidification, which have impacts on fisheries and tourism. Sea level rise combined with more intense coastal storms has already caused damage in coastal communities in Massachusetts, including during winter storms. As a dense, urban coastal community, Revere can expect to experience increased frequency and severity of many of these climate impacts, particularly in coastal neighborhoods, including Beachmont, Oak Island and Point of Pines. Revere has already experienced flooding during severe winter storm events, and several areas of the city experience regular flooding due to drainage issues or lack of seawalls.

COASTAL FLOODING

Two main impacts- SLR and storm surge cause coastal flooding. Melting of the ice caps causes SLR and depending on the GHG emissions scenarios (low, medium, and high) models predict between 3ft and 7 ft. of SLR by 2070 in the Greater Boston area. At the same time, Massachusetts's coastline is experience subsidence, meaning the land is slowly sinking, which also impacts how SLR is experienced. Several areas of the city are actually below sea level and already face drainage issues. Massachusetts's communities along the coast already experience "sunny day flooding" during high tides, particularly during kind tide events (highest of the high tides). SLR impacts will be chronic, meaning that as the water level rises, certain areas will be covered by water all or some of the time (at least twice a day during high tide).

In addition to SLR, storm surge causes acute instances of coastal flooding during extreme weather events, during which periods wind and wave action push ocean water over the land. The land impacted by storm surge is often delineated as part of the flood plain. A significant portion of Revere's land is in the current Federal Emergency Management Agency (FEMA) flood zones (see Figure 6 below). These zones include the 1% annual chance flood hazard zone (zone A),[13] as well as the 0.2% annual chance flood hazard zone (zone X), and the high-risk coastal area (zone VE) along Revere Beach. Preserved natural systems such as Revere Beach Reservation, the Rumney Marsh Reservation, and Belle Isle Marsh Reservation help protect from coastal flooding as well as flood storage. However, other areas also currently experience flooding, including along Chelsea River and Revere Beach Parkway, along the Winthrop-Revere border, the Wonderland Park to Erricola Park, and the Point of Pines neighborhood. Property owners in the designated flood plain are required to purchase flood insurance as part of the FEMA's National Flood Insurance Program (NFIP). However, flood insurance is often costly and may be a barrier for some residents. Revere also participates in the Community Rating System (CRS),[14] which allows for discounted flood insurance in communities that go beyond the minimum required floodplain management actions.

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12 Fourth National Climate Assessment (2018). Chapter 18: Northeast. Retrieved from https://nca2018.globalchange.gov/chapter/18/

13 FEMA uses percent chance of flooding based on historical data. A 1% chance flood, also known as a 1 in 100 year flood, has a 1% chance of occurring every year. Similarly a .2% chance flood has a .2% chance of occurring in any given year. However, this flood data is limited because it's based off historical flood data, and not future predictions that include climate change risks.

14 FEMA. "National Flood Insurance Program Community Rating System" https://www.fema.gov/national-flood-insurance-program-community-rating-system. Accessed: Sept. 17, 2019

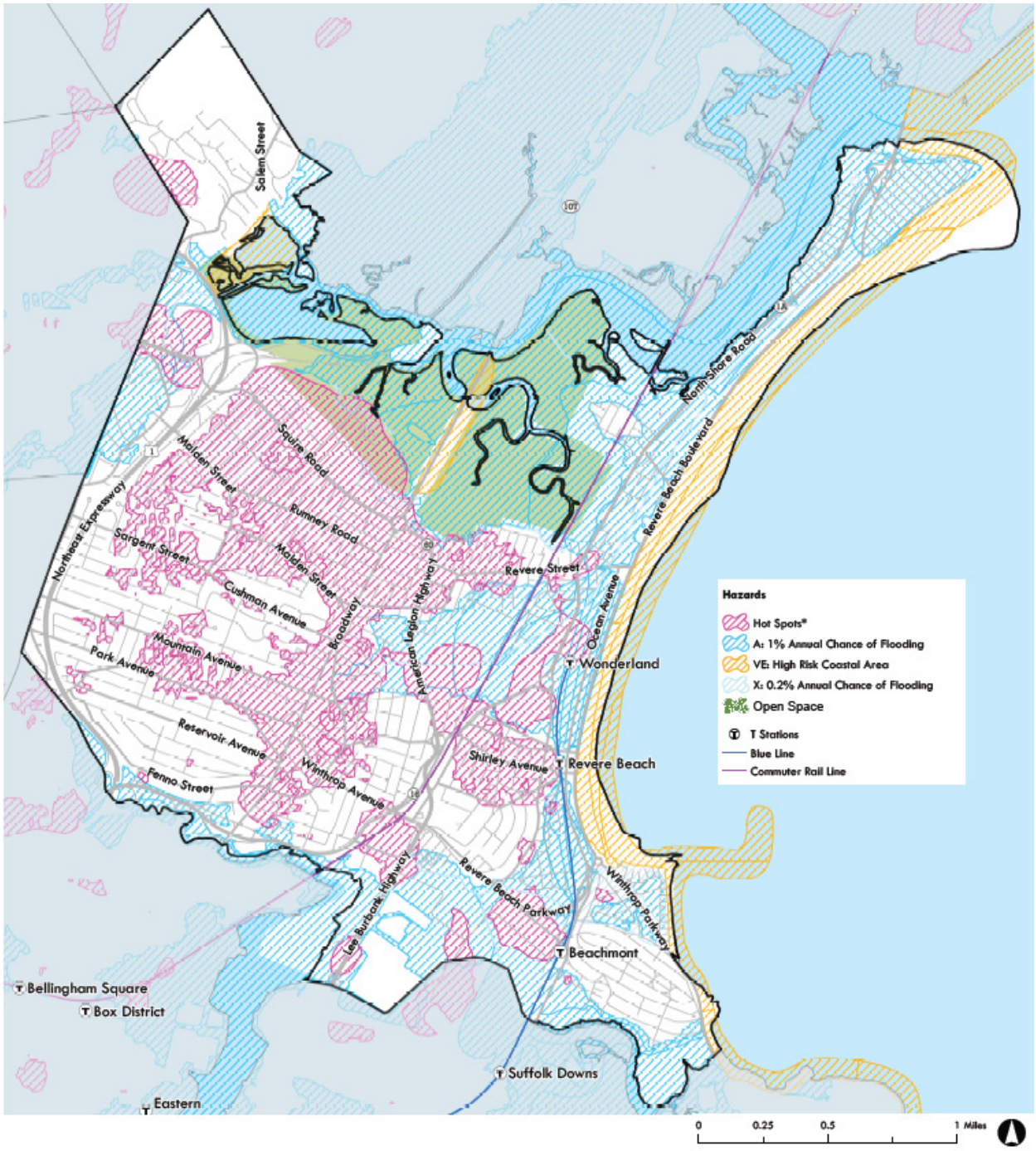

Figure 6: Current FEMA flood zones and urban heat island in Revere.

Several municipal and state-owned critical infrastructure assets are in the existing floodplain, including the Wonderland MBTA stop (the Beachmont and Revere Beach stop are on the edges of the floodplain), along with the Garfield School, Beachmont Veterans Memorial School, Rumney Marsh Academy, and Revere High School. The Revere Police Department is on the edge of the floodplain, and the State Police station at Revere Beach is on the floodplain. Other key private assets, such as the Irving Oil Terminal along Chelsea River, are also in the floodplain. Key transportation corridors, including Route 107/Broadway, Ocean Avenue, North Shore Road (Route 1A), Revere Beach Parkway, and the MBTA Blue Line, are also in the floodplain. Additional

coordination with State agencies that own and operate critical infrastructure and assets in Revere will be necessary to develop a robust adaptation and resilience plan, including working with the MBTA, MassDOT, and DCR.

One of the major limitations of the FEMA flood maps is that they are based on historical data and floodplain information. They do not yet include forward-looking data that include the impacts of climate change, either in terms of SLR or increased frequency and severity of storm events. However, 1% chance and .2% chance storms will become more frequent over the coming decades.

URBAN/INLAND FLOODING

In addition to coastal flooding due to sea-level rise and storm surge, flooding can be caused by extreme precipitation (e.g., rainfall, snow/snowmelt, ice storms), which can overflow streams, rivers, and overwhelm the sewer system. Low lying areas and areas with high levels of impervious surfaces also experience flooding during extreme precipitation events due to challenges infiltrating runoff into the ground or pumping water out. Revere's sewer systems are separated, meaning that municipal sanitary wastewater is contained in different pipes than the stormwater. Sanitary wastewater is sent through the Massachusetts Water Resources Authority (MWRA) system to be treated at the Deer Island plant in Boston. However, several neighboring communities utilize a Combined Sewer Overflow (CSO) in which both sanitary wastewater and stormwater are conveyed in the same pipes. During heavy precipitation events, the combined sewer system can be overwhelmed, and overflows will discharge untreated sanitary wastewater into Chelsea River and Broad Sound. This type of discharge from neighboring communities can be particularly problematic when it impacts the health and safety of Revere Beach. This discharge has negative impacts on public health and safety, as well as tourism and economic development. Roadways may also become flooded if natural waterways and storm sewers are over-loaded. As mentioned in the Public Facilities Chapter, Revere's aging sewer infrastructure and individual's sump pumps also is at risk of infiltration and inflow of stormwater into the sanitary sewer pipes, causing both overflows and water quality issues. The City is currently addressing these issues as mandated by an Environmental Protection Agency Consent Decree (see Public Facilities chapter for more information). Drainage and sewer issues were noted in the Municipal Vulnerability Preparedness Plan as a high priority for the City.

HEAT WAVES AND URBAN HEAT ISLAND

In addition to flooding, another major impact of climate change in Massachusetts is increased heat, particularly during summer and shoulder seasons (such as spring and fall). By 2050, the average annual temperatures in the Northeastern US are predicted to increase by between 2.8 and 6.2 degrees Fahrenheit. The number of high heat days over 90 degrees is also expected to increase from 5 days a year historically to 12 to 31 days a year by 2050.[15]

Under current temperature conditions, Revere already experiences significant "hot spots" (see Figure 6). Figure 6 shows land satellite data visualizing temperature data for Revere, with dark pink areas representing the hottest 5% areas in the city. As a dense, urban city, Revere also experiences "urban heat island effect," in which areas like roofs and pavement have higher surface temperatures during the day. While temperatures typically cool during the night, urban heat islands that have trapped heat during the day will stay warm

15 Mass.gov and Northeast Climate Science Center. https://www.mass.gov/files/massachusetts-climate-projections-mvp-training-workshops.pdf

throughout the night and cause hot air temperatures to persist.[16] Revere's lack of green space and street trees, as well as its high percentage of paved surfaces, add to the impacts of the urban heat island.

High temperatures associated with heat waves present a significant threat to public health and safety. Heatwaves impact the quality of the air (including particulate matter and ground-level ozone), which exacerbates cardiovascular disease. High temperatures can also lead to heat exhaustion, heatstroke, and other health issues, especially in the elderly, young children, outdoor workers, and those with pre-existing conditions such as cardiovascular disease.

MUNICIPAL VULNERABILITY PREPAREDNESS (MVP) DESIGNATION

In 2017 the Massachusetts Executive Office of Energy and Environmental Affairs launched the Municipal Vulnerability Preparedness program to support municipalities to plan and implement climate change resilience actions. In 2018 the City received an MVP planning grant to host a series of community workshops on resilience and develop a final report. The City was designated an MVP community in 2019 and is eligible to receive additional grant funding from the State to implement resilience projects identified as priorities in the final report. The City is currently working with their engineering consultants, AECOM, to apply for an Action Grant to further look at the feasibility of proposed actions. The MVP Plan[17] identified key hazards, critical assets, and facilities at risk, and presented priority recommendations. The top four hazards identified during the MVP workshop process were:

- Coastal flooding
- Inland flooding
- Storms
- High temperatures

Flooding issues are particularly challenging in the city's marshes and wetlands, where freshwater and tidal systems converge. Fortunately, several of the wetlands are protected and can absorb stormwater. However, existing wetlands are under threat from pollution and run-off, particularly from storm events. Increased development also has placed more pressure on the stormwater system, and more development has been in existing and future floodplains. Power outages associated with storms were identified as a concern, a sentiment also echoed by participants during master plan forums.

The MVP process explored various vulnerabilities and also highlighted critical assets and facilities that are impacted by climate change, including hospitals, assisted living facilities, and schools. It also identified five vulnerable zones across the city to focus on during the MVP process, including Beachmont, Point of Pines/ Riverside, and Oak Island/Revere Beach, West/North Revere, and Sales Creek. Many of these areas are currently impacted by hurricane inundation and are projected to be impacted by four feet of sea-level rise by 2100.

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16 Environmental Protection Agency (Nd). Heat Island Impacts. Retrieved February 14, 2019 from https://www.epa.gov/heat-islands/heat-island-impacts

17 AECOM. City of Revere, Massachusetts: Municipal Vulnerability Preparedness Summary of Finding Report. June 2019. https://www.mass.gov/files/documents/2019/07/11/Revere%20Report.pdf

The recommendations developed in the MVP Plan include both hard infrastructure improvements such as seawall construction and rehabilitation, as well as policies that will improve preparedness. Top recommendations include:

- Flood mitigation projects,
- Drainage improvements,
- Installing and repairing pump stations and flood gates,
- Requirements for new development to increase resilience (such as building requirements and zoning), and
- Improving public education around climate.

While the MVP program itself does not provide funding for these mitigation efforts, it is important to note that the Environmental Bond Bill does provide such funding, which can complement existing flooding mitigation efforts, such as the Eastern County Ditch cleaning.

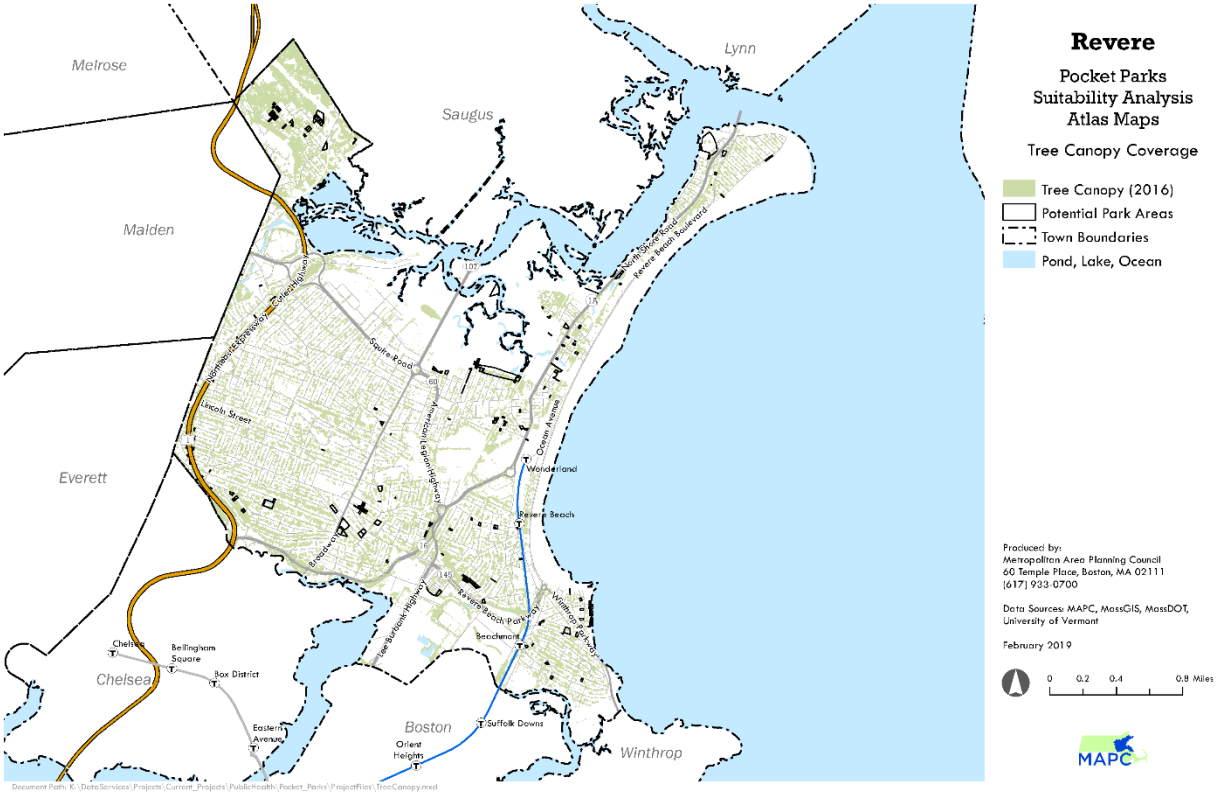

Figure 7: Urban tree canopy in Revere

URBAN TREE CANOPY

Revere became a Tree City USA in 2018 in recognition of their work on urban trees. Revere is a participant of the Massachusetts Greening the Gateways Cities Program (GGCP), which is aimed at increasing urban tree canopy and planting more trees. Increasing urban tree canopy can have the following benefits:

- Increased energy efficiency by reducing heating and cooling needs
- Reduced stormwater runoff
- Improved air quality
- Increased property values

However, planting street trees and urban trees can be challenging in terms of finding appropriate and suitable space for them, as well as continued maintenance over time. The typical life span of a street tree is only 10-15 years in a dense urban setting due to the stresses they face.[18] Additionally, it is challenging to spend public funds on improvements to private property, such as a program that would fund trees on private property/yards where the tree may have a longer life span. Revere may consider developing an urban forest plan and specific targets for maintenance and planting of new trees, as well as public-private partnerships that may be able to fund additional tree planting.

18 Roman, Lara and Frederick Scatena. "Street tree survival rates: meta-analysis of previous studies and application to field survey in Philadelphia, PA, USA" Urban Forestry and Urban Greening. (2011) 269-274. http://www.actrees.org/wp-content/uploads/2012/08/roman-scatena-2011-street-tree-mortality.pdf

Challenges

The city of Revere faces several challenges on both energy use and climate preparedness. As a city that is mostly developed, there is limited opportunity to use land-use policies such as zoning and building code to substantially improve building stock for either efficiency or resilience purposes, because these tools are better suited for new development or deep retrofits. However, these tools will still make an impact on new development and properties going through redevelopment or deep retrofits.

While the City has direct control over its own energy use and consumption, it will need to develop key policies and programs that either incentivize or mandate residents and businesses to be more energy-efficient or install clean energy.

As an urbanized coastal community, Revere not only faces challenges associated with coastal storms and flooding but also with urban flooding and heat island impacts. Climate change also disproportionately impacts vulnerable populations, and special considerations are needed to ensure that all Revere community members are addressed in resiliency planning, including low-income communities, communities of color, and those for whom English is their second language (or have linguistic isolation).

Opportunities

Despite the challenges that Revere faces around energy and climate, there are many opportunities to reduce climate impacts both through mitigation of greenhouse gases, as well as preparedness and adaptation efforts across the city.

The City has an opportunity to develop a comprehensive Climate Action Plan, which is commonly a community-wide planning document that outlines goals and opportunities for climate mitigation and GHG reduction. These plans often include GHG reduction goals not only for the building sector but also for transportation and waste sectors. Some communities, such as Somerville, have chosen to jointly address climate adaptation within their Climate Action Plan to maximize community benefits and collaboration. Municipalities across the region are setting net-zero[19] goals and developing plans to achieve these reductions over the next several decades. As noted above, Revere is part of the Metro Mayors Coalition commitment to becoming a net-zero region by 2050.

While much of Revere is developed, its significant opportunities for redevelopment could be catalysts for key energy efficiency and resilience initiatives. New planned residential and mixed-use developments along the waterfront can continue to use resilience best practices (such as elevated occupied first floors or locating mechanical equipment on the roof, among other examples). There are a few examples of recent and planned developments that use innovative and resilient building strategies, including the Suffolk Downs development currently in the permitting process. This 161-acre site is located in the current FEMA floodplain and faces climate impacts such as sea-level rise and storm surge. In its current plans, the developer intends to plan to an eleven-foot base flood elevation and also incorporate large portions of open space that can double as flood storage. Additionally, the developer will be including energy efficiency goals in the development. The City can also use larger developments such as these to leverage private dollars to fund and finance local infrastructure projects that provide public benefits, such as seawalls and drainage and sewer improvements. In the instance of Suffolk Downs, these improvements have been due to both the leadership of the developer, community input, and the permitting process, including site plan review and the environmental permitting process. As the project is implemented, these climate mitigation and resilience measures should be evaluated to determine their effectiveness and potential replicability in other developments.

The City has an opportunity to ensure (either through incentives or mandates) that these types of climate benefits are considered by codifying these best practices into zoning policies, site plan review processes, and other tools. For example, the City of Boston under Article 80 has implemented a Resiliency Check List for new developments over 50,000 sq. ft., as well as a Smart Utilities Policy for large developments that requires feasibility studies of key technologies. Whiles some of this can and does happen during site plan review, by codifying it in policy, the City will ensure these goals are met no matter which individuals sit on the planning board. It can also help ensure that the community continues to leverage public benefits from private development, including climate benefits.

Another opportunity for Revere is in the potential for a new community center and new high school, which could be designed as a "resilience hub," to provide shelter and resources for the community during extreme

19 Net-zero energy has several definitions, but often means that the GHG emissions produced are offset and that there is a net zero of carbon pollutions created. For more information on net-zero planning the region, https://www.mapc.org/net-zero/.

weather events and electrical grid outages. Ideally, new public facilities such as these would reflect local climate goals around energy use, clean energy, and climate resilience.

There are also many opportunities through Parks and Recreation, DPW, and planning staff to develop stronger partnerships and collaboration with the Department of Conservation and Recreation (DCR) to utilize green infrastructure and nature-based solutions to increase resilience, as well as many other co-benefits associated with green space. Green Infrastructure (GI) not only improves water quality, but also provides urban cooling, air quality benefits, beautification, and other benefits depending on the type of GI.

Additionally, Revere can continue to work regionally to address climate issues through the Metro Mayors Coalition Climate Preparedness Taskforce. Revere is part of a regional commitment with fourteen other municipalities to prepare the region for the impacts of climate change, as well as a commitment to become a net-zero region by 2050. These partnerships and collaboration strengthen local work, as well as enhance coordination with State agencies such as MBTA, MassDOT, and DCR and advocate for improvements to State policies.

Community Input

FEEDBACK FROM FORUMS

Many participants noted the need for more green space and open space, including street trees. Several people also noted the need for better waste collection programs, including recycling and curbside composting.

Input and feedback on the sustainability topics of energy and climate were collected during the first open-house kick-off meeting through interactive boards, as well as the second community forum. During the open house, participants were asked: "What would make Revere more sustainable?" Many participants noted the need for more green space and open space, including street trees. Several people also noted the need for better waste collection programs, including recycling and curbside composting. In addition, participants were asked to note where they already see climate impacts or expect to see them, including flooding and heat. Many residents already experience flooding in key areas such as the Point of Pines neighborhood and around Belle Isle Marsh. As noted in their verbal and written comments, participants were shocked when looking at the map of urban heat across the city.

The *Next Stop Revere* Community Forum focused on Transportation, Sustainability, Open Space, and Public Health was held on May 8th, 2019. During the forum, the Metropolitan Area Planning Council presented on key considerations for Energy and Climate and hosted a breakout session on this topic. Participants in the breakout discussion included a mix of Revere staff members, Steering Committee members, and residents. Participants were asked to provide feedback on seven proposed goals and discuss the topic of energy and climate more broadly. Participants were also asked to fill out a short questionnaire ranking each of the proposed goals. 100% of the people who filled out the questionnaire marked "protect and adapt important infrastructure from natural hazards and climate change" as high importance. Increasing access for residents and businesses to clean energy also ranked high (either all high priority or medium priority). During the

discussion, energy infrastructure, such as power lines and threats from coastal storms, were discussed. Residents also felt like they needed more reliable information and education on clean energy, in particular, rooftop solar.

FEEDBACK FROM THE SURVEY

The online survey asked participants to rank the importance of several key issues for Revere. Over 70% of respondents marked "Improving energy efficiency and alternative energy sources" as important, very important, or extremely important. Additionally, "Finding nature-based solutions to manage flooding" was rated as important or higher by 82.73%, including 32.46% who marked it as extremely important. There were also several write-in comments about the importance of sustainability and open, green space for the community.

KEY THEMES

This section provides a summary of feedback received from members of the public. The community feedback through the forums and survey show that sustainability issues around energy and climate are a high priority for residents and a critical element to improving the quality of life of Revere's residents. Feedback also shows that Revere residents are already experiencing climate impacts, such as flooding and heat issues. There is a strong desire to increase open, green space that would provide multiple public benefits, including recreational and community gathering space, improve air quality, reduce urban heat islands, and manage and improve stormwater.

Recommendations

Goal 1

Reduce energy use and GHG emissions across the community

Planning

Strategy 1.1: Create an Energy and Climate Committee that can advise on issues of climate mitigation (reduction of Green House Gas (GHG) emissions and energy savings), as well as climate preparedness and resilience.

Land Use and Regulatory

Strategy 1.2: Develop and adopt a citywide Climate Action Plan to reduce Greenhouse Gas Emissions (GHC) for all sectors (including buildings, transportation, waste, etc.). Set ambitious, specific, and measurable municipal goals for GHG reductions over time.

Strategy 1.3: Adopt zoning and design guidelines that help reduce GHG through energy efficiency and clean energy in new development and retrofits.

Goal 2

Increase access for residents, businesses and non-profits to clean energy for electricity and heating/cooling needs

Programming, Partnerships and Internal City Operations

Strategy 2.1: Lead a Solarize+ campaign that includes clean heating and cooling options.

Strategy 2.2: Provide residents and businesses with resources for consumer protection on renewable energy options in coordination with the Consumer Affairs Department, a regional office based in Revere.

Strategy 2.3: Participate in a Community Choice Aggregation or Green Municipal Aggregation program to provide a higher percentage of clean energy. In these programs, municipalities contract with a competitive electricity supplier to provide additional clean energy to local customers through the existing electricity grid. Often these programs supply clean energy for a reduced cost, and participants may see cost savings.

Strategy 2.4: Increase municipal solar PV, particularly at the schools, in order to reduce energy costs and GHG emissions. Consider pairing with energy storage for resilience benefits.
Strategy 2.5: Ensure that new municipal facilities, including schools, are net-zero buildings or meet the highest energy efficiency standards possible.

Land Use and Regulatory

Strategy 2.6: Reduce municipal barriers and streamline processes to adopting solar, including reviewing zoning code to determine any barriers to solar installation and providing clear materials to residents regarding the permitting and inspection process.

Goal 3

Ensure that built infrastructure is protected or adapted from natural hazards and climate change impacts

Programming, Partnerships and Internal City Operations

Strategy 3.1: Explore opportunities to acquire and protect land within the floodplain, as well as open space opportunities to be paired with flood storage to enhance flood management.

Strategy 3.2: Ensure that any existing or proposed capital improvements incorporate resilient design standards that will mitigate the impacts of climate change and strengthen resilience.

Strategy 3.3: Incorporate cost-effective green infrastructure strategies and best management practices in the construction, renovation, and maintenance of all municipal public buildings and facilities to expand energy efficiency, renewable energy, environmental stewardship, help mitigate stormwater runoff and the impacts of climate change.

Strategy 3.4: Continue participation in the Greening the Gateway Cities Program to increase tree canopy cover in the city.

Planning

Strategy 3.5: Develop a shoreline protection plan that includes both grey and green infrastructure solutions to manage sea-level rise and storm surge.

Strategy 3.6: Develop a plan and guidelines for using open space and green infrastructure to combat urban heat island impacts, including setting goals for increase urban tree canopy by certain percentages annually.

Strategy 3.7: Partner with State agencies and utility providers that own and operate key assets in the city, including MBTA, DCR, and energy utilities, to plan and coordinate infrastructure improvements, following successful participation in other regional coalitions such as the Mystic Valley Watershed Association and other coalitions.

Land Use and Regulatory

Strategy 3.8: Adopt Resilient Flood Overlay district (or update existing flood overlay) to plan for future sea-level rise projections and establish design guidelines and best practices for both traditional built infrastructure as well as green infrastructure that used natural systems to provide services.

Goal 4

Implement programs to increase education, awareness, and access to climate resilience for all community members, including those most vulnerable to climate change impacts

Programming, Partnerships and Internal City Operations

Strategy 4.1: Establish a "resilience hub" for community members to use during an emergency and provide other community services (including storm shelter and cooling center). Ideally, the site will have energy storage and can operate during a grid outage.
Strategy 4.2: Ensure that materials on climate change are translated into multiple languages and are available to a wide diversity of groups, especially those most impacted by climate change.

Strategy 4.3: Partner with local community organizations such as Revere Beach Partnership, Alliance for Health and Environment, and Point of Pines Neighborhood and houses of worship to create a neighbor helping neighbor program during extreme weather events and increase climate awareness.

Strategy 4.4: Establish curriculum in local schools and after school programs to educate students about climate change mitigation and adaptation. Solar PV and other technology at schools can help provide a "living laboratory" for students.

Strategy 4.5: Educate and create programs for residents and businesses to make resilience improvements to their private property, including floodproofing and coordinate with the Consumer Affairs Department to disseminate information to residents and businesses.

Strategy 4.6: Expand recycling programs, such as the "pink bag" textile recycling program, and explore the possibility of offering a composting program.

Planning

Strategy 4.7: Assess housing stock in relation to anticipated climate change effects and target low-income homeowners in high-risk locations with programming to make changes that reduce the risk of climate-induced flooding and thermal impacts.

Strategy 4.8: Explore ways to incentivize the use of electric vehicles, such as through educational outreach, designated parking, and installation of charging stations.

Strategy 4.9: Continue to coordinate with the Northeast Homeland Security Regional Advisory Council (NERAC) to ensure proper evacuation preparation measures are in place, with particular attention to residents dependent upon public transit.