the green worcester sustainability and resilience strategic plan

2020

City of Worcester
and
Green Worcester Working Group

The City *of* WORCESTER

GREEN WORCESTER
Community | Resilience | Sustainability

"The health of the eye seems to *demand* a horizon. We are never tired, so long as we can see far enough."

— Ralph Waldo Emerson, *Nature*

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CITY OF WORCESTER

RESOLVED:

That the City Council of the City of Worcester does hereby support the timeline and action items set forth by the Green Worcester Sustainability and Resilience Strategic Plan.

In City Council **April 27, 2021**

Resolution adopted by a yea and nay vote of Eleven Yeas and No Nays

A Copy. Attest:

Nikolin Vangjeli
City Clerk

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Acknowledgements

Thanks to all the residents, City staff, and representatives of Worcester's institutional, business, and nonprofit communities who participated in making this plan a reality!

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Table of Contents

What's in the Plan? How Should I Read It?

The Green Worcester Plan includes an Executive Summary and twelve chapters in one volume, and an Appendix in a separate volume. Chapter I discusses broad issues around the need for a systematic approach to sustainability and resilience and the Green Worcester Vision.

Chapter II focuses on how the City of Worcester's government can create a more coordinated approach across city departments and how it can collaborate with residents, businesses, community organizations, and institutions to achieve sustainability and resilience goals.

In ten topic-area sections, Chapters III through XII contain strategies and actions by topic areas such as energy, transportation, waste, and water, while at the same time identifying interactions and interconnections.

The Green Worcester Plan can be read all the way through or selectively, according to the reader's interests. Government agencies, businesses, nonprofit institutions, and others can choose specific topics relevant to their activities.

- For a quick overview of key themes and major early recommendations, read the Executive Summary.
- Read Chapter I – A Green Heart for Worcester for definitions of sustainability and resilience, a review of sustainability activities and achievements in the City of Worcester in recent decades, and the Green Worcester Vision.
- Chapter II – The Green Worcester Approach: Stewardship, Transparency, and Accountability focuses on how Worcester's city government can organize for an integrated approach to effective implementation in collaboration with non-governmental partners.
- The topic-oriented Chapters III-XII all have a parallel organization:
  - *"Summary"* of key strategies and actions in the chapter
  - *"Goal"* to be achieved
  - *"Why"* each topic and goal is important
  - *"What we're doing now"* to show what government and others have been doing so far in the topic area
  - *"How"* we can achieve the goals in a matrix of actions with measures of progress and indications of "Who" should work on the action and "When," a general timetable for implementation.
  - *"Getting Started"* provides suggested early actions for government, business, institutions and nonprofits, and individuals and households.

In a separate volume, the Appendix provides further resources, examples, and evaluation tools to support the Green Worcester Plan topic areas.


PARK

The Green Worcester Sustainability and Resilience Strategic Plan

About this Plan

The Green Worcester Plan is a strategic framework for an integrated and systematic approach to making Worcester one of the most sustainable and climate-resilient mid-sized cities in America by 2050. The Plan focuses on City leadership, goals, strategies, and actions, with the collaboration of partners across the city, including residents, institutions, businesses, nonprofits and others.

After adopting a Climate Action Plan in 2006, the City of Worcester established a robust program of energy conservation, efficiency, and renewable energy use in City-owned facilities and operations. With partners, the City has acted to reduce water pollution and contaminated sites, invested in parks and trees, implemented single-stream recycling, supported local food system networks, and installed electric vehicle charging stations – but there is much that remains to be done. In 2019 the City completed a Municipal Vulnerability Preparedness plan to identify priority climate change hazards and preparedness actions and the City Council approved a Climate Emergency Resolution "to…combat global warming [and] end citywide greenhouse gas emissions as quickly as possible and no later than 2030."

The City's Energy & Asset Management Division developed the plan in 2019–2020 with the assistance of the Green Worcester Working Group, made up of city staff, representatives of environmental organizations and residents, and a consultant. Public participation included a professional, scientific public opinion survey; several online surveys; a public workshop; and a public open house on proposed goals and actions.

Why Now?

The increasingly urgent and complex challenges of sustainability and climate change are here to stay. In response, we must coordinate all our investments in energy, buildings and development, transportation, and stormwater management; that we care for our green and blue spaces; and that our land use planning maximizes benefits for Worcester and all its residents. This will give priority to investments that provide "co-benefits," the quality of life, equity, and prosperity benefits that come from actions that promote sustainability and climate change resilience.

How We'll Get it Done

The Plan includes a framework for transparent and accountable implementation. A new Department of Sustainability and Resilience with dedicated funding will lead City sustainability and resilience efforts, assisted by an Interdepartmental Implementation Committee made up of City staff and a Green Worcester Advisory Committee composed of civic partners. It will be a "living plan" with online data, annual progress reports for the public, and regular review and revision to stay up-to-date with new opportunities.

building a green and equitable Worcester

Our Green Worcester Vision

Twenty-first century Worcester **will be sustainable, resilient, green, livable, prosperous, and equitable.**

Government, residents, businesses and institutions will work together in **shared stewardship and mutual care of our city and our planet.** We will use our resources efficiently and wisely for **minimal impact on our environment, while integrating sustainability and resilience into all policies.**

Powered 100% by clean and affordable energy, we will be physically, socially, and economically resilient to the impacts of climate change. Our commitment to sustainability and resilience will benefit everyone who lives, works, and studies in Worcester.

- New and older buildings will produce enough energy for their own needs (net zero) and are healthy and climate resilient.
- Our connected green and blue open spaces will support a healthy natural environment for people and wildlife.
- Residents and visitors will have multiple sustainable, safe, convenient, and reliable transportation choices to get around our vibrant city.
- Our water and related infrastructure systems will be managed to enhance sustainability and resilience.
- Government, citizens, and businesses will move toward zero waste.
- We will have local, sustainably-grown food.
- Our water, soil, and air will be clean and healthy.
- We will be a center of sustainability education and vocational training, providing paths to local, well-paid green jobs.
- Sustainability and resilience principles will permeate education and all municipal policies and actions.

Our Green Worcester Goals

1. 100% Clean and Affordable Energy
By 2030: 100% renewable energy for municipal facilities
By 2035: 100% renewable electricity citywide
By 2045: 100% renewable energy that includes heating and transportation.

2. Connected Green and Blue Spaces with Healthy Natural Systems
Maintain, improve, connect, and expand quality natural systems in a linked network of parks, open spaces, and water bodies, including street trees and public spaces.

3. Net Zero and Climate Resilient Buildings
Require new buildings to be net zero and climate-resilient, and promote deep energy retrofits of existing buildings.

4. Sustainable Transportation Choices
Provide safe, convenient, and comfortable pedestrian, bicycle, and public transportation networks and transition to vehicles powered by renewable electricity.

5. Zero Waste
Implement a plan to prevent – reduce – reuse – compost – and recycle waste.

6. One Water: Integrated Water Management
Manage drinking water, wastewater, and stormwater as one resource; increase the use of natural green infrastructure to manage stormwater and to avoid flooding.

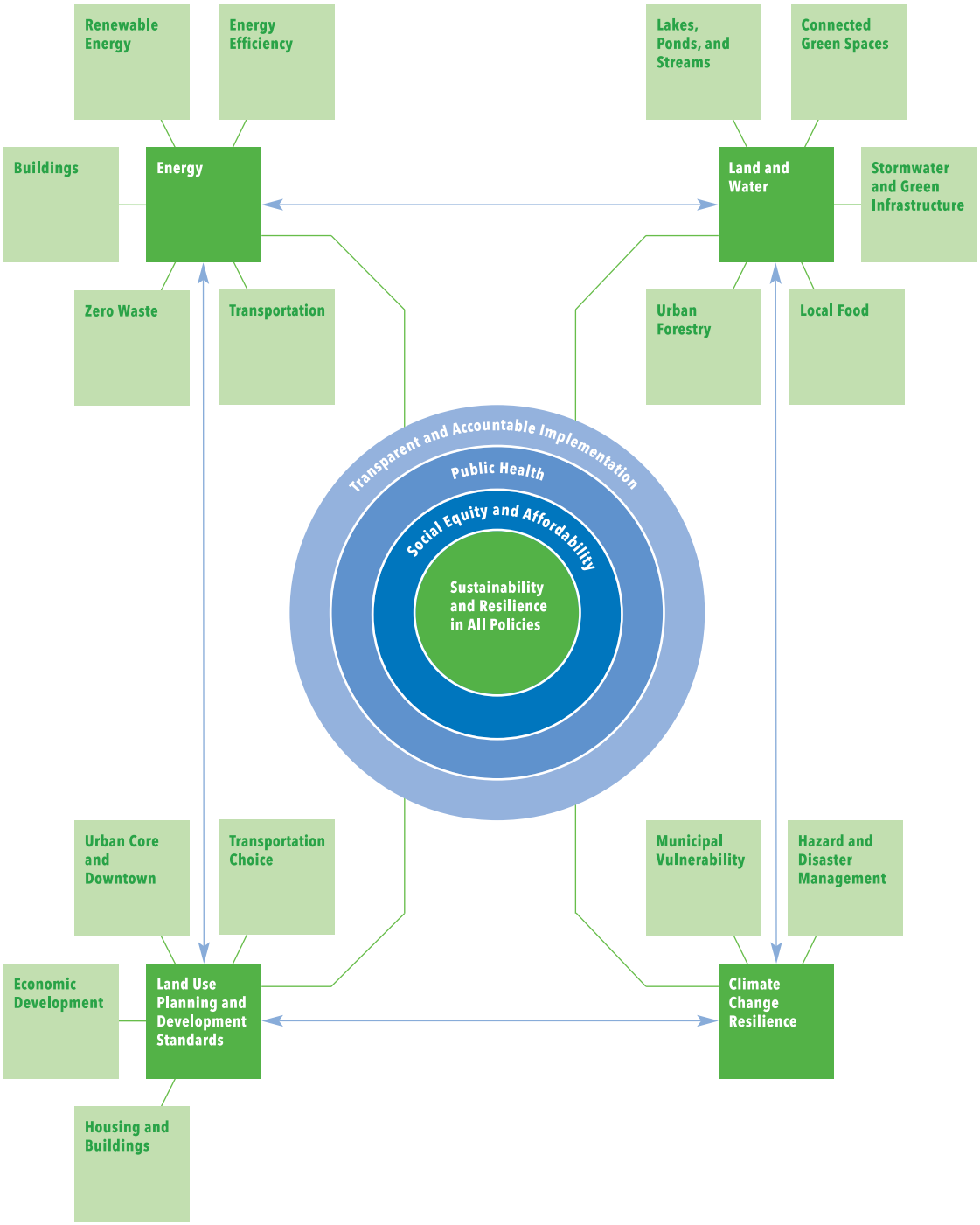
7. Sustainable Local Food Systems
Ensure that residents have access to food that is sustainably-produced, locally-sourced, healthy, affordable, and culturally-appropriate.

8. Pollution Prevention
Ensure that residents breathe healthy indoor and outdoor air and are not exposed to contaminated soils and toxic products.

9. Climate Change Resilience
Make the city resilient to climate change impacts, such as extreme storms, flooding, and heat.

10. Sustainability, Resilience, and Green Education in All Policies
Implement integrated sustainability and resilience policies for land use, transportation, housing, and economic development – while making Worcester the regional center for sustainability education and training for green jobs.

Sustainability and Resiliency in All Policies



The Big Picture

- Energy. *The foundation of the Green Worcester Plan is a citywide transition to 100% clean, renewable energy by 2045,* in City facilities, through the City's Community Choice Electricity Aggregation Program, and working with other levels of government and suppliers.

- Buildings and Transportation. We need *energy retrofits for older buildings; safe, convenient, and reliable pedestrian, bicycle, and transit networks; and new land use policies* to support walkable, compact, activity centers.

- Natural Systems. *Investment in natural systems, like planting trees, and maximum reduction of waste, toxics, and pollution produces multiple sustainability, climate change adaptation, and quality of life benefits.*

- Social Equity. *A focus on social equity and representation in the Advisory Committee is needed to make sure the Green Worcester Plan benefits everyone.* Low-income and minority communities are among the most vulnerable to the impacts of pollution, climate change, and lack of green space.

- Education and Awareness.

"Sustainability and Resilience in All Policies" requires raising awareness, communication, and partnerships across City departments, in the Worcester Public Schools and workforce training, and throughout the city. New systems and regulations require adequate City staff and partners for data collection, training, maintenance, and enforcement.

Ten Early Actions to Implement the Green Worcester Plan

1. Organize to implement the plan in City government by creating a Department of Sustainability, a Green Worcester Advisory Committee, and a Green Worcester Interdepartmental Implementation Committee.

2. Actively promote the 100% renewable energy option among Worcester electricity consumers.

3. Plan, design, and implement sustainable transportation and mobility options by identifying priority Complete Streets projects for state funding, developing a Pedestrian, Bicycle, and Micromobility Plan, and collaborating with the WRTA to improve transit.

4. Develop and adopt net zero, climate resilience, and healthy homes standards for new and existing buildings.

5. Develop an Urban Forestry Master Plan and continue the Lakes & Ponds Program to create a blueprint for investments that provide shade and reduce heat, reduce pollution, slow and reduce stormwater that causes flooding and pollution and provide wildlife habitat – while improving aesthetics, promoting physical activity, and supporting economic development.

6. Develop and implement a Zero Waste Master Plan including a program for residential organic waste.

7. Establish sustainability and climate resilience performance outcomes or standards for all new projects seeking tax incentives or other public funding from the City.

8. Identify and implement opportunities for green infrastructure in City facilities and landscapes, and promote green infrastructure on private properties.

9. Update the City's Environmentally Preferable Purchasing Policy to include an Extended Producer Responsibility purchasing ordinance to favor vendors with responsible waste reduction programs.

10. Ensure that the new comprehensive plan expected in the next several years is informed by the Green Worcester Plan and integrate Green Worcester goals and strategies into day to day planning for boards and commissions and for project proponents.

Achieving the Green Worcester Goals with Co-Benefits

Save Money!

- Since 2009, the City's energy conservation and renewable energy measures in municipal facilities have resulted in a 2 to 1 Financial Return on Investment.
- For households, building insulation and other energy conservation measures with Mass Save program rebates save on insulation, heating and electricity costs. Energy Star appliances save about $100 a year in energy costs on average.
- Driving an electric car on average saves half the annual cost of a fossil-fuel powered car in fuel, maintenance, and repairs.

Be Healthier!

- Less air pollution through more transportation choice, tree planting, and other efforts results in better health by reducing premature death.
- Opportunities for safe walking and biking promote physical activity, reducing obesity and related diseases.

Keep Cool!

- More trees and "cool roofs" (reflective paint on roofs) mean lower temperatures, more shade, and lower air conditioning costs.

Create Jobs!

- Energy efficiency and renewable energy installations need workers.
- Green infrastructure needs workers for regular maintenance.
- Cleaning up and redeveloping contaminated brownfield sites brings new development and associated jobs.

Enjoy Green and Blue Spaces!

- Healthy, balanced, and well-connected green spaces improve quality of life, support habitat and nature recreation, and enhance property values.
- Healthy blue spaces – the city's lakes, ponds, and streams – provide recreation and habitat.

Improve Quality of Life in the Urban Core, Downtown, and Neighborhood Centers

- More street trees, green spaces and transportation choices – coupled with less air pollution and impervious surfaces – support a community-oriented, walkable, healthy, and vital urban way of life.

City of Worcester, Massachusetts: Joseph M. Petty, *Mayor* | Edward M Augustus, Jr., *City Manager* | John Odell, *Director, Energy and Asset Management Department*

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I

A Green Heart for Worcester:

Our Values and Vision

Summary Chapter I
A Green Heart for Worcester: Our Values and Vision

Chapter I sets the stage for creating the Green Worcester Plan. This chapter focuses on the Vision and the framework underlying the development of the vision: Worcester's values and previous initiatives to advance sustainability and resilience, sustainability values expressed by the public in a survey and workshops, the importance of a more systematic and integrated approach, and the concept of a Sustainable Return on Investment.

Our Vision for Green Worcester

Twenty-first century Green Worcester will be sustainable, resilient, green, livable, prosperous, and equitable. Government, residents, businesses and institutions will work together in shared stewardship and mutual care of our city and our planet. We will use our resources efficiently and wisely for minimal impact on our environment, while integrating sustainability and resilience into all policies. Our commitment to sustainability and resilience with equity will benefit everyone who lives, works, and studies in Worcester.

- We will be powered 100% by clean and affordable energy.
- We will be physically, socially, and economically resilient to the impacts of climate change.
- New and older buildings will be healthy, climate resilient, and net zero, powered by renewable energy.
- Residents and visitors will have multiple sustainable, safe, convenient, and reliable transportation choices to get around our vibrant city.
- Our connected green and blue open spaces will support a healthy natural environment for people and wildlife.
- Our water and related infrastructure systems will be managed to enhance sustainability and resilience.
- Government, citizens, and businesses will move toward zero waste.
- We will have local, sustainably-grown food.
- Our water, soil, and air will be clean and healthy.
- We will be a center of sustainability education and vocational training, providing paths to local, well-paid green jobs.
- Sustainability and resilience principles will permeate education and all municipal policies and actions.

Worcester's Commitment to Sustainability and Resilience

City of Worcester Sustainability Milestones

1993
Pay-as-you-throw and recycling waste management program

2003
City Council resolution to join the Cities for Climate Protection Campaign

2004–5
Greenhouse gas inventory and adoption of 20% renewable electricity goal for city operations in 2010

2006–7
Climate Action Plan

2009–14
Worcester Tree Initiative begins and successfully replants 30,000 trees lost to insect infestation

2010
Designated as a Green Community by the State

2011–2020
$80 million investment in energy efficiency and renewable energy in City facilities and operations

2017
Mayor and City Manager sign the US Climate Mayors' statement to support Paris Climate Agreement

2017
8 Megawatt municipal solar energy array opens on former landfill

2018
Mayor signs a commitment letter to advance solar energy use

2018
Complete Streets Policy approved by the State

2019
City Council resolution declaring a climate emergency

2019
Integrated Water Management Plan

2019
Municipal Vulnerability Preparedness plan for climate change resilience

2019–20
Green Worcester Plan

2020
Community Choice Electricity Aggregation Program

In 2019 the Worcester City Council adopted a resolution declaring a climate emergency. This resolution commits the city "to a citywide just transition and climate emergency mobilization effort to combat global warming, which, with appropriate financial and regulatory assistance from State and Federal authorities, ends citywide greenhouse gas emissions as quickly as possible and no later than 2030."

This Green Worcester Sustainability and Resilience Strategic Plan is the first step in designing a new, integrated policy approach to making Worcester the "greenest" mid-size city in America while advancing the mobilization effort to combat global warming. The resolution acknowledged that the City of Worcester would need State and Federal action and funding to end greenhouse gas emissions "citywide," a word that encompasses many issues where municipal control is limited, such as transportation. The Green Worcester Plan is focused primarily on what city government can control but it also recognizes the importance of State and Federal properties, actions, programs, and funding, as well as the essential role to be played by an array of non-governmental partners and civic organizations, who are likewise not directly managed by the City. The Plan includes a more nuanced schedule for energy, ranging from 2030 net zero for City-owned facilities and operations to 2045 for complete net zero energy, including transportation and building energy. At the time of writing, during the 2020 pandemic, many uncertainties remain about the resources for sustainability and resilience that Worcester city government will be able to draw on in the coming years. Depending on the emergence of these and other opportunities, the energy goals will be adjusted to be earlier.

Important characteristics of the Green Worcester Plan to take into consideration include:

- The Plan is intended to be a "living plan," both aspirational and pragmatic. It calls for an annual progress report and review that encourages accelerated actions and goals as opportunities arise.
- Chapter II focuses on stewardship, transparency and accountability strategies and actions that are relevant to equity, inclusiveness, and accountability in all topics in the Plan.
- The Plan reflects the reality that the City has limited data on many issues. Access to new data and modeling will enhance the City's ability to make progress.
- As an integrated policy framework, the Plan includes action items and guidance to develop new functional plans and updates, and implementation of existing plans, ensuring that they all reflect desired sustainability and resilience outcomes. Although the Green Worcester Plan includes relevant action items, it is not intended to cover detailed analysis or all possible interventions in the topic areas. It is not the city's comprehensive or land use plan.
  - New plans: Urban Forestry Master Plan; Pedestrian, Bicycle and Micromobility Plan; Zero Waste Master Plan
  - Updates and implementation of existing plans: Comprehensive Plan; Open Space and Recreation Plan; Complete Streets Plan; Integrated Water Management Plan; Hazard Mitigation Plan; Municipal Vulnerability Plan; Comprehensive Health Improvement Plan.

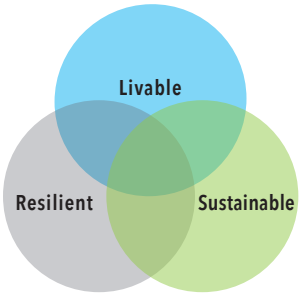
The City of Worcester has been committed to sustainability and climate action since the 1990s from waste diversion and recycling to energy conservation, efficiency, and renewable energy use in city facilities and operations and an over $60 million investment in parks and open spaces. Today, as scientists warn of accelerating global warming, loss of biodiversity, and plastics pollution, Worcester is intensifying that commitment.

In addition to the City's initiatives, commitments, and accomplishments, efforts by citizen groups, nonprofit organizations and businesses, and students in the city's universities and colleges have all contributed to Worcester's growing implementation of sustainability and climate change resilience actions. Many challenges remain and there is still a lot of work to do, but Worcester's city government and community can be proud of its accelerating sustainability and climate change mitigation efforts over the last three decades.

Many of these past accomplishments and initiatives have been coordinated loosely or not at all, often as separate projects or programs in "silos" without much communication. Today, as the challenges of sustainability and climate change become more urgent and more complex, an effective program requires a more integrated and systematic approach to sustainability and climate change resilience.

Defining Sustainability and Resilience

What do we mean by "sustainability" and "resilience?"



"Worcester is already becoming warmer and wetter."

The simplest definition of sustainability is a set of policies and practices that results in meeting the needs of present generations without compromising the ability of future generations to meet their own needs. This was the definition of sustainable development in the 1987 United Nations report "Our Common Future," also known as the Brundtland Report.[1] This foundational definition has become more complex as the holistic and interrelated character of sustainability has merged with the increasing recognition of climate change and its impacts.

- Sustainability includes promoting healthy environmental systems and habitats as well as supporting conditions for continued ecosystem services. Ecosystem services are the benefits to humans provided by a healthy ecosystem, for example, food and water, flood and disease control, and nutrient cycling.
- Climate change affects many aspects of sustainability and is now generally included in sustainability planning. Climate change action plans (like Worcester's 2006 plan) are sometimes created separately and may include broader sustainability elements. This Green Worcester Plan incorporates climate action planning for resilience.
- "Resilience" is the term often used in discussing climate change actions. Climate change resilience is the ability of a community to adapt and thrive in the face of extreme shocks and stresses. The narrow definition of resilience focuses on climate-change related impacts, such as flooding and heat, but shocks and stresses encompass a range of events – from the COVID-19 pandemic to deindustrialization. Resilient communities anticipate risks, plan to limit their impacts and adopt strategies that integrate all community systems – civic, environmental, social and economic – to mitigate and support recovery from extreme events while providing a good quality of life.

The world is warming faster than expected

As this plan is being written in 2019-2020, multiple new studies and reports are emerging on the acceleration of climate change, with average global land and water temperatures rising faster than expected, melting Arctic ice and permafrost, faster rise in sea levels, more intense storms, and changes in habitat, vegetation and wildlife.[2] The 20-teens are the hottest decade on record.[3] International efforts to agree on measures to reduce the rate of increase in the average global temperature are contentious.

In the coming decades, Massachusetts is expected to experience significant increases in temperature, both in summer and winter; annual average precipitation

[1] https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf
[2] Henry Fountain, "Climate Change Is Accelerating, Bringing World 'Dangerously Close' to Irreversible Change," *New York Times,* Dec. 4, 2019.
[3] Andrew Freedman, "The 2010s will go down in history as the Earth's warmest," *Washington Post,* December 5, 2019.

is projected to increase, though with important seasonal differences, such as more frequent and damaging ice storms and floods; earlier peak spring streamflow; more frequent droughts. These climate shifts will lead to changes in forest composition; changes in insect populations, including disease vectors; and a longer growing season, though one disrupted by extreme weather events.[4] Sea levels are rising faster on the northeast coast of the United States than anywhere else in the world.[5] In general, Worcester will become warmer and wetter by 2050.

Climate trends in Massachusetts	Climate projections for Worcester
■ 2.9 degrees increase in average temperature since 1895 ■ 11 inches in sea level rise since 1922 ■ 11 more days in the growing season since 1950 ■ 55% increase in strong storms since 1958	■ Increase in total precipitation and days with over 2 inches of precipitation annually ■ Winter precipitation volume to increase 30% ■ Annual days below freezing to decrease ■ More winter precipitation to be rain or freezing rain ■ Higher chance of ice and freezing rain storms ■ More days over 90 degrees ■ More chance of drought

Worcester as a "climate refuge city" over the coming decades.

As an interior city, Worcester will be vulnerable to increased flooding from extreme storm events that bring more precipitation, but it will not be directly affected by sea level rise. However, the costs and impacts of sea level rise on coastal municipalities, such as repeated tidal flooding or increased or unavailable insurance, are expected to make more people choose to live away from the coasts. Worcester can attract new residents for sustainability reasons – becoming known for being "green" – as well as for its increasing onomic, social, and cultural success. Worcester can benefit from state assistance in climate change mitigation, (for example, the legislature passed a $1.3 billion bond on July 25, 2019 for city and town climate change projects), but the city will also find that the state expectations will rise with new sustainability and climate change standards.

Worcester Values

What Worcester residents think about sustainability and resilience.

The Green Worcester planning project was advised by the Green Worcester Working Group, made up of City staff, residents, and representatives of environmental groups. It included over 30 interviews of city staff and representatives of institutions and nonprofit organizations; a professionally administered public opinion survey and online version of the survey; a drop-in public open house and an online survey for those who could not participate in the open house. The public opinion survey was administered in English and Spanish to a representative group of 606 Worcester residents by MassInc Polling Group. (The results of this survey can be found in the Appendix.) In order to provide an opportunity for additional residents to participate in the survey, separate online versions of the survey (in both English and Spanish) were made available in summer and fall of 2019. The availability of the online survey was publicized with flyers in English and Spanish through distribution at events, email lists, and social media. There were 297 respondents to the English language online survey and 3 respondents to the Spanish language survey.

The telephone survey found that 89% of respondents said it is "very important" (64%) or "somewhat important" (25%) that the city become a "green and

[4] For details see MAPC, Metro Boston Regional Climate Change Adaptation Strategy Report, 2014, (http://www.mapc.org/sites/default/files/RCCAS_full_report_rev_8-28-14.pdf)
[5] https://sealevelrise.org/states/massachusetts/
[6] Marcello Rossi, "Some northern cities could be reborn as 'climate havens'," Yale Climate Connections, August 2019.

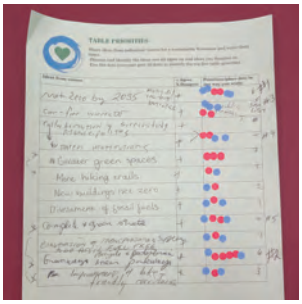
World cloud of workshop vision statements

sustainable place." Worcester's communities of color place a higher level of importance on making the city a green and sustainable place. Among non-white residents, 74% thought this was "very important," compared to 59% of white residents. People in Worcester are concerned about climate change and its likely impacts on the greater Worcester region and many residents recycle and are conscious of energy conservation. The online survey had similar results, with nearly 90% support for transforming Worcester into a green and sustainable city. Top priorities were improving public transportation and reducing pollution, waste and greenhouse gas emissions. In both surveys, respondents showed they were not well informed about City government sustainability initiatives.

At a public workshop on October 16, 2019, over 80 participants heard brief presentations on existing sustainability accomplishments and the Green Worcester Plan; wrote individual vision statements for sustainability in Worcester; and discussed and identified top priorities within small groups. (A report on the workshop findings can be found in the Appendix.)

The most commonly-mentioned vision elements were enhancing and accelerating energy efficiency, the transition to renewable energy sources, and more transportation alternatives to personal vehicles—better walking, biking, and public transportation options. Other popular themes included a focus on environmental justice communities (the urban core of the city), green and blue spaces, and food security

Green Worcester Workshop, October 16, 2019



Green Worcester Priority Sheet

Youth Survey

In the fall of 2019, a shorter version of the online survey was made available by the Worcester Division of Youth Services to youth in their programs. The survey attracted thirty-two responses, of whom approximately one-half identified as Black (including a few who also identified as Latino), about 40% identifying as Latino, with the remainder identifying as White. The respondent groups were also almost evenly divided between males and females. About two-thirds were college students and the rest were in high school. While the respondent group was small, it provides a window into the thinking of Worcester youth about sustainability and resilience.

Almost all respondents said it was "very important" that Worcester be a green and sustainable city, with the few remaining respondents saying that it is "somewhat important." When asked about the importance of a list of issues (as in the telephone survey), the items deemed "very important" by a large majority of respondents were: reduction of GHG emissions, pollution, and waste; cleanup of contaminated soils; access to healthy foods; teaching of sustainability in schools; and green businesses and jobs. Items on safer bicycling and walking, improved public transportation, and non-polluting transportation, were slightly less likely to be seen as "very important," suggesting that for a minority of respondents, the relationship between sustainability and transportation policy may not be clear. Almost all respondents said that climate change is real (four said "maybe") and identified potential climate change impacts, especially more heat waves. The youth respondents were also asked what actions that they could take personally to become more sustainable. The majority focused on actions related to reducing waste, recycling more, and conserving water and electricity.

Open House

On March 10, 2020, the Green Worcester project held a 4 pm – 7 pm drop-in public open house in the Worcester Senior Center. At this time, people were becoming more conscious of the pandemic and the Governor declared a state of emergency about the pandemic on this very evening. About twenty people signed in at the event. The event was designed so that attendees could drop in to the senior center for ten to twenty minutes during the three-hour event, view a set of posters with proposed Green Worcester Plan vision, goals, and actions, and provide their comments and priorities. Although this was a small group of

attendees, they indicated that certain items were of particular interest. The top priorities in selected topic areas were as follows:

Administration	■ Create a Department of Sustainability
Energy	■ 100% renewable energy for municipal facilities by 2030 ■ 100% renewable energy citywide by 2035 ■ Transition to renewable energy for heating and transportation by 2045
Buildings	■ Incentives and financing options to accelerate energy retrofits
Zero Waste	■ Divert food waste and curbside green waste collection ■ Increase trash and recycling containers in public places
Natural Systems	■ Prioritize new green spaces in the urban cores ■ Implement and enforce regulations on land disturbance and development
Food Systems	■ Expand school gardens and a garden curriculum in the public schools
Transportation	■ Develop a Complete Streets priority plan ■ Transition to electric vehicles for the WRTA and City government
Climate Change	■ Expand the tree canopy and green spaces and limit impervious surfaces
Sustainability In All Policies	■ Integrate Green Worcester policies into day to day planning ■ Identify and plan for compact activity centers and urban villages ■ Ensure that zoning changes advance sustainability and resilience

Online Public Review

A Public Review draft of the Green Worcester Plan was posted online for public review between October 18 and November 18, 2020. Through an online platform that allowed direct comment on the document, approximately 350 comments were registered. The planning team read all the comments and made some modifications based on the public comments to respond to concerns and clarify issues, taking into the account the scope and level of detail appropriate to the plan.

Sustainability and Resilience Values and the City Strategic Plan

In 2018, the Worcester City Manager's office created a Strategic Plan that includes four priority areas and a series of strategies and key performance indicators (KPIs). The Strategic Plan was developed by engaging city staff, residents, and businesses, and in conjunction with planning for a new Office of Urban Innovation which is designed to coordinate implementation of the Strategic Plan, including development of modern datasets that will allow more effective, data-driven decision making.

The four priority areas make explicit the values that guide the community and city government of Worcester:

Vibrant, Thriving City

- Honor and celebrate diverse and inclusive cultural events.
- Provide opportunities for business development and employment growth.
- Maintain a safe and appealing infrastructure.

Opportunities for All

- Support opportunities for skill development, employment, and educational advancement for all residents.
- Provide opportunities for all residents to access the services and support they need to live a healthy life.
- Support civic engagement and provide all residents with equitable access to information and communication with City leadership.

Strong Neighborhoods

- Support safe and affordable housing options.
- Maintaining appealing neighborhoods with high-quality infrastructure and green spaces.
- Promote a sense of safety and security for all residents.

Sound Fiscal and Operational Government

- Prudent steward of municipal services.
- Attractive employer of high-performing, talented workforce.
- Transparent and regular engagement.

These four priority areas imply, but do not make explicit, the sustainability and resilience values that have become important to Worcester. For example, the City's work reducing greenhouse gas emissions in its own facilities, recent City Council resolution declaring a climate emergency, and the many local groups involved in related issues, show that the city is poised to become a sustainability and resilience leader. The surveys and public engagement undertaken as part of the Green Worcester planning process also show that people in Worcester want the city to be more sustainable and climate-change resilient, but often are not well informed about what is already happening in the city.

The Green Worcester Plan therefore proposes that the City of Worcester explicitly add a fifth strategic priority area – Sustainable and Resilient City – to its city government Strategic Plan. Similarly, the new comprehensive planning initiative expected in the early 2020s will make sustainability and resilience central to the plan for 21st century Worcester. The proposed fifth strategic priority area is as follows:

Sustainable and Resilient City

- Become a zero-emissions and zero waste city.
- Prepare for the impacts of climate change and other extreme events.
- Protect and enhance natural systems.
- Incorporate sustainability and resilience into all policies to improve and protect quality of life for all residents, and to create community and social resilience, with special attention to environmental justice and vulnerable populations.

The Green Worcester Plan: Systematic Thinking and "Co-benefits"

Green Worcester requires systematic thinking

Sustainability and resilience are complex concepts that include interrelated ecological, economic and social dimensions. Planning for Green Worcester requires systems thinking. In this case, the City of Worcester is the system whose interrelated components act together to deliver more benefits as a whole than the sum of the individual parts. Approaching sustainability from a systems perspective means avoiding policy and implementation silos by paying attention to interrelationships, seeking out and incorporating different perspectives, understanding the potential for unintended consequences, and agreeing together on scope and scale of improvements.

Green Worcester provides "co-benefits"

This means that the Green Worcester Plan and its implementation requires a process that is more than a collection of individual projects. Identifying how "projects" can produce multiple benefits, sometimes called "co-benefits"– and avoid conflicts – is essential. Co-benefits of sustainability and resilience include improving public and environmental health, cost savings for households, improved urban livability, increased transportation choice, stimulating new businesses and jobs, and enhancing opportunities for housing and economic stability for current and new residents.

Green Worcester incorporates equity, health, and prosperity lenses

A systematic and holistic approach to sustainability and resilience requires explicit attention to the perspectives or "lenses" of equity, health, and economic prosperity. These perspectives ensure that the development and implementation of policy and actions will be coordinated with other city goals to make sure that all communities receive benefits, especially the most vulnerable populations, and that the plan provides multiple "co-benefits" so that the whole is more than the sum of the parts. Sometimes this is called the "Triple Bottom Line," the integration of environmental, social, and economic values for sustainable outcomes.

The Equity Lens

The importance of equity and inclusiveness in sustainability and resilience planning and implementation has become a standard. It means asking key questions about all policies and projects – Who benefits? Who gets to decide? Cities often establish separate social equity advisory groups and increasingly include explicit equity evaluation criteria for strategies and actions. A 2014 report by the Urban Sustainability Directors Network defined equity in the following way:

"Equity in sustainability incorporates procedures, the distribution of benefits and burdens, structural accountability, and generational impact. This includes:

- Procedural Equity – inclusive, accessible, authentic engagement and representation in processes to develop or implement sustainability programs and policies
- Distributional Equity – sustainability programs and policies result in fair distributions of benefits and burdens across all segments of a community, prioritizing those withhighest need
- Structural Equity – sustainability decision-makers institutionalize accountability; decisions are made with a recognition of the historical, cultural, and institutional dynamics and structures that have routinely advantaged privileged groups in society and resulted in chronic, cumulative disadvantage for subordinated groups
- Transgenerational Equity – sustainability decisions consider generational impacts and don't result in unfair burdens on future generations."[7]

In 1994, Executive Order 12898[8] ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations") incorporated environmental justice into requirements for federally funded projects, requiring federal agencies "to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations." The State of Massachusetts identifies a community as an Environmental Justice community if it has any of the following characteristics: 1) Block group whose annual median household income is equal to or less than 65 percent of the statewide median; or 2) 25% or more of the residents identify as a race other than white; or 3) 25% or more of households have no one over the age of 14 who speaks English only or very well. Using these characteristics, approximately 70% of Worcester is a designated "environmental justice" census tract. However, the urban core has higher percentages of low-income, nonwhite, and limited English populations. In addition

Examples and Toolkits for Equity and Inclusiveness

- **Carbon Free Boston Social Equity Report, 2019.** https://www.greenribboncommission.org/document/carbon-free-boston-social-equity-report/
- **Resilient Boston, 2017.** Boston's resilience plan is a companion plan to the city's climate change plan, *Climate-Ready Boston,* and focuses on equity issues within the context of resilience. www.boston.gov/sites/default/files/document-file-07-2017/resilient_boston.pdf
- **Just Providence, 2017.** After adopting a sustainability plan in 2014, Providence developed a separate but linked equity lens project and framework, "Equity in Sustainability," with foundation support. www.providenceri.gov/sustainability/climate-justice-action-plan-providence/
- **NAACP Environmental & Climate Justice Program (ECJP).** In 2019, the ECJP published a detailed toolkit for local communities to organize and participate in climate change planning: *Our Communities, Our Power.* https://live-naacp-site.pantheonsite.io/wp-content/uploads/2019/04/Our-Communities-Our-Power-TOOLKIT-FINAL.pdf

[7] https://www.usdn.org/uploads/cms/documents/usdn_equity_scan_sept_2014_final.pdf
[8] https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice

to these groups, socially vulnerable populations also include the elderly, children, and people with disabilities.[9]

The 2019 Climate Emergency resolution adopted by the Worcester City Council refers to the idea of a "just transition." "Climate Justice" and "Just Transition" are terms used to focus on incorporation of economic and social justice as a foundation of climate change adaptation. First developed by the union movement, "Just Transition" is a conceptual framework based on the idea of a shift to a low-carbon and climate resilient economy. The concept has broadened to become more proactive by adding a vision of healthy, thriving, and connected local economies that will meet the needs of workers and communities in the transition to a low-carbon and climate resilient economy.

There are many organizations in Worcester dedicated to advancing equity and inclusiveness, and city government in principle is committed to equity. Ensuring that social equity and environmental justice be a bedrock principle of Green Worcester is a strong thread throughout the interviews, committee meetings, public surveys and public meetings conducted to develop the Green Worcester plan. Grassroots organizations in the city have been very active in advocating for renewable energy, the Worcester Climate Emergency Declaration, and sustainable policies and activities. Cities are increasingly finding that they need to institutionalize the equity lens by working with representatives of environmental justice and socially vulnerable groups to create organizational structures that can be effective. Foundation and other grants are available to support the time and effort needed on all sides to support civic and governmental organizational structures to institutionalize consistent attention to the equity impacts, consequences, and benefits of sustainability and resilience initiatives.

This Green Worcester Plan recommends institutionalizing the City's sustainability and resilience actions through the creation of a Department of Sustainability, an Interdepartmental Sustainability Implementation Committee made up of Sustainability Coordinators from City departments, and a Green Worcester Advisory Committee made up of people representing the interests of residents, business, environmental justice communities, institutions, and other stakeholders in civil society. These three groups – the department, the interdepartmental committee, and the advisory committee – can begin using the equity lens in a consistent way by applying a series of equity questions to initiatives and projects. The social equity scorecard developed for Boston can serve as a foundation The scorecard has a series of questions focused on fairness, affordability, inclusion, respect for cultural values, and regular measurement of equity benefits and impacts on equity.

Social Equity Questions to ask about Green Programs and Projects:

Is it Fair?

Is it accessible?

- Available to and beneficial for all communities and addresses historical disparities and cultural differences

Is it affordable?

- All private residents can afford it and negative impacts on the public sector are limited

Are there just workforce opportunities?

- Fairness and balance in workforce and contractor diversity, including addressing historical disparities.

Who Gets to Decide?

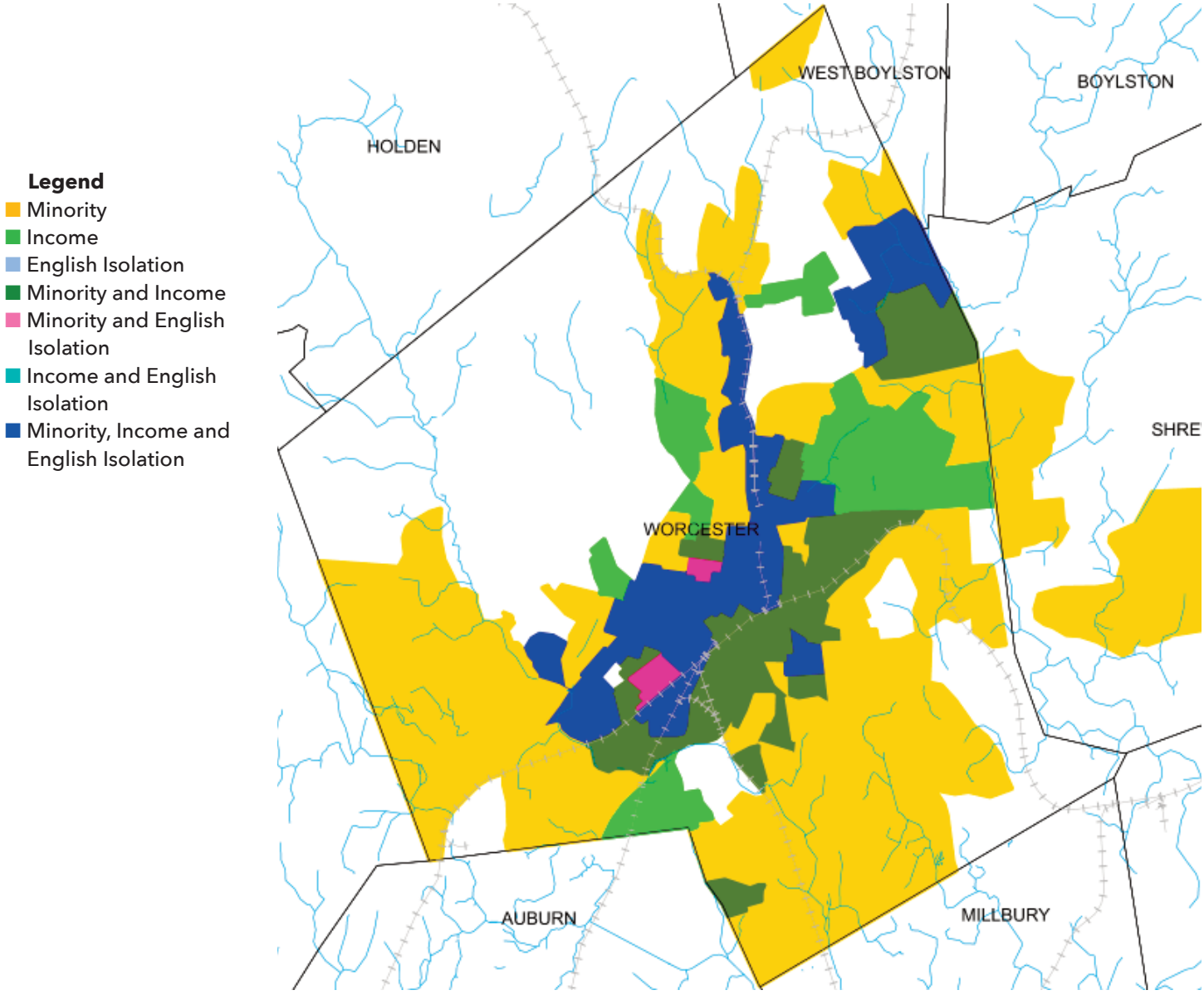
Is it inclusive?

- Impacted or socially vulnerable communities have an active and meaningful role in decision making.

Are values considered?

- Decision making processes go beyond dollars and cents to address shared values and cultural differences.

[9]See the Social Vulnerability Index: https://svi.cdc.gov/ and https://toolkit.climate.gov/tool/social-vulnerability-index



Worcester Environmental Justice Populations 2010
Source https://www.mass.gov/info-details/environmental-justice-communities-in-massachusetts

The Health Lens

Public health planners already speak about "Health in All Policies (HiAP)."[10] The Worcester Division of Public Health has developed a HiAP vision for community health with nine priority areas: racism and discrimination; substance use; access to care; mental health; economic opportunity; cultural responsiveness; access to healthy food; physical activity; and safety. Sustainable and resilient practices are strongly correlated with better public health outcomes. Fossil fuel emissions and particulates exacerbate chronic respiratory and other diseases. More trips taken by walking or bicycling not only reduce greenhouse gas emissions but provide opportunities for healthier lifestyles. Sustainably-produced local food makes healthy food choices available to more people.

[10]See https://www.cdc.gov/policy/hiap/index.html

Source: www.practicalplaybook.org

The Economic Prosperity Lens

Green economies create new industries and jobs. The Bureau of Labor Statistics defines "green jobs" as those in renewable energy production, energy efficiency, and environmental management. This includes "all occupations throughout the wind, solar, hydro, biomass, geothermal, and nuclear energy supply chain....[J]obs related to reducing energy intensity in buildings, appliances, and transportation.... [and] jobs that directly relate to environmental health. On average, green jobs pay above the national average, despite lower average educational requirements.[11] In 2019, the clean energy sector alone accounted for over 18,000 jobs in over 1,100 businesses in Central Massachusetts, and included a diverse workforce, according to the Massachusetts Clean Energy Center.[12] Sustainable and resilient practices provide efficiencies and cost savings for consumers, households, businesses, and government.

Economic analysis of sustainability and resilience projects should be evaluated for costs and benefits on a life cycle basis, taking into account savings over the long term and avoided costs of all kinds, such as the costs of flooding or other disasters. Green cities are cleaner and more livable, and they attract new residents and businesses.

Sustainable Return on Investment: Costs, Benefits, Resources

Sustainable practices and projects are sometimes assumed to be more expensive than traditional, status quo approaches, often because traditional economic models do not capture the full value of the benefits of sustainable growth and the full

[11] "Advancing Inclusion through Clean Energy Jobs," https://www.brookings.edu/wp-content/uploads/2019/04/2019.04_metro_Clean-Energy-Jobs_Report_Muro-Tomer-Shivaran-Kane_updated.pdf;"Redefining Green Jobs for a Sustainable Economy," https://tcf.org/content/report/redefining-green-jobs-sustainable-economy/

[12] MassCEC 2019 Industry Report, p. 31.

costs of traditional approaches. However, many sustainability projects have direct financial benefits for individual households, businesses and organizations, and city government. These include savings on energy and water bills as well as positive returns on capital investment and relatively few years for payback on investment. For example, the City of Worcester's energy efficiency and renewable energy project for municipal buildings has life-cycle savings of approximately $164 million on an investment of $80 million over ten years – a savings of more than two dollars for every dollar invested. Private households and businesses realize a positive return on investment (ROI) on a variety of energy conservation or renewable energy projects, including Energy Star electronics and appliances, lighting, insulation, HVAC, solar installations, and electric vehicles.

Triple Bottom Line, Cost-Benefit Analysis and Sustainable Return on Investment (SROI)

A full accounting of the costs and benefits of sustainability programs requires an understanding of costs and benefits beyond financial metrics such as traditional (financial) Return on Investment (ROI), Net Present Value (NPR), and payback in years. Triple bottom line cost-benefit analysis, also known as Sustainable Return on Investment (SROI) has been developed to capture the full benefits of sustainable projects and investments, including operations and maintenance. This type of analysis provides financial results and monetary values for social and environmental impacts that traditionally have been treated as externalities or qualitative benefits, such as improved air and water quality and restored habitat. Using SROI analysis can help the City evaluate proposed projects for investment, identifying projects with the highest overall estimated benefits. This kind of analysis is increasingly used by both the public and private sector, including for federally funded transportation and Army Corps of Engineers projects, state building projects, and municipal building and utility agencies. It is endorsed by sustainability rating systems like LEED and the Envision rating system for sustainable infrastructure. In communities like Worcester, much of the infrastructure is nearing (or already beyond) its life span. New investment is renewing buildings, downtown, and neighborhoods in the city. The planning and design for retrofits and new growth is happening now. Worcester has the opportunity to use new investment to become more efficient, livable, sustainable, resilient, and inclusive.

Financing and Funding Resources

In addition to municipal resources, funding for sustainability and resilience projects and programs are available from federal, state, and philanthropic sources. State and federal financing resources and rebates exist to incentivize households and businesses to implement energy efficiency, renewable energy, and other sustainability improvements.[13]

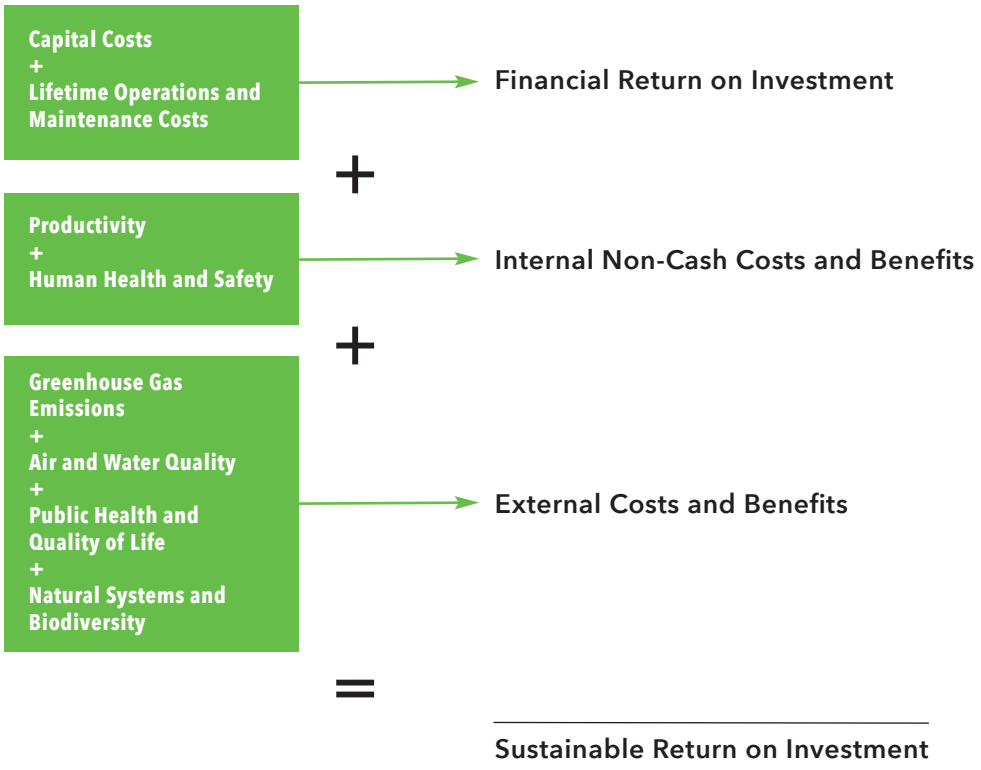
New options for financing are also becoming available. Examples include Qualified Energy Conservation Bonds and PACE (Property Assessed Clean Energy) programs. Municipalities can take advantage of Qualified Energy Conservation Bonds (QECBs) that allow a federal tax credit to investors, reducing interest costs to the municipality. QECBs can be used for a very broad range of projects and programs including upgrading vehicle fleets, green community programs, demonstration projects, and so on. Massachusetts has just begun to implement

[13]DSIREusa.org is an online catalog of grants and incentives for renewables and energy efficiency by state.

PACE programs that allow property owners to finance 100% of hard and soft costs of clean, renewable and efficient energy investments. The investments are repaid on the property tax bill over decades and the repayment terms stay with the property even if it changes ownership.

The Green Worcester Plan's commitments to equity and inclusiveness will require attention to social innovation and non-traditional investment, and financing strategies to help environmental justice communities--more vulnerable and under-resourced groups—participate in achieving the goals of the plan. Examples include revolving loan funds, distributed renewable energy systems with community or nonprofit ownership, and other emerging options.

Components of Sustainable Return on Investement



(Source: LBA based on "Triple Bottom Line Calculator," http://www.bostonplans.org/getattachment/838900d5-3b91-4029-aa08-b80e025de66b)

II

The Green Worcester Approach:

Stewardship, Transparency and Accountability

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Summary Chapter II
Stewardship, Transparency and Accountability

This chapter of the Green Worcester Plan focuses on how city government can organize itself to advance policy and implement the plan through coordinating city departments and leading collaborations with non-governmental groups and residents. The strategies and actions apply to all the topic areas in subsequent chapters. There are many non-governmental groups active in a variety of environmental and climate change organizations in Worcester. The goal is that all members of the Worcester community know what the Green Worcester goals are and how they can contribute to achieving the goals.

A. Goal

The City has a public, transparent, and accountable commitment to implementing the Green Worcester Plan, making sustainability and resilience values understood and practiced throughout the Worcester community.

B. Why?

Although the City has much to be proud of, the City's sustainability efforts up to now have been fragmented. The focus has been on the work of the Energy and Asset Management Division's programs for energy efficiency and renewable energy. Various other departments, from Public Works and Parks to the Worcester Public Schools, have programs and activities related to sustainability but they are not well-coordinated with the work of other departments in a systematic way. Despite important achievements, Worcester has lacked a holistic and integrated approach to sustainability and resilience. This chapter provides a framework for the City to organize implementation, transparency, and accountability across city departments and to work with multiple stakeholders across the city to advance achievement of the Green Worcester goals. This organizational framework applies to all the topic areas in the Green Worcester Plan.

C. What We Have Done So Far

Municipal

- The **Energy and Asset Management (EAM) Division** has focused on energy efficiency and renewable energy in city facilities. EAM has been the City's manager for the Municipal Vulnerability Preparedness Plan, the Green Worcester Sustainability and Resilience Plan, the pursuit and implementation of the Green Communities designation by the state, implementation of the multi-year multi-million dollar municipal energy savings performance contract, and implementation of the Green Community Electricity Aggregation program. Other departments are not required to coordinate with EAM, though there are informal information exchanges.
- **Worcester Public Schools'** Facilities Department does energy efficiency work in its buildings, often in partnership with EAM.
- The **Worcester Energy web site,** managed by EAM, provides information on Worcester's sustainability initiatives, with an emphasis on energy but also including some other sustainability and resilience information, such as the Municipal Vulnerability Preparedness report on resilience priorities.
- In separate divisions, the **Department of Public Works** plans, designs, maintains, and manages waste, recycling, and composting; drinking water, wastewater, and stormwater; parks and open space (including oversight of updates to the Open Space and Recreation Plan); street design and maintenance; and construction of public buildings (e.g. new schools).
- The **Planning & Regulatory Services Division** developed a Complete Streets Policy with a Transportation Advisory Committee. It expects to update the City's outdated 1987 comprehensive plan in the early 2020s.

- The **Emergency Management Division** oversees updates to the Worcester Hazard Mitigation Plan.
- The **Green Worcester Working Group**, made up of city staff and organizational representatives, functioned as an advisory group to the Green Worcester Planning process. It was first established as a small group in 2018 and expanded with additional civic representatives in 2019.
- The City of Worcester participates in **Earth Day** festivals and city cleanups involving many volunteers – a city tradition since 1990. The Regional Environmental Council coordinated Earth Day activities 1990-2002, and the Ecotarium took on that role since 2003.

Non-governmental organizations

- Numerous nonprofit groups, institutions, community groups, and cooperatives organize programs, activities, and events related to sustainability, resilience, and climate change.
- They have varying levels of membership, stability, and capacity for action. Some are affiliated with strong state or national groups.
  - Mass Audubon Worcester/ Broad Meadow Brook Sanctuary
  - Greater Worcester Land Trust
  - Tower Hill Botanic Garden/ Worcester Tree Initiative
  - Ecotarium
  - Park Spirit
  - Renewable Energy Worcester
  - Fare-Free Worcester
  - Worcester Roots
  - Regional Environmental Council (REC)
  - Climate Action Circle
  - 350 Central Mass
  - Mothers Out Front Worcester
  - Worcester Earn-A-Bike
  - Woo Rides
  - Walk/Bike Worcester
  - Watershed Associations
  - Clean Water Action
- There are many environmental and climate change youth groups, as well as collegiate academic programs and student groups. Mass Audubon sponsors "Climate Cafes," forums focused on climate change and environmental justice, and also sponsored a Youth Climate Summit in Worcester in early 2020 which had representation from the following groups:
  - Worcester Technical Public School
  - Regional Environmental Council (Youth Grow)
  - Sunrise Worcester
  - Quinsigamond Community College
  - College of the Holy Cross (Eco Action)
  - Assumption College (Green Hounds)
  - Bancroft Schools
  - Worcester State University (sustainability office @ WSU)
  - Clark University
  - St. Peters Central Catholic (climate club)

- Worcester no longer has an environmental umbrella organization, a role once served by the Regional Environmental Council, nor is there a central source of information on who is doing what, how, and when in sustainability and resilience.

The Regional Environmental Council (REC), as its name indicates, was founded in 1972 and originally conceived as an umbrella environmental advocacy organization for Central Massachusetts whose members would represent smaller organizations. Over the course of 40 years, REC played an important advocacy role for sustainability issues in Worcester, including open space planning, water resource protection, and the creation of the 2006 Climate Action Plan. In the 1970s and 1980s, REC was an active advocate in the areas of waste and recycling, land use, environmental education, watershed protection, open space preservation, and planning and enforcement. In the 1990s, it continued working on many of these issues, organized the regional Earth Day celebration, and began its community garden and youth development programs.

New organizations emerged from the REC, such as the Greater Worcester Land Trust and the Blackstone Valley Heritage Corridor, and over time the REC became a membership organization and advocacy nonprofit that worked with other organizations, hiring its first director in 1993. With the emergence of the environmental justice movement, the social justice aspects of urban environmental advocacy led REC members to create community gardens. By 2017, REC was running 15 programs on a small budget and decided to focus almost entirely on food justice and food security issues. (See Chapter IX Sustainable Food Systems.)

Over the last 20 years, REC increasingly focused on food by managing farmers' markets and developing the school garden program, in addition to its community garden and urban farming work. Its food justice programs are very important to the city, but the city now lacks an umbrella organization that coordinates smaller civic efforts and effectively advocates for sustainability and resilience.

D. How

The success of the Green Worcester Plan depends on stewardship, transparency, and accountability. Successful stewardship of the plan requires that there be a group or groups responsible for working towards achieving the goals, strategies and action items in the plan, including regular review, evaluation, and, if necessary, modification. Transparency means that the public has access to information and opportunities to influence decision-making. Accountability requires providing information on who is responsible for implementation, with public measures of progress on achieving goals. The strategies and actions in this chapter are applicable to all the subsequent chapters on topic areas. Organizational strategies to achieve these values include:

- Create a Department of Sustainability within City government separate from a new Public Facilities Department (and retire the Energy and Asset Management Division).
- Create a Green Worcester Advisory Committee made up of non-governmental stakeholders to serve as the forum for information exchange and to advise on the City's sustainability and resilience activities.

- Implement transparent measurement, accountability, and compliance systems for City government and the public, including a public annual progress report.
- Engage the public through education and outreach on sustainability and resilience issues, including outreach to environmental justice communities.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions City Organization for Implementation	Measures of Progress
1. New Department of Sustainability: ***Create a Department of Sustainability and Resilience within City government separate from a new Public Facilities Department (and retire the Energy and Asset Management Division).*** The Department of Sustainability will have responsibility for broader sustainability and resilience programs as well as the City's energy programs. This may include moving certain municipal functions, such as urban forestry and transportation planning, to the Department of Sustainability. In addition, the new department will provide a strong advisory role to municipal functions, such as the design and construction of new municipal buildings and major renovations. The department will also coordinate with sustainability and resilience activities, programs, and groups outside City government and expand public education, awareness, and participation. A study will be released in the early 2020s with recommendations on setting up such a department as an early action item. ■ Designate Green Worcester coordinators in each City department and a cross-departmental Green Worcester Implementation Committee, adding new, knowledgeable staff if necessary. ■ Create an Implementation Committee working group with a focus on developing cost-efficient and effective compliance and enforcement methods for sustainability-related regulations. ■ Create an Implementation Committee working group with a focus on creating a resilience priority task list from the Hazard Management Plan, Municipal Vulnerability Preparedness Plan, and the Green Worcester Plan. This priority list can then be used to seek State and other outside funding. ■ Develop sustainability report cards for potential and existing municipal projects in collaboration with the Implementation Committee for use during project design and implementation. ■ Develop a social equity report card for sustainability. ■ Incorporate sustainability, resilience, and equity into the Planning Division's expected new city comprehensive plan. ■ Advocate for and seek out state, federal, and philanthropic funding for Worcester sustainability and resilience projects. ■ Continue to seek partnerships with local universities for technical models and analyses. ■ Advocate for a fossil-fuel divestment strategy in the City's retirement plan system.	**Who:** City Manager **When:** EA and ongoing
2. Sustainability and resiliency codes and regulations: ***Ensure that the City provides sufficient enforcement, training, and knowledgeable staff to develop and implement sustainability and resiliency codes and regulations.*** ■ Ensure there is clarity as to where responsibility lies with respect to enforcement of the existing and future resilience regulations and codes. ■ Provide sufficient resources and train City staff to enforce existing and future sustainability and resiliency regulations such as energy building code requirements and stormwater management regulations. ■ Provide training, as needed, for departmental Green Worcester coordinators, including application of an equity lens.	**Who:** City Manager **When:** EA and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions City Organization for Implementation	Measures of Progress
3. Green Worcester Advisory Committee: ***Create a Green Worcester Advisory Committee made up of non-governmental stakeholders to serve as the forum for information exchange and to advise on the City's sustainability and resilience activities.*** ■ The Department of Sustainability would staff this group. Appointed by the City Manager, members of this group should represent residents in each of the City Council districts, environmental justice communities, the business community, institutions, nonprofit environmental groups, and persons with special expertise. The Committee would employ equity, health and prosperity lenses when reviewing and advising on initiatives and projects. ■ Responsibilities would include quarterly review of progress in implementing the Green Worcester plan, review of an annual progress report prepared by the Department of Sustainability, review and comment on relevant municipal projects, as well as interface with and education of the public at events. ■ The annual report would be presented in a joint public hearing to the City Council and relevant boards and commissions, and would be published on the City website. ■ Representation of environmental justice communities should include more than one person, because of the diversity to be found in these communities, which include vulnerable populations such as low-income, minority, immigrant, and limited-English residents. Explore opportunities to fund capacity-building for this purpose. Funding sources could include local and regional funders such as the Greater Worcester Community Foundation and the Barr Foundation, as well as national organizations such as the Funders' Network for Smart Growth and Livable Communities, Partners for Places, and the Surdna Foundation.	**Who:** City Manager **When:** EA and ongoing
4. Green Worcester Fund: ***Create a Green Worcester Fund for the City's sustainability and resilience programs.*** ■ Identify and designate a funding source from City funds. ■ Explore designating a portion of savings resulting from energy-efficiency and renewable energy programs for the Green Worcester Fund. ■ Explore a small surcharge on property sales to help fund Green Worcester goals and priorities and affordable housing. Boston has passed a transfer fee of up to 2 percent on real property sales over $2 million (1% paid by seller and 1% paid by buyer), with the funds to be used for affordable housing, and is awaiting state approval. In addition, the Governor in 2019 proposed a real estate transfer tax to pay for climate change resilience infrastructure. Worcester could create a combined green and affordable housing transfer tax tailored to Worcester conditions whose proceeds could be divided between Green Worcester and affordable housing programs. ■ Explore potential funding through Qualified Energy Conservation Bonds. ■ Seek grant funding for Green Worcester projects.	**Who:** City Manager **When:** EA – establish the fund early even if initial capitalization of the fund is constrained.
5. Sustainability Performance Outcomes for New Developments: ***Establish sustainability performance outcomes to be met by all new construction or redevelopment projects seeking tax incentives from the City*** ■ Required performance outcomes can be written to give project applicants the option to choose how they will meet the desired outcomes in their projects, subject to approval by the City. A system of this kind makes it possible to consider innovative solutions that may	**Who:** Planning Division with Green Worcester, Planning Board, City Manager **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
not have been available at the time an ordinance or operating procedure document is approved. At the same time, the City can indicate preferred sources of required performance outcomes such as LEED requirements and the metrics and outcomes used in the MEPA certification process. Focusing on outcomes rather than on prescribed standards that may become obsolete allows for the incorporation of innovative approaches that enhance performance.	
City Transparency and Accountability	
6. Develop and implement a Sustainability and Resiliency Dashboard. ■ The dashboard should be designed to track progress on sustainability and resilience goals as data become available and more reliable. Topics include municipal energy use and GHG emissions; community-wide GHG emissions; transition to transportation alternatives; progress towards zero waste; air and water quality; resiliency actions; and other metrics as appropriate. City departments and civic partners will contribute to this reporting process.	**Who:** Department of Sustainability with IT Department and partners **When:** EA to ST– Begin with existing energy data for city facilities and expand by developing data
7. Annual Progress Report: *Prepare an annual public progress report on implementation of the Green Worcester Plan.* ■ The Department of Sustainability will prepare the annual report with review by the Green Worcester Advisory Committee. The report would be presented in a joint public hearing to the City Council and relevant boards and commissions. ■ Update the Green Worcester plan at least once every ten years based on the annual reports, unforeseen barriers and opportunities (such as new technologies), and a public participation process.	**Who:** Department of Sustainability with IT Department and partners **When:** EA and ongoing
8. Outreach Strategy: *Implement a transparent Green Worcester outreach strategy to include traditional and new media and activities.* ■ The strategy, at a minimum, should include a web site with the dashboard, press releases, social media, email lists, events, a central calendar of relevant events sponsored by others, an implementation dashboard, studies and reports, and a newsletter. ■ Convert the WorcesterEnergy website into a Green Worcester site encompassing broader programs and serving as a citywide resource on sustainability and resilience events and activities. ■ Use Community Based Social Marketing (CBSM) techniques to encourage residents and other Worcester stakeholders to make sustainable and resilient behaviors part of their everyday lives. Rather than simply providing information, a CBSM approach is a results- and action-oriented approach that identifies barriers to change and helps people make changes in their behavior.	**Who:** Department of Sustainability with Advisory Committee **When:** EA to ST: Begin in collaboration with the Green Worcester Advisory Committee and citizen groups to identify how best to reach residents and stakeholders

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
9. Data and Data-Driven Decisions: ***Work with the Office of Urban Innovation to develop relevant datasets to measure progress and make data-driven decisions about sustainability and resilience.*** ■ Since Worcester established its energy programs in 2007, the Energy and Asset Management Division has kept good records about energy efficiency and renewable energy, especially in municipal facilities. Other data is available because of state mandates (such as recycling data) or studies and plans (such as the Integrated Water Management Plan). This Green Worcester project includes a Green Worcester Inventory of Programs and Projects as of 2019 as an appendix to this Plan. However, other data relevant to sustainability is not available, often because it has not yet been digitized. ■ Work with the Office of Urban Innovation to include a sustainability lens to the proposed "lean management" process for city government operations. (Lean management is a process for problem solving that emphasizes customer satisfaction, quality, safety, and efficiency while maximizing value and minimizing waste.) ■ Create a list of data priorities for implementation of the Green Worcester Plan in coordination with the Office of Urban Innovation. Some of these priorities are likely to have other benefits for the city. For example, targeting programs to promote energy retrofits for housing would benefit from better housing data that includes information on the amount and distribution of rental and ownership housing, housing types, investor-ownership and owner-occupancy in the triple decker stock, existing energy system types, and so on.	**Who:** Department of Sustainability **When:** EA and ongoing
Green Worcester in Public School Education	
10. School Curriculum: ***Integrate sustainability and resilience into the curriculum at all levels in the Worcester Public Schools*** ■ WPS offers an environmental science course at the high school level and some schools have schoolyard gardens, but sustainability/resilience elements as related to life in Worcester should be included throughout the school curriculum in every grade. Massachusetts uses an adaptation of the Next Generation Science Standards which includes climate change education. Students and faculty in the Boston Public Schools developed a sustainability and climate change curriculum for K-12 students that is aligned with state standards and has its own website with lessons, projects, and teacher resources: www.climatecurriculum.com/ ■ Develop programs in green building systems, green infrastructure design and maintenance at Worcester Technical HIgh School. Promote green technical careers through the WPS Innovation Pathways Program.	**Who:** Department of Sustainability **When:** EA – Reach out to the WPS to begin discussions. ST – Work with partners to bring local sustainability and resilience education and action ideas to public schools
Collaboration with Civic Partners	
11. Promotion to Private Stakeholders: ***Publicize and promote the Green Worcester Plan to important city stakeholders and civic groups such as the large and small business community, realtors and developers, neighborhood associations, educational and medical institutions, faith communities, immigrant associations, and social services groups.*** ■ Invite stakeholder groups to endorse the plan and commit to advancing one or more goals of the plan.	**Who:** Department of Sustainability, Public Information Office **When:** EA and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
12. Business Committee: ***Encourage the Greater Worcester Chamber of Commerce to create a sustainability and resilience committee.*** ■ While the Chamber generally supports sustainability, a committee would focus attention on the city's sustainability goals in an explicit way.	**Who:** Department of Sustainability and partners **When:** EA
13. Worcester Civic Group on Sustainability and Resilience: ***Promote and help create a citywide sustainability/resilience umbrella group or coordinating network to link existing organizations, provide public information and access to ongoing activities, and work with the City and other partners to achieve Green Worcester goals.*** ■ Explore launching a local coordinating network with organizations that may be well-positioned for this action such as Mass Audubon, the Ecotarium, or WPI or other higher education institutions. ■ Funding sources could include local and regional funders such as the Greater Worcester Community Foundation and the Barr Foundation, as well as national organizations such as the Funders' Network for Smart Growth and Livable Communities, Partners for Places, and the Surdna Foundation.	**Who:** Department of Sustainability with Advisory Committee and civic partners **When:** EA to ST
14. Collaboration with Educational Institutions: ***Promote continued collaboration with the City's educational institutions to achieve Green Worcester goals.*** ■ Explore opportunities to collaborate with Worcester Public Schools and private schools to engage younger students in sustainability and resilience issues and solutions. ■ Create and maintain an updated list of Green Worcester priority questions or issues for potential student or faculty research to disseminate to WPI, Clark, and other Worcester institutions of higher education. Students already do projects on Worcester issues. Work with faculty to identify opportunities for student work that can inform Green Worcester priorities. ■ Encourage city staff and the public to engage with students and their projects through listening sessions, open houses, or exhibits of finished work. This would serve not only to help train the next generation of professionals, but also inspire and promote sustainability in Worcester.	**Who:** Department of Sustainability and institutions **When:** EA and ongoing
15. Pilot "Sustainability District": ***Designate one or more pilot "Sustainability Districts" as areas to test, refine, and promote new sustainability and resilience efforts.*** ■ The pilot district should include commercial as well as residential areas and meet criteria related to a mix of land uses, diversity, and similar issues. A potential first pilot could be the Canal/Polar Park/Green Island area. The criteria and process to choose one or more Sustainability Districts could be part of the comprehensive planning process expected in the early 2020s. (See ecodistricts.org for examples of existing districts that follow a defined protocol.) ■ Incorporate sustainable design standards for new development and rehabilitation/renovation over a defined size threshold in proposed Sustainability Districts. This could be part of a Sustainability District zoning overlay.	**Who:** Department of Sustainability, partner departments, City Manager Office When: ST and ongoing **When:** ST and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Join Global Sustainability Networks	Measures of Progress
16. LEED Certification: ***Consider seeking LEED certification as a sustainable community.*** ■ LEED (Leadership in Energy and Environmental Design) is a program of the nonprofit U.S. Green Building Council which is known for certification of green buildings. The sustainable community evaluation system is available for free, but certification and professional credentials are offered for a fee. Massachusetts communities certified under LEED 4.1 include Devens, Cambridge, New Bedford, and Northampton. LEED certification would help Worcester establish its public profile as a sustainable and resilient city.	**Who:** Department of Sustainability. **When:** EA – ST
17. Mayors' Covenant: ***Join the Global Covenant of Mayors for Climate and Energy.*** ■ Globally there are 10,000 city members, 188 of which are in the US. Massachusetts members include Boston, Cambridge, Lexington, Medford, New Bedford, Northampton, Salem, Somerville, and Wellfleet. Each municipality has an online dashboard with summary progress information. (www.globalcovenantofmayors.org) Greenhouse gas emissions reporting is done through the CDP (Carbon Disclosure Project) (www.cdp.net).	**Who:** City of Worcester **When:** EA and ongoing
18. Urban Sustainability Network: ***Join the Urban Sustainability Directors Network.*** ■ USDN provides a network for information and innovation so that Worcester can learn from what other municipalities are doing. www.usdn.org	**Who:** Department of Sustainability **When:** EA and ongoing
19. Carbon Neutral Cities: ***Seek nomination for membership in the Carbon Neutral Cities Alliance.*** ■ The Carbon Neutral Cities Alliance (CNCA) is a collaboration of leading global cities working to cut greenhouse gas emissions by 80-100% by 2050 or sooner. Among other initiatives, it funds early-stage innovation projects led by cities to cut GHG emissions. Membership is by invitation based on membership criteria. https://carbonneutralcities.org/	**Who:** Department of Sustainability **When:** EA to ST

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Create the Department of Sustainability and Green Worcester Advisory Committee. ■ Designate Green Worcester coordinators in each City department and a cross-departmental Green Worcester Implementation Committee. ■ Join the Global Convenant of Mayors for Climate and Energy. ■ Join the Urban Sustainability Directors' Network.	■ Endorse the Green Worcester Plan. ■ Designate a representative for the Green Worcester Advisory Committee. ■ Create a Green Worcester or Sustainability and Resilience group at the Greater Worcester Regional Chamber of Commerce.	■ Endorse the Green Worcester Plan. ■ Begin working with the City and assisting in fund-raising to create a citywide umbrella sustainability/resilience coordinating network to link existing organizations, provide public information and access to ongoing activities, and work with the City and other partners to achieve Green Worcester goals.	■ Ask your neighborhood organization or other civic organization to endorse the Green Worcester Plan.

III

Green Worcester:

100% Clean and Affordable Energy

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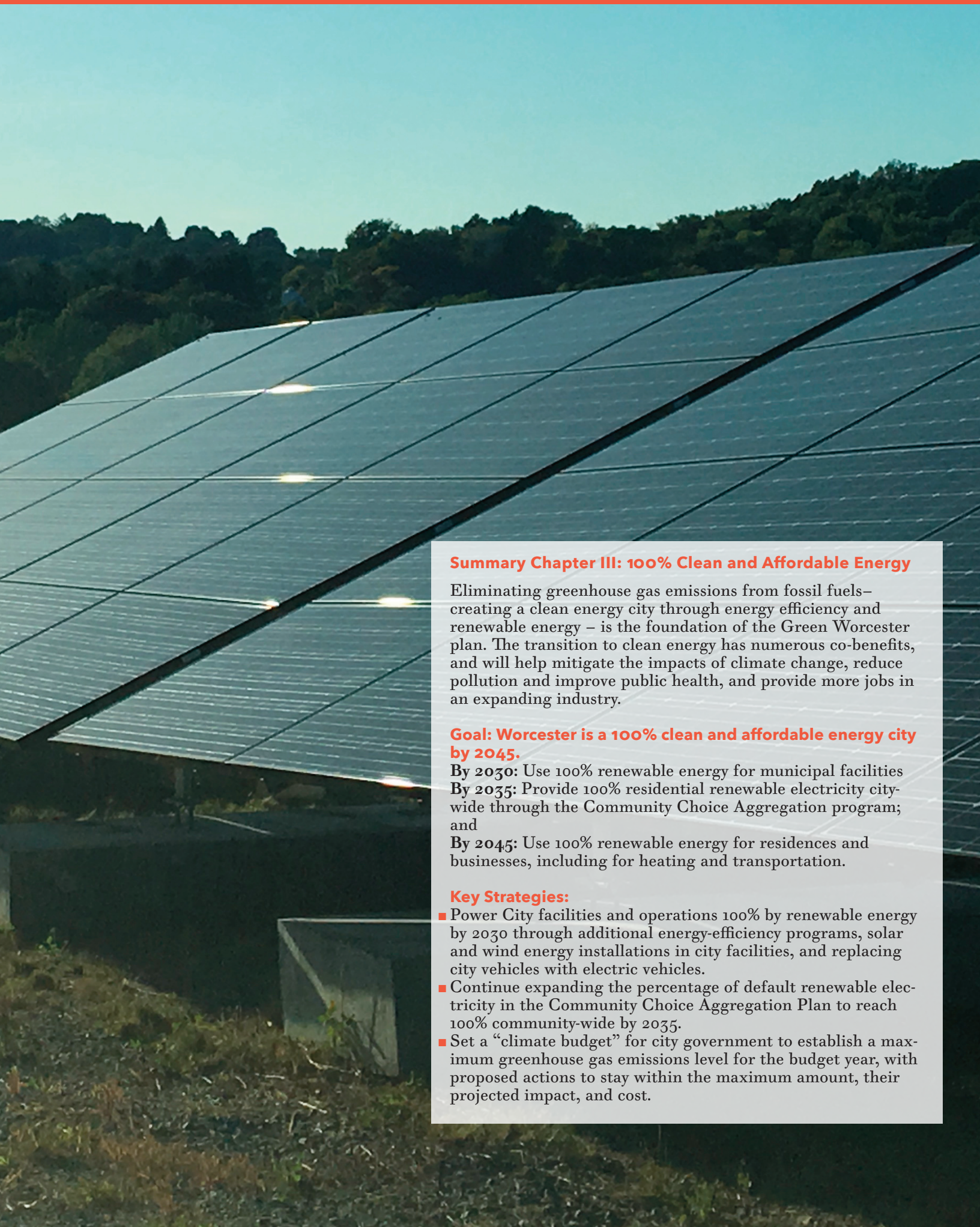


Summary Chapter III: 100% Clean and Affordable Energy

Eliminating greenhouse gas emissions from fossil fuels– creating a clean energy city through energy efficiency and renewable energy – is the foundation of the Green Worcester plan. The transition to clean energy has numerous co-benefits, and will help mitigate the impacts of climate change, reduce pollution and improve public health, and provide more jobs in an expanding industry.

Goal: Worcester is a 100% clean and affordable energy city by 2045.

By 2030: Use 100% renewable energy for municipal facilities
By 2035: Provide 100% residential renewable electricity city-wide through the Community Choice Aggregation program; and
By 2045: Use 100% renewable energy for residences and businesses, including for heating and transportation.

Key Strategies:

- Power City facilities and operations 100% by renewable energy by 2030 through additional energy-efficiency programs, solar and wind energy installations in city facilities, and replacing city vehicles with electric vehicles.
- Continue expanding the percentage of default renewable electricity in the Community Choice Aggregation Plan to reach 100% community-wide by 2035.
- Set a "climate budget" for city government to establish a maximum greenhouse gas emissions level for the budget year, with proposed actions to stay within the maximum amount, their projected impact, and cost.

A. Goal

Worcester is a 100% clean energy city by 2045.
By 2030: Use 100% renewable energy for municipal facilities
By 2035: Provide 100% residential renewable electricity citywide through the Community Choice Aggregation program; and
By 2045: Use 100% renewable energy for residences and businesses, including for heating and transportation.

Health: Renewable energy sources eliminate polluting gases and particulate matter that degrade human health and the natural environment.

Equity: Renewable energy sources reduce the unequal impacts of pollution and other consequences of fossil fuel on environmental justice areas and especially vulnerable populations such as children and the elderly.

Prosperity: Energy efficiency and renewable energy reduces energy costs for public and private entities and creates local jobs for installation and maintenance

Climate Change Resilience: Zero-emissions renewable energy does not contribute to global warming and its consequences.

B. Why

"The most urgent problem we face today is that Earth's atmosphere and waters are warming at a rate that, if continued, will result in catastrophic effects on a global scale. Local consequences will be increased average temperatures (both in the air and in surface waters), more extreme storm events (both rain, ice and snowstorms), more flooding as well as more drought, and many changes to the natural environment"

We have known for decades that dependence on fossil fuels, through emissions of greenhouse gases (GHG), causes many deleterious effects on the natural environment and human health and society.[14] The most urgent problem we face today is that Earth's atmosphere and waters are warming at a rate that, if continued, will result in catastrophic effects on a global scale. Local consequences will be increased average temperatures (both in the air and in surface waters), more extreme storm events (both rain, ice and snowstorms), more flooding as well as more drought, and many changes to the natural environment.

By 2019-2020 when this plan is being written, the evidence on global warming shows an acceleration of greenhouse gas effects and proliferation of climate-related disasters. disasters. Eliminating our dependence on fossil fuels through energy conservation and changing to renewable energy sources is a fundamental priority of our sustainability and resilience strategy. This policy priority has been accepted by Worcester City government and the Commonwealth of Massachusetts.

The State of Massachusetts is a national leader in energy efficiency and renewable energy policy. In 2007, Massachusetts joined the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort by Northeast and Mid-Atlantic States to reduce CO2 emissions from large fossil-fueled power plants. In 2008, the state's Global Warming Solutions Act of 2008 (M.G.L. c. 21N) required a state Clean Energy and Climate Plan for 2020, with a 2020 emissions target set at 25% below 1990 levels and an 80% reduction below 1990 levels for 2050. Another 2008 statute, the Green Communities Act, provides state assistance to communities meeting certain requirements. Worcester became one of the first state-designated Green Communities, receiving a $852,000 grant to help homeowners meet the requirements of the Stretch Code, an addition to the Building Code that promotes energy efficiency.

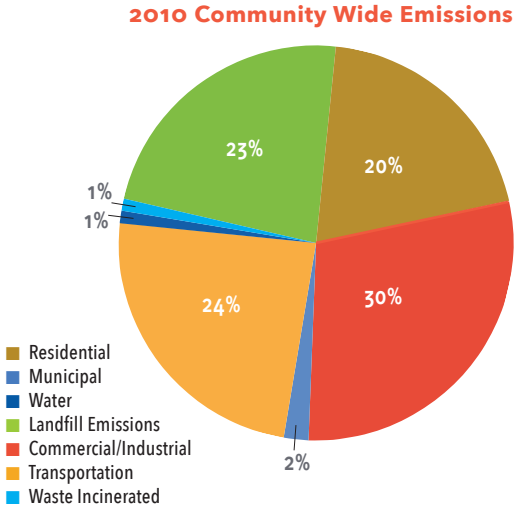
State policies now include requiring increasing percentages of renewable energy sources by suppliers to the electric grid (the Renewable Portfolio Standard) to reach 80% in 2050, adopting California vehicle emissions standards, support to

[14] The primary greenhouse gases (GHG) responsible for warming the Earth's atmosphere are carbon dioxide, methane, nitrous oxide, ozone, and water vapor.

increase the number of electric vehicles, and programs to support installation of highly efficient or renewable HVAC systems. The Solar Massachusetts Renewable Target (SMART program), in collaboration with utility companies, provides incentives for solar energy installations through fixed rates for excess energy sold back to the utilities. Small projects are included and, as of 2020, there are specific set-asides for projects serving low-income users. In 2020, Governor Baker made a commitment to net-zero emissions by 2050. Worcester Mayor Petty is one of the chairs of Mayors for 100% Renewable Energy, an initiative to advocatefor 100% renewable electricity by 2035 and 100% renewable energy for heating and transportation by 2045.

"Worcester Mayor Petty is one of the chairs of Mayors for 100% Renewable Energy, an initiative to advocate for 100% renewable electricity by 2035 and 100% renewable energy for heating and transportation by 2045."

A City of Worcester GHG inventory performed in 2010 showed that the largest municipal government sources of emissions at that time were city and school buildings, outdoor lighting, and vehicle fuel uses. Other municipal sources included employee commutes and purchasing decisions resulting in landfill and waste incineration emissions.



The 2010 inventory estimated community-wide emissions, that is, all homes and buildings, emissions produced by all cars and trucks passing through the city, landfill emissions, and municipal emissions. The inventory was based on data and estimates during the depths of the Great Recession and may not represent community-wide emissions today. The short-term impacts of the 2020 pandemic emergency have reduced emissions, but potential long-term impacts are uncertain. An updated GHG inventory is needed.

While the high percentage of methane emissions coming from the municipal landfill's is notable in the 2010 inventory, the City's energy assessment concluded that the peak level of emissions had passed, the emissions are declining, and they were no longer worth capturing. (While methane emissions initially have more impact on atmospheric warming than carbon dioxide, methane is much less persistent over time.) However, there is concern about methane emissions from gas leaks in Worcester. Natural gas leaks, which include methane, are common in Massachusetts because of aging gas infrastructure. HEET (Home Energy Efficiency Team) maps information on open gas leaks and repaired leaks that gas suppliers are required to submit to the state at the end of each year. Their 2018 map for Worcester shows 823 unrepaired leaks and 221 leaks repaired in 2018.

Technical modeling and analysis. In 2019, the City of Boston, the Boston Green Commission, and the Institute for Sustainable Energy at Boston University issued the *Carbon Free Boston* report. Based on modeling of different pathways and combinations of policies and technology to achieve a carbon neutral Boston by 2050, the project includes a set of technical reports and policy appendices that discuss the models and assumptions, including costs.[15] Although this project is focused on Boston, it could serve as an excellent foundation for Worcester to modify as needed for more technical analyses than are possible in this Green Worcester Plan. New technologies and zero-GHG fuels may also help accelerate the transition to 100% clean energy.

[15] https://www.greenribboncommission.org/wp-content/uploads/2019/01/Carbon-Free-Boston-Report-web.pdf
http://sites.bu.edu/cfb/carbon-free-boston-report-released/technical-reports/

C. What We're Doing Now

Municipal

- The **Municipal Energy Efficiency and Renewable Energy program** was established in 2009. GHG municipal emissions have decreased across nearly all areas of municipal operations.
- Establishment of the **Worcester Energy website.**
- **Among the first state-designated Green Communities (2010).** This designation is based on the City's energy-efficiency and renewable energy policies and makes the city eligible for state funding for clean energy projects. Worcester has received funding for implementation of a residential stretch code and the costs of energy conservation programs in City facilities.
- **Promotion of residential energy audits** and conservation projects through Mass Save.
- In 2012 the City joined the **EPA Green Power Partnership and was designated a Green Power Partner** because of its commitment to purchase electricity above the program's minimum 20% requirement.
- Agreement (2009) with Honeywell International to be the City's **Energy Services Company (ESCo) to install energy conservation and renewable energy measures in municipal buildings as well as solar projects on municipal properties:** $100+ million in investments and $164 million in savings and other benefits.
- 2017 opening of a **municipal solar farm on the Greenwood Street Landfill** – the largest in New England, on 25 acres, with 8,100kW capacity, and 28,600 solar panels.
- **Municipal solar installations** on 14 schools and 2 water filtration plant locations
- **Outdoor and indoor municipal lighting conversion to LED:** 13,419 street lights; all City and public school buildings; 4 municipal parking garages; as well as municipal parking lots and parks.
- **Water Filtration Plant energy improvement**s are expected to result in an overall 50% decrease in energy use through the summer months and an overall 20% decrease in the winter months, resulting in an approximately 30% decrease on an annual basis.
- **Community Choice Electricity Aggregation Program.** Through this program for group purchase of electricity starting in February 2020, participating customers in Worcester receive an additional 20% renewable electricity from renewable energy projects in New England, over and above the minimum amount required by state law, for a total of 36% renewable electricity in 2020, 38% in 2021, and 40% in 2022. Enrollment is by default, with an option to opt out – and there is an option to choose 100% renewable electricity service. (www.WorcesterCommunityChoice.com)

National Grid Programs

- National Grid owns the electricity distribution system in the City. The electric grid is aging and needs upgrading.
- Private solar panels and other distributed energy systems are required to tie into the existing grid.
- National Grid piloted a **Smart Energy Solutions Program** in Worcester between 2015 and 2018. The program included smart thermostats and programs to incentivize electricity use reduction.
- The company created the **Sustainability Hub** in the Main South neighborhood near downtown Worcester. The Hub is open to the public and provides education

to its visitors about smart grid technologies, energy efficiency, renewables, electric vehicles, and sustainability, and includes an EV charging station.

- The Massachusetts Department of Public Utilities regulates utilities (including National Grid) and is currently studying the company's management of its electric vehicle program, expected long delays in solar connections due to a transmission study, and the resulting need for system upgrades in central and western Massachusetts. According to the Greater Worcester Chamber of Commerce, city businesses that want to install solar systems have found it very difficult to work with National Grid to tie into the grid.[16] Problems connecting to the grid may slow down Worcester's ability to move to sustainable energy.

Wind and Solar in Worcester

- The 2007 **Large Wind (Energy Conversion Facilities) Ordinance** allows for wind turbines by special permit.
- In 2008, a 242-foot, 500 kW wind turbine was erected at Holy Name School and is the only one in Worcester. The school also has a multi-hour, battery-based 500 kW energy storage system to capture and store power from the wind turbine. The school's 2001 annual electricity bill of $250,000 (the school was always heated by electricity) was reduced to $40,000 by 2018.[17]
- Solar arrays on municipal, commercial, residential, and other properties have been installed throughout the city. **As of November 2019, there were 1,573 solar installations with total generation capacity of 2,414,346 kW of electricity in the City of Worcester,** according to the Massachusetts Clean Energy Center tracking system (https://www.masscec.com/data-and-reports). Of these, the vast majority of installations were on residences: 1,498 installations were on residential buildings of three or fewer units and 5 on multifamily buildings of four or more units. Commercial/office buildings accounted for 26 installations (not including 4 on retail), and there were 10 industrial installations. The City was responsible for 14 school installations and two other facilities. The remainder included higher education, religious buildings and a few others.
- **Renewable Energy Worcester (RENEW) is a Community Energy Cooperative** formed in 2016 and supported by a group of nonprofit organizations and churches. Their focus is on renewable energy projects for low-income, limited English, and communities of color, with initial priority for solar power to lower energy costs for faith communities and small nonprofits. They have completed one project at the Mustard Seed Catholic Worker House in 2018 and are working on a solar array project for Christian Community Church.

Institutions

- Four of Worcester's higher education institutions – Worcester State University, Clark University, College of the Holy Cross, and University of Massachusetts Medical School – have signed the **American College and University Presidents' Climate Commitment,** committing their institutions to reducing greenhouse gas emissions. These commitments include a carbon neutrality goal for 2030 by Clark, 2040 by Holy Cross, 2050 by Worcester State, and 2060 by UMass Medical School. As part of the program, the institutions must provide an annual, public report at https://reporting.secondnature.org/. Along with these institutions, the other higher education institutions and some private schools have established energy conservation, energy-efficiency, renewable energy and resilience programs to reduce their GHG emissions.

[16] https://www.wbur.org/bostonomix/2019/10/10/regulators-solar-power-installation-delays
[17] https://www.telegram.com/news/20180909/holy-name-central-catholic-in-worcester-flexes-green-energy-power

Other

- The Greater Worcester Chamber of Commerce has established an Electric Energy and Policy group to advocate on electrical energy and utility issues that affect regional businesses. These issues include challenges related to solar energy installation and distribution in relation to the utility system. (https://www.worcesterchamber.org/policy-advocacy/policy-updates/
- Dismas House, which focuses on housing for former offenders, and the Commonwealth/Worcester Green Low-Income Housing Coalition, founded in 2014, promote energy efficiency and renewable energy. Dismas House has reduced energy consumption in its properties and the Coalition has assisted over 40 properties and 19 housing nonprofits in Worcester and surrounding towns with energy upgrades, solar, insulation and heating so as to lower utility costs and reduce carbon output.

State Initiatives

- The state requires that electricity suppliers provide 80% renewable electricity by 2050 and the governor made a recent commitment to reach net zero energy statewide by 2050.[18]
- In 2020, the State Senate passed bills setting a goal of net-zero emissions by 2050, establishing a Climate Policy Commission, setting deadlines for carbon-pricing for transportation and buildings, and establishing energy efficiency standards for a number of products.
- The House passed its own climate bill for reduction of greenhouse gas emissions by 2050, also including investment in green energy workforce development, utility grid modernization and solar energy net metering. The House also passed an amendment known as the Environmental Justice Act requiring environmental impact reports for projects likely to cause environmental damage and located within a mile of an environmental justice population (or 5 miles if the impact is airborne).
- At the time of writing of this plan, a final compromise bill had not yet been passed or signed by the governor.

D. How

Reducing Worcester's greenhouse gas emissions to near zero citywide by 2045 through incremental expansion of electricity from renewable sources is at the foundation of the Green Worcester Plan. To make Worcester a "net zero" community, the plan focuses on actions to eliminate GHG gas emissions so that the total citywide energy load is carbon free because the net carbon-emitting energy used is equal to or less than the net green energy produced and purchased.

Major strategies to achieve this goal are:

- Continue City government leadership in energy efficiency and transitioning to renewable energy
- Promote the 100% option under the Worcester Community Choice Electricity Aggregation Program to accelerate renewable energy adoption.
- Partner with state, regional, and local entities for progress towards additional energy efficiency and zero-GHG energy sources for electrification of energy.
- Develop a "climate budget" for city government.

[18] https://www.energylivenews.com/2020/01/22/massachusetts-governor-sets-out-2050-net-zero-commitment/

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Citywide Greenhouse Gas Emissions	Measures of Progress
1. Zero Emissions: *Eliminate 100% of greenhouse gas emissions citywide.* ■ This is an aggressive timetable to achieve a "net-zero" community, which in the broadest sense means using renewable energy sources for all energy needed within the electricity, heat, and transport sectors. In practice, net-zero on a community level often means 100% renewable electricity, reductions in GHG emissions from other sectors, and purchase of carbon offsets supporting GHG reduction projects for remaining emissions. ■ Update and publish the citywide greenhouse gas emissions inventory. ■ Continue reduction of emissions in City facilities and operations. ■ Implement actions below	**Who:** Department of Sustainability and Department of Public Facilities **When:** EA to ST – update GHG inventory; MT–100% renewable energy for municipal facilities by 2030; 2030s – 100% renewable electricity community-wide by 2035; 2040s – 100% renewable energy for heating and transportation by 2045.
2. Community Choice Program: *Achieve 100% renewable electricity sources by 2035 via aggregation.* ■ Continue expanding the percentage of default renewable electricity in the Community Choice Aggregation Program to reach 100% community-wide by 2035 or earlier. ■ Promote early adoption of 100% renewable electricity by customers starting in 2020.	**Who:** Department of Sustainability **When:** 2030s - 100% renewable electricity community-wide by 2035
3. Carbon Neutral Cities Alliance: *Seek nomination for membership.* ■ The Carbon Neutral Cities Alliance (CNCA) is a collaboration of leading global cities working to cut greenhouse gas emissions by 80-100% by 2050 or sooner. Among other initiatives, it funds early-stage innovation projects led by cities to cut GHG emissions. Membership is by invitation based on membership criteria. https://carbonneutralcities.org/	**Who:** Department of Sustainability **When:** EA to ST
Energy-efficiency and Emissions Reduction in City Facilities and Operations	
4. Net Zero City Operations: *Aim to make city facilities and operations net zero by 2030, including the city vehicle fleet.* ■ Develop a "climate budget" for city government. This would establish a maximum GHG emissions level for the budget year, with proposed actions to stay within the maximum amount, their projected impact, and cost. (See the Oslo climate budget: www.oslo.kommune.no/politics-and-administration/green-oslo/best-practices/oslo-s-climate-strategy-and-climate-budget/#gref) ■ Do climate/carbon impact modelling for city purchasing, policy, and development decisions, in order to base those decisions on reducing and mitigating GHG emissions. Seek a university partnership for this modelling program. ■ Continue additional energy-efficient management of City facilities through the new Department of Public Facilities to reach 100% renewable energy for municipal facilities by 2030. ■ Continue programs to conserve energy and increase energy-efficiency. ■ Continue additional energy-efficient management of City facilities. ■ Seek to reduce GHG emissions from heating and air conditioning in city facilities. (See Chapter V Net Zero and Climate Resilient Buildings).	**Who:** Department of Sustainability; Department of Public Facilities **When:** EA and ongoing MT – 100% renewable electricity for municipal facilities and fleet by 2030

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
■ As vehicles in the City fleet go out of service, replace them with electric vehicles to reach an all-renewable fleet by 2030. (See Chapter IV. Sustainable Transportation Choices.) ■ Publicize the City's energy-efficiency and renewable energy initiatives through signage at city facilities (including the solar array at the old landfill) showing energy and cost savings.	
5. Flexible Commutes for City Employees: ***Develop commuting and/or work at home programs for City employees to cut emissions.*** ■ The state provides guidebooks for implementing employer-based commuting options, from carpooling to flexible work programs. Use the lessons learned during the pandemic when developing these programs. https://www.mass.gov/lists/worksite-commute-options-documents	**Who:** Department of Sustainability with Human Resources Department **When:** EA to ST
City and Region-Wide Energy Initiatives	
6. Energy Pilot Projects: ***Identify opportunities for innovative energy pilot projects.*** ■ Pursue innovative pilots such as micro-grids, co-generation of electricity and heating/cooling, and geothermal districts working with the State, National Grid, and private parties.	**Who:** Department of Sustainability **When:** ST and ongoing
7. Building Disclosure Policy: ***Adopt a building performance disclosure policy for non-residential buildings.*** ■ Adopt the policy for buildings that meet a size threshold such as 5,000 or 10,000 square feet. (See Chapter V Net Zero and Climate Resilient Buildings.)	**Who:** Department of Sustainability **When:** ST
8. PACE Program: ***Opt into the proposed Massachusetts PACE (Property Assessed Clean Energy) program.*** ■ PACE programs allow property owners to finance 100% of hard and soft costs of investments in clean, renewable energy through payment over decades on the property tax bill. A State PACE program for non-residential buildings is expected in 2020 and will likely become available for residential buildings. https://www.massdevelopment.com/what-we-offer/key-initiatives/pace/ ■ Advocate for PACE commercial and residential programs and implement them when approved by the State.	**Who:** Department of Sustainability; City Manager **When:** as made available by the State
9. Public EV Charging: ***Establish EV charging stations in all City-owned parking areas with 20 or more parking spaces.*** ■ (See Chapter VI Sustainable Transportation Choices.)	**Who:** Department of Sustainability and DPW **When:** EA to ST and ongoing
10. Multifamily EV charging: ***Require EV stations and EV-ready parking at all new 5-unit plus multifamily buildings with on-site parking.*** ■ (See Chapter VI Sustainable Transportation Choices.)	**Who:** Department of Sustainability with Planning Division, Planning Board **When:** EA to ST
11. Solar Zoning Ordinance: ***Develop and adopt a solar zoning ordinance with clear standards for siting solar farms and solar installations (residential and commercial).*** ■ The state has provided a model ordinance: https://www.energy.gov/eere/solar/downloads/massachusetts-model-zoning-bylaw-regulation-solar-energy-systems	**Who:** Department of Sustainability with Planning Division, Planning Board **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
12. Solar Map Tool: ***Work with educational institutions to create a solar map tool with information on solar opportunities in Worcester, including information on utility poles, roof material, and so on.*** ■ See the Google tool for solar roof potential by address https://www.google.com/get/sunroof and the Cambridge Solar Map Tool – https://www.mapdwell.com/en/solar/cambridge	**Who:** Department of Sustainability and educational institutions **When:** EA to ST
13. Regional Electricity Aggregation: ***Work towards becoming a Level II Aggregator.*** ■ Similar to the Cape Cod Compact, this would serve Worcester and other municipalities in the Central Massachusetts region.	**Who:** Department of Sustainability and Community Choice Electricity Aggregation Program **When:** ST to MT
14. Energy Ownership Models: ***Support efforts to diversify energy ownership models.*** ■ Examples of community-based energy models include cooperatives, the Vermont Clean Energy Development Fund, and Connecticut Energy Improvement Districts.	**Who:** Department of Sustainability **When:** EA and ongoing

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Continue the energy-efficiency and renewable energy program for city facilities. ■ Update and publish the GHG emissions inventory ■ Opt in to PACE programs when available. ■ Seek membership in the Carbon Neutral Cities Alliance. ■ Begin developing a climate budget.	■ Continue and establish new energy conservation and renewable energy projects. ■ Work through the Chamber of Commerce to help resolve issues with the utility.	■ Continue energy conservation and renewable energy projects. ■ Collaborate with the City to create information and data to accelerate renewable energy projects.	■ Choose 100% renewable energy sources through the Community Choice Aggregation Program. ■ Find out your carbon footprint from online tools and work to reduce it.

IV

Green Worcester:

Connected Green and Blue Spaces with Healthy Natural Systems

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Summary Chapter IV Connected Green and Blue Spaces with Healthy Natural Systems

Goal: Maintain, improve, connect, and expand quality natural systems in a linked network of parks, open spaces, and waterways, including street trees and public spaces.
Chapter IV emphasizes strategies and actions for sustainability and climate change resilience that are consistent with the City's Open Space and Recreation Plan (OSRP), which is being updated in 2020. The OSRP contains more detailed information, strategies, and actions for promoting the sustainability and climate resilience of Worcester's natural systems and environment.

Key Strategies:

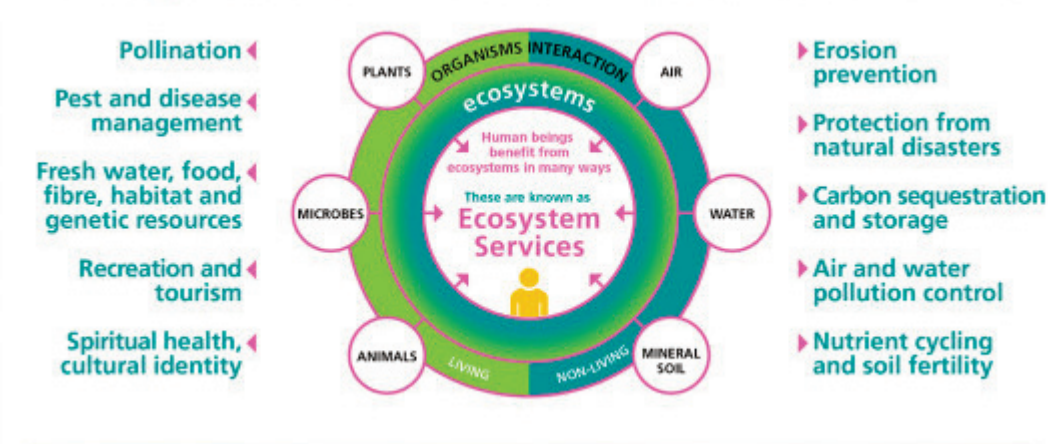
- Continue to keep the City's Open Space and Recreation Plan updated with an enhanced focus on sustainability and climate change resilience.
- Seek to link green open space resources to strengthen the connectivity of natural systems.
- Develop and implement an Urban Forestry Plan.

A. Goal

Maintain, improve, connect, and expand quality natural systems in a linked network of parks, open spaces, and waterways, including street trees and public spaces.

B. Why

Natural resources and natural systems provide "eco-system services" at the foundation of human societies. These services are generally divided into four broad categories: provisioning services, such as the production of food and water; regulating services, such as controls on climate and disease; supporting services, such as nutrient cycles and oxygen production; and cultural services, such as spiritual and recreational benefits from the ecosystem.



Source: https://wle.cgiar.org/content/what-are-ecosystem-services

In cities like Worcester, natural resources include parks, green recreation areas, conservation lands, wetlands, surface waters and streams, as well as the public street trees and landscaped areas found in the most urbanized areas of the city core. Natural resources also extend to private green areas and gardens. From a sustainability point of view, these resources are most valuable to the extent that they constitute systems and networks that are valuable not only for people and human needs, but that support habitats and ecosystem services for other living things. Caring for our natural environment to continue to provide habitat for native plants and for wildlife is a critical element of an urban sustainability plan.

Health: Access to natural areas and recreation improves physical and mental health.

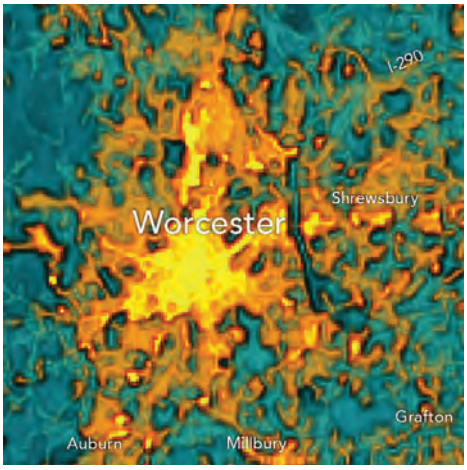
Equity: Residents of environmental justice neighborhoods have less access to recreational waters and to natural areas.

Prosperity: Communities with excellent park systems are central to livability and quality of life that attract residents and businesses.

Climate Change Resilience: Healthy natural systems help mitigate climate change impacts of stormwater, floods, heat, and storms.

Open space resources. Worcester has 60 parks, 20 lakes and ponds, and more than 100 conservation properties owned by private owners, such as the Greater Worcester Land Trust, as well as the city and the state. Approximately 17% of the city's land area (more than 3,700 acres) is protected open space. According

to state data, the city has nearly 1,500 acres of "Core Habitat," which is defined as areas that "promote long-term persistence of rare species, other species of Conservation Concern, exemplary natural communities, and intact ecosystems." Twenty-three species found in Worcester are listed as endangered, threatened, or of special concern.[19]

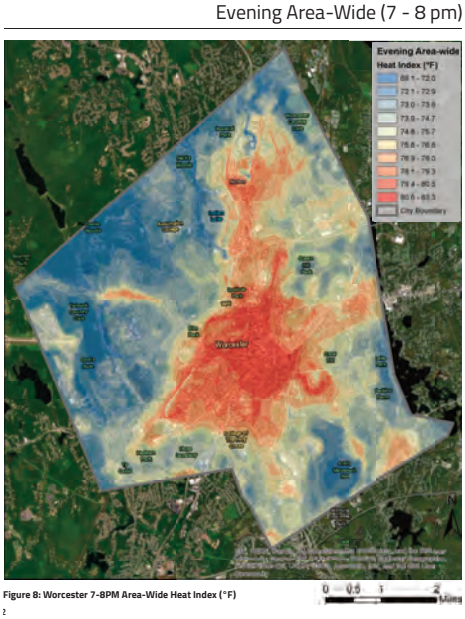


Worcester Urban Heat Island map created from Landsat 8 land surface composite over summers in the late 20-teens. Source: www.bostonography.com/2019/massachusetts-heat-islands/

Natural systems values. Natural systems values that are important to a city in relation to sustainability include connectivity, habitat conditions, and temperature. Connected natural areas and corridors provide habitat for wildlife to move through the city and region. Waterways are particularly important for habitat. Among the city's most important wildlife corridors are Mass Audubon's Broad Meadow Brook Wildlife Sanctuary, the largest urban wildlife sanctuary in New England, and the Blackstone River Valley National Heritage Corridor.

"Planting trees to expand the city's tree canopy is among the most effective sustainability and climate change adaptation actions that a city can take. Planting trees provides multiple sustainability benefits."

Urban heat islands. Because the urban core and arterial corridors of Worcester and similar cities are densely built with many impervious surfaces and few green areas, they are hotter. This is called the urban heat island because temperatures are higher than in rural areas. Heat island effects include illness and mortality (children and the elderly are most vulnerable), higher air conditioning costs, air pollution and greenhouse gas emissions, and water pollution.



Evening Heat Island August 2019
(Source: Heat Watch Report, Worcester, Massachusetts.)

In August 2019, sixteen citizen science volunteers working with WPI faculty gathered data by driving specified routes in Worcester to create a map of Worcester's heat islands and heat vulnerability. Project results found "extreme heat areas in the afternoon in a confined downtown area and following the Shrewsbury Street corridor…. The urban heat island effect is most pronounced in the evening hours, with higher temperature differentials and a wide swath of the urban center retaining heat. The models show industrial areas heating up early in the day and releasing heat by evening."[20]

The importance of trees – urban forestry. Planting trees to expand the city's tree canopy is among the most effective sustainability and climate change adaptation actions that a city can take. Planting trees provides multiple sustainability benefits. Trees cool urban heat islands; reduce air pollution and sequester carbon dioxide; help manage stormwater and conserve water; reduce soil erosion; save energy; provide habitat; and make cities more attractive to people and

[19] 2013 Worcester Open Space and Recreation Plan.
[20] Worcester, MA Urban Heat Island Assessment, 2019. https://osf.io/tdcvb/; Final Report, https://osf.io/7emcw/

businesses. Street trees are among the most cost-effective sustainability investments for cities. When Worcester suffered the loss of trees in the Burncoat neighborhood from the Asian Long-Horned Beetle (ALB) infestation (discovered 2008), a 2008 report estimated that for every dollar invested in replanting street trees, the City of Worcester gained $1.69 in benefits.[21]

The public urban forest encompasses all the areas with trees in urban areas such as parks, public gardens, street trees and landscaped street medians, river and lake corridors and edges, wetlands, and conservation areas. The private urban forest extends to areas such as campuses, business parks, cemeteries, and residences. Street trees are not evenly distributed in Worcester, with many fewer trees in the densely developed urban core than in the city's single-family residential neighborhoods.

C. What We're Doing Now

Open Space

Worcester's 2013 Open Space and Recreation Plan is being updated in 2020 (and is updated every 7 years in order to retain eligibility for State open space and recreation funding). Several goals in the 2013 plan are relevant to the Green Worcester Plan and will likely continue into the 2020 plan:

- *Enhance Natural and Cultural Resources.* Objectives include restoring and improving natural resource properties; acquisition of key parcels; protection of potable drinking water
- *Improve Public Access to Water Resources.* Objectives include improving access to waterfronts and water resources.
- *Upgrade Delivery of Park and Open Space Maintenance Services.* Objectives includes funding natural resource maintenance and management
- *Integrate Parks and Open Space Planning with Other Related City Initiatives.* Objectives include aligning public park and open space initiatives with other city planning initiatives.
- *Promote Urban Landscape Improvements.* Objectives include supporting Complete Streets; promoting local food initiatives; and aligning park and open space policy with climate change adaptation actions.
- *Improve Open Space System Connectivity.* Objectives include revitalizing street trees; introducing bicycle lanes; upgrading trail systems; identifying and connecting neighborhood preserves; enhancing transit networks.
- The plan includes a Seven-Year Action Plan, as will the 2020 update, in a matrix connecting goals, objectives, and detailed actions. Actions partially or fully implemented since 2013 include:
  - $60 million in park improvements
  - Installation of several green infrastructure elements in city parks to improve stormwater management
  - Continued partnerships with organizations like the Greater Worcester Land Trust, institutions, and "Friends" groups for some parks,
  - The *Lakes and Ponds Program* which is focused on improving water quality and access in the lakes and ponds used for full-contact recreation and includes partnerships with local watershed organizations
  - The *East-West Trail,* a recreational trail created by ParkSpirit in collaboration with the City DPW and other partners: a 14-mile, cross-city hiking experience that connects 20 green spaces with city streets and throughways for a challenging trek through Worcester's hills. (parkspirit.org/the-east-west-trail)

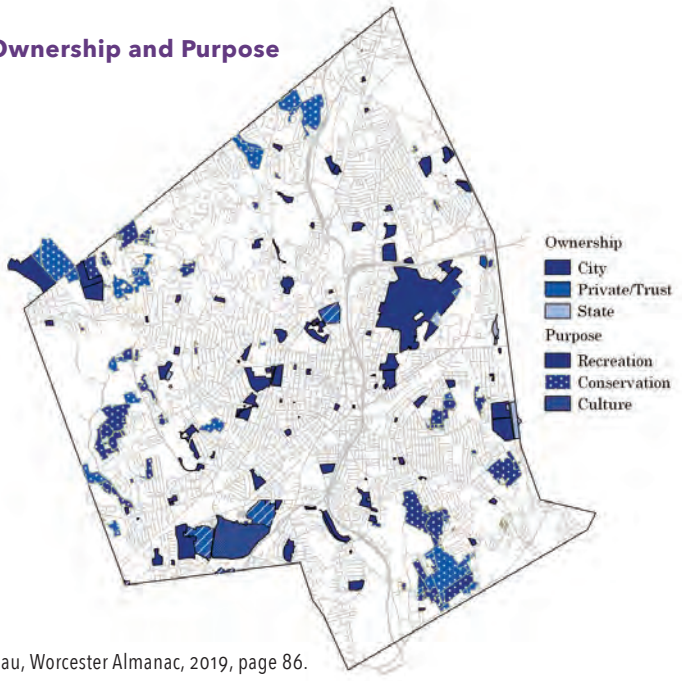
[21] Report on the Status of Street Trees in Worcester, MA, October 2008, www.mass.gov/eea/docs/dcr/stewardship/forestry/urban/docs/worcester-report.pdf

Urban Forestry

The City of Worcester does not yet have a comprehensive up-to-date street tree inventory or an urban forestry plan, but it is a high priority of the Parks Division.

- The *Worcester Tree Initiative (WTI)* was established as a partnership of the City, the state Department of Conservation and Recreation, the US Department of Agriculture and nonprofit organizations to respond to the Asian Long-Horned Beetle (ALB) infestation (discovered 2008) and loss of trees in northern neighborhoods in Worcester and in adjacent towns. Since 2009, approximately 30,000 trees have been planted, focusing in the area affected by the ALB infestation, replacing the Norway maple monoculture with more diversity of species. Currently, the WTI is a partnership of the Department of Public Works and Parks and Tower Hill Botanical Garden, which continues tree planting in the city. WTI now includes a forestry program for young adults to maintain newly planted trees and is expanding its activities to plant more trees in the urban core of Worcester.
- *Protection of Public Shade Trees Ordinance*. The City's 2008 public tree protection ordinance was a response to tree loss from ALB and severe ice storms. All public tree planting, maintenance and removal requires approval by the tree warden.
- *Private Property Tree Adoption Initiative*. When streets and sidewalks are too narrow for street tree planting, the City will provide trees for planting on private property adjacent to the sidewalk and teach the owners how to maintain them. After three years, the tree belongs to the private property owner.
- *Tree Donation Program*. The City accepts donations of trees for public spaces. At a cost of approximately $500, the city will buy and plant the tree with a donation plaque. Typically, 5 or 6 trees are donated a year.
- *Right Tree, Right Place Program*. In planting trees for healthy growth, the City endeavors to select trees that fit their intended purpose taking into account the growing space in the proposed location.

Worcester Open Space by Ownership and Purpose



Source: Worcester Regional Research Bureau, Worcester Almanac, 2019, page 86.

Reservoir Lands Habitat Management

- The City owns 8,000 acres of watershed land outside city boundaries that protect the city's drinking water. This land is actively managed to provide a healthy ecosystem. Management of forests, invasive species, and wildlife habitat promote biodiversity, maximize infiltration of water, and reduce pollutants that go into the reservoirs. Because these are drinking water reservoirs, the water is not open for recreational use. The City works with Massachusetts Fish and Wildlife and the State Ornithologist on programs such as:
  - A long-term black bear population study on reservoir lands including radio collar tracking, trapping and tagging.
  - Monitoring a nesting pair of loons including banding and annual deployment of loon nest rafts.
  - A long-term bird population study on Reservoir Division lands.
  - Construction of an osprey platform.
  - Construction and installation of wood duck boxes in beneficial habitat areas.

City Regulations Affecting Natural Systems

- *Regulatory protections.* Worcester has a local Wetlands Protection Ordinance in addition to the state Wetlands Protection Act. The local ordinance regulates development within 100 feet of catch basins (outside the combined sewer overflow area). Any development within the Stormwater Protection Zone must provide erosion and sediment controls and be approved by the Conservation Commission. In addition, the City has an Aquifer Protection Overlay Zone, Floodplain Overlay District, Water Resource Protection Overlay District, as well as permits under the Clean Water Act. The zoning ordinance requires erosion controls for any development.
- *Zoning open space requirements.* Continuing Care Retirement Communities and Cluster Subdivisions must have 25% open space.

Civic Organizations and Volunteer Groups

- The Parks and Recreation Division has staff constraints, raising concerns about the ability of the division to take on any new responsibilities. It works with park "Friends" groups and Park Spirit, a small nonprofit focused on supporting Worcester parks and the East-West Trail, and students from Worcester Technical High School. Great city park systems are dependent on robust support from nonprofit organizations and organized volunteers.

D. How?

The Open Space and Recreation Plan contains the detailed information, strategies, and actions for promoting the sustainability and climate resilience of Worcester's natural systems and environment. Overlapping Green Worcester strategies intensify this focus:

- Develop an Urban Forestry Plan, including planting of street trees and street landscaping to reduce the urban heat island effect and help manage stormwater in the urban core.
- Enhance connectivity of natural green and blue spaces for habitat and nature appreciation.
- Manage open space resources to reduce nonpoint pollution to streams and surface waters.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions General Open Space Policy	Measures of Progress
1. Open Space and Recreation Plan: ***Continue to update and implement the City's Open Space and Recreation Plan as required to ensure City eligibility for state funding.*** ■ State approval of an OSRP now requires a section on climate change resilience in relation to open space and recreation. ■ Enhance implementation of policies related to natural spaces, connectivity, stormwater management and reduction of nonpoint source pollution, street trees, and green spaces, especially in the urban core. ■ Give priority to protection and stewardship of open spaces that contribute to climate change resilience through mitigation of flooding and urban heat island effects.	**Who:** Parks and Recreation Division; Planning Division; Department of Sustainability **When:** EA and ongoing. Update by 2021 and every 7 years thereafter
2. Join the City Parks Alliance. ■ This is a national organization of urban parks that offers expertise and peer exchange on innovations and opportunities for urban parks. www.cityparksalliance.org	**Who:** Parks and Recreation Division **When:** EA to ST
3. Urban Core and Green Spaces: ***Make new green spaces, street trees, sidewalk planters, and street landscaping in the urban core of the city a high priority (in the Open Space and Recreation Plan and other municipal plans) in order to reduce the urban heat island effect and help manage stormwater.*** ■ Worcester's urban core is densely developed with commercial buildings, triple-deckers, other multi-family buildings, and small-lot single family houses. This is where the urban heat island is most pronounced, where inadequate infrastructure results in more flooding, and where green spaces are most lacking for residents. ■ Incorporate these green co-benefits into municipal infrastructure and development projects in the urban core; pocket parks can be a great strategy of increasing green spaces in dense urban contexts. ■ Develop green spaces and landscaping standards for private developments in the urban core to implement this strategy and to provide co-benefits. ■ Continue to encourage private sponsorship of planting and maintenance of trees and shrubs in street medians, as on Shrewsbury Street.	**Who:** Parks and Recreation Division; Planning Division; Economic Development **When:** EA and ongoing
4. GreenStreets Routes: ***Designate "GreenStreets" routes for neighborhood access to parks to implement improvements that enhance safe and comfortable walking and biking and prioritize these routes for shade by planting trees.*** ■ Parks and recreational waters (lakes and ponds open for swimming, boating, and fishing) should be connected to neighborhoods and downtown by enhanced routes – safe, comfortable, and convenient bicycle and pedestrian networks.	**Who:** Transportation Advisory Group; Public Works and Parks; Planning Division; Department of Sustainability **When:** EA–ST and ongoing
5. Cluster Subdivision: ***Revise the Cluster Subdivision zoning provision to allow by-right development using zoning consistent with the principles of the State's Model Open Space Design/ Natural Resources Protection Zoning.*** ■ This model is part of the State's Smart Growth/Smart Energy Toolkit and is designed to promote more cluster subdivisions that result in protection of high quality natural open space. (https://www.mass.gov/service-details/smart-growth-smart-energy-toolkit-module-bylaws	**Who:** Parks and Recreation Division; Planning Division; Economic Development **When:** EA and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Trees	Measures of Progress
6. Urban Forestry: ***Develop and implement an Urban Forestry Plan.*** ■ Inventory and analyze the Worcester public and private tree canopy to identify species, condition, location, coverage, and need. Create a GIS layer of street trees including data on species, condition, planting date (as available) and develop a process to keep the data up to date. ■ Adopt guidelines for tree removal and replacement with street tree planting standards such as soils and root barriers adjacent to paving, guidance for distances from utilities and lights, and so on. ■ Prioritize expansion of trees (street, other public- and privately-owned) in the urban core to provide shade, mitigate the urban heat island effect, and slow down and absorb rain and stormwater. ■ Create connected networks of shaded corridors, especially in the urban core. ■ Establish a municipal tree nursery and greenhouse on city land. The City used to have two city greenhouses. ■ Publicize the program for donation of trees for public spaces and the program for residents to accept a free tree onto their property from the City as long as they agree to care for the tree. ■ (See the Appendix for urban forestry resources, including for volunteer programs.)	**Who:** Public Works and Parks with Department of Sustainability; Office of Urban Innovation **When:** EA-ST and ongoing
7. Tree Standards: ***Establish development standards for tree retention, replacement and planting for private projects that meet size thresholds.***	**Who:** Who: Planning Department with Parks **When:** EA to ST
Water Supply Lands	
8. Habitat Lands: ***Continue management of Worcester's water supply open space lands (located outside the city limits) as high-quality environmental systems.***	**Who:** Public Works and partners **When:** EA and ongoing
Lakes & Ponds Program and Nonpoint Source Pollution	
9. Lakes & Ponds Program: ***Continue the program to improve water quality and expand it to additional surface water features.*** ■ Evaluate natural water bodies in the City for priority remediation or restoration work using criteria such as public health, climate resilience potential, habitat value, and recreation value. ■ Continue to work with local watershed associations and other community and environmental partners.	**Who:** Public Works – Lakes & Ponds Program **When:** EA and ongoing
10. High Performance Private Landscapes: ***Raise public awareness about beneficial stormwater best management practices for drainage areas of lakes and ponds, such as permeable pavement, rain gardens, rain barrels, and lawn buffers at stream and pond shores.*** ■ Develop a manual for property owners that provides information on options and limitations in the development process. ■ Develop and distribute a simple eco-landscaping practices list, such as Integrated Pest Management and organic maintenance practices, and use of native species for residents and contractors and make it available on the website. Possible partners for this could include watershed and neighborhood associations, Mass Audubon, the Ecotarium, and the Greater Worcester Land Trust.	**Who:** Department of Sustainability; environmental nonprofits **When:** EA-ST and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
■ Work with landscaping companies and large landowners, such as golf courses and institutions, to establish stormwater best management practices.	
11. Upgrade Regulations: ***Complete and enforce any needed upgrades to regulations related to land disturbance and development that result in nonpoint pollution to streams, lakes and ponds.*** ■ Require planted buffers between streams, lakes and ponds and lawns and impervious surfaces. ■ Implement elements of the Integrated Water Management Plan to reduce and eliminate contamination of public surface waters. (See Chapter VII One Water)	**Who:** Planning Division, Conservation Commission, Public Works **When:** EA to ST and ongoing

E. Getting Started

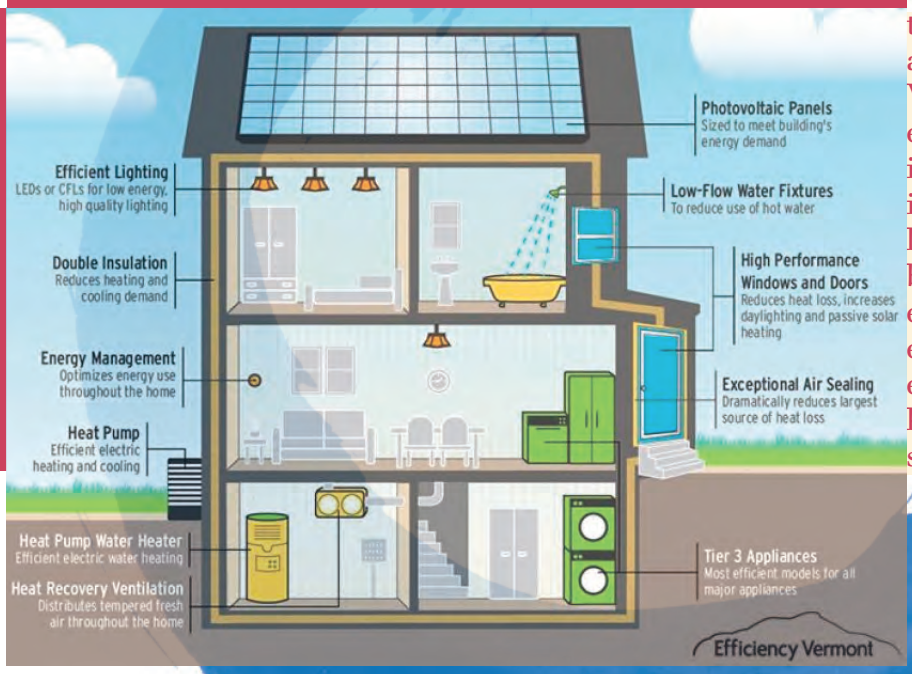
Government	Business	Institutions/Nonprofits	Households/Individuals
■ Develop an Urban Forestry Plan. ■ Enhance sustainability and climate change resilience strategies in the Open Space and Recreation Plan.	■ Include green spaces and trees, and minimize impervious surfaces in business locations.	■ Continue and expand use of best practices for landscape management, minimizing impervious surfaces.	■ Minimize use of fertilizers and herbicides. ■ Plant native species and avoid invasive species. ■ Minimize impervious surfaces.

V

Green Worcester:

Net-Zero and Climate-Resilient Buildings

Features of a Net Zero Home



Source: www.24hplans.com

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Summary Chapter V: Net Zero and Climate Resilient Buildings

Chapter V focuses especially on transitioning existing and new buildings in Worcester to clean energy. Because Worcester is a historic city with a large inventory of older buildings, retrofitting these buildings to be more energy efficient and to operate on renewable energy, including for heating and cooling, is a significant challenge.

Goal: Require new buildings to be net zero and climate resilient and promote deep energy retrofits of existing buildings. A net-zero building produces enough renewable energy to meet its own energy consumption needs.

Key Strategies:

- Use renewable electricity rather than fossil fuels for building energy systems.
- Make new buildings net zero through requirements and incentives.
- Use no fossil fuels as primary source of building energy in new City buildings.
- Promote standard energy retrofits and incentivize and provide financing options for deep energy retrofits of older buildings.

A. Goal

Require new buildings to be net zero and climate resilient and promote deep energy retrofits of existing buildings. A net-zero building produces enough renewable energy to meet its own energy consumption needs.

B. Why

Moving away from fossil fuels in the building sector requires radical improvements in energy efficiency through insulation, air-sealing, high efficiency systems and building components, smarter energy management and transitioning to electricity, solar, and other renewables for heating, cooling, lighting and all other energy uses, and ensuring that the electricity comes from renewable energy sources. The Worcester Community Choice Electricity Aggregation Program will move residential customers to renewable energy, but transitioning heating and cooling, as well as overall energy efficiency, will be challenging.

Health: More indoor comfort and health.

Equity: Retrofits of older, triple decker and multifamily housing, and workforce development and training for building retrofits and other green jobs.

Prosperity: Energy retrofits stimulate new green businesses and jobs.

Climate Change Resilience: Eliminating GHG emissions and building retrofits mitigate climate change impacts.

In 2019, Massachusetts was ranked as the most energy-efficient state by the American Council for an Energy-Efficient Economy because of its many energy efficiency policies and programs, including adoption of the "Stretch Code" appendix to the base building code, and energy efficiency programs.[22] However, as of 2020, state law does not allow municipalities to ban oil and gas installations in new construction and major renovations. Worcester adopted the Stretch Code as a prerequisite of designation as one of the first Green Communities and received state funding for a limited period to help homeowners meet the new code requirements. Mass Save is a program developed by the State and utility companies that offers significant rebates for energy efficient upgrades for insulation, heating, and cooling.[23]

Building energy retrofits. Even requiring that new buildings be net zero would not be enough to make a big difference in emissions from buildings in Worcester. Massachusetts cities like Worcester have many older buildings, which means that achieving a low-carbon building stock will require a commitment to significant energy retrofits of existing buildings. It is estimated that there are 4,000 triple-decker buildings and 3,500 two-family buildings in Worcester, comprising about half of the city's housing units, and most of those units are rental units, often without individual unit energy meters. Many of these buildings have investor-owners who may not believe that the cost of energy efficiency (even with subsidies through state programs) are worth the effort or investment. In

[22] https://database.aceee.org/state/massachusettshttps://www.energylivenews.com/2020/01/22/massachusetts-governor-sets-out-2050-net-zero-commitment/; https://www.bostonglobe.com/2020/07/21/metro/ag-rejects-brooklines-ban-oil-gas-pipes-new-buildings/

[23] Worcester specific data can be found at:
- MA Energy Efficiency Advisory Council – http://ma-eeac.org/results-reporting/
- Mass Save Data – https://www.masssavedata.com

addition to commercial, residential, and mixed-use buildings, Worcester also has major institutional, medical, and industrial buildings that may be difficult to move entirely away from fossil fuels by 2045. Typical building energy retrofits reduce energy use up to 25%, but "deep retrofits" can result in savings of over 50%.[24]

Deep retrofits require a thorough and intensive approach to super insulate the building and address all building systems: heating and air conditioning, hot water, lighting, appliances, plug loads, and heat pumps for cold climates. While there are long-term energy savings, the up-front costs can be expensive.[25] At the same time, increased understanding that COVID-19 spreads through aerosols requires that that ventilation systems be optimized for public health. Worcester has at least one development company which has used Worcester companies to upgrade and retrofit triple deckers for rental. The Massachusetts Clean Energy Center launched a Triple Decker Design Challenge competition with a November 2020 deadline and January 2021 selection of winners to "identify replicable triple-decker energy retrofit approaches. The program seeks to set a new and scalable standard for transitioning these iconic New England dwellings into high-performing, low-carbon buildings." Although retrofitting existing buildings like triple deckers is a challenge, a successful model will have significant economic development potential for Worcester.

(Source: www.masscec.com/triple-decker-design-challenge)

Geothermal energy district networks. An innovative approach to eliminating gas heating is to create networks of geothermal energy, which is the constant earth temperature of 50 to 60 degrees a few yards below the earth's surface. Below-ground pipes access the heat and pumps circulate it in the building, eliminating the need for furnaces, air conditioners, and hot water heaters. Using geothermal energy for individual buildings in urban conditions can be difficult and expensive in small urban lots. However, interconnected geothermal systems that replace existing gas pipes can heat multiple buildings while turning existing gas infrastructure into clean, affordable energy and retaining jobs for gas company workers. Individual homes and businesses would own the heat pumps

[24] https://aceee.org/blog/2019/05/deep-retrofits-financing-needs-play
[25] https://www.greenbuildingadvisor.com/green-basics/remodel-project-deep-energy-retrofit

while the gas utility would own and manage the pipe systems. Eversource has submitted three pilot projects to state regulators for approval in 2020.[26] If these are successful and affordable, geothermal districts of this type could be a good option for older Worcester neighborhoods.

Passive House construction. Passive House is a system developed in Germany to build new or retrofit houses to be so energy efficient and air-tight that they consistently maintain a comfortable temperature through continuous insulation, triple-pane windows, and an air quality control system that constantly circulates and filters air. Passive houses are 90% more energy-efficient than the average house and more resilient to emergencies such as power outages.

C. What We're Doing Now

Municipal

- Solar installations on 14 school and 2 water filtration plant locations.
- Conversion to LED lighting: 13,419 street lights; city buildings; 4 municipal parking garages; municipal parking lots and parks.
- Short-term local reimbursement program for energy efficiency programs.
- Promotion of residential energy audits and conservation projects through Mass Save.
- Agreement with Honeywell International to be the City's Energy Services Company (ESCo) to install energy conservation and renewable energy measures in municipal buildings.
- Community Choice Electricity Aggregation Program to provide renewable energy to buildings and residences. (http://www.worcesterenergy.org/leading-by-example/iecc-2021)
- Advocacy for stricter energy code standards.

Educational/medical institutions and private installations

- Both private and state educational and medical institutions in Worcester have been sustainability leaders in the City.
  - Worcester Polytechnic Institute: policy since 2007 to design all new buildings to meet LEED standards; five LEED certified buildings; building energy and lighting retrofit program. (LEED is a sustainability certification system for buildings and communities.)
  - Clark University: policy that new buildings over 5,000 sf will attain a minimum LEED Silver certification unless it costs more than 10% of the total life cycle cost of the building; all major renovations (over 50% of cost of total replacement) will meet a LEED Silver minimum and LEED criteria are applied to smaller renovation projects. University policies also require sustainable practices in site selection, materials, operations and maintenance.
  - College of the Holy Cross: policy to meet LEED Silver standards in all new major construction and renovation; 2 LEED Gold buildings
  - Worcester State University: Worcester State has four LEED Gold buildings and solar panels on three buildings.
  - Assumption College: Assumption College has one LEED Gold building.

[26] https://www.wbur.org/earthwhile/2020/01/13/heat-eversource-geothermal-energy-climate-change

- Quinsigamond Community College: climate mitigation policies including energy efficient operations; power plant and fleet/fuel management; behavioral/cultural change incentives; on-campus renewable energy production; carbon off-sets
- UMass Medical: two Silver and one Gold LEED buildings.
- The Department of Mental Health's Worcester Recovery Center and Hospital: one Gold LEED building.
- Worcester Academy: LEED Silver building renovation
- Bancroft School: 896 high-efficiency solar panels
- Holy Name High School: wind turbine.

- Over 1,500 private residential and non-residential installations of solar panels and energy retrofits including Mercantile Center downtown, which has a LEED Silver office building.

D. How

A sustainable, net-zero building sector in Worcester depends on several interrelated strategies:

- Make new buildings net-zero through requirements and incentives.
- Promote standard energy retrofits and incentivize and provide financing options for deep energy retrofits of older buildings.
- Use electricity rather than fossil fuels for building energy systems.
- Make renewable energy the source of electricity and heat.

Time Frame

EA - Early Action
(1–2 years)

ST - Short Term
(3–5 years)

MT - Medium Term
(6–10 years)

2030s, 2040s

Actions City-owned Buildings	Measures of Progress
1. Sustainability of All City Building Systems: ***Continue to transition City-owned buildings away from dependence on fossil fuels and towards full electrification and renewable energy through establishing sustainability requirements and thresholds for all City buildings.*** (See Chapter III 100% Clean and Affordable Energy.) ■ Adopt a policy of LEED Gold or an equivalent green building certification for all new construction of City buildings, including renovations valued at 50% or more of the building. ■ Work towards an Energy Star Rating of 75 or more for existing buildings. ■ Adopt a policy of Net Zero building with no fossil fuels used as a primary or substantial source of building energy for all new construction of City buildings.	**Who:** Department of Sustainability, City Manager, City Council, Department of Public Facilities **When:** EA and ongoing
2. Municipal Strategic Building Energy Management Plan. ■ Develop and implement a Strategic Building Energy Management Plan for existing municipal buildings, with a sustainability lens that considers life-cycle costs of investments and aligns with the City's ambitious goals for reduction of energy consumption. Created by the new Facilities Department, the plan should include: ▫ Stakeholder engagement ▫ Real time monitoring of all assets ▫ Stakeholder engagement ▫ Timely operation and maintenance ▫ Accurate record keeping of building assets and projects associated with them, such as through asset management systems	**Who:** Department of Sustainability, Department of Public Facilities Department with Parks **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
▫ Investment in human capital as well as artificial intelligence to assist with analysis of the real time energy use data to identify and fix inefficiencies ▫ During upgrades, investment in systems powered by renewable energy sources, or, if not possible, that are flexible enough to be converted to those sources as soon as available and affordable ▫ Equipment procurement process and decision making to include – Life-cycle and sustainable return on investment analysis – Flexibility/ease of conversion to cleaner energy sources – Resilience to extreme weather events	
Private Sector Buildings	
3. Fossil Fuels to Renewable Fuels: ***Develop a program to move all Worcester buildings from dependence on fossil fuels, including natural gas, to renewable energy sources.*** ■ Aim towards interim goals of 30% of units heated by renewables by 2030 and 100% of units heated by renewables by 2045. ■ Use strategies available to the City to advance toward interim goals. Working with the state, energy nonprofits, and utilities, develop incentives, financing options, and return on investment information to accelerate deep retrofits of existing buildings, including triple-deckers. Advocate for changes to state law allowing municipalities to require new buildings and major renovations to use renewable energy in all building systems. ■ Create a heating system database of the city's buildings with information on the type and age of the heating system and other relevant information and use the database to promote and incentivize replacement of aging fossil-fuel systems with renewable energy systems as older systems need replacement. ■ Work with Mass Save to aggressively promote energy efficiency retrofit programs for existing residential and non-residential buildings. Increase the number of commercial and residential buildings that complete an energy audit and implement recommended energy efficiency measures. Ensure increased outreach to environmental justice communities which utilities report have been significantly less likely to benefit from the Mass Save program so far. ■ In new construction projects supported by the City TIF (Tax Increment Financing) program, create minimum clean energy requirements and incentives for energy efficient construction beyond the minimum.	**Who:** Department of Sustainability with partners **When:** EA to ST
4. Mandatory Energy Efficiency in City-Funded programs. ■ Make energy efficiency retrofits mandatory in the Worcester Housing Now rehabilitation program for private owners, and other relevant housing programs that include city funding assistance for rehabilitation. ■ Include building insulation and high-efficiency heating and cooling. ■ Work with owners to identify best options for rental properties, whether central heating with unit thermostats for units or sub-metering to incentivize tenant energy conservation and also allow tenants to reap some of the benefits of lower energy costs.	**Who:** Department of Sustainability; Housing and Neighborhood Development; Mass Save **When:** EA-ST and ongoing
5. Annual Energy Performance Data on Large Buildings: ***Require buildings that meet size thresholds to submit annual energy performance data by adopting a building performance disclosure policy.*** ■ Examples include the Cambridge Building Energy Use Disclosure Ordinance (www.cambridgema.gov/CDD/zoninganddevelopment/sustainablebldgs/buildingenergydisclosureordinance) and the Chicago energy rating system to rate and make public the energy efficiency of	**Who:** Department of Sustainability.; City Manager; City Council **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
large buildings (10,000 sf and above). (www.smartcitiesdive.com/news/chicago-implements-energy-rating/) ■ Create an efficient reporting and analysis system by working with the Urban Innovation Office.	
6. Cool Roof Incentives: ***Establish an incentive program for "cool roofs" and "green roofs" to reduce air conditioning costs, the urban heat island effect, and, in the case of green roofs, help in stormwater management.*** ■ Cool roofs have white or other reflective colors or materials to reduce concentration of heat. Currently they are more common on commercial and industrial buildings. Summer temperatures can rise to 150 degrees or more on standard roofs. Cool roofs can reduce the heat by 50 degrees or more. ■ Green roofs are building roofs with a layer of vegetation planted over a waterproof system. (See Chapter VII One Water.) Green roofs provide natural insulation, reducing energy costs, stormwater absorption, and help reduce the urban heat island effect. ■ Work with materials providers and roofing contractors to encourage them to offer cool roofs and green roofs. ■ Incentives can include accelerated or discounted permitting, for example.	**Who:** Department of Sustainability; Planning Department; Public Works; Housing and Neighborhood Development **When:** ST
7. Distributed Energy Systems: ***Promote solar installations, geothermal networks, and other distributed energy systems, working with the state, National Grid, and other stakeholders.*** ■ Work with utilities to undertake pilot projects for geothermal heating districts using natural gas infrastructure in neighborhoods, starting with triple-decker (higher-density) neighborhoods.	**Who:** Department of Sustainability **When:** EA and ongoing
8. Sustainability Incentives for Private Buildings: ***Provide at least two incentives for private sector buildings that meet the standards of LEED or an equivalent green building rating system.*** ■ Possible incentives can include permitting time incentives; density incentives; tax credits; permitting fee incentives.	**Who:** Department of Sustainability; Planning Department; Economic Development **When:** EA to ST
9. Green Vocational Training: ***Establish training programs at the Worcester Technical High School for sustainable building systems and renewable energy.***	**Who:** Department of Sustainability; Worcester Public Schools **When:** EA to ST
Building Energy Policies	
10. Awards: ***Promote establishment of an annual award for green development projects, including retrofits.*** ■ Collaborate with an organization such as the American Institute of Architects, the US Green Building Council, or the Chamber of Commerce to develop an awards program.	**Who:** Department of Sustainability with appropriate organization **When:** EA to ST
11. Code compliance: ***Enforce consistent compliance with current energy codes.*** ■ Provide the appropriate number of building inspectors with up to date energy code training in order to enforce consistent compliance.	**Who:** Inspectional Services Department **When:** EA and ongoing
12. Home MPG Rating: ***Advocate for passage of state legislative proposals to require an energy assessment label (at time of sale) for single family, 1-4 family, and condominium homes.*** ■ The label would be like the Energy Star ratings for appliances and include factors like lighting, heating, insulation, doors, and windows. This would make energy consumption and costs transparent to the new buyers and incentivize home owners/home sellers to invest in energy efficiency.	**Who:** Green Worcester **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

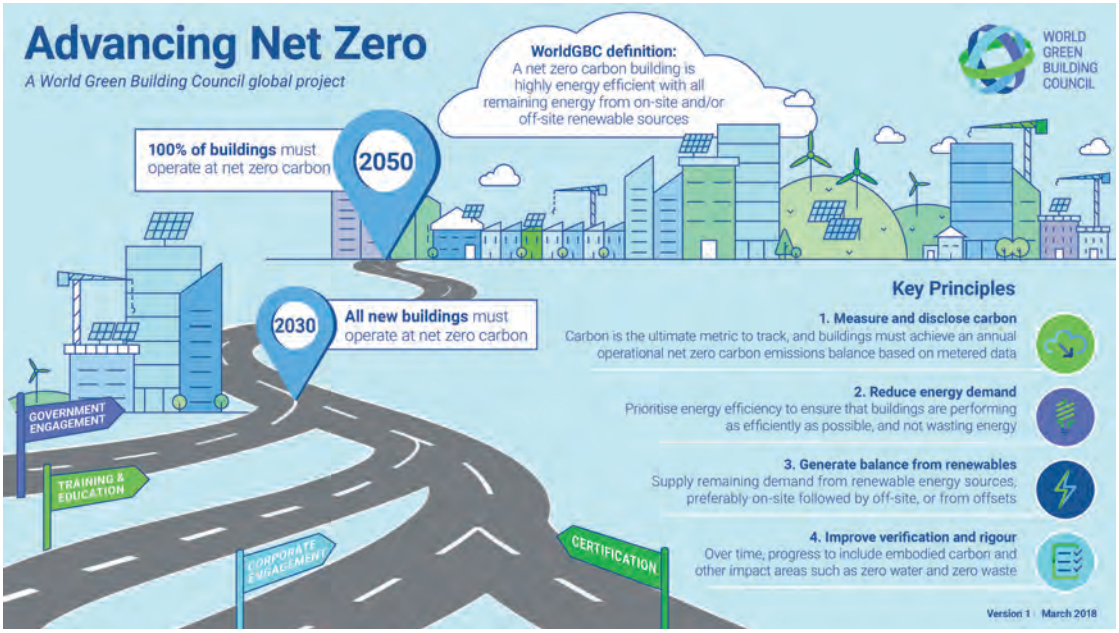
MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
13. State Energy Code: ***Continue to support and advocate for advanced state energy code regulations, such as a net zero energy code.*** ■ In 2019, the City participated in voting on energy efficient codes that impact state codes. http://www.worcesterenergy.org/leading-by-example/iecc-2021	**Who:** Department of Sustainability **When:** EA to ST
Land Use	
14. Land Use and Zoning: ***Use the comprehensive plan and zoning ordinance to support initiatives and regulations that promote reduced GHG emissions in housing and non-residential buildings.*** (See Chapter XII Sustainability and Resilience in All Policies.)	**Who:** Planning Department with others **When:** EA
15. Sustainable Reuse of Underutilized Properties. ■ Based on the comprehensive plan and zoning ordinance, develop sustainable transition or reuse plans for vacant malls and shopping centers, incorporating energy-efficient mixed-use development, green infrastructure and community uses. (See Chapter XII Sustainability and Resilience in All Policies.)	**Who:** Planning Division with Economic Development and Department of Sustainability. **When:** 2022 and ongoing

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Aggressively promote Mass Save audits and implementation of insulation recommendations. ■ Make energy efficiency retrofits mandatory for any programs that receive City funding assistance. ■ Adopt a policy for new municipal construction to be net zero. ■ Develop a Municipal Strategic Building Energy Management Plan.	■ Use the audits, assistance and rebates from Mass Save to establish energy efficient and renewable energy systems in businesses.	■ Continue and expand energy efficiency and renewable energy initiatives in buildings.	■ Request a Mass Save audit and make improvements with rebates. ■ Invest in electric heating and cooling systems (heat pumps).



www.worldgbc.org/advancing-net-zero/what-net-zero

VI

Green Worcester:

Sustainable Transportation Choices

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Summary Chapter VI Sustainable Transportation Choices

Goal: Provide safe, convenient, and comfortable pedestrian, bicycle, and public transportation networks and transition to vehicles powered by renewable electricity

Key Strategies:

- Shift more trips from cars to transit, biking, and walking.
- Power most automobiles, trucks, buses, and trains with electricity from renewable or low greenhouse gas sources.
- Develop and implement a Pedestrian, Bicycle, and Micromobility Plan.
- Reduce automobile trips through efficient land use policies and development patterns that support centers of housing and employment density and other activities that are served by transit and accessible by safe, comfortable, and convenient bicycle and pedestrian routes.

A. Goal

Provide safe, convenient, and comfortable pedestrian, bicycle, and public transportation networks and transition to vehicles powered by renewable electricity.

Reducing greenhouse gas emissions from transportation is a major strategic priority of the Green Worcester plan. While the City is on a continuing positive trajectory in reducing emissions from other sources, such as municipal facilities and water treatment, reducing transportation emissions is a major challenge. The City, the region, and the state continue to be very dependent on transportation by fossil fuel-based vehicles. In addition to providing safe, comfortable, and convenient transportation choices for everyday trips beyond commuting, there are multiple co-benefits to an effective, carbon-free, multi-modal transportation system. Less pollution, improved health, green stormwater and heat reduction co-benefits from trees and landscaping, and economic development are all linked to providing more transportation choice.

Health: Walking and biking promote healthy lifestyles. Fossil fuel emissions and particulates have proven deleterious effects on human health.

Equity: A transportation system designed for sustainability makes destinations more accessible to all, distributes services more fairly by providing more choices in how to access destinations, and enhances social connections.

Prosperity: Effective multi-modal systems support mixed-use developments, and serve all businesses, their employees and customers.

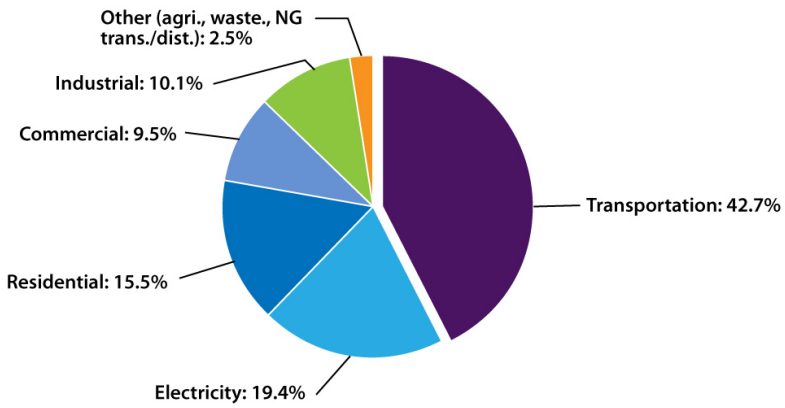
Climate Change Resilience: Multi-modal systems reduce GHG emissions and provide more transportation choice.

B. Why

Reducing greenhouse gas and other pollution emissions from transportation is a complex task involving multiple stakeholders, agencies, and investments, and the everyday decisions of residents, businesses, and visitors. Newer transportation options such as ride-hailing (for example, Uber and Lyft) and potential impacts of autonomous cars, by themselves, are not expected to reduce GHG emissions or vehicle miles traveled (VMT) unless they are powered by low-carbon fuels and carry multiple passengers. Moreover, success in creating a significantly more sustainable transportation system is closely connected to a city's development patterns and land use policies. The drastic decline in air pollution during the 2020 pandemic shutdown showed the role of fossil-fuel transportation in producing pollution. At the time of writing, the near- and medium-term impacts of the pandemic on transportation modes and infrastructure is uncertain, given potential user preferences and fiscal impacts.

Transportation is the largest source of greenhouse gas emissions in Massachusetts (42% of emissions as of 2016), with motor vehicles accounting for most of those emissions. Cars, SUVs, minivans, and pickup trucks account for 26% of greenhouse gas emissions in the state. While the Massachusetts Department of Transportation (Mass DOT) has found that 52% of all trips in the state are 3 miles or less, 80% of these short trips are made in vehicles. Moreover, pollution and particulates from fossil fuel-based transportation affects

public health by increasing the severity or rates of diseases ranging from asthma to cancer.



MA 2016 GHG emissions by sector (electricity treated as its own sector)
Source: https://www.mass.gov/service-details/ma-ghg-emission-trends

State initiatives. Massachusetts is a member of the Transportation and Climate Initiative (TCI), a group made up of 12 states and the District of Columbia, which is developing a regional policy to accelerate the transition to a low-carbon transportation system. The proposed program would cap emissions of carbon dioxide from the combustion of the fossil component of finished motor gasoline and on-road diesel fuel in the region. Fuel suppliers would be regulated based on the emissions emitted by their fuels. The program would result in somewhat higher fossil fuel prices. Adoption of the program is not expected before 2022 at the earliest.[27] This regional initiative parallels the successful nine-state Regional Greenhouse Gas Initiative (RGGI) cap and trade program for electric power generators mentioned in Chapter III.

Worcester transportation. The City of Worcester has made important strides in energy efficiency and renewable energy initiatives focused on municipal buildings and facilities. However, like many Massachusetts communities, Worcester is highly car dependent. Although the city has a densely-built urban core around downtown which, in principle, is walkable, bikeable, and suitable for transit, during the twentieth century the city also developed more suburban-style neighborhoods and corridors, and small centers dispersed around the city. For example, unlike many cities, where educational and medical institutions anchor a walkable downtown or urban villages ("college towns"), in Worcester, the "eds and meds" tend to be scattered in different neighborhoods. Worcester's ongoing revival in the twenty-first century is bringing a new focus and investment to the urban core and demands for transportation alternatives, but the city's development and employment patterns make car culture persistent. Ridership on the WRTA bus system has declined since 2016 and the WRTA's budget is constrained. There are limited safe biking and walking facilities. Most workers in Worcester commute to work by driving alone.[28]

The Green Worcester Plan recognizes that there are many emissions within the city that result from trips with origins and destinations outside the city. The plan includes recommendations for transportation demand management for city government that can help reduce trips and associated emissions from surrounding towns, but it does not include policy recommendations for the towns. In addition, the plan does not include recommendations for airplane emissions associated with Worcester Regional Airport, which is owned by Massport, an independent public authority.

[27] https://www.transportationandclimate.org/sites/default/files/TCI-Framework_10-01-2019.pdf
[28] *Worcester Research Bureau, Worcester Almanac 2018,* p. 72. http://www.wrrb.org/wp-content/uploads/2018/04/WRRB-Worcester-Almanac-2018.pdf

Electric Vehicles. Electrification of the transportation system is as important as electrification of building systems. Electric vehicles are three times more efficient than internal combustion engines.[29] The GHG emissions impact is, of course, dependent on using renewable energy to produce the electricity that charges the vehicle. While personal electric cars are part of the solution to zero emissions transportation, it is important to recognize that they carry fewer people per vehicle than public transit. This means that subsidies for electric cars have smaller per capita benefits than strategies which reduce total vehicle travel and costs. Reducing GHG emissions from some types of vehicles, such as heavy-duty trucks and airplanes, is likely to be more challenging.

Micromobility. New options for urban transportation that are low-speed (typically with top speeds of about 15 mph), lightweight (under 1,000 pounds), and human- or electric-powered are now classified under the term "micromobility." Because vehicles with an internal combustion engine or with a top speed of 28 mph are not considered to be micromobility, the expansion of micromobility options and uses contributes to the reduction of GHG emissions.

Micromobility includes bicycles, electric bicycles and pedal-assisted bicycles, electric scooters, and electric skateboards. They can be privately-owned or accessed through a shared fleet. Bike share and scooter share systems in urban centers expand options to avoid car trips and provide efficient transportation for trips under 10 miles that may be too long for walking. According to a report on micromobility, use of shared micromobility vehicles more than doubled between 2017 and 2018, including increasing use for trips to connect to transit or for commuting to work.[30] However, to give users confidence that micromobility trips will be safe, transportation planning to include micromobility options requires new, flexible ways to allocate street space and access to the curb; attention to different demands at different times of the day; and sufficient infrastructure. There is growing evidence that micro-mobility options (not just bike share) increase people's willingness to travel without a personal vehicle and even provide physical activity benefits.

Pedestrian and Bicycle Transportation. In 2019, Mass DOT issued a Pedestrian Transportation Plan and a Bicycle Transportation Plan, both accompanied by Municipal Resource Guides for Walkability and Bikability.[31] The state's 2019-2023 Capital Investment Plan supports implementation of these plans with a $60 million program as well as existing programs such as the Complete Streets Funding Program, Chapter 90, the Shared Use Path Program, and the Safe Routes to School Infrastructure Program.

Both the bicycle and pedestrian plans have two fundamental goals: 1) eliminate fatalities and serious injuries of pedestrians and bicyclists, and 2) increase the percentage of "everyday trips" made on foot and by bicycles (trips of 6 miles or less). Connecting to transit for longer trips (bridging the "last mile" gap) is also an important element in pedestrian and bicycle plans. Everyday trips include not only commuting but trips for shopping, social contacts, errands, and so on. Surveys have found that 60% of people would consider biking if they have confidence that their trips will be safe, comfortable, and convenient from start to finish of the trip.[32] Bicycle routes that fit that description are called "high

[29] Carbon Free Boston Summary Report, 2019, p. 63

[30] https://nacto.org/shared-micromobility-2018/

[31] Massachusetts Pedestrian Transportation Plan, 2019; Massachusetts Bicycle Transportation Plan, 2019; Massachusetts Municipal Resource Guide for Walkability, 2019; Massachusetts Municipal Resource Guide for Bikability, 2019

comfort" bikeways and have known design features. Similarly, pedestrians need the same confidence in safety, comfort, and convenience.

The Mass DOT Potential for Everyday Biking Analysis in the Bicycle Plan shows high potential in Worcester. The main barriers to walking and biking as transportation are incomplete networks and lack of connectivity, exposure to high-speed motor vehicle traffic, poor pavement quality, multi-lane intersections and rotaries, and lack of adequate lighting. Worcester has sidewalks on just over half its street network and a study found that the city has the highest concentration of dangerous intersections in the state for pedestrians.

Transit. The Worcester Regional Transit Authority (WRTA) serves 36 communities, including the City of Worcester, making it the second largest transit authority in Massachusetts. Thirteen communities have fixed-route service and 3 have deviated fixed route service, with all communities served by paratransit service for disabled persons. WRTA ridership has declined since 2016. Ride-hailing services (e.g., Uber) and institutional shuttle services have increased. The City of Worcester is served by commuter rail service to Boston from Union Station.

Area Within 0.5 Miles of a WRTA Stop

Source: Worcester Research Bureau, *City on the Move,* September 2019, p. 9

Transit expert Jarret Walker has pointed out in many publications that transit systems must find a balance between ridership and coverage. From an environmental and sustainability point of view the goal is to compete successfully with cars, making increasing ridership an essential goal. Coverage goals are focused on providing service to the people who most depend on transit, generally low-income, elderly, disabled, and groups who cannot drive. "The core challenge of transit design, then, is how to run vehicles so that people with different origins, destinations, and purposes can make their trip at the same time and will be motivated to choose transit to do so." Because transit riders are pedestrians, ridership also depends on the quality of the pedestrian environment at transit stops, while bicycle routes reinforce transit for longer trips.[33] The map above shows

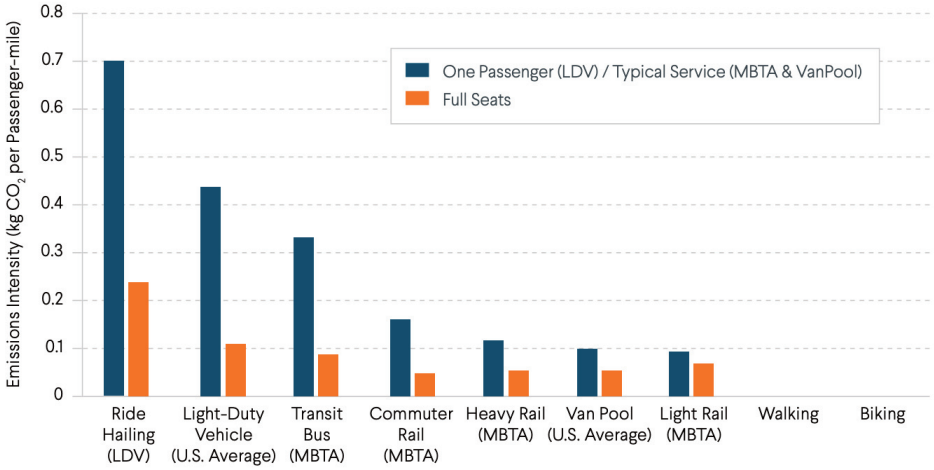
[32] 70% of respondents to a survey by the Central Massachusetts Metropolitan Planning Organization, said they would be willing to travel over 5 miles by bike. (CMMPO, Regional Bicycle Plan, 2018, p. 7)

[33] Jarrett Walker, *Human Transit,* pp. 12-13.

that most residents are within a half-mile of a bus stop, except for the less densely-built northwestern Worcester neighborhoods. However, that coverage says nothing about the frequency, reliability, and efficiency of the transit services in the current route design. To advance sustainability, the WRTA system has to capture more choice riders – i.e., people who have other transportation options – while still providing service for people who have no other choice. (See the Appendix for maps showing WRTA routes and frequencies.)

GHG Intensity of Transportation Modes

Transportation modes have very different impacts on emissions of GHGs. Emissions from light-duty vehicles (LDV) are based on the national average fuel economy for the in-use fleet of all light-duty vehicles (cars, SUVs, and pick-up trucks). Ride hailing assumes a deadhead factor of 1.6. "Full-seats" = 3 passengers for ride hailing, four passengers for typical LDV use, and full capacity for other modes. In Boston, heavy rail refers the Red, Orange, and Blue lines, and light rail refers to the Green line. Source: Data from U.S. Department of Transportation, Federal Transit Administration, *Public Role in Responding to Climate Change (2001)* ISO-New England grid GHG emissions factor.



Source: *Carbon-Free Boston Summary Report,* 2019, Figure 23, p. 55.

"Curb Management." For decades, the main use of curbside space has been car storage, otherwise known as parking. Today, cities are increasingly focusing on access for people rather than storage for cars. The many modes of 21st century urban transportation, especially in downtown and mixed-use districts, represent increasing competition for access to the curb. Traditional transit and micro-transit, ride-hailing services, delivery companies, bike share and electric scooter docks, and shared autonomous vehicles are among the many mobility options that people access from the curb and that are more sustainable than parking for fossil-fueled cars. Dynamic access and use of the curb can be flexible to accommodate different needs during the day. (Managing access to the curb by multiple transportation modes can also be more financially beneficial for cities than traditional parking meters.)[34]

Pop-up experiments and pilot projects. Many cities experiment with "tactical urbanism" projects to test ideas about increasing speed and reliability, access and safety, and rider experience. The pop-ups can be quickly set up with traffic cones, simple striping, or other inexpensive materials. The impacts of these projects are then evaluated to see if they should become permanent. In the Boston area, there have been several successful pilot projects to set up peak hour rapid bus lanes.[35]

[34] "Granite Becomes Gold: Curb Value Transformations" American Planning Association, 2020 National Planning Conference; Brian Barth, "Curb Control," Planning, (June 2019), https://www.planning.org/planning/2019/jun/curbcontrol/;

[35] National Academies of Sciences, Engineering, and Medicine 2019. Fast-Tracked: A Tactical Transit Study. Washington, DC: The National Academies Press. https://doi.org/10.17226/25571.

C. What We're Doing Now

Regional Transportation Planning

The Central Massachusetts Metropolitan Planning Organization (CMMPO) is responsible for planning the use of federal transportation funds for the City of Worcester and other municipalities in the region. Major goals in the region's 2040 Long Range Transportation Plan include expanding the bicycle, pedestrian, and transit network by adding 200 miles of bicycle and pedestrian facilities by 2040, reducing the mileage of sidewalks in poor condition by 10% over 10 years, and reducing the share of commuters who drive alone. In 2018, the CMMPO completed a Regional Pedestrian Plan and a Regional Bicycle Plan. The Regional Pedestrian Plan goals included encouraging walking and pedestrian mode share; increasing pedestrian safety and security; integrating pedestrian needs into public and private projects; and expanding data on regional pedestrian infrastructure.

The bicycle plan identified and mapped the potential for 100.24 miles of bicycle facilities in Worcester. In contrast, according to the plan, there are only 11.08 miles of existing bicycle facilities, 4.49 miles of programmed facilities, and 3 miles of a separated path multi-use facility (the Blackstone River Greenway and 0.14 miles on Tainter Street). The plan's list of existing and potential bicycle facilities in Worcester implies that almost all existing facilities are fragments of less than one mile, though some of these may connect to other segments. Because the CMMPO is responsible for a very large region and the City of Worcester lacks an up-to-date city plan, the regional bicycle plan proposals must be examined in light of land use policies and preferred patterns that will emerge with the expected new comprehensive plan to be developed in the early 2020s.

Bus Rapid Transit pilot project in Everett. The successful test resulted in a permanent rush hour bus lane and a bicycle lane.
Source: *Boston Globe*, Josh Reynolds
https://www.bostonglobe.com/metro/regionals/north/2016/12/21/everett-hails-bus-only-lane-broadway-success/9wDjozXVolbCkz2ziPf9lJ/story.html

Worcester Regional Transit Authority

The WRTA serves over 1,200 bus stops, with nearly 40 bus shelters predominantly located in Worcester. There are 52 full-sized fixed route buses: 17 are diesel-electric hybrids, 29 are clean diesels, and six are all-electric vehicles. After 2015, operating funds from the state decreased. Ridership on fixed-route service has declined since 2016. Although the City works collaboratively with the WRTA, it does not control funding or management of the transit system.

Riding the bus in Worcester is transportation of last resort. According to 2017 data from the U.S. Census Bureau, nearly 84% of Worcester residents take a car, truck, or van to work, while only 2.5% percent take the bus. Slightly more than 6% of Worcester households in 2017 owned no automobiles, while 40% owned two cars.

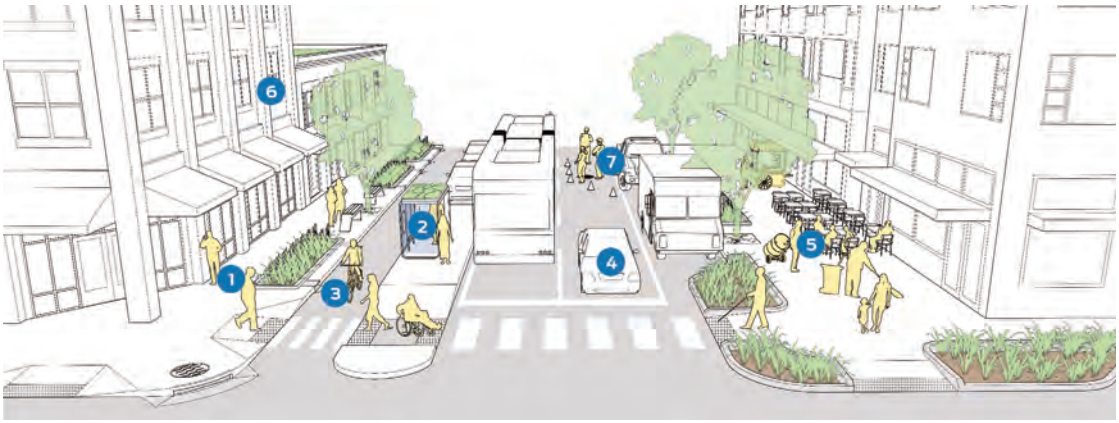
- A 2016 survey of riders found that 70% did not have a household vehicle, and the vast majority of riders had household incomes below the median resident household income of approximately $46,000. Nearly 70% of riders had household incomes below $25,000, and another 17% had incomes below $40,000.
- At the time of the transit rider survey, 42% of respondents were commuting to work, 16% were going shopping, 15% were going to a medical appointment, 11% to a social appointment, and 6.5% going to school.
- The WRTA estimates that buses currently run at 45% of capacity.[36]

WRTA Service Standards from 2012 state: "It shall be the policy of the WRTA to space routes such that within approximately 90% of the densely populated areas of the core city, Worcester, residents shall reside within one quarter (1/4) of a mile from a bus route." Route design takes into account population density (4,000 persons per square mile), employment density (200 employees or more), route and corridor spacing, demographics, service equity, interline enhancement, route directness, proximity to trip generators and destinations, and intermodal connectivity.

In 2015-2017, the WRTA operated a subsidized bus route among higher education institutions in Central Massachusetts but it was dropped because of low ridership and loss of financial support from the institutions (the Higher Education Consortium of Central Massachusetts – HECCMA).

City of Worcester

- **City of Worcester Pedestrian, Bicycle, and Roadway Safety and Complete Streets Report (2017).** The Department of Public Works in 2017 reported to the City Council on City work on widening sidewalks, planting street trees, painting bike lanes, installing safety measures, and traffic calming measures at intersections, as well as adoption of a Complete Streets policy. The city spent $2.3 million for pedestrian safety in 2017 and 2018.[37]



Complete Streets are Green Streets
Source: https://nacto.org/publication/urban-street-stormwater-guide/streets-are-ecosystems/complete-streets-green-streets/

[36] Worcester Research Bureau, *City on the Move: An Overview and Assessment of Worcester's Transportation Needs,* Report 18-07, September 2018; and *The Implications of a Fare-Free WRTA,* Report 19-04, May 2019.

[37] Traffic and pedestrian safety plan unveiled in Worcester," *Worcester Magazine,* October 5, 2017 (www.worcestermag.com/2017/10/05/traffic-pedestrian-safety-plan); http://www6.worcesterma.gov/WebLink/PDF/ox11glidfzqy3ztgcqvxx5em/1/20171003ccm%20(20).pdf.

- **Complete Streets Policy.** The City of Worcester adopted a Complete Streets Policy in December 2017, "to facilitate the development of an integrated, multimodal transportation system that provides safe, convenient, and efficient accommodation for all modes of transportation, including walking, bicycling, driving, and transit." Adoption of this policy makes the City eligible for state funding after the City identifies and designates priority Complete Streets projects.
- **Transportation Advisory Group.** As part of the Complete Streets Policy, the City established a multi-disciplinary and multi-stakeholder Transportation Advisory Group (TAG), to "assist in developing guiding polices, provide input and feedback on transportation proposals, and foster interdepartmental coordination."

Safe Routes to School Program

Worcester has received funding for the Safe Routes to School Program, which is designed to promote walking and bicycling to school through infrastructure improvements. Other aspects of Safe Routes to School include enforcement, safety education, and incentives. While many children live within walking distance of their schools, it has become so common for parents to drive their children to and from school that it creates traffic congestion – and unnecessary GHG emissions. A combination of infrastructure and safety improvements can make the physical conditions better, but additional efforts are often needed to encourage walking. The City's Department of Public Health coordinated a Safe Routes to School Task Force 2013–2018. Work included active transportation language in the wellness policy; pilot activities including crossing guard training, pedestrian safety training for second graders, and encouragement activities. Some individual WPS schools are partners with the Mass DOT Safe Routes to School program.

Walk and Bike Audits

Audits of pedestrian and bicycle facilities in Worcester exist for two corridors. In 2019, WalkBoston, a pedestrian advocacy nonprofit, completed the Green Hill Neighborhood Walk Audit focusing on Lincoln Street with funds from the state Mass in Motion program. A 2016 walk and bike infrastructure assessment was conducted by WalkBoston and MassBike along Chandler Street. WalkBoston in 2019 also provided a comment to Mass DOT on the pedestrian and bicycle accommodations in the design of the Kelley Square Improvement Project.

Bike Share Programs

During 2017-18 Worcester had a dockless bike-sharing program that was ended by the company involved. The City is interested in identifying the best system for Worcester and finding a new provider. Bike share programs at universities include the Wellness Center at Worcester State and student-run programs Cycles of Change at Clark University and Gumpel's Gears at WPI.

Electric Vehicles and Charging Stations

According to Registry of Motor Vehicles Data provided to the *Boston Globe,* as of July 2018 there were 27 electric vehicles registered in the City of Worcester, 0.04% of total vehicles.[38] The nonprofit organization E4TheFuture is supporting the Good2Go electric car-sharing affordable pilot program in Worcester that will be launched in 2020 with a small number of cars. Public and semi-public EV charging stations in Worcester include City Hall, Quinsigamond Community

College, Worcester Polytechnic Institute (6), Union Station and Major Taylor Boulevard parking garages, Clark University (3), UMass medical school (8), Medical Center (2), and the College of the Holy Cross (4) and Broad Meadow Brook Conservation Center (2). The City is pursuing installation of additional EV chargers on a number of municipal properties with incentives from National Grid. Federal tax credits for EVs are being phased out starting in 2020. The state rebate program for electric cars, briefly unavailable, was reinstated as of January 1, 2020.

State Legislation

The State Senate in January 2020 passed a bill requiring the MBTA to transition bus purchases and leases to zero-emissions vehicles starting in 2030 and operate an entirely zero-emissions passenger bus fleet by the end of 2040. It also makes the electric car rebate program permanent. As of this writing, the legislation awaits approval by the House and the Governor.

D. How

The transition to a zero-carbon transportation system depends on three major strategies and many actors in addition to local jurisdictions:

- Shift more trips from cars to transit, biking, and walking.
- Power most automobiles, trucks, buses, and trains with electricity from low-GHG sources.
- Reduce automobile trips through land use policies and regulations for efficient development patterns that support walkable, compact centers of housing and employment density that are served by transit and accessible by safe, comfortable, and convenient bicycle and pedestrian networks.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Transportation nad Mobility Planning	Measures of Progress
1. Sustainable Transportation and Mobility: ***Establish a sustainable transportation and mobility policy and planning section within the Department of Sustainability.*** ■ To maximize GHG emissions reduction and sustainability benefits, the Department of Sustainability will coordinate transportation policy-making and planning with City departments and with the WRTA and the Central Massachusetts MPO. ■ Move the Transportation Advisory Committee to the Department of Sustainability. ■ Oversee the circulation, transportation, and mobility element of the expected new comprehensive plan. ■ Include sustainability arguments in advocating for additional state funding for the WRTA.	**Who:** Department of Sustainability, collaborating with Planning and Public Works **When:** EA and ongoing
2. Transportation Emissions Reductions: ***Make the reduction of greenhouse gas emissions an explicit goal of City of Worcester transportation planning.*** ■ Model or estimate GHG consequences when considering options, while also considering safety, access, equity, and other criteria. ■ Develop programs to reduce emissions from municipal employee commuting, such as carpooling, guaranteed ride home, telecommuting, and so on. (See Chapter III 100% Clean Energy.)	**Who:** Planning Division, Department of Sustainability, and Public Works **When:** EA and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
3. Connectivity: Make connected networks an explicit goal of City of Worcester transportation planning. Maximize connectivity to move people – not just vehicles – between destinations.	**Who:** Planning Division, Department of Sustainability, and Public Works **When:** EA to ST
4. Event Transportation: ***Promote sustainable transportation choices at high profile locations and events, such as Polar Park and DCU events.*** ■ These choices could include shuttles from Union Station and from satellite parking locations. Temporary, pop-up safe bicycle networks can be organized for events and serve as demonstration projects for permanent changes.	**Who:** Department of Sustainability working with venues **When:** EA and ongoing
5. Idling Reduction: ***Enforce the Massachusetts Anti-Idling Law (Chapter 90, Sec. 16A).*** ■ Use the state DEP Idling Reduction Toolkit. ■ Ensure that City vehicles comply with anti-idling policies. ■ Employ Community Based Social Marketing to develop anti-idling program (e.g. at pick-up parking lots, etc.).	**Who:** Department of Sustainability **When:** ST
Electric Vehicles	
6. Electric Vehicle Use: ***Promote the use of electric vehicles in Worcester.*** Electric vehicles (EVs) do not emit greenhouse gases or particulate pollution. However, their carbon footprint depends on whether fossil fuels are used to produce the electricity they use. The increasing percentage of renewable energy used in Worcester will reduce and eventually eliminate the carbon footprint of EVs charged in Worcester. ■ Develop a plan to install more EV charging stations in public places, including streets, and, with partners, in employment centers and multi-family residential centers. Access to safe and convenient EV chargers gives potential buyers confidence that they will not be stranded on longer trips (aka range fear). ■ Establish EV charging stations in all City-owned parking areas with more than 20 parking spaces. ■ As vehicles in the City fleet go out of service, replace them with EVs. The state Department of Public Utilities recently approved a National Grid program to assist municipalities in making the transition to EVs. ■ Transition the City-owned school bus fleet to electric vehicles and encourage and incentivize vendors of bus services to do the same. Worcester Public Schools owns some school buses but the majority are operated by a vendor. ■ Require installation of EV chargers in redevelopment or development projects over 20,000 sf that include surface or structured parking. For example, Boston requires that 5% of parking spaces in new projects have EV chargers and another 15% be EV-ready in certain areas of the city. New garage projects there must have 25% EV chargers and be wired for 100% of spaces. The City of Los Angeles Department of Public Works offers rebates and incentives for commercial businesses that install EV chargers. ■ Require a percentage of EV charging stations and EV-ready parking at all new 5-unit plus multifamily buildings with on-site parking. All	**Who:** Department of Sustainability working with other departments as appropriate **When:** EA and ongoing

Time Frame

EA - Early Action
(1–2 years)

ST - Short Term
(3–5 years)

MT - Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
new 5+ unit buildings require site plan approval and this change can be accomplished through amendment of the Planning Board Rules and Regulations. ■ Consider incentives for EV ownership such as preferential parking or partial rebates of motor vehicle excise fees ■ Consider using a permitting system to ensure safe installation of EV charging stations and to provide data on the number of charging stations in the City. A template for permitting can be found at https://afdc.energy.gov/files/pdfs/EV_charging_template.pdf ■ From an equity perspective, consider working with local banks as part of their CRA (Community Reinvestment Act) programs to develop a low- or zero-interest EV financing program for income-eligible buyers, similar to affordable housing programs. The State of California has a rebate program for income-eligible buyers of EVs. ■ Promote training programs for high school students in maintaining electric vehicles.	
Transit	
7. WRTA Fleet: ***Transition the WRTA bus fleet to 100% electric buses by 2035.*** A pilot project for electric buses has been a learning experience because of problems with bus design and other issues. The City should work with the WRTA and the state to advocate for electrification of the bus fleet. ■ Aim for 50% of the fleet by 2025; 75% by 2030; and 100% by 2035.	**Who:** WRTA **When:** ST and ongoing
8. Transit Demand: ***Work with large employers to identify transit demand and priority routes for their employees, and seek funding for solutions to reduce single occupancy vehicle use.***	**Who:** Department of Sustainability with WRTA, Transportation Planner, Transportation Advisory Group, Institutions **When:** ST and ongoing
9. Consultation with the WRTA: ***Include the WRTA in the Transportation Advisory Group and consult the WRTA from the beginning in City transportation, street redesign and resurfacing projects.***	**Who:** Department of Sustainability, Planning Division, Public Works **When:** EA and ongoing
10. WRTA Service Optimum: ***Review WRTA service and make changes as needed to promote higher ridership while balancing coverage and social service responsibilities.*** ■ Identify what optimum service in terms of routes, frequency, reliability, and comfort would be to achieve significantly more ridership. ■ Identify options to meet coverage and social service goals. ■ Identify locations where pedestrian improvements (e.g., sidewalks and shelters) are needed to support major transit stops and coordinate with pedestrian and Complete Streets planning. ■ Implement and study pilot projects to find workable changes. ■ Seek funding needed for changes. ■ Explore eliminating fares throughout the system. A 2019 report by the Worcester Regional Research Bureau advocated eliminating fares to promote ridership because collecting fares costs more than they contribute to the system. This was based on the current route and service model and the effect on fares of any changes to that model would have to be reviewed. ■ If eliminating fares is not viable, create a program for employers to subsidize bus fares.	**Who:** WRTA, Department of Sustainability, Planning Division **When:** EA to MT

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
11. Transit to Serve Higher Education: ***Work with higher education employers, institutions and student populations to identify transit demand and priority routes, and seek funding.*** ■ While a previous route serving higher education was eliminated during the Great Recession for lack of demand, as locations such as downtown Worcester and the Canal District become more attractive to students, there may be new interest and willingness to serve the colleges and universities.	**Who:** WRTA, Deptartment of Sustainability, Planning Division **When:** EA to MT
Complete Streets	
12. Complete Streets Policy: ***Implement the policy by developing a priority plan for designing roadway space for all users.*** ■ Ensure that pedestrian and bike facilities are deployed with network links to community destinations in mind, rather than providing fragmented facilities that abruptly end before destinations. ■ Integrate Complete Streets principles into street design guidelines, standards, and other construction guides. ■ Identify priority streets for state Complete Streets funding assistance and identify low-cost, "low hanging fruit" projects. ■ Identify, implement, and evaluate demonstration projects to inform changes to policies and standards. ■ Prioritize re-surfacing projects with network connections for Complete Streets improvements and coordinate with bus stop improvements. ■ Make Complete Streets into Green Streets by maximizing opportunities for street trees, landscaping, and street planters that help reduce urban heat island temperatures and help manage stormwater.	**Who:** Planning Division, Transportation Planner, Transportation Advisory Group, Public Works **When:** EA and ongoing
Pedestrian and Bicycle Networks and Facilities	
13. Micromobility Plan: ***Develop and Implement a Pedestrian, Bicycle, and Micromobility Plan.*** ■ Review and build on the state and CMMPO plans. ■ Make land use decisions that support networks for safe and convenient walking, bicycling, and public transportation that link city destinations. ■ Identify and implement bicycle networks to support non-commuter short trips under 3 miles to central and neighborhood commercial areas, parks, and other neighborhood destinations. ■ Establish bicycle parking at public and private destinations along bicycle networks, including bicycle parking requirements for new development and redevelopment. ■ Use safety data to identify and prioritize for improvements to the most hazardous routes and intersections that discourage routine travel by bicyclists and pedestrians, and include education for motorists. ■ Design and implement demonstration bike route projects with traffic cones or striping to identify feasibility and survey users for feedback ■ Explore implementation of innovative design options such as bicycle boulevards and "low- stress" routes. Bicycle boulevards are low-speed streets that have been optimized for safe and comfortable bicycle travel. Low-stress bicycle routes focus on improving bicyclists' experience of high-stress (high volume or speed) traffic connections linking low-stress route segments which discourage people from bicycle travel – for example, the need to cross a high traffic arterial to get from one low traffic street or trail to another. These design options are also candidates for demonstration projects. (See the Appendix for resources on innovative approaches.)	**Who:** Department of Sustainability, Planning Division, Public Works **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
14. Bike and Micromobility Share: ***Find a reliable partner to create a new city micro-mobility share program for bicycles, scooters, and similar light-weight transportation.*** ■ Give preference to systems with docking stations.	**Who:** City of Worcester **When:** EA to ST
15. Open Streets Program: ***Create an "Open Streets" program to close a set of downtown or other suitable streets on Sunday mornings, monthly or weekly, or as one-off events, for biking and walking.*** ■ Worcester has an annual event like this on Park Avenue for stART on the Street. Many cities around the world have programs of this type to encourage biking and walking, often through downtowns or neighborhood centers that can benefit economically. Massachusetts communities that have hosted open streets events or programs include Boston, Cambridge, Somerville, Lawrence, Hyannis, Newburyport, Beverly, and South Hadley.	**Who:** Department of Sustainability, Transportation Planner, Police Department **When:** EA and ongoing
Trucks	
16. Energy-efficient Truck Routes: ***Study and revise, as needed, the truck routes for city-owned or city-contracted trucks, to enhance energy efficiency and reduce GHG emissions.*** ■ For example, garbage and recycling routes can be optimized for efficiency and emissions reductions.	**Who:** Department of Sustainability, Transportation Planner **When:** EA to ST
17. Mitigate Truck Route Impacts: ***Develop, implement and enforce a truck route plan that avoids negative impacts on residential and commercial areas.***	**Who:** Transportation Planner, Public Works, Police Department **When:** EA and ongoing
18. Truck Idling: ***Work with the Port of Worcester and CSX to reduce or eliminate idling at their yards.***	**Who:** Department of Sustainability, Port **When:** ST and ongoing
19. Last Mile Freight Delivery: ***Work with businesses for opportunities to establish innovative "last mile" freight delivery options that reduce GHG emissions.*** ■ These options can also provide safer conditions for pedestrians, cyclists and public transport passengers, and improve quality of service, lower costs and efficiency for delivery service providers.	**Who:** Department of Sustainability, Transportation Planner, relevant businesses
Land Use	
20. Coordinated Land Use Decisions: ***Use the comprehensive plan and zoning ordinance to support multi-modal transportation, especially walking, bicycling, and transit.*** ■ (See Chapter XI Sustainability and Resilience in All Policies.)	**When:** Planning Division, collaborating with other departments and resident and business stakeholders **When:** EA
21. Zero-Emission Urban Villages: Use the comprehensive plan and zoning ordinance to support existing and future mixed-use, higher-density neighborhood "urban village" centers that support zero-emissions pedestrian, bicycle, and other micromobility transportation. ■ (See Chapter XI Sustainability and Resilience in All Policies.)	**When:** Planning Division, collaborating with other departments and resident and business stakeholders **When:** EA

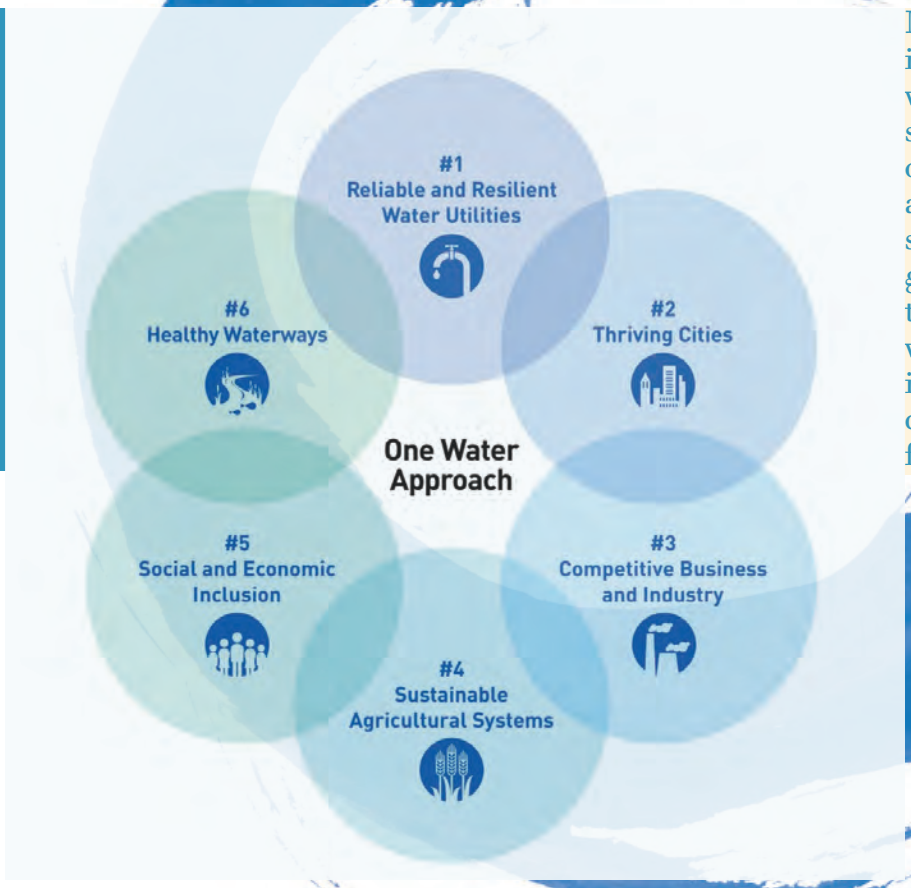
E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Make emissions reduction and connected networks explicit goals and criteria for city transportation planning. ■ Identify Complete Streets priority projects for implementation ■ Develop a Pedestrian, Bicycle, and Micromobility Plan. ■ Create an Open Streets program with routes to encourage walking and biking. ■ Establish programs for flexible commuting and work from home for city employees.	■ Establish flexible commuting and work from home programs as feasible. ■ Provide bicycle parking for employees and customers.	■ Establish flexible commuting and work from home programs as feasible. ■ Provide or enhance bicycle routes and parking.	■ Choose to walk or bike to destinations within three miles of home.

VII

Green Worcester:

One Water – Integrated Water Management



Source: U.S. Water Alliance One Water Roadmap, p. 15

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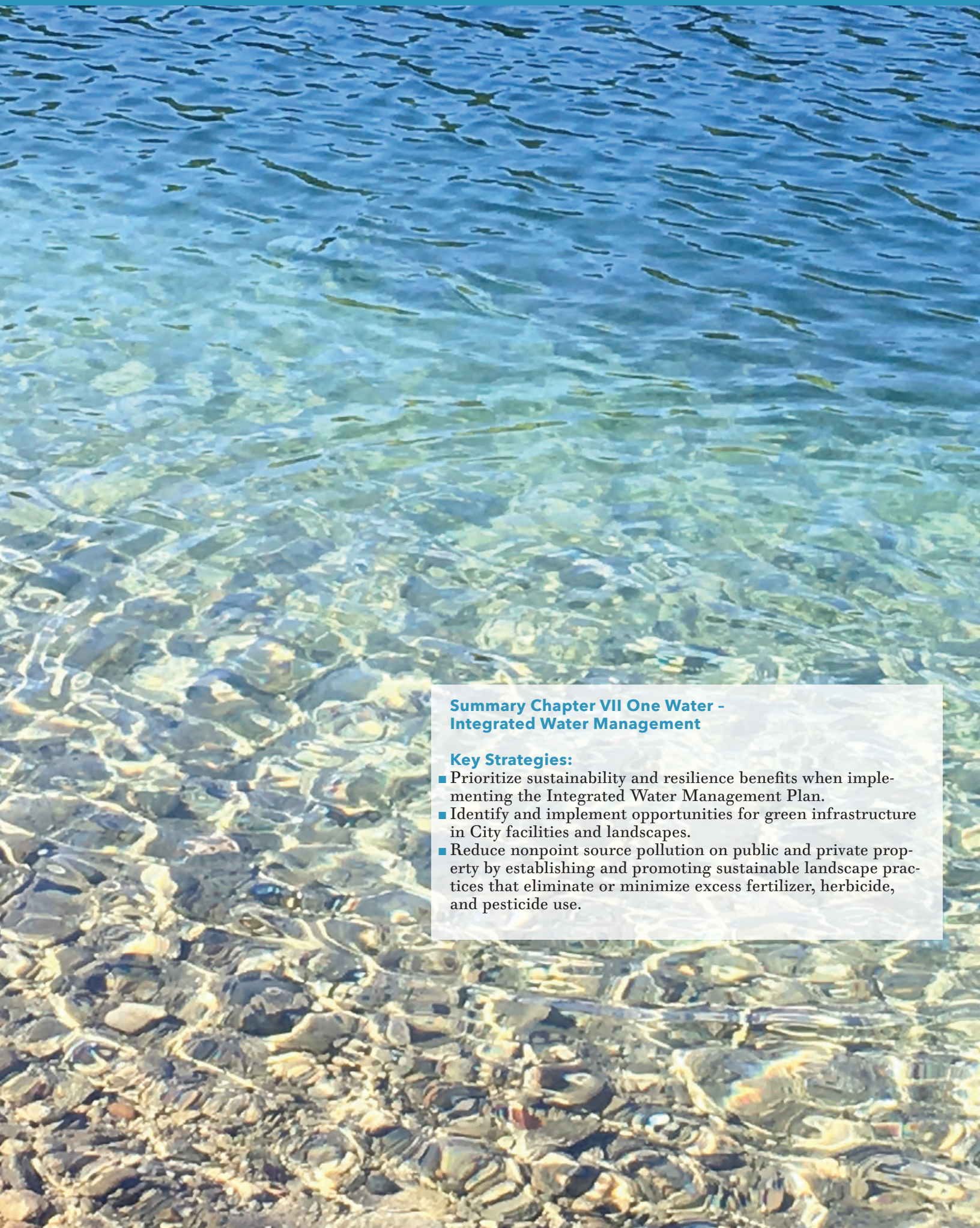

Summary Chapter VII One Water – Integrated Water Management

Key Strategies:

- Prioritize sustainability and resilience benefits when implementing the Integrated Water Management Plan.
- Identify and implement opportunities for green infrastructure in City facilities and landscapes.
- Reduce nonpoint source pollution on public and private property by establishing and promoting sustainable landscape practices that eliminate or minimize excess fertilizer, herbicide, and pesticide use.

A. Goal

Manage drinking water, wastewater, and stormwater as one resource and use natural systems through green infrastructure for stormwater management and to avoid flooding.

B. Why

In 2019, the City of Worcester completed an Integrated Water Management Plan (IWMP) with a 50-year time horizon. Water is a prerequisite for all life and all water is part of one cycle. Sustainable city water systems provide clean drinking water, keep keep pollutants out of surface waters, and and manage wastewater and stormwater as resources in an integrated system. According to the US Water Alliance, the One Water approach is based on these principles:

- All water has an intrinsic value – water is never a waste product.
- All water can and must be managed carefully to maximize its benefit.
- Water programs and projects should be designed to provide multiple benefits – economic, environmental, and social.
- One Water is a systems approach, with understanding of the multiple actors that affect water resources and the ecosystem's reliance on those resources.[39]

Health: People and all living things need clean water.

Equity: Low-income urban neighborhoods and locations with a high percentage of impervious surfaces are more vulnerable to flooding and pollution.

Prosperity: Well-managed and maintained water systems and infrastructure provide stability.

Climate Change Resilience: Climate change is expected to bring more extreme storms, drought, flooding, and changes to aquatic environments for wildlife. Integrated water management will help the city adapt to these changes.

The One Water or Integrated Water Management Approach is now supported by the Environmental Protection Agency to help communities meet their obligations under the federal Clean Water Act and Safe Drinking Water Act. As described in the Worcester Integrated Water Management Plan (IWMP), the integrated planning approach allows municipalities to optimize their investments in water infrastructure by identifying and sequencing the most serious water quality issues and highest priority projects

Nonpoint Source Pollution (NSP). Stormwater runoff pollution – often called nonpoint source pollution in contrast to point sources such as industrial effluent – is now the number one source of water pollution in Massachusetts, including Worcester. The sources of nonpoint source pollution are developed areas, transportation, agriculture, forestry, modification of water sources, atmospheric deposition, landfills, contaminated areas, waste management sites, and natural resource extraction. In an urban area like Worcester, the main sources of nonpoint source pollution are stormwater runoff containing oil, grease, and chemicals, including road salt, from impervious surfaces (building roofs, roads, and parking areas), construction runoff and sediment, fertilizers and herbicides, and

[39] US Water Alliance, One Water Roadmap, p. 11.

animal waste (pets and wildlife). The State's Massachusetts Nonpoint Source Management Program Plan 2020-2024 (2019) focuses on four priority pollutants: sediment, nutrients, pathogens, and climate change impacts.[40]

- *Sediment.* Although sedimentation is a natural process, excess sedimentation can adversely affect drinking water systems, outfalls, aquatic habitat and aquatic organisms.
- *Nutrients.* Excess nutrients, primarily nitrogen and phosphorus, often come from stormwater runoff from lawns, fields, and other fertilized areas. They produce excessive algal growth and cyanobacteria (a problem in Worcester's Indian Lake and Coes Pond, for example), affecting aquatic life and public health.[41]
- *Pathogens.* These disease-causing organisms come from the feces of humans, pets, livestock, and wildlife and can contaminate waterbodies.
- *Climate Change.* Climate change impacts, such as extreme storm events with high precipitation, can result in increased stormwater runoff, abnormal water levels and flow rates, and flooding. Higher temperatures in streams will affect aquatic habitat for cold water fish.

The state plan provides Best Management Practices (BMPs), a collection of practices to prevent and intercept nonpoint source pollution including regulations, low-impact development, green infrastructure, and habitat restoration. The plan emphasizes a coordinated and integrated approach. BMPs "can be more effective if governmental agencies, private sector interests, and stakeholder groups coordinate projects and implement solutions that address nonpoint pollution sources in a holistic manner. BMPs can either complement each other – erosion control BMPs typically increase the effectiveness and reduce the maintenance requirements of a site's sediment controls – or undermine each other – armoring stream banks may increase flow velocity and channel erosion downstream. In general, controlling NPS pollutants through prevention where possible is the most cost-effective approach. Control of these pollutants generally becomes more difficult and expensive the farther they travel down the stormwater pathway."[42]

Stormwater Utility Districts. The cost of stormwater management is often included either in a community's general fund or its water and sewer enterprise fund fees. (An enterprise fund is a separate fund for a specific type of service with fee revenues for the service and separate accounting of costs to provide the service, including capital costs.) Stormwater management costs are currently included in Worcester's sewer fee. Stormwater fees for stormwater enterprise funds allow cities to charge property owners for the stormwater runoff into public systems that is generated by the impervious surfaces on their property (such as parking areas, walkways, and building footprints). The concept behind the charge is that property owners should pay for the use of public infrastructure required to receive and treat the stormwater that comes from their properties. About 1,500 communities nationwide have stormwater utilities. Twenty-one communities in Massachusetts have established stormwater enterprise funds under MGL Chapter 44, Section 53F½, including Worcester's neighbor, Shrewsbury. MAPC (the Metropolitan Area Planning Council) has a toolkit for establishing a stormwater fund.[44]

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[40] https://www.mass.gov/doc/final-2020-2024-massachusetts-nonpoint-source-management-program-plan/download
[41] http://www.worcesterma.gov/uploads/c0/e9/c0e9326524ab6cb4dd655908e0d31111/recreational-water-quality-report-2019.pdf
[42] *Ibid.,* pp. 83-84.
[43] https://www.mass.gov/files/documents/2017/10/11/best-practice-enterprise-funds.pdf
[44] https://www.mapc.org/resource-library/stormwater-financing-utility-starter-kit/

From a sustainability point of view, stormwater fees raise awareness about the impact of impervious surface and nonpoint source pollution. Property owners pay the fee based on the runoff produced by the impervious surfaces on their property. Because they receive discounts if they make changes that result in less stormwater runoff into the public stormwater system and to streams, ponds and lakes, stormwater utilities incentivize best management practices that reduce runoff and its impacts. With the expected continued increase in precipitation and extreme storms as a result of climate change, reducing stormwater runoff and nonpoint pollution from private property is important for the future. Fees are calculated statistically based on different property types.

Green Infrastructure.[45] "Green infrastructure" refers to stormwater management practices that use natural processes to capture, filter, and slow down rainwater. By using soil and plants, green infrastructure reduces flooding and pollution by mimicking natural processes and turns rain into a resource instead of a waste product. Examples of green infrastructure include vegetated roofs ("green roofs"), absorbent gardens ("rain gardens"), bioswales (a long vegetated depression that receives and slows down stormwater), street trees, street planters, permeable pavement that allows rain to infiltrate soil, and rainwater harvesting (rain barrels).

Green infrastructure requires a different approach to maintenance. Gray infrastructure, such as underground pipes, tends to be very expensive up front to design and install, but does not need much maintenance until it leaks or breaks. Green infrastructure is less expensive to design and install, but it needs regular inspection and upkeep of planted areas. This creates jobs. The Water Environment Federation has created a National Green Infrastructure Certification Program (NGICP) that certifies a standard set of green infrastructure skills and abilities. Training programs for this certification are being used in many cities across the country, including by the Boston Water and Sewer Commission. Jobs programs in green infrastructure operations and maintenance for low income communities and disconnected youth have been developed in a number of communities.[46] Cities experienced with green infrastructure have manuals on maintenance, for example, Portland, Oregon's volunteer program, Green Streets Stewards, which has a maintenance guide and other materials.[47]

[45] https://www.nrdc.org/stories/green-infrastructure-how-manage-water-sustainable-way
[46] *Staying Green and Growing Jobs,* 2016. https://www.americanrivers.org/wp-content/uploads/2016/05/staying-green-and-growing-jobs.pdf
[47] https://www.portlandoregon.gov/bes/article/319879

Urban Green Infrastructure Installations (Philadelphia Clean Waters, Green City)
Source:https://d3n8a8pro7vhmx.cloudfront.net/mplsbike/pages/7231/attachments/original/1524674719/stormwater.jpg?1524674719

Two bioswales within a residential development: in the back, a completed planted bioswale; in the foreground construction showing water-collection area (with coarse stone) and drainage path, before soil and plants have been added.
Source: Wikimedia Commons.

B. What We're Doing Now

City of Worcester

- Integrated Water Management Plan (IWMP). The IWMP, submitted to the EPA in October 2019, is a comprehensive plan to identify and prioritize investments over the next 50 years in drinking water supply, drinking water treatment and distribution, wastewater collection, stormwater collection, and the Upper Blackstone Wastewater Treatment Facility (a regional treatment plant with the majority of use from the city). Because it is critical to public health, the drinking water system is the highest priority. The plan analyzes the other investment areas through a variety of criteria. Like many older cities, Worcester's infrastructure is aging and suffers from many years of deferred maintenance and upgrades. Approximately one third of the overall system dates from the nineteenth century. The city's urban core is served by a combined sewer overflow (CSO) system. To comply with the Federal Clean Water Act, the City must separate sewer and stormwater pipes. The plan and multiple appendices can be found at www.worcesterma.gov/cww/integrated-plan.pdf

The goals of the plan, in order, are:

- "Protect public health and safety by maintaining high-quality drinking water, reducing sanitary sewer overflows, and minimizing basement sewage backups caused by deficiencies in the wastewater system.
- Protect and improve full-contact recreational waters – Lake Quinsigamond, Indian Lake, Coes Reservoir, Bell Pond, and Cook Pond.
- Improve drainage and reduce flooding, particularly in the Green Island neighborhood, manage wet weather flows to the Upper Blackstone wastewater treatment facility, and improve water quality of stormwater that discharges to surface waters.
- Maintain affordable water and sewer rates.
- Improve treatment effectiveness and operations at the Quinsigamond Avenue CSO Treatment Facility."

Most of the plan is focused on improvements to the pipes, pumps, and plants that make up the City's "gray infrastructure." This gray infrastructure includes 10 reservoirs and 15 dams; 400 miles of sewer pipelines and 29 pump stations; and 349 outfalls collecting stormwater runoff that discharges into surface waters (streams, rivers, ponds, and lakes). The water and sewer systems operate through enterprise funds. A water and sewer fee is collected and the system is financed through a separate budget and accounting system. Stormwater costs are included in the sewer fee, unlike in many communities where there is a separate stormwater fee and utility.

To analyze water quality in Worcester, the IWMP mapped 28 "drainage service areas" for the land areas within the City that drain to surface waters overland or by outfalls. (These are not the same as full watersheds, which stretch into neighboring communities.) Although some of these waters are listed by the state Department of Environmental Protection (DEP) as impaired, the IWMP found that the data was so inadequate and old that it cannot be used to represent pollution levels today. An Appendix to the IWMP includes fact sheets for each of the water bodies and their drainage areas, including percentage of impervious surfaces, water quality data, and source of impairments. Upgrades to the Upper Blackstone Treatment Facility have contributed to substantial water quality improvements along the entire river since 2009.

The IWMP prioritizes capital reinvestments for existing systems to increase the reliability of the collection systems, protect recreational water quality and the environment, and reduce reactive maintenance while benefiting Environmental Justice communities. The top new capital investment project is the Green Island Flooding Relief Conduit which is designed to reduce capacity-related flooding and combined sewer overflows in Green Island, an Environmental Justice area which historically has experienced flooding more than any other part of the city. Because there is so much need for reinvestment in existing systems, the Green Island Flooding Relief Conduit, estimated to cost $40M, is not scheduled until the 2030s.

- *Green infrastructure projects.* The City has installed permeable pavement green infrastructure projects as part of improvements at a number of city parking lots, walkways, parks and playgrounds. The IWMP included the analysis of opportunities which included consideration of soils, seasonal high groundwater levels, and slopes. The city's drainage areas were evaluated and organized into three tiers for surface waters according to : human contact (primary and secondary contact recreation to no contact); the number of reported flooding events; and for the feasibility of green infrastructure in relation to geological and physical characteristics. Twelve drainage areas were identified as having greater need and suitability for green infrastructure, but, of the eight drainage areas identified with high need, five were also found to have lower feasibility. However, green infrastructure projects are highly specific to locations, so project design is very important.
- *Water Conservation.* The City provides or promotes the use of low-flow water fixtures and free toilet leak detection kits to residents. Fountains and spray parks use recirculation systems.
- *Drinking water protection through land management.* The City's drinking water reservoirs (located outside the city boundaries) are protected by approximately 8,000 acres of watershed. This land is actively managed to provide a healthy ecosystem. Management of forests, invasive species, and wildlife habitat promotes biodiversity, maximizes infiltration of water, and reduces pollutants that go into the reservoirs.
- *Regulatory protections.* Worcester has a local Wetlands Protection Ordinance in addition to the state Wetlands Protection Act. The local ordinance regulates development within 100 feet of catch basins. Any development within the Stormwater Protection Zone must provide erosion and sediment controls and be approved by the Conservation Commission. In addition, the City has an Aquifer Protection Overlay Zone.
- *Stormwater management and housekeeping.* The City' Stormwater Management Plan was updated in 2015. Activities include cleaning of the City's 18,000 catch basins at least once every two years to reduce pollution; Outfall Screening Program, every three years for E. coli screening; Street Sweeping Program; Catch Basin Stenciling Program; Illicit Sewer Connection Program; Culvert and

City Green Infrastructure Locations

- Beaver Brook daylighting
- City Green Infrastructure Locations
- Beaver Brook daylighting
- Bell Pond Beach
- Blackstone Gateway Park
- Burncoat Street Playground
- Clason Beach
- Coes Knife Park
- Crompton Park
- Green Hill Park
- Holmes Field
- Mill Street Greenway median
- Morgan Park
- Northeast Cutoff
- Senior Center Parking Lot
- Shore Park
- Ty Cobb Park

Brook Inlet Inspection and Maintenance Program; Dog Waste Program; and Fertilizer Use Reduction at Green Hill Golf Course. Stormwater management activities are included in the sewer enterprise annual maintenance budget and typically account for 60% of that budget.

Institutions and Green Infrastructure

- "Greening Worcester," a plan created by a team of UMass-Amherst graduate students in 2014, contains a variety of landscape and green infrastructure proposed designs for specific locations in the city.[48]
- Worcester's education institutions have pioneered green infrastructure projects in the city, such WPI's East Hall, which has the first green roof in the city. WPI also has underground cisterns to capture rainwater at its Sports and Recreation Center, and the water is used to irrigate gardens around campus.

Water quality monitoring

- Volunteers assist the Blackstone River Coalition by sampling sites in and around Worcester and by testing the water samples for nutrients, conductivity, and turbidity in Mass Audubon's water-testing lab at Broad Meadow Brook Wildlife Sanctuary.
- The City's Lakes & Ponds program works with the city's watershed associations and citizen scientists to monitor water quality in recreational lakes and ponds.

D. How

Sustainable water policy for conservation and combatting pollution in an urban center combines "gray infrastructure" with nature-based designs that are connected to the City's open space, landscape maintenance, forestry, and land use policies.

Key strategies for making Worcester's water resources and system more sustainable are:

- Continuation of land management around reservoirs for drinking water
- Implementation of green infrastructure where feasible
- Reduction of nonpoint source pollution through environmental monitoring programs on city property and by raising awareness among private property owners

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions General	Measures of Progress
1. Sustainability and Resilience Benefits: ***Prioritize sustainability and resilience benefits when implementing the Integrated Water Management Plan.***	**Who:** Public Works, Department of Sustainability **When:** EA and ongoing
2. System-wide Stormwater Model: ***Create a comprehensive system-wide stormwater hydraulic/hydrologic model to help the city to better understand the drainage infrastructure and inform capital improvement priorities (to address flood resiliency).*** Using the IWMP, this work will include:	**Who:** Public Works, Department of Sustainability **When:** EA and ongoing

[48] https://www.umass.edu/larp/project/greening-worcester-planning-and-designing-green-infrastructure-networks-habitat-recreation

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
■ System wide hydrologic/hydraulic drainage evaluation and modeling to ensure project prioritization and effectiveness. ■ Comprehensive flood mitigation solutions for recurring flooding problems. ■ Analysis of the most at-risk areas to flooding under future climate scenarios.	
3. Watershed Model for Water Supply: ***Create a comprehensive system-wide watershed model of the water supply reservoir network (to address drought resiliency).*** ■ Consider design options for the underground Blackstone canal to address the recurring flooding in the Green Island area as it is located in a vulnerable floodplain and is home to many low-income residents.	**Who:** Public Works **When:** EA and ongoing
4. Urban Forestry and Stormwater: ***Include stormwater management improvements and benefits when developing an Urban Forestry Master Plan.*** (See Chapter IV Connected Green and Blue Spaces.)	**Who:** Department of Sustainability, Parks and Recreation, Planning Divisions **When:** EA to ST
5. Low Impact Development Standards: ***Establish regulations and guidelines to require standards on Low Impact Development, stormwater runoff reduction, and green infrastructure in new development and in significant additions and renovations.*** ■ See guidance for urban environments such as the stormwater best management practices guidance document prepared for Boston: www.bwsc.org/sites/default/files/2019-01/stormwater_bmp_guidance_2013.pdf	**Who:** Department of Sustainability, Planning Department, Public Works **When:** EA to ST
6. Stormwater Utility: ***Explore creating a stormwater utility to incentivize use of best management practices on private property.*** ■ The operations and capital costs of implementing the 50-year IWMP will be substantial, making the creation of a stormwater utility likely to be contentious in Worcester. However, a stormwater utility is also a recommendation of the 2019 Municipal Vulnerability Preparedness report as a way to increase resilience to climate change impacts bringing extreme storms and flood impacts. ■ Explore pilot and incremental stormwater utility projects, as part of the Lakes & Ponds Program or a Sustainability Pilot District for example, to build understanding and support for a citywide stormwater utility. MAPC has developed a resource guide on stormwater utilities and financing: www.mapc.org/resource-library/stormwater-financing-utility-starter-kit/ ■ Consider adding a small fee for funding and maintaining stormwater green infrastructure.	**Who:** Department of Sustainability, Public Works **When:** ST to MT
7. Landscape Practices: ***Use Integrated Pest Management and organic landscape practices in managing city-owned property to reduce stormwater impacts of fertilizer, herbicides, and pesticides on surface waters.*** ■ The City already has a fertilizer reduction program for the golf course. Expand landscape management practices to eliminate harmful pesticides and other chemicals, including neonicotinoids, pesticides that are harmful to pollinators.	**Who:** Parks and Recreation **When:** EA and ongoing

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Green Infrastructure Actions	Measures of Progress
8. City Green Infrastructure: ***Identify and implement opportunities for green infrastructure in City facilities and landscapes.*** ■ Provide educational signage to inform the public about green infrastructure sites and the benefits they provide. ■ Establish development standards in large municipal development projects to use green infrastructure and sustainable landscape practices where feasible.	**Who:** Parks and Recreation **When:** EA and ongoing
9. Private Green Infrastructure: Promote green infrastructure practices to manage stormwater in private development. ■ Establish development standards and regulations requiring large development projects to use green infrastructure and sustainable landscape practices where feasible. ■ Ensure enforcement of compliance with site plan approvals. ■ Establish tree and landscape standards in the Zoning Ordinance to reduce impervious surfaces and incentivize green infrastructure. ■ Incentivize and publicize the use of gravel or brick driveways and patios, and similar best practices, to reduce impervious surfaces by residential property owners.	**Who:** Planning Department, Department of Sustainability **When:** ST and ongoing
10. Prepare Streams for Climate Change Impacts: Map currently culverted streams and study the potential for daylighting and green infrastructure. ■ Identify, prioritize, and implement interventions at locations expected to experience increased volume and intensity of rain events because of climate change impacts.	**Who:** Department of Sustainability, Public Works; Planning Department collaboration with educations institutions **When:** ST to MT
11. Workforce Development for Green Infrastructure: ***Develop youth workforce development programs, like the park ranger program, for maintenance of green infrastructure projects.*** ■ Establish training for the National Green Infrastructure Certification Program in Worcester. ■ Seek partners such as the vocational school, Regional Environmental Council, and the Green Jobs Academy.	**Who:** Workforce Development, Public Schools; Public Works, nonprofit partners **When:** ST to MT
Landscape Practices	
12. Landscape Practices: ***Promote sustainable landscape practices for private property that eliminate or minimize excess fertilizer, herbicide, and pesticide use to private property owners and landscaping contractors.*** ■ There are many handouts and web resources available to promote better landscape practices that are used by Conservation Commissions, environmental organizations, and other groups to inform residents ■ Inform private landscaping companies about the City's promotion of sustainable landscape practices and encourage them to incorporate and offer these practices. ■ Create a program for volunteer private properties for pilot/demonstration sites ■ Use Community Based Social Marketing tools to spread best practices.	**Who:** Conservation Commission, environmental organizations, Department of Sustainability **When:** EA and ongoing
13. Lakes & Ponds Program: ***Continue and expand the Lakes & Ponds program and coordinate with initiatives to reduce non-point source pollution to lakes, ponds, and streams.*** ■ (See Chapter IV Healthy and Balanced Natural Systems and Chapter X: Reducing Pollution.)	**Who:** Public Works-Lakes & Ponds **When:** 2020 and ongoing

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Establish standards to promote green infrastructure and minimize nonpoint source pollution. ■ Install signage at green infrastructure sites to raise public awareness about benefits. ■ Use Integrated Pest Management and organic landscape management practices.	■ Minimize impervious surfaces and incorporate stormwater best management practices, including green infrastructure and organic landscape practices. .	■ Minimize impervious surfaces and incorporate stormwater best management practices and green infrastructure and organic landscape practices.	■ Avoid using synthetic fertilizers, herbicides, and insecticides. ■ Use pervious surface materials for driveways, patios, paths and other hardscape elements to enhance infiltration of rainwater. ■ Incorporate rain gardens, swales, and similar stormwater management elements in residential landscapes.

VIII

Green Worcester:

Towards Zero Waste

Summary Chapter VIII Towards Zero Waste

Goal: Implement a plan to prevent – reduce – reuse – compost- and recycle waste.

As part of its commitment to reducing waste, Worcester has enacted an ordinance banning plastic bags and is working on implementing a curbside collection of textiles program.

Key Strategies:

- Develop and implement a Zero Waste Master Plan.
- Develop a residential green waste diversion program.
- Require plans for sustainable disposal of construction and demolition waste.
- Develop expanded city procurement policies to reduce waste and toxics.

A. Goal

Implement a plan to prevent – reduce – reuse – compost – and recycle waste.

B. Why

Disruption of the global recycling economy. Waste generation and storage contribute to greenhouse gas emissions and pollution. In the nearly 60 years between 1960 and 2017, the average amount of municipal solid waste generated per American rose from 2.68 pounds to 4.51 pounds.[49] Recycling of materials such as cardboard, paper, glass, metal and plastics seemed to be the solution. Recycling became a global business, with municipalities and industries in the recycling business selling recyclables to China and other countries. However, at least a third of the recyclables were contaminated by non-recyclable materials, including many plastics that are difficult to recycle, and were not recycled at all. In 2018, China effectively closed its market to waste such as plastics and paper from other countries by requiring very low rates of contamination. This decision overturned the global waste management economy and reduced prices and markets for recyclables, including the Worcester recycling program, which has become more costly.[50]

Health: Some types of waste contain substances toxic to human health and other types, such as microplastics, pollute our air, land, and water.

Equity: The adverse impacts of waste and poor waste management affect the most vulnerable populations disproportionately.

Prosperity: Waste and materials management is an expanding economic sector that supports many jobs.

Climate Change Resilience: Climate Change Resilience – Waste management is linked to greenhouse gas emissions.

Zero waste. Many communities are now planning for "zero waste," defined by the Zero Waste Alliance as "the conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health."[51] The idea of zero waste is related to the broader concept of a "circular economy," which goes beyond recycling to focus on preventing waste by redesigning products and supply chains and turning waste into resources that can be used again. This ultimately requires actions by major businesses, governments, and others on a much larger scale than is possible for municipal governments. "In practice, on the municipal level, zero waste means reducing the waste that goes to final disposal (landfill or incineration) to as close to zero as possible."[52]

Source:http://zwia.org/wp-content/uploads/2018/07/Zero-Waste-Hierarchy-7.0-graphic-board-approved-June-21-2018.png

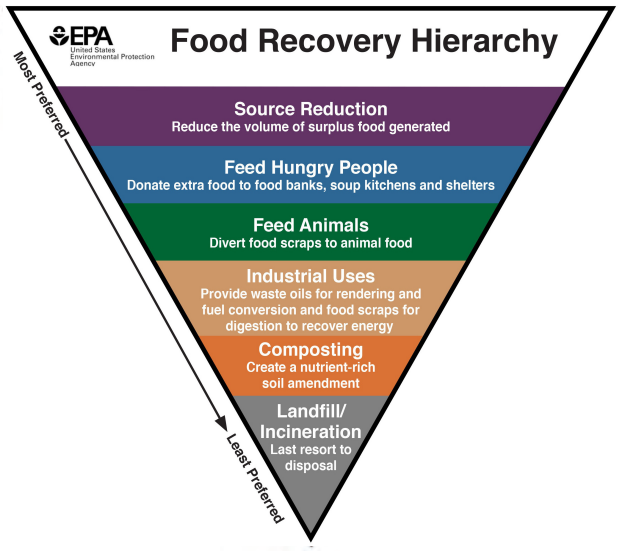
[49] https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials#NationalPicture
[50] Kate O'Neil, *Waste*, p. 44, 152; https://www.telegram.com/news/20180725/worcester-faces-new-challenges-in-recycling-as-costs-rise-demand-changes
[51] http://zwia.org/zwh/
[52] Kate O'Neil, Waste, p. 34.

The State waste management context. The Massachusetts 2030 Solid Waste Master Plan (adopted 2019) describes the impacts on Massachusetts of the reduced global recycling capacity since 2018.[53] In Massachusetts and the northeast U.S. in general, landfills are closing and are not being replaced, while incinerators are no longer seen as good solutions to solid waste disposal. Materials recovery facility capacity in the state is very constrained. The state rather than individual municipalities, is responsible for regulating the overall solid waste disposal system. However, the state has significant capacity for processing food materials through composting and anaerobic digestion, and it also has excess capacity for processing construction and demolition waste. There are growing options for donation and reuse, particularly for food materials, building materials, textiles, office furniture and equipment, and mattresses. These efforts also can create jobs and economic activity. The state has implemented programs to reduce green waste from businesses and to incentivize prevention and source reduction, as well as programs to reduce construction and demolition waste.

State goals are to reduce disposal 30% by 2030, reduce disposal 90% by 2050, and to reduce the toxicity of the solid waste stream. According to the plan, the greatest diversion potential is food, cardboard, untreated wood, textiles, and bulky materials. Food, mattresses, glass, and textiles are suitable for local markets.

Construction and Demolition Waste (C & D). Certain construction materials – asphalt pavement, brick, concrete, metal, wood, and clean gypsum woodboard – are banned from disposal, as are some materials that are often generated during construction and demolition projects, such as cardboard, tires, CRTs/electronics, white goods, and brush and stumps. The State has regulations and guidelines for municipal transfer facilities and solid waste facilities for dealing with these bans. The Massachusetts Department of Environmental Protection encourages re-use and recycling of materials not subject to bans.[54] RecyclingWorks Massachusetts provides extensive guidance for C & D reuse and recycling in projects at a range of scales. Creation of a waste management plan before a project begins is recommended to maximize waste diversion and sometimes results in overall project cost savings.
(https://recyclingworksma.com/construction-demolition-materials-guidance/).

Green Waste. Dealing with food waste through composting and redistribution is particularly well-suited to local programs. The Massachusetts Department of Environmental Protection estimates that, after recycling, 25% of waste in the state is food waste and amounts to more than one million tons annually. Since 2014, the State has banned disposal into the general waste stream of organic wastes by businesses and institutions that dispose of one ton or more of organic waste a week. A 2016 study found that the ban had many economic benefits including job creation, growth in Gross State Product, and generation of state and local tax revenue.[55] The state highlights Worcester State University as an institution complying with this law.[56]



Source: https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy

[53] https://www.mass.gov/guides/solid-waste-master-plan
[54] https://www.mass.gov/doc/frequently-asked-questions-construction-demolition-materials-waste-ban/download
[55] https://www.mass.gov/guides/commercial-food-material-disposal-ban#-massachusetts-food-waste-data-
[56] https://www.mass.gov/guides/commercial-food-material-disposal-ban#-regulations-&-guidance-

C. What We're Doing Now

City of Worcester

- **Worcester Waste Streams.** The major waste streams relevant to the City of Worcester are sewage and greywater (processed in the wastewater treatment system), municipal solid waste, construction and demolition waste (C & D), hazardous waste, and E-waste (electronics).
- **Ban on Plastic Bags.** The City banned plastic shopping bags for retail use in October 2019 with some exemptions. Implementation of the plastic bag ban was postponed during the pandemic emergency period until September 1, 2020.
- **Solid Waste and Recycling.** The City of Worcester has used a "Pay as You Throw" waste reduction and recycling program since 1993 for residential properties with one to six units. This program resulted in a significant diversion of solid waste from disposal to recycling and in 2008 Worcester adopted single stream recycling with an open top bin. In 2017 the Worcester residential recycling rate was 32%, about average for Massachusetts communities. Since 2015, Worcester has received state DEP grants under the Sustainable Materials Recovery Grant Recycling Dividends Program of $60-65,000 annually to be used in recycling programs, as well as $175,000 in 2015 under the Mattress Recycling Incentive program. Multifamily buildings with 6+ units and businesses with recycling programs are served by private waste companies. Multifamily buildings, condominium associations and small businesses are allowed to use the municipal residential drop off center for recycling, and many do.
- **Where Does Solid Waste and Recycling Go?** The City contracts with Casella Waste Management to process recyclables. Worcester's trash (solid waste), along with solid waste from other municipalities in the region, goes to the Wheelabrator Millbury solid waste-to-energy incinerator, one of 73 municipal solid waste incinerators in the US. It is regulated by the Massachusetts Department of Environmental Protection. The facility states that it annually diverts 481,500 tons of waste from landfills, separates 9,200 tons of metals for recycling, and produces enough energy to power 49,500 homes. It also produces air pollutants and toxic ash that remains after incineration goes to a designated landfills in Shrewsbury and Connecticut. Trash incineration is controversial and declining in the United States. No new incinerators have been built since 1997. Studies have shown that waste to energy systems do not produce energy efficiently.
- **Clean City Program.** The Clean City program developed in 2019 includes many initiatives to reduce litter and waste in the city. One proposal, implementation of a clear bag program for recycling, is controversial, because of the potential environmental impacts of the plastic bags and the cost to residents. Similar to the yellow bag, "pay as you throw," system for nonrecyclable waste, this proposal is intended to help avoid litter resulting from overflowing recyclable bins. Although the clear bags are recyclable, this part of the program has not been approved as of this writing. Other aspects of the program have been well-received:
  - Implementation of a Clean Team
  - Citywide Education, Outreach, & Public Awareness Campaign
  - Provide and Maintain Waste Containers in Neighborhood Business Districts
  - Provide Annual Grants to Districts to Fund Neighborhood Based Clean-Ups
  - Expanded Hours and Services at the Millbury Street Recycling Facility
  - Curbside Textile Collection Program
  - Introduce Drawstrings for Yellow Bags for Solid Waste

- **Composting.** Worcester has a municipal composting program for leaves and yard waste. The compost is free to residents, used by City departments, and sold to commercial businesses. The City does a one-time annual fall leaf collection from streets and residents can bring yard waste to three collection sites. About 10,000 tons are collected annually. The city also sells backyard compost bins to residents at a reduced price.
- **Street Sweeping** occurs over 10 weeks in the spring and fall.
- **Hazardous Household Waste Events** have been held by DPW every year for the last 30 years, typically bi-annually.
- **Managing Wastes and Toxics in the Public School System.** The Worcester Public Schools since 2010 have developed an extensive program, the Environmental Management System, to manage environmental health and safety issues in the school system. These range from dealing with building material risks, such as asbestos, lead and copper in drinking water, PCBs, and so on in older buildings, to indoor environmental quality, integrated pest management, and waste. Policies emphasize preventing pollution – source reduction and toxics use reduction. WPS has developed guidance for academic and operations departments to change purchasing to increase the use of Environmentally Preferred Products (EPPs). The most recent status report on the EMS system was published in November 2019 (https://worcesterschools.org/wp-content/uploads/2019/11/EMS-Status-Report-November-2019.pdf).

Private Sector, Institutions and Nonprofit Organizations

- **Construction/demolition waste and reuse.** Worcester and the region have several nonprofit organizations and businesses in the waste diversion sector including the Habitat for Humanity ReStore, Massachusetts Housing Alliance Donations Clearinghouse, Worcester County Food Bank, and companies that process construction and demolition waste. UMass Medical operates a SWAP (Surplus With A Purpose) Shop to facilitate reuse by students, faculty and staff of surplus office supplies, small furniture and laboratory equipment.
- **Organics and food waste collection.** As noted earlier, institutional and commercial producers of at least a ton of organic waste annually must comply with state law. In addition to Worcester State University, UMass Medical Center has been collecting food scraps from the 7500 meals it prepares per day and sending them to the Tyde Brook Farm in Holden for composting. They have also been recycling cooking oil. UMass Memorial Hospital has also been recycling oil from its kitchens since 2010 and has reduced total oil use by 35%. The City of Worcester collects cooking oil from residents at its Residential Drop-Off Center. Other institutions such as Clark University and WPI have varying degrees of food waste collection and composting. REC composts waste from the Mobile Market at its YouthGROW farm where it has large-scale composters but prefers donating food if possible to groups such as Rachel's Table, Catholic Charities, the Mustard Seed, and Ss. Francis and Therese Catholic Worker.

D. How

The top priority for Worcester is to move towards zero waste and to establish more ways to prevent waste altogether – keeping materials out of the waste stream – and to manage more waste through transformation into useful resources, such as collecting green waste for compost.

Key strategies include:

- Development and implementation of a Zero Waste Master Plan to promote waste prevention, materials reuse, and diversion of green waste and construction and demolition waste.
- Development of expanded and improved city procurement policies to reduce waste and toxics and promote use of recyclable products.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Waste Management	Measures of Progress
1. Waste Management Master Plan: ***Develop and Implement a Zero Waste Master Plan.*** ■ Review plan examples from other municipalities. For example, the Cambridge Zero Waste Master Plan contains a discussion of options and their potential effects on reduction of GHG emissions and reduction of trash. https://www.cambridgema.gov/Departments/publicworks/Initiatives/zerowastemasterplan ■ Conduct a waste audit of City properties and departments (including Worcester Public Schools) to identify priority opportunities for preventing and diverting waste. When needed, use Green Teams and LEAN processes to improve waste diversion. ■ Consider an ordinance requiring recycling in buildings with 6+ units and commercial buildings. ■ Require municipal and private projects to include a plan for sustainable disposal of construction and demolition debris as part of the permitting process. See https://recyclingworksma.com/construction-demolition-materials-guidance/ for guidance. Moreover, continue to promote preservation and adaptive reuse of historic structures, which can minimize the generation of construction and demolition debris. ■ Continue to apply for state grants to enhance materials management programs. ■ Continue and expand public awareness and behavior change campaigns (using Community Based Social Marketing tools) to promote waste prevention, reduction, and recycling, and to reduce contamination of recyclables.	**Who:** Public Works with Department of Sustainability **When:** EA – Develop Zero Waste Plan ST – Begin implementing program and ongoing 2030 – Reduce waste 30% on a 2019 base 2050 – Reduce waste by 80% on a 2019 base (including green and C & D waste)
2. Trash and Recycling Receptacles: ***Increase the number of and place trash and recycling receptacles strategically in public places.***	**Who:** Public Works **When:** EA and ongoing
3. Purchasing Policies: ***Establish environmentally conscious purchasing policies aimed at reducing waste and toxic materials and promoting use of recyclable materials.*** ■ Adopt an Extended Producer Responsibility (ERP) purchasing ordinance to favor vendors with responsible recycling and diversion programs. ■ Provide a checklist for City departments to use in their purchasing programs. Resources include the WPS environmental management program and the state's environmentally preferable purchasing programs. (www.mass.gov/environmentally-preferable-products-epp-procurement-programs)	**Who:** Procurement Department with Department of Sustainability **When:** EA to ST **Who:** Department of Sustainability **When:** EA to ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Green Waste	Measures of Progress
4. Composting: ***Expand and initiate programs to divert waste to compost.*** ■ Develop a curbside organics collection program (aka curbside composting) for residences and small businesses (that are not covered by the state commercial food waste disposal ban for enterprises that generate a ton or more per week). ■ Enhance the city yard waste composting program.	**Who:** Public Works with Department of Sustainability **When:** EA – policy development ST – implementation
5. Food Waste Elimination: ***Promote food waste elimination initiatives by WPS, institutions, and businesses and reduce use of disposable food service ware.*** ■ Consider amending municipal license requirements to require food service containers that are compostable or recylable.	**Who:** Department of Sustainability with partners **When:** ST and ongoing
6. Reuse Initiatives: ***Work with community organizations and City departments to organize Swap Shops, Fix It clinics, and similar initiatives.*** ■ Many communities have them at DPW centers, Repair Events Zero Waste Day events, Library of Things or Tool Libraries, and similar community activities and opportunities. One example is the Westborough Rotary Club sponsorship of a Repair Café with the Town Library; see RepairCafe.org) https://carbonneutralcities.org/	**Who:** Department of Sustainability, community organizations **When:** EA and ongoing

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Develop a Zero Waste Master Plan. ■ Adopt an Extended Producer Responsibility purchasing ordinance.	■ Ensure compliance with state recycling requirements.	■ Continue and expand policies and practices to avoid excessive waste including Extended Producer Responsibility for purchasing.	■ Ensure that your recyclables are not contaminated. ■ Compost your waste if you have a backyard. ■ Seek out and buy products that do not have excessive packaging. ■ Avoid one-time use plastics and other disposable products.

IX

Green Worcester:

Sustainable Food Systems

Sustainability
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Summary Chapter IX Sustainable Food Systems

GOAL: Develop a strong and resilient regional food system that provides city residents with access to food that is sustainably-produced, locally-sourced, healthy, affordable, and culturally-appropriate.

Key Strategies:

The local food movement has tremendous support from the Worcester community and can point to many successes. Key strategies include:

- Expand urban agriculture programs serving low-income and food-insecure populations.
- Expand local food sourcing policies for the City and for institutions.
- Promote development of the local food marketplace.
- Develop a resilient regional food production, processing, and distribution system.

A. Goal

A strong and resilient regional food system that provides city residents with access to food that is sustainably-produced, locally-sourced, healthy, affordable, and culturally-appropriate.

B. Why

Local food, sustainability, and resilience. Sustainability and resilience in food systems is closely linked to several concepts: food security, food justice, and food sovereignty.

- Food insecurity is defined by the US Department of Agriculture as lack of consistent access to enough nutritionally adequate food for an active, healthy life because of insufficient household resources. Food-insecure households are not necessarily food insecure all the time. Food insecurity may reflect a household's need to make trade-offs between important basic needs, such as housing or medical bills, and purchasing nutritionally adequate foods. The four "pillars" of food security are availability, access, utilization, and stability.
- The food justice movement emphasizes providing opportunities for people to participate in a food system that meets their dietary, cultural and economic needs.
- Food sovereignty means that people should be able to produce their own food, if they wish, and to procure and select foods that they want.

"Since 2015, REC (the Regional Environmental Council) in Worcester has focused on its urban agriculture programs, food security and food justice."

A sustainable food system rests on the foundation of regional food production that reduces GHG emissions and reduces synthetic chemical use. From a sustainability point of view, the benefits of local food require more than the fact that shorter distances from farm to consumer are involved. Local food production is often assumed to be more sustainable than food from more distant production areas because of the presumed lower GHG emissions resulting from shorter transportation distances in the supply chain. However, studies show that the majority of GHG emissions in agriculture are from production practices. For example, fresh produce grown in a local farm greenhouse running on fossil fuels and transported in a small truck may not be more sustainable than conventional supplies.Ideas about sustainability in local food production emerged from critiques of a conventional agriculture system using many synthetic chemical inputs and resulting in highly processed foods. Alternative agriculture that is associated with greater sustainability is based on a collection of practices such as crop diversity, organic standards, limited use of synthetic herbicides and fertilizers, use of cover crops, free range livestock, and less processing and packaging, as well as shorter supply chains.[57] Alternative food marketing systems, such as farmers' markets, Community Supported Agriculture (CSA), and food hubs, create direct relationships between producers and consumers that promote resilience and sustainability through enhanced social capital.

Resilient food systems. The local food and food justice movement is well-established in the city and in the county, which is the home of approximately 20% of the farms in Massachusetts. Food insecurity is an issue in the City of Worcester.

[57] Rachel Shindelar, "The Ecological Sustainability of Local Food Systems," RCC Perspectives, No. 1 (2015), pp. 19–24. https://www.jstor.org/stable/10.2307/26241302

The 2018 Community Health Improvement Plan (CHIP) found that 22 percent of city residents receive food stamps (SNAP benefits) and three zip codes qualify as food deserts where at least a third of the population lives more than a mile from a large grocery store. In 2017, more than 80,000 people in Worcester County, many of whom live in the city, received assistance from food banks, pantries and community meal programs. The pandemic emergency drew attention to the importance of resilient food production, supply chains, and distribution for both food security and for the restaurant economy which is so important to urban areas.

Indoor Agriculture and Sustainability

Indoor hydroponic farm allows local year round tomato and lettuce crops. Source: Wikipedia Commons.

Indoor agriculture offers opportunities in cities for adaptive reuse of empty or underutilized buildings. Indoor urban agriculture can produce organic crops and typically uses less water than outdoor agriculture. However, it requires significant amounts of energy and is very dependent on technology to support the growing environment. The amount of energy, whether that energy comes from fossil fuel or renewable energy, and if that compares favorably overall with the cost of land production and shipping affects the extent to which it can be considered sustainable, despite other benefits. The cost of the electricity to run lighting systems indoors also means that indoor producers today tend to concentrate on the most valuable crops for profitable specialty markets. Studies are now underway to develop methods to make lighting use more energy-efficient and develop less energy-intensive lighting.[58] The cost of urban land also affects the viability of indoor and vertical farming, and there may be as yet unknown nutritional aspects (e.g., trace elements and micronutrients) of growing food without soil.

Food Waste

As noted earlier in Chapter VIII, food makes up a high percentage of waste and is very suitable for local waste management.

C. What We're Doing Now

City of Worcester

- **Zoning.** The 2018 Urban Agriculture Zoning Ordinance allows urban agriculture as a land use. Some undeveloped tax levy parcels have been made available for urban farming.
- **Public School Meals.** Worcester Public Schools offers free breakfast and lunch at school to all students. Menus include fresh fruits and vegetables, whole-grain breads, minimally processed foods and, when feasible, locally-sourced food.
- **Meals for Children and Seniors.** The Summer Feeding Program provides free lunch to children at sites throughout the city and Elder Services of Worcester coordinates free meals for seniors.

Nonprofit Organizations

- **Worcester Regional Food Hub.** Starting in 2015 and supported by the Greater Worcester Chamber of Commerce and the Health Foundation of Central Massachusetts, the Food Hub promotes local food access and consumption in the

[58] Mark Crumpacker, "New Study to Look at the Energy Costs of Indoor Farming," Medium, November 2018, www.medium.com.

city and region. Among its first initiatives was to connect institutional buyers, such as school districts, with local farmers through aggregations and distribution of local produce. It also has a commercial kitchen incubator for food entrepreneurs.

The goals of the Food Hub are:

- Strengthen sustainable agriculture by supporting and enhancing the production–to–distribution chain for local producers and small acreage farmers.
- Promote healthy eating by providing people of all incomes with access to fresh and healthy products.
- Fuel economic development through the support of emerging entrepreneurs and increased consumption of locally produced food. This includes an incubator program, "Launching Diverse Food Entrepreneurs in Worcester," which has graduated its first cohort.

- **The Worcester Food Policy Council** works on policy development, legislative advocacy, data collection and analysis, and focuses on:
  - Healthy Food for All – fresh, culturally appropriate, and affordable fruits, vegetables, and healthy meals for all neighborhoods
  - Growing Urban Agriculture – ensuring that anyone can farm land and sell their products in the City.
  - Building a Food Movement for All – farmers, nutritionists, activists, researchers
- **Tax Levy Parcels for Urban Agriculture.** The Education & Agriculture Training (EAT) Center, a collaboration of the City of Worcester, REC, Ascentria Care Alliance, and Worcester Common Ground uses suitable undeveloped tax levy parcels for urban agriculture. EAT Centers provide training and tools for refugees with an agricultural background in their countries of origin.
- **Regional Environmental Council (REC).** Since 2015, REC has focused on its urban agriculture programs, food security, and food justice. The organization's most recent strategic plan lays out a strategy to focus on strengthening the quality of three program areas – the community and school garden network, urban farms with youth and immigrants, and farmers' markets including the mobile farmers' market program – while continuing advocacy work.
  - *Community Gardens.* UGROW is REC's network of 67 gardens including community gardens, school gardens, and six urban farm sites producing for the market. Over 500 volunteer gardeners participate, including 18 schools (involving 2000 students) and senior centers. It began in 1992 with one garden and one volunteer. The community gardens produce over 15,000 pounds of food annually for consumption by gardeners.
  - *Urban Farms.* Urban farms produce for sale in the market. REC manages urban farms at the four EAT Centers described above. Two YouthGrow urban farms, in Main South and Bell Hill, are youth jobs programs run by REC. Some 30-40 low-income teens are employed year-round and learn about leadership, professional development, and social justice, as well as urban agriculture. YouthGrow farm production results in over 4,000 pounds of organic food annually, which is sold at REC farmers markets and donated to people in need. The youth also make their own hot sauce, Drop It Like Its Hot Sauce.

Community gardens grow food and build community.
Source: REC

Sweetpeas and peonies a Worcester Farmers' Market.

- **Farmers' Markets.** There are year-round, indoor and outdoor, and mobile farmers' markets in Worcester.
  - REC manages the Beaver Brook Park Farmers' Market (Monday and Friday mornings, June – November), the University Park Farmers Market (Saturdays, June – November) and the mobile farmers' market which visits neighborhoods and community center locations in the city's most food-insecure neighborhoods providing 80,000 pounds of local food.
  - The Canal District Farmer's Market operates at Crompton Place on Saturdays year round with approximately 14 farm vendors.
  - Black Seed Farmers Market is a year-round indoor market at the Denholm Building on Main Street.
  - Farmers' Market at the Worcester Common Oval is open during lunch hour from June to August.
  - The indoor Worcester Public Market at Kelley Square opened in early 2020 with about 30 food vendors, mostly selling value-added products.
- **Health Organization Programs.** The Family Health Center of Worcester, Project Bread, and the REC, with multi-year funding from Blue Cross Blue Shield, are developing systems for effective hunger screening through in-office referrals, access through mobile markets, and connection of patients to community programs and services that affect the social determinants of health, including healthy diets.

Indoor Farms


Indoor sowing of an annual crop.

- **Freight Farms.** Co-founded by a Clark University alumnus, Freight Farms provides hydroponic farms in shipping containers, predominantly to the institutional market. Worcester State University and Clark University use Freight Farms to produce fresh greens for their dining halls. The company says that its first model consumed less than five gallons of water and 125 kWh of electricity a day and a new model was announced in 2019.
- **A Stone Soup Hydroponics Greenhouse** has been announced as a cooperative project of Worcester Roots, Green Revitalize, UMass Memorial Health Care and Technocopia. However, it has not yet become operational.
- **REC Indoor Production.** REC is working with the Seven Hills Foundation to provide indoor food production at their sites for Stearns Tavern café.

D. How

The local food movement has strong roots and networks in Worcester and is working towards a regional food system that could play a significant role in supplying the city. Support to strengthen a regional system is based on production and markets:

- Expand production through urban agriculture programs serving low-income and food-insecure populations.
- Expand markets through enhanced local food sourcing policies for the City, for institutions, and robust farmers market networks.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Community Garden and Urban Farms	Measures of Progress
1. Existing sites: ***Protect access to land of existing community gardens and urban farms.*** ■ Work with community partners to protect existing community garden and urban farming sites through acquisition or long-term lease. A model for community garden preservation is the Neighborhood Gardens Trust in Philadelphia (www.ngtrust.org/) which works with the Pennsylvania Horticultural Society. Organizations in Worcester such as Tower Hill Botanic Garden or the Ecotarium may be able to play a role.	**Who:** Department of Sustainability, community partners **When:** EA and ongoing
2. New urban agriculture sites: ***Identify additional locations for community gardens and larger-scale production.*** ■ Increase the percentage of the population living in multi-family housing that has access to a community garden. ■ Promote educational efforts around the Urban Agriculture Zoning Ordinance. ■ Secure resources to make vacant city-owned properties available for urban gardens. ■ Consider an ordinance allowing homeowners to keep chickens.	**Who:** Department of Sustainability, community partners **When:** EA and ongoing
3. Community orchards: ***Identify potential locations for community orchards in selected public spaces or edges of community gardens.*** ■ Work with local groups to compete for the location and management of these orchards, for example, by neighborhood groups or park "Friends" groups.	**Who:** Department of Sustainability, community groups; Parks and Recreation **When:** ST and ongoing
Schools and Institutions	
4. Farm to School: ***Continue and expand the Farm to School program for WPS, working with the Worcester Food Hub.***	**Who:** WPS, Worcester Food Hub **When:** EA and ongoing
5. Gardens in Schools: ***Integrate school gardens and garden curricula in the Worcester Public Schools.*** ■ Work with community partners such as REC and the Worcester Public Schools to develop district-wide grade level-based opportunities to engage in school gardens curriculum and farm visits. ■ Include school gardens in all designs to update or replace Worcester Public Schools.	**Who:** Department of Sustainability, WPS, **When:** EA and ongoing
6. Local food sourcing: ***Promote local food sourcing by all institutions.***	**Who:** Department of Sustainability, institutions **When:** EA and ongoing
Policy	
7. Preferential Procurement: ***Adopt preferential procurement policies to source locally-produced foods.***	**Who:** Department of Sustainability, Procurement **When:** EA
8. Resilient Regional System: ***Develop a plan to enhance the resilience of the regional food supply system.*** ■ Work with organizations such as the Food Policy Council and the Food Hub. ■ Explore academic interest in regional food system resilience issues. ■ Incorporate food system resilience into hazard management planning.	**Who:** Department of Sustainability, higher ed institutions **When:** EA

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

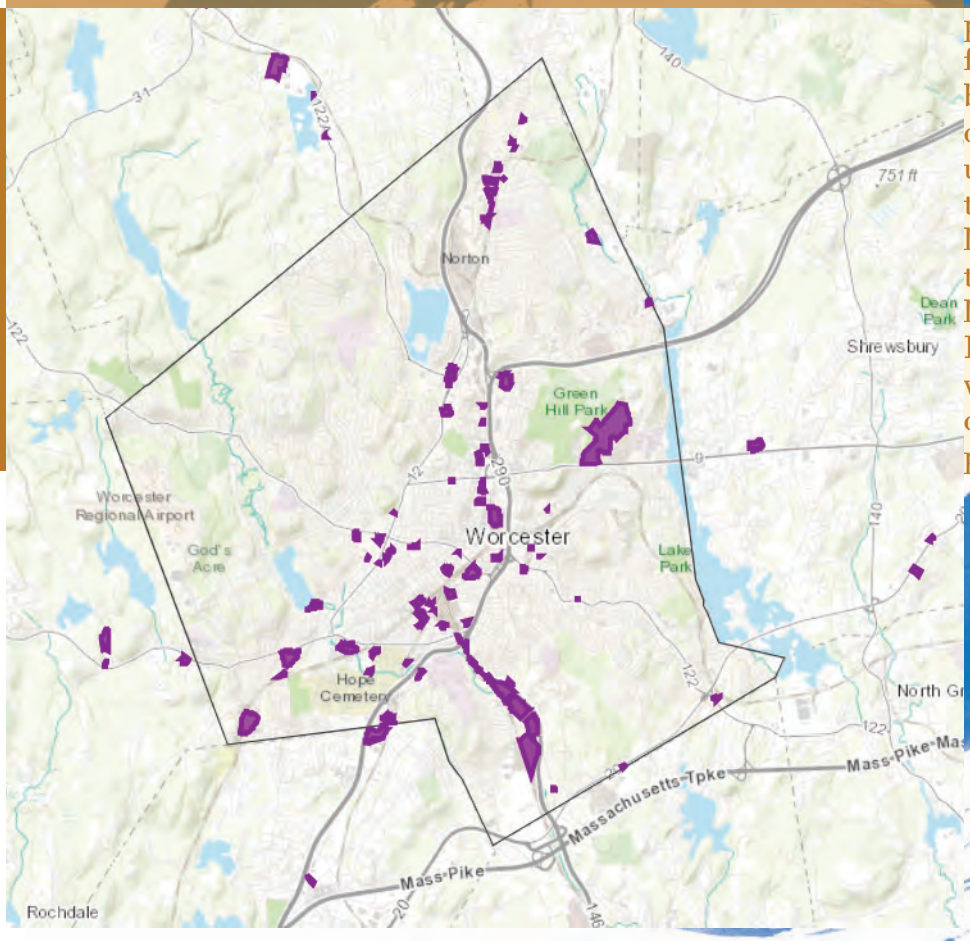
Actions	Measures of Progress
9. Indoor Farming: ***Develop a pilot project with students to develop a sustainable return on investment analysis of indoor farming.*** ■ Include identification of the energy costs and land costs of indoor farming in relation to land-based farming. ■ Include analysis of the indoor farming potential in underutilized buildings. ■ Use a Sustainable Return on Investment analysis.	**Who:** Department of Sustainability, higher ed institutions **When:** ST

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Strengthen the Farm to School Program in WPS ■ Develop options to help protect community gardens and urban farms through acquisition or long term leases.	■ Buy local food products and support the local food economy.	■ Buy local food products and support the local food economy.	■ Buy local food products.

Green Worcester:

Pollution Prevention



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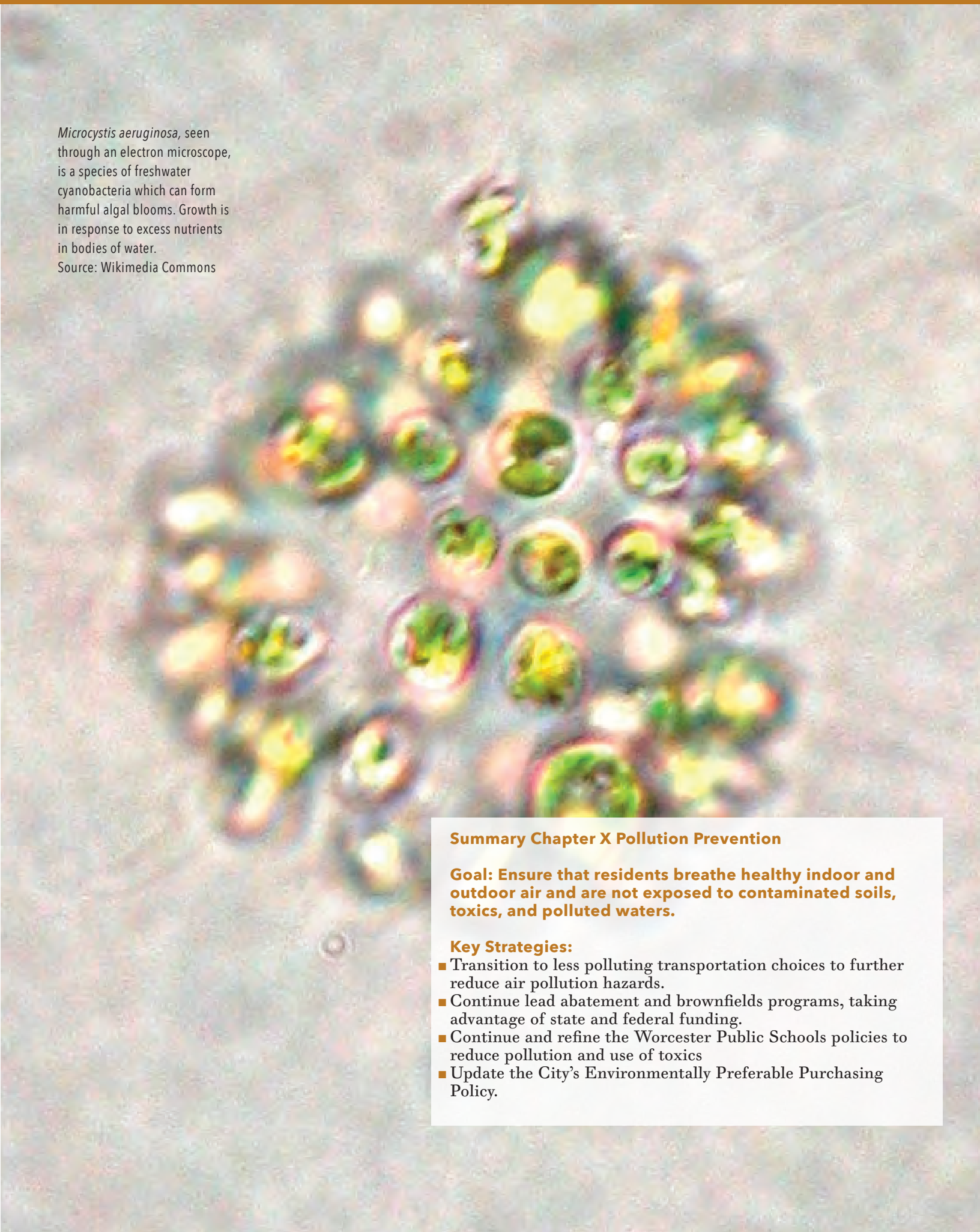
Potential Brownfields in Worcester
(Source: MADEP Potential Brownfields in Central MA https://mass-eoeea.maps.arcgis.com/apps/webappviewer/index.html?id=26519e6fofa149958e2732145f295431)



Microcystis aeruginosa, seen through an electron microscope, is a species of freshwater cyanobacteria which can form harmful algal blooms. Growth is in response to excess nutrients in bodies of water.
Source: Wikimedia Commons

Summary Chapter X Pollution Prevention

Goal: Ensure that residents breathe healthy indoor and outdoor air and are not exposed to contaminated soils, toxics, and polluted waters.

Key Strategies:

- Transition to less polluting transportation choices to further reduce air pollution hazards.
- Continue lead abatement and brownfields programs, taking advantage of state and federal funding.
- Continue and refine the Worcester Public Schools policies to reduce pollution and use of toxics
- Update the City's Environmentally Preferable Purchasing Policy.

A. Goal

Ensure that residents breathe healthy indoor and outdoor air and are not exposed to contaminated soils, toxics, and polluted waters.

Health: Pollution and toxics reduction improves public health.

Equity: Environmental justice populations are more likely to have exposure to pollutants and toxics.

Prosperity: Improved public health and elimination of pollution and toxic hazards is cost-effective.

Climate Change Resilience: Elimination of air and water pollution from fossil fuel emissions provides resilience benefits.

B. Why

Air pollution. Sustainable communities have low levels of pollution and contamination. Many pollutants result from fossil-fuel based transportation: ozone and particulate pollution in the air, as well as lead in the soil, the legacy of leaded gasoline. Exposure to air with high levels of ozone and particulate matter results in premature death from heart attacks, strokes, diabetes, and cancer, and worsens a range of respiratory diseases from asthma to infections like COVID-19. Children, the elderly, people with existing disease, and environmental justice communities are most vulnerable. Worcester has historically had some of the highest rates of asthma among children in Massachusetts. About 14% of public school students in the 2015-2016 school year had been diagnosed with asthma.[59] The American Lung Association publishes an annual report card, "State of the Air," on pollution at the county level. Worcester County in 2019 received a grade of D for ozone pollution, an A for 24-hour particulate pollution and a pass for annual particulate pollution. The county has shown significant improvement in ozone pollution since 2011, though some of that improvement may have been the result of lower economic and transportation activity during the Great Recession. Because much of the county is semi-rural or rural, these data probably understate the impact of air pollution within the City of Worcester. This is particularly the case for neighborhoods where people live within approximately 1,000 feet of a highway, where studies have found more adverse health effects.[60]

Indoor air quality and ventilation. Worcester's many older buildings, both City facilities and private properties, may have poor indoor air quality. Poor indoor air quality in City schools contributes to Worcester's childhood asthma problem. Greater understanding of the spread of COVID-19 through aerosol spray has heightened the need for improving ventilation in schools and other buildings. While the energy and net-zero building goals of the Green Worcester Plan emphasize efficient insulation, it is essential that ventilation systems be optimized for public health.

Lead paint and industrial contamination. Older communities like Worcester also have legacy pollution and contamination in buildings and sites. Lead paint was used until 1978 and can still be found in older buildings and surrounding soil. It is a hazard if chips, flakes, or dust are ingested, inhaled, or absorbed through the skin, and even low levels can affect the physical and mental devel-

[59] 2018 Greater Worcester Community Health Improvement Plan, p. 74, http://www.worcesterma.gov/building-a-healthy-community
[60] https://www.lung.org/clean-air/outdoors/who-is-at-risk/highways

opment of young children. More than 90,000 of Worcester's housing units (79%) were built before 1978, when lead paint was banned. Worcester's legacy industrial sites include many "brownfields" with contamination from industrial processes. National, state, and local programs are targeted at removing lead hazards from homes and remediating brownfields in advance of redevelopment. Other hazards to human health in older buildings include asbestos and other materials that affect indoor air quality. Many products and packaging continue to include toxic chemicals that are linked to health problems.[61]

Pollution of lakes and ponds. The City of Worcester has more than 20 lakes and ponds. Four lakes are publicly accessible – Bell Pond, Lake Quinsigamond, Coes Reservoir, and Indian Lake – and support water-contact recreational activities with six public beaches and one public boat ramp. The Lakes & Ponds Program for municipal lakes and ponds management was created to monitor and enhance water quality in collaboration with seven watershed associations, universities, environmental organizations, and city and state agencies. The water quality of Worcester's lakes and ponds can be impaired by invasive aquatic plants, excessive nutrients, litter, sediments, industrial contaminants, and bacteria. In certain conditions, naturally occurring cyanobacteria (also known as blue-green algae) can produce harmful algal blooms which release toxins that are harmful to aquatic life, other wildlife, pets, and, in some cases, people. Algal blooms occur in Worcester lakes and ponds but cyanotoxins have not yet been observed. The City has developed a proactive program, including a community initiative called the Worcester Cyanobacteria Monitoring Collaborative, to prevent, monitor and test, treat, and respond to cyanobacteria.

C. What We're Doing Now

City of Worcester

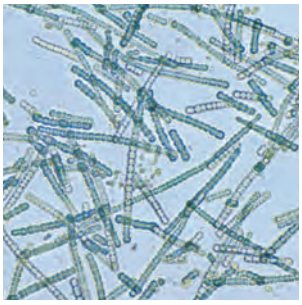
Lead paint abatement on a mid-20th century home.
Source: Wikimedia Commons

- **Lead Abatement.** Over 10 years and with more than 30 partner organizations, the Worcester Lead Action Collaborative (WLAC) (later called Worcester Green & Healthy Homes Coalition) achieved a 94% reduction in lead poisoning for children under the age of 6 in Worcester through community education and outreach efforts, public policy initiatives, and by de-leading more than 700 units of affordable housing. The collaborative secured more than $14 million in federal grant money to address these issues. Since 2015 the City of Worcester has continued to build on this work through the municipal Childhood Lead Poisoning Prevention and Healthy Housing programs the collaborative helped establish. Since 2007, the City has received $15m in lead abatement grants including a $5.6 million lead abatement grant from the US Department of Housing and Urban Development (HUD), which included $5 M for direct lead abatement and $600K for an analysis of health hazards in housing. This will pay for direct lead abatement in 250 units and analysis for hazards like mold and radiation in 120 units. The City also offers a lead paint poisoning prevention assessment on request for households with children under six, including rental households.
- **Brownfields.** Remediation of brownfields to promote both health and redevelopment has long been an important priority of the City of Worcester and the State of Massachusetts. The City of Worcester and the Central Massachusetts

[61] See the "Who's Minding the Store?" report card ranking retail chains on efforts to eliminate toxic chemicals: https://retailerreportcard.com/wp-content/uploads/2019/11/retailerreportcard.com_2019_factsheet.pdf

Regional Planning Commission regularly receive federal funding through the Environmental Protection Agency for brownfields assessment. The City has a Brownfield Cleanup Revolving Loan Fund to assist property owners in remediating site contamination.

- **Harmful Algal Blooms and Cyanotoxins.** Cyanobacteria, often known as blue-green algae, are found naturally in waters and on land throughout the world. They can produce both harmful toxins and beneficial compounds, depending on conditions. Harmful algal blooms (HAB) in lakes and ponds are typically caused by excess nutrients, such as fertilizers that enter the lakes and ponds through nonpoint source pollution. The blooms often cause a surface scum that turns the water bright blue or blue-green, but can also form a mat on bottom sediment, which is harder to observe. The cyanobacteria produce toxins that can be fatal to wildlife and pets. Exposure to these toxins can also affect humans, causing skin rashes, respiratory and gastric distress, and in rare cases, death. The EPA and state agencies do not regulate cyanotoxins but have guidelines for closing lakes and ponds when there are high concentrations of cyanobacteria. Cyanobacteria are more prevalent in warmer water temperatures, shallow water, and where there are high nutrient inputs – conditions often found in Worcester Lakes such as Indian Lake and Coes Pond. Greater periods of warm water resulting from climate change could exacerbate the problem over time.



A blue-green algae species – *Cylindrospermum sp* – magnified. Source: Wikimedia Commons

Through the Lakes & Ponds program, the City of Worcester has the most advanced municipal program in Massachusetts to test, prevent, and treat for HAB and cyanotoxins. The goal of the program is to prevent and reduce cyanobacteria blooms so that it is not necessary to close recreational lakes and ponds. Indian Lake, Bell Pond, Coes Reservoir and Lake Quinsigamond are monitored weekly.

The Lakes & Ponds program includes the Worcester Cyanobacteria Monitoring Collaborative, which engages citizen scientists to collect samples contributing to a national study; water treatments to reduce levels of phosphorus – an indicator for cyanobacteria – in the lakes, including an alum-dosing station triggered by stormwater levels going into Indian Lake, which has the greatest propensity for cyanobacteria; and partnering with universities and the EPA.

- **Environmental Purchasing Policy.** The City has a basic Environmentally Preferable Purchasing Policy which identifies a preference for "products containing recycled materials" and "environmentally preferable products," but lacks more specificity.[62] The Massachusetts Environmentally Preferable Products Procurement Program is regarded as a model for state-level programs and other resources are available to develop a sustainable procurement policy (see the Appendix).[63] The Worcester Public Schools Environmental Management System includes policies that emphasize source reduction and toxics use reduction, with guidance for operations and academic departments to change their purchasing to increase the use of Environmentally Preferred Products (EPPs). (See Chapter VIII.)

[62] www.worcesterma.gov/uploads/c2/b2/c2b21d6a10410db7fdb6f6bbb2ba00ae/epp.pdf
[63] https://www.mass.gov/environmentally-preferable-products-epp-procurement-programs

D. How

Pollution in the air (including indoor air), water, and soil continues to affect Worcester residents and is linked to the practices and programs discussed in other chapters of this plan. Worcester can reduce pollution and the use of toxics by reducing GHG emissions and improving indoor air quality and ventilation, continuing lead abatement and brownfields programs, reducing toxics through city procurement policies, and continuing water quality programs.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Policies and Programs	Measures of Progress
1. Procurement Policies: ***Update the City's Environmentally Preferable Purchasing Policy.*** ■ The Department of Sustainability can convene a subcommittee of the inter-department sustainability group to identify how to update the policy, taking into account departmental needs and streamlining the process. The WPS experience may be a good foundation for this effort.	**Who:** Department of Sustainability and subcommittee, Procurement **When:** EA and ongoing
2. Land Use and Transportation: ***Implement transportation and land use policies and actions to reduce greenhouse gas emissions and particulate matter.*** ■ Track and publicize air pollution reduction impacts of transportation emissions reductions. ■ (See Chapter VI Sustainable Transportation and Chapter XII Sustainability in All Policies)	**Who:** Department of Sustainability, Planning Division **When:** EA and ongoing
3. Toxic Materials Reduction: ***Encourage local businesses to adopt policies to avoid toxic materials in their operations and products.*** ■ Track and publicize companies that make the commitment.	**Who:** Department of Sustainability, Chamber of Commerce **When:** EA and ongoing
4. Brownfields: ***Continue brownfields remediation programs and policies.*** ■ Track and publicize the number of sites remediated and redeveloped.	**Who:** City of Worcester, CMRPC **When:** EA and ongoing
5. Lead Abatement: ***Continue lead abatement programs, including regular public outreach to increase awareness of the programs.*** ■ Publicize the number of units assessed and abated.	**Who:** City of Worcester **When:** EA and ongoing
6. Water Quality and Toxins: ***Continue and expand water quality programs and partnerships.*** ■ (See Chapter IV Healthy and Balanced Natural Systems and Chapter VII One Water)	**Who:** Department of Public Works, Lakes and Ponds Program **When:** EA and ongoing

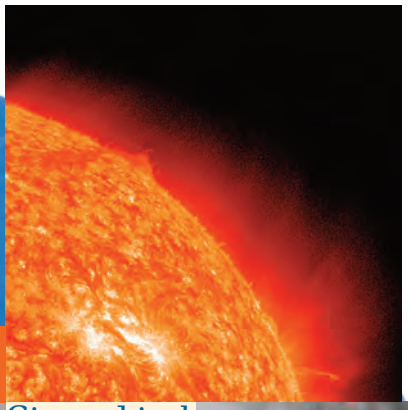
E. Getting Started

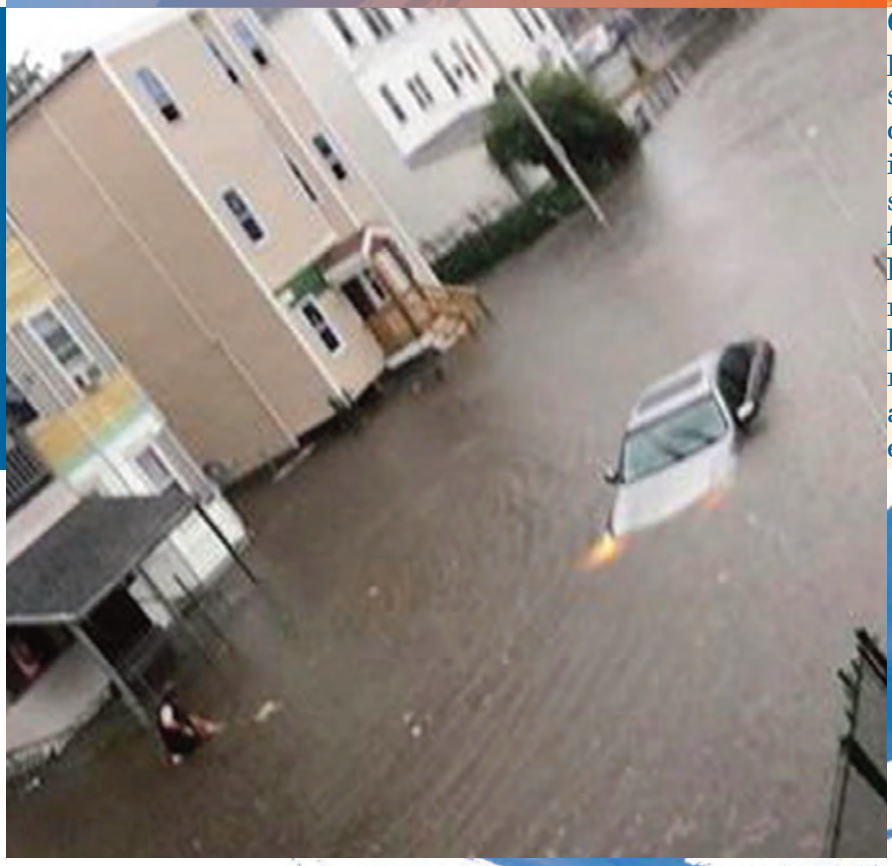
Government	Business	Institutions/Nonprofits	Households/Individuals
■ Update the City's Environmentally Preferable Purchasing Policy.	■ Adopt policies to avoid toxic materials.	■ Adopt environmentally preferable purchasing policies.	■ Avoid purchasing products with toxic materials.

XI

Green Worcester:

Climate Change Resilience





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Summary Chapter XI Climate Change Resilience

Goal: Make the city and its population resilient to climate change impacts, such as extreme storms, flooding, and higher heat.

Key Strategies:

- Invest in improved management and maintenance of the stormwater system to mitigate flooding.
- Give priority to green infrastructure options to mitigate urban heat island impacts and flooding.
- Protect critical city-owned buildings from climate change impacts.
- Protect open spaces and water resources.
- Expand the tree canopy.
- Incorporate climate change resilience and adaptation into hazard management and emergency planning.

A. Goal

Make the city and its population resilient to climate change impacts, such as extreme storms, flooding, and more intense heat.

Health: Climate impacts and events such as extreme heat affect public health.

Equity: Low income and other vulnerable populations have fewer resources to respond to and recover from climate change impacts and stresses.

Prosperity: Implementation of resilience strategies creates businesses and jobs.

B. Why

"A resilient city knows how to adapt its systems and processes, build back better, preserve and enhance environmental conditions, and focus on long term environmental sustainability and the well-being and prosperity for its citizens."

The risks of the future are not the same as the risks of the past. Climate change has introduced a new level of uncertainty about our future. As scientists measure changes and refine models, and society struggles with both local and global responses, we must prepare for the impacts of climate change while recognizing a greater level of uncertainty than what we were used to only a few decades ago.

The 100 Resilient Cities program supported by the Rockefeller Foundation created the framework of "shocks" and "stresses" to discuss urban resilience.[64] Shocks are extreme natural or human-made events which result in loss of life and injury, material, economic, and/or environmental losses and impacts. Stresses are ongoing conditions with persistent negative impacts such as environmental degradation, social inequality, and economic instability. A resilient city prepares for shocks and stresses by reducing vulnerability and enhancing awareness. It can recover by ensuring the continuity or restoration of city services. And finally, a resilient city knows how to adapt its systems and processes, build back better, preserve and enhance environmental conditions, and focus on long term environmental sustainability and well-being and prosperity for its citizens.

In the Green Worcester public opinion survey and online survey, Worcester residents showed their awareness of climate change and the need to adapt to climate change impacts. Many of the strategies and actions included in the preceding chapters of the Green Worcester Plan are directly related to reduction of greenhouse gas emissions, mitigation of climate change impacts, and climate change adaptation measures. The most recent update of the City's Hazard Mitigation Plan (HMP), adopted in February 2019, includes a brief section on climate change hazard impacts based on state-level projections from 2013 or earlier, as well as more specific references to expected climate change impacts in relation to greater frequency of extreme storm events and increasing summer temperatures.[65] Focused planning for climate change impacts in the City of Worcester can be found in the State-funded Municipal Vulnerability Preparedness (MVP) Plan completed in June 2019 for the City of Worcester. The State now requires Open Space and Recreation Plans to include goals and actions related to climate change impacts, and Worcester's update of its plan, expected to be completed by the end of 2020, will also include attention to climate change.

[64] https://www.rockefellerfoundation.org/wp-content/uploads/100RC-City-Resilience-Framework.pdf; http://resiliencetools.net/node/14
[65] http://www.cmrpc.org/worcester-hazard-mitigation-plan

According to the Worcester MVP plan, "in recent years, the effects of climate change that the City of Worcester has been experiencing have become more apparent. Climate change manifests itself in a number of extreme, and often conflicting, weather events. As New England now has more intense precipitation events, the City was twice designated America's 2nd Snowiest U.S. City (population 100,000 or more) during the winters of 2012-2013 (109" of snow) and 2014-2015 (120" of snow). Over the last ten years climate change has also led to more extreme and prolonged heat waves during the summer months. In 2016, the City was in Stage III drought, yet, in the fall of that same year, an intense rain event caused severe flash flooding, exposing the City's stormwater system vulnerabilities."[66]

The vulnerabilities identified in the MVP include:

- *Energy systems:* stress and reliability due to peak demands; impact of storm events on aboveground infrastructure; lack of backup energy supply options for critical facilities
- *Transportation:* road infrastructure vulnerable to flooding; reliability and continuity of public transportation
- *Communication:* lack of redundancy in the emergency communications system
- *Water quality:* potential groundwater contamination issues from industrial legacy; combined sewer overflows
- *Trees and vegetation:* need for expanded tree canopy to mitigate the urban heat island; increased heat effects on species mix; need for improved tree maintenance to avoid hazards during storm events
- *Vulnerable populations:* High proportions of environmental justice populations who face higher risks from climate impacts, service disruptions, and costs resulting from impacts
- *Municipal facilities:* need for improved systems, especially in potential emergency shelters, such as schools

C. What We're Doing Now

- **Integrated Water Management Plan (IWMP).** Discussed in Chapter VII One Water, the IWMP was prepared with potential climate change impacts in mind and is organized to allow the City to identify and adapt to unforeseen changes in conditions.
- **Lakes & Ponds Program.** Discussed in Chapters IV Connected Green and Blue Spaces, Chapter VII One Water, and Chapter X Pollution Prevention, the Lakes & Ponds Program includes monitoring and actions that provide the City with information and options to deal with impacts of climate change, such as how warming water temperatures change the aquatic environment.
- **Hazard Mitigation Plan Update (HMP).** In order to be eligible for federal disaster assistance, Worcester is required to have a Hazard Mitigation Plan that is updated every five years. The most recent update was adopted by the City Council in February 2019 and includes detailed maps. The plan includes goals, strategies, and actions to address the identified hazards in the categories of Structure and Infrastructure; Preparedness, Coordination and Response Action; Education and Awareness; and Local Planning and Regulation. Priority rankings and mitigation impact rankings are also included. Many of the actions listed in the

[66] MVP Plan, page 5.

HMP overlap with other recent plans, including the MVP, this Green Worcester Plan, and the Open Space and Recreation Plan Update.

- **Municipal Vulnerability Preparedness Plan (MVP).** Worcester's Municipal Vulnerability Preparedness plan was completed in 2019 using a process mandated by the State to identify priority projects to make Worcester more resilient to future climate change impacts. The process involved identification of climate-related hazards and categories of action to adapt and respond to climate change. Worcester stakeholders identified three priority hazards: flooding from extreme precipitation (heavy rain), ice and snowstorms coupled with extreme cold, and extreme heat coupled with drought. They identified the categories of infrastructure (built facilities and assets), society (people and services), and environment (water systems, trees, and open space) as the priority areas related to these hazards. Like the HMP, many strategies and actions overlap with other plans.
- **Open Space and Recreation Plan (OSRP).** As noted earlier, the State now requires that OSRPs include consideration of impacts of climate change, which will be included in the update expected to be concluded in late 2020.

"By preparing for climate change, Worcester has the opportunity to become the 'climate refuge city' of choice in Massachusetts as people on the coast may prefer to move to more inland locations."

C. How

By preparing for climate change, Worcester has the opportunity to become the "climate refuge city" of choice in Massachusetts as people on the coast may prefer to move to more inland locations. The importance of an integrated approach to resilience and climate change adaptation is clear from the many ways in which Worcester's most recent planning efforts include attention to climate change. By creating a climate change implementation working group, the City can ensure that resilience actions have multiple benefits for the Worcester community, especially the most vulnerable.

Time Frame

EA - Early Action (1–2 years)

ST - Short Term (3–5 years)

MT - Medium Term (6–10 years)

2030s, 2040s

Actions Coordination and Policy	Measures of Progress
1. Resilience Working Group: ***Create a climate change resilience working group of municipal staff to coordinate tasks and timelines for priority resilience actions from the MVP, HMP, and other relevant planning groups, such as the Planning and Public Health Departments.***	**Who:** Department of Sustainability **When:** EA and ongoing
2. Resilience Building Standards: ***Establish standards for climate resilience in new and rehabilitated buildings.***	**Who:** Department of Sustainability, Planning Division **When:** EA to ST
3. Resilient Food System: ***Promote a robust and resilient regional food system.*** ■ Working with partners such as REC and the Worcester Food Hub. (See Chapter IX Sustainable Food Systems)	**Who:** Department of Sustainability **When:** EA to ST
4. MVP Priority Actions (Related discussion In Green Worcester chapters)	
■ **Infrastructure Resilience** □ Invest in improved management and maintenance of the City's stormwater system. (Chapter VII One Water) □ Investigate a stormwater enterprise fund/stormwater utility fee to support enhanced stormwater management initiatives. (See Chapter VII One Water)	**Who and When:** See relevant Green Worcester Chapters, MVP Plan, HMP Plan, IWMP, future Comprehensive Plan Update.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
▫ Prioritize green infrastructure projects to mitigate urban heat island effect and reduce flooding. (Chapter VII One Water) ▫ Develop a public outreach and education initiative. (Chapter II Green Worcester Approach) ▫ Implement adaptation/resilience strategies to harden critical city-owned buildings. ▫ Advocate and assist in creating a resilient transportation network. (See Chapter VI Sustainable Transportation Choices) ▫ Assess the vulnerability of drinking water supply to future drought conditions. (See Chapter VII One Water)	
■ **Social Resilience** ▫ Initiate an education program/campaign that is inclusive, multi-lingual, and makes information accessible. (See Chapter II Green Worcester Approach) ▫ Help people know how to find out when and how to shelter during storm events ▫ Improve the City's emergency planning to incorporate climate change ▫ Increase and improve communication to the most vulnerable populations during emergencies ▫ Empower renters and property owners with a checklist to improve building resilience and be prepared for hazardous climate change impacts	**Who and When:** See relevant Green Worcester Chapters, MVP Plan, HMP Plan, IWMP, future Comprehensive Plan Update
■ **Environmental Resilience** ▫ Protect open space and water resources, including expansion of the Lakes & Ponds Program (See Chapter IV Connected Green and Blue Spaces; Chapter VII One Water; Chapter X Reducing Pollution and Toxics) ▫ Incorporate Low Impact Development (LID) requirements in regulations to manage stormwater (See Chapter VII One Water) ▫ Improve waste collection practices such as composting and recycling (See Chapter VIII Towards Zero Waste) ▫ Increase the urban tree canopy through a tree inventory, replacement programs, regulations, and maintenance (See Chapter IV Connected Green and Blue Spaces)	**Who and When:** See relevant Green Worcester Chapters, MVP Plan, HMP Plan, IWMP, OSRP Update; future Comprehensive Plan Update
5. HMP Priority Actions **(Related discussion in Green Worcester chapters)**	
■ **Transportation:** ***Integrate disaster mitigation into transportation projects*** (See Chapter VI Sustainable Transportation Choices)	**Who:** Department of Sustainability, Transportation Advisory Group, Public Works **When:** EA and ongoing
■ **Drought and Water Supply:** ***Implement water supply emergency/drought projects.*** (See Chapter VI Sustainable Transportation Choices)	See HMP and IWMP
■ **Public Information and Awareness:** ***Improve information available and educate property owners*** about flood hazards and mitigation; benefits of wetlands to increase compliance; connection between storm drains and nature resource areas. Use Community Based Social Marketing techniques. (See Chapter IV Healthy and Balanced Natural Systems; Chapter VII One Water; Chapter X Reducing Pollution and Toxics)	See HMP

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
■ **Update the Zoning and Wetlands Protection Ordinances: *Incorporate Low-Impact-Development and limit impervious surfaces,*** including modernizing parking requirements. (See Chapter XII Sustainability and Resilience in All Policies)	**Who:** Conservation Commission, Planning Division **When:** EA
■ **Best Management Standards: *Create BMPs for land clearing and grading*** to avoid creating steep slopes and large retaining walls (See Chapter XII Sustainability, Resilience and Green Education in All Policies	**Who:** Planning Division, Conservation Commission **When:** EA

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Create a climate change resilience working group through the Department of Sustainability to coordinate climate change priority actions.	■ Identify climate change vulnerabilities of the business and employees and make a plan to mitigate them.	■ Identify climate change vulnerabilities of the institution, employees, and people who receive services, and make a plan to mitigate them.	■ Identify climate change impacts that can affect you and your family, seek information about how you can mitigate potential impacts and how you can seek assistance if needed.

XII

Green Worcester:

Sustainability, Resilience, and Green Education in All Policies

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Summary Chapter XII Sustainability, Resilience, and Green Education In All Policies

Goal: Implement integrated planning for quality of life, using sustainability and resilience criteria for land use, transportation, housing, and economic development planning and project evaluation.

Key Strategies and Actions:

To become a 21st century urban leader, Worcester must incorporate sustainability and resilience into all policies, including its land use, housing, and economic development planning. The city will not be able to achieve the high aspirations for energy efficiency and renewable energy in buildings and transportation without new land use approaches, while intensifying stewardship and connection of its natural systems. The City should also organize in an intentional way to promote green education and workforce training to gain prosperity benefits from efforts to achieve the Green Worcester vision.

- Integrate Green Worcester goals and strategies into the Comprehensive Plan and use place-based planning with robust community participation to develop improvement programs where the whole is greater than the sum of the parts
- Integrate Green Worcester goals and strategies into day to day planning and the zoning ordinance.
- Maximize "co-benefits" by prioritizing integrated improvements in the urban core of the city.
- Identify and plan for compact "urban villages," building on existing commercial areas, to create mixed-use, walkable centers with micromobility options that can be networked with surrounding neighborhoods, each other, and downtown.
- Convene public and private partners to create a green workforce training initiative.

A. Goal

Implement integrated sustainability and resilience policies for land use, transportation, housing, and economic development – while making Worcester the regional center for sustainability education and training for green jobs.

B. Why

Sustainability now includes attention to a broad range of issues, as well as concerns often considered to be primarily "environmental," such as resource use and depletion, biodiversity, pollution, and climate change. Today we recognize the need to understand our communities as holistic systems. That means that sustainability and resilience are integral to land use, housing, and economic development. Just as health planners promote a "Health in all Policies" approach to public health, we must have a "Sustainability in all Policies" approach to city planning and project implementation.

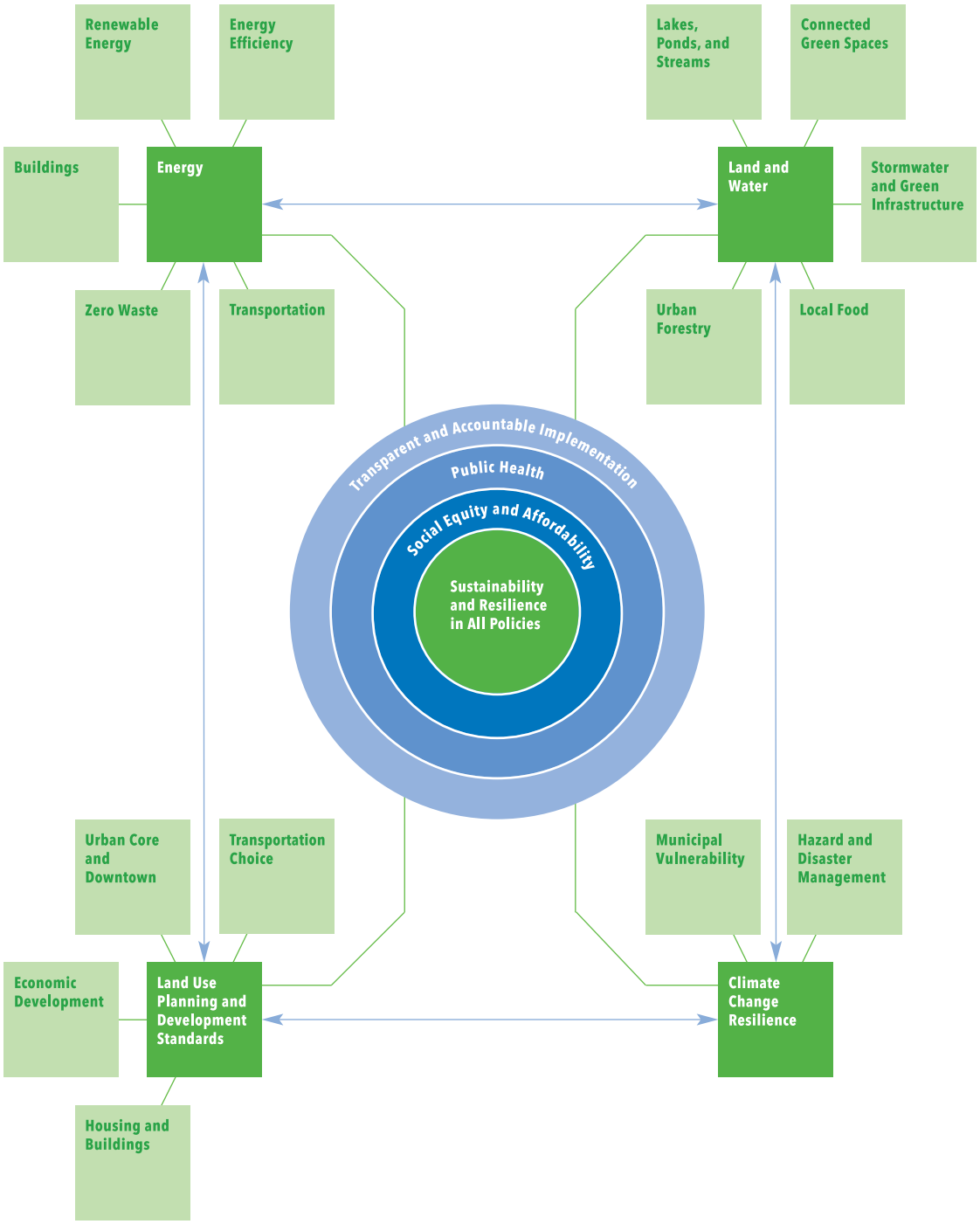
The American Planning Association (APA) published a guide to comprehensive planning, "Sustainable Places: Best Practices for Comprehensive Plans," structured by six principles that include sustainability-related goals:

- **Livable Built Environment:** Ensure that all elements of the built environment, including land use, transportation, energy, and infrastructure, work together to provide sustainable, green places for living, working, and recreation with a high quality of life.
- **Harmony with Nature:** Ensure that the contributions of natural resources to human well-being are explicitly recognized and valued and that maintaining their health is a primary objective.
- **Resilient Economy:** Ensure that the community is prepared to deal with both positive and negative changes in its economic health and to initiate sustainable urban development and redevelopment strategies that foster green business growth and build reliance on local assets.
- **Interwoven Equity:** Ensure fairness and equity in providing for the housing, services, health, safety, and livelihood needs of all citizens and groups.
- **Healthy Community:** Ensure that public health needs are recognized and addressed through provisions for healthy foods, physical activity, access to recreation, health care, environmental justice, and safe neighborhoods.
- **Responsible Regionalism:** Ensure that all local proposals account for, connect with, and support the plans of adjacent jurisdictions and the surrounding region.[67]

The Comprehensive Plan, with a revised zoning code to follow, is the vehicle to establish how the City of Worcester will integrate sustainability and resilience "co-benefits" based on the Green Worcester Plan framework. Public projects should be chosen and designed to maximize co-benefits and regulation of private projects should be required or incentivized to contribute towards meeting the city's sustainability and resilience goals.

[67] David Godschalk and David Rouse, *Sustaining Places: Best Practices for Comprehensive Plans,* PAS Report 578, Chicago: American Planning Association, 2015.

Sustainability and Resiliency in All Policies



Green Education and Training. The sustainability and resilience transition outlined in this Plan will require a greater emphasis on green education in traditional contexts like K-12 schools and higher education. It also will open up and expand job opportunities at a variety of skill levels to evaluate, design, implement, and maintain the projects and initiatives to achieve the Green Worcester vision and goals. To support and accelerate the sustainability and resilience transition, Worcester can aim to become the regional center for green education and training.

C. What We're Doing Now

"The City needs new land use approaches to achieve its high aspirations for sustainability and resilience."

- The City created a **Strategic Plan** for city government with Key Performance Indicators (KPIs).
- A new **Office of Urban Innovation** began to operate in July 2019 to make city government decision-making more data-driven by improving the City's data gathering for KPIs and an open data system.
- In addition to this Green Worcester Plan, the City has **other recent or soon to be completed plans that include strategies and actions that should be incorporated into the new comprehensive plan:** Hazard Mitigation Plan (2019), Municipal Vulnerability Preparedness Plan (2019), Integrated Water Management Plan (2019), Open Space and Recreation Plan (expected 2021).
- The City's Health Department is active in creating the annual C**omprehensive Health Improvement Plan,** which includes attention to many of the issues discussed in this Green Worcester Plan.
- The City has created a **Transportation Advisory Group for Complete Streets planning.**
- Parking maximums to discourage provision of excessive parking while promoting density and transportation choice are included in the **Commercial Corridor Overlay Districts in the Zoning Ordinance.** By special permit, the Planning Board has discretion to modify parking maximums. In addition, provision of bicycle parking may reduce the number of vehicle parking spaces according to a schedule.
- **The comprehensive plan will be followed by a new zoning ordinance** to reflect the new comprehensive plan.
- The **Worcester Housing Now program** includes promotion of energy efficiency elements for improvements and rehabilitation of 2–4 unit residential buildings.
- The City has engaged in a few **place-based planning efforts,** most recently in the Green Island neighborhood.
- The Massachusetts Environmental Policy Act (MEPA) certification for the Polar Park and associated mixed-use project has resulted in a set of **sustainability and resilience commitments** for these projects, as does the Community Benefits Agreement negotiated with the developers.

D. How

To become a 21st century urban leader, Worcester must incorporate sustainability and resilience into all policies. The Department of Sustainability will play a central coordinating role, ensuring that sustainability and resilience criteria are used to evaluate and implement City initiatives and programs.

The city will not be able to achieve the high aspirations for energy efficiency and renewable energy in buildings and transportation without new land use approaches, while intensifying stewardship and connection of its natural systems. The Green Worcester Plan must be one of the foundations for Worcester's new comprehensive plan, expected in the early 2020s, with a revised zoning code to follow. Important policies for Green Worcester include:

- Use place-based planning with robust community participation to develop improvement programs where the whole is greater than the sum of the parts.
- Prioritize the urban core for sustainability and resilience improvements to maximize "co-benefits" through integrated improvements. The people who live in the core represent the city's most vulnerable environmental justice populations and the urban core is most affected by the urban heat island, impervious surfaces, lack of trees and open spaces, older housing, air pollution, and similar conditions.
- Identify and plan for compact "urban villages," building on existing commercial areas, to create mixed-use, walkable centers with micromobility options that can be networked with surrounding neighborhoods and city destinations
- A robust green education and training program integrated with economic development initiatives and programs will also bring significant co-benefits to Worcester. The Department of Sustainability should convene representatives of public and private education and training programs to develop a coordinated program that provides pathways to good green jobs for workers at all skill levels.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions Land Use and Development Policies	Measures of Progress
1. Integrate Green Worcester goals and strategies into day to day planning. ■ Make checklists as appropriate for planners, the Planning Board, members of the Zoning Board of Appeals, the Conservation Commission, and the Historical Commission for reference during discussion and deliberation. ■ Provide project proponents with information and checklists on the City's sustainability and resilience goals and strategies. ■ Include the sustainability and resilience goals and strategies in pre-development discussions.	**Who:** Department of Sustainability with Planning Division **When:** EA
2. Comprehensive Plan: *Ensure that the City's new comprehensive plan is informed by the Green Worcester Plan and other relevant plans, as well as a robust community participation program.* ■ Use the Green Worcester Plan, the APA Sustainable Places framework, and other evaluation tools to help guide the planning process. ■ Identify and plan for compact "urban villages," building on existing commercial areas, to create mixed-use, walkable, and micromobility-friendly centers that can be networked with surrounding neighborhoods, each other, and downtown. ■ Prioritize the urban core for sustainability and resilience improvements to maximize "co-benefits" through integrated improvements.	**Who:** Department of Sustainability with Planning Division and stakeholders **When:** EA – ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
3. Zoning and Development Standards: ***Ensure that changes to zoning and development standards resulting from the comprehensive plan advance achievement of Worcester's sustainability and resilience goals.*** ■ Publicize the City's energy-efficiency and renewable energy initiatives through signage at city facilities (including the solar array at the old landfill) showing energy and cost savings. ■ Consider an early action initiative to insert basic standards on energy, transportation choice, tree planting, and stormwater management into the zoning ordinance. (See previous chapters and resources in the Appendix.) ■ Identify needs for systems, procedures, training, and additional staff to gain better compliance and enforcement of existing and proposed new standards. (See Chapter II The Green Worcester Approach) ■ Make City projects comply with standards for non-City projects.	**Who:** Department of Sustainability **When:** EA
4. Policy Development: ***Use the guidance of the Green Worcester Plan and other frameworks to develop transportation planning, design, and construction policies.*** (See Chapter VI Sustainable Transportation and Chapter VI Resources in the Appendix.)	**Who:** Department of Sustainability **When:** EA – ST
5. Envision Rating System: ***Consider using the Envision™ infrastructure rating system to evaluate proposed infrastructure projects for high performance sustainability.*** Envision™ is a holistic sustainability rating system and planning guide for civil infrastructure to help communities achieve higher performance infrastructure projects and systems. Created and managed by the Institute for Sustainable Infrastructure (ISI), founded by the American Public Works Association (APWA), the American Society of Civil Engineers (ASCE), and the American Council of Engineering Companies (ACEC), Envision was developed in collaboration with Harvard University's Zofnass Program for Sustainable Infrastructure and the Graduate School of Design. Use of the rating system as a self-assessment tool is free. Many public agencies of all sizes use Envision including the Massachusetts Water Resources Authority; multiple departments in large cities such as Los Angeles, Austin, Montreal, and New York; public works departments in smaller towns and cities like Wellesley MA, Norwalk CT, and Cedar Rapids IA; and multi-jurisdiction agencies like the U.S. Army Corps of Engineers. See https://sustainableinfrastructure.org/	**Who:** Department of Sustainability, Public Works **When:** EA – ST
6. LEED Community: ***Consider seeking LEED certification as a sustainable community.*** LEED, Leadership in Energy and Environmental Design, is a program of the nonprofit U.S. Green Building Council and is known for certification of green buildings. The sustainable community evaluation system is available free, but certification and professional credentials are offered for a fee. Massachusetts communities certified under LEED 4.1 are Devens, Cambridge, New Bedford, and Northampton. LEED certification would help Worcester establish its public profile as a sustainable and resilient city. (See resources in the Appendix.)	**Who:** Department of Sustainability **When:** EA – ST

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Focused Activities Actions	Measures of Progress
7. Pilot Sustainability District: ***Designate a pilot "Sustainability District" as an area to test, refine, and promote new sustainability and resilience efforts.*** A potential area for such a pilot district is the Green Island-Canal District area, building on environmental commitments made for MEPA certification and the Community Benefits Agreement by the Polar Park and mixed use developments, as well as neighborhood improvements programmed for Green Island. (See Chapter II The Green Worcester Approach.) ■ Incorporate sustainable design standards for this area for new development and rehabilitation/renovation over a defined size threshold.	**Who:** Department of Sustainability, Planning Division, Economic Development, Worcester Redevelopment Authority **When:** EA – ST
8. Sustainability Performance Outcomes: ***Establish sustainability performance outcomes to be met by all new construction or redevelopment projects seeking tax incentives from the City.*** Required performance outcomes can be written to give project applicants the option to choose how they will meet the desired outcomes in their projects, subject to approval by the City. A system of this kind makes it possible to consider innovative solutions that may not have been available at the time an ordinance or operating procedure document is approved. At the same time, the City can indicate preferred sources of required performance outcomes such as LEED requirements and the metrics and outcomes used in the MEPA certification process. (See Chapter II The Green Worcester Approach.)	**Who:** Planning Department with Green Worcester, Planning Board, City Manager **When:** EA – ST
9. Place-Based Neighborhood Planning: ***Create and implement a program for place-based neighborhood or district planning with community participation.*** The Comprehensive Plan should identify districts or neighborhoods for priority planning for integrated improvements. Outside resources can include student studio projects from graduate school planning programs.	**Who:** Planning Department; Housing and Neighborhood Development **When:** ST and ongoing
Sustainability Education and Training	
10. School Curriculum: ***Integrate sustainability and resilience into the curriculum at all levels in the Worcester Public Schools.*** ■ WPS offers an environmental science course at the high school level and some schools have schoolyard gardens, but sustainability/resilience elements as related to life in Worcester should be included throughout the school curriculum in every grade. Massachusetts uses an adaptation of the Next Generation Science Standards which includes climate change education. Students and faculty in the Boston Public Schools developed a sustainability and climate change curriculum for K-12 students that is aligned with state standards and has its own website with lessons, projects, and teacher resources: www.climatecurriculum.com/. ■ Develop programs in green building systems, green infrastructure design and maintenance, and green vehicle maintenance at the Worcester Technical High School. ■ Promote green technical careers through the WPS Innovation Pathways Program. In this program students commit to two years of college and career planning classes, two years of technical classes taken at Worcester Technical High School from November – March, and a 100 – hour internship during the summer or a capstone project by the end of their senior year.	**Who:** Department of Sustainability **When:** –EA – Reach out to the WPS to begin discussions. –ST – Work with partners to bring local sustainability and resilience education and action ideas to public schools.

Time Frame

EA – Early Action
(1–2 years)

ST – Short Term
(3–5 years)

MT – Medium Term
(6–10 years)

2030s, 2040s

Actions	Measures of Progress
11. Workforce Development Partners: ***Convene a working group to develop a framework for a coordinated green jobs framework in Worcester.*** ■ Partner with the Green Jobs Academy (SMOC), the Green Jobs Coalition, the Worcester Employment Center, and other partners to develop a coordinated approach to have a high quality education and vocational training to provide a path to green jobs.	**Who:** Department of Sustainability, Economic Development; WPS partner organizations **When:** EA - ST
12. Workforce Development for Green Infrastructure: ***Develop youth workforce development programs, like the park ranger program, for maintenance of green infrastructure projects.*** ■ Establish training for the National Green Infrastructure Certification Program in Worcester. ■ Seek partners such as the vocational school, Regional Environmental Council, and the Green Jobs Academy.	**Who:** Workforce Development, Public Schools, Public Works, nonprofit partners **When:** ST to MT
Public Awareness	
13. Outreach Strategy: ***Implement a transparent Green Worcester outreach strategy to include traditional and new media and activities.*** ■ Include a web site with an implementation dashboard, press releases, social media, email lists, events, a central calendar of relevant events sponsored by others, and a newsletter. ■ Install broad scope signage, such as billboards advertising the "Green Worcester" identity, and targeted signage to highlight and explain the benefits of sustainability and resilience projects and initiatives. ■ Develop a program to support neighborhood "sustainability ambassadors" linking youth engaged in summer jobs program to adult mentors in their neighborhood. Link to sustainability curricula in the WPS. ■ Use Community Based Social Marketing (CBSM) techniques to encourage residents and other Worcester stakeholders to make sustainable and resilient behaviors part of their everyday lives. Rather than simply providing information, a CBSM approach is a results- and action-oriented approach that identifies barriers to change and helps people make changes in their behavior.	**Who:** Department of Sustainability with Advisory Committees organizations **When:** EA – ST: Begin in collaboration with the Green Worcester Advisory Committee and citizen groups to identify how best to reach residents and stakeholders

E. Getting Started

Government	Business	Institutions/Nonprofits	Households/Individuals
■ Create a robust green education program in the schools ■ Create a robust public outreach and education program ■ Incorporate Green Worcester into the Comprehensive Plan. ■ Promote broad participation in the planning process, especially from environmental justice populations and neighborhoods ■ Convene a working group on green jobs	■ Participate in the comprehensive planning process	■ Participate in the comprehensive planning process	■ Participate in the comprehensive planning process

the green worcester sustainability and resilience strategic plan

2020

Appendix

The City *of* WORCESTER

GREEN WORCESTER

Community | Resilience | Sustainability

Green Worcester Sustainability and Resilience Strategic Plan

APPENDIX

Table of Contents

A. **Public Survey Results**

The consultant team included MassINC Polling Group (MPG), a leading non-partisan public opinion research company with offices in Boston and Northampton, Massachusetts. MPG has conducted numerous polls and focus groups on climate and transportation issues across Massachusetts, and is the pollster for WBUR, one of Boston's National Public Radio stations. The public opinion survey was administered by telephone (including mobile numbers) in English and Spanish to a representative group of 606 Worcester residents by MassInc Polling Group.

THE MassINC POLLING GROUP

Opinion Brief | July, 2019

Green Worcester: Resident Priorities, Beliefs, and Actions

City resident survey explores public opinion on the Green Worcester initiative

Residents are on board with the concepts behind Green Worcester

Residents of the City of Worcester are supportive of the aims of making Worcester a greener and more sustainable place. In all, 64% called Worcester becoming a green and sustainable place "very important," while another 25% called it "somewhat important" (Figure 1). That level of priority carries over to policy. Worcester residents support a variety of potential measures which would contribute to making the city a more sustainable place. Many of the activities that could be included in the Green Worcester initiative are prioritized by large majorities of residents.

Respondents were asked to about their priorities for measures to improve the city. Topping the list was cleaning up toxic chemicals at industrial sites - 77% called that a major priority. Tied for second at 73% were reducing air and water pollution along with reducing natural gas leaks. Reducing greenhouse gas production was somewhat lower, with 61% calling it a major priority. This echoes a theme that comes up often in climate change opinion polling, where issues around "pollution" generate more engagement than explicit ties to greenhouse gases or climate change.

At the bottom of the list was creating a home energy rating system, which 31% called a major priority. None of the demographic groups we examined reached a majority calling this issue a major priority. Still, nearly one third of the city call this a major priority, so if undertaken, such a system may draw interest. But there are many other ideas which more residents prioritize.

KEY FINDINGS

The survey finds residents feel favorably toward the idea of Worcester as a green and sustainable city, with 64% calling it very important that the city become a "green and sustainable place" and another 25% calling it "somewhat important".

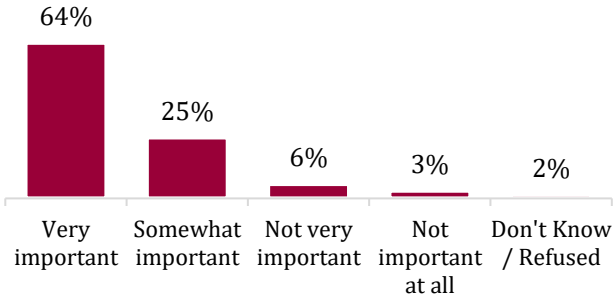
In terms of specific programs, residents would endorse many as "major priorities" for the city. This includes both current programs such as clean up, pollution reduction, and tree planting, as well as ideas for how to make Worcester a more sustainable place in the future.

Concern about climate change is widespread and includes anticipation of a variety of localized impacts in the greater Worcester region.

Residents are already engaging in many green activities on their own, though not motivated by climate change concerns. These activities vary widely by demographic groups in the city.

Residents are less aware of environmental programs the city is currently undertaking, and many seemed not to understand what it would mean for Worcester to be "green" or a "sustainable city". Both suggest a need for educating the public on the issue.

Figure 1: Residents view becoming a green and sustainable city as important



Q: How important is it to you that Worcester works on becoming a city that is "green" and sustainable?

Some of the items showed interesting and useful demographic variation in terms of interest levels. Bicycle and pedestrian infrastructure fell in the middle of the list overall, with 61% calling it a major priority. But among certain groups, it was closer to the top of the list. Lower-income residents (73%), residents in households without cars (71%) and households with children (69%) were particularly likely to rate this item highly. This variation highlights the fact that different activities and policies will be of great interest to certain segments of the city's population and that moving toward greater sustainability will mean different things to different people.

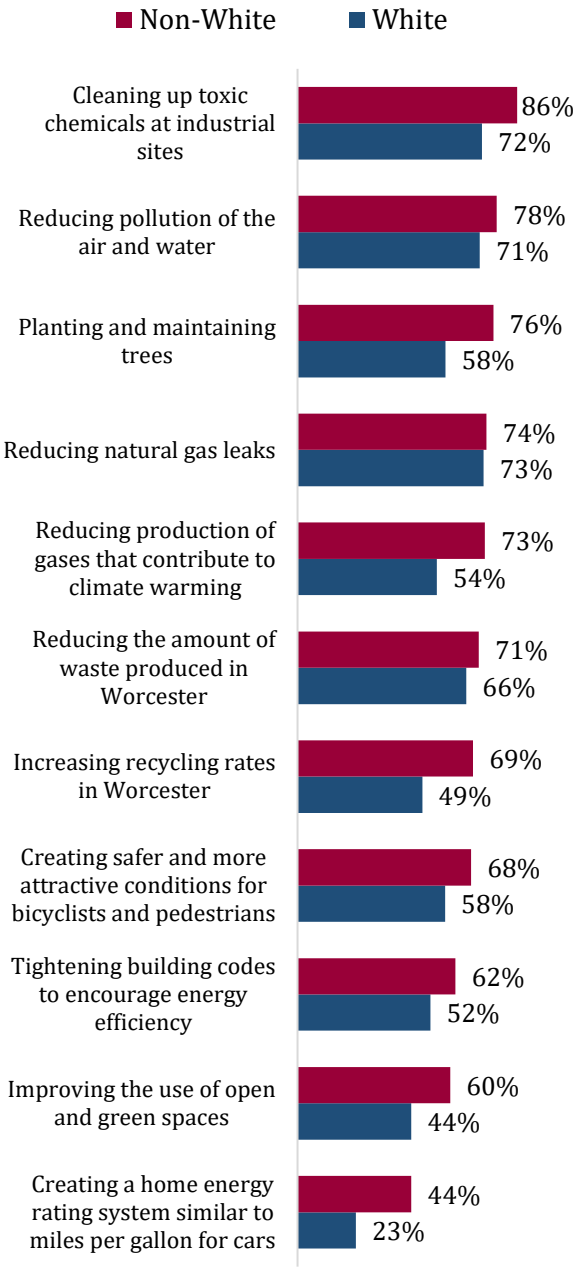
Priority of many Green Worcester issues varies by race and ethnicity

Consistent with much other polling on climate and environmental policy, Worcester's communities of color place a higher level of importance on making the city a green and sustainable place. Among non-white residents, 74% thought this was "very important," compared to 59% of white residents.

Black and Hispanic residents were also more likely to prioritize some (but not all) of the policies included in the poll (Figure 2). For example, 66% of Black residents and 61% of Hispanic residents call improving the use of green and open space a major priority, compared to 44% of white residents. Planting and maintaining trees shows a similar gap, with 58% of white residents calling it a major priority, less than Hispanic residents (80%) or Black residents (77%). Among non-white residents, 73% consider reducing greenhouse gases a major priority; a little more than half (54%) of white resident think similarly.

The finding that non-white residents are more concerned about climate change and more supportive of action is echoed in other polling from across Massachusetts and nationwide. MPG has been conducting polling on climate change since 2011, and has observed similar

Figure 2: Variation in priorities, by race / ethnicity of residents
% calling each a major priority, by race



dynamics throughout that period.[1] This phenomenon also bears out in national polling and polling in other states[2] specific to climate change. As a report on a survey focusing on Latino opinion from the Yale Program on Climate Change Communication put it, "Overall, we find a very consistent pattern: Latinos are much more engaged with the issue of global warming than are non-Latinos."[3] Lake Research Partners reported on a national poll in April 2018, writing, "The strongest awareness and concern comes from those who are the most affected— Latinos and African Americans. They report the highest levels of personal and health effects from climate impacts."[4]

Climate change concern tied to support for environmental policy

Residents are concerned about local impacts of climate change, with 74% of residents saying Worcester and Central Massachusetts will suffer impacts from climate change in the next 2 decades. Just 19% believe the region will not feel any impact. Those concerned about local impacts includes 61% or more of each of the demographic groups examined as a part of survey analysis, so concern is widespread. Looking at demographic variation, residents under 30 (82%) and Hispanic residents (80%) are the most likely to see climate change coming to Worcester.

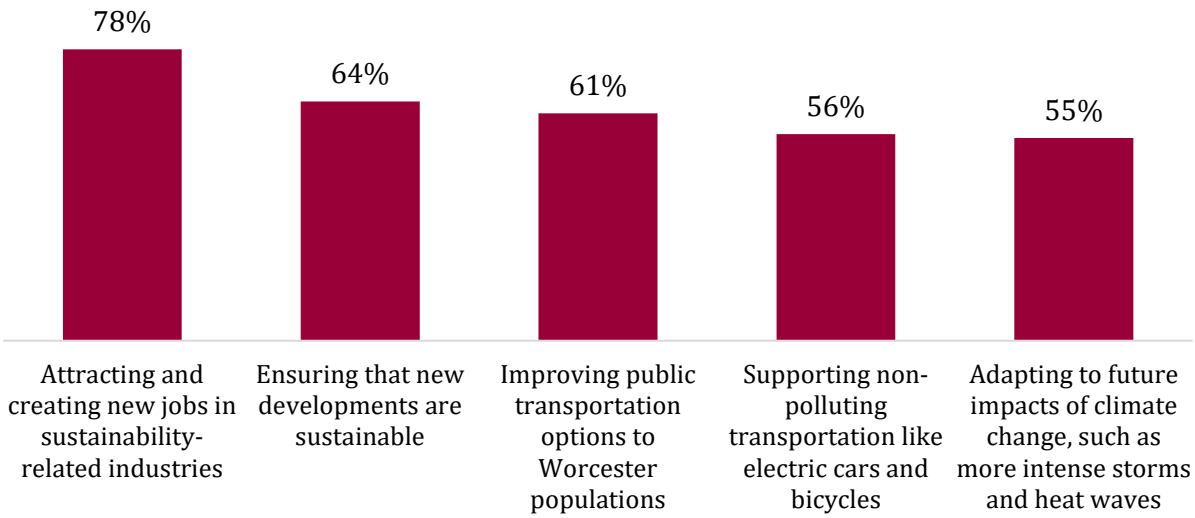
Among those who see local impacts as likely, the most common change residents anticipate is more severe storms throughout the year (78%) as well as extreme heat waves (78%). Also in the top tier of anticipated consequences is more ice and freezing rain storms (70%). In other words, those who see climate change as likely anticipate impacts during both hot and cold times of year.

Other surveys have found those concerned about climate change are often more supportive of environmental policy options. This is true in this survey as well. Those who anticipate the impacts of climate change coming to Worcester are more supportive of the ideas behind Green Worcester. For example, among those who anticipate local climate impacts, 63% prioritize non-polluting transportation options, compared to 31% of those who do not see local impacts. On all but one of the priorities questions (planting trees), those concerned about local impacts are at least nominally more supportive of environmental policies. Given the high percentage of residents who believe climate change is coming, this is encouraging for city leaders looking to advance the cause of Green Worcester.

This support comes with a caveat. In much of our survey work here at MPG, we find that residents are more likely to *support* policies put forth by leaders, but they are unlikely to *demand* them. Climate change and environmental issues more broadly tend not to be at the top of voter priority lists. Even as more and more people express alarm about climate change, other issues continue to be seen as higher priorities. Gallup, who has been polling on the nation's most important problem for decades, finds just 4% of

[1] "Looking for Leadership: Public Opinion in Massachusetts on the Response to Global Warming." Steve Koczela, Ben Forman, and Rich Parr. The Massachusetts Institute for a New Commonwealth, March 2015.
[2] "Californians' Views on Climate Change." Public Policy Institute of California, July 2018.
[3] "Climate Change in the Latino Mind." Anthony Leiserowitz, Matthew Cutler and Seth Rosenthal, Yale Program on Climate Change Communication.
[4] "American Climate Perspectives." Lake Research Partners, April 2018.

Figure 3: Residents' future priorities for sustainability in Worcester
% calling each major priority for making Worcester a more sustainable place in the future



Americans cite an environmental issue of any kind as their top concern.[5]

For civic leaders looking to act on climate change, this means that the onus to act is on them. Residents and voters are not to the point of demanding action. But leaders can act with confidence, knowing residents are open to leaders taking the initiative on green activities and will support a variety of policy options to promote sustainability and fight climate change.

Green jobs top residents' wish list for future sustainability

Residents support a variety of actions which would improve aspects of the city's condition now. But they also want the city to look to its future sustainability as well. Attracting and creating new green jobs was at the top of the list of major priorities for making Worcester a more sustainable place in the future, with 78% calling it a major priority. This concept polls well across demographic groups, with 70% or more of each of the demographic groups calling this a major priority. Green jobs and clean energy consistently poll highly in other surveys around the country as well as here in Massachusetts.

Growing green jobs is an example of a policy with multiple benefits. Some residents will focus on the environmental advantages, while others will prioritize the economic benefits such jobs could bring to Worcester. Indeed, there was little difference in response on this policy between residents who believed in climate change and those who did not. Other research has shown that concern over the environment is often not the only reason people engage in environmentally friendly actions or support environmentally friendly policies. Secondary benefits can be just as important a motivation.

Next on the list of future priorities are expanding access to healthy food and active lifestyles (65%). This was particularly important to residents with lower levels of income and education. Among the lowest income residents, 80% called this issue a "major priority". Priority declined steadily to 55% among the highest

[5] "Most Important Problem." Gallup, September 2018.

income group. Renters are more likely (74%) than homeowners (54%) to prioritize this as a policy goal, as are younger residents, and residents from households without cars.

The next three items on the list of future priorities are ensuring new developments are sustainable (64%), improving transit options (64%) for Worcester residents, and supporting non-polluting transportation options (56%). Last on the list is climate change adaptation, where 55% called it a major priority, although the difference between this and the next lowest item was not statistically significant.

Residents want benefits of sustainability spread around

Worcester residents are not just concerned about what the city does on sustainability, but how those policies are rolled out across the city. The highest priority was ensuring benefits are shared by all populations of the city, including low income and minority populations, with 70% calling this a major priority.

The importance of equity as an overall goal is reflected in other issues throughout the survey. On many items, there was considerable variation by socioeconomic and race factors. Examining these differences in priorities, knowledge and experience will help city leaders ensure Green Worcester recognizes and benefits the full diversity of the city's population.

Other tools in this endeavor may be education and public information campaigns. In all, 67% place major priority on integrating sustainability into school curriculum, while 56% call public information campaigns a major priority.

Residents have all different levels of knowledge about the kinds of things Worcester is already doing. Similarly, they are engaged in a widely varying set of sustainability activities themselves, so these kinds of communications activities could play an important role in encouraging residents to participate in the Green Worcester endeavor.

Residents are aware of some green actions the city is taking, others remain unfamiliar

Residents want to prioritize green policies, but many are unfamiliar with what city government is currently doing in this area (Figure 4). Tree replanting is the top sustainability initiative residents say they are aware of, with 60% saying they know either a great deal or a fair amount about the restoration. Given the visible and long lasting changes to Worcester's landscape caused by the Asian Longhorn Beetle infestation, it is understandable this item is the most widely known.

There are considerable differences in knowledge levels between demographics on this and other items in this question set. The biggest gaps exist along the lines of education level and homeownership. Homeownership is often an indicator of tenure in a given location, since renters tend to move more frequently. They are also typically more closely woven into the

community fabric, and more likely to have heard about the kinds of municipal endeavors covered in this survey. Residents with higher levels of education have heard more about sustainability initiatives relative to those with less education.

Residents are relatively informed about open space in the city. Just over half (55%) report having heard at least a fair amount about the extensive parks and open space in Worcester, and 43% say the same of the Broad Meadow Brook Wildlife Sanctuary. For each of these items, there are also double-digit gaps in

Figure 4: Residents know the most about the Longhorned Beetle infestation; knowledge of other initiatives varies considerably *% who say they have heard at least "a fair amount" about each item*	
Over 30,000 trees have been planted since Asian Longhorned Beetle infestation destroyed many trees in northern Worcester in 2009.	60%
Worcester has 60 parks, 20 lakes and ponds, and about 17% of its area is designated as open space.	55%
Mass Audubon's Broad Meadow Brook Wildlife Sanctuary in Worcester is the largest urban wildlife sanctuary in Massachusetts.	43%
The City replaced 14,000 of its streetlights with LED lights to save energy.	39%
Worcester DPW has been developing an Integrated Plan for long term maintenance of water and sewer infrastructure.	31%
Worcester has over five active watershed groups that work with city government to improve water quality in streams and ponds.	29%
The City has the largest municipally owned solar farm in New England on top of a capped landfill.	26%
In 2018-2019, the City has been working on a plan for adaptation to climate change impacts.	18%
Worcester has a new Blue Space program with a goal of identifying and reducing threats to the quality of city's 20 lakes and ponds.	14%

awareness between the highest and lowest education groupings.

Each of the other items was known by 39% or fewer of city residents, covering a range of activities from efficient streetlights (39%) to water and sewer planning (31%) and the city's Blue Space program (14%). Near the bottom of the list is the city's plan for adaptation to climate change, with just 18% reporting at least a fair amount of knowledge. Even among those who expect local impacts of climate change, just 20% are informed about this plan. There is no pocket of the city's population where information on this initiative is particularly high.

Residents are taking a variety of actions on their own, not only driven by climate change

In addition to municipal initiatives, making Worcester a more green and sustainable place also relies on individual and household behaviors (Figure 5). The most widely adopted behaviors are turning off lights to conserve energy (89% say they do so "most of the time"), recycling (78%), and using energy efficient bulbs (73%). Below these three, there is a sharp drop off to the next tier of activities. About half say they lower the thermostat at night, recycle electronics, avoid single use items, and choose local foods. The least frequent activities are food related, with just 22% reporting composting food scraps, and 27% participating in home or community gardening. Residents may not link these activities with sustainability.

In many instances, these sustainability activities are not evenly distributed across the city's population. In particular, lower income residents are less likely to report engaging in many of the activities included in the survey. While 87% of those reporting household incomes over $100,000 a year say they recycle

Figure 5: Worcester residents on personal action related to sustainability ***% of respondents who said they take each action "most of the time"***					
	Overall	**< $25k**	**$25k to < $50k**	**$50k to <$100k**	**$100k +**
Turn off lights when you leave a room	89%	84%	91%	93%	88%
Recycle paper, plastic, or glass	78%	64%	71%	87%	87%
Replace lightbulbs with energy efficient bulbs, such as LEDs	73%	62%	67%	77%	85%
Lower the thermostat at night in cold weather and raise it in warm weather	52%	41%	53%	52%	65%
Recycle electronics	51%	41%	43%	59%	62%
Avoid one-use/disposable items such as water bottles	50%	53%	46%	52%	48%
Choose locally-produced foods when possible	49%	54%	50%	51%	49%
Conserve water, such as by taking short showers and using rain barrels	42%	57%	38%	39%	43%
Visit Worcester's parks, beaches, or conservation land	33%	32%	32%	30%	38%
Walk or bike, when feasible, rather than drive	31%	35%	35%	31%	26%
Participate in community or home gardening	27%	14%	24%	36%	34%
Compost your food scraps	22%	18%	28%	23%	23%

paper, plastic, and glass "most of the time", only 64% of the lowest income residents say the same. Similar gaps exist on other items in the survey, though not all. This serves as a reminder that gaining resident participation in green activities will involve targeted communications and outreach strategies designed to reach specific audiences.

In terms of green-friendly activities and opinion, this poll follows the contours of broader public opinion. Residents who believe in climate change are more supportive of policy interventions related to sustainability. However, their own actions are not necessarily affected by their beliefs. There are no consistent differences in the prevalence of environmentally friendly actions between those who anticipate impacts of climate change and those who do not. This suggests near-term gains in fighting climate change will come more from systemic policy change and individual behaviors driven by a variety of motivations rather from individual choices driven by concern over the impacts of climate change.

Open-ended question shows residents are not sure what it means to have a "green" or "sustainable" city

The positive findings on the quantitative questions in the survey indicate that residents support many green policies when they are discussed in detail. But an open-ended question at the beginning of the survey offers a note of caution. Many responses to this initial open-ended question indicated that the terms "green" and "sustainable" don't mean much to many residents, especially older residents and those with less education and income. Among others, there is some skepticism that the concepts of "green" or "sustainable" apply to Worcester. The rest of the survey suggests these problems can be overcome with more

Figure 6: Worcester residents' reaction to Worcester as a "green city" *% of respondents who cited each topic in response to open-ended question**	
No reaction / Don't know	32%
Negative comments (Worcester is not a green city, shouldn't be a goal)	15%
Recycling / waste / plastic	11%
Conserving energy / renewable energy	11%
Parks / trees / green space	9%
General positive (City doing good job / moving in right direction)	9%
Other types of sustainability (economic, etc)	9%
Other	8%
Greener transportation	7%
Cleanliness / pollution	7%
Food / agriculture / community gardens	2%
**Totals add up to more than 100% since many comments covered more than one issue.*	

information, but it shouldn't be assumed that most residents know what is meant by "Green Worcester" or the term "sustainable" without context.

When asked for their initial reaction to what the terms "green city" and "sustainable city" might mean for the City of Worcester, many residents came up blank. The largest category of open ended comments (32%) were non-responsive: residents said they either had never heard those terms, didn't know what they meant or how they would relate to the city, or just repeated back the terms without any elaboration. "I don't understand what it means. I've never thought about it," said one resident. Older residents and those with the lowest levels of education and household income were most likely have no reaction to the opening question.

Another 9% interpreted "sustainable" broadly, rather than with an environmental focus, most commonly referring to jobs or economic sustainability. "We have manufacturing and businesses to keep us alive," offered one resident. Once again, older residents were most likely to have non-environmental sense of sustainability. Taken together, 4 in 10 residents either were unfamiliar with the terms or thought they meant something other traditional environmental policy (energy-efficiency, recycling, etc). Public communications and education can help bridge these gaps.

Explaining the terms "green" and "sustainable" is one challenge; another is convincing residents that they are achievable goals for the cities. Some 15% of residents had a negative initial reaction to making Worcester green or sustainable. "I don't think of Worcester as a sustainable city," said one resident. Others seemed unaware of the green policies already in place. "Not very accurate. We recycle, but it's not a place where I see a lot of sustainable initiatives," said another. "We're not there yet. I don't see a lot of green stuff going on." Residents with a bachelor's or advanced degree were more likely to have a negative reaction, as did those with household incomes over $50,000.

A common theme in these comments was that sustainability was worth reaching for, but that the city wasn't there yet. A few, however, rejected it as a goal for the city, calling it "crazy", "stupid", or "ridiculous". These naysayers are definitely a minority of residents. The bigger problem is many residents see Worcester as an old industrial city and have a hard time reconciling that with being a green or sustainable city.

That is not to say that all the comments were negative or off the mark: 11% mentioned conserving or shifting to green energy, most commonly solar. An equal number (11%) mentioned recycling, waste reduction, or reducing plastics, 9% mentioned the city's parks, trees, or green space, and 7% each

mentioned cleaning up the city generally or pursuing greener transportation. Residents under age 50 were more likely to mention clean energy and transportation than were older residents. And 9% offered a general positive comment without specifics. Some of these indicated the city was making progress. "It's becoming a sustainable city and has become more cognizant of the environment," said one resident. Growing that 9% to a larger share of the population could be a goal of a sustained communications efforts around sustainability.

Conclusion

The open-ended responses highlight a communications challenge for city officials looking to advance sustainability in Worcester. The good news is that the rest of the survey suggests a broad openness, and even a level of importance, to making Worcester a green and sustainable place, and to the policies that would achieve those goals.

Overall, residents support the ideas behind the Green Worcester initiative, and many of the present and future policy priorities that could be contained in a new sustainability plan for the city. There is significant room to gain ground in terms of awareness, bringing residents on board with the aims of the initiative. Residents vary widely in what they already know about local sustainability, and even whether they know there is an organized local initiative. In terms of the personal sustainability, there is considerable variation in what actions residents are taking. Each of these represents areas where the Green Worcester initiative could potentially make a difference and help move Worcester toward a green future.

Worcester is fertile ground for green policies; city officials need to plant the seeds of specific policies and then nurture them with dedicated communications and education outreach.

Appendix – Methodology

As a part of the Green Worcester initiative, The MassINC Polling Group conducted a telephone survey of residents in June and July of 2019. The questionnaire was designed collaboratively by The MassINC Polling Group, Larissa Brown + Associates, and staff from the City of Worcester, with comment from the Green Worcester Working Group. Topics included resident priorities regarding improving conditions in Worcester, making it a sustainable city, and sustainability initiatives that could help the city continue to grow greener, as well as views of climate change and related issues. This report summarizes key themes of this telephone survey.

The survey was conducted in English and Spanish by live telephone interviewers in June and July 2019. A total of 606 residents of Worcester were interviewed by Braun Research, Inc. Results were weighted to represent the adult resident population of the city of Worcester based on known and estimated population parameters draw from Census Bureau figures. Demographic parameters included gender, age, race / ethnicity, education and ZIP code. The margin of sampling error is approximately 4 percentage points with a 95 percent level of confidence. The geographic distribution of respondents relative to the general population is shown in the table below.

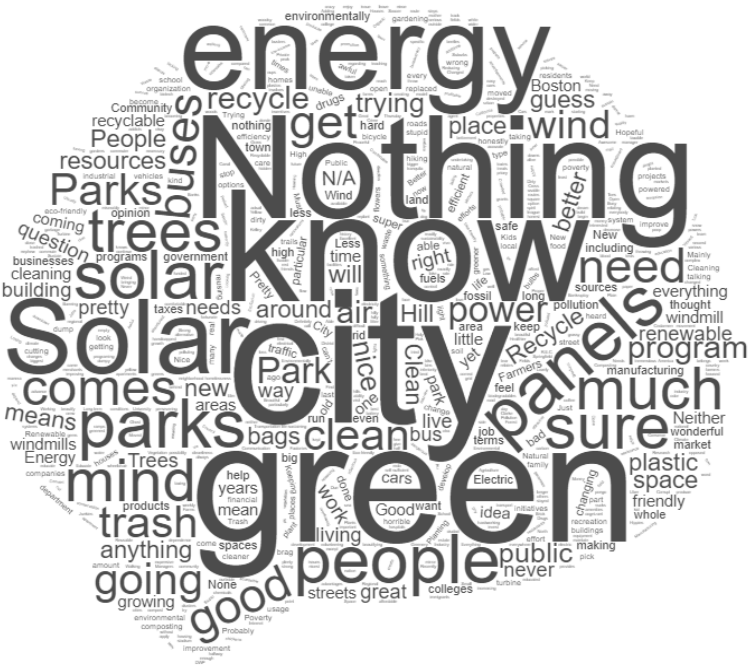
Distribution of population, survey responses by ZIP code			
ZIP Code	**Population**	**Pop. %**	**Weighted %**
01602	23,721	13%	13%
01603	20,722	11%	11%
01604	34,579	19%	18%
01605	25,910	14%	14%
01606	20,831	11%	11%
01607	8,742	5%	5%
01608	3,625	2%	2%
01609	23,886	13%	13%
01610	24,673	13%	13%

For Worcester residents who may wish to participate but who were not called as a part of conducting the initial survey, a copy of the survey will be made available at the City of Worcester's website. Ongoing results of this online survey will be monitored by city staff to ensure all opinions and viewpoints are heard.

Green Worcester Survey of Residents
Topline Results
Survey of 606 Residents of Worcester, Massachusetts
Field Dates: June 26-July 8, 2019

When you think of the terms “sustainable city” or “green city” as it relates to Worcester in particular, what comes to mind?

No reaction / Don't know	32%
Negative comments (Worcester is not a green city, shouldn't be a goal)	15%
Recycling / waste / plastic	11%
Conserving energy / renewable energy	11%
Parks / trees / green space	9%
General positive (City doing good job / moving in right direction)	9%
Other types of sustainability (economic, etc)	9%
Other	8%
Greener transportation	7%
Cleanliness / pollution	7%
Food / agriculture / community gardens	2%



When it comes to <u>improving conditions</u> in Worcester, how much of a priority do you think each of the following issues *should be* for Worcester city government? How about **READ FIRST?** Would you say that it is a major priority, minor priority, or not a priority? How about **READ NEXT, RANDOMIZE ORDER.** *Note: order sorted for display.*

	Major priority	Minor priority	Not a priority	Don't Know / Refused
Cleaning up toxic chemicals at industrial sites	77%	16%	6%	2%
Reducing pollution of the air and water	73%	21%	5%	1%
Reducing natural gas leaks	73%	17%	7%	2%
Reducing the amount of waste produced in Worcester	67%	24%	7%	2%
Planting and maintaining trees	64%	27%	8%	1%
Reducing production of gases that contribute to climate warming	61%	25%	11%	3%
Creating safer and more attractive conditions for bicyclists and pedestrians	61%	29%	9%	<1%
Increasing recycling rates in Worcester	56%	27%	14%	3%
Tightening building codes to encourage energy efficiency	55%	32%	10%	3%
Improving the use of open and green spaces	50%	29%	15%	7%
Creating a home energy rating system similar to miles per gallon for cars	31%	45%	21%	4%

When it comes to making Worcester <u>a more sustainable place in the future</u>, how much of a priority do you think each of the following issues *should be* for Worcester city government? How about **READ FIRST?** Would you say that it is a major priority, minor priority, or not a priority? How about **READ NEXT, RANDOMIZE ORDER.** *Note: order sorted for display.*

	Major priority	Minor priority	Not a priority	Don't Know / Refused
Attracting and creating new jobs in sustainability-related industries	78%	15%	6%	1%
Expanding residents' access to healthy food and active lifestyles	65%	26%	8%	1%
Ensuring that new developments are sustainable	64%	26%	5%	4%
Improving public transportation options to Worcester populations	61%	29%	9%	2%
Supporting non-polluting transportation like electric cars and bicycles	56%	31%	12%	2%
Adapting to future impacts of climate change, such as more intense storms and heat waves	55%	32%	11%	2%

Thinking about sustainability initiatives in Worcester, how much of a priority do you think each of the following issues *should be* for Worcester city government? How about **READ FIRST?** Would you say that it is a major priority, minor priority, or not a priority? How about **READ NEXT, RANDOMIZE ORDER.** *Note: order sorted for display.*

	Major priority	Minor priority	Not a priority	Don't Know / Refused
Ensuring that sustainability initiatives provide benefits to all populations, including low-income and minority communities	70%	21%	7%	2%
Incorporating sustainability into the curriculum at the city's public schools	67%	20%	9%	3%
Implementing public information campaigns to educate residents about sustainability initiatives.	56%	33%	10%	1%

Do you think Worcester and Central Massachusetts are likely to experience impacts of climate change in the next twenty years?

Yes	74%
No	19%
Don't Know / Refused	7%

ASK ONLY IF YES OR UNSURE TO PREVIOUS QUESTION

Which of the following climate change impacts do you think that Worcester and Central Massachusetts is likely to experience in the next twenty years? **READ SLOWLY, SELECT ALL THAT APPLY.**

Heavy flooding	54%
Extreme heat waves	78%
Drought	54%
More powerful storms in all seasons	78%
More ice or freezing rain storms	70%
Losses to farmers and agriculture in our region	66%
None of the above	1%
Don't Know / Refused	3%

Thinking about your own household, how often do you do the following? **READ FIRST** Would you say you do this most of the time, some of the time, or hardly ever? How about **READ NEXT, RANDOMIZE ORDER.** *Note: order sorted for display.*

	Most of the time	Some of the time	Hardly ever	Not available to me (do not read)	Don't Know / Refused
Turn off lights when you leave a room	89%	7%	3%	<1%	0%
Recycle paper, plastic, or glass	78%	8%	13%	2%	0%
Replace lightbulbs with energy efficient bulbs, such as LEDs	73%	17%	9%	1%	0%
Lower the thermostat at night in cold weather and raise it in warm weather	52%	20%	25%	2%	1%
Recycle electronics	51%	21%	23%	4%	1%
Avoid one-use/disposable items such as water bottles	50%	24%	25%	1%	1%
Choose locally-produced foods when possible	49%	35%	14%	1%	1%
Conserve water, such as by taking short showers and using rain barrels	42%	27%	29%	1%	1%
Visit Worcester's parks, beaches, or conservation land	33%	37%	29%	<1%	0%
Walk or bike, when feasible, rather than drive	31%	29%	39%	2%	<1%
Participate in community or home gardening	27%	21%	45%	6%	0%
Compost your food scraps	22%	12%	59%	5%	2%

Other than what we just talked about, do you take any other actions that make your household more sustainable?

Nothing else	66%
Conserve energy at home	10%
Reuse items, reduce / eliminate waste	6%
Insulation / new windows / MassSave	6%
Conserve water	4%
Change energy source (solar panels, wood stove, natural gas instead of oil)	4%
Other	3%
Don't litter / pick up litter	2%
Smart or energy efficient thermostat / lights / appliances	2%
Use cleaner transportation	1%
Food (local, organic, less meat, grow own food)	1%
Plant or maintain trees / plants	<1%

How much have you heard about these sustainability projects and initiatives in the City of Worcester? How about **READ FIRST** Would you say you have heard a great deal, a fair amount, not very much, or nothing at all? How about **READ NEXT, RANDOMIZE ORDER.** *Note: order sorted for display.*

	A great deal	A fair amount	Not very much	Nothing at all	Don't Know / Refused
Over 30,000 trees have been planted since Asian Longhorned Beetle infestation destroyed many trees in northern Worcester in 2009.	41%	19%	16%	22%	2%
Worcester has 60 parks, 20 lakes and ponds, and about 17% of its area is designated as open space.	24%	30%	15%	30%	<1%
Mass Audubon's Broad Meadow Brook Wildlife Sanctuary in Worcester is the largest urban wildlife sanctuary in Massachusetts.	21%	22%	19%	36%	2%
The City replaced 14,000 of its streetlights with LED lights to save energy.	20%	19%	15%	45%	1%
Worcester DPW has been developing an Integrated Plan for long term maintenance of water and sewer infrastructure.	11%	20%	19%	48%	1%
The City has the largest municipally owned solar farm in New England on top of a capped landfill.	10%	17%	21%	51%	1%
Worcester has over five active watershed groups that work with city government to improve water quality in streams and ponds.	10%	18%	22%	48%	1%
In 2018-2019, the City has been working on a plan for adaptation to climate change impacts	6%	12%	21%	60%	2%
Worcester has a new Blue Space program with a goal of identifying and reducing threats to the quality of city's 20 lakes and ponds.	5%	9%	20%	65%	1%

How important is it to you that Worcester works on becoming a city that is "green" and sustainable?

Very important	64%
Somewhat important	25%
Not very important	6%
Not important at all	3%
Don't Know / Refused	2%

Which one of the following best describes your work situation—employed full time, employed part time, or not currently employed?

Employed full time	52%
Employed part time	12%
Not currently employed	36%
Don't Know / Refused	1%

If not currently employed, are you a student, a homemaker, retired, or temporarily unemployed?

A student	14%
A homemaker	10%
Retired	53%
Temporarily unemployed	19%
Don't Know / Refused	3%

Do you have any children under age 18 in your household?

Yes	31%
No	69%
Prefer not to say	<1%

Do you currently own your home, or rent?

Own	45%
Rent	42%
Live with parents	7%
Live in student housing	1%
Another arrangement	4%
Prefer not to say	1%

How many cars, if any, does your household own? _____

No cars	12%
1 car	36%
2 cars	32%
3 or more cars	19%
Don't Know / Refused	1%

Demographics

Race

White non-Hispanic	63%
Black	10%
Asian	7%
Other	1%
Hispanic	18%
Don't Know / Refused	1%

Age

18 to 29	29%
30 to 49	33%
50 to 69	25%
70+	13%
Prefer not to say	<1%

Gender

Male	48%
Female	52%
Other / prefer not to say	<1%

Education

High School or less	42%
Some college, no degree	29%
College graduate (BA/BS)	17%
Advanced degree	11%
Don't Know / Refused	2%

About the Poll

These results are based on a survey of 606 residents of the City of Worcester, Massachusetts conducted as a part of the Green Worcester initiative. The questionnaire was designed collaboratively by The MassINC Polling Group, Larissa Brown and Associates, and City of Worcester staff. Live telephone interviews were conducted in English and Spanish June 26-July 8, 2019 via both landline and cell phone. Results were weighted to known population parameters for adult residents of Worcester based on age, gender, race and ethnicity, education, and 5 digit ZIP code. The margin of sampling error is approximately 4 percentage points with a 95 percent level of confidence. The poll was sponsored by the City of Worcester.

B. **Resources by Chapter**

This Appendix to the Green Worcester Plan provides two kinds of resources keyed to each of the Chapters of the plan: 1) examples of plans and other documents that may assist in identifying ways to implement the plan, and 2) metrics and standards to measure sustainability and potentially pursue third-party certification for the city or specific projects.

Each section of resources by chapter includes, as relevant, a brief listing of standards or indicators from the evaluation systems below.

LEED for Existing Cities and Communities
LEED, Leadership in Energy and Environmental Design, a program of the nonprofit U.S. Green Building Council, is known for its sustainability ratings for buildings. In 2019, LEED released a new rating and certification program, LEED 4.1 for Existing Cities and Communities. It draws on other rating systems, such as the STAR Communities rating system (STAR stands for "Sustainability Tools for Assessing and Rating Communities" and the organization has merged with LEED), which was developed by and for local governments. Like other programs in the LEED system, certification and professional credentials are offered for a fee, but the basic categories and system are available for free. Massachusetts communities certified under LEED 4.1 are Devens, Cambridge, New Bedford, and Northampton. Each topical section of the Green Worcester Plan includes a brief review of the requirements to meet the LEED v. 4.1 Existing Cities and Communities certification standards. (https://new.usgbc.org/leed-for-cities)

Envision™ Sustainable Infrastructure Framework
Envision is a holistic sustainability rating system and planning guide for civil infrastructure to help communities achieve higher performance infrastructure projects and systems. Created and managed by the Institute for Sustainable Infrastructure (ISI), founded by the American Public Works Association (APWA), the American Society of Civil Engineers (ASCE), and the American Council of Engineering Companies (ACEC), Envision was developed in collaboration with Harvard University's Zofnass Program for Sustainable Infrastructure and Graduate School of Design. Use of the rating system as a self-assessment tool is free, but like LEED, the system offers third-party certification for a fee and a credentialing process for professionals. Many public agencies of all sizes use Envision including the Massachusetts Water Resources Authority (which supplies water to Worcester on an emergency basis only); multiple departments in large cities such as Los Angeles, Austin, Montreal, and New York; public works departments in smaller towns and cities like Wellesley MA, Norwalk CT, and Cedar Rapids IA; and multi-jurisdiction agencies like the U.S Army Corps of Engineers. The Envision v. 3 Guidance Manual describes the system as follows:

> "Community infrastructure development is subject to the resource constraints of multiple departments and agencies, each with different schedules, agendas, mandates, budget cycles, and funding sources. Ratings systems and tools intended for buildings are not designed for this context and cannot adequately assess the extensive external benefits and impacts infrastructure has on a community. Envision

assesses not only individual project performance, but how well the infrastructure project contributes to the efficiency and long-term sustainability of the communities it serves. In this way, Envision not only asks, "Are we doing the project right?" but also, "Are we doing the right project?"
https://sustainableinfrastructure.org/

ISO Standards for Sustainable City Quality of Life

The International Organization for Standardization (ISO) has developed a set of indicators to evaluate the sustainability of city services and quality of life. ISO is an independent organization made up of the standard-setting organizations of 164 countries, including the American National Standards Institute (ANSI). The ISO develops voluntary international standards based on a global consensus to promote the creation of good quality services and products that are safe and reliable. ISO is developing a series of international standards for an integrated approach to sustainable development. This includes ISO 37120:2018, "Sustainable cities and communities – indicators for city services and quality of life." The indicators help "cities learn from one another by allowing uniform comparison across a wide range of performance measure, and…support policy development and priority setting." They are "applicable to any city, municipality, or local government that wants to measure its performance in a comparable and verifiable manner, irrespective of size and location." In 2019, ISO added ISO 37123: 2019–indicators for resilient cities — intended to be used in conjunction with ISO 37120. (The full documents with definitions and methodologies are available for purchase at techstreet.com..) See Brad Kelechava, "Sustainable City Quality of Life Indicators in ISU 37120," American National Standards Institute, blog August 13, 2018, https://blog.ansi.org/2018/08/indicators-sustainable-city-iso-37120-2018/#gref .

B.I - A GREEN HEART FOR WORCESTER: OUR VALUES AND VISION

RESOURCES

Health

"Health in All Policies," Office of the Associate Director for Policy and Strategy, Centers for Disease Control and Prevention (CDC), https://www.cdc.gov/policy/hiap/index.html.

Equity

- City of Boston, *Carbon Free Boston Social Equity Report*, 2019, www.greenribboncommission.org/wp-content/uploads/2019/05/CFB_Social_Equity_Report_WEB.pdf
- City of Providence, *Equity and Sustainability*, 2016. www.providenceri.gov/wp-content/uploads/2017/02/Equity-and-Sustainability-SummaryReport-2-20-reduced.pdf
- Angela Park, *Social Equity in Sustainability: An Equity Scan of Local Government Sustainability Programs*, Urban Sustainability Directors Network (USDN), 2014. https://www.Urban Sustainability Directors Network.org/uploads/cms/documents/Urban Sustainability Directors Network_equity_scan_sept_2014_final.pdf
- NAACP Environmental & Climate Justice Program, *Our Communities, Our Power*, 2019. https://live-naacp-site.pantheonsite.io/wp-content/uploads/2019/04/Our-Communities-Our-Power-TOOLKIT-FINAL.pdf
- Equitable & Just National Climate Platform, 2019, www.ajustclimate.org/#platform

Prosperity

- Muro, Mark, et al., "Advancing Inclusion through Clean Energy Jobs," April 2019, https://www.brookings.edu/wp-content/uploads/2019/04/2019.04_metro_Clean-Energy-Jobs_Report_Muro-Tomer-Shivaran-Kane_updated.pdf;
- Novello, Amanda and Greg Carlock, "Redefining Green Jobs for a Sustainable Economy," The Century Foundation, December 2, 2019, https://tcf.org/content/report/redefining-green-jobs-sustainable-economy/
- Massachusetts Clean Energy Center, *Ten-Year Impact Report, 2010-2020*, https://www.masscec.com/masscecs-ten-year-impact-report
- Boston Redevelopment Authority and USDN, "Triple Bottom Line Calculator," http://www.bostonplans.org/getattachment/838900d5-3b91-4029-aa08-b80e025de66b)
- *"Sustainable Return on Investment" (PDF).* American Public Works Association. HDR, Inc. https://www.apwa.net/library/meetings/sustainability/8412.pdf
- Jeroen Kraaijenbrin, "What The 3Ps Of The Triple Bottom Line Really Mean, " *Forbes* December 10, 2019, https://www.forbes.com/sites/jeroenkraaijenbrink/2019/12/10/what-the-3ps-of-the-triple-bottom-line-really-mean/?sh=7b38d7905143
- **"**Sustainable Return on Investment – Capturing more than economic value**,"** July 11, 2019, Brendle Group, https://www.brendlegroup.com/sustainable-return-on-investment-capturing-more-than-economic-value/
- American Institute of Chemical Engineers, Videos on SROI, https://www.aiche.org/academy/videos/introduction-sustainability-return-on-investment-part-1

INDICATORS, STANDARDS AND METRICS

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: QUALITY OF LIFE

WellBeing
QL1.1 Improve Community Quality of Life
QL1.2 Enhance Public Health & Safety
QL1.3 Improve Construction Safety
QL1.4 Minimize Noise & Vibration
QL1.5 Minimize Light Pollution
QL1.6 Minimize Construction Impacts

Community
QL3.1 Advance Equity & Social Justice
QL3.2 Preserve Historic & Cultural Resources
QL3.3 Enhance Views & Local Character
QL3.4 Enhance Public Space & Amenities

CATEGORY: LEADERSHIP

Collaboration
LD1.1 Provide Effective Leadership & Commitment
LD1.2 Foster Collaboration & Teamwork
LD1.3 Provide for Stakeholder Involvement
LD1.4 Pursue Byproduct Synergies

Planning
LD2.1 Establish a Sustainability Management Plan
LD2.2 Plan for Sustainable Communities
LD2.3 Plan for Long-Term Monitoring & Maintenance
LD2.4 Plan for End-of-Life

Economy
LD3.1 Stimulate Economic Prosperity & Development
LD3.2 Develop Local Skills & Capabilities
LD3.3 Conduct a Life-Cycle Economic Evaluation

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

- **ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.**

B. II – THE GREEN WORCESTER APPROACH: STEWARDSHIP, TRANSPARENCY, AND ACCOUNTABILITY

RESOURCES

- City of Providence, RI, Sustainability Dashboard https://performance.providenceri.gov/stat/goals/r6yh-954f
- City of Cambridge, MA Sustainability Dashboard https://sustainabilitydashboard.cambridgema.gov/dashboard/
- City of Vancouver, CA, Sustainability https://vancouver.ca/green-vancouver.aspx
- Green City Times, https://www.greencitytimes.com/green-city-times-eye-on-sustainability/; https://www.greencitytimes.com/10-greenest-cities-in-the-world/
- City of Durham, NC Sustainability Dashboard, https://durhamnc.gov/3852/Sustainability-Dashboard

B.III – 100% CLEAN AND AFFORDABLE ENERGY

RESOURCES

- Worcester Climate Action Plan, 2006. www.worcesterenergy.org/leading-by-example/climate-action
- Commonwealth of Massachusetts, Global Warming Solutions Act 10-Year Progress Report, www.mass.gov/progress-towards-reducing-greenhouse-gas-emissions
- Worcester Climate Emergency Resolution, 2019
- Worcester Community Choice (Electric) Aggregation Program, www.masspowerchoice.com/worcester
- City of Boston and Boston University Institute for Sustainable Energy, *Climate Free Boston*, http://sites.bu.edu/cfb/
- Carbon Neutral Cities Alliance, www.carbonneutralcities.org
- Energy Efficiency Impact Report, https://energyefficiencyimpact.org/
- Massachusetts Clean Energy Center, *Ten Year Impact Report*, https://files-cdn.masscec.com/reports/ 10-year-digital-pages%20final%20final.pdf
- *Massachusetts 2050 Decarbonization Roadmap*, 2020, https://www.mass.gov/info-details/ma-decarbonization-roadmap#final-reports-

INDICATORS, STANDARDS AND METRICS

LEED V. 4.1 CITIES AND COMMUNITIES CRITERIA

Energy efficiency and GHG emissions reduction are foundational to the LEED city sustainability criteria. Certification is based on meeting prerequisites and attaining threshold scores in specific areas.

Prerequisites:
- Power access, reliability, and resiliency: 100% coverage; reliability performance monitoring; and power surety and resiliency.
- Energy and GHG emissions management: measure annual energy consumption and GHG emissions for the city (tons CO2e per capita).

Energy Performance Score:
- Calculation based on annual energy consumption from all sectors along with the source of energy, emissions co-efficient for electricity and all fuel types, and total population.

Energy Efficiency:
- Street Lighting and public area lighting, minimum efficiency requirement.
- Water and Wastewater: minimum of 50% of pumps meet federal or international equivalent standards for pump efficiency.
- District Energy Systems: no district energy systems

Renewable Energy:
- Renewables - on-site renewables, new and existing off-site renewables.

Low Carbon Economy:
- GHG intensity: total GHG emission emitted by the city per unit economic output measure in GDP produced by the city.
- Reduction in Carbon intensity: (GHG intensity = total city GHG/Total GDP).

Grid Harmonization:
- Improve operational efficiency and encourage consumer participation in energy use optimization
- Load Optimization: e.g., dynamic pricing to motivate load shifting

- Demand Response: critical peak pricing; critical peak rebate
- Net Metering and Interconnection Policy: adopt or be committed to (meet IEEE or local equivalent standards)

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: RESOURCE ALLOCATION

ENERGY
RA2.1 Reduce Operational Energy Consumption
RA2.2 Reduce Construction Energy Consumption
RA2.3 Use Renewable Energy
RA2.4 Commission & Monitor Energy Systems

CATEGORY: CLIMATE AND RESILIENCE

EMISSIONS
CR1.1 Reduce Net Embodied Carbon
CR1.2 Reduce Greenhouse Gas Emissions
CR 1.3 Reduce Air Pollutant Emissions

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Greenhouse gas emissions measured in tons per capita (core indicator)
- Total end-use energy consumption per capita (GJ/year) (core indicator)
- Percentage of total end-use energy derived from renewable sources (core indicator)
- Percentage of city population with authorized electrical service (residential) (core indicator)
- Number of gas distribution service connections per 100 000 population (residential) (core indicator)
- Electricity consumption of public street lighting per kilometer of lighted street (kWh/year) (supporting indicator)
- Average annual hours of electrical service interruptions per household (supporting indicator)
- Number of different electricity sources providing at least 5 % of total energy supply capacity
- Electricity supply capacity as a percentage of peak electricity demand
- Percentage of critical facilities served by off-grid energy services

B.IV – CONNECTED GREEN AND BLUE SPACES WITH HEALTHY NATURAL SYSTEMS

RESOURCES

Urban Forestry

- *Urban Forestry Management Plan Toolkit* https://ufmptoolkit.net/
- *OpenTreeMap* (www.opentreemap.com). A free web-based application to create community-based maps. The City could set up a website and invite the public to identify and map trees in Worcester.
- *i-Tree Software for Urban Forest Management (www.itreetools.org).* i-Tree is a free, state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools. Tools of potential interest to Worcester include:
  - i-Tree Canopy offers a quick and easy way to produce a statistically valid estimate of land cover types (e.g., tree cover) using aerial images available in Google Maps. Canopy also estimates values for air pollution reduction and capturing atmospheric carbon. Canopy can be used by urban forest managers to estimate tree canopy cover, set canopy goals, and monitor canopy change over time.
  - i-Tree Streets focuses on the benefits of street trees. Using a sample or complete inventory, Worcester can quantify and put a dollar value on annual environmental and aesthetic benefits of street trees.
  - i-Tree Vue allows uses the freely available National Land Cover Database (NLCD) satellite-based imagery to assess the tree canopy benefits and model potential planting scenarios for benefits.
- University of Vermont Spatial Laboratory Tree Canopy Assessments, www.vtcommunityforestry.org/resources/inventories-management-plans/tree-canopy-assessments

Parks

- *City Parks Alliance* (www.cityparksalliance.org). The City Parks Alliance (CPA), an independent national organization of urban park leaders that serves as a network for civic and community leaders, government agencies, parks and recreation authorities, funders, and other urban parks stakeholders. The organization's mission is to promote the creation of vibrant, healthy parks and green spaces that contribute to community well-being. Among CPA objectives are urban parks advocacy, gathering and sharing best practices, and building partnerships with health, economic, education, environmental and other community development organizations.

INDICATORS, STANDARDS AND METRICS

LEED v. 4.1 Cities and Communities:

- Required:
  - Ecosystem assessment, maps, and planning narrative for parks and natural resources conservation and restoration. (As in the Worcester Open Space and Recreation Plan.)
  - Wetlands Ordinance and State Wetlands Act meet requirements.
  - Easily accessible green space – at least 121 square feet per person
  - Total minimum area of green space – at least 7212 square feet
  - Minimum of 70% of dwelling units have green space within ½ mile walking distance
- Light Pollution Reduction: measurements needed to meet Glare and Sky-Glow requirements

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: NATURAL WORLD

Siting
NW1.1 Preserve Sites of High Ecological Value
NW1.2 Provide Wetland & Surface Water Buffers
NW1.3 Preserve Prime Farmland
NW1.4 Preserve Undeveloped Land

Conservation
NW2.1 Reclaim Brownfields
NW2.2 Manage Stormwater
NW2.3 Reduce Pesticide & Fertilizer Impacts
NW2.4 Protect Surface & Groundwater Quality

Ecology
NW3.1 Enhance Functional Habitats
NW3.2 Enhance Wetland & Surface Water Functions
NW3.3 Maintain Floodplain Functions
NW3.4 Control Invasive Species
NW3.5 Protect Soil Health

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Square metres of public indoor recreation space per capita (supporting indicator)
- Square metres of public outdoor recreation space per capita (supporting indicator)
- Percentage of areas designated for natural protection (supporting indicator)
- Percentage change in number of native species (supporting indicator)
- Green area (hectares) per 100,000 population (core indicator)

B.V – NET ZERO AND CLIMATE RESILIENT BUILDINGS

RESOURCES

- World Green Building Council. www.worldgbc.org
- US Green Building Council. www.usgbc.org; Massachusetts chapter www.usgbcma.org
- Cambridge Building Energy Use Disclosure Ordinance, www.cambridgema.gov
- High Performance Buildings, https://www.mass.gov/high-performance-buildings
- Mass Save Program, www.masssave.com
- Deep Energy Retrofit Case Study: Massachusetts… https://masslandlords.net/deep-energy-retrofit-case-study-massachusetts-single-family-home/
- Zero Energy Project, https://zeroenergyproject.org/2018/09/23/my-zero-energy-retrofit-beats-my-401k/
- Cook, Jeffrey J., Sydney Forrester, Bryn Grunwald, Jenny Heeter, Clark Henry, and Monisha Shah. 2019. *Up to the Challenge: Communities Deploy Solar in Underserved Markets*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-72575. https://www.nrel.gov/docs/fy19osti/72575.pdf.
- Massachusetts Clean Energy Center, Triple Decker Design Challenge, https://www.masscec.com/triple-decker-design-challenge
- Embodied Carbon in Construction Calculator - free tool to calculate embodied energy in materials. https://www.buildingtransparency.org/en/

INDICATORS, STANDARDS AND METRICS

LEED v.4.1 CITIES AND COMMUNITIES

Requirements:

- Adopt a building performance disclosure policy.
- Adopt a policy for all new construction undertaken by city government to achieve LEED Silver or an equivalent green building certification.
- Provide a minimum of two incentives for private sector LEED or an equivalent green building rating system in the city (permitting time incentives; density incentives; tax credits; permitting fee incentives).
- Identify Compact and Complete Centers (criteria for CCCs include: 1/2 mile of centers of mixed use, density, walkability, transit availability; ADA compliant sidewalks, bikeways, and crosswalks; 90% of buildings in CCCs have access to at least 10 diverse uses; percentage of population residing in CCCs)
- High Priority Site Option: historic preservation and redevelopment promotion. Worcester meets this option with the Historical Commission, historic district and historic site preservation ordinances; also policies to promote redevelopment areas

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Final energy consumption of public buildings per year (GJ/m2) (core indicator)

B.VI - SUSTAINABLE TRANSPORTATION CHOICES

RESOURCES

- Massachusetts Pedestrian Transportation Plan, 2019
- Massachusetts Bicycle Transportation Plan, 2019
- Massachusetts Municipal Resource Guide for Walkability, 2019
- Massachusetts Municipal Resource Guide for Bikeability, 2019
- Central Massachusetts Metropolitan Planning Organization (CMMPO), Regional Pedestrian Plan, 2018
- CMMPO, Regional Bicycle Plan, 2018
- National Association of City Transportation Officials (NACTO) publishes best practice guides including, the *Urban Street Design Guide*, *Urban Bikeway Design Guide*, *Transit Street Design Guide*, *Bike Share Station Siting Guide*, and *Urban Street Stormwater Guide,* https://nacto.org/publications/design-guides/
- NACTO, *Curb Appeal: Curbside Management Strategies for Improving Transit Reliability*, https://nacto.org/tsdg/curb-appeal-whitepaper/
- ITE, Curbside Management Practitioners Guide, https://www.ite.org/pub/?id=C75A6B8B-E210-5EB3-F4A6-A2FDDA8AE4AA
- National Academies of Sciences, Engineering, and Medicine 2019. *Fast-Tracked: A Tactical Transit Study*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25571 .
- Maaza C. Mekuria et al., *Low-Stress Bicycling and Network Connectivity*, Mineta Transportation Institute, Report 11-19 (May 2012), https://transweb.sjsu.edu/sites/default/files/1005-low-stress-bicycling-network-connectivity.pdf
- Healthiest Practices Open Streets http://www.healthiestpracticeopenstreets.org/
- Open Streets Project Toolkit https://openstreetsproject.org/open-streets-toolkit/
- Worcester Regional Research Bureau (WRRB), *City on the Move: An Overview and Assessment of Worcester's Transportation Needs*, Report 18-07, September 2019
- WRRB, *The Implications of a Fare-Free WRTA*, May 2019
- Walker, Jarrett. *Human Transit*. Island Press, 2012.
- The state offers a toolkit for starting a Walking School Bus: https://www.mass.gov/service-details/safe-routes-to-school-encouragement. See also: Starting a Walking School Bus. http://www.walkingschoolbus.org/
- *Carbon Free Boston Summary Report* 2019. https://www.greenribboncommission.org/wp-content/uploads/2019/01/Carbon-Free-Boston-Report-web.pdf

INDICATORS, STANDARDS AND METRICS

LEED V. 4.1 – CITIES AND COMMUNITIES

- Transportation performance score: calculate daily VMT (Vehicle Miles Traveled); calculate transportation performance score based on total annual VMT and population data
- Access to Quality Transit: mode split for commuting; quality of transit facilities (e.g., shelters); intermodal connectivity (3 or more modes); minimum frequency of trips
- Alternative fuel vehicles: electric charging stations; alternative fuel stations (non-gasoline, low-polluting fuels)
- Smart mobility and transportation policy: at least four policies such as transit to have Passenger Information System; GPS; synchronized signals and transit signal priority; real time parking management systems; electronic toll collection systems; RFID technology for logistics and/or public transportation
- Identify Compact and Complete Centers (CCC-1/2 mile of centers of mixed use, density, walkability, transit availability; ADA compliant sidewalks, bikeways, and crosswalks; 90% of buildings in CCCs have access to at least 10 diverse uses; percentage of population residing in CCCs)

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

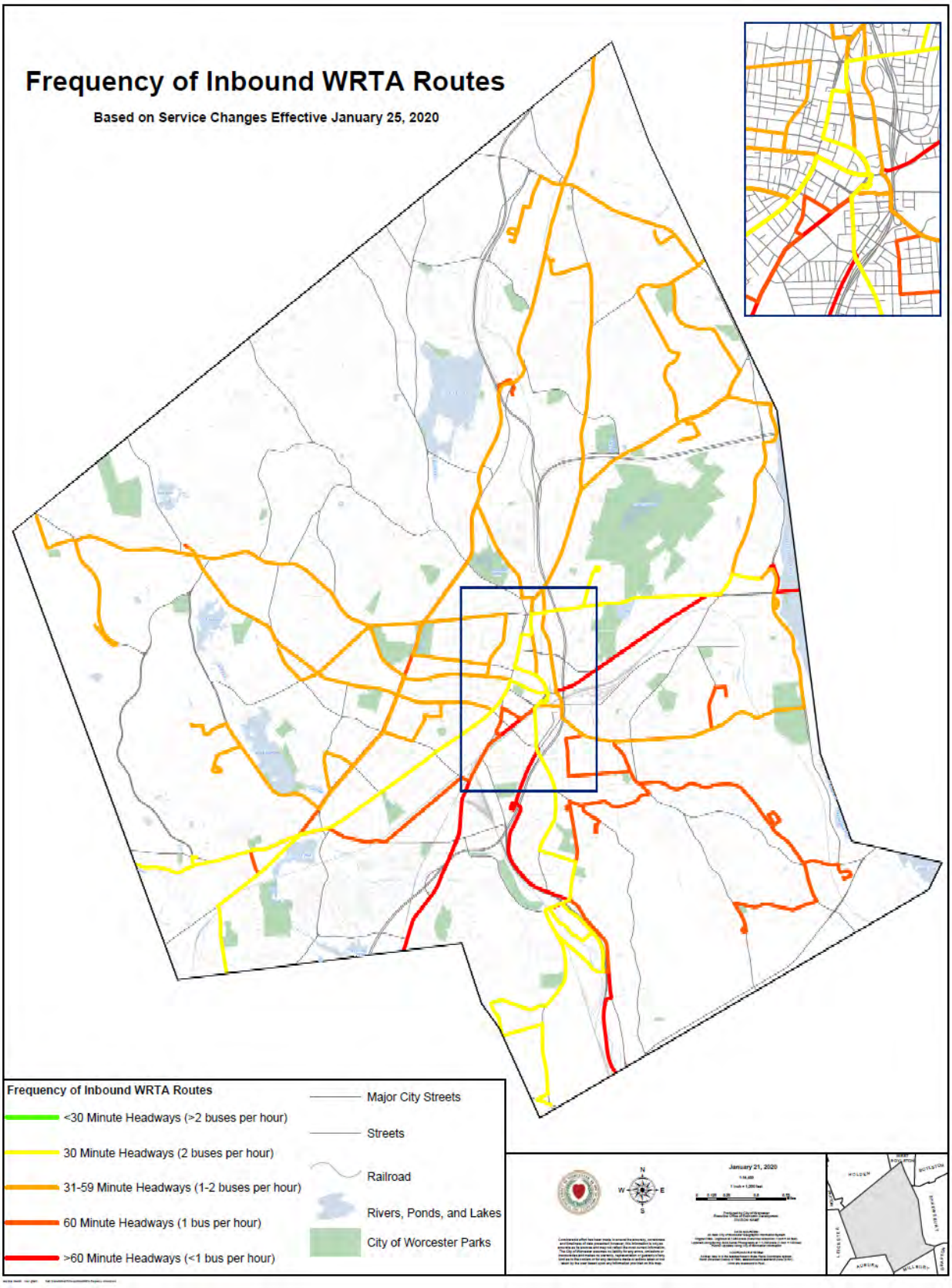
CATEGORY: QUALITY OF LIFE

Mobility
QL2.1 Improve Community Mobility & Access
QL2.2 Encourage Sustainable Transportation
QL2.3 Improve Access & Wayfinding

INTERNATIONAL STANDARDS ORGANIZATION

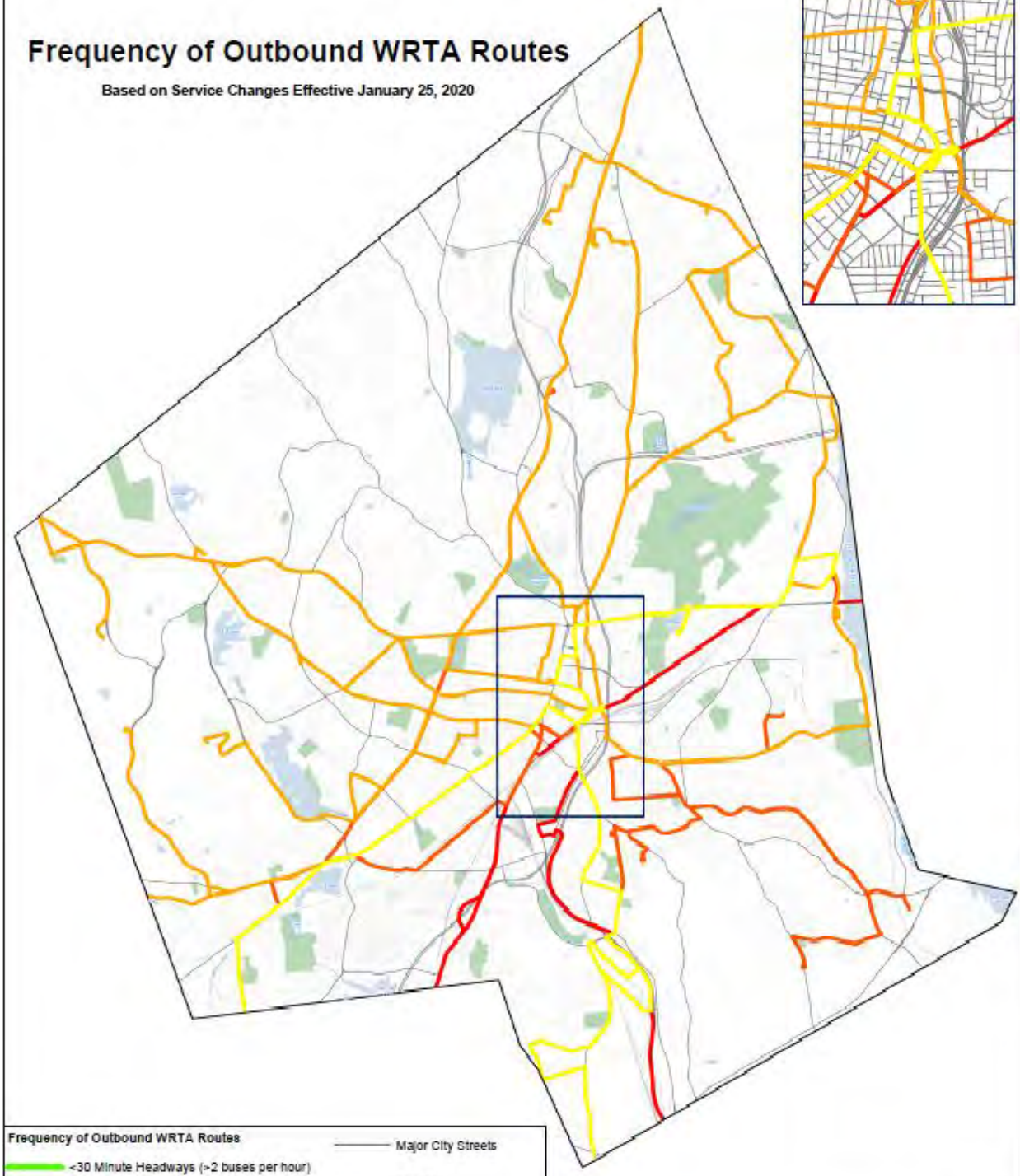
ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Kilometers of public transport system per 100,000 population (core indicator)
- Annual number of public transport trips per capita (core indicator)
- Percentage of commuters using a travel mode to work other than a personal vehicle (supporting indicator)
- Kilometers of bicycle paths and lanes per 100,000 population (supporting indicator)
- Transportation deaths per 100,000 population (supporting indicator)
- Percentage of population living within 0.5 km of public transit running at least every 20 min during peak periods (supporting indicator)
- Average commute time (supporting indicator)


Frequency of Inbound WRTA Routes
Based on Service Changes Effective January 25, 2020
Frequency of Inbound WRTA Routes
<30 Minute Headways (>2 buses per hour)
30 Minute Headways (2 buses per hour)
31-59 Minute Headways (1-2 buses per hour)
60 Minute Headways (1 bus per hour)
>60 Minute Headways (<1 bus per hour)
Major City Streets
Streets
Railroad
Rivers, Ponds, and Lakes
City of Worcester Parks
January 21, 2020

Frequency of Outbound WRTA Routes

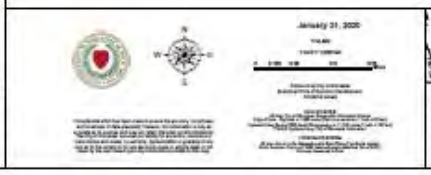
Based on Service Changes Effective January 25, 2020



Frequency of Outbound WRTA Routes

- <30 Minute Headways (>2 buses per hour)
- 30 Minute Headways (2 buses per hour)
- 31-59 Minute Headways (1-2 buses per hour)
- 60 Minute Headways (1 bus per hour)
- >60 Minute Headways (<1 bus per hour)

- Major City Streets
- Streets
- Railroad
- Rivers, Ponds, and Lakes
- City of Worcester Parks



B.VII - ONE WATER – INTEGRATED WATER MANAGEMENT

RESOURCES

- US Water Alliance, "One Water Roadmap: The Sustainable Management of Life's Most Essential Resource," (2016), www.uswateralliance.org/sites/uswateralliance.org/files/publications/Roadmap%20FINAL.pdf
- City of Worcester, Integrated Water Management Plan, October 2019, http://www.worcesterma.gov/cww/integrated-plan.pdf
- Secino, B. J., Merchant, B. P., Marsan, C. B., & Racine, R. K. (2018). *Stormwater Runoff Reduction on the Worcester Polytechnic Institute Campus*. Retrieved from https://digitalcommons.wpi.edu/iqp-all/5205
- Green Jobs Academy, www.greenjobsacademy.org
- Philadelphia Green City, Clean Waters Program, www.phila.gov/water/sustainability/greencitycleanwaters/Pages/default.aspx

INDICATORS, STANDARDS AND METRICS

LEED V. 4.1 CITIES AND COMMUNITIES

- Water Access and Quality – prerequisites met by Worcester
  - Public water supply; drinking water quality; treated wastewater quality; policy to comply with NPDES stormwater regulations
  - Water Performance
  - Measure daily per capita domestic water consumption – met
  - Water performance score based on per capita consumption and total population
  - Integrated Water Management – maintain water balance
  - Requirement met by 2019 IWM plan
- Stormwater Management
  - Mitigate flooding using low-impact development and green infrastructure; demonstrate that 35% of land area has designated green stormwater providing bioretention and infiltration services that are interconnected.
- Smart Water Systems
  - Annual water audit; adopt strategies for automation of water supply system for at least 50% of total water supply network

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: RESOURCE ALLOCATION

Water
RA3.1 Preserve Water Resources
RA3.2 Reduce Operational Water Consumption
RA3.3 Reduce Construction Water Consumption
RA3.4 Monitor Water Systems

CATEGORY: NATURAL WORLD

Siting
NW1.2 Provide Wetland & Surface Water Buffers

Conservation
NW2.2 Manage Stormwater

NW 2.4 Protect Surface & Groundwater Quality

Ecology
NW3.2 Enhance Wetland & Surface Water Functions
NW3.3 Maintain Floodplain Functions

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Percentage of city population with potable water supply service (core indicator)
- Percentage of city population with sustainable access to an improved water source (core indicator)
- Total domestic water consumption per capita (liters/day) (core indicator)
- Compliance rate of drinking water quality (core indicator)
- Total water consumption per capita (liters/day) (supporting indicator)
- Average annual hours of water service interruptions per household (supporting indicator)
- Percentage of water loss (unaccounted for water) (supporting indicator)
- Percentage of city population served by wastewater collection (core indicator)
- Percentage of city's wastewater receiving centralized treatment (core indicator)
- Percentage of population with access to improved sanitation (core indicator)
- Compliance rate of wastewater treatment (supporting indicator)

B.VIII - TOWARDS ZERO WASTE

RESOURCES

- City of Cambridge Zero Waste Master Plan (2019) https://www.cambridgema.gov/Departments/publicworks/Initiatives/zerowastemasterplan
- San Francisco Zero Waste Case Study, https://www.epa.gov/transforming-waste-tool/zero-waste-case-study-san-francisco
- Austin (TX) Resource Recovery Master Plan (2011) www.austintexas.gov/zerowaste
- Vancouver (BC) Zero Waste 2040 (2018) www.council.vancouver.ca/20180516/documents/pspc2a.pdf
- City of San Antonio Recycling and Resource Recovery Plan, 2013 update www.sanantonio.gov/Portals/0/Files/SWMD/About/RecyclingResourceRecoveryPlan.pdf
- NASPO (National Association of State Purchasing Agents) Green Purchasing Guide, https://www.naspo.org/green/index.html
- Massachusetts Environmentally Preferable Purchasing, https://www.mass.gov/environmentally-preferable-products-epp-procurement-programs
- Sustainable Procurement Policies Roadmap, www.ecocenter.org/sustainable-procurement-policies-roadmap
- Urban Sustainability Directors Network (USDN), *The Buck Stops Here: Sustainable Procurement Playbook for Cities,* http://responsiblepurchasing.org/purchasing_guides/playbook_for_cities/rpn_Urban Sustainability Directors Network_playbook_for_cities.pdf
- City of Portland (OR) Sustainable Procurement Policy 2018 www.portlandoregon.gov/brfs/article/695574
- Kate O'Neill, *Waste.* Medford MA: Polity Press, 2019.
- Ellen MacArthur Foundation, *The New Plastics Economy Global Commitment 2019 Progress Report*, www.newplasticseconomy.org/assets/doc/Global-Commitment-2019-Progress-Report.pdf

INDICATORS, STANDARDS AND METRICS

LEED v. 4.1 CITIES AND COMMUNITIES

The LEED standards for waste are in six categories: Solid Waste Management, Waste Performance, Special Waste Streams, Responsible Sourcing for Infrastructure, Material Recovery, and Smart Waste Systems. The intent is to manage all waste streams, including industrial, biomedical, and household hazardous waste. Waste management performance is based on all these waste streams, not just residential waste.

Solid Waste Management

- Prerequisite: 100% coverage of all types of buildings/city population by waste management services
- Prerequisite: Solid Waste Management Plan--sorting of waste in a minimum of types – organic, recyclables, e-waste, other. Source segregation or central sorting facility; compliance with federal or state regulations on waste storage and collection; waste handling and processing facility – composting of organic waste; recyclables sorted into a minimum of six categories; materials recovery facility – send materials to produce recycled products; divert a minimum of 35% of construction and demolition waste from city government infrastructure works

Waste Performance

- Measure total weight of waste and total waste diverted from landfills or incineration for minimum most recent calendar year. Performance score based on data and population.
  - Waste to energy counts as waste diversion if facility meets European Commission directives

  Special Waste Streams Management
  - Required – report waste streams generated and % diverted.
  - Responsible Sourcing for Infrastructure
    - Encourage use of products for which life cycle information is available and that have been extracted and sourced in a responsible manner.
    - Meet at least one of following for at least 20% of total value of permanently installed top 3 materials used in infrastructure: extended producer responsibility; leadership extraction practices-material reuse; leadership extraction practices-recycled content; leadership extraction practices-other USGBC approved program

  Material Recovery
  - Intent to recover from the waste stream materials which have a have value and provide mechanisms for collection and channelization to producers – move towards circular economy
  - Extended Producer Responsibility facilities to collect and store
  - Mandate a manufacturers or producer's Extended Producer Responsibility (ERP) policy – address e-waste, packaging; guideline on collection, etc.; mandate to collect at least 10% of total annual waste generated (e waste)
  - Non-recyclable Waste Generation Reporting: waste stream study and reporting; dialogue with identified producers

  Smart Waste Management Systems
  - Improve operational efficiency
  - Pneumatic transport systems
  - Loading stations, transport network underground; central waste handling facility; Smart Bins and Route Optimization: ultrasonic sensors in municipal bins; optimize fleet routing for waste collection

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: RESOURCE ALLOCATION

Materials
RA1.1 Support Sustainable Procurement Practices
RA1.2 Use Recycled Materials
RA1.3 Reduce Operational Waste
RA1.4 Reduce Construction Waste
RA1.5 Balance Earthwork On Site

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Percentage of city population with regular solid waste collection (residential) (core indicator)
- Total collected municipal solid waste per capita (core indicator)
- Percentage of the city's solid waste that is recycled (core indicator)
- Percentage of the city's solid waste that is disposed of in a sanitary landfill (core indicator)

- Percentage of the city's solid waste that is treated in energy-from-waste plants (core indicator)
- Percentage of the city's solid waste that is biologically treated and used as compost or biogas (supporting indicator)
- Percentage of the city's solid waste that is disposed of in an open dump (supporting indicator)
- Percentage of the city's solid waste that is disposed of by other means (supporting indicator)
- Hazardous waste generation per capita (tonnes) (supporting indicator)

B.IX – SUSTAINABLE FOOD SYSTEMS

RESOURCES

- USDA Urban Agriculture Tool Kit
  https://www.ams.usda.gov/sites/default/files/media/urbanagriculturetoolkit.pdf
- BBC *Climate change food calculator: What's your diet's carbon footprint?*
  https://www.bbc.com/news/science-environment-46459714
- *Food's Carbon Footprint* http://www.greeneatz.com/foods-carbon-footprint.html
- Springfield, MA – Wellspring Harvest commercial hydroponic greenhouse.
  https://wellspring.coop/co-op-businesses/greenhouse-cooperative

  For profit, worker-owned cooperative business. Greenhouse sales began in August 2018. Investment fund raised money for construction and startup capital. Jobs and profit sharing for employees Eds and Meds as a market.. Institutional markets can provide stable, large scale demand which will enable greenhouses to build the capacity to produce at scale, and therefore at more affordable prices.

INDICATORS, STANDARDS AND METRICS

LEED V. 4.1 CITIES AND COMMUNITIES

- The Cities and Communities LEED rating does not include food production criteria.
- Options for LEED v. 4.0 Neighborhood Development (large subdivisions or new towns):
  - Neighborhood gardens – provide permanent and viable garden space in a development project.
  - CSA – purchase community-supported agriculture shares for at least 80% of dwelling units for at least 2 years
  - Proximity to farmers market – project is within walking distance of a farmers' market.

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Total urban agricultural area per 100,000 population (core indicator)
- Amount of food produced locally as a percentage of total food supplied to the city (supporting indicator)
- Percentage of city population undernourished (supporting indicator)
- Percentage of city population that is overweight or obese — Body Mass Index (BMI) (supporting indicator)

B.X – POLLUTION PREVENTION

RESOURCES

- NASPO (National Association of State Procurement Officials) Green Purchasing Guide, https://www.naspo.org/green/index.html
- Massachusetts Environmentally Preferable Purchasing, https://www.mass.gov/environmentally-preferable-products-epp-procurement-programs
- Sustainable Procurement Policies Roadmap, www.ecocenter.org/sustainable-procurement-policies-roadmap
- Urban Sustainability Directors Network (USDN), "The Buck Stops Here: Sustainable Procurement Playbook for Cities," http://responsiblepurchasing.org/purchasing_guides/playbook_for_cities/rpn_Urban Sustainability Directors Network_playbook_for_cities.pdf
- City of Portland (OR) Sustainable Procurement Policy 2018 www.portlandoregon.gov/brfs/article/695574

INDICATORS, STANDARDS AND METRICS

LEED V. 4.1 – CITIES AND COMMUNITIES

- See Transportation and Materials Management sections.

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: RESOURCE ALLOCATION

Materials
RA1.1 Support Sustainable Procurement Practices
RA1.2 Use Recycled Materials
RA1.3 Reduce Operational Waste
RA1.4 Reduce Construction Waste
RA1.5 Balance Earthwork On Site

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Fine particulate matter (PM2.5) concentration (core indicator)
- Particulate matter (PM10) concentration (core indicator)
- Greenhouse gas emissions measured in tonnes per capita (core indicator)
- NO2 (nitrogen dioxide) concentration (supporting indicator)
- SO2 (sulfur dioxide) concentration (supporting indicator)
- O3 (ozone) concentration (supporting indicator)
- Noise pollution (supporting indicator)

B.XI - CLIMATE CHANGE RESILIENCE

RESOURCES

- Worcester Hazard Management Plan
- Worcester Municipal Vulnerability Preparedness Plan, 2019.
- www.resilientma.org

INDICATORS, STANDARDS AND METRICS

LEED v. 4.1 CITIES AND COMMUNITIES

- Vulnerability and capacity assessment including identification of geophysical, hydrological, climatological, meteorological, biological, social, technological, industrial, transport, and pollution impacts; risk identification, risk assessment, most exposed and affected sectors. Set adaptation and mitigation goals for at least the top two natural and man-made hazards.
- Resilience Plan meeting at least two of the following: climate adaptation and mitigation strategies; emergency planning and preparedness; strategies for early warning systems; critical infrastructure location; policy intervention for building structures; capacity building.

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

CATEGORY: CLIMATE AND RESILIENCE

Resilience
CR2.1 Avoid Unsuitable Development
CR2.2 Assess Climate Change Vulnerability
CR2.3 Evaluate Risk & Resilience
CR2.4 Establish Resilience Goals and Strategies
CR2.5 Maximize Resilience
CR2.6 Improve Infrastructure Integration

INTERNATIONAL STANDARDS ORGANIZATION

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities.

- Percentage of city population covered by multi-hazard early warning system
- Percentage of emergency responders who have received disaster response training
- Percentage of local hazard warnings issued by national agencies annually that are received in a timely fashion by the city
- Number of hospital beds in the city destroyed or damaged by natural hazards per 100,000 population
- Number of active and temporary waste management sites available for debris and rubble per square kilometer
- Percentage of emergency responders in the city equipped with specialized communication technologies able to operate reliably during a disaster event
- Number of evacuation routes available per 100,000 population

- Percentage of city population that can be served by city food reserves for 72 hours in an emergency
- Percentage of the city's population living within one kilometer of a grocery store
- Percentage of city area covered by publicly available hazard maps
- Pervious land areas and public space and pavement built with porous, draining materials as a percentage of city land area
- Percentage of city land area in high-risk zones where risk-reduction measures have been implemented
- Percentage of city departments and utility services that conduct risk assessment in their planning and investment
- Annual number of critical infrastructures flooded as a percentage of critical infrastructure in the city
- Annual expenditure on water retention measures as a percentage of city prevention measures budget
- Number of different sources providing at least 5 % of total water supply capacity
- Percentage of city population that can be supplied with drinking water by alternative methods for 72 hours

B.XII – SUSTAINABILITY, RESILIENCE, AND GREEN EDUCATION IN ALL POLICIES

RESOURCES

- David Godschalk and David Rouse, *Sustaining Places: Best Practices for Comprehensive Plans*, PAS Report 578, Chicago: American Planning Association, 2015.

INDICATORS, STANDARDS AND METRICS

LEED v. 4.1 CITIES AND COMMUNITIES

- Requirement – comprehensive demographic narrative and maps; track and measure living standards metrics – education, median gross rent, Gini coefficient, median household income, unemployment rate, median Air Quality Index (AQI), violent crime per capita.
- Trend improvements: improvements in four of seven socioeconomic metrics
- Distributional Equity: equitable per capita income; equitable workforce mobility; graduation rate equity: equitable employment; access and proximity
- Environmental Justice: identify priority environmental justice conditions; identify priority areas.
- Housing and Transportation Affordability: comprehensive housing policy; at least 60% of households compared to National Typical would spend less than 45% of income on housing + transportation
- Civic and Community Engagement: both high tech and high touch; inclusion of traditionally unrepresented or underrepresented groups; appointments to boards and commissions reflect gender, racial and ethnic diversity; 51% of survey respondents believe they can have a positive impact on community and/or at least 80% report positive levels of neighborhood cohesion
- Civil and Human Rights: policy-based mission statement to promote discrimination-free quality of life; ensure voting rights of all eligible voters; integrate community policing and procedural justice into Police Department operations; local officer or Commission on Human Rights

ENVISION™ SUSTAINABLE INFRASTRUCTURE FRAMEWORK

Planning
LD2.1 Establish a Sustainability Management Plan
LD2.2 Plan for Sustainable Communities
LD2.3 Plan for Long-Term Monitoring & Maintenance
LD2.4 Plan for End-of-Life

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 37120: Sustainable cities and communities – indicators for city services and quality of life and ISO 37123–indicators for resilient cities. Below are indicators for general planning in addition to those listed in other chapters.

Economy

- City's unemployment rate (core indicator)

- Assessed value of commercial and industrial properties as a percentage of total assessed value of all properties (supporting indicator)
- Percentage of persons in full-time employment (supporting indicator)
- Youth unemployment rate (supporting indicator)
- Number of businesses per 100 000 population (supporting indicator)
- Number of new patents per 100 000 population per year (supporting indicator)
- Annual number of visitor stays (overnight) per 100 000 population (supporting indicator)
- Commercial air connectivity (number of non-stop commercial air destinations) (supporting indicator)
- Percentage of city population living below the international poverty line (core indicator)
- Percentage of city population living below the national poverty line (supporting indicator)
- Gini coefficient of inequality (supporting indicator)

Education

- Percentage of female school-aged population enrolled in schools (core indicator)
- Percentage of students completing primary education: survival rate (core indicator)
- Percentage of students completing secondary education: survival rate (core indicator)
- Primary education student–teacher ratio (core indicator)
- Percentage of school-aged population enrolled in schools (supporting indicator)
- Number of higher education degrees per 100 000 population (supporting indicator)

Finance

- Debt service ratio (debt service expenditure as a percentage of a city's own-source revenue) (core indicator)
- Capital spending as a percentage of total expenditures (core indicator)
- Own-source revenue as a percentage of total revenues (supporting indicator)
- Tax collected as a percentage of tax billed (supporting indicator)

Governance

- Women as a percentage of total elected to city-level office (core indicator)
- Number of convictions for corruption and/or bribery by city officials per 100 000 population (supporting indicator)
- Number of registered voters as a percentage of the voting age population (supporting indicator)
- Voter participation in last municipal election (as a percentage of registered voters) (supporting indicator)

Health

- Average life expectancy (core indicator)
- Number of in-patient hospital beds per 100 000 population (core indicator)
- Number of physicians per 100 000 population (core indicator)
- Under age five mortality per 1 000 live births (core indicator)
- Number of nursing and midwifery personnel per 100 000 population (supporting indicator)
- Suicide rate per 100 000 population (supporting indicator)

Housing

- Jobs–housing ratio (supporting indicator)Percentage of city population living in inadequate housing (core indicator)
- Percentage of population living in affordable housing (core indicator)
- Number of homeless per 100 000 population (supporting indicator)
- Percentage of households that exist without registered legal titles (supporting indicator)

Safety

- Number of firefighters per 100,000 population (core indicator)
- Number of fire-related deaths per 100,000 population (core indicator)
- Number of natural-hazard-related deaths per 100,000 population (core indicator)
- Number of police officers per 100,000 population (core indicator)
- Number of homicides per 100,000 population (core indicator)

- Number of volunteer and part-time firefighters per 100,000 population (supporting indicator)
- Response time for emergency response services from initial call (supporting indicator)
- Crimes against property per 100,000 population (supporting indicator)
- Number of deaths caused by industrial accidents per 100 000 population (supporting indicator)
- Number of violent crimes against women per 100,000 population (supporting indicator)

Culture and Sports

- Number of cultural institutions and sporting facilities per 100,000 population (core indicator)
- Percentage of municipal budget allocated to cultural and sporting facilities (supporting indicator)
- Annual number of cultural events per 100,000 population (e.g., exhibitions, festivals, concerts) (supporting indicator)

Telecommunications

- Number of internet connections per 100,000 population (supporting indicator)
- Number of mobile phone connections per 100,000 population (supporting indicator)

C. Memorandum on Sustainability Frameworks and Example City Sustainability Plans

MEMORANDUM

TO: Green Worcester Working Group
FROM: Larissa Brown, Principal, Larissa Brown + Associates (LBA)
RE: Sustainability Frameworks and Example City Sustainability Plans

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The City of Worcester has engaged Larissa Brown + Associates (LBA) to assist in developing a Sustainability Strategic Plan (SSP) for the City. The project is led by the City's Energy and Asset Management Division (EAM) and advised by a Green Worcester Working Group (GWWG) made up of City staff, representatives of local organizations, and several interested individuals. The planning process also includes interviews, focus groups, and public meetings.

An early task in creation of the SSP is to identify a framework for the plan that includes a sustainability vision, the categories and topics to be addressed, and a set of sustainability goals for Worcester. The purpose of this memorandum is to inform the members of the GWWP about the state of practice in sustainability planning as shown in sustainability rating systems and recent examples of sustainability and climate change action plans from other municipalities. The GWWP meeting scheduled for July 31, 2019 will be conducted as a workshop for GWWP members to work together to identify preferred elements of a vision and the topic areas most suitable for the Worcester SSP. Documents discussed in this memo can be found in the following Google drive: https://drive.google.com/drive/folders/1CJ-7Hzm3zdABXa6O25fGQX5LlZLzgZx-?usp=sharing.

I. BACKGROUND

A. Sustainability Planning and Activities in Worcester

Worcester has a Climate Action Plan (CAP) completed in 2006, which included a community and municipal greenhouse gas (GHG) inventory, emissions reduction targets, and a set of actions to achieve the targets. Following some of the recommendations of the CAP, the City created the EAM, and has focused the majority of its sustainability efforts on increasing the energy efficiency of City buildings and increasing the amount of energy provided by renewable energy, including installation of the largest municipally-owned solar array in New England. This focus on an energy-efficiency program, encompassing city-owned buildings, street lights, renewable energy installations, and installation of LED lighting in municipal parking, parks, and streetlights has resulted in estimated life-cycle savings of $164 million (two dollars in savings for every dollar of investment) as well as a reduction of municipal electrical use and associated GHG emissions.

The City met its targets for reduced GHG emissions (11% below 2002 levels by 2010) and increased use of renewable electricity for municipal operations (20% by 2010). In addition, the City was one of the first communities to qualify as a Green Community under the state's Green Communities Act, enacted in 2008, and has benefited from state funding for energy efficiency projects. With its very large inventory of municipal facilities, the City fell somewhat short of the state's Green Community target of reducing emissions from municipal operations by 20% by 2015 but, given the context, still performed quite well. In addition to recommendations on reducing GHG emissions from buildings, the 2006 CAP included related recommendations in categories such as transportation, recycling, open space and trees, community outreach and so on, some of which have been less consistently implemented.

A partial update of the CAP, including an updated GHG inventory, was prepared in 2013 to guide the City's sustainability work for the next five years in seven topic areas:

- Building Energy
- Municipal Operations
- Waste
- Transportation
- Consumption
- Green Infrastructure
- Community

In addition to new goals, targets, and action items to build on the City's energy efficiency and renewable energy initiatives focused on buildings, the draft CAP update included a significant expansion of goals and actions to reduce GHG emissions from transportation, waste management, food consumption, and materials management. Moreover, the update added more discussion of potential climate change impacts, including goals and actions to provide the sustainability benefits of open space, green infrastructure, and street tree planting. The draft plan also touched on the need to include social equity considerations "for true sustainability in the city," by connecting other agencies and community organizations to the climate action and sustainability agenda.

The much-commented "Worcester renaissance" after a long transition from traditional industry now offers the prospect of enhanced private and public investment in the City. Moreover, like many older cities, basic infrastructure is at the end of its design life and must be upgraded to meet 21st century standards, requiring costly investments. This is the moment to invest in future-oriented state of the art systems. As cities around New England and the country plan for sustainability, climate change adaptation, and resilience, and take steps to implement their plans, they are not only improving quality of life for their residents, they are increasing their economic competitiveness and long-term prosperity and success.

The present planning process is intended to update and broaden the CAP to provide Worcester with an integrated sustainability vision, a set of goals and measurable targets, strategies to achieve the vision and goals, action items for the short, medium, and long term, and a governance system for implementation, including collaboration with non-municipal entities. Related municipal plans are also under development. A Municipal Vulnerability Preparedness (MVP) priority plan, including a vulnerability assessment of five sites, will be completed in summer 2019 and the results of that process will be integrated into the SSP. Designation of Worcester as an MVP community by the state will make it eligible for state funding for climate resilience projects. The City is working on an Integrated Water Management Plan related to EPA-mandated stormwater and water system permits which is expected to be in draft form by Fall 2019. An update to the City's 2013 Open Space and Recreation Plan is also expected to be submitted for state approval in 2020 to meet requirements for eligibility for state funding. Finally, the City intends to develop the first new comprehensive plan in over thirty years, probably beginning in 2020 The SSP developed in the present project will influence and be incorporated into the comprehensive plan. In addition, the City is launching a neighborhood revitalization plan for the Green Island neighborhood associated with the construction of Polar Stadium and mixed-use development projects in the Canal Street area. This area of focused investment and revitalization may offer opportunities in the near term to pilot and demonstrate Worcester's commitment to sustainability.

B. The Constituency for Sustainability in Worcester

Building and strengthening the constituency for sustainability is important to the success of the SSP. A telephone survey was administered in late June and early July 2019 to 606 Worcester adult residents to gauge attitudes towards sustainability and climate change topics and knowledge of Worcester sustainability-related projects. The survey respondent group was weighted to be representative of the Worcester population—for example, with 18% of respondents identifying as Hispanic.

One of the first questions in the survey asked respondents what comes to mind when they hear the terms "sustainable" or "green" city. About a third could not come up with anything at all. However, by the end of the survey, after being asked about their reaction to potential policies and actions, respondents were overwhelmingly positive about becoming a sustainable city. When asked "How important is it to you that Worcester become a city that is "green" and "sustainable?", 64% answered "Very important" and 25% answered "Somewhat important." That means that nearly ninety percent of respondents think that sustainability is important to Worcester's future. When presented with a list of potential future sustainability goals and asked whether they should be major, minor, or not a priority, the item "Attracting and creating new jobs in sustainability-related industries," received the highest level of support, identified by 78% of the respondents as a major priority. While a majority of respondents overall were positive about Worcester becoming more sustainable, respondents who identified as people of color and lower income were more supportive of Worcester becoming a more sustainable city than whites. At the same time, when asked how much they know about sustainability initiatives already underway in Worcester, most respondents did not know much about what the City and other groups are doing. An important aspect of this project is to help expand and deepen the constituency for sustainability actions through defining a vision for sustainability and marketing existing sustainability accomplishments and initiatives.

C. Creating a Framework for Green Worcester

The first task is to develop an overall framework for the plan—one that is ambitious and visionary, grounded in the reality of Worcester conditions while creating opportunities to take advantage of funding and other assistance to move more rapidly towards incorporating sustainability and climate change resilience into Worcester's renaissance, its everyday operations, and its identity.

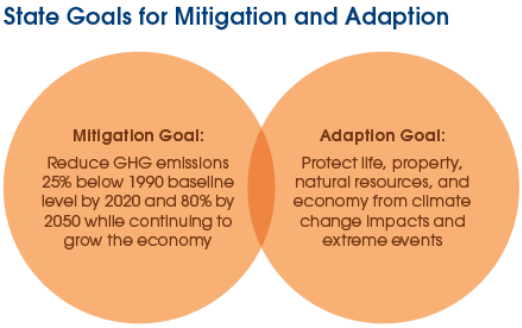
II. HOW SHOULD WE DEFINE SUSTAINABILITY?

A. Defining Sustainability and Resilience

The simplest definition of sustainability—which has survived the test of time--is a set of policies and practices that results in meeting the needs of present generations without compromising the ability of future generations to meet their own needs. It includes promoting healthy environmental systems and habitats and supporting conditions for continued ecosystem services. Ecosystem services are the benefits to humans provided by a healthy ecosystem, for example, food and water, flood and disease control, and nutrient cycling. Climate change affects many aspects of sustainability and is now generally included in sustainability planning, although climate change action plans (like Worcester's) are sometimes created separately and may include broader sustainability elements. "Resilience" is the term often used in discussing climate change actions. Climate change resilience is the ability of a community to adapt and thrive in the face of extreme events and stresses. Resilient communities anticipate risks, plan to limit their impacts and adopt strategies that integrate all community systems – civic, environmental, social and economic – to support recovery and growth. The concepts of sustainability

and climate change resilience are increasingly used as if they are interchangeable.The SSP will seek to use definitions of sustainability and resilience that are short, easily understood, imageable (with graphics) and reflective of the vision and themes of the plan.

In the coming decades, Massachusetts is expected to experience significant increases in temperature, both in summer and winter; increased annual average precipitation, though with important seasonal differences, such as more frequent and damaging ice storms and floods; earlier peak spring streamflow; more frequent droughts; changes in forest composition; changes in insect populations; and a longer growing season.[1] Worcest can benefit from state assistance in climate change mitigation, (the legislature passed a $1.3 billion bond on July 25, 2019 for city and town climate change projects), but the city will also find that the state raises expectations with new sustainability and climate change standards.



B. Themes and Topics for the Worcester Sustainability Plan

While all sustainability plans include a core set of categories—typically energy, waste, transportation, water, natural resources, and climate change—today they often also include attention to an array of quality of life and equity issues such as health, food systems, the economy, culture, and civic participation.

III. BEST PRACTICES FRAMEWORKS AND SYSTEMS

Sustainability rating systems for buildings emerged in the 1990s. In the last decade, several sustainability rating systems at the community scale have been developed. Examination of these rating systems indicates the range of attributes and characteristics that communities now use in sustainability and climate change planning, in identifying targets and goals, and in measuring progress.

A. STAR Communities Rating System www.starcommunities.org

STAR COMMUNITIES
SUSTAINABILITY TOOLS FOR ASSESSING & RATING COMMUNITIES

First released in 2012, the STAR Community Rating System (STAR) was developed by and for local governments to serve as a sustainability evaluation system, encompassing economic, environmental,

[1] For details see MAPC, Metro Boston Regional Climate Change Adaptation Strategy Report, 2014, (http://www.mapc.org/sites/default/files/RCCAS_full_report_rev_8-28-14.pdf)

and social performance measures. Organized as a menu of goals, objectives and evaluation measures, the STAR system allows communities to define and customize a data-driven approach to sustainability. Massachusetts communities that have used the STAR system and become certified include Devens, Cambridge, and Northampton.

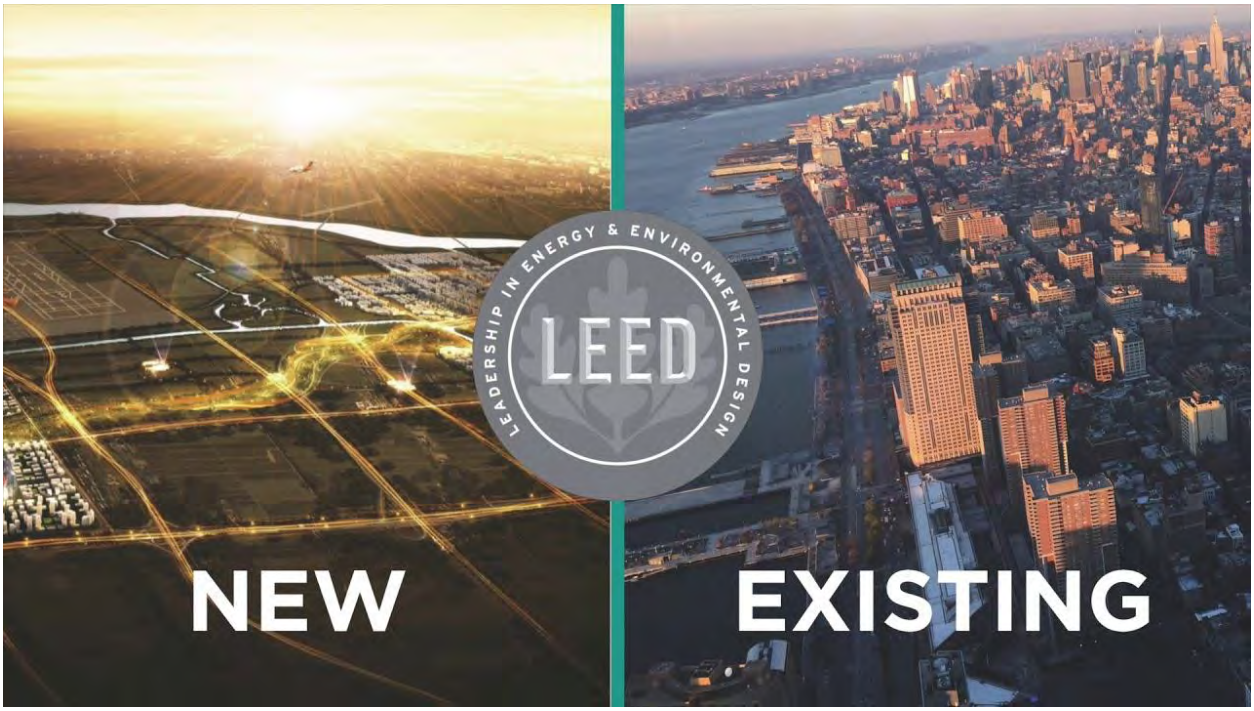
There are seven sustainability themes and an additional category called "Innovation and Process" to promote and recognize exemplary processes and innovation. These theme areas cover a broad array of topics and together constitute a comprehensive range of issues that would typically be found in a community master plan or comprehensive plan. The themes are:

- Built Environment: Quality, choice, and access where we live, work and play
- Climate and Energy: Increase efficiency, reduce impact
- Economy and Jobs: Quality jobs, shared prosperity
- Education, Arts and Community: Vibrant, connected and diverse culture
- Equity and Empowerment: Inclusion and access for all community members
- Health and Safety: Strong, resilient, and safe
- Natural systems: Protect and restore the resources of life

Built Environment	Climate & Energy	Economy & Jobs	Education, Arts & Community	Equity & Empowerment	Health & Safety	Natural Systems
Ambient Noise & Light	Climate Adaptation	Business Retention & Development	Arts & Culture	Civic Engagement	Active Living	Green Infrastructure
Community Water Systems	Greenhouse Gas Mitigation	Green Market Development	Community Cohesion	Civil & Human Rights	Community Health & Health System	Invasive Species
Compact & Complete Communities	Greening the Energy Supply	Local Economy	Educational Opportunity & Attainment	Environmental Justice	Emergency Prevention & Response	Natural Resource Protection
Housing Affordability	Industrial Sector Resource Efficiency	Quality Jobs & Living Wages	Historic Preservation	Equitable Services & Access	Food Access & Nutrition	Outdoor Air Quality
Infill & Redevelopment	Resource Efficient Buildings	Targeted Industry Development	Social & Cultural Diversity	Human Services	Indoor Air Quality	Water in the Environment
Public Spaces	Resource Efficient Public Infrastructure	Workforce Readiness		Poverty Prevention & Alleviation	Natural & Human Hazards	Working Lands
Transportation Choices	Waste Minimization				Safe Communities	

STAR Merges with LEED. In 2017 STAR Communities merged with the U.S. Green Building Council (USGBC), the home of the LEED (Leadership in Energy and Environmental Design) certification system, and no longer exists as a stand-alone certification system. In 2019, a new rating and certification system, drawing on STAR, LEED, and other rating systems, such as the SITES system for sustainable landscapes was released: LEED 4.1 for Cities and Communities.

B. LEED 4.1 for Existing Cities and Communities https://new.usgbc.org/leed-v41#cities-and-communities



The nonprofit U.S. Green Building Council (USGBC) began by developing environmental standards for buildings in the 1990s and is the most well-known certification system for "green building"—Leadership in Energy and Environmental Design (LEED). Criticized for its focus on new individual buildings that neglected the environmental impacts of locations that might result in higher transportation emissions, the USGBC has begun to address this issue in LEED 4.1, the most recent set of LEED evaluation systems. As noted above, LEED 4.1 for Existing Cities and Communities, incorporates many aspects of STAR and other systems. The LEED system is organized to offer certification and professional credentials for an (expensive) fee, but the basic categories and system are available for free.

This system has eight categories plus Integrated Planning and Leadership, Green Building Policy and Incentives, Innovation, and Regional. Five of the LEED categories focus on core sustainability topics: Natural Systems and Ecology; Transportation and Land Use; Water Efficiency; Energy and Greenhouse Gas Emissions; and Materials and Resources. A sixth category, called Quality of Life covers a broader set of topics relevant to social, economic, and civic sustainability and resilience. The Innovation category offers credits for new approaches to sustainability and resilience, and the Regional category gives credit for attention to regionally specific issues, such as the differences between arid and wet environments. The thematic topics and credit areas are:

Natural systems and ecology

- Ecosystem Assessment
- Green Spaces
- Natural Resources Conservation and Restoration
- Light Pollution Reduction
- Resilience Planning

Transportation and land use

- Transportation Performance
- Compact, Mixed Use and Transit Oriented Development
- Transportation Choices
- Alternative Fuel Vehicles
- Smart Mobility
- Historic Preservation and Preferred Locations

Water efficiency

- Water Access and Quality
- Water Performance
- Stormwater Management
- Smart Water Systems

Energy and greenhouse gas emissions

- Power Access, Reliability and Resiliency
- Energy Performance
- Energy Efficiency
- Distributed Energy Resources
- Clean and Green Power
- Smart Energy Systems

Materials and resources

- Solid Waste Management
- Waste Performance
- Responsible Sourcing for Infrastructure
- Extended Producer Responsibility
- Smart Waste Management Systems

Quality of life

- Quality of Life Performance
- Equitable Development
- Public Health
- Poverty Alleviation
- Environmental Justice
- Affordable Housing
- Civic and Community Engagement
- Emergency Management and Response
- Civil and Human Rights

Innovation

- Innovation

Regional priority

- Regional Priority

C. Envision™ Sustainable Infrastructure Framework

https://sustainableinfrastructure.org/

Envision is a holistic sustainability rating system and planning guide for civil infrastructure to help communities achieve higher performance infrastructure projects and systems. Created and managed by the Institute for Sustainable Infrastructure (ISI), founded by the American Public Works Association (APWA), the American Society of Civil Engineers (ASCE), and the American Council of Engineering Companies (ACEC), Envision was developed in collaboration with Harvard University's Zofnass Program for Sustainable Infrastructure and Graduate School of Design. Use of the rating system as a self-assessment tool is free, but like LEED, the system offers third-party certification for a fee and a credentialing process for professionals. Many public agencies of all sizes use Envision including the Massachusetts Water Resources Authority (which supplies water to Worcester on an emergency basis only); multiple departments in large cities such as Los Angeles, Austin, Montreal, and New York; public works departments in smaller towns and cities like Wellesley MA, Norwalk CT, and Cedar Rapids IA; and multi-jurisdiction agencies like the U.S Army Corps of Engineers.

The Envision v. 3 Guidance Manual describes the system as follows:

> "Community infrastructure development is subject to the resource constraints of multiple departments and agencies, each with different schedules, agendas, mandates, budget cycles, and funding sources. Ratings systems and tools intended for buildings are not designed for this context and cannot adequately assess the extensive external benefits and impacts infrastructure has on a community. Envision assesses not only individual project performance, but how well the infrastructure project contributes to the

Energy	Water	Waste	Transportation	Landscape	Information
Distribution	Treatment	Solid waste	Airports	Public Realm	Telecom
Hydroelectric	Distribution	Recycling	Roads / Highways	Parks	Cables
Coal	Capture / Storage	Hazardous	Bikes / Pedestrians	Ecosystem Services	Internet
Natural Gas	Stormwater	Waste	Railways	Natural Infrastructure	Phones
Wind	Flood Control	Collection & Transfer	Transit	Environmental Remediation	Data Centers
Solar	Nutrient Management		Ports		Sensors
Biomass			Waterways		

efficiency and long-term sustainability of the communities it serves. In this way, Envision not only asks, "Are we doing the project right?" but also, "Are we doing the right project?"

Envision is organized around five categories, 14 subcategories, and 64 indicators.

- **Quality of Life**: Wellbeing, Mobility, Community.
  - Alignment with community goals
  - Incorporation into existing community networks
  - Long term benefit to the community
  - Community engagement in the decision-making process
- **Leadership**: Collaboration, Planning, Economy.
  - Communication and collaboration from the beginning within project teams
  - Involvement of a wide variety of people in creating ideas for the project
  - Understanding of the long-term, holistic view of the project and its life cycle.
- **Resource Allocation**: Materials, Energy, Water.
  - Resources are the assets that are needed to build infrastructure and keep it running.
  - Broadly concern about with the quantity, source, and characteristics of these resources and their impacts on the overall sustainability of the project.
  - Resources addressed include physical materials (both those that are consumed and that leave the project), energy, and water use. These resources are finite and should be treated as an asset to use respectfully.
- **Natural World**: Siting, Conservation, Ecology.
  - Infrastructure projects have an impact on the natural world around them, including habitats, species, and nonliving natural systems.
  - The natural systems around us perform critical functions called ecosystem services that provide us with clean air, clean water, healthy food, and hazard mitigation.
  - The way a project is located within these systems and the new elements they may introduce to a system can create unwanted impacts on these ecosystem services.
  - This section addresses how to understand and minimize negative impacts while considering ways in which the infrastructure can interact with natural systems in a synergistic, positive way.
- **Climate and Resilience**: Emissions, Resilience.
  - Minimize emissions that may contribute to climate change and other short- and long-term risks
  - Ensure that infrastructure projects are resilient: informed, resourceful, robust, redundant, flexible, integrated, and inclusive.

Quality Of Life
14 Credits

WELLBEING
QL1.1 Improve Community Quality of Life
QL1.2 Enhance Public Health & Safety
QL1.3 Improve Construction Safety (N)
QL1.4 Minimize Noise & Vibration
QL1.5 Minimize Light Pollution
QL1.6 Minimize Construction Impacts (N)

MOBILITY
QL2.1 Improve Community Mobility & Access
QL2.2 Encourage Sustainable Transportation
QL2.3 Improve Access & Wayfinding

COMMUNITY
QL3.1 Advance Equity & Social Justice (N)
QL3.2 Preserve Historic & Cultural Resources
QL3.3 Enhance Views & Local Character
QL3.4 Enhance Public Space & Amenities

QL0.0 Innovate or Exceed Credit Requirements

Leadership
12 Credits

COLLABORATION
LD1.1 Provide Effective Leadership & Commitment
LD1.2 Foster Collaboration & Teamwork
LD1.3 Provide for Stakeholder Involvement
LD1.4 Pursue Byproduct Synergies

PLANNING
LD2.1 Establish a Sustainability Management Plan
LD2.2 Plan for Sustainable Communities (N)
LD2.3 Plan for Long-Term Monitoring & Maintenance
LD2.4 Plan for End-of-Life

ECONOMY
LD3.1 Stimulate Economic Prosperity & Development
LD3.2 Develop Local Skills & Capabilities
LD3.3 Conduct a Life-Cycle Economic Evaluation (N)

LD0.0 Innovate or Exceed Credit Requirements

Resource Allocation
14 Credits

MATERIALS
RA1.1 Support Sustainable Procurement Practices
RA1.2 Use Recycled Materials
RA1.3 Reduce Operational Waste
RA1.4 Reduce Construction Waste (N)
RA1.5 Balance Earthwork On Site

ENERGY
RA2.1 Reduce Operational Energy Consumption
RA2.2 Reduce Construction Energy Consumption (N)
RA2.3 Use Renewable Energy
RA2.4 Commission & Monitor Energy Systems

WATER
RA3.1 Preserve Water Resources
RA3.2 Reduce Operational Water Consumption
RA3.3 Reduce Construction Water Consumption (N)
RA3.4 Monitor Water Systems

RA0.0 Innovate or Exceed Credit Requirements

Natural World
14 Credits

SITING
NW1.1 Preserve Sites of High Ecological Value
NW1.2 Provide Wetland & Surface Water Buffers
NW1.3 Preserve Prime Farmland
NW1.4 Preserve Undeveloped Land

CONSERVATION
NW2.1 Reclaim Brownfields (N)
NW2.2 Manage Stormwater
NW2.3 Reduce Pesticide & Fertilizer Impacts
NW2.4 Protect Surface & Groundwater Quality

ECOLOGY
NW3.1 Enhance Functional Habitats
NW3.2 Enhance Wetland & Surface Water Functions
NW3.3 Maintain Floodplain Functions
NW3.4 Control Invasive Species
NW3.5 Protect Soil Health

NW0.0 Innovate or Exceed Credit Requirements

Climate and Resilience
10 Credits

EMISSIONS
CR1.1 Reduce Net Embodied Carbon
CR1.2 Reduce Greenhouse Gas Emissions
CR1.3 Reduce Air Pollutant Emissions

RESILIENCE
CR2.1 Avoid Unsuitable Development
CR2.2 Assess Climate Change Vulnerability
CR2.3 Evaluate Risk & Resilience (N)
CR2.4 Establish Resilience Goals and Strategies (N)
CR2.5 Maximize Resilience
CR2.6 Improve Infrastructure Integration

CR0.0 Innovate or Exceed Credit Requirements

Rewritten
(N) New

D. American Planning Association – Sustainable Places

The American Planning Association (APA) recently published a guide to comprehensive planning, "Sustainable Places: Best Practices for Comprehensive Plans," structured by six principles that include sustainability-related goals:

- **Livable Built Environment**: Ensure that all elements of the built environment, including land use, transportation, housing, energy, and infrastructure, work together to provide sustainable, green places for living, working, and recreation, with a high quality of life
- **Harmony with Nature**: Ensure that the contributions of natural resources to human well-being are explicitly recognized and valued and that maintaining their health is a primary objective.
- **Resilient Economy**: Ensure that the community is prepared to deal with both positive and negative changes in its economic health and to initiate sustainable urban development and redevelopment strategies that foster green business growth and build reliance on local assets.
- **Interwoven Equity:** Ensure fairness and equity in providing for the housing, services, health, safety, and livelihood needs of all citizens and groups.
- **Healthy Community**: Ensure that public health needs are recognized and addressed through provisions for healthy foods, physical activity, access to recreation, health care, environmental justice, and safe neighborhoods.
- **Responsible Regionalism**: Ensure that all local proposals account for, connect with, and support the plans of adjacent jurisdictions and the surrounding region.[2]

IV. EQUITY AND ENVIRONMENTAL JUSTICE IN SUSTAINABILITY PLANNING

The concept of environmental justice emerged in the 1980s when low-income and communities of color began to fight the location of toxic waste sites in their communities. Analysis showed that race was the most important factor influencing the siting of toxic waste facilities, and it continues to be the case that environmental hazards and pollution are disproportionately found in these communities. In addition, these communities are more vulnerable to adverse impacts for a variety of reasons such as larger populations of children and elderly people who are more sensitive to health impacts; location in flood plains, industrial zones, and adjacent to

> In the Envision rating system, one of the indicators in the Quality of Life category is "Advance Equity and Social Justice," with a good description of its importance: "'Equity and social justice' refer to the responsibility of a society to ensure that civil and human rights are preserved and protected for each individual, and that all persons are treated equally and without prejudice regardless of race, color, wealth, religion (creed), gender, gender expression, age, national origin (ancestry), disability, marital status, sexual orientation, or military status. This includes "environmental justice," which refers to the fair treatment and meaningful engagement of all people with regard to environmental protection….Equitable and just systems of infrastructure development are opportunities to strengthen social cohesion, raise awareness, and further develop the social support systems that increase resilience." (Envision v. 3 Guidance Manual, p. 48)

[2] David Godschalk and David Rouse, *Sustaining Places: Best Practices for Comprehensive Plans*, PAS Report 578, Chicago: American Planning Association, 2015.

highways, where land values are lower; historic patterns of residential segregation; and people have fewer resources to withstand or recover from environmental stresses.[3]

In 1994, Executive Order 12898 ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations") incorporated environmental justice into requirements for federally funded projects. The Environmental Protection Agency (EPA) defines environmental justice as:

> "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.
>
> - Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies.
> - Meaningful involvement means: People have an opportunity to participate in decisions about activities that may affect their environment and/or health. The public's contribution can influence the regulatory agency's decision. Community concerns will be considered in the decision-making process, and decision makers will seek out and facilitate the involvement of those potentially affected."[4]

The EPA has developed EJScreen, a mapping tool that displays environmental and demographic indicators and combines it into a set of 11 EJ indexes to identify geographic areas with environmental justice concerns.[5] A social vulnerability index (SoVI) was developed by the Hazards & Vulnerability Research Institute at the University of South Carolina.[6]

A. Just Transition and Climate Justice[7]

"Just Transition" is a conceptual framework first developed by the trade union movement in relation to creating protections and opportunities for workers affected by a societal shift to a low-carbon and climate resilient economy. The concept has broadened to become more proactive by adding a vision of healthy, thriving, and connected local economies that will meet the needs of workers and communities in the transition to achieving the vision of sustainability. "Climate Justice" is a term used to focus on incorporation of economic and social justice as a foundation of climate change adaptation. Activists organize the "frontline communities" (low-income and communities of color particularly vulnerable to adverse impacts) around environmental justice issues "at the intersection of race, poverty and pollution" with a focus on ensuring that a transition to clean energy also includes cleaning up pollution and providing green jobs.

A. The Equitable and Just National Climate Platform www.ajustclimate.org

On July 18, 2019, a large coalition of environmental and environmental justice organizations issued the Equitable and Just National Climate Platform.[8] The platform lays out an agenda and vision for the future:

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[3] Tishman Environment and Design Center, "Local Policies for Environmental Justice: A National Scan," (New York: New School, February 2019) p. 8; https://tishmancenter.org/local-land-use-policies-for-environmental-justice-in-collaboration-with-nrdc/

[4] https://www.epa.gov/environmentaljustice/learn-about-environmental-justice

[5] https://www.epa.gov/ejscreen/what-ejscreen

[6] /artsandsciences.sc.edu/geog/hvri/hvri-resources

[7] This discussion draws on "'Just Transition'—Just what Is it? An analysis of Language, Strategies, and Projects," Labor Network for Sustainability and Strategic Practice Grassroots Policy Project, https://www.labor4sustainability.org/uncategorized/just-transition-just-what-is-it/

[8] https://ajustclimate.org/#platform

- No community left behind
- A healthy climate and air quality
- Reduction in cumulative impacts
- An inclusive, just, and pollution-free energy economy
- Access to affordable energy
- A healthy transportation and goods movement system
- Safe, healthy communities and infrastructure
- Economic diversity and community wealth building
- Anti-displacement, relocation, and the right to return
- Water access and affordability
- Self-determination, land access, and redevelopment
- Funding and research
- U.S. responsibility for climate action and international cooperation

B. NAACP Environmental & Climate Justice Program (ECJP)

The ECJP published a toolkit for local communities to organize and participate in climate change planning: *Our Communities, Our Power: Advancing Resistance and Resilience in Climate Change Adaptation Action Toolkit* (Baltimore: NAACP, 2019).[9] The toolkit provides a detailed roadmap, from creating a committee and running a meeting, building a constituency, communications, and legislative advocacy to policy making in 13 topic areas:

- Democracy and governance
- Economic justice
- Energy systems
- Emergency management
- Food systems
- Gender and LGBTQ responsive climate resilience
- Housing
- Land use planning and management
- Restorative criminal justice
- Sea level rise and coastal resilience
- Transportation systems
- Waste management
- Water resource management

C. Using the Equity Lens in Providence, Boston, and Cleveland

1. Just Providence

After adopting a sustainability plan in 2014, Providence developed a separate but linked equity lens project and framework: "Equity in Sustainability: A collaborative initiative by the City of Providence and frontline communities of color of Providence to bring a racial equity lens to the City's sustainability agenda." The year-long planning process (2016-2017) was a joint initiative of the Environmental Justice League of Rhode Island, Groundwork Rhode Island, and the City of Providence Office of Sustainability and supported by a $100,000 grant from the Rhode Island Foundation and Partners for Places. The process was undertaken by a newly established Racial and Environmental Justice Committee made up of

[9] https://live-naacp-site.pantheonsite.io/wp-content/uploads/2019/04/Our-Communities-Our-Power-TOOLKIT-FINAL.pdf

representatives of communities of color. The plan's recommendations were adopted by the City's Office of Sustainability in 2017. The process included racial equity trainings and developed 12 priority areas:

- Clean streets
- Industrial hazards
- Youth programs
- Diverse, local jobs
- Affordable housing and gentrification
- Race and representation
- Government accountability and service
- Policing practices
- Community safety
- Expanded public transit
- Mental health resources
- Education

This plan was influenced by the Just Transition model of equity in sustainability transitions and adopted a set of principles and values based on the Just Transition model. "A racially equitable and just Providence…"

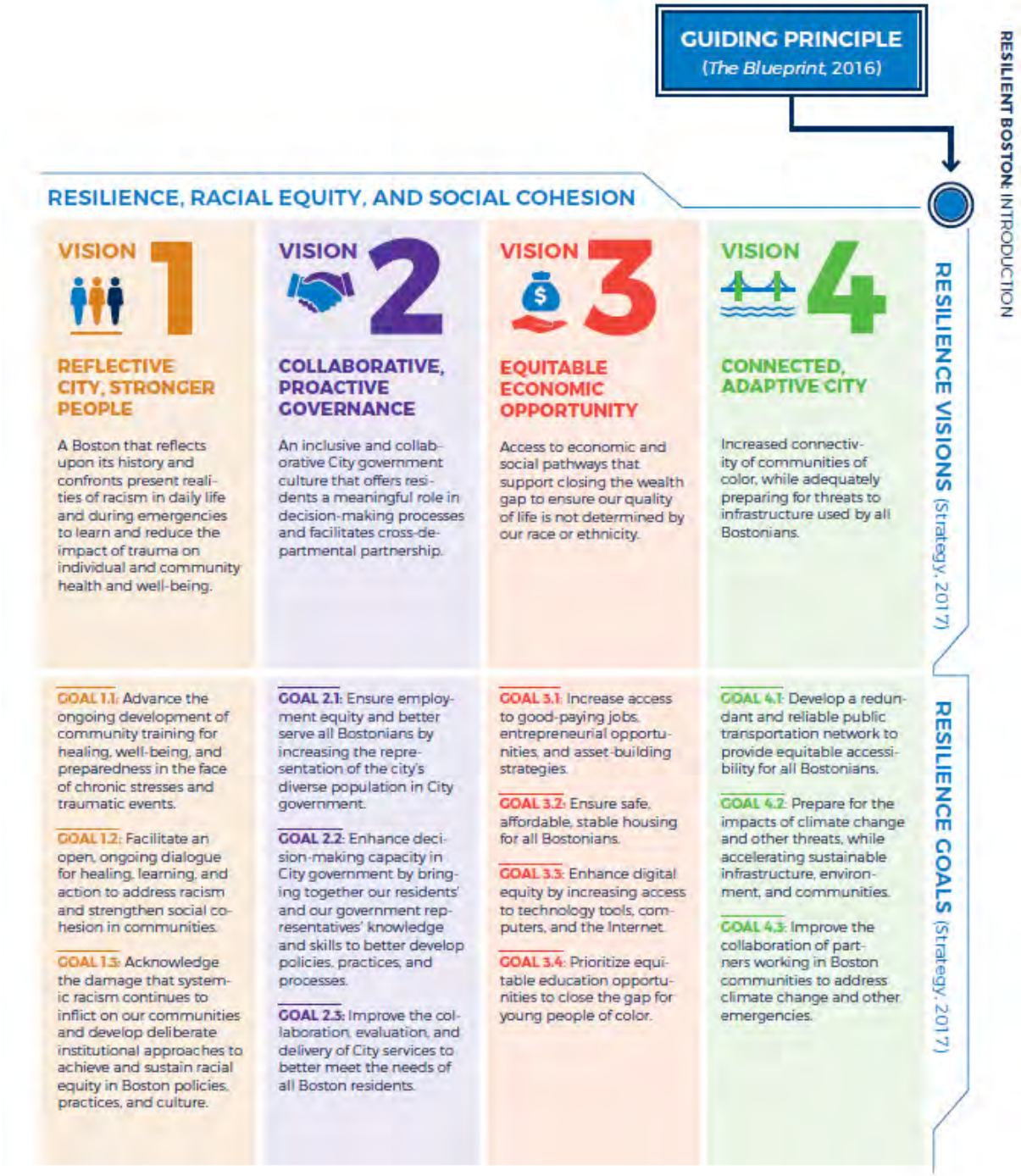
- …moves us toward el Buen Vivir ["living well without living better at the expense of others"]
- …support safe spaces for frontline communities of color
- …knows people are sacred and respects their cultures and traditions
- …upholds self-determination.
- …co-creates and co-leads governance…to ensure equitable access to resources, information and power.
- …values education for our children and youth…as a fundamental right.
- …practices local, regional, national and international solidarity
- …must create meaningful work
- …requires building a sustainable economy now [move towards zero waste, clean and efficient public transport, clean community energy, regional food and water systems, efficient/affordable/durable housing, ecosystem restoration and stewardship]
- ...respects community rights to land, water, and food sovereignty
- …works to end the extractive economy

Providence is currently developing a Climate Justice Plan with the Racial and Environmental Justice Committee that will be guided by the Just Providence framework. [10]

2. Resilient Boston

Boston's resilience plan, supported by the Rockefeller Foundation-funded 100 Resilient Cities program is a companion plan to the city's climate change plan, "Climate-Ready Boston." It focuses on equity issues within the context of resilience, such as economic inequality, climate change and environmental stresses, community trauma, health inequities, aging and inequitable transportation infrastructure, and systemic racism. The plan has four visions: 1) Reflective City, Stronger People; 2) Collaborative, Proactive Governance; 3) Equitable Economic Opportunity; and 4) Connected, Adaptive City. [11]

[10] http://www.providenceri.gov/sustainability/climate-justice-action-plan-providence/
[11] www.boston.gov/sites/default/files/document-file-07-2017/resilient_boston.pdf



3. Cleveland Racial Justice Toolkit

The neighborhood crowd-funding organization ioby (In Our Backyards, Inc.), worked closely with residents and the City on incorporating equity into Cleveland's sustainability and climate action planning. They created a Racial Justice Toolkit (www.ioby.org/justice), which includes videos, examples from other communities, and a publication: "A Racial Justice Guide: Lessons from Cleveland leaders who are breaking barriers, building bridges, and healing communities." The guide describes four models

of localized racial justice projects led by citizens that were supported by fundraising on the ioby neighborhood crowd funding platform:

- Model 1: Make Art Talk Race
  Creation of a mural in a location that separates downtown from a neighborhood that is predominantly African-American and includes dense public housing
- Model 2: Design for Justice
  A one-day charrette-style "Design as Protest" event organized by an architect to identify ways to improve the built environment for local communities, including identifying priority projects.
- Model 3: A Space for Healing
  Renovation of a vacant neighborhood property for local center for holistic health treatments, artist in residence, and community learning space.
- Model 4: Community Media Project
  A five part documentary series on race, racism and multiculturalism.

Other projects mentioned in the publication include community gardens and farms, a youth-led food justice coalition, advocacy group for a bike and pedestrian path, cooperatively-owned solar streetlights in a disinvested neighborhood.

V. TRIPLE BOTTOM LINE COST-BENEFIT ANALYSIS AND SUSTAINABILITY

Sustainable practices and projects are sometimes assumed to be more expensive than traditional, status quo approaches, often because traditional economic models do not capture the full value of the benefits of sustainable growth. These can include "transformative technological advances, preservation of essential natural capital, and the full health benefits of cleaner air and a safer climate, including the containment of pandemic diseases."[12] The 2018 report, *The New Climate Economy*, which has a global focus, has five thematic categories: energy, cities (focused on systems that support livable density), food and land use, water, and industry. In communities like Worcester, much of the infrastructure is nearing (or already beyond) its life span. New investment is renewing buildings, downtown, and neighborhoods in the city. The planning and design for retrofits and new growth is happening now. "We are on the cusp of a new economic era: one where growth is driven by the interaction between rapid technological innovation, sustainable infrastructure investment, and increased resource productivity. This is the only growth story of the 21st century. It will result in efficient, livable cities; low-carbon, smart and resilient infrastructure; and the restoration of degraded lands while protecting valuable forests. We can have growth that is strong, sustainable, balanced, and inclusive."[13]

Triple bottom line cost-benefit analysis (TBL-CBA), incorporating life-cycle cost analysis (LCCA) has been developed to capture the full benefits of sustainable projects and investments.

- "Triple bottom line" is a shorthand phrase for measuring performance across three domains: profit, people and planet.
- "Cost-benefit analysis" is a systematic way of evaluating and comparing potential decisions, policies, or projects to compare benefits with savings.

[12] Global Commission on the Economy and Climate, *2018 New Climate Economy Report*, p. 8,
[13] Ibid.

- "Life-cycle cost analysis" is used to evaluate the most cost-effective alternative that includes costs of all up-front and future investment, operations, maintenance, rehabilitation and replacement, and the residual value of assets at the end of the life cycle.

This type of analysis provides financial results and monetary values for social and environmental impacts that traditionally have been seen as externalities or qualitative benefits, such as improved water quality and restored habitat. A key consideration in TBL-CBA is which factors will be included in the analysis.

TBL-CBA is increasingly used by both the public and private sector, including for federally funded transportation and Army Corps of Engineers projects, state building projects, and municipal building and utility agencies. The LEED and Envision rating systems endorse use of TBL-CBA.

VI. RECENT MUNICIPAL SUSTAINABILITY PLANS

A. BGreen 2020: A Sustainability Plan for Bridgeport, Connecticut (2012)

The BGreen plan was jointly sponsored by the City of Bridgeport and the Bridgeport Regional Business Council. The Executive Summary highlights the economic benefit of going green for Bridgeport, a city with an estimated 2019 population of 147,000 that is challenged by its industrial legacy, pollution from regional transportation and utility systems, high 23 percent poverty rate, and vulnerability to sea level rise. (Worcester's poverty rate in 2017 was estimated at 21.8 percent).

The sustainability plan is explicitly focused on green initiatives as an economic and environmental justice strategy: "Environmental action will provide the economic foundation to grow the city's jobs, tax base, and opportunity while lowering household bills for energy, water, and property taxes." (p. 3) A unique aspect of Bridgeport's sustainability plan is its early use of TBL within a municipal scale plan. Though not as rigorous as the TBL-CBA process discussed above, proposed strategies and initiatives were reviewed through a triple bottom line accounting framework "to assess their overall community impact." (p. 17)

Key strategies of the plan include:

- "An Energy Improvement District in Bridgeport will implement renewable electricity generation projects and develop programs to retrofit municipal buildings, businesses and homes, that reduce the city's greenhouse gas emissions from buildings, lower household and commercial utility bills, and shrink property tax bills by making city operations more energy efficient.
- A focus on transit and complete streets will lower greenhouse gas emissions from transportation and lower households' transportation costs by limiting the need for automobiles.
- A Green Collar Institute will consolidate resources to help businesses improve their bottom line through efficiency, help individuals develop the skills they need to find jobs in the new economy, assist the city in attracting and growing green businesses locally through a Green Business Incubator and a Green Business Cluster, and drive the creation of a green marketplace through purchasing policies.
- Zoning and Geographic Information Systems that encourage green redevelopment will reclaim the city's vacant and contaminated land for taxpaying buildings that will provide local jobs and affordable housing opportunities, and will shrink property tax bills by reducing the burden on existing households to support municipal services.
- Increased recycling and composting will significantly reduce the cost of disposal, create local jobs, save money in the city budget, thereby reducing taxes, and move us away from an industrial process that emphasizes disposable goods.

- A Conservation Commission will implement a parks plan that will bring open space, greenery, and the waterfront within reach of every city resident, and add neighborhood amenities like pocket parks, community gardens and other quality of life measures. And it will also champion the stormwater management issues that take into account the fragile nature of our community.
- A youth Conservation Corps, going door-to-door, will provide information to residents and businesses to help them save money, be stewards of the environment, and help improve the quality of life in our community." (p.14)

Thematic strategy categories

- Green Energy & Buildings
- Greenfields [vacant properties] & Green Wheels [transportation]
- Green Spaces
- Water Resources
- Municipal Solid Waste, Materials Use & Recycling
- Green Businesses, Jobs and Purchasing
- Green Marketing, Education and Outreach

B. The 2019 Baltimore Sustainability Plan

While Baltimore is larger than Worcester (estimated 2018 population of 602,495), it is a city still in transition from its industrial past, has a very diverse population, and a high 22% poverty rate. The city's development patterns include a dense urban core, areas of commercial and residential revitalization, and middle-class single-family neighborhoods similar to older suburban areas on the edges of the city.

The 2019 plan updates the 2009 Sustainability Plan and was developed by the City's Commission on Sustainability and Office of Sustainability. The update was developed over several years, with an extensive community engagement process including recruitment of citizen "Sustainability Ambassadors" who received equity training and conducted interviews with neighbors, friends, and family. Upon adoption, the plan became part of the City's comprehensive plan. The Commission's role is to oversee implementation of the plan through an annual review and report, an annual public open house, and a periodic update at least every three years on strategies, benchmarks, and metrics. In terms of process, the Commission states its commitments to transparency, collaboration, and accountability.

As a member of the USA Sustainable Cities Initiative (USA-SCI), Baltimore is one of three US cities to pilot implementation of United Nations Sustainable Development 2030 goals adopted by the UN in 2015. These goals, function as Baltimore's sustainability vision.

Like many recent plan updates, the 2019 plan explicitly incorporates an "equity lens," expanding on the original focus on core environmental issues to include the social and economic aspects of sustainability and racial equity. The Baltimore plan describes the use of an equity lens in the plan as a way to focus "on the experiences that have been historically harmful to some of our residents," that "broadens the scope of voices represented in the plan, inclusive not only of race but also gender, age, neighborhood, and employment status….The equity lens was used in framing issues and in crafting strategies, actions, and measures of success….Most importantly, it broadened the meaning of sustainability—for a vision that is meaningful for ALL residents in the city." (page 9

The plan framework is organized under five categories that originated in the STAR system (version 1). It also integrates related plans on open space, food, water and recovery, climate action, disaster preparedness, and urban agriculture.

C. L.A.'s Green New Deal Sustainable City pLAn 2019.

The tagline for the 2019 Los Angeles sustainability plan is: "Environment – Economy – Equity." This plan is the first four-year update of the 2015 Sustainable City pLAn. The four key principles of the plan are:

- "A commitment to the Paris Climate Agreement and to act urgently with a scientifically-driven strategy for achieving a zero carbon grid, zero carbon transportation, zero carbon buildings, zero waste, and zero wasted water.
- A responsibility to deliver environmental justice and equity through an inclusive economy, producing results at the community level, guided by communities themselves.
- A duty to ensure that every Angeleno has the ability to join the green economy, creating pipelines to good paying, green jobs and a just transition in a changing work environment.
- A resolve to demonstrate the art of the possible and lead the way, walking the walk and using the City's resources - our people and our budget - to drive change." (page 8)

The plan is intended to guide a "transition to an equitable and abundant economy powered by 100% renewable energy….[to support] the creation of hundreds of thousands of good, green jobs in all of our communities by:

- Building the country's largest, cleanest, and most reliable urban electrical grid to power the next generation of green transportation and clean buildings….
- Educating and training Angelenos to participate in the new green economy….
- Enacting sustainable policies that prioritize economic opportunity. We will mandate and incentivize the transition to a zero carbon city in a way that prioritizes the needs and opportunities of disadvantaged communities, ensuring that the new green economy fulfills the promise of a more just and equitable economy."

Topic areas:

- Environmental Justice
- Renewable Energy
- Local Water
- Clean & Healthy Buildings
- Housing & Development
- Mobility & Public Transit
- Zero Emission Vehicles
- Industrial Emissions & Air Quality Monitoring
- Waster & Resource Recovery
- Food Systems
- Urban Ecosystems & Resilience
- Prosperity & Green Jobs
- Lead by Example

Source: Baltimore 2019 Sustainability Plan, p.1.

What's New

- Globally-recognized adherence to a strict carbon budget that is consistent with the Paris Climate Agreement
- Adoption of a quantitative greenhouse gas (GHG) reduction pathway that charts a course to carbon neutrality
- Integration of equity initiatives across chapters, identified by the symbol E
- Third-party review of GHG reduction pathways and potential benefits of different initiatives to Angelenos
- Quantification of projected health outcomes from air quality improvements and job growth from investments resulting from pLAn commitments
- A Renewable Energy chapter to incorporate 2015 pLAn Local Solar and Climate Leadership commitments
- Expansion of Energy Efficient Buildings to Clean and Healthy Buildings capturing energy efficiency as well as new targets for net zero carbon buildings
- Deeper treatment of Air Quality via a new Industrial Emissions and Air Quality Monitoring chapter, as well as initiatives in Mobility & Public Transit and Zero Emission Vehicles
- First-ever commitments to address oil and gas operations in the city
- Dedicated Food Systems chapter incorporating community priorities
- Urban Ecosystems is expanded to Urban Ecosystems & Resilience to incorporate 2015 pLAn climate resilience goals on urban heat
- Inclusion and promotion of the leadership of our community partners in achieving our shared goals
- Incorporation of homelessness initiatives in recognition of link to sustainability
- Emphasis of link between L.A.'s sustainability targets and the United Nations Sustainable Development Goals

Accelerating our Targets

L.A.'s Green New Deal accelerates the following targets:

- Supply 55% renewable energy by 2025; 80% by 2036; and 100% by 2045
- Source 70% of our water locally by 2035, and capture 150,000 acre ft/yr (AFY) of stormwater by 2035
- Reduce building energy use per sq.ft. for all types of buildings 22% by 2025; 34% by 2035; and 44% by 2050
- Reduce Vehicle Miles Traveled per capita by at least 13% by 2025, 39% by 2035, and 45% by 2050
- Ensure 57% of new housing units are built within 1,500 feet of transit by 2025; and 75% by 2035
- Increase the percentage of zero emission vehicles in the city to 25% by 2025; 80% by 2035; and 100% by 2050
- Create 300,000 green jobs by 2035; and 400,000 by 2050
- Convert all city fleet vehicles to zero emission where technically feasible by 2028
- Reduce municipal GHG emissions 55% by 2025 and 65% by 2035 from 2008 baseline levels, reaching carbon neutral by 2045

D. Sustainable Providence (2014)

Providence, with a diverse population estimated at 179,219 is often viewed as a city comparable to Worcester. It is another former industrial city with a high 26.9% poverty rate, but it has a larger metropolitan area than Worcester. The city's Sustainable Providence Plan from 2014 is supported by a broader SustainPVD program and the separate sustainable equity framework, "Just Providence," adopted in 2017 and described earlier. The thematic focus areas of the plan are:

- Waste
- Food
- Transportation
- Water
- Energy
- Land Use and Development Plan

The City's Office of Sustainability includes a web portal with a dashboard showing progress toward plan goals, as well as additional pages focusing on energy initiatives, climate change, equity, and actions that individuals can take. (http://www.providenceri.gov/sustainability/)

Office of Sustainability

The Office of Sustainability works to provide a better quality of life for all residents while maintaining nature's ability to function over time by minimizing waste, preventing pollution, promoting efficiency and developing local resources to revitalize the local economy. This office is also tasked with reducing energy consumption in city-owned facilities, to cost-effectively lower utility operating costs, and to ensure occupant comfort and safety in city facilities.

Take Action | Sustainability Dashboard | Equity

RePowerPVD | Climate Justice PVD | Newsletter

E. Cleveland Climate Action Plan 2018 Update: Building Thriving and Resilient Neighborhoods for All

Cleveland, with an estimated 2018 population of 390,000, has a very high poverty rate of 34.5 percent, with almost half of its children living in poverty. Its 2018 Climate Action Plan updates a 2013 plan. Cleveland began a sustainability program in 2009 and in 2019 it is celebrating ten years of sustainability work and 50 years since the city's Cuyahoga River caught fire in 1969—an event that attracted national attention to the need to fight pollution. The Mayor's Office of Sustainability manages planning and implementation. Funders for the 2018 update included the Funders' Network for Smart Growth, Livable Communities-Partners for Places grant; George Gund Foundation; Cleveland Foundation. In addition to the climate action plan update, sustainability activities, and a progress dashboard that can be found on the program website (www.sustainablecleveland.org), the City has a "Sustainable Cleveland Municipal Action Plan" (2013) for municipal operations.

Cleveland has been a STAR certified community since 2014 and it is a member of the Global Covenant of Mayors for Climate and Energy (www.globalcovenantofmayors.org), an organization of over 9,000 cities and local governments across 132 countries and 6 continents, representing 800 million people committed to creating climate change resilient and low-emissions communities. As part of this coalition, Cleveland tracks and publishes progress in emissions reduction through the Carbon Disclosure Project (CDP), a nonprofit that provides a global system of environmental impact measurement and disclosure for cities, states, regions, companies, and investors. (www.cdp.net)

Like the Bridgeport plan, the Sustainable Cleveland initiative is focused on sustainable economic development and highlights how business and government can work together to bring green jobs to the city. The plan includes an appendix with a Green Jobs/Workforce Development Analysis. (p. 10) It also has a strong equity focus:

> "Equity serves as the main thread that ties this plan together. One of the advantages of organizing around climate action is that strategies to reduce GHGs and adapt to climate change create many other quality of life benefits. For example, investing in cleaner transportation options also improves air quality and creates safer, more walkable streets, thereby increasing the health and well-being of residents. Prioritizing actions within communities of color and low-income neighborhoods will have a greater impact because they have traditionally been impacted disproportionately by pollution sources and development patterns that both contribute to climate change." (p. 9)

ioby (In Our Backyard, Inc.)
This nonprofit helps city residents improve their communities through a crowd funding platform for neighborhood projects. They have offices in Cleveland, Detroit, Memphis, New York and Pittsburgh but work with communities around the country. They provide coaching on fundraising and have helped over 2,000 projects and trained over 20,000 leaders. The median donation for projects is $35 and donors' gifts a tax deductible.
In addition to the Racial Justice Guide discussed earlier, ioby has guides on a variety of topics such as traffic calming, green infrastructure, fund raising for local projects, winter community projects, etc. www.ioby.org/resources/freeguides

Cleveland Climate Action Fund (CCAF)
Founded in 2008, the Cleveland Climate Action Fund (formerly known as the Cleveland Carbon Fund) was the first community-based, open-access carbon reduction fund in the United States. It funds local projects that reduce emissions while increasing resilience and contributing to the local economy, social well-being, and environmental stewardship. In ten years, over $100,000 has funded local projects. The Fund is part of the Cleveland Foundation, making donations tax-deductible. (www.clevelandclimateaction.org)

Cleveland encourages citizen-initiated and citizen-led projects and works with ioby (In Our Backyards, Inc.), a nonprofit crowd-funding platform, and the Cleveland Climate Action Fund, a nonprofit that funds local carbon mitigation projects.

The 2019 Climate Action Plan update has five thematic focus areas (shown on this page) and a category of "cross-cutting priorities." These are priorities that relate to all the focus areas:

- Social & Racial Equity
- Good Jobs, Green Jobs
- Climate Resilience
- Business Leadership

The Sustainable Cleveland Municipal Action Plan (SC-MAP) contains goals and actions for municipal operations in the categories of:

- Design, Construction and Maintenance
- Energy
- Transportation
- Water
- Materials Management and Purchasing

The SC-MAP also includes an estimated cost-benefit analysis which focuses on estimated savings to the city and emission reductions, but does not included a broader triple bottom line or life cycle analysis.

D. Worcester Green Projects Inventory (2020)

GREEN PROJECT INVENTORY - MUNICIPAL PROJECTS						
Sub-Category	**City Department/ Division**	**Project/ Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N); describe if Y**	**Source of Reported Metrics, if applicable**
ENERGY						
Energy Efficiency and Renewable Energy	Energy Task Force	Greenhouse Gas Emissions Inventory	Community-wide greenhouse gas inventory.	2004	**Y**	http://www.worcesterenergy.org/uploads/47/27/472786b8f49ef214aecd6bb94bf4d7dd/cap-final-report_2007.pdf
Energy Efficiency and Renewable Energy	Energy Task Force	Climate Action Plan	Greenhouse gas emissions reduction plan.	2006-2007.		http://www.worcesterenergy.org/uploads/47/27/472786b8f49ef214aecd6bb94bf4d7dd/cap-final-
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	Creation of EAM	Creation of the Energy and Asset Management Division	2013		
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	Small Business Sustainability Pilot	25 detailed small business energy assessments with partners and federal funding. Six months after delivery of these assessment reports, only a small percentage of projects had actually been implemented. Lack of capital and time to invest in energy efficiency were cited as two of the principle barriers to project implementation.	2012		Small Business Energy/Sustainability Assessment Pilot Project Final Report, GDS for City of Worcester
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	Municipal Energy Efficiency and Renewable Energy Program	Multi-year, multi-million dollar energy efficiency and renewable energy project for municipal facilities. This endeavor was a significant step toward modernizing municipal facilities and achieving long term energy and cost savings, $100+million in investments and $164 million in savings and other benefits expected.	Established 2007		Mass Energy Insight data: www.massenergyinsight.net
	City Energy and Asset Management Division	Energy Savings Performance Contract	Agreement with Honeywell International to be the City's Energy Services Company (ESCO); energy audit followed by implementation of energy conservation and renewable energy projects. Implemented $26.6 million energy savings performance contract with energy conservation and renewable energy measures for 92 municipal facilities, 2011-2015.	2009 and renewal		
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	Purchase of Renewable Energy Certificates.	Purchase of renewable energy certificates to reduce the carbon footprint of municipal operations.	2009 and ongoing (renewal)		
Energy Efficiency and Renewable Energy	City Council adoption	Stretch Code	City of Worcester adoption 2010. In 2009, Massachusetts became the first state to adopt an above-code appendix to the "base" building energy code- the "Stretch Code" (780 CMR Appendix 115.AA). The Stretch Code, which emphasizes energy performance, as opposed to prescriptive requirements, is designed to result in cost-effective construction that is more energy efficient than that built to the "base" energy code.	Adopted 2010; Effective 2011		
Recognitions/Designations/Awards	City Energy and Asset Management Division	Green Community Designation	Worcester was designated a Green Community by the Massachusetts DOER's Green Communities Program in 2010 and has been reporting every year on its designation and commitments annual ever since. The commitment has been to reduce municipal energy use by 20% from the baseline, to purchase energy efficient vehicles, and more. Received Green Community grants in 2010, 2016, 2019.	2010 onward		
Recognitions/Designations/Awards	City Energy and Asset Management Division	EPA Green Power Partnership	The City joined the EPA Green Power Partnership and was designated a Green Power Partner because of its commitment to purchase electricity above the program's minimum 20% requirement	2012		
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	Residential Rebate Pilot	Financial incentives to homeowners to encourage energy efficiency improvements: 167 projects including 207 dwelling units for 1-4 family homes.	2014		

GREEN PROJECT INVENTORY - MUNICIPAL PROJECTS						
Sub-Category	**City Department/ Division**	**Project/ Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N); describe if Y**	**Source of Reported Metrics, if applicable**
Renewable Energy	City Energy and Asset Management Division	Municipal Solar Farm	City of Worcester constructed the then-largest municipal solar array in New England (8.1 MW-DC and 28,600 solar panels) on 25 acres atop the capped Greenwood Street landfill. Anticipated 6-year payback on the investment. Array's life expectancy is 30+ years	Completed in 2017.	Solar electricity is measured by PowerDash Inc. and is reported in order to claim Solar Renewable Energy Certificates.	Green Community Designation Annual Report
Energy Efficiency	City Energy and Asset Management Division	Municipal Street Lights Retrofit to LEDs	13,419 municipal street light converted to LEDs, with expected savings of ~$910,000 and over 6,000,000 kW a year in electricity – a reduction of 60%.	Completed in 2017	Software is used to measure electrical consumption of every street light.	Green Community Designation Annual Report. Measurement and Verification Report (part of Energy Savings Performance Contract).
Renewable Energy Projects' Support / Cost Savings	City Energy and Asset Management Division	Municipal Net Metering Contract	Executed Three Net Metering Contracts with Nexamp subsidiaries, which will save the City nearly $ 710,000 per year in electricity costs. This also supported a solar farm construction in the state of Massachusetts.	Completed in 2014 and 2016		
Renewable Energy / Cost Savings	City Energy and Asset Management Division	Community Choice Electricity Aggregation Program	On June 20, 2017, the City Council authorized the commencement of Worcester Community Choice Aggregation with the goals of cost stability, modest reductions in electrical costs, providing an option for green electricity for customers, and providing modest additional funding for municipal sustainability staff and programs.	Effective 2020	Y	Program reports
Education / Communication	City Energy and Asset Management Division	WorcesterEnergy website	www.WorcesterEnergy.org website to communicate City efforts related to energy efficiency, conservation and sustainability.	ongoing		
Energy Efficiency	Division of Planning and Regulatory Services	Worcester Energy - Pilot Rebate Program	$631,364 (74% of a total $852K state Green Communities Grant was expended in rebates of up to $5,000 per dwelling unit for homeowners of 1-4 unit properties who wanted to undertake energy efficiency and renewable energy improvements to their properties; a higher incentive formula was applied to income-eligible applicants.	2012-2014	Y	Program report: 207 dwelling units (167 buildings) participated in the program
Energy Efficiency	DPW&P - Reservoir Division	Facility lighting retrofit	Retrofit high efficiency LED lighting in water pumping stations and facilities			Facility Operations
Renewable Energy	DPW&P - Water Filtration Plant	Rooftop Solar Array	Install 60 kw rooftop array at the filtration plant.	2011	Y	Facility Operations
Renewable Energy	DPW&P - Water Filtration Plant	Ground Solar Array	Install 60 kw ground solar array on the grounds of the Filtration Plant property.	2013	Y	Metering/Billing
Energy Efficiency	DPW&P - Water Filtration Plant	LED Lighting Upgrade	Upgrade interior and exterior lighting to LED to increase efficiency and reduce electricity costs.	2017-2020 (ongoing)		
Energy Efficiency	DPW&P - Water Filtration Plant	Filter Air Scour System Upgrade	Upgrade the plant's filter air scour system to a more efficient system resulting in reduced air scour run times and reduced energy costs.	2014-2016	Y	Facility Operations
Energy Efficiency/ reduced waste water	DPW&P - Water Filtration Plant	Filter Media Adjustment	Through increasing the size of the filter media (anthracite) from 1.1 mm to 1.5 mm the plant was able to reduce waste water and electricity costs through increasing filter run times.	2010-2016	Y	Facility Operations
Energy Efficiency	DPW&P - Water Filtration Plant	Pump Upgrade	Upgrade domestic water pumps with variable drive pumps to increase efficiency and reduce electrical costs.	2019		Facility Operations

GREEN PROJECT INVENTORY - MUNICIPAL PROJECTS						
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Energy Efficiency	DPW&P - Water Filtration Plant	Ozone System Upgrade Project	Replace the existing inefficient first generation ozone generators producing 2% ozone with new high efficiency plate style generators that produce 15%+ ozone. Estimated annual savings of 1,766,00 kw of electricity translating to a savings of $162,600.00 annually.	2018-2019		Facility Operations
Energy Efficiency	DPW&P-Parks	LED Lighting Upgrade	Lighting throughout city park properties and facilities have been or will be converted to LED as an efficiency measure.	ongoing		Facility Operations
Regulation	Division of Planning and Regulatory Services	Wind Energy Ordinance	Large Wind Energy Conversion Facilities Ordinance allows wind energy turbines by special permit; amended 2010 to allow small scale turbines	2007; amended 2010		
GREEN AND BLUE SPACES - NATURAL SYSTEMS						
Open Space and Recreation	Division of Planning & Regulatory Services and DPW-Parks	Open Space and Recreation Plan	City Office of Planning and Community Development updates the Open Space and Recreation Plan every 7years.	latest update expected 2021	Y	OSRP update will include data on implementation of previous goals and other relevant data.
Open Space and Recreation	City	Perkins Farm acquisition - conservation land swap	Established major precedent setting conservation land swap resulting in 10:1 net gain of conservation land at Perkins Farm.	1990s		
Open Space and Recreation	City and nonprofit groups	Perkins Farm management plan	Completed passive recreation management plan at Perkins Farm which will serve as model for management plans for other city conservation areas. This was a team effort between City of Worcester and several conservation groups - Lake Quinsigamond Watershed Association, Lake Quinsigamond Commission, Grafton Hill Neighborhood Association, Mass Audubon.	1990s		
Open Space and Recreation	City and nonprofit groups	Walking trails and bike paths	With major involvement from the Regional Environmental Council as well as several other conservation groups, the City launched trail and bike path initiatives.	1990s		
Open Space and Recreation	DPW&P - Engineering	Crow Hill Project (45 Clarendon St) - acquisition and remediation.	A 15-acre open space parcel; remediation of 4.5 acres with engineered soil cap; use for passive recreation.	2018-2019	Y	DEP Compliance Reporting
Open Space and Recreation	DPW&P - Reservoir Division	Bald Eagle Monitoring/Banding	Monitor nesting pair of Bald Eagles at Pine Hill Reservoir and collaborate with Massachusetts Fish and Wildlife in their annual chick banding program for a long term population study.	ongoing		
Open Space and Recreation	DPW&P - Reservoir Division	Black Bear Population Study	Collaborate with Massachusetts Fish and Wildlife on a long-term black bear population study on reservoir lands including radio collar tracking, trapping and tagging.	ongoing		
Open Space and Recreation	DPW&P - Reservoir Division	Loon Monitoring/Banding	Monitor nesting pair of Loons at Pine Hill Reservoir and collaborate with Massachusetts Fish and Wildlife on banding and annual deployment of loon raft.	ongoing		
Open Space and Recreation	DPW&P - Reservoir Division	Grassland Habitat	Manage approximately 80 acres of grassland habitat including enhancements to promote pollinators.	ongoing		
Open Space and Recreation	DPW&P - Reservoir Division	Song Bird Population Study	Collaborate with the State Ornithologist on their long-term population study on Reservoir Division lands.	ongoing		
Open Space and Recreation	DPW - Reservoir Division	Osprey Platform	Construction of Osprey platform on Quinapoxet Reservoir in collaboration with Massachusetts Fish and Wildlife.	2015		
Open Space and Recreation	DPW&P - Reservoir Division/Worcester Public Schools	Wood Duck Box Project	Construct and install Wood Duck boxes in beneficial habitat areas in collaboration with Mass Fish and Wildlife and the Worcester Technical High School Carpentry and Environmental programs.	2016		

GREEN PROJECT INVENTORY - MUNICIPAL PROJECTS						
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Open Space and Recreation	DPW&P - Lakes and Ponds	Aquatic Invasive Plant Monitoring and Management Program	Created and implemented custom weed management programs that use a variety of methods, including lake drawdown, mechanical harvesting, and herbicide treatments to reduce the detrimental effects that invasive aquatic plants have on local ecology and recreational use of surface waters.	Since 2016	Yes, # of acres treated	Annual Lakes and Ponds Reports
Open Space and Recreation	DPW&P - Lakes and Ponds	Cyanobacteria Bloom Prevention and Mitigation Program	Preventive treatment and response application of algaecides in lakes with increased likelihoods of cyanobacteria blooms to increase public safety and detriment to ecosystems. Applications determined by the results from the cyanobacteria and water quality monitoring programs.	Since 2017	Yes, treatments performed	Annual Lakes and Ponds Reports
Open Space and Recreation	DPW&P - Reservoir Division/Worcester Public Schools	Kestrel Box Project	Construct and install Kestrel boxes in beneficial habitat areas in collaboration with Mass Fish and Wildlife and the Worcester Technical High School Carpentry and Environmental programs.	2017		
Open Space and Recreation	DPW&P/ED	Park Improvements	Blackstone Gateway Park & Institute Park (boardwalks/pedestrian bridges)			
Open Space and Recreation	DPW-Parks	Mowing Practices	Altered mowing practices in City parks to increase the acreage of natural habitat and decrease treatment.	Ongoing		
Open Space and Recreation	DPW-Parks	Urban Forestry	Through the forestry division of the parks department there are approximately 150-250 trees planted each year throughout the city.	Ongoing		
Open Space and Recreation	DPW-Parks	Invasive plant control	Various locations within park land are treated regularly to remove and control the spread of invasive plant species.	Ongoing		
Open Space and Recreation	DPW-Parks	Land Management Program	The department manages 1,400 acres of city parkland consisting of recreation areas, fields and forest throughout the city.	Ongoing		
Open Space and Recreation	DPW&P - Reservoir Division	Land Management & Forestry Program	Active management of approximately 8,000 acres of land within the drinking water reservoir system watersheds in a holistic approach to maintain and improve drinking water quality. Management includes a comprehensive forest management program, management of invasive species, and habitat management providing subsequent positive impacts to wildlife habitat and biodiversity. Proper management provides a healthy ecosystem to maximize the filtration capacity of the forests and reduce pollutants, organics, and nutrient loading into the reservoirs.	ongoing	Y	Department reporting and files
Open Space and Recreation	DPW&P - Reservoir Division	Water Quality Land Acquisition Program	Acquire land within the drinking water reservoirs watersheds for watershed protection purposes. This program has protected 1,240 acres of land since 2005.	2005 and ongoing	Y	Department reporting and files
Urban Forestry	DPW-Parks	Worcester Tree Initiative	The Worcester Tree Initiative (WTI) was established as a partnership of the City, the state Department of Conservation and Recreation, the US Department of Agriculture and nonprofit organizations to respond to the Asian Long-Horned Beetle (ALB) infestation (discovered 2008) and loss of trees in northern neighborhoods in Worcester and in adjacent towns. Since 2009, approximately 30,000 trees have been planted, focusing in the area affected by the ALB infestation, replacing the Norway maple monoculture with more diversity of species. Currently, the WTI is a partnership of the Department of Public Works and Parks and Tower Hill Botanical Garden, which continues tree planting in the city. WTI now includes a forestry program for young adults to maintain newly planted trees and is expanding its activities to plant more trees in the urban core of Worcester.	2009 and ongoing	Y	WTI reporting
Urban Forestry - Regulations	DPW-Parks	Protection of Public Shade Tress	Ordinance requiring all public tree planting, maintenance and removal of public shade trees to be approved by tree warden.	2008 and ongoing		

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Urban Forestry	DPW-Parks	Private Property Tree Adoption	When streets and sidewalks are too narrow for street tree planting, the City will provide trees for planting on private property adjacent to the sidewalk and teach the owners how to maintain them. After three years, the tree belongs to the private property owner.	ongoing		
Urban Forestry	DPW-Parks	Tree Donation Program	The City accepts donations of trees for public spaces. At a cost of about $500 the City will buy and plant the tree with a donation plaque. Typically, 5 or 6 trees are donated annually.	ongoing		
Urban Forestry	DPW-Parks	Right Tree, Right Place Program	The City selects trees that fit their intended purpose taking into account the growing space in the proposed location.	ongoing		
Regulations	Division of Planning and Regulatory Services	Regulatory protections	Wetlands Protection Ordinance	1990 and amended, 2007, 2016, 2019		
BUILDINGS: ENERGY-EFFICIENT AND RENEWABLE ENERGY						
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	School renewable energy	Solar installations on 14 schools.	2011 - 2016		Mass Energy Insight data
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	School white roof projects	Solar installations on 6 schools accompanied by white roof coating to reduce maintenance costs, improve solar productivity, and reduce cooling loads for facilities.	2015-2016		Mass Energy Insight data
Energy Efficiency and Renewable Energy	City Energy and Asset Management Division	Energy Audit	Energy audit of municipal facilities.	2009-2011		Mass Energy Insight data
Energy Efficiency	City Energy and Asset Management Division	Lighting Retrofits to LED	4 municipal parking garages; most city buildings; municipal parking lots and parks	Completed in 2017		Mass Energy Insight data
Energy Efficiency	City Energy and Asset Management Division	Claremont/Woodland Academy School Lighting Retrofit Project	Replacement of approximately 2,300 interior CFL lights with high-efficiency intelligent LED (light-emitting diode) lights, saving up to 40% in electricity costs.	Completed in September 2018		Mass Energy Insight data
Energy Efficiency	DPW&P - Engineering	New Building Construction or Major Renovation	Nelson Place Elementary School: first LEED for Schools v. 4 Certified in Mass; certified at Silver level. Mass Dept of Energy staff suggested that, based on energy modeling of the design, it would be the most efficient public building built to date (2017) in Massachusetts in MA.	Completed in September 2017		Mass Energy Insight data; Mass Department of Energy.
Energy Efficiency	City Energy and Asset Management Division		Promotion of residential energy audits and conservation projects through Mass Save.			Mass Save
Energy Efficiency	City Energy and Asset Management Division		Advocacy for stricter energy code standards.			
Energy Efficiency	City Energy and Asset Management Division		Doherty High School design modified to make the 420,000 sf building "not just carbon neutral but carbon negative"	Design 2020-2021; construction completion expected 2024		
SUSTAINABLE TRANSPORTATION CHOICES						
Transportation Planning	Division of Planning and Regulatory Services	Complete Streets	Policy to encourage appropriate design and use of public streets for all users; Policy in place, Transportation advisory group created to assist in implementation.	Ongoing		
Transportation Planning	Division of Planning and Regulatory Services	Complete Streets	Transportation Advisory Committee established 2019.	Ongoing		

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Transportation Planning	Division of Planning and Regulatory Services	Integration of Transportation into Planning Department	Senior Transportation Planner position opened in early 2019;			
Alternative Transpiration	City	Bike Share	Dockless bike sharing program, 2017-2018. The City is seeking a new provider.			
Electric Vehicles	City Energy and Asset Management Division	Electric Vehicle Charging	Public and semi-public EV charging stations in Worcester include City Hall, Union Station and Major Taylor Boulevard parking garages. The City is pursuing installation of additional EV chargers on four municipal properties with incentives from National Grid.	Ongoing	Y - # of current chargers installed plus # planned/ dates of expected installation	City reporting
WATER MANAGEMENT						
Planning	DPW&P	Integrated Water Resources Management Plan	Comprehensive plan to identify and prioritize investments in the water, wastewater and stormwater infrastructure for the next 50 years. Specific goals are: Protect public health and safety; Safeguard recreational waters; Improve drainage and reduce flooding; Maintain affordable water and sewer rates; Enhance wastewater treatment.	2018-2019		
Water Quality/ Stormwater	DPW&P	Stormwater Management Plan	Activities include cleaning of the City's 18,000 catch basins at least once every two years to reduce pollution; Outfall Screening Program, every three years for E. coli screening; Street Sweeping Program; Catch Basin Stenciling Program; Illicit Sewer Connection Program; Culvert and Brook Inlet Inspection and Maintenance Program; Dog Waste Program; and Fertilizer Use Reduction at Green Hill Golf Course. Stormwater management activities are included in the sewer enterprise annual maintenance budget and typically account for 60% of that budget.	updated 2015		Annual Stormwater Report
Water Conservation/Resiliency	DPW&P- Reservoir Division	Transfer Main Rehabilitation	Rehabilitation of the 1930s 36" steel Quinapoxet Reservoir transfer main to reduce water loss and provide a more resilient and reliable system.	2020		
Water Supply Protection	DPW&P- Reservoir Division	Kendall Reservoir Risk Mitigation Project	Install drainage infrastructure and underground containment units to protect the quality of the City drinking water supply through removal of TSS and providing containment for a potential release of hazardous materials.	2018-2019		
Water Supply Protection	DPW&P- Reservoir Division	Emergency Spill Response Program	Outfitted an emergency spill response trailer and implemented a spill response program including annual training to respond to and prevent environmental impacts to the drinking water supply	ongoing		
Water Supply Protection/Flood Management/ Resiliency	DPW&P- Reservoir Division/Engineering Division	Dam Management Program	The program provides inspection, maintenance, and repair of City controlled dams throughout the City and the reservoir system.	ongoing		
Water Quality/Stormwater	DPW&P - Sewer Operations	Catch Basin Maintenance Program	Clean the 18,000 City catch basins at a minimum of once every two years to reduce total suspended solids, nutrient loading and trash from entering surface water bodies.	ongoing	Y	Annual Stormwater Report
Water Quality/Stormwater	DPW&P - Sewer Operations	Bell Pond Beach Improvement Project - Green Infrastructure (GI)	Install permeable concrete and other drainage features to reduce erosion and sedimentation to Bell Pond.	2012		
Water Quality/Stormwater	DPW&P - Sewer Operations	Outfall Screening Program	Wet weather and dry weather screening of the outfalls in the city are conducted on a three year rotating basis for E-coli. This monitoring provides key information on the quality of water passing through the City stormwater system and greatly aids in tracking illicit sewer connections that ultimately impact surface waters in the city.	ongoing	Y	Annual Stormwater Report

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Water Quality Monitoring	DPW&P - Lakes and Ponds with volunteers	Worcester Cyanobacteria Monitoring Collaborative Citizen Science Group	Local volunteer-led sampling and analysis of water from 8 Worcester lakes for cyanobacteria and other planktonic life. Volunteers are trained in sample collection and microscopy, and learn how to identify aquatic organisms and their significance in the ecosystem. Data helps to make predictions about algae blooms and ecosystem functioning on a local scale, and contributes to a larger EPA study to examine temporal and spatial dynamics of cyanobacteria.	Since 2017	Yes, # of volunteers trained, lakes assessed, and observations of cyanobacteria made.	inaturalist.org CyanoScope Project, Worcester Cyanobacteria Monitoring Program Monthly Reports; Annual State of the Lakes Reports
Water Quality Monitoring	DPW&P - Lakes and Ponds	Cyanobacteria Density Monitoring	Professional contracted collection and enumeration of cyanobacteria in recreational waters suspected to be at risk for cyanobacteria blooms for use in determining management strategies.	Since 2017	Yes, # of samples collected	no, unless there is an exceedance
Water Quality Monitoring	DPW&P - Lakes and Ponds	Lakes and Ponds Water Quality Monitoring Program	Collection and analysis of major water quality indicators in lakes and their tributaries and outlets, twice monthly at four recreational water bodies.	Since 2017	Yes	Annual State of the Lakes Reports
Water Quality/Stormwater	DPW&P - Sewer Operations	Northeast Cutoff Rain Garden Project (GI)	Install rain garden along Northeast Cutoff to treat approximately 5,000 SF of paved surface.	2016		
Water Quality/Stormwater	DPW&P - Sewer Operations	Clason Beach Project (GI)	Install permeable concrete pavers along the perimeter of the parking lot area to increase infiltration and reduce runoff. This project was initiated to reduce erosion and subsequent deposition of TSS and nutrients to Coes Reservoir.	2015		
Water Quality/Stormwater	DPW&P - Street Division	Leaf Collection Program	Approximately 54,000 cubic yards (10,000 tons) of leaves are collected through this program ultimately removing these nutrients and organics from entering the city stormwater system which would ultimately impact the surface waters in the city.	ongoing	Y	Annual Stormwater Report
Water Quality/ Stormwater	DPW&P - Street Division	Street Sweeping Program	Over the course of a year DPW&P sweeps 10,000 miles of curb collecting approximately 72,000 cubic yards of material preventing it from entering the drainage system and impacting surface waters of the city.	ongoing	Y	Annual Stormwater Report
Water Quality/Stormwater	Division of Planning and Regulatory Services	Wetlands Protection Ordinance & Regulations - Stormwater Protection Zone	Innovative regulations around stormwater management; requiring permitting by the Conservation Commission for construction activities located within 100' of surface system storm drain inlet (assuming meets certain slope and size thresholds).	Ongoing	N	
Floodplain Management	Division of Planning and Regulatory Services/ISD	FEMA Community Rating System	Participate in elective program committed to exceeding national minimum floodplain management standard. Provide education to real-estate brokers, residents, and professional about relevant flood plain information.	Ongoing	Y	# inquiries re: floodplain properties (data is incomplete)
Water Conservation/Resiliency	DPW&P - Water Operations	Leak Detection Program	The entire drinking water distribution system in the city is surveyed for leaks on an annual basis. Leak repair minimizes water waste/water loss and improves system performance.	Ongoing/Annually	Y	Department reporting and DEP regulatory reporting
Water Conservation	DPW&P - Water Operations	Water Conservation Program	Providing or promoting the use of low flow fixtures to residential customers with the goal of reducing baseline water consumption. In addition, free toilet leak detection kits are made available to residents.	Ongoing	Y	Department records
Water Conservation	DPW&P - Water Operations	Rain Barrel Program	Rain barrels are offered at a discount to residents through the manufacturer on an annual basis. Approximately 1,000 rain barrels have been purchased by residents through the program to date.	2007 ongoing annually	Y	Department records
Water Conservation/Resiliency	DPW&P - Water Operations	Water Main Rehabilitation Program	Systematic rehabilitation or replacement of water main throughout the distribution system. This effort reduces water loss and improves resiliency of the system.	ongoing	Y	Department reporting and records

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Water Quality/Public Health	DPW&P - Water Operations	Distribution Sampling Program	Through both regulatory and non-regulatory distribution sampling the quality of the city drinking water supply can be monitored and maintained.	ongoing/weekly, monthly & annually	Y	Various regulatory reporting, Consumer Confidence Report, Department records
Water Quality/Public Health	DPW&P - Water Operations	Water Quality Investigation	Reports of potential water quality problems from either the public or staff are investigated and acted upon if warranted.	Ongoing	Y	Department records
Water Quality/Public Health	DPW&P - Water Operations/Sewer Operations/ Reservoir Division/Water Filtration Plant/lakes & Ponds/Environmental	Public Education Program	DPW&P has an extensive public education program covering drinking water, water conservation, wastewater, stormwater, recreational waters, land use, recycling & waste collection and many other related issues and services. Activities include classroom education throughout the Worcester Public School system and universities, tables at various events throughout the city, presentations to various groups, tours of facilities, social media posts, videos, programming on public access television and mailings.	ongoing		Department records
Water Quality	DPW&P - Sewer Operations	Tree Box Filters	A total of 26 tree box filters have been installed in various locations in the city. These filters remove total suspended solids (TSS) and phosphorus from stormwater prior to discharge to surface waters in the city.		Y	Annual Stormwater Report
Wastewater /Water Quality/ Cost Savings	DPW&P - Sewer Engineering/Operations	Inflow & Infiltration Reduction Program	Identification and reduction of the inflow and infiltration of groundwater and surface water into the sewage disposal system through system rehabilitation, lining, and other projects reclaims system capacity and operating efficiency to reduce system overflows that may have negative impacts to the environment. In addition, resolving I/I issues reduces overall treatment costs and improves treatment capacity at the treatment facility.	ongoing	Y	Various system reports and studies on file at DPW&P
Water Quality	DPW&P - Sewer Operations	Hydrodynamic Separators	A total of 33 hydrodynamic separators have been installed and are maintained the sewer operations. These units remove TSS from stormwater prior to discharge to surface waters in the city.		Y	Annual Stormwater Report
Water Quality	DPW&P - Sewer Operations	Bio-Filtration Units	Two FocalPoint biofiltration units have been installed at key locations in the Indian Lake watershed. These units filter TSS and nutrients (phosphorus) from stormwater prior to discharge to surface waters in the city.		Y	Annual Stormwater Report
Water Quality	DPW&P - Sewer Operations	Catch Basin Stenciling Program	Catch Basins in sensitive areas are stenciled to indicate no dumping as the discharge goes to surface water.	ongoing	Y	Annual Stormwater Report
Water Quality	DPW&P - Sewer Operations	Illicit Sewer Connection Program	Manholes and surface drain pipes are inspected to locate and eliminate illicit sanitary sewage connections from the surface storm drain system.	ongoing	Y	Annual Stormwater Report
Flooding/ Water Quality	DPW&P - Sewer Operations	Culvert & Brook Inlet Inspection & Maintenance Program	Continuously inspect and maintain 60 culverts and brook inlet locations throughout the city to remove debris and prevent flooding situations.	ongoing	Y	Annual Stormwater Report
Water Quality/Public Health	DPW&P - Sewer Operations	Dog Waste Program	The dog waste ordinance and education program was initiated to reduce dog waste from entering in the surface stormwater system. This reduces bacteria and nutrients being discharged to surface waters.	ongoing	Y	Annual Stormwater Report
Water Quality/Public Health	DPW&P - Green Hill Golf Course	Fertilizer Use Reduction	Green Hill Golf Course implemented a reduction in phosphorus containing fertilizer. A majority of fertilizer in use is zero phosphorus fertilizer which greatly reduces the phosphorus in runoff entering surface waters of the city.	ongoing	Y	Annual Stormwater Report
Water Quality	DPW&P - Sewer Operations/ Engineering	Policy prohibiting drainage in unpaved streets	The policy prohibits installation of catch basins in unpaved private streets. This prevents TSS from entering the storm drain system and ultimately being discharged to surface waters.	1993	Y	Annual Stormwater Report

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Water Quality	DPW&P - Engineering	Private Street Conversion Program	Through the Private Street Conversion process, private streets are made public and improved through installation of drainage and paving. This greatly reduces silt laden runoff to surface waters of the city.	ongoing	Y	Annual Stormwater Report
Water Quality	DPW&P - Sewer Operations	FOG (Fats, Oils, Grease) Program	Inspection of grease traps (primarily in restaurants and food service establishments) to ensure they are properly cleaned and maintained. Fats, oils and grease entering the sanitary sewer system is a leading cause of blockages and eventual sewer overflows that potentially impact surface waters and public health.	ongoing	Y	Annual Stormwater Report
Water Quality	DPW&P-Parks	Institute Park Improvements	Two Vortechnic water quality devices installed for the removal of TSS and floatables from stormwater entering Salisbury Pond	2008		
Water Quality	DPW&P-Parks	Institute Park Improvements	Three additional Vortechnic water quality devices to be installed throughout the park and sediment forebay at Salisbury pond to further improve water quality through the removal of TSS and floatables from stormwater.	2020		
Water Quality/ Conservation	DPW&P-Parks	Elm Park - Elm Park Pond Improvements	A new retaining wall was constructed along the shore of the pond to reduce existing erosion issues. A well was installed for providing water to the pond rather than using water from the city's water redistribution system.	2015-2016		
Water Quality	DPW&P-Parks	Shore Park Improvements	Stormwater improvements incorporated into the Shore Park improvement project significantly reduced erosion of the beach and surrounding park area.	2018		
Quality/Infiltration	DPW&P-Parks	Ty Cobb Park Improvements (GI)	Walkways were replaced/installed using porous asphalt to increase infiltration and reduce runoff.	2015		
Flooding	DPW&P-Parks	Beaver Brook daylighting (GI)	The park was redesigned and the Beaver Brook culvert was daylighted in the park to allow the brook to overflow and flood the playing fields to manage stormwater and reduce flooding in the surrounding area and downstream.	2007		
Water quality /Infiltration	DPW&P-Parks	Blackstone Gateway Park (GI)	Walkways within the park installed using porous asphalt to increase infiltration and reduce runoff and potential erosion issues.	2018		
Quality/Infiltration	DPW&P-Parks	Burncoat Street Playground (GI)	The playground surface installed consists of a porous material that allows infiltration of stormwater to reduce runoff and potential erosion issues.	2017		
Water Quality/Stormwater	DPW&P-Parks	Coes Knife Park Improvements (GI)	Multiple stormwater management best management practices were incorporated into the park design to manage stormwater runoff from surfaces. Designs increased infiltration and reduced stormwater runoff to reduce potential erosion issues and TSS from stormwater.	2016		
Water Quality/ Stormwater/ flooding	DPW-Parks	Crompton Park Improvements (GI)	Installation of porous asphalt, porous pavers and other stormwater improvements to promote infiltration and improve flood control. Future installation of porous rubber playground surface and porous walkways.	2016 - 2019		
Water Quality/ Stormwater	DPW-Parks	Farber Field	Installation of synthetic field and drainage system improvements to reduce runoff and potential erosion issues.	2020		
Water Quality/ Stormwater/ Habitat	DPW-Parks	Green Hill Park	Installed stormwater improvements at Vietnam Memorial location to reduce runoff and alleviate localized standing water issues. Constructed vernal pool.	2007		
Quality/Stormwater	DPW-Parks	Green Hill Park Pond Dam	Changed outfall location to direct overflow to Coal Mine Brook and remove flow from the combined sewer system.			
Water Quality/Stormwat	DPW-Parks	Holmes Field (GI)	Installation of pervious playground surfaces to promote infiltration and reduce runoff.	2018		
Water Quality/Stormwat	DPW-Parks	Mill Street Greenway (GI)	Design for Greenway along the Coes and Patch Reservoirs includes green infrastructure in the median.	?		
Water Quality/ Stormwater	DPW-Parks	Providence Street Playground	Installation of synthetic field and drainage system improvements to reduce runoff and potential erosion issues.	2016		

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Water Quality/ Stormwater	DPW-Parks	Rockwood Field Improvements	Install subsurface stormwater system to improve stormwater management and increase stormwater storage to reduce flooding potential.	2008		
Water Quality/ Surface Water	DPW-Parks	Parks Ponds	Ponds located at Elm Park, University Park and the Vietnam Memorial are treated for invasive species on a yearly basis.	Ongoing		
Water Conservation	DPW&P-Parks	Spray Parks & City Hall Fountain	The City spray parks and the fountain at City Hall operate on systems that recirculate water through filtration units to conserve drinking water.			
Water Quality		Route 20 Sewer Extension Project	The project provides a comprehensive solution to the sewerage needs of the area and eliminates the need to operate the Broadmeadow Brook and Grafton Street pump stations. T	2018-2020		http://www.worcesterma.gov/route-20-sewer-extension
Water Quality and Stormwater Management		Green Infrastructure	Green infrastructure projects at 17 locations as of 2020 (some listed above).			
Water Quality and Stormwater Management	EAM	Green Infrastructure	Rain garden as part of Senior Center renovation to mitigate stormwater pollution and flooding adjacent to the parking lot.	2020		
Drinking Water Filtration	DPW	Water Filtration Plant construction	Constructed state-of-the-art Water Filtration Plant.	1997		
Land Management	Division of Planning and Regulatory Services	Regulations	Wetlands Protection Ordinance; Aquifer Protection Overland Zone; Floodplain Overlay District; Water Resource Protection Overlay District.	1990; amended 2007, 2016, 2019		
Education and Awareness	Blackstone River Valley National Heritage Corridor	Expansion and reauthorization	Secured the official expansion and reauthorization of Blackstone River Valley National Heritage Corridor to include all of the City of Worcester and town of Leicester, therefore enhancing the city's and region's ability to attract tourism and focus attention on water quality issues of the Blackstone.	1990s (early)		
Education and Awareness	DPW	Waterway Signs	City DPW places signs identifying the City's many waterways.	1990s (early)		
Education and Awareness	DPW	Storm drain stenciling project	City DPW undertakes storm drain stenciling project working with school groups and individuals.	1990s (early)		
Regulations	Division of Planning and Regulatory Services	Local wetlands protection ordinance	Passage of local wetlands protection ordinance which regulates development within 100 feet from catch basins.	1990s (early)		
Regulations	Division of Planning and Regulatory Services	Aquifer Protection Overlay Zone	Passage of the Aquifer Protection Overlay Zone, which is expected to allow city water supply to expand by 20% due to new well fields now protected by overlay zoning.	1990s (early)		
WASTE						
Waste Disposal	DPW&P - Street Division	Residential Trash Collection Program	The Sanitation arm of the Street Division collects approximately 21,000 tons of household waste per year through the pay-as-you throw collection program.	1993-ongoing	Y	Department reporting & records
Recycling	DPW&P - Street Division	Waste Recycling Program	The recycling program, operated as part of the residential trash collection program, operates at a recycling rate of approximately 32% in 2019.	1993-ongoing	Y	Department reporting & records
Recycling	DPW	Single Stream Recycling	Implementation of single stream recycling.	2007 - schools; 2008 - residential curbside up to 6 units		
Recycling	DPW&P - Water Filtration Plant	Plastic Recycling Program	Instituted a plastic recycling program throughout the facility.	2018	Y	Department reporting & records
Waste Disposal	DPW&P - Street Division (Nuisance Inspection)	Illegal Dumping Removal and Investigation	Locations of illegal dumping throughout the city are cleaned, investigated and violations issued accordingly.	ongoing	Y	Department reporting & records

GREEN PROJECT INVENTORY - MUNICIPAL PROJECTS						
Sub-Category	**City Department/ Division**	**Project/ Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N); describe if Y**	**Source of Reported Metrics, if applicable**
Graffiti Removal	DPW&P - Street Division (Nuisance Inspection)	Graffiti Removal Program	Quick response program to remove graffiti around the city using environmentally friendly, soy based graffiti remover and a hot-water pressure washer system.	ongoing	Y	Department reporting & records
Waste cleanup and disposal	DPW&P - Street Division	Earth Day Cleanups	Annual event where cleanups are undertaken at approximately 80 locations around the city with approximately 1,000 volunteers. Approximately 70 to 80 tons of trash/waste is collected and disposed of during this annual event.	ongoing annual event	Y	Department reporting & records
Hazardous Waste	DPW&P - Street Division	Household Hazardous Waste Collection Day	Annual event where residents are encouraged to drop off hazardous materials generated or stored at their residences. This removes those materials that have the potential to be disposed of improperly or accidentally released to the environment.	ongoing annual event	Y	Annual Stormwater Report
Hazardous Waste	DPW	Lead Paint Program	Municipal Childhood Lead Poisoning Prevention and Healthy Housing programs distribute lead abatement funds, and offers a lead paint poisoning prevention assessment on request for households with children under six, including rental households.	ongoing		
Trash	DPW&P-Parks	Trash Collection Program	The department cleans up trash and empties trash receptacles within City parks on a daily basis.			
Trash	Ordinance	Plastic Bag Ban	Plastic bags banned in retail in 2019. Implementation 2020.	Ongoing		
Waste Disposal	DPW&P-Parks	Municipal Composting	Worcester has one of the largest municipal composting programs in the state. The compost is free to residents, used by City departments, and sold to commercial businesses. The City does a one-time annual fall leaf collection from streets and residents can bring yard waste to three collection sites.	Ongoing	Y	Composting report
School System Waste Disposal	Worcester Public Schools	Hazardous Waste	Environmental Management System, to manage environmental health and safety issues in the school system. These range from dealing with building material risks, in older buildings, to indoor environmental quality, integrated pest management, and waste. Policies emphasize source reduction and toxics use reduction. Developed guidance for academic and operations departments to change purchasing to increase the use of Environmentally Preferred Products (EPPs).	2010 - Ongoing		The most recent status report on the EMS system was published in November 2019, https://worcesterschools.org/wp-content/uploads/2019/11/EMS-Status-Report-November-2019.pdf
FOOD SYSTEMS						
Food	Worcester Public Schools	Farm to School Program	Offers free breakfast and lunch at school to all students. Menus include fresh fruits and vegetables, whole-grain breads, minimally processed foods and locally-sourced food whenever available.			
Urban Agriculture	City Council adoption	Tax Levy Parcels for Urban Agriculture	The Education & Agriculture Training (EAT) Center, a collaboration of the City of Worcester REC, Ascentria Care Alliance, and Worcester Common Ground uses suitable undeveloped tax levy parcels for urban agriculture that provides training and tools for refugees with an agricultural background in their countries of origin.			
Land Use Planning	Division of Planning and Regulatory Services	Urban Agriculture - Zoning Ordinance Amendment	Adoption of Section 16-Urban Agriculture for local food production/sales (excluding livestock).	2019		
POLLUTION PREVENTION						
Land Development	Economic Development	Brownfields Program	Brownfield Cleanup Revolving Loan Fund to assist property owners in remediating site contamination.	Ongoing	Y - amount loaned	
Water Quality	DPW - Lakes & Ponds; volunteers; university and EPA partners	Worcester Cyanobacteria Monitoring Collaborative	Citizen scientists collect samples contribute to a national study; water treatments to reduce levels of phosphorus – an indicator for cyanobacteria – in the lakes, including an alum-dosing station triggered by stormwater levels going into Indian Lake, which has the greatest propensity for cyanobacteria; and partnering with universities and the EPA.	Ongoing		

GREEN PROJECT INVENTORY - MUNICIPAL PROJECTS						
Sub-Category	**City Department/ Division**	**Project/ Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N); describe if Y**	**Source of Reported Metrics, if applicable**
Lead Abatement	City	Childhood Lead Poisoning Prevention and Healthy Housing Program	Worcester Lead Action Collaborative (2005-2014), city-nonprofit collaborative; City programs since 2015; community education and outreach, public policy initiatives, de-leading of hundreds of affordable housing units; lead paint poisoning prevention assessment provided on request.	Ongoing	Y - number of units deleaded	Program reports. Since 2007, receipt of $15 m in federal funds for direct lead abatement and analysis of health hazards in housing.
Environmental Purchasing Policy	City	Environmentally Preferable Purchasing Policy	Basic Environmentally Preferable Purchasing Policy identifies a preference for products with recycled materials and "environmentally preferable products."	Ongoing		
Environmental Management	Worcester Public Schools	Environmental Management System	Policies that emphasize source reduction and toxics use reduction; guidance for operations and academic departments to change their purchasing to increase the use of Environmentally Preferred Products. Resources include a study of indoor air pollution in schools. Ventilation improvements for schools were initiated in 2020.	Ongoing		
CLIMATE CHANGE RESILIENCE						
Climate Change Resilience	City Energy and Asset Management Division	Municipal Vulnerability Assessment	With a state grant of $100,000 Municipal Vulnerability Preparedness grant the City prepared a climate change vulnerability assessment, designed an action plan for preparedness activities, and conducted a number of targeted vulnerability assessments of critical sectors.	2018-June 2019		
Vulnerability and Risk	Emergency Management	Natural Hazard Mitigation Plan	Existing, regional, plan from 2012; update completed with CMRPC for a Worcester specific plan in 2018. Reviews hazards such as drought, flooding, extreme temperatures, sever snow/ice storms, etc.	2019	Y - Action Plan;	Various data sources collected
Water Quality and Quantity	DPW	Integrated Water Management Plan	Stormwater management, including green infrastructure; flood mitigation.	2019 and ongoing		
Water Quality and Quantity	DPW	Lakes & Ponds Program	Monitoring and actions provide information and options to deal with the impacts of climate change, such as warming water temperatures changing the aquatic environment.	ongoing		
Open Space	Division of Planning and Regulatory Services	Open Space and Recreation Plan	State requirement to include consideration of climate change impacts.	expected completion 2021		
Climate Change	Municipal Vulnerability Plan	New resilience standards	The MVP plan recommends incorporating LID standards and limitation of impervious surfaces (including parking lots) in Zoning and Wetlands Protection Ordinances; and creating Best Management Standards for land clearing and grading to avoid creating steep slopes and large retaining walls.			
SUSTAINABILITY, RESILIENCE, AND GREEN EDUCATION IN ALL POLICIES						
Land Use Planning & Transportation	Division of Planning and Regulatory Services	City Comprehensive Plan Update	Existing plan dates to 1987. The plan will identify existing data, reports and related findings, and will involve a robust community engagement element to gather information about community needs and desires. The Green Worcester Plan and other plans will be integrated into the Update.	Initiated in 2021		
Regulations	Division of Planning and Regulatory Services	Ordinance Amendments	Passage of New Worcester Zoning Ordinance which includes regulatory provisions for comprehensive site plan approval, aquifer protection overlay zoning (as mentioned), cluster zoning for open space provisions and designation of open space and park zones. Some amendments passed since then. After completion of the Comprehensive Plan Update, a review and	1990s (early); new review and update expected mid-2020s.		
Land Use - Stormwater	Division of Planning and Regulatory Services	Front Yard "Paving" - Zoning Ordinance Amendment	Land use regulations limit % of front yard areas that can be rendered impervious.			

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Sub-Category	**City Department/ Division**	**Project/ Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N); describe if Y**	**Source of Reported Metrics, if applicable**
Land Use Planning & Open Space Protection	Division of Planning and Regulatory Services	Green Infrastructure/LID ordinance review	CMRPC & Mass Audubon provided a comprehensive review of subdivision rules/regulations, site plan review, zoning ordinance, and stormwater ordinance and provided recommendations to encourage Low Impact Development (LID) and nature-based solutions both within and between	Completed in 2017?		
Climate Change	Municipal Vulnerability Plan	New resilience standards	The MVP plan recommends incorporating LID standards and limitation of impervious surfaces (including parking lots) in Zoning and Wetlands Protection Ordinances and creating Best Management Standards for land clearing and grading to avoid creating steep slopes and large retaining walls.	2019		
Strategic Plan	Office of the City Manager	Strategic Plan for City Government	Includes Key Performance Indicators	2019		
Data driven decisions	Office of the City Manager	Office of Urban Innovation	Improve City data gathering and organization for KPIs and an open data system.	2019		
Health Information	City Health Department	Comprehensive Health Improvement Plan	Annual plan on city and regional health data and priorities.	Annual		
Parking	Division of Planning and Regulatory Services	Parking maximums	Included in the Commercial Corridor Overlay Districts to discourage excessive parking; with Planning Board discretion to modify parking			
Housing	Housing Department	Worcester Housing Now	Program to support 2-4 unit rehabilitation and affordability including promoting energy efficiency elements.			
MEPA certification	Economic Development	Polar Park MEPA certification and Community Benefits Agreement	Sustainability and resilience commitments for Polar Park and associated mixed-use development in the MEPA certification and in the Community Benefits Agreement.	2019		

GREEN PROJECT INVENTORY - NON-MUNICIPAL AND COMMUNITY PROJECTS						
Sub-Category	**Organization**	**Project /Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N)**	**Source of Reported Metrics, if applicable**
ENERGY						
Renewable Energy	Solar generation city-wide	State's Renewable Portfolio Standard	As of November 2019: 1,573 solar installations on residential, commercial, industrial, institutional, and municipal facilities with total generation capacity of 2,414,345.83 kW of electricity in the City of Worcester. (1.96 MW capacity of solar energy installed in the city (RPS Solar Carve-Out I) between 2010-2014; 20.3 MW capacity of solar energy installed in the city (Solar Carve Out II program) between 2014-2018.)	2010-2018		https://www.masscec.com/data-and-reports).
Renewable Energy	Holy Name High School	Large Wind Turbine	600 kW Vestas RRB - 262ft tall, producing 850 mWh/year. The installation has decreased long-term energy costs for the school and provides educational opportunities to students in the area.	2008		www.telegram.com/news/20180909/holy-name-central-catholic-in-worcester-flexes-green-energy-power
Energy conservation	National Grid	Smart Energy Solutions Pilot in Worcester	National Grid's pilot to study smart metering and how it can impact customer behavior in managing the grid impact during peak usage (as a precursor to grid modernization project that will result in more sustainable and intelligent energy usage).	2014-2018		https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/9179984
Energy education	National Grid, Clark University and partners.	Sustainability Hub	912 Main Street 2,220 sf space donated by Clark Univ. Exhibits, demonstrations, education on energy efficiency and renewable energy, including community meeting space and university student ambassadors.	2011 - present		
Renewable Energy	Worcester Crossing Plaza	Small Wind Turbine	18 Small-scale wind turbines on parking lot lights at Worcester Crossing Plaza - now removed.	2010-2015		https://www.telegram.com/article/20150322/NEWS/303229690
Energy conservation and Renewable energy	Higher education institutions	American College and University Presidents' Climate Commitment	Four higher education institutions in Worcester have signed a pledge to conserve energy, be more efficient, and utilize renewable energy to help reduce their GHG emissions. Signatories include: Clark University, Holy Cross, University of Massachusetts Medical School, Worcester State University	ongoing		Annual, public reporting at https://reporting.secondnature.org
Energy conservation and Renewable energy	Worcester Polytechnic Institute	GHG tracking	Greenhouse Gas Reduction Plan (2017)	2017		https://www.wpi.edu/sites/default/files/inline-image/Offices/Sustainability/GHG_Plan_WPI_Exec%20Summ%20Final2.pdf
Energy conservation and Renewable energy	Clark University	GHG tracking	Annual tracking of Greenhouse Gas emissions, and a commitment to be net-zero by 2030	2010 onward		www.clarku.edu/offices/campus-sustainability/sustainable-clark/energy-climate/; https://unhsimap.org/home (carbon and nitrogen-accounting platform to track campus-wide sustainability.
Energy conservation and Renewable energy	Assumption University	Multiple programs	EPA certification as a Green Power Partner in 2014; partnerships with an 18-acre solar photovoltaic farm in Spencer MA, which generates 1/3 of energy used by the collage; rooftop solar panels on the library; CHP cogeneration at the heating plant reducing emissions; building lighting retrofits			https://www.assumption.edu/student-experience/sustainability
Energy conservation and Renewable energy	Bancroft School	Solar installation	900 high-efficiency solar panels			
Energy conservation and renewable energy	Mass Audubon at Broad Meadow Brook	Green technology improvements	Energy audit for buildings and recommendations implemented; three photovoltaic arrays installed (total purchase of 24.91 kW); 100% green energy for all energy not produced on site; deep energy retrofit of a residence to become the Fargo Education Center; installation of water conservation measures.			https://www.massaudubon.org/get-outdoors/wildlife-sanctuaries/broad-meadow-brook/about/green-features
Community Energy Cooperative	Renewable Energy Worcester (RENEW)	Renewable Energy projects for env. Justice communities	Initial priority for solar power to lower energy costs for faith communities and small nonprofits. One project completed as of 2020 (Mustard Seed Catholica Worker House). Working on solar project for Christian Community Church.	Formed 2016.		https://www.cooppower.coop/worcester
Energy conservation and electric vehicles	E4 the Future	Community Clean Energy Project	Goals: exploring promising new technologies and project models, expanding local clean energy generation, emphasizing energy efficiency, and clearing the obstacles to participation for our economically disadvantaged neighbors.	Ongoing		https://e4thefuture.org/
Energy Advocacy	Greater Worcester Chamber of Commerce	Electric Energy and Policy Group	Advocate on electrical energy and utility issues that affect regional businesses.	Formed 2020		https://www.worcesterchamber.org/policy-advocacy/policy-updates/

GREEN PROJECT INVENTORY - NON-MUNICIPAL AND COMMUNITY PROJECTS						
Sub-Category	**Organization**	**Project /Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N)**	**Source of Reported Metrics, if applicable**
Energy Efficiency	Dismas House and Commonwealth/ Worcester Green Low-Income Housing Coalition		Promotion of energy efficiency and renewable energy; assistance to housing nonprofits with energy upgrades, solar, insulation and heating	2014 and ongoing		
Energy Policy	Commonwealth of Massachusetts	Policy Plan	Massachusetts 2030 Decarbonization Roadmap	2020		https://www.mass.gov/info-details/ma-decarbonization-roadmap
Energy Policy	Commonwealth of Massachusetts	Statute	Signing of An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy (Senate Bill 9)	Jan-21		
GREEN AND BLUE SPACES - NATURAL SYSTEMS						
Urban Forestry	Tower Hill Botanic Garden with others	Worcester Tree Initiative (WTI)	Established as a partnership of the City, the state Department of Conservation and Recreation, the US Department of Agriculture and nonprofit organizations to respond to the Asian Long-Horned Beetle (ALB) infestation (discovered 2008) and loss of trees in northern neighborhoods in Worcester and in adjacent towns. Currently, the WTI is a partnership of the Department of Public Works and Parks and Tower Hill Botanical Garden, which continues tree planting in the city. WTI now includes a forestry program for young adults to maintain newly planted trees and is expanding its activities to plant more trees in the urban core of Worcester.	2009 and ongoing	About 30,000 trees planted;focus in the ALB-affected area; replace monoculture with more species diversity.	
Open Space Preservation	Multiple	Private open space conservation.	About 17% of the city's area (4,230 of the 24,685 acres) are designated open space. 31% of the open space is owned by City Parks Division and the rest by non-municipal entities.			
Trails and Connections	Park Spirit and City of Worcester	East-West Trail	14-mile, cross-city hiking experience, connecting 20 Green Spaces (13 parks, 5 Greater Worcester Land Trust properties, one Clark University Arboretum, and one cemetery) with city streets and throughways for a challenging trek through Worcester's hills.	Opened 2016	Y	parkspirit.org/the-east-west-trail
Parks	Friends Groups	Park Upkeep and Maintenance	Some parks have "Friends" groups that work with the city's Parks Division to support park maintenance and programs. Groups include Friend of Newton Hill at Elm Park; Friends of Institute Park; Friends of Worcester Dog Parks.			
Open space preservation & management	The Greater Worcester Land Trust	Open space preservation	Approximately 300 acres under protection and management.	1990s and ongoing		
Open space preservation & management	Mass Audubon at Broad Meadow Brook	Wildlife Sanctuary	Largest urban wildlife sanctuary in New England; over 400 acres cooperatively managed or owned by Mass Audubon; 5 miles of 15 trails, including a one-mile universally accessible sensory trail			https://www.massaudubon.org/get-outdoors/wildlife-sanctuaries/broad-meadow-brook
Environmental Education and Awareness Building	Mass Audubon at Broad Meadow Brook	Nature education programs	Many programs for children, youth and adults including summer day camp and Field Naturalist Certificate Program.			https://www.massaudubon.org/get-outdoors/wildlife-sanctuaries/broad-meadow-brook
Environmental Education and Awareness Building	Collaborations with WPS	Multiple	Worcester schools have benefitted from several new partnerships between environmental groups and local schools to provide environmental programs.			
Environmental Education and Awareness Building	REC, WPI, and others	Multiple	Worcester area colleges have had hundreds of students participate in environmental internships including many coordinated by the Regional Environmental Council over the past 13 years through the project center at Worcester Polytechnic Institute.			
Environmental Education and Awareness Building	Mass Audubon		Pollinator Garden Pilot			https://www.massaudubon.org/get-outdoors/wildlife-sanctuaries/broad-meadow-brook

GREEN PROJECT INVENTORY - NON-MUNICIPAL AND COMMUNITY PROJECTS						
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Trails and Connections	Park Spirit and City of Worcester	East-West Trail	14-mile, cross-city hiking experience, connecting 20 Green Spaces (13 parks, 5 Greater Worcester Land Trust properties, one Clark University Arboretum, and one cemetery) with city streets and throughways for a challenging trek through Worcester's hills.	Opened 2016	Y	parkspirit.org/the-east-west-trail
Parks	Park Friends Groups	Park Upkeep and Maintenance	Some parks have "Friends" groups that work with the city's Parks Division to support park maintenance and programs. Groups include Friend of Newton Hill at Elm Park; Friends of Institute Park; Friends of Worcester Dog Parks.			
Open Space Preservation	Multiple		About 17% of the city's area (4,230 of the 24,685 acres) are designated open space. 31% of the open space is owned by City Parks Division.			
Environmental Education	The Blackstone Heritage Corridor Visitor Center at Worcester		The Blackstone Heritage Corridor Visitor Center at Worcester is the gateway to the Blackstone River Valley National Heritage Corridor, the Blackstone River Valley National Historical Park, and the City of Worcester. It provides visitors and residents with a connection to recreational, historical, cultural and geographic attractions throughout the region.			https://blackstoneheritagecorridor.org/exploring-the-blackstone-river-valley/visitor-centers/worcester-blackstone-visitor-center/
Environmental Education and Awareness Building	Worcester Public Schools	Multiple	Worcester schools have benefitted from several new partnerships between environmental groups and local schools to provide environmental programs.			
Environmental Education and Awareness Building	Institutions	Multiple programs	Worcester area colleges have had hundreds of students participate in environmental internships including many coordinated by the Regional Environmental Council over the past 13 years through the project center at Worcester Polytechnic Institute.			
BUILDINGS						
Institutions	Worcester Polytechnic Institute	LEED Buildings	Policy since 2007 to design all new buildings to meet LEED standards; 5 LEED certified buildings; building energy and lighting retrofit program.	2007 and ongoing		
Institutions	Clark University	LEED Buildings	Policy that new buildings over 5,000 sf will attain a minimum LEED Silver certification unless it costs more than 10% of the total life cycle cost of the building; all major renovations (over 50% of cost of total replacement) will meet a LEED Silver minimum and LEED criteria are applied to smaller renovation projects. University policies also require sustainable practices in site selection, materials, operations and maintenance	ongoing		Annual, public reporting at https://reporting.secondnature.org
Institutions	College of the Holy Cross	LEED Buildings	Policy to meet LEED silver standards in all new major construction and renovation; 2 LEED gold buildings; interior and exterior lighting replacement with energy efficient lighting and sensors	ongoing		Annual, public reporting at https://reporting.secondnature.org
Institutions	Worcester State University	LEED Buildings	4 LEED Gold buildings and solar panels on three buildings.			Annual, public reporting at https://reporting.secondnature.org; Also see http://das.solardesign.com/gcdash.php?site=WorcesterStateUniv
Institutions	Assumption University	LEED Buildings	One LEED gold building			
Institutions	Umass Medical	LEED Buildings	2 silver and one gold LEED buildings.			Annual, public reporting at https://reporting.secondnature.org
Institutions	Worcester Recovery Center and Hospital	LEED Buildings	One gold LEED building.			
Institutions	Worcester Academy	LEED Buildings	LEED silver building renovation			
Energy - conservation/ renewable	Worcester Polytechnic Institute	LEED Buildings	Since 2007, WPI requires new buildings to achieve LEED certification. As of 2019, 5 LEED-certified buildings have been constructed.	2007 onward		
Energy - conservation/ renewable	Clark University	Solar installation	Solar panels installed on Shaich Family Alumni and Student Engagement Center with goal of providing 50% of the building's power	2016 onward		https://www.clarku.edu/offices/campus-sustainability/
Energy - conservation/ renewable	Worcester State University	LEED Buildings	Worcester State has constructed 4 LEED-certified Gold buildings, and installed solar panels on the rooftops of 3 buildings on campus. Generate 140,000 kilowatt hours of electricity annually	Ongoing	Y - kW of generating capacity	https://www.worcester.edu/Sustainability-Initiatives/#Solar-Energy
Energy - conservation/ renewable	Assumption University	LEED Buildings	Constructed 1 LEED-certified Gold building.			https://www.assumption.edu/student-experience/sustainability

GREEN PROJECT INVENTORY - NON-MUNICIPAL AND COMMUNITY PROJECTS						
Sub-Category	**Organization**	**Project /Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N)**	**Source of Reported Metrics, if applicable**
Energy - conservation/ renewable	Clark University	LEED Buildings	New buildings over 5,000 sf will attain a minimum LEED Silver certification unless it costs more than 10% of the total life cycle cost of the building. Similarly, all major renovations (over 50% of cost of total replacement) will meet a LEED Silver minimum and LEED criteria are applied to smaller renovation projects. University policies also require sustainable practices in site selection, materials, operations and maintenance.	Ongoing		https://www.clarku.edu/offices/campus-sustainability/
Energy - conservation/ renewable	Worcester State University	LEED Buildings	Worcester State has constructed 4 LEED-certified Gold buildings, and installed solar panels on the rooftops of 3 buildings on campus. Generate 140,000 kilowatt hours of electricity annually	Ongoing	Y - kW of generating capacity	https://www.worcester.edu/Sustainability-Initiatives/#Solar-Energy
Energy - conservation/ renewable	One Mercantile Street		LEED silver office building	2013		
Private solar installations and energy retrofits	Multiple		As of November 2019: 1,573 solar installations on residential, commercial, industrial, institutional, and municipal facilities with total generation capacity of 2,414,345.83 kW of electricity in the City of Worcester. (1.96 MW capacity of solar energy installed in the city (RPS Solar Carve-Out I) between 2010-2014; 20.3 MW capacity of solar energy installed in the city (Solar Carve Out II program) between 2014-2018.)	2010-2019 and ongoing		https://www.masscec.com/data-and-reports).
Polar Park development projects	Multiple	MEPA Certificate and Community Benefits Agreement	Environmental commitments for Polar Park and associated mixed-use development include a variety of considerations and actions, such as reserving rooftop area for future solar systems; measures to reduce GHG emissions.	2021		
SUSTAINABLE TRANSPORTATION						
Transportation Planning	Central Massachusetts Metropolitan Planning Organization (CMMPO)	2040 Long-Range Transportation Plan	Plan document with 20-year horizon for the use and prioritization of federal transportation funds for Central Massachusetts, including pedestrian, bicycle, and transit, as well as roads.	every 20 years	Y	http://www.cmrpc.org/cmmpo
Transportation Planning	CMMPO	Regional Pedestrian & Regional Bicycle Plan	Recommendations focused on how to plan, integrate, and fund pedestrian facilities, working with regional and state agencies, and the plan includes maps of existing and planned facilities. The bicycle plan identified and mapped the potential for 100.24 miles of bicycle facilities in Worcester.	Complete 2018	Y	http://www.cmrpc.org/cmmpo
Public Transportation	WRTA	Bus Service	The WRTA serves over 1,200 bus stops and nearly 40 bus shelters, most of which are located in Worcester. There are 52 full-sized fixed route buses: 17 are diesel-electric hybrids, 29 are clean diesels, and six are all-electric vehicles.	Y	% coverage of transit routes, ridership #s	WRTA reports
Public Transportation	MBTA	Commuter Rail Service	Established rail link to Boston with several trains now running daily. Ongoing studies for increasing frequency and speed of service	Y	# or frequency of train service	MBTA reports
Alternative transportation	WalkBike Worcester	Advocacy focused on walking and bicycling in Worcester	Goals: To Improve non-motorized connections among neighborhoods, to public transit, and to destinations such as shops, parks, schools, and services; calm traffic, and improve safety; reduce environmental and climatic impact of transportation; encourage daily physical activity to combat obesity and other health problems; increase transportation option for populations with lower access to personal vehicles, including low-income individuals, the young, and college students			
Alternative transportation	WalkBoston and MassBike	Chandler Street Assessment	Walk and bike infrastructure assessment for Chandler Street	2016		https://walkboston.org/wp-content/uploads/2016/08/WalkBoston-BicycleandPedestrianInfrastructureAssessment-Worcester.pdf?8621dc&8621dc
Alternative transportation	Walk Boston	Neighborhood Walk Audit	Green Hill Neighborhood Walk Audit (2019)	2019		https://walkboston.org/wp-content/uploads/2019/11/WalkBoston-Worcester-Green-Hill-walk-audit-report-FINAL.pdf?8621dc&8621dc
Alternative transportation	Clark University	Cycles of Change	Bike Share program; Ride Share and Carpool finder; Zipcar membership			
Alternative transportation	WPI	Gompei's Gears	Free bike share program run by student Green Team at 4 location on campus with 18 bikes. Zipcar program.	2016 and ongoing		

GREEN PROJECT INVENTORY - NON-MUNICIPAL AND COMMUNITY PROJECTS						
Sub-Category	**Organization**	**Project /Initiative**	**Brief Description of the Project/Initiative**	**Approximate timeline**	**Metrics (Y/N)**	**Source of Reported Metrics, if applicable**
Alternative transportation	Holy Cross	Multiple	Use of battery operated cars, bikes and carts; bike rack installation; 4 zipcars			
Alternative transportation	Assumption University	Green Bikes program	Student bike share program			
Alternative transportation	Assumption University	Car programs	U-Car car-sharing platform including hybrid car; electric vehicles used by departments			
Electric Vehicles	Institutions and businesses	Electric Vehicle Charging	Local higher education institutions and businesses are installing electric vehicle charging stations on privately owned property, partly with incentives from National Grid. Locations include Quinsigamond Community College, Worcester Polytechnic Institute (6), Clark University (3), UMass medical school (8), Medical Center (2), the College of the Holy Cross (4), Worcester State University (2), and Broad Meadow Brook Conservation Center (2)	Y -	# of total privately-installed EV charging stations	
Electric Vehicles	E4 the Future	Good2Go Pilot	Project to create an affordable electric car-sharing program for Worcester.	2020 and ongoing		
Polar Park redevelopment	Multiple	MEPA Certificate and Community Benefits Agreement	Environmental commitments for Polar Park and associated mixed-use development include a variety of considerations and actions, such as reservation of up to 10 % of parking spaces with EV charging stations or EV-ready; Transportation Demand Management measures to minimize SOV trips; pedestrian and bicycle access improvements.	2021		
ONE WATER						
Local watershed management and advocacy	Watershed Associations	Establishment of active grassroots watershed associations	Establishment of several active grassroots watershed associations throughout the city: Coes Pond, Indian Lake, Lake Quinsigamond, Tatnuck Brook	1990s (early)		Links at http://www.worcesterma.gov/water-sewer/recreational-waters
Local watershed management and advocacy	Watershed Coalition	Formation of Blackstone Headwaters Coalition	City conservation and watershed groups team up to form the Blackstone Headwaters Coalition and group receives funding from the Greater Worcester Community Foundation	1990s (early)		
Local watershed management and advocacy	Blackstone Headwaters Coalition	Guide to Worcester as the Headwaters of the Blackstone	Designed and printed guide to Worcester as the Headwaters of the Blackstone - a team effort of Massachusetts Audubon and Worcester Historical Museum, funded by the Massachusetts Foundation for the Humanities	1990s (early)		
Local watershed management and advocacy	Blackstone River Coalition; Mass Audubon water testing lab	Water Quality Monitoring	Volunteers sample and test 30 sites in and around Worcester. About 90 volunteers cover 75 sites throughout the Blackstone River watershed from Worcester to Pawtucket. The testing lab is at Mass Audubon's Broad Meadow Brook Wildlife Refuge.			https://www.blackstoneheadwaterscoalition.org/water-monitoring.html
Local watershed management and advocacy	Coes and Parches Ponds Watershed Associations	Coes Dam rehabilitation	Secured state DEM funds to rehab Coes Dam which will ultimately become a historic park and conservation area.	2014		
Water Quality/ Stormwater	UMASS Amherst	Greening Worcester	Plan created by a team of UMass-Amherst graduate students in 2014, contains a variety of landscape and green infrastructure proposed designs for specific locations in the city.	2014		https://www.umass.edu/larp/project/greening-worcester-planning-and-designing-green-infrastructure-networks-habitat-recreation
Conservation/ Stormwater	Worcester Polytechnic Institute	Sports & Recreation Center	Underground cisterns to capture rainwater installed at the Sports and Recreation Center, capture rainwater that is later used to irrigate gardens around campus.			
Water Quality/ Stormwater	Worcester Polytechnic Institute	East Hall Green Roof	Green roof on East Hall reduces stormwater runoff and was the first green roof in the City of Worcester.			
Water Quality/ Stormwater	Worcester Polytechnic Institute	Massachusetts Water Resource Outreach Center	Study - Storm Water Runoff Reduction on the Worcester Polytechnic Institute Campus	2018		https://digital.wpi.edu/pdfviewer/rx913q48q
Polar Park redevelopment	Multiple	MEPA Certificate and Community Benefits Agreement	Environmental commitments for Polar Park and associated mixed-use development include a variety of considerations and actions, such as reduction in impervious area to reduce the urban heat island effect; stormwater management systems with increased capacity, use of rain gardens	2021		

GREEN PROJECT INVENTORY - NON-MUNICIPAL AND COMMUNITY PROJECTS						
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Environmental Education and Awareness Building	Mass Audubon	Green Infrastructure	Rain gardens at nature center and education center; rainwater collection			https://www.massaudubon.org/get-outdoors/wildlife-sanctuaries/broad-meadow-brook/programs-classes-activities
Water Quality/ Stormwater	Blackstone Headwaters Coalition	Rain Gardens Program	Rain Gardens - constructed at Mass Audubon, Worcester Youth Center, Clark U Admissions, Midland Street School, Fisherville and Regatta Point State Park, Worcester DEW&P Northeast Cutoff.			https://www.blackstoneheadwaterscoalition.org/
Water Quality/ Stormwater	Clark University	Rain Garden	Rain garden installed in front of admissions department.			https://www.clarku.edu/offices/campus-sustainability/sustainable-clark/food-water-landscape/
Environmental Education and Awareness Building	Blackstone Headwaters Coalition	Environmental Modeling	The Enviroscape Model used in classrooms and at public events demonstrates the effect of land use on waterway quality.			
WASTE						
Food Waste	UMASS Medical Center	Composting and organic waste management	Collecting food scraps from the 7500 meals it prepares per day and sending them to the Tyde Brook Farm in Holden for composting. They have also been recycling cooking oil.			
Food Waste	Umass Memorial Hospital		Recycling of kitchen oils	2010 and ongoing		
Food Waste	Regional Environmental Council	Composting and organic waste management	REC composts waste from the Mobile Market at its YouthGROW farm where it has large-scale composters but prefers donating food if possible to groups such as Rachel's Table, Catholic Charities, the Mustard Seed, and Ss. Francis and Therese Catholic Worker			
Food Waste	Institutions	Food waste diversion	Clark University; WPI, Assumption University and other institutions have some food waste composting			
Food Waste	Holy Cross	Food waste diversion	Trayless service reduces food waste; elimination of all styrofoam;			
Food Waste	WPI	Reducing and diverting food waste	Reduction of kitchen food waste (Trim Trax program); send about 60 tons of food waster annual to a pig farm for animal feed; food donation to local shelters, Food Recovery Network: student volunteers pick up food form dining halls and transport it to Worcester shelters.			
Construction & Demolition Waste	Multiple		Regional nonprofits and businesses in the waste diversion sector include: Habitat for Humanity ReStore, Massachusetts Housing Alliance Donations Clearinghouse, Worcester County Food Bank.			
Recycling and Waste Diversion	Umass Medical	Surplus reuse	SWAP (Surplus With a Purpose) Shop to facilitate reuse by students, faculty and staff of surplus office supplies, small furniture, and lab equipment.			
Recycling and Waste Diversion	Clark University	Multiple programs	EPA Waste Wise Partner; electronics recycling; excess furniture and supplies donations			https://www.epa.gov/smm/wastewise; https://connect.re-trac.com/login?identifier=wastewise
Recycling and Waste Diversion	WPI	Multiple programs	Annual waste audit; book and food donations. Establishments of "waste stations" that consolidate trash, recycling, plate/tray, and food waste bins.			
Recycling and Waste Diversion	Assumption University	Recycling programs	Resident hall single-stream recycling; maintenance recycling of batteries, scrap metal, light bulbs, vehicle oil, cooking oil, refrigerants and food cans; electronic recycling and donation program; zero waste station for recycling of items such as CFL light bulbs, ink cartridges, and office supplies; book donation program; paper shredding and recycling program			
Composting	Assumption University	Green waste and food waste programs	Composting of yard waste and food waste			
Recycling	Worcester State	Recycling programs	Single stream recycling since 2006			
Recycling	Holy Cross	Multiple programs	Waste diversion in place since mid-90s; single stream recycling adopted 2012			
FOOD SYSTEMS						

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Urban Agriculture	Regional Environmental Council	Multiple programs	Network of 67 gardens including community gardens, school gardens, and urban farm sites production for the market. Over 500 volunteer gardeners participate, including 18 schools (involving 2000 students) and senior centers. It began in 1992 with one garden and one volunteer. The community gardens produce over 15,000 pounds of food annually for consumption by gardeners Urban Farms. Urban farms produce for sale in the market.	Food programs began 1992 - ongoing		REC reports
Farmers' Markets and local food	Regional Environmental Council		Seasonal, year-round, and mobile farmers' markets.			REC reports
Farmers' Markets and local food	Regional Environmental Council and Seven Hills Foundation		REC collaboration to provide indoor food production for the Stearns Tavern café.	2020 and ongoing		
Farmers' Markets and local food	Worcester Public Market		About 30 food vendors, mostly selling value-added products.	2020 and ongoing		
Farmers' Markets and local food	Clark University	The Local Root	Student-run, on-campus fresh and local food market, including subscription and on-campus delivery service.	2012-2018		
Farmers' Markets and local food	Holy Cross	Multiple programs	Dining Services purchase 20-25% of all products from local companies sponsors a weekly farmer's market in season;			
Farmers' Markets and local food	WPI	Campus farmers market	Twice a month, August - November market			
Farmers' Markets and local food	Clark University and Worcester State	Fresh greens	Fresh greens grown on campus for dining halls			
Farmers' Markets and local food	Freight Farms		Co-founded by a Clark University alumnus, Freight Farms provides hydroponic farms in shipping containers, predominantly to the institutional market. Worcester State University and Clark University use Freight Farms to produce fresh greens for their dining halls. The company says that its first model consumed less than five gallons of water and 125 kWh of electricity a day and a new model was announced in 2019.	Ongoing		
Farmers' Markets and local food	WooSox	WooSox Farms	Urban farm on the second deck of the third base concourse at Polar Park. Supported by Harvard Pilgrim and managed by REC with YouthGrow farmers.	2021 and ongoing		REC expected to provide metrics
Farmers' Markets and local food	GW Chamber and Health Foundation of Central Mass	Worcester Regional Food Hub	Supported by the Greater Worcester Chamber of Commerce and supported by the Health Foundation of Central Massachusetts, the food hub seeks to strengthen sustainable agriculture by supporting and enhancing the production-to-distribution chain for local producers and small acreage farmers	2015 and ongoing		
Farmers' Markets and local food	Worcester Food Policy Council		3 focus areas: Healthy Food for All --fresh, culturally appropriate, and affordable fruits, vegetables, and healthy meals for all neighborhoods; Growing Urban Agriculture –ensure that anyone can farm land and sell their products in the City; Building a Food Movement for All – farmers, nutritionists, activists, researchers.			
	WPI	Food Recovery Network		2015 and ongoing		
POLLUTION PREVENTION						
Water Quality	DPW - Lakes & Ponds; volunteers; university and EPA partners	Worcester Cyanobacteria Monitoring Collaborative	Citizen scientists collect samples contribute to a national study; water treatments to reduce levels of phosphorus – an indicator for cyanobacteria – in the lakes, including an alum-dosing station triggered by stormwater levels going into Indian Lake, which has the greatest propensity for cyanobacteria; and partnering with universities and the EPA.	Ongoing		

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	Mass Audubon	Water Quality Lab	Water-testing lab at Broad Meadow Brook Wildlife Sanctuary. Volunteers sample and test 30 sites in and around Worcester. About 90 volunteers cover 75 sites throughout the Blackstone River watershed from Worcester to Pawtucket.	Ongoing		
CLIMATE CHANGE RESILIENCE						
Advocacy	WPI	Students for a Just and Sustainable Future	Focus on climate change awareness and projects.			
Advocacy	Climate Action Circle	Coalition	Citywide climate coalition			
Advocacy	350 Central Mass	Campaigns	Local affiliate of 305.org and 350 Mass for a Better Future. Campaigns to eliminate use of fossil fuels and promote climate justice.			https://www.350centralmass.org/
Advocacy	Mothers Out Front Worcester	Clean Heat, Clean Air Campaign	2021 campaign to stop expansion of polluting energy infrastructure and enact systemic change to provide clean, safe, and affordable heat to homes and businesses. Advocate for passage of state legislation.			https://www.mothersoutfront.org/team/massachusetts/worcester/
Advocacy	Mass Audubon - Broad Meadow Brook	Climate Cafes	Discusstions created and facilitated by high school students and open to all community members.			
Advocacy	Sunrise Worcester	Campaigns	Local affiliate of the national youth-led climate justice organization. Promotes immediate action and enacting a Green New Deal.			
Advocacy	Educational institutions	Student clubs	Student groups focused on climate change can be found at Worcester Technical Public School; Quinsigamond Community College; College of the Holy Cross (Eco-Action); Assumption University (Green Hounds); Worcester State University; Clark University; Worcester Polytechnic Institute; Bancroft School; St Peters Central Catholic School			
Polar Park redevelopment	Multiple	MEPA Certificate and Community Benefits Agreement	Environmental commitments for Polar Park and associated mixed-use development include a variety of considerations and actions, such as design and systems to increase resilience to projected climate conditions, including drought, extreme heat and increased precipitation, such as "cool roofs," dought resistant plantings, operable windows.	2019-20		
SUSTAINABILITY, RESILIENCE, AND GREEN EDUCATION IN ALL POLICIES						
Institutional Sustainability	Assumption University	Multiple	Greenhounds student sustainability club promotes individual and community sustainable practices. CRS Social Justice Ambassadors led a Fair Trade initiative resulting in approval by Fair Trade Colleges and Universities as a Fair Trade College.			https://www.assumption.edu/student-experience/sustainability
Institutional Sustainability	Clark University	Multiple	Climate Action Plan and updates (2007-2015); Climate-Friendly Investing Policy; green building design policy; Green Purchasing policy; Building Heating policy; Universal Waste Policy			www.clarku.edu/offices/campus-sustainability/policies/
Institutional Sustainability	Holy Cross	Multiple	Eco-Action student environmental group; Student Government Association established an environmental liaison in every residence hall			https://www.holycross.edu/campus-life/sustainability/office-sustainability
Institutional Sustainability	Worcester State	Multiple	Climate Action Plan. Students with a common interest in sustainability live together in a specific residence hall and are required to take a sustainability seminar.	2012		https://www.worcester.edu/Sustainability-Initiatives/
Institutional Sustainability	WPI	Multiple	Sustainability Plan 2012 and 2020; establishment of an Office of Sustainability and Director of Sustainability (2014); Greenhouse Gas Reduction Plan (2017); Annual Sustainability Report; Green Revolving Fund; Green Purchasing Policy. Sustainability Project Competition for undergraduate and graduate students (2008 and ongoing). Green Team student group runs events to raise awareness and runs Gompei's Gears bike share. The Student Sustainability Leaders Roundtable meets with the Office of Sustainability once each term to discuss initiatives and coordinate activities. Eco-Reps are volunteers who work with the Office of Sustainability to promote sustainable practices among students on campus.			Receipt of AASHE STARS Gold rating for overall performance in operational, educational, research, and community aspects of sustainability, 2017. https://www.wpi.edu/offices/sustainability
Institutional Sustainability	WPI	Green Revolving Fund	The fund finances projects for increased efficiency or reduced consumption that will produce savings that are reinvested in the fund each year.	2017 and ongoing		
Sustainability education	WPI	Programs open to community	Symposia and competitions; e-waste drive; discounted LEED Green Associate Certification course			

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Institutional Sustainability	Umass Medical	Multiple programs	Recycling and reuse programs; EV charging; energy conservation			https://www.umassmed.edu/growinggreen/
Urban Forestry education	Tower Hill Botanic Garden	Worcester Tree Initiative programs	Arbor Day/Week events; Master Tree Stewards Training Program; Community Tree Stewards; Community Planting Events; Young Adult Foresters; Urban Tree Syumposium	2009 onward		www.treeworcester.org/
Environmental Education and Awareness Building	The Blackstone Heritage Corridor Visitor Center at Worcester	Collaboration	The Blackstone Heritage Corridor Visitor Center at Worcester serves as a gateway to the Blackstone River Valley National Heritage Corridor, the Blackstone River Valley National Historical Park, and the City of Worcester. It provides visitors and residents a connection to recreational, historical, cultural and geographic attractions throughout the region.			
Environmental Education and Awareness Building	REC and others	Earth Day	Regional Environmental Council in concert with the Worcester Parks Dept, the EcoTarium and many others has established a strong and growing annual Earth day celebration in the city with educational programs, children activities and clean - ups involving dozens of cooperating organizations.	ongoing		
Green Joba	Green Jobs Academy	Weatherization job training	Provides entry level skills training and continuing education for in-demand, living wage jobs with a career ladder in the weatherization industry.			http://greenjobsacademy.org/
Environmental Education and Awareness Building	Worcester Institute for Senior Education		Assumption University hosts this group. Courses on sustainability topics. Special InterestGroup (SIG) on environmental issues: "examines public policy and the technoloty of how energy is produced, used, and conserved, and how our approach to energy can and should change in the future."	ongoing		https://assumptionwise.org/