

## Greenfield Municipal Net-Zero Operations Plan



*Solar panels installed on Greenfield's capped landfill on Cumberland Road. This project was the first of its kind in Massachusetts. This 2MW array supplies equivalent to 50% of the electricity needed to power municipal operations.*



**Franklin Regional  
Council of Governments**

## Acknowledgements

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## Introduction

The City of Greenfield has a steady record of reducing municipal greenhouse gas (GHG) emissions. In 2021, the Massachusetts Department of Energy Resources (DOER) recognized the City of Greenfield's efforts with a **Leading by Example Award for achieving a 67.7% reduction in greenhouse gas emissions since 2008**. While this is an impressive feat, the City is committed to continuing to pursue projects that will eliminate the use of fossil fuels and bring municipal operations to net-zero.

With funding provided from the MA DOER, the FRCOG provided technical assistance to the City of Greenfield to develop a community greenhouse gas (GHG) inventory and a municipal net-zero operations plan. Taken together, these documents provide a foundation for Greenfield's path towards net-zero over the next couple of decades.

## Planning Context

In 2015, 196 countries (including the United States) adopted the Paris Agreement, which is an international treaty on climate change. Its overarching goal is to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.<sup>1</sup> **The Paris Agreement includes 2°C as the upper limit for global warming, but scientists have concluded 1.5°C of warming should be the primary goal because it reduces the risk for the worst outcomes of climate change in most of the world, such as extreme heat waves, drought, and water stress.**<sup>2</sup> According to the International Panel on Climate Change's (IPCC)

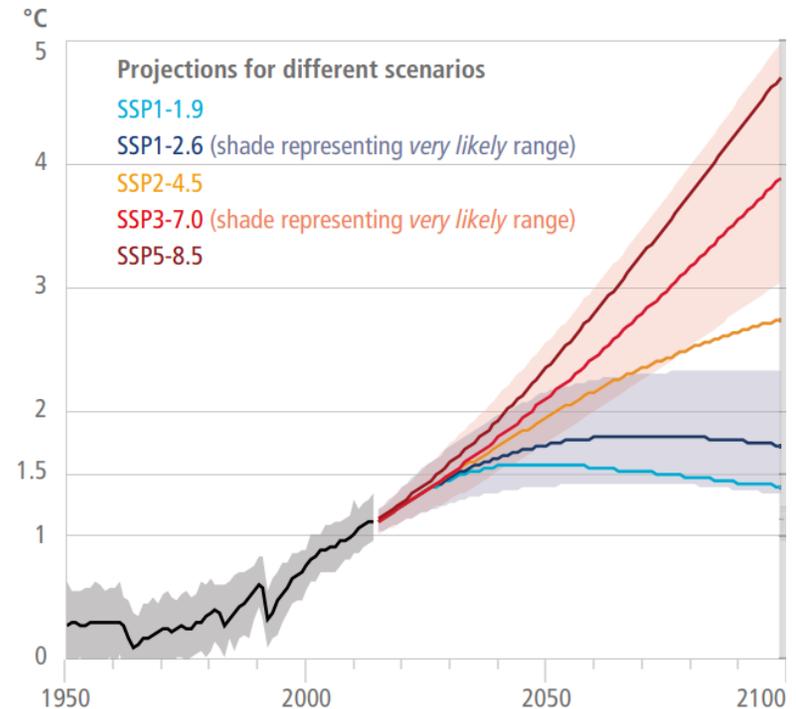


Figure 1. Global surface temperature change, increase relative to the period 1850-1900. SSP1-1.9 represents the scenario in which global CO<sub>2</sub> emissions fall to net-zero by 2050. Other projections included in the figure estimate changes in temperature if global CO<sub>2</sub> emissions begin either to decline after 2050, or never decline. For example, in the SSP5-8.5 scenario current levels of CO<sub>2</sub> are almost doubled by 2050. Scientists predict this would lead to over 2°C of warming by 2050. Source: International Panel on Climate Change (IPCC) Sixth Assessment Report Summary for Policymakers.

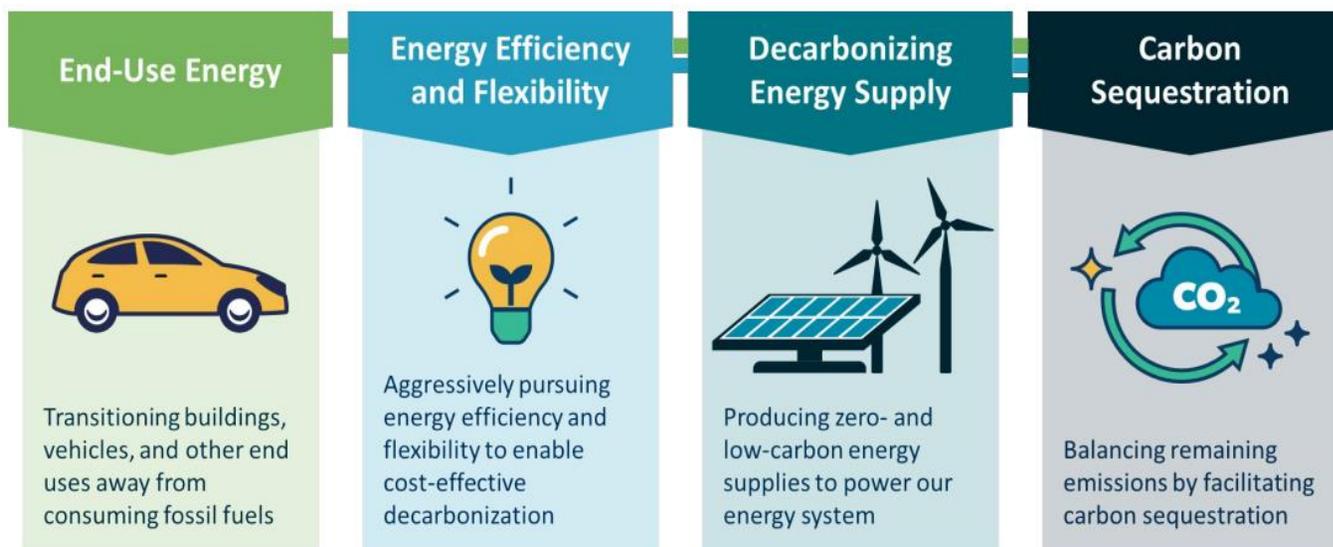
<sup>1</sup> United Nations Framework Convention on Climate Change. *The Paris Agreement*. <https://unfccc.int/process-and-meetings/the-paris-agreement>

<sup>2</sup> Massachusetts Institute of Technology Climate Portal. *Why did the IPCC choose 2°C as the goal for limiting global warming?* <https://climate.mit.edu/ask-why-did-ipcc-choose-2deg-c-goal-limiting-global-warming>

Sixth Assessment Report, which was released in 2023, limiting warming to around 1.5°C requires global GHG emissions to peak before 2025 at the latest, and be reduced by 43% by 2030.

In 2021, Massachusetts passed An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy (2021 Climate Law) with the ultimate goal of achieving Net Zero GHG emissions in 2050, becoming one of the first states in the country to establish such a limit. Reaching this limit requires an 85% reduction in GHG emissions from 1990 levels. Massachusetts, and Greenfield, like other parts of the world, are experiencing the impacts of climate change, including more frequent and intense heatwaves, more extreme weather events, and increased precipitation. **By transitioning to net-zero emissions, Greenfield can contribute to global efforts to mitigate climate change and reduce GHG emissions, thus minimizing the severity of these impacts.**

Near-term actions that limit global warming to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems, compared to higher warming levels, but cannot eliminate them all.<sup>3</sup> The IPCC's Sixth Assessment Report concluded there is a greater than 50% likelihood that global warming will reach or exceed 1.5°C in the near term, even under a very low



*Four Pillars of Decarbonization. MA Clean Energy and Climate Plan for 2050.*

<sup>3</sup> International Panel on Climate Change (IPCC) Sixth Assessment Report Summary for Policymakers. [https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC\\_AR6\\_WGII\\_SummaryForPolicymakers.pdf](https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf)

greenhouse gas emissions scenario, **thus underscoring the urgency for even small communities like Greenfield to reduce emissions and decarbonize as quickly as possible.**<sup>4</sup>

The impacts of climate change disproportionately affect priority populations. Priority populations in the context of climate change are people or communities who may be disproportionately impacted by climate change due to life circumstances that systematically increase their exposure to climate hazards or make it harder to respond.<sup>5</sup> Factors such as income, race, language, physical ability, access to transportation, health status, and age shape whether someone or their community will be disproportionately affected by climate change because of underlying contributors such as racial inequality, financial insecurity, or accessibility barriers that create vulnerability. By working to reduce municipal emissions and support efforts to limit global warming, Greenfield can work towards a more equitable and just future, ensuring that priority populations are not left behind and that the burden of climate change is shared more fairly.

### **Net-Zero Emissions**

Net-zero emissions refers to achieving a balance between the GHGs emitted into the atmosphere and the GHGs removed from the atmosphere. It involves reducing greenhouse gas emissions as much as possible and compensating for the remaining emissions through various methods, such as carbon sequestration. Simply put, achieving net zero means that all of the emissions in Massachusetts (and Greenfield) from transportation, residential energy use, commercial energy use, waste management, heat fuels, will be balanced to zero when factoring in carbon sequestration from forests, wetlands, and farmlands.

### **Municipal Net-Zero Operations Plan Scope**

This plan focuses on Greenfield's municipal energy use, which accounts for 2% of Greenfield's community GHG emissions. The Department of Energy & Sustainability hopes to continue net-zero planning at the community level in order to tackle emissions from the two largest sources in the City: residential transportation and residential building heating fuels. Please see the *City of Greenfield Community Greenhouse Gas Inventory*, which is included as an Appendix to this plan, for a full summary of GHG emissions.

### **Greenfield's Progress towards Net-Zero Emissions**

Greenfield became a designated Green Community in 2010. To become a Green community, municipalities must meet the following five criteria:

- Pass zoning in designated locations for the as-of-right siting of renewable or alternative energy generating facilities, research and development facilities, or manufacturing facilities;
- Adopt expedited application and permitting for renewable energy development;
- Adopt an Energy Reduction Plan (ERP) demonstrating a reduction of 20% of energy use after five years of implementation;

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<sup>4</sup> Ibid.

<sup>5</sup> Municipal Vulnerability Preparedness Toolkit: Environmental Justice & Equity. <https://resilientma.mass.gov/mvp/content.html?toolkit=justice>

- Adopt a Fuel-Efficient Vehicle Policy; and
- Adopt the Stretch Code.

Becoming a Green Community is advantageous for small communities with limited budgets, as the program provides grant funding for energy efficiency projects with no match requirements. Since 2010, Greenfield has been awarded \$892,325 in grant funds through the program, which have allowed the City to complete energy conservation and energy efficiency measures in the municipal buildings and implement other clean energy projects. **As of 2017, Greenfield is a “Specially Eligible Community” because the City achieved and has maintained their 20% energy use reduction goal.** This status enables Greenfield to apply for additional grant opportunities through the Green Communities program, such as funding for behavior-based energy efficiency programs, double the maximum award amounts for hybrid and battery-electric vehicles, community outreach programs, and other innovative clean energy projects.

The Department of Energy & Sustainability has a practice of working with project teams and other municipal department heads when the City is planning to construct new buildings and making recommendations to ensure the buildings will be net-zero energy ready. The City’s two most recent upgrades include a new Fire Station and a new Library. Both of these projects adhered to Eversource’s incentive program to confirm compliance with a net-zero ready pathway.<sup>6</sup> Greenfield used “Pathway 1” to design the buildings so that they met a number of requirements including low Energy Use Intensity targets (30 for the library and 35 for the fire station).<sup>7</sup> Meeting the requirements of Pathway 1 provided the City with the greatest financial incentives. At the end of one year of occupancy, Eversource will confirm that the buildings are performing as intended.

A summary of the progress Greenfield has made towards reducing municipal emissions is provided in the table below.

**Table I. Greenfield’s Progress 2010-2023**

Year	Action
2010	<ul style="list-style-type: none"> <li>▪ <b>Achieved Green Communities Designation</b>, which came with a grant that funded energy conservation measures lighting and sensors, energy staff position, feasibility study on electrical aggregation, and community energy efficiency program, in municipal facilities including Greenfield Middle School</li> </ul>
2012	<ul style="list-style-type: none"> <li>▪ <b>Constructed a 2MW solar farm on the City’s capped landfill that provides equivalent to 50% of municipal electricity</b></li> <li>▪ Installed four public EV charging stations on City property</li> </ul>

<sup>6</sup> Eversource uses three different pathways to determine financial incentives. More information is available via Mass Save: <https://www.masssave.com/en/business/programs-and-services/new-construction-and-major-renovations>

<sup>7</sup> More information about EUI targets is included on page 8, and a table showing the EUI of all municipal buildings is on page 10.

Year	Action
2014	<ul style="list-style-type: none"> <li>▪ Received a Green Communities Competitive Grant to fund LED streetlight conversion and building envelope improvements in the Green River School</li> <li>▪ All street, parking lot, park, and building lighting (interior and exterior) were upgraded to LEDs. This project began in 2014 and ended in 2019.</li> <li>▪ WMECo Main Street Program: Greenfield partnered with Eversource to install energy efficiency upgrades at approximately 50 businesses in and around downtown at no cost to the property owner</li> <li>▪ Solar Challenge: 500 KW of rooftop solar was added to homes and businesses through this program</li> <li>▪ Energy Smart Homes (2011-2014): A 3-year EPA Grant was utilized to connect all residents with MassSave and income eligible energy programs</li> </ul>
2015	<ul style="list-style-type: none"> <li>▪ <b>The City of Greenfield developed a <i>Sustainable Greenfield Master Plan</i></b>, and created the Sustainable Greenfield Implementation Committee to follow through with the Plan’s goals</li> <li>▪ The City created a municipal aggregation program (Greenfield Light &amp; Power), which delivers 100% renewably produced electricity to all residents at a competitive rate</li> <li>▪ Contracted with Siemens (ESCO) to complete energy upgrades to schools and municipal buildings</li> </ul>
2016	<ul style="list-style-type: none"> <li>▪ Greenfield adopted a Complete Streets Policy, which aims to upgrade streets and sidewalks to improve safety for walkers, bikers, wheelchair users, buses, and cars</li> <li>▪ Greenfield adopted a Tree Ordinance, which includes a commitment to plant one to two trees for every tree taken down depending on tree size, and allows the planting of trees in the tree belt</li> <li>▪ Constructed the new Greenfield High School, which achieved LEED Gold status</li> </ul>
2017	<ul style="list-style-type: none"> <li>▪ Received a Green Communities Competitive Grant to fund ASHP retrofits at City Hall and rooftop unit replacements at the Middle School and Four Corners School</li> <li>▪ Building Management Retro commissioning: improvements made at school buildings have resulted in 5% total savings in electricity costs at those buildings</li> <li>▪ <b>Governor Baker recognized the City for its outstanding leadership as a designated Green Community that reduced its municipal energy consumption by over 20% since achieving Designation</b></li> <li>▪ EPA Green Power Partner Community (2017- present): Greenfield continues to be acknowledged as an EPA Green Power Partner Community for utilizing 100% green electricity in Greenfield Light &amp; Power</li> </ul>
2018	<ul style="list-style-type: none"> <li>▪ Greenfield opened the Jon Zon Community Center, which is a zero-net-energy-ready facility</li> <li>▪ Greenfield opened the new DPW Office Building, which is a zero-net-energy-ready facility</li> </ul>
2019	<ul style="list-style-type: none"> <li>▪ Received a Green Communities Competitive Grant to fund replacing rooftop units at the Police Department</li> <li>▪ Installed eight EV charging stations in the Parking Garage through Eversource’s EV Make Ready Program</li> </ul>
2021	<ul style="list-style-type: none"> <li>▪ Constructed a 1.2MW solar farm on the City’s wellfield</li> </ul>

Year	Action
	<ul style="list-style-type: none"> <li>▪ Greenfield adopted the PACE program, which assisted in the implementation of the first Commercial PACE project in Massachusetts (Abercrombie Building on Bank Row)</li> </ul>
2022	<ul style="list-style-type: none"> <li>▪ Received a Green Communities Competitive Grant to fund installing heat pumps at the Wastewater Treatment Plant, installing EV charging stations at the Sanderson Street Offices, and two battery electric vehicles for the municipal fleet</li> <li>▪ Greenfield began constructing the new Fire Station, which will be a zero-net-energy-ready facility</li> </ul>
2023	<ul style="list-style-type: none"> <li>▪ Greenfield opened the new Library, which is a zero-net-energy-ready facility with solar PV</li> <li>▪ The Greenfield DPW received a donation from a private resident to fund a rooftop solar PV array, which will make the DPW Office Building the first municipal net-zero building</li> </ul>

### Green Municipal Aggregation

The main benefit of a community setting up a municipal aggregation program is that it allows all consumers to purchase electricity that is sourced by more renewable energy than is required by Massachusetts’ Renewable Portfolio Standard (RPS). The RPS requires regulated distribution companies (in Greenfield, Eversource) to provide customers with a minimum amount of renewable energy content. The RPS began with a compliance obligation of one percent in 2003, and increased by one-half percent annually until it reached four percent in 2009. In 2009, as a part of the Green Communities Act of 2008, the RPS Class I annual obligation was set to increase by 1% annually. In 2018, the legislature changed this to a 2% per year increase through the Clean Energy Standard (CES). Between the requirements set forth in the RPS and CES, at least 80% of the electricity sold in Massachusetts has to be clean or renewable by 2050.<sup>8</sup> As of 2023, electricity sold in Massachusetts must include a minimum



*The new Greenfield Public Library, located on Main Street, was constructed as a net-zero ready building. Photo credit: Paul Franz/Greenfield Recorder*

<sup>8</sup> Program Summaries: Summaries of all the Renewable and Alternative Energy Portfolio Standard Programs. <https://www.mass.gov/service-details/program-summaries>

of 59% clean energy resources, 22% of which comes from renewable energy projects that are located within the New England region.

In 2014, the City established Greenfield Light & Power to bring the benefits of renewable energy to its residents and businesses via municipal aggregation, and promote environmental sustainability and economic growth. Greenfield Light & Power enables residents to purchase clean electricity at the same cost or in some cases below the cost of basic service power from the utility. Greenfield is a Green Power Partnership community, as certified by the Environmental Protection Agency (EPA), because the aggregation program uses green power from “new” renewable energy facilities. EPA defines “new” as those facilities put into service within the last 15 years (on or after January 1 of the year 15 years prior to the current date). This rolling 15-year new date will help continuously drive the development of new renewables.<sup>9</sup>

The 2021-2024 aggregation plan offers three programs<sup>10</sup>:

- Standard Plan – with 5% additional Mass Class I RECs for 9.879¢/kWh
- Local Green Plan – with 82% additional Mass Class I RECs for 13.281¢/kWh
- Budget Plan – with 0% additional Mass Class I RECs for 9.629¢/kWh

Greenfield’s municipal electric account is enrolled in the Standard Plan. The City is working on creating the next 2-year aggregation plan and encourages more residents and businesses to consider enrolling in the Local Green Plan.

## Greenfield’s Municipal Emissions

Emissions associated with Greenfield’s municipal operations totaled 2,846 MTCO<sub>2</sub>e in 2022. A breakdown of emissions by fuel source is shown in Figure 3 below, and a more detailed GHG inventory is included as an Appendix to this Plan. The majority of the City’s emissions come from natural gas and fuel use for the municipal vehicle fleet. **Emissions associated with electricity and heating oil have decreased substantially since Greenfield began tracking energy use in Mass Energy Insight in 2008: emissions from electricity have declined by 39% and emissions from heating oil have declined by 96%.**<sup>11</sup> These impressive reductions are largely due to the City’s efforts to complete fuel-switching projects in the municipal buildings that use heating oil. To date, the City has successfully electrified four of the 15 municipal buildings, with the new fire station

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<sup>9</sup> Eligible renewable energy facilities include solar photovoltaic, wind, geothermal, eligible hydropower, eligible biomass, co-firing of eligible forms of biomass with non-renewables (acceptable under certain conditions), biodiesel-fueled (B100) generators, fuel cells using eligible fuel sources listed above. For more information about eligibility, and the program, see the EPA’s Green Power Partnership Requirements:

[https://19january2017snapshot.epa.gov/sites/production/files/2016-01/documents/gpp\\_partnership\\_reqs.pdf](https://19january2017snapshot.epa.gov/sites/production/files/2016-01/documents/gpp_partnership_reqs.pdf)

<sup>10</sup> The 2021-2024 plan will run through January 2024 meter reads.

<sup>11</sup> Please note Greenfield’s municipal electric use has increased since 2008 due to the ongoing electrification of buildings, but overall emissions have substantially decreased because Massachusetts’ grid is being powered by a larger mix of renewable energy in 2023 than in 2008.

soon to be the fifth, and the wastewater treatment plant currently undergoing fuel-switching project from oil to heat pumps. School buildings were previously heated with oil, but the City completed upgrades so that the boilers now use natural gas.

Emissions from vehicle fuel use have not substantially declined since the City became a Green Community in 2010 due to the limited market availability of heavy-duty electric vehicles. However, the Director of Energy & Sustainability commissioned a fleet study for the City's vehicles, which will help to identify opportunities to finance fuel-efficient upgrades. The City hopes to complete the study by 2024. Additionally, the City looks forward to working with the Police Department to purchase all electric vehicles and install charging stations at their station, as soon as viable options become available for their fleet.

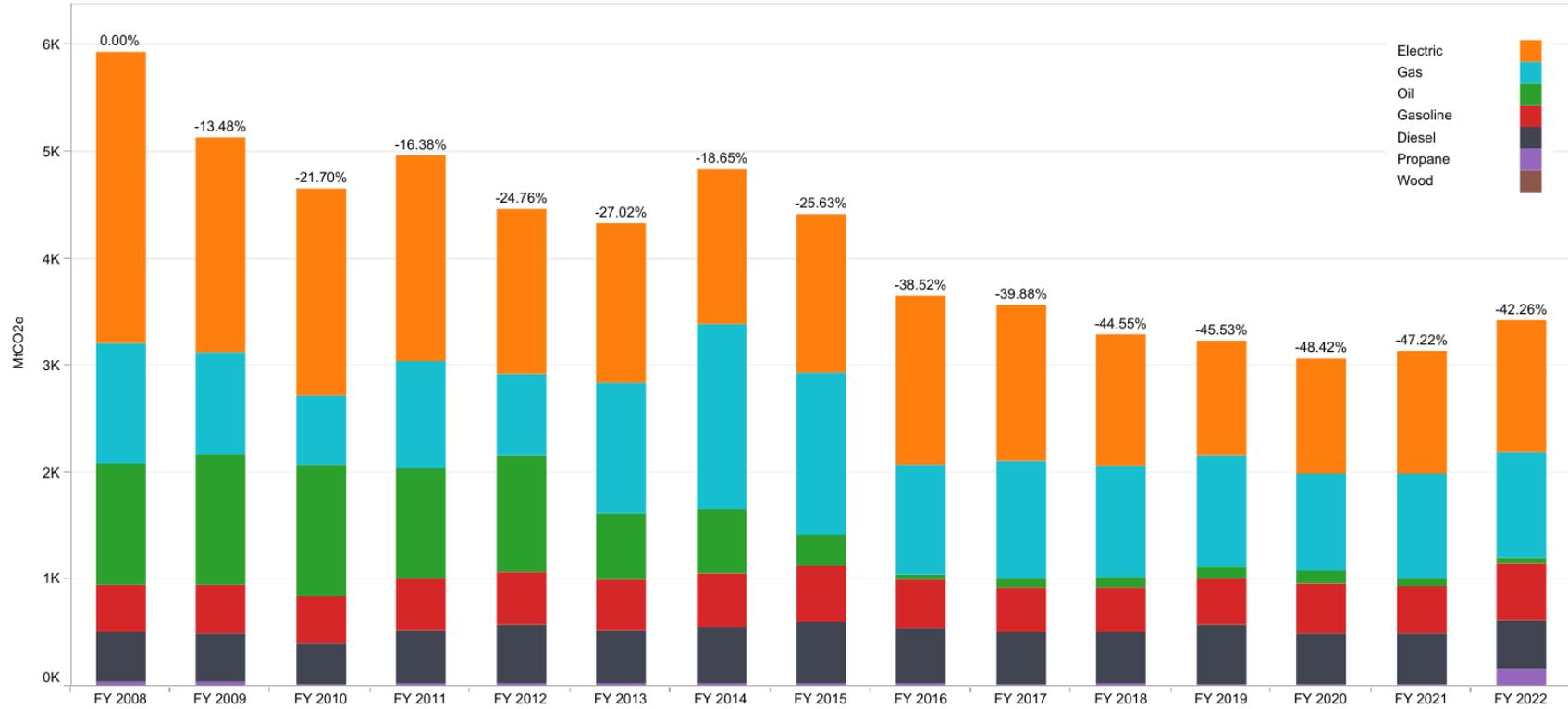
The Director of Energy & Sustainability maintains a list of all municipal buildings along with their associated Energy Use Intensity (EUI), which is presented below in Table 1. EUI is calculated based on the energy required to operate the building per square foot, and is a useful measure because it normalizes comparisons between buildings. In Greenfield, buildings with an EUI of 40 kBTU/sf or less are considered energy efficient, whereas buildings with an EUI of 60 kBTU/sf and greater are considered high priorities for energy reduction. The Transfer Station and Police Station have the highest EUIs. Both of these buildings present challenges for decarbonization, but they remain high priority buildings to target for energy efficiency improvements.

## **Roadmap to Net-Zero Municipal Operations**

As noted, the Greenfield Director of Energy & Sustainability has been working to decrease GHG emissions associated with the City's day-to-day activities. The City of Greenfield will continue to decrease emissions by:

- Decarbonizing municipal buildings by eliminating the use of fossil fuels
- Installing rooftop solar on municipal facilities
- Decreasing emissions associated with the vehicle fleet
- Purchasing electricity sourced from renewables and supporting the state's transition to a clean electric grid

The following Action Plan details how Greenfield will pursue these goals over the next several years.



**Figure 2. Greenfield Municipal Emissions by Fuel Source, FY2008 to FY2022**

Source: Mass Energy Insight.

*Please note the use of propane is due to the temporary Fire Station. Propane use was exceptionally high in FY22, as there were some issues with the apparatus bays.*

**Table 2. Energy Use Intensity of Greenfield's Municipal Facilities, FY 2021.**

		Electricity 2021			Natural Gas 2021			Oil 2021			2021 Total	
SF	Building	kWh	MMBtu	BTU/sf	Therms	MMBtu	BTU/sf	Gallons	MMBtu	BTU/sf	kbtu/sf	
20,570	Green River School (not in use- winterized)	25,403	87	4,214	0	0	0	0	0	0	4	<b>Energy efficient Buildings (&lt;40 kBTU/sf/year)</b>
7,200	Vet's Field House (winterized Dec-March)	11,599	40	5,497	0	0	0	0	0	0	5	
9,928	Community Center	93,422	319	32,107	0	0	0	0	0	0	32	
1,500	DPW Offices	13,542	46	30,804	0	0	0	0	0	0	31	
169,650	High School	894,240	3,051	17,985	31,921	3,192	18,816	0	0	0	37	
16,430	City Hall	182,320	622	37,862	3	0	18	0	0	0	38	
35,377	Town Yard	68,487	234	6,605	10,256	1,026	28,991	0	0	0	36	
14,410	20 Sanderson St	33,840	115	8,013	4,322	432	29,993	0	0	0	38	
62,140	Federal St School	169,120	577	9,286	22,408	2,241	36,061	0	0	0	45	<b>Look for opportunities to achieve &lt;40 kBTU/sf/year</b>
29,590	North Parish School	82,720	282	9,538	10,665	1,067	36,043	0	0	0	46	
37,439	Four Corners School	130,476	445	11,891	14,237	1,424	38,027	0	0	0	50	
32,732	Newton St + Mods	138,499	473	14,437	11,708	1,171	35,769	0	0	0	50	
120,692	Middle School	595,200	2,031	16,826	50,511	5,051	41,851	0	0	0	59	
21,200	Fire Station*	102,579	350	16,509	876	88	4,132	4,341	603	28,462	49	
15,990	Library*	80,125	273	17,097	7,944	794	49,681	0	0	0	67	<b>Top priorities for energy reduction</b>
11,500	Police Station	179,200	611	53,168	6,036	604	52,487	0	0	0	106	
7,707	Transfer Station	58,592	200	25,940	12,720	1,272	165,045	0	0	0	191	

Source: Greenfield Director of Energy & Sustainability

\* The Fire Station and Library have been decommissioned; data for the new buildings are not yet available.

**Table 3. Net-Zero Municipal Buildings Action Plan**

<i>Overarching goal for Greenfield’s Municipal Buildings: Decarbonize and reduce/eliminate the use of fossil fuels for heating and cooling.</i>					
<b>Building(s)</b>	<b>Action</b>	<b>Potential Co-Benefits</b>	<b>Funding</b>	<b>Lead/Partners</b>	<b>Progress</b>
<b>Police Station, Transfer Station</b>	Conduct energy audits and/or feasibility studies for upgrading the HVAC systems for municipal buildings with the greatest EUI ratings. Look at operational changes at the transfer station since building upgrades are likely unfeasible.	Reduced operational costs; increased access to renewable energy; improved building resiliency.	Green Communities Municipal Energy Technical Assistance Grant (META)	Director of Energy & Sustainability, Central Maintenance, FRCOG	The Transfer Station has a high EUI and will be challenging to improve; an engineering/building study would help to determine next steps.
<b>School buildings, Town Yard, 20 Sanderson Street Offices</b>	Conduct a feasibility study for electrifying the remaining municipal buildings that rely on fossil fuels.	Increased access to renewable energy; improved building resiliency.	Municipal Energy Technical Assistance Grant (META)	Director of Energy & Sustainability, FRCOG	The City has electrified 4 of the 15 municipal buildings. A feasibility study would also help to determine costs associated with electrification. Geothermal is a preferred option for some of the school buildings, costs permitting. Extreme heat threatens school closures, so heat pumps that provide heating and cooling is a priority.
<b>All</b>	Explore financing incentives available through the Inflation Reduction Act (IRA) for rooftop solar on municipal buildings.	Reduced operational costs; increased access to renewable energy through on site generation; improved building resiliency.	City funds, Grants, IRA Direct Pay Option	Director of Energy & Sustainability, Finance Director	All buildings that are good candidates for rooftop solar have been assessed, but funding is needed to install the arrays.
<b>Green River School</b>	Upgrade the building’s electrical system so that it can support a heat pump HVAC system as well as a rooftop solar array.	Increased access to renewable energy; improved building resiliency.	City funds	Director of Energy & Sustainability, Central Maintenance	Future use of the building TBD. Funding is needed in order to complete this work.

*Overarching goal for Greenfield's Municipal Buildings: Decarbonize and reduce/eliminate the use of fossil fuels for heating and cooling.*

<b>Building(s)</b>	<b>Action</b>	<b>Potential Co-Benefits</b>	<b>Funding</b>	<b>Lead/Partners</b>	<b>Progress</b>
<b>All municipal buildings</b>	Develop and implement operation and maintenance processes for operating the heating and cooling systems at all municipal buildings.	Increased awareness of energy consumption; reduced operational costs.	Green Communities Competitive Grant Program	School Facilities Staff, Director of Energy & Sustainability, Central Maintenance	City Staff will need to work with Staff at the Schools to implement energy saving practices. Because Greenfield is a Specially Eligible Community, the City is eligible for grant funds through the Green Communities program for behavior-based energy efficiency training programs.
<b>Eligible Municipal Buildings</b>	Explore microgrids fueled by renewable energy as they become viable. Prioritize sites that provide essential services to increase community resiliency.	Increased access to renewable energy; improved building resiliency.	Municipal Vulnerability Preparedness Program	Eversource, Director of Energy & Sustainability	The City would like to increase resiliency at eligible municipal buildings with battery storage and explore replacing backup generators with battery storage in tandem with implementing rooftop solar where applicable.
<b>Waste Water Treatment Plant</b>	Participate and invest in demand management programs. Tap into incentives from the utility and ISO New England, the regional grid system operator, and install building energy technologies that enable load management tactics.	Reduced operational costs.	Staff Time	WWTP Superintendent, Director of Energy & Sustainability, UMass Clean Energy Extension	A demand management program could be a possibility for the WWTP, but would require some research.

**Table 4. Net-Zero Municipal Transportation Action Plan**

<i>Overarching goal for Greenfield’s Municipal Vehicles: Reduce the City’s reliance on gasoline and diesel fuel to power the municipal vehicle fleet.</i>					
<b>Department</b>	<b>Action</b>	<b>Potential Co-Benefits</b>	<b>Funding</b>	<b>Lead/Partners</b>	<b>Progress</b>
<b>Municipal Vehicle Fleet</b>	Adopt a zero emission municipal fleet policy. Commit to a complete transition by no later than 2033 for all vehicle uses with viable zero emission makes and models.	Reduced air pollution; reduced operational costs.	Green Communities Competitive Grant Program; Mass EVIP; City funds	Director of Energy & Sustainability, Police Department, DPW	The City has commissioned a fleet study with completion planned by 2024.
<b>Sanderson Street Building, Police Station, Schools</b>	Install EV charging stations where they will be needed to support an electric municipal fleet.	Reduced air pollution by supporting the adoption of EV vehicles.	Green Communities Competitive Grant Program; Mass EVIP	Director of Energy & Sustainability	The City is working on upgrading the electric system at the Sanderson Street offices so an EV charging station can be installed in Fall 2023. There are currently no chargers at the Police Station or at the schools. The City is exploring EV options for these locations and will install chargers as needed.
<b>Schools</b>	Work with a third party vendor to secure electric school buses. Commit to develop a plan by 2033 and undergo full electrification.	Reduced air pollution by supporting the adoption of EV vehicles.	EPA Clean School Bus Grants	Director of Energy & Sustainability, School Committee, School Transportation Director	The City has looked into electrifying the school bus fleet, however, access to charging poses a potential hurdle.

**Table 5. Net-Zero Programmatic Changes & Public Outreach Actions**

<i>Overarching goal for Greenfield's Operations and Community Outreach: Continue to implement practices that decrease the City's GHG emissions</i>					
<b>Program</b>	<b>Action</b>	<b>Potential Co-Benefits</b>	<b>Funding</b>	<b>Lead/Partners</b>	<b>Progress</b>
<b>Clean Energy Supply</b>	Continue to offer a municipal aggregation program that allows residents to purchase electricity produced by renewables.	Increased stability in electricity prices; greater percentage of renewable electricity than is required by state law.	Funded through the competitive supply contract	Greenfield Department of Energy & Sustainability	Greenfield is in the process of developing the new supply contract for 2024-2026 with increased Class I REC content in the standard offer (10%).
<b>Building Code</b>	Adopt a policy that would require all new buildings and major renovations to be free of fossil fuels.	Increased access to renewable energy; improved building resiliency; lower energy costs.	Staff time for education & outreach	Greenfield Department of Energy & Sustainability, City Council, Inspector of Buildings	The City is looking at the new Specialized Opt-In Stretch Code once more feedback is available, and is interested in pursuing a fossil fuel free ordinance if the pilot program is expanded across MA. The City recognizes the importance of implementing a policy that will result in decarbonized buildings.

*Overarching goal for Greenfield's Operations and Community Outreach: Continue to implement practices that decrease the City's GHG emissions*

Program	Action	Potential Co-Benefits	Funding	Lead/Partners	Progress
<p><b>Capital Planning</b></p>	<p>Use the capital planning matrix to evaluate all projects against current energy and sustainability goals, including the Sustainable Master Plan. Continue vetting all vehicle purchases through the Energy &amp; Sustainability Department to ensure adherence to the Green Communities Fuel Efficient Vehicle Policy. Ensure all building upgrades and retrofits meet energy and sustainability criteria. Apply the recommendations from recent new construction projects for new municipal buildings to achieve net-zero or net-zero ready status.</p>	<p>Reduced operational costs; increased access to renewable energy.</p>	<p>Staff time</p>	<p>Greenfield Department of Energy &amp; Sustainability, City Council, Sustainable Greenfield Implementation Committee, Planning and Construction Committee</p>	<p>This was a recommendation in the City's Municipal Vulnerability Preparedness Plan. Capital projects should be vetted by the Department of Energy &amp; Sustainability to ensure they adhere to the City's Sustainable Master Plan, and support the state's climate goals.</p>

*Overarching goal for Greenfield's Operations and Community Outreach: Continue to implement practices that decrease the City's GHG emissions*

<b>Program</b>	<b>Action</b>	<b>Potential Co-Benefits</b>	<b>Funding</b>	<b>Lead/Partners</b>	<b>Progress</b>
<b>City Processes</b>	Integrate the Department of Energy & Sustainability into the process of reviewing new building projects for residential and commercial projects.	Reduced operational costs for building owners that implement energy efficiency measures.	Staff time	Greenfield Department of Energy & Sustainability, Department of Planning and Development, Planning Board, Inspector of Buildings	This is a new practice of the Department of Planning and Development to notify and seek comments from Energy & Sustainability for projects seeking Planning Board approval.
<b>Public Education &amp; Outreach</b>	Train Planning Board, Building Inspectors, and related staff in net-zero building standards to familiarize them with high-performance building practices, to empower them to conduct relevant energy and performance calculations during plan review, and to enable inspectors to identify common construction mistakes and code violations so that they can conduct effective inspections.	Increased understanding leading to increased adoption; reduced operational costs for building owners that implement energy efficiency measures.	Staff time	FRCOG	This could be an effective practice on the regional level. The City could work with surrounding towns or FRCOG to host a regional training on net-zero building standards.
	Continue to promote Mass Save rebates & incentives, and other available funding opportunities to help residents decrease their reliance on fossil fuels.	Increased awareness of energy consumption; increased building energy efficiency; increased access to renewable energy; reduced energy bills.	Staff time	Department of Energy & Sustainability	Current practice of the Department of Energy & Sustainability; Energy related programs are listed on the Department website.
	Advocate with Greenfield's Legislative Delegation to overhaul Mass Save to make it easier for	Increased building energy efficiency; increased access	Staff time	Department of Energy &	Director has been advocating with stakeholder groups.

*Overarching goal for Greenfield's Operations and Community Outreach: Continue to implement practices that decrease the City's GHG emissions*

<b>Program</b>	<b>Action</b>	<b>Potential Co-Benefits</b>	<b>Funding</b>	<b>Lead/Partners</b>	<b>Progress</b>
	residents and commercial businesses to navigate.	to renewable energy; reduced energy bills.		Sustainability; FRCOG	

## **Implementing the Greenfield Municipal Net-Zero Operations Plan**

The Department of Energy & Sustainability has already led many efforts to reduce Greenfield's municipal emissions, and will continue to work on the action items outlined in this Plan to reach net-zero emissions by 2050. Implementing many elements of this plan will require input and buy-in from other municipal departments. Next steps include:

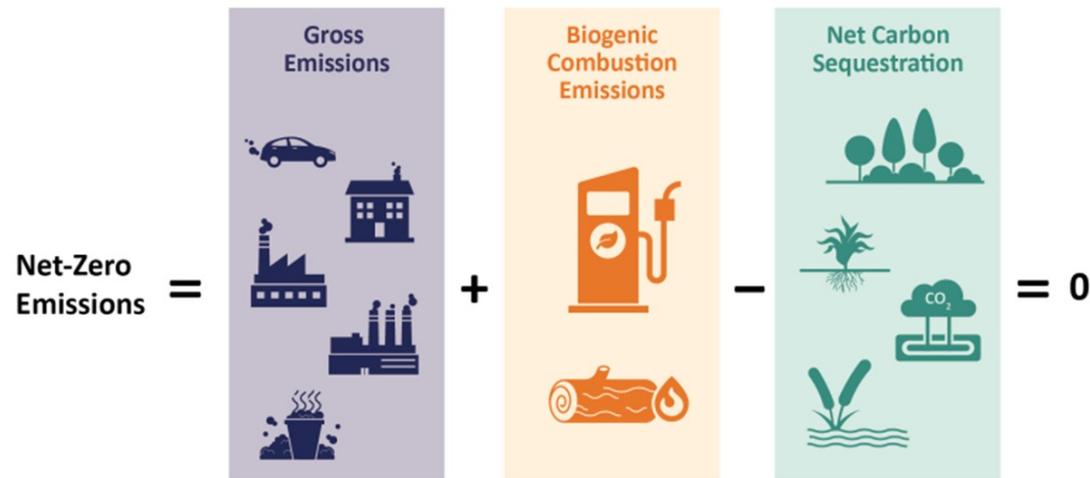
- Reviewing the Greenfield Municipal Net-Zero Operations Plan with the Sustainable Greenfield Implementation Committee
- Partnering with the FRCOG to continue this planning effort at the community level, and presenting this Plan to residents during the scoping process
- Continuing to apply for competitive grants through the Green Communities program and other appropriate outlets to decarbonize municipal buildings and upgrade the municipal vehicle fleet

## **Appendix: City of Greenfield Community Greenhouse Gas Inventory**

## **Appendix: City of Greenfield Community Greenhouse Gas Inventory**

# City of Greenfield

## Community Greenhouse Gas Inventory



Source: MA Clean Energy and Climate Plan for 2050



**Franklin Regional  
Council of Governments**

*Prepared June 2023 for the Greenfield Department of Energy  
and Sustainability*

*Funding provided to the FRCOG by the MA Department of  
Energy Resources (DOER)*

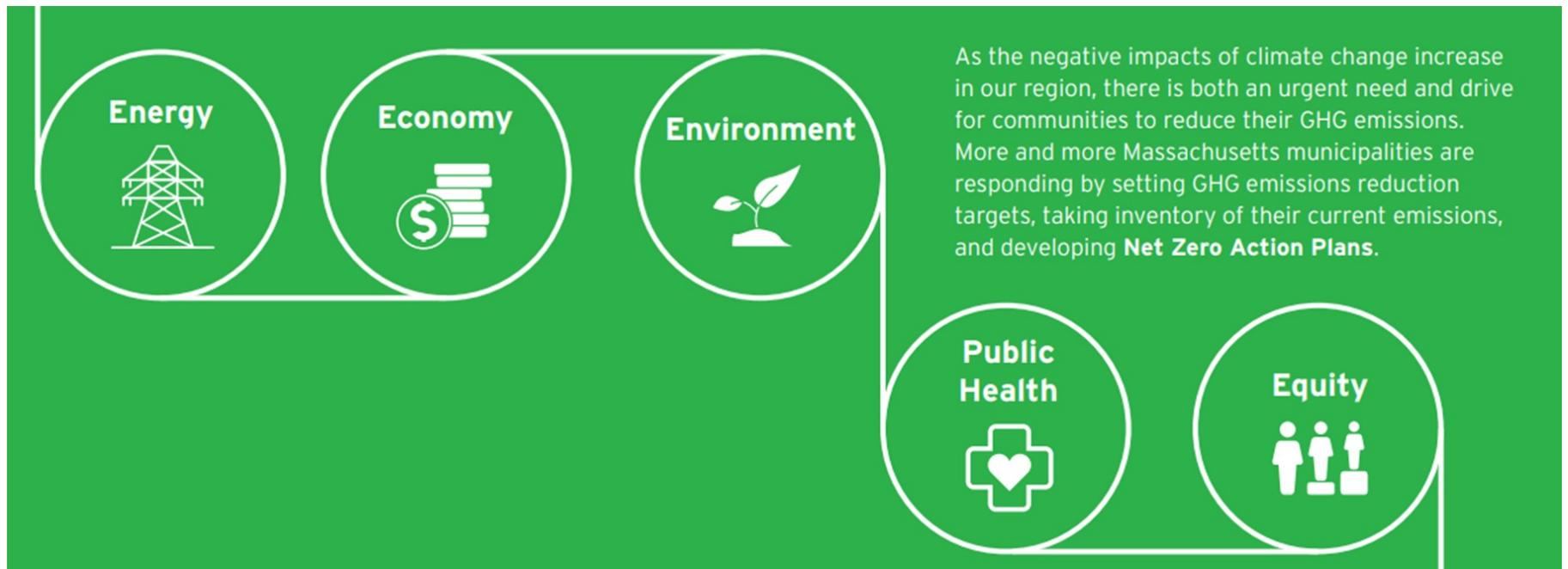
# Introduction

A greenhouse gas (GhG) inventory provides a baseline from which to measure progress against and a method for benchmarking the effectiveness of local climate mitigation programs and policies. The data produced provides a local understanding of how residents, businesses, and municipal operations contribute to the community's GhG emissions footprint.

The MA Executive Office of Energy and Environmental Affairs (EEA) established a goal for net-zero emissions by 2050, which is an 85% decrease in emissions from 1990. Achieving net zero means that all of the emissions in the state from transportation, residential energy use, commercial energy use, waste management, and heat fuels will be balanced to zero when factoring in carbon sequestration from forests, wetlands, and farmlands.

Greenfield is taking an important step by completing a greenhouse gas inventory on the community scale. Once a baseline is in place, the city will be in a position to develop an action plan to achieve net-zero emissions.

This community GhG inventory was developing using methodology provided by the Metropolitan Area Planning Commission (MAPC) and UMass Clean Energy Extension. The FRCOG thanks both of these organizations for providing essential resources and guidance.



Source: MAPC's Net Zero Framework for Action

# Methodology

One of the primary goals for the community GhG inventory is to have an easily replicable tool that can be updated year after year as more data become available. This inventory relies on the use of publicly available datasets that are updated on a somewhat frequent basis. Therefore, there are several instances that required the use of proxy data. As better data become available, the inventory can be updated. Additionally, this inventory uses data that are **precise** and **relevant** for Greenfield. This ensures the emissions inventoried are associated with the residents and businesses of the municipality, and are emissions that are under the direct control of municipal residents, businesses, or officials. If the municipality or residents take actions to decrease their emissions, these actions should be apparent in emissions data over time.

Data were collected from 2015 and 2019 as a way to assess how emissions changed over a 4-year period. Data from 2020 are the most recent available, but were not used due to pandemic related data anomalies for municipal and commercial energy use.

## Categories Included in the Inventory

This inventory focuses on Scope 1 and Scope 2 emissions, as defined by the Global Protocol.<sup>1</sup> As previously noted, the tool developed by MAPC aims to simplify the process of developing a GhG inventory by using publicly available datasets, while maintaining high levels of accuracy. Therefore, some sources of GhG emissions are not included in this tool. Examples of excluded sources of emissions include stationary energy related to agricultural, forestry, and fishing activities, off-road vehicles, and small equipment powered by fossil fuels such as lawnmowers and chainsaws.<sup>2</sup>

Scope	Definition
<b>Scope 1</b>	GhG emissions from sources located within Greenfield's boundary
<b>Scope 2</b>	GhG emissions occurring as a consequence of the use of grid-supplied electricity, heat, and/or cooling within Greenfield's boundary
<b>Scope 3</b>	All other GhG emissions that occur outside the city boundary as a result of activities taking place within Greenfield's boundary

Electricity, transportation, and building heating fuels are the main categories included. Emissions from each of these categories are provided for residential, municipal, and commercial energy uses. This inventory also accounts for emissions offset by carbon sequestration occurring within Greenfield's boundaries.

<sup>1</sup> More information about the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories can be found online: [https://ghgprotocol.org/sites/default/files/standards\\_supporting/GPC\\_Executive\\_Summary\\_1.pdf](https://ghgprotocol.org/sites/default/files/standards_supporting/GPC_Executive_Summary_1.pdf)

<sup>2</sup> MAPC's Greenhouse Gas Inventories for Massachusetts Cities & Towns Step-by-Step Guide can be found online: [https://www.mapc.org/wp-content/uploads/2020/03/04102020\\_MAPC-Step-by-Step-GHG-Inventory-Guide.pdf](https://www.mapc.org/wp-content/uploads/2020/03/04102020_MAPC-Step-by-Step-GHG-Inventory-Guide.pdf).

## Electricity Use

**Definition:** Includes emissions released in the process of generating electricity for all end uses (lighting, appliances, heating, transportation). Emissions are based on the electricity ratepayers in the community purchase, use, and claim credit for. Does not include any electricity generated in the municipality.

### Data Sources

Residential	Mass Save Municipal Profile
Municipal	Mass Energy Insight
Commercial	Mass Save Municipal Profile & Municipal Aggregation Data

**Data Quality:** These data are specific to the municipality and highly accurate.

**Emissions Factors:** Reported in Mass Energy Insight.

**Considerations:** Greenfield participates in a municipal aggregation program. Most residents opt into a plan that allows them to purchase renewable electricity generated by national wind farms. Some residents opt to pay a higher rate to purchase electricity sourced by MA Class 1 RECS. This requires the utility to secure locally produced renewable energy, in addition to what is required by the state’s Renewable Portfolio Standard. Energy purchased by Greenfield residents under this option was subtracted from total energy use in the city. Although the basic plan supports the purchase of renewables, they are accounted for in the emissions factors.

## Building Heating Fuel Use

**Definition:** Includes emissions released in the process of heating building spaces and hot water using oil, propane, and coal. Electricity use for heating is not included in this category, because it is included in the electricity category.

### Data Sources

Residential	American Community Survey Energy Information Administration Assessor Parcel Data
Municipal	Mass Energy Insight
Commercial	MA Executive Office of Labor and Workforce Development (EOWLD) Employment and Wages (ES-202) data Energy Information Administration

**Data Quality:** Data for the municipality are very accurate, as they are collected on an annual basis. Residential heating fuel use is estimated based on the number of households using a specific type of fuel as reported in the American Community Survey, and how much fuel is used based on dwelling type as reported by the EIA. Commercial fuel use is based on an estimate developed by MAPC.



*An architectural rendering of Greenfield’s new Public Library, which is currently under construction. The building will be net-zero with rooftop solar PV panels.*



## Transportation Emissions

**Definition:** Includes emissions released in the process of burning fuels to operate commercial, municipal, and personal vehicles within Greenfield. Electricity use for transportation is not included in this category, because it is included in the electricity category. Public transportation data could not be obtained for the purposes of this inventory. UMass Clean Energy Extension is working on coming up with a way to track emissions for public transportation.

### Data Sources

<b>Residential</b>	MAPC data from the RMV
<b>Municipal</b>	Mass Energy Insight
<b>Commercial</b>	MAPC data from the RMV

**Data Quality:** Private vehicle fuel use can be calculated based on mileage traveled and mpg for most private vehicles, based on RMV data. The most recent data available are from Q4 2014; MAPC is working on updating these data through 2020. Municipal data is accurate and reported on an annual basis.

**Emissions Factors:** Reported in Mass Energy Insight.

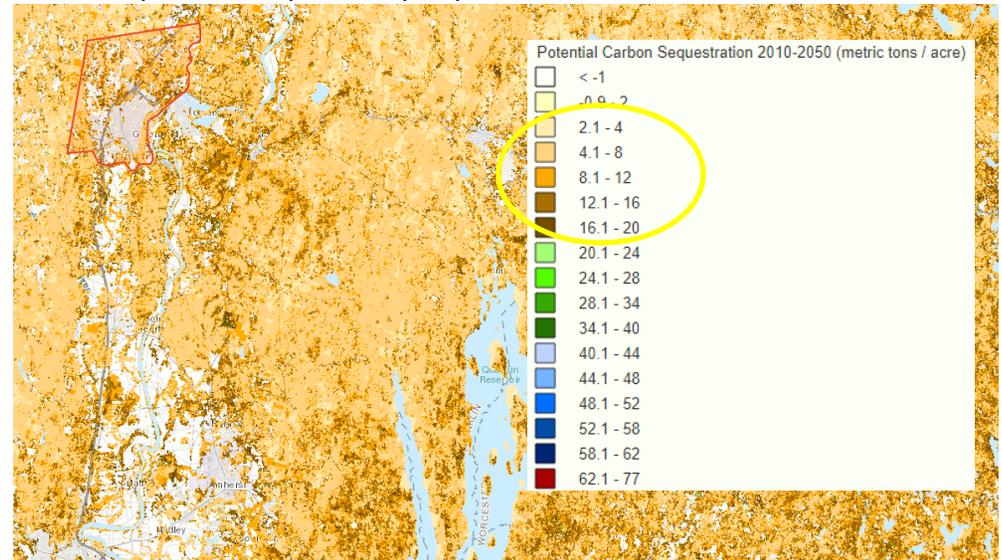
**Considerations:** Emissions are calculated based on the miles traveled and fuel economy of vehicles based in Greenfield, and not on the estimates of emissions generated by vehicles as they move through Greenfield.



## Carbon Sequestration

**Definition:** The process of removing carbon from the atmosphere for use in photosynthesis, resulting in the maintenance and growth of plants and trees. The rate (or amount and speed) at which a forest sequesters carbon changes over time.<sup>3</sup>

**Data Sources:** Carbon sequestration estimates are based on a dataset derived from the National Forest Carbon Monitoring System (NFCMS).<sup>4</sup> The Nature Conservancy has a Resilient Lands Mapping Tool that applies this dataset to selected areas. Users can draw a polygon and obtain estimates of carbon sequestration per acre per year.



*Snapshot of the Nature Conservancy's Resilient Lands Mapping tool. According to the tool, Greenfield's forests will sequester 2 to 16 metric tons of carbon per acre by 2040.*

**Data Quality:** These estimates rely on national datasets, but are the best available at this point in time.

<sup>3</sup> Forest Carbon: An essential natural solution for climate change. UMass Amherst 2019.

[https://masswoods.org/sites/masswoods.org/files/Forest-Carbon-web\\_1.pdf](https://masswoods.org/sites/masswoods.org/files/Forest-Carbon-web_1.pdf)

<sup>4</sup> <https://maps.tnc.org/resilientland/>

# Greenhouse Gas Emissions Inventory

Emissions in Greenfield totaled 142,411 MTCO<sub>2</sub>e in 2019.<sup>5</sup> This represents an 11% decrease from emissions in 2015. Greenfield’s emissions are roughly equivalent to 30,685 gasoline-powered passenger vehicles driven for one year, or 8 MTCO<sub>2</sub>e per resident.<sup>6</sup>

**Residential transportation accounts for over a third of all emissions generated by the community.** This inventory uses 2015 transportation as a proxy, because 2019 data won’t be available until 2023. As residents move to driving EVs, emissions from this category will continue to decrease.

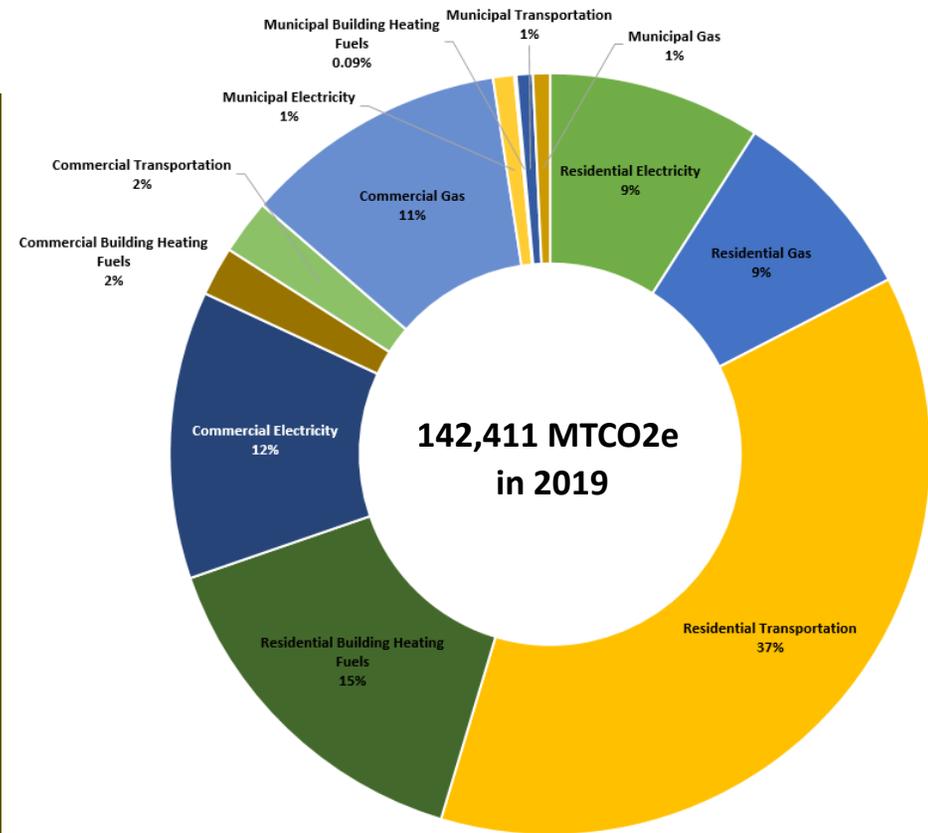
**One third of all homes in Greenfield use fuel oil as a heating source,** which accounts for 80% of the energy use reported in the “residential building heating fuels” category. The other two heating fuels in this category are propane and wood, which are used by 8% of homes in Greenfield. The remaining % of homes in the city use utility gas or electricity. As more homeowners switch to using air source heat pumps to reduce fossil fuel use, emissions from this category are expected to decrease.

An average of 6,296 were enrolled in the municipal aggregation program in 2019, with the majority of households enrolled in a program that allowed them to purchase renewable electricity sourced from national wind. 4 households and 0 commercial business opted into a program that allowed them to purchase electricity from 100% MA Class 1 renewables. **The combined usage of the residences (24,750 kWh) was subtracted from the inventory** because this plan requires the utility to purchase additional electricity from local sources.

**Energy use from commercial buildings accounted for 25% of Greenfield’s emissions in 2019.**

<sup>5</sup> The unit of measurement used in this GhG inventory is metric tons of carbon dioxide equivalent (MTCO<sub>2</sub>e). The unit "CO<sub>2</sub>e" represents an amount of a GHG whose atmospheric impact has been standardized to that of one unit mass of carbon dioxide (CO<sub>2</sub>), based on the global warming potential (GWP) of the gas. <https://www.epa.gov/sites/default/files/2014-12/documents/ghgcalculatorhelp.pdf>

<sup>6</sup> EPA Greenhouse Gas Equivalencies Calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>



Sector	MTCO <sub>2</sub> e
Residential Transportation	52,998.70
Residential Building Heating Fuels	21,493.05
Commercial Electricity	17,382.53
Commercial Gas	16,005.24
Residential Electricity	12,214.20
Residential Gas	11,944.55
Commercial Transportation	3,321.43
Commercial Building Heating Fuels	2,971.77
Municipal Electricity	1,282.12
Municipal Gas	1,037.94
Municipal Transportation	984.99
Municipal Building Heating Fuels	126.62
<b>Total</b>	<b>142,411</b>

# Getting to Net-Zero Emissions

## Carbon Sequestration

Greenfield lies in the heart of Franklin County, which is a heavily forested area of Massachusetts. According to 2016 MassGIS land cover data, Greenfield is 60% forested. Estimates from The Nature Conservancy's Resilient Land mapping tool indicate Greenfield's forests sequester 1,026 MTCO<sub>2</sub>e per year, which offsets >1% of the community's GhG emissions. Data from Greenfield's 2021 Open Space and Recreation Plan were used to determine the number of acres of forest that should be included in the estimate. Lands permanently protected by a Conservation Restriction (CR), permanently protected by State or Federal agency, or temporarily protected through the Chapter 61 program were counted towards the offset.

Greenfield's other natural working lands such as wetlands and agricultural soils also capture carbon and offset the community's emissions. However, at this point in time, there are not reliable methods of calculating these offsets. Once estimates are available, they will be incorporated into this inventory for accuracy.

## Current Progress & Taking Action

The City of Greenfield and its residents are committed to a net-zero future. In 2014, the City adopted the Sustainable Greenfield Master Plan. On the municipal scale, Greenfield achieved a 27% reduction in energy use in FY20. On the community scale, there are active groups who are working to build a more sustainable Greenfield. One such group, Greening Greenfield, frequently hosts workshops and open meetings to teach residents about reducing their reliance on fossil fuels.

Efforts to achieve net-zero will rely on a transformation of the way Greenfield's community heats and cools their homes and businesses, and how they get around the Connecticut River Valley and beyond.

Greenfield's Department of Energy and Sustainability is developing a municipal net-zero operations plan, which will help the city inch closer towards its goal.



*A 2MW solar array on the City's capped landfill has been in operation since 2012 and generates equivalent to half of the municipality's energy use.*