



Community Greenhouse Gas Emissions Inventory

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Prepared by:



Table of Contents

- Section 01 **Introduction**
- Section 02 **Findings in Brief**
- Section 03 **Per Capita GHG Comparison**
- Section 04 **GHG Emissions Forecast**
- Appendix 1 **GHG Inventory Calculation Summary Spreadsheets**
- Appendix 2 **GHG Forecast Assumptions**

Demographic Data in This Report

This assessment contains population data generated at the US Census “Place” level which represents demographics within the boundaries of the City of Fitchburg. Other assessments may contain population data or maps generated at the Census Tract or Block Group level due to the level of granularity needed for those assessments. This may lead to differences in reported population counts due to Census boundary variations.





Introduction

Background

The City of Fitchburg is developing a Sustainability Plan for the community. The plan will help those who live and work in Fitchburg imagine and achieve a future where the earth and all who live on it thrive. The Sustainability Planning process seeks to establish Greenhouse Gas emission reduction targets that align with recommendations from the Intergovernmental Panel on Climate Change. This Community Greenhouse Gas (GHG) Inventory is a foundational document to support the Sustainability Planning process.

The Value of Greenhouse Gas Inventories

The goal of the City of Fitchburg Greenhouse Gas (GHG) Emissions Inventory is to estimate the GHG emissions associated with the activities of the people who live, work, learn, travel, visit, and recreate within the City's geographical boundaries during the subject years of 2014, 2018, and 2022.

Measuring the energy aspects of human activities and the associated GHG emissions offers a unique way to compare the effectiveness of various energy and sustainability best management practices. Greenhouse gas emissions and energy¹ serve as common denominators for the comparison of kilowatts of electricity, natural gas therms, tons of coal, and gallons of liquid fuels consumed; as well as vehicle miles traveled, tons of waste processed, and gallons of potable water distributed. In short, maintaining and updating city-wide GHG emissions inventories for the City can effectively track progress in the implementation of the City's Sustainability Plan and help to identify priorities for future implementation focus.

¹ Energy is expressed as kBtu (a thousand British thermal units) or MMBtu (a million Btus).

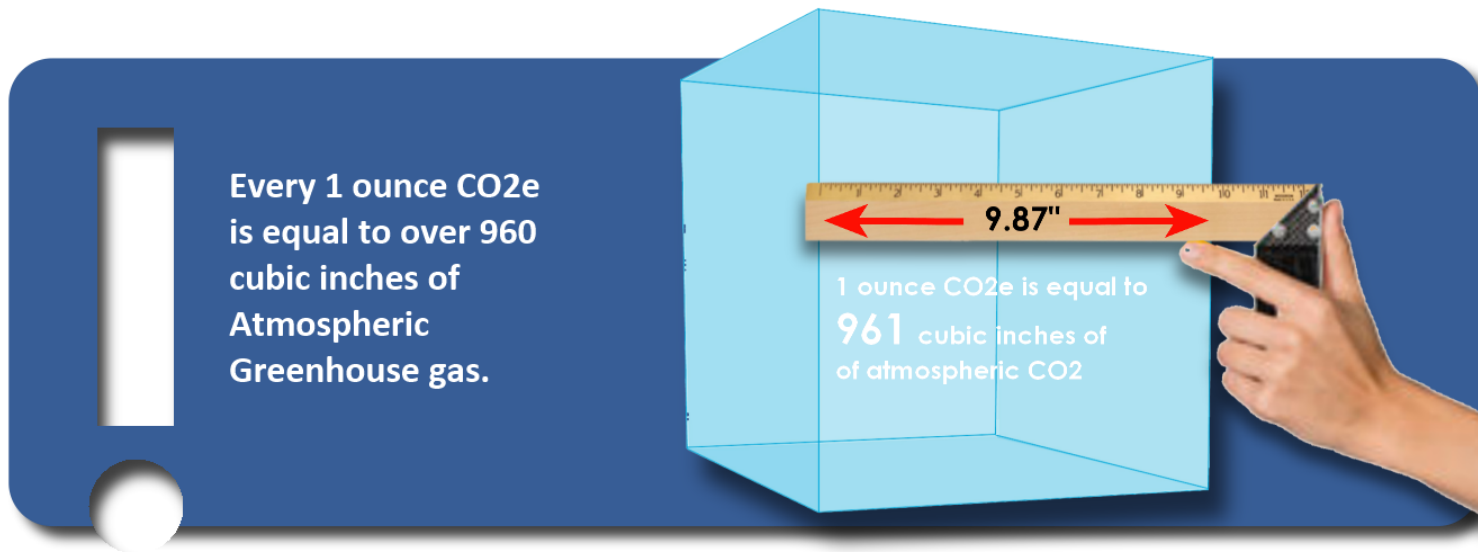
Introduction

The Carbon Cycle and the Role of Greenhouse Gases

The Carbon Cycle is exchanged among the oceans, atmosphere, and ecosystem. This cycle has been a closed, balanced system for hundreds of thousands of years. This cycle is present in the atmosphere primarily as carbon dioxide and methane. These two primary greenhouse gases uniquely allow light to pass while capturing infrared energy. This “Greenhouse Effect” directly impacts Earth’s atmospheric energy and temperatures – without the historic levels of greenhouse gases present in the atmosphere, the average surface temperature of the Earth would be 0 degrees Fahrenheit.

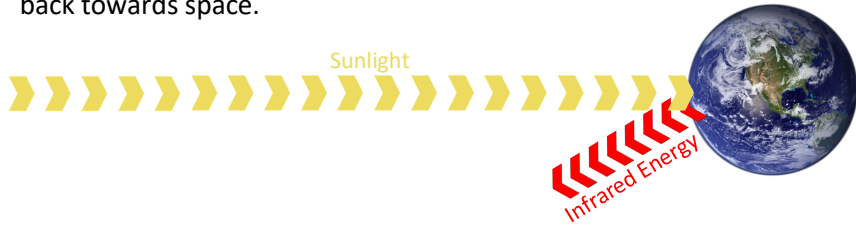
Graphic Representations

Greenhouse Gas Inventories quantify gas emissions in terms of weight - typically Metric Tons. It is important to understand that these references refer to gaseous pollution emissions which enter and occupy Earth’s atmosphere. To help facilitate an increased awareness of the order of magnitude our collective GHG emissions represent, some of the emissions data reported in this report are also graphically represented in terms of volume of atmosphere. These volumes illustrate the amount of atmospheric space the referenced greenhouse gas emissions will occupy where they will remain, actively impacting our climate for as long as 200 years.



Earth's Infrared Energy

When sunlight strikes the Earth, it warms the surface and becomes heat energy – or **infrared energy**. This infrared energy then radiates back towards space.

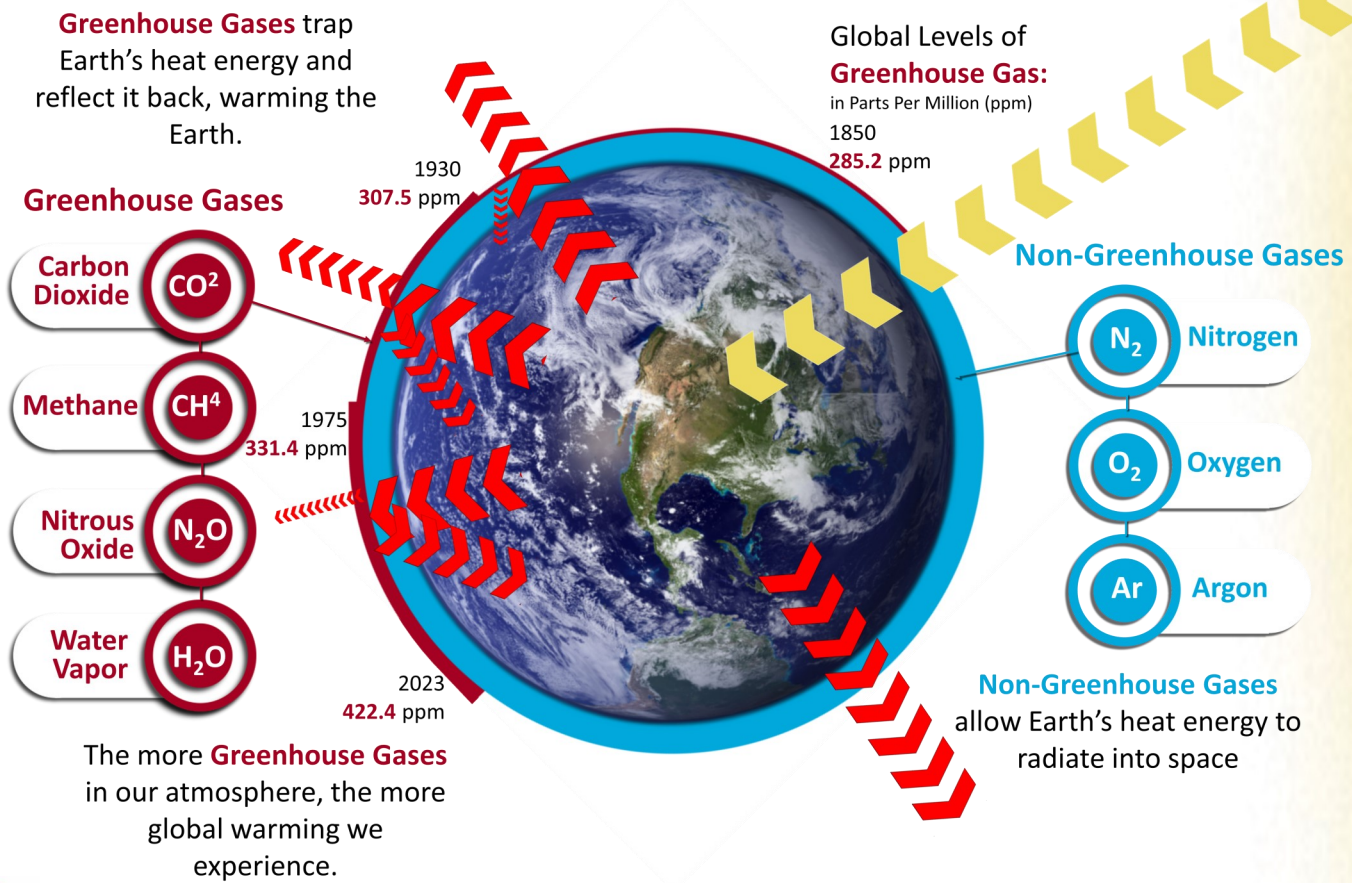


Greenhouse Gas Impact on Our Climate

Our atmosphere is made up of both **Non-Greenhouse** and **Greenhouse Gases**.

Non-Greenhouse Gases do not react to visible light, nor infrared light. That means both sunlight and infrared energy pass through them unaffected, allowing Earth's heat energy to radiate into space.

Greenhouse Gases also do not react to visible light, however, they **DO** react to infrared energy, trapping Earth's heat energy and reflecting it back, warming the Earth.



Introduction

What is a Greenhouse Gas Inventory?

A community Greenhouse Gas (GHG) Inventory follows a standard protocol to quantify a city's greenhouse gas (GHG) emissions, including CO₂, CH₄, N₂O. GHG inventories fluctuate year-to-year as we change our energy consumption, get access to better data, or gain new knowledge about how GHGs impact the atmosphere.

What Are GHG's?

Greenhouse Gases (GHG) absorb radiation and trap heat in the Earth's atmosphere. They are the basis of the Greenhouse Effect. The more GHGs there are, the more heat that is trapped in our atmosphere, leading to Global Warming and Climate Change. GHGs measured in this inventory include carbon dioxide, methane, and nitrous oxide.

Why Measure GHG?

As described by David Osborne and Ted Gaebler "If you don't measure results, you can't tell success from failure. If you can't see success, you can't reward it. If you can't see failure, you can't correct it." GHG inventories are useful. Planners need them, elected officials want them, and the future may see their development as a basic requirement of state and federal funding.

What is CO₂e?

Carbon Dioxide (CO₂) is a GHG emitted naturally and from fossil fuel combustion for energy and heat. Global warming contributions from other greenhouse gases are referred to in terms of "carbon dioxide equivalent" or CO₂e, which represents the amount of CO₂ that would have the same global warming potential as other GHGs. Community GHG inventories are tracked in terms of metric tons of CO₂e.

Methodology, Sources, and Terminology

This GHG inventory is assembled based on the Greenhouse Gas Protocol for businesses and communities established by the World Resources Institute and World Business Council for Sustainable Development (www.ghgprotocol.org/) and is consistent with the protocol established by ICLEI Local Governments for Sustainability. The terminology used in this report is consistent with international Carbon Footprinting protocols. Unless noted otherwise, the Greenhouse Gas (GHG) emissions shown in this report are in metric tons of CO₂e: Carbon Dioxide Equivalent. CO₂e is a standard for expressing the impact of all greenhouse gas including those from other pollutants including methane (CH₄), nitrous oxide (N₂O), and fluorinated gasses like Chlorofluorocarbons (CFC) in terms of the equivalent amount of CO₂ that would have the same impact.

GHG inventories, generally, arrive at an estimated emission in each emissions sector by multiplying raw consumption data - total electricity consumed as an example - by an emissions factor which define the greenhouse gases emitted per unit of raw consumption. The chart to the right illustrates the sources used for all raw consumption and emission factor data used in the GHG inventory calculations.

GHG Emission Sector	Project Resource
Residential Energy Consumption - Electricity	Data Source: Alliant Energy + Madison Gas & Electric Emissions Factors: Same as above
Residential Energy Consumption - Natural Gas	Data Source: Madison Gas & Electric Emissions Factors: US EPA
Non-Residential Energy Consumption - Electricity	Data Source: Alliant Energy + Madison Gas & Electric Emissions Factors: Same as above
Non-Residential Energy Consumption - Natural Gas	Data Source: Madison Gas & Electric Emissions Factors: US EPA
Transportation - On Road	Data Source: State of Wisconsin DOT Emissions Factors: US EPA MOVES model
Waste - Solid Waste	Data Source: City of Fitchburg, Dane County, State of Wisconsin Emissions Factors: US EPA Warm Model, US EPA
Water and Wastewater	Data Source: City of Fitchburg, Madison Metropolitan Sewerage District Emissions Factors: US Community Protocol population based emissions models / Fuel Mix Disclosure Report / US EPA eGRID, US EPA



Greenhouse Gas Sectors

Where do GHGs come from?



Energy

Emissions are produced from the combustion of natural gas, coal, and other fossil fuels primarily for heating, cooling, and electricity generation.



Transportation

Emissions come from the combustion of fossil fuels for ground transportation and air travel.



Solid Waste

Emissions in the inventory estimate the decomposition of biodegradable waste (e.g., food and yard waste) in the landfill.



Water + Wastewater

Emissions from energy uses are calculated for the collection and treatment of wastewater.



Section


02


Findings In Brief

2014 By The Numbers

 **GHG Emissions**
446,008
17.12 MT Per Capita
37.55 MT / Job
0.2509 MT / \$1,000 GDP

 **Population**
26,050

 **GDP**
\$1,777,953,572
\$68,252 GDP Per Capita

 **Employment**
11,877

2022 By The Numbers

 **GHG Emissions**
419,413
14.17 MT Per Capita
34.01 MT / Job
0.1892 MT / \$1,000 GDP

 **Population**
30,834

 **GDP**
\$2,216,582,118
\$74,869 GDP Per Capita


 **Employment**
12,332

8 Year Trend Dashboard

 **GHG Emissions**
-26,595 **-5.96%**
-2.95 MT Per Capita
-3.54 MT / Job
-0.06 MT / \$1,000 GDP

 **Population**
+4,784 **+18.36%**

 **GDP**
+\$438,628,546 **+24.67%**
+\$6,618 GDP Per Capita

 **Employment**
+455 **+3.83%**

City of Fitchburg GHG Emissions Overview

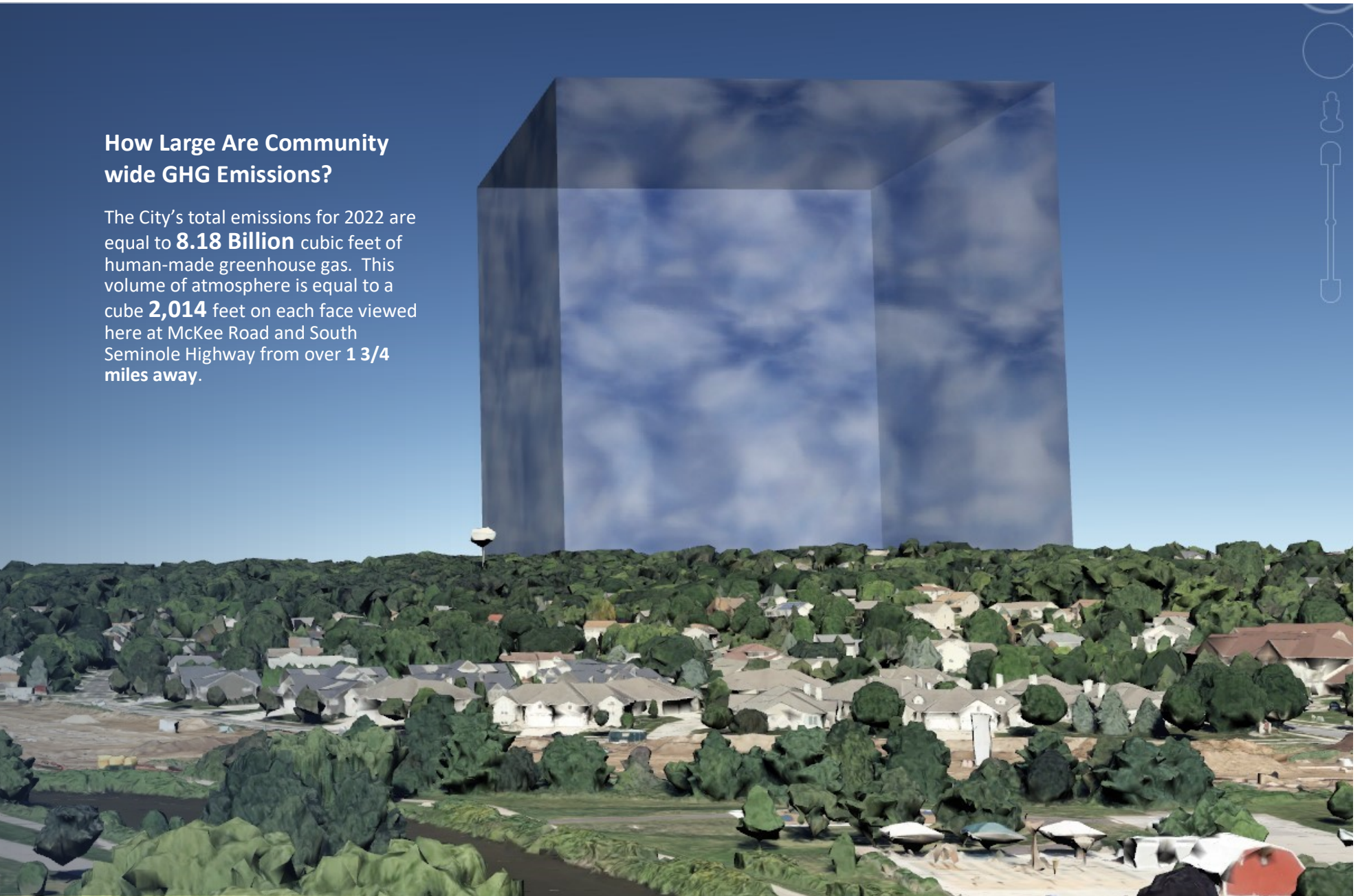
Community wide total emissions for City of Fitchburg decreased from 446,008 metric tons in 2014 to 419,413 metric tons in 2022, a 5.96% reduction. Over the same period, the City's population increased 13.65% from 26,050 to 29,606, making the per capita emissions trend a reduction of 17.3% per person. The City of Fitchburg's community-wide employment increased 3.83% while GDP increased 13.65% during the same timeframe, clearly indicating economic growth can happen in the City of Fitchburg while GHG emissions decrease.

 [Click here to return to TOC](#)



How Large Are Community wide GHG Emissions?

The City's total emissions for 2022 are equal to **8.18 Billion** cubic feet of human-made greenhouse gas. This volume of atmosphere is equal to a cube **2,014** feet on each face viewed here at McKee Road and South Seminole Highway from over **1 3/4 miles** away.

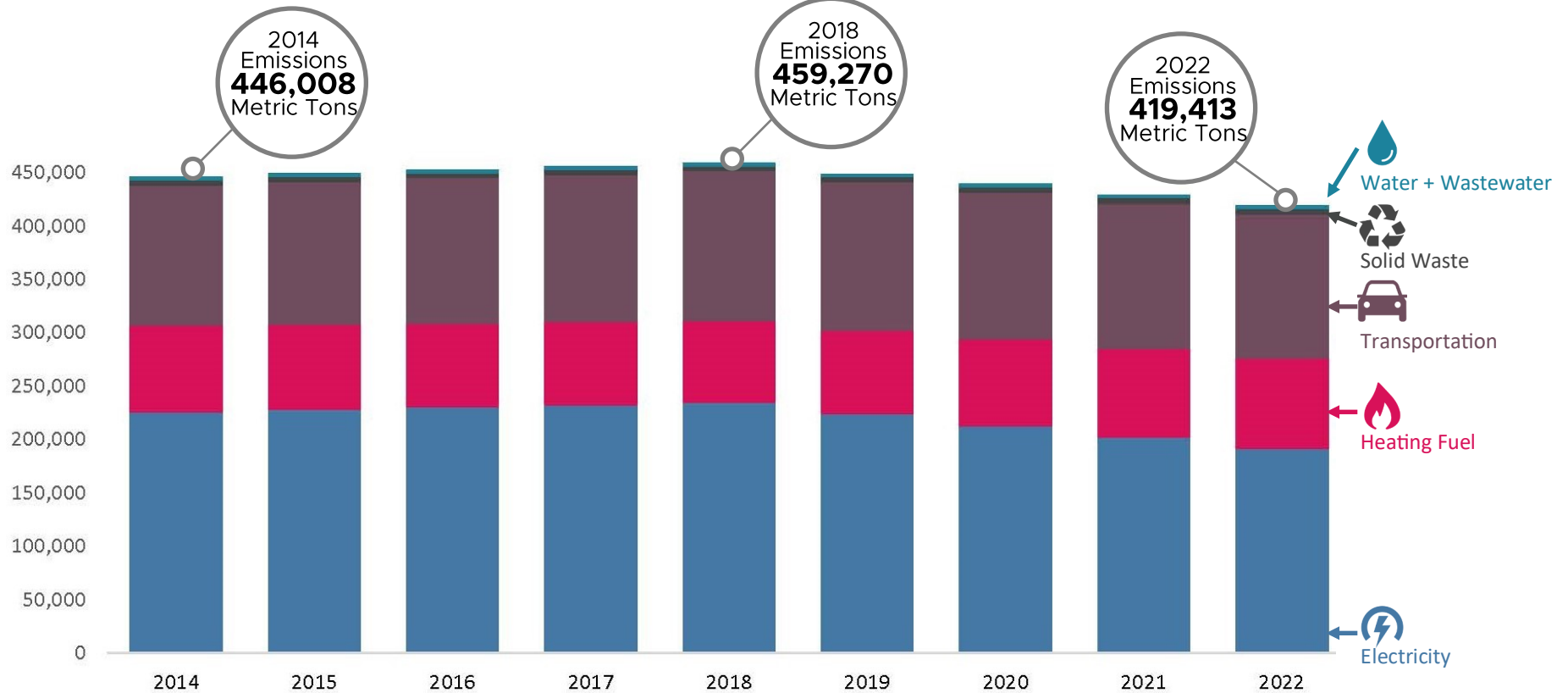
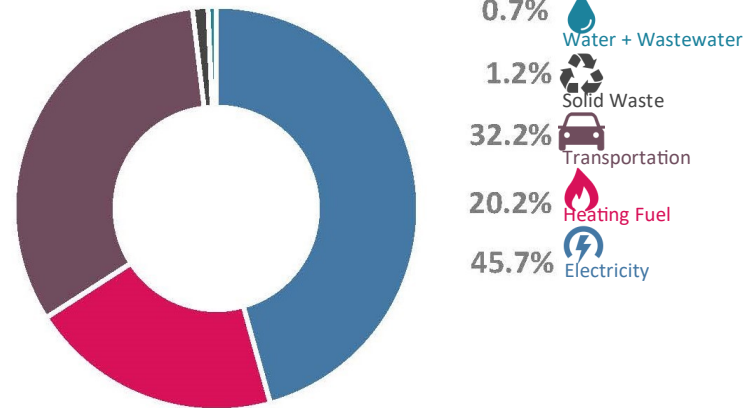


Findings in Brief: Community-Wide

City-Wide Annual GHG Emissions

Total GHG emissions in City of Fitchburg increased from 446,008 metric tons in 2014 to 459,270 metric tons in 2018. Since 2018, emissions have decreased to 419,413 million metric tons in 2022. The overall trend through the eight-year timeframe, however, is a total reduction of 5.96%. The buildings sector makes up 65.9% of total emissions (45.7% electricity, 20.2% natural gas) while the transportation sector is 32.2%, solid waste 1.2% and water and wastewater 0.7%. Trends by sector are detailed on the following page.

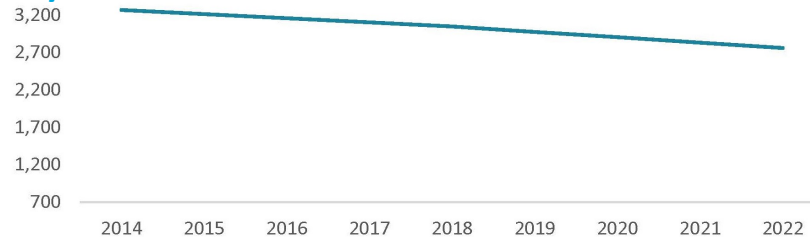
City-Wide GHG by Sector



Findings in Brief: Community-Wide

 Water + Wastewater

City-Wide Sector GHG Trend Lines



2014

3,270
Metric Tons

2022

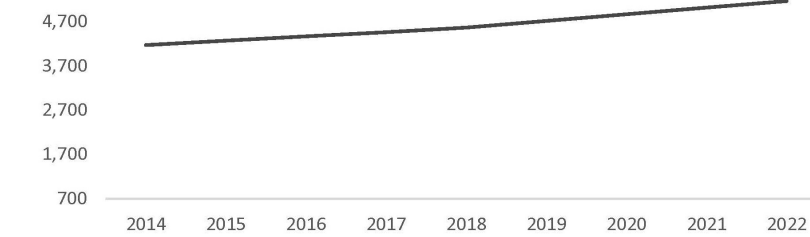
2,761
Metric Tons

Change

-15.6%



 Solid Waste



4,170
Metric Tons

5,168
Metric Tons

+23.9%



 Transportation



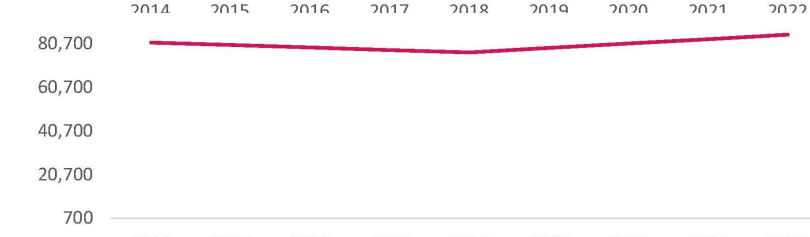
131,242
Metric Tons

139,049
Metric Tons

+2.9%



 Natural Gas



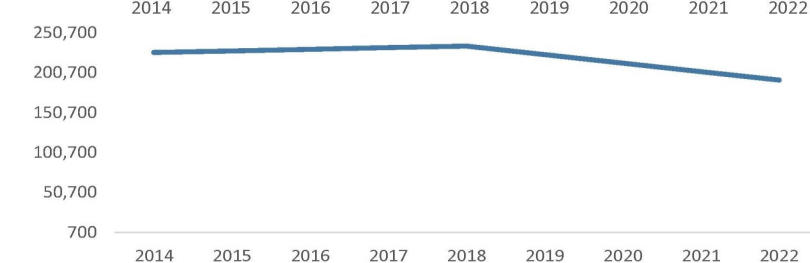
81,190
Metric Tons

84,824
Metric Tons

+4.5%



 Electricity



226,136
Metric Tons

191,612
Metric Tons

-15.3%



Findings in Brief: Community-Wide

Consumption Trends—Energy Residential Electricity

As outlined to the right, the city's **total** residential electric consumption has increased 16.6% since 2014, however, due to population increases electricity consumption decreased – 7.6% on a **per-household basis**.

Residential Heating Fuel

Over the same timeframe, **total** residential heating fuel use increased 7.5%. When population increases are considered, heating fuel decreases jump to -14.8% on a **per-household basis**.

Non-Residential Electricity

The city's **total** non-residential electric consumption has increased 7.7% since 2014. When compared to community-wide employment trends, the increase in electricity consumption is slightly less at 3.8% on a **per job basis**.

Non-Residential Heating Fuel

Similar to non-residential electricity consumption, **total** non-residential heating fuel use increased 2.5%. Again, when compared to community-wide employment trends, the reduction in heating fuel consumption decreased –1.3% on a **per job basis**.

2022 Energy Consumption

		Change since 2014
Electricity Residential (MWh)	92,012	16.6%
Electricity Non-Residential (MWh)	236,631	7.7%
Heating Fuel Residential (MMBtu)	651,646	7.5%
Heating Fuel Non-Residential (MMBtu)	950,702	2.5%

MWh = megawatt hours; MMBtu = million British thermal units

Per Capita Energy Consumption

		Change since 2014
Electricity Residential (MWh / household)	6.59	-8.3%
Electricity Non-Residential (MWh / job)	19.19	3.6%
Heating Fuel Residential (MMBtu / household)	46.64	-17.4%
Heating Fuel Non-Residential (MMBtu / job)	77.09	-1.3%

MWh = megawatt hours; MMBtu = million British thermal units



Findings in Brief: Community-Wide

		Change since 2014
2022 On-Road Transportation		
Vehicle Miles Driven (miles in millions)	265	6.9%
Vehicle Miles Driven Per Person (miles / year)	8,960	-5.9%
Vehicles Per Household	1.51	-3.1%
Total Vehicles	21,104	22.3%
Electric Vehicles*	206	N/A
Share of Vehicles That are Electric*	1.0%	N/A
Public EV Charging Stations (Level 2)	12	N/A
Public EV Charging Stations (DC Fast Charger)	16	N/A

* includes full electric and plug-in hybrid electric vehicles

			Change since 2014
2022 Solid Waste Generation			
Total Solid Waste Handled (tons)	6,336	% of total	17.1%
Solid Waste Per Person (lbs / year)	428		3.0%
Recycling (tons)	1,604	25.3%	-0.6%
Organics / Yard Waste / Trees (tons)	759	12.0%	29.3%
MSW diverted as waste-to-energy (tons)	0	0.0%	N/A
Solid waste sent to landfill (tons)	3,973	62.7%	23.8%
Diversion rate*		37.3%	-8.3%

* diversion rate = solid waste kept from landfills through recycling or reuse

Consumption Trends—Transportation

Community-wide vehicle miles traveled (VMT) increased 6.9% between 2014 and 2022. However, it should be noted that pre-COVID pandemic VMT trends were increasing at a higher rate of 12.2% between 2014 and 2018. It is too soon yet to determine if the reduced growth in VMT which began during the pandemic will be an enduring trend or simply an anomaly from that period.

Based on community population increases, VMT decreased –15.3% on a *per-household basis*.

Total vehicle count in the city has increased 22.3% since 2014. The share of vehicles in the community which are electric is increasing; however, as of 2022 just 1% are electric vehicles (EV).

Consumption Trends—Solid Waste

The city's *total* solid waste handled increased 17.1% since 2014. An a *per capita basis* this represents an increase of 3.0%.

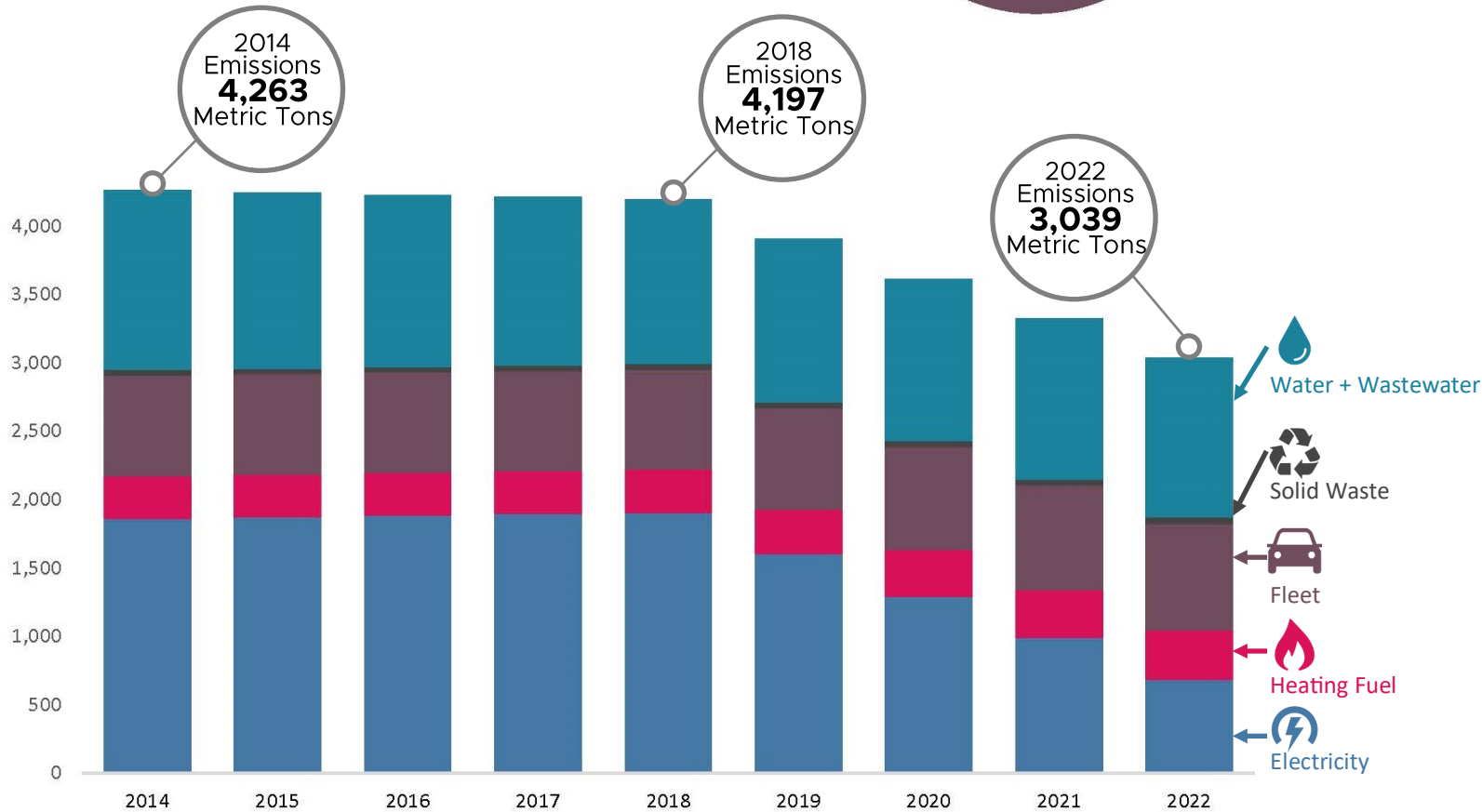
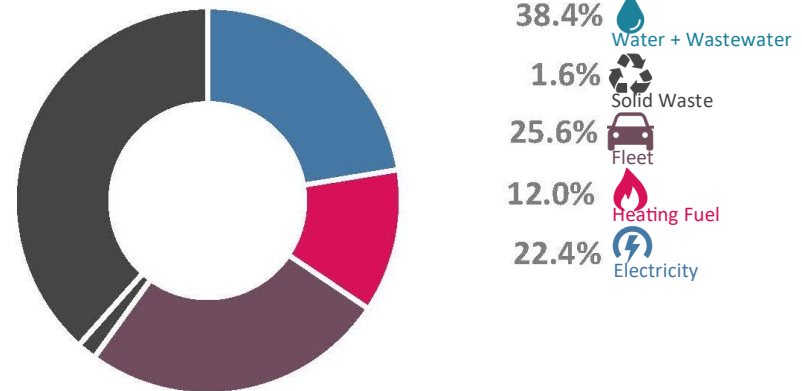
The share of total solid waste sent to the landfill increased from 59.3% of total solid waste collected in 2014 to 62.7% in 2022. The result is a total increase of landfilled solid waste of 23.8% for the timeframe.

Findings in Brief: City Operations

City Operations Annual GHG Emissions

Total GHG emissions for City of Fitchburg operations decreased from 4,263 metric tons in 2014 to 3,039 metric tons in 2022. The overall trend through the eight-year timeframe is a total reduction of 28.7%. The buildings sector makes up 34.4% of total emissions (22.4% electricity, 12.0% natural gas) while the fleet sector is 25.6%, solid waste 1.6% and water 38.4%. Trends by sector are detailed on the following page. (Note: city operations emissions are included in the previous Community-Wide emissions)

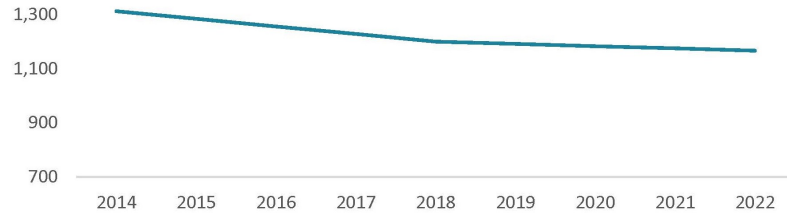
City-Wide GHG by Sector



Findings in Brief: City Operations

 Water + Wastewater

City-Wide Sector GHG Trend Lines



2014

1,313
Metric Tons

2022

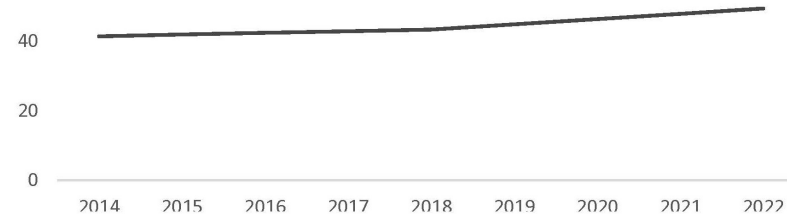
1,167
Metric Tons

Change

-11.1%



 Solid Waste



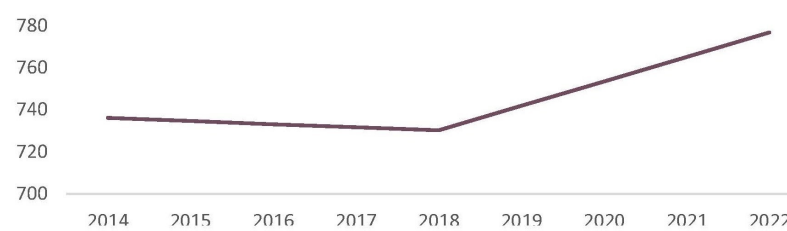
41
Metric Tons

49
Metric Tons

+19.3%



 Fleet



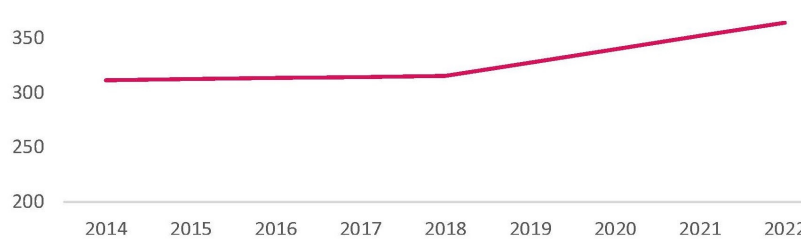
736
Metric Tons

777
Metric Tons

+5.5%



 Natural Gas



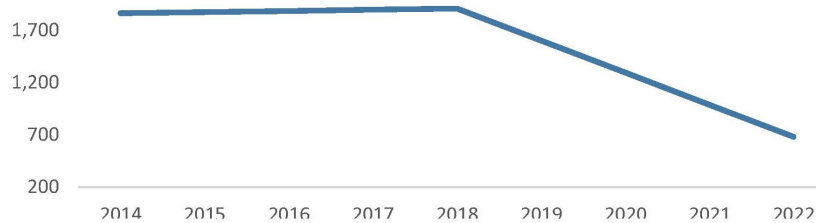
312
Metric Tons

364
Metric Tons

+17.0%



 Electricity



1,861
Metric Tons

682
Metric Tons

-63.4%



Section

03

Per Capita GHG Comparison

[Click here to return to TOC](#)

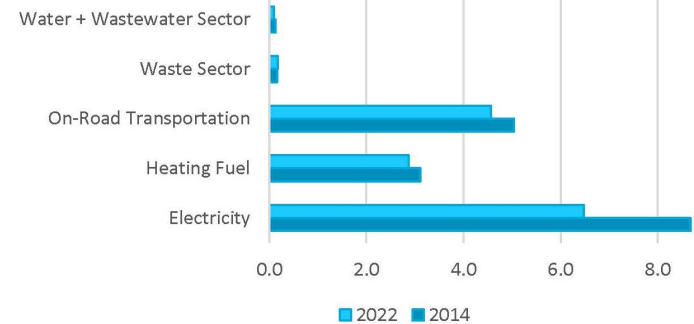
Per Capita GHG Comparison

The results of community GHG inventories vary somewhat due to the information collected and variations in inventory methodology. We believe, however, that as an emerging practice, municipalities should look towards building and sharing data in order to develop a stronger understanding of where each municipality can advance efficiencies and meet Greenhouse Gas reduction goals. In support of this goal, comparing total community emissions between communities can be effectively done by looking at per capita emissions.

Understanding City of Fitchburg's Per Capita GHG Emissions

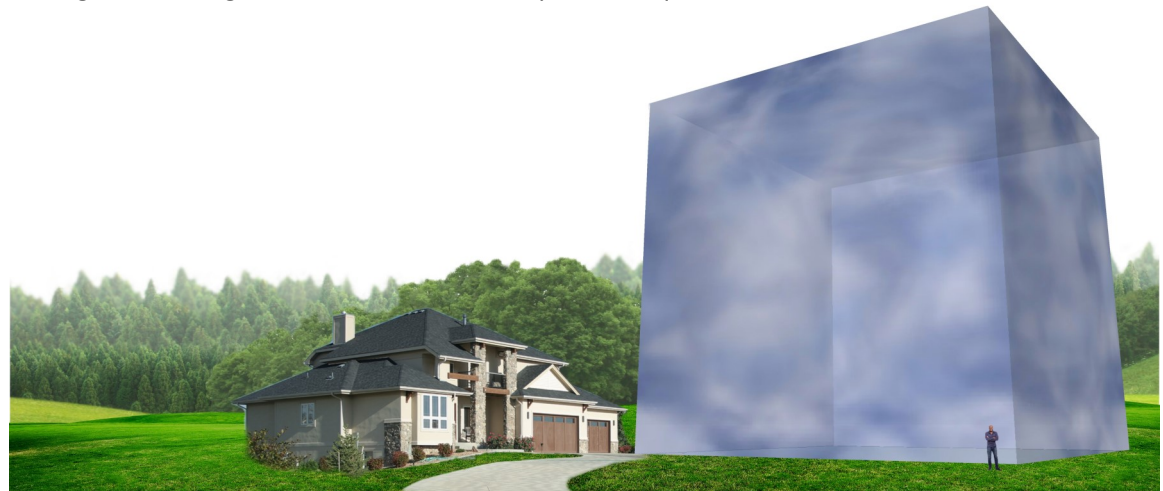
2014 per capita emissions for the City were 17.1. The reported 2022 community wide emissions for City of Fitchburg totaled 419,413 metric tons for a per capita GHG emissions average 14.2 metric tons (MT). This represents a 20% reduction in per capita emissions for the community. The chart to the right indicates the breakdown by sector.

Per Capita GHG Emissions 2014 vs 2022 (MTCO_{2e})



How Large Are City-Wide Per Capita GHG Emissions?

The City of Fitchburg total emissions per capita for 2022 are equal to **277,962** cubic feet of human-made greenhouse gas. This volume of atmosphere is equal to a cube 65' feet on each face:



Section

04

GHG Emissions Forecast



[Click here to return to TOC](#)

GHG Emissions Forecast

Why Create a GHG Emission Forecast?

Increasing greenhouse gas emissions, and consequently, atmospheric concentrations, will have many effects on our global, regional, and local climate conditions. Future changes are expected to include a warmer atmosphere, a warmer and more acidic ocean, more powerful storms, broader swings in weather variability, and changes in precipitation patterns. The extent of future climate change depends on our ongoing GHG emissions. The more we emit, the more intense our future climate changes will be. Put another way, the extent of climate change we experience in the future depends on the policies our communities put into place and the actions we as individuals take to reduce greenhouse gas emissions.

A GHG emission forecast supports GHG reduction planning efforts by anticipating what emissions may be like if actions are not taken. The potential future trends illustrated in the forecast supports planners in identifying emission sectors which may benefit from prioritization or which may harbor the greatest potential benefits for reduction strategies. Finally, the completed GHG emission forecast, combined with the underlying assumptions used to create the forecast model, can be used as a **GHG reduction projection tool** during future climate action planning efforts.





GHG Emissions Forecast

Business-As-Usual Forecast

Emissions are often predicted using a business-as-usual (BAU) approach. The IPCC describes BAU as the emissions outcome if future trends mirror historical ones without policy changes. Such forecasts don't factor in new emission-reduction efforts beyond current commitments and consider expected demographic shifts like population and job trends in a community.

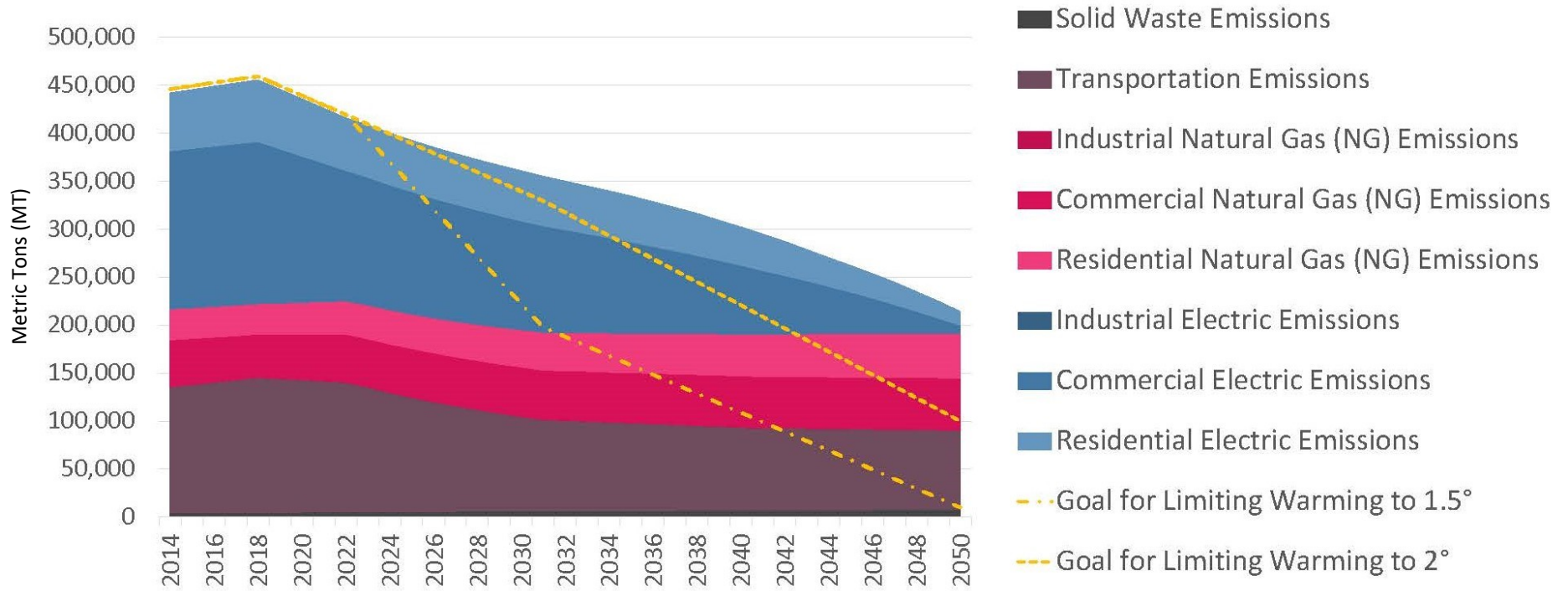
This method evaluates a community's potential emissions growth before pinpointing reduction strategies. BAU projections highlight the scale of needed cuts before accounting for actions like federal vehicle efficiency standards, technological progress like energy-efficient devices, or local conservation initiatives such as green building codes.

For assumptions shaping this BAU forecast, see the appendix.

Uncertainty

Forecasts for GHG emissions are not definitive predictions of future events, but instead are projected outcomes based on specific assumptions and methodologies. The GHG projections in this report should be viewed with an awareness of the underlying assumptions and the inevitable limitations associated with any modeling attempt, as detailed in the provided forecast assumptions. It's essential to recognize that these forecast outcomes carry a degree of uncertainty. Factors like shifts in industrial structures, the specific effects of policies, evolving weather patterns, and economic shifts all introduce variability in the anticipated future emissions trajectories.

GHG Emissions Forecast



Where BAU Projections Are Aiming

	1.5°C	2°C	2°C IMPACTS	3.8°C / (6.84°F)
EXTREME HEAT Global population exposed to severe heat at least once every five years	14%	37%	2.6x WORSE	46%+
SEA-ICE-FREE ARCTIC Number of ice-free summers	AT LEAST 1 EVERY 100 YEARS	AT LEAST 1 EVERY 10 YEARS	10x WORSE	Annually
SEA LEVEL RISE Amount of sea level rise by 2100	0.40 METERS	0.46 METERS	.06M MORE	1m+
SPECIES LOSS: VERTEBRATES Vertebrates that lose at least half of their range	4%	8%	2x WORSE	16%
SPECIES LOSS: PLANTS Plants that lose at least half of their range	8%	16%	2x WORSE	33%
SPECIES LOSS: INSECTS Insects that lose at least half of their range	6%	18%	3x WORSE	28%
ECOSYSTEMS Amount of Earth's land area where ecosystems will shift to a new biome	7%	13%	1.86x WORSE	28%+
PERMAFROST Amount of Arctic permafrost that will thaw	4.8 MILLION KM ²	6.6 MILLION KM ²	38% WORSE	Unknown
CROP YIELDS Reduction in maize harvests in tropics	3%	7%	2.3x WORSE	10%+

GHG Emissions Forecast

Understanding Impacts of BAU Forecast

By placing emissions forecasts within a global perspective of climate change impacts, we can develop a sense of what the BAU forecast means for the City of Fitchburg. Global impacts can be viewed through understanding difference between 1.5°C, 2°C, and 3.8°C degree global warming.

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations Environment Programme (UNEP) body for assessing the science related to climate change and providing support in climate action policy making. The scientific consensus of the international IPCC working groups is to reduce global GHG emissions as needed in order to limit global warming to 1.5°C. In addition, the Paris Agreement aims to limit global warming to 1.5 to 2 degrees C above pre-industrial levels, considered to be the threshold for dangerous climate change.

The UNEP Emissions Gap Report published in November 2019 calculates that by 2030, global emissions will need to be 25% lower than 2018, and then reaching 80% reductions by 2050 to put the world on the least-cost pathway to limiting global warming to below 2°C. To limit global warming to 1.5°C, the same report finds emissions would need to be 55% lower than they were in 2018 and then achieving 90% or greater reductions by 2050.

The infographic to the left, created by the World Resources Institute summarizes some of the global climate change impact differences between reducing global emissions to cap global warming at 1.5°C vs capping global warming at 2°C. We've added an illustration of the impacts related to a 3.8°C warming - which is where current City of Fitchburg Business-as-Usual projections point.

Source and Graphic: World Resources Institute



Section

A1

GHG Inventory Calculation Summary Sheets

[Click here to
return to TOC](#)



Community Wide Integrated Inventory Tool
Tool Updated 4/13/23

City of Fitchburg
Sustainability Plan

11/21/2023

Community Wide Emissions Inventory Data Calculations

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu / Consumption Change Since	GHG Change Since
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			
Electricity¹:													
Notes: Gross Consumption - Alliant Energy													
2 Residential	1,811	6,178	1,388	2,029	6,924	1,462	12.1%	2,248	7,670	1,187	10.8%	24.2%	-14.5%
2 Commercial, Industrial, Farm	28,040	95,671	21,494	27,130	92,567	19,542	-3.2%	26,220	89,462	13,844	-3.4%	-6.5%	-35.6%
2 Streetlights	25	86	19	57	195	41	127.2%	89	305	47	56.0%	254.4%	144.1%
2 Municipal	85	289	65	121	412	87	42.4%	157	534	83	29.8%	84.7%	27.2%
Gross Consumption - Madison Gas and Electric													
2 Residential	77,128	263,160	59,124	83,594	285,222	62,943	8.4%	89,764	306,276	53,746	7.4%	16.4%	-9.1%
2 Commercial, Industrial, Farm	186,709	637,051	143,126	198,281	676,535	149,299	6.2%	205,062	699,673	122,780	3.4%	9.8%	-14.2%
2 Streetlights	762	2,598	584	640	2,183	482	-16.0%	745	2,542	446	16.5%	-2.2%	-23.6%
2 Municipal	4,041	13,787	3,097	3,999	13,645	3,011	-1.0%	4,358	14,869	2,609	9.0%	7.9%	-15.8%
Total Gross Consumption													
2 Residential	78,938	269,338	60,512	85,623	292,145	64,405	8.5%	92,012	313,946	54,933	7.5%	16.6%	-9.2%
2 Commercial, Industrial, Farm	214,749	732,722	164,620	225,411	769,101	168,840	5.0%	231,282	789,135	136,623	2.6%	7.7%	-17.0%
2 Streetlights	787	2,684	603	697	2,379	523	-11.4%	834	2,847	493	19.7%	6.1%	-18.2%
2 Municipal	4,125	14,076	3,162	4,120	14,057	3,098	-0.1%	4,515	15,404	2,692	9.6%	9.4%	-14.9%
Subtractions													
24) Facility Solar Energy (on-site and purchased)	-	-	-	-	-	-	N/A	(1,442)	(4,920)	(863)	N/A	N/A	
3 Waste, Water, Wastewater Process Electricity	(3,603)	(12,294)	(2,762)	(3,408)	(11,629)	(2,566)	-5.4%	(3,784)	(12,912)	(2,266)	11.0%	5.0%	
Net Consumption With Emissions													
Residential	78,938	269,338	60,512	85,623	292,145	64,405	6.4%	92,012	313,946	54,933	-14.7%		-9.2%
Commercial, Industrial, Farm	214,749	732,722	164,620	225,411	769,101	168,840	2.6%	231,282	789,135	136,623	-19.1%		-17.0%
Streetlights	787	2,684	603	697	2,379	523	-13.3%	834	2,847	493	-5.7%		-18.2%
Municipal	522	1,782	400	712	2,428	532	32.9%	(712)	(2,428)	(437)	-182.2%		-209.2%
Subtotals	298,599	1,018,821	226,136	315,851	1,077,683	234,300	3.6%	328,643	1,121,331	191,612	-18.2%	10.1%	-15.3%
4 Alliant Blended emission factor (tonnes per M	0.767			0.720				0.528			-26.7%		N/A
4 Madison Gas and Electric Blended emission fa	0.767			0.753				0.599			-20.5%		N/A
Electricity as a % of total citywide amounts		23.6%	50.7%		24.4%	51.0%	0.6%		24.8%	45.7%	-10.4%		-9.9%
Electricity per Household (kWh)	7,130			6,710			-5.9%	6,585			-1.9%	-7.6%	
Electricity per Job (kWh)	18,428			18,487			0.3%	19,121			3.4%	3.8%	



Community Wide Integrated Inventory Tool
Tool Updated 4/13/23

City of Fitchburg
Sustainability Plan

11/21/2023

Community Wide Emissions Inventory Data Calculations

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu / Consumption Change Since	GHG Change Since
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			
Heating Fuel¹:													
Notes:													
Gross Consumption													
Residential		606,139	32,125		595,134	31,542	-1.8%		651,646	34,537	9.5%		
5 Residential Natural Gas (therms)	6,062,840	606,139	32,125	5,952,758	595,134	31,542	-1.8%	6,518,014	651,646	34,537	9.5%	7.5%	7.5%
Commercial/ Industrial		919,861	48,753		845,862	44,831	-8.0%		941,926	49,922	11.4%		2.4%
5 Commercial/ Industrial Natural Gas (therms)	9,200,808	919,861	48,753	8,460,644	845,862	44,831	-8.0%	9,421,515	941,926	49,922	11.4%	2.4%	2.4%
Municipal		7,824	415		7,757	411	-0.9%		8,776	465	13.1%		12.2%
5 Municipal Natural Gas (total therms)	78,258	7,824	415	77,592	7,757	411	-0.9%	87,782	8,776	465	13.1%	12.2%	12.2%
Subtractions													
5 Residential - Renewable Natural Gas Sourced (therms)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	
5 Commercial - Renewable Natural Gas Sourced (therms)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	
3 Waste, Water, Wastewater Process Heating Fuel	(19,459)	(1,945)	(103)	(18,026)	(1,802)	(96)	-7.4%	(18,999)	(1,899)	(101)	5.4%	-2.4%	
Net Consumption With Emissions													
Residential		606,139	32,125		595,134	31,542	-1.8%		651,646	34,537	9.5%		7.5%
Commercial		919,861	48,753		845,862	44,831	-8.0%		941,926	49,922	11.4%		2.4%
Municipal		9,769	312		9,559	316	1.3%		10,676	364	15.5%		17.0%
Subtotals		1,535,769	81,190		1,450,555	76,688	-5.5%		1,604,247	84,824	10.6%	4.5%	4.5%
9 Natural Gas mission factor (tonnes per MMBtu)	0.053			0.053				0.053					
Heating as a % of total citywide amounts		35.5%	18.2%		32.8%	16.7%			35.5%	20.2%			
Heating energy per Household (BTU)		55			47		-14.8%		47		0.0%	-14.8%	
Heating energy per Job (BTU)		78			69		-12.0%		77		N/A	-1.3%	



Community Wide Integrated Inventory Tool
Tool Updated 4/13/23

City of Fitchburg
Sustainability Plan

11/21/2023

Community Wide Emissions Inventory Data Calculations

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu / Consumption Change Since	GHG Change Since
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			
Transportation:													
Notes: Grand Transportation							Consumption				Consumption		
¹¹ Vehicle miles traveled (thousands of miles)	248,132			278,419			12.2%	265,283			-4.7%	6.9%	N/A
¹² Estimated number of vehicles in community	17,260			20,548				21,104	1.5		2.7%	22.3%	
¹³ Registered electric vehicles in community (BEV)	-	0.0%		114	0.6%			206	1.0%		80.7%	N/A	
Estimated EV Share of VMT	-			1,545				2,589					
VMT With Emissions	248,132		131,242	276,875		140,668		262,693					
¹⁴ Average MPG	17.45			18.19				18.03					
Estimated Fuel Consumed (total)	14,216,099	1,753,561		15,220,619	1,877,469		7.1%	14,567,401	1,778,734		-4.3%	1.4%	N/A
¹⁵ Estimated Gasoline and e10 Gasoline Share	10,423,594	1,251,978		11,042,369	1,326,299			10,245,534	1,230,591			-1.7%	
Estimated Diesel Share	3,792,504	501,583		4,178,250	551,170			4,321,867	548,142			9.3%	
¹⁵ Emission factor (tonnes per thousand VMT)	0.5289			0.5081			-3.9%	0.5141			1.2%		N/A
Subtotals		1,753,561	131,242		1,877,469	140,668	7.2%		1,778,734	135,049	-4.0%	1.4%	2.9%
Transportation as a % of total citywide amounts		40.6%	29.4%		42.5%	30.6%			39.4%	32.2%			
Vehicle Miles Traveled (VMT) per Household	22,413			21,820			-2.6%	18,987			-13.0%	-15.3%	
Solid Waste:													
Notes: Gross Consumption							Consumption				Consumption		
Solid Waste Handled	5,411			6,015			11.2%	6,336			5.3%	17.1%	N/A
¹⁷ Recycled (tons)	1,614	29.8%	-	1,749	29.1%	-	8.3%	1,604	25.3%	-	-8.3%	-0.6%	N/A
¹⁷ Organics / Yard Waste / Trees	587	10.9%	95	770	12.8%	124	31.1%	759	12.0%	122	-1.4%	29.3%	29.3%
¹⁷ MSW managed as RDF (tons)	-	0.0%	-	-	0.0%	-	N/A	-	0.0%	-	N/A	N/A	N/A
¹⁷ Landfill (tons)	3,209	59.3%	4,076	3,496	58.1%	4,440	8.9%	3,973	62.7%	5,046	13.6%	23.8%	23.8%
Diversion Rate	40.7%			41.9%				37.3%					
Subtotals		-	4,170		-	4,564	9.4%		-	5,168	13.2%	N/A	23.9%
¹⁸ Emission factor - RDF (tonnes per ton)	0.52			0.52				0.52					
¹⁹ Emission factor - Organics (tonnes per ton)	0.16			0.16				0.16					
²⁰ Emission factor - Landfill (tonnes per ton)	1.27			1.27				1.27					
Solid Waste as a % of total citywide amounts		0.0%	0.9%		0.0%	1.0%			0.0%	1.2%			
Total Solid Waste per Capita (lbs)	415			419			0.8%	411			-1.9%	-1.1%	



Community Wide Integrated Inventory Tool
Tool Updated 4/13/23

City of Fitchburg
Sustainability Plan

11/21/2023

Community Wide Emissions Inventory Data Calculations

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu / Consumption Change Since	GHG Change Since
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			
Water:													
Notes: Gross Consumption							Consumption				Consumption		
21 Water Flows (gallons in millions)	706.0			710.3			0.6%	800.6			12.7%	13.4%	
Electricity (MWh)	1,698	5,794	1,302	1,584	5,405	1,193	-6.7%	1,930	6,584	1,155	21.8%	13.6%	-11.2%
Natural gas (therms)	2,155	215	11	1,458	146	8	-32.3%	2,155	215	11	47.8%	0.0%	0.0%
Gasoline and e10 Gasoline (gal.)	-	-	0	-	-	0	N/A	-	-	0	N/A	N/A	N/A
Diesel (gal.)	-	-	0	-	-	0	N/A	-	-	0	N/A	N/A	N/A
Subtotals		6,009	1,313		5,550	1,200	-8.6%		6,800	1,167	-2.8%		-11.1%
Emission factor -Water (tonnes per million)	1.86			1.69				1.46					
Water as a % of total citywide amounts		0.1%	0.3%		0.1%	0.3%			0.2%	0.3%			
Total Water per Capita (gallons)	27,102			24,731			-8.7%	25,964			5.0%	-4.2%	
Wastewater:													
Notes: Gross Consumption							Consumption				Consumption		
22 Wastewater Flows (gallons in millions)	686.2			657.0			-4.3%	668.0			1.7%	-2.7%	
23 Estimated Biologic Emissions			398			381				388			
24 Electricity (MWh)	1,905	6,501	1,461	1,824	6,224	1,374	-4.3%	1,855	6,328	1,110	1.7%	-2.7%	-24.0%
24 Natural gas (therms)	17,304	1,730	92	16,568	1,656	88	-4.3%	16,844	1,684	89	1.7%	-2.7%	-2.7%
24 Gasoline and e10 Gasoline (gal.)	810	91	6	776	87	6	-4.3%	788	88	6	1.7%	-2.7%	-2.7%
Diesel (gal.)	-	-	0	-	-	0	N/A	-	-	0	N/A	N/A	N/A
Emissions from combustion of digester gas (tonnes)			0			0	N/A			0	N/A	N/A	N/A
Subtotals		8,321	1,957		7,967	1,849	-5.5%		8,100	1,594	-13.8%		-18.6%
Emission factor -Wastewater (tonnes per million)	2.85			2.81				2.39					
Wastewater as a % of total citywide amounts		0.2%	0.4%		0.2%	0.4%			0.2%	0.4%			
Total Wastewater per Capita (gallons)	26,342			22,874			-13.2%	21,663			-5.3%	-17.8%	
Citywide Totals (Scope 1 & 2):	Total MMBTU:	4,322,482	446,008	Total MMBTU:	4,419,225	459,270	3.0%	Total MMBTU:	4,519,212	419,413	-8.7%	4.6%	-6.0%
	Per Capita:		17.12	Per Capita:		15.99	-6.6%	Per Capita:		13.60			-20.6%



Community Wide Integrated Inventory Tool
 Tool Updated 4/13/23

City of Fitchburg
 Sustainability Plan

11/21/2023

Community Wide Emissions Inventory Data Calculations

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu / Consumption Change Since	GHG Change Since
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			

- Notes:**
- Electricity in MWh, natural gas in therms. Carbon dioxide equivalents (GHG) are expressed in metric tonnes, which equal 1,000 kilograms, 2,204.6 pounds, or 1.102 US tons.
 - Source: Utility annual reporting. 2014 energy consumption for Alliant Energy is back-cast from 2018 and 2022 reported consumption levels due to data unavailability.
 - To avoid double-counting, energy consumption and emissions associated with process electricity and process natural gas for wastewater treatment and solid waste management are subtracted Electricity and Heating Fuel sectors. Note, wastewater energy consumption is excluded as service is provided by Madison Metropolitan Sewerage District (MMSD) and is not included in community wide energy totals.
 - Source: Utility annual reporting by Madison Gas and Electric and Alliant Energy. Madison Gas and Electric emission factor for 2014 was used for Alliant Energy emission factor for 2014 due to Alliant Energy 2014 emission factor unavailability.
 - Source: Natural Gas utility annual reporting
 - EPA emission factors <https://www.epa.gov/climateleadership/ghg-emission-factors-hub>
 - Based on GHG Protocol guidance <https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>, GHG emissions for biomass fuel sources includes CH4 and N2O emissions within GHG calculations with CO2 emissions reported separately as biogenic emissions not contributing to total GHG emissions. Global warming potentials for CH4 and N2O are based on IPCC 6th Assessment Report. Emission factors for CH4, N2O, and biogenic CO2 are based on EPA emission factors <https://www.epa.gov/climateleadership/ghg-emission-factors-hub>
 - Source: City of Fitchburg pro-rata share of State of Wisconsin Department of Transportation data by County <https://wisconsin.gov/pages/projects/data-plan/veh-miles/default.aspx>. 2021 data used in lieu of 2022 due to data availability with pro rata shares calculated based on 2021 census population estimates and 2021 estimated vehicle counts.
 - Total number of vehicles in community is based on US Census data ACS 5-year estimates Table A10030 ; Housing Units by Vehicles Available
 - Registered Electric Vehicles in Community do not include HEV or PHEV categories and is based on registration data reported for zip codes 53711 and 53575 by EV Hub <https://www.atlasevhub.com/materials/state-ev-registration-data/>
 - Average MPG calculated using data from the Federal Highway Administration Table VM-1
 - Estimated fuel share of community-wide VMT and average emission factor per VMT calculated using data from the Federal Highway Administration Table VM-1. e10 gasoline share of gasoline consumption estimated based on State average share of consumption https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_mg.html&sid=US and https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_use_en.html&sid=US
 - Prorata community share of County data reported by Wisconsin DNR <https://dnr.wisconsin.gov/topic/Landfills/Fees.html> Organics tonnage for year 2014 is as reported by City, for years 2018 and 2022 tonnage is calculated at an average of 0.275 tons per cubic yard of organics waste collection reported.
 - Solid Waste RDF emissions emissions factors based on facility Facility Level Information on GreenHouse gases Tool GHG data reporting, total GHG emissions divided by total reported solid fuels burned <https://ghgdata.epa.gov/ghgp/main.do> Where regional facility is not reported, average emission factors are used.
 - Emission Factor for organics based on Compost factors from GHG Protocol for Cities Version 1.1 <https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>
 - Emission factor based on documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM), Organic Materials Chapters, Exhibit 1-10, U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, February 2016
 - Water flows relate to reported distribution within community only.
 - Wastewater flows relate to reported collection within community only. Wastewater flows estimated as share of water distribution
 - Biogenic CO2 from wastewater treatment is provided for information purposes only and is estimated based on average emission factor values. Biogenic CO2 is not included in total GHG emissions as per GHG Protocol guidance <https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>
 - As reported by City and Madison Metropolitan Sewerage District. Electricity was reported for all years. Natural gas and fuel were reported only for 2014, values for 2018 and 2022 are projected based on wastewater flow ratios.



Citywide Integrated Inventory Tool

Tool Updated 4/13/23

Municipal Operations Emissions Inventory Data Calculations

City of Fitchburg

Sustainability Plan

11/20/2023

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu Change Since 2014	GHG Change Since 2014	
	FTE 200			FTE 200				FTE 200						
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG				
Electricity¹														
Notes: Gross Consumption							Consumption				Consumption			
Buildings, Grounds, Streetlights	4,125	14,076	3,162	4,120	14,057	3,098	-0.1%	4,515	15,404	2,692	9.6%	9.4%	-14.9%	
Subtractions							Subtractions				Subtractions			
Buildings and Grounds - Wind Sourced	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A		
Buildings and Grounds - Solar Sourced	-	-	-	-	-	-	N/A	(1,442)	(4,920)	(863)	N/A	N/A		
Streetlights - Wind Sourced	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A		
Streetlights - Solar Sourced	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A		
(other) - Wind Sourced	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A		
(other) - Solar Sourced	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A		
² Waste, Water, Wastewater Process	(1,698)	-	-	(1,584)	-	-	-6.7%	(1,930)	-	-	21.8%	N/A		
Net Consumption With Emissions							GHG Emissions				GHG Emissions			
Buildings, Grounds, Streetlights	2,427	14,076	1,861	2,536	14,057	1,907	2.5%	1,143	10,484	682	-64.3%		-63.4%	
Subtotals	4,125	14,076	1,861	4,120	14,057	1,907	2.5%	4,515	15,404	682	-64.3%		-63.4%	
Blended emission factor (tonnes per M	0.767			0.752				0.596			-20.7%			N/A
Building Square Footage	173,498	81.1 EUI Electricity		195,498	71.9 EUI Electricity			222,330	69.3 EUI Electricity		-3.6%	-14.6%		
Electricity as a % of total citywide amounts	47.9%			43.7%				47.8%			22.4%			



Citywide Integrated Inventory Tool

Tool Updated 4/13/23

Municipal Operations Emissions Inventory Data Calculations

City of Fitchburg

Sustainability Plan

11/20/2023

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu Change Since 2014	GHG Change Since 2014
	FTE 200			FTE 200				FTE 200					
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			
Heating Fuel¹:													
Notes: Gross Consumption	7,824			7,757			Consumption	8,776			Consumption		
Natural Gas (therms)	78,258	7,824	415	77,592	7,757	411	-0.9%	87,782	8,776	465	13.1%	12.2%	12.2%
Propane / LP (gallons)	-	-	-	-	-	-		-	-	-			
Oil (gallons)	-	-	-	-	-	-		-	-	-			
Wood Pellet (tons)	-	-	-	-	-	-		-	-	-			
Biogenic CO2 from Wood and Wood Pellet Use	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	N/A
Subtractions							Subtractions				Subtractions		
Buildings - Renewable Natural Gas Sourced (other) - Renewable Natural Gas Sourced	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	
Waste, Water, Wastewater Process	(2,155)	(1,945)	(103)	(1,458)	(1,802)	(96)	-32.3%	(2,155)	(1,899)	(101)	47.8%	-2.4%	
Net Consumption With Emissions							GHG Emissions				GHG Emissions		
Buildings and Grounds		5,878	312		5,955	316	1.3%		6,877	364	15.5%		17.0%
Subtotals	-	5,878	312	-	5,955	316	1.3%	-	6,877	364	15.5%		17.0%
Natural Gas mission factor (tonnes per MMBtu)	0.053			0.053				0.053					
Emission factor - Propane (MT per MMBtu)	0.063			0.063				0.063					
Emission factor - Oil (MT per MMBtu)	0.073			0.073				0.073					
Emission factor - Wood (MT per MMBtu)	0.001			0.001				0.001					
Emission factor - Wood Pellets (MT per MMBtu)	0.004			0.004				0.004					
Building Square Footage	173,498	45.1	EUI Heating	195,498	39.7	EUI Heating		222,330	39.5	EUI Heating	-0.5%	-12.5%	
Combined Electricity+Heating EUI		126.2	EUI Combined		111.6	EUI Combined			108.8	EUI Combined	-2.5%	-13.8%	
Natural gas as a % of total citywide amounts		20.0%	7.3%		20.3%	7.5%			21.3%	12.0%			
Transportation:													
Notes: Fleet Fuel	736			730			Consumption	777			Consumption		
Diesel (gal.)	31,806	4,119	323	28,828	3,733	293	-9.4%	31,000	4,015	315	7.5%	-2.5%	-2.5%
BioDiesel B20 (gal.)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	N/A
Gasoline (gal.)	46,450	5,295	413	49,191	5,608	437	5.9%	51,944	5,922	462	5.6%	11.8%	11.8%
e10 Gasoline (gal.)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	N/A
e85 (gal.)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	N/A
Propane	-	-	0.0	-	-	0.0	N/A	-	-	-	N/A	N/A	N/A
Total Vehicles in Fleet	-			-				-					
Subtotals		9,414	736		9,341	730	-0.8%		9,936	777	6.4%		5.5%
Transportation as a % of total citywide amounts		32.1%	17.3%		31.8%	17.4%			30.8%	25.6%			



Citywide Integrated Inventory Tool

Tool Updated 4/13/23

Municipal Operations Emissions Inventory Data Calculations

City of Fitchburg

Sustainability Plan

11/20/2023

Emissions Sectors	2014			2018			Change from Prior Study Year	2022			Change from Prior Study Year	MMBtu Change Since 2014	GHG Change Since 2014
	FTE 200			FTE 200				FTE 200					
	Consumption	MMBtu	GHG	Consumption	MMBtu	GHG		Consumption	MMBtu	GHG			
Solid Waste:													
Notes: Solid Waste Share	Community Wide	City Ops Share		Community Wide	City Ops Share		Community Wide	City Ops Share					
⁴ Estimated Commercial Share of MSW	59.0%			59.0%			59.0%						
³ Community Wide Solid Waste Handled	5,411	54		6,015	57		6,336	61					
Recycled (tons)	1,614	16	0	1,749	17	0	1,604	15	0			-0.6%	
Organics / Yard Waste / Trees	587	6	1	770	7	1	759	7	1			29.3%	
MSW managed as RDF (tons)	0	-	N/A	0	-	N/A	0	-	N/A			N/A	
Landfill (tons)	3,209	32	40	3,496	33	42	3,973	38	48			23.8%	
Subtotals		54	41		57	43	4.7%		61	49	14.0%		19.3%
Solid waste as a % of total citywide amounts		0.2%	1.0%		0.0%	0.0%			0.0%	1.6%			
Water:													
Notes: Gross Consumption Share							Consumption				Consumption		
Water Flows (gallons in millions)	706			710			0.6%	801			12.7%		N/A
Electricity (MWh)	1,698	5,794	1,302	1,584	5,405	1,193	-6.7%	1,930	6,584	1,155	21.8%	13.6%	-11.2%
Natural gas (therms)	2,155	215	11	1,458	146	8	-32.3%	2,155	215	11	47.8%	0.0%	0.0%
Gasoline (gal.)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	N/A
Diesel (gal.)	-	-	-	-	-	-	N/A	-	-	-	N/A	N/A	N/A
Subtotals		6,009	1,313		5,550	1,200	-8.6%		6,800	1,167	-2.8%		-11.1%
Emission factor -Water (tonnes per million gallons)	1.86			1.69				1.46					
Wastewater as a % of total citywide amounts		20.5%	30.8%		18.9%	28.6%			21.1%	38.4%			
Municipal Operations Totals:	29,369	4,263		29,354	4,197		-1.6%	32,217	3,039		-27.6%	9.7%	-28.7%
	Per-FTE:	21.3		Per-FTE:	21.0		-1.6%	Per-FTE:	15.2				-28.7%
	Share of Citywide	1.0%		Share of Citywide	0.9%			Share of Citywide	0.7%				

- Notes:
- Electricity in MWh, natural gas in therms. Carbon dioxide equivalents (GHG) are expressed in metric tonnes, which equal 1,000 kilograms, 2,204.6 pounds, or 1.102 US tons.
 - To avoid double-counting, energy consumption and emissions associated with process electricity and process natural gas for wastewater treatment and solid waste management are subtracted Electricity and Heating Fuel sectors. Note, wastewater energy consumption is excluded as service is provided by Madison Metropolitan Sewerage District (MMSD) and is not included in community wide energy totals.
 - Municipal Operations share of Solid Waste is estimated ProRata share of commercial portion of MSW based on FTE share of community-wide employment.
 - Estimate of average residential and commercial share from EPA MSW Residential/Commercial Percentage Allocation: https://www.epa.gov/sites/default/files/2016-01/documents/rev_10-24-14_msw_residential_commercial_memorandum_7-30-13_508_fnl.pdf

Section

A2

GHG Forecast Assumptions

 [Click here to return to TOC](#)

GHG Emissions Forecast

City of Fitchburg GHG Forecast Assumptions:

Demographics:

Population: Total Population projections through 2050 are projected based on extending City's projected growth rates through 2040 as reported in Comprehensive Plan.

Households: Total household counts through 2050 are projected based on extending City's projected growth rates through 2040 as reported in Comprehensive Plan.

Jobs: Total commercial and industrial jobs through 2050 are projected based on City's average jobs growth rate since 2014.

Climate Data

Cooling Degree Days (CDD): Projected climate changes for the region will include increased summer temperatures. The increase in temperatures will result in an increase, or variability, in air conditioning demand. The forecast calculates annual changes in air conditioning demand based on projections provided by the "Climate Explorer" tool developed by US NOAA in support of the National Climate Assessment work. <https://crt-climate-explorer.nemac.org/>

Heating Degree Days (HDD): Projected climate changes for the region will include increased winter temperatures. The increase in temperatures will result in a decrease, or variability, in building heating demand. The forecast calculates annual changes in heating demand based on projections provided by the "Climate Explorer" tool developed by US NOAA in support of the National Climate Assessment work. <https://crt-climate-explorer.nemac.org/>

Electricity:

Residential: Demand is based on a per household basis and modified based on the projected Cooling Degree Days for each year, assuming 15% of electricity is used for cooling (RCP 8.5 model). 50% of projected increased electrical vehicle usage is attributed to residential EV charging.

Commercial and Industrial: Demand is based on a per job basis and modified based on projected cooling degree days for each year, assuming that 15% of commercial and 7.5% of industrial electricity is used for cooling. (RCP 8.5 model). 50% of projected increased electrical vehicle usage is attributed to commercial EV charging



GHG Emissions Forecast

All electricity emission factors are calculated using estimated emissions factors for 2030, 2040, and 2050 based on current, known, supplier commitments. For electrical suppliers with unknown or unestablished emission commitments, and for electricity purchased from the SERC grid, electricity emission factors are calculated based on EPA forecasts (<https://fas.org/sgp/crs/misc/R45453.pdf>). Estimated emissions factors are reduced 5% by 2030, 10% by 2040, and 15% by 2050.

Natural Gas:

Residential: Demand is based on a per household basis and modified based on the projected Heating Degree Days for each year, assuming 75% of natural gas is used for heating (RCP 8.5 model).

Commercial and Industrial: Demand is based on a per job basis and modified based on projected heating degree days for each year, assuming that 40% of commercial and 20% of industrial natural gas is used for heating (RCP 8.5 model).

Natural Gas emissions factors are projected to be unchanged.

Transportation:

Vehicle Miles Traveled is based on US Department of Transportation VMT per capita projections through 2050 (1.1% annual growth rate through 2037 and 0.8% annual growth rate from 2038 through 2050. **NOTE:** due to COVID impacts, projections begin using 2019 VMT data in lieu of 2020 https://www.fhwa.dot.gov/policyinformation/tables/vmt/vmt_forecast_sum.cfm

Vehicle fuel use is calculated based on US Energy Information Agency projected rolling stock average fuel efficiency projections, modified to 85% projected MPG to account for heavy duty vehicle MPG share (based on US Department of Transportation data on current light duty to average all vehicle MPG ratios) <https://www.eia.gov/todayinenergy/detail.php?id=31332>

Total vehicle stock is based on per household projections maintaining existing average number of vehicles per household through 2030 (1.5) and then reducing the average vehicle per household 15% through 2050 (1.275).

Electric Vehicle Adoption: National projections expect an increased uptake of electric vehicles in coming years. The Edison Electric Institute has estimated that electric vehicle will be 7% of all vehicles on the road in the country by

2030. (<http://www.ehcar.net/library/rapport/rapport233.pdf>, <https://berla.co/average-us-vehicle-lifespan/>).

Solid Waste:

Total Solid Waste handled is based on total number of households and maintaining existing volume per household and emissions factors per ton handled.

Wastewater:

Total Wastewater handled is based on total number of households and maintaining existing volume per household and emissions factors per household.

Note:

GHG emissions forecasts are not predictions of what will happen, but rather modeled projections of what may happen given certain assumptions and methodologies. GHG forecasts in this report should be interpreted with a clear understanding of the assumptions that inform them and the limitations inherent in any modeling effort.

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