STERLING HEIGHTS, MI

2022 Inventory of Community and Government Operations Greenhouse Gas Emissions

Prepared For:

Sterling Heights, MI

Produced By:

ICLEI – Local Governments for Sustainability USA
July 2024

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Executive Summary

The City of Sterling Heights recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. To address these, the City of Sterling Heights Sustainability Commission was formed on March 17, 2020. The current goals of the commission include:

- To create a Sustainability Plan by the end of its first year of existence, and thereafter update and maintain a three-year sustainability plan that outlines specific areas for City Council to study and the Commission’s recommendations relating to those areas
- To develop and advise the City Council on implementation of community-wide strategies regarding waste reduction, recycling, and sustainable growth and development
- To create a model of sustainability through efforts to advocate, educate, and promote the social, economic, and environmental health of the community, now and into the future
- To work in collaboration with City staff, officials, and existing City nonprofit partners to determine annual City and community priorities, projects, and resources relative to sustainability issues and that are designed to improve the environment, reduce operating costs, or reduce the City’s carbon footprint
- To assist City staff with the engagement of the City’s residents and businesses in sustainability initiatives
- To broaden the lens and scope of energy and environmental needs in the future such as wind and solar energy, clean air and water, and improving green infrastructure and other best management practices
- To research initiatives outside of the City to determine how other communities are addressing sustainability

This report provides estimates of greenhouse gas emissions resulting from activities in Sterling Heights as a whole and at the municipal scale in 2022.

Key Findings: Community-Wide Inventory

Figure 1 shows community-wide emissions by sector. The largest contributor is Industrial Energy with 29% of emissions. The next largest contributors are Residential Energy (25%) and Transportation & Mobile Sources (24%). Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Commercial Energy, Solid Waste, Water & Wastewater, and Process & Fugitive Emissions were responsible for the remaining (22%) emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within Sterling Heights; information that is key to guiding local reduction efforts. These data will also provide a baseline against which the city will be able to compare future performance and demonstrate progress in reducing emissions.

COMMUNITY EMISSIONS AT A GLANCE

1 **Industrial Energy** 29%

2 **Residential Energy** 25%

3 **Transportation** 24%

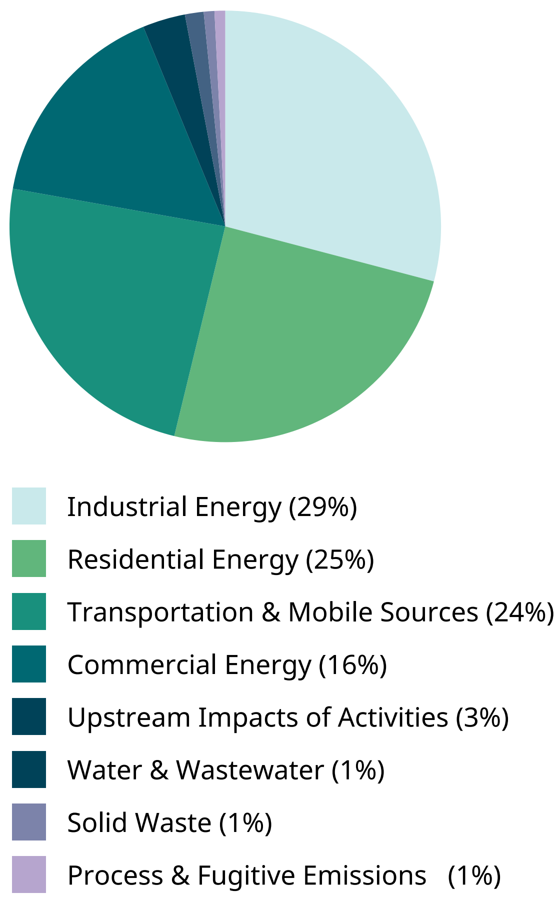


Figure 1: Community-Wide Emissions by Sector

Key Findings: Government Operations Inventory

Figure 2 shows government operations emissions by sector. The largest contributor is Buildings & Facilities with 37% of emissions. The next largest contributors are Vehicle Fleet (20%) and Streetlights & Traffic Signals (15%). Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Transit Fleet, Process & Fugitive, Employee Commute, Solid Waste Facilities, Water & Wastewater, and Electric Power Production were responsible for the remaining (28%) emissions.

Documentation of lawn care activity data was a particular focus of the Local Government Operations (LGO) inventory, and contributes 91 metric tons carbon dioxide equivalent (MT CO_2e) to the overall inventory, 3.4% of the Vehicle Fleet and 0.7% of all LGO emissions. Emissions from all government operations contribute to 0.7% of community-wide emissions.

GOVERNMENT OPERATIONS EMISSIONS AT A GLANCE

1 **Buildings & Facilities** 37%

2 **Vehicle Fleet** 20%

3 **Streetlights & Traffic Signals** 15%

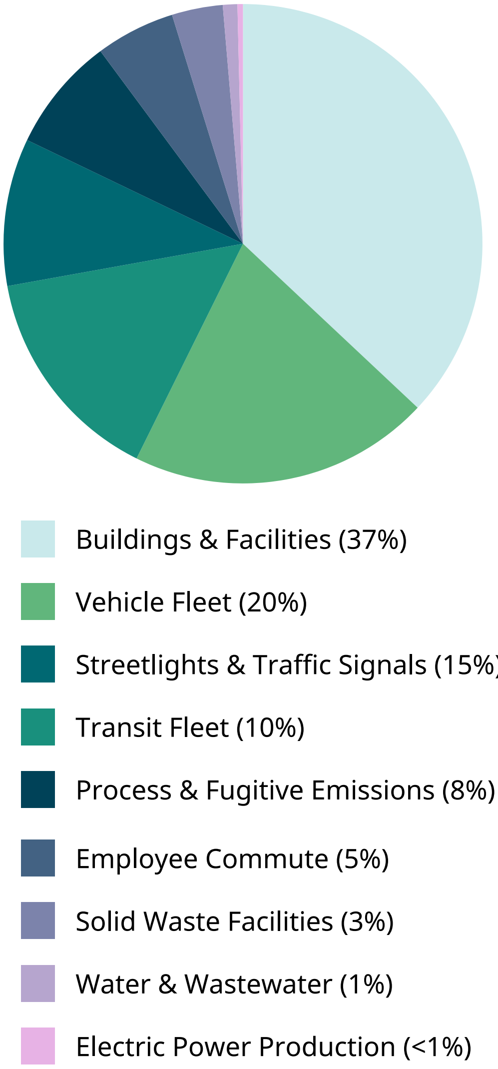


Figure 2: Government Operations Emissions by Sector

Introduction to Climate Change

Naturally-occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is burning fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere.

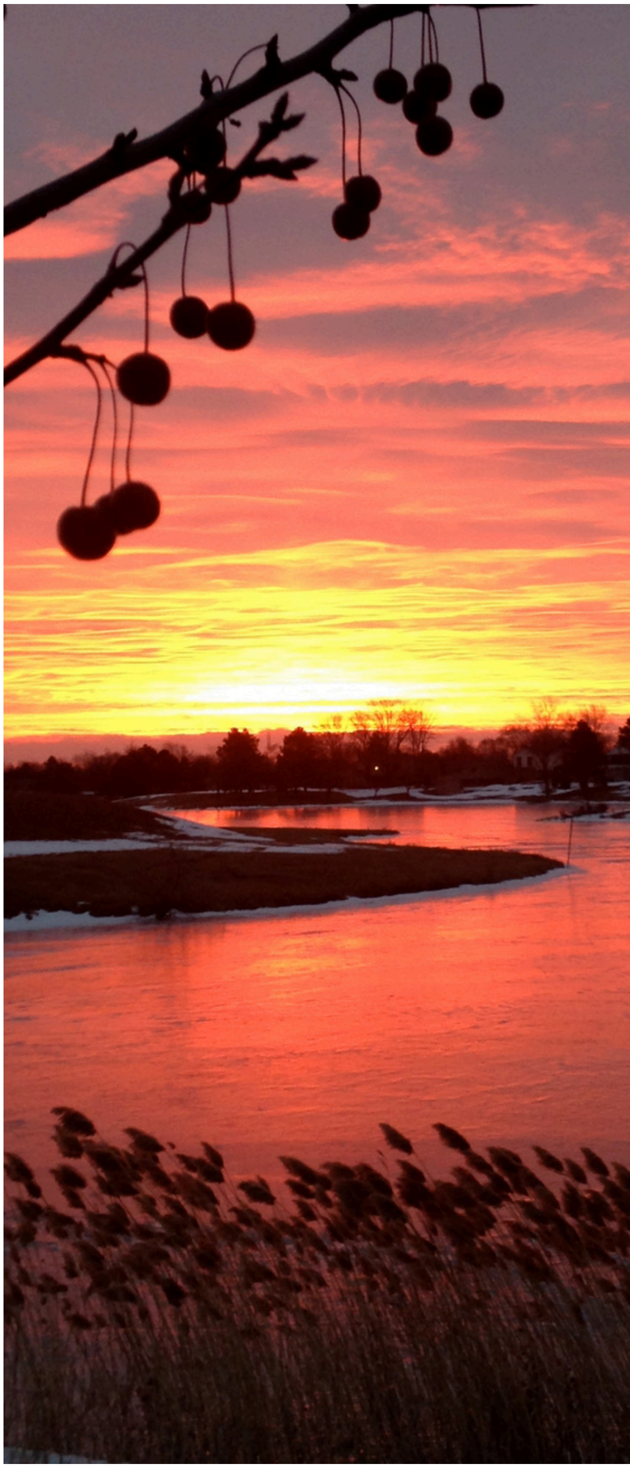
Collectively, these gases intensify the greenhouse effect, causing global average surface and lower atmospheric temperatures to rise, threatening the safety, quality of life, and economic prosperity of global communities. Although the natural greenhouse effect is needed to keep the earth warm, a human-enhanced greenhouse effect with the rapid accumulation of GHGs in the atmosphere leads to too much heat and radiation being trapped. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report confirms that human activities have unequivocally caused global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C [1]. The City of Sterling Heights must thoroughly consider climate change in each of its applicable responsibilities, the regular and evolving threat assessments for our region, and our collective contribution to the greater global problem [2].

[1] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.
[2] SP: The Sustainability Plan (Version 1). Released June 16, 2021. Sustainability Commission [C. Mcleod, A. Bittner, J. Bahorski, M. Vanderpool, N. Inks, M. Graf, M. Farooqi, J. Matthews, R. Robinson, and A. Frank]. City of Sterling Heights.

According to the 2023 National Climate Assessment, Sterling Heights faces a climate that has warmed and precipitation that has increased since the first half of the 20th century, alongside the rest of the Midwest. Rising temperatures, extreme precipitation, drought, and other climate-related events in the Midwest are impacting agriculture, ecosystems, cultural practices, health, infrastructure, and waterways. Given our proximity to the Great Lakes, we also face the possibility of uncertain long-term projections related to lake levels and the health of environments and ecosystems dependent on such.

Given the concentrated, developed nature of Sterling Heights, the community faces increased heat risks associated with urban heat islands and tree canopy loss to flooding from extensive hardscaping and impermeable surfaces. While the physical health of Sterling Heights's residents is at the forefront of concerns associated with such consequences, these hazards can also bring about disruptions to quality of life and cause cascading detriments through the destruction of infrastructure, community cohesion, and more. In relation to human health, higher temperatures can amplify the risk for heat-related and respiratory illnesses, especially for our City's most vulnerable (children and the elderly). Other threats to human well-being manifest in the form of increased geographic range and extended presence of disease-carrying vectors like mosquitos and ticks [3]. In 2012 the cost of treating Lyme disease in Michigan, at the time a low-incidence state, was $9 million alone. Amblyomma americanum, a specific tick species linked to ehrlichiosis, has already been reported in the Upper Midwest and is likely to see its domain expanded.

Severe storms are another concern for our community, especially given that the amount of precipitation falling in the most intense 1% of events has increased 45% between 1958 and 2021 [4]. An increase in rainfall during severe storms, and more frequent occurrences of them, can bring about localize flooding more often and more violently. The impacts, which range from drownings to damage to critical



[3] City of Sterling Heights. 2021. Sustainability Commission Sustainability Plan - Section V.B. Climate Change. Retrieved from https://www.sterlingheights.gov/1766/Sustainability-Commission.
[4] U.S. Global Change Research Program. 2023. National Climate Assessment – Ch 24: Midwest. Retrieved from https://nca2023.globalchange.gov/chapter/24/.

infrastructure like stormwater systems and water treatment facilities, are only expected to grow more exacerbated due to urban deforestation, loss of wetlands, and increased impervious surfaces due to urban development.

Increases in natural disasters across the country have shown that even just a single severe weather event could significantly strain city financials, as well as the economic burden (i.e. higher insurance rates) placed upon businesses and residents. Current warming projections place the planet on track for a global warming level of 2°C - increasing extreme precipitation and weather intensity by 10-15% throughout the Midwest, potentially even 20% in some areas [5]. Infrastructure damage, employment losses, and the need for emergency services could all contribute to costs brought about as a result.

Many communities in the United States have started to take responsibility for addressing climate change at the local level. Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, when residents save on energy costs, they are more likely to spend at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health. The City's Sustainability Plan calls for actions that are meaningful and measurable. Therefore responding to the threat also must include commitments from the city towards reductions and ongoing measurement of progress [6]. Meaningful actions cannot be planned without a baseline to work from, leading to the development of the 2022 community-wide and LGO inventories.

[5] U.S. Global Change Research Program. 2023. National Climate Assessment – Ch 24: Midwest.
[6] City of Sterling Heights. 2021. Sustainability Commission Sustainability Plan - Section V.B. Climate Change.

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

Facing the climate crisis requires the concerted efforts of local governments and their partners, those that are close to the communities directly dealing with the impacts of climate change.

Cities, towns and counties are well placed to define coherent and inclusive plans that address integrated climate action — climate change adaptation, resilience and mitigation. Existing targets and plans need to be reviewed to bring in the necessary level of ambition and outline how to achieve net-zero emissions by 2050 at the latest. Creating a roadmap for climate neutrality requires Sterling Heights to identify priority sectors for action, while considering climate justice, inclusiveness, local job creation and other benefits of sustainable development.

To complete this inventory, Sterling Heights utilized tools and guidelines from ICLEI - Local Governments for Sustainability (ICLEI), which provides authoritative direction for greenhouse gas emissions accounting and defines climate neutrality as follows:

> The targeted reduction of greenhouse gas (GHG) emissions and GHG avoidance in government operations and across the community in all sectors to an absolute net-zero emission level at the latest by 2050. In parallel to this, it is critical to adapt to climate change and enhance climate resilience across all sectors, in all systems and processes.

To achieve ambitious emissions reduction, and move toward climate neutrality, Sterling Heights will need to set clear goals and act rapidly following a holistic and integrated approach. Climate action is an opportunity for our community to experience a wide range of co-benefits, such as creating socio-economic opportunities, reducing poverty and inequality, and improving the health of people and nature.

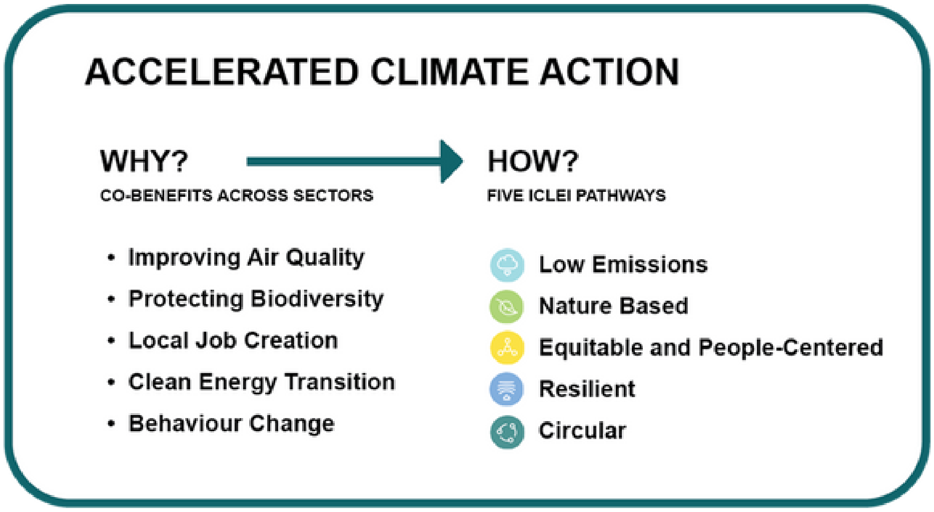


Figure 3: Co-Benefits and ICLEI Pathways to Accelerated Climate Action

ICLEI GreenClimateCities Framework

For this inventory, Sterling Height's process is informed by ICLEI's GreenClimateCities Framework for integrated climate action. Sterling Heights follows the stepwise approach shown below in Figure 4, which involves collecting and analyzing climate data, action, implementation, leadership, and collaboration—always with an equity lens.

The Framework is organized into Analyze, Act, and Accelerate phases for communities pursuing integrated climate action. The Framework incorporates greenhouse gas emissions reductions, climate adaptation actions, and equitable, inclusive decision-making. Sterling Heights's inventory has Science-Based Targets [7] and falls under Step C- Analyze and set a baseline. Sterling Heights recognizes that the framework is not linear and that while the conclusion of the Analyze phase is intended to be followed by the development of a climate action plan, other steps may already be completed. For instance, Sterling Heights's existing Sustainability Commission and Sustainability Plan better fit under the Accelerate phase. The next step reduction measures described later in this report must also be detailed and financed prior to implementation and, thus, should only be used as ideas for consideration under the Act phase rather than set policies to enact.

Over 600 U.S. communities have followed this basic Framework, previously known as ICLEI's Five Milestones for Emissions Management. Today, it is represented through the streamlined Analyze-Act-Accelerate model shown below.

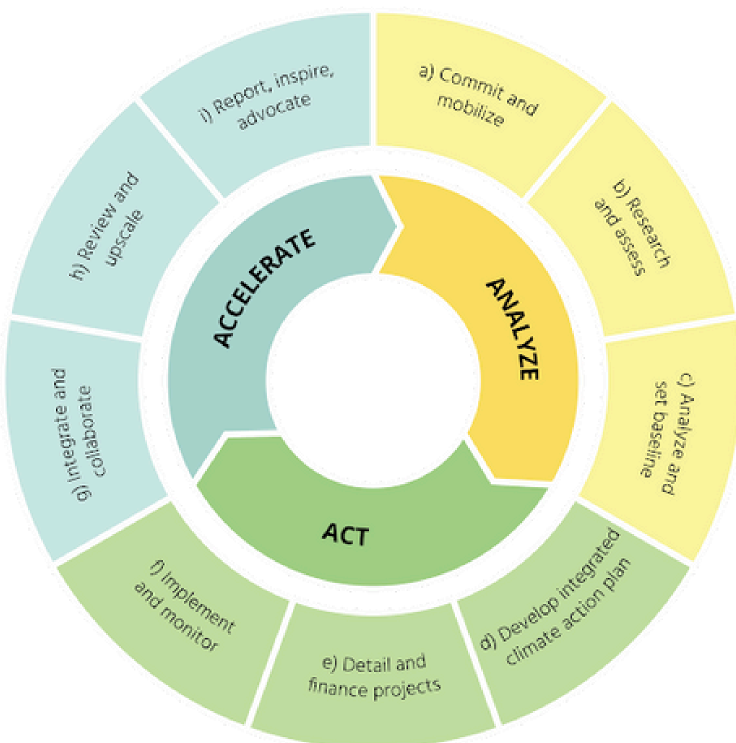


Figure 4: ICLEI GreenClimateCities Framework

[7] Science-Based Targets are calculated climate goals, in line with the latest climate science, that represent your community's fair share of the ambition necessary to meet the Paris Agreement commitment of keeping warming below 1.5°C. To achieve this goal, the Intergovernmental Panel on Climate Change (IPCC) states that we must reduce global emissions by 50% by 2030 and achieve climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas (GHG) emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from the Sterling Heights community as a whole. The government operations inventory is mostly a subset of the community inventory, as shown in Figure 5. For example, data on commercial energy use by the community include energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

As local governments continue to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (Community Protocol) and the Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions (LGO Protocol), both of which are described below.

Figure 5: Relationship of Community and Government Operations Inventories

Three greenhouse gases are included in this inventory: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Many of the charts in this report represent emissions in “carbon dioxide equivalent” (CO_2e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the IPCC 5th Assessment Report.

Table 1: Global Warming Potential Values (IPCC, 2014)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265

Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions [8] was released by ICLEI in 2019, and represents a national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

The community inventory in this report includes emissions from the five Basic Emissions Generating Activities required by the Community Protocol. These activities are:

- Use of electricity by the community
- Use of fuel in residential and commercial stationary combustion equipment
- On-road passenger and freight motor vehicle travel
- Use of energy in potable water and wastewater treatment and distribution
- Generation of solid waste by the community

The community inventory also includes the following activities:
- Wastewater treatment processes
- Off-road transportation
- Industrial processes
- Carbon sequestration emissions and removals
- Upstream Activities
- Municipal operations fleet

Local Government Operations (LGO) Protocol

In 2010, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released Version 1.1 of the LGO Protocol [9]. The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory.

The following activities are included in the LGO inventory:
- Energy and natural gas consumption from buildings & facilities
- Emissions from diesel generators
- On-road transportation from employee commute, vehicle fleet, and transit fleet
- Solid waste generation by government employees

[8] ICLEI. 2012. US Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from https://icleiusa.org/us-community-protocol/

[9] ICLEI. 2008. Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from https://s3.amazonaws.com/icleiusaresources/lgo_protocol_v1_1_2010-05-03.pdf

Quantifying Greenhouse Gas Emissions

Sources and Activities

Communities contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the community inventory: 1) GHG emissions that are produced by “sources” located within the community boundary, and 2) GHG emissions produced as a consequence of community “activities.”

Table 2: Source vs. Activity for GHG Emissions

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere.	The use of energy, materials (solid waste), and/or services by members of the community that result in the creation of GHG emissions.

Activities within a community include, but are not limited to: heating of homes, driving cars, and throwing away trash. Sources are where the emissions from those activities occur, which may or may not be the same place the activity occurs. When you drive your car, the source is the car's tailpipe. Similarly, when a gas furnace in your home runs, the source is the exhaust vent of the furnace. On the other hand, when you throw away trash, the source is at the landfill the trash is sent to. When you flip a switch and use electricity, the source is the power plant where the electricity is generated. Because landfills and power plants are usually located outside the community, careful inclusion of both sources and activities provides a fuller picture of community emissions.

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Sterling Heights's LGO greenhouse gas emissions inventory uses 2022 as its baseline year because it is the most recent year for which the necessary data are available.

Quantification Methods

GHG emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of GHG emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

Activity Data x Emission Factor = Emissions

Most emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other GHG-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see the appendices for a detailed listing of the activity data used in composing this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh of electricity). For this inventory, calculations were made using ICLEI's ClearPath Climate Planner tool.

Community Emissions Inventory Results

The total community-wide emissions for the 2022 inventory are shown in Table 3 and Figure 6.

Table 3: Community-Wide Emissions Inventory

Sector	Fuel or Source	2022 Usage	Usage Unit	2022 Emissions (MT CO2e)
Residential Energy	Electricity	404,239,011	kWh	239,053
	Natural Gas	47,153,641	Therms	250,794
	Distillate Fuel Oil No.2	1,788	MMBtu	133
	Propane	65,969	MMBtu	4,094
	Kerosene	62	MMBtu	5
	Wood	17,737	MMBtu	177
Residential Energy Total				**494,256**
Commercial Energy	Electricity	285,123,208	kWh	168,612
	Natural Gas	26,152,418	Therms	139,096
	Distillate Fuel Oil No.2	74,280	MMBtu	5,531
	Propane	84,409	MMBtu	5,238
	Wood	65,277	MMBtu	650
Commercial Energy Total				**319,127**
Industrial Energy	Electricity	788,023,119	kWh	466,010
	Natural Gas	21,741,909	Therms	115,394
Industrial Energy Total				**581,404**
Transportation & Mobile Sources	Gasoline - On Road	742,874,697	VMT	299,501
	Diesel - On Road	88,757,116	VMT	127,836
	Gasoline - Public Transit	5,650	Gallons	50
	Diesel - Public Transit	124,882	Gallons	1,275
	Gasoline - Off Road	184,460	MMBtu	13,237
	Diesel - Off Road	312,565	MMBtu	23,129
	CNG - Off Road	14,276	MMBtu	878

Table 3: Community-Wide Emissions Inventory (Continued)

Sector	Fuel or Source	2022 Usage	Usage Unit	2022 Emissions (MT CO2e)
Transportation & Mobile Sources	LPG - Off Road	158,618	MMBtu	9,768
	Jet Kerosene - Aviation	360,443	Gallons	3,526
	Diesel - Rail	9,933	MMBtu	741
Transportation & Mobile Sources Total				**479,941**
Solid Waste	Landfilled Waste	43,162	Tons	15,037
	Flaring of Landfill Gas	86,183,619	Cubic Feet / Year	233
	Combustion of Landfill Gas	26,326,145	Cubic Feet / Year	4
	Green Waste - Biologic Treatment of Waste	9,224	Tons	1,300
Solid Waste				**16,574**
Water & Wastewater	Electricity - Supply of Potable Water	11,511,887	kWh	11,483
	Natural Gas - Supply of Potable Water	87,414	Therms	465
	Electricity - Wastewater Treatment	9,221,686	kWh	9,198
	Natural Gas - Wastewater Treatment	646,893	Therms	3,441
	Process N2O - Wastewater Treatment	133,744	Population Served	142
	Process N2O - Effluent Discharge	133,744	Population Served	2,731
	Combustion of Biosolids and Sludges	4	Metric Tons per Day	387
Water & Wastewater Total				**27,847**
Process & Fugitive Emissions	Natural Gas Distribution	95,047,968.06	Therms	16,490
Process & Fugitive Emissions Total				**16,490**

Table 3: Community-Wide Emissions Inventory (Continued)

Sector	Fuel or Source	2022 Usage	Usage Unit	2022 Emissions (MT CO2e)
Upstream Impacts of Activities	Electric Power Transmission and Distribution Losses	1,477,385,338	kWh	63,866
Upstream Impacts of Activities Emissions Total				**63,866**
Total Gross Emissions				**1,999,505**

Figure 6 shows the distribution of community-wide emissions by sector. Industrial Energy is the largest contributor, followed by Residential Energy and Transportation & Mobile Sources. Commercial Energy is the final major contributor that follows. Upstream Impacts of Activities, Water & Wastewater, Solid Waste, and Process & Fugitive Emissions make up the remainder of emissions.

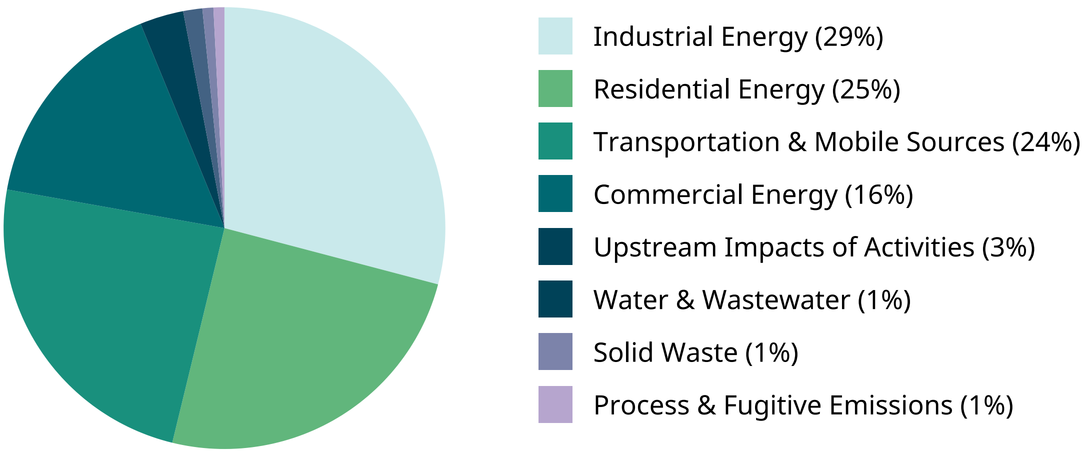


Figure 6: Community-Wide Emissions by Sector

Next Steps

The inventory should be used to focus and prioritize actions to reduce emissions. Based on the inventory results, the following areas have the greatest potential for emissions reduction [10]:

- Transportation
  - Follow through on the recommendations of the EV Charging Station Master Plan [11]:
    - Electrification policy recommendations
    - Ordinance and zoning recommendations
      - Land use - EV charging stations
      - Land use - EV charging stations in the public right-of-way
      - EV parking and design requirements
    - Public education
  - Conversion of on-road gasoline and diesel vehicle miles traveled (VMT) to electricity
    - Implementation of charging stations at city facilities, parks, and commercial properties
    - Provision of educational resources for residents charging at home
  - Reduction of on-road gasoline and diesel VMT
    - Develop partnerships with County and regional mass-transit authorities
- Building Energy
  - Increased efficiency of electricity, stationary fuel combustion, and non-utility fuel systems in new and existing buildings
    - Address via zoning (or other) incentives for new developments to obtain building certification through green building certification programs
  - Electrification of new and existing buildings with stationary and non-utility fuel-dependent systems
    - Amend the City's Zoning Ordinance to permit green energy structures within all zoning districts under proper conditions

Completion of another GHG inventory in two to five years from completion of this inventory is recommended to assess progress resulting from any actions implemented. The detailed methodology section of this report, as well as notes and attached data files in the ClearPath Climate Planner tool provided to Sterling Heights, will be helpful to complete a future inventory consistent with this one.

[10] City of Sterling Heights. 2021. Sustainability Commission Sustainability Plan - Section III Sustainability Mobility & IV Sustainable Development and Land Use. Retrieved from https://www.sterlingheights.gov/1766/Sustainability-Commission.
[11] City of Sterling Heights. 2022. EV Charging Station Master Plan - 6. Recommendations. Retrieved from https://www.semcog.org/publications.

Government Operations Emissions Inventory Results

The total government operations emissions for the 2022 inventory are shown in Table 4 and Figure 7.

Table 4: Government Operations Emissions Inventory

Sector	Fuel or Source	2022 Usage	Usage Unit	2022 Emissions (Mt CO2e)
Buildings & Facilities	Electricity	4,848,146	kWh	2,867
	Electric Transmission and Distribution Losses			210
	Natural Gas	347,273	Therms	1,847
Buildings & Facilities Total				**4,924**
Street Lights & Traffic Signals	Electricity	3,112,267	kWh	1,840
	Electric Transmission and Distribution Losses			135
Street Lights & Traffic Signals Total				**1,975**
Vehicle Fleet	Gasoline - On Road	237,574	Gallons	2,101
	Diesel - On Road	19,385	Gallons	198
	Gasoline - Off Road	227	Gallons	2
	Diesel - Off Road	30,903	Gallons	316
	Gasoline - Lawn Maintenance	10,268	Gallons	91
Vehicle Fleet Total				**2,708**
Transit Fleet	Gasoline	5,650	Gallons	50
	Diesel	124,882	Gallons	1,275
Transit Fleet Total				**1,325**
Employee Commute	Gasoline-Part/Full Time Employees	1,731,921	Miles	691
	Diesel-Part/Full Time Employees	21,782	Miles	12

Table 4: Government Operations Emissions Inventory (Continued)

Sector	Fuel or Source	2022 Usage	Usage Unit	2022 Emissions (Mt CO2e)
Employee Commute*	Electric-Part/Full Time Employees	40,169	Miles	8
	Gasoline-Temp Employees	7,213	Miles	3
	Diesel-Temp Employees	73	Miles	0.04
	Electric-Temp Employees	146	Miles	0.03
Employee Commute Travel Total				**714**
Electric Power Production	Diesel - Generators	650	MMBtu	49
Electric Power Production Total				**49**
Solid Waste	Waste Generation	1,316	Tons	458
Solid Waste Total				**458**
Water & Wastewater Treatment Facilities	Electricity	204,772	kWh	122
	Electric Transmission and Distribution Losses			9
Water & Wastewater Total				**131**
Process & Fugitive Emissions	Fugitive Emissions from Natural Gas Distribution	347,273	Therms	60
	HFC-410a - Hydrofluorocarbon & Refrigerant Emissions	1	Metric Tons	969
Process & Fugitive Emissions Total				**1,029**
Total Government Operations Emissions				**13,312**

*Employee Commute data is based on scaled survey data distributed to part and full-time employees, of which ~11% of responded. There may be inaccuracies as a result of the scaling of data from a small sample population, which may not be representative of the overall employee population.

Figure 7 shows the distribution of Government Operations emissions by sector. Buildings & Facilities, Vehicle Fleet, and Streetlights and Traffic Signals are the largest sources of emissions. Transit Fleet, Process and Fugitive Emissions, Employee Commute, and Solid Waste Facilities make up the remainder of significant contributors. Water & Wastewater and Electric Power Production add minimal emissions to the overall government total.

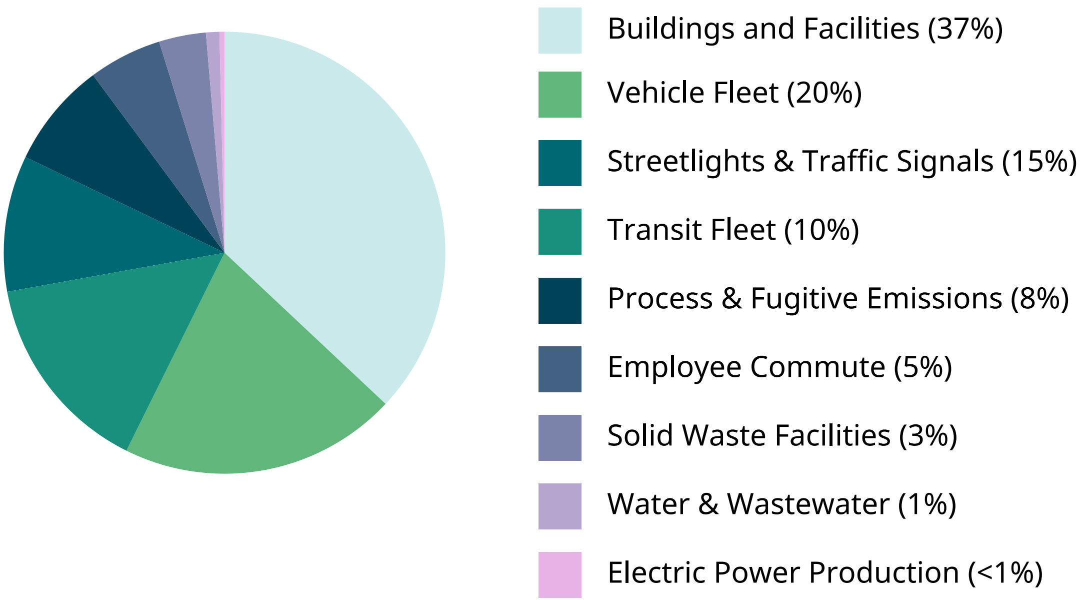


Figure 7: Government Operations Emissions by Sector

Next Steps

The inventory should be used to focus and prioritize actions to reduce emissions. Based on the inventory results, the following areas have the greatest potential for emissions reduction [12]:

- Buildings and Facilities
  - Convert existing buildings from natural gas to electricity
- Vehicle Fleet
  - Continue purchasing and converting internal combustion engine vehicles to electric vehicles or hybrid
    - Require investment analyses and factoring in of sustainability initiatives for all future vehicle purchases
    - Analyze current vehicles in city fleet for electrification potential
- Employee Commute
  - Implement telework policy

Completion of another GHG inventory in two to five years is recommended to assess progress resulting from any actions implemented. The detailed methodology section of this report, as well as notes and attached data files in the ClearPath Climate Planner tool and a master data Excel file provided to Sterling Heights, will be helpful to complete a future inventory consistent with this one.

[12] City of Sterling Heights. 2021. Sustainability Commission Sustainability Plan - Section III Sustainability Mobility & IV Sustainable Development and Land Use.

Greenhouse Gas Emissions Forecasts

Sterling Height's most recent community-wide greenhouse gas (GHG) inventory includes emissions from activities and sources that took place within the city during the 2022 calendar year. Using the 2022 GHG inventory as a baseline, ICLEI prepared a basic "business-as-usual" forecast for 2030.

Business-As-Usual (BAU) Forecast

The BAU forecast (Figure 8) is a projection of emissions through the year 2030. The projected emissions estimated population growth [13], changes in automotive fuel efficiency standards [14], and changes to the carbon intensity of grid electricity [15].

Sterling Heights's 2022 emissions were 1,999,505 Metric Tons Carbon Dioxide equivalent (MT CO2e). Based on population growth, increasing on-road vehicle fuel efficiency, and state grid intensity projections, Sterling Heights's 2030 emissions will be 1,530,322 CO2e, a 23.5% reduction. To meet its 2030 absolute (745,815 MT CO2e - 62.7% reduction) and per-capita (733,818 MT CO2e - 63.3% reduction) emissions reduction targets, further reduction action will be needed. The targets are indicated on the chart by a red dashed line (absolute) and green solid line (per-capita).

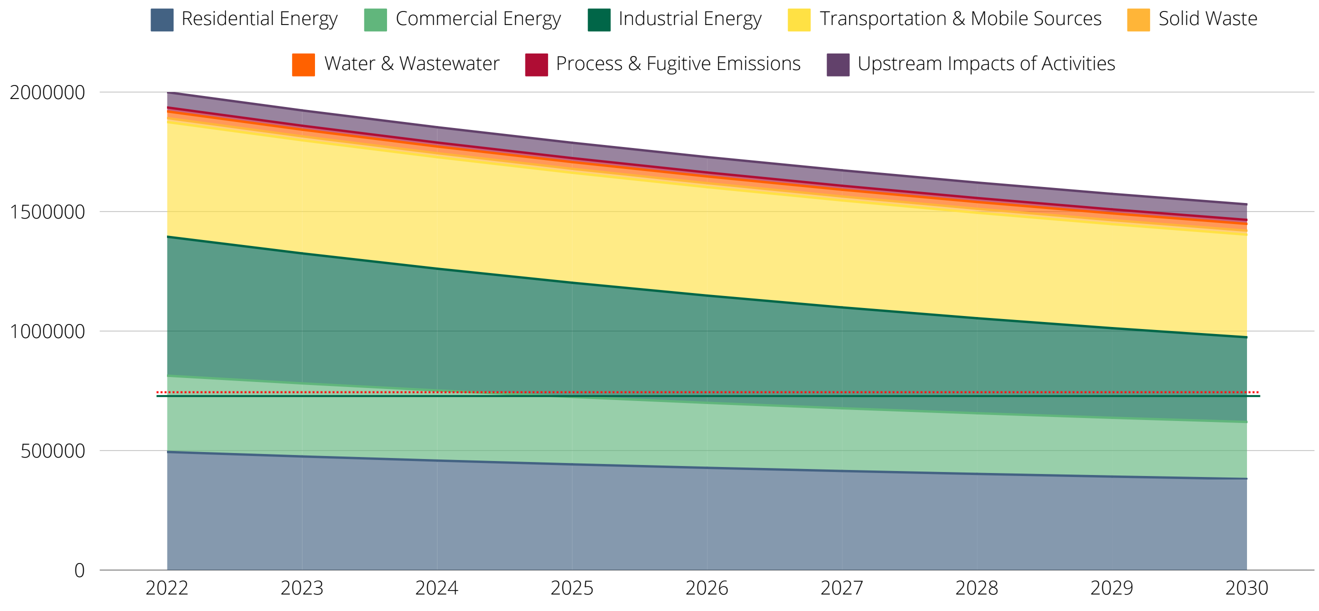


Figure 8: Business-As-Usual Forecast for Community-Wide Emissions from 2022-2030

[13] Southeast Michigan Council of Governments (SEMCOG) Population Estimates
[14] ICLEI's Carbon Intensity Reference Sheet
[15] Michigan Public Act 235

Conclusion

This inventory marks the completion of Step C of the GreenClimateCities Framework - Analyze and set a baseline. Sterling Heights's next step is Step D - Develop an integrated climate action plan. The completion of this greenhouse gas inventory will help to inform the goals, strategies, and actions contained within the plan.

The Paris Agreement commits to holding global temperatures below 2°C pre-industrial levels and pursuing efforts to limit temperature increase to 1.5°C above pre-industrial levels in order to significantly reduce the risks and impacts of climate change. To meet the commitment, the Intergovernmental Panel on Climate Change (IPCC) states that we must reduce global emissions by 50% by 2030 and reach climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%. More than ever, it is imperative that countries, regions, and local governments set targets that are ambitious enough to slash carbon emissions between now and mid-century.

Science-Based Targets (SBTs) are calculated climate goals, in line with the latest climate science, that represent a community's fair share of the global ambition necessary to meet the Paris Agreement commitment. Community education, involvement, and partnerships will be instrumental to achieve a science-based target.

To support the bold climate action of Sterling Heights, ICLEI has calculated the city's 2030 Science-Based Targets from the 2022 baseline [16]:

- **Per-Capita SBT (based on World Wide Fund for Nature's One Planet City Challenge calculation methodology): 63.3% Reduction**
- **Absolute SBT (based on baseline year and projected 2030 population): 62.7% Reduction**

Science-Based Targets are climate goals in line with the latest climate science. They represent the city's fair share of the ambition necessary to meet the Paris Agreement commitment to limit the current rate of global warming to 1.5°C between 2030 and 2052.

In addition, Sterling Heights will continue to track key energy use and emissions indicators on an on-going basis. It is recommended that communities update their inventories on a regular basis, especially as plans are implemented, to ensure measurement and verification of impacts. Regular inventories also allow for "rolling averages" to provide insight into sustained changes and can help reduce the change of an anomalous year being incorrectly interpreted. This inventory shows that Industrial and Residential Energy as well as Transportation Patterns will be particularly important to focus on. Through these efforts and others, Sterling Heights can achieve environmental, economic, and social benefits beyond reducing emissions.

[16] "Science Based Climate Targets: A Guide for Cities." Science Based Targets Network, November 4, 2021. https://sciencebasedtargetsnetwork.org/.

Appendix: Methodology Details

Energy

Table 5: Energy Data Sources

Activity	Data Source	Data Gaps/Assumptions
Community-wide		
Residential Electricity & Losses	DTE Energy	DTE's IT systems have data limitations, which may mismatch customer addresses and their respective city/county or include/exclude jurisdiction border and boundary addresses
Residential Natural Gas	Consumers Energy	Data converted from MCF to therms using Environmental Protection Agency (EPA) conversion guidance
Residential Non-Utility Fuels (Distillate Fuel Oil No.2, Kerosene, etc.)	United States Energy Information Administration (EIA); United States Census Bureau	2022 data unavailable; 2021 EIA data scaled from state to city-level using household heating fuel consumption data from the U.S. Census
Commercial Electricity & Losses	DTE Energy	See Residential Energy
Commercial Natural Gas	Consumers Energy	Data converted from MCF to therms using EPA conversion guidance; Data includes non-FLIGHT industrial and agricultural data
Commercial Non-Utility Fuels (Distillate Fuel Oil No.2, Kerosene, etc.)	United States Energy Information Administration (EIA); United States Census Bureau	2022 data unavailable; 2021 EIA data scaled from state to city-level using commercial job counts from U.S. Census Bureau's OnTheMap tool; Motor gasoline data removed to avoid double counting with National Emissions Inventory (NEI) off-road lawn care data
Industrial Electricity & Losses	DTE Energy	See Residential Energy
Industrial Natural Gas	EPA Facility Level Information on GreenHouse gases Tool (FLIGHT)	Subtracted from other industrial natural gas consumption included in the commercial sector

Table 5: Energy Data Sources (Continued)

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Electricity & Losses	DTE Energy	Unlabeled entries assigned to Buildings & Facilities sector; Warning lighting (labels) assigned to Streetlights & Traffic Signals
Natural Gas	Consumers Energy	Data converted from MCF to therms using EPA conversion guidance
Electric Power Production	City of Sterling Heights Public Works	Calculations made using the Technical Resilience Navigator Generator Runtime Calculator with 2024 generator data; Distillate fuel oil no.1 used for diesel

Table 6: DTE Energy & RFCM eGRID Emissions Factors for Electricity Consumption

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)	
2022	2189.4	149	21	CH_4 and N_2O emissions factors not available from DTE - eGRID emissions factors used as defaults

Transportation

Table 7: Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Community-wide		
On Road Transportation	Google Environmental Insights Explorer (EIE)	In-boundary, inbound, and outbound kilometers used to determine total in-boundary VMT
Public Transit	City of Sterling Heights Parks & Recreation; SMART	2022 data downscaled by attribution of boardings that use City fuel; Custom fuel economy provided by SMART for factor set
Off Road Transportation	EPA NEI	2020 data most recent available; Downscaled from county to city level using population
Rail	EPA NEI	2020 data most recent available; Downscaled from county to city level using population; No passenger rail reported for Macomb County - assume no passenger rail operating within Sterling Heights

Table 7: Transportation Data Sources (Continued)

Activity	Data Source	Data Gaps/Assumptions
Community-wide		
Aviation	Wayne County Airport Authority	All scope 3 emissions provided allocated to CO_2 for fuel calculations; Fuel consumption of airport operations estimated using emissions and emissions factors; Jet Kerosene assumed for fuel type as it is more common than aviation gasoline; Passenger attribution of fuel consumption based on ratio of Sterling Heights population to total passenger boardings (likely an overestimate); International passenger selected for flight type due to Detroit Metropolitan Wayne County Airport serving as a major international airport
Waterborne	EPA NEI	2022 data is for county level. Given the prevalence of Anchor Bay and Lake St. Clair, and the lack of any major bodies of water within the Sterling Heights jurisdiction - downscaled emissions likely to overrepresent any waterborne activity and are not included
Local Government Operations		
On-Road Fleet	City of Sterling Heights Public Works	Some data may be missing due to innaccurate reporting and recording errors. Unclear data was removed from this estimation
Off-Road Fleet	City of Sterling Heights Public Works	Some data may be missing due to innaccurate reporting and recording errors. Unclear data was removed from this estimation
Lawn Maintenance	City of Sterling Heights Public Works	Average mower productivity calculated for all speeds of 60" mowers operated by the contractor; Number of weeks mowers are operated estimated by months of operation provided by the City; Fuel economy for mower or engine not available from either manufacturer nor reported by the contractor - gathered from customer reports
Part & Full-time Employee Commute	City of Sterling Heights Public Works	Employee commute survey responses scaled to City employee population (does not include commissioners); All responses that did not provide useable data for days off use average number of hours off of 62.37 provided by the City; All responses that did not provide useable distance traveled to work data use average distance calculated from other survey respondents

Table 7: Transportation Data Sources (Continued)

Activity	Data Source	Data Gaps/Assumptions
Community-wide		
Temporary Employee Commute	City of Sterling Heights Public Works	Employee commute survey responses scaled to entire temporary employee population; Distance to work reported by part/full-time employees used for temp employees; All employees working a single day per year grouped into temporary employee population
Transit Fleet	City of Sterling Heights Parks & Recreation; SMART	City leases buses from SMART and runs its own program, so SMART data included in local government operations as well; Data downscaled by attribution of boardings that use City of Sterling Heights fuel

For vehicle transportation, it is necessary to apply average miles per gallon and emissions factors for CH4 and N2O to each vehicle type. The factors used are shown in Table 8.

Table 8: Miles per Gallon (MPG) and Emissions Factors by Vehicle Type

Fuel	Vehicle Type	MPG	CH4 (g/mile)	N2O (g/mile)
2021 US National Defaults (updated 2023) for 2022 Inventories*				
Gasoline	Passenger car	25.3	0.0084	0.0069
Gasoline	Light truck	18.2	0.0117	0.0087
Gasoline	Heavy truck	5.38355	0.0719	0.0611
Gasoline	Motorcycle	44	0.0084	0.0069
Diesel	Passenger car	25.3	0.0005	0.001
Diesel	Light Truck	18.2	0.001	0.0015
Diesel	Heavy truck	6.56	0.0051	0.0048

*ICLEI's transportation factor set utilizes fuel economy by vehicle type rather than fuel type, resulting in the same MPG for passenger cars and light trucks

Table 8: MPG and Emissions Factors by Vehicle Type (Continued)

Fuel	Vehicle Type	MPG	CH4 (g/mile)	N2O (g/mile)
2022 Sterling Heights Mini Bus				
Gasoline	Para Transit	10.1	0.0117	0.0087
Diesel	Para Transit	10.94	0.001	0.0015
2022 Sterling Heights SMART public transit				
Diesel	Transit Bus	5	0.001	0.0015

Potable Water/Wastewater

Table 9: Water/Wastewater Data Sources

Activity	Data Source	Data Gaps/Assumptions
2022 Community-wide		
Potable Water Supply Energy Usage	Great Lakes Water Authority	Data provided for energy used to supply water for entire population served - downscaled to Sterling Heights population served; Data not subtracted from commercial sector - facility lies out-of-boundary
Wastewater Treatment Energy Usage	Great Lakes Water Authority	Data provided for energy used to treat entire population served - downscaled to Sterling Heights population served; Data not subtracted from commercial sector - facility lies out-of-boundary
N2O Process & Discharge	Great Lakes Water Authority	1.25 used for industrial-commercial discharge multiplier to represent default assumption of 25% increase from these sources

Table 9: Water/Wastewater Data Sources (Continued)

Activity	Data Source	Data Gaps/Assumptions
Combustion of Biosolids and Sludges	Great Lakes Water Authority	Data provided for entire population served - downscaled to Sterling Heights population served
2022 Local Government Operations		
Electricity	DTE Energy	Includes irrigation, water pumps, water booster, retention ponds, lift stations, and water district entries

Solid Waste

Table 10: Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
2022 Community-wide		
Solid Waste Generation	Green For Life (GFL) Environmental	N/A
Flaring and Combustion of Landfill Gas	Green For Life (GFL) Environmental	LFG represents entire landfill - downscaled by ratio of Sterling Heights tonnage to total waste tonnage
Compost	Green For Life (GFL) Environmental	N/A
2022 Local Government Operations		
Waste Generation	City of Sterling Heights Public Works	Dumpsters are assumed to contain uncompacted waste; Per EPA's Volume to Weight Conversion for Solid Waste - uncompacted waste generally weighs 250-300 pounds/cubic yard; Calculations assume a middle range of this weight as a default

Fugitive Emissions

Table 11: Fugitive Emissions Data Sources

Activity	Data Source	Data Gaps/Assumptions
2022 Community-wide		
Fugitive Emissions from Natural Gas Distribution	Consumers Energy	Utilizes ClearPath defaults from EDF User Guide for Natural Gas Leakage Rate Modeling Tool
2022 Local Government Operations		
Fugitive Emissions from Natural Gas Distribution	Consumers Energy	Utilizes ClearPath defaults from EDF User Guide for Natural Gas Leakage Rate Modeling Tool
Hydrofluorocarbon & Refrigerant Emissions	City of Sterling Heights Public Works	Pounds of fugitive gas released converted to metric tons

Agriculture, Forestry and Land Use

Table 12: Forests and Urban Trees Sequestration and Emissions Data Sources

Activity	Data Source	Data Gaps/Assumptions
2022 Local Government Operations		
Agriculture Energy	Consumers Energy	Included in the commercial sector

Inventory Calculations

The 2022 inventory was calculated following the US Community Protocol and ICLEI's ClearPath Climate Planner software. As discussed in Inventory Methodology, the IPCC 5th Assessment was used for global warming potential (GWP) values to convert methane and nitrous oxide to CO2 equivalent units. ClearPath Climate Planner Climate Planner's inventory calculators allow for input of the sector activity (i.e. kWh or VMT) and emission factor to calculate the final carbon dioxide equivalent (CO2e) emissions.