



CITY OF
GRAND
RAPIDS

GRAND RAPIDS, MICHIGAN

2019 Inventory of Community-Wide and Government Operations Greenhouse Gas Emissions



Prepared For:

City of Grand
Rapids, Michigan

Prepared By:

ICLEI – Local Governments
for Sustainability USA
November 2023

Table of Contents

Tables and Figures	03
Credits and Acknowledgments	04
Letter from the City Manager	05
Executive Summary	06
Key Findings	08
Community-wide Inventory.....	08
Government Operations.....	09
Introduction to Climate Change	10
How Has and Will Grand Rapids' Climate Change?.....	11
Greenhouse Gas Inventory as a Step Toward Climate Neutrality.....	12
ICLEI Climate Mitigation Milestones.....	13
Inventory Methodology	14
Understanding a Greenhouse Gas Emissions Inventory.....	14
Community-Wide Emissions Protocol.....	15
Local Government Operations Protocol.....	16
Quantifying Greenhouse Gas Emission.....	16
<i>Sources and Activities</i>	16
<i>Base Year</i>	17
<i>Quantification Methods</i>	17
Natural Gas Data Discussion.....	18
Community Emissions Inventory Results	19
Conclusion	22
Appendix: Methodology Details	24
Energy.....	24
Transportation.....	25
Wastewater.....	26
Potable Water.....	26
Solid Waste.....	26
Fugitive Emission.....	27
Upstream Impacts.....	27
Inventory Calculations.....	27

ICLEI – Local Governments for Sustainability USA

This template was updated by ICLEI USA in 2023.

Tables and Figures

List of Tables

Table 1: Global Warming Potential Values (IPCC, 2014).....	14
Table 2: Source vs. Activity for Greenhouse Gas Emissions.....	16
Table 3: Community-Wide Emissions Inventory.....	19
Table 4: Energy Data Sources.....	24
Table 5: Consumers Energy (2019) Emissions Factors for Electricity Consumption.....	24
Table 6: Transportation Data Sources.....	25
Table 7: MPG and Emissions Factors by Vehicle Type.....	25
Table 8: Wastewater Data Sources.....	26
Table 9: Potable Water Data Sources.....	26
Table 10: Solid Waste Data Sources.....	26
Table 11: Fugitive Emissions Data Sources.....	27
Table 12: Upstream Impacts Data Sources.....	27

List of Figures

Figure 1: Community-Wide Emissions by Sector.....	08
Figure 2: Government Operations Emissions by Sector.....	09
Figure 3: The Greenhouse Effect.....	10
Figure 4: Co-Benefits and ICLEI Pathways to Accelerated Climate Action.....	12
Figure 5: ICLEI Climate Mitigation Milestones.....	13
Figure 6: Relationship of Community and Government Operations Inventories.....	16
Figure 7: Community-Wide Emissions by Sector.....	21

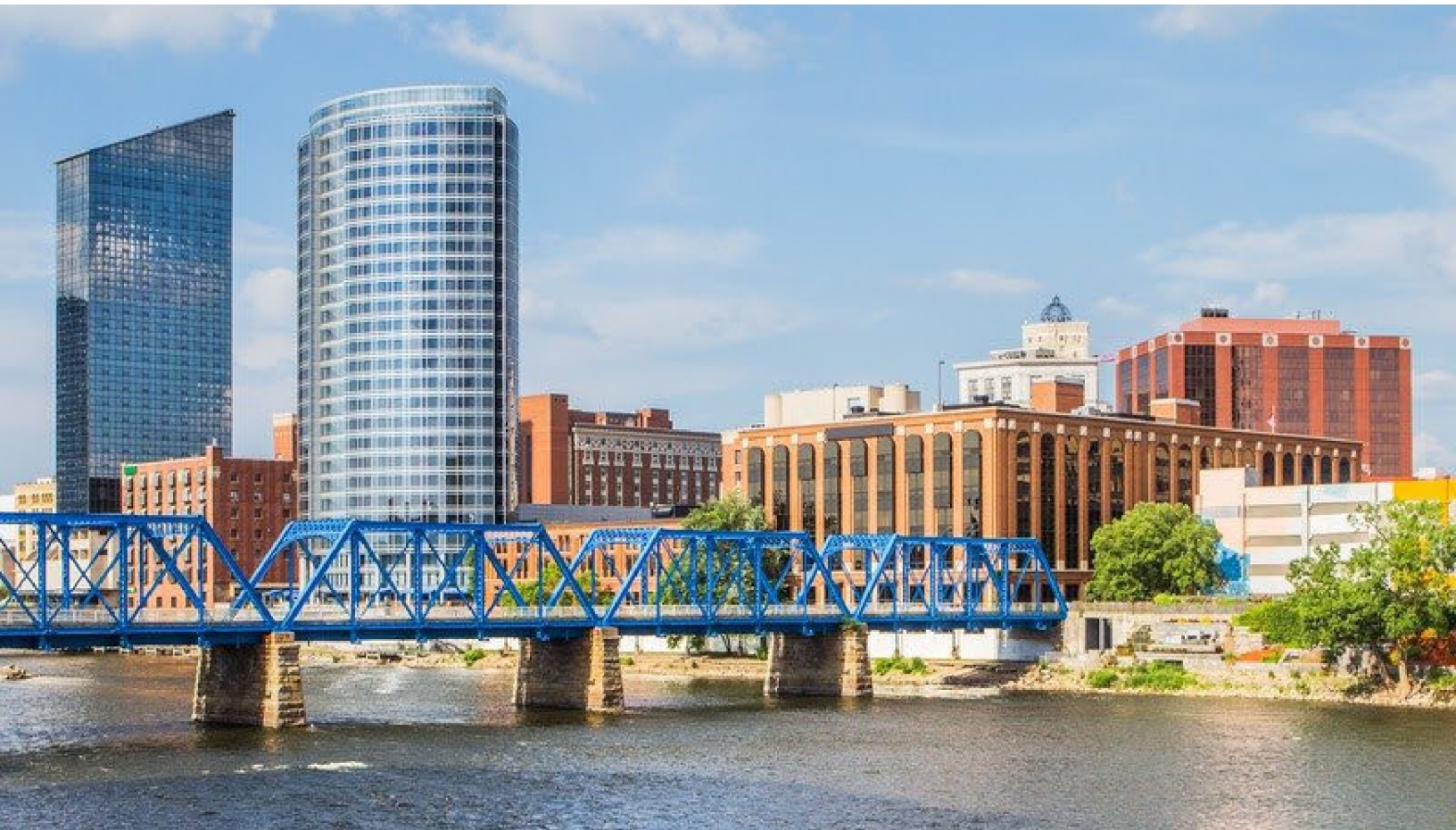


This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/). It may not be used for any commercial purpose. Any non-commercial use of this material must provide attribution to ICLEI Local Governments for Sustainability USA.

Credits and Acknowledgments

The City of Grand Rapids and ICLEI USA would like to acknowledge and thank the following for their contributions to this report:

- Alison Waske Sutter, Sustainability and Strategy Officer, for serving as the project manager for this inventory
- Annabelle Wilkinson, Environmental and Climate Justice Specialist, for contributing content
- Consumers Energy, DTE Energy, Vicinity Energy, Kent County Department of Public Works, City of Grand Rapids Water and Environmental Services Departments and the Development Center, The Rapid, and West Michigan Sustainable Business Forum for providing information needed to calculate emissions
- João Oliveira and Mike Dazy (former Office of Sustainability staff that helped collect needed information on emissions from government operations)
- Fishbeck (FTCH) for creating the City of Grand Rapids' Energy Efficiency and Conservation Strategy (2009)



Letter from the City Manager

As City Manager of the City of Grand Rapids, I'm proud of the work our team has done to build upon our historical successes in environmental sustainability and elevate our commitment to climate change action. That commitment is directly reflected in our City's six core values and in our Strategic Plan. We define sustainability as making decisions with the goal of achieving long-term net positive benefits that are informed by an understanding of how those decisions impact climate resiliency and the environment, people and communities, and finances, both today and in the future.

We are working to ensure the health of all people and the environment are advocated for, protected and enhanced. One of the objectives in our Strategic Plan is specifically focused on reducing carbon emissions, increasing climate adaptation and ensuring climate resiliency.

We know that without goals and measures, our sustainability commitment might be aspirational but not transformational. So in the fall of 2021, we adopted our first municipal greenhouse gas reduction goal – an 85% reduction by 2030 in comparison to our baseline of 2008 and carbon neutrality by 2040. While this goal is much more aggressive than those adopted by most other governmental and corporate entities, our optimism is backed up by our performance. Based on the tremendous effort of many of our departments, we reduced emissions by 30% as of 2020. In addition, we expect to achieve a 47% reduction by 2025 by converting 18,000 streetlights to LEDs, powering up our innovative biodigester and installing a nearly one megawatt ground-mounted, behind-the-meter solar array at our Lake Michigan Filtration Plant. Furthermore, 45% of our municipal electricity use was powered by renewable energy in 2022.

While it is critical that we lead by example and demonstrate that significant emissions reductions are achievable, we know that the City's municipal emissions only account for just over 2% of our community's total emissions. It is paramount that we work in partnership with our residents and employers to identify effective ways to achieve our community-wide science-based emissions reduction target of 62.8% per capita by 2030. While these strategies will require financial investment, many can provide near-immediate returns on investment (energy efficiency projects) and others have resilience benefits (on-site solar generation) that will drastically reduce and possibly eliminate future costs resulting from climate impacts.

In closing, I'd like to thank our Office of Sustainability and Strategy, particularly our Sustainability and Strategy Officer Alison Waske Sutter, for their leadership on this work and their collaboration with City departments, utilities and the community. Finally, I am grateful to our City Commission for recently adopting our fiscal year 2024 budget, which includes \$27 million in climate change investments.

In partnership,

Mark A. Washington
City Manager

Executive Summary

The climate in Grand Rapids is changing, and these changes are causing immediate threats to its citizens, health, economy, and the community's overall vitality. In light of these trends, the City of Grand Rapids has decided to plan for climate change, making sure the City is considering what changes are projected to take place in the future and integrating that information into how we, as a City, operate. Guiding this work is a commitment to ensuring the health of all people - especially frontline communities that are already and will continue to experience a disproportionate share of the impacts associated with a changing climate – are advocated for, protected, and enhanced. Understanding and reducing greenhouse gas emission levels is essential to mitigating the impacts of climate change. This GHG inventory is a critical component needed to identify key emissions reduction/climate mitigation goals and actions for the community to include in the City's Climate Action and Adaptation Plan (CAAP). The City is currently co-creating the CAAP in partnership with the [Community Collaboration on Climate Change](#) and other community stakeholders that will act as a roadmap for how the community will address both mitigating and adapting to climate change.

Within the pages of this report, readers will find information on the largest sectors impacting Grand Rapids community-wide emissions. The residents and employers located in the City of Grand Rapids generated 2.5 million metric tons of carbon dioxide equivalents (also referred to as a greenhouse gas (GHG) footprint) in 2019. The three largest sources of emissions were buildings (40% total with single and multi-family residential accounting for 28% and commercial buildings accounting for 11%), the transportation sector (30% total with gasoline-powered vehicles accounting for 18%), and industrial facilities (25%). The following fuel types are responsible for the following energy-related emissions: electricity (37%), natural gas (29%), gasoline (18%), diesel (7%) and other (9%).

To achieve aggressive emissions reduction goals, Grand Rapids must focus on energy efficiency, electrification, and renewable energy. Some of the key programs and initiatives the City is working on to further these strategies include:

- Increased communication and promotion of climate change related work:
 - A new climate change website that can be accessed via grandrapidsmi.gov/sustainability
 - The publication of a monthly e-newsletter from the Office of Sustainability – you can sign up at the bottom of grandrapidsmi.gov/sustainability
 - A free, publicly available 4-part [training series](#) on climate change that is also made available for City staff
- Efforts to reduce emissions from government operations:
 - Conduct updated energy audits of key operations, establish department specific emissions reduction targets and implement efficiency projects
 - Update a City policy outlining how low to no emissions and climate resiliency can be incorporated into the City's design, construction and operation of City facilities
 - Install on-site solar at the Butterworth Landfill and other City properties
 - Purchase renewable energy credits to offset the remaining electricity supplied to the City created with fossil fuels
 - Create a plan to transition the City fleet to low or zero-emission vehicles

- Collaboration with diverse stakeholders to reduce emissions from the building, transportation and other key emissions sectors across the Grand Rapids community, including:
 - Identification of policies and programs that can equitably reduce energy consumption within the commercial and residential building sector via the Equitable, Healthy and Zero Carbon Buildings Initiative (E.H.Zero)
 - Completion of a single-family residential renovation pilot via E.H.Zero that is leveraging grant funding to implement housing upgrades that will support the households' financial stability, increased health outcomes, emissions reduction, and increased climate adaptation
 - Work with the Transportation Climate Advisory Team (T-CAT) to identify strategies to reduce emissions from the transportation sector
 - Evaluation and implementation of a comprehensive materials management program that will increase customer service, decrease contamination and ensure long-term, broad sustainability objectives can be achieved
 - Further analysis of emissions from the industrial sector

Implementing these and other actions to effectively address the community's emissions will require an "all hands on deck" approach. That is why Grand Rapids invites you to join us as it moves forward with creating a more efficient, innovative, and sustainable Grand Rapids for all.

The City is grateful for the many partners engaging in this important emissions reduction/climate change mitigation work. It will take the collective partnership and action of the City, residents, and employers to make impactful progress on the community-wide 62.8% per capita science-based emissions reduction target by 2030. The City must also work on increasing the adaptive capacity and resilience of the community. Together, Grand Rapids can build upon its successes and demonstrate that the City can be nationally recognized as an equitable, welcoming, innovative and collaborative city with a robust economy, safe and healthy community, and the opportunity for a high quality of life for all.



Key Findings

Community-Wide Inventory

Figure 1 shows community-wide emissions by sector in 2019. The largest contributor is Transportation with 30.1% of emissions. The next largest contributors are Residential Energy (27.8%) and Industrial Energy (25.1%). Actions to reduce emissions in all of these sectors will be a key part of a climate action plan. Commercial Energy, Solid Waste, Upstream Impacts, Water & Wastewater, Process & Fugitive Emissions, and Agriculture were responsible for the remaining (approximately 17%) emissions.

The Community-wide Inventory Results section of this report provides a detailed profile of emissions sources across the Grand Rapids community; 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.

EMISSIONS AT A GLANCE

1 Transportation
30.1%

2 Residential
Energy
27.8%

3 Industrial
Energy
25.1%

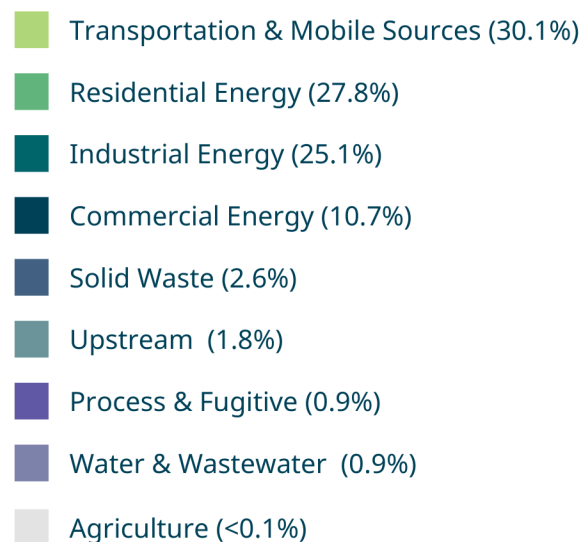
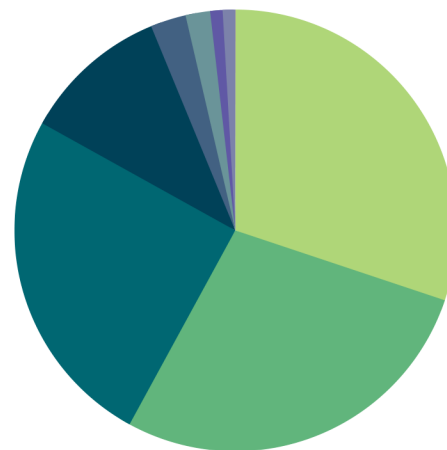


Figure 1: Community-Wide Emissions by Sector

Government Operations Inventory

Figure 2 shows government operations emissions by sector. The largest contributor is electricity with 76% of emissions. The next largest contributors are natural gas (12%) and fuel for the fleet (10%). Steam energy was responsible for the remaining (less than 3%) emissions.

Emissions from government operations contributed 2.21% of community-wide emissions. This measure was calculated based on data the City of Grand Rapids produced in partnership with Cadmus, a nationally recognized climate consultant, via SolSmart. The government operations inventory used a different methodology than the community-wide inventory. This means the two inventories did not account for all of the same emissions or use comparable sectors. For example, process and fugitive emissions from the distribution of natural gas were included in the community-wide inventory, but this was not included in the LGO inventory.

GOVERNMENT OPERATIONS EMISSIONS AT A GLANCE

- 1** Electricity
76%
- 2** Fleet
12%
- 3** Natural Gas
10%

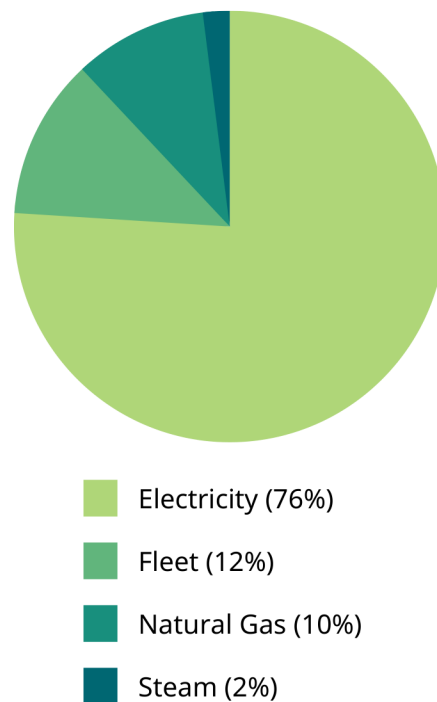


Figure 2: Government Operations Emissions by Sector

Introduction to Climate Change

Naturally occurring greenhouse gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect, as shown in the figure below [1]. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise, threatening the safety, quality of life, and economic prosperity of all humans. Although the natural greenhouse effect is needed to keep the earth warm, the 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 are unequivocally increasing the concentration of greenhouse gases (GHGs) and changing the global and local climate [2]. The most significant contributor is burning fossil fuels for transportation, electricity generation, building and water heating, and industrial processes, which releases large amounts of carbon dioxide and other GHGs into the atmosphere. Many regions are already experiencing the consequences of global climate change, and Grand Rapids is no exception.

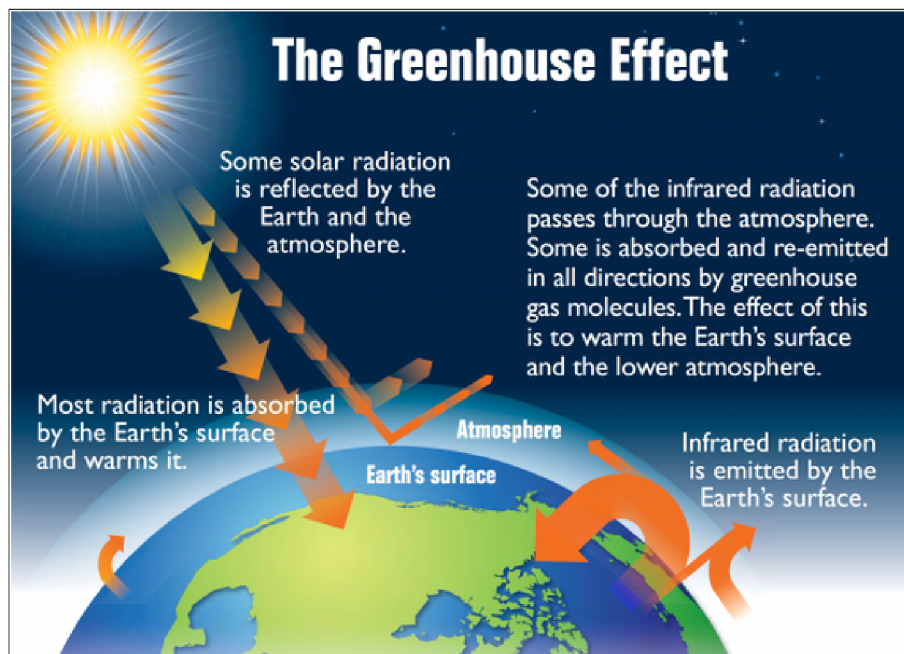


Figure 3: The Greenhouse Effect [1]

[1] Environmental Protection Agency. (n.d.). Basics of Climate Change. U.S. Environmental Protection Agency. <https://www.epa.gov/climatechange-science/basics-climate-change>

[2] 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.



Human activities have caused approximately 1.8°F of global warming since pre-industrial levels. Global warming is expected to reach 2.7°F between 2030 and 2050 (considered a high confidence or very likely scenario). Emissions from human activities will remain in the atmosphere for hundreds to thousands of years, continuing to cause additional long-term changes in the climate system, such as sea-level rise and subsequent impacts [3].

How Has and Will Grand Rapids' Climate Change?

The climate in Grand Rapids is changing, and these changes are causing immediate threats to its citizens, health, economy, and the community's overall vitality. In summary, Grand Rapids' climate is getting hotter and wetter, and producing more extreme weather events.

Even though the average annual air temperature has decreased by 0.2°F from 1951 to 2017, it's known that over the last several years Grand Rapids has experienced increased annual winter and spring temperatures. Average annual temperature is projected to increase by 3°F to 5°F by mid-century (2050). Nighttime temperatures are also rising, and the number of cold days (average 24-hour temperature < 32°F) is declining [4].

Annual precipitation is changing too: in the last several decades Grand Rapids has experienced a 16% increase in annual precipitation, with the greatest change happening in spring (a 35.8% increase, amounting to roughly an extra 3.1 inches). However, types of precipitation will vary (i.e., more winter precipitation in the form of rain)[4].

In addition, Grand Rapids has seen an increase in the frequency and intensity of severe storms, with the City experiencing a 40% increase in the number of heavy precipitation events (heaviest 1% of storms) annually. The total volume of rainfall in these extreme events has also increased by 52%. Although there will be more precipitation overall, more is anticipated to fall in shorter, extreme events, which increases the potential for drought in the future. These are just some of the changes that have led to serious impacts to the community's infrastructure, economy, social networks, cultural identity, and safety. These impacts are likely to be more extreme as the climate continues to change [4].

[3] IPCC, 2018: [Summary for Policymakers](#). In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

[4] Great Lakes Integrated Sciences + Assessment. 2019. Climate Change in the Great Lakes Region and Grand Rapids, Michigan. Retrieved from <https://glisa.umich.edu/wp-content/uploads/2022/08/Grand-Rapids-Climate-Summary.pdf>

Greenhouse Gas Inventory as a Step Toward Climate Neutrality

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

Cities, towns, and counties are well positioned to create 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. Net-zero emissions are "achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period" [5]. Creating a roadmap for net-zero emissions requires Grand Rapids to identify priority sectors for action, while considering climate justice, inclusiveness, local job creation, and other benefits of sustainable development.

To complete this inventory, the City of Grand Rapids 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, the City of Grand Rapids has set a goal to reduce community-wide emissions by 62.8% per capita by 2030. Climate action is an opportunity for Grand Rapids to experience a wide range of co-benefits, such as creating socio-economic opportunities, reducing poverty and inequity, and improving the health of people and nature (see Figure 4 to explore why and how accelerated climate action happens).

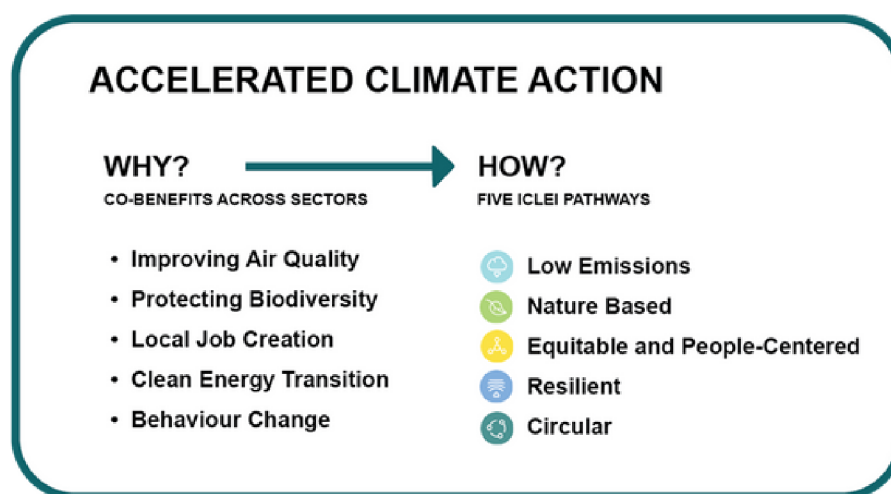


Figure 4: Co-Benefits and ICLEI Pathways to Accelerated Climate Action

[5] IPCC. 2018. Annex I: Glossary in: Global Warming of 1.5°C. Retrieved from <https://www.ipcc.ch/sr15/chapter/glossary/#:~:text=The%20process%20by%20which%20countries,with%20electricity%2C%20industry%20and%20transport.>

The City of Grand Rapids is acting as a leader in this space, but it takes a community working together to achieve climate neutrality. 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 in the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.

ICLEI Climate Mitigation Milestones

In response to the climate emergency, many communities in the United States are taking responsibility for addressing emissions at the local level. Some sources of greenhouse gas emissions can be directly or indirectly controlled through local policies. In Michigan, state laws and regulatory agencies control building and energy codes as well as regulated utilities. However, local governments can reduce community-wide emissions through land use patterns, transportation demand management, waste diversion, and economic incentives, partnerships and advocacy. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along with Five Milestones, also shown in Figure 5:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions Science-Based Target [6];
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents the completion of ICLEI's Climate Mitigation Milestone One, and provides a foundation for future work to reduce greenhouse gas emissions in Grand Rapids. The City completed Milestone Two by adopting ICLEI's science-based target of 62.8% per capita community-wide emissions reduction for 2030 in November 2022 and the City is currently in the process of Milestone 3, developing a climate action plan, which is expected to be completed by the end of 2024.



Figure 5: ICLEI Climate Mitigation Milestones

[6] 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, sources and activities generating emissions in the community. This report presents emissions from the Grand Rapids community as a whole. The government operations inventory is mostly a subset of the community-wide inventory. For example, data on commercial energy use by the community include energy consumed by government buildings, and community vehicle-miles-traveled estimates include miles driven by government 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.

Three greenhouse gases are included in this inventory: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Many of the charts in this report represent emissions in “carbon dioxide equivalent” (CO₂e) 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 ₂ O)	265



Community-Wide Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions [7] 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-wide 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 (e.g., natural gas, propane) in residential and commercial stationary combustion equipment (e.g., furnace, hot water)
- On-road passenger and freight motor vehicle travel
- Use of energy in potable water and wastewater/sewer treatment and distribution
- Generation of solid waste by the community

The community-wide inventory also includes the following activities:

- Wastewater treatment processes
- Off-road transportation
- Fugitive emissions from natural gas
- Upstream impacts from electricity distribution
- Use of electricity by the agricultural sector

The City hired Fishbeck to complete a 2008 community-wide inventory; however, due to deteriorated data quality and methodology changes, a comparison between 2008 and 2019 inventories could not be performed. Most notably, data collection methodologies have become more accurate in the 11 years since the 2008 inventory was developed. It is important to acknowledge that a greenhouse gas inventory is a tool used to benchmark a moment in time showcasing community emissions. To ensure future inventories can be compared to the 2019 inventory, the City will follow the same data collection practices and include the same sectors as they have here.

[7] ICLEI. 2012. US Community Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from <http://www.icleiusa.org/tools/ghg-protocol/community-protocol>

Local Government Operations (LGO) Protocol

The City of Grand Rapids conducted a local government operations inventory in 2019 that was produced in partnership with the U.S. Department of Energy’s National Renewable Energy Laboratory and Cadmus, via SolSmart, to confirm LGO emissions. Cadmus is a nationally recognized climate consultant.

While ICLEI USA did not complete this inventory, featuring the LGO emissions in tandem with community-wide emissions can illustrate a holistic image of the emission profile occurring within Grand Rapids. Comparing those LGO emissions to the community-wide emissions measured in this report, government operations only account for 2.21% of total community-wide emissions (see Figure 6).



Figure 6: Relationship of Community and Government Operations Inventories

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-wide 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 Greenhouse Gas Emissions (GHG)

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

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their communities. A purely source-based emissions inventory could be summed to estimate total emissions released within the community’s jurisdictional boundary. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary. The division of emissions into sources and activities replaces the scopes framework that is used in government operations inventories, but that does not have a clear definition for application to community-wide inventories.

Base Year

The inventory process requires the selection of a base year with which to compare current and future emissions. The City of Grand Rapids's LGO greenhouse gas emissions inventory utilizes 2008 as its baseline year because it was the most historic year for which the necessary data was 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 estimated emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

$$\text{Activity Data} \times \text{Emission Factor} = \text{Emissions}$$

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 CO₂/kWh of electricity). For this inventory, calculations were made using ICLEI's [ClearPath Climate Planner tool](#).



Natural Gas Data Discussion

DTE Energy provided anonymized data for natural gas accounts with Grand Rapids mailing addresses located within one of the 11 zip codes in Grand Rapids. Of those 11 zip codes, only 1 is 100% within the city, 3 have the large majority of the zip code in the city, 2 are fairly evenly split within and outside of the city, and 5 have very little area within the city. There are many households and businesses with a Grand Rapids mailing address that are located within one of these 11 zip codes, but outside of the city proper. Based on these data restrictions, the City's Office of Sustainability and Strategy chose to include 100% of the natural gas consumption data for: the zip code completely within the city (49503), the three zip codes with the vast majority within the city (49504, 49505, and 49507), and all of the consumption for 49508 while only approximately half of that zip code falls within the city boundaries. The decision to include all of 49508 was to account for the small portion of land area that falls within the city proper for remaining five zip codes (49509, 49512, 49525, 49546, and 49548), which have been excluded from the data. Finally, DTE Energy's data for 49506 includes East Grand Rapids accounts. The City's Office of Sustainability and Strategy chose to attribute 67% of this zip code to the City of Grand Rapids residential natural gas consumption. The City was left with no option but to include 100% of 49506 for commercial businesses.



Community Emissions Inventory Results

The total community-wide emissions for the 2019 inventory are shown in Table 3 and Figure 7.

Table 3: Community-Wide Emissions Inventory

Sector	Fuel or Source	2019 Usage	Usage Unit	2019 Emissions (Mt CO2e)	Percent of Total Gross Emissions
Residential Energy	Electricity	657,812,127	kWh	329,838	13.2%
	Natural Gas	68,259,505	Therms	363,048	14.6%
Residential Energy Total				692,886	27.8%
Commercial Energy	Electricity	158,786,042	kWh	75,639	3.0%
	Distillate Fuel Oil No. 2	288,903	MMBtu	21,511	0.9%
	Propane	154,218	MMBtu	9,571	0.4%
	Kerosene	1,805	MMBtu	137	<0.0%
	Natural Gas	29,531,860	Therms	157,070	6.3%
	Wood	190,172	MMBtu	1,893	0.1%
Commercial Energy Total				265,821	10.7%
Industrial Energy	Electricity	892,108,903	kWh	447,318	17.9%
	Natural Gas	33,587,150	Therms	178,262	7.2%
Industrial Energy Total				625,580	25.1%
Transportation & Mobile Sources	Gasoline	1,091,226,936	VMT	458,236	18.4%
	Diesel	113,016,167	VMT	166,810	6.7%
	CNG	13,236	VMT	0.45	<0.0%
	Public Transit			14,729	0.6%
	Off-Road			109,868	4.4%
Transportation & Mobile Sources Total				749,643	30.1%

*Blank cells are a result of variability in the format of available data by sector and fuel or source type.

Table 3: Community-Wide Emissions Inventory (continued)

Sector	Fuel or Source	2019 Usage	Usage Unit	2019 Emissions (Mt CO2e)	Percent of Total Gross Emissions
Solid Waste	Combustion of Solid Waste Generation (Waste to Energy)	185,388	Short Tons	64,257	2.6%
	Composting	15,943	Tons	1,111	<0.0%
Solid Waste Total				65,368	2.6%
Water & Wastewater	Wastewater Energy Use	22,429,510	kWh	11,247	0.5%
		25,956	MMBtu	1,381	0.1%
	Supply of Potable Water Energy Use	7,934,666	kWh	3,979	0.2%
		13,766	MMBtu	732	<0.0%
	N2O			5,951	0.2%
	Septic Systems			91	<0.0%
Water & Wastewater Total				23,380	0.9%
Process and Fugitive	Natural Gas Distribution	131,378,515	Therms	22,794	0.9%
Process & Fugitive Emissions Total				22,794	0.9%
Agriculture	Electricity Consumption	1,032,465	kWh	560	<0.0%
Agriculture Total				560	<0.0%
Upstream Impacts	Electric Power Transmission And Distribution Losses	1,732,169,047	kWh	46,032	1.8%
Upstream Impacts Total				46,032	1.8%
Total Gross Emissions				2,492,064	
Forests and Trees	Forests			-3,757	0.2%**
	Trees Outside of Forests			-15,892	0.6%**
Forests & Trees Total				-19,649	0.8%**
Total Emissions with Sequestration				2,472,415	

*Blank cells are a result of variability in the format of available data by sector and fuel or source type.

**Value represents the percentage of total emissions with sequestration.

Figure 7 shows the distribution of community-wide emissions by sector. Transportation is the largest contributor, followed by Residential, and Industrial Energy.

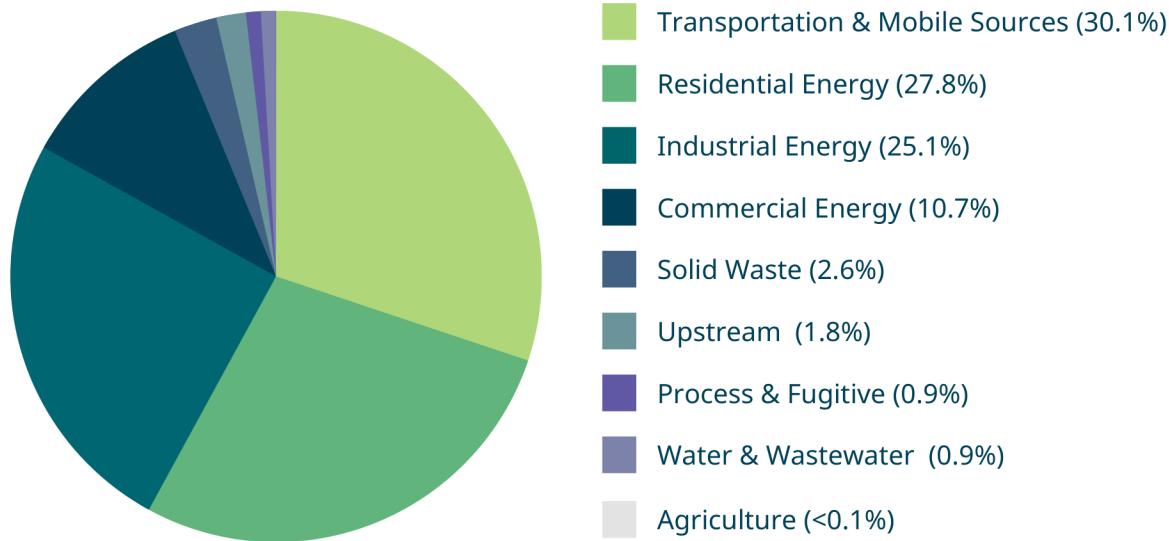


Figure 7: Community-Wide Emissions by Sector



Conclusion

This inventory marks the completion of Milestone One of the Five ICLEI Climate Mitigation Milestones.

The Intergovernmental Panel on Climate Change (IPCC) states that to meet the Paris Agreement commitment of keeping warming below 1.8°F we must reduce global emissions by 50% of the 2019 level by 2030 and reach climate neutrality by 2050 [8]. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations that have generated the most greenhouse gases to date 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 greenhouse gas/carbon emissions between now and mid-century (2050).

Science-Based Targets (SBTs) are calculated climate goals, in line with the latest climate science, that represent a community's fair share (taking into consideration wealthy nations generation of a larger proportion of emissions to date) of the global ambition necessary to meet the Paris Agreement commitment to keep warming to below 1.8°F [9]. Community education, involvement, and partnerships will be instrumental in achieving an SBT.

To support the bold climate action needed in Grand Rapids, ICLEI has calculated the City's science-based targets in terms of per capita and absolute. Per capita refers to an average emissions figure per person, and absolute refers to the total amount of community-wide GHGs [10]:

- **Per Capita SBT: 62.8%**
- **Absolute SBT: 60.5%**

In November 2022, the City completed Milestone Two by adopting a 62.8% per capita science-based target community-wide emissions reduction target.

This inventory should be used to focus and prioritize actions to reduce emissions. The Grand Rapids community should focus on the sectors with the greatest emissions, which include transportation, industry and residential buildings.



[8] 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.

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

[10] USA, ICLEI. "Race to Zero." ICLEI USA, April 7, 2021. <https://icleiusa.org/race-to-zero/>.

ICLEI recommends the following actions, which are believed to produce greater emissions reductions in the largest generating sectors:

- On-road transportation
 - Vehicle electrification: Transition from internal combustion engine vehicles (passenger, transit fleets, government fleets, etc.) to electric-powered
 - Land use/infrastructure planning: Improve infrastructure to incentivize public transit usage, vehicle sharing, micro-mobility, walking, and biking
 - Work with communities to expand public transportation options
- Residential, industrial, and commercial electricity use
 - Increase distributed solar (solar installed directly on homes and buildings)
- Residential, industrial, and commercial stationary fuel use
 - Electrify building heating: Convert gas-powered heating appliances (e.g., water heaters, furnaces) to electric-powered

Completion of another GHG inventory in two to five years is recommended to assess progress resulting from any actions implemented. Regular inventories also allow for “rolling averages” to provide insight into sustained changes and can help reduce the chance of an anomalous year being incorrectly interpreted. Finally, the City is currently in the process of developing its Climate Action and Adaptation Plan, which is Milestone 3. The City expects this plan to be completed at the end of 2024. You can follow the City’s progress by signing up for the Office of Sustainability’s monthly [e-newsletter](#) and keeping an eye on their [climate change website](#). Through these efforts and others, Grand Rapids can achieve environmental, economic, and social benefits beyond reducing emissions.



Appendix: Methodology Details

Energy

Table 4: Energy Data Sources

Activity	Data Source	Data Gaps/Assumptions
Residential, Commercial, and Industrial Electricity Consumption	Consumers Energy	For commercial electricity consumption, buildings are assigned based on metering rates and include large users such as hospitals and universities. This data also includes municipal and institutional buildings.
Residential, Commercial, and Industrial Natural Gas Consumption	DTE Energy	Natural gas usage data provided by DTE included usage from outside of the city proper; therefore, estimations were used to obtain usage within city limits. See the Natural Gas Data Discussion section for more information.
Residential Non-Utility Fuel Consumption	Energy Information Administration	A downscaling estimate based on statewide commercial fuel combustion estimates (from EIA) and job counts at the state and local levels were used.

Table 5: Consumers Energy (2019) Emissions Factors for Electricity Consumption

Emissions Factor/ Year	CO2 (lbs./MWh)	CH4 (lbs./GWh)	N2O (lbs./GWh)	Data Gaps and Assumptions
Consumers Energy/eGRID - 2019	1,098	114	16	The CO2 factor was provided by Consumers Energy and the CH4 and N2O factors were sourced from EPA eGRID.

Transportation

Table 6: Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Vehicle Miles Travelled	Google Environmental Insights Explorer	Data does not include public transit.
Government Operations	City of Grand Rapids	Records calculated emissions by fuel usage, which does not calculate CH ₄ and N ₂ O emissions except CNG, which was recorded as a direct emissions entry. The off-road calculator was used for heavy-duty vehicles (diesel) because data represents activity as "rigid."
Transit Ridership	City of Grand Rapids	For the diesel hybrid from The Rapid, the source used standard diesel.
Off-Road	EPA National Emissions Inventory	Records represent all off-road/mobile sources. Source data only provides CO ₂ /CH ₄ emissions.

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 7.

Table 7: MPG and Emissions Factors by Vehicle Type

Fuel	Vehicle Type	MPG	CH ₄ (g/mile)	N ₂ O (g/mile)
Gasoline	Passenger car	24.1	0.0183	0.0083
Gasoline	Motorcycle	24.1	0.0183	0.0083
Diesel	Passenger car	24.1	0.0005	0.001
Diesel	Light truck	17.6	0.001	0.0015
Diesel	Heavy truck	6.4	0.0051	0.0048

Wastewater

Table 8: Wastewater Data Sources

Activity	Data Source	Data Gaps/Assumptions
Energy used in wastewater facilities	Consumers Energy	The data provided for the City of Grand Rapids included other jurisdictions. The city accounts for approximately 50% of the total usage value; therefore, 50% of the activity data was used in the inventory.
Nitrogen Discharge	City of Grand Rapids	None identified.
Process N2O Emissions From Wastewater Treatment	City of Grand Rapids	None identified.
Septic Systems	City of Grand Rapids	There are approximately 300 septic tanks in the City of Grand Rapids with an average household size of 2.51 persons; therefore, the population used to estimate septic tank emissions was 753.

Potable Water

Table 9: Potable Water Data Sources

Activity	Data Source	Data Gaps/Assumptions
Energy used in potable water facilities	Consumers Energy	The data provided for the City of Grand Rapids included other jurisdictions. The city accounts for approximately 50% of the total usage value; therefore, 50% of the activity data was used in the inventory.

Solid Waste

Table 10: Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
Combustion of Solid Waste Generation (Waste to Energy)	Kent County	None identified.
Composting	City of Grand Rapids	This record represents data for 2018 and part of 2019 (one full calendar year).

Fugitive Emissions

Table 11: Fugitive Emissions Data Sources

Activity	Data Source	Data Gaps/Assumptions
Natural Gas Distribution	DTE Energy	Natural gas usage data provided by DTE included usage from outside of the city proper; therefore, estimations were used to obtain usage within city limits. See the Natural Gas Data Discussion section for more information.

Upstream Impacts

Table 12: Upstream Impacts Data Sources

Activity	Data Source	Data Gaps/Assumptions
Electric Power Transmission and Distribution Losses	Consumers Energy	None identified.

Inventory Calculations

This 2019 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’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.



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/). It may not be used for any commercial purpose. Any non-commercial use of this material must provide attribution to ICLEI Local Governments for Sustainability USA.