

ENERGY BASELINES AND GREENHOUSE GAS INVENTORY

The City of Grand Rapids (the City) joined the United States (US) Conference of Mayors Climate Protection Agreement that called for local and national action to reduce greenhouse gas (GHG) emissions. Recognizing its leadership role in the effort to reduce emissions and mitigate the potential impacts of climate change, the City, in conjunction with an application for an Energy Efficiency Conservation Block Grant (EECBG) from the US Department of Energy (USDOE), contracted Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) to complete a greenhouse gas inventory for the City's governmental operations and the community as a whole.

The City is also a member of ICLEI¹ – Local Governments for Sustainability (ICLEI), which is a membership association of local governments and national and regional local government associations that have made a unique commitment to sustainable development. ICLEI is made up of 1,107 local governments, representing over 400 million people worldwide.

The purpose of the GHG inventories is to provide a baseline against which the City of Grand Rapids can measure progress towards the reduction of its emissions. GHG emissions are expressed in metric tons of carbon dioxide equivalent (CO₂e) produced by energy consumption and other activities of the City and community.

The GHG inventory report is presented in two sections: Governmental Operations – Tier I and Community – Tier II. Because there are many sources of data for energy use, demographics, etc., the best quality data was selected, noting the direct source of the information referenced, and, where necessary, when provided with more than one set of data for the same activity, an explanation of why the data selected was considered of a higher quality.

In 2008, the City of Grand Rapids governmental operations generated approximately 94,745 metric tons of CO₂e², of which approximately 17,225 metric tons was from renewable energy sources, for a net generation of approximately 77,520 metric tons of CO₂e. As shown in Figure 4, the Water and Environmental Services (wastewater) Departments had the largest emissions of CO₂e (32% and 27%, respectively). The other largest sources were Traffic and Street Lighting and Facility Management, 15% and 9%, respectively. The remaining sources are from the City's mobile fleet, Libraries, Fire Department, Parks and Cemeteries, Police Department, and other miscellaneous sources.

¹ ICLEI is formerly known as the International Council for Local Environmental Initiatives

² Please refer to the Protocol section for an explanation of CO₂e.

GREENHOUSE GAS INVENTORY METHODOLOGY

The inventory methodologies selected for both the City of Grand Rapids governmental operations and the City-wide sources follow standards appropriate to the activities in each group.

REPORTING YEAR

A primary aspect of the GHG emissions inventory process is the requirement to select an appropriate baseline year with which to compare emissions among time periods. The US Council of Mayors in its Climate Protection Agreement recommends using 1990 as the baseline year. This would prove difficult for the City of Grand Rapids because the quality of data that is available would not produce an accurate inventory.

The City elected to complete the governmental operations GHG inventory for the calendar year 2008 activities, which does not correlate with the City's fiscal year of July 1 to June 30. In some instances, complete calendar year 2008 data was not available (e.g., natural gas); therefore, where necessary, fuel usages were inferred based on 2009 usages.

For the community GHG inventory, accurate data for the calendar year 2008 was not available for the Transportation Sector, which is the sector with the largest emissions of the community. However, a fairly complete data set for calendar year 2007 was obtained, so the community inventory is based primarily on a combination of the calendar year 2007 and fiscal year 2008 data unless otherwise indicated. If the City elects to prepare GHG inventories for subsequent years, the models and spreadsheet developed in this effort can be utilized, keeping in mind substantive changes that may have occurred between the reporting years.

PROTOCOLS

The six GHGs identified in the Kyoto Protocol were evaluated for this inventory:

- Carbon Dioxide (CO₂)
- Methane (CH₄)
- Nitrous Oxide (N₂O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF₆)

Of these gases, CO₂, CH₄, and N₂O occur naturally in the environment and are released through the combustion of fossil fuels, from livestock operations, and from agricultural activities. The remaining gases are man-made and are generally released through specific industrial processes and energy transmission activities.

The City of Grand Rapids elected to complete the GHG inventories in accordance with the guidance and protocols of ICLEI, which developed the International Local Government GHG Emissions Analysis Protocol and the Local Government Operations Protocol (Version 1, September 2008). These protocols provide guidance to local governments in quantifying GHG emissions from both its internal operations (Tier I) and from the whole communities within its geopolitical boundaries (Tier II).

Because of the diverse sources of GHG emissions from the City operations, protocols from additional sources were also utilized to best match the activity to the calculation method. The basis of most of the GHG inventory protocols (including that provided by ICLEI) was established by the World Resources Institute and the World Business Council for Sustainable Development in *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, Revised Edition* (2004), hereafter referred to as the GHG Protocol.

In addition, FTC&H relied on protocols developed by The Climate Registry and United States Environmental Protection Agency's (USEPA) Climate Leaders program for select governmental operations sources. The Climate Leaders' protocol utilizes a similar framework as the GHG Protocol; however, it has frequently updated emission factors and assumptions specific to activities in the United States.

A verification process is part of all the protocols employed for this effort, developed to ensure that the data, assumptions, and procedures used to develop the inventory are reliable and defensible. FTC&H has developed this inventory with the intent that it could be verified by a third-party auditor.

The protocols define three categories or "Scopes" of emissions for an inventory. Scope 1 and 2 emissions are direct and indirect emissions, respectively, from the City's operations under its control (e.g., on-site combustion and purchased electricity, respectively).

Direct emissions (Scope 1 Emissions) from City activities result from the following activities:

- Combustion of fuel oil or natural gas in boilers, furnaces, and generators
- Consumption of fuel oil or gasoline in City-owned/leased vehicles
- Fugitive emissions from cooling equipment

Indirect Emissions (Scope 2 Emissions) from City activities result from the following activities:

- Use of purchased electricity
- Use of purchased steam

The activities listed above are not intended to exhaustively catalog of the City's emission sources; they were selected to provide recognizable examples of sources of GHG emissions.

Emission factors for most of the common emission sources from the City's operations are from the following sources:

- GHG Protocol
- Intergovernmental Panel on Climate Change
- The Climate Registry General Reporting Protocol for the Voluntary Reporting Program
- The USEPA Climate Leaders Program
- The California Climate Action Registry
- The USEPA AP-42
- Sound engineering judgment

The community inventory also utilized emission factors provided by ICLEI in its software model employed for the inventory process.

All GHGs are calculated separately and converted to the CO₂e on the basis of their global warming potential (GWP). For instance, the GWP for N₂O is 310 times that of CO₂, and the GWP of SF₆ is 23,900 times that of CO₂. All GHGs in this analysis are presented as their CO₂e value.

SIGNIFICANCE THRESHOLD

Within the City of Grand Rapids' operations, there are emission sources that are categorized as Scope 1 or Scope 2 emissions but are difficult to accurately measure and minimal in magnitude. These sources include select backup generators; fugitive emissions from heating, ventilating, and air conditioning (HVAC) equipment; and fugitive emissions from vehicle maintenance facilities. These are only example sources. The small emission sources were omitted from the inventory if adequate data was not available and appropriate notations were made in the workbooks.

Likewise, there are sources within the community that could not be quantified. For instance, the City was not able to obtain the tons of rail freight that passed through the rail yards in the City limits. Therefore, emissions from this source category were omitted and notations made in workbooks.

UNCERTAINTY ANALYSIS

The GHG inventories are based on the most reliable data available and this inventory fairly represents the GHG emissions from the City of Grand Rapids governmental activities and community as a whole. However, there are uncertainties associated with the emission estimates. Selected estimates, such as those for CO₂ emissions from energy-related activities, are considered to have low levels of uncertainty. For some other categories of emissions, such as the emissions from vehicle use (lack of data or details of the vehicle make/model), increases the uncertainty level associated with the estimates presented.

Generally, stationary source emissions are based on the utility bills and purchase records, with the assumption that all materials and fuels were processed, consumed, wasted, or emitted. However, for certain sources, site-specific knowledge of the activity and/or emission factors are used to determine actual emissions. For this inventory, the assumption is that the information provided by each of the City employees is accurate and verifiable through any audit process. The quality of this GHG inventory is reliant on this assumption. Larger source emissions from the community, such as those from vehicle traffic, are based on modeled data provided by agencies (both governmental and non-governmental) engaged in those activities.

The GHG inventory from the City's operations is based on calendar year 2008; however, in some circumstances, the data was not available within reasonable time constraints. In these instances, the City used the best available data. For example, the City purchases natural gas from DTE Energy (through its MichCon operations). DTE Energy provided a summary of natural gas purchased by the City based on City account numbers. In most instances, the natural gas summaries provided by DTE Energy summarized monthly usages for a 12 to 14 month period prior to May 2009. In these cases, the 2009 natural gas usages were used in lieu of the 2008 months not provided. All assumptions are clearly noted in the calculation workbooks.

RENEWABLE ENERGY CREDITS AND BIOFUELS

The City purchases renewable energy through Consumers Energy's Green Generation Program (GGP). According to City officials, they entered into an agreement to purchase 20% of its electric supply from Michigan-based renewable energy sources through this program. The GGP is Green-e Energy Certified³, which is an independent certification and verification program for renewable energy sources. According to the Green-e Energy website, the renewable energy sources are certified through a verification process to ensure the following:

³ <http://www.green-e.org/>

- The renewable energy is from a new project. The windmill, solar panel, or other generators that produced the renewable energy must have been built after 1997.
- There has been no double-selling. Sellers are reviewed twice a year, and the energy is accounted for and tracked through the annual Green-e Energy verification audit process.
- The certified-renewable energy goes beyond what is required by law or claimed against a mandate.

The Climate Leaders guidance documents for Indirect Emissions from Purchases/Sales of Electricity and Steam and for Green Power and Renewable Energy Certificates (RECs) were used to calculate the City's GHG emissions reduction from its renewable energy purchase. The GHG emission reductions from the renewable energy purchase is credited to the bottom line of the City's inventory in the Renewable Energy Adjustment.

The City also purchases biodiesel (B20) and a gasoline ethanol blend (E10) for use in its mobile fleet. The EPA Climate Leader guidance document for Direct Emissions from Mobile Combustion Sources indicates the mobile source CO₂ emissions from non-fossil fuels, such as ethanol and biodiesel, are considered biogenic emissions. The biogenic CO₂ emissions from mobile source combustion are calculated according to this guidance, and are included as a GHG emission reduction off the bottom line of the City's inventory in the Renewable Energy Adjustment.

TIER 1 - GOVERNMENTAL OPERATIONS INVENTORY

LOCAL GOVERNMENT PROFILE INFORMATION

The City of Grand Rapids, the second largest city in the State of Michigan, encompasses an area of approximately 45 square miles. Grand Rapids is located in west central Michigan, roughly 30 miles due east of Lake Michigan, and is considered the urban center for the region. The Grand River, a major state waterway, runs through the center of the City. According to the U.S. Census population estimate, the City's population was 193,396⁴ in 2008. The last official US Census count was in 2000, and the population was estimated to be 197,800. In fiscal year 2008, the City employed approximately 1,700 full time people.

For the fiscal year 2008, the City managed a General Operating Fund budget of approximately \$120,000,000⁵. Of this budget, approximately \$1,250,000 was spent on utilities for City-owned/leased buildings.⁶

⁴ US Census Bureau

⁵ [http://www.grand-rapids.mi.us/download_upload/binary_object_cache/frontpage_Final%20Fiscal%20Plan%20\(Final%20File\).pdf](http://www.grand-rapids.mi.us/download_upload/binary_object_cache/frontpage_Final%20Fiscal%20Plan%20(Final%20File).pdf), page 71

⁶ [http://www.grand-rapids.mi.us/download_upload/binary_object_cache/frontpage_Final%20Fiscal%20Plan%20\(Final%20File\).pdf](http://www.grand-rapids.mi.us/download_upload/binary_object_cache/frontpage_Final%20Fiscal%20Plan%20(Final%20File).pdf), page 116

The USDOE's, Building Energy Codes Program has assigned Kent County to climate zone No. 14. A separate USDOE program, the Building Technologies Program – Residential Buildings, assigned the area to the “cold and very cold” climate zone.

The heating and cooling degree day data for calendar year 2008 was obtained from the National Oceanic and Atmospheric Administration (NOAA)⁷ and reported 541 cooling degree days and 7,037 heating degree days.

Size	45 square miles
Population	193,396
Annual Budget	\$120,000,000
Employees	1,700
Climate Zone	14
Heating Degree Days	7,037
Cooling Degree Days	541

The City of Grand Rapids provides a wide variety of services to its residents and the business community. These services include:

- Water Treatment
- Water Distribution
- Wastewater Collection
- Wastewater Distribution
- Fire Protection
- Police
- Mass Transit (Downtown Shuttle Buses)
- Stadiums/Sports Venues
- Convention Center
- Street Lighting and Traffic Signals
- Municipal Solid Waste/Yard Waste Pick-up and Transportation

Not all of the activities of the City are included in this inventory. A detailed narrative regarding the sources of emissions can be found in the Organizational Boundary section.

⁷ <http://www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.jsp#>

ORGANIZATIONAL BOUNDARY

The City of Grand Rapids owns and maintains over 265 properties which are a mix of buildings, parks, pump stations, reservoirs, booster pump stations, and parking structures. This includes the structures at the Lake Michigan Water Filtration Plant in West Olive. A listing of the City properties included in the GHG inventory is provided electronically in an MS[®] Excel spreadsheet format as Appendix 1.

This GHG inventory was prepared for City activities related to its governmental operations, including City-owned or leased buildings, water and wastewater utility infrastructure, parks, cemeteries, parking facilities, lighting infrastructure, downtown transit, maintenance (infrastructure and street), police, and fire activities. The City did not include the Grand Rapids Public Museum, John Ball Zoo, event/sporting venues, conference centers, or schools. A brief summary of the City's operations included in this inventory follows:

WASTEWATER TREATMENT AND COLLECTION

The City's Environmental Services Department operates both storm water and wastewater treatment and collection. The Wastewater Treatment Plant (WWTP) provides wastewater collection and treatment for the City of Grand Rapids and 10 surrounding communities, totaling approximately 265,000 customers within a 125 square mile geographical area. The WWTP has a design capacity of 61 million gallons per day (MGD).⁸ In calendar year 2008, the WWTP had an average flow of 49.2 MGD.⁹

The City maintains over 70 properties associated with its storm water and wastewater treatment and collection. To support the wastewater and storm water systems, the City operates 56 lift stations, a combined sewer overflow basin, storm water and meter stations, regulators, a maintenance garage, and the WWTP.¹⁰

WATER TREATMENT AND DISTRIBUTION

The City's Water Department supplies an average of 37 MGD of water to the City of Grand Rapids and seven surrounding communities, along with portions of Ottawa County. The City's water distribution system contains over 1,200 miles of pipes.¹¹

⁸ City of Grand Rapids website www.GRCity.us

⁹ City of Grand Rapids Environmental Services Department

¹⁰ City of Grand Rapids Office of Energy and Sustainability

¹¹ Grand Rapids Water System, 2008 Water Treatment Report

The City operates and maintains the Lake Michigan Water Filtration Plant in West Olive, Michigan. Although not located within the City limits, activities related to the Water Filtration Plant is included in this inventory. To support the water supply system, the City operates pumping stations, reservoirs, regulators, boosters, warehouses, garages, and office space related to water delivery within the City limits.¹²

DEPARTMENTS

- Facilities Management helps to maintain and improve City-owned facilities, including the City's vehicle fleets, with the exception of the Fire Department fleet and DASH buses. Facilities Management maintains over 20 buildings, including City Hall, Community Archives and Research Center, and Public Works; in addition to garages, office space, and storage buildings for other departments use. Therefore, for the purposes of the GHG inventory, emissions from Police Department properties and its fleet, Streets and Sanitation Department properties, and the buildings used by Traffic Safety are included under Facilities Management for the GHG inventory.
- The City's Parking Services Department maintains over 35 ramps and parking lots. The DASH system of 6 diesel-powered shuttle buses is part of the Parking Services Department; however, emissions from the buses are presented separately.
- The Grand Rapids Fire Department occupies 11 fire stations, and operates 2 battalion chief vehicles, 7 engines, 2 rescue engines, 4 ladder trucks, 5 medical squads, and various special response units.¹³ The vehicles operated by the Fire Department are included in its GHG inventory and are not part of the Vehicle Fleet's inventory.
- The Parks and Cemeteries Department maintains over 2,000 acres of parkland throughout the City, 6 cemeteries, the Indian Trails Golf Course, and several recreational facilities.¹⁴ This department is also referred to as the Parks and Recreation Department.
- The Grand Rapids Public Library operates and maintains the main library and 7 branches throughout the City.¹⁵
- The Traffic Safety Department designs, constructs, operates, and maintains the traffic control and street lighting infrastructure in the City.

¹² City of Grand Rapids Office of Energy and Sustainability

¹³ City of Grand Rapids website www.GRcity.us

¹⁴ City of Grand Rapids website www.GRcity.us

¹⁵ City of Grand Rapids website www.GRcity.us

VEHICLE FLEET

The City maintains a fleet of vehicles as summarized in Table 2:

Table 2 – City of Grand Rapids Vehicle Fleet

Vehicle Type ¹⁶	Number of Vehicles	Model Year Range	2008 CY Miles
Gasoline Car	283	1996-2008	3,592,800
Light Trucks, SUVs, Vans	69	1995-2008	468,603
Heavy Duty	86	1991-2008	563,341
Diesel Heavy Duty	235	Various	1,422,525

Vehicles for the Fire Department and DASH bus system are included with the GHG inventories for the Fire Department and Parking Services Department, respectively.

POWER GENERATION FACILITIES

The City does not own or operate any power generation facilities; however, the Covanta Kent Inc. Waste-To-Energy Facility, located at 950 Market Street, SW, generates electricity and steam which is supplied to the District Heating and Cooling Operations (DHCO); and the Veolia Energy Grand Rapids LLC facility, located at 156 West Fulton, generates steam for use within the Central Business District. Neither of these operations is included in the City's governmental operations inventory, but is included in the community inventory. Indirect emissions from City buildings that use steam from the Veolia Energy facility are included in the City's GHG inventory.

Natural gas is provided to the City by DTE Energy (through its MichCon operations) and electricity is provided by Consumers Energy. Neither DTE Energy nor Consumers Energy operates energy-generating assets within the City limits.

SOLID WASTE FACILITIES

The City does not own or operate any municipal solid waste disposal facilities; however, a City-operated yard waste drop off site is located at 2001 Butterworth. There are no municipal solid waste landfills within the City limits.

AGRICULTURAL OPERATIONS

The City does not operate any agricultural operations or composting facilities. Compost waste from City residents is sent to Spurt Industries. This operation has been included in the Community GHG Inventory.

¹⁶ City of Grand Rapids Fleet Management Department

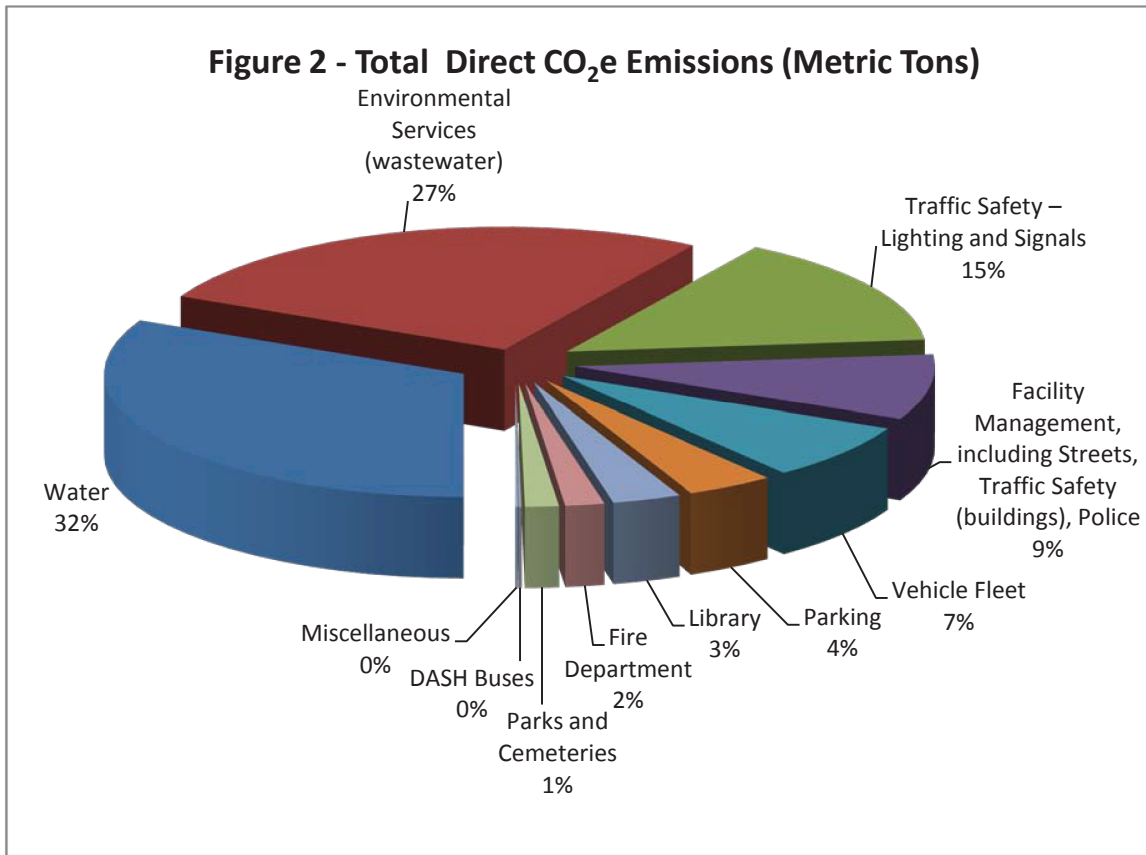
GHG EMISSIONS

Details of each sector are presented in the Organizational Boundary section of this report. A summary of the GHG emissions from each sector in the City's governmental operations is presented in Table 3.

Table 3 - City of Grand Rapids GHG Emissions

Department	Total Indirect CO₂e Emissions (metric tons)	Total Direct CO₂e Emissions (metric tons)	Total CO₂e Emissions (metric tons)	Percent of Total Emissions
Water	27,689.76	2,774.97	30,464.74	32%
Environmental Services (wastewater)	22,603.10	2,685.60	25,288.69	27%
Traffic Safety – Lighting and Signals	13,827.61	0.00	13,827.61	15%
Facility Management, including Streets, Traffic Safety (buildings), Police	7,296.04	863.90	8,159.94	9%
Vehicle Fleet	0.00	7,001.49	7,001.49	7%
Parking	3,726.26	0.47	3,726.73	4%
Library	2,197.12	722.51	2,919.63	3%
Fire Department	754.95	909.80	1,664.75	2%
Parks and Cemeteries	999.68	433.82	1,433.50	2%
DASH Buses	0.00	145.76	145.76	0%
Miscellaneous	51.40	59.19	110.59	0%
Gross CO₂e Emissions	79,145.93	15,597.50	94,743.43	NA
Renewable Energy Adjustment*	16,683.01	540.24	17,223.25	NA
Net CO₂e Emissions	62,462.93	15,057.26	77,520.18	NA

*Includes credits for both renewable electrical energy purchases and biogenic emissions from biofuels in fleet vehicles.



The following table summarizes the City's Indirect GHG emissions from electrical and steam usage by Department.

Table 4 – City of Grand Rapids Indirect Emissions from Electrical and Steam Usage

Department	Indirect CO₂ Emissions (metric tons)	Indirect CH₄ Emissions (kg)	Indirect N₂O Emissions (kg)	Total Indirect CO₂e Emissions (metric tons)
Parks and Cemeteries	936.67	20.33	16.28	942.15
Cemeteries	25.65	0.56	0.45	25.80
Golf	31.55	0.68	0.55	31.73
Environmental Services	2,750.38	59.70	47.80	2,766.45
WWTP (1300 Market)	19,721.40	428.04	342.76	19,836.64
Facility Management	7,171.99	152.67	124.39	7,213.75
Streets and Sanitation	3.67	0.08	0.06	3.70
Traffic Safety (buildings only)	69.66	1.51	1.21	70.07
Police	8.48	0.18	0.15	8.53
Street Lighting and Traffic Signals	13,747.28	298.38	238.93	13,827.61
Parking	3,704.61	80.41	64.39	3,726.26
Fire Department	750.58	16.01	13.02	754.95
Library	2,184.36	47.41	37.96	2,197.12
Water	11,746.42	254.95	204.15	11,815.06
Lake Michigan Filtration Plant	15,782.47	342.55	274.30	15,874.70
Miscellaneous	51.10	1.11	0.89	51.40
Gross Indirect GHG Emissions	78,686.28	1,704.56	1,367.29	79,145.93
Renewable Energy Adjustment (electricity)	16,595.68	293.37	261.84	16,683.01
Net Indirect GHG Emissions	62,090.60	1,411.19	1,105.45	62,462.93

The following tables summarize the City's Direct GHG Emissions from natural gas usage, vehicle fleet, and diesel generators.

Table 5 – City of Grand Rapids Direct Emissions from Natural Gas Usage

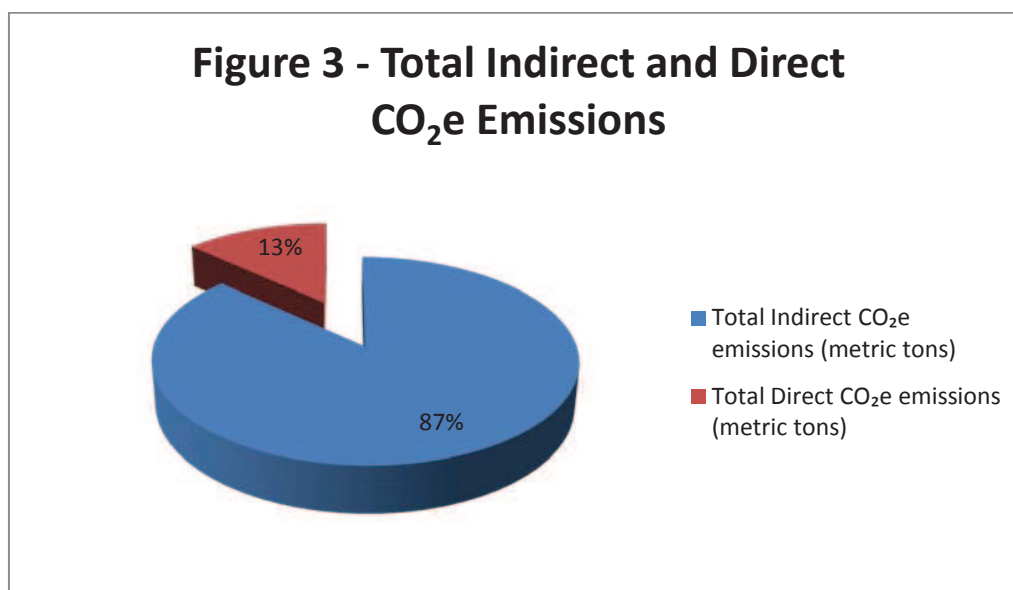
Department	Direct CO₂ Emissions (metric tons)	Direct CH₄ Emissions (kg)	Direct N₂O Emissions (kg)	Total Direct CO₂e Emissions (metric tons)
Parks and Cemeteries	396.86	6.79	6.79	399.11
Cemeteries	26.44	0.45	0.45	26.59
Golf	8.07	0.14	0.14	8.12
Environmental Services	552.30	9.45	9.45	555.42
WWTP (1300 Market)	1,469.62	25.15	25.15	1,477.94
Facility Management	836.40	14.32	14.32	841.14
Streets and Sanitation	-	-	-	-
Traffic Safety (buildings only)	8.91	0.15	0.15	8.96
Police	0.03	0.00	0.00	0.03
Street Lighting and Traffic Signals	-	-	-	-
Parking	0.47	0.01	0.01	0.47
Fire Department	400.95	6.86	6.86	403.22
Library	718.44	12.30	12.30	722.51
Water	705.97	12.08	12.08	709.97
Lake Michigan Filtration Plant	2,053.37	35.15	35.15	2,065.01
Miscellaneous	53.78	0.92	0.92	54.09
SUM	7,231.60	123.78	123.78	7,272.57

Table 6 – City of Grand Rapids Mobile Fleet Emissions

Department	Direct CO₂ Emissions (metric tons)	Direct CH₄ Emissions (kg)	Direct N₂O Emissions (kg)	Fugitive HFC R-134 Emissions (kg)	Total Direct CO₂e Emissions (metric tons)
Facility Management	6,909.61	99.29	114.07	54.43	7,001.49
Fire Department	495.61	28.71	12.79	6.40	506.58
DASH Buses	144.44	0.37	0.35	1.20	145.76
Gross GHG Emissions from Mobile Fleet	7549.66	128.37	127.22	62.03	7,653.82
Renewable Energy Adjustment (biodiesel and ethanol)	540.24	NA	NA	NA	540.24
Net GHG Emissions from Electricity Use	7009.41	128.37	127.22	62.03	7,113.58

Table 7 – City of Grand Rapids Diesel Generator Emissions

Department	Direct CO ₂ Emissions (metric tons)	Direct CH ₄ Emissions (kg)	Direct N ₂ O Emissions (kg)	Total Direct CO ₂ e Emissions (metric tons)
Environmental Services	648.53	97.52	5.32	652.23
Facility Management	10.05	1.41	0.08	10.10
Police	3.65	0.51	0.03	3.67
Miscellaneous	5.08	0.71	0.04	5.10



OPTIONAL SCOPE 3 EMISSIONS

Scope 3 emissions are those emissions that are the result of the City's activities, but are from sources not owned or controlled by the City (e.g., employee travel to and from work, emissions from landfills resulting from waste placement, etc). Scope 3 emissions are considered voluntary and are not included in the City's GHG inventory.

BIOGENIC EMISSIONS

Biogenic Emissions are defined by the USEPA as emissions that result from natural biological processes, such as the decomposition or combustion of vegetative matter. Biogenic emissions are part of a closed carbon loop and are balanced by the natural uptake of CO₂ by growing vegetation; resulting in a net zero contribution of CO₂ emissions to the atmosphere. Examples of biogenic emission sources include burning vegetation (biomass) to produce electricity or using plant-based biofuels for transport.¹⁷ CO₂ emissions

¹⁷ <http://www.epa.gov/greenpower/gpmarket/index.htm>

from composting performed by the City are considered biogenic. Biogenic Emissions from renewable energy are summarized as renewable energy adjustments in the tables above.

The CO₂ emissions from the decomposition processes at the WWTP are considered biogenic and do not require calculation. The CH₄ and N₂O emissions from WWTP's are not considered biogenic and do require calculation. However, CH₄, and N₂O emissions from wastewater treatment primarily occur from anaerobic decomposition. The City's WWTP uses an aerobic process. The *EPA Technical Support Document For Wastewater Treatment: Proposed Rule For Mandatory Reporting Of Greenhouse Gases*, indicates CH₄ emissions should be calculated for domestic wastewater by multiplying the flow, BOD, maximum CH₄ producing potential (0.6 kg CH₄/Kg BOD default), and CH₄ correction factor (MCF), indicating the extent to which the organic content (measured as BOD) degrades anaerobically. The MCF is obtained from IPCC¹⁸, which indicates the MCF for a well maintained aerobic treatment plant, is zero. Therefore, methane emissions from the decomposition of waste in the City's aerobic WWTP are considered nil. For N₂O emissions, the IPCC guidance indicates the emissions are small, and may be considered a minor source. Typically N₂O emissions would only be considered from wastewater treatment processes with nitrification and denitrification steps. Therefore, N₂O emissions from the WWTP decomposition process were not considered.

¹⁸ Chapter 6 – Waste Water Treatment and Discharge Table 6.3

TIER 2 – COMMUNITY INVENTORY

For the community inventory, the City used the Clean Air Climate Protection (CACP) software provided by ICLEI. Because the City of Grand Rapids is a member of ICLEI, it is encouraged to use this software to aid in calculating GHG emissions from the community's activities. The software is based upon the Local Government Operations Protocol which incorporates the GHG programs, protocols, and methodologies of the ICLEI and the sources discussed earlier in the Protocol section of this report. It is a standard accepted method for determining a community's GHG emissions. Output data is aggregated into six sectors: Residential, Commercial, Industrial, Transportation, Waste, and Other. A summary of the activities included in each sector follows.

RESIDENTIAL

In 2006 to 2008, the City of Grand Rapids had slightly more than 71,000 occupied housing units. Of the total housing units, approximately 67 percent were single-unit structures, 33 percent were multi-unit structures, and less than 0.5 percent were mobile homes.¹⁹ While the City Assessor's Office was able to provide information regarding the number of properties on the tax rolls, this information did not provide a detailed breakdown on types of housing units. The information from the US Census Bureau provided details of housing units, size (single unit/multi unit), and home heating methods necessary for this assessment.

The Residential sector contribution to the Community GHG Inventory results primarily from the use of electricity and natural gas. Electricity is used for lighting, to heat and cool the home, and to power appliances. Natural gas is used for home heating, for cooking, and to power appliances such as hot water heaters and clothes dryers. Home heating can also be accomplished through the use of bottled, tank or LP gas, fuel oil, kerosene, wood/corn, solar or geothermal means.

Electricity is supplied to the area by Consumers Energy, which provided data on the gross amount of electricity used by residential customers in the City for calendar year 2005 and also for the period November 2008 through October 2009. Residential electricity usage for calendar year 2007 was determined based upon US Department of Energy reports for 2007 applied to the electricity data provided by Consumers Energy.²⁰

¹⁹ US Census Bureau, http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=16000US2634000&-gr_name=ACS_2008_3YR_G00_DP3YR4&-ds_name=ACS_2008_3YR_G00_-lang=en&-sse=on, October 29, 2009

²⁰ US Department of Energy, Energy Information Administration, Electric Power Annual 2007 – State Data Tables, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html November 10, 2009

Natural gas is delivered to the area by DTE Energy (through its MichCon operations). DTE Energy provided gross residential natural gas delivery information for calendar year 2007 on an “Estimated Actual” basis and for “Normalized” usage (which is based upon weather conditions). Because natural gas is combusted at each individual location, these GHG emissions have been calculated for the Residential Sector-based upon the gross natural gas usage.

The US Census Bureau provided information regarding Home Heating Fuel Use for housing units in the City of Grand Rapids. The US Census Bureau reported occupied home heating usage as follows:

- Utility Gas 92.8%
- Bottled, Tank or LP Gas 0.5%
- Electricity 5.6%
- Fuel Oil, Kerosene, etc. 0.2%
- Other Fuels (Assumed Wood) 0.6%
- No Fuels Used 0.2%²¹

Because there is no single main supplier of bottled, tank or LP gas or fuel oil or kerosene, there was no single source of usage data for these fuels. To determine an approximation of community Residential heating consumption, several assumptions were made. First, it was assumed that the heating demand would be consistent on an energy unit (BTU) basis. Second, it was assumed that the vast majority of natural gas consumed by the Residential sector was used for home heating, while electricity consumed would be split evenly between heating and for lighting and appliances.

The home heating fuel use percentages shown above were applied to the heating value of the gross natural gas delivered to the Residential sector in order to calculate estimated energy usage of bottled, tank or LP Gas, fuel oil, kerosene, etc., and wood. This energy usage (BTU) was then converted into units of fuel based upon standard energy contents of the material.

COMMERCIAL

This sector includes a wide variety of activities including hospitals, institutions, non-City governmental operations, retail, restaurants, motels/hotels, and offices. For informational purposes, 2008 data (2007 data was not provided) from the City Assessor’s office revealed that there were more than 2,800 commercial properties occupying approximately 30,034,321 square feet.

²¹ US Census Bureau, 2006 – 2008 American Community Survey, http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=16000US2634000&-qr_name=ACS_2008_3YR_G00_DP3YR4&-ds_name=ACS_2008_3YR_G00_-lang=en&-sse=on, October 29, 2009

The contribution of GHG emissions from the Commercial sector are primarily a result of electricity usage and natural gas consumption. Electricity is used for lighting, to heat and cool the business, and to power equipment such as ovens and office equipment. Natural gas is used for heating and powering equipment such as ovens, heaters, and dryers. Due to the number of commercial properties, it was not possible to obtain an energy usage on an individual basis. Gross energy usage for commercial classification customers was obtained from Consumers Energy and DTE Energy. Select categories of the Commercial Sector are discussed below.

SCHOOLS AND UNIVERSITIES

The Grand Rapids Public Schools operates:

- 31 Elementary Schools
- 16 Middle Schools
- 6 High Schools
- 7 Alternative Education Schools
- 8 Juvenile Justice Schools
- 13 Special Education Schools
- 6 Center for Innovation Schools.²²

In addition, there are at least 17 private elementary and secondary schools throughout the City.²³

Within the City limits, there are 10 four-year universities and colleges operating in some capacity (full campuses and distance learning centers), as well as the two-year Grand Rapids Community College.²⁴

HOSPITALS

There are 11 hospitals in addition to numerous clinics, specialty centers, and outpatient offices operating within the City.

GOVERNMENTAL OPERATIONS

This category includes the activities that use electricity and natural gas for the City of Grand Rapids, Kent County, the State of Michigan, and the United States Federal government. It is important to note that the data available for the community inventory does not differentiate the City's natural gas or electricity use, and, therefore, it is combined with all of the other activities in the Commercial Sector. The reader should be mindful of this so as to avoid "double-dipping" the City's emissions if comparing the two inventories.

²² Grand Rapids Public Schools, <http://grpublicschools.org/grps1/>, November 10, 2009

²³ City of Grand Rapids 2008 Assessor Records, November 4, 2009.

²⁴ City of Grand Rapids, Final Fiscal Plan FY2010-FY2014, [http://www.grand-rapids.mi.us/download_upload/binary_object_cache/frontpage_Final%20Fiscal%20Plan%20\(Final%20File\).pdf](http://www.grand-rapids.mi.us/download_upload/binary_object_cache/frontpage_Final%20Fiscal%20Plan%20(Final%20File).pdf), November 10, 2009

UTILITY USAGE

Electricity is supplied to the area by Consumers Energy, which provided data on the gross amount of electricity used by commercial customers for calendar year 2005 and also for the period November 2008 through October 2009. Commercial electricity usage for 2007 was determined based upon US Department of Energy reports for 2007 applied to the electricity data provided by Consumers Energy.²⁵ None of the activities in this sector generate electricity.

Natural gas is delivered to the area by DTE Energy (through its MichCon operations). DTE Energy provided gross natural gas delivery information to the community's commercial properties for calendar year 2007 on an "Estimated Actual" basis and for "Normalized" usage (which is based upon weather conditions). Because natural gas is combusted at each individual location, these GHG emissions have been calculated for the Commercial Sector based upon the gross natural gas usage.

INDUSTRIAL

This sector includes a wide variety of industrial activities including process boilers, auto parts manufacturers, welding operations, dynamometers, chemical processes, and asphalt plants. The Veolia Energy Grand Rapids LLC facility²⁶ and supplemental fuel use at the Covanta Kent Inc. Waste-to-Energy Facility are included in this sector. For informational purposes, 2008 data (2007 data was not provided) from the City Assessor's office revealed that there were nearly 450 industrial properties occupying approximately 23,081,260 square feet.

The contribution of GHG emissions from the Industrial sector are primarily a result of electricity usage and fuel consumption for lighting, to heat and cool the business, and to power equipment. Fuel consumption includes natural gas, gasoline, No. 2 (diesel) fuel oil, No. 6 (residual) oil, and solid waste. Due to the number of industrial customers, it was not possible to obtain an energy usage on an individual basis for electricity and natural gas. Gross energy usage for the industrial classification customers was provided by Consumers Energy and DTE Energy. Usage for other fuels was obtained from the Michigan Department of Environmental Quality (MDEQ), Michigan Air Emissions Reporting System (MAERS) for the 2007 reporting year.

²⁵ US Department of Energy, Energy Information Administration, Electric Power Annual 2007 – State Data Tables, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html November 10, 2009

²⁶ The Veolia Energy Grand Rapids LLC Plant provides steam to facilities within the City. Veolia's network consists of four fossil-fuel fired industrial boilers that produce 450,000 pounds of steam annually to over 130 customers in the City's Central Business District.

UTILITY USAGE

Electricity is supplied to the area by Consumers Energy, which provided data on the gross amount of electricity used by industrial customers in 2005 and also from November 2008 through October 2009. Industrial electricity usage for 2007 was determined based upon US Department of Energy reports for 2007 applied to the electricity data provided.²⁷ The Covanta Kent Waste-to-Energy facility is the only facility within this sector that generates electricity. The GHG emissions from this facility have been included in the Community GHG inventory.

Natural gas is delivered to the area by DTE Energy (through its MichCon operations). DTE Energy provided gross natural gas delivery information to the community's industrial properties for calendar year 2007 on an "Estimated Actual" basis and for "Normalized" usage (which is based upon weather conditions). Because natural gas is combusted at each individual location, these GHG emissions have been calculated for the Industrial Sector based upon the gross natural gas usage.

Other fuel use at some industrial sources was reported through the MAERS, and reports for CY 2007 and 2008 were obtained for sources with a Grand Rapids facility address. Fuel types and amounts were identified in the MAERS report and aggregated on a total usage basis. The following fuels were identified in the MAERS report: fuel oil, process gas (treated as landfill gas or biogas in the software), and stationary gasoline. While natural gas usage is reported in the MAERS, this data was not used for purposes of this report, as the gross natural gas delivery information from DTE Energy would include natural gas deliveries to small industrial sources that are exempt from reporting to MAERS.

TRANSPORTATION

GHG emissions from the Transportation sector occur from the combustion of fuel in cars, trucks, buses, trains, ships, and aircraft. The most direct method of determining GHG emissions from this sector is to determine the type of vehicle/engine and the associated type and amount of fuel consumed. This information is not readily available for all sources in this sector. A discussion of the categories of GHG emissions and how they were determined for this sector follows.

²⁷ US Department of Energy, Energy Information Administration, Electric Power Annual 2007 – State Data Tables, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html November 10, 2009

ROADWAYS

Fuel consumption could not be obtained for most personal or commercial vehicles operating within the City. Fuel purchased within the City is not necessarily consumed in the City. To address this issue, GHG emissions from roadway traffic has been determined using miles of roadway and average annual vehicle miles travelled over those roadways. Roadway classifications and vehicle fleet mix affect the amount of GHG emissions generated.

The road infrastructure in the City is characterized by the US Department of Transportation – Federal Highway Administration as follows²⁸:

Table 8 - City of Grand Rapids Road Infrastructure

Road Classification	Miles	Daily Vehicle-Miles	Annual Average Daily
Interstate	51	2,497	63,532
Other Freeways and Expressways	51	2,591	
Other Principal Arterial	184	4,308	
Minor Arterial	403	4,190	
Collector	266	1,309	
Local	1,778	1,249	

The Annual Average Daily Traffic value for roadways other than interstates/freeways was not available from the Federal Highway Administration. Traffic count information for the classifications urban collector, urban local road, and urban minor arterial, and urban principal arterial was provided by the Grand Valley Metropolitan Planning Council (GV-MPC) for 2007, 2008, and 2009. Different sections of roadway were sampled in the different years. Data was reported on an Average Daily Traffic basis, which consists of actual traffic counts taken on a section of road over a 1 week period. This information cannot be converted to Annual Average Daily Traffic. As a result, roadway emissions were calculated using only the freeway classification data.

²⁸ Office of Highway Policy Information Federal Highway Administration Highway Statistics 2007, <http://www.fhwa.dot.gov/policyinformation/statistics/2007/>

The Transportation Assistant in ICLEI's CACP calculator uses the miles of roadway, Annual Average Daily Traffic, fuel type, and vehicle stock distribution to determine GHG emissions contributed from the sector. Fuel type was assumed to be split 85% gasoline and 15% diesel. The distribution of vehicle stock was obtained from the US-DOE Energy Information Administration as follows²⁹.

Table 9 – USDOE Distribution of Vehicle Stock

Residential Vehicles		83%
Passenger Cars	72% of Residential	
Pickup Trucks	17% of Residential	
Sport Utility	5% of Residential	
Large Vans	3% of Residential	
Minivans	3% of Residential	
Non-Residential Vehicles		17%
Business Fleets (includes some Gov't.)	49 – 55% of Non-Residential	
State, County, and Municipal Gov't.	10% of Non-Residential	
Federal Gov't.	2% of Non-Residential	
Unaccounted (includes some Gov't.)	45 – 51% of Non-Residential	

PUBLIC TRANSPORTATION - PASSENGER BUS

Public interurban bus transportation in the City is provided primarily by The Rapid, which is separate from that provided by DASH. GHG emissions from DASH bus service are included with the City's governmental operations inventory. Information on transportation characteristics for The Rapid was obtained from its website and The Rapid's Transportation Manager.³⁰ Data was provided for The Rapid's 2007 fiscal year, which runs from October 1 – September 30.

The Rapid maintains 117 full-size, diesel-powered buses and 5 hybrid buses. Additionally, there are gasoline powered service vehicles used by The Rapid. Fuel usage for FY 2007 was reported as follows:

Table 10 - The Rapid Fuel Usage For FY 2007

Unleaded Gasoline	22,449 gallons
Diesel Fuel	817,516 gallons

The following information was obtained from The Rapid's Report Card³¹:

Table 11 - The Rapid Report Card Information FY 2007

Passengers	7,753,258
Passengers per Revenue Mile	1.95
Revenue Miles (calculated)	3,976,030

²⁹ US Department of Energy, Energy Information Administration, <http://www.eia.doe.gov/emeu/altfuelvh/stock1.html>

³⁰ The Rapid, The Rapid Report Card, 2007 Annual Report Card; <http://www.ridetherapid.org/about/reports-publications/report-card>

³¹ The Rapid, The Rapid Report Card, 2007 Annual Report Card; <http://www.ridetherapid.org/about/reports-publications/report-card>

Fuel usage, miles driven and types of vehicle were entered into the CACP calculator to determine the GHG emissions contributed from these sources.

SCHOOL BUSES

Dean Transportation provides bus transportation for preschool, elementary, middle school regular education, and special education transportation for all grades, including high school. The Rapid provides transportation services for regular education high school students, which was presented above.

The following information for the 2007 - 2008 School Year was provided by Dean Transportation: number of buses, type of fuel used, amount of fuel used and total miles traveled. This information was input into the CACP calculator to determine the GHG emissions contributed from these sources.

Table 12 – Dean Transportation 2007 - 2008 School Year

Number of Buses	136 + 12 Spares
Type(s) of Fuel	Ultra Low Sulfur Diesel
Fuel Usage, gallons	318,828
Miles Traveled	2,869,452

RAIL TRAFFIC

Rail traffic in the City of Grand Rapids consists of passenger service and freight service. Passenger rail service is provided by Amtrak. Freight service is provided by two Class I railroads, CSX and Norfolk Southern, and one short line/regional railroad, Grand Rapids Eastern Railroad. There are three rail freight owners in the City of Grand Rapids: CSX Railroad owns 10 miles of tracks within the City limits; Grand Rapids Eastern Railroad owns 6.1 miles of tracks; and Norfolk Southern owns 3.3 miles.³² None of the rail freight owners or other sources were able to provide the data needed for this inventory in the form of type and amount of fuel used and total rail miles traveled (required by the CACP calculator). Amtrak provided passenger rail data for fiscal year 2008 which revealed there were 57,465 "boardings and alightings," with a total calculated diesel fuel use of 2,586 gallons.

AIRPORTS

There are no airports within the City limits. The City's international airport, Gerald R. Ford International Airport, is located 15 miles outside of the City. GHG emissions from this source were not calculated.

PORT FACILITIES

There are no commercial or industrial port facilities within the City limits.

³² Michigan Center for Geographic Information Framework version 9b.

WASTE

The Covanta Kent Inc. Waste-To-Energy Facility is capable of processing 625 tons of municipal solid waste per day and generating up to 18 megawatts of electricity and/or 116,000 pounds of steam per hour for export.³³ This facility burned 177,993 tons of waste from the City of Grand Rapids and other customers in calendar year 2007³⁴.

The yard waste from city residents and businesses is managed by Spurt Industries in one of its facilities outside of the City. In fiscal year 2008, the City sent 11,093 tons of yard waste to Spurt. Composting produces “negative” emissions or credits, details of which are reflected in Appendix 2.

OTHER OPERATIONS

There are only minimal agricultural operations within the City limits, consisting primarily of household gardens. There are no emissions from these sources included in this inventory.

Operations in this classification also include use or emission of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. These chemicals are typically used in air conditioning/chilling and in the manufacture of computer parts. There is no single or reliable source on the use of these chemicals due to the number of facilities that use the chemicals and the number of repair personnel who can service this equipment.

GREENHOUSE GAS INVENTORY

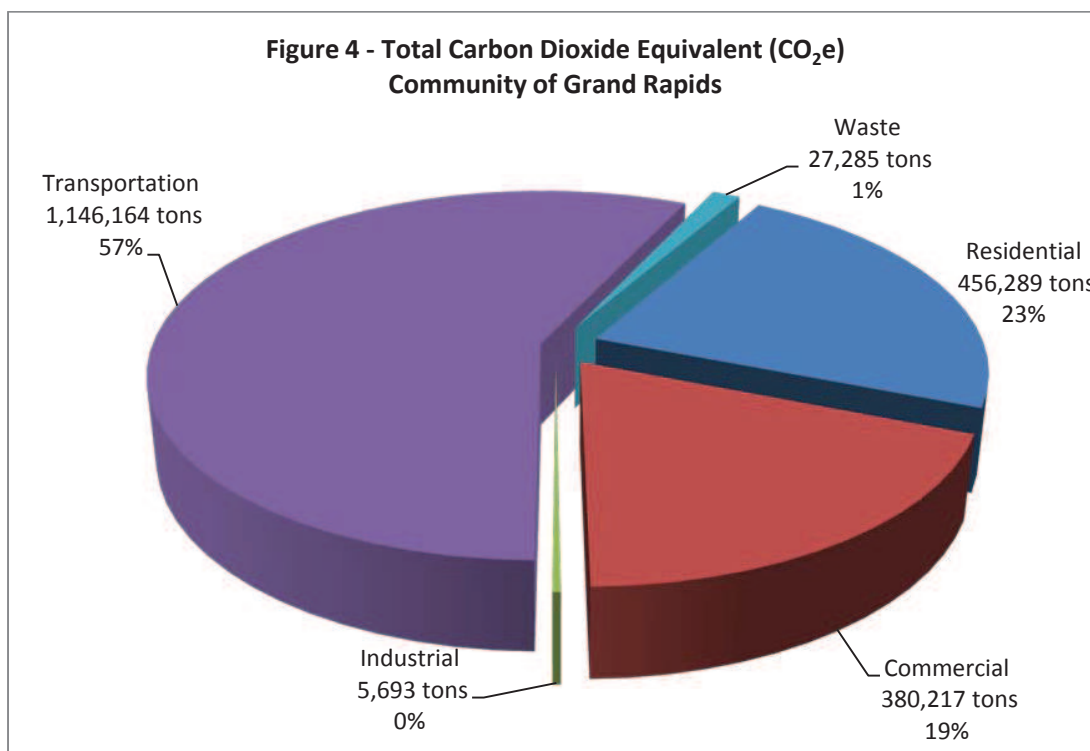
The detailed results of the GHG inventory are presented in Appendix 1. A summary of the community is illustrated below:

Table 13 – Community of Grand Rapids GHG Inventory Summary (Metric Tons)

	CO ₂	N ₂ O	CH ₄	CO ₂ e	%
Residential	454,716	1.09	58.78	456,289	22.6%
Commercial	379,245	0.72	35.74	380,217	18.9%
Industrial	5,683	0.02	0.15	5,693	0.3%
Transportation	1,128,275	54.52	47.04	1,146,164	56.9%
Waste	-	-	1,299.31	27,285	1.4%
Total	1,967,919	56.35	1,441.01	2,015,648	

³³ Kent County Department of Public Works, <http://www.accesskent.com/YourGovernment/PublicWorks/wte.htm> ; Covanta Kent <http://www.covantaholding.com/site/locations/covanta-kent.html>

³⁴ Michigan Air Emissions Reporting System



As illustrated in Figure 4, over half of the GHG emissions from the community are the result of transportation-related activities such as personal and commuter driving, mass transportation, commercial trucking, etc. The Residential Sector is the second highest contributor to the inventory. Interesting to note is that the Industrial Sector accounts for 0.3% of the community's GHG emissions.

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