Milwaukee County, WI

2018 Community Greenhouse Gas Emissions Inventory

Produced for Milwaukee County

By ICLEI - Local Governments for Sustainability USA

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ICLEI Local Governments for Sustainability USA

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ICLEI-Local Governments for Sustainability USA

This report was prepared by Tom Herrod, Senior Program Officer and Matthew Katz, Program Associate at ICLEI Local Governments for Sustainability USA. The authors would like to thank Milwaukee County staff for providing much of the insight and local information necessary for the completion of this report.

Table of Contents

Executive Summary

Milwaukee County government ("County") recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. In recent years, the County has committed to the principles and targets of the Paris Climate Agreement to substantially reduce the risks and impacts of climate change (File No. 17-506).

This report provides an inventory of greenhouse gas emissions resulting from activities occurring within Milwaukee County geographic borders during 2018. This accounts for emissions from the entire community, including those produced by visitors, residents, and businesses. The inventory supports Milwaukee County government's commitment to reduce community-wide emissions by 45% relative to 2010 levels by 2030, and to achieve net zero greenhouse gas emissions by 2050 (File No. 19-582).

Key Findings

Figure 1 provides a summary of Milwaukee County community GHG emissions for 2018. Industrial Energy was the largest contributor to community emissions, with industrial grid electricity consumption contributing approximately 24% of total emissions. The Transportation sector followed, with On-Road vehicles emitting almost 30% of all community emissions. Residential Energy comes after with natural gas consumption contributing to roughly 14% of community-wide emissions.

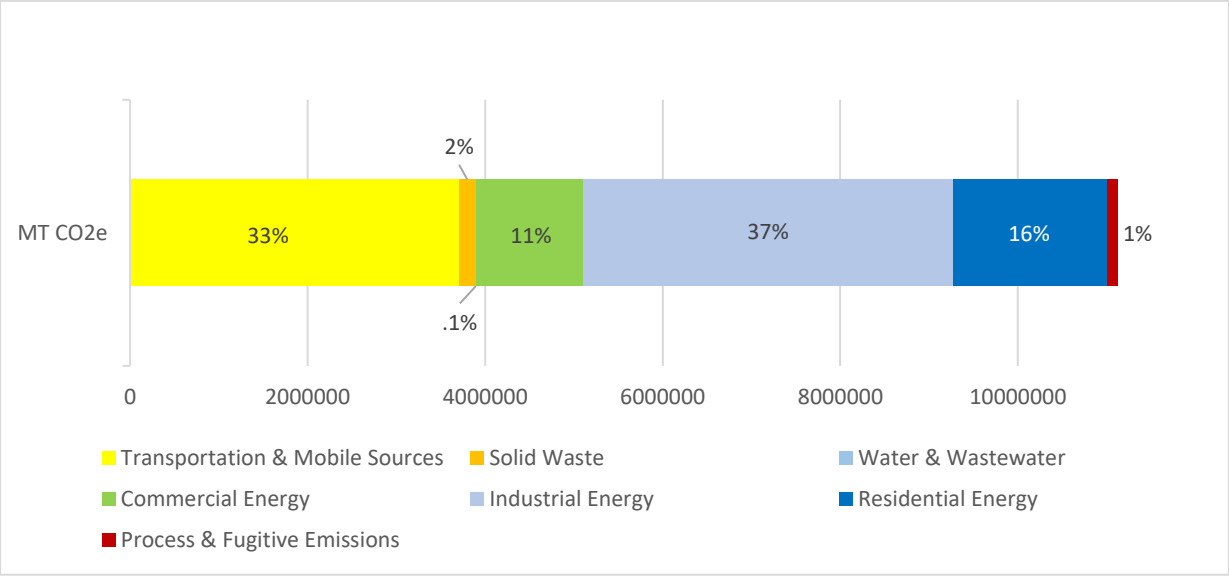

Figure 1: 2018 Community Emissions by Sector

Climate Change Background

Certain gases, when dispersed in the atmosphere, affect the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

Climate change is already impacting the people and communities of Wisconsin. According to a 2020 report by the Wisconsin Initiative on Climate Change Impacts (WICCI), Wisconsin has become 2.1°F warmer since the 1950s, with winters warming more rapidly than summer. Moreover, during this time, Wisconsin's annual precipitation has increased by about 4.5 inches, or about 15%. By mid-century, WICCI projects that the number of extreme heat days in Wisconsin could triple, and the extreme precipitation events will likely increase in frequency and magnitude. In Milwaukee County and other urbanized areas, this may result in more flooding, reduced air and water quality, and increased stress on vulnerable populations.

Many communities in the United States have taken 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, money not spent on energy is more likely to be spent at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.

Figure 2: ICLEI Climate Mitigation Milestones

ICLEI Climate Mitigation Program

Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management,

energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. 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 Five Milestones, also shown in Figure 2:

1. Conduct an inventory and forecast of local greenhouse gas emissions;
2. Establish a greenhouse gas emissions reduction target;
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 1, and provides a foundation for future work to reduce greenhouse gas emissions in Milwaukee County.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents community-wide emissions for Milwaukee County, including local governments and other businesses. Emissions from Milwaukee County government operations are not show separate from the community's total emissions, as these were disclosed in a previous report (see File No. 20-318). However, local government emissions are accounted for in the community totals - for example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles (see Figure 3).

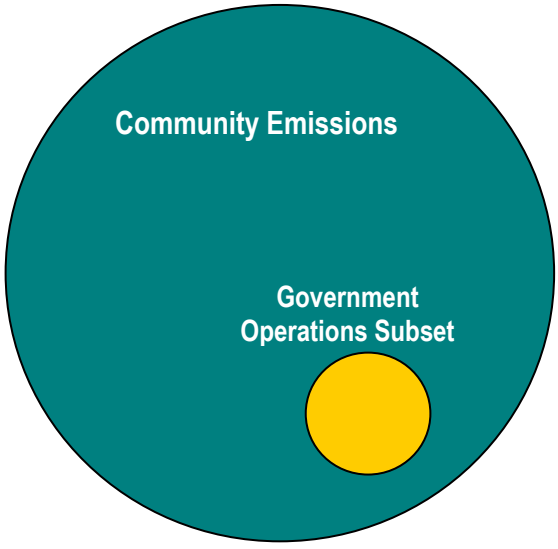

Figure 3: Relationship of Community and Government Operations Inventories

Community Emissions Protocol

To be accurate, replicable and comparable to other community GHG inventories, this inventory follows the Community Greenhouse Gas Emissions Protocol (Community Protocol)[1]. The Community Protocol was released by ICLEI in October 2012, updated in July 2019, and represents a new 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 inventory presented in this report includes emissions from the five Basic Emissions Generating Activities required by the Community Protocol. These activities are:

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

In addition, the inventory includes wastewater process emissions, public transit emissions[2], rail emissions, aviation emissions, off-road transportation or mobile emissions, and fugitive emissions from local natural gas distribution. Three greenhouse gases are included in this inventory: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Carbon dioxide represents the vast majority of the community emissions and is produced from burning fossil fuels such as coal, gasoline, diesel, and natural gas. Methane emission comes primarily from waste decomposition in landfills and from local natural gas distribution system leakage, as well as small amounts as a byproduct of fuel combustion. In communities where fossil fuel extraction activities occur, methane can be a larger contributor to overall emissions, but often is a small percentage of urban communities with methane capture in landfills. Nitrous oxide is the smallest contributor to the inventory and comes from wastewater treatment process emissions, as well as small amounts as a byproduct of fuel combustion.

[1] Community Greenhouse Gas Emissions Protocol (Community Protocol)
[2] Included in On-Road VMT emissions

Quantifying Greenhouse Gas Emissions

Sources and Activities

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

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.

Figure 4: Source and Activity description

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.

GHG Emissions Scope

GHG Emissions are also categorized by Scope for reporting purposes. This allows for the collection of activity data without double counting when reporting. Scope 1 emissions are emissions occurring within the boundary of the community, such as combustion of natural gas for heating or gasoline for vehicles. Scope 2 emissions are emissions that occur outside the boundary but are demanded by activity within the boundary, such as electricity generation. Scope 3 emissions occur outside a boundary but relate to in-boundary activities. These include in-boundary generated solid waste or wastewater that is exported to another boundary or cross-boundary transportation. Scope 3 emissions also include upstream impacts emissions, often referred to as life-cycle emissions. These emissions are associated with pre-consumption life-cycle phases, such as raw material extraction and manufacturing processes that occur

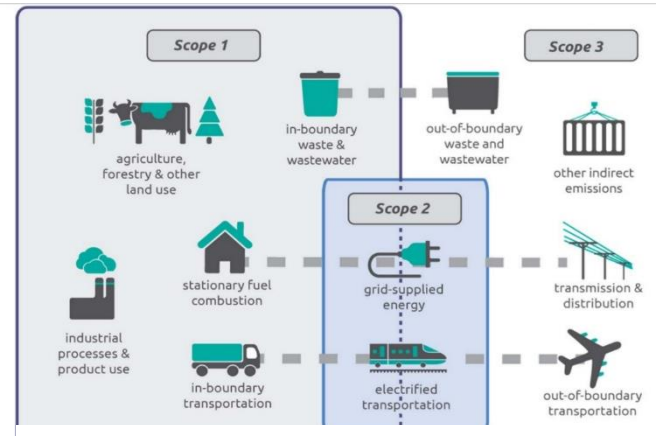

Figure 5: GHG Emissions Scopes

outside the boundary. Within Milwaukee County's inventory, upstream emissions relate to electricity grid transmission and distribution loss. These emissions are calculated, but not included in the total county-wide emissions, per reporting protocols[3].

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

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

  Activity Data x Emission Factor = Total Emissions

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

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs. CO_2/kWh of electricity).

[3] Global Covenant of Mayors for Climate & Energy Common Reporting Framework

Inventory Results

The total emissions for the 2018 inventory were calculated at 11,127,231 metric tons CO_2e (Table 1) (Upstream Impacts of Activities were not included).

Table 1. 2018 Community Emissions by Sector & Fuel/Source

Sector	Fuel/Source	Usage	Usage unit	Emissions ($MTCO_2e$)	% Contribution (Per sector & Total)
Residential energy	Grid Electricity	266,950,767	kWh	158,113	9%
	Natural Gas	290,962,976	Therms	1,547,530	89%
	Propane	218,166	MMBtu	13,869	1%
	Kerosene	172,611	MMBtu	13,068	1%
Residential Energy Total				**1,732,580**	**16%**
Commercial Energy[4]	Grid Electricity	726,150,554	kWh	430,094	36%
	Natural Gas	145,219,277	Therms	772,371	64%
	Distillate Fuel Oil No. 1	21,260	Gallons	217	0.02%
	Propane	555	Gallons	3	0.0002%
	Landfill Gas	N/A	N/A	30	0.002%
	Digester Gas	272,648	MMBtu	70	0.01%
Commercial Energy Total				**1,202,785**	**11%**
Industrial Energy	Grid Electricity	4,585,357,279	kWh	2,715,875	65%
	Natural Gas	273,530,234	Therms	1,451,748	35%
	Distillate Fuel Oil No. 2	42,381	Gallons	435	0.01%
Industrial Energy total				**4,168,058**	**37%**
On-road transportation	Gasoline	5,931,471,890	VMT	2,283,340	62%
	Diesel	608,859,697	VMT	911,157	25%
Aviation	N/A	N/A	N/A	184,566	5%
Rail	Diesel	2,239,904	Gallons	23,074	1%
Off-Road/Mobile	Gasoline	N/A	N/A	97,721	3%

[4] Commercial sector includes municipal and institutional buildings

	Diesel	N/A	N/A	153,812	4%
	Other Fuels	N/A	N/A	54,855	1%
Transportation Total				**3,708,525**	**33%**
Solid Waste	Waste Landfilled: Residential (In-boundary disposal)	226,993	Tons	82,522	45%
	Waste Landfilled: Residential (Outside boundary disposal)	15,530	Tons	5,871	3%
	Waste Landfilled: Non-Residential (In-boundary disposal)	241,087	Tons	87,646	48%
	Waste Landfilled: Non-Residential (Outside boundary disposal)	16,495	Tons	6,235	3%
Solid Waste Total				**182,274**	**2%**
Water and wastewater[5]	Treatment Process	1,100,000	Serviced Population	2,551	26%
	Effluent Discharge	1,100,000	Serviced Population	6,739	68%
	Digester Gas Flaring	114,991	MMBtu	587	6%
Water and wastewater Total				**9,877**	**0.1%**
Process & Fugitive	Natural Gas Distribution- Fugitive Emissions	709,712,487	Therms	123,132	100%
Process & Fugitive Total				**123,132**	**1%**
Upstream Impacts of Activities	Transmission and Distribution Losses	5,578,458,600	kWh	79,298	N/A
Upstream Impacts of Activities Total				**79,298[6]**	**N/A**
Community Total Emissions (MT CO_2e)				**11,127,231**	

[5] Water and Wastewater sector does not include energy usage
[6] Upstream Impacts of Activities emissions are not included in total emissions

Figure 6 shows the percent contribution from sectors of 2018 community emissions. Industrial Energy was the largest contributor to community emissions, followed by Transportation and Residential Energy.

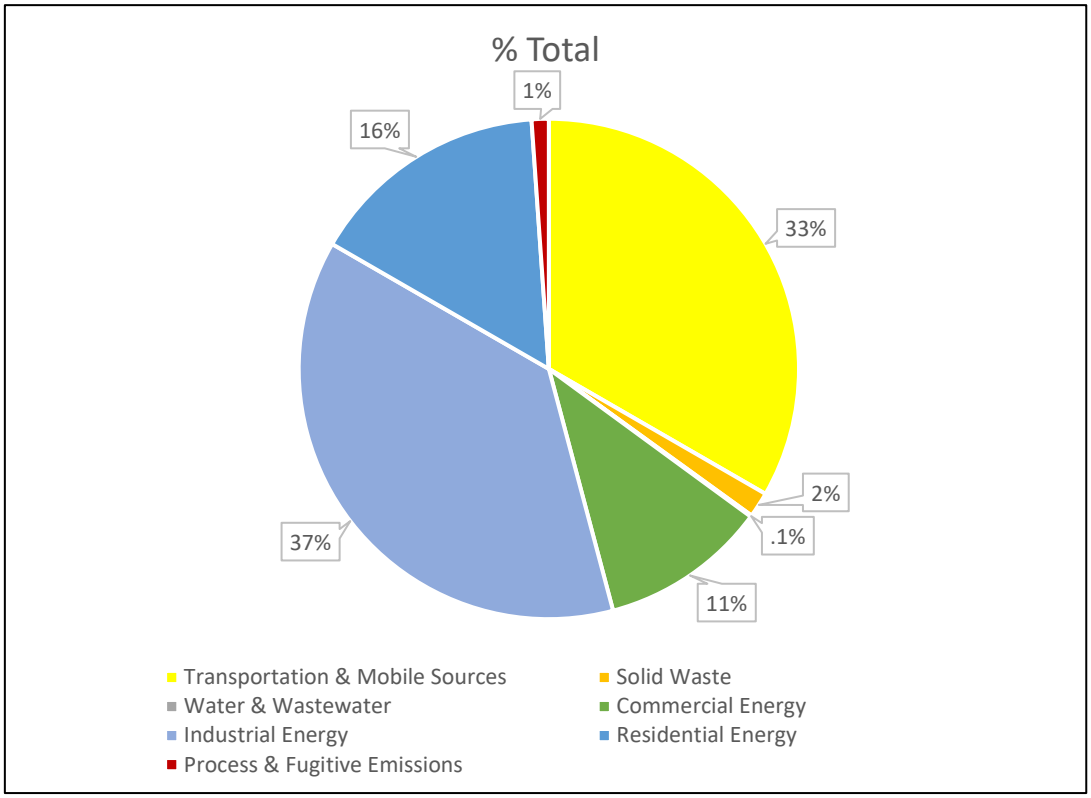

Figure 6: 2018 Community Emissions

Inventory Discussion

Major Sources of Emissions

As mentioned, the Industrial Energy sector is the largest contributor to Milwaukee County's community emissions. However, similar to the majority of American communities, the Commercial and Residential Energy sectors are also significant contributors. Most of energy sector emissions come from stationary natural gas combustion and grid electricity consumption. Natural gas is primarily used in all energy sectors for heating purposes and emits

GHGs when combusted. Grid electricity is used to power lighting, appliances, machines, and more. Unlike natural gas, grid electricity consumption indirectly emits emissions because fossil fuels are combusted at a power plant facility. Electricity is then distributed through the grid. Other power sources like renewable energy may be used to produce electricity, which do not emit GHG emissions directly. While not a byproduct of combustion, emissions

leak from distribution infrastructure when natural gas is distributed to buildings, commonly referred to as Fugitive Emissions.

Transportation is another large contributor to community-wide GHG emissions. Similar to many United States communities, Milwaukee County's transportation emissions emit approximately a third of total emissions. The majority of these emissions, more than 85%, come from On-Road transportation. On-Road transportation can represent many forms of transit, but within the County's inventory, it represents passenger cars, transit buses, various truck types, and motorcycles. These vehicles emit GHGs by combusting gasoline and diesel, derived from the fossil fuel, crude oil. Other sources of transportation emissions are aviation vehicles, which combust jet fuel or aviation gasoline, and commuter and freight rail, which most often combust diesel. Lastly, there are off-road vehicles such as recreational vehicles, construction machines, and mobile sources like lawnmowers.

While not as much as the energy and transportation sectors, the solid waste sector still emits notable emissions. Part of the County's community waste is made of organic material like food, leaves, paper, and more, which naturally decomposes, causing methane (CH4) emissions. There are also emissions from wastewater treatment. These emissions result from cleaning wastewater and often come from combusting and flaring treatment byproducts like digester gas.

Built Environment- Electricity Consumption Alternative Analysis

In many U.S. cities, commercial buildings use a higher percentage of the electricity load compared to industrial buildings. Conversely, industrial buildings tend to use a higher percentage of natural gas consumption compared to commercial buildings. This is generally the result of Industrial buildings using more "process" energy to manufacture or produce goods. Commercial buildings often use a relatively higher amount of electricity to provide energy for lights, elevators, air movement, and office equipment.

We Energies' data for commercial and industrial energy use does not follow these general trends for U.S. cities. As a result, the City of Milwaukee used an Electricity Consumption Alternative Analysis to estimate commercial and industrial electricity consumption for its community emissions inventory. Based on commercial square footages from the Assessor's office[7], along with average commercial building electricity consumption data from the Commercial Buildings Energy Consumption Survey (CBECS)[8], the City extrapolated industrial and commercial electricity consumption from the We Energies data.

[7] City of Milwaukee Assessor
[8] Commercial Buildings Energy Consumption Survey (CBECS)

Table 2 provides estimates of Milwaukee County commercial and industrial electricity consumption using the Electricity Consumption Alternative Analysis. Note that the estimates assume that patterns of commercial and industrial electricity use in Milwaukee are the same for Milwaukee County. The estimates are presented here as informational only and do not impact the results of this inventory. However, Milwaukee County may want to consider applying the Electricity Consumption Alternative Analysis in future inventories.

Table 2. Comparison of "Billed" consumption and estimated consumption (Informational Only)

Milwaukee County Community 2018 Electricity Consumption		Estimation using Assessor and CBECS average
Sector	Usage (kWh)	Estimate (kWh)
Residential	266,950,767	266,950,767
Commercial	726,150,554	3,430,853,399
Industrial	4,585,357,279	1,880,654,434
TOTAL	5,578,458,600	5,578,458,600

Benchmarking

Benchmarking Milwaukee County emissions against similar communities is challenging due to the wide range of data quality and methodologies used by other governments. Moreover, differences in a community's geography and climate can greatly impact the sources (sectors) of its emissions. Nevertheless, Table 3 compares Milwaukee County's emissions against several peer communities. Based on this limited sample, Milwaukee County's per-capita community emissions appear to be below the average of its peers.

Table 3. Community Emissions for Peer Counties

Community	Total Emissions (MT CO_2e)	Population	Per Capita Emissions (MT CO_2e/person)
Milwaukee County, WI (2018)	11,127,231	948,201	11.7
Cuyahoga County, OH (2017)[9]	26,033,850	1,257,401	20.7
Davidson County, TN (2018)[10]	13,461,292	684,017	19.7
King County, WA (2017)[11]	19,915,100	2,118,119	9.4

Methodology

Community Inventory Data

Electricity and Natural Gas

Electricity and natural gas usage data were obtained from utility data provided by We Energies.

CO_2 electricity emissions factors were obtained from We Energies and CH_4/N_2O electricity emissions factors were obtained from EPA's eGRID 2018 RFCW[12].

Table 4. Electricity Emissions Factors

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2018	1,298	117	17

Additional Fuel Types

Residential propane and kerosene use were estimated based on EIA usage data[13] for Midwest homes. The number of households using each fuel was obtained from the United States Census Bureau[14]. Other residential heating fuels like coal were not estimated.

[9] Cuyahoga County Greenhouse Gas Emissions Inventory
[10] CDP 2018 City-wide Emissions
[11] King County 2017 Inventory Update, Contribution Analysis, and Wedge Analysis
[12] EPA eGRID 2018
[13] EIA Annual Household Site Fuel Consumption
[14] United States Census Bureau Housing Characteristics

Commercial and Industrial Distillate Fuel Oil No. 1, Distillate Fuel Oil No. 2, Propane, and Landfill Gas emissions data was acquired from EPA's Facility Level GHG Emissions Data Tool (FLIGHT)[15].

Electricity Generation

Direct emissions from We Energies' South Creek, Elm Road, and Valley Power Plants were not included in total emissions because the resulting emissions will have already been captured as the indirect or Scope 2 emissions from consumption of grid-supplied energy, under the Stationary Energy sector. While direct emissions were not counted, emissions and fuel consumption data were acquired from the FLIGHT tool.

On-Road Passenger and Commercial Transportation

Annual vehicle miles traveled (VMT) and vehicle share mix data were included in MOVES files provided by the Southeastern Wisconsin Regional Planning Commission (SEWRPC)[16]. SEWRPC provides VMT for a) Trips that both begin and end within the Milwaukee County boundary (in boundary), b) Trips that either begin or end within Milwaukee County (origin-destination), and c) Trips that neither end nor begin within Milwaukee County (pass through trips). MOVES files provided by SEWRPC include VMT for Motorcycles, Passenger Cars, Transit Buses, Single Unit Trucks, and Combination Trucks. Data did not include VMT for Light-Duty Trucks.

To calculate emissions, the VMT needed to be allocated to different vehicle and fuel types. Because VMT by vehicle type was not broken down into fuel type, ICLEI's National Defaults were used to further allocate to separate vehicle and fuel types.

Table 5. Milwaukee County VMT by Fuel and Vehicle Type

Fuel	% of VMT[17]	
Gasoline	90.6	
Diesel	9.3	
Vehicle type	**% of Gasoline VMT**	**% of Diesel VMT**
Passenger car	97.8	11.90
Light truck	N/A	N/A
Heavy truck (Includes transit buses)	1.5	88.10
Motorcycle	0.7	N/A

Next it is necessary to apply average miles per gallon and emissions factors for CH_4 and N_2O to each vehicle type. The factors used are shown in Table 6.

[15] EPA FLIGHT
[16] SEWRPC
[17] % of VMT does not add to 100% because it is assumed that some On-road vehicles are electric vehicles (accounted for in stationary energy sectors) or alternative fuels, which are not counted in VMT.

Table 6. MPG and Emissions Factors by Vehicle Type[18]

Fuel	Vehicle type	MPG	CH_4 g/mile	N_2O g/mile
Gasoline	Passenger car	24.21489	0.0186	0.0093
Gasoline	Heavy truck	5.361348	0.086	0.0664
Gasoline	Motorcycle	24.21489	0.0186	0.0093
Diesel	Heavy truck	6.224736	0.0051	0.0048
Diesel	Passenger Car	24.21489	0.0005	0.001

Public Transit

In Milwaukee County, public transit is provided by the Milwaukee County Transit System[19]. Vehicle Miles Traveled and fuel consumption data was provided by Coleman & Williams, Ltd. Per SEWRPC, On-Road VMT includes all public transit vehicles, so public transit emissions were not separated.

Aviation

Aviation data was acquired from the EPA's 2017 National Emissions Inventory[20]. The NEI does not report activity data, but reports direct emissions, so emissions were directly entered. For Aviation, CO_2 was only reported for the following aviation reporting classifications: Aircraft/Commercial, Aircraft/General Aviation/Turbine, Aircraft/Air Taxi/Piston, and Aircraft/Air Taxi/Turbine.

Off-Road

Off-road (non-road) and mobile emissions are broken down by diesel, gasoline, and other fuels. Data was acquired from the EPA's 2017 National Emissions Inventory[20]. The NEI does not report activity data, but reports direct emissions, so emissions were directly entered. For Off-Road, CO_2 and CH_4 were reported.

Waterborne

Milwaukee County acknowledges that emissions from waterborne transportation occur inside the jurisdiction. However, activity/emissions data is unavailable at this time. The County and City of Milwaukee are working with the Port of Milwaukee to ensure data is more accessible in upcoming years.

[18] Bureau of Transportation Statistics Average Fuel Efficiency of U.S. Light Duty Vehicles
EIA Freight Transportation Fuel Efficiency (Gasoline)
EIA Freight Transportation Fuel Efficiency (Diesel)
EPA Emissions Factors for Greenhouse Gas Inventories
EPA Methodology for Estimating Emissions of CH_4, N_2O, and Indirect GHGs from Stationary Combustion
[19] Milwaukee County Transit System
[20] EPA National Emissions Inventory

Rail

The County identified the following active rail operators:

- Commuter: Amtrak
- Class 1 Freight: Union Pacific, Canadian National, and Canadian Pacific
- Class 2/3 Freight: Wisconsin & Southern Railroad (WSOR)

Amtrak fuel consumption was calculated by utilizing Amtrak fuel consumption calculation methodologies provided to ICLEI in the past. Methodologies follow: (One Way Distance (miles) X Annual Frequency) X Fuel Usage Rate (gallons/mile). Amtrak Fuel Usage Rate was acquired through past calculations of Amtrak data. The annual frequency was estimated using Amtrak routes[21] [22], and distance was estimated using ArcGIS measuring tools.
Freight rail data was geo-processed using proprietary data and GIS software and provided by Matthew Harrell, Geographic Information Specialist at the Illinois EPA – Air Quality Planning Division.

Wastewater

Wastewater is treated by the Milwaukee Metropolitan Sewerage District (MMSD)[23]. The District provided data regarding facility energy usage, digester Gas flaring/combustion, effluent discharge, and treatment process emissions. Because emissions from treatment facility energy usage were assumed to be included in We Energies reported energy consumption data, facility-specific emissions were not counted. Because the Milwaukee County population is approximately 86.2% of MMSD's service population, digester Gas flaring/combustion, effluent discharge, and treatment process emissions records were split up by location of wastewater treatment (Generated in-boundary or Imported).

Potable Water

MMSD was unable to quantify the electric and natural gas consumption for each of the conveyance sites. However, while Milwaukee County acknowledges that emissions resulting from energy consumption are occurring at these facilities, it is assumed that emissions are accounted for because they are included in We Energies' reported energy consumption data.

Solid Waste

Solid waste emissions solely come from waste generation. Waste generation was categorized by type, residential or non-residential and disposal location, the Metro Recycling & Disposal landfill in Franklin or the Orchard Ridge RDF

[21] Amtrak Hiawatha Schedule
[22] Amtrak Empire Schedule
[23] Milwaukee Metropolitan Sewerage District

landfill in Menomonee Falls. Total waste disposal for the Metro Recycling & Disposal landfill was provided by the Wisconsin Department of Natural Resources[24]. Because no data existed for total waste disposed at Orchard Ridge, nor data specifying residential and non-residential waste, the following assumptions and estimations were made:

- Total annual waste generated: 2.89 lbs waste/person/day[25] x 948,201 population x 365 days
- Total annual non-residential waste generated: 2.89 lbs. waste/person/day[25] x 488,376 jobs[26] x 365 days (This calculation assumes the average job generates the average per capita waste)

Using the total waste disposed at the Metro Recycling & Disposal landfill, and the discussed assumptions, waste type and location were estimated.

Landfill Gas Flaring/Combustion

Landfill Gas Flaring/Combustion data was provided by Metro Recycling & Disposal and Orchard Ridge RDF landfill representatives during the City of Milwaukee's 2018 community inventory data collection process. Data represented entire landfill activity, not just Milwaukee County's share. While Milwaukee County acknowledges that emissions result from county generated waste, due to the de minimis value, emissions are not included in the total community emissions.

Composting

Milwaukee County acknowledges that emissions resulting from composting organic material occur in-boundary. However, activity/emissions data is unavailable at this time.

Fugitive Emissions

Emissions from natural gas leakage were obtained using assumptions based on the EDF User Guide for Natural Gas Leakage Rate Modeling Tool (0.3% leakage rate)[27]. These emissions were allocated to Milwaukee County using the portion of total natural gas distributed within the residential, commercial, industrial sectors.

Process Emissions

Milwaukee County acknowledges that emissions resulting from industrial processes occur in-boundary. However, emissions data was not reported in the EPA's FLIGHT tool[15]. This is most likely due to reporting threshold rules established by the EPA.

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[24] Wisconsin Department of Natural Resources
[25] EPA Facts and Figures on Materials, Wastes and Recycling
[26] 2019 Milwaukee County Workforce Profile
[27] EDF User Guide for Natural Gas Leakage Rate Modeling Tool.

Transmission and Distribution Emissions

A portion of electricity is typically lost when transmitted and distributed through power infrastructure. Because electricity-related emissions are based on electricity consumption rather than generation, some emissions are not counted. To calculate these emissions, We Energies provided a grid loss factor, which was multiplied by total electricity consumption. Milwaukee County acknowledges that these emissions occur, however, they are not counted towards total emissions due to protocol reporting frameworks.

Inventory Calculations

The 2018 inventory was calculated following the U.S. Community Protocol and ICLEI's ClearPath software. The 5th IPCC Climate Assessment was used for global warming potential (GWP) values to convert methane and nitrous oxide to CO_2 equivalent units. ClearPath's inventory calculators allow for input of the sector activity (i.e. kWh or VMT) and emission factors to calculate the final CO_2e emissions.

County and City Methodology/Source Comparison

Table 7. City and County of Milwaukee inventory methodology and source comparison

		Methodology	Sources	Notes
Residential Energy	Electricity Consumption	✓	✓	
	Residential Heating Fuels	✓	✓	
	Natural Gas Consumption	✓	✓	
Commercial Energy	Electricity Consumption	✓	✓	
	Natural Gas Consumption	✓	✓	
	Non-Utility Fuel Combustion	✓	✓	

Industrial Energy	Electricity Consumption	✓	✓	
	Natural Gas Consumption	✓	✓	
	Energy Generation	✓	✓	
	Stationary Non-utility fuel combustion	✓	✓	
Transportation	On-Road	X	✓	-County VMT data did not include light truck vehicle types, city VMT did -Unlike city VMT, County VMT was already annualized, so no annual multiplier was used. -City inventory utilized a combination of Origin-Destination and In-boundary VMT, while county data was already combined.
	Public Transit	✓	X	-No source provided public transit data for the City inventory due to inclusion in VMT
	Waterborne	✓	✓	-No Data
	Off-Road	X	✓	-City did not utilize NEI data because data is limited to county-wide, and downscaling can be inaccurate.
	Rail	X	X	-Rail emissions were not included in city inventory
	Aviation	X	X	-Aviation emissions were not included in city inventory due to lack of data -County used 2017 National Emissions Inventory estimates
Solid Waste	Waste Generation	✓	X	-County received data from WDNR
	LFG Combustion	✓	✓	
	LFG Flaring	✓	✓	
Water/ Wastewater	Incineration/Combustion	✓	✓	
	Energy Consumption	✓	✓	

	Process/treatment Emissions	✓	✓	
Process/ Fugitive Emissions	Fugitive Emissions	✓	✓	
Upstream Impacts[6]	Grid Loss	X	X	- City did not report grid loss emissions

Next Steps

In completing this community greenhouse gas emissions inventory, Milwaukee County government has taken an important step towards fulfilling its climate and equity commitments. The Milwaukee City-County Task Force on Climate Change and Economic Equity (Task Force) is developing a plan to reduce community GHG emissions while reducing racial inequity through green jobs. Based on the results of this inventory, the Task Force may want to consider how the below actions could help reduce community emissions in Milwaukee County.

1. Increase and promote building energy efficiency.
    a. Residential/Commercial Energy Efficiency Actions
    b. Industrial Energy Efficiency Actions
2. Convert building heating to air source or geothermal heat pumps.
    a. Air-Source Heat Pumps
    b. Geothermal Heat Pumps (ground source)
3. Increase production and use of renewable energy.
    a. On-site Renewable Energy Generation
    b. Solarize/Group Buys
    c. Community Solar Gardens
        i. Deployment/Subscriptions
        ii. Community Solar 101
4. Reduce per-capita vehicle miles traveled.
    a. Reduce Transportation Footprints
    b. Expand Public Transit
5. Promote electric vehicles (EVs).
    - EV Implementation Strategic Planning