



City of Miami 2019 & 2021 Greenhouse Gas Inventories

Citywide & Government Operations

December 2023

City of Miami Greenhouse Gas (GHG) Inventories

The City of Miami developed greenhouse gas (GHG) inventories for calendar years 2019 and 2021 that reflect citywide emissions and local government operations emissions.

- The Citywide Inventory reports activities taking place within the City of Miami's five district boundaries.
- The Local Government Operations Inventory reports activities associated with City of Miami government operations.

A total of four inventories are included in this 2019 & 2021 Greenhouse Gas Inventories report:

- 2019 Citywide Inventory
- 2021 Citywide Inventory
- 2019 Local Government Operations Inventory
- 2021 Local Government Operations Inventory

Miami's first Citywide GHG Inventory was conducted for 2006 and used as the baseline for the City's first GHG reduction plan, MiPlan¹. Subsequently, the City conducted another Citywide Inventory for 2018 that serves as the baseline for the Miami Forever Carbon Neutral plan², which established an interim 60% greenhouse gas reduction goal by 2035.

These inventories provide valuable data that can be used to track progress toward Miami's goal of carbon neutrality by 2050. The City will continue to conduct emissions inventories biannually for odd-numbered years to monitor progress toward emissions reduction goals and better understand areas of impact for decarbonization.

GHG Inventory Development

The City of Miami developed GHG inventories for calendar years 2019 and 2021 that reflect citywide and local government operations emissions. The citywide inventories were developed using the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC) – a global standard for citywide inventory accounting – while the government operations inventories were developed based on the Local Government Operations Protocol (LGOP). The City developed its citywide inventories according to the GPC BASIC framework, which is the most used option among cities globally. In addition, the City continued to use the global warming potentials (GWP) established in the International Panel on Climate Change (IPCC) 5th Assessment Report to maintain a consistent basis of comparison for inventories year-over-year.

The City used the ClearPath online GHG inventory tool to calculate each inventory. This tool was developed by ICLEI – Local Governments for Sustainability and was designed to simplify the GHG inventory development process for local governments. ClearPath allows users to enter city-specific data to estimate GHG emissions based on standardized calculation methodologies and includes sector-specific emissions calculators that accept a variety of data types while also providing default inputs and emissions factors. The tool also provides users with detailed reports and charts that can be used to identify areas where emissions can be reduced and to track progress toward emission reduction goals.

In demonstrating its commitment to addressing the causes and impacts of climate change, the City of Miami is a member of C40 Cities – a global network of cities with shared commitments on climate change. As a member, Miami is required to report its citywide GHG emissions to C40 using a common reporting platform that supports comparison and progress tracking among other C40 cities.

1. MiPlan: <http://egov.ci.miami.fl.us/Legistarweb/Attachments/87211.pdf>

2. Miami Forever Carbon Neutral: <https://www.miamigov.com/files/4e5f26f7-2622-4c90-834a-eaaa6aa3321e/Miami-Forever-Carbon-Neutral-FULL.pdf>

Electricity Emissions Factor

Because the mix of energy sources used to produce electricity changes constantly, electricity emissions factors also change over time. Florida Power and Light’s (FPL) energy generation from zero-carbon sources has increased from 23.0% in 2018 to 28% in 2021³. During this same period, FPL’s generation from coal and oil decreased. The result is an electricity emission factor that has decreased over time, which helps to reduce citywide and government operations electricity emissions. Table 1 shows the changes in the electricity emissions factors used in the city’s GHG inventories, including carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) values, while Figure 1 illustrates the CO₂ values from this table that are associated with FPL’s energy sources.

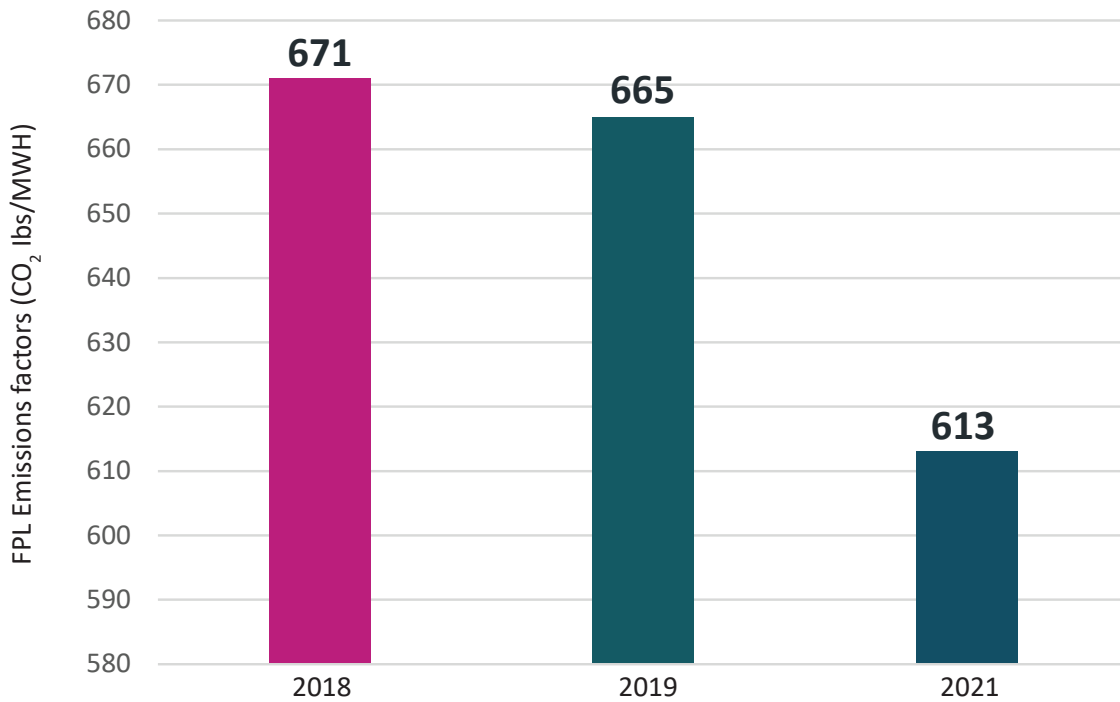
Table 1. Electricity emission factor for 2018, 2019, and 2021

Emission Factor	Year		
	2018	2019	2021
CO ₂ lbs./MWh*	671	665	613
CH ₄ lbs./GWh**	66	55	53
N ₂ O lbs./GWh**	9	7	7

* CO₂ emissions from FPL emissions factor data

**CH₄ and N₂O from eGRID data for the FRCC area

Figure 1. Florida Power & Light CO₂ emissions factor



Source: 2018 and 2019 values - NextEra Energy, Inc. | By the Numbers, 2021 value - InvestorPresentation_NextEraEnergy

3. NextEra Energy Annual Reports: <https://www.investor.nexteraenergy.com/reports-and-filings/annual-reports>

Methodological Changes and Data Gaps since 2018 Inventory

As part of the 2019 and 2021 inventory development process, some minor methodological changes were implemented as compared to the 2018 inventory. These changes were made to improve future data collection efficiency and to more completely estimate citywide GHG emissions based on guidance in the GPC.

Changes include:

- Switching to the Google Environmental Insights Explorer (EIE) tool to collect citywide vehicle travel data for the on-road emissions sub-sector; this dataset was not available when the 2018 inventory was developed.
- Collecting and reporting more granular information for two new transportation emissions sub-sectors – waterborne navigation and off-road vehicles and equipment.
- Updating the methodology for calculating solid waste emissions and revising 2018 inventory values – updated emissions can be found on page 8.

In several instances, 2019 and 2021 data were unavailable during the inventory development timeline. The City opted to use the 2018 inventory data as a placeholder while it seeks to complete the data collection process and revise the 2019 and 2021 inventories. Incomplete data was available for citywide and local government operations natural gas use while the nitrogen load of treated wastewater was unavailable. Similarly, data was collected on the number of commercial parcels served by septic systems, but it was out of proportion with the 2018 data, so the city opted to hold the 2018 data constant while exploring the issue further.

Emissions Inventory Results

Citywide emissions decreased 7% from 2018 to 2021, primarily led by a 23% decrease in on-road transportation emissions that is attributed, in part, to lingering impacts from the COVID-19 pandemic. Residential and commercial energy use both decreased during that period as well, while waste emissions showed an increase that is attributed to a change in the waste disposal emissions calculation methodology. Government operations emissions experienced a 7% increase from 2018 to 2021, led by a 115% increase in the City's vehicle fleet emissions that was primarily due to improved fuel consumption data tracking. Government operations emissions decreased in buildings and facilities and from employee commutes during this period. From analyzing these and future inventories, the city can confirm its primary emissions sources and continue development and implementation of emissions reduction strategies to achieve its climate goals.

COVID-19 and Emissions Implications

COVID-19 restrictions were first implemented in Florida in March 2020, and Miami declared a state of emergency on March 12. A shelter-in-place order and local prohibition on non-essential business services and operations went into effect March 24. The lasting effects of COVID-19 restrictions likely impacted Miami's 2021 GHG emission inventory, but the magnitude of that impact cannot be precisely measured. During this period, the City experienced decreases in on-road transportation emissions and stationary energy (buildings) emissions which may be partially attributed to pandemic-related decreases in travel and services. Future GHG inventories will shed light on any long-term impacts from the pandemic on Miami's community and government operation emissions.

Citywide Emissions Inventory Results

The city followed GPC guidance in developing the citywide emissions inventories. This protocol requires emissions reporting in three primary sectors:

- Stationary Energy (Buildings)
- Transportation
- Waste

In 2019, citywide emissions totaled 3,437,247 metric tons of carbon dioxide equivalent (MTCO₂e). As shown in Figure 2, most emissions are from the Stationary Energy (Buildings) sector (56%). Transportation is the second largest sector (41%), while the Waste sector is responsible for the remaining emissions (3%).

In 2021, citywide emissions totaled 3,105,635 MTCO₂e – a 9.6% decrease from 2019. Despite the decrease, the proportion of emissions from each sector remained relatively constant since 2019, with a slight increase in Stationary Energy (Buildings), as shown in Figure 3.

Figure 2. Citywide 2019 emissions by sector

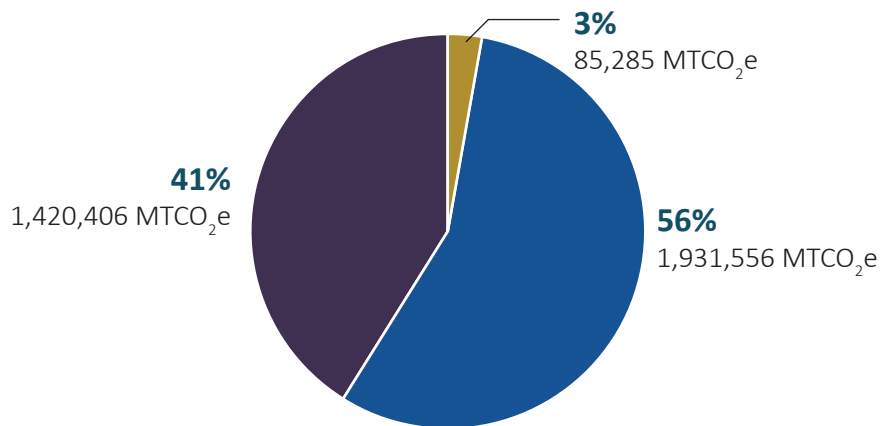
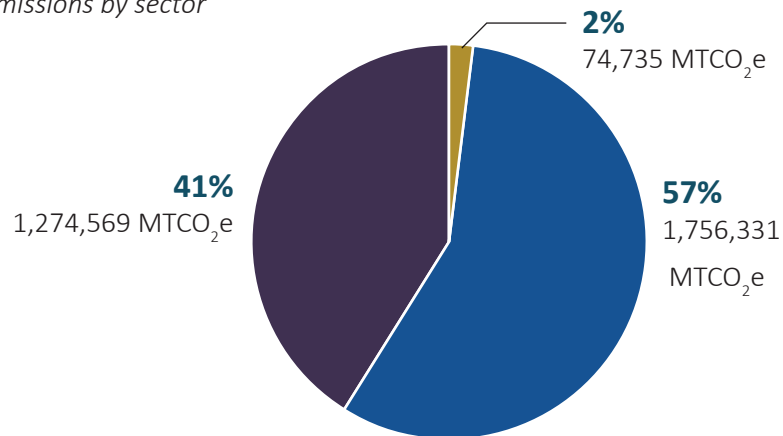


Figure 3. Citywide 2021 emissions by sector



■ Stationary Energy ■ Transportation ■ Waste

Citywide Year-Over-Year Comparison

Table 2 compares citywide GHG emissions results for 2018, 2019, and 2021, and provides additional detail on the sources of emissions within each sector.

The Stationary Energy (Buildings) sector details are presented with five subsectors, including: Residential, Commercial & Institutional; Industrial; Energy Production; and Fugitive Emissions.

The Transportation sector is split into: On-road; Public Transit; Waterborne Navigation; and Off-road subsectors.

The Waste sector shows details for: Solid Waste Disposal, Wastewater Treatment Process and Septic Treatment subsectors.

Table 2. Citywide emissions inventories 2018-2021

GPC #	Emissions Sub-sectors	2018	2019	2021
		Emissions (MTCO ₂ e)	Emissions (MTCO ₂ e)	Emissions (MTCO ₂ e)
Stationary Energy (Buildings)		1,854,759	1,931,556	1,756,331
Residential Energy		663,319	671,311	638,676
I.1.1	Residential Natural Gas	20,032 ^b	19,742 ^d	20,516 ^d
I.1.2	Residential Electricity	643,287	651,569	618,160
Commercial / Institutional Energy ^a		1,162,788	1,244,756	1,106,947
I.2.1	Commercial and Institutional Natural Gas	125,525	127,202	126,252
I.2.2	Commercial and Institutional Electricity	1,037,263	1,117,554	980,695
Industrial Energy		23,763	10,561	5,788
I.3.1	Industrial Natural Gas	4,128	4,128	4,128
I.3.2	Industrial Electricity	19,635	6,433	1,660
Energy Production		153,703	109,850	120,071
I.4.4	Waste-to-Energy ^c	153,703	109,850	120,071
Fugitive Emissions		4,882	4,927	4,920
I.8.1	Fugitive Emissions from Natural Gas Distribution	4,882	4,927	4,920

Transportation	1,426,634	1,420,406	1,274,569
On-road	1,409,583	1,227,825	1,086,092
II.1.1 On-road Gasoline and Diesel Vehicles	1,405,761	1,223,458	1,080,960
II.1.1 Trolley System	3,822	4,367	5,132
Public Transit ^e	17,051	17,543	13,013
II.2.2 Metrorail and Metromover	17,051	17,543	13,013
Waterborne Navigation	NA	7,451	7,383
II.3.1 Waterborne Navigation	NA	7,451	7,383
Off-road	NA	167,587	168,081
II.5.1 Off-road Vehicles	NA	167,587	168,081
Waste	55,253	85,285	74,735
Solid Waste Disposal	40,832	71,586	60,442
III.1.2 Disposal in Landfills Outside the City	40,832	71,586	60,442
Wastewater Treatment	12,386	12,131	12,741
III.4.2 Wastewater Treatment Process	12,386	12,131	12,741
Septic Treatment	2,035	1,568	1,553
III.4.2 Septic Treatment	2,035	1,568	1,553
	TOTAL (MTCO_{2e})	3,336,638	3,437,247
	Change from 2018	-	+3%

a. Commercial / Institutional energy sub-sectors also include energy used in the city's potable water supply, wastewater treatment processes, and combustion of biogas from wastewater treatment.

b. The City of Miami 2018 Greenhouse Gas Inventory Full Report misstated residential natural gas emissions; the value reflected above is based on the corrected natural gas consumption data for 2018.

c. A portion of Miami's citywide waste is collected and sent to a facility where it is incinerated to produce energy to power itself and for the regional electric grid. These emissions are categorized as stationary energy emissions in the GPC inventory guidance and reported as emissions from "energy sent to the grid." These emissions are documented but not included in the City's total as they are counted when the electricity created is used in other communities' building energy sectors.

d. Incomplete natural gas data was provided for the 2019 and 2021 inventories. The City used the 2019 and 2021 data it was able to collect from one utility provider and held constant the previously reported 2018 natural gas data from its other utility provider.

e. Public transit emissions do not include emissions from Metrobus at this time as the City has not developed a methodology that is able to isolate Metrobus VMT within City limits.

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Citywide & Government Operations

As shown in Table 2, citywide emissions increased by 3% from 2018 to 2019 and decreased by 7% from 2018 to 2021. This 2021 decrease could be partially attributed to COVID-19 impacts on activity levels citywide. Electricity emissions are the greatest individual contributor to total emissions in all three years and make up over 50% of total emissions. On-road vehicles (~35%) contribute the second most emissions, followed by natural gas (~5%).

Figure 4 shows that over the three-inventory year period, there was relatively little change in the distribution of emissions by sector even though total emissions amounts have varied.

Figure 4. Citywide emissions trends by sector

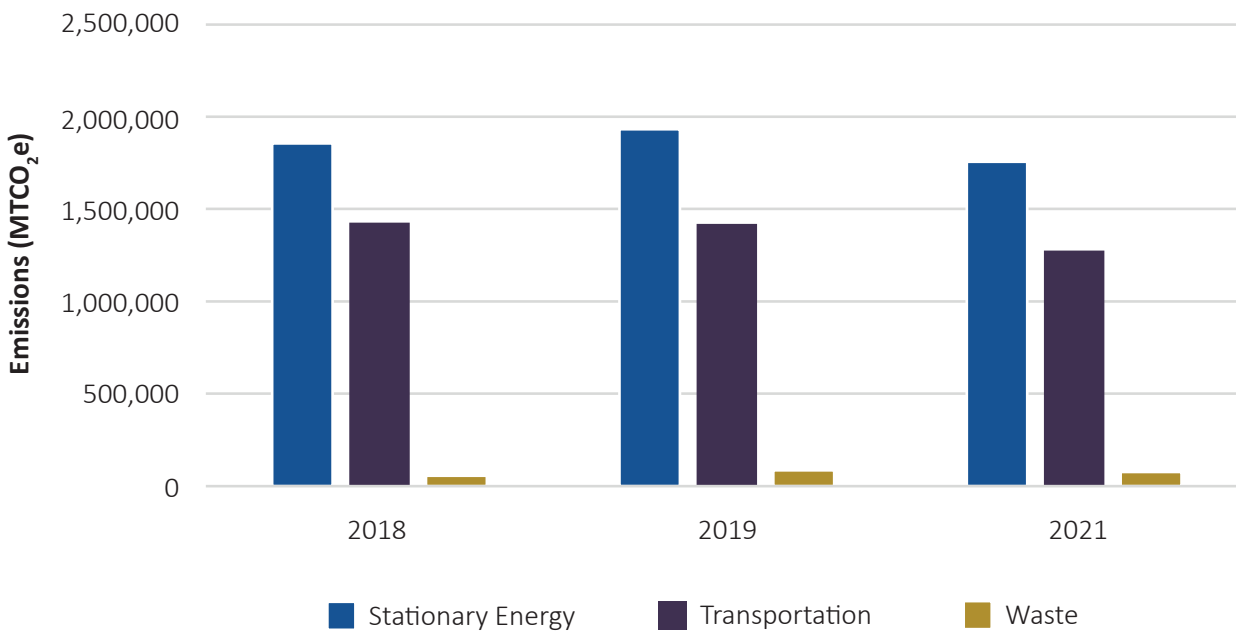
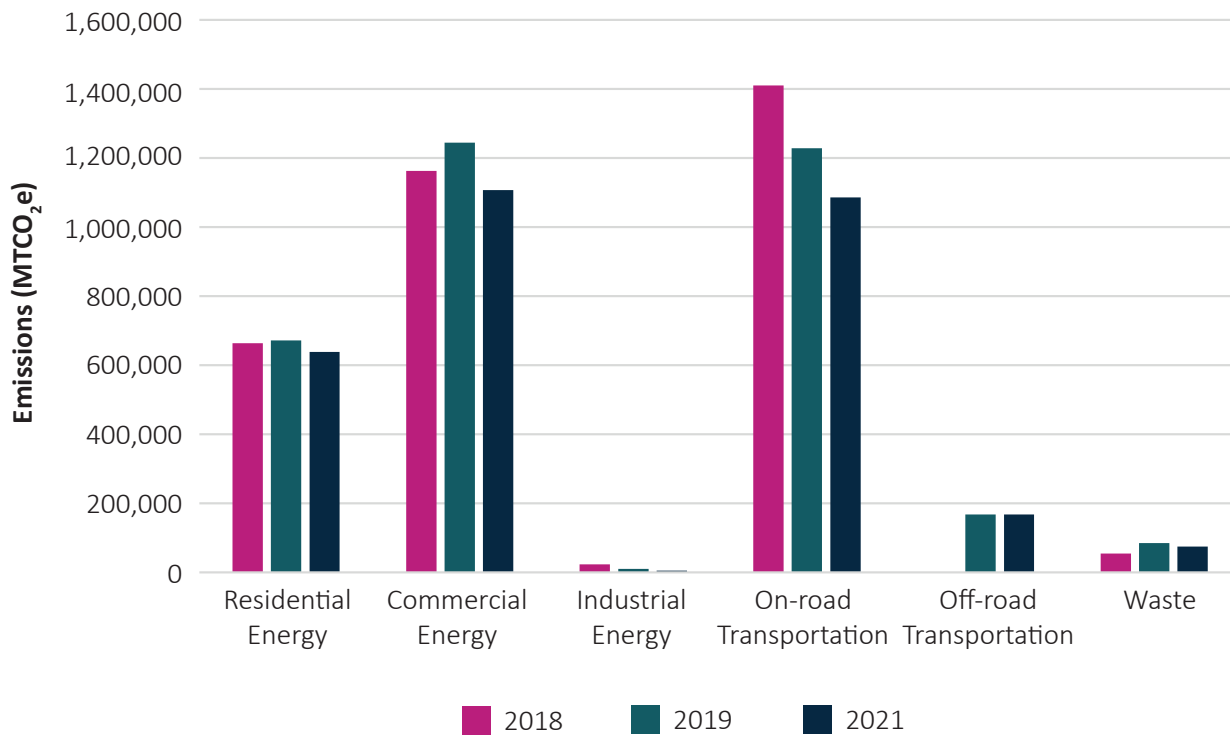


Figure 5 illustrates emissions trends for a set of sub-sectors. As shown, the On-road Transportation sub-sector saw the largest reduction in emissions from 2018 to 2021 with a decrease of nearly 325,000 MTCO₂e.

Figure 5. Citywide emissions trends by sub-sector



Citywide GHG Target Progress

Tracking Miami’s GHG emissions inventories over time demonstrates the City’s progress in addressing climate change through emissions management. Figure 6 shows that the City has made progress in reducing its citywide GHG emissions since 2018 and is trending close to the GHG reduction pathway trajectory. However, there are currently only three inventory data points and the 2021

inventory may have been influenced by COVID impacts, so it is difficult to draw concrete conclusions about the City’s long-term emissions trends at this time. The emissions target trajectory shown in Figure 6 demonstrates that Miami must continue to implement its ambitious, citywide climate actions and seek external partnerships to influence emissions outside the City’s direct control to maintain a trajectory toward carbon neutrality by 2050.

Figure 6. Citywide progress toward GHG target achievement



Local Government Operations Emissions Inventory Results

The city followed LGOP guidance in developing the local government operations emissions inventories. Emissions are reported under the following five main sectors:

- Building & Facilities
- Streetlights
- Vehicle Fleet
- Transit Fleet
- Employee Commute.

In 2019, total government operations emissions were 66,616 MTCO₂e. As shown in Figure 7, most emissions are from the Building & Facilities sector (44%), followed by the Vehicle Fleet sector (21%), and Employee Commute sector (20%). The Streetlights & Traffic Signals sector (8%) and the Transit Fleet sector (7%) are responsible for the remaining emissions.

In 2021, total government operations emissions totaled 64,507 MTCO₂e. Despite the emissions decrease since 2019, the proportion of local government emissions from each sector remained relatively constant since 2019. As shown in Figure 8, most emissions are from the Building & Facilities sector (47%), followed by the Vehicle Fleet sector (22%), and Employee Commute sector (17%). The Transit Fleet sector (8%) and Streetlights & Traffic Signals sector (6%) are responsible for the remaining emissions.

Vehicle emissions from Employee Commute were previously identified as the second largest source of local government CO₂ emissions in the 2018 inventory but declined precipitously in the 2021 inventory and were displaced by Vehicle Fleet emissions in 2021.



Figure 7. LGO 2019 emissions by sector

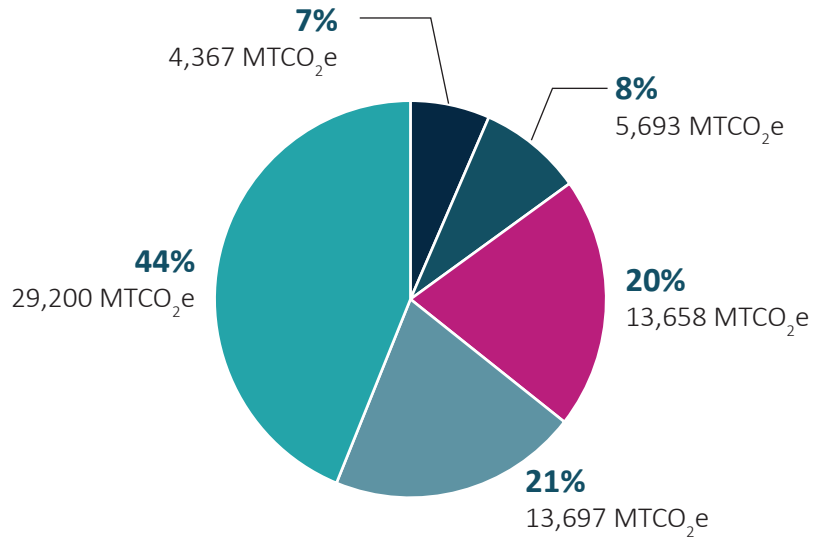
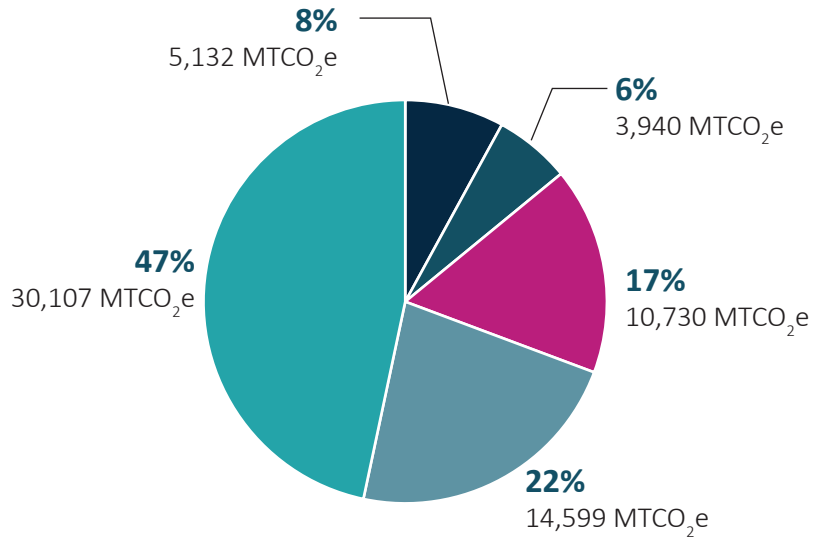


Figure 8. LGO 2021 emissions by sector



Local Government Operations Year-Over-Year Comparison

As shown in Table 3, emissions increased by 11% from 2018 to 2019 and 7% from 2018 to 2021. The decrease from 2019 to 2021 could be partially attributed to COVID-19 impacts on citywide operations. Electricity emissions are the greatest individual contributor to total emissions in all three years and make up 26%-24% of total emissions. The second largest single contributor in 2019 and 2021 is Natural Gas use (18%-23%), while in 2018 it was Vehicle Fleet (21%-22%).

Table 3. Local government operations inventories 2018-2021

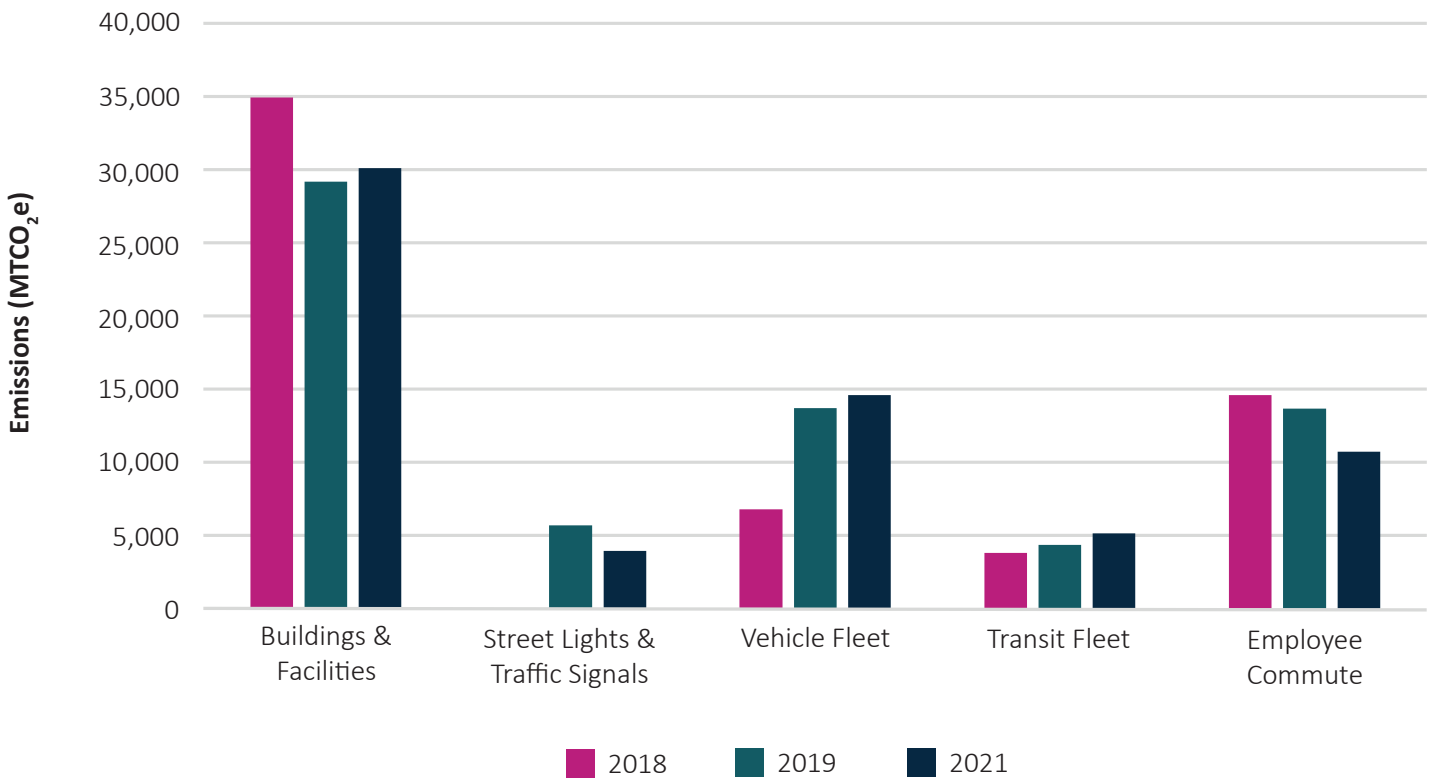
Emissions Sectors	2018	2019	2021
	Emissions (MTCO _{2e})	Emissions (MTCO _{2e})	Emissions (MTCO _{2e})
Buildings & Facilities	34,946	29,200	30,107
Natural Gas	14,064	11,808	14,636
Electricity	20,882	17,392	15,471
Street Lights & Traffic Signals	0^a	5,693	3,940
Street Lights & Traffic Signals	-	5,693	3,940
Vehicle Fleet	6,800	13,697	14,599
On-road Gasoline Fleet	2,639	3,024	2,867
On-road Diesel Fleet	4,045	10,623	11,703
Off-road Gasoline Fleet	5	NA	NA
Off-road Diesel Fleet	111	50	28
Transit Fleet	3,822	4,367	5,132
Trolley System- Diesel	3,822	4,367	5,132
Employee Commute	14,599	13,658	10,730
City of Miami Employee Commute	14,599	13,658	10,730
Total	60,167	66,616	64,507
Change from 2018	-	+11%	+7%

a. Street Lights & Traffic Signals were reported as part of "Buildings & Facilities" in 2018 as FPL could not disaggregate the data at the time.

Figure 9 illustrates the LGO emissions sector changes over time. As shown, the Buildings & Facilities sector and the Employee Commute sector both saw declining emissions since 2018; Buildings & Facilities provided a larger total amount of reductions (approximately 4,800 MTCO₂e from 2018 to 2021) approximately a 14% decrease, while Employee Commute had the largest percentage decrease (27%) during this period. This is likely due to the City

making hybrid scheduling available to City employees in 2021 thus reducing the number of days employees commute to work. The Vehicle Fleet sector showed an increase of 115% since 2018, or nearly 7,800 MTCO₂e/yr, which was likely due to a change in the fuel consumption data tracking methodology and potentially based on changes in the vehicle fleet composition since the 2018 inventory was developed.

Figure 9. LGO emission trends by sector



Key Messages

- **City of Miami GHG emissions are trending lower** consistent with the carbon neutrality goal established in Miami Forever Carbon Neutral, decreasing 7% from 2018 to 2021, which is partly due to lingering effects of the COVID-19 pandemic.
- **Emissions from electricity use are the greatest contributor to total citywide emissions**, contributing over 50% of emissions; On-road Transportation emissions are the second largest source, contributing nearly 35% of total emissions.
- **Emissions from electricity use in Buildings & Facilities and Streetlights & Traffic Signals, are also the greatest contributor to government operations emissions**, contributing approximately 30% of emissions; natural gas use in Buildings & Facilities is the second largest source, contributing nearly 23% of total emissions.
- City of Miami will use greenhouse gas inventories to evaluate long-term emissions trends and to understand changes within each emissions sector to inform program development that can reduce emissions; **regular greenhouse gas emissions inventories are an important component to monitoring implementation progress** on Miami Forever Carbon Neutral.
- **City of Miami staff were trained on citywide and government operations greenhouse inventory development** as part of the 2019 and 2021 inventory project and identified opportunities to streamline and improve data collection for future inventories.

Acknowledgements

Developing greenhouse gas inventories requires data collection from many City departments and outside entities. A sincere thank you to the following for their assistance in helping put together this report.

- **City of Miami General Services Administration**
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- **City of Miami Department of Resilience and Public Works**
- **City of Miami Department of Solid Waste**
- **Miami-Dade County Office of Resilience**
- **Miami-Dade County Department of Solid Waste Management**
- **Miami-Dade County Water & Sewer Department**
- **Florida Department of Transportation**
- **Florida Highway Safety and Motor Vehicles**
- **AECOM**
- **Florida City Gas**
- **Florida Power & Light**
- **Google Environmental Insights Explorer**
- **TECO Energy**



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