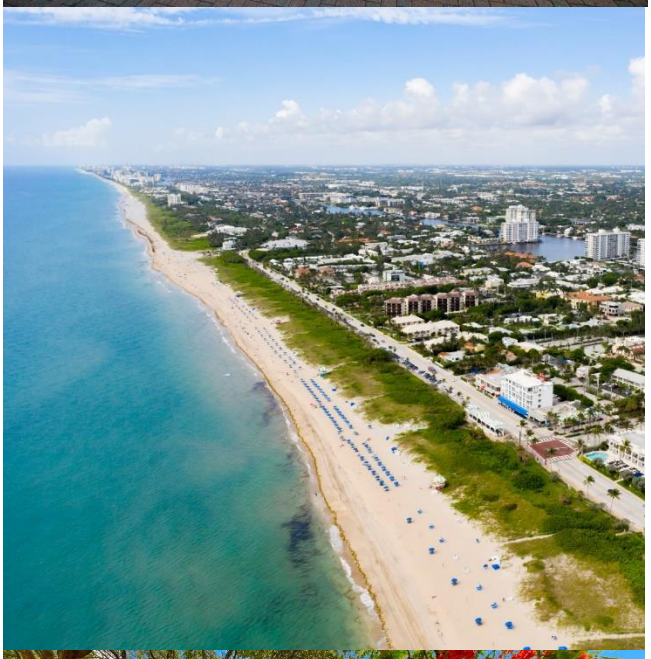

City of Delray Beach

2019 Inventory of Community Greenhouse Gas Emissions

OCTOBER, 2022

Produced by
the City of Delray Beach
Office of Sustainability and Resilience

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ICLEI-Local Governments for Sustainability USA
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Executive Summary

The City of Delray Beach 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.

Multiple Goals, Policies, Objectives and Performance Measures in the Always Delray Comprehensive Plan address GHG reduction directly or indirectly:
Conservation, Sustainability, and Resiliency (CSR) Goals 1-9
Housing (HOU) Goals 1, 4
Capital Improvements (CIE) Goals 2, 3

Along with this inventory, the science-based targets mark a major first step forward by the City, recognizing the need and setting a goal for carbon emission reduction. For City government, achieving green building certifications, transitioning to more electric vehicles, making our utilities pumps and operations run more efficiently, installing solar voltaic systems, and many more actions big and small will be needed to reach the goal. A commitment and coordination by all City Departments will also be imperative to success.

This report provides estimates of greenhouse gas emissions resulting from activities in the City of Delray Beach as a whole in 2019, inclusive of emissions specifically from the City's government operations. Engaging with non-governmental sectors will also be required to meet carbon emission reduction goals. The City's progress on emission reductions generated by governmental sources will be key to leading this community effort.

Key Findings

Figure 1 shows communitywide emissions by sector. The largest contributor is Transportation and Mobile Sources with 52% of emissions. The next largest contributors are Residential Energy (24%) and Commercial Energy (20%). Actions to reduce emissions in all these sectors will be a key part of a climate action plan. Industrial Energy, Water and Wastewater, Solid Waste, and Fugitive Emissions were responsible for the remaining 4% of emissions.

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

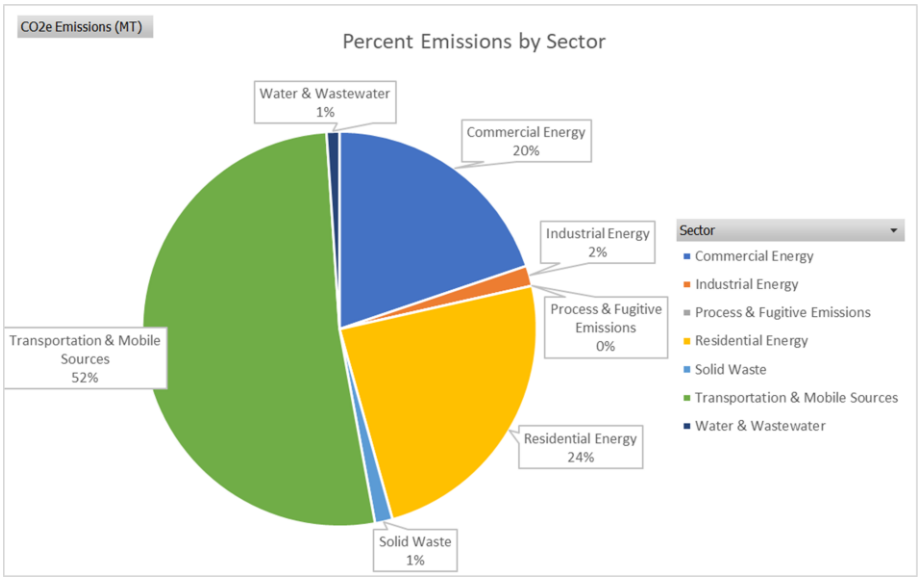


Figure 1: Community-wide Emissions by Sector

Introduction to Climate Change

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is 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, threatening the safety, quality of life, and economic prosperity of global communities. Although the natural greenhouse effect is needed to keep the earth warm, a human enhanced greenhouse effect with the rapid accumulation of GHG in the atmosphere leads to too much heat and radiation being trapped. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report confirms that human activities have unequivocally caused an increase in carbon emissions[1]. Many regions are already experiencing the consequences of global climate change, and Delray Beach is no exception.

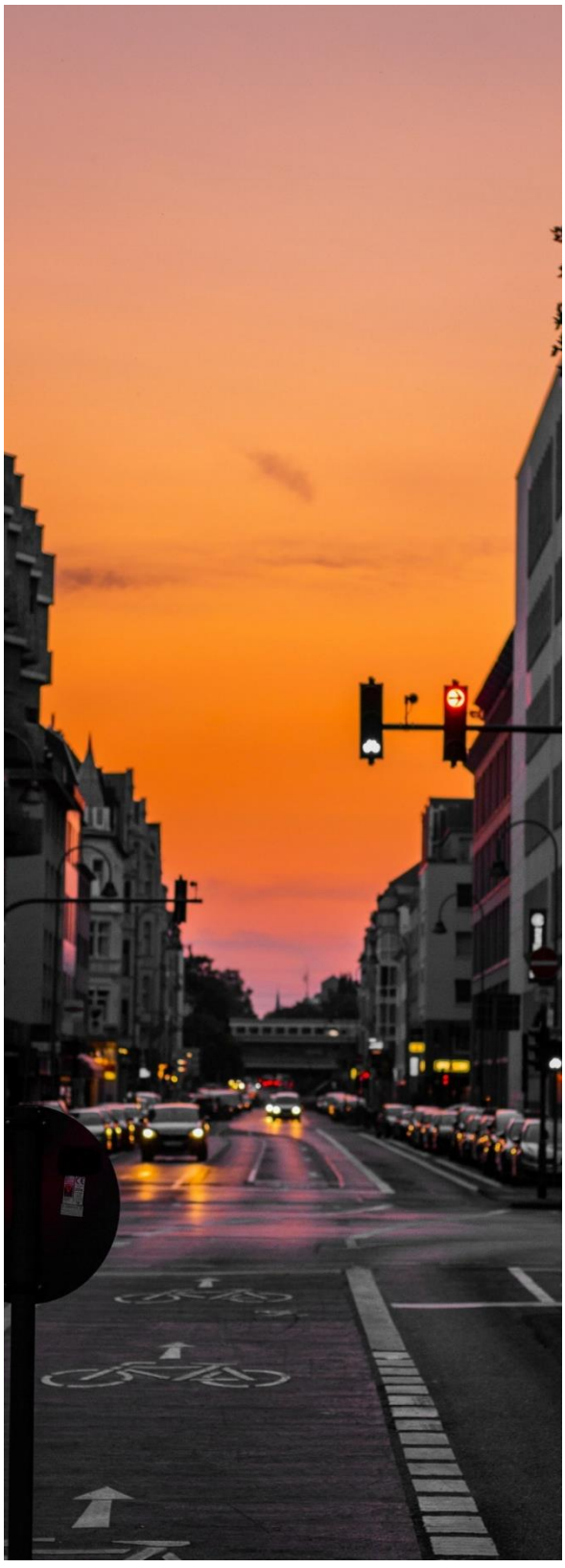
Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (high confidence) Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system, such as sea level rise, with associated impacts (high confidence), but these emissions alone are unlikely to cause global warming of 1.5°C (medium confidence). Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C (high confidence). These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options (high confidence)[2].

[1]IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

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

According to the 2018 Fourth National Climate Assessment, the southeast U.S. will experience potentially devastating impacts from seasonal changes and hazards occurring at unprecedented magnitudes. Southeast Florida, including Delray Beach, is at particular risk for coastal hazards, such as flooding, erosion, and hurricanes that will continue to intensify with sea-level rise. So many people visit and move to this region to enjoy the beautiful coast, but its seaside location also puts it at extreme risk. In addition, climate change will continue to produce warmer seasons and extreme temperatures that threaten many sectors within Delray Beach and the greater region, most notably tourism, public health, and agriculture[3].

Many communities in the United States have started to take responsibility for addressing climate change at the local level. Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, when residents save on energy costs, they are more likely to spend at local businesses and add to the local economy. Reducing fossil fuel use improves air quality, and increasing opportunities for walking and bicycling improves residents' health.



[3] U.S. Global Change Research Program. 2018. National Climate Assessment – Ch 19: Southeast. Retrieved from https://nca2018.globalchange.gov/chapter/19/

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

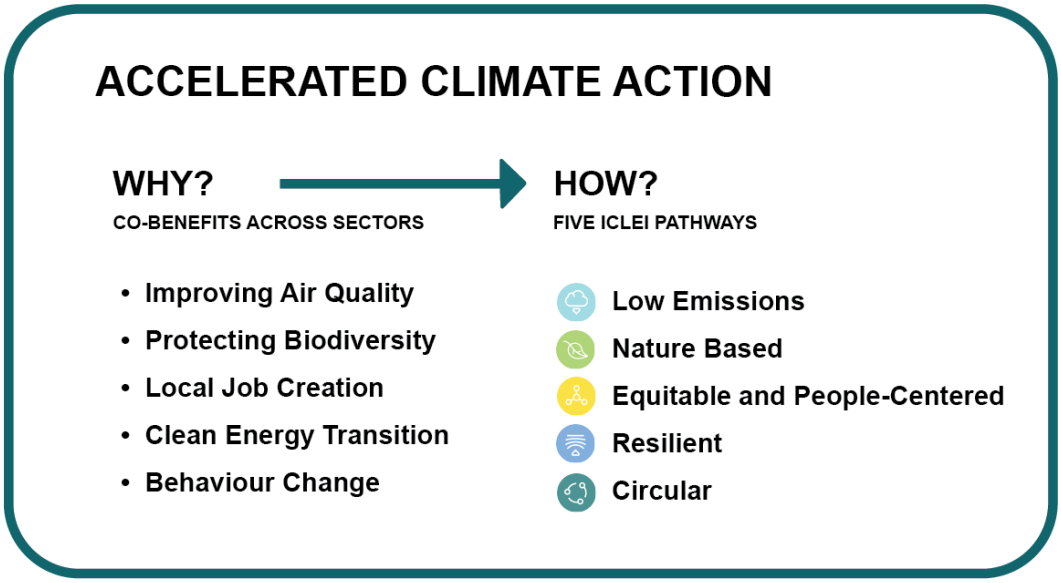
Facing the climate crisis requires the concerted efforts of local governments and their partners, those that are close to the communities directly dealing with the impacts of climate change.

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

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

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

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



ICLEI Climate Mitigation Milestones

In response to the climate emergency, many communities in the United States are taking responsibility for addressing emissions at the local level. 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, as well as influencing regional emissions through partnerships and advocacy. 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 Science Based Target[4];
3. Develop a climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

This report represents the completion of ICLEI's Climate Mitigation Milestone One, and provides a foundation for future work to reduce greenhouse gas emissions in Delray Beach.

Figure 2: ICLEI Climate Mitigation Milestones

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

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from both the Delray Beach community as a whole, and from operations of the Delray Beach government. The government operations inventory is mostly a subset of the community inventory, as shown in Figure 3. For example, data on commercial energy use by the community includes energy consumed by municipal buildings and community vehicle-miles-traveled estimates, that include miles driven by municipal fleet vehicles.

Figure 3: Relationship of Community and Government Operations Inventories

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

Three greenhouse gases are included in this inventory: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Many of the charts in this report represent emissions in "carbon dioxide equivalent" (CO2e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the IPCC 5th Assessment Report:

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

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	28
Nitrous Oxide (N2O)	265

Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions[5] was released by ICLEI in 2019, and represents a national standard in guidance to help U.S. local governments develop effective community GHG emissions inventories. It establishes reporting requirements for all community GHG emissions inventories, provides detailed accounting guidance for quantifying GHG emissions associated with a range of emission sources and community activities, and provides a number of optional reporting frameworks to help local governments customize their community GHG emissions inventory reports based on their local goals and capacities.

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

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

The community inventory also includes the following activities:

- Wastewater processing
- Fugitive emissions from natural gas leakage

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. Nitrous oxide is primarily from grid electricity (from fuel combusted to create electricity) and gasoline used for passenger vehicles. Methane community-wide emissions comes primarily from grid electricity (from fuel combusted to create electricity), gasoline used for passenger vehicles, the methane-to-energy plant, flaring of digester gas, and leakage from the local natural gas distribution system

Local Government Operations (LGO) Protocol

The LGO Protocol was not completed in this inventory but is included here for future reference. In 2010, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released Version 1.1 of the LGO Protocol.[6] The LGO Protocol serves as the national standard for

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

[6] ICLEI. 2008. Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol

quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory.

The following activities are included in an LGO inventory: energy and natural gas consumption from buildings & facilities; wastewater treatment processes; and on-road transportation from employee commute and vehicle fleet.

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.

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

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Delray Beach's community greenhouse gas emissions inventory utilizes 2019 as its baseline year, because it is the most recent year for which the necessary data are available.

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 = Emissions

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

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO2/kWh of electricity). For this inventory, calculations were made using ICLEI's ClearPath tool.

Community Emissions Inventory Results

The total communitywide emissions for the 2019 inventory are shown in Table 2 and Figure 4.

Table 2: Communitywide Emissions Inventory

Sector	Fuel or source	2019 Usage	Usage unit	2019 Emissions ($MTCO_2e$)
Residential energy	Electricity (Florida Power & Light)	438,433,399	kWh	132,902.0
Residential energy total				**132,902.0**
Commercial energy	Electricity	359,103,208	kWh	108,855.0
	Natural gas	584.92	MMBtu	31.110
Commercial energy total				**108,886.11**
Industrial energy	Electricity	30,123,888	kWh	9,131.4
Industrial energy total				**9,131.4**
On-road transportation	Gasoline	499,709,043.70	Annual VMT	206,096.0
	Diesel	53,311,146.32	Annual VMT	78,693.0
Transportation total				**284,789.0**
Solid Waste	Flaring of Landfill Gas – Class I	655,207	Cubic Feet/Day	627.68
	Flaring of Landfill Gas – Class III	857,954	Cubic Feet/Day	565.48
	Combustion of Landfill Gas	1,504,427	Cubic Feet/Day	44.618
	Combustion of Solid Waste	19,300.47	Short Tons	6,302.0
Solid waste total				**7,539.778**
Water and wastewater	Water Treatment Energy Usage	1,0576,441	kWh	3,206.0
	Wastewater Treatment Energy Usage	8,502,026	kWh	2,577.2
Water and wastewater total				**5,783.2**
Process & Fugitive Emissions	Fugitive Emissions from Natural Gas Distribution – government usage	5,849.2	Therms	1.0148
Process & Fugitive total				**1.0148**
			Total community-wide emissions	**549,032.50**

Figure 4 shows the distribution of communitywide emissions by sector. Transportation and Mobile Sources is the largest contributor (52%), followed by Residential Energy (24%), and Commercial Energy (20%).

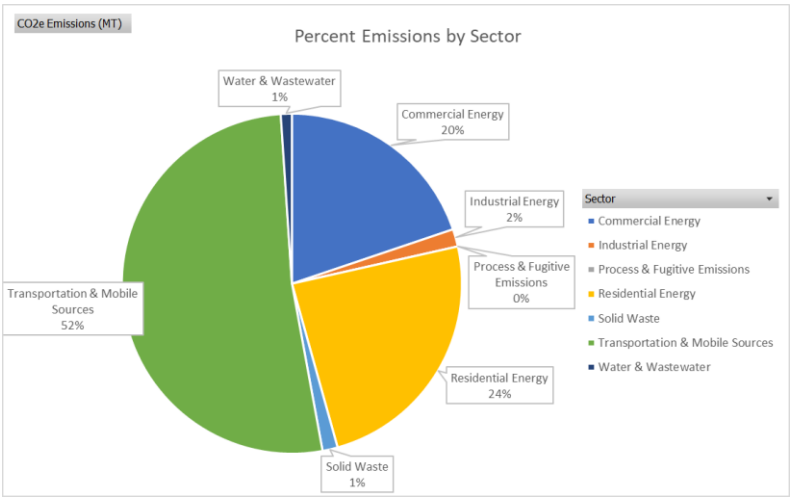


Figure 4: Community-wide Emissions by Sector

Next Steps:

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

- Transportation & Mobile Sources
- Residential Energy
- Commercial Energy

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

Conclusion

This inventory marks the completion of Milestone One of the Five ICLEI Climate Mitigation Milestones. The next steps are to forecast emissions, set an emissions-reduction target, and build upon the existing [Name of Existing Plan or Sustainability Program in the Community] with a more robust climate action plan that identifies specific quantified strategies that can cumulatively meet that target.

The Intergovernmental Panel on Climate Change (IPCC) states that to meet the Paris Agreement commitment of keeping warming below 1.5°C we must reduce global emissions by 50% by 2030 and reach climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%. More than ever, it is imperative that countries, regions, and local governments set targets that are ambitious enough to slash carbon emissions between now and mid-century.

Science-Based Targets are calculated climate goals, in line with the latest climate science, that represent a community's fair share of the global ambition necessary to meet the Paris Agreement commitment. To achieve a science-based target, community education, involvement, and partnerships will be instrumental. This inventory document only reports emissions which illustrate the local contribution of GHGs. Inherently, there is no mitigation strategy or goal associated with the emissions data, but if there is no action taken in follow up then the report has not served its purpose. The appropriate next step for the City is to set targets for GHG emission reductions, which if met will help avoid the most serious impacts of climate change. The consensus scientific opinion is that overall world-wide GHG emissions must be reduced by 50% by 2030, with net zero emissions reached by 2050. The Office of Sustainability and Resilience recommends that the City formally adopt these as goals, at a minimum. Though these are ambitious targets, considering that our community and others like us have a higher historic contribution to global GHGs, it is highly encouraged to set even more aggressive goals, such as a 60% reduction by 2030. Once adopted, reaching the goals will require taking significant steps to reduce emissions from the largest sources.

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

Appendix: Methodology Details

Energy

The following tables show each activity, related data sources, and notes on data gaps. It should be noted that a Greenhouse Gas Inventory was completed in February of 2019, using data for 2017. The 2019 report showed a much higher total emissions for the City, 998,446 $mtCO_{2e}$. The main sources of the difference were in the areas of transportation and residential energy. Future GHG inventories should focus on ensuring data is collected in a comprehensive and consistent manner, so that an accurate assessment of reductions can be made.

Table 3: Energy Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Residential, commercial, and industrial electricity consumption	FPL	Information obtained by ICLEI
Commercial natural gas consumption	Invoices to City of Delray Beach	Only includes City government facilities

Table 4: Emissions Factors for Electricity Consumption

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2019	664.89	55	7

Transportation

Table 5: Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Vehicle miles traveled	Google EIE	Information obtained by ICLEI; Public busses not included

For vehicle transportation, it is necessary to apply average miles per gallon and emissions factors for CH4 and N2O to each vehicle type. The factors used are shown in Table 6.

Table 6: MPG and Emissions Factors by Vehicle Type (2019 US National Defaults)

Fuel	Vehicle type	MPG	CH_4 g/mile	N_2O g/mile
Gasoline	Passenger car	24.37713	0.0183	0.0083
Gasoline	Light truck	17.86788	0.0193	0.0148
Gasoline	Heavy truck	5.371652	0.0785	0.0633
Gasoline	Motorcycle	24.37713	0.0183	0.0083
Diesel	Passenger car	24.37713	0.0005	0.001
Diesel	Light truck	17.86788	0.001	0.0015
Diesel	Heavy truck	6.392468	0.0051	0.0048

Wastewater

Table 7: Wastewater Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide & Local Government Operations		
Nitrogen Discharge	N/A	N/A
Digester Gas Combustion/Flaring		
Energy used in wastewater facilities	South Central Regional WW Plant	Electrical usage was subtracted from the Commercial electricity usage obtained from FPL, so it is not duplicated

Potable Water [if reported separately, omit if not]

Table 8: Potable Water Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Potable Water	CDB Utilities Dept	Electrical usage was subtracted from the Commercial electricity usage obtained from FPL, so it is not duplicated

Solid Waste

Table 9: Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Class I LFG Flared	Solid Waste Authority of Palm Beach County (SWA)	N/A
Class III LFG Flared		N/A
FLG Combusted		This data is for LFG combusted in biosolids processing. 316.5 Btu/scf is the average of Class I (360) and Class III (273). Data did not reflect exact amount from each of these that went into Biosolids drying, so a 50/50 mix was assumed.
Solid Waste Combusted	SWA and Waste Management	Data obtained from WM Garbage (16254.41 tons) + Vegetation (3046.06 tons)= 19,300.47 tons

Fugitive Emissions

Table 10: Fugitive Emissions Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Fugitive Emissions	Invoices to City of Delray Beach	Natural gas usage data was taken from invoices to the City of Delray Beach, and only represents City government usage. Requests for community data were made but no response received from Florida Public Utilities

Inventory Calculations

The 2019 inventory was calculated following the US Community Protocol and ICLEI's ClearPath software. As discussed in Inventory Methodology, the IPCC 5th Assessment was used for global warming potential (GWP) values to convert methane and nitrous oxide to CO2 equivalent units. ClearPath's inventory calculators allow for input of the sector activity (i.e. kWh or VMT) and emission factor to calculate the final CO2e emissions.