City of Boca Raton

2018 Inventory of Community and Government Operations Greenhouse Gas Emissions

April 2, 2020

Produced by the City of Boca Raton Office of Sustainability
With Assistance from ICLEI - Local Governments for Sustainability USA

ICLEI USA
Local Governments for Sustainability

Credits and Acknowledgements

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ICLEI-Local Governments for Sustainability USA

The 2018 Inventory of Community and Government Operations Greenhouse Gas Emissions was completed by:

Jesse Carpentier, Program Officer

Jim Shraak, Program Assistant

Meredith Anderson, Program Assistant

Sam Ruderman, Program Assistant

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Executive Summary

The City of Boca Raton 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. Furthermore, Boca Raton has multiple opportunities to benefit by acting quickly to reduce community GHG emissions, such as reducing energy and transportation costs for residents and businesses, creating green jobs, improving health of residents, and making the community an even more attractive place to live and locate a business.

The City of Boca Raton continues to demonstrate leadership in community sustainability and environmental stewardship at the local, state and even the national level. The Mayor and City Council are committed to conserving energy, reducing air pollution and greenhouse gas production, conserving water resources, preserving environmentally sensitive lands, protecting native wildlife and providing educational programs. In 2019, Boca Raton released a Sustainability Action Plan, which prioritizes the completion of this communitywide and municipal greenhouse gas inventory.

This report provides estimates of city-wide greenhouse gas emissions resulting from activities in Boca Raton in 2018, as well as the 2018 emissions specifically from the City's government operations.

Key Findings

Figure ES-1 shows communitywide emissions by sector. The largest contributor is transportation & mobile sources with 36% of emissions. The next largest contributors are residential energy (24%) and commercial energy (35%). Actions to reduce emissions in all sectors will be a key part of any action on climate change. Solid waste, industrial energy, water & wastewater, and solid waste were responsible for the remaining (less than 6%) of emissions.

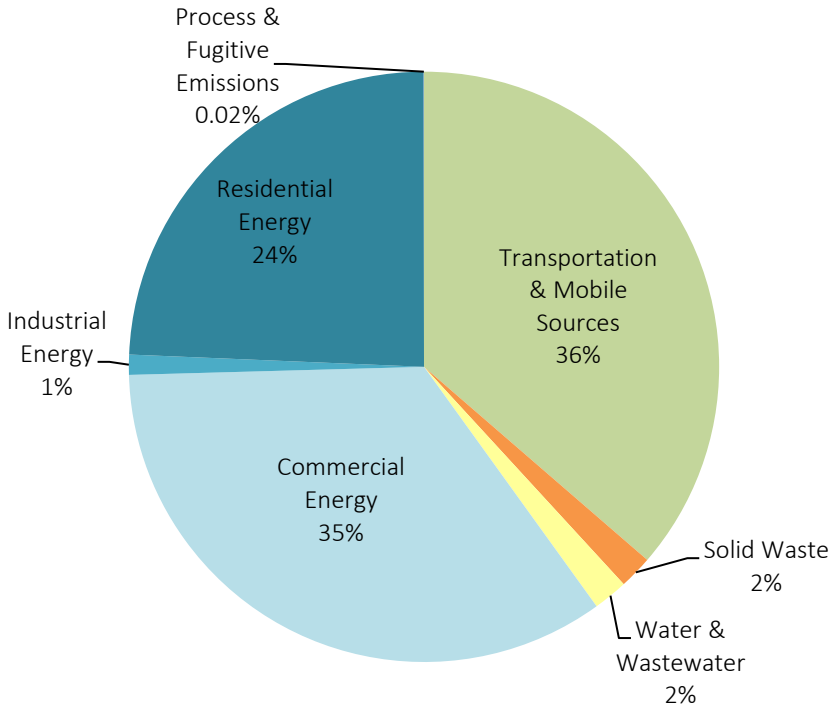


Figure ES- 1 Communitywide Emissions by Sector

Figure ES-2 shows local government operations emissions. Energy use in buildings and facilities accounts for a vast majority (59%) of these emissions. The next largest contributor is water & wastewater facilities (24%), vehicle fleet (9%), followed by employee commute (6%). Street lights and traffic signals account for the remaining 2% of emissions.

Figure ES-3 shows the local government emissions as a proportion of total communitywide emissions.

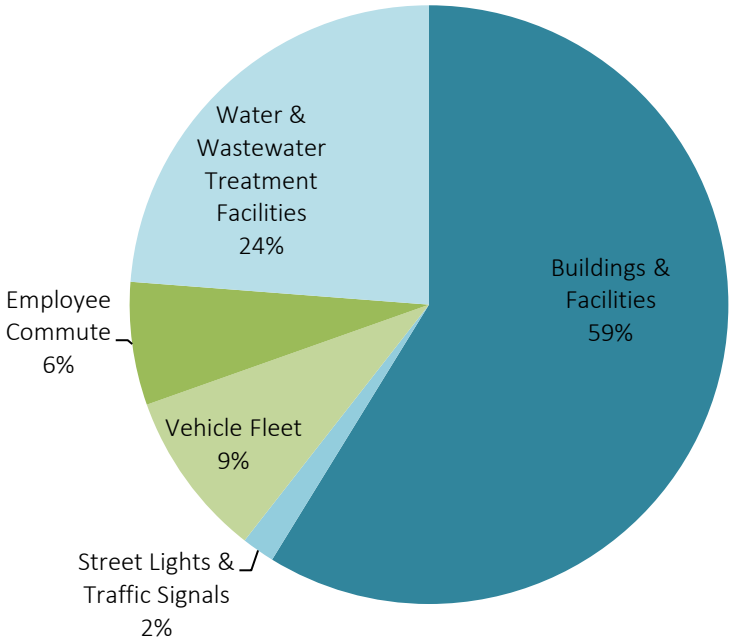


Figure ES- 2 Government Operations Emissions by Sector

The Inventory Results section of this report provides a detailed profile of emissions sources within Boca Raton; 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.

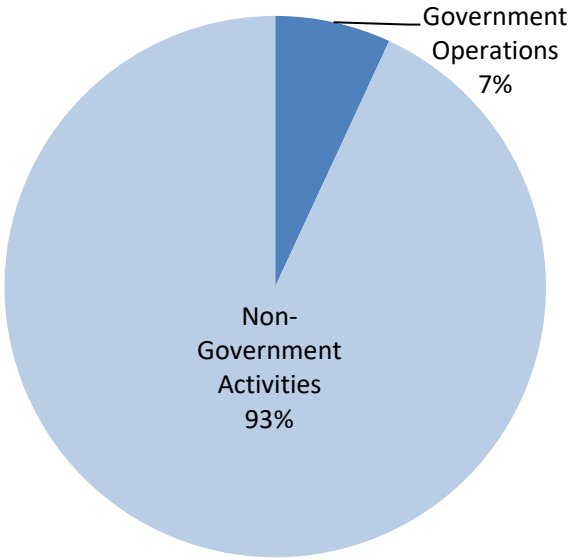
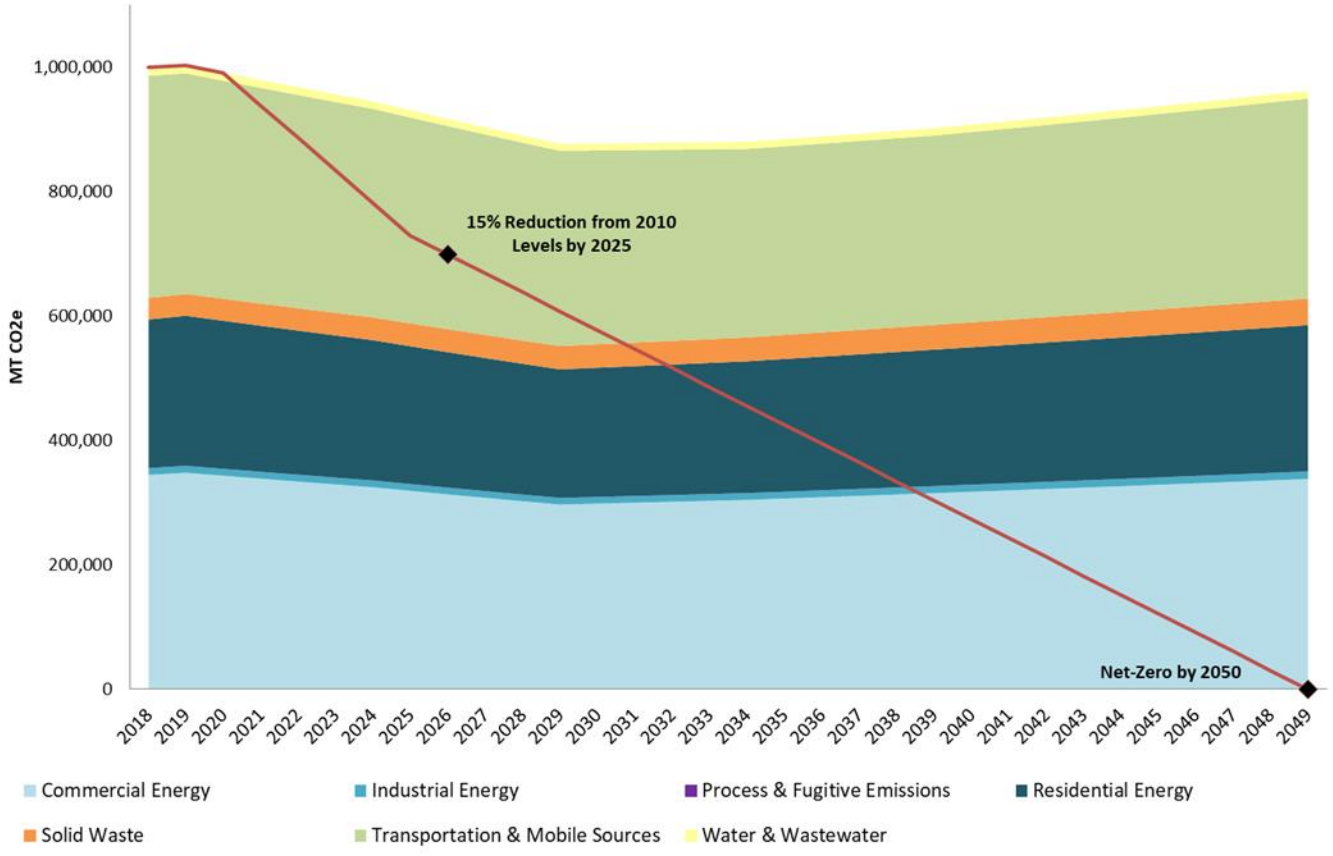


Figure ES- 3 Non-Government vs. Government Emissions

Business-As-Usual Forecast

Using the 2018 Communitywide Inventory as a baseline, emissions were forecasted to the year 2050. The following figure illustrates business-as-usual emissions (a scenario in which no actions are taken by the City to reduce emissions), and a potential reduction pathway representing the 15% reduction target established in the City's Sustainability Action Plan and a potential net-zero target for 2050. The forecast and potential reduction pathway will help inform a climate action strategy to be developed by the City in the near-future.



Climate Change Background

Naturally occurring gases dispersed in the atmosphere play a role in determining the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Over the last century and a half human activities, primarily the burning of fossil fuels for transportation and electricity, have increased these gasses concentrations in the atmosphere resulting in the trapping of more heat leading to changes in the global climate. Collectively, these gases, known as greenhouse gases (GHG), intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise. Global climate change influences seasonal patterns and intensifies weather events, threatening the safety, quality of life, and economic prosperity of communities everywhere[1]. Many regions are already experiencing the consequences of global climate change, and Boca Raton is no exception.

The City of Boca Raton is in the process of conducting a Climate Change Vulnerability Assessment (CCVA) as a joint project with six other municipalities and the County. This regional CCVA will help the City understand its specific vulnerabilities to the impacts of Climate Change and how they can be addressed at a regional scale. Even without a completed CCVA, the City can anticipate specific impacts. According to the 2018 National Climate Assessment, the southeast U.S. will experience potentially devastating impacts from seasonal changes and hazards occurring at unprecedented magnitudes. Southeast Florida, including Boca Raton, is at particular risk for coastal hazards, such as flooding, erosion, storm surge, and hurricanes that will continue to intensify with sea-level rise. The southeast is also particularly vulnerable to extreme heat. While the City's warm climate and coastal location is a major attractors of new residents, visitors, and business investment they are also the sources of vulnerability in a changing climate. Increased heat and flooding will threaten many sectors within Boca Raton and the greater region including tourism and public health[2].

Many communities in the United States have started to take responsibility for addressing climate change at the local level but climate change is not the only reason to reduce fossil fuel emissions. While it is important for every city to play their role in a global climate solution, the local benefits to climate action alone make reducing GHG emissions

[1] International Panel on Climate Change. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp. Retrieved from https://www.ipcc.ch/report/ar5/syr/

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

a smart investment by cities. More efficient use of energy decreases utility and transportation costs for residents and businesses leaving more money to invest into the local economy. Energy efficiency retrofitting and renewable energy installation are by their nature local jobs that cannot be outsourced, growing the local job market. Reducing vehicle miles travelled by increasing biking, walking and transit and reducing fossil fuel use through increasing electric vehicles alleviates parking needs and traffic congestion while improving public health by reducing air pollution and encouraging physical activity.

ICLEI Climate Mitigation Milestones

Many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies giving local governments 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 1:

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.

Figure 1 ICLEI Climate Mitigation Milestones

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 City of Boca Raton.

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 Boca Raton community as a whole, and from the City of Boca Raton government operations. The government operations inventory is mostly a subset of the community inventory (see Figure 2). 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. Only a small portion of municipal emissions are not included in communitywide emissions (described in Government Operations Emissions Inventory Results).

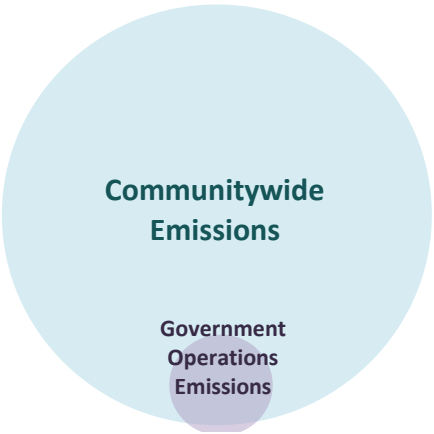


Figure 2 Relationship Between Communitywide and Local Government Emissions

As local governments have continued to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (Community Protocol) and the Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions (LGO Protocol), both of which are described below.

Three greenhouse gases are included in this inventory: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Many of the charts in this report represent emissions in "carbon dioxide equivalent" (CO_2e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the IPCC 5th Assessment Report:

Table 1 Global Warming Potential Values (IPCC, 2014)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265

Community Emissions Protocol

Version 1.2 of the U.S. Community Protocol for Accounting and Reporting GHG Emissions[3] 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 residential and commercial 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 (99%) of the community emissions and is produced from burning fossil fuels such as coal, gasoline, diesel, and natural gas. Nitrous oxide accounts for about 0.5 percent of communitywide emissions, primarily from grid electricity (from fuel combusted to create electricity) and gasoline used for passenger vehicles. Methane accounts for about 0.2 percent of community-wide emissions, and 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 Protocol

In 2010, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released Version 1.1 of the LGO Protocol.[4] The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the

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

[4] 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

principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory.

The following activities are included in the LGO inventory:

- Energy and natural gas consumption from buildings & facilities
- Wastewater treatment processes
- On-road transportation from employee commute and vehicle fleet

Similar to the communitywide inventory, carbon dioxide accounts for a majority of emissions at 99%, followed by 0.6% nitrous oxide and 0.1% methane. Nitrous oxide emissions are primarily from the wastewater treatment process, and methane emissions are primarily from grid electricity.

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.

This inventory is not meant to be an exhaustive catalogue of all emissions for which the community is responsible. Some emissions are challenging if not impossible to quantify, for example, those emissions resulting from the manufacturing and transport of consumer goods consumed within the City. For those categories of emissions, the City's Sustainability Action Plan focuses on policy and behavior to address what are known but unmeasured sources of emission, for example, advocating for a purchasing policy that prioritizes locally produced goods and services. For the emissions that are more easily quantifiable, for example electricity purchased within the City, these are

clear benchmarks from which we can measure success of policies and incentives aimed at increasing efficiency and decreasing emissions.

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Boca Raton's community greenhouse gas emissions inventory utilizes 2018 as its baseline year, because it is the most recent year for which the necessary data are available. The 2018 IPCC Special Report on Global Warming of 1.5°C set targets to meet from a baseline of 2010, however, data for many emission sources is not retained for that amount of time. The goals for GHG emission reduction in the Sustainability Action Plan are based on the IPCC's targets and will assume no increase between 2010 and 2018 emissions, using this 2018 baseline when measuring progress on the reduction targets. As it is probable that emissions did rise between 2010 and 2018, this assumption will result in surpassing those targets.

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 CO_2/kWh of electricity). For this inventory, calculations were made using ICLEI's ClearPath tool.

Community Emissions Inventory Results

The total communitywide emissions for the 2018 inventory are shown in Table 2 and Figure 3.

Table 2 Communitywide Emissions Inventory

Sector	Fuel or source	2018 Usage	Usage unit	2018 Emissions ($MTCO_2e$)
Residential energy	Electricity (Florida Power & Light)	756,399,715	kWh	231,671.045
	Natural Gas	1,149,395.82	therms	6,113.2
	Propane	15,862	gallons	984.38
	Fuel oil (Distillate Oil #2)	549	gallons	40.88
			Residential energy total	**238,809**
Commercial energy	Electricity	1,142,496,718	kWh	295,309
	Natural gas	1,033,956.11	therms	5,499.3
			Commercial energy total	**344,616**
Industrial energy	Electricity	4,772,288	kWh	5,401
	Natural gas	1,016,946.10	therms	5,397.4
			Industrial energy total	**10,798**
On-road transportation	Gasoline (passenger vehicles)	686,589,498.35	vehicle miles	284,591
	Diesel (passenger vehicles)	11,812,292.44	vehicle miles	6,530.2
	Diesel (freight trucks)	39,866,487.00	vehicle miles	65,447
Transit use	Diesel (Tri-Rail)	38,760.32	gallons	395.74
			Transportation total	**356,963**
Solid Waste	Waste Generated (processed at Methane-to-Energy Plant)	N/A –emissions calculated by receiving agency		17,913
			Solid waste total	**17,913**
Water and wastewater	Electricity – Wastewater Treatment Plant (Florida Power & Light)	30,038,592	kWh	9,200.2
	Electricity – Water Pumps (Florida Power & Light)	9,895,923.72	kWh	3,030.9
	Digester Gas Flared	35,543,000	standard cubic feet	115.60
	Digester Gas Combusted (used for boiler operations)	7,838,300	standard cubic feet	1.2065
	Nitrogen Discharge	437.24	kg N/day	449.2065
	Process Nitrous Oxide Emissions	0.354	metric tons	93.7
			Water and wastewater total	**12,773**
Fugitive	Natural Gas Leakage	6.5232	metric tons	182.65
			Fugitive total	**182.65**
			Total communitywide emissions	**982,054**

Figure 3 shows the distribution of communitywide emissions by sector. Transportation & mobile sources is the largest contributor, followed by commercial and residential energy.

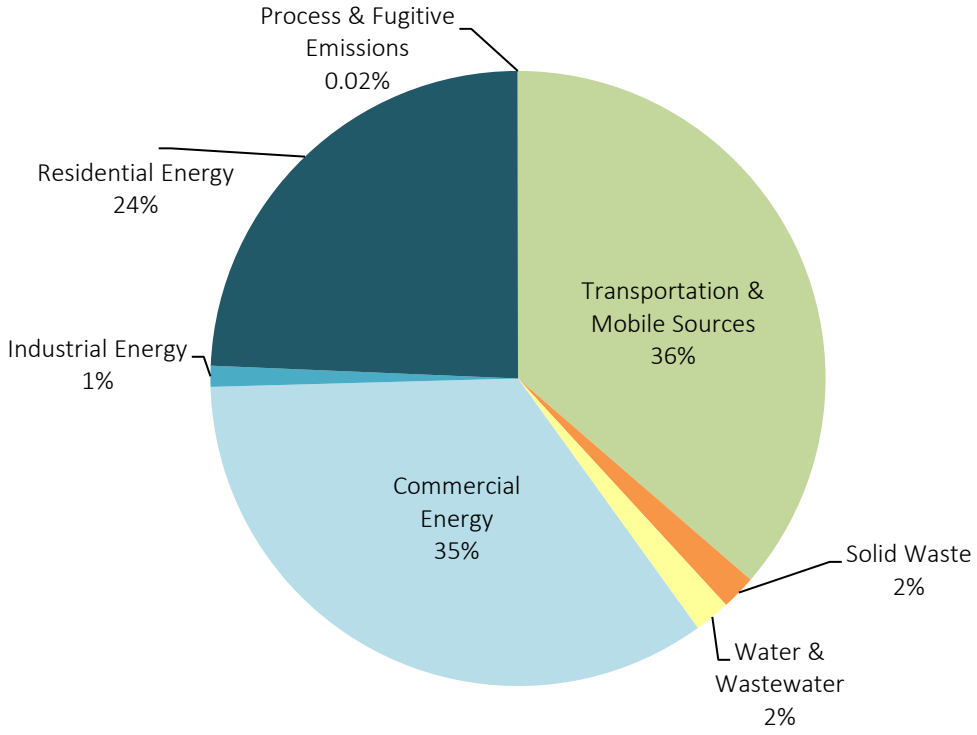


Figure 3 Communitywide Emissions by Sector

Next Steps

The inventory results 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:

- Reducing per-capita VMT through land use planning and encouraging use of transit, bicycling, and walking.
- Investment in infrastructure to improve safety and comfort for people on bikes and people walking such as separated bike lanes and sidewalks with canopy trees.
- Promotion of electric vehicles (EVs) to replace gasoline passenger vehicles through the provision of public spaces charging and through fleet policies to increase EVs in City fleet and familiarize staff with EVs
- Energy efficiency for residential and commercial buildings through building codes and incentives which mandate or incentivize green building credentials (e.g. LEED or similar) in new construction and major renovations as well as incentives for energy efficiency retrofits (such as weatherization and conversion to more efficient HVAC systems)
- Continued reductions in the electricity emissions factor by adding renewable energy by reducing soft costs to residential installation, encouraging commercial installation, adding on site renewables to City facilities, and engaging with Florida Power and Light to increase renewable energy in their fuel mix.

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 City of Boca Raton, will be helpful to complete a future inventory consistent with this one.

Government Operations Emissions Inventory Results

Government operations emissions for 2018 are shown in Table 3 and Figure 4.

Table 3 Local Government Emissions Inventory

Sector	Fuel or source	2018 Usage	Usage unit	2018 Emissions ($MTCO_2e$)
Buildings & Facilities	Electricity (Florida Power & Light)	151,595,486	kWh	46,431
			Buildings & Facilities total	**46,431**
Street Lights & Traffic Signals	Electricity (Florida Power & Light)	4,599,698	kWh	1,408.8
			Street Lights & Traffic Signals total	**1,408.8**
Vehicle Fleet	Gasoline (off-road)	1,721.2	gallons	15.24
	Diesel (off-road)	27,105.31	gallons	279.05
	Gasoline (on-road)	498,403.5	gallons	4,376
	Diesel (on-road)	240,293	gallons	2,453.4
			Transportation total	**7,123.7**
Employee Commute	Gasoline	11,348,382.35	vehicle miles	5,082.3
	Biodiesel/Ethanol	55,113.12	vehicle miles	20.15
	Electric	39366.52	vehicle miles	3.4
	Hybrid Gasoline	294,067.87	vehicle miles	115.8
	Plug-in Hybrid Electric	62,986.43	vehicle miles	23.03
			Solid waste total	**5,244**
Water and wastewater	Electricity – Wastewater Treatment Plant (Florida Power & Light)	44,174,400	kWh	13,530
	Electricity – Water Pumps (Florida Power & Light)	14,552,829	kWh	4,457.3
	Digester Gas Flared	52,269,000	standard cubic feet	170
	Digester Gas Combusted (used for boiler operations)	11,527,000	standard cubic feet	1.9
	Nitrogen Discharge	643	kg N/day	488.56
	Process Nitrogen Oxide Emissions	0.52	N_20	137.8
			Water and wastewater total	**18,785**
			Total government emissions	**78,990**

Figure 3 shows the distribution of emissions among the four sectors included in the inventory. Buildings and facilities represents the vast majority of emissions, followed by water and wastewater treatment, vehicle fleet, and employee commute. Public street lights/traffic signals account for a very small portion of emissions. Note that the emissions from water and wastewater are higher in the municipal inventory because Boca Raton operates a water

and wastewater treatment plant that serves customers outside the City's boundaries (32% of total customers), and that portion of activity is not included in the communitywide inventory.

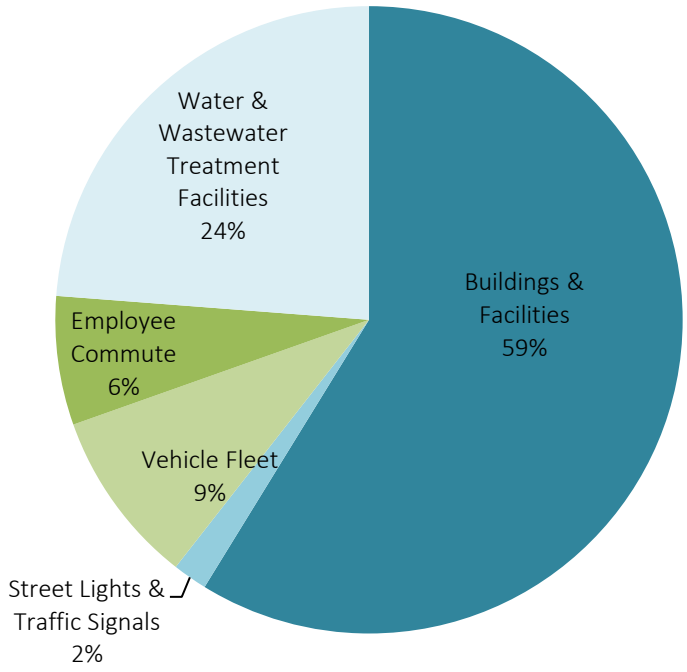


Figure 4 Local Government Operations Emissions by Sector

Next Steps

The local government operations emissions inventory points to a need for energy conservation, as energy use from buildings, facilities, street lights, and traffic signals account for 88% of emissions. The following are some steps that the City of Boca Raton can take to address energy use, many of which have already been identified in the City's Sustainability Action Plan (marked by an asterisk):

- Identify opportunities to retrofit City facilities for energy efficiency*
- Educate City staff on how to conserve energy and water*
- Certify as a SolSmart Gold Community*
- Create incentives and requirements for solar energy systems*
- Adopt requirements for new construction of City buildings that maximize energy efficiency (e.g. LEED criteria) and on-site energy production (e.g. solar)
- Identify opportunities for onsite energy production and energy retrofits on existing City buildings
- Install LEDs and auto shut-off lights in City buildings

Regarding emissions from vehicle fleet, the City can take the following steps to reduce vehicle-miles traveled in gasoline vehicles:

- Develop requirements for “right-sizing” the fleet and purchasing electric/hybrid vehicles as much as possible*
- Develop requirements for employee activities that involve using a vehicle, such as more efficient route design and efficient driving behavior. Utilize the GIS systems to identify behavior and policy modification options. Install systems that allow vehicles to use auxiliary systems without idling engines.
- Encourage staff to utilize virtual conferencing to replace in person off-site meetings as much as possible.

The City released an employee commute survey in late 2019, the results of which were used to estimate greenhouse gas emissions from miles traveled to and from work. The survey also asked employees questions about influences their decision to drive vs. take other forms of transit to work. The following are possible actions the City could take, all of which are informed by the survey responses:

- Facilitate a carpooling program that matches employees with each other based on commute route and work schedule. Over 30% of respondents said they would consider carpooling. Many respondents said they would be more likely to carpool if they could find other employees with whom to carpool.
- Offer a subsidy for commuters who choose to carpool, bike, or take transit. Many respondents said they would be more likely to carpool, bike, or take transit if there was a subsidy. This option may become particularly important when the Virgin USA/Brightline station opens in 2021.
- Start a Guaranteed Ride Home program that ensures employees will be able to get home if there is an emergency or an unexpected barrier to taking transit or carpooling home on any given day.
- Install more electric vehicle charging stations at all City buildings and develop a policy to allow for employees to charge personal vehicles. Many respondents said they would be more likely to purchase an electric vehicle if there was a charging station at their work site.
- Allow flexibility in work schedules for employees, if appropriate for their position and responsibilities, such as an alternative work schedule (4/10 or 9/80) and/or to telework a certain number of days per year. A majority of respondents said they would be interested in alternative or flexible scheduling. Several local cities (Hollywood, Hallandale Beach, Margate, etc.) have moved to a 4/10 schedule and have found reduced energy costs, reduction in the use of sick time, increased employee satisfactions, and increased ability to provide service to residents by offering service hours outside of a standard 9-5 schedule.

Forecasting Emissions

Using the 2018 communitywide inventory as a baseline, business-as-usual GHG emissions were forecasted to the year 2050 (Figure 5). "Business-as-usual" means that there is no action taken by the City of Boca Raton to reduce emissions.

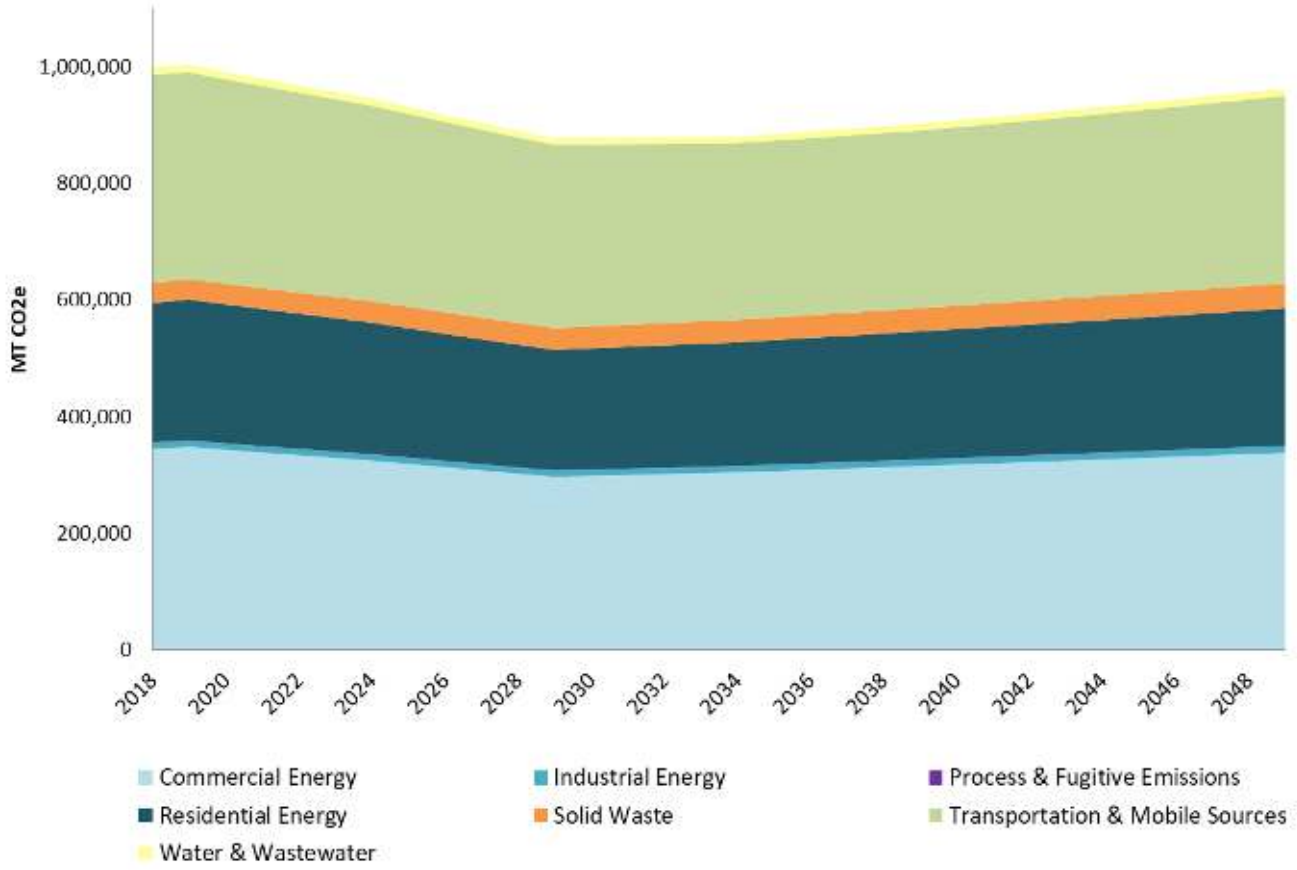


Figure 5 Business-As-Usual Emissions 2018-2050

The primary reason for the drop in emissions between 2018 and 2030 is Florida Power & Light's planned expansion of solar power generation[5], which will reduce the carbon intensity of electricity purchased within the City. However, despite the drop in carbon intensity, emissions will continue to rise due to population growth unless other action is taken by the City. See the Appendix for details on population growth rates and carbon intensity factors incorporated into the business-as-usual forecast.

[5] Florida Power & Light. 2019. Ten-Year Site Plan 2019-2028. https://www.fpl.com/company/pdf/10-year-site-plan.pdf

Reduction Targets

The business-as-usual forecast provides a baseline for establishing reduction targets. Comparing the reduction targets to the business-as-usual forecast demonstrates exactly how much emissions need to be reduced by the target year. In the Sustainability Action Plan, the City of Boca Raton established a reduction target of 15% from 2010 levels by 2025. Although a secondary target is yet to be adopted, an increasingly common practice is to adopt a net-zero emissions target by 2050, as recommended by the IPCC[6]. Figure 6 compares the business-as-usual forecast with a potential emissions reduction pathway towards both targets[7].

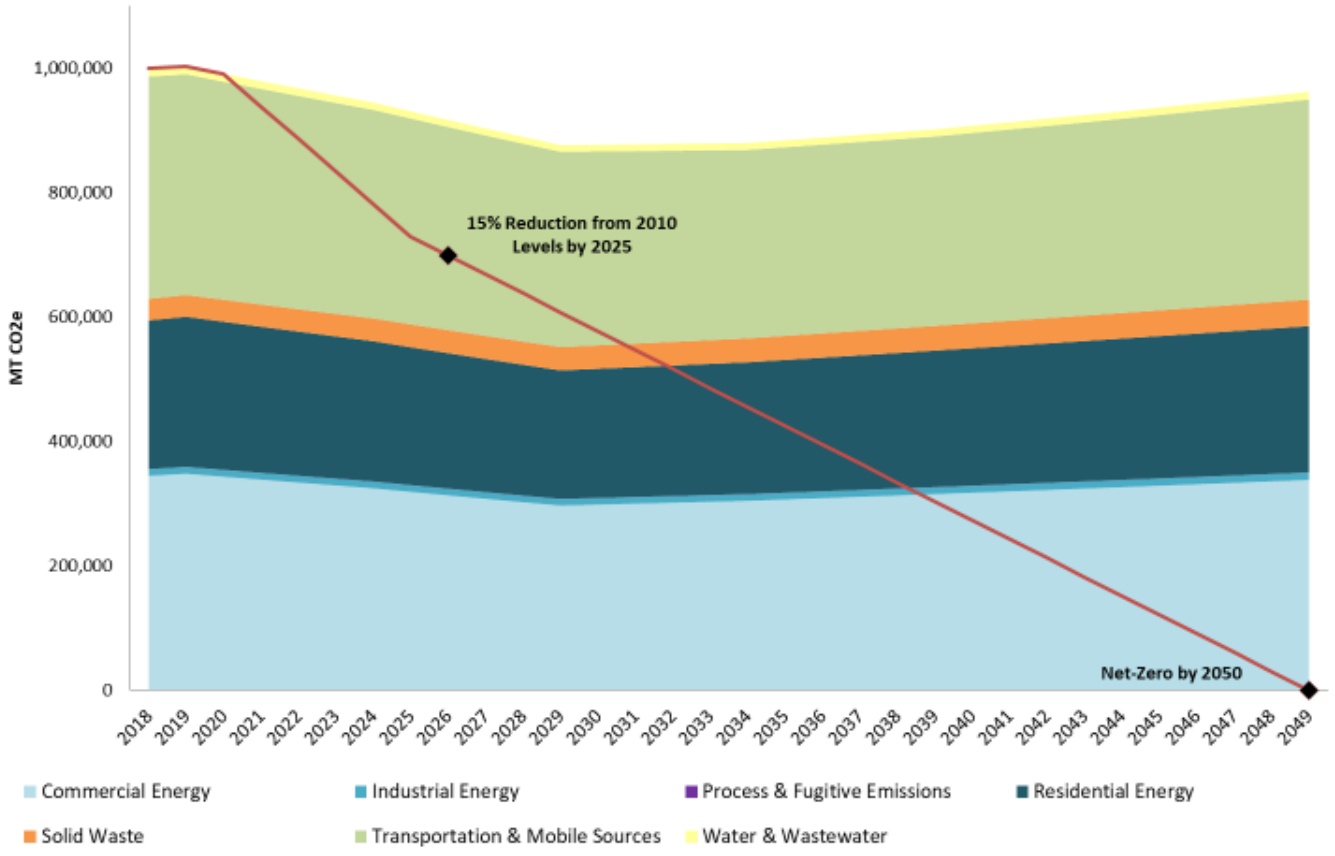


Figure 6 Potential Emissions Reduction Pathway for 2018-2050

[6] IPCC. 2018. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments. Retrieved from https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/

[7] No inventory was completed in 2010, so there is no calculated baseline for the 2025 target. 2010 emissions were estimated by applying the 2018 per-capita emissions to the 2010 population.

Conclusion

This inventory marks completion of Milestone One of the Five ICLEI Climate Mitigation Milestones. The City should build on this inventory and forecast by quantifying and prioritizing actions within the Sustainability Action Plan to meet the 2025 target. The City should also adopt a more aggressive target and strategy for 2050, such as the net-zero target recommended by IPCC. In addition, Boca Raton should continue to track key energy use and emissions indicators on an on-going basis. ICLEI recommends updating the inventory at least every five years to measure emissions reduction progress. Furthermore, ICLEI offers the Contribution Analysis tool, which will allow Boca Raton to more accurately determine what influences changes in emissions over time.

This inventory shows that energy use, particularly within the commercial sector and government operations, as well as communitywide transportation patterns will be particularly important on which to focus. The City's Sustainability Actions Plan includes actions which address commercial and residential energy use as well as transportation. In order to meet GHG reduction targets and effectively reduce emissions the City should focus efforts on policies, incentives, and education in these sectors. Transitioning City fleet to include more electric vehicles and implementing first and last mile solutions to link to current and planned rail lines are two high priority actions. Currently the City does not have a green building program for either City owned or private development. Making sure that new buildings incorporate energy efficiency by design is another high priority action as is facilitating a transition to solar energy.

The City is committed to climate action. In 2021 the City will have completed a climate change vulnerability assessment as part of a regional collaborative. The CCVA will guide the City on priority actions to adapt to future impacts of climate change. This GHG inventory is intended to help guide the City on the other half of the issue, mitigating the driving causes of climate change.

Appendix A: Inventory Methodology Details

Energy

The following table shows each activity related to energy consumption, data source, and notes on data gaps.

Table 4 Energy Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Residential, commercial, and industrial electricity consumption	Florida Power & Light	FPL provided emissions factors for CO_2[8]. FPL did not provide emissions factors for CH4 and N2O, so EPA's eGRID 2018[9] values were used for those gases. eGRID provides average emissions factors for the state. See table 5.
Residential, commercial, and industrial natural gas consumption	Florida Public Utilities	None
Residential fuel oil and propane	U.S. Energy Information Administration (residential fuel consumption) [10] U.S. Census American Community Survey (# households using each type of fuel) [11]	The latest available datasets for both EIA and the ACS are for the year 2017, which was used as a proxy for 2018. It can be assumed that the numbers have not changed significantly between those two years.
Local Government Operations		
Electricity consumption	Florida Power & Light	FPL provides a CO2 emissions factor, but did not provide emissions factors for CH4 and N2O, so EPA's eGRID 2018 values were used for those gases. eGRID provides average emissions factors for the state. See table 5.

[8] Florida Power & Light. By the Numbers. http://www.nexteraenergy.com/sustainability/overview/about-this-report/by-the-numbers.html

[9] EPA. Emissions & Generation Resource Integrated Database (eGRID); https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

[10] U.S. Energy Information Administration. 2017. State Energy Consumption Estimates: 1960 through 2017. Retrieved from https://www.eia.gov/state/seds/sep_use/notes/use_print.pdf Table CT4

[11] American Fact Finder. House Heating Fuel. Universe: Occupied Housing Units. 2017 American Community Survey Estimates. Retrieved from: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Natural gas consumption	N/A	Data not available and is likely to be very minimal.

Table 5 Emissions Factors for Electricity Consumption

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2018	943.3	68	9

Transportation

Table 6 Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide		
Vehicle miles travelled	Palm Beach Transportation Planning Agency (annual VMT) South Florida Regional Climate Compact (vehicle mix)	PBTPA's VMT data for Boca Raton is for 2015. Annual VMT was adjusted for 2018 population.
Transit ridership	Tri-Rail (onboardings per station, system mileage, train schedule, & number of trains per day). Department of Energy Alternative Fuels Data Center (light rail MPG)	Fuel usage was unavailable and had to be estimated. Tri-Rail provides total system mileage and # on-boardings at Boca Raton for the year 2018. Rail miles traveled was calculated by multiplying the number of trains per year by the total system mileage. Fuel use was estimated by multiplying rail miles traveled by the AFDC's average MPG for light rail. Boca Raton accounts for approximately 7.6% of ridership, using Tri-Rail data on on-boardings per station, which was multiplied by the annual rail miles traveled to get an approximate fuel usage allocated to Boca Raton.
Local Government Operations		
Government vehicle fleet	City of Boca Raton, Municipal Services	The data did not provide a breakdown specific vehicle types, but it did provide fuel use by fuel type. Thus, emissions are calculated correctly, but not separated by vehicle type.
Employee commute	Employee Commute Survey (vehicle miles traveled per fuel type)	Respondents were used as a sample to represent all employees (221 respondents is over 10%, which ICLEI considers a significant response). Assumed employees travel to work 290 days a year.

For vehicle transportation, 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.

Table 7 MPG and Emissions Factors by Vehicle Type[12]

Fuel	Vehicle type	MPG	CH4 g/mile	N2O g/mile
Gasoline	Passenger car	24.21489	0.0186	0.0093
Gasoline	Light truck	17.52427	0.0201	0.0167
Gasoline	Heavy truck	5.36	0.086	0.0664
Diesel	Passenger car	24.21489	0.005	0.001
Diesel	Light truck	17.52427	0.001	0.0015
Diesel	Heavy truck	6.224736	0.0051	0.0048

Wastewater and Water Treatment

Table 8 Wastewater & Water Treatment Data Sources

Activity	Data Source	Data Gaps/Assumptions
Communitywide & Local Government Operations		
Nitrogen Discharge	City of Boca Raton, Utilities Department	Boca Raton's wastewater treatment plant does not only serve Boca Raton residents/businesses (32% are outside City limits). Total emissions from wastewater treatment processes are accounted for under LGO, but only the community's portion (68%) is accounted for in the communitywide inventory. The U.S. Community Protocol Default for the industrial commercial discharge multiplier (1.25) was used to calculate nitrogen oxide emissions from wastewater treatment (Section WW.7).
Digester Gas Combustion/Flaring		
Electricity – Wastewater Treatment Plant		
Electricity – Water Pumps		
Nitrogen Discharge		
Process Nitrogen Oxide Emissions		

[12] These are standard defaults provided by ICLEI USA for many GHG inventories, and are derived from the following sources:

- Table 2.8 Motor Vehicle Mileage Fuel Consumption and Fuel Economy 1949-2010, https://www.eia.gov/totalenergy/data/annual/showtext.php?t=ptb0208;
- Freight Existing Trucks Fuel Efficiency Heavy Motor Gasoline Reference AEO2015, https://www.eia.gov/opendata/qb.php?category=1373322&sdid=AEO.2015.REF2015.EFI_NA_FGHT_RADS_MGS_NA_NA_MPG.A;
- Freight Existing Trucks Fuel Efficiency Heavy Diesel Phase 2 AEO2015, https://www.eia.gov/opendata/qb.php?sdid=AEO.2015.PHASEII.EFI_NA_FGHT_RADS_DSL_NA_NA_MPG.A; Table 4-23M:
- Average Fuel Efficiency of U.S. Light Duty Vehicles, Bureau of Transportation Statistics (2015).

Solid Waste

According to the Solid Waste Authority of Palm Beach County, all solid waste generated from the community and the local government in 2018 was sent to a methane-to-energy plant-- Palm Beach Renewable Energy Park (PBRE). No solid waste was landfilled. However, PBRE generates emissions, which the agency had already measured to meet EPA reporting requirements and provided to the City for this inventory. There are no available data on waste generation by local government facilities, so this was not included in the LGO inventory. It is assumed that these emissions would be insignificant, so the time-consumptive process of determining and applying a methodology to estimate local government waste generation was not prioritized.

Fugitive Emissions

Emissions from natural gas leakage were obtained from the EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT)[13]. These emissions were allocated to Boca Raton using the portion of total natural gas sold by Florida Public Utilities. Boca Raton's natural gas use represented 0.89% of total residential, commercial and industrial gas supplied by Florida Public Utilities in 2018.

Inventory Calculations

The 2018 inventory was calculated following the US Community Protocol and ICLEI's ClearPath software. As discussed in Inventory Methodology, the 5th IPCC Climate Assessment 100-year values 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 factor to calculate the final CO_2e emissions.

[13] EPA. 2018. EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT). Retrieved from https://ghgdata.epa.gov/ghgp/main.do

Appendix B: Business-As-Usual Forecast

The business-as-usual forecast was completed using Clearpath, the same software used for the inventory. Clearpath estimates future emissions up until year 2050 based on user-defined factor sets that can be applied to each sector. The three following factors were accounted for in the business-as-usual forecast.

1. Carbon intensity of purchased electricity from Florida Power & Light

Florida Power and Light's 10-year site plan includes the expansion of solar generation, which will reduce the percentage of purchased electricity generated by fossil fuels.

Table 9 2018 and 2028 Electricity Sources (FPL[14])

Electricity source	2018	2028
Solar	1.5%	14.5%
Nuclear	23%	23.2%
Fossil Fuels	76.9%	61%
Other (purchased)	-1.4%	1.3%

The carbon intensity factor is a rate of change applied to electricity emissions per year, which is calculated using the following steps:

i. Calculate the annual rate of change using the compound annual growth rate formula, with "0.769" (old percentage of fossil fuels) as the beginning value and "0.61" (new percentage of fossil fuels) as the ending value.

$$\mathrm{CAGR} = \left(\frac{V_{\mathrm{final}}}{V_{\mathrm{begin}}}\right)^{1/t} - 1$$

V_{begin}= beginning value
V_{final} = final value
t = time in years

$$= [(0.61/0.769)^{(1/10)}] - 1 = \mathbf{-0.023}$$

[14] Florida Power & Light. 2019. Ten-Year Site Plan 2019-2028. https://www.fpl.com/company/pdf/10-year-site-plan.pdf

ii. The result is -0.023, which presents a negative growth rate (i.e. a reduction rate). This rate was then applied to electricity emissions for each year from 2018 to 2028.

2. Carbon intensity of vehicles

Changes in the carbon intensity for each mile driven are expected to decrease due to Pavley I & II regulations, which influence the Corporate Average Fuel Economy (CAFE) standards. The following carbon intensity factors were pre-calculated by the EPA's OMEGA 1.4.1 Model[15], which is based on CAFE standards established in 2017 and previous CAFE standards representing the average mix of model years on the road. These carbon intensity factors were applied to the Transportation emissions forecast from 2018 to 2050.

Table 10 VMT Carbon Intensity Factors

Forecast Period	Carbon Intensity Factor (All Traffic)
2015-19	-0.017
2020-24	-0.020
2025-29	-0.018
2030-34	-0.012
2035-39	-0.006
2040-44	-0.002
2045-49	-0.001

3. Population growth rates

Population growth is the most significant factor influencing business-as-usual emissions, because a rising population means a rise in all activities generating emissions. Using forecasted population from the City of Boca Raton Development Services Department, the following growth rates were applied to all emissions sectors in the forecast from 2018 to 2050.

Table 11 Population Growth Rates

Forecast Period	Annual Growth Rate
2015-19	0.01
2020-24	0.009
2025-29	0.005
2030-34	0.005
2035-39	0.007
2040-44	0.007
2045-49	0.007

[15] EPA. 2018. Optimization Model for Reducing Emissions of Greenhouse Gases from Automobiles (OMEGA). Retrieved from: https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases#omega-1.4.1