

FY 2018

Greenhouse Gas Emissions
2018 INVENTORY

Charleston
SOUTH CAROLINA

PUBLISHED AUGUST 2020

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CONTENTS

INTRODUCTION	4
Overview.....	4
Community Indicators.....	4
KEY FINDINGS.....	5
Overall Emissions	5
Chapter 1: CITYWIDE INVENTORY	6
2018 Citywide Inventory.....	6
Comparison Between Inventories.....	8
Chapter 2: GOVERNMENT INVENTORY.....	10
2018 Government Inventory.....	10
Comparison Between Inventories.....	12
CONCLUSION	14
Next Steps.....	14
Public Input Opportunities	14
APPENDIX	15
Factor Sets.....	15
Methodology	15

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- **Energy:** Berkeley Electric Cooperative and Dominion Energy
- **Other:** S.C. Department of Health and Environmental Control- BAQ- Emissions Inventory Section
- **Transportation:** Berkeley-Charleston-Dorchester Council of Governments (BCDCOG), City of Charleston Department of Public Service- Fleet Maintenance, City of Charleston Fire Department, City of Charleston Police Department, and City of Charleston Department of Human Resources
- **Waste:** City of Charleston Department of Public Service- Environmental Services
- **Wastewater:** Charleston Water System

This report was completed in August 2020 by the City of Charleston Sustainability Division, part of the Mayor's Office of Resilience and Emergency Management. Thank you to the Resiliency and Sustainability Advisory Committee for support and assistance, especially Stewart Weinberg.

INTRODUCTION

OVERVIEW

The City of Charleston continues to experience first-hand impacts of climate change and is determined to reduce greenhouse gas (GHG) emissions. As a proud signatory of Climate Mayors, the City has committed to reducing emissions 80% by 2050, relative to 2002 baseline emissions.

In order to track progress on this goal, the City performs periodic greenhouse gas inventories.

Charleston has completed multiple inventories over the years, including 2002, 2006, and 2010. This report outlines data for the year 2018 and how the results compare with the City's 2002 baseline year and other past inventories.

Two inventories are conducted to evaluate greenhouse gas emissions and determine Charleston's footprint.

- 1. Citywide Inventory:** This inventory expands to the entire city limits of Charleston. It is often called a "community inventory" as it represents emissions from activities throughout the entire City of Charleston community.
- 2. Government Inventory:** This inventory is specific to City government operations only, such as City vehicle fleet and City government buildings. As City government operations primarily occur within City limits, these emissions are also included as part of the overall citywide inventory.

COMMUNITY INDICATORS

Table 1 shows how the community has changed over time. Charleston has seen an up-tick in population and economic activity. The reduced heating degree days and increased cooling degree days from 2002 to 2018, albeit minor, do correlate to a warming climate.

TABLE 1: CHANGES IN COMMUNITY INDICATORS

COMMUNITY INDICATOR	2002 (BASELINE)	2006	2010	2018	CHANGE SINCE 2002 BASELINE
POPULATION (City of Charleston Department of Planning)	98,795	107,845	120,083	148,143	+ 50%
GROSS DOMESTIC PRODUCT (Open Data Network)	\$40.5 M	\$43.3 M	\$41.6 M	\$46.9 M	+ 15%
COOLING DEGREE DAYS (National Weather Service)	2,567	2,370	2,706	2,920	+ 14%
HEATING DEGREE DAYS (National Weather Service)	1,784	1,743	2,118	1,696	- 5%

WHY ARE GREENHOUSE GASES (GHG) IMPORTANT?

Greenhouse gases trap heat in our atmosphere. i.e. carbon dioxide and methane.

This buildup of gases acts like a blanket around the earth that traps heat, leading to long term warming, which disrupts the climate.

As a prime example, when humans burn fossil fuels for energy, we add more and more greenhouse gases into the atmosphere, thickening "the blanket".

WHY MEASURE?

Measuring emissions helps us to track our progress and identify new opportunities to lessen our contribution to climate change.

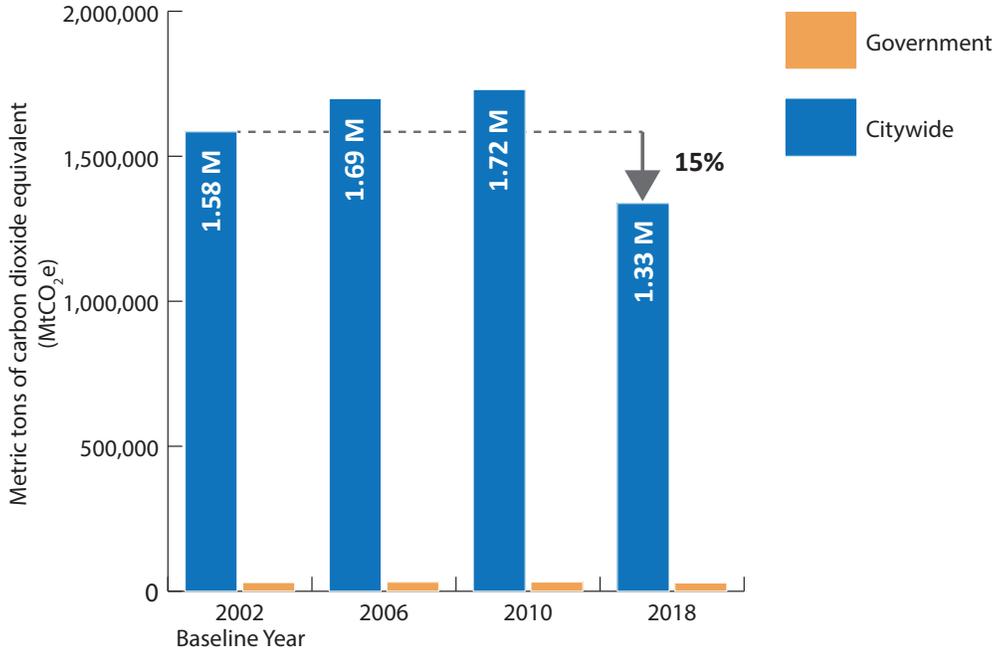
MEASURE FROM WHAT YEAR?

2002 is the baseline year, meaning metrics on goals reflect progress from that year's inventory.

KEY FINDINGS

OVERALL EMISSIONS

FIGURE 1: CITYWIDE VS. GOVERNMENT ANNUAL GHG EMISSIONS



Since 2002, the baseline year, greenhouse gas **emissions in Charleston citywide have decreased approximately 15%** to 1,337,254 metric tons of carbon dioxide equivalent (MtCO₂e) despite significant increases in economic activity, jobs and population.

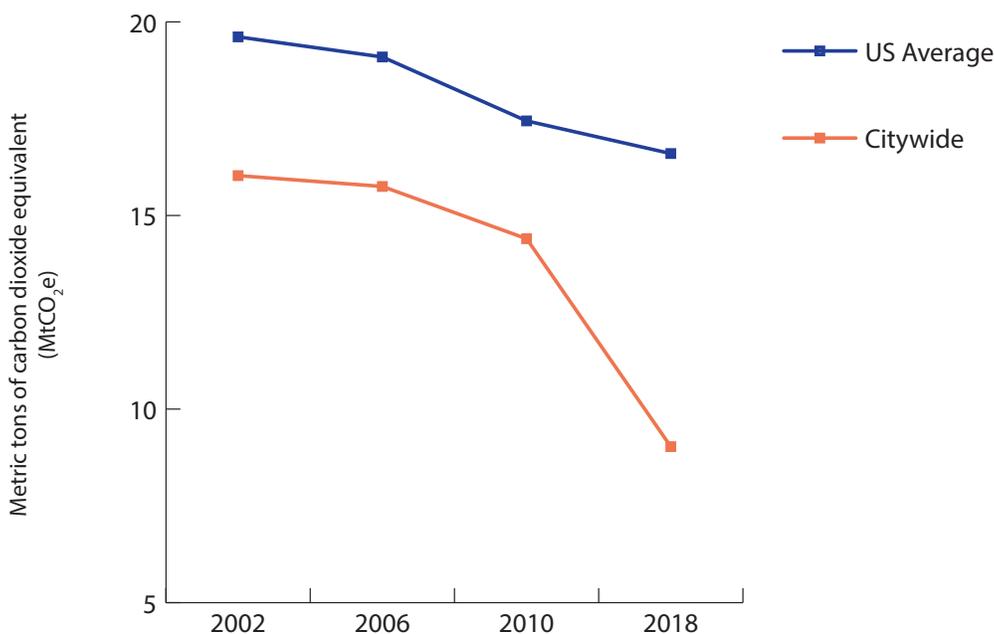
Government emissions account for only 2% of citywide emissions, and have decreased about 5% to 28,568 MtCO₂e from 2002 to 2018.

While both inventories demonstrate progress towards achieving lower emissions, there is still more work to be done.

Per capita emissions for the average Charleston resident in 2018 have decreased 44% to 9.03 MtCO₂e since 2002. A significant reduction in emissions per capita is due to overall lower emissions in addition to an increase in total City population.

This per capita is well below the per capita emissions rate for the average US resident, which in 2018 is 16.6 MtCO₂e per The World Bank and World Resources Institute.

FIGURE 2: CITYWIDE ANNUAL GHG EMISSIONS PER CAPITA



2018 CITYWIDE INVENTORY

BUILDINGS

65% of emissions citywide are from buildings. The commercial sector has the largest percentage, at nearly 58%, followed by the residential sector at 40%. 80% of the energy used in buildings comes from electricity, while 20% is powered by natural gas.

Dominion Energy furnished energy data for buildings citywide in three categories, those marked commercial/industrial were entered as commercial. All data is from revenue districts found within the City of Charleston. Berkeley Electric Cooperative provided data for residential (which includes houses of worship) and commercial (which includes schools) usage- they do not have industrial accounts.

TRANSPORTATION

Transportation is still the second largest emitter accounting for 25% of citywide emissions at 337,618 MtCO₂e. Along with population growth, transportation use has likely increased too, but so to has the efficiency of vehicles.

This data was collected differently in 2018 as the BCDCOG has since built jurisdictions into the road centerline data in their modeling software and are now able to get a more accurate number. The data is not tracked annually, so an average figure for annual Vehicle Miles Traveled (VMT) of 2015 actuals and 2020 estimates was computed, which equaled 992,904,394 for automobiles, and 93,216,273 for trucks.

WASTE

Waste accounts for 6% of citywide emissions at 84,697 MtCO₂e. Life-cycle costs are not included in this calculation, i.e. the footprint to design, build and transport a product.

This data is from the City's Department of Public Service and includes both garbage and trash pickup from City haulers and from two private haulers that are contracted to assist with services in Outer West Ashley (Carolina Waste) and Daniel Island (Republic Services). There are no longer any incinerators used for citywide waste.

OTHER

This category is primarily used for industrial direct emission sources. This data is from SCDHEC and is 2017 carbon dioxide and methane emissions for the larger facilities in Charleston that have Title V air operating permits. Smaller facilities are not required to send in an emission inventory.

FIGURE 3: CITYWIDE 2018 GHG EMISSIONS FROM BUILDINGS

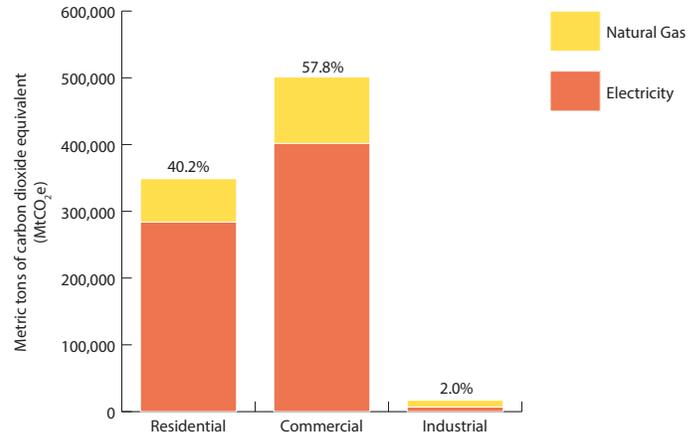


FIGURE 4: CITYWIDE 2018 GHG EMISSIONS FROM TRANSPORTATION

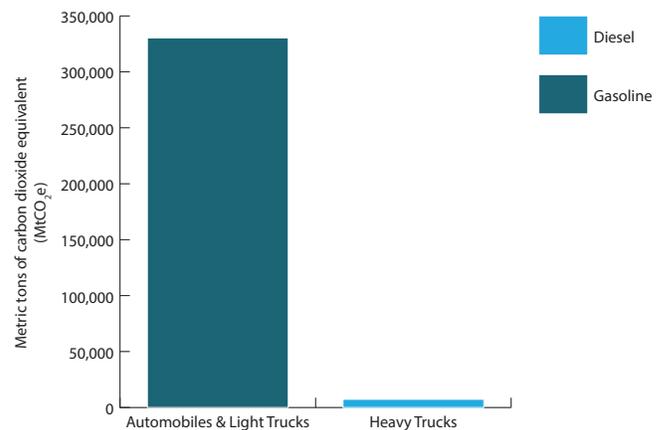
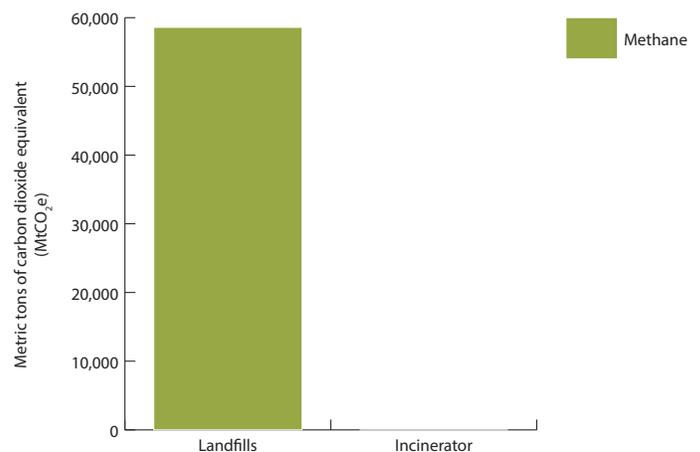


FIGURE 5: CITYWIDE 2018 GHG EMISSIONS FROM WASTE



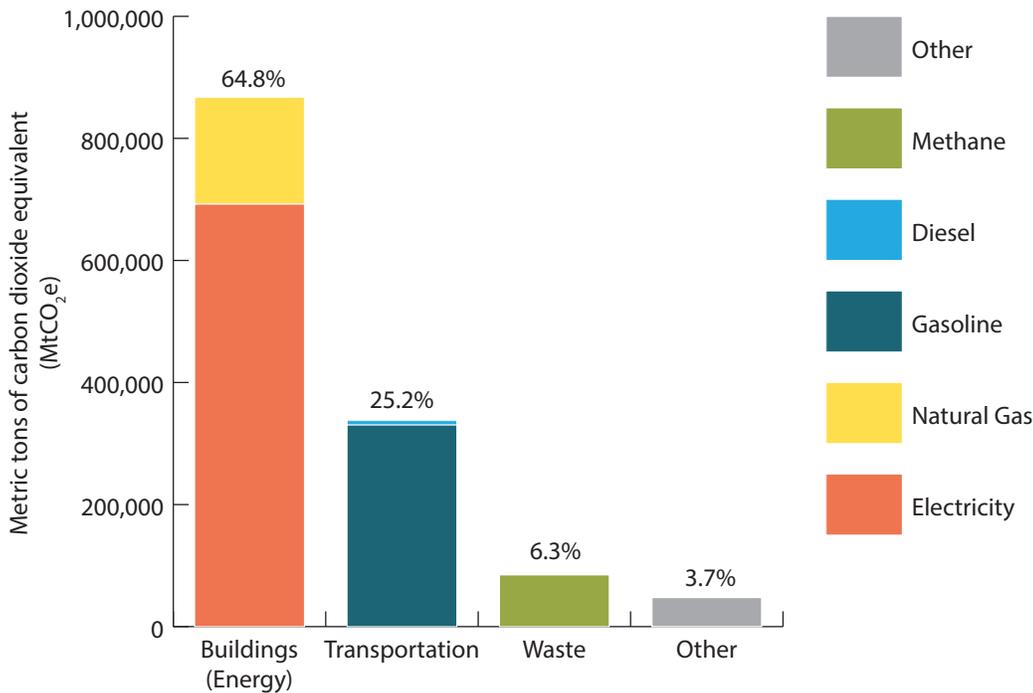
Citywide Emissions are tracked within four distinct sectors:

- 1. Buildings** includes energy use in residential, commercial, government, and industrial buildings.
- 2. Transportation** includes emissions from cars, motorcycles, and trucks, but not boats, ships, planes or rail, whose contributions could not easily be estimated.
- 3. Waste** includes landfill emissions from residential, commercial, and government waste picked up by City haulers.
- 4. Other** includes direct emissions from industries that are not fully captured by the above categories. Life-cycle emissions from products and services consumed could not be easily estimated and are not included.

In 2018, the total emissions citywide were 1,337,254 MtCO₂e.

Buildings accounted for nearly 65% of citywide emissions at 867,200 MtCO₂e and remain the largest sector of pollution citywide.

FIGURE 6: CITYWIDE 2018 GHG EMISSIONS BY SECTOR AND SOURCE



WHAT UNITS ARE EMISSIONS MEASURED IN?

For simplicity and ease of comparison, all emissions were converted to the same units.

In this way, greenhouse gas emissions from electricity generation, natural gas combustion, vehicle emissions, etc. are all measured in metric tons of carbon dioxide equivalent (MtCO₂e).

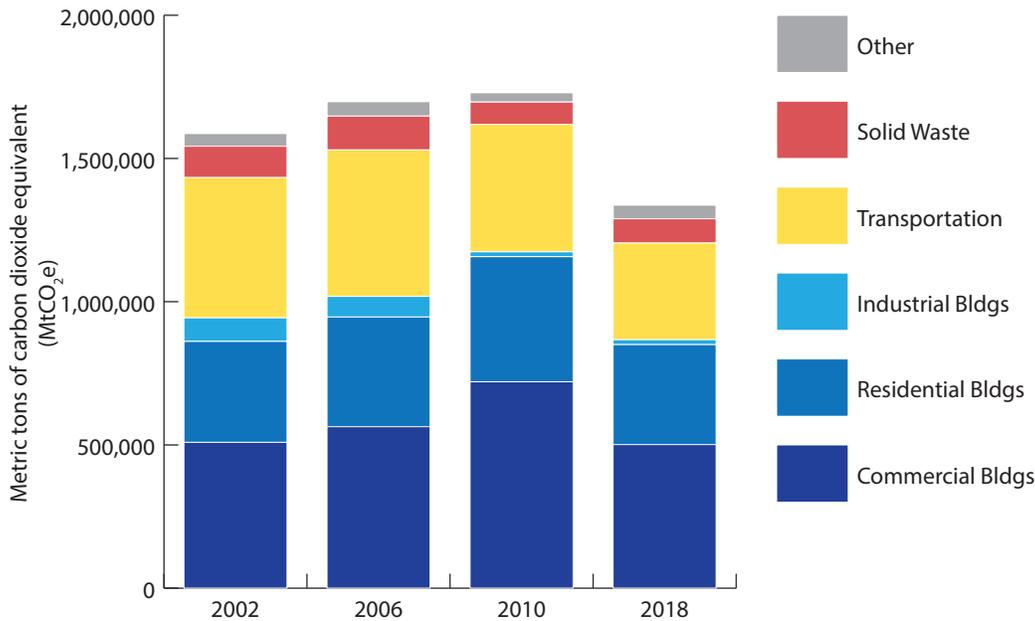
Using CO₂ equivalents for all measurements allows us to easily measure the impact of unrelated activities, such as a comparison of greenhouse gas reductions achieved from increasing fuel efficiency versus composting.

MtCO₂e = metric tons of carbon dioxide equivalent

mMtCO₂e = million metric tons of carbon dioxide equivalent

COMPARISON BETWEEN INVENTORIES

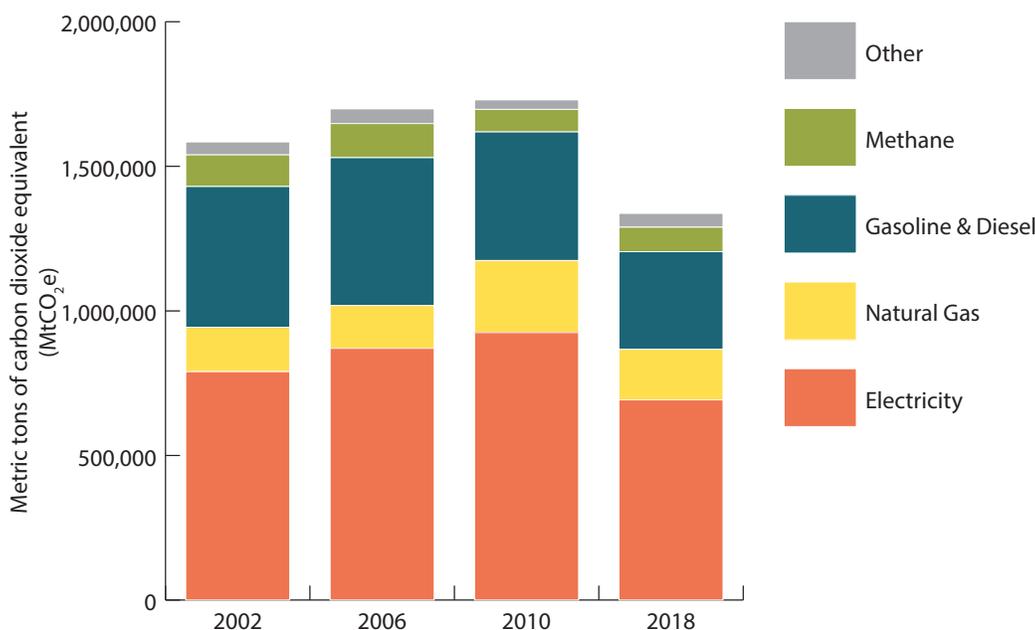
FIGURE 7: CITYWIDE ANNUAL GHG EMISSIONS BY SECTOR



Since 2002, (baseline year) total citywide emissions have decreased 15% to 1,337,254 MtCO₂e, despite an increase in population and economic activity.

While energy from buildings continues to release the most greenhouse gases citywide (65%), emissions from this sector have actually decreased from 2002 to 2018. Table 3 shows increases in activity use which are expected with a growing population, economy and an increase in cooling degree days as seen in Table 1. Energy efficiency and a cleaner fuel mix used to produce electricity help explain decreases in emissions. Sources of energy in buildings include grid electricity and natural gas.

FIGURE 8: CITYWIDE ANNUAL GHG EMISSIONS BY SOURCE



The second largest sector remains transportation, with the sources of fuel being gasoline and diesel. Transportation shows an unusual decrease in emissions over time despite the population growth. This could be due to a combination of more efficient vehicles on the road, and a change in the way this data was collected as now there is more accurate jurisdictional data available to use that did not exist in the past.

Waste, associated with methane, and other direct industrial emissions, remain the smallest sectors. This data is also collected differently and more accurately in 2018.

TABLE 2: CITYWIDE ANNUAL GHG EMISSIONS BY SECTOR (MtCO₂e)

CITYWIDE SECTOR	2002 (BASELINE)	2006	2010	2018	CHANGE SINCE 2002 BASELINE
RESIDENTIAL-ELECTRICITY	300,614	332,322	372,745	283,867	- 6%
RESIDENTIAL-NATURAL GAS	51,816	50,598	63,971	65,054	+ 26%
COMMERCIAL-ELECTRICITY	478,513	532,414	546,614	401,605	- 16%
COMMERCIAL-NATURAL GAS	30,465	31,205	173,821	99,574	+ 227%
INDUSTRIAL-ELECTRICITY	10,659	5,799	5,697	6,735	- 37%
INDUSTRIAL-NATURAL GAS	71,457	66,164	11,298	10,365	- 85%
TRANSPORTATION	486,621	511,409	444,713	337,618	- 31%
SOLID WASTE	109,294	117,959	77,939	84,697	- 23%
OTHER- DIRECT INDUSTRIAL	44,705	50,797	32,984	47,739	+ 7%
TOTAL MtCO₂e	1,584,144	1,698,667	1,729,782	1,337,254	- 16%

TABLE 3: CITYWIDE ANNUAL ACTIVITY USE BY SECTOR

CITYWIDE SECTOR	2002 (BASELINE)	2006	2010	2018	CHANGE SINCE 2002 BASELINE
RESIDENTIAL-ELECTRICITY (kWh)	575,177,038	642,224,135	720,344,617	837,147,695	+ 46%
RESIDENTIAL-NATURAL GAS (therms)	9,742,363	9,513,225	12,027,742	12,231,261	+ 26%
COMMERCIAL-ELECTRICITY (kWh)	915,557,426	1,028,910,800	1,056,352,954	1,184,366,403	+ 29%
COMMERCIAL-NATURAL GAS (therms)	5,727,938	5,867,111	32,681,418	18,721,668	+226%
INDUSTRIAL-ELECTRICITY (kWh)	20,393,373	11,207,225	11,009,099	19,860,926	- 3%
INDUSTRIAL-NATURAL GAS (therms)	13,463,552	12,466,223	2,128,643	1,952,913	- 85%
TRANSPORTATION - GASOLINE (VMT)	1,300,060,000	1,396,330,000	1,304,480,000	992,904,394	-17%
TRANSPORTATION - DIESEL (VMT)				93,216,273	
SOLID WASTE (tons)	75,964	81,592	53,910	58,585	-23%



YOU CAN HELP! Reducing emissions is a community-wide challenge and requires everyone to do their part. Sign the City of Charleston's Climate Action Pledge and commit to doing your part towards a community-wide climate solution! Visit www.charleston-sc.gov/sustainability to sign the pledge and discover opportunities to reduce your carbon footprint.

ARE ALL GREENHOUSE GASES EQUAL?

Some gases are more effective than others at making the planet warmer and "thickening the earth's blanket".

Two key ways are their efficiency absorbing energy and how long they remain in the atmosphere. Gases with a higher **global warming potential** (GWP) absorb more energy, per pound and thus contribute more to warming the earth.

For example, N₂O emitted today remains in the atmosphere for more than 100 years, on average- this longevity contributes to its GWP.

Carbon Dioxide (CO₂)
GWP = 1

Methane (CH₄)
GWP = 28

Nitrous Oxide (N₂O)
GWP = 265

(Source: IPCC 5th Assessment)

2018 GOVERNMENT INVENTORY

Government Emissions are tracked within four distinct sectors:

- 1. City buildings** include all City offices and facilities and their associated lighting, such as ball field and parking lights.
- 2. Street lights** include light poles that line our streets.
- 3. Fleet** includes all vehicles in the City fleet, such as cars, trucks, and major construction equipment. This figure includes police and fire public safety vehicles too.
- 4. Employee commute** includes employee transportation to and from work.

In 2018, the total emissions from government operations were 28,568 MtCO₂e.

Government emissions are calculated into the citywide emissions metrics, and make up 2% of the total citywide emissions in 2018.

BUILDINGS

In 2018, City buildings and facilities (including traffic lights) accounted for nearly 42% of emissions, emitting 11,885 MtCO₂e. While buildings continue to be the largest driver of emissions, this sector has decreased 26% from 2002, despite an increase in square footage of City facilities.

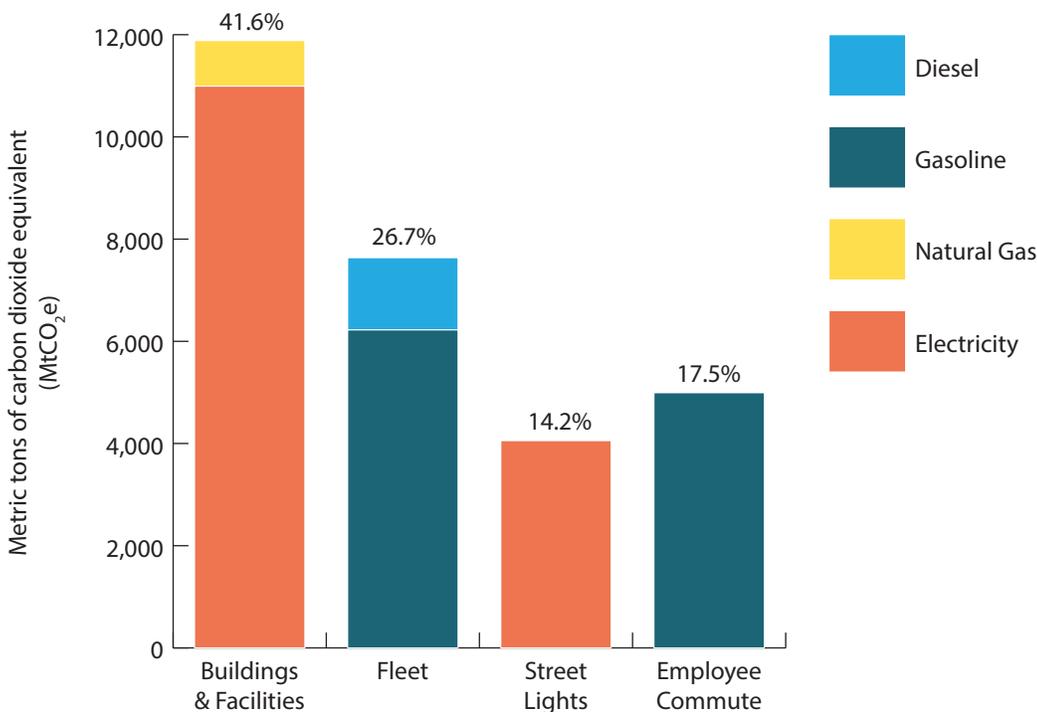
This data was gathered from Dominion Energy who manages all accounts for City operations.

FLEET

The City fleet accounted for 27% of government emissions at 7,635 MtCO₂e.

This data was collected from the three City of Charleston departments who oversee the fleet: Charleston Police Department, Charleston Fire Department, and the Charleston Department of Public Service- Fleet Management Division.

FIGURE 9: GOVERNMENT 2018 GHG EMISSIONS BY SECTOR AND SOURCE



STREET LIGHTS

Street lights remain relatively flat and account for about 14% of government emissions at 4,055 MtCO₂e.

This data was gathered from Dominion Energy.

EMPLOYEE COMMUTE

The employee commute of City staff accounted for 18% of government emissions at 4,993 MtCO₂e. The average full year staff for 2018 was 1,691 employees per the City's Human Resources Department.

This data was extrapolated from adjusting the 2010 data to account for an increase in staff.

WATER AND SEWAGE

Charleston Water System is a private entity and the City does not have jurisdiction over it. Their electricity consumption data is included in the citywide inventory. In addition, Charleston Water System does not operate incinerators nor digesters.

WASTE

Waste from government operations are not easily monitored separate from the entire community, so this information is included in the citywide inventory.

WHAT IS THE IPCC?

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for objectively assessing the science related to climate change.

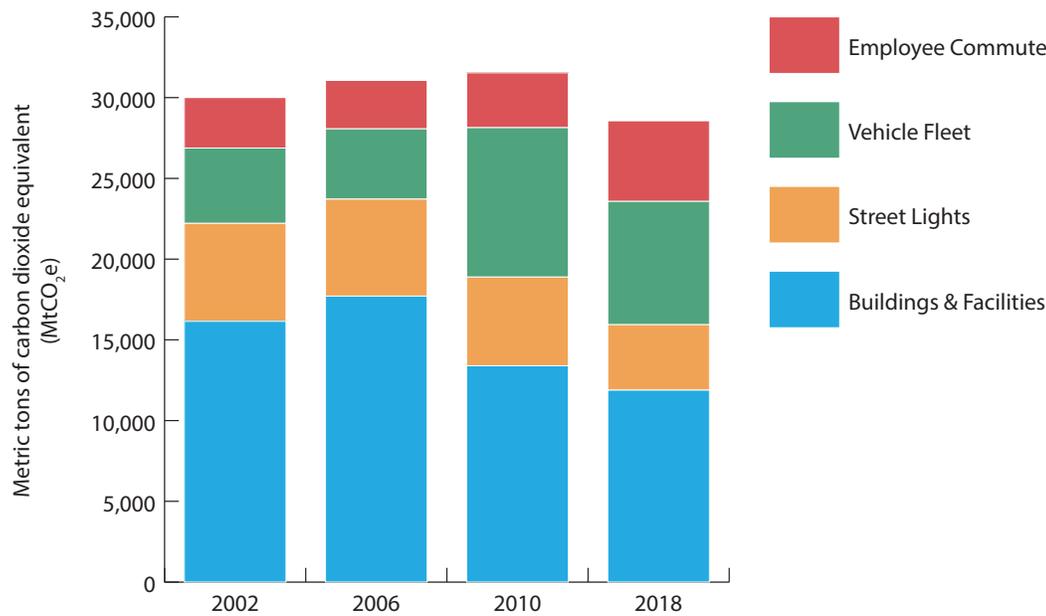
WHY DO SOME METRICS IN THIS REPORT DIFFER FROM THE GREEN PLAN?

Emissions data in the 2010 Green Plan was based on older IPCC 2nd Assessment criteria, standard at the time.

The data has been updated in this report to reflect the current IPCC 5th Assessment to ensure the most accurate apples to apples comparison over time.

COMPARISON BETWEEN INVENTORIES

FIGURE 10: GOVERNMENT ANNUAL GHG EMISSIONS BY SECTOR



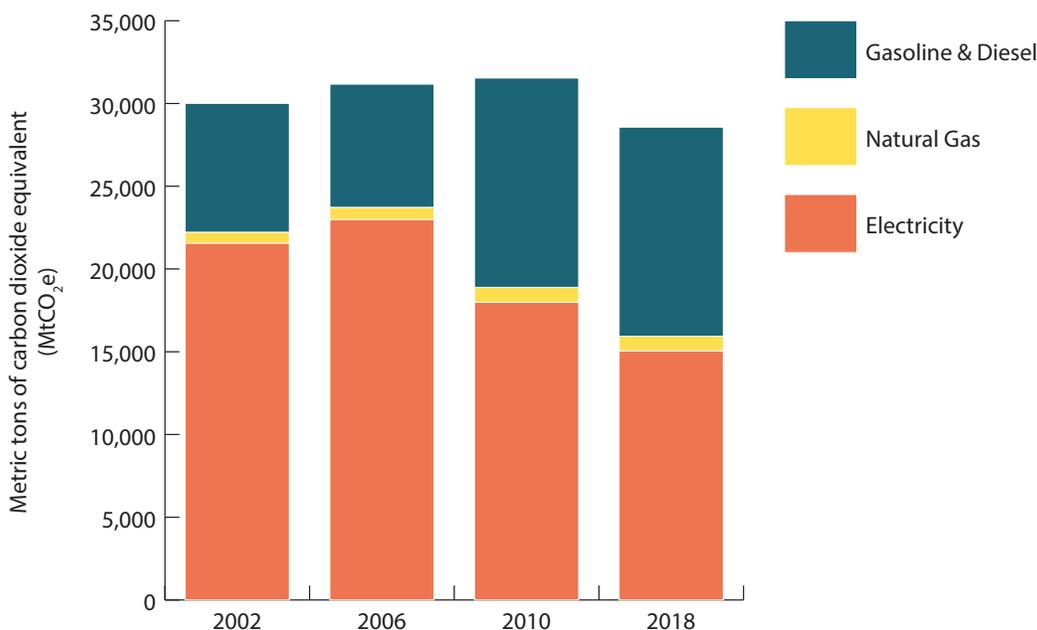
Since 2002, emissions have decreased 5% to 28,568 MtCO₂e.

There is a 26% decrease in emissions from City buildings. This is likely due to a combination of a cleaner electrical grid and from the City's commitment to prioritize energy efficiency to ensure buildings and facilities are performing as efficiently as possible and not wasting energy.

Also relevant, the City's square footage of buildings and facilities has increased greatly since 2002, such as constructing new fire stations, and the expansion of the Gaillard Center.

Streetlight emissions have remained relatively flat. 2002 data was unclear so the 2006 estimate was used as a placeholder.

FIGURE 11: GOVERNMENT ANNUAL GHG EMISSIONS BY SOURCE



Over time, emissions from electricity have decreased while natural gas emissions have remained relatively flat.

Gasoline and diesel emissions have increased as both the number of City employees has increased (increasing emissions from employee commute), and the City vehicular Fleet has increased, in response to the greater number of employees.

The increases are seen in gasoline and diesel which are vehicle based, and the decreases are seen in electricity.

TABLE 4: GOVERNMENT ANNUAL GHG EMISSIONS BY SECTOR (MtCO₂e)

GOVERNMENT SECTOR	2002 (BASELINE)	2006	2010	2018	CHANGE SINCE 2002 BASELINE
BUILDINGS-ELECTRICITY	15,481	16,974	12,495	10,992	- 29%
BUILDINGS-NATURAL GAS	666	735	900	893	+ 34%
STREET LIGHTS-ELECTRICITY	6,066	6,006	5,493	4,055	- 33%
VEHICLE FLEET	4,666	4,352	9,252	7,635	+ 64%
EMPLOYEE COMMUTE	3,127	3,102	3,398	4,993	+ 60%
TOTAL MtCO₂e	30,006	31,168	31,538	28,568	- 5%

TABLE 5: GOVERNMENT ANNUAL ACTIVITY USE BY SECTOR

GOVERNMENT SECTOR	2002 (BASELINE)	2006	2010	2018	CHANGE SINCE 2002 BASELINE
BUILDINGS-ELECTRICITY (kWh)	29,620,139	32,802,841	24,147,475	32,415,130	+ 9%
BUILDINGS-NATURAL GAS (therms)	125,306.85	138,183	169,212	167,974	+ 34%
STREET LIGHTS-ELECTRICITY (kWh)		11,606,745	10,615,368	11,958,442	
VEHICLE FLEET-GASOLINE (gallons)	197,004	195,022		708,642	+ 259%
VEHICLE FLEET-DIESEL (gallons)	287,597	258,494		138,384	- 52%
EMPLOYEE COMMUTE-Gasoline (VMT)	8,353,558	7,549,288	5,574,524	7,251,169	-13%
EMPLOYEE COMMUTE- DIESEL (VMT)	150.77	617,073			

UNCERTAINTY

While tracking emissions is really helpful, it is important to note that any greenhouse gas inventory is still an estimate and uncertainty exists in data collection, aggregation and the calculation of emissions.

Many different sources of data are being combined to formulate the emissions estimate and often times the way data is collected can vary year by year.

CONCLUSION

NEXT STEPS

While progress towards reducing emissions is evident, there is still more work to be done. Meaningful climate action starts with having an adopted action plan and following through with implementation. This greenhouse gas inventory is a key first step towards taking climate action, which is important because climate change poses a threat to our infrastructure, public health and well being.

Results from this inventory will be analyzed and turned into meaningful action items as part of a climate action planning process. The process will also include reevaluating goals and is estimated to be completed in winter 2020-21.

A key goal of the planning process will be to create a strategy outlining climate mitigation action items that will be supported by the community and approved by City Council for implementation.

To get there, Charlestonians are invited to participate in an inclusive public input process to help create an equitable action plan representative of the community's interests.

Participation from a diverse group of people including residents, business owners, faith-based groups, academia, elected officials, and special interest groups are integral to creating this action plan! Key participation groups include:

- **Resiliency and Sustainability Advisory Committee**
A committee of City Council, this group will guide the overall climate action planning process and create a public platform for valuable feedback throughout the development of the strategy. This committee makes recommendations to City Council for consideration.
- **Climate Action Taskforce**
This team is responsible for ultimately creating the new climate action plan based on feedback from the public, subcommittees and the Resiliency and Sustainability Advisory Committee. This team will create the scope of the new strategy and will make recommendations to the Resiliency and Sustainability Advisory Committee.
- **Subcommittees**
These small teams will support the Climate Action Taskforce by focusing on subject areas in a high level of detail. Subject matter experts will take deeper dives into specific focus areas to discuss and evaluate the impact and feasibility of potential action items. Teams will make recommendations to the Climate Action Taskforce.

- **Public Input** will be vital to the success of the climate action planning process and will be incorporated both inside and outside the committee levels. Below are some methods to get involved.

PUBLIC INPUT OPPORTUNITIES

- 1. Participate in an input session meeting.**
Community meetings will be held to gather input for the climate action planning process. Due to COVID-19 health concerns, these meetings will be held virtually during fall 2020. Session dates will be posted online at www.charleston-sc.gov/sustainability.
- 2. Complete climate action planning surveys.**
Available surveys will be posted online throughout fall 2020 at www.charleston-sc.gov/sustainability. Surveys may be submitted online, or via email or mail.
- 3. Attend Resiliency and Sustainability Advisory Committee meetings.**
Listen to the committee's discussions and provide your feedback during the public comment period. Meeting dates are posted online at www.charleston-sc.gov/RSAC.
- 4. Contact the City's Sustainability Division.**
Submit comments or reach out via phone, email or mail. Contact information is posted online at www.charleston-sc.gov/sustainability.
- 5. Reach out to City Council members.**
Contact your representative and other members too directly via phone, email or mail. Contact information is posted on the City's main website.
- 6. Volunteer on a taskforce or subcommittee.**



YOU CAN HELP!

Get involved in the climate action process and help shape your community's actions!

APPENDIX

FACTOR SETS

TABLE 6: CHANGES IN EMISSIONS FACTORS

GRID ELECTRICITY	2002	2018
CO ₂ lbs / mWh	1146.39	743.328
CH ₄ lbs / gWh	29	67
N ₂ O lbs / gWh	19	9
TRANSPORTATION		
Gas passenger vehicle fuel economy (MPG)	21.9	24.2148
Gas Passenger Vehicle CH ₄ / mile	0.0496	0.0186
Gas Passenger Vehicle N ₂ O / mile	0.0513	0.0093
WASTE		
Percentage Mixed MSW	37.06	37.06
Percentage Newspaper	0.2575	0.2575
Percentage Office Paper	0.2575	0.2575
Percentage Corrugated Cardboard	0.2575	0.2575
Percentage Magazines / Third Class Mail	0.2575	0.2575
Percentage Food Scraps	20.88	20.88
Percentage Grass	13.676	13.676
Percentage Leaves	13.676	13.676
Percentage Branches	13.676	13.676

METHODOLOGY

The 2018 citywide inventory was completed using the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC).

Whereas, emissions in the 2018 government inventory were calculated and reported per the Local Government Operations Protocol (LGOP). The inventories were performed using ICLEI's Clearpath tool.

WHAT ARE FACTOR SETS?

Emissions factors provide the basis for the carbon footprint calculation and can vary by year.

For example, as the fuel mix to produce electricity becomes cleaner (largely from phasing out coal plants and adding renewable energy production), emissions are reduced from electricity consumption.

This cleaner grid is taken into account as part of the factor set.