MID-OHIO REGIONAL
MORPC
PLANNING COMMISSION

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2019 CITY OF COLUMBUS GREENHOUSE GAS INVENTORY

Introduction

The City of Columbus recognizes the impact of climate change on the economic well-being of the region and quality of life for residents. As a member of the Global Covenant of Mayors, the City of Columbus is actively engaged in mitigating and adapting to the effects of climate change. Per the requirements of the Global Covenant of Mayors, Columbus has committed to inventorying its annual greenhouse gas (GHG) emissions, setting targets for future year emissions, and creating a climate action and adaptation plan. The City of Columbus asked the Mid-Ohio Regional Planning Commission (MORPC), whose staff has extensive experience in the energy sector and developing GHG inventories, to complete the 2019 city operations and community wide GHG inventory.

Greenhouse Gas Inventory Tool

The 2019 GHG inventory was conducted using the ICLEI-USA ClearPath[1] tool. ClearPath includes separate tracks for government operations and community-wide GHG inventories. Results from each track are presented in following sections. ClearPath includes tracks to inventory both local government operations and community scale GHG emissions. The tracks are consistent with widely accepted, U.S.-based protocols, the Local Government Operations Protocol and the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.

ICLEI-USA's ClearPath tool is provided as a recommended resource for all members of the Global Covenant of Mayors. It includes inventory, forecast, planning and monitoring modules.

The ClearPath tool relies on user-defined factor sets to analyze emissions that occur within a specific geography. In some instances, national averages are used when more locally-specific data are not available. Of particular note, the emissions resulting from the electricity grid rely on a factor set provided by the US Environmental Protection Agency (US EPA). The Emissions & Generation Resource Integrated Database (eGRID) provides sub-region emission factors for even years, on a two-year lag cycle (for example, emission rates for 2018 were provided in 2020). For odd years, the previous year's emission rates will be used as a place holder, as will be the case for even years if the GHG Inventory is produced prior to the release of updated data. If data provided in previous inventories are updated, the notation will appear below. For the Columbus GHG Inventory, the emissions factor set for Reliability First Corporation West (RFCW, the sub-region that includes Columbus) is used to analyze emissions. More information on eGRID can be found on the US EPA's website.[2]

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[1] http://icleiusa.org/clearpath/. (Accessed August 11, 2020)
[2] https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid. (Accessed August 11, 2020)

Changes in Model or Methodology

The methodology utilized in the 2019 GHG Inventory is the same as in the 2018 GHG Inventory unless mentioned in this section. Significant changes to the model or methodology are noted below:

- In March of 2020, the US EPA updated eGRID values for RFCW. These updated values are lower than previous years, as a result of less coal being utilized to generate electricity in the sub-region.
- Two changes were made regarding solid waste:
  - Solid waste was characterized utilizing a study from Ohio EPA[3] rather than using the national average.
  - A new methodology for calculating the impact of methane from landfills was utilized in this inventory. In previous inventories, emissions from the decomposition of solid waste only included those that occurred in that reporting year. However, decomposition occurs over multiple years releasing methane at varying rates throughout that time period. The methodology utilized in the 2019 Inventory utilizes the methodology recommended by ICLEI.
- US EPA currently assumes a methane leakage (fugitive emissions) rate of 1.4%.[4] Previous City of Columbus GHG Inventories, when included, have used 0.3%. The 2019 Inventory utilizes a 0.5% fugitive emissions rate to begin to bring reporting in-line with available data. This value should be updated if and when more accurate data become available.

Greenhouse Gases

The following greenhouse gases are included in City of Columbus inventories:

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)

These three gases are used to calculate a total carbon dioxide equivalent (CO_2e) value for City of Columbus emissions. In order to do so, ClearPath uses global warming potential (GWP) values for both methane and nitrous oxide. The GWP allows for the non-CO_2 gases to be presented in common terms that indicate the relative strength of their greenhouse effect in the atmosphere. ClearPath utilizes GWP values presented in Assessment Reports from the Intergovernmental Panel on Climate Change (IPCC). The GWPs are updated in each new Assessment Report from the IPCC. GWP values from the Second Assessment Report were used for the 2005 government operations inventory. Both government and community inventories from 2013-2017 used GWPs from the Fourth Assessment Report. GWP values available in the Fifth Assessment Report are used for the 2018 and 2019 GHG Inventories.

Sectors Included

The following sectors are included in the 2019 GHG inventories:

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[3] https://www.epa.state.oh.us/Portals/41/OMM/Ohio-Waste-Characterization-Recycling-Economics-Report.pdf?ver=2019-08-29-123006-543. (Accessed August 11, 2020)

[4] https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016. (Accessed August 11, 2020)

TABLE 1. SECTORS – GOVERNMENT OPERATIONS INVENTORY

Sectors – Government Operations Inventory
Buildings and Facilities – Electricity Use
Buildings and Facilities – Natural Gas Use
Street Lights and Traffic Signals – Electricity Use
Vehicle Fleet – On Road Fuel Use
Vehicle Fleet – Off Road Fuel Use
Solid Waste Facilities – Refuse Collection
Water and Wastewater Treatment Facilities – Electricity Use
Water and Wastewater Treatment Facilities – Natural Gas Use
Water and Wastewater Treatment Facilities – Combustion of Digester Gas
Water and Wastewater Treatment Facilities – Flaring of Digester Gas

TABLE 2. SECTORS – COMMUNITY SCALE INVENTORY

Sectors – Community Scale Inventory
Residential Energy – Electricity Use
Residential Energy – Natural Gas Use
Commercial and Industrial Energy – Electricity Use
Commercial and Industrial Energy – Natural Gas Use
Transportation – On Road Fuel Use
Transportation – Off Road Fuel Use
Transportation – Public Transit Fuel Use
Transportation – Aviation Fuel Use
Transportation – Rail Fuel Use
Water and Wastewater Treatment Facilities – Electricity Use
Water and Wastewater Treatment Facilities – Natural Gas Use
Water and Wastewater Treatment Facilities – Combustion of Digester Gas
Water and Wastewater Treatment Facilities – Flaring of Digester Gas
Municipal Solid Waste
Biological Treatment of Biosolids
Biological Treatment of Yard Waste and Woody Material
Fugitive Emissions from Natural Gas Distribution

2019 Government Operations Emissions

Government operations contributed 337,741 metric tons of CO_2e in 2019. This represents a 3% decrease from 2018. Green Memo III[5] utilizes 2005 as a benchmark for city initiatives impacting city operations.[6] When considering the total emissions from government operations since 2013, the year in which annual inventories began, the negative trend (decreasing emissions) that had been seen through 2015 has leveled-off, or slightly increased, through 2019. This is a significant accomplishment as population increased over 20% during the same time period.

Compared to 2005, emissions have decreased over 17%. On a per capita basis, which would offer a levelized view of the City's efficiency in providing services, government operations created 0.38 metric tons of CO_2e per person in 2019, a 31% decrease per capita from 2005.

FIGURE 1. GOVERNMENT OPERATIONS – TOTAL EMISSIONS – 2019

City of Columbus
Government Operations CO_2e Emissions
Total Emissions in Metric Tons of CO_2e
2019

408,366	355,574	342,388	315,418	347,631	330,562	348,730	337,741
2005	2013	2014	2015	2016	2017	2018	2019
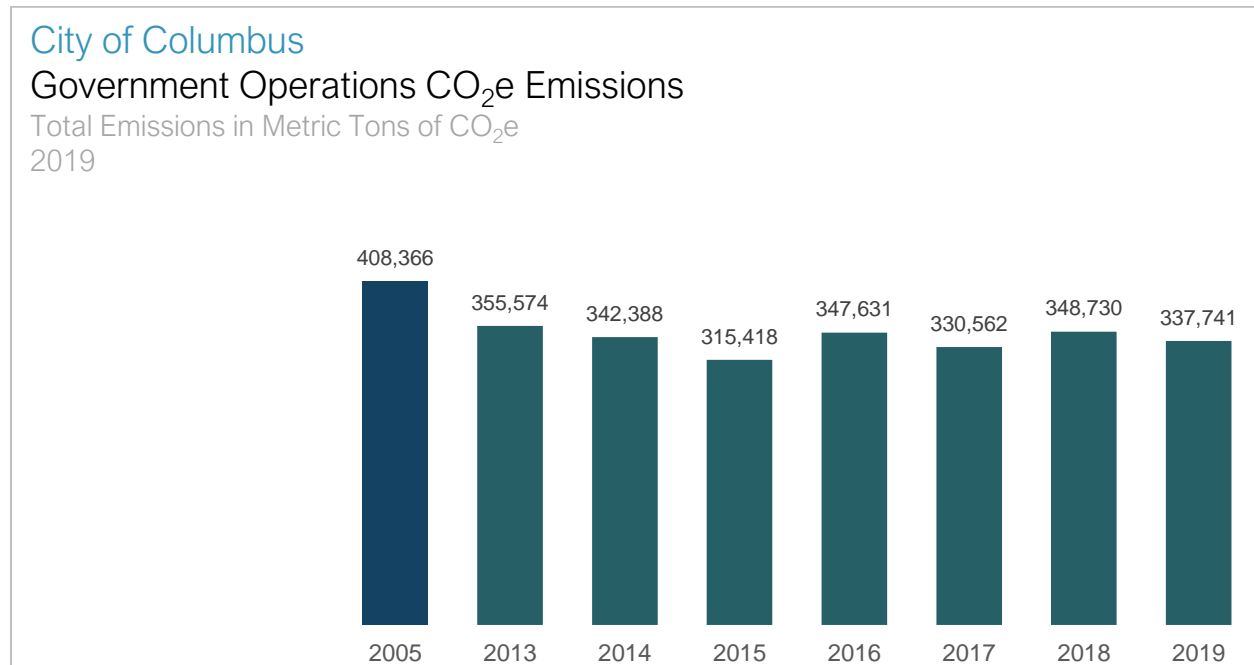
TABLE 3. GOVERNMENT OPERATIONS ANNUAL EMISSIONS BY SECTOR[7]

Government Operations Annual Emissions (Metric tons CO₂e)	2005	2013	2014	2015	2016	2017	2018	2019
Buildings & Facilities	87,931	76,431	87,309	79,818	88,451	81,284	86,011	75,347
Street Lights & Traffic Signals	29,134	26,749	32,442	31,788	30,471	21,616	25,265	18,733
Vehicle Fleet	33,965	30,281	29,459	26,184	23,587	22,564	23,473	23,445
Solid Waste Facilities	97,245	97,218	98,597	102,290	108,272	110,308	111,721	122,917
Water & Wastewater Treatment Facilities	160,091	124,895	94,582	75,337	96,851	94,790	102,259	97,300
Total Emissions	408,366	355,574	342,388	315,418	347,631	330,562	348,730	337,741

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[5] https://www.columbus.gov/Templates/Detail.aspx?id=2147506164. (Accessed August 11, 2020)
[6] It is important to note that values presented in Green Memo III may differ from those presented in this report. This is primarily due to sector attribution, which may vary when goals and programs are being developed in order to align initiatives, funding sources, etc. This report keeps attribution of emissions within sectors as analyzed, and as is consistent with CDP reporting.
[7] Totals may differ due to rounding.

FIGURE 2. GOVERNMENT OPERATIONS – EMISSIONS PER CAPITA – 2019

City of Columbus
Government Operations CO$_2$e Emissions
Metric Tons of CO$_2$e per Capita
2019
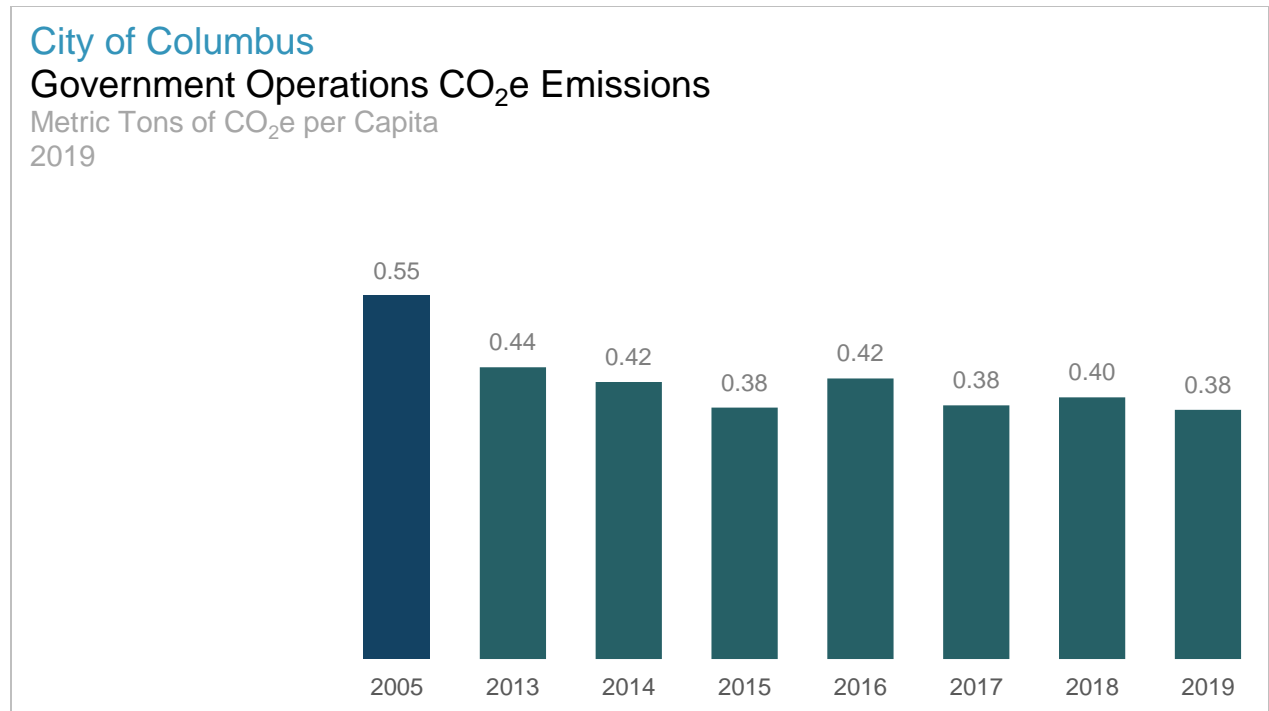
TABLE 4. GOVERNMENT OPERATIONS – ANNUAL EMISSIONS PER CAPITA

Government Operations Annual Emissions	2005	2013	2014	2015	2016	2017	2018	2019
Population	743,511	805,348	817,383	829,690	818,912	861,141	880,828	895,877
Buildings & Facilities	0.12	0.09	0.11	0.10	0.11	0.09	0.10	0.08
Street Lights & Traffic Signals	0.04	0.03	0.04	0.04	0.04	0.03	0.03	0.02
Vehicle Fleet	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.03
Solid Waste Facilities	0.13	0.12	0.12	0.12	0.13	0.13	0.13	0.14
Water & Wastewater Treatment Facilities	0.22	0.16	0.12	0.09	0.12	0.11	0.12	0.11
Total Emissions per Capita (Metric tons CO$_2$e)	0.55	0.44	0.42	0.38	0.42	0.38	0.40	0.38

Sector relative emissions contributions

Emissions are relative to the fuel being consumed directly, the primary fuel mix of the electricity consumed, and the processes that occur during operations. Providing for the water and waste needs of a city are often the greatest contributors to emissions when looking at government operations alone. Both services have higher energy use intensities in their operations, and each produces emissions as a byproduct of their processes. In 2019, solid waste facilities and water service facilities accounted for 64% of emissions from government operations (36% and 29%, respectively). The increase in solid waste emissions is primarily due to methodology changes.

Despite a lower energy use intensity and minimal emission byproducts of operations, city-owned buildings and facilities are still responsible for a large portion of emissions from city government operations (22%). As City of Columbus Fleets are primarily reliant on gasoline and diesel as fuel

sources, fleet vehicles accounted for 7% of emissions from government operations. Streetlights and traffic signals accounted for the remaining 6% of total City government operation emissions.

FIGURE 3. GOVERNMENT OPERATIONS – SECTOR PERCENTAGE OF TOTAL ANNUAL EMISSIONS – 2019

City of Columbus
Government Operations CO_2e Emissions
Sector Percentage of Total
2019

- Buildings & Facilities 22%
- Street Lights & Traffic Signals 6%
- Vehicle Fleet 7%
- Solid Waste Facilities 36%
- Water & Wastewater Treatment Facilities 29%
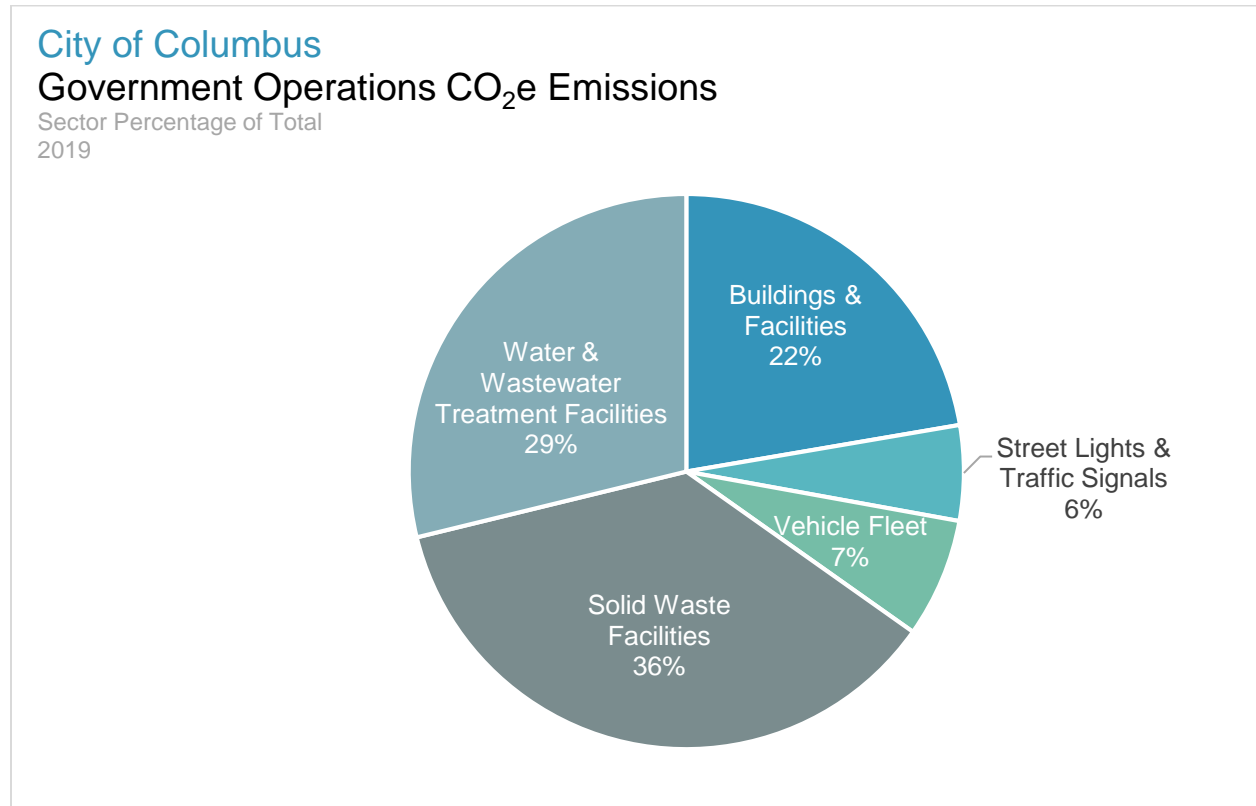
Sector emissions contributions between 2005 and 2019

Nearly all sectors analyzed are currently producing fewer emissions in 2019 than they were in 2005. Only solid waste facilities produce more CO_2e emissions in 2019 than in 2005, most of which can be accounted for in population growth and methodology changes that weighs methane heavier than in 2005.

TABLE 5. GOVERNMENT OPERATIONS – PERCENT CHANGE IN EMISSIONS FROM 2005

Government Operations Emissions	Percent Change in Total Emissions 2005 to 2019	Percent Change in Emissions per Capita 2005 to 2019
Buildings & Facilities	-14.3%	-28.89%
Street Lights & Traffic Signals	-35.7%	-46.64%
Vehicle Fleet	-31.0%	-42.71%
Solid Waste Facilities	26.4%	4.90%
Water & Wastewater Treatment Facilities	-39.2%	-49.56%
Total Emissions	-17.3%	-31.36%

Annual emissions data for each sector are provided below with a three year moving average trend line for individual sectors. The benchmark year of 2005 is noted in dark blue.

FIGURE 4. GOVERNMENT OPERATIONS – ANNUAL SECTOR CONTRIBUTIONS – 2013-2019[8]

City of Columbus
Government Operations CO_2e Emissions
Annual Sector Contributions in Metric Tons
2013 - 2019
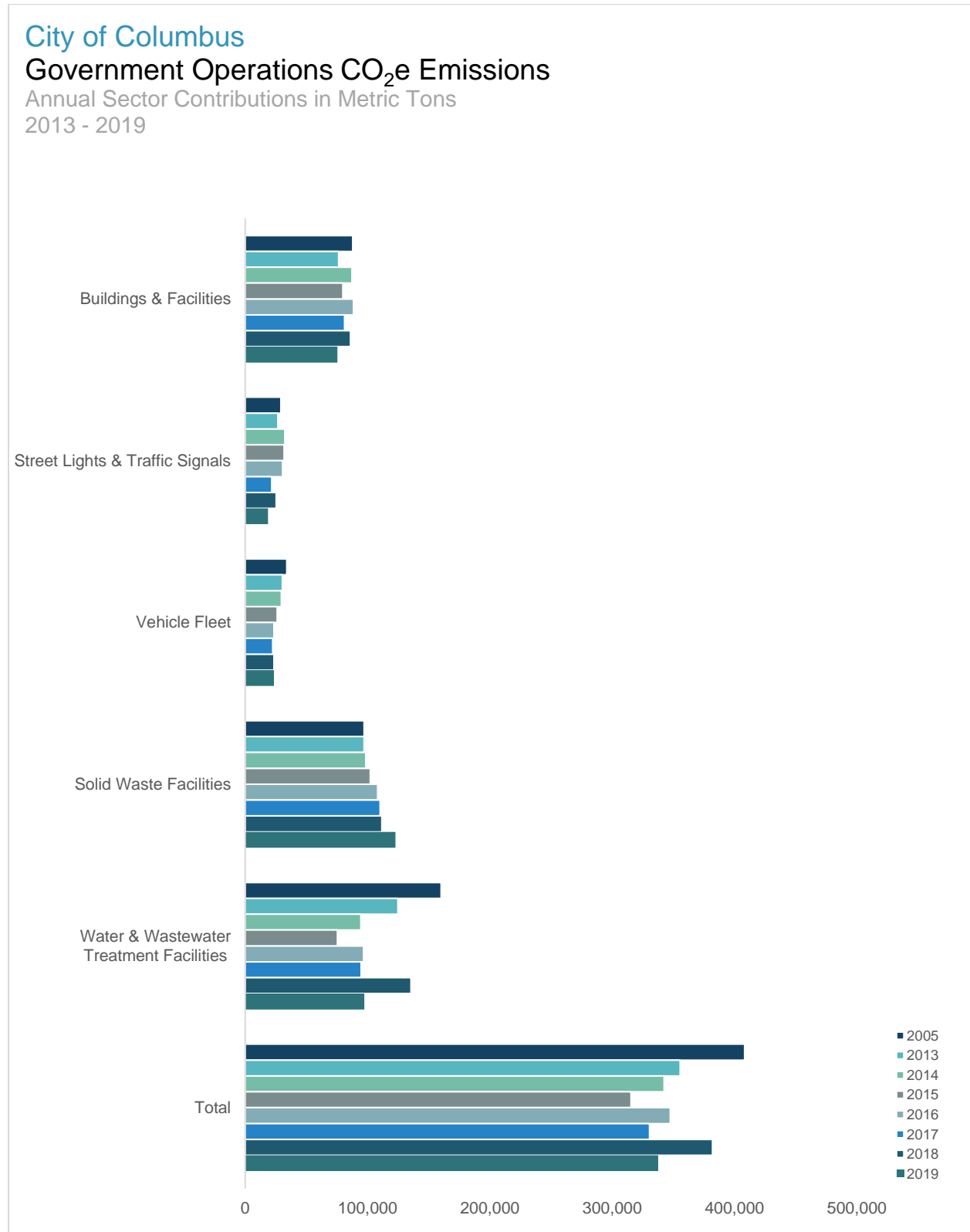
[8] Emissions from energy use at Waste and Wastewater Treatment Facilities is included in Buildings and Facilities in 2016. This methodology was corrected beginning in the 2017 City of Columbus Greenhouse Gas Inventory.

FIGURE 5. GOVERNMENT OPERATIONS – ANNUAL WATER AND WASTEWATER TREATMENT FACILITIES CONTRIBUTIONS – 2013-2019

City of Columbus
Government Operations CO$_2$e Emissions
Annual Water and Wastewater Treatment Facilities Contributions in Metric Tons with 3 Year
Moving Average Trend
2013 - 2019
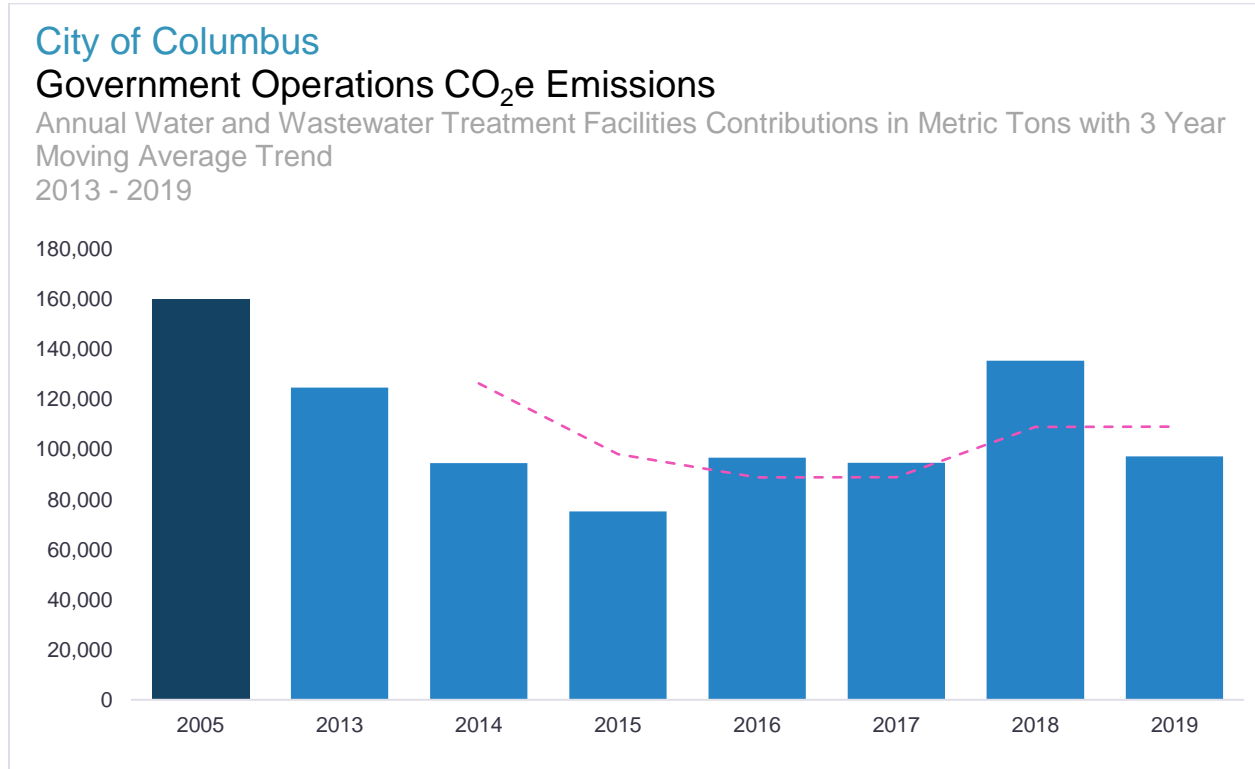
FIGURE 6. GOVERNMENT OPERATIONS – ANNUAL SOLID WASTE FACILITIES CONTRIBUTIONS – 2013-2019

City of Columbus
Government Operations CO$_2$e Emissions
Annual Solid Waste Facilities Contributions in Metric Tons with 3 Year Moving Average
Trend
2013 - 2019
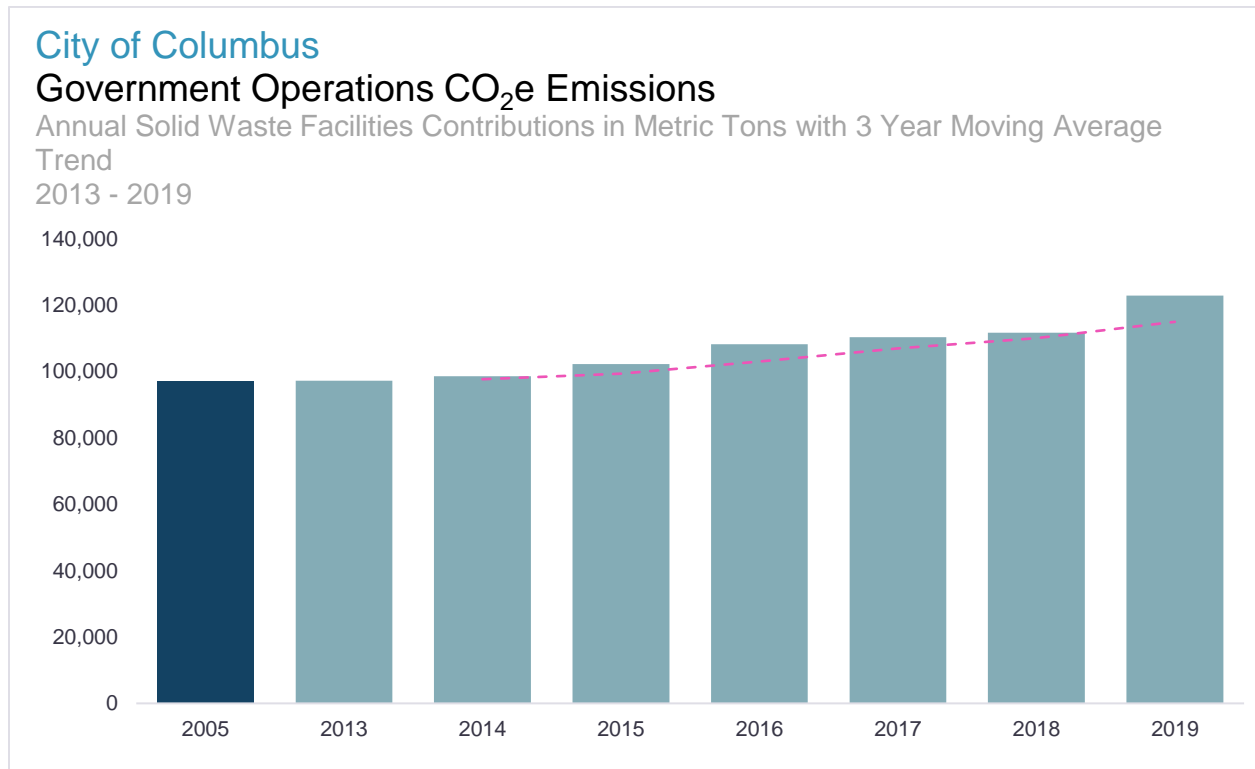
FIGURE 7. GOVERNMENT OPERATIONS – ANNUAL FLEET VEHICLE CONTRIBUTIONS – 2013-2019

City of Columbus
Government Operations CO_2e Emissions
Annual Fleet Vehicle Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
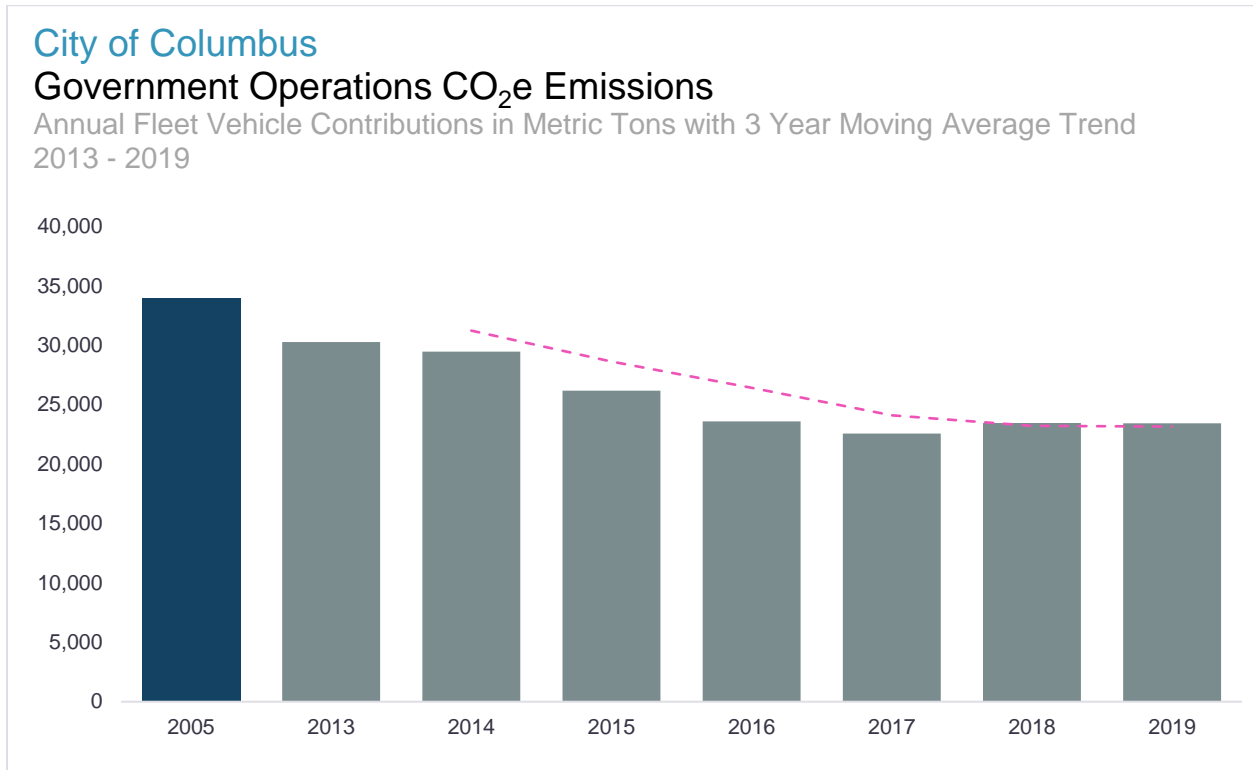
FIGURE 8. GOVERNMENT OPERATIONS – ANNUAL STREET LIGHT AND TRAFFIC SIGNS CONTRIBUTIONS – 2013-2019

City of Columbus
Government Operations CO_2e Emissions
Annual Street Light and Traffic Signs Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
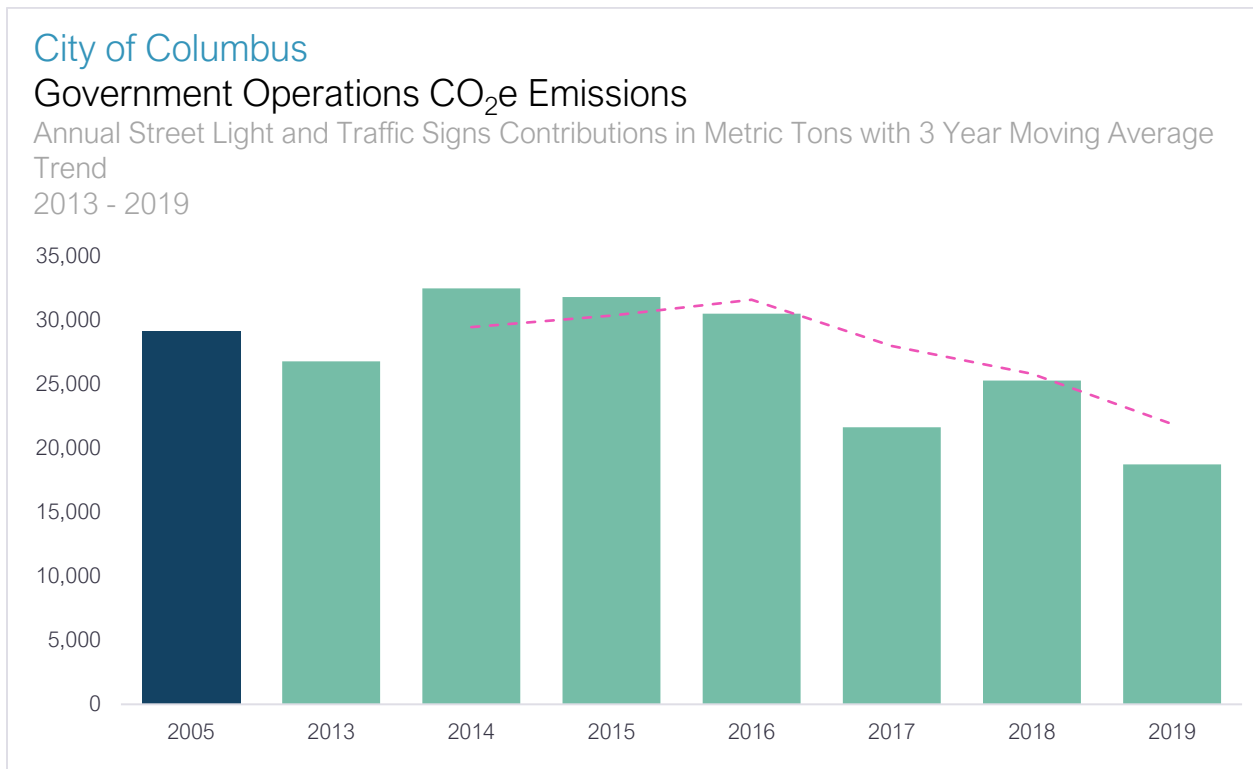
FIGURE 9. GOVERNMENT OPERATIONS – ANNUAL BUILDING AND FACILITIES CONTRIBUTIONS – 2013-2019

City of Columbus

Government Operations CO_2e Emissions

Annual Building and Facilities Contributions in Metric Tons with 3 Year Moving Average Trend

2013 - 2019

City of Columbus
Government Operations CO$_2$e Emissions
Total Emissions by Sector Percentage and in Metric Tons
2013 - 2019

- Buildings & Facilities
- Street Lights & Traffic Signals
- Vehicle Fleet
- Solid Waste Facilities
- Water & Wastewater Treatment Facilities

Year	Buildings & Facilities	Street Lights & Traffic Signals	Vehicle Fleet	Solid Waste Facilities	Water & Wastewater
2005	22%	7%	8%	24%	39%
2013	21%	8%	9%	27%	35%
2014	25%	9%	9%	29%	28%
2015	25%	10%	8%	32%	24%
2016	25%	9%	7%	31%	28%
2017	25%	7%	7%	33%	29%
2018	23%	7%	6%	29%	35%
2019	22%	6%	7%	36%	29%

0   50,000   100,000   150,000   200,000   250,000   300,000   350,000   400,000   450,000

2019 Community-Wide Emissions

Cities across the world report emissions, although some methodologies vary as do gasses that are included. For comparison, below is a graph of cities that use the same methodology that are relatively similar to Columbus in terms of population, GDP, and land use. These values reflect 2017 emissions produced community-wide.

FIGURE 11. CITY COMPARISON OF TOTAL COMMUNITY EMISSIONS – 2017

City of Columbus
City Comparison of Community Scale CO_2e Emissions
Total Reported Emissions in Metric Tons of CO_2e
2017

Austin	Columbus	Detroit	Nashville and Davidson
13,001,831	11,239,037	10,329,322	13,461,292
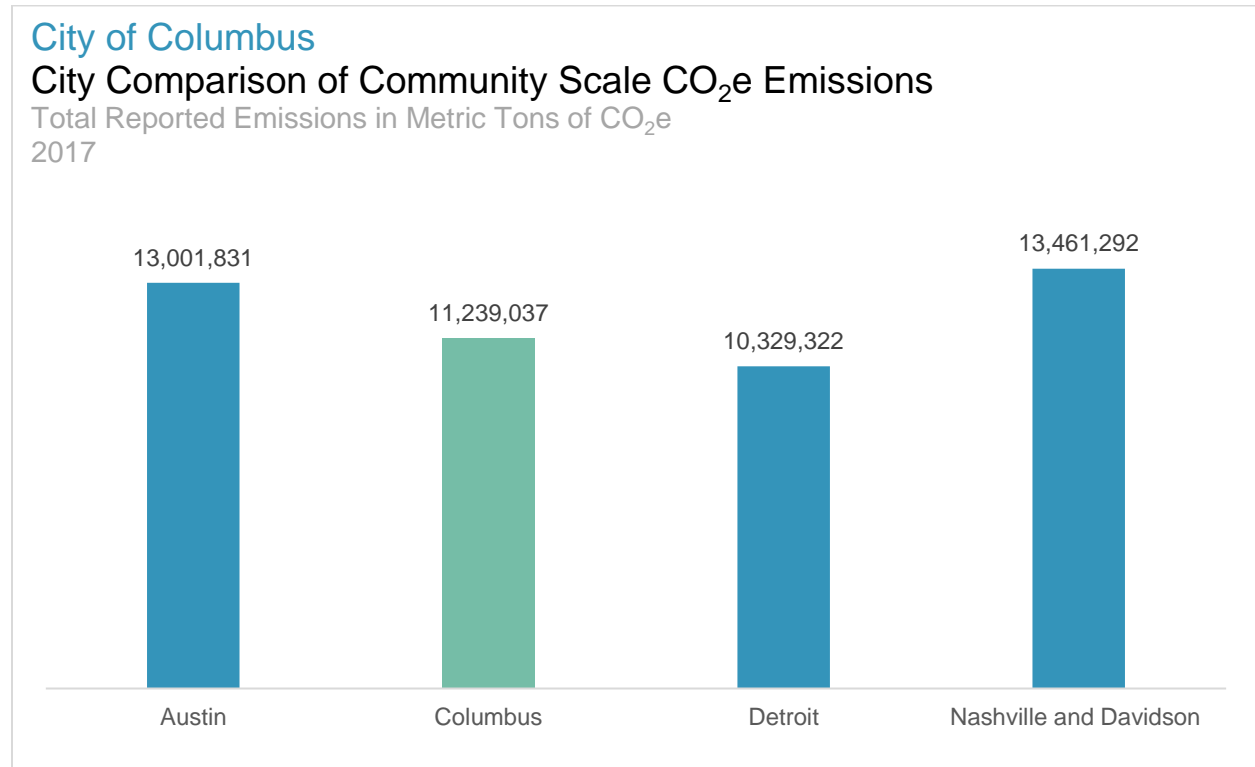
Activities community-wide contributed 10,961,483 metric tons of CO_2e in 2019. This represents a 5% decrease from 2018. Green Memo III[9] utilizes 2013 as a benchmark for community-wide emissions. When considering the total emissions community-wide since 2013, a clear trend does not emerge other than Columbus typically varies year-to-year by a few percentage points, hovering between 11 and 12 million metric tons of CO_2e per year. However, with the 5% reduction in emissions since 2018 may suggest a downward trend is developing. It is important to note that population increased 11% during the same time period. That emissions have remained stable despite such significant growth in the city is a notable accomplishment.

Compared to 2013, emissions have decreased by almost 3%. On a per capita basis, the community of Columbus creates 12.24 metric tons of CO_2e per person, a nearly 7% decrease in the per capita emissions from 2018, and a nearly 13% decrease in emissions per capita from 2013.

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[9] https://www.columbus.gov/Sustainable-Columbus/Columbus-Green-Community-Plan-(Green-Memo-3)/

FIGURE 12. COMMUNITY SCALE – TOTAL EMISSIONS – 2013-2019

City of Columbus
Community Scale CO_2e Emissions
Total Emissions in Metric Tons of CO_2e
2019
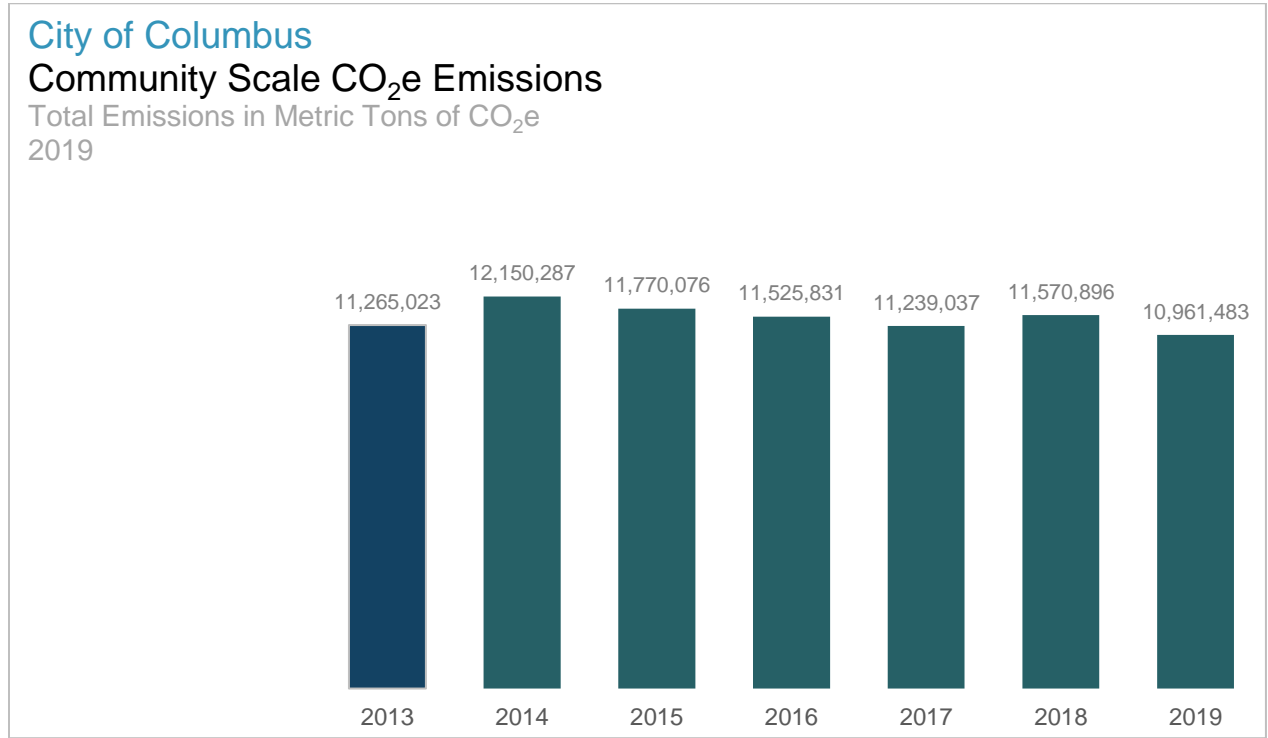
TABLE 6. COMMUNITY SCALE – TOTAL EMISSIONS BY SECTOR – 2013-2019

Community Scale Sector Emissions (Metric tons CO_2e)	2013	2014	2015	2016	2017	2018	2019
Residential Energy	2,641,935	3,020,841	2,700,722	2,614,721	2,423,504	2,763,887	2,492,497
Commercial Energy	4,883,764	4,640,654	4,216,227	4,170,874	3,748,313	3,573,927	3,343,330
Industrial Energy	287,152	713,266	657,967	626,048	611,877	371,757	347,443
Transportation	3,015,878	3,365,275	3,796,842	3,696,430	4,029,621	4,373,857	4,292,211
Solid Waste	249,007	249,877	244,372	263,633	275,496	332,321	304,903
Fugitive Emissions	59,171	63,481	57,928	56,682	55,435	52,887	83,799
Water/Wastewater	128,116	96,893	96,017	97,444	94,790	102,259	97,300
Total Emissions	11,265,023	12,150,287	11,770,076	11,525,831	11,239,037	11,570,896	10,961,483

FIGURE 13. COMMUNITY SCALE – EMISSIONS PER CAPITA – 2013-2019

City of Columbus
Community Scale CO_2e Emissions
Metric Tons of CO_2e per Capita
2019
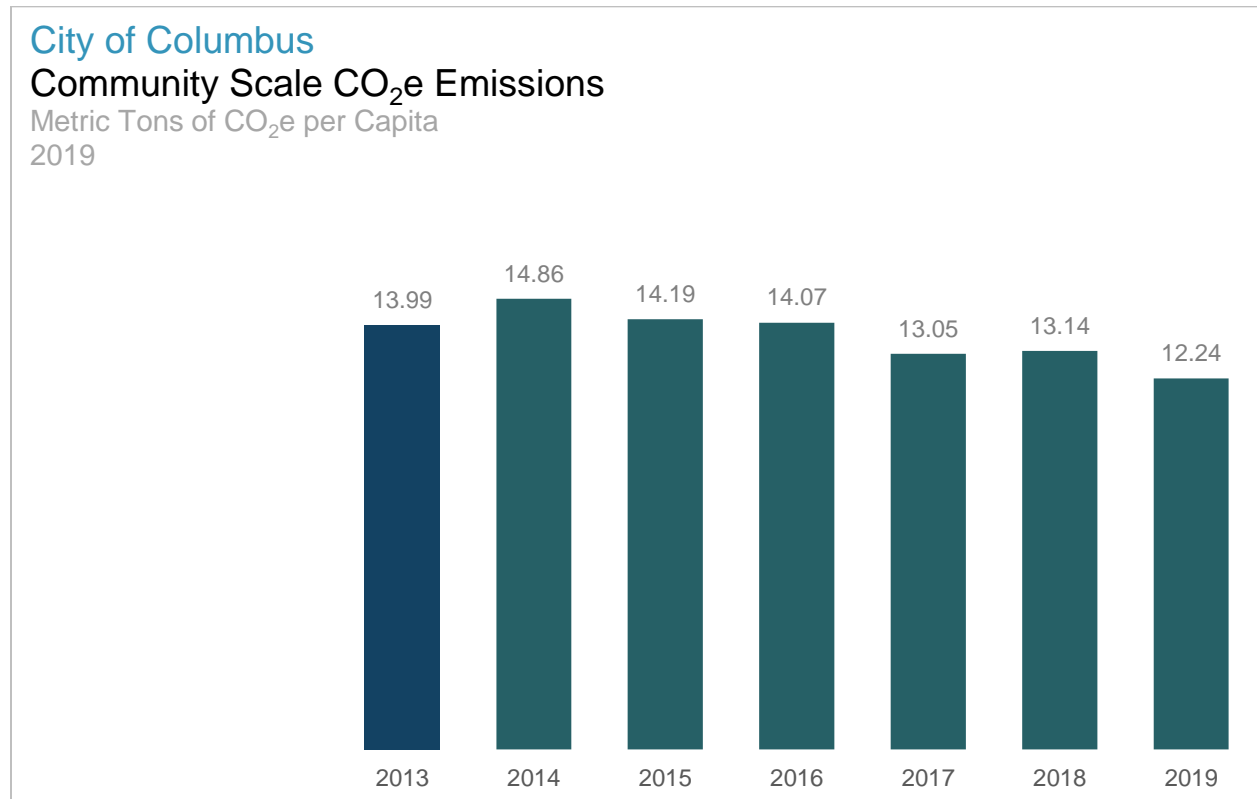
TABLE 7. COMMUNITY SCALE – EMISSIONS PER CAPITA – 2013-2019

Community Scale Sector Emissions	2013	2014	2015	2016	2017	2018	2019
Population	805,348	817,383	829,690	818,912	861,141	880,828	895,877
Residential Energy	3.28	3.70	3.26	3.19	2.81	3.14	2.78
Commercial Energy	6.06	5.68	5.08	5.09	4.35	4.06	3.73
Industrial Energy	0.36	0.87	0.79	0.76	0.71	0.42	0.39
Transportation	3.74	4.12	4.58	4.51	4.68	4.97	4.79
Solid Waste	0.31	0.31	0.29	0.32	0.32	0.38	0.34
Fugitive Emissions	0.07	0.08	0.07	0.07	0.06	0.06	0.09
Water/Wastewater	0.16	0.12	0.12	0.12	0.11	0.12	0.11
Total Emissions (Metric tons CO_2e)	13.99	14.86	14.19	14.07	13.05	13.14	12.24

Sector relative emissions contributions

In 2017, 2018, and 2019 the transportation sector accounts for the greatest portion of emissions on a community-wide basis (39%). The *2018: ACS 1-Year Estimates Subject Tables* note that in 2018, 78% of people commute via single-occupancy vehicles[10] and it should be assumed that 2019 will see a similar value. As population increases, so do commute times due to increased

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[10] https://data.census.gov/cedsci/table?q=columbus%20ohio%20&tid=ACSST1Y2018.S0801&hidePreview=false. (Accessed August 11, 2020)

congestion, and thus emissions. Whereas vehicle efficiency is increasing due to increased standards and the adoption of fuel-efficient and alternative fuel vehicles, it is not expected to offset the increase in vehicles on the road. As is typical of similar-sized cities in the United States, commercial and residential sectors make up the next two largest contributors to emissions in the City of Columbus (31% and 23%, respectively). The industrial sector accounts for 3% of total emissions in 2019, which is in line with its contribution to the City's economic activity. Solid waste and water services make up 4% of emissions, with the final 1% being accounted for by process and fugitive emissions.

FIGURE 14. COMMUNITY SCALE – SECTOR PERCENTAGE OF TOTAL EMISSIONS - 2019

City of Columbus
Community Scale CO_2e Emissions
Sector Percentage of Total
2019

Fugitive Emissions
1%

Water/Wastewater
1%

Solid Waste
3%

Residential
Energy
23%

Transportation
39%

Commercial
Energy
31%

Industrial Energy
3%
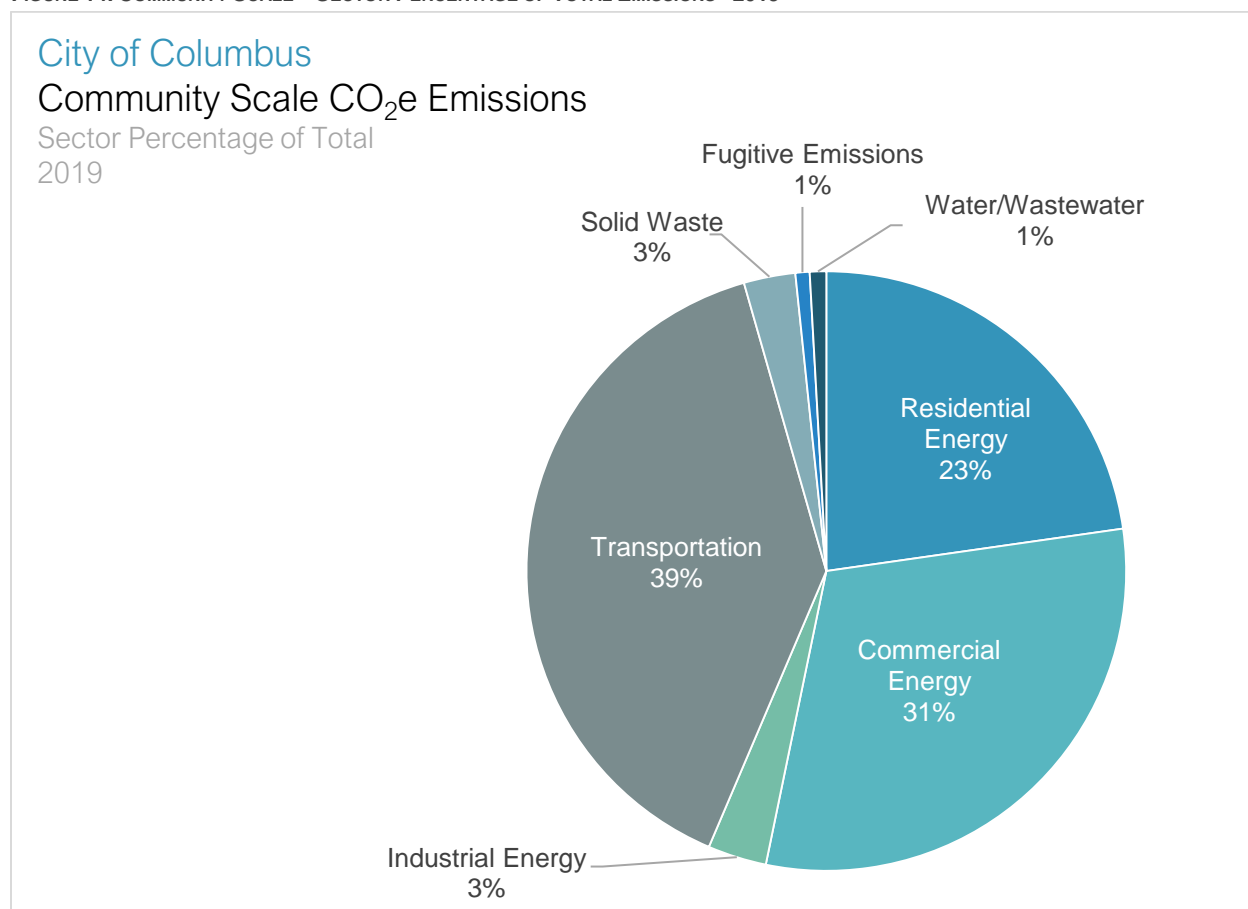
Sector emissions contributions between 2013 and 2019

Columbus is experiencing a relatively low emissions rate compared to historical values. The City's population has grown 11% since 2013, while the metropolitan statistical area for Columbus has experienced an 11% growth in gross domestic product since 2013[11]. Even though the majority of community sectors are emitting more greenhouse gases than in 2013, most are doing so at a lower rate per person than has been seen in most previous analyses for Columbus.

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[11] According to the Bureau of Economic Analysis https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1. (Accessed August 11, 2020)

TABLE 8. COMMUNITY SCALE – PERCENT CHANGE IN EMISSIONS FROM 2013

Community Scale Emissions	Percent Change in Total Emissions 2013 to 2019	Percent Change in Emissions per Capita 2013 to 2019
Residential Energy	-5.7%	-15.2%
Commercial Energy	-31.5%	-38.5%
Industrial Energy	21.0%	8.8%
Transportation	42.3%	27.9%
Solid Waste	22.4%	10.1%
Fugitive Emissions	41.6%	27.3%
Water/Wastewater	-24.1%	-31.7%
Total Emissions	-2.7%	-12.5%

It should be noted that increases in emissions from the transportation sector consistently outpace growth in population and economic activity and are 42% higher than they were in 2013. As well, increased emissions from the solid waste sector are partially due to population growth and partially due to methodology changes. Nonetheless, they represent two consistently growing sources of GHG emissions for the City of Columbus.

Fugitive emissions are a function of the quantity of natural gas used in the analysis area. As mentioned, the 2019 Inventory utilizes a higher fugitive emissions rate than in previous analyses. It is still lower than the US EPA calculated rate of 1.4% and may change in future analyses.

Although emissions from the industrial sector have increased 21% since 2013, it may not be indicative of decreased efficiency in operations as new industrial activity may have located in the area, or if existing businesses have seen an increase in productivity.

Annual emissions data for each sector are provided below with a three year moving average trend line for individual sectors. The benchmark year of 2013 is noted in dark blue.

FIGURE 15. COMMUNITY SCALE – ANNUAL SECTOR EMISSION CONTRIBUTIONS – 2013-2019

City of Columbus
Community Scale CO$_2$e Emissions
Annual Sector Contributions in Metric Tons
2013 - 2019
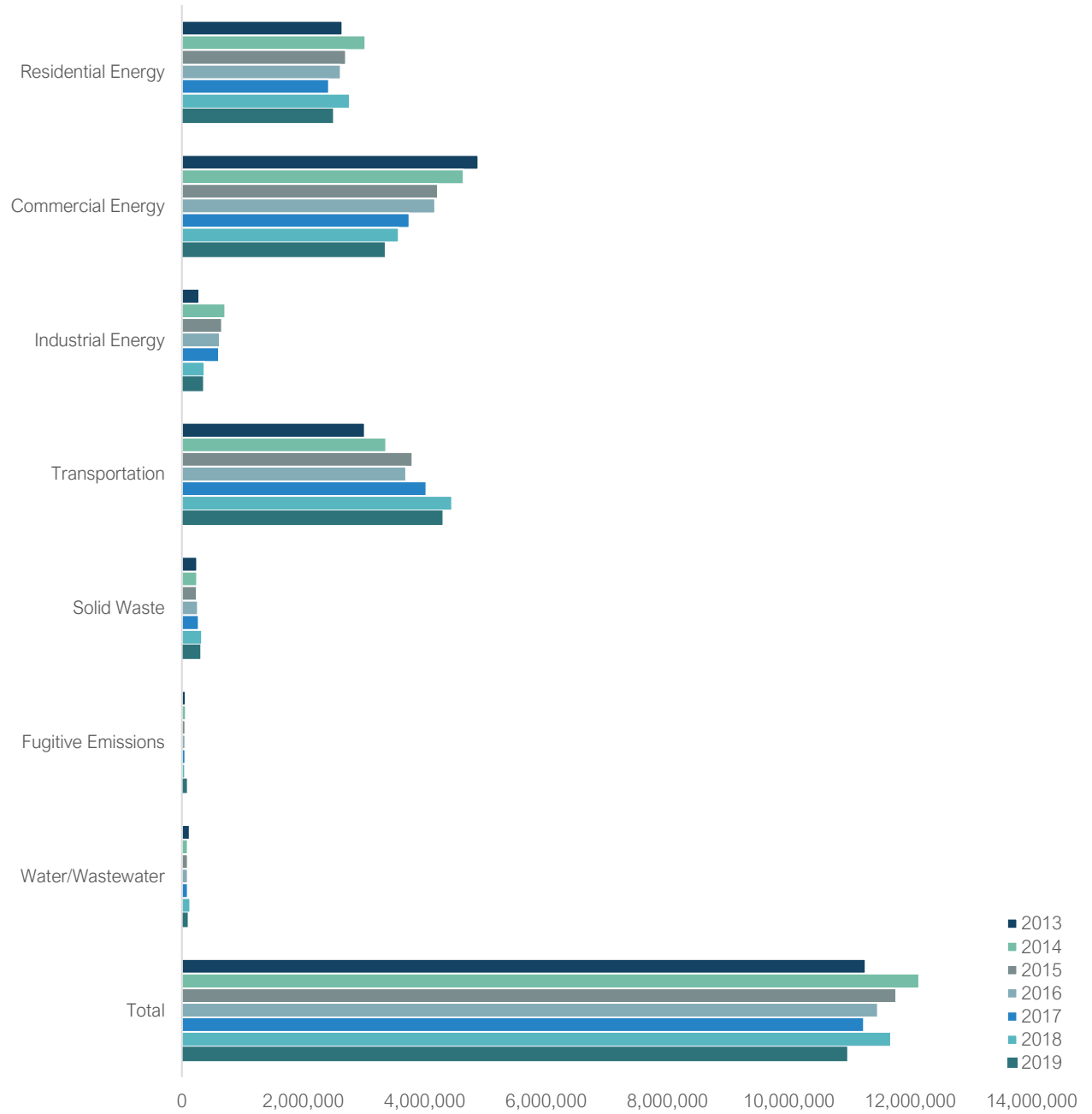
FIGURE 16. COMMUNITY SCALE – ANNUAL WASTE AND WASTEWATER SECTOR CONTRIBUTIONS – 2013-2019

City of Columbus
Community Scale CO$_2$e Emissions
Annual Water and Wastewater Treatment Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
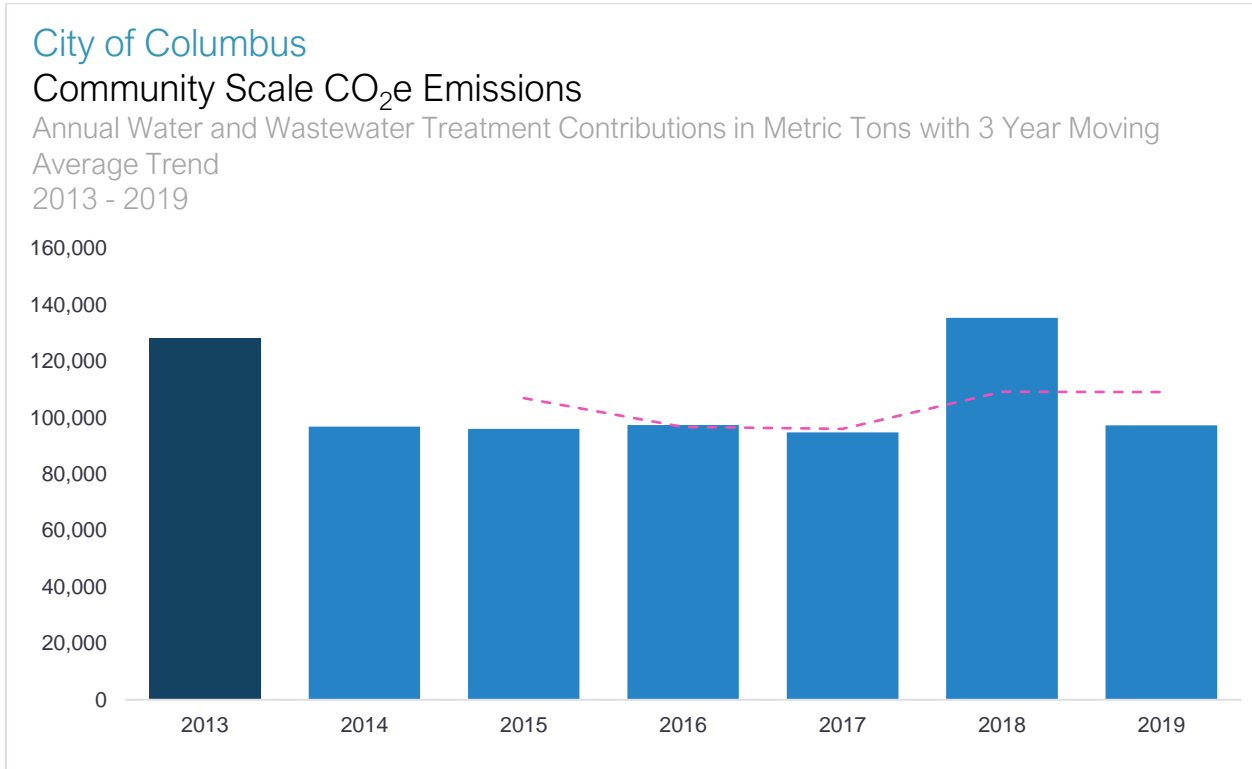
FIGURE 17. COMMUNITY SCALE – ANNUAL FUGITIVE EMISSION CONTRIBUTIONS – 2013-2019[12]

City of Columbus
Community Scale CO$_2$e Emissions
Annual Fugitive Emissions Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
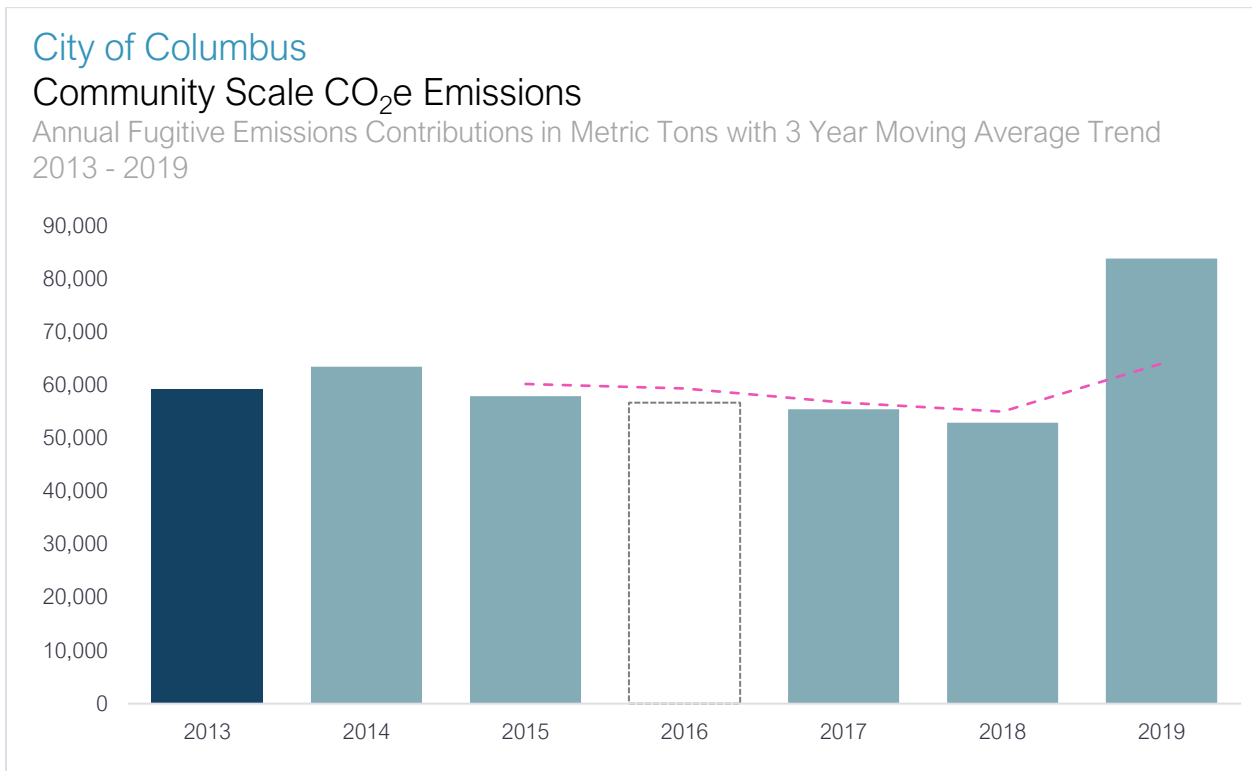
[12] Fugitive emissions were not calculated or included in the 2016 GHG Inventory. The dotted box represents an assumed value.

FIGURE 18. COMMUNITY SCALE – ANNUAL SOLID WASTE SECTOR CONTRIBUTIONS – 2013-2019

City of Columbus
Community Scale CO_2e Emissions
Annual Solid Waste Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
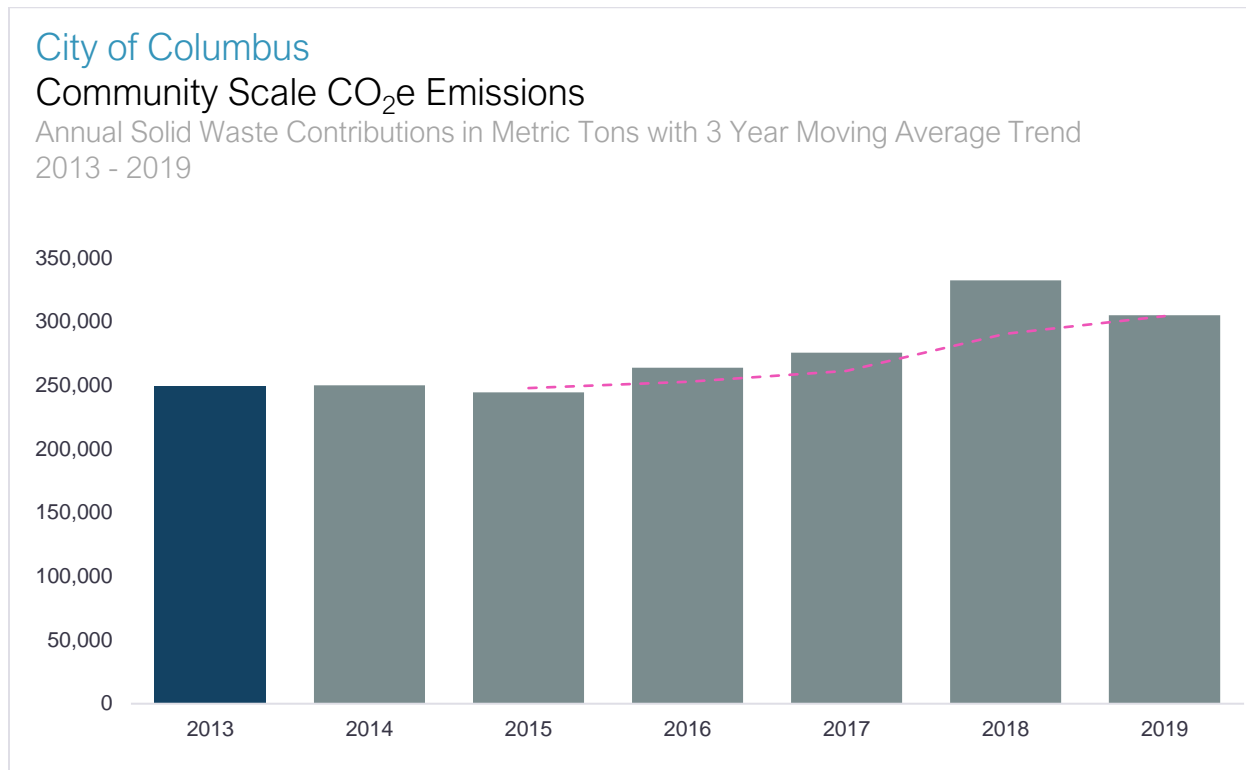
FIGURE 19. COMMUNITY SCALE – ANNUAL TRANSPORTATION SECTOR CONTRIBUTIONS – 2013-2019

City of Columbus
Community Scale CO_2e Emissions
Annual Transportation Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019

22
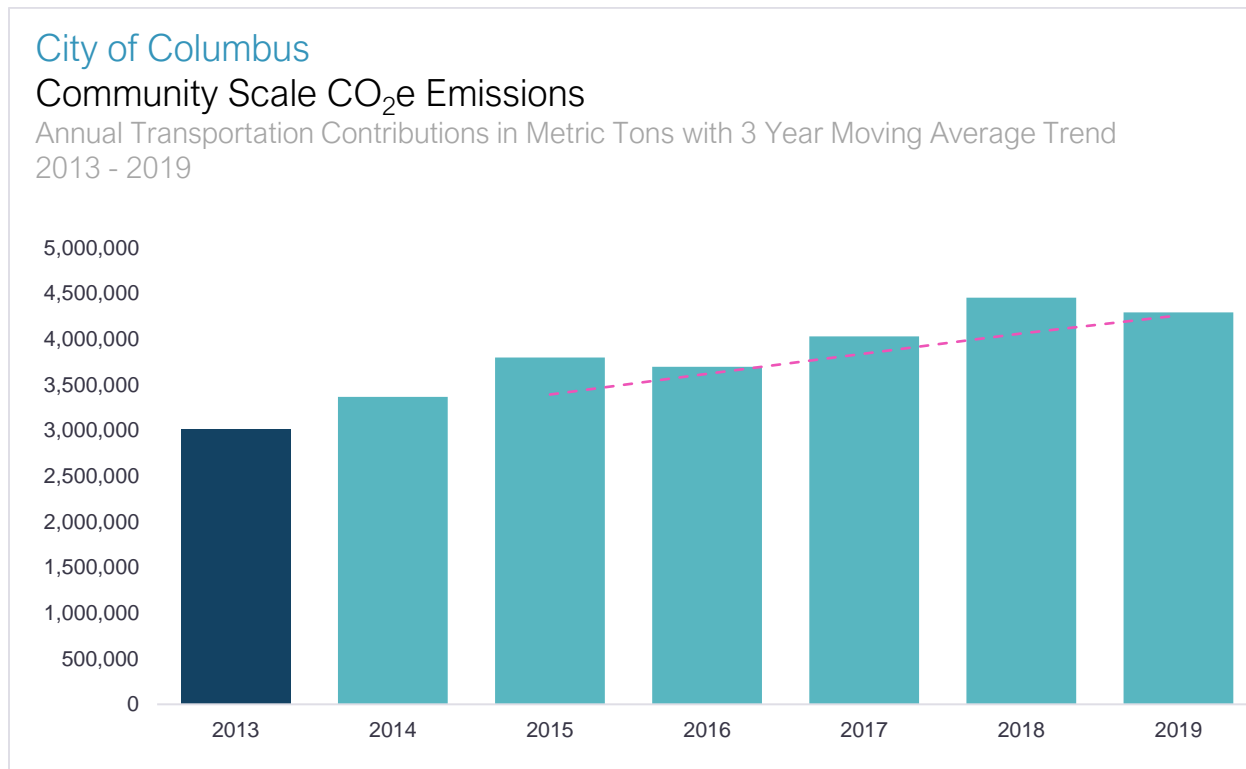
FIGURE 20. COMMUNITY SCALE – ANNUAL INDUSTRIAL SECTOR CONTRIBUTIONS – 2013-2019

City of Columbus
Community Scale CO_2e Emissions
Annual Industrial Energy Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
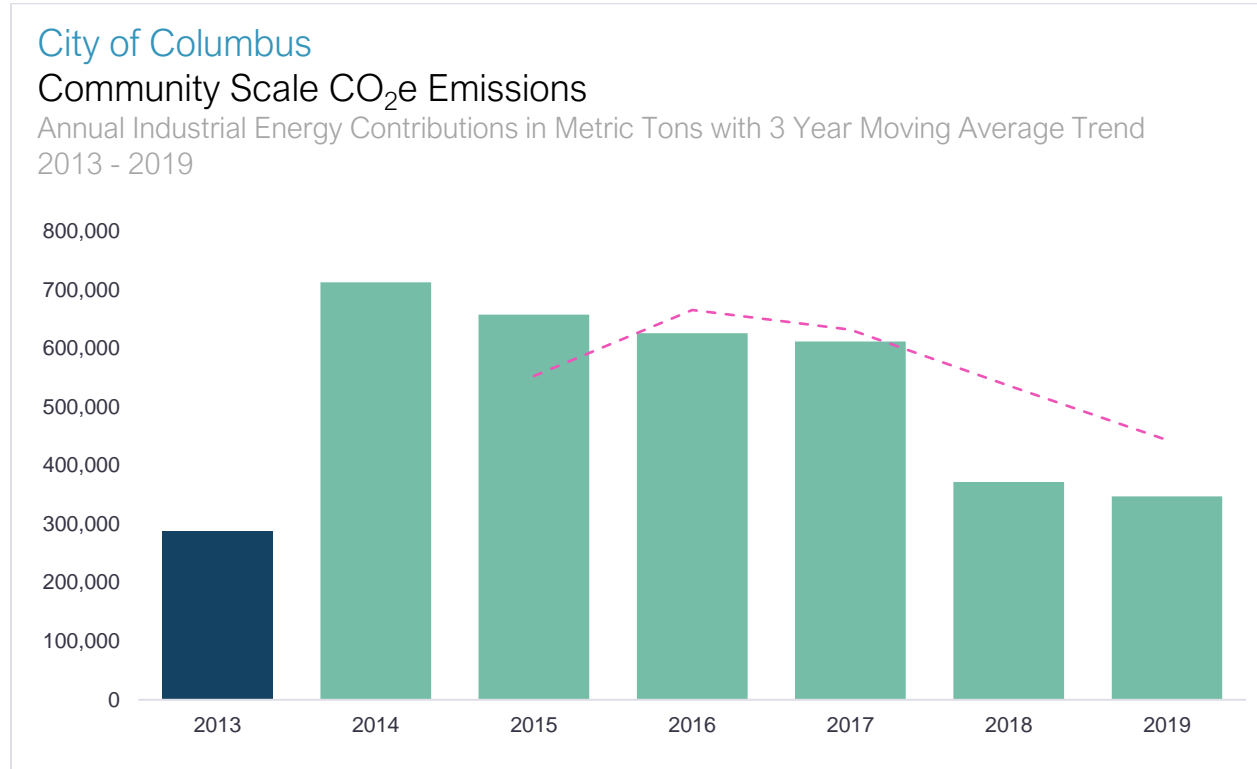
FIGURE 21. COMMUNITY SCALE – ANNUAL COMMERCIAL SECTOR CONTRIBUTIONS – 2013-2019

City of Columbus
Community Scale CO_2e Emissions
Annual Commercial Energy Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
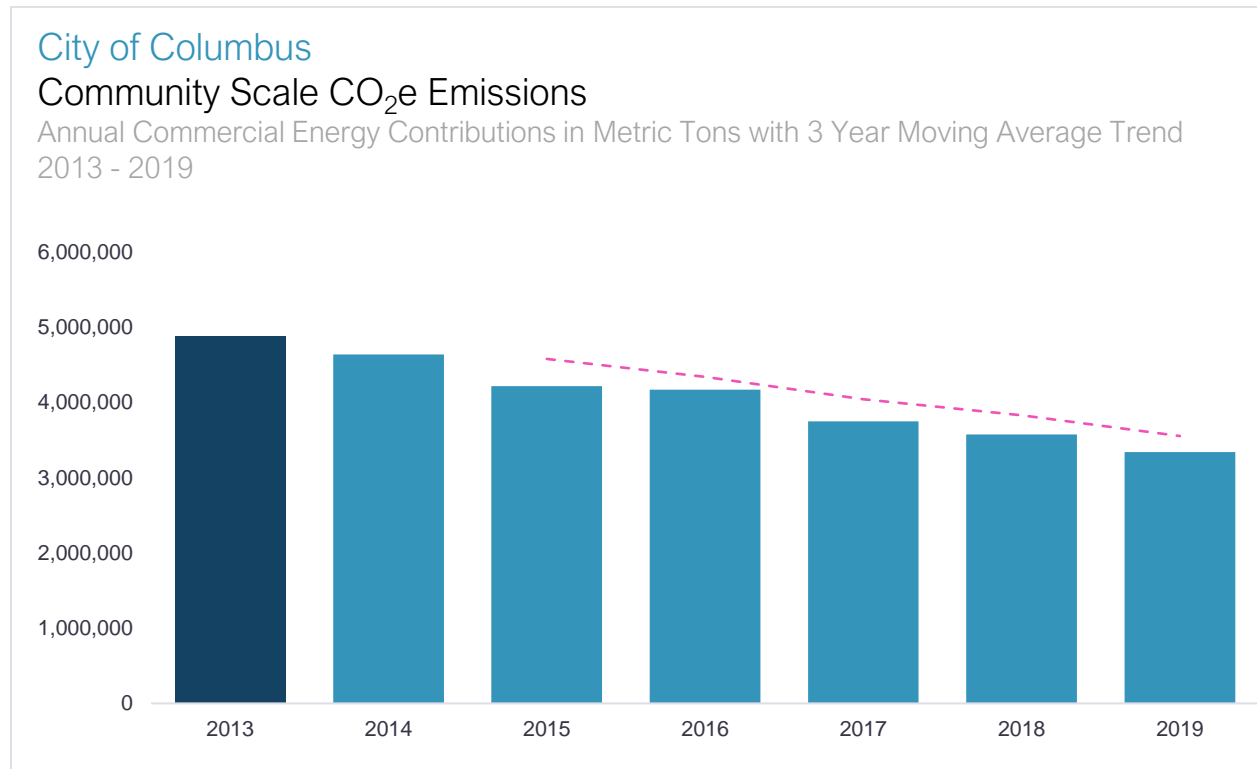
City of Columbus
Community Scale CO_2e Emissions
Annual Residential Energy Contributions in Metric Tons with 3 Year Moving Average Trend
2013 - 2019
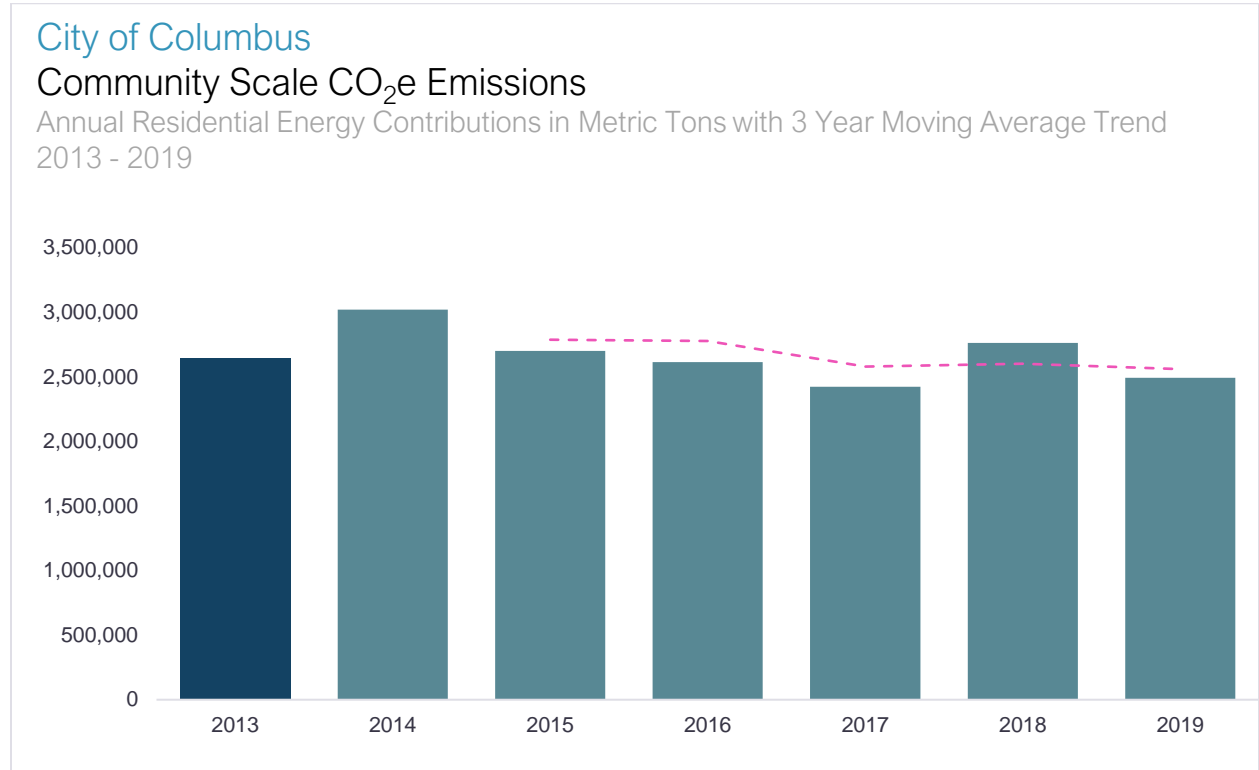
FIGURE 23. COMMUNITY SCALE – PERCENTAGE OF TOTAL EMISSIONS BY SECTOR – 2013-2019

City of Columbus
Community Scale CO$_2$e Emissions
Total Emissions by Sector Percentage and in Metric Tons
2013 - 2019

- Residential Energy
- Commercial Energy
- Industrial Energy
- Transportation
- Solid Waste
- Fugitive Emissions
- Water/Wastewater
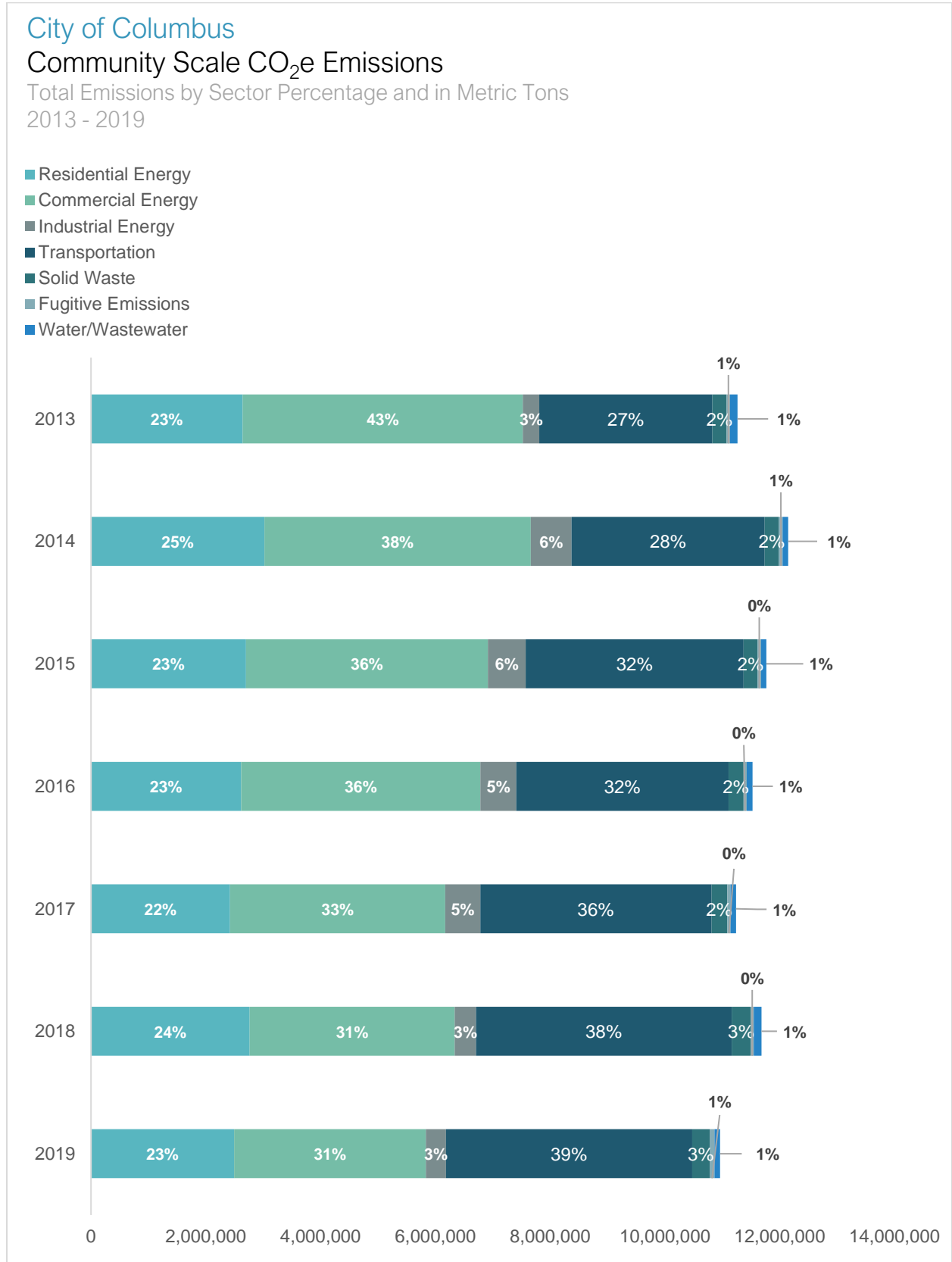
Appendix A

Inputs
Energy Consumption and Waste Values

Community Scale Inputs	Unit	2016	2017	2018	2019
Residential Natural Gas Usage	MMBtu	15,549,233	15,710,210	20,280,912	19,014,639
Commercial Natural Gas Usage	MMBtu	13,831,531	14,529,943	10,040,435	9,649,676
Industrial Natural Gas Usage	MMBtu	4,839,784	4,963,302	161,932	127,198
Residential Electric Usage - AEP	kWh	2,776,284,947	2,675,953,721	2,890,640,718	2,701,175,306
Commercial/Industrial Electric Usage - AEP	kWh	5,332,567,481	5,134,004,677	5,241,305,315	5,077,234,606
Residential Electric Usage - DPU	kWh	66,851,275	66,621,085	78,522,037	80,561,233
Commercial Electric Usage - DPU	kWh	130,435,929	106,813,606	113,923,918	113,998,160
Industrial Electric Usage - DPU	kWh	587,071,546	613,696,855	639,762,013	639,841,221
Transit Buses, Diesel	Gallons	2,012,291	1,950,033	1,907,288	1,730,300
Transit Buses, CNG	Gallons	1,497,898	1,779,363	2,061,696	2,232,396
Paratransit Buses, Diesel	Gallons	339,773	346,180	340,861	308,109
Paratransit Buses, Gasoline	Gallons	34,127	30,258	28,302	27,259
Aviation – Airport, kerosene jet fuel	Gallons	59,713,628	68,362,002	73,251,020	81,766,923
Aviation – Airport, gasoline	Gallons	84,767	54,479	75,315	81,903
Aviation – Helicopter (kerosene jet fuel)	Gallons	61,708	100,154	111,161	118,244
On Road, Passenger, Gasoline	Miles	7,363,342,017	7,475,738,443	7,835,788,415	7,934,217,355
On Road, Passenger, Diesel	Miles	22,156,496	22,494,699	23,578,100	28,092,665
On Road, Freight, Gasoline	Miles	6,659,384	6,736,467	11,908,782	26,721,204
On Road, Freight, Diesel	Miles	259,715,974	262,722,228	464,442,498	400,590,749
Freight Rail, Diesel	Gallons	-	9,910,732	2,119,594	2,242,506
Wastewater Treatment Plants - Electricity - DPU	kWh	75,205,564	92,829,836	98,662,456	97,313,001
Water Treatment Plants - Electricity - DPU	kWh	58,228,740	60,707,038	67,114,035	68,130,723
Wastewater Treatment Plants - Natural Gas	MMBtu	66,640	75,325	67,778	109,264
Water Treatment Plants - Natural Gas	MMBtu	36,523	31,681	51,733	21,294
Gas Production - Jackson Pike	scf/day	-	1,000,000	810,000	932,918
Gas Composition - Jackson Pike	Percent Methane	-	65%	62%	61%528845
Heat Content - Jackson Pike	Btu/scf	-	580	570	588
Gas Production - Southerly	scf/day	-	700,000	700,000	882,767
Gas Composition - Southerly	Percent Methane	-	56%	56%	63%
Heat Content - Southerly	Btu/scf	-	512	512	554
Destruction Efficiency – Jackson Pike and Southerly	Percent	-	99%	99%	99%

Government Operations Inputs	Unit	2016	2017	2018	2019
Natural Gas	MMBtu	276,538	407,557	656,413	528,845
Electric	kWh	107,802,332	104,989,940	90,052,367	88,680,470
Street Lights and Signals - Electricity - DPU	kWh	42,520,846	38,069,976	44,058,418	35,181,696
Aviation - Helicopter	Gallons	61,708	100,154	111,161	118,244
City Fleet EVs (on road)	kWh	n/a	n/a	34,850	34,850
City Fleet CNG (on road)	Gallons	476,151	562,787	658,932	750,904
City Fleet Biodiesel (on road)	Gallons	0	470,960	353,342	459,112
City Fleet Diesel (on road)	Gallons	868,701	300,396	966,559	246,845
City Fleet Gasoline (on road)	Gallons	1,569,238	1,402,088	918,043	1,547,154
City Fleet E85 (on road)	Gallons	2,060	5,190	0	8,755
City Fleet Propane (on road)	Gallons	-	-	7,317	3,485
City Fleet CNG (off road)	Gallons	-	672	1,510	11,616
City Fleet Biodiesel (off road)	Gallons	-	93,886	95,908	170,324
City Fleet Diesel (off road)	Gallons	-	2,928	9,033	9,070
City Fleet Gasoline (off road)	Gallons	-	5,842	4,444	26,657
City Fleet E85 (off road)	Gallons	-	-	-	446
City Fleet Propane (off road)	Gallons	-	-	15,716	19,146
Municipal Solid Waste Generation (Landfill Total)	Tons	320,807	326,839	331,027	325,178
Wastewater Treatment Plants - Electricity	kWh	75,205,564	92,829,836	98,662,456	97,313,001
Water Treatment Plants - Electricity	kWh	58,228,740	60,707,038	67,114,035	68,130,723
Wastewater Treatment Plants - Natural Gas	MMBtu	66,640	75,325	67,778	109,264
Water Treatment Plants - Natural Gas	MMBtu	36,523	31,681	51,733	21,294
Gas Production - Jackson Pike	scf/day	-	1,000,000	810,000	932,918
Gas Composition - Jackson Pike	Percent Methane	-	65%	62%	60.6%
Heat Content - Jackson Pike	Btu/scf	-	580	570	588
Gas Production - Southerly	scf/day	-	700,000	700,000	882,767
Gas Composition - Southerly	Percent Methane	-	56%	56%	63.35%
Heat Content - Southerly	Btu/scf	-	512	512	554
Destruction Efficiency – Jackson Pike and Southerly	Percent	-	99%	99%	99%

Emission Rates from eGRID

Community Scale					
Analysis Year	Name	Region	CO_2 lbs/MWh	CH_4 lbs/GWh	N_2O lbs/GWh
2013	EPA eGRID 2010 Proxy for 2013	RFCW	1503.5	18.2	24.8
2014	EPA eGRID 2010 Proxy for 2014	RFCW	1503.5	18.2	24.8
2015	EPA eGRID 2012 Proxy for 2015	RFCW	1379.5	17.1	21.7
2016	EPA eGRID 2014 Proxy for 2016	RFCW	1497.1	161.3	23.7
2017	EPA eGRID 2016 Proxy for 2017	RFCW	1243.4	108	19
2018	EPA eGRID 2016 Proxy for 2018	RFCW	1243.4	108	19
2019	EPA eGRID 2018 Proxy for 2019	RFCW	1166.1	117	17

Government Operations					
Analysis Year	Name	Region	CO_2 lbs/MWh	CH_4 lbs/GWh	N_2O lbs/GWh
2005	EPA eGRID 2007 Year 2005	Ohio	1771.8	20.99	29.9
2013	EPA eGRID 2010 Proxy for 2013	RFCW	1503.5	18.2	24.8
2014	EPA eGRID 2010 Proxy for 2014	RFCW	1503.5	18.2	24.8
2015	EPA eGRID 2012 Proxy for 2015	RFCW	1379.5	17.1	21.7
2016	EPA eGRID 2014 Proxy for 2016	RFCW	1497.1	161.3	23.7
2017	EPA eGRID 2016 Proxy for 2017	RFCW	1243.4	108	19
2018	EPA eGRID 2016 Proxy for 2018	RFCW	1243.4	108	19
2019	EPA eGRID 2018 Proxy for 2019	RFCW	1166.1	117	17

Whereas all values are stated to come from EPA's eGRID value tables, it should be noted that EPA eGRID 2014 values noted in the tables above are not accurate. Documentation does not exist as to why there is a discrepancy, although EPA eGRID value tables note a V2, which could mean that the values for 2014 were updated after the greenhouse gas inventory for 2014 was conducted. Reliability First Corporation West (or RFCW) is the correct region to use for this analysis.

Appendix B

Progress Towards the 2020 Emissions Reduction Goal

Renewable Energy Credits (RECs), commonly known as offsets, are an important mechanism utilized by cities and communities to help reach emission reduction goals while in-boundary renewable energy resources are being built out. RECs are not factored into a greenhouse gas inventory. To estimate the impacts of RECs, one would reduce total emissions reported in an inventory by the emissions reductions associated with RECs purchased in the same year.

The City of Columbus set a community-wide emissions reduction target of 20% by 2020, utilizing 2013 as the baseline year. During this same time period, the City's population grew by 11%, making an absolute emissions reduction more difficult to achieve. The tables below thus present progress towards achieving the 20% goal in absolute and per capita terms in order to capture the levelized impacts of emission reduction activities. Inclusive of RECs, but without factoring in population growth, the City of Columbus has achieved 20% of its 2020 emissions target (or one-fifth of the goal). When adjusting for population growth, the City has achieved 69% of its 2020 emissions target inclusive of emissions offset by the purchase of RECs.

Absolute Emissions	From GHG Inventory Report
2013 Emissions Benchmark (metric tons)	11,265,023
2020 Emissions Reduction Goal	20%
2020 Goal Emissions (metric tons)	9,012,018
Absolute Reduction Needed to Meet Goal (metric tons)	2,253,005
2019 Emissions (metric tons)	10,961,483
2019 RECs Offset (metric tons)	154,920
2019 Emissions Including RECs (metric tons)	10,806,563
Percent of Target Achieved	**20%**

Per Capita	From GHG Inventory Report
2013 Population	805,348
2013 Emissions per Capita (metric tons)	13.99
2019 Population	895,877
2019 Emissions per Capita (metric tons)	12.24
2019 Emissions per Capita Including RECS (metric tons)	12.06
2020 Per Capita Goal - 20% Reduction from 2013 (metric tons)	11.19
Absolute Reduction Needed to Meet Per Capita Goal (metric tons)	2.80
Percent of Target Achieved	**69%**

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Mid-Ohio Regional Planning Commission