City of Evansville

2017 Inventory of Government Operations
Greenhouse Gas Emissions

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Produced for the City of Evansville
From ICLEI - Local Governments for Sustainability USA

Credits and Acknowledgements

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City Controller's Office
Purchasing Department
METS
Evansville Water & Sewer Utility

ICLEI-Local Governments for Sustainability USA

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Executive Summary

The City of Evansville 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, Evansville has multiple opportunities to benefit by acting quickly to reduce community GHG emissions such as reducing energy costs, creating green jobs, improving health of residents, making your community a more attractive place to live and locate a business.

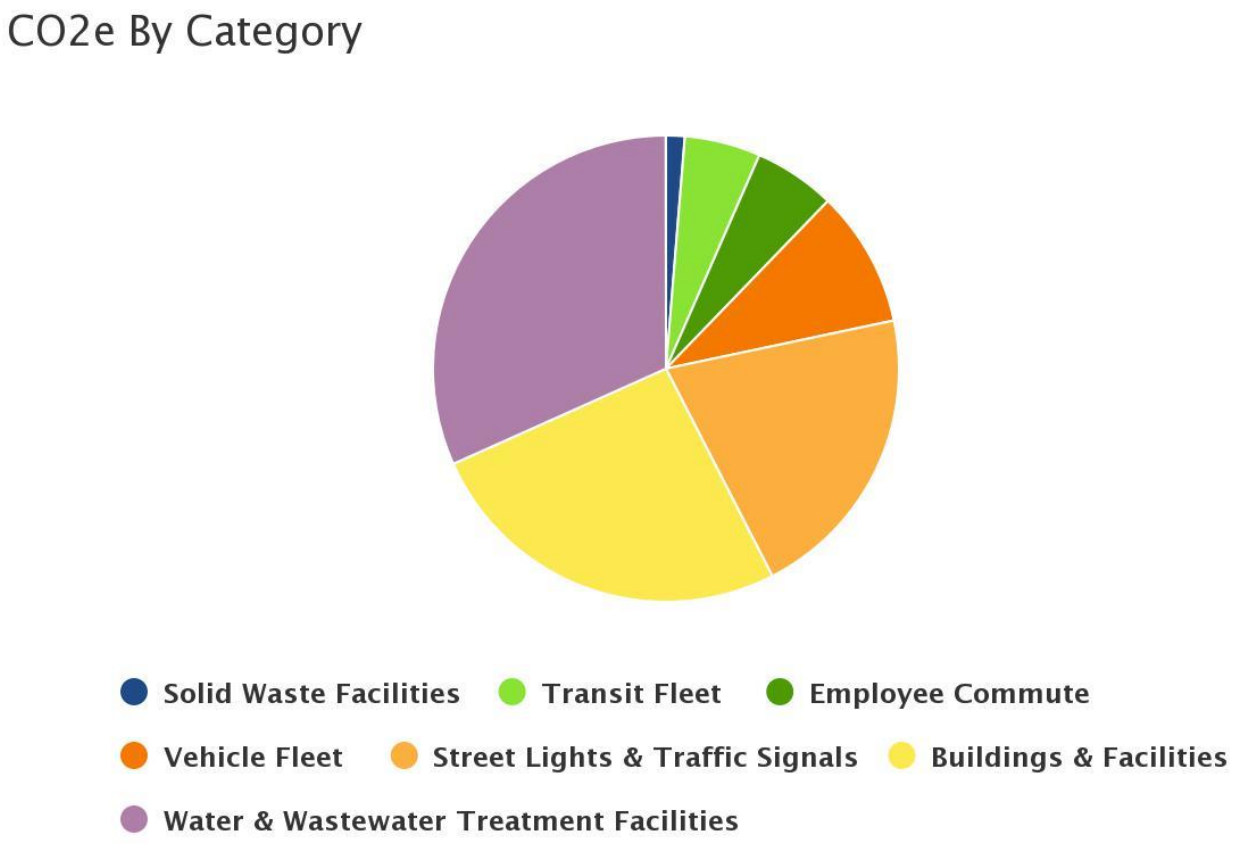
The Evansville City Council has pledged to power all city operations with 100% renewable energy by 2050. Evansville has begun the climate action planning process, starting with inventorying emissions. This report provides estimates of greenhouse gas emissions resulting from activities in Evansville as a whole in 2017, as well as emissions specifically from Evansville's government operations.

Key Findings

Figure ES 1 shows local government operations emissions. As you can see, largest contributor in this set is the Water & Wastewater sector with 31.7% of emissions. The next largest contributor is the Buildings & Facilities sector with 25.8% of emissions. Actions to reduce emissions in both of these sectors will be a key part of a climate action plan. Street Lights & Traffic Signals, Vehicle Fleet, Employee Commute, Transit Fleet, and Solid Waste were responsible for the remainder of local government operations emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within Evansville; 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 1: Evansville Government Operations Emission by Sector (MT CO2e)



Next Steps

The City of Evansville will use the information in this report to set emissions reduction targets, create plans to reach those targets, and implement those plans to reduce emissions and save money.

Climate Change Background

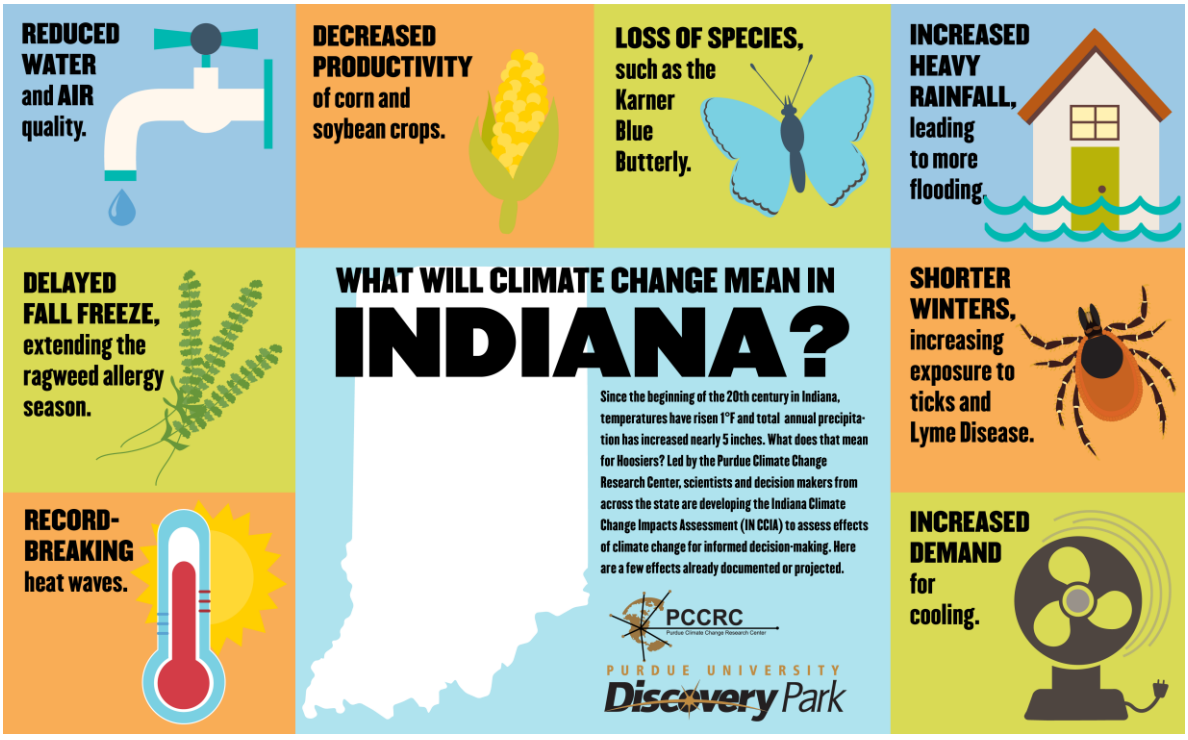
Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise. Evansville could be impacted by increasing frequency of extreme heat events, increased precipitation and flooding events, and decreased control of disease-carrying pests such as mosquitoes and ticks due to warmer winters.

Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, money not spent on energy is more likely to be spent at local businesses and add to the local economy. Reducing fossil fuel use improves air quality and provides increasing opportunities for walking and bicycling improves residents' health.

Regional and Local Impacts

The Purdue Climate Change Research Center (PCCRC) has published extensive resources on how climate change will affect Indiana statewide and at the county level. The PCCRC led the research and production of the Indiana Climate Change Impacts Assessment (IN CCIA). More information on the PCCRC and IN CCIA can be found here:

- **PCCRC Website:** https://ag.purdue.edu/climate/
- **Indiana Climate Change Impacts Assessment Website & Resources:** https://ag.purdue.edu/indianaclimate/
- **Vanderburgh County Climate:** https://ag.purdue.edu/indianaclimate/wp-content/uploads/2019/04/ClimateFacts_Vanderburgh_11302018_reduced.pdf



Evidence of Human-Caused Climate Change

There is overwhelming scientific consensus that the global climate is changing, and that human actions, primarily the burning of fossil fuels, are the main cause of those changes. The Intergovernmental Panel on Climate Change (IPCC) is the scientific body charged with bringing together the work of thousands of climate scientists. The IPCC's Fourth Assessment Report states that "warming of the climate system is unequivocal."[1] Furthermore, the report finds that "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations."

2012 was the hottest year on record for the continental United States, with two dozen cities breaking or tying their all-time high temperature records.[2] Globally, the 12 years from 2001-2012 are among the 14 hottest on record, and 1998 was the only year in the 20th century hotter than 2012.[3] 1976 was the last year with a below average global temperature. The steady uptick in average temperatures is significant and expected to continue if action is not taken to greatly reduce greenhouse gas emissions.

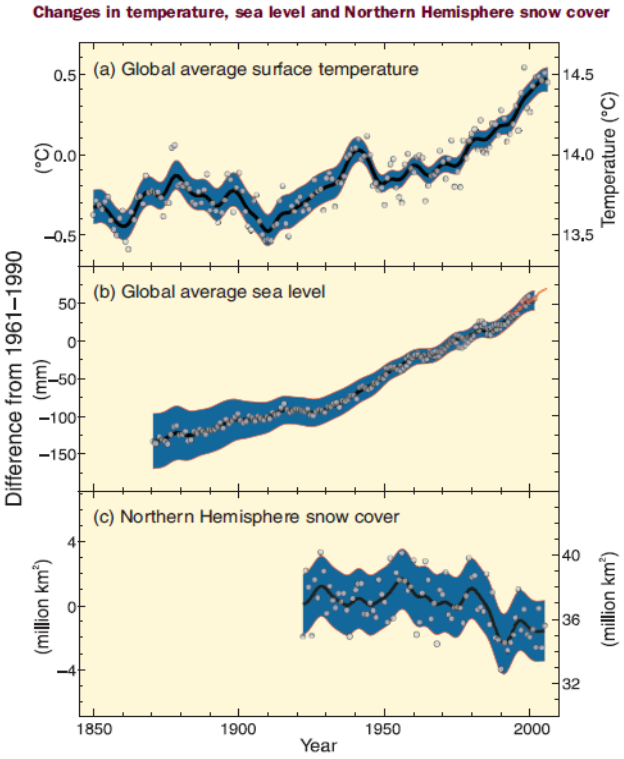


Figure 1: Observed changes in global temperature, sea level and snow cover

ICLEI Climate Mitigation Program

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. 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.

[1] IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.
[2] Burt, Chirstopher C. "2012 a Record Warm Year for Continental U.S"., January 2, 2013. http://www.wunderground.com/blog/weatherhistorian/comment.html?entrynum=112
[3] NOAA: State of the Climate 2012 Summary. http://www.ncdc.noaa.gov/sotc/

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones:

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.

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

Figure 2: ICLEI Climate Mitigation Milestones

Sustainability & Climate Change Mitigation Activities in Evansville

Evansville has already implemented programs that have or will lead to ancillary benefits in the form of energy conservation and greenhouse gas mitigation.

- City Council Resolution C-2019-03: 100% renewable energy powering city operations by 2050
- Certified Tree City USA
- Recycling and waste reduction programs
- Solar installation at West Wastewater Treatment Plant
- LED bulbs in city facilities

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 operations of the Evansville government. Evansville is focusing first on government operations emissions in order to lead by example. The government operations inventory is mostly a subset of the community inventory, as shown in figure 3. For example, data on commercial energy use by the community includes energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

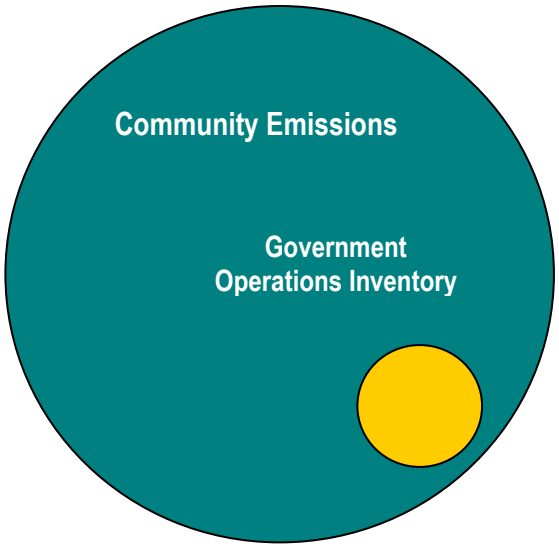


Figure 3: Relationship of Community and Government Operations Inventories

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 Local Government Operations Protocol (LGO Protocol), which is described below.

Local Government Operations Protocol

In 2008, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released 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 principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory.

Quantifying Greenhouse Gas Emissions

Emissions Scopes

For the government operations inventory, emissions are categorized by scope. Using the scopes framework helps prevent double counting. There are three emissions scopes for government operations emissions:

[4] Local Government Operations Protocol. http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol

- **Scope 1:** All direct emissions from a facility or piece of equipment operated by the local government. Examples include tailpipe emissions from local government, and emissions from a furnace in a local government building.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling.
- **Scope 3:** All other indirect or embodied emissions not covered in Scope 2. Examples include contracted services, embodied emissions in good purchased by the local government, and emissions associated with disposal of government generated waste.

Scope 1 and Scope 2 emissions are the most essential components of a government operations greenhouse gas analysis as they are the most easily affected by local policy making.

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. Evansville's community greenhouse gas emissions inventory utilizes 2017 as its base year. 2017 was chosen due to the availability of data and its ability to provide a recent baseline of emissions.

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 the software ClearPath.

Government Operations Emissions Inventory Results

Emissions by Scope

As was described in the introduction, Scopes are used to keep track of emissions in order to avoid double counting within and between entities. Table 1 lists government operations emissions by scope. Scope 1 emissions come from fuel use in government facilities and vehicles; Scope 2 emissions come from electricity use, and Scope 3 are other indirect emissions. CO_2 from biogenic sources is listed as information items, as it is part of the active carbon cycle.

Table 1: Government Operations Emissions by Scope

Total Emissions							
	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
SCOPE 1	13,914	12,266	0.548	5.49	0	0	0
SCOPE 2	30,599	30,395	2.64	0.464	0	0	0
SCOPE 3	3,338	2683.3	25.09	0.093	0	0	0

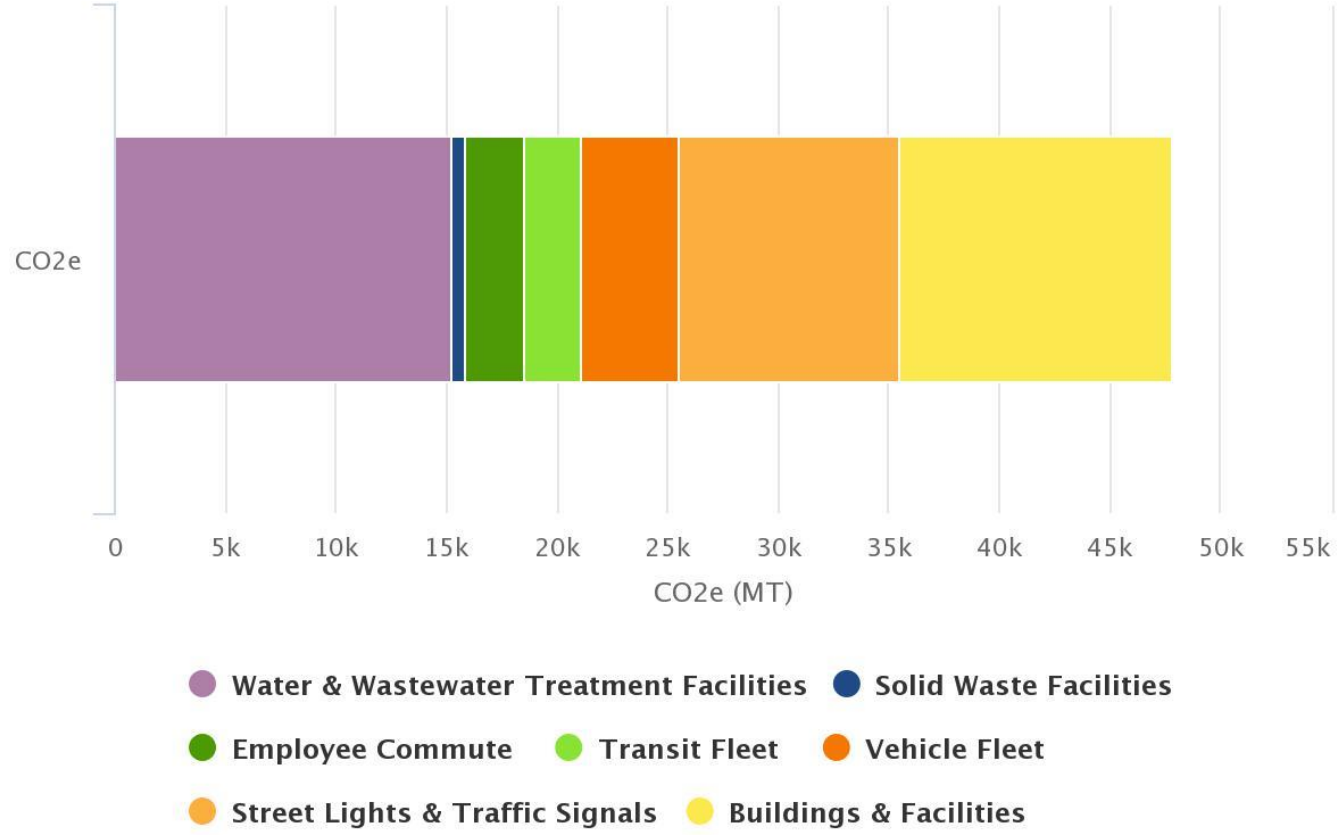
Emissions by Sector

For developing emissions reduction policies, it is often most useful to look at emissions broken down by sector, as each sector will have a particular set of strategies to reduce emissions. Table 2 and Figure 4 show Evansville's government operations emissions broken down by sector, while the remainder of this section breaks down these emissions in further detail within each sectors.

Table 2: Government Operations Emissions by Sector

Sector	**metric tons CO2e**
Buildings and Facilities	12,364
Vehicle Fleet	4522
Street Lights & Traffic Signals	9940
Water & Wastewater	15,170
Employee Commute	2714
Transit Fleet	2518
Government-Generated Solid Waste	624
Totals	**47,852**

Figure 4: Government Operations Emissions by Sector (MTCO2e)



Buildings & Facilities

Buildings and facilities were the second largest sector of government operations emissions. Table 3 shows building emissions by scope and emissions type.

Table 3: Building and Facility Emissions by Scope and Emission Type

BUILDINGS & OTHER FACILITIES								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	3945	3933.74	0.371	0.00742	0	0	0
	Total Direct Emissions	3945	3933.74	0.371	0.00742	0	0	0
SCOPE 2		CO_2e	CO_2	CH_4	N_2O			
	Purchased Electricity	7145	7097.57	0.6165	0.1085			
	Fugitive Emissions	1274	1265.43	0.1099	0.0193			
	Total Indirect Emissions	8419	8363.00	0.7264	0.1278			

Table 4 shows building emissions by department. Fugitive emissions associated with electricity production and use are not included in Table 4. This information will be helpful in engaging department directors to identify strategies to reduce energy use. Table 4 also shows building energy cost by department. Evansville spent $1,869,850.65 on building energy use in 2017, showing that there is considerable opportunity for cost savings through building energy conservation measures. Table 4 does not include electricity and natural gas emissions from the Water & Wastewater sector. These emissions are included in the Water & Wastewater section.

Table 4: Building Emissions and Energy Cost by Department

Department	metric tons CO2e	Energy Cost
Parks & Recreation	4870	$844,175.08
Mesker Park Zoo	2426	$380,000
Public Works	1090	$142,695.57
Fire Department	992	$155,600
Levee Authority	911	$198,422.87
Animal Control	238	$24,734.99
Police Department	214	$31,705.90
Central Dispatch	161	$35,425.71
Port Authority	159	$35,000
Emergency Management Agency	91	$15,232.65
Urban Forestry	21	$2,890.65
TIF Projects	12	$2,767.23
Economic Development	5	$1,200
Totals	**11,090**	**$1,869,850.65**

Table 5 shows buildings sector emissions by source. Electricity use is the largest source of buildings emissions, followed by natural gas use. Fugitive emissions associated with electricity production and use are not included.

Table 5: Buildings Emissions by Source

Source	metric tons CO2e
Electricity	7145
Natural Gas	3945
Totals	**11,090**

Table 6 shows the five individual departments with the highest emissions. These departments may present particularly cost-effective energy reduction opportunities. Fugitive emissions associated with electricity production and use are not included in Table 6.

Table 6: Five Largest Contributors to Emissions from Buildings Sector

Department	Metric Tons CO2e	% of Building Sector Emissions	Energy Cost
Parks & Recreation	4870	43.9%	$844,175.08
Mesker Park Zoo	2426	21.9%	$380,000
Public Works	1090	9.8%	$142,695.57
Fire Department	992	8.9%	$155,600
Levee Authority	911	8.2%	$198,422.87
Totals	**10,289**	**92.7%**	**$1,720,893.52**

Vehicle Fleet

After streetlights & traffic signals, vehicles were the fourth largest source of government operations emissions. In 2017, Evansville's vehicle fleet performed a number of essential services. Table 7 shows vehicle emissions by scope.

Table 7: Vehicle Emissions by Scope and Emission Type

VEHICLE FLEET		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 1		CO_2e
	Mobile Combustion	4522
	Total Direct Emissions	4522

Table 8 shows vehicle emissions by fuel type.

Table 8: Local Government Vehicle Fleet Emissions by Fuel Type

Source	metric tons CO_2e	Consumption (gal)
Gasoline	3237	368,611.553
Diesel	1168	114,394.363
Off-Road Diesel	117	11,500
Totals	**4522**	**494,505.016**

Table 9 shows vehicle emissions by department. This information will be helpful in engaging department directors to identify strategies to reduce vehicle fuel use. However, the emissions breakdowns in Table 9 do not include bulk gasoline and diesel purchases. Bulk purchases are included in Tables 7 & 8.

Table 9: Vehicle Emissions by Department

Department	metric tons CO2e
Police Department	1736.08
Water & Sewer (EWSU)	1189.47
City & Street Maintenance	259.29
Fire Department	268.53
Building Commission	67.71
Traffic Engineering	64.82
Animal Control	65.61
Urban Forestry	51
Levee Authority	49.83
METS	23.47
City Cemeteries	19.33
City Engineering	15.16
Emergency Management Agency	10.15
Other Departments	17.98
Total	**3,838.43**

Public Lighting

Like most local governments, Evansville operates a range of public lighting including traffic signals and street lighting. In 2017, streetlights & traffic signals were the second largest source of government operations emissions. Table 10 shows public lighting emissions by scope and emission type.

Table 10: Public Lighting Emissions by Scope and Emission Type

STREETLIGHTS, TRAFFIC SIGNALS, AND OTHER PUBLIC LIGHTING					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	9512.5	9448.97	0.821	0.144
	Fugitive Emissions	427.1	424.26	0.037	0.0065
	Total Indirect Emissions	9939.6	9873.23	0.8247	0.1505

Table 11 shows public lighting emissions and energy cost by lighting type. Street lighting was the largest contributor to lighting sector emissions.

Table 11: Emissions by Lighting Type

Lighting Type	metric tons CO2e	% of Sector Emissions	Electricity Use (kWh)	Cost ($)
Traffic Signals / Controllers	263.8	2.8%	464,692.96	$58,086.62
Streetlights	9248.7	97.2%	16,288,873.12	$2,036,109.14
Totals	**9512.5**	**100%**	**16,753,566.08**	**$2,094,195.76**

Wastewater & Water

The Water & Wastewater sector was the largest source of government operations emissions in 2017.

Wastewater Treatment

Wastewater collection and treatment is an essential public service provided by Evansville. Wastewater treatment processes require a significant amount of energy. In addition, as wastewater is collected, treated, and discharged, chemical processes in aerobic and anaerobic conditions lead to the creation and emission of methane and nitrous oxide. Table 12 shows wastewater collection and treatment emissions by scope and emissions type.

Table 12: Wastewater Emissions by Scope and Emission Type

WASTEWATER TREATMENT FACILITIES								
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**						
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
	Stationary Combustion	437.9	436.67	0.041	0.0008	0	0	0
	Process Emissions	1628.1	0	0	5.464	0	0	0
	Total Direct Emissions	2066	436.67	0.041	5.4648	0	0	0

SCOPE 2	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	4817.6	4785.45	0.42	0.073

Total Indirect Emissions	4817.6	4785.45	0.42	0.073

Table 13 shows wastewater emissions and energy costs broken down by different processes within the treatment plant or collection system. This information may be useful in identifying opportunities for emissions reductions and cost savings within the wastewater treatment system.

Table 13: Wastewater Emissions by Equipment or Process

Subsector	metric tons CO2e
Facility Energy Use	5255.5
Nitrification/ Denitrification	447
Treated Effluent Discharge	1181.1
Totals	**6883.6**

Potable Water Treatment & Delivery

Treatment and supply of potable (safe to drink) water is another essential service provided by Evansville and is also energy intensive. Table 14 shows emissions from water treatment and supply by scope and emissions type.

Table 14: Water Treatment & Delivery Emissions by Scope and Emission Type

WATER TRANSPORT FACILITIES					
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**			
SCOPE 1		CO_2e	CO_2	CH_4	N_2O
	Stationary Combustion	862.67	860.16	0.081	0.0016
	Total Direct Emissions	862.67	860.16	0.081	0.0016
SCOPE 2		CO_2e	CO_2	CH_4	N_2O
	Purchased Electricity	6897.3	6851.2	0.595	0.105
	Fugitive Emissions	526	522.49	0.045	0.008
	Total Indirect Emissions	7423.3	7373.69	0.64	0.113

Table 15 shows water emissions and energy costs broken down by different system components. This information may be useful in identifying opportunities for emissions reductions and cost savings within the water supply system.

Table 15: Water Delivery Emissions by Equipment Type

Subsector (Equipment Type)	metric tons CO2e	% of Sector Emissions
Drinking Water Treatment	4577.6	55.2%
Drinking Water Pumps	3182.4	38.4%
Totals	**7760**	**93.6%**

Employee Commute

Employee commute emissions are not under direct operational control of Evansville, but Evansville has a variety of tools available to influence them. Total employee commute emissions are 2714 metric tons CO2e, as shown in table 16.

Table 16: Employee Commute Emissions

EMPLOYEE COMMUTE		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 3		CO_2e
	Mobile Combustion	2714

Evansville can influence employee commute emissions primarily by promoting alternative commute modes such as public transit and carpooling, and by offering options such as compressed workweeks and telecommuting that reduce the number of trips employees must make.

Transit Fleet

Evansville operates a public transit fleet, Metropolitan Evansville Transit System (METS). Table 17 shows emissions from the operation of that fleet.

Table 17: Transit Fleet Emissions

TRANSIT FLEET							
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**					
SCOPE 1		CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs
	Mobile Combustion	2518.64	2513.76	0.054	0.0118	0	0
	Total Direct Emissions	2518.64	2513.76	0.054	0.0118	0	0

Government-Generated Solid Waste

Many local government operations generate solid waste, much of which is eventually sent to a landfill. Typical sources of waste in local government operations include paper and food waste from offices and facilities, construction waste from public works, and plant debris from parks departments. Emissions from this waste will occur over time as the waste breaks down in the landfill. Emissions are shown in Table 18 and attribute all future emissions from generated waste to the year in which that waste was sent to the landfill.

Table 18: Government Generated Solid Waste Emissions

SOLID WASTE GENERATION		
Scope	**Emission Type**	**Greenhouse Gas Emissions (metric tons)**
SCOPE 3		CO_2e
	Waste All Facilities	624.2
INDICATORS	Short tons of solid waste	1471.9

Table 19 shows waste emissions broken down by the department generating the waste. This information may be helpful in developing waste reduction strategies.

Table 19: Waste Emissions by Department

Department	metric tons CO2e
Parks & Recreation	221.5114
Water & Sewer (EWSU)	156.903
Mesker Park Zoo	91.298
Fire Department	63.908
Levee Authority	18.3185
Oak Hill/Locust Hill Cemetery	16.738
METS	12.173
Traffic Engineering	12.173
Animal Control	9.8906
Port Authority (LST)	9.1298
Central Dispatch	6.0865
Police Department	6.0865
Totals	**624.2163**

Conclusion

This inventory marks completion of Milestone One for government operations of the Five Milestones for Climate Mitigation. The next steps are to set an emissions reduction target, and to develop a climate action plan that identifies specific quantified strategies that can cumulatively meet that target. In addition, Evansville should continue to track key energy use and emissions indicators on an on-going basis. ICLEI recommends completing a re-inventory at least every five years to measure emissions reduction progress.

Emissions reduction strategies to consider for the climate action plan include energy efficiency, renewable energy, vehicle fuel efficiency, alternative transportation, vehicle trip reduction, and waste reduction among others. This inventory shows that Water & Wastewater, Street Lights, and Buildings & Facilities will be particularly important to focus on. Through these efforts and others, the City of Evansville can achieve additional benefits beyond reducing emissions, including saving money and improving Evansville's economic vitality and its quality of life.

Recommended next steps include first replacing city streetlights with LED bulbs as lights burn out. LED bulbs can save 50-80% of energy use, greatly reducing energy costs and emissions associated with powering streetlights. Renewable energy, likely solar, will need to be implemented on a large scale to reduce emissions and meet the city's 100% renewable energy goal, starting with the wastewater treatment plants, the water filtration plant, and pump and lift stations. Large city government facilities, such as the Civic Center and the C.K. Newsome Community Center should begin to transition to renewable energy. Mesker Park Zoo, all fire stations, police stations, and other government facilities should also begin transitioning to renewable energy. Transitioning to renewable energy will save the city money and will reduce a large portion of the emissions associated with government operations.

The city's vehicle fleet should begin to transition to hybrid and/or electric vehicles. It is recommended that every new vehicle purchased should be a hybrid electric or 100% electric vehicle. Electrifying the city's vehicle fleet will save on fuel costs and reduce emissions. In order to reduce emissions resulting from employee commutes, the city should incentivize alternative transportation, carpools, and other methods to reduce single passenger trips to work. This could include a reduced or eliminated fare on METS public transit for city employees, providing front row parking spaces for carpools, allowing employees to work from home or telecommute more often, and providing plenty of electric vehicle charging stations for employees to use.

Appendix: Inventory Details

Table A-1 provides details on calculation methods and data sources for each included emissions sector.

Table A-1: Government Operations Inventory Calculation Method and Data Source Details

	Activity data		Emissions factor			Method
Buildings electricity use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	49,970,482.08	**kWh**	**0.16525**	**MT/MMBtu**	**Protocol**	**other**
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

	Activity data		Emissions factor			Method
Buildings natural gas use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	996,028.45	**therms**	**0.05302**	**MT/MMBtu**	**Protocol**	**other**
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable so an estimation based on amount spent using average price/therm was used. Purchase orders for each department were obtained for the estimation. Average price/therm was based on data found in this document: https://www.vectren.com/assets/downloads/rates/in-south-gas-costs.pdf						

	Activity data		Emissions factor			Method
Streetlight & traffic signal electricity use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	16,753,566.08	**kWh**	**0.16525**	**MT/MMBtu**	**Protocol**	**other**
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

	Activity data		Emissions factor			Method
Vehicle fleet gasoline use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	368,611.553	**gallons**	**0.070268**	**MT/MMBtu**	**Protocol**	**7.1.1.1**
Method and data source notes: Data Source: Purchasing Department and MUNIS software.						

	Activity data		Emissions factor			Method
Vehicle fleet diesel use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	114,394.363	**gallons**	**0.073964**	**MT/MMBtu**	**Protocol**	**7.1.1.1**
Method and data source notes: Data Source: Purchasing Department and MUNIS software.						

	Activity data		Emissions factor			Method
Vehicle fleet off-road diesel use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	11,500	**gallons**	**0.073964**	**MT/MMBtu**	**Protocol**	**7.1.1.1**
Method and data source notes: Data Source: Purchasing Department and MUNIS software.						

	Activity data		Emissions factor			Method
Transit fleet diesel use	**Value**	**Unit**	**Value**	**Unit**	**Source**	
	246,206	**gallons**	**0.073934**	**MT/MMBtu**	**Protocol**	**7.1.1.1**
Method and data source notes: Data Source: METS and National Transit Database.						

Transit fleet CNG use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	3,375	gallons	0	MT/MMBtu	Protocol	7.1.1.1
Method and data source notes: Data Source: METS and National Transit Database.						

Employee commute gasoline	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	300,761.14	gallons	0.070268	MT/MMBtu	Protocol	12.2.1
Method and data source notes: Data Source: Employee survey and Human Resources. Survey was sent to all city employees. This survey provided data used to estimate mpg, miles traveled to work, and type of vehicle. Human Resources provided a total count of city employees so the data could be converted from approximately 150 responses to the total number of employees (approximately 1585).						

Employee commute diesel	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	4,175.35	gallons	0.073964	MT/MMBtu	Protocol	12.2.1
Method and data source notes: Data Source: Employee survey and Human Resources. Survey was sent to all city employees. This survey provided data used to estimate mpg, miles traveled to work, and type of vehicle. Human Resources provided a total count of city employees so the data could be converted from approximately 150 responses to the total number of employees (approximately 1585).						

Solid waste generation	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	1471.9	tons	902.47	kg CO2/ton	protocol	9.1/other
Method and data source notes: Data Source: MUNIS software. Data on size of dumpsters/toters/etc. and frequency of the containers being emptied was available on MUNIS. This provided a fairly accurate estimation on total tons of waste generated by government operations.						

Wastewater electricity use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	8289163.84	kWh	0.16525	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

Wastewater natural gas use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	76677.4	therms	0.05302	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable so an estimation based on amount spent using average price/therm was used. Purchase orders for each department were obtained for the estimation. Average price/therm was based on data found in this document: https://www.vectren.com/assets/downloads/rates/in-south-gas-costs.pdf						

Wastewater effluent discharge	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	1382.32	Daily N load	0.005	kg N2O/kg N	Protocol	10.10
Method and data source notes: Data Source: EWSU. Exact data was unavailable so a population-based estimation was made using ClearPath.						

Wastewater nitrification/denitrification	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	171,451	People served	7	g/person	Protocol	10.7
Method and data source notes: Data Source: EWSU.						

Sewage treatment electricity use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	195,718.48	kWh	0.16525	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

Sewage treatment natural gas use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	5,682.025	therms	0.05302	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable so an estimation based on amount spent using average price/therm was used. Purchase orders for each department were obtained for the estimation. Average price/therm was based on data found in this document: https://www.vectren.com/assets/downloads/rates/in-south-gas-costs.pdf						

Water Filter Plant electricity use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	6,324,894.71	kWh	0.16525	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

Water Filter Plant natural gas use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	143,212.6	therms	0.05302	MT/MMBtu	Protocol	Other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable so an estimation based on amount spent using average price/therm was used. Purchase orders for each department were obtained for the estimation. Average price/therm was based on data found in this document: https://www.vectren.com/assets/downloads/rates/in-south-gas-costs.pdf						

Water Distribution Plant electricity use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	217,933.52	kWh	0.16525	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

Water Distribution Plant natural gas use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	19,020.75	therms	0.05302	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable so an estimation based on amount spent using average price/therm was used. Purchase orders for each department were obtained for the estimation. Average price/therm was based on data found in this document: https://www.vectren.com/assets/downloads/rates/in-south-gas-costs.pdf						

Pump & lift stations electricity use	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	5,604,810.4	kWh	0.16525	MT/MMBtu	Protocol	other
Method and data source notes: Data Source: MUNIS software. Exact data was unavailable, so an estimation based on amount spent using average price/kWh was used. Purchase orders for each department were obtained for the estimation.						

Electricity grid loss	Activity data		Emissions factor			Method
	Value	Unit	Value	Unit	Source	
	20,632,520.96	kWh	4.49	% loss	EPA eGRID	6.2.6
Method and data source notes: Data Source: MUNIS software & EPA eGRID. Electricity from all departments was summed and a 4.49% loss rate provided by EPA eGRID was used to calculate grid loss.						