

# Baseline Emissions Report: City of Livingston and Park County

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## Summary

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The following report describes the results of a Greenhouse Gas Emissions Inventory completed for the governments of Park County and the City of Livingston. The purpose of this document is to provide a baseline against which future inventories can be compared. Its purpose is not to provide a strategy for reducing emissions. An inventory provides information that allows City and County employees to identify sectors where there are opportunities to increase energy efficiency or implement other energy and cost savings measures and helps decision-makers understand the impacts of these measures. These results are described as Park County including all areas in Park County excluding the City of Livingston, Park County in its entirety, and the City of Livingston. Results for the inventory were as follows:

**Table 1. Greenhouse Gas Emissions totals for the entirety of Park County, Park County excluding the City of Livingston, and the City of Livingston as well as their comparative populations (United States Census Bureau, 2010) and percentages of the whole.**

	<b>Park County &amp; City of Livingston</b>	<b>Park County</b>	<b>City of Livingston</b>
<b>Emissions Total</b>	8,712.37 MTCO <sub>2e</sub>	5,824.85 MTCO <sub>2e</sub>	2,898.10 MTCO <sub>2e</sub>
<b>Emissions Percentage</b>	100%	66.8%	33.2%
<b>Population Total</b>	15,636	8,592	7,044
<b>Population Percentage</b>	100%	55%	45%

## Background

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Reducing energy use by the City of Livingston and Park County governments is a straightforward way to save the local tax-base money and to improve the quality of life for residents. Understanding energy use and emissions production is a necessary first step in creating a plan for a reduction in energy use. A greenhouse gas emissions inventory forms a baseline against which future energy-reduction or efficiency improvements can be compared.

Generally, as greenhouse gasses increase this is because of an increase in energy consumption. While this is not always true due to the different global warming potentials of different gasses, it is logical to draw a correlation between one sector of government having higher GHG emissions and therefore higher energy consumption and higher energy costs. It is harder to draw this correlation with solid waste and wastewater because of the methane associated with those operations having a much greater global warming potential than carbon dioxide.

### What is a greenhouse gas inventory?

A greenhouse gas inventory is an estimate of the amount of greenhouse gases produced by an institution over a set period of time. Greenhouse gas inventories can generally be completed by any institution interested in an accounting of their emissions including businesses, governments, non-profits, school districts, etc. Generally, an inventory measures greenhouse gasses produced during a full calendar year as weather fluctuations can affect greenhouse gas output (heating increases in the winter or air conditioning use in the summer etc.).

Most greenhouse gas inventories include the six greenhouse gasses regulated under the Kyoto Protocol, an international treaty backed by the United Nations that commits nations to greenhouse gas reduction targets. Although an inventory measures these six gases, all results are presented as Metric Tons of Carbon Dioxide Equivalents (MTCO<sub>2e</sub>). The reason for this is that each greenhouse gas has a different Global Warming Potential (GWP). GWP is a measure of how much heat 1 ton of a certain greenhouse gas traps in the atmosphere over 100 years, relative to 1 ton of carbon dioxide (considered the baseline greenhouse gas, with a GWP of 1). The six gases covered by the Kyoto Protocol and their GWP are listed below:

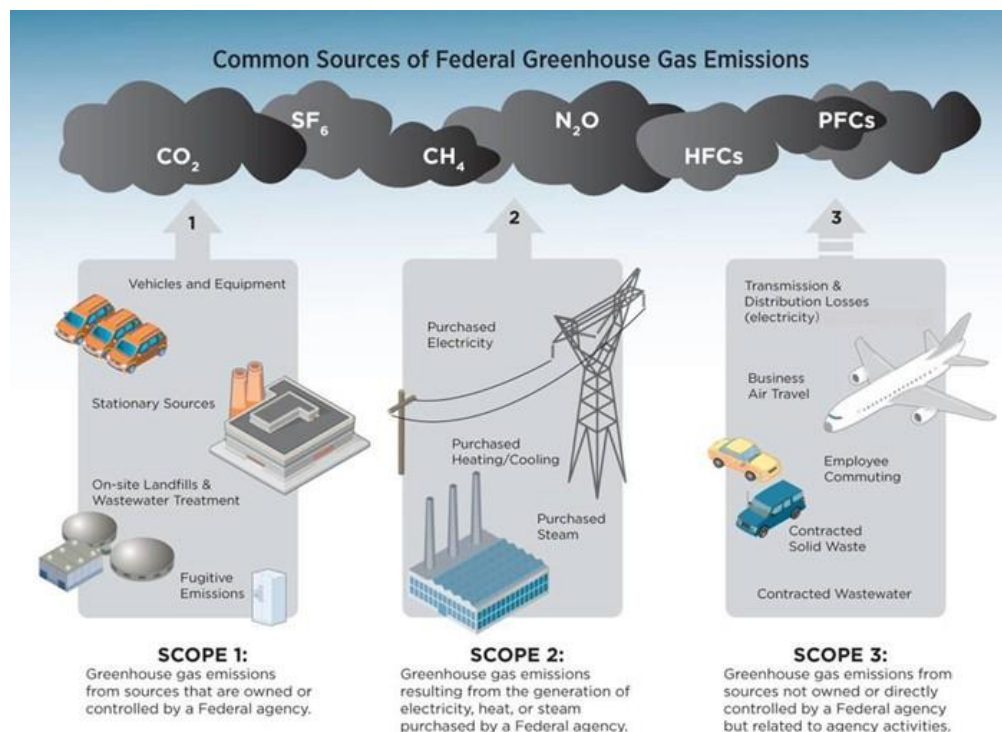
**Table 2. The six greenhouse gases regulated by the Kyoto Protocol and their corresponding global warming potentials (United States Environmental Protection Agency) (United Nations Framework Convention on Climate Change).**

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO <sub>2</sub> )	1
Methane (CH <sub>4</sub> )	28-36
Nitrous Oxide (N <sub>2</sub> O)	265-298

Hydrofluorocarbons (HFCs)	140-11,700
Perfluorocarbons (PFCs)	6,500-9,200
Sulfur Hexafluoride (SF <sub>6</sub> )	23,900

Reporting all greenhouse gas emissions included in the inventory as a standard metric ton of carbon dioxide equivalent (MTCO<sub>2</sub>e) allows for easy comparison between actions that produce different types of greenhouse gases. For instance, comparison between wastewater treatment and electricity use where the former mostly produces methane and the latter can produce a combination of gases including carbon dioxide, methane, and nitrous oxide.

A greenhouse gas inventory measures emissions produced in multiple ways. Each emission type is classified into a scope. The scope describes how the emission relates to the institution conducting the inventory. There are three emissions scopes: direct emissions, facility-related indirect emissions, and indirect emissions:



**Figure 1. Illustration demonstrating the differences between direct, energy-related indirect, and indirect emissions within a municipality (United States Environmental Protection Agency, 2018).**



## Methods

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The method for completing a greenhouse gas emissions inventory depends on the software chosen. For our inventory, we chose to use the Environmental Protection Agency's Local Greenhouse Gas Inventory Tool which is a free spreadsheet tool designed for local governments that are interested in compiling an inventory (United States Environmental Protection Agency). The Local Greenhouse Gas Inventory Tool can be used to complete two types of inventories:

- (1) Community Module:** Measures greenhouse gas emissions produced by community-wide sources, including residential, commercial, industrial, and government sources.
- (2) Government Operations Module:** Measures greenhouse gas emissions produced from sources directly under government control, such as the energy use of government buildings or gas use by government vehicles.

We chose to complete the Government Operations Module for the Park County government, the City of Livingston government, and the combined City-County governments. We chose the Government Operations Module for two main reasons, first being that it is a smaller inventory and can be completed more quickly, and secondly, confining the inventory to emissions that the city and county governments have full control over allows them to more quickly use the information to inform their conservation and efficiency goals.

This inventory was completed between October 2019 and August 2020. 2018 was chosen as the baseline year for which all data was collected (for example, all city electricity bills from January 2018 to December 2018). This is because it was the most recent year for which there was completely available data. There were a few exceptions to this rule. An employee commute survey was sent out in January 2020. The new Wastewater treatment plant, or Water Reclamation Facility (WRF), in Livingston opened in July 2019. Data was gathered from July 2019 – May 2020 with an estimated value used for June 2020 to complete the year's worth of data. A Tawnya Healy at We Recycle was contacted in attempt to gather recycling quantities for Park County, but the data was not provided in the time this study was completed. Lastly, the percent of urban tree cover was calculated with data taken in 2014.

**Table 3. The Government Operations Module of the EPA’s Local Greenhouse Gas Inventory Tool measures ten types of emissions, each classified under the scopes discussed in the Background section.**

<b>Scope</b>	<b>Emission Type</b>	<b>Description</b>	<b>GHG Measured</b>
<b>Scope 1: Direct Emissions</b>	Stationary Combustion	Fossil fuel use by stationary sources (generators, heating etc.)	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
	Mobile Combustion	Fossil fuel use by vehicles (gasoline, diesel etc.)	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
	Solid Waste Disposal	Emissions from landfills within the inventory boundary	CH <sub>4</sub>
	Wastewater Treatment	Emissions from wastewater treatment within the boundary	CH <sub>4</sub> , N <sub>2</sub> O
<b>Scope 2: Energy-related indirect emissions</b>	Facility Indirect Emissions	Emissions from generating the electricity used by facilities	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
<b>Scope 3: Indirect emissions</b>	Water Consumption	Emissions generated from importing water	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
	Land Management	Emissions from fertilizer use within the boundary	N <sub>2</sub> O
	Urban Forestry	CO <sub>2</sub> sequestration from urban tree cover within the boundary	CO <sub>2</sub> (sequestered)
	Waste Generation	Emissions from exporting waste to landfills outside the boundary	CH <sub>4</sub>

	Employee Commutes	Emissions from fuel used during employee commutes	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
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Some emission types were not relevant to City-County government operations. The entirety of the county operates on wells so there is no water treatment, the only greenhouse gasses associated water are from the electricity used at groundwater pumps and lift stations. Much of the county uses gravity fed systems as well. The EPA's Local Greenhouse Gas Inventory Tool requested data for agriculture and land management to calculate scope 3 emissions associated with the application of fertilizer, but no data was available. Additionally, the City County Complex facility is a shared building by both Park County and the City of Livingston but was classified under the Park County calculations for this inventory.

After data was collected, they were categorized into eight "sectors". These sectors describe major categories of City-County energy use and each can be a separate focus of emissions reduction:

- (1)** Solid Waste
- (2)** Wastewater
- (3)** Vehicle Fleet
- (4)** Buildings and Facilities
- (5)** Water
- (6)** Streetlights
- (7)** Employee Commute
- (8)** Urban Forestry

Multiple emission types often comprised each sector. For instance, the Solid Waste sector includes emissions from Stationary Combustion (Natural Gas usage by Solid Waste buildings), Mobile Combustion (gas and diesel usage from Solid Waste trucks), Facility Indirect Emissions (Electricity use of Solid Waste buildings), and Waste Generation (emissions from trucking the waste to the landfill and emissions from the breakdown of the waste in the landfill). A complete breakdown of the data sources and calculations for each sector can be found in the [Appendix](#) section.

In order to calculate the greenhouse gas emissions associated with solid waste, a second tool was used called Waste Reduction Model (WARM), created by the U.S. Environmental Protection Agency Office of Resource Conservation and Recovery. Many tools and software available to calculate greenhouse gas emissions from solid waste use a life cycle approach. This tool uses vehicle fuel consumed, miles traveled, type of landfill, and quantities of various types of materials both landfilled and recycled. Emissions factors for different materials modeled in WARM represent the full life cycle of the material. “Certain components of these life-cycle GHG emission factors, however, do not occur immediately following end-of-life management of a material, but over a longer period of time.” and “, it is not appropriate to directly compare the benefits of alternative waste management as modeled through WARM with traditional GHG Inventory reports, which quantify GHG emissions from different sectors on an annual basis.” (U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, 2019) This approach makes it challenging to align the numbers from one year of solid waste produced with a one year inventory of government operations.

When considering recycling and waste reduction, WARM considers the current material mix for different recycled goods. “For example, in source reducing 100 tons of aluminum cans, WARM models that only 32 tons of virgin aluminum manufacture[d] are avoided, because the current mix for aluminum is 32 percent virgin inputs and 68 percent recycled inputs.” (U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, 2019) WARM also provides greenhouse gas credits for those values of paper and wood products recycled because reduced demand for virgin wood increases the amount of carbon stored in forests by reducing the amount of wood harvested. “These emission reductions, resulting from the avoided degradation of organic materials into methane in landfills and the accumulation of carbon in forests, can occur over a timeframe of years to decades.” (U.S. Environmental Protection Agency Office of Resource Conservation and Recovery, 2019)

It is evident that the WARM tool is far too specific and detailed to calculate just one year’s worth of emissions related to our solid waste. It’s valuable to note that the emissions from decaying material in our landfills does not occur instantaneously as it’s disposed, but rather over a long period of time. However, we believe that the scope for WARM is far too broad, including material extraction, and recycling resulting in a reduction in demand for virgin material. For this reason the greenhouse gas emissions associated with solid waste will be over-represented, and data will be analyzed both with and without the results from the WARM analysis.

## Findings

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Greenhouse gas (GHG) emissions were compiled for the entirety of Park County, for all areas in Park County excluding the City of Livingston, as well as the City of Livingston. To aid in conceptualizing this quantity of CO<sub>2</sub> emissions: a typical passenger vehicle could travel over 21 million miles, almost ¼ of the distance from Earth to the Sun, and emit the same amount of CO<sub>2</sub> as the entirety of Park County including the City of Livingston. Park County excluding the City of Livingston's equivalent miles traveled by a typical passenger vehicle are over 14 million, about 1/6th of the distance from the Earth to the Sun (United States Environmental Protection Agency, 2018) (Cool Cosmos).

**Table 4. GHG emissions by the entirety of Park County, Park County excluding the City of Livingston, and for the City of Livingston in metric tons of carbon dioxide equivalencies, as well as equivalent miles traveled by a typical passenger vehicle.**

	<b>Park County &amp; City of Livingston</b>	<b>Park County</b>	<b>City of Livingston</b>
<b>Emissions</b>	8,712.37 MTCO <sub>2</sub> e	5,826.97 MTCO <sub>2</sub> e	2,880.90 MTCO <sub>2</sub> e
<b>Equivalent Miles Traveled by Typical Passenger Vehicle</b>	21,565,272 mi.	14,423,193 mi.	7,130,940 mi.

## Park County & City of Livingston Total Emissions

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### Gross Emissions by Department

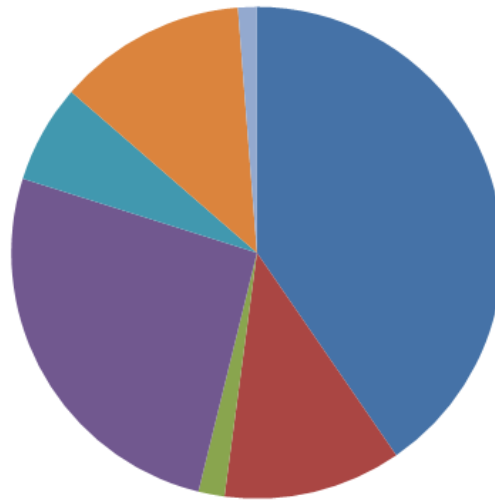
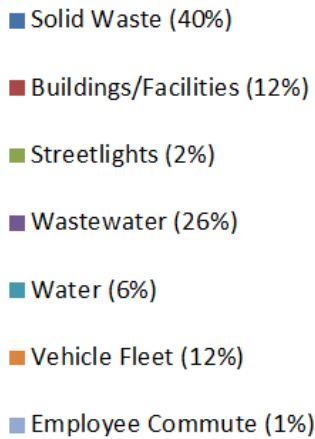


Figure 2. Total GHG emissions for all departments of the entirety of Park County.

### Gross Emissions by Department

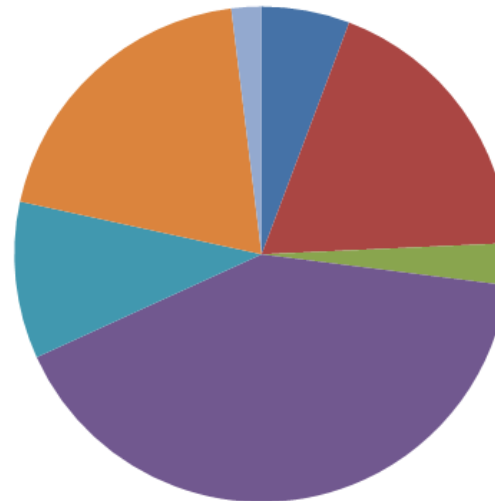
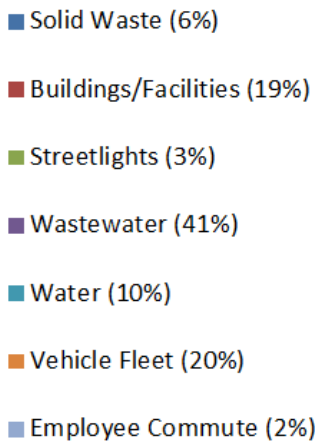


Figure 3. Total GHG emissions for all departments of the entirety of Park County not including the transport to and decomposition of solid waste in the Great Falls landfill.

### Solid Waste

The Solid Waste Sector accounts for a large portion of City-County emissions at 40%. However, this quantity can be misleading. As stated above in the [Methods](#) section, this emissions inventory quantifies emissions produced by government operations. While collecting and transporting solid waste and recycling is a government operation, solid waste and recycling quantities are produced by all residents of Park County and the City of Livingston, and thus emissions from this waste artificially inflate a government operations

inventory. Additionally, the WARM software used uses a life cycle approach, and calculates the transportation to the landfill, and the GHG emissions from the decomposition of waste within the landfill over the entire lifespan of the material. A more accurate count of City-County government emissions would include only emissions produced by government handling of residential and commercial solid waste and recycling, not including the transport of solid waste to the landfill and the greenhouse gas emissions of the solid waste's decomposition. Another approximation was made using solely the GHG emissions from city and county refuse vehicles and their corresponding facilities. This lowers the Solid Waste sector to 6% of total government emissions. A breakdown of emissions is included above.

Around the City of Livingston, residents bring their recyclables to the Transfer station located in Livingston. Around Park County there are 13 locations for residents to drop off their garbage and recycling with different sites accepting different recyclable items. Our city and county recycling service is We Recycle Montana and they pick up recycling from each of our green box locations throughout the county. The City of Livingston trucks their glass recycling to We Recycle Montana in Bozeman, but all other recyclables are picked up by the company. Because of this and the fact that all recycling within the city moves through Livingston's transfer station, Livingston has data on the recycling collected, and Park County does not. For this reason, in the WARM software, the City of Livingston was assumed to have all recycling data available, and none was allotted to Park County.

**Table 5. GHG emissions from all solid waste disposal in the entirety of Park County.**

Transport to, and decomposition of, solid waste in the Great Falls landfill	+ 3,205.64 MTCO <sub>2</sub> e
Refuse trucks	+ 34 MTCO <sub>2</sub> e
Solid Waste buildings	+ 192.5 MTCO <sub>2</sub> e
Avoided emissions from recycling	- 1,537.92 MTCO <sub>2</sub> e
<b>Total</b>	<b>+ 1,894.2 MTCO<sub>2</sub>e</b>
<b>Total (excluding transport to, and decomposition of solid waste in the Great Falls landfill)</b>	<b>+ 226.5 MTCO<sub>2</sub>e</b>

## Wastewater

The wastewater sector accounts for 26% of total emissions, broken down as follows.

**Table 6. GHG emissions from wastewater treatment within the City of Livingston.**

Water Reclamation Facility Electricity	+ 925.7 MTCO <sub>2</sub> e	87.0%
WRF Natural Gas	99 MTCO <sub>2</sub> e	9.3%
City Sewer Pumps	+ 26.8 MTCO <sub>2</sub> e	2.5%
Sewer Department Vehicles	+ 12 MTCO <sub>2</sub> e	1.1%
<b>Total</b>	<b>+ 1063.5 MTCO<sub>2</sub>e</b>	<b>100%</b>

The vast majority of emissions (87%) in the Wastewater sector are produced by the electricity use of the Water Reclamation Facility (WRF). There is only one electric meter at the WRF so, at this time, there is not any refined data regarding electricity use within the plant to be able to distinguish, for instance, the buildings with offices and occupants versus the buildings with machinery and equipment associated to the wastewater treatment. Additionally, there are an estimated 100 septic systems within the City of Livingston, and 4,438 septic systems within Park County.

## Vehicle Fleet

The vehicle fleets of Park County and the City of Livingston contribute just 12% of government operations annual emissions. All vehicles owned and operated by the City and County use gasoline or diesel fuel.

**Table 7. GHG emissions from the vehicle fleets of both Park County excluding the City of Livingston, and the City of Livingston and their corresponding percentages of the total emissions.**

City of Livingston	+ 222 MTCO <sub>2</sub> e	28.5%
Park County excluding the City of Livingston	+ 558 MTCO <sub>2</sub> e	71.5%



<b>Total</b>	<b>+ 780 MTCO<sub>2</sub>e</b>	<b>100%</b>
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The vehicle fleet for the entirety of Park County accounts for 90% of all GHG emissions when compared to the combustion of fuel in solid waste vehicles, wastewater vehicles, and water vehicles.

**Table 8. GHG emissions from the entirety of Park County comparing different sectors of mobile combustion.**

Solid Waste	+ 34 MTCO <sub>2</sub> e	3.9%
Wastewater	+ 12 MTCO <sub>2</sub> e	1.4%
Water	+ 37 MTCO <sub>2</sub> e	4.3%
Vehicle Fleet	+ 778 MTCO <sub>2</sub> e	90.4%
<b>Total Mobile Combustion Emissions</b>	<b>+ 861 MTCO<sub>2</sub>e</b>	<b>100%</b>

### Buildings/Facilities

The buildings and facilities used by the Park County and City of Livingston governments account for 11.72% of annual emissions. Just under 60% of these emissions are from electricity while just over 40% are from heating.

**Table 9. GHG emissions for the buildings and facilities for both Park County and the City of Livingston governments and their corresponding percentages of the total emissions.**

Electricity	+ 578 MTCO <sub>2</sub> e	56.6%
Heating	+ 444 MTCO <sub>2</sub> e	43.4%
<b>Total</b>	<b>+ 1022 MTCO<sub>2</sub>e</b>	<b>100%</b>

### Water

Neither Park County nor the City of Livingston import water from outside their jurisdictional boundaries, or treat water within their boundaries. Instead, water is pumped from a groundwater aquifer. This accounts for 6% of City-County total annual emissions. This inventory only included water pumps for the City of Livingston. Gardiner, Clyde Park, Wilsall, and Cooke City also pump water from the aquifer and some communities utilize gravity fed systems, but refined data was not available.

### Streetlights

The streetlights in Park County and the City of Livingston comprise 2% of annual emissions. The city is billed for every streetlight within its limits, while the power company Northwestern Energy owns some of the lights and bills the city accordingly. Gardiner is the only town in Park County with exclusively city owned streetlights. All other streetlights in Park County are owned and maintained by Northwestern Energy, with the County billed at a flat rate.

### Employee Commute

Employee Commute emissions for City and County employees contribute 1% of total emissions. In December of 2018 the City of Livingston employed a total of 103 people as year-round staff, and Park County employed 132. While not a large slice of total emissions, the data from the survey is interesting on its own.

**Table 10. Results from an employee commute survey from City and County government employees extrapolated using data from a poll sent out in 01/2020 surveying 41% of the total employees.**

<b>Employee Commute Survey Results</b>	
Average one-way commute length	7.27 miles
<b>Percentage of people using different commute types</b>	
Single occupancy vehicle	80.5%
Carpool	3.9%
Bike/walk	13.5%
Motorcycle	1.6%
Transit	0.2%
Work from home	0.4%

### Urban Tree Cover

There are 3.9 million square feet of canopy cover within the City of Livingston as of 2014 (Garvey, 2014), where the City of Livingston is approximately 5.3 square miles as of 2017 (City of Livingston, 2017). This constitutes a percentage of 2.6% tree cover within the City of Livingston. For the software used to calculate the GHG inventory, all tree cover was input into the Buildings & Facilities sector. This data was solely used for the City of Livingston as there is no data available for the entirety of Park County.

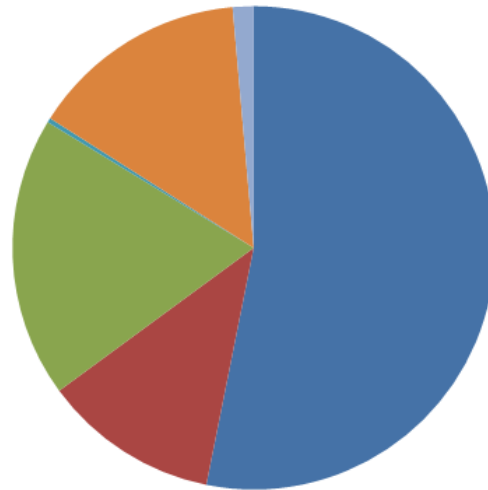
### Park County Emissions

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The ratio of GHG emissions by sector for the government of Park County are as follows.

#### Gross Emissions by Department

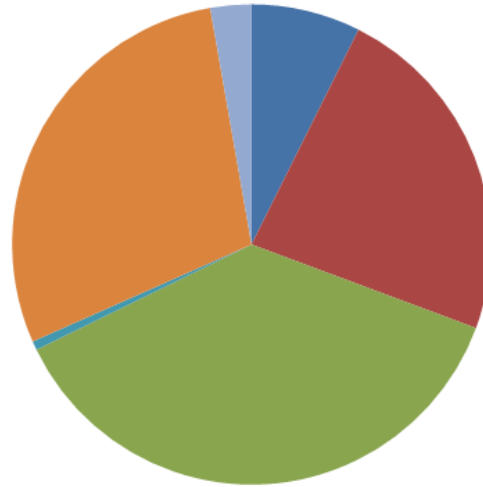
- Solid Waste (53%)
- Buildings/Facilities (12%)
- Wastewater (19%)
- Water (0%)
- Streetlights (0%)
- Vehicle Fleet (15%)
- Employee Commute (1%)



**Figure 4. Total GHG emissions for Park County excluding the City of Livingston by department.**

## Gross Emissions by Department

- Solid Waste (7%)
- Buildings/Facilities (23%)
- Wastewater (37%)
- Water (0%)
- Streetlights (1%)
- Vehicle Fleet (29%)
- Employee Commute (3%)



**Figure 5. Total GHG emissions for Park County excluding the City of Livingston by department excluding the transportation and decomposition of solid waste at the Great Falls landfill.**

### Solid Waste

The Solid Waste Sector accounts for a little over half of County emissions at 53%. Removing transport to and decomposition of solid waste in the Great Falls landfill lowers this share to 7%. Emissions break down as follows.

**Table 11. GHG emissions from solid waste in Park County not including the City of Livingston.**

Transport to, and decomposition of, solid waste in the Great Falls landfill	+ 2,879.87 MTCO <sub>2</sub> e
Refuse trucks	+ 24 MTCO <sub>2</sub> e
Solid Waste buildings	+ 192.5 MTCO <sub>2</sub> e
<b>Total</b>	<b>+ 3,096.4 MTCO<sub>2</sub>e</b>
<b>Total (excluding transport to, and decomposition of solid waste in the Great Falls landfill)</b>	<b>+ 216.5 MTCO<sub>2</sub>e</b>

### Wastewater

While most Park County residents are connected to septic systems, an estimated 4,438 systems, the County does operate a lagoon wastewater treatment system in Gardiner. Data

was not readily available and was excluded from this analysis. Wastewater accounts for 19% of total Park County emissions.

**Vehicle Fleet**

GHG emissions related to the mobile combustion of fuel in Park County vehicles accounts for 15% of total County emissions.

**Buildings/Facilities**

The buildings and facilities in Park County contribute 12% of total emissions. Recall that the City County Building located in Livingston was used to calculate emissions in Park County.

**Table 12. GHG emissions from electricity and heating for all buildings in Park County excluding the City of Livingston.**

Electricity	+ 432.5 MTCO <sub>2</sub> e	63%
Heating	+ 254 MTCO <sub>2</sub> e	37%
<b>Total</b>	<b>+ 648.5 MTCO<sub>2</sub>e</b>	<b>100%</b>

This sector includes all buildings and facilities used by the County except for solid waste and wastewater buildings as those buildings are under the City of Livingston’s jurisdiction.

**Table 13. Electricity and heating consumption for all buildings in Park County excluding the City of Livingston and their corresponding fractions of the total electricity and natural gas consumed (mcf = thousand cubic feet of natural gas).**

<b>Building</b>	<b>Electricity (kWh)</b>	<b>% of Total</b>	<b>Heating (mcf)</b>	<b>% of Total</b>
Airport SRE	839	0.10%	29	0.65%
Mission Field Airport	17,495	2.09%	248	5.56%
Arch Park	10	0.00%	0	0.00%
City-County Complex	589,920	70.39%	2,570	57.60%
City-County Complex Garage	163	0.02%	0	0.00%
Fairgrounds	96,296	11.49%	1,019	22.84%

Gardiner Depot	4,028	0.48%	0	0.00%
Green Acres Park	3,428	0.41%	0	0.00%
Road Department	63,264	7.55%	0	0.00%
Search & Rescue	21,145	2.52%	361	8.09%
Weed Shed	8,237	0.98%	0	0.00%
Yellowstone Gateway Shop	897	0.11%	0	0.00%
YG Museum	32,365	3.86%	235	5.27%
<b>Total</b>	<b>838,087</b>	<b>100%</b>	<b>4462</b>	<b>100%</b>

### Water

Park County does not import water from outside their jurisdictional boundaries, nor treat water within their boundaries. Instead, water is pumped from a groundwater aquifer. Some communities within the county utilize gravity fed systems, but refined data was not available.

### Streetlights

The streetlights in Park County comprise less than one percent of annual emissions. Gardiner is the only town in Park County with exclusively city owned streetlights. All other streetlights in Park County are owned and maintained by Northwestern Energy, with the County billed at a flat rate.

### Employee Commute

In 2018 Park County had 132 full-time employees. Emissions from County employee commutes comprise 1% of total Park County emissions. Commute modes are, as follows.

**Table 14. Results from an employee commute survey from County government employees extrapolated using data from a poll sent out in January of 2020 surveying 42% of the total employees.**

<b>Employee Commute Survey Results</b>	
Average one-way commute length	9.72 miles
<b>Percentage of people using different commute types</b>	

Single occupancy vehicle	76.3%
Carpool	1.0%
Bike/walk	17.7%
Motorcycle	4.0%
Transit	0.3%
Work from home	0.7%

### Urban Tree Cover

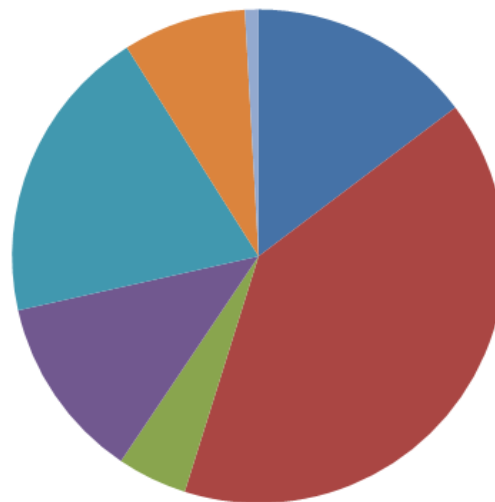
There is no data available for Park County.

### City of Livingston Emissions

The ratio of GHG emissions by sector for the government of the City of Livingston are as follows.

#### Gross Emissions by Department

- Solid Waste (15%)
- Wastewater (40%)
- Streetlights (5%)
- Buildings/Facilities (12%)
- Water (20%)
- Vehicle Fleet (8%)
- Employee Commute (1%)



**Figure 6. Total GHG emissions for the City of Livingston by sector.**

### Solid Waste

The solid waste sector accounts for 15% of City emissions. Total emissions break down as follows:

**Table 15. GHG emissions from solid waste in the City of Livingston.**

Transport to, and decomposition of, solid waste in the Great Falls landfill	+ 1,863.69 MTCO <sub>2</sub> e
Refuse trucks	+ 10 MTCO <sub>2</sub> e
Solid Waste buildings	+ 88.63 MTCO <sub>2</sub> e
Avoided emissions from recycling	— 1,537.92 MTCO <sub>2</sub> e
<b>Total</b>	<b>+ 424.40 MTCO<sub>2</sub>e</b>
<b>Total (excluding transport to and decomposition of solid waste in the Great Falls landfill)</b>	<b>+ 98.63 MTCO<sub>2</sub>e</b>

### Wastewater

Wastewater treatment is the single largest source of emissions for the City of Livingston at 40% of total emissions.

**Table 16. GHG emissions from wastewater treatment in the City of Livingston.**

WRF Electricity	+ 908.56 MTCO <sub>2</sub> e	78.5%
WRF Natural Gas	+ 99 MTCO <sub>2</sub> e	8.6%
City of Livingston Sewer Pumps Electricity	+ 26.78 MTCO <sub>2</sub> e	2.3%
City of Livingston Wastewater Trucks	+ 12 MTCO <sub>2</sub> e	1.0%
Wastewater Treatment	+ 111.43 MTCO <sub>2</sub> e	9.6%
<b>Total</b>	<b>+ 1,157.77 MTCO<sub>2</sub>e</b>	<b>100%</b>



The vast majority of emissions (78.5%) in the Wastewater sector are produced by the electricity use of the Water Reclamation Facility (WRF). There are two electricity meters at the WRF so, at this time, there is not any refined data regarding electricity use within the plant. Additionally, there is an estimated 100 people using septic systems within the City of Livingston.

### Vehicle Fleet

The vehicle fleet of the City of Livingston comprises a relatively small slice of total City-County vehicle fleet emissions, at 8%.

**Table 17. City of Livingston vehicle fleet's fuel consumption and the corresponding percent of total.**

Fire	2,390.93 gal diesel	7.9%
EMS	7,844.49 gal diesel	25.8%
Police	8,450.53 gal gasoline	27.8%
Solid Waste	1,118.16 gal gasoline	3.7%
Water	4,190.26 gal gasoline	13.8%
Sewer	1,393.46 gal gasoline	4.6%
Public Works	4,983.76 gal gasoline	16.4%
<b>Total</b>	<b>30,371.58 gal gasoline</b>	<b>100%</b>

### Buildings & Facilities

The buildings and facilities in the City of Livingston contribute 12% of the emissions totals and are pretty even split between electricity and heating:

**Table 18. GHG emissions from electricity and heating for all buildings & facilities within the City of Livingston.**

Electricity	+ 145.5 MTCO <sub>2e</sub>	41.9%
Heating	+ 202 MTCO <sub>2e</sub>	58.1%
<b>Total</b>	<b>+ 347.5 MTCO<sub>2e</sub></b>	<b>100%</b>

This sector includes all buildings and facilities in the City except the City-County Complex at 414 Callender Street as jurisdiction for those energy bills falls under the Park County Public Works Department.

**Water**

Emissions attributable to the energy used by City water pumps comprise 20% of total GHG emissions within the City of Livingston.

**Streetlights**

City streetlights contribute 5% to total emissions within the City of Livingston. This number will rise in the very near future as the annexation of the Green Acres subdivision is completed and streetlight operations in the subdivision transfer from the County to City ownership.

**Employee Commute**

In 2018 the City of Livingston employed 103 people. Employee Commute emissions of City employees contribute less than 1% of total City emissions. While not a large slice of total emissions, the data from the survey is interesting on its own.

**Table 19. Results from an employee commute survey from City government employees extrapolated using data from a poll sent out in January 2020 surveying 39% of the total employees.**

<b>Employee Commute Survey Results</b>	
Average one-way commute length	3.84 miles
<b>Percentage of people using different commute types</b>	
Single occupancy vehicle	90.2%
Carpool	1.6%
Bike/walk	7.7%
Motorcycle	2.6%
Transit	0%

Work from home	0%
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**Urban Tree Cover**

The city of Livingston has a 2.6% tree cover within the urban areas. This value was input into the GHG footprint software under the Buildings & Facilities sector.

**Next Steps**

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The following recommendations are made based on the data acquired with a goal to reduce any and all GHG emissions that may be accomplished within the City of Livingston and Park County’s power. As stated in the Background, despite the fact that this report discusses a greenhouse gas inventory, these values and percentages can be correlated to energy consumption and cost. As shown in Figure 3, the buildings and facilities, vehicle fleet, wastewater, and water sectors are among the highest polluters. The buildings and facilities sector shows emissions from electricity and natural gas, the water sector from electricity, the vehicle fleet from diesel fuel and gasoline, and the wastewater sector from electricity, natural gas, and the emissions associated with the actual treatment of wastewater. Knowing these sectors all hold many different greenhouse gasses within them, all having different global warming potential is important. We couldn’t say that one sector certainly costs the taxpayers more than another because of the wide differences between diesel fuel combustion and methane production from wastewater treatment, for instance. Despite that, it’s still valuable to note the top three or four emitting sectors of the government to pay special attention to and prioritize when it comes to energy consumption reduction.

**Solid Waste**

In addition to the EPA’s WARM software skewing and amplifying our solid waste greenhouse gas footprint, the Great Falls landfill used by the City of Livingston and Park County is 170 miles away from the landfill we use. As stated in the Methods section, a life cycle based emissions calculation for government operations that includes residential solid waste and recycling quantities can be misleading. There are several ways to reduce the GHG emissions from the solid waste sector. One being to simply to reduce the waste residents produce. This can be done by encouraging residential composting as food waste composes the largest percentage of municipal solid waste, at 22% of the trash sent to the landfill (United States Environmental Protection Agency, 2019). Additionally, improving residents’ knowledge on recycling may help increase the amount sent to the recycling facility, and reduce what’s sent to the landfill. Another way to reduce GHG emissions from solid waste is to improve on the efficiency of refuse trucks either in their routes, or by switching to a biodiesel fuel, or all electric truck. Lastly, any improvements made to the

electricity and natural gas use in the solid waste buildings would help reduce GHG emissions. This might include insulation, sealing the envelope, space heating, and lighting to name a few.

**Table 20. GHG emissions for solid waste in both Park County excluding the City of Livingston, and the City of Livingston.**

	<b>Park County excluding the City of Livingston</b>	<b>The City of Livingston</b>
Transport to, and decomposition of, solid waste in the Great Falls landfill	+ 2,879.87 MTCO <sub>2</sub> e	+ 1,863.69 MTCO <sub>2</sub> e
Refuse trucks	+ 24 MTCO <sub>2</sub> e	+ 10 MTCO <sub>2</sub> e
Solid Waste buildings	+ 192.50 MTCO <sub>2</sub> e	+ 88.63 MTCO <sub>2</sub> e
Avoided emissions from recycling	0 MTCO <sub>2</sub> e	— 1,537.92 MTCO <sub>2</sub> e
<b>Total</b>	<b>+ 3,096.37 MTCO<sub>2</sub>e</b>	<b>+ 98.63 MTCO<sub>2</sub>e</b>
<b>Total (excluding transport to, and decomposition of solid waste in the Great Falls landfill)</b>	<b>+ 3,096.37 MTCO<sub>2</sub>e</b>	<b>+ 424.4 MTCO<sub>2</sub>e</b>

### Wastewater

As seen in [Table 6](#), electricity consumption at the Water Reclamation Facility is the largest emitter of greenhouse gases at 26% of the total used by all wastewater treatment related operations. A 2017 report by the U.S. Department of Energy stated electricity typically constitutes 25%-40% of a wastewater treatment plant’s annual operating budget. “Since wastewater treatment plants are usually the largest electric consumer within a municipality, they are often called upon to implement energy reduction measures to help cities meet their broader energy and sustainability goals.” (Better Buildings, 2017). It’s recommended that the WRF obtain more detailed data regarding the electricity consumption for different aspects of the treatment process, like the blowers, aerators, pumps, and lifts to get a better understanding of what could be improved. It’s likely that there may be some energy efficient switches to be made. However, within the last year the City of Livingston’s Public Works office, Street Shop, and WRF have all received LED lighting upgrades. Additionally, the WRF received rebates from Northwestern Energy for installing a total of 17 energy efficient variable frequency drive pumps and eight energy

efficient exhaust fans. For wastewater treatment these are some of the highest electricity consuming devices. Logging data for individual pumps and blowers to optimize efficiency of the wastewater treatment process is a more viable option at the moment.

While the GHG emissions from natural gas combustion are only 4.75% of total emissions, there may be room for improvements particularly in insulation, the envelope, and heating. Other sources of emissions (sewer pumps and department vehicles) may be more readily upgraded to be more efficient, but any avoided emissions are somewhat negligible compared to the electricity consumption of the WRF.

### Vehicle Fleet

The vehicle fleet of Park County ([Table 14](#)) and the City of Livingston ([Table 19](#)) comprise a relatively small slice of total emissions at 12%. While this percentage is low, it is not the lowest sector and energy efficiency strategies should be taken seriously. The City of Livingston purchases new police vehicles once every 1-2 years, and a new municipal solid waste truck every 2 years. There is ample time and opportunity to make energy efficient choices soon. [Table 7](#) shows that Park County has much more to gain as their GHG emissions for their vehicle fleet are over 2.5x larger than those of the City of Livingston. More refined data for the City of Livingston's vehicles was provided in [Table 17](#), however Park County had far more vehicles and a breakdown of their government sector and fuel consumption would be overwhelming and not useful. As vehicles outlive their useful lifespan and need to be replaced, there is an opportunity for the City and County governments to consider hybrid or electric cars in their replacement plans.

### Buildings/Facilities

Retrofitting of lighting in some city and county buildings has already begun but further efficiency upgrades to buildings and facilities could be scheduled as they become possible such as HVAC upgrades, installation of programmable thermostats or building envelope improvements. Efficiency upgrades in Park County and City of Livingston buildings have been ongoing, including in the City-County Complex, City Road Shops and other facilities. Further upgrades, including LED bulb installation, HVAC system upgrades, the installation of programmable thermostats, and building envelope upgrades should continue as these opportunities become available in city and county facilities. Both the City and the County should make an effort to track energy usage as improvements are made. While the City County Building consumes 70.39% of the total electricity and 57.60% of the total natural gas in Park County, there have already been HVAC upgrades, building envelope improvements, and installation of programmable thermostats. It's important to note the second highest consuming building within Park County is the fairgrounds, consuming 11.49% of total electricity and 22.84% of total natural gas. As these two buildings/facilities are among the highest emitting, priority should be made to make improvements there before others.

## Water

This is a sector where both conservation and efficiency upgrades are possible. There may be opportunities for the City of Livingston and/or Park County to invest in, work with larger organizations, or apply for grants to fund large programs like providing faucet and showerhead aerators free to residents. A larger project might be giving rebates to residents who choose to install low flow toilets. Programs like these have been especially popular in states like California and Arizona where water is a scarce and highly valued resource. As well, certain water pumps operate on an as-needed basis and water conservation among City of Livingston residents could reduce the amount of time these pumps are operating and thus their electricity use. Equipment upgrades to the water pumps are also possible to improve efficiency while operating. Our local energy provider Northwestern Energy provides rebates for many water efficiency measures including variable flow drive water pumps, but these rebates are not always available or guaranteed. Gardiner, Clyde Park, Wilsall, and Cooke City also pump water from the aquifer and some communities utilize gravity fed systems, but refined data was not available. Future iterations of this inventory could study other means of acquiring this data.

## Streetlights

Within the City of Livingston there are both city owned lights as well as lights owned by the power company, Northwestern Energy. Northwestern Energy bills both the city and county at a flat rate for those lights it owns and maintains. Gardiner is the only town in Park County with exclusively city owned streetlights. All other streetlights in Park County are either owned and maintained by Northwestern Energy with the County billed at a flat rate, or privately billed to residents. Until the potential date that the city and county own all lights within their jurisdiction, they can only make improvements on the energy efficiency of their lights and create legislation promoting energy efficiency within city and county boundaries.

## Employee Commute

The length of the average commute of a City or County worker suggests that there are many people within biking or walking range of their work. City improvements to bike lanes and other pedestrian friendly infrastructure including but not limited to sidewalk and curb ramp improvements could encourage more people to use zero emission modes in their commute. Public health initiatives or challenges among departments could encourage zero emissions modes of travel as well. Other emissions could be prevented through an emphasis on carpool use over single occupancy vehicles. Although the average one-way commute length suggests that there is not a large missed opportunity for increasing biking and walking among County employees, there could be success among emissions reduction

through carpool encouragement or the encouragement of alternative-fuel vehicle use, such as the installation of electric vehicle charging stations at the City-County Complex.

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# Appendix

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## Track the Data

The following shows where data and calculations were made for most of the tables included in this report.

Table 1: There are separate Iggit excel files for 'combined' Park County and the City of Livingston, for 'Liv\_Sectors' for Livingston, and 'Park\_Sectors' for Park County excluding the City of Livingston.

Table 4: Each separate Iggit excel file for the combined city and county, Park County excluding the City of Livingston, and the City of Livingston. Additionally the 'Report Tables' excel file for calculating the equivalency in miles traveled.

Table 5 and Table 11: Livingston\_waste.warm file, the combined Iggit excel file for mobile combustion, stationary combustion, and electricity.

Table 6: In the 'combined' and 'Liv\_Sectors' Iggit excel file under stationary combustion and electricity shows the electric and natural gas use for the WRF building. The Iggit file has a 'wastewater' tab to calculate the GHG emissions by the treatment of wastewater. City sewer pumps and sewer department vehicles are under the 'electricity' and 'mobile combustion' tabs of the Iggit file.

Table 7: The 'mobile combustion' tab in both the 'Liv\_Sectors' and 'Park\_Sectors' Iggit excel files.

Table 8: The 'Park\_Sectors' Iggit file under 'mobile combustion'.

Table 9: In the 'combined' Iggit file under stationary combustion and electricity for Buildings/Facilities.

Table 10, Table 14, and Table 19: Employee Commute Survey Responses Excel file.

Table 11 and Table 15 and Table 20: Solid Waste PDF data input into WARM software assuming Park County has zero recycling, inputting all recycling values into CoL. Livingston\_waste.warm file.

Table 12 and Table 13: Electricity\_Natural Gas\_ParkCo\_Buildings,Refuse,Sewage Pumps excel file.

Table 16: The 'Liv\_Sectors' Iggit excel file under electricity, stationary combustion, mobile combustion, and wastewater. The WRF\_Questionnaire excel file.

Table 17: 'Liv\_Sectors' Iggit excel file under mobile combustion.

Table 18: Electricity\_Natural Gas\_Livingston excel file.

On April 16<sup>th</sup>, 2020 Kaleb Pearson at Park County Health Department stated that between 1969 and 2019 there were 6,658 permits on file for septic systems. This number includes replacements, repairs, and upgrades so there are likely duplicates in that number. To approximate the number of septic systems he recommended multiplying the number of permits by 2/3. This would result in a total number of 4,438 residences in Park County excluding the City of Livingston. Shannon Holmes with the City of Livingston approximates 100 septic systems within city limits.

In the NWE\_CO2e\_estimates PDF, Northwestern Energy provided their CO<sub>2</sub> equivalent emissions for their electricity production, this was used in all calculations and most all electricity and natural gas throughout Park County was purchased from Northwestern Energy. There were some exceptions to this rule; some of the electricity purchased in Park County was purchased from Park Electric. An email exchange with a Matt Haggerty from Park Electric Co Op on 4/23/2020 revealed the electricity production to be 70% renewable.

### Data types collected

#### By emission type:

Park County:

Emission Type	Data Collected
Stationary Combustion	<ul style="list-style-type: none"><li>● Bulk fuel tank invoices for the Road and Refuse departments</li><li>● Northwestern Energy invoices for natural gas usage</li></ul>
Mobile Combustion	<ul style="list-style-type: none"><li>● Vehicle gas usage data from WEX tracking system</li><li>● Standard MPG measurements provided by the EPA</li></ul>
Wastewater Treatment	<ul style="list-style-type: none"><li>● Estimates of septic system usage for the population of Park County not served by the Water Reclamation Facility.</li></ul>

Facility Indirect Emissions	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for electricity</li> <li>● Park Electric Co-op invoices for electricity</li> </ul>
Waste Generation	<ul style="list-style-type: none"> <li>● Annual solid waste tonnage</li> <li>● Annual recycling tonnage, by category</li> <li>● Trucking distance to the landfill</li> <li>● Trucking distance to the recycling facility</li> <li>● Waste Reduction Model software (published by the EPA) to calculate emissions</li> </ul>
Employee Commutes	<ul style="list-style-type: none"> <li>● Employee Commute survey: <ul style="list-style-type: none"> <li>○ Commute distance</li> <li>○ Commute modes</li> <li>○ Days per week worked</li> </ul> </li> </ul>

City of Livingston:

<b>Emission Type</b>	<b>Data Collected</b>
Stationary Combustion	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage</li> </ul>
Mobile Combustion	<ul style="list-style-type: none"> <li>● Vehicle gas usage data invoices</li> <li>● Standard MPG measurements provided by the EPA</li> </ul>
Wastewater Treatment	<ul style="list-style-type: none"> <li>● Characteristics of wastewater treatment at the Water Reclamation Facility</li> </ul>
Facility Indirect Emissions	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for electricity</li> </ul>

Waste Generation	<ul style="list-style-type: none"> <li>● Annual solid waste tonnage</li> <li>● Annual recycling tonnage, by category</li> <li>● Trucking distance to the landfill</li> <li>● Trucking distance to the recycling facility</li> <li>● Waste Reduction Model software (published by the EPA) to calculate emissions</li> </ul>
Employee Commutes	<ul style="list-style-type: none"> <li>● Employee Commute survey: <ul style="list-style-type: none"> <li>○ Commute distance</li> <li>○ Commute modes</li> <li>○ Days per week worked</li> </ul> </li> </ul>

**By sector:**

Park County:

Sector	Data Included
Solid Waste, including residential waste tonnage	<ul style="list-style-type: none"> <li>● Bulk diesel tank invoices for refuse trucks</li> <li>● Gas usage by Refuse Department vehicles</li> <li>● Park Electric Co-op invoices for electricity usage by County solid waste buildings</li> <li>● Waste Reduction Model<sup>1</sup> estimates of emissions from trucking and decomposition of waste</li> </ul>
Solid Waste, not including residential waste tonnage	<ul style="list-style-type: none"> <li>● Bulk diesel tank invoices for refuse trucks</li> <li>● Gas usage by Refuse Department vehicles</li> <li>● Park Electric Co-op invoices for electricity usage by County solid waste buildings</li> </ul>

Wastewater	<ul style="list-style-type: none"> <li>● Estimates of septic tank usage in Park County</li> </ul>
Vehicle Fleet	<ul style="list-style-type: none"> <li>● Gas usage by Park County vehicles</li> </ul>
Buildings and Facilities	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage by Park County buildings/facilities</li> <li>● Park Electric Co-op invoices for electricity usage by County buildings/facilities</li> </ul>
Water	<ul style="list-style-type: none"> <li>● None</li> </ul>
Streetlights	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for electricity usage by Gardiner streetlights</li> </ul>
Employee Commute	<ul style="list-style-type: none"> <li>● Responses to the Employee Commute Survey by Park County employees.</li> </ul>

City of Livingston:

Sector	Data Included
Solid Waste, including residential waste tonnage	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage by Solid Waste Department buildings</li> <li>● Gas usage by Solid Waste Department trucks</li> <li>● Northwestern Energy invoices for electricity usage by City Solid Waste buildings</li> <li>● Waste Reduction Model<sup>1</sup> estimates of emissions from trucking and decomposition of waste</li> </ul>
Solid Waste, not including residential waste tonnage	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage by Solid Waste Department buildings</li> <li>● Gas usage by Solid Waste Department trucks</li> </ul>

	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for electricity usage by City Solid Waste buildings</li> </ul>
Wastewater	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage by the Water Reclamation Facility</li> <li>● Gas invoices for the Sewer Department</li> <li>● Characteristics of wastewater treatment by the Water Reclamation Facility</li> <li>● Northwestern Energy invoices for electricity usage by the Water Reclamation Facility and sewer pumps</li> </ul>
Vehicle Fleet	<ul style="list-style-type: none"> <li>● Gas usage by City of Livingston vehicles</li> </ul>
Buildings and Facilities	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage by City of Livingston buildings/facilities</li> <li>● Northwestern Energy invoices for electricity usage by City of Livingston buildings/facilities</li> </ul>
Water	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for natural gas usage by City of Livingston water pumps</li> <li>● Gas usage by Water Department Vehicles</li> <li>● Northwestern Energy invoices for electricity usage by City of Livingston water pumps</li> </ul>
Streetlights	<ul style="list-style-type: none"> <li>● Northwestern Energy invoices for electricity usage by City of Livingston streetlights</li> </ul>
Employee Commute	<ul style="list-style-type: none"> <li>● Responses to the Employee Commute Survey by City of Livingston employees</li> </ul>