

CITY OF SPOKANE

2019 Community and Local Government Operations Greenhouse Gas Emissions

INVENTORY REPORT





Land Acknowledgement

We acknowledge that we are on the unceded land of the Spokane people. And that these lands were once the major trading center for the Spokanes as they shared this place and welcomed other area tribes through their relations, history, trade, and ceremony. We also want to acknowledge that the land holds the spirit of the place, through its knowledge, culture, and all the original peoples Since Time Immemorial.

As we take a moment to consider the impacts of colonization may we also acknowledge the strengths and resiliency of the Spokanes and their relatives. As we work together making decisions that benefit all, may we do so as one heart, one mind, and one spirit.

We are grateful to be on the shared lands of the Spokane people and ask for the support of their ancestors and all relations. We ask that you recognize these injustices that forever changed the lives of the Spokane people and all their relatives.

We agree to work together to stop all acts of continued injustices towards Native Americans and all our relatives. It is time for reconciliation. We must act upon the truths and take actions that will create restorative justice for all people.

> Adopted by Spokane City Council on the 22nd day of March 2021 via Resolution 2021-0019

Table of Contents

Cover Page	1
Land Acknowledgement	2
Table of Contents	3
Glossary	4
Executive Summary	6
Introduction	8
Communitywide GHG Inventory	14
Overview	14
Energy	
Transportation	23
Refrigerants	26
Solid Waste	27
Wastewater	
Government Operations GHG Inventory	32
Overview	32
Solid Waste Operations	34
Vehicles & Equipment Fleet	
Wastewater Operations	42
Water Systems	45
Streetlights & Traffic Signals	47
Other Emissions Sources	
Recommendations for Future Inventories	52
Appendices	55
Appendix A: Emissions Summary Tables	56
Appendix B: Data Sources and Assumptions	
Appendix C: Activity Data and Emissions Factors	61
Appendix D: Biogenic Emissions Summary	63



Glossary

Biomass	Non-fossilized organic material from plants, animals, and other organisms
BNSF	Burlington Northern Santa Fe railroad
CH₄	Methane (GWP = 28)
CNG	Compressed natural gas
CO ₂	Carbon dioxide (GHG)
Denitrification	Process through which nitrogen is released back into the atmosphere by converting nitrate into gaseous nitrogen during wastewater treatment process
EPA	Environmental Protection Agency
Fugitive emissions	Emissions from the direct release to the atmosphere of GHG compounds from various types of equipment and processes (e.g., refrigeration and air conditioning systems, fire suppression systems)
GHG	Greenhouse gas
GWP	Global warming potential - measure of how much energy the emissions of one ton of a GHG will absorb over a given period of time, relative to the emissions of one ton of CO2
HFCs	Fugitive hydrofluorocarbons (GWP varies by specific gas)
HPMS	Highway Performance Monitoring System
LPG	Liquefied petroleum gas
MMBtu	One million British Thermal Units (unit of energy measurement)
MOVES	Motor Vehicle Emission Simulator (EPA model)
MTCO ₂ e	Metric tons of carbon dioxide equivalent
N ₂ O	Nitrous oxide (GWP = 265)
Nitrification	Process through which nitrogen compounds are turned into nitrates during wastewater treatment process
NSLF	Northside Landfill
Off-road vehicles	Vehicles and equipment typically used onsite for activities related to agriculture, construction, lawn and garden, etc.
Paratransit vehicles	Accessible transit service with individualized rides operating alongside conventional fixed-route services
PFCs	Perfluorinated compounds (GWP varies by specific gas)
Refrigerants	Refrigeration systems, fire suppression equipment, and vehicle air conditioning



RPWRF	Riverside Park Water Reclamation Facility
SF ₆	Sulfur hexafluoride (GWP = 23,500)
SRTC	Spokane Regional Transportation Council
SSLF	Southside Landfill
T&D	Transmission and distribution
UP	Union Pacific Railroad
VMT	Vehicle miles travelled
WTE	Waste to Energy – combustion of municipal solid waste to generate energy as heat or electricity



CITY OF SPOKANE, WASHINGTON Greenhouse Gas Inventory Results

The City of Spokane has committed to reducing greenhouse gas (GHG) emissions within its community and governmental operations.

As an important step in its climate action planning process, the City has completed GHG inventories for 2017, 2018, and 2019.

These inventories help the City set targets and goals, measure progress over time, and inform which actions will have the greatest GHG emissions reduction benefits.

Where We Are & Where We're Going



1,968,982 Estimated Metric Tons of Carbon Dioxide Equivalent (MTCO₂e)





Two Inventories:

- **Community-wide.** Emissions from community activities, like energy use, transportation, and waste disposal. Prepared in compliance with the *Global Protocol for Community-Scale GHG Inventories and the U.S. Community Protocol for Accounting and Reporting of GHG Emissions.*
- **Government operations.** Emissions from everyday government activities (see results on Page 2). Prepared in compliance with the *Local Government Operations Protocol for the Quantification and Reporting of GHG Emissions Inventories*.

Did You Know?

The City of Spokane has set greenhouse gas reduction goals (from a 2016 baseline) for the next three decades for community emissions:







Community GHG Emissions Trend

2017 and 2019

	2017 Emissions (MTCO ₂ e)	2019 Emissions (MTCO ₂ e)	% Change
Energy	1,103,395	1,080,649	-2%
Transportation	641,624	653,461	2%
Refrigerants	115,518	120,812	5%
Solid Waste	104,547	111,569	7%
Wastewater	3,333	2,490	-25%
Total	1,968,418	1,968,982	0%
Per-Capita	8.93	8.67	-3%

Emissions were flat from 2017 to 2019.

On a per-capita basis (controlling for population growth), emissions **decreased by 3%**.



Emissions From City Government Operations – 2017 and 2019, in MTCO₂e

Emissions produced by the City of Spokane's government operations increased 5% from 2017 due to downtime for repairs of solid waste and wastewater energy generation equipment.

These emissions represent 7% of Spokane's total community emissions.



Other Government Operations:

- Vehicle fleet
- Wastewater facilities
- Water facilities
- Energy in other facilities
- Employee commute
- Streetlights and traffic signals
- Refrigerants

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Visit greenspokane.org for more information about the greenhouse gas inventory and climate action planning process. Follow us on social media to stay up to date with all the efforts going on across the city.



Introduction

The following report summarizes findings from the **2019 greenhouse gas (GHG) inventories** completed for City of Spokane's **community and government operations**. It also provides comparisons to 2017 and 2018 inventory results.

Background

Greenhouse Gases

GHGs cause climate change by absorbing radiation and trapping heat that would otherwise escape from the atmosphere. Human activities like transportation, electricity production, and industrial operations are the largest contributors of GHGs in the U.S.¹

GHG inventories typically focus on the following gases:²

- **Carbon dioxide (CO₂)** emitted through burning fossil fuels, solid waste, biomass, and certain chemical reactions
- Methane (CH₄) emitted during the production and transport of coal, natural gas, and oil, livestock and agricultural practices, land use, and decay of organic waste in landfills
- Nitrous Oxide (N₂O) emitted during agricultural, land use, and industrial activities, combustion of fossil fuels and solid waste, and wastewater treatment
- **Fluorinated gases** hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆) are emitted from a variety of household, commercial, and industrial applications and processes.

Each gas differs in terms of global warming potential (GWP); as such, the standardized unit "metric tons of carbon dioxide equivalent" ($MTCO_2e$) is used to sum and compare total GHG emissions.

Greenhouse Gas Inventories

GHG accounting is a set of **methods for quantifying/estimating GHG emissions** produced by a community or other entity. While some inputs used in inventory

Introduction | 8

¹ <u>https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#t1fn1</u>

² <u>https://www.epa.gov/ghgemissions/overview-greenhouse-gases</u>



calculations are obtained from measured data (e.g., electricity and natural gas consumption), others are modeled based on robust assumptions (e.g., transportation mileage). GHG inventories provide insights into the **primary sources of GHG emissions and inform climate action planning**.

The focus of this GHG inventory is **anthropogenic GHG emissions** – emissions that are a direct result of human activities or result from natural processes that have been affected by human activities. In accordance with inventory protocols and best practices, **biogenic emissions are excluded from totals** in this report. Refer to *Appendix D: Biogenic Emissions Summary* for more information on biogenic emissions.

Greenhouse Gas Emissions Reduction Targets

The City of Spokane has been completing and publishing GHG inventories since 2009 and has committed to continuing to update these inventories at least every three years (SMC 15.05.060).

Using 2016 as its baseline year, the City has <u>adopted</u> the following **emissions reduction targets** to align with Washington State's goals:³

- 45% below 2016 levels by 2030
- 70% below 2016 levels by 2040
- Net zero emissions by 2050

Inventory Scope and Boundaries

Two GHG inventories were prepared for inventory year 2019:

- **Communitywide**: emissions that occurred within City of Spokane's geopolitical boundaries across the residential, commercial, municipal, and industrial sectors. Spokane's city boundary covers approximately 69.5 square miles (Figure 1).
- **Local Government Operations**: emissions that resulted from the City's governmental operations. Includes sources under the City's operational

³ Note the City set these targets using baseline inventory year 2016. The 2016 inventory was completed using different methodologies and data sources than the 2017, 2018, and 2019 inventories. The City plans to restate 2016 emissions to align with inventory years 2017-2019 and update emissions reduction targets using the updated 2016 baseline.



control (City has full authority to introduce and implement operating policies at facility), regardless of geographic location.



Figure 1. City of Spokane Geo-Political Boundary

These inventories are considered "geographic" (communitywide) or "operational" (local government operations) inventories and do not include the majority of Scope 3 upstream and downstream emissions associated with consumed goods and services. As shown in Figure 2, GHG emissions are categorized into three "scopes":

- **Scope 1 emissions**: Direct emissions from owned/controlled sources or sources occurring within the community's geographic boundary.
- **Scope 2 emissions**: Indirect emissions from purchased energy consumed by the community or government.
- **Scope 3 emissions**: All other indirect emissions related to the consumption of goods and services by a community or government.



Figure 2. Scope 1, 2, 3 Emissions Sources (source: <u>WRI/WBCSD Corporate Value Chain (Scope 3) Accounting</u> and Reporting Standard (page 5))



Methodology

The 2019 inventories are prepared in accordance with three protocols:

- <u>Global Protocol for Community-scale GHG Emissions (GPC)</u>: Developed by the <u>World Resources Institute</u>, <u>C40 Cities Climate Leadership Group</u>, and <u>ICLEI (Local Governments for Sustainability)</u>, the GPC provides standards for disclosure and reporting requirements for community-scale inventories that align with global standards (<u>IPCC Guidelines for National Greenhouse</u> <u>Gas Inventories</u>).
- U.S. Community Protocol (USCP) for Accounting and Reporting of Greenhouse Gas Emissions: Developed by ICLEI (Local Governments for Sustainability) and a Steering Committee of U.S. local government members and technical subject matter experts. The USCP provides detailed guidance on how to perform communitywide GHG inventory calculations for U.S. cities.
- Local Government Operations Protocol (LGOP): Developed by the California Air Resources Board (CARB), California Climate Action Registry (CCAR), ICLEI (Local Governments for Sustainability), and <u>The Climate</u>



<u>Registry</u>, the LGOP provides detailed guidance on best practices for completing a government operations GHG emissions inventory for U.S. jurisdictions.

Inventory Process

The inventory process includes the following steps:

- Inventory scoping Identify inventory boundaries, confirm inventory methodology, identify data sources and limitations, confirm inventory calculation platform.
- **Data collection and processing** Identify data sources and limitations, distribute internal and external data requests, collect and organize data, perform data cleaning/transformations as needed.
- **Inventory calculations** Enter data into ICLEI's ClearPath tool which automatically calculates emissions for each sector.⁴
- **Quality control review** Review data transformations performed to prepare data for ClearPath entry, review ClearPath inputs for accuracy.
- **Analysis and reporting** Review ClearPath outputs for each emissions source/sector/inventory year, identify trends, report findings.

Inventory Report Overview

The remaining sections of this report are broken out as follows:

Communitywide GHG Inventory

- Overview
- Energy
- Transportation
- Refrigerants
- Solid Waste
- Wastewater
- Emissions and Removals from Forests and Trees

Government Operations Inventory

- Overview
- Solid Waste Operations

⁴ ClearPath is the industry standard for community and government operations inventory platform. It is a comprehensive tool that allows users to enter key data inputs and uses these inputs to calculate emissions by sector in alignment with the GPC, USCP, and LGOP. Some inputs are derived from local/measured data; others are modeled or based on assumptions using best available data.



- Vehicles & Equipment Fleet
- Wastewater Operations
- Water Systems
- Streetlights & Traffic Signals
- Other Emissions Sources

Recommendations for Future Inventories

• Appendices:

- A: Emissions Summary Tables
- B: Data Providers and Contact Information
- C: Factor Sets
- D: Biogenic Emissions Summary



Communitywide GHG Inventory

Overview

The City of Spokane's community produced 1,968,982 metric tons of carbon dioxide equivalent (MTCO₂e) in 2019. Greenhouse gas (GHG) emissions sources included in this inventory are from:

- Energy: 55% of communitywide emissions Residential, commercial, and industrial grid electricity, natural gas, and other fossil fuel consumption. This emissions source also includes transmission and distribution (T&D) losses from the electricity grid and fugitive emissions from natural gas distribution.
- **Transportation**: *33% of communitywide emissions* On- and off-road vehicles, transit vehicles, and rail transportation.
- **Refrigerants**: *6% of communitywide emissions* Fugitive hydrofluorocarbons (HFCs) commonly used in refrigeration or air conditioning.
- Solid Waste: 6% of communitywide emissions City of Spokane's Waste to Energy (WTE) facility, the Northside Landfill, and compost generation.
- **Wastewater**: *0.1% of communitywide emissions* Process emissions from wastewater treatment.



Figure 3. 2019 Total Communitywide GHG Emissions by Source (MTCO₂e)

SPOKANE

Total **emissions increased less than 1%** from 2017 to 2019 while total population increased 3%. On a **per capita basis, emissions decreased 3%**.



Figure 4. Total and Per Capita Annual GHG Emissions (MTCO₂e)

Each emissions source is discussed in further detail in the report sections that follow.



Energy

Overview

Energy consumption produced 1,080,649 $MTCO_2e$ in 2019 (55% of total emissions). These emissions result from:

- **Electricity:** *55% of total energy emissions* Electricity consumption in residential, commercial, and industrial sectors and associated transmission and distribution (T&D) losses.
- **Natural gas:** 40% of total energy emissions Natural gas consumption in residential, commercial, and industrial sectors and associated fugitive emissions from distribution.
- **Fuel oil and propane:** *5% of total energy emissions* Consumption of fuel oil and propane by residential sector only due to lack of available data for industrial and commercial sectors.



Figure 5. 2019 Energy Emissions by Sector and Source

Energy emissions **decreased about 2%** from 2017 to 2019. Emissions from electricity increased 4% over this time period while emissions from natural gas decreased 9%.



Figure 6. Annual Energy Emissions by Fuel Source (MTCO₂e)



Comparing total energy consumption by fuel source (in MMBtu) shows that the **largest source of energy consumption is natural gas in the residential sector**. For the commercial and industrial sectors, energy needs are met primarily through electricity.





Electricity | Scope 2

Electricity consumption produced 595,673 MTCO₂e in 2019 (30% of Spokane's total communitywide GHG emissions and 55% of total energy emissions). Over 99% of Spokane's 2019 consumed electricity was provided by Avista and the remaining electricity was provided by Inland Power and Light (IPL).



Most of 2019's electricity emissions are from the residential and commercial sectors, 49% and 48% respectively. The industrial sector contributed only 3% of 2019 electricity emissions.



Figure 8. Annual Electricity GHG Emissions by Sector (MTCO₂e)

As shown in Figure 9, **electricity emissions have increased 4%** since 2017 while consumption has decreased 3%. As such, this overall increase in emissions is attributed to an increase in Avista's emissions factors (carbon intensity of electricity) over that same time period.

Based on Avista's generation resource mix, approximately **41% of the community's electricity is currently coming from renewable energy**.⁵ In 2019, Avista announced their goals to provide 100 percent clean electricity by 2045, so these emissions are expected to decrease moving forward.⁶

Communitywide GHG Inventory | 18

⁵ <u>https://www.myavista.com/about-us/about-our-energy-mix</u>

⁶ https://www.myavista.com/about-us/our-commitment



Figure 9. Annual Electricity Emissions and Consumption 2017 - 2019

On a **per capita basis, electricity consumption has decreased by 6%** while population has grown 3%.

Electricity Consumption	Residential Commercial Ind		Industrial	
GHG emissions (MTCO ₂ e)	275,705	272,379	18,682	
Activity data (kWh)	989,729,255 978,371,848 66,311,03			
Emissions Factors	Avista Emissions Factor 2019 (Appendix C)			
	Inland Power & Light Emissions Factor 2019 (Appendix C)			
Activity Data Sources	Avista Utilities			
	Inland Power & Light			
GPC Reference	I.1.2 I.2.2 I.3.2		1.3.2	

Transmission & Distribution Losses	Residential Commercial Industri			
GHG emissions (MTCO ₂ e)	14,061	13,891	953	
Activity data (kWh)	989,729,255	978,371,848	66,311,039	
Emissions Factors	 Avista Emissions Factor 2019 (Appendix C) Inland Power & Light Emissions Factor 2019 (Appendix C) 			
Activity Data Sources	 Avista Utilities Inland Power & Light U.S. EPA Emissions & Generation Resource Integrated Database (eGRID) 			
GPC Reference	l.1.3	1.2.3	I.3.3	

Natural Gas | Scope 1

Natural gas produced 432,219 MTCO₂e in 2019 (22% of Spokane's total communitywide GHG emissions and 40% of total energy emissions).

Communitywide GHG Inventory | 19



Avista is the City's natural gas provider. In 2021, Avista announced their aspirational goals to be carbon neutral in natural gas operations by 2045, so these emissions are expected to decrease over time.⁷

Most of 2019's natural gas emissions are from the residential sector (62%), followed by the commercial sector (37%). Less than 2% of natural gas emissions

are from the industrial sector and distribution losses.

Natural gas emissions have **decreased 9%** since 2017 due to decreased consumption in the commercial (-17%) and industrial (-83%) sectors.



Figure 10. Annual Emissions from Natural Gas Consumption by Sector (thousands of MTCO₂e)

Natural Gas Consumption	Residential	Commercial	Industrial
GHG emissions (MTCO ₂ e)	269,814	157,826	2,662
Activity data (therms)	50,729,835	29,674,155	501,601
Emissions Factor (MTCO2e/therm)	0.005318	0.005318	0.005307
ClearPath Default			
Activity Data Sources	Avista Utilities		
GPC Reference	I.1.1	I.2.1	I.3.1

Natural Gas Distribution Losses	2019
GHG emissions	1,916 MTCO2e
Activity data	80,905,591 therms
Emissions Factor ClearPath Default	0.00002368 MTCO2e/therm
Activity Data Sources	Avista Utilities
GPC Reference	l.8.1

⁷ <u>https://www.myavista.com/about-us/our-commitment</u>



Other Fuels | Scope 1

Data on other fuel consumption is currently only available for the **residential** sector; as such, these emissions are calculated using data on residential fuel consumption in the state of Washington with census data on Spokane's household fuel use.

Propane, fuel oil, wood, and kerosene consumption produced 52,757 MTCO₂e in 2019 (5% of energy emissions, 3% of total emissions). These emissions have fluctuated significantly from 2017-2019 due to changes in consumption at the state level.





Kerosene Consumption	2019
GHG emissions	19 MTCO2e
Activity data	1,853 gallons
Emissions Factor ClearPath Default	0.0102205 MTCO2e/gallon
Activity Data Sources	U.S. Energy Information Administration
	U.S. Census Data
GPC Reference	1.1.1

Wood Consumption	2019
GHG emissions	2,171 MTCO2e
Activity data	217,903 MMBtu
Emissions Factor ClearPath Default	0.009961 MTCO2e/MMBtu
Activity Data Sources	U.S. Energy Information Administration
	U.S. Census Data
GPC Reference	1.1.1

Fuel Oil Consumption	2019
GHG emissions	45,622 MTCO2e
Activity data	612,739 MMBtu



Fuel Oil Consumption	2019
Emissions Factor ClearPath Default	0.07445638 MTCO2e/MMBtu
Activity Data Sources	U.S. Energy Information Administration
	U.S. Census Data
GPC Reference	1.1.1

Propane Consumption	2019
GHG emissions	4,945 MTCO2e
Activity data	875,672 gallons
Emissions Factor ClearPath Default	0.00564736 MTCO2e/gallon
Activity Data Sources	U.S. Energy Information Administration
	U.S. Census Data
GPC Reference	l.1.1



Transportation

Overview

Transportation produced $653,461 \text{ MTCO}_2e$ in 2019 (33% of total emissions). Emissions sources in this sector include:

- **On-road vehicles:** *85% of total transportation emissions* Fuel combustion (gasoline, diesel, LPG) in passenger, light-duty, and heavy-duty vehicles as well as transit and paratransit vehicles.
- **Off-road vehicles and equipment:** *15% of total transportation emissions* Fuel combustion (gasoline, diesel, CNG, LPG) in off-road vehicles and equipment. Aviation related emissions are not included due to lack of data from Spokane International Airport.
- **Rail:** 0.03% of *total transportation emissions* Fuel combustion in Amtrak and Union Pacific railways.



Figure 12. Annual Transportation Emissions by Vehicle Type (thousands of MTCO2e)

On-Road Vehicles | Scope 1

On-road vehicles produced 557,760 MTCO₂e in 2019 (85% of transportation emissions, 28% of total emissions). Emissions are estimated using Spokane Regional Transportation Council's (SRTC) travel demand model and state data from the Highway Performance Monitoring System (HPMS).

71% of on-road transportation emissions are from gasoline passenger, lightduty, and heavy-duty vehicles.

Communitywide GHG Inventory | 23





*Figure 13. 2019 Transportation Emissions by Fuel and Vehicle Type (thousands of MTCO*₂*e)*

On-Road Vehicles	2019
GHG emissions	543,428 MTCO2e
Activity data	1,051,801,330 vehicle miles travelled
Emissions Factors	2019 Transportation Factor Set (Appendix C)
Activity Data Sources	Spokane Regional Transportation Council
GPC Reference	II.1.1

Transit Vehicles	2019
GHG emissions	14,332 MTCO2e
Activity data	1,407,620 gallons
Emissions Factors	8,283,574 vehicle miles travelled
Activity Data Sources	2019 Transportation Factor Set (Appendix C)
GPC Reference	Spokane Transit Authority
GHG emissions	II.1.1

Off-Road Vehicles & Equipment | Scope 1

Off-road vehicles and equipment include machinery like forklifts, backhoes, tractors, golf carts, lawn mowers, and leaf blowers that typically run on fossil-fuels but are not intended for use as passenger or freight vehicles.

Off-road vehicles and equipment produced 95,536 MTCO₂e (15% of transportation emissions, 5% of total emissions). Emissions have **increased 2%** since 2017. The majority of emissions are from **agricultural**, **industrial**, **construction and mining**, **commercial**, **and lawn and garden equipment**.

Emissions are estimated using the EPA's Motor Vehicle Emission Simulator (MOVES) Nonroad Engines, Equipment, and Vehicles model. This model generates emissions for Spokane County; population is used to scale emissions down to the city level.

Communitywide GHG Inventory | 24





*Figure 14. Annual Off-Road Vehicle and Equipment Emissions by Fuel Type (thousands of MTCO*₂*e)*

Off-Road Vehicles	2019	
GHG emissions	95,536 MTCO2e	
Activity data	N/A coloulated using U.S. EDA MOV/ES NONDOAD model	
Emissions Factor	N/A - Calculated Using 0.5. EPA MOVES NONROAD MODEL	
Activity Data Sources	U.S. EPA MOVES NONROAD model	
GPC Reference	II.5.1	

Rail Scope 1

Rail transportation produced 165 MTCO₂e in 2019 (0.03% of transportation emissions, 0.01% of total emissions). Three railroad companies operate through the City of Spokane:

- **Amtrak** provided estimated total diesel consumed within city limits to estimate emissions.
- **Union Pacific (UP)** provided gross ton mile data for Spokane County as a percentage of UP's total gross ton mileage to estimate emissions.
- Burlington Northern Santa Fe (BNSF) did not provide inventory data.

Amtrak	2019
GHG emissions	165 MTCO2e
Activity data	16,043 gallons of diesel
Emissions Factor ClearPath Default	0.010284859 MTCO2e/gallon
Activity Data Sources	Amtrak
GPC Reference	II.2.1

Union Pacific	2019
GHG emissions	0.00097152 MTCO2e
Activity data	N/A – MTCO2e provided by UP
Emissions Factor	
Activity Data Sources	Union Pacific Railroad
GPC Reference	II.2.1



Refrigerants

Emissions from leakage of refrigerant systems and products releases Scope 1 GHGs. Refrigerant uses include refrigeration systems, fire suppression equipment, and vehicle air conditioning.

Refrigerant emissions are **estimated using national estimates** reported by the U.S. Environmental Protection Agency (EPA), scaled down to Spokane using population.

Estimated refrigerant leakage produced 120,812 MTCO₂e in 2019 (6% of total emissions). **National refrigerant use has increased**, causing these emissions to increase 5% since 2017.



Figure 15. Annual Refrigerants Emissions (MTCO₂e)

Refrigerants	2019	
GHG emissions	120,812 MTCO2e	
Activity data	N/A used EDA calculated MTCO2e	
Emissions Factor	N/A – USECI EPA Calculated MTCOZE	
Activity Data Sources	U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks:	
	1990-2019	
GPC Reference	IV.2	



Solid Waste

Overview

Solid waste activities produced 111,569 $MTCO_2e$ in 2019 (6% of total 2019 communitywide emissions). These emissions result from:

- Waste-to-Energy (WTE) Facility: 89% of total solid waste emissions Emissions associated with the combustion of solid waste at the City's WTE facility.
- Landfill: 7% of total solid waste emissions Emissions from methane released as waste-in-place decomposes under anaerobic conditions in the Northside Landfill (NSLF).
- **Compost:** *4% of total solid waste emissions* Consumption of electricity and natural gas in solid waste facilities.

Solid waste emissions have **increased 7%** since 2017, primarily from a **7% increase in emissions from the City's WTE facility** over that same time period. 2017 WTE facility emissions are unusually low due to scheduled maintenance of the WTE facility's turbine and generator. This maintenance caused extended downtime of the WTE facility, resulting in lower emissions.





The LGOP does not provide quantification methodologies to estimate the GHG reductions or benefits associated with recycling but this information can be reported optionally. These emissions would be considered "Scope 3" as Spokane's recycled waste is exported outside of the City's boundaries. Spokane has opted not to include these emissions in the GHG inventory due to data and analysis limitations.



Waste-to-Energy Facility | Scope 1

The City's WTE facility received a total of 276,238 tons of waste in 2019, producing $99,773 \text{ MTCO}_2e$ (89% of solid waste operations emissions and 5% of communitywide emissions).

Refer to the *Solid Waste Operations* section of this report for more details, including an analysis of the actual 2019 emissions generated at the City's WTE facility compared to the greenhouse gas (GHG) emissions impact the same volume of waste would have had in a typical landfill with similar weather patterns as Spokane.

WTE Facility	2019
GHG emissions	99,773 MTCO2e
Activity data	N/A – used EPA reported MTCO2e
Emissions Factor	
Activity Data Sources	City of Spokane
GPC Reference	1.4.4

Northside Landfill | Scope 1

City of Spokane's (closed) Northside Landfill produced 7,364 MTCO₂e in 2019 (7% of solid waste emissions; less than 1% of total government operations emissions). These emissions **increased 4%** from 2017.

Emissions from the Southside Landfill (SSLF) are excluded from the communitywide inventory as the landfill is located outside of the City's geographic boundary; however, these emissions are included in the government operations inventory as the facility is owned/operated by the City.

NSLF	2019
GHG emissions	7,364 MTCO2e
Activity data	N/A – used reported MTCH4
Emissions Factor	
Activity Data Sources	City of Spokane
GPC Reference	III.1.1

Compost | Scope 3

Barr-Tech LLC is a private business that provides composting services to Spokane's community. Barr-Tech did not respond to requests for composting tonnage data for the purposes of this inventory.



In the absence of measured data, this inventory **relies on compost tonnage reported to the Washington Department of Ecology** (Ecology) for Spokane County and used population to scale these totals down to City of Spokane.

Estimated compost tonnage produced 4,433 MTCO₂e in 2019 (4% of solid waste emissions, less than 1% of communitywide emissions).

Compost	2019
GHG emissions	4,433 MTCO2e
Activity data	63,910 tons
Emissions Factor ClearPath Default	0.0694 MTCO2e/ton
Activity Data Sources	Washington Department of Ecology: Recovered Material,
	Collection, and Sector Data (2018)
GPC Reference	III.2.2



Wastewater

The treatment of wastewater includes several processes that generate Scope 1 GHG emissions; for example, the nitrification and denitrification of wastewater, discharging effluent to rivers and estuaries, and the flaring and combustion of digester gas.

Wastewater treatment processes at the City's **Riverside Park Water Reclamation Facility (RPWRF)** produced 2,490 MTCO₂e in 2019 (less than 1% of communitywide emissions. These emissions have **decreased 25%** since 2017.



Figure 17. Annual Wastewater Treatment Process Emissions by Source (MTCO₂e)

Flaring of Digester Gas	2019
GHG emissions	274 MTCO2e
Activity data	242,298 cubic feet of digester gas/day
Emissions Factor ClearPath Default	0.00113 MTCO2e / cubic feet / day
Activity Data Sources	City of Spokane
GPC Reference	III.4.1 and III.4.3

Combustion of Digester Gas	2019
GHG emissions	4 MTCO2e
Activity data	85,714 scf/day
Emissions Factor ClearPath Default	0.000047 MTCO2e/scf/day
Activity Data Sources	City of Spokane
GPC Reference	I.3.1



Nitrification/Denitrification	2019
GHG emissions	548 MTCO2e
Activity data	236,440 people (population served)
Emissions Factor ClearPath Default	0.002312 MTCO2e/person
Activity Data Sources	City of Spokane
GPC Reference	III.4.1 and III.4.3

Effluent Discharge	2019
GHG emissions	1,664 MTCO2e
Activity data	Daily N Load = 1995 kg N/day
Activity data	Population Served = 236,440 people
Emissions Factor ClearPath Default	0.00704 MTCO2e/person
Activity Data Sources	City of Spokane
GPC Reference	III.4.1 and III.4.3



Government Operations GHG Inventory

Overview

Spokane's Government Operations produced 147,357 metric tons of carbon dioxide equivalent (MTCO₂e) in 2019 – approximately **7% of communitywide emissions**. Greenhouse gas (GHG) emissions sources in this inventory include:

- Solid Waste Operations: 73% of government operations emissions City's Waste to Energy (WTE) facility, the North and South Side Landfills, and grid electricity and natural gas consumption within facilities.
- Vehicles & Equipment Fleet: 8% of government operations emissions On- and off-road fleet vehicles and equipment.
- Wastewater Operations: 6% of government operations emissions Process emissions from wastewater treatment and grid electricity and natural gas consumption within facilities.
- Water Systems: *5% of government operations emissions* Grid electricity and natural gas consumption in water systems facilities.
- Streetlights & Traffic Signals: *1% of government operations emissions* Grid electricity consumed to power City's streetlights and traffic signals.
- **Other**: *6% of government operations emissions* Grid electricity, natural gas, and kerosene consumption in City buildings and facilities that do not fall within one of the operational categories above. Also includes emissions from employee commuting and business travel as well as refrigerants.



Figure 18. Overview of Government Operations Emissions (thousands of MTCO₂e)

Total emissions from government operations have **increased 4%** since 2017. This increase primarily comes from a **7% increase in emissions from the City's WTE**



facility over that same time period. 2017 WTE facility emissions were unusually low due to scheduled maintenance of the WTE facility's turbine and generator which caused extended downtime of the WTE facility, resulting in lower emissions.

As the City's WTE facility is an atypical emissions source compared to peer governments, Figure 19 shows total emissions excluding Solid Waste Operations.



Figure 19. Overview of Government Operations Emissions without Solid Waste Operations

Renewable Electricity

Avista's electricity generation resource mix currently includes approximately 41% energy from renewables.⁸ Approximately 43% of the electricity that the City of Spokane purchases from Avista is generated by renewable energy sources. This slightly higher rate is due to City Hall's enrollment in Avista's Solar Select[®] (solar electricity) program in 2019.⁹

Government Operations GHG Inventory | 33

⁸ <u>https://www.myavista.com/about-us/about-our-energy-mix</u>

⁹ https://www.myavista.com/energy-savings/green-options/community-renewable-options



Solid Waste Operations

Overview

Solid Waste Operations contributed 73% of total 2019 government operations emissions (108,134 MT CO_2e). These emissions result from:

- Waste-to-Energy (WTE) Facility: 92% of total solid waste emissions Emissions associated with the combustion of solid waste at the City's WTE facility.
- Landfills: 7% of total solid waste emissions Emissions from methane released as waste-in-place decomposes under anaerobic conditions in the City's landfills.
- **Energy:** *1% of total solid waste emissions* Consumption of electricity and natural gas in solid waste facilities.

Solid waste emissions have **increased 6%** since 2017, primarily from a **7% increase in emissions from the City's WTE facility** over that same time period. 2017 WTE facility emissions are unusually low due to scheduled maintenance of the WTE facility's turbine and generator which caused extended downtime of the WTE facility, resulting in lower emissions.





Waste-to-Energy Facility | Scope 1

Spokane's WTE facility combusts municipal solid waste to recover energy that is used onsite (excess is sold to Avista as electricity). The City landfills ash left



behind from combusted waste.¹⁰ The WTE facility meets Spokane's Regional Clean Air Policy, the Washington State Department of Ecology standards, and the Spokane Regional Health District standards.¹¹

The City's WTE facility received a total of 276,238 tons of waste in 2019, contributing 99,773 MTCO₂e (92% of solid waste operations emissions and 73% of total government operations emissions).

WTE Facility	2019
GHG emissions	99,773 MTCO2e
Activity data	N/A used EDA reported MTCO2e
Emissions Factor	N/A - Used EPA reported MTCO2e
Activity Data Sources	City of Spokane

WTE Analysis

Landfilling the same amount of waste (276,238 tons) noted above would have produced 45% less direct emissions; however:

- Utilizing the WTE facility diverted 9,501 tons of **ferrous metals** to recycling, avoiding 16,981 MT CO₂e.¹²
- The facility produced 505,276 MMBtu of energy, avoiding 41,219 MT CO₂e.¹³
- When the avoided emissions from WTE are considered, the remaining emissions impact from WTE in Spokane is 24% less than the landfill impact would have been. Refer to Figure 21 for summary.

Additionally, the City of Spokane manages the community's waste within city boundaries, reducing the transportation emissions for shipping municipal solid waste versus landfilling. Differences in emissions from trucking and transportation and other detailed life cycle elements were not evaluated as part of this high-level comparative assessment. The results of this high-level analysis indicate the need

Government Operations GHG Inventorv 35

¹⁰ The inert ash resulting from the WTE process (and other materials bypassed from the WTE facility) are shipped to the Roosevelt Regional Landfill in Klickitat County, Washington. Bypassed material consists of a mixture of inert materials and other municipal solid waste generated by Spokane County as a whole. The Scope 3 emissions related to this exported waste have not been included in this inventory as the waste primarily consists of inert materials.

¹¹ Waste to Energy Plant - City of Spokane, Washington (spokanecity.org)

¹² Ferrous metal emissions were calculated using <u>recycled steel carbon footprint</u> calculations

¹³ Electricity missions were calculated using the 2019 Avista emissions factor.



for a full life cycle assessment to understand the comprehensive benefits of using WTE compared to landfilling.





Landfills | Scope 1

City of Spokane's landfills produced 7,784 MTCO₂e in 2019 (7% of emissions from Solid Waste Operations; 5% of total government operations emissions).

95% of landfill emissions were from the Northside Landfill (NSLF) and the remaining 5% from the Southside Landfill (SSLF).

- **NSLF** produced 7,364 MTCO₂e in 2019, a **4% increase** from 2017.
 - The NSLF closed to the public in 1988 but has an open Municipal Solid Waste Cell that accepts waste on a limited basis.
- **SSLF** produced 420 MTCO₂e in 2019, a **17% decrease** from 2017.
 - The SSLF is outside of the City of Spokane's geographic boundaries but is included in the government operations inventory as it is owned and operated by the City.
 - The SSLF closed to the public in 1987 and no longer accepts waste but still produces a small amount of emissions due to waste-in-place.





NSLF	2019
GHG emissions	7,364 MTCO2e
Activity data	N/A used reported MTCI14
Emissions Factor	N/A – used reported MTCH4
Activity Data Sources	City of Spokane

SSLF	2019
GHG emissions	420 MTCO2e
Activity data	N/A – used reported MTCH4
Emissions Factor	
Activity Data Sources	City of Spokane

Energy

The City of Spokane's Solid Waste Operations energy consumption produced 577 $MTCO_2e$ in 2019 (1% of Solid Waste Operations emissions; less than 1% of total government operations emissions).

- Electricity (Scope 2) 85% of solid waste energy emissions
- Natural Gas (Scope 1) 15% of solid waste energy emissions

Energy emissions have **decreased 41%** since 2017 from the **43% decrease in purchased energy consumption** (-5,727 MMBtu). Over the same time period, the WTE facility has **generated 4% more energy** (+20,298 MMBtu). These changes are due to the downtime that occurred from the required turbine and generator maintenance during 2017 that required increased purchases of energy while the generator was offline.





Figure 23. Annual Solid Waste Energy Purchased and Generated (MMBtu)

Electricity Consumption	2019
GHG emissions	491 MTCO2e
Activity data	1,764,136 kWh
Emissions Factors	Avista Emissions Factor 2019 (Appendix C)
Activity Data Sources	Avista Utilities

Natural Gas Consumption	2019
GHG emissions	86 MTCO2e
Activity data	16,141 therms
Emissions Factors ClearPath Default	0.005328047
Activity Data Sources	Avista Utilities

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Vehicles & Equipment Fleet

Overview

Emissions from City-owned vehicles and equipment produced 12,428 MTCO₂e in 2019 (8% of total government operations emissions).

- **On-Road Fleet Vehicles:** *97% of vehicle emissions* Emissions from City-owned fleet vehicles (primarily diesel and gasoline powered vehicles).
- Off-Road Vehicles and Equipment: *3% of vehicle emissions* Emissions from City-owned off-road vehicles and equipment (primarily diesel powered).

Emissions from vehicles and equipment have **increased 1%** since 2017. In 2022, the City's Fleet Services released the <u>Spokane Green Fleet Playbook</u> that outlines the strategies and actions required to reduce fleet emissions.



Figure 24. 2019 Vehicle and Equipment Emissions (MTCO₂e)





*Figure 25. Annual Emissions from Fleet Vehicles & Off-Road Equipment (thousands of MTCO*₂*e)*

Fleet Vehicles | Scope 1

City of Spokane's fleet vehicles produced $11,999 \text{ MTCO}_2e$ in 2019 (97% of vehicle emissions; 8% of total government operations emissions). These emissions have **increased 1%** since 2017.

The majority of 2019 fleet emissions are from **diesel-powered vehicles** (55%) followed by gasoline (33%) and compressed natural gas (CNG, 16%). Emissions from LPG-powered and electric vehicles make up 0.06% of fleet emissions. Gasoline-powered vehicles use a 10% ethanol blend in their fuel mix.



*Figure 26. Annual Emissions by Fuel Type (thousands of MTCO*₂*e)*

Fleet vehicle miles travelled (VMT) have increased 16% since 2017, primarily due to a **27% increase in light-duty VMT**. In 2019, 52% of VMT was from light-duty vehicles, followed by heavy-duty vehicles (32%), and passenger vehicles (16%).



Improvements in the fleet vehicle data management system have improved the tracking of mileage across the fleet, leading to this increase which is not reflected in the volume of fuel used.



Figure 27. Annual Fleet VMT by Vehicle Type

On-Road Vehicles	2019
GHG emissions	11,999 MTCO2e
Activity data	5,983,762 vehicle miles travelled
Emissions Factors	2019 Transportation Factor Set (Appendix C)
Activity Data Sources	City of Spokane

Off-Road Vehicles & Equipment | Scope 1

Off-road vehicles and equipment produced 429 MTCO₂e in 2019 (3% of vehicle emissions, less than 1% of total government operations emissions). 94% of these emissions are from **diesel-powered vehicles**. Off-road vehicle emissions have **decreased 9%** since 2017.

Off-Road Vehicles	2019
GHG emissions	429 MTCO2e
Activity data	5,530 MMBtu
Emissions Factors ClearPath Defaults	0.07754 MTCO2e/MMBtu
Activity Data Sources	City of Spokane



Wastewater Operations

Overview

Wastewater facility operations contributed 6% of total government operations emissions in 2019 (8,919 MT CO_2e). These emissions result from:

- Energy Consumption: 72% of total wastewater emissions Emissions associated with electricity and natural gas consumption.
- Wastewater Treatment Process: 28% of total wastewater emissions Emissions from effluent discharge, nitrification and denitrification processes, flaring of digester gas, and combustion of digester gas at the Riverside Park Water Reclamation Facility.



Wastewater emissions have increased 1% since 2017.

Energy

Riverside Park Water Reclamation Facility (RPWRF) energy consumption produced $6,429 \text{ MTCO}_2e$ in 2019 (72% of wastewater emissions; 4% of total government operations emissions).

- Electricity (Scope 2) 77% of solid waste energy emissions
- Natural Gas (Scope 1) 23% of solid waste energy emissions

Energy emissions have **increased 16%** since 2017 due to a **547% increase in natural gas consumption** (+22,707 MMBtu). RPWRF also generates energy from the combustion of biogas that is produced through the wastewater treatment process. The increased natural gas usage in 2019 was primarily due to required maintenance of the pressurized biogas line, limiting the ability to use biogas in the



facility's boilers for several weeks. The facility **generated 40% less energy** (- 25,606 MMBtu) when comparing to 2017 due to that issue.



Figure 29. Annual Wastewater Operations Energy Purchased and Generated (MMBtu)

Electricity Consumption	2019
GHG emissions	4,951 MTCO2e
Activity data	17,783,633 kWh
Emissions Factors	Avista Emissions Factor 2019 (Appendix C)
	Inland Power & Light Emissions Factor 2019 (Appendix C)
Activity Data Sources	Avista Utilities
	Inland Power & Light

Natural Gas Consumption	2019
GHG emissions	1,478 MTCO2e
Activity data	277,919 therms
Emissions Factors ClearPath Default	0.005318 MTCO2e/therms
Activity Data Sources	Avista Utilities

Wastewater Treatment Process Emissions | Scope 1

Wastewater treatment includes several processes that generate GHG emissions; for example, the nitrification and denitrification of wastewater, discharging effluent to rivers and estuaries, and the flaring and combustion of digester gas.

Wastewater treatment processes produced 2,490 MTCO₂e in 2019 (28% of wastewater emissions; 2% of total government operations emissions). RPWRF's emissions have **decreased 25%** since 2017.





Figure 30. Annual Wastewater Treatment Process Emissions by Source (MTCO₂e)

Flaring of Digester Gas	2019
GHG emissions	274 MTCO2e
Activity data	242,298 cubic feet of digester gas/day
Emissions Factor ClearPath Default	0.00113 MTCO2e / cubic feet / day
Activity Data Sources	City of Spokane

Combustion of Digester Gas	2019
GHG emissions	4 MTCO2e
Activity data	85,714 scf/day
Emissions Factor ClearPath Default	0.000047 MTCO2e/scf/day
Activity Data Sources	City of Spokane

Nitrification/Denitrification	2019
GHG emissions	548 MTCO2e
Activity data	236,440 people (population served)
Emissions Factor ClearPath Default	0.002312 MTCO2e/person
Activity Data Sources	City of Spokane

Effluent Discharge	2019
GHG emissions	1,664 MTCO2e
Activity data	Daily N Load = 1995 kg N/day
Activity data	Population Served = 236,440 people
Emissions Factor ClearPath Default	0.00704 MTCO2e/person
Activity Data Sources	City of Spokane

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Water Systems

Overview

Energy consumed to produce and deliver potable water produced 5% of total government operations emissions (6,994 MT CO₂e). These emissions have **increased 1%** since 2017.

- Electricity (Scope 2) 96% of solid waste energy emissions
- Natural Gas (Scope 1) 4% of solid waste energy emissions

The City's **Upriver Hydroelectric Dam** also produces energy (hydropower) that pumps water to the community. The dam **generated 13% less energy** (-28,719 MMBtu) in 2019 compared to 2017.

The dam is a run-of-the-river hydroelectric facility so precipitation cycles can create wide variability in these annual generation amounts. The City's <u>Water</u> <u>Conservation Master Plan</u> presents goals, targets, strategies and actions to conserve our water supply and to sustainably manage it for future generations.



Government Operations GHG Inventory | 45



Electricity Consumption	2019
GHG emissions	6,749 MTCO2e
Activity data	24,233,935 kWh
Emissions Factors	Avista Emissions Factor 2019 (Appendix C)
	Inland Power & Light Emissions Factor 2019 (Appendix C)
Activity Data Sources	Avista Utilities
	Inland Power & Light

Natural Gas Consumption	2019
GHG emissions	245 MTCO2e
Activity data	46,091 therms
Emissions Factors ClearPath Default	0.005316 MTCO2e/therms
Activity Data Sources	Avista Utilities



Streetlights & Traffic Signals

Overview

Streetlights and traffic signal **electricity consumption** (Scope 2) produced 1,908 MTCO₂e in 2019 (1% to total government operations emissions). Emissions have **decreased 4%** since 2017 due primarily to a **10% decrease in electricity consumption**. Decreased electricity consumption is the result of conversions to LED technology.



Figure 31. Annual Streetlight & Traffic Signal Electricity Consumption and Emissions (2017-2019)

Electricity Consumption	2019
GHG emissions	1,908 MTCO2e
Activity data	6,853,195 kWh
Emissions Factors	Avista Emissions Factor 2019 (Appendix C)
Activity Data Sources	Avista Utilities



Other Emissions Sources

Overview

Emissions that do not fall into one of the previous categories (solid waste, vehicles, wastewater, water, streetlights) are presented as "Other" emissions below. These emissions are 6% of total 2019 government operations emissions (8,975 MT CO₂e).

- Energy: 69% of "other" emissions Consumption of electricity and natural gas in government owned and operated buildings and facilities not accounted for in the above report sections.
- Employee Commute and Business Travel: *30% of total "other" emissions* Emissions occurring from employee commute and business travel.
- **Refrigerants:** *1% of total "other" emissions* Fugitive emissions that result from refrigerant leakage.

Energy

Energy consumed in buildings and facilities other than solid waste, wastewater, water facilities produced 6,164 $MTCO_2e$ in 2019 (4% of total government operations emissions).

- **Electricity** (Scope 2) 52% of energy emissions
- Natural Gas (Scope 1) 48% of energy emissions
- **Kerosene** (Scope 1) 0.009% of energy emissions

These energy emissions have **decreased 7%** since 2017. While natural gas consumption has increased 3%, electricity consumption has decreased 5%. Additionally, 15% of 2019's electricity in "other" buildings was provided through **Avista's Solar Select® program** (100% renewable electricity) at City Hall which helped achieve a 14% decrease in electricity emissions compared to 2017.





Electricity Consumption	2019
GHG emissions	3,202 MTCO2e
Activity data	13,612,266 kWh
Emissions Factors	Avista Emissions Factor 2019 (Appendix C)
	Avista Solar Select [®] Emissions Factor 2019 (Appendix C)
	Inland Power & Light Emissions Factor 2019 (Appendix C)
Activity Data Sources	Avista Utilities
	Inland Power & Light

Natural Gas Consumption	2019
GHG emissions	2,962 MTCO2e
Activity data	556,841 therms
Emissions Factors ClearPath Default	0.005319 MTCO2e/therms
Activity Data Sources	Avista Utilities

Kerosene Consumption	2019
GHG emissions	1 MTCO2e
Activity data	55 gallons
Emissions Factors ClearPath Default	0.1818 MTCO2e/gallon
Activity Data Sources	City of Spokane

Employee Commute | Scope 3

Employee commuting produced 2,565 MTCO₂e in 2019. The City does not have direct control over employee commute choices, so the associated emissions only indirectly affect government operations emissions. However, the City does encourage alternative commute options through the commute trip reduction program.



Employee Commute	2019
GHG emissions	2,565 MTCO2e
Activity data	N/A – obtained calculated MTCO2e from survey reports
Emissions Factors	
Activity Data Sources	Washington State Department of Transportation Commute Trip
	Reduction Employer Survey Reports

Business Travel | Scope 3

Business travel produced 172 MTCO₂e in 2019 (less than 1% of total government operations). **80% of these emissions are from air travel** and 20% from personal vehicles. Figure 32 and Figure 33 map these travel destinations.

Figure 32. 2019 Business Air Travel Destinations



Figure 33. 2019 Personal Vehicle Travel Destinations (not pictured – Quantico, VA)





Air Travel	2019
GHG emissions	137 MTCO2e
Activity data	781,180 aviation passenger miles
Emissions Factors ClearPath Default	0.000175376 MTCO2e/aviation passenger mile
Activity Data Sources	City of Spokane

Ground Travel	2019
GHG emissions	34 MTCO2e
Activity data	93,744 vehicle miles travelled
Emissions Factors	2019 Transportation Factor Set (Appendix C)
Activity Data Sources	City of Spokane

Refrigerants | Scope 1

Fugitive emissions from refrigerants produced 74 $MTCO_2e$ in 2019 (less than 1% of total government operations emissions). These emissions have **decreased 21%** since 2017.

Refrigerants	2019
GHG emissions	74 MTCO2e
Activity data	0.057153 MT of HFC-134a released
Emissions Factor	N/A – activity data stated in MT of HFC
Activity Data Sources	City of Spokane



Recommendations for Future Inventories

This report summarizes the 2019 emissions profile for the Spokane community and City operations. Emissions reduction efforts should focus on the largest sources of emissions as well as those over which the City and community have the greatest influence.









Improvements for Future Inventories

The inventory findings described above represent the best available data, assumptions, and calculation methodologies at this time. The following updates would improve completeness and accuracy of future communitywide inventories:

• **Obtain missing datasets from private sector** – emissions data from several private entities were not available for the completion of this inventory,



including: BNSF rail transportation data, Barr-Tech composting data, Spokane International Airport transportation data.

- Obtain local datasets county, state, and national datasets were used in the absence of local data for propane, fuel oil, wood, and kerosene consumption, on-road vehicle miles travelled, public transit, off-road vehicles and equipment, rail transportation, refrigerants, and compost. If localized datasets become available in the future, they should be used in lieu of scaling down broader datasets.
- **Re-baseline 2016 inventory** the 2016 inventory was completed using different methodologies and data sources than the 2017, 2018, and 2019 inventories. 2016 should be recalculated utilizing ClearPath and the same data sources to ensure comparability with future inventories.

Future Climate Action Planning Efforts

GHG inventories provide foundational information about City of Spokane's primary communitywide and government operations emissions which provides insights for future climate action planning efforts.

Building upon this information, the City could consider pursuing additional analyses that would provide a more comprehensive overview of priority areas for the climate action planning (emissions reduction, climate resilience, and sustainability).

WTE Lifecycle Analysis

1 Conduct a comprehensive life cycle assessment for solid waste operations to better **understand the full benefits the City's WTE facility** is delivering to the community compared to landfilling.

Emissions Forecast

- Use current emissions and future projections to forecast future emissions. Include expected emissions reductions from national, state, and regional policies.
- 2 Use this forecast to analyze the gap between future emissions and emissions reduction targets.
- **3** Identify **priority areas for local emissions reduction** efforts based on analysis above.

Recommendations for Future Inventories | 53



Climate Risk and Vulnerability Assessment

- 1 Use best available scientific literature and analyses to **assess the greatest threats** to City of Spokane's community, infrastructure, and natural resources from climate change.
- 2 Determine the City's and community's **capacity to adapt** to these changes and identify the most vulnerable populations, infrastructure, and resources to support through local climate adaptation and resilience efforts.
- **3** Use these findings to develop citywide **adaptation goals**.

Climate Action Plan (CAP)

- **1 Document findings** of the GHG emissions and climate risk and vulnerability analyses.
- **2** Use these findings to **develop strategic goals and pathways** to address climate vulnerabilities and reduce emissions.
- **3** Vet these strategies with internal and external subject matter experts as well as the Spokane community to ensure they are equitable and reflect the City's priorities, values, and community.

Implementation and Monitoring

- **1** Develop and execute a plan for **funding and implementation** of CAP strategies.
- 2 Monitor and report on progress over time, update analyses regularly, and adaptively manage climate actions to ensure the City achieves its climate targets and goals.



Appendices



Appendix A: Emissions Summary Tables

Figure 36. Annual Communitywide GHG Emissions (MTCO₂e)

GHG Emissions by Sector (MTCO2e)	2017	2018	2019
Energy	1,103,395	1,001,699	1,080,649
Electricity	574,962	591,974	595,673
Residential	279,654	284,382	289,767
Commercial	276,429	288,054	286,271
Industrial	18,879	19,538	19,636
Natural Gas	472,595	392,711	432,219
Residential	261,680	244,816	269,814
Commercial	190,311	142,847	157,826
Industrial	15,607	2,441	2,662
Distribution Losses	4,997	2,607	1,916
Other Fuels	55,838	17,014	52,757
Residential	55,838	17,014	52,757
Transportation	641,624	650,216	653,461
On-road vehicles	548,086	555,184	557,760
Off-road	93,373	94,867	95,536
Rail	166	164	165
Other	223,398	226,139	234,872
Solid Waste	104,547	106,236	111,569
Combustion of Solid Waste	93,188	94,571	99,773
Composting	4,302	4,385	4,433
NSLF	7,056	7,280	7,364
Process & Fugitive	115,518	116,782	120,812
HFCs	115,518	116,782	120,812
Wastewater	3,333	3,121	2,490
Flaring of Digester Gas	246	270	274
Combustion of Digester Gas	11	9	4
Process N2O - WW Treatment	595	548	548
Process N2O - Effluent	2,482	2,294	1,664
Total Emissions	1,968,418	1,878,054	1,968,982



Figure 37. Annua	l Per Capita	Communitywide	GHG Emissions	; (MTCO₂e)

GHG Emissions by Sector (MTCO2e)	2017	2018	2019
Energy	5.01	4.46	4.76
Electricity	2.61	2.63	2.62
Residential	1.27	1.27	1.28
Commercial	1.25	1.28	1.26
Industrial	0.09	0.09	0.09
Natural Gas	2.14	1.75	1.90
Residential	1.19	1.09	1.19
Commercial	0.86	0.64	0.69
Industrial	0.07	0.01	0.01
Distribution Losses	0.02	0.01	0.01
Other Fuels	0.25	0.08	0.23
Residential	0.25	0.08	0.23
Transportation	2.91	2.89	2.88
On-road vehicles	2.49	2.47	2.46
Off-road	0.42	0.42	0.42
Rail	0.00	0.00	0.00
Other	1.01	1.01	1.03
Solid Waste	0.47	0.47	0.49
Combustion of Solid Waste	0.42	0.42	0.44
Composting	0.02	0.02	0.02
NSLF	0.03	0.03	0.03
Process & Fugitive	0.52	0.52	0.53
HFCs	0.52	0.52	0.53
Wastewater	0.02	0.01	0.01
Flaring of Digester Gas	0.00	0.00	0.00
Combustion of Digester Gas	0.00	0.00	0.00
Process N2O - WW Treatment	0.00	0.00	0.00
Process N2O - Effluent	0.01	0.01	0.01
Total Emissions	8.93	8.36	8.67
Population	220,444	224,683	227,121



Figure 38. Annual Government Operations GHG Emissions (MTCO₂e)

GHG Emissions by Sector (MTCO2e)	2017	2018	2019
Solid Waste Operations	101,734	102,932	108,134
WTE	93,188	94,571	99,773
Grid Electricity	903	534	491
Natural Gas	83	71	86
NSLF	7,056	7,280	7,364
SSLF	504	476	420
Vehicles & Equipment	12,332	11,516	12,428
Fleet Vehicles	11,859	11,174	11,999
Off-Road Vehicles	473	342	429
Wastewater Operations	8,864	8,404	8,919
Grid Electricity	4,824	4,810	4,951
Natural Gas	707	473	1,478
Flaring Digester Gas	246	270	274
Combustion Digester Gas	11	9	4
Process N2O - WW Treatment	595	548	548
Process N2O - Effluent	2,483	2,294	1,664
Water Systems	6,903	7,672	6,994
Grid Electricity	6,632	7,422	6,749
Natural Gas	270	250	245
Streetlights & Traffic Signals	1,979	1,972	1,908
Grid Electricity	1,979	1,972	1,908
Other	9,330	9,107	8,975
Buildings & Facilities	6,614	6,402	6,164
Grid Electricity	3,737	3,828	3,202
Natural Gas	2,877	2,574	2,962
Kerosene	1	1	1
Employee Commute	2,622	2,629	2,737
Employee Commute	2,461	2,461	2,565
Business Travel - Car	32	33	34
Business Travel - Air	129	135	137
Refrigerants	94	75	74
Refrigerants	94	75	74
Total Emissions	141,142	141,604	147,357



Appendix B: Data Providers and Contact Information

Communitywide GHG Inventory

Energy

Da	ita Input	Data Provider - Name	Data Provider - Email
A\ • •	rista : Electricity consumption Electricity emissions factors Natural gas consumption	John Lyons (Avista) & Janna Loeppky (Avista)	John.Lyons@avistacorp.com Janna.Loeppky@avistacorp.com
IP •	L: Electricity consumption	lan Swan (IPL)	ians@inlandpower.com

Transportation

Data Input	Data Provider - Name	Data Provider - Email
On-Road vehicle miles travelled	Ryan Stewart (Spokane Regional Transportation Council)	rstewart@srtc.org
Transit vehicle miles travelled	Brian Conley (Spokane Transit Authority)	BConley@spokanetransit.com
Rail – Amtrak	Laura Fotiou (Amtrak)	Laura.Fotiou@amtrak.com
Rail – Union Pacific	Melissa Schop	meschop@up.com

Solid Waste

Data Input	Data Provider - Name	Data Provider - Email
WTE emissions report	Jen Lennon (City of Spokane)	jlennon@spokanecity.org
NSLF data emissions report	Jen Lennon (City of Spokane)	jlennon@spokanecity.org

Wastewater

Data Input	Data Provider - Name	Data Provider - Email
Wastewater emissions report	Jeff Donovan (City of Spokane)	jdonovan@spokanecity.org



Government Operations GHG Inventory

Energy

Data Input	Data Provider - Name	Data Provider - Email
Avista:Electricity consumptionNatural gas consumption	Logan Callen (City of Spokane)	Icallen@spokanecity.org
IPL:Electricity consumption	Logan Callen (City of Spokane)	lcallen@spokanecity.org

Solid Waste Operations

Data Input	Data Provider - Name	Data Provider - Email
WTE emissions report	Jen Lennon (City of Spokane)	jlennon@spokanecity.org
NSLF/SSLF data emissions report	Jen Lennon (City of Spokane)	jlennon@spokanecity.org

Vehicles & Equipment Fleet

Data Input	Data Provider - Name	Data Provider - Email
VMT and fuel consumption by vehicle/equipment ID	Brandon Paschal (City of Spokane)	bpaschal@spokanecity.org

Wastewater Operations

Data Input	Data Provider - Name	Data Provider - Email
Wastewater emissions report	Jeff Donovan (City of Spokane)	jdonovan@spokanecity.org

Other Emissions Sources

Data Input	Data Provider - Name	Data Provider - Email
Employee commute - CTR reports	Logan Callen (City of Spokane)	lcallen@spokanecity.org
Business travel - personal vehicle miles travelled report	Logan Callen (City of Spokane)	lcallen@spokanecity.org
Business travel - aviation miles travelled report	Logan Callen (City of Spokane)	lcallen@spokanecity.org



Appendix C: Factor Sets

ClearPath requires the following Factor Set inputs to calculate GHG emissions.

2019 Transportation

Gasoline	Passenger Vehicle	Light Truck	Heavy Truck	Transit Bus	Paratransit Bus	Motorcycle
MPG	24.1	17.6	5.371652	17.6	17.6	24.1
g CH4/mi	0.0183	0.0193	0.0785	0.0193	0.0193	0.0183
g N2O/mi	0.0083	0.0148	0.0633	0.0148	0.0148	0.0083
Diesel	Passenger Vehicle	Light Truck	Heavy Truck	Transit Bus	Paratransit Bus	Motorcycle
MPG	24.1	17.6	6.392468	17.6	17.6	24.1
g CH4/mi	0.0005	0.001	0.0051	0.001	0.001	0.0005
g N2O/mi	0.001	0.0015	0.0048	0.0015	0.0015	0.001
Data Sources:	ICLEI Default	s				

2019 Waste Characterization

Waste Type	Percent of Total Waste
Percentage Newspaper	0.56%
Percentage Office Paper	0.60%
Percentage Corrugated Cardboard	4.71%
Percentage Magazines / Third Class Mail	1.98%
Percentage Food Scraps	15.21%
Percentage Grass	0.00%
Percentage Leaves	6.02%
Percentage Branches	1.04%
Percentage Dimensional Lumber	1.26%
Data Sources:	State of Washington Department of Ecology: 2015- 2016/2020-2021 Washington Statewide Waste Characterization Study



2019 Grid Electricity

Avista Emissions Factor 2019	
CO2 kg/MWh	276.67
CH4 kg/GWh	25.95
N2O kg/GWh	3.57
Data Sources:	Avista Utilities

Avista Solar Select ® Emissions Factor 2019	
CO2 kg/MWh	0
CH4 kg/GWh	0
N2O kg/GWh	0
Data Sources:	Avista Utilities

Inland Power & Light Emissions Factor 2019	
CO2 lb/MWh	715.2
CH4 lb/GWh	68.0
N2O lb/GWh	10.0
Data Sources:	U.S. EPA Emissions & Generation Resource Integrated Database (eGRID)



Appendix D: Biogenic Emissions Summary

Biogenic emissions refers to the carbon contained in organic materials that was originally removed from the atmosphere through natural processes and would eventually cycle back to the atmosphere through natural degradation processes.

The combustion of biomass (non-fossilized organic material from plants, animals, and other organisms) produces both anthropogenic and biogenic emissions. Biogenic emissions also result from forestry and land management practices. These emissions are included in this report for informational purposes.

Sources of Biogenic Emissions in Inventory:

- Waste to Energy Combustion combustion of biomass at Spokane's WTE facility emitted 134,316 MT of biogenic CO₂ in 2019.
- Wastewater Treatment combustion of biogas at RPWRF emitted 880 MT of biogenic CO₂ in 2019.
- Land Use Changes (see detailed section below)

Emissions and Removals from Forests and Trees

Emissions and sequestration from land use changes over the period 2016-2019 were estimated using ICLEI's Land Emissions and Removals Navigator (LEARN) tool. Land change types during this period include:

- Forest Change
 - Forest to grassland 62 MTCO₂e/year
 - Forest to settlement 2,072 MTCO₂e/year
 - Forest to other 95 MTCO₂e/year

Forest Remaining Forest

- Undisturbed forest (2,141) MTCO₂e/year
- Insect/disease (6) MTCO₂e/year
- Harvest/other 122 MTCO₂e/year
- Trees Outside Forest
 - Tree canopy loss 231 MTCO₂e/year
 - Canopy maintained/gained (21,846) MTCO₂e/year

The largest source of **emissions** was **conversion of forest to settlement**; the largest source of emissions **removals** was **tree canopy maintained/gained**. As part of Spokane Municipal Code section <u>12.02.905</u>, it is the City's Urban Forestry



goal to have thirty percent (30%) of the total land area within the City to be healthy and functioning tree canopy coverage by 2030.



