



Town of Erie 2021 Community & Municipal Greenhouse Gas Emissions Inventory Report



LOTUS
Engineering & Sustainability

“As the Town of Erie grows and expands, we will become a leader in sustainability by providing outreach and leadership alongside inclusive and accessible opportunities that support the growth of our economy and engage the community while protecting our natural environment.”

– Town of Erie’s Sustainability Plan

TABLE OF CONTENTS

EXECUTIVE SUMMARY	I
<i>Energy Sector Targets</i>	<i>i</i>
<i>Transportation Sector Targets</i>	<i>i</i>
<i>Waste Sector Target</i>	<i>i</i>
<i>Education and Outreach Sector Targets</i>	<i>i</i>
 OVERVIEW	 1
 2021 COMMUNITY GHG EMISSIONS	 2
 Emissions Overview	 2
 Emissions By Scope	 4
 Emissions By Sector	 5
<i>Stationary Energy</i>	<i>6</i>
<i>Transportation</i>	<i>7</i>
<i>Waste & Wastewater</i>	<i>8</i>
<i>Industrial Processes and Product Use</i>	<i>9</i>
 BASIC+ Emissions	 9
<i>Transmission and Distribution Losses</i>	<i>9</i>
<i>Transboundary Aviation</i>	<i>9</i>
 2021 Municipal Operations GHG Emissions	 10
<i>Emissions by Sector</i>	<i>10</i>
<i>Emissions by Source</i>	<i>10</i>
 CARBON SEQUESTRATION	 12
 SUMMARY	 13

TABLE OF TABLES

<i>Table 1. Erie 2021 community GHG emissions by sector and source (BASIC+).</i>	<i>3</i>
<i>Table 2. Annual emission intensities in Erie.</i>	<i>5</i>
<i>Table 3. 2021 municipal operations GHG emissions by source.</i>	<i>11</i>

TABLE OF FIGURES

<i>Figure ES 1. Total 2021 community-wide GHG emissions by sector.</i>	<i>ii</i>
<i>Figure ES 2. Total 2021 community-wide GHG emissions by source.</i>	<i>ii</i>
<i>Figure 1. Erie's 2021 community emissions by sector and source.</i>	<i>2</i>
<i>Figure 2. Community emissions by scope.</i>	<i>4</i>
<i>Figure 3. Erie's 2021 community stationary energy use sector emissions.</i>	<i>6</i>
<i>Figure 4. Erie's 2021 community transportation sector emissions.</i>	<i>7</i>
<i>Figure 5. Erie's 2021 waste emissions breakdown.</i>	<i>8</i>
<i>Figure 6. Erie's 2021 municipal emissions by sector.</i>	<i>10</i>
<i>Figure 7. Erie's 2021 municipal emissions by source.</i>	<i>11</i>
<i>Figure 8. Annual carbon sequestration occurring through Erie's land area.</i>	<i>13</i>

Executive Summary

The Town of Erie has committed to the following goals to reduce greenhouse gas (GHG) emissions, as outlined in the 2019 Sustainability Plan:

ENERGY SECTOR TARGETS

- Reduce average household electricity use by 3% by 2025.
- Reduce average household natural gas use by 3% by 2025.
- Increase the number of green buildings that are tracked in the community annually.
- Source 25% of community-wide electricity use from renewable resources by 2025.
- Source 25% of commercial electricity use from renewable resources by 2025.
- Source 20% of residential electricity use from renewable resources by 2025.

TRANSPORTATION SECTOR TARGETS

- Determine a baseline and increase transit ridership by 10% by 2025.
- Increase transit serving the community by adding one additional daily bus route by 2025.
- Increase the share of electric vehicles registered in the community by 25% by 2025.

WASTE SECTOR TARGET

- Establish a waste baseline and set a target for increased diversion by 2022.

EDUCATION AND OUTREACH SECTOR TARGETS

- Double the number of businesses participating in the Erie Green Business Program by 2025.
- Host or participate in a minimum of five community events annually to educate the community about sustainability.

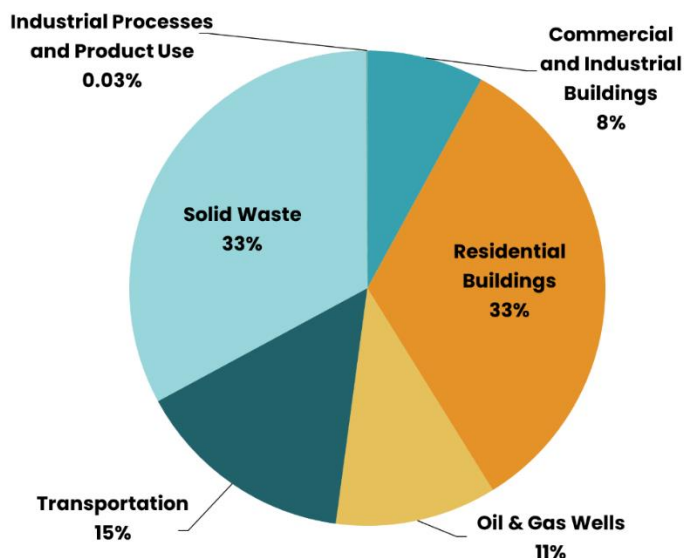


Figure ES 1. Total 2021 community-wide GHG emissions by sector.

emissions, each comprising 33 percent of total emissions. Transportation emissions made up 15 percent, followed by oil and gas well emissions at 11 percent and commercial and industrial building energy usage at 8 percent. Wastewater emissions and emissions from industrial processes and product use were negligible. See Figure ES 1 above. Despite wastewater treatment emissions comprising such a small percentage of overall emissions, Erie's wastewater treatment plant is the largest commercial user of electricity in the Town. Emissions from this electricity use are captured in the stationary energy sector.

Erie developed two 2021 GHG emissions inventories to track progress toward these goals: one for community emissions and one for emissions from municipal operations.

Erie's 2021 community GHG emissions totaled 353,418 metric tons of carbon dioxide equivalent (mt CO₂e) and included all GHG emissions generated in Erie from building energy use, transportation, and waste.

Broken down by sector, emissions from landfilled waste and residential building energy use emissions were the two largest contributors to Erie's GHG

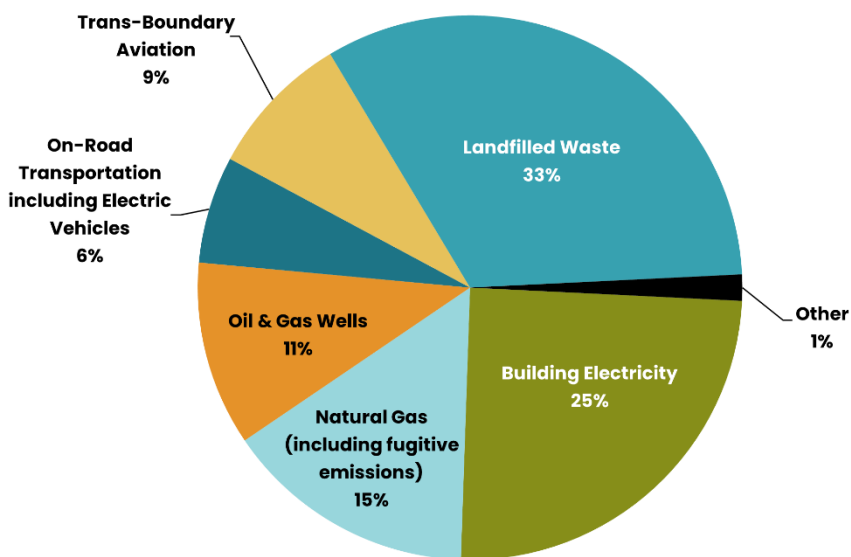


Figure ES 2. Total 2021 community-wide GHG emissions by source.

The largest source of emissions in the Town of Erie in 2021 was landfilled waste.

This includes emissions from waste generated in the community as well as the emissions associated with the Front Range Landfill, which is located in Town boundaries. Other significant sources of emissions in Erie are electricity use (25%), natural gas use (15%), and oil and gas wells (11%). A breakdown of emissions sources can be seen in Figure ES 2.

Erie's 2021 municipal operations GHG emissions totaled 15,338 metric tons (4.3% of Erie's community emissions) of carbon dioxide equivalent (mt CO₂e) and included all GHG emissions generated by Erie's municipal operations, including building energy use, transportation, waste, and consumption. Municipal operations emissions account for less than 5 percent of all community emissions. A detailed breakdown of municipal emissions can be found later in this report.

The 2021 GHG inventories reflect the Town's advancement toward its climate goals. However, continual action is needed to meet the Town's goals and limit environmental impact. These inventories provide a way for Erie to recognize opportunities for emissions reductions and encourage and prioritize sustainable action in future planning and policy.

Overview

To help achieve Erie's goals to reduce greenhouse gas (GHG) emissions and combat the realities and consequences of the changing climate, the Town has completed a community wide GHG inventory to measure and identify the sources of GHG emissions from within its community. A second inventory was completed to identify GHG emission sources from municipal operations. GHG emissions are heat-trapping gases that contribute to climate change through atmospheric warming and are often produced as a result of fossil-fuel combustion and other human activities. This report focuses on the calendar year of 2021.

Lotus Engineering and Sustainability, LLC (Lotus) was hired to complete the 2021 community and municipal GHG emissions inventories alongside Town staff. The community inventory was developed using the methodology outlined in the Global Protocol for Community-Scale GHG Inventories (GPC) for a BASIC inventory. BASIC inventories include emissions generated from building energy, transportation, waste and industrial processes and product use. The municipal operations GHG inventory was developed using the Local Government Operations Protocol (LGOP).

Additional emission sources (sometimes referred to as BASIC+ sources) such as oil and gas wells, electricity transmission and distribution (T&D) losses, and transboundary aviation were calculated for the 2021 community inventory. See the subsection titled BASIC+ Emissions for more information.

The following report reviews 2021 GHG BASIC+ emissions sectors and sources, and progress toward Erie's sustainability goals.

Moving forward, the Town has committed to publicly reporting emissions every other year with the next inventory reflecting 2023.

2021 Community GHG Emissions

Emissions Overview

In 2021, community GHG emissions in Erie totaled 353,418 metric tons of carbon dioxide equivalent (mt CO₂e). Landfilled waste was the largest source of GHG emissions for Erie in 2021, producing 115,187 mt CO₂e or 33 percent of all emissions. This includes emissions from the Front Range landfill, which is located in Town boundaries. Figure 1 (below) shows the percentage of emissions produced by each sector and source, while Table 1 shows the quantity of emissions. Emissions from each sector are described in more detail in the following sections.

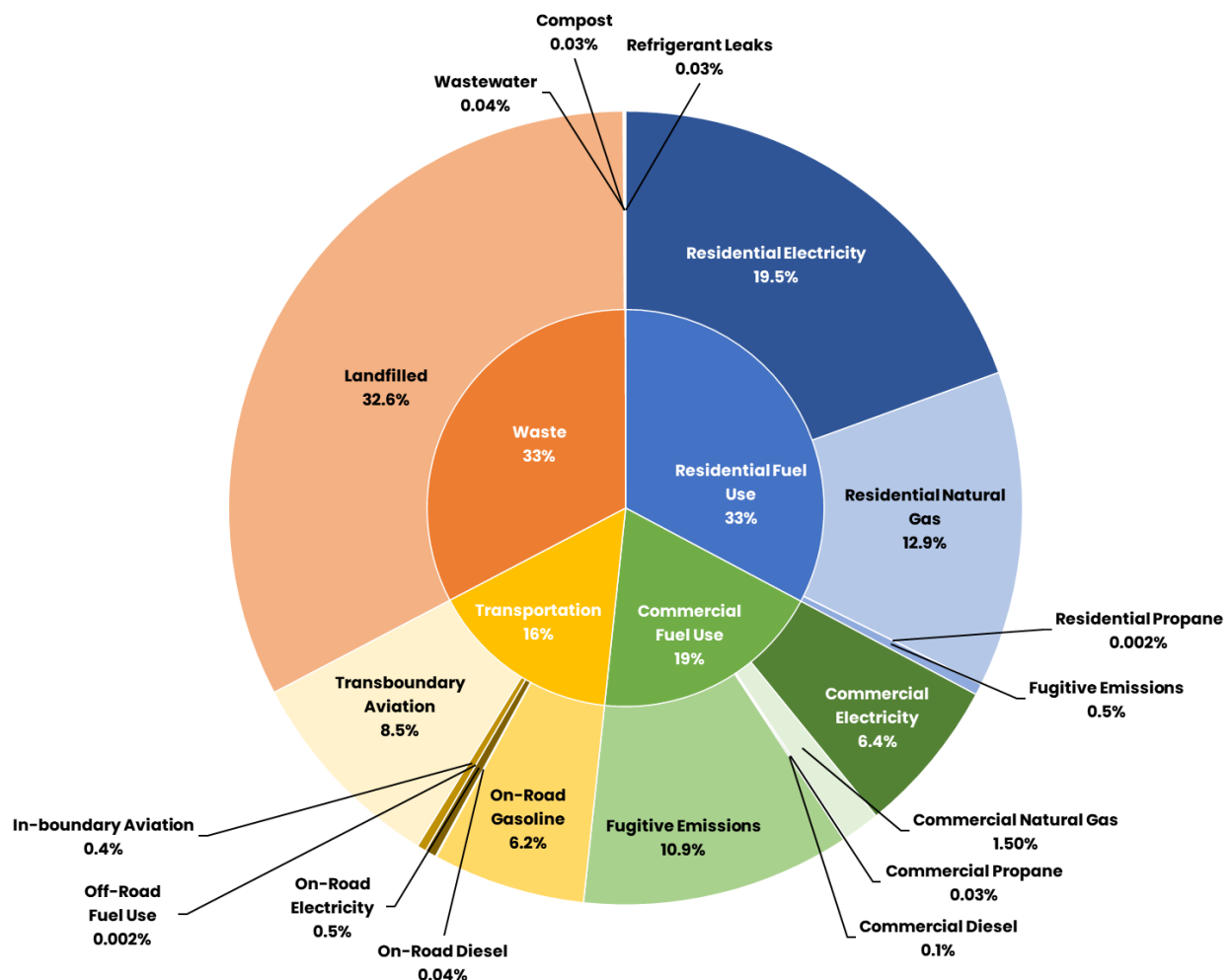


Figure 1. Erie's 2021 community emissions by sector and source.

Table 1. Erie 2021 community GHG emissions by sector and source (BASIC+).

Emissions Sources	Scope	Emissions (mtCO ₂ e)		Percent
Residential Energy	1, 2,3	116,649		33%
Residential Electricity	2		65,251	20%
Residential Natural Gas	1		45,497	13%
Residential Propane	1		9	0.002%
Fugitive Emissions	1		1,611	0.5%
Residential Transmission & Distribution Loss	3		3,504	1.0%
Commercial & Industrial Energy	1, 2,3	66,964		19%
Commercial & Industrial Electricity	2		21,314	6%
Commercial & Industrial Natural Gas	1		5,287	1%
Commercial & Industrial Propane	1		107	0.03%
Commercial & Industrial Diesel	1		302	0.09%
Fugitive Emissions	1		38,681	11%
Commercial Transmission & Distribution Loss	3		1,136	0.3%
Transportation	1, 2, 3	55,198		15%
On-Road Gasoline	1		21,968	6%
On-Road Diesel	1		140	0.04%
On-Road Electricity	2		1,533	0.5%
Off-Road Fuel Use	1		7	0.002%
In-Boundary Aviation	1		1,325	0.4%
Transboundary Aviation	3		30,150	9%
EV Transmission & Distribution Loss	3		76	0.02%
Waste	1, 3	115,421		33%
Landfilled	1		115,187	33%
Compost	3		105	0.03%
Wastewater	1		130	0.04%
Industrial Processes and Product Use	1	101		0.03%

Refrigerant Leaks	1	101	0.03%
Total		353,418	100%

Emissions By Scope

Emission sources fall into one of three scope categories.

- **Scope 1** includes GHG emissions from sources within the Town boundary, such as building fuel use (other than electricity; see scope 2 notes below) or vehicle activity within the Town.
- **Scope 2** includes emissions from the use of grid-supplied electricity, heat, steam, and cooling within the Town boundary. The only scope 2 emission source for Erie is grid-supplied electricity.
- **Scope 3** emissions include all other GHG emissions occurring outside the Town as a result of activities within the Town boundary. For example, compost is a scope 3 emission for Erie, as compost generated in Erie is currently taken to be disposed of outside the Town boundary.

Scope 1 emissions accounted for 65 percent of Erie's total emissions (228,150 mt CO₂e). Landfilled waste, residential natural gas usage, and fugitive emissions from oil and gas wells were the three largest contributors to Scope 1 emissions. Scope 2 emissions from grid-supplied electricity made up 25 percent of total emissions from the Town (88,097 mt CO₂e). Scope 3 emissions (landfilled waste and compost) made up 10 percent of Erie's emissions (37,170 mt CO₂e). Figure 2 (below) shows the percentage of emissions from each scope.¹

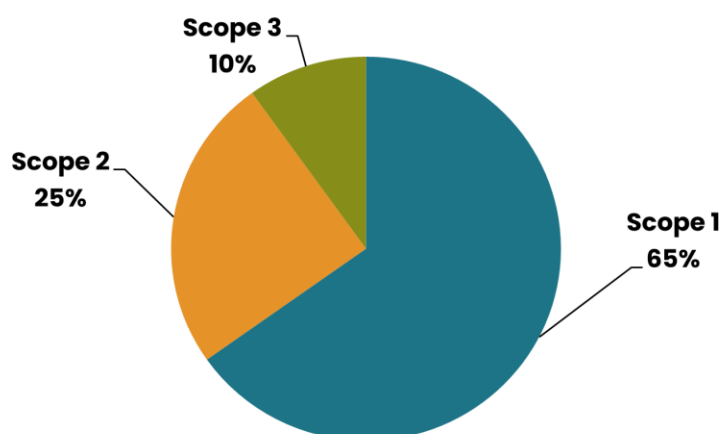


Figure 2. Community emissions by scope.

¹ As noted above, additional Scope 3 emission sources (sometimes referred to as BASIC+ sources) from transmission and distribution (T&D) losses and transboundary aviation were calculated for the 2021 inventory. See the subsection titled BASIC+ Emissions for more information.

Emissions By Sector

Emissions sectors are the broad categories of activities that result in GHG emissions. Erie's inventory is split into the following emissions sectors:

- Stationary Energy (including Residential Fuel Use, Commercial and Industrial Fuel Use, and Oil and Gas Wells).
- Transportation.
- Solid Waste and Wastewater Treatment.
- Industrial Processes and Product Use.

Each emissions sector contains individual sources, which represent the specific activities resulting in the emissions. Emissions sectors and the sources within them are further discussed in the following subsections. A summary of emissions from BASIC+ emissions is included following the emission sector summaries.

With a population of 30,038 in 2021, emissions per resident were approximately 12 mt CO₂e. Other emission intensities are shown in Table 2. Colorado's annual per capita emissions were 16 mt CO₂e in 2019. In the same year, national per capita emissions totaled 18 mt CO₂e and international per capita emissions totaled eight mt CO₂e. Looking at the per capita emissions in Erie's neighboring communities, the City of Boulder totaled 11 mt CO₂e in 2021, the City of Lafayette totaled nine mt CO₂e in 2021, and the City of Longmont totaled 10 mt CO₂e in 2019.

Table 2. Annual emission intensities in Erie.

Metric	Annual Emissions (mt CO₂e)
Erie per capita (2021)	12
Erie per occupied household (2021)	41
Erie per employed person (2021)	16
Colorado per capita ² (2019)	16
National per capita ³ (2019)	18
International per capita ³ (2019)	8
City of Boulder per capita (2021)	11

² Colorado annual per capita GHG emission data are from EIA Energy-Related CO₂ Emissions Data Tables; data are from 2019.

³ National and international annual per capita GHG emissions data are from WRI's Climate Watch Dashboard; data are from 2019.

City of Lafayette per capita (2021)	9
City of Longmont per capita (2019) ⁴	10

STATIONARY ENERGY

The stationary energy sector includes emissions from buildings, primarily from electricity and natural gas usage. Other sources of stationary energy emissions include propane and diesel combustion, electricity for street lighting, irrigation sales, and oil and gas wells. Fugitive emissions, or emissions from the sourcing and transport of natural gas, are also included.

Emissions from stationary energy accounted for 52 percent of Erie's GHG emissions (182,698 mt CO₂e) and, therefore, addressing building emissions is critical to achieving Erie's GHG reduction goals stated in the Sustainability Plan.

Figure 3 (below) breaks down the specific sources of stationary energy emissions. Overall, electricity use, including T&D losses, accounted for 51 percent (91,205 mt CO₂e) of stationary energy emissions, and natural gas, including fugitive emissions, made up 29 percent (52,582 mt CO₂e). Propane and diesel use accounted for less than one percent of stationary energy emissions. Fugitive emissions from oil and gas wells comprised a significant percentage of stationary energy emissions compared to similar communities, coming in at 21 percent (38,494 mt CO₂e).

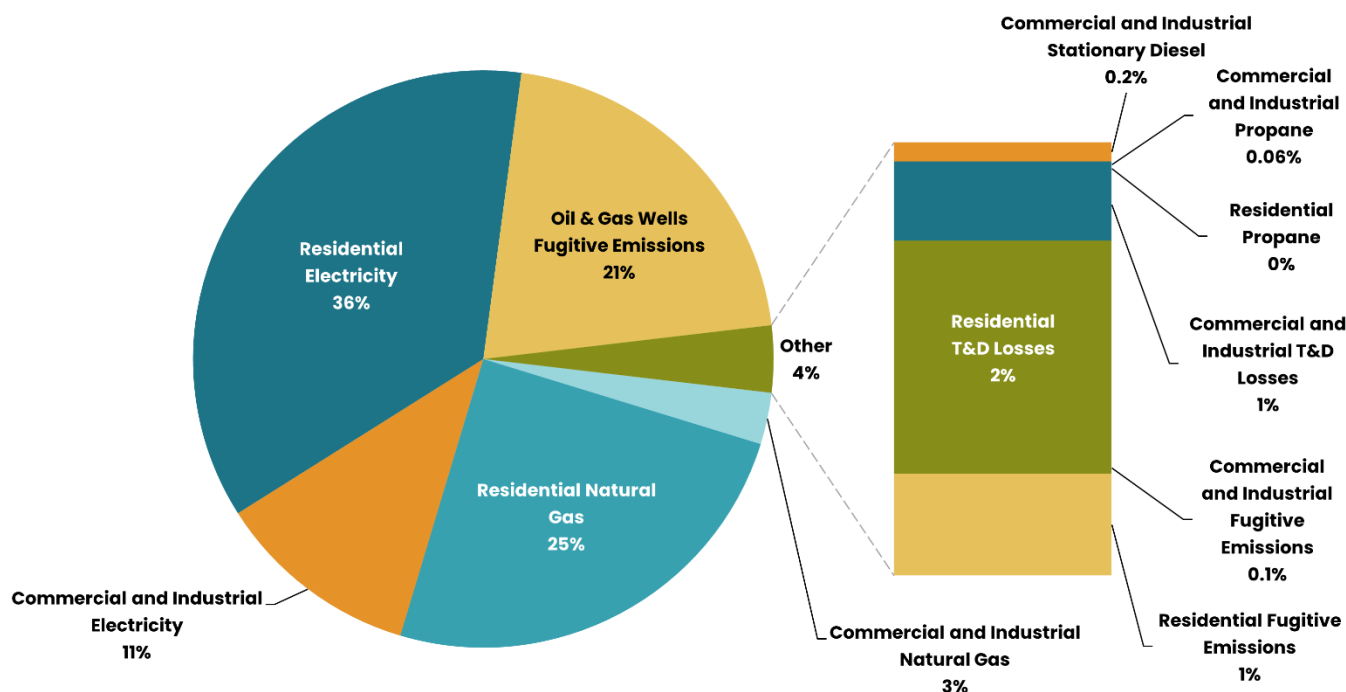


Figure 3. Erie's 2021 community stationary energy use sector emissions.

⁴ Boulder, Longmont, and Lafayette emissions per capita taken from previous inventories conducted by Lotus.

Splitting energy use by building type provides a more detailed understanding of the sources contributing to stationary energy emissions. In 2021, commercial buildings (e.g., shops, offices, hotels, warehouses, and other places of business) accounted for 15 percent of Erie's stationary energy emissions (28,145 mt CO₂e), while homes made up 63 percent of stationary energy emissions (114,261 mt CO₂e). Residential electricity use was the largest source of stationary energy emissions (65,251 mt CO₂e). Commercial natural gas emissions, including fugitive emissions (5,474 mt CO₂e), were lower than residential natural gas emissions (47,107 mt CO₂e). Commercial and residential propane usage, as well as commercial diesel usage, were minimal, making up less than one percent of emissions.

TRANSPORTATION

The transportation sector accounted for 15 percent of Erie's total GHG emissions (55,198 mt CO₂e). Figure 4 (below) provides a breakdown of the contributing sources to emissions from the transportation sector. Transboundary aviation emissions were the largest source of emissions in this sector, comprising 56% and totaling 30,150 mt CO₂e. In-boundary aviation by contrast only comprised 2 percent of transportation emissions (1,325 mt CO₂e). Emissions from on-road gasoline (including emissions from ethanol) vehicles made up 34 percent of transportation emissions (18,445 mt CO₂e) and on-road diesel vehicles made up 7 percent (3,522 mt CO₂e). Transit, off-road diesel, and electric vehicles and associated T&D losses together made up just under two percent of total transportation emissions.

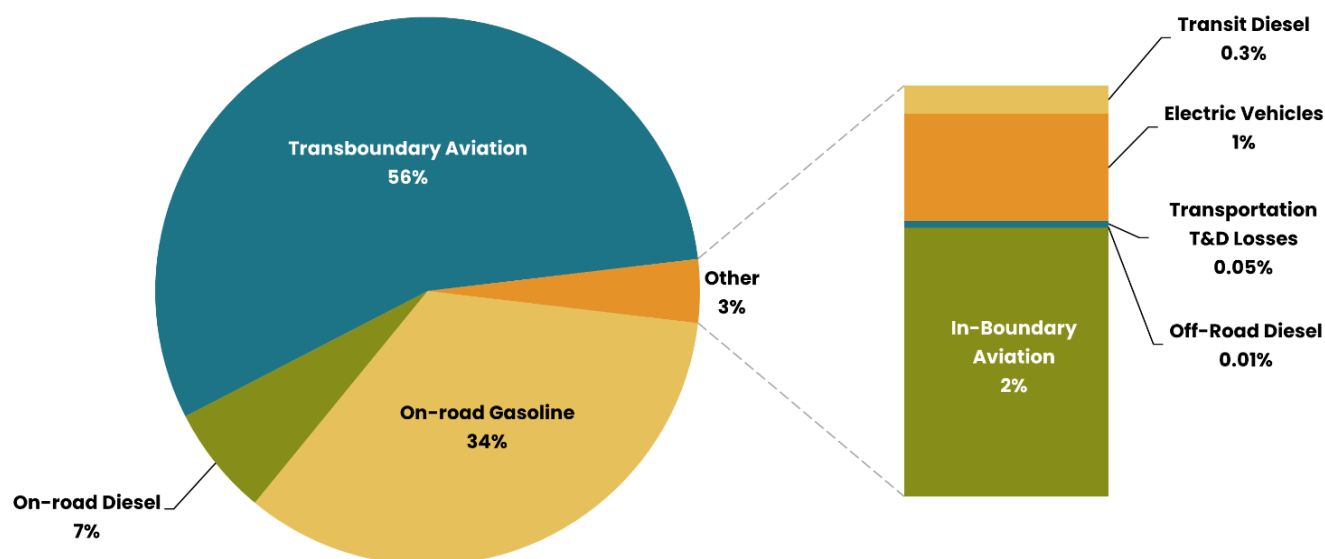


Figure 4. Erie's 2021 community transportation sector emissions.

WASTE & WASTEWATER

Waste and wastewater emissions made up 33 percent of Erie's total 2021 emissions (115,412 mt CO₂e).

The vast majority of solid waste generated in Erie is disposed of within the Town boundary. Compost is taken outside of the Town boundary for disposal. Most waste emissions are attributable to the Front Range Landfill, which is located within Town boundaries. Front Range Landfill collects waste from many of Denver's northern suburbs. Overall, more than 1.7 million tons of landfilled solid waste were deposited at the Front Range Landfill in 2021, which produced 109,280 mt CO₂e or 95 percent of all waste emissions. Town residents produced 13,063 tons of landfilled waste (Figure 5) with the majority coming from residential customers (12,996 tons, or 99%). In 2021, approximately 1.5 tons of landfilled waste per household were produced; this is approximately half the national average.⁵

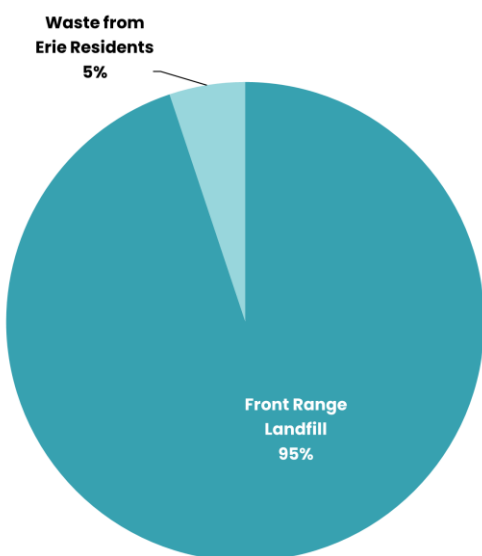


Figure 5. Erie's 2021 waste emissions breakdown.

*More than **1.7 million tons** of solid waste were deposited at the Front Range Landfill in 2021. Town of Erie residents produced **only 13,063 tons** of landfilled waste in the same year.*

Wastewater treatment was negligible in terms of total emissions (130 mt CO₂e). All wastewater produced in Erie is treated at a facility within the Town boundaries. As mentioned previously, while emissions from wastewater treatment make up a small percentage of overall emissions, the wastewater plant itself does contribute significantly to commercial electricity usage. Electricity usage at the wastewater treatment plant comprises

⁵ This data point comes from the EPA's National Overview: Facts and Figures on Materials, Wastes, and Recycling. In 2018, each person produced an estimated 4.9 pounds of waste per day. It was assumed that the average national household size is 3.15, there are 2,000 pounds in a US ton, and there are 365 days in one year.

approximately 9% of Erie's total commercial and industrial electricity usage. This value is captured in Erie's stationary energy sector emissions.

INDUSTRIAL PROCESSES AND PRODUCT USE

The only source of emissions within this sector is refrigerant leaks. This data point accounts for any emissions that occur from commercial air conditioning leakage. For Erie in 2021, this refrigerant leakage produced 101 mt CO₂e, comprising only 0.03% of Erie's total emissions.

BASIC+ Emissions

As noted in the introduction, the BASIC+ emissions from electricity transmission and distribution (T&D) losses and transboundary aviation were calculated for the 2021 inventory. **Together these sources accounted for 34,790 mt CO₂e, approximately 10 percent of overall emissions.**

TRANSMISSION AND DISTRIBUTION LOSSES

T&D losses represent electricity that is generated but does not reach intended customers due to inefficiencies in the transmission and distribution systems. These losses can range year-to-year and can be reduced through the utility making updates to the grid. In 2021, it was estimated that 5.28 percent of electricity did not make it to the intended customer resulting in approximately 7.8 million kWh being lost on the way to Erie. Total emissions from these losses are 4,640 mt CO₂e.

TRANSBOUNDARY AVIATION

Transboundary Aviation emissions take into account the flights taken by Erie residents at Denver International Airport (DEN). It is estimated that 30,150 mt CO₂e were emitted in 2021 by Erie residents flying out of DEN.

2021 Municipal Operations GHG Emissions

EMISSIONS BY SECTOR

Erie's 2021 municipal emissions were broken down into four sectors: stationary energy, transportation, waste and wastewater, and consumption-based sources. The stationary energy sector created the most emissions, making up 85 percent of all municipal emissions (13,011 mt CO₂e). The transportation sector came next, comprising 13% of emissions (1,978 mt CO₂e), which includes both emissions from Town fleet vehicles and equipment as well as employee commuting. Consumption-based emissions made up one percent of emissions (212 mt CO₂e). Waste and wastewater emissions also made up less than one percent of emissions (138 mt CO₂e). See Figure 6.

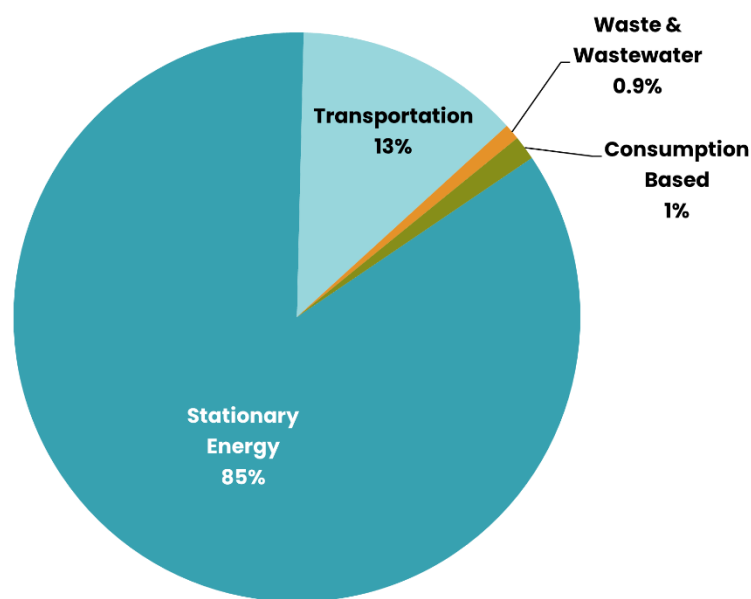


Figure 6. Erie's 2021 municipal emissions by sector.

EMISSIONS BY SOURCE

Erie's largest source of municipal emissions in 2021 was stationary and mobile electricity.

This includes grid-supplied electricity for Erie facilities and grid-supplied electricity used to charge employee-owned electric vehicles. This category made up 67 percent of municipal emissions (10,287 mt CO₂e). Stationary fossil fuels were the second largest source of emissions, making up 18 percent of emissions (2,276 mt CO₂e). This includes stationary diesel and natural gas used at Town facilities. The third-largest source of municipal emissions was aviation, comprising 9 percent of emissions (1,325 mt CO₂e); these emissions come from jet fuel and aviation gas usage at Erie Municipal Airport. On-road fossil fuel vehicles, or emissions from fossil fuel vehicles used for employee commuting and fossil fuel vehicles in Erie's

municipal fleet, made up 3 percent of emissions (510 mt CO₂e). Remaining sources made up one percent or less of total municipal emissions each. See Figure 7 (below) and Table 3.

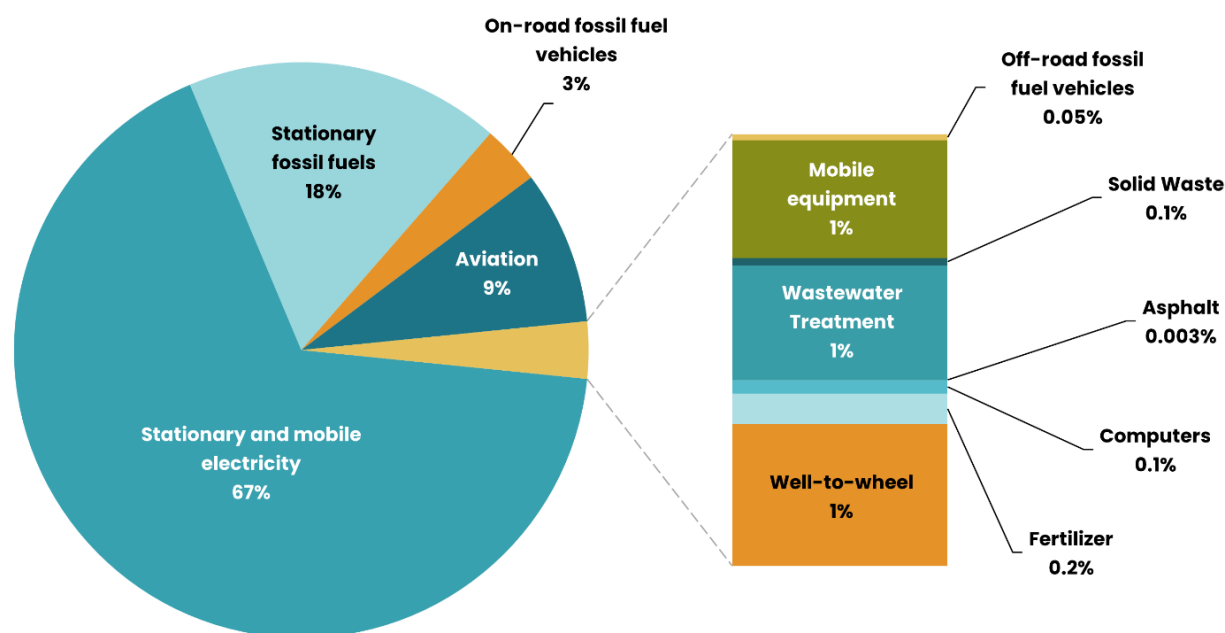


Figure 7. Erie's 2021 municipal emissions by source.

Erie's municipal emissions comprise 4 percent of total community emissions. While small, this amount is not negligible—all emissions have a footprint. As the community of Erie continues to work toward its sustainability goals, the Town will continue to work to reduce its own municipal emissions.

Table 3. 2021 municipal operations GHG emissions by source.

Emission Source	Emissions (mt CO ₂ e)	% of Total
Stationary and mobile electricity	10,287	67%
Stationary fossil fuels	2,726	17.8%
Fossil-fuel powered fleet vehicles	340	2.2%
Electric fleet vehicles	2	1.1%
Employee commuting	170	0.01%
Off-road fossil fuel vehicles	7	0.05%
Mobile equipment	134	0.9%
Erie Municipal Airport	1,325	8.6%
Solid Waste	8	0.1%
Wastewater Treatment	130	1%
Asphalt	0.5	0.003%
Computers	16	0.1%

Fertilizer	34	0.2%
Well-to-wheel	161	1.1%
Total	15,338	100%

Carbon Sequestration

Biological carbon sequestration is the process by which atmospheric carbon dioxide is taken up by plants through photosynthesis and stored as carbon in biomass and soils. The plants and soil that hold the carbon taken from the atmosphere make up a **carbon sink**. The quantity of carbon stored in the plants and soil is the **carbon stock**. Plants are continually taking in the carbon from the atmosphere and storing it. But when plants burn, are eaten, or land changes from one cover type to another (i.e., from a forest to developments), carbon gets released back into the atmosphere. The annual change to the carbon stock is called the **carbon flux**.

ICLEI's Land Emissions and Removals Navigator (LEARN) tool was used to estimate the annual carbon flux of the land within Erie's town boundary. The LEARN tool uses the National Land Cover dataset to estimate land cover changes over time and the associated changes in carbon stock. Carbon stock changes are divided by the quantity of years in the analysis period to generate an annual carbon sequestration value.

The LEARN tool was run for Erie's town boundary across the time period of 2011–2019, with 2019 being the most recent data available. To analyze the impact of urban trees on Erie's annual carbon sequestration, the City of Golden was selected as a proxy for Erie's geography and climate. Over the eight years analyzed, Erie's land sequestered an average of 105 mt CO₂e per year (Figure 8 below).

	Removals(t CO ₂ e/yr)	Emissions(t CO ₂ e/yr)
Undisturbed Forest	-18	
Forest Disturbances		
Non-Forest to Forest	-1	
Forest to Settlement		
Forest to Grassland		
Forest to other non-forest lands		
Trees outside of forests	-86	
Harvested Wood Products	0	
TOTAL	-105	0
Net GHG balance	-105	

Figure 8. Annual carbon sequestration occurring through Erie's land area.

It should be noted that the LEARN tool puts an emphasis on carbon sequestration occurring through trees and forests. This is because this land cover type generates the most carbon sequestration per land area and maintaining or planting additional trees is one of the easiest ways to maintain and increase the amount of carbon sequestered.

Most of Erie's terrestrial carbon sequestration occurs in trees outside of forests, or the Town's urban trees. A small amount of sequestration is occurring in the Town's 52 acres of forest. The majority of the Town's land is classified as Settlement or Croplands. Erie should work to preserve and ultimately expand its urban trees and forests in order to maintain the Town's annual carbon sequestration.

Summary

Erie's 2021 GHG inventories illustrate the Town's progress toward its climate goals stated in its Sustainability Plan. This report identifies all sources of emissions in and attributed to the Town. Coupled with the Town of Erie's Sustainability Plan, the information in this report provides a valuable starting point from which to begin monitoring emissions reductions. Significant emissions reductions are needed to meet the Town's goals and limit environmental impact. With the information provided in this inventory, Erie can identify the greatest opportunities to reduce GHG emissions and encourage and prioritize sustainable action in future planning and policy.