Appendix D: Greenhouse Gas Emissions Inventory

GPCOG
GREATER PORTLAND
COUNCIL OF GOVERNMENTS

Freeport Climate Action Plan

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Acronyms

ACS	American Community Survey
CACP	Clean Air and Climate Protection
CBECS	Commercial Buildings Energy Consumption Survey
CEES	Committee for Energy Efficiency and Sustainability
CH4	Methane
CMP	Central Maine Power
CO2	Carbon Dioxide
CO2e	Carbon Dioxide equivalent
FLIGHT	Facility Level Information on Greenhouse gases Tool
FSAB	Freeport Sustainability Advisory Board
GHG	Greenhouse Gas
GMRI	Gulf of Maine Research Institute
GOPIF	Governor’s Office of Policy Innovation and the Future
GPCOG	Greater Portland Council of Governments
HFCs	Hydrofluorocarbons
MMBtu	Metric Million British thermal unit
MT	Metric Tons
N20	Nitrous Oxide
ODS	Ozone-Depleting Substances
PBA	Primary Building Activity
PFCs	Perfluorocarbons
SF6	Sulfur Hexafluoride
SMPDC	Southern Maine Planning and Development Commission
T&D Loss	Transmission and Distribution Loss

Introduction

By conducting an inventory of greenhouse gas (GHG) emissions, municipalities can better understand their contribution to global climate change and take meaningful steps toward mitigating their impact. As part of Freeport's climate action planning process, the Greater Portland Council of Governments (GPCOG) conducted an inventory of the town's municipal and community-wide greenhouse gas (GHG) emissions for the year 2019. This inventory provides Freeport with detailed emissions data, which can be used to:

- **Identify opportunities for reducing emissions**
- **Create specific key performance indicator targets for strategy areas**
- **Develop a baseline to track progress toward meeting emissions reductions targets**

Inventory Year

Due to major disruptions from Covid-19, this inventory uses data from the year 2019 to reflect pre-pandemic activity. Human activity significantly changed for an extended period of time, reducing daily GHG emissions up to -17% [1]. Many communities conducting annual inventories noticed that the baseline years of 2020 and 2021 reflected the pandemic irregularities – which impacted the emissions data. Current best practices recommend using 2019 as a baseline year until 2022 data is available and complete, which it was not during development of this inventory.

This inventory was restricted to the Town of Freeport in Cumberland County, Maine. Freeport occupies an area of 46.47 square miles, with 34.70 square miles of land. In 2019, the population of Freeport was 8,439 people. Freeport is home to significant industrial and natural landmarks, including the Desert of Maine and Wolfe's Neck Woods State Park. The Town is also a popular tourist destination, with over 3.5 million visitors each year [2].

As part of Freeport's Climate Action Plan process, GPCOG used this baseline inventory to develop two emissions reduction scenarios for the Freeport Sustainability Advisory Board (FSAB) to consider recommending the Town Council adopt. The first scenario follows reduction targets established by the 2020 state climate action plan, Maine Won't Wait [3]. The second scenario provides more ambitious milestones following international emission reduction targets in line with the International Climate Agreement (ICA) pledge to keep global warming within 1.5°C of pre-industrial levels, also referred to as 'science-based targets'. These scenarios include targets for both community-wide and municipal emission reductions. Setting emissions targets is a valuable step for the Town of Freeport to both measure mitigation progress over time and signal a commitment to the wider-community and the region that they are prioritizing action to address climate change. See the scenarios in the Emission Reduction Pathway section of this report.

1 https://www.nature.com/articles/s41558-020-0797-x
2 https://visitmaine.com/places-to-go/greater-portland-and-casco-bay/freeport
3 The State releases annual updates on the progress of Maine Won't Wait and resources for Mainers. https://www.maine.gov/climateplan/

The science-based targets propose net zero emissions by 2050, with an intermediate goal of a 65% reduction in emissions by 2030. Other communities in Maine have committed to strive towards this target.

After consideration, FSAB chose to recommend the science-based target to the Town Council for adoption.

Net Zero Emissions

Net zero describes when greenhouse gases going into the atmosphere are balanced by removal out of the atmosphere. Removal strategies are pursued only after all emissions reduction strategies are exhausted.

The Freeport Town Council voted to accept the new emissions reduction target in October of 2023 in a 4 to 2 vote (one councilor absent). This report uses the emissions reduction scenario that was accepted by the Town. These accepted targets will guide the Town's planning and decision-making for measures that address GHG emissions. The successful passage of the targets was a collaborative effort between FSAB, Freeport Town Council, Freeport town staff, and community members who provided input through surveys and workshops [4].

Significance of a Greenhouse Gas Inventory

Greenhouse gases (GHGs) are the gases responsible for trapping heat inside the Earth's atmosphere. These gases occur naturally and help regulate our planet's temperature but also occur as a result of human activities, such as the burning of fossil fuels for energy production and transportation.

A GHG inventory is a list of emission sources and an estimation of the quantity of associated emissions that occur within a community's geographic boundary. Inventories can be a tool for communities to:

- determine a community's emissions footprint for informing climate action planning,
- set baseline emissions reduction targets and track greenhouse gas emissions performance over time,
- identify emissions reduction priority areas, and
- demonstrate municipal accountability and leadership.

Emissions in this inventory are separated into two records, (1) community-wide and (2) municipal and school.

The goals of a GHG inventory are to provide the Town with a comprehensive breakdown of the highest emitting sectors and to act as a comparison tool to measure progress in reducing GHG emissions. The Town will use the actual emission data of Freeport to best inform prioritization of climate action strategies. The 2019 inventory is a baseline for Freeport's emissions and a snapshot of the Town's emitting activities at that point in time. GPCOG recommends that the GHG inventory protocol is replicated every 3 years to measure how emissions are changing over time in order to evaluate the progress of emission reduction strategies.

4 See Climate Action Plan for more details on community engagement.

Methodology and Data Collection Process

This inventory uses the methodology outlined in the SMPDC GHG Emissions Inventory Protocol, which provides a standardized system for the GHG emissions collection process for Southern Maine communities. The SMPDC protocol is informed by the U.S. Community Protocol for Reporting and Accounting for community greenhouse gas emissions, an internationally used best practice methodology.

This report presented emissions resulting from:

1. A **Community-Wide Inventory** which accounts for all GHG emissions produced by the activities of a community's members, including its residents, workforce, businesses, and visitors. This looks at all emissions sources from stationary energy, transportation, and waste sectors.

2. A **Municipal Operations Inventory** produces a detailed account of the sources and amounts of GHG emissions within the jurisdictional boundaries of the town generated by municipal operations. Municipal GHG emissions are also included in the community-wide inventory.

Inventory Year The Community-wide and Municipal Operations GHG emissions inventories were completed using a combination of sources that report data from 2019 - the selected baseline year. The inventory year of 2019 was selected as the most recent and readily available data that accurately reflects non-pandemic era activity.

Inventory Boundary The inventory boundary is the geographic extent of Freeport's administrative jurisdiction. All emissions that happen inside the administrative boundary are included. Emissions that happen outside the boundary but as a direct result of community activity within the boundary (i.e. electricity use, landfilling of waste) are also included. See "Emission Scopes" for more information.

Greenhouse Gases

This GHG inventory for Freeport includes three of the six internationally recognized greenhouse gases. The three gases included are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). This inventory will not include the greenhouse gases categorized as ozone-depleting substances (ODS), such as hydrofluorocarbons or perfluorocarbons, because:

1. They primarily result from industrial, agriculture, forestry, and land use sectors; sectors which are not included in the protocol for this inventory, and of which there is limited application in Freeport.
2. It is difficult to measure the warming effect of ODS: they deplete another greenhouse gas, stratospheric ozone [5].
3. ODS resulting from human activity are being phased out by the Clean Air Act.

Further information on the GHG gases included or excluded from the inventory are described in the SMPDC Greenhouse Gas Inventory Protocol. The GHGs that have the greatest effect on the climate are described below.

All the greenhouse gases included in this inventory are converted and displayed as metric tons of carbon dioxide equivalent, or MT CO_2e. The greenhouse gases are measured in the equivalent amount of CO_2 that would result in similar levels of warming. CO_2e is used to help quantify the warming potential of each of the other included greenhouse gases and allows them all to be categorized as the displayed MT CO_2e.

MT CO_2e

Metric tons of carbon dioxide equivalent. This is the standard unit used for GHG emissions. It is comprised of metric tons of carbon dioxide, but also includes other greenhouse gases. The tonnage of other greenhouse gases is adjusted to the equivalent tonnage of carbon dioxide necessary to produce the same warming effect.

Example: If 1 metric ton of methane was emitted, it would be counted as 25 MT CO_2e, since methane has 25 times the warming effect of carbon dioxide.

TABLE 1. Summary of Greenhouse Gases

Greenhouse Gas [6]	Emitting Sources	Effect on Climate
CO_2 Carbon Dioxide	• Burning carbon- based resources (i.e., fossil fuels) • Decomposition of organics (e.g., food waste) • Respiration of plants and animals • Chemical reactions	• Contributes ~79% of global emissions and warming to the atmosphere. • Increase in warming effect, 1990- 2019: 161%
CH_4 Methane	• Agriculture (livestock and land) • Production and transport of fossil fuels • Landfill off-gassing	• Contributes ~11% of greenhouse gas emissions. • The warming impact is 25 times greater than that of CO2 • Increase in warming effect, 1990- 2019: 113%
N_2O Nitrous Oxide	• Agricultural soil management (fertilizers and manure) • Burning carbon-based resources • Industrial byproduct • Wastewater treatment	• Contributes ~7% of emissions to the atmosphere • The warming impact is 298 times greater than that of CO2 • Increase in warming effect, 1990- 2019: 154%
Fluorinated Gases (HFCs, PFCs, SF6) (not included in inventory)	• Refrigerants, aerosols, solvents • Industrial byproduct • Electricity distribution • No natural sources	• Contribute ~3% of global emission • Last hundreds or thousands of years in the atmosphere • Have between 12,000 to 22,000 times the warming impact of CO2 • Emissions of fluorinated gases increased 90% from 1990- 2020

5 https://www.epa.gov/sites/default/files/2015-07/documents/fugitiveemissions.pdf
6 https://www.epa.gov/ghgemissions/overview-greenhouse-gases

Sectors

There are three major sectors examined in this Community-wide and Municipal Operations GHG emissions inventory: stationary energy, transportation, and waste. These sectors are each broken down further into various subsectors and emission scopes.

- The **Stationary Energy Sector** refers to the energy consumed by buildings, facilities and other fixed structures that are connected to the electricity grid or burn on-site fossil fuels for power generation. This sector includes all energy used for lighting, heating, cooling, and other miscellaneous building services. Stationary energy also captures any industrial processes and equipment. Calculated as part of the stationary energy sector is Transmission and Distribution Loss (T&D Loss) and Fugitive Emissions from the power sector.
    - **Transmission and Distribution Loss (T&D Loss)** is an estimate of the energy lost in the process of supplying electricity to consumers. These losses mainly occur from energy dissipated in the conductors, transformers, and other equipment used for transmission, transformation, and distribution of grid-supplied electricity.
    - **Fugitive Emissions** account for the natural gas lost in the extraction and transportation across pipelines to utilities and establishments.
- The **Transportation Sector** measures the emissions from the combustion of fossil fuels from automobiles, public transportation, marine vehicles, and air transport occurring within Freeport's geographic boundary.
- The **Waste Sector** includes emissions produced during the management of waste produced within town boundaries.

Emission Scopes

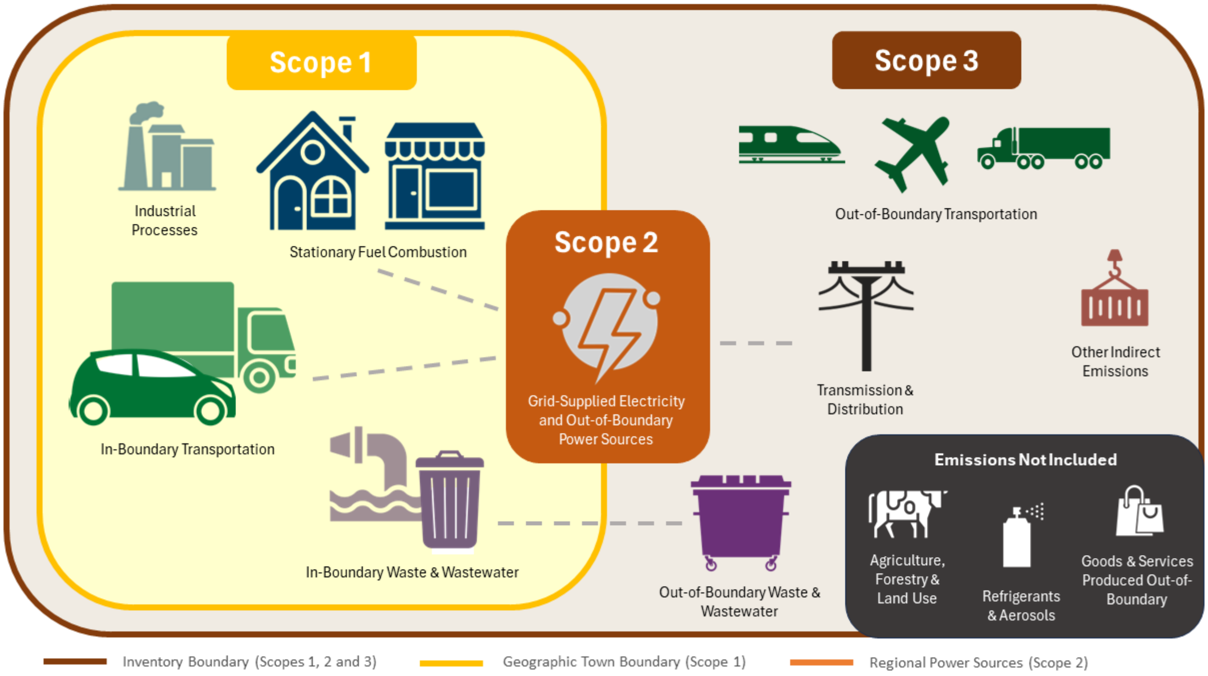


FIGURE 1. Emission Scopes from Global Protocol for Community-scale Greenhouse Gas Emission Inventories [7].

Greenhouse gas emissions may be created either directly or indirectly. Direct emissions are generated and released within the boundaries of the town and include Scope 1 emissions (refer to Table 2). Indirect emissions (Scopes 2 and 3) are emitted outside of the town boundaries but are produced as a result of in-boundary activity. Examples of indirect emissions include the consumption of energy from the electrical grid, or the incineration of Freeport's waste at the ecomaine facility. This Inventory does not include 'upstream' indirect emissions generated by creating or distributing goods, food, or services that Freeport residents purchase, with the exception of production and transportation of goods occurring in town boundaries. Generally, emissions that can be influenced by government coordination and/or community initiatives (I.e., under the control of residents, businesses, or the municipality) are included in this inventory. Greenhouse gas emissions are classified into three scopes. These scopes designate the community boundaries of the calculated emissions and allow for a comprehensive understanding of community emissions, and provide a framework for developing strategies to reduce them.

TABLE 2. Summary Of Emissions Scopes For Greenhouse Gas Inventory

Emission Scope	Source	Example
Scope 1	Emissions produced within the town boundary	• Combustion of fuels within buildings in Freeport or vehicles driven in Freeport
Scope 2	Emissions resulting from consumption of energy supplied from outside town boundaries	• Consumption of grid-supplied electricity
Scope 3	Emissions occurring outside town boundaries as a result of town activity	• Transportation of goods or resident commute miles outside of town

7 https://ghgprotocol.org/sites/default/files/standards/GPC_Full_MASTER_RW_v7.pdf

Tools and Resources

This GHG Inventory uses an emissions modeling software called ClearPath, developed by ICLEI – Local Governments for Sustainability. This software allows for GHG accounting of both community and municipal emissions and their related sectors. ClearPath utilizes the current methodologies and best practices outlined in the U.S. Community Protocol and the Local Government Operations Protocol: a protocol developed by ICLEI[8]. SMPDC's protocol details how to use ICLEI's ClearPath tool to calculate community-wide greenhouse gas emissions and forecast future emissions. Where data is unavailable, GPCOG uses best practices to model and estimate emissions. The inventories will be regularly revised as new and better data become available, as models are improved, and as international standards and guidance evolve. The inventory is meant to identify ***medium to longer-term trends*** in the direction of greenhouse gases, rather than exact absolute numbers or year-to-year changes.

Challenges and Limitations

Greenhouse gas emissions modeling is not a perfect science. Conducting an emissions inventory uses the best available data, along with a variety of emissions modeling software, to estimate a town's total footprint within each sector. It is not an exact measurement of every ton of emissions. The reported greenhouse gas emissions should be used by the town as a guide for understanding sources and relative amounts. The quality of the collected data can vary depending on the source and sector. Some data sources, such as building electricity usage, are viewed as high quality and are tracked by the utility, but discrete fuel (i.e., home heating oil) usage data is not tracked at a community level and as a result, is modeled using the best available methodology and data.

The greenhouse gas emissions inventory for the Town of Freeport is not reflective of the actual carbon footprint for each resident. Community-wide GHG inventories are limited to the energy-related emissions produced within the three emission scopes described above. However, indirect emissions from purchasing goods and services (i.e., Scope 3), also contribute to climate pollution. While those emissions are not included in the emissions analysis of the Town, they should still be considered when evaluating an individual's or organization's environmental impact. One of the aims of this GHG inventory and resulting Climate Action Plan is to contribute to the global shift towards renewable energy and sustainable development and consumption, to reduce indirect resident emissions.

Data Collection

Data for this inventory was collected from the Town of Freeport, utility companies which provide electric and natural gas services within the town boundary, other utilities, and proprietary data from the transportation modeling software Streetlight. The tables below describe the emission and data sources included for each sector as part of the Community-wide and Municipal Operations inventories.

8 https://icleiusa.org/ghg-protocols/

TABLE 3. Community Inventory Overview

Sector	Subsector	Emissions Sources	Energy Type	Data Source
Stationary Energy	Residential	Energy use in buildings as well as losses from distribution systems	Electricity	Consumption data from Central Maine Power (CMP)
			Natural Gas	Consumption data from Summit Natural Gas
		Energy use in buildings	Discrete Fuels	Fuel consumption data from 5-year ACS average
	Commercial	Energy used in commercial, government, and institutional buildings as well as losses from distribution systems	Electricity	Consumption data from Central Maine Power (CMP)
			Natural Gas	Consumption data from Summit Natural Gas
		Energy used in commercial, government, and institutional buildings	Discrete Fuels	Fuel consumption data modeled using commercial facility characteristics (size and fuel) data sets [9]
	School	Energy used for school buildings and facilities	Electricity	Consumption data from Central Maine Power (CMP)
			Natural Gas	Consumption data from Maine Natural Gas
			Discrete Fuels	Consumption data of propane for RSU 5 from Freeport RSU's Accounts Payable Coordinator
	Industrial	Energy used in manufacturing and industrial facilities as well as losses from distribution systems	Electricity	Consumption data from Central Maine Power (CMP)
			Natural Gas	Consumption data from Summit Natural Gas
		Energy used in manufacturing and industrial facilities	Discrete Fuels	Fuel consumption data modeled using industrial facility characteristics data sets [10]
Transportation	Passenger Vehicles	Fuel combusted from all passenger vehicle trips that are attributable to travel within the town boundaries	Gasoline, Diesel, Electricity	Modeled energy consumption/activity data based on real activity data from Streetlight
	Commercial Vehicles	Fuel combusted from all commercial and municipal vehicle trips that are attributable to travel within the town boundaries	Gasoline, Diesel, Electricity	Modeled energy consumption/activity data based on real activity data from Streetlight
	School Fleet	Fuel combustion of on-road school vehicles	Gasoline, Diesel	Consumption data from Freeport RSU's Director of Facilities and Transportation
	Public Transit	Fuel combusted from all passenger miles traveled on public transit within town boundaries	Gasoline, Diesel	Modeled energy consumption/activity data based on real activity data from Streetlight

TABLE 3 (cont.)

Waste	Solid Waste-Incineration	GHG emissions resulting from the incineration of all trash generated by residential, commercial and municipal activity in the community that is sent to an incineration plant	Incineration Emissions	Ecomaine – Town curbside tonnage and emissions
	Wastewater	Process and fugitive emissions from treating wastewater from all residential and commercial activities	Electricity	Consumption data from Central Maine Power (CMP)
			Aerobic and Anaerobic Digestion	Processing of wastewater at the wastewater treatment facility
			Septic Systems	Modeled fugitive emissions from the number of septic tanks and average household size

TABLE 4. Municipal Operations Inventory Overview

Sector	Subsector	Emissions Sources	Energy Type	Data Source
Stationary Energy	Buildings & Facilities	Energy used within municipally owned buildings	Electricity	Consumption data from Central Maine Power (CMP)
			Natural Gas	Consumption data from Summit Natural Gas
			Discrete Fuels	Consumption data from CN Brown Energy
	Streetlights & Traffic Signals	Electricity used in town streetlights and traffic signals	Electricity	Consumption data from Central Maine Power (CMP)
Transportation	Fleet Vehicles	Fuel combustion of on and off-road municipal vehicles	Gasoline, Diesel	Consumption data from Freeport's Public Works Department
	Marine Vessels	Fuel combustion of municipally owned marine vessels	Gasoline	Consumption data from Freeport's Superintendent of Vehicle Maintenance
Waste	Wastewater Treatment	Emissions from wastewater treatment	Anaerobic Digestion	Number of wastewater connections and septic tanks provided by Freeport's Department of Public Works
		Grid electricity used in wastewater treatment	Electricity	Consumption data from Central Maine Power

9 https://www.eia.gov/consumption/commercial/
10 https://www.maine.gov/labor/cwri/qcew1.html

Community-Wide Inventory

The Community-wide Inventory for Freeport includes all emission sources and associated quantities of emissions for the stationary energy, transportation, and waste sectors. Differentiations are made between residential and commercial emissions. The Community-wide Inventory also includes all emissions from municipal operations. Freeport's schools are part of a Regional School Unit and not under direct municipal jurisdiction, but their in-boundary emissions are called out in Table 9.

The overall community greenhouse gas emissions for Freeport in 2019 are estimated at 132,638 MT CO_2e. The majority of emissions (58%) resulted from transportation, primarily gasoline vehicles. Stationary energy sources were the second highest emitting sector at 38% of community-wide emissions. Waste management made up just 5% of Freeport's emissions.

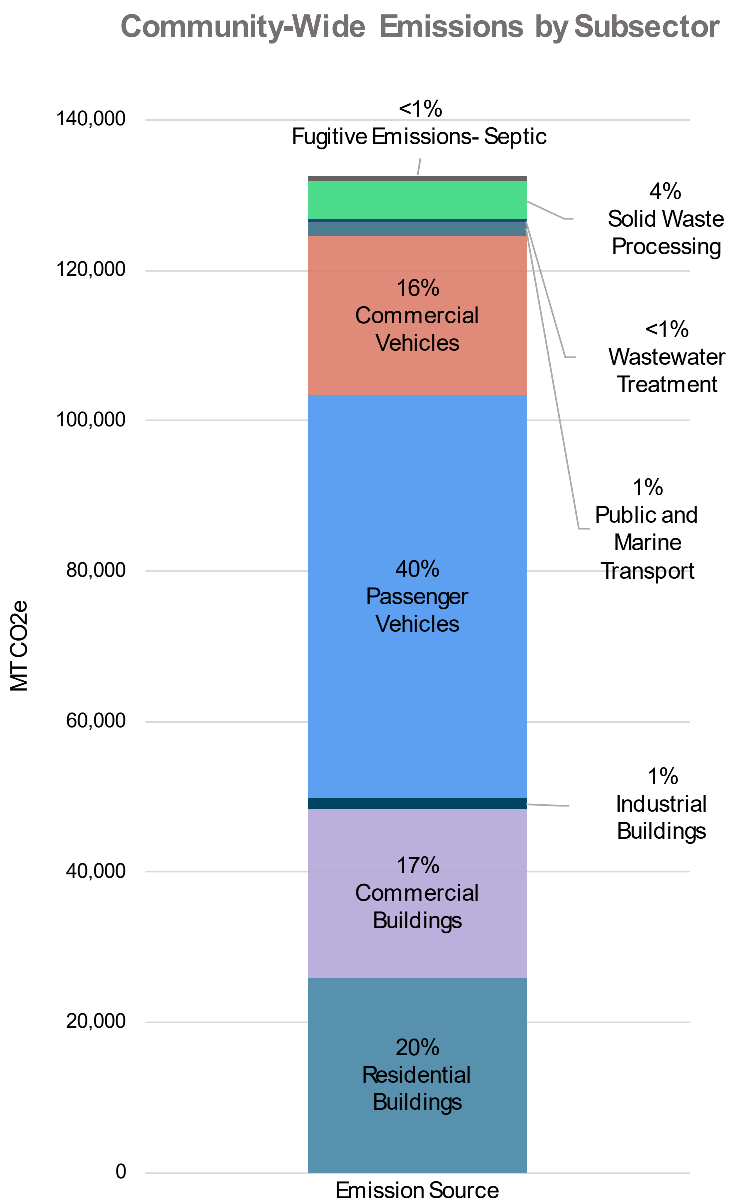
All emissions captured in this inventory result from activity occurring within the community boundaries, even if some of the emissions themselves are generated beyond town lines. An example of this would be waste produced by Freeport residents that is exported to the ecomaine facility to be incinerated and converted into electricity.

The following table provides the general breakdown by sector of community emissions for Freeport. Each sector is analyzed in detail below.

Process and fugitive emissions are emissions unintentionally released into the atmosphere as a by-product of equipment and infrastructure imperfections. For example, methane from a septic tank. Upstream impacts of activities refer to the emissions generated from production processes, such as the transmission and distribution (T&D) losses associated with electricity from the grid. Fugitive emissions and T&D Loss are accounted for in the buildings section.

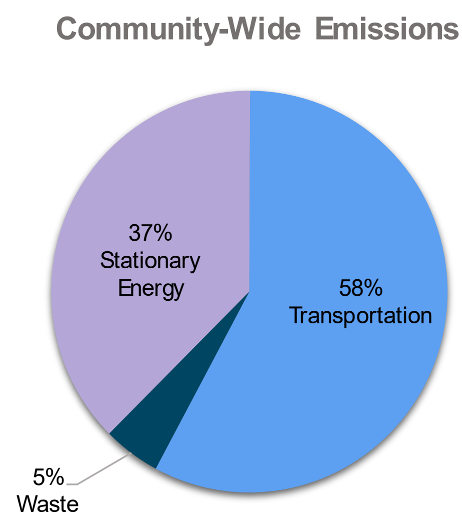
TABLE 5. Community-Wide Emissions by Sector

Sector	Subsector	GHG Emissions (MT CO_2e)	% Of GHG Emissions
Stationary Energy	Residential Buildings	26,010	20%
	Commercial Buildings	22,302	17%
	Industrial Buildings	1,512	1%
Transportation	Passenger Vehicles	53,580	40%
	Commercial Vehicles	21,146	16%
	Buses	1,133	1%
	Marine Vessels	760	<1%
Waste	Solid Waste Processing	5,247	4%
	Wastewater Treatment	250	<1%
	Fugitive Emissions- Septic	697	<1%
Total Community Emissions		**132,638**	**100%**



The community-wide GHG emissions correspond to approximately 15.7 MT CO_2e per capita. However, this inventory provides an estimate for the emissions at the community-wide scale and is not a realistic picture of emissions per person. The emissions include electricity, fuel, and transportation use from seasonal residents and tourists, who are not counted as part of the population. Also, as previously mentioned, the inventory does not account for the direct and indirect emissions of goods and services consumed by residents or visitors – such as air travel, clothing, or food.

FIGURE 2. Community-Wide Emissions by Subsector



Stationary Energy

Total stationary emissions (37.5%) were estimated at 49,824 MT CO_2e. In Freeport, residential energy use is the highest emitting subsector, producing over half of all stationary emissions.

TABLE 6. Stationary Emissions by Subsector

Sector	Emissions Source	GHG Emissions (MT CO_2e)	% of Stationary Energy Emissions	% of Community Emissions
Stationary Energy	**Total Residential Emissions**	**26,010**	**52%**	**20%**
	Residential Electricity	5,438	11%	4%
	Residential T&D Losses	277	1%	<1%
	Residential Natural Gas	1,164	2%	1%
	Residential Fugitive Emissions	38	<1%	~0%
	Residential Bottled, Tank, or LPG	4,407	9%	3%
	Residential Distillate Fuel No. 2	13,323	27%	10%
	Residential Wood/Biomass	1,363	3%	1%
	Total Commercial Emissions	**22,302**	**45%**	**17%**
	Commercial Electricity	8,581	17%	6%
	Commercial T&D Loss	438	1%	<1%
	Commercial Natural Gas	7,725	16%	6%
	Commercial Fugitive Emissions	252	1%	<1%
	Commercial/Industrial Distillate Fuel No. 2	5,307	11%	4%
	Total Industrial Emissions	**1,512**	**3%**	**1%**
	Industrial Electricity	1,299	3%	1%
	Industrial Upstream T&D Losses	66	<1%	~0%
	Industrial Natural Gas	142	<1%	~0%
	Industrial Fugitive	5	<1%	~0%
Total Stationary Energy Emissions		**49,824**	**100%**	**37%**

Stationary Energy Emissions

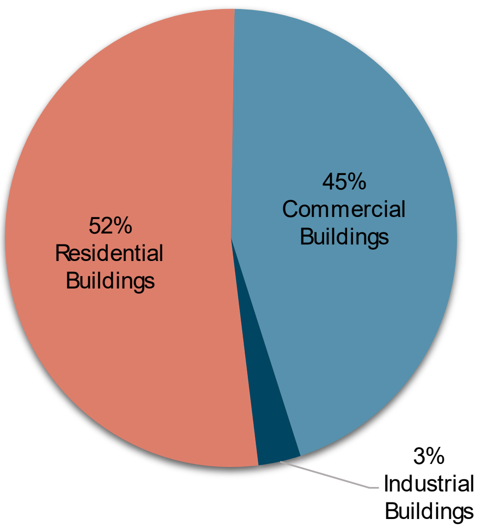
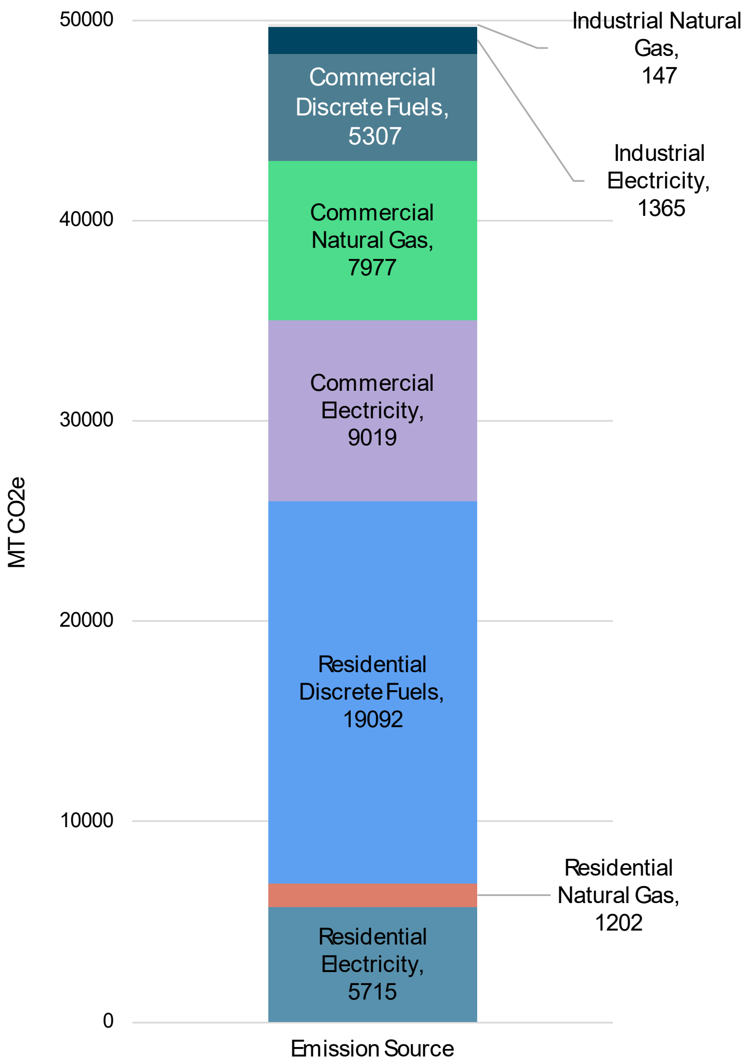


FIGURE 3. Community-wide stationary energy emissions and subsector emission sources

Stationary Energy Emissions by Subsector



MMBtu

Metric Million British thermal unit. This is the standard unit for measuring energy usage and consumption. One kilowatt hour is equivalent to approximately 0.0034 MMBtu.

Residential Energy Usage

The subsector of Residential Energy Usage measures the emissions produced from residential consumption of grid-supplied electricity and the combustion of stationary fuels for home heating. Residential emissions accounted for 52% of emissions for the stationary energy sector and 19% of total community-wide emissions at 26,010 MT CO_2e.

Residential energy usage emissions were calculated using 2019 town-wide electricity and natural gas consumption data. Discrete fuel consumption, which includes heating oil, was modeled using a combination of ACS data, community home heating characteristics, and Maine statewide home heating characteristics (as per the SMPDC protocol).

TABLE 7. Residential Energy Consumption of Grid-supplied Electricity and Stationary Fuel Combustion

Subsector	Emissions source	GHG Emissions (MT CO_2e)	% of Subsector Emissions
Residential Energy Usage	**Total Grid Electricity**	**5,715**	**22%**
	Electricity Consumption	5,438	21%
	Upstream T&D Loss	277	1%
	Total Natural Gas	**1,202**	**5%**
	Natural Gas Consumption	1,164	5%
	Fugitive Emissions	38	<1%
	Total Discrete Fuels	**19,092**	**73%**
	Bottled, Tank, or LPG	4,407	17%
	Distillate Fuel/Kerosene	13,323	51%
	Wood/Biomass	1,363	5%
	Total Residential Emissions	**26,010**	**100%**

Commercial Energy Usage

The subsector of Commercial Energy Usage measures the emissions produced from commercial consumption of grid-supplied electricity and the combustion of stationary fuels for heating. Emissions were calculated using annual town-wide electricity and natural gas consumption data. Discrete fuel consumption for the commercial sector, which includes heating oil, was modeled using a combination of Maine Industry Employment and Wages data, Commercial Buildings Energy Consumption Survey (CBECS) data, and Primary Building Activity (PBA) data. The modeling methodology used can be found in the discrete fuel use section of the Greenhouse Gas Inventory Protocol for Southern Maine Communities. Commercial emissions (15%) were estimated at 22,302 MT CO_2e.

Compared to residential stationary energy sources, commercial buildings use more energy from the grid and more from localized fossil fuel sources.

TABLE 8. Commercial Energy Consumption of Grid-supplied Electricity and Stationary Fuel Combustion

Subsector	Emissions source	GHG Emissions ($MT\ CO_2e$)	% of Subsector Emissions
Commercial Energy Usage	**Total Grid Electricity**	**9,019**	**40%**
	Electricity Consumption	8,581	38%
	Upstream T&D Loss	438	2%
	Total Natural Gas	**7,977**	**36%**
	Natural Gas Consumption	7,725	35%
	Fugitive Emissions	252	1%
	Total Discrete Fuels	**5,307**	**24%**
	Distillate Fuel Oil No.2	5,307	24%
	Total Commercial Emissions	**22,302**	**100%**

Industrial Energy Usage

Emissions were calculated using annual town-wide electricity and natural gas consumption data. Industrial emissions (1% of total emissions) were estimated at 1,512 MT CO_2e.

Industrial energy usage emissions were calculated on ClearPath using 2019 town-wide electricity and natural gas consumption data provided by local utilities. Retail management and dock-building are two of Freeport's industries.

Industrial energy usage in Freeport primarily uses grid-supplied energy.

TABLE 9. Industrial Energy Subsector and Emissions by Fuel Type

Subsector	Emissions source	GHG Emissions ($MT\ CO_2e$)	% of Subsector Emissions
Industrial Energy Usage	**Total Grid Electricity**	**1,365**	**90%**
	Electricity Consumption	1,299	86%
	Upstream T&D Loss	66	4%
	Total Natural Gas	**147**	**10%**
	Natural Gas Consumption	142	9%
	Fugitive Emissions	5	<1%
	Total Industrial Emissions	**1,512**	**100%**

Schools Energy Usage

Since Freeport's schools are in a Regional School Unit (RSU), the Town does not have control over the school buildings and buses. Therefore, the Town does not have direct control over the emissions of Freeport's schools, and the schools are not included in the Municipal Inventory. The school buildings located within Freeport have their emissions accounted for by the town-wide electricity usage. The school emissions are included under commercial energy, but called out for transparency. The total emissions from school buildings located within Freeport are described in the chart below.

Emissions were calculated using annual school building electricity, propane, and natural gas consumption data. The total emissions from schools made up 1.2% of Freeport's total emissions in 2019.

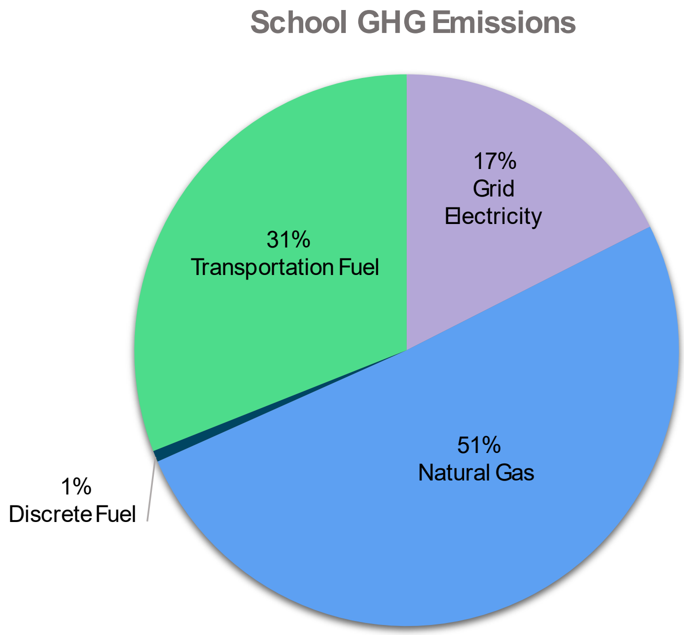


FIGURE 4. School Emission Sources

TABLE 10. School Energy Consumption of Grid-Supplied Electricity and Stationary Fuel Combustion

Subsector	Emissions source	GHG Emissions ($MT\ CO_2e$)	% of Subsector Emissions
Schools Energy Usage	**Total Grid Electricity**	**290**	**18%**
	Electricity Consumption	276	17%
	Upstream T&D Loss	14	>1%
	Total Natural Gas	**835**	**51%**
	Natural Gas Consumption	809	49%
	Fugitive Emissions	26	2%
	Total Discrete Fuels	**11**	**>1%**
	Discrete Fuel Consumption	11	>1%
	Total Transportation Fuel	**509**	**31%**
	Gasoline Buses	74	5%
	Diesel Buses	435	26%
	Total School Emissions	**1,645**	**100%**

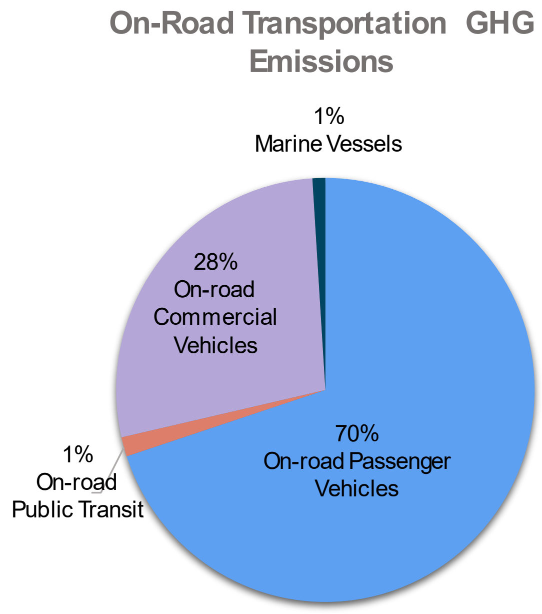
Transportation Energy and Mobile Sources

The transportation sector consists of all on-road transportation and mobile sources in Freeport. The community-wide transportation sector also encompasses the municipal fleet of on- and off-road vehicles and marine vessel fuel consumption.

Emissions were calculated from total community vehicle miles traveled (VMT) using proprietary data from the transportation modeling software Streetlight. The VMT is based on all trips that occur as a result of people travelling to, from, or within a community, but does not include those which pass through without stopping. This means that if a Freeport resident commutes from Freeport to Portland every day for work, only the portion driven within the geographic boundary of Freeport is included in the inventory. Passthrough traffic (on the interstate, for example) are not included. Transportation emissions are calculated using VMT, vehicle type, fuel type, and emissions factors for each greenhouse gas. The full details and methodology are outlined in the SMPDC Inventory Collections Protocol and adapted for Cumberland County from the Estimating On-Road Transportation Emissions in York County, Maine. Gasoline and diesel fuel economies are weighted based on the makeup of vehicle type.

In 2019, the emissions from transportation in Freeport were 92,386 MT CO_2e. This was the overall highest emitter and made up over half (58%) the community-wide emissions. This is significantly higher than the average distribution of transportation emissions in Maine, which was 49% statewide in 2019 [11]. This is most likely due to Freeport's popularity as a tourist and commercial destination, with a significant number of vehicle miles traveled contributed by non-Freeport residents. There is no data currently available that allows for differentiation between resident and non-resident transportation emissions.

11 https://www.maine.gov/dep/news/news.html?id=8474333



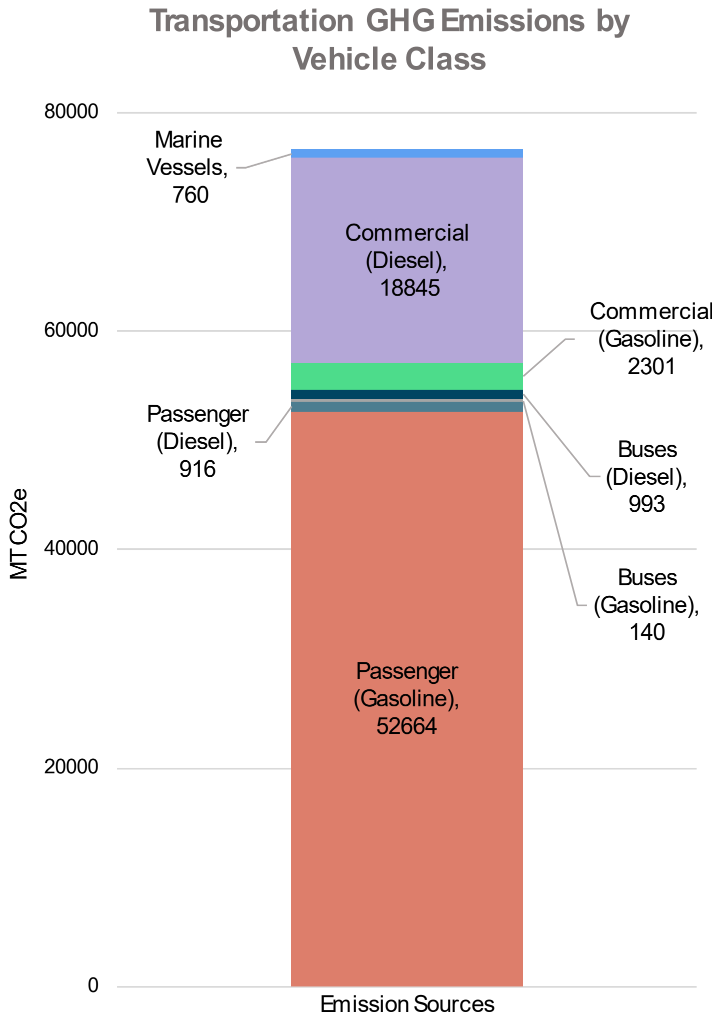


FIGURE 5. Community-wide Transportation Emissions by Vehicle Class

TABLE 11. Community-Wide Transportation Emissions

Sector	GHG Emissions (MT CO_2e)	GHG Emissions (MT CO2e)	% of Transportation Emissions	% of Community Emissions
Transportation	**On-road Passenger Vehicles**	**53,580**	**70%**	**40%**
	Gasoline	52,664	69%	40%
	Diesel	916	1%	<1%
	On-road Buses	**1,133**	**1%**	**<1%**
	Gasoline	140	<1%	~0%
	Diesel	993	1%	<1%
	On-road Commercial Vehicles	**21,146**	**28%**	**16%**
	Gasoline	2,301	3%	2%
	Diesel	18,845	25%	14%
	Marine Vessels	**760**	**1%**	**<1%**
	Gasoline	407	<1%	<1%
	Diesel	353	<1%	<1%
Total Transportation Emissions		**76,619**	**100%**	**58%**

Freeport is serviced by the Amtrak Downeaster line, which is a rail line that services communities from North Station in Boston, MA up to Brunswick, ME. Although rail emissions are a contributing factor to the town's overall emissions, data is not easily obtainable and is not included in the scope of this inventory. Similarly, emissions from freight rail and aviation are not included as part of this inventory. These sectors are not included because data is either not available or not applicable to the town.

Waste

The emissions from this sector are based on the processing of the trash and recycling produced by the town. This sector also addresses greenhouse gas emissions produced by sewage management and septic tanks. Municipal solid waste disposal and wastewater treatment account for only 5% of Freeport's emissions. However, as noted earlier the upstream impacts of waste and consumption are not captured in this inventory. Reducing overall consumption -and thereby reducing waste- are important strategies for minimizing the lifecycle emissions from goods and services.

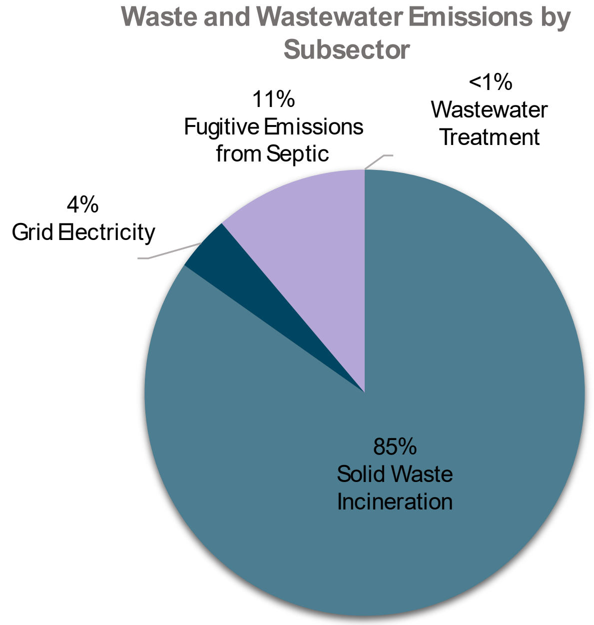


FIGURE 6. Community-Wide Waste Emissions by Subsector

TABLE 12. Community-wide Waste Emissions

Subsector	Emissions source	GHG Emissions (MT CO_2e)	% of Subsector Emissions	% of Community Emissions
Waste	Solid Waste Incineration	5,247	85%	4%
	Fugitive Emissions from Septic	697	11%	~0%
	Wastewater Treatment (Anaerobic Digestion)	<1	~0%	<1%
	WWTP – Grid Electricity	251	4%	~0%
	Total Waste Emissions	**6,195**	**100%**	**5%**

Solid Waste

The solid waste subsector of this GHG inventory includes the emissions from solid waste produced and sent to ecomaine for incineration. Freeport utilizes ecomaine's waste management and recycling services for municipal and town-wide waste. Freeport is an owner member of ecomaine, which means the Town collects the solid waste produced by community members at local solid waste facilities and then the waste is sent to ecomaine's waste-to-energy plant. When necessary, ecomaine does landfill solid waste. Although none of Freeport's waste was landfilled during the inventoried year, it may be in future GHG inventories Solid waste emissions (4%) were estimated at 5,248 MT CO_2e.

Freeport residents and businesses may also hire a private hauler to pick up waste. There are two licensed waste haulers who service Freeport, but data was not available and is not included in this inventory.

Recycling in Freeport

Emissions resulting from recycling and composting are not included in the scope of this inventory. Recycling waste products does have an emissions impact from collecting, transporting, and processing materials. However, recycling also significantly offsets emissions through three major channels:

1. Recycling offsets the emissions from obtaining, processing, and distributing virgin materials.
2. Paper and cardboard recycling increases the overall carbon storage capacity of forests.
3. Diverting materials from landfills and Waste-to-Energy facilities reduces the emissions produced from incineration and off-gassing.

The emissions savings from recycling were calculated for Freeport following ICLEI's Recycling and Composting Emissions Protocol 4. While these figures do not affect the 2019 community-wide emissions, the emissions saved from recycling should be tracked as a metric for achieving emission reduction targets.

In 2019, Freeport avoided 1,950 MT CO_2e of emissions by recycling. Freeport's 2019 recycling rate of 33.7% is similar to Maine's statewide recycling rate of 33.9% [12].

Material Type	Tonnage Produced	Emissions Savings (MT CO_2e)
Metals	39	-215
Glass	123	-40
Plastics	74	-169
Paper/Cardboard	563	-1,523
Total Emissions Avoided	**799**	**-1,950**

12 https://www.maine.gov/dep/waste/recycle/

Water and Wastewater Treatment

Fugitive and wastewater treatment emissions (<1% of total) account for approximately 697 MT CO2e. Wastewater treatment emissions are estimated using factors based on the specific treatment processes used by Freeport Water District and Southern Freeport Water District to treat wastewater, and the total population served in Freeport. There were approximately 1,324 wastewater connections in 2019 and an estimated 2,703 septic tanks.

Fugitive emissions from septic tanks made up the majority of emissions for this sector. Septic releases carbon dioxide and methane as it decomposes, both significant greenhouse gases. Similarly, these gases are released during the treatment of sewage at the wastewater treatment plant. The grid electricity used to power the wastewater treatment plant and pump stations accounts for 0.2% of community-wide emissions annually.

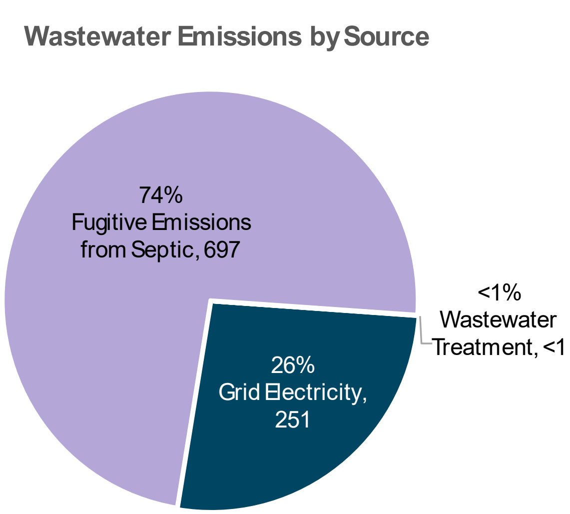


FIGURE 7. Community-Wide Wastewater Emissions by Source

Municipal Operations Inventory

This section details the GHG emissions resulting from Municipal Operations. As part of the science-based emission reduction targets, the Town set a target to reach net zero municipal emissions by 2040.

Total municipal emissions for 2019 were estimated to be 1,452 CO_2e. Municipal emissions account for 1.1% of community-wide emissions. The largest emissions sector was transportation (74%) resulting primarily from fuel use in the municipal fleet.

TABLE 13. Municipal Emissions by Sector

Subsector	Emission Source	GHG Emissions (MT CO_2e)	% Of Total Municipal Emissions
Stationary Energy (26%)	Buildings & Facilities	378	26%
	Streetlights & Traffic Signals	2	<1%
Transportation (74%)	Municipal Fleet – Gasoline & Diesel	1070	73%
	Marine Vessels	2	~0%
Municipal Totals		**1,452**	**100%**

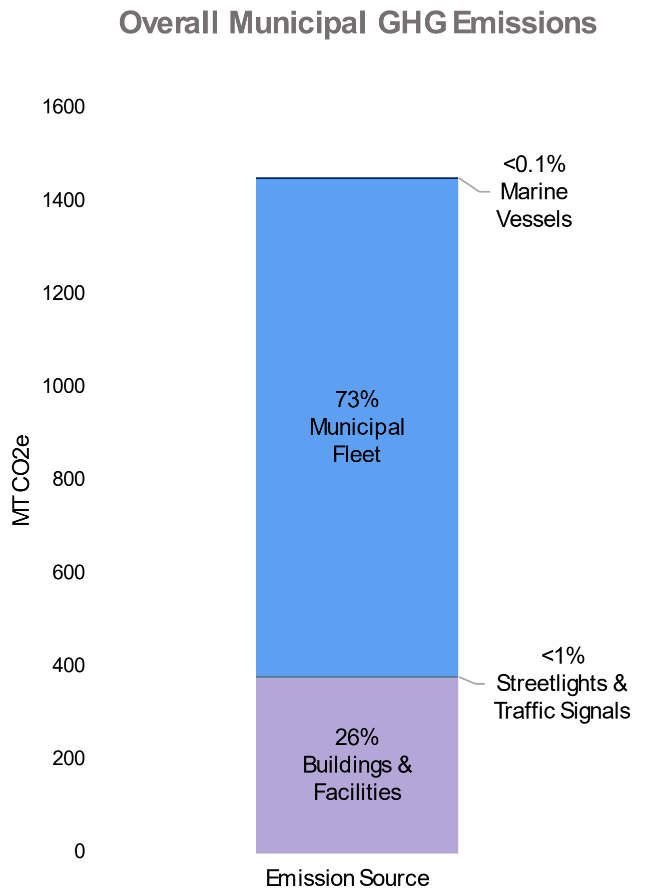


FIGURE 8. Municipal Operations Emissions by Sector

Stationary Energy

Stationary energy usage by Freeport's municipal operations accounted for 378 MT CO_2e. Within this sector, natural gas used for heating in municipal buildings was the most significant contributing energy source of carbon emissions with 230 MT CO_2e.

TABLE 14. Stationary Energy Emissions

Sector	Energy Subsector	Energy Consumption (MMBtu)	GHG Emissions (MT CO_2e)	% of Municipal Stationary Emissions
Stationary Energy	Buildings & Facilities - Electricity	1,783	117	31%
	Buildings & Facilities - Natural Gas	4,325	230	61%
	Buildings & Facilities - Distillate Fuel Oil No. 2	310	23	6%
	Buildings & Facilities - Propane	119	7	2%
	Street, Traffic & Area Lights	26	2	<1%
	Street & Traffic Lights T&D Losses	1	<1	<1%
	Totals	**6,564**	**378**	**100%**

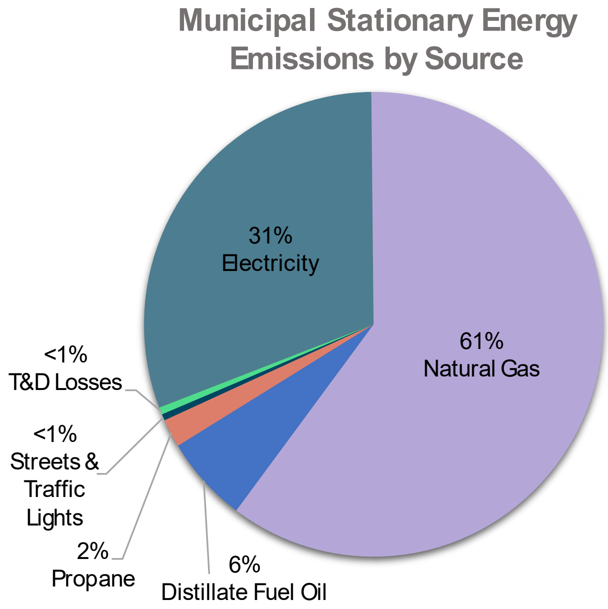


FIGURE 9. Municipal Stationary Emissions by Emissions Source

Transportation

The municipal fleet was responsible for approximately 1,072 MT CO_2e with 23% of those emissions coming from gasoline usage, 77% coming from diesel usage, and <1% coming from Freeport's marine vessels.

TABLE 15. Transportation Emissions from Municipal Fleet

Sector	Energy Subsector	GHG Emissions (MT CO_2e)	% of Municipal Transportation Emissions
Transportation	Municipal Fleet – Gasoline	242	23%
	Municipal Fleet – Diesel	828	77%
	Marine Vessel – Gasoline	2	<1%
	Totals	**1,072**	**100%**

Annual vehicle fuel data was provided by the Public Works department and marine vessel fuel data was provided by Freeport's Harbormaster. Fuel consumption data is not broken down by municipal department and instead is documented by all department fuel usage as a lump sum. The municipal transportation fuel usage consists of real consumption data provided by town records.

Data could be further improved by tracking fuel consumption by municipal department to better inform vehicle fuel efficiency investments. In addition to measuring emissions from the combustion of municipal fleet vehicles, Freeport may want to expand the transportation sector for future inventories by measuring the emissions from employee commutes

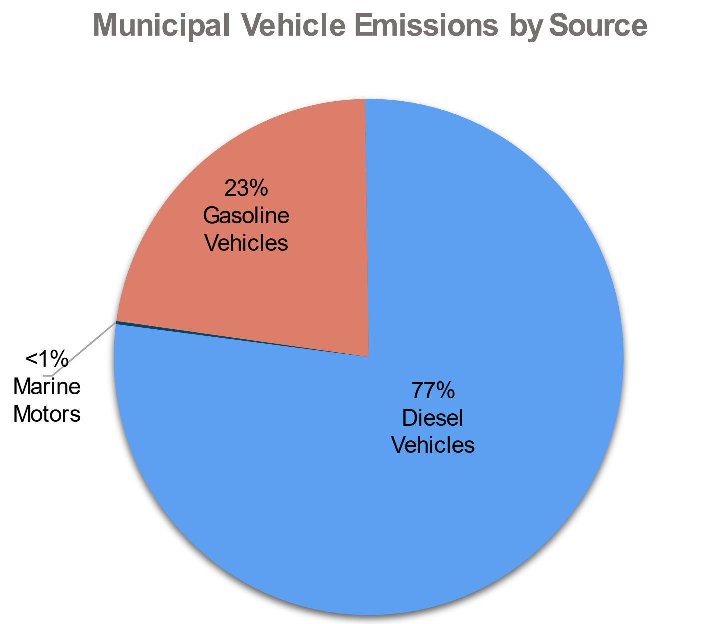


FIGURE 10. Municipal Transportation Emissions by Emissions Source

Waste

The Town does not currently track solid waste produced by its municipal operations, so emissions as a result of municipal waste disposal and incineration are instead captured within the scope of the community inventory. The wastewater treatment facilities which service the Town are not part of municipal government and instead have their own governing bodies. Emissions as a result of wastewater treatment are also captured in the scope of the community inventory.

Freeport Recycling Facilities –ecomaine drop-off

1. Freeport Transfer Station
2. Freeport Public Works
3. Freeport Police Station

Wastewater

The Town does not own or operate its own wastewater treatment facility for municipal operations and is instead serviced by Freeport Sewer District, a quasi-municipal corporation with a separately elected Broad of Trustees.

Water and Wastewater Treatment Facilities Servicing Freeport

1. Freeport Sewer District (Owned by Maine Water Co.)
2. South Freeport Water District

Emission Reduction Target

Setting emission reduction targets establishes clear, quantifiable goals for the town to measure. It can help align with state, federal and international goals, and ensures the town acts to reduce the future impacts of climate change. Reducing energy usage can also generate cost-savings for the municipality, businesses, and residents. The modeling software used for this inventory, ClearPath, was used to support establishing emission reduction targets and detail the actions needed to achieve those targets in the Climate Action Plan.

Three emissions forecast scenarios were modeled for Freeport's community-wide emissions:

- Business as Usual, or the baseline scenario, where no emission reduction strategies are employed.
- **Maine Won't Wait**, an emission reduction scenario aligned with the State's climate action plan of reducing emissions 45% by 2030 and 80% by 2050.
- **International Climate Agreement**, an emission reduction scenario aligned with international goals to keep the global temperature from increasing over 1.5˚ C by reducing emissions 65% by 2030 and achieving net zero by 2050.

With guidance from FSAB, Freeport Town Council adopted the International Climate Agreement scenario. As part of this strategy, Freeport will strive to achieve net zero community emissions by 2050 and net zero municipal emissions by 2040.

This scenario =uses science-based target calculated from the most recent assessment report released by the Intergovernmental Panel on Climate Change (IPCC), and scales emission reductions based on financial characteristics of the community.

ClearPath's emissions reduction uses the 2019 inventory as a baseline to provide a list of strategies needed to achieve reduction targets, such as residential electrification. These numbers are not a hard-set guide, but an attempt to illustrate possible pathways to achieving reduction targets. Electrification and efficiency strategies can be balanced against other sectors' strategies and should align with realistic expectations of progress in each sector. For example, if more residential buildings undergo weatherizations, then fewer commercial buildings will need to be weatherized to achieve the same community-wide emissions savings.

Net Zero describes when greenhouse gases going into the atmosphere are balanced by removal out of the atmosphere. Removal strategies are pursued only after all emissions reduction strategies are exhausted.

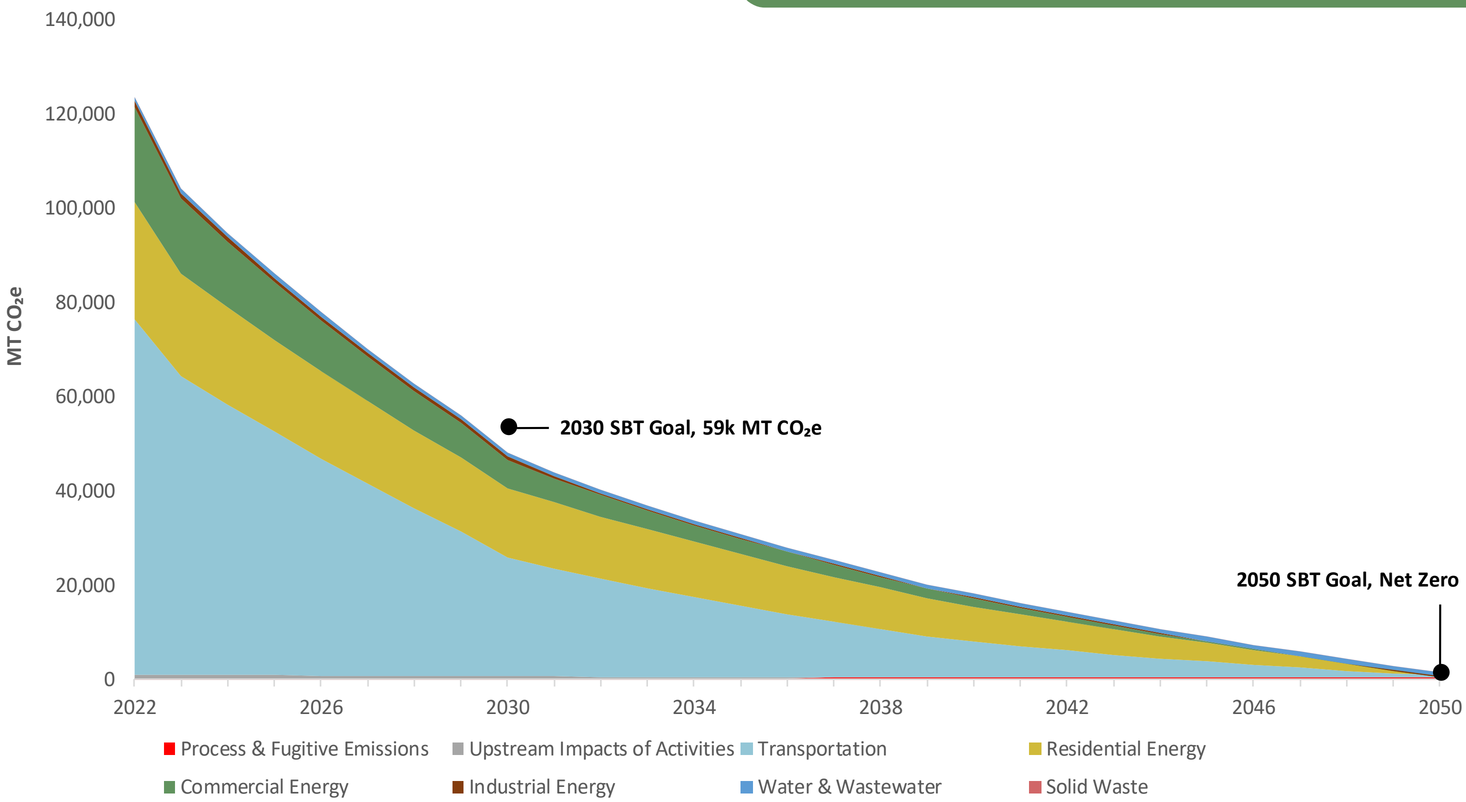


FIGURE 11. Freeport Emissions Forecast aligned with International Climate Agreement's science-based targets

Why are there emissions in 2050?

Emissions in 2050 account for the realistic remainder of fossil fuel use, as some residents will not make the transition to electrified heating sources. Similarly, with transportation, not all community members will have transitioned to electric vehicles, and some vehicles may not have existing alternative fuel technology. At this point, Freeport may consider auditing the natural space in town to assess the amount of carbon absorbed.

TABLE 16. Freeport Emissions Forecast with Science-Based Targets

Sector	2019 GHG Emissions (MT CO_2e)	2030 GHG Emissions (MT CO_2e)	2040 GHG Emissions (MT CO_2e)	2050 GHG Emissions (MT CO_2e)
Residential Energy	25,695	14,854	7,417	512
Commercial Energy	21,612	5,984	1,721	0
Transportation	76,619	25,004	7,670	534
Total Reduction from 2019		**63%**	**86%**	**Net Zero**

ClearPath modeling looks at stationary and transportation community-wide emissions with the 2019 inventory as a baseline with projected targets to model how much emissions need to decrease and generates potential strategies for how to meet those reductions goals.

Reduction Pathway Assumptions

To create emission reduction pathways and reduction strategies, additional parameters related to population and infrastructure changes were incorporated in the models. The assumptions, which apply to all emission forecasts, are described below:

Population Growth	Freeport's historical population data indicates an increasing trend. Data from the U.S. Census was used to calculate an annual growth rate of 0.74% for 2023-2050 [13].
Electricity Grid	In 2019, Maine established a new Renewable Portfolio Standard (RPS). The law requires that 80% of the state electricity grid is supplied from renewable energy sources by 2030, with an additional goal to increase the RPS to 100% by 2050 [14]. These RPS values informed the carbon intensity coefficient for grid-supplied electricity in Freeport's models.
Weatherization Upgrades	Weatherization projects for buildings vary in type and scale, as described in the Stationary Energy Strategies table. Consequently, the impact on building energy efficiency can vary greatly. The ClearPath reduction strategies models a conservative savings of 271 kWh per household per year or 3% of the average household annual electricity usage. Commercial/industrial facilities' weatherization upgrades were modeled at 2% per building per year.
Passenger Vehicle CAFE Standards	Fuel efficiency is expected to improve over the next few decades due to federal regulation. Corporate Average Fuel Economy (CAFE) regulations were incorporated into the carbon intensity coefficient for passenger vehicles only [15]. ICLEI provides a standard set of factors to apply to forecasts, developed from an EPA fuel efficiency change model [16].

13 https://data.census.gov/table/ACSDP5Y2022.DP05?q=freeport%20town,%20cumberland%20county,%20maine
14 https://www.maine.gov/energy/index.php/initiatives/renewable-energy/renewable-portfolio-standards
15 https://www.nhtsa.gov/press-releases/usdot-proposal-updated-cafe-hdpuv-standards
16 https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases#omega-1.4.1

Business as Usual Emissions

The modeling software used for this inventory, ClearPath, can generate the forecast of emissions assuming a "business as usual" approach using the 2019 inventory as a baseline. In a business-as-usual approach, no emission mitigation strategies are employed, and the town continues to function without intentional reduction of fossil fuel use.

With the Business as Usual scenario, Freeport would emit 99,942 MT CO_2e from stationary energy and transportation in 2050, a 20% decrease from 2019. The Electricity Grid Coefficient (more renewable energy in the grid) is the primary explanation for the general decline in emissions despite the increase in population.

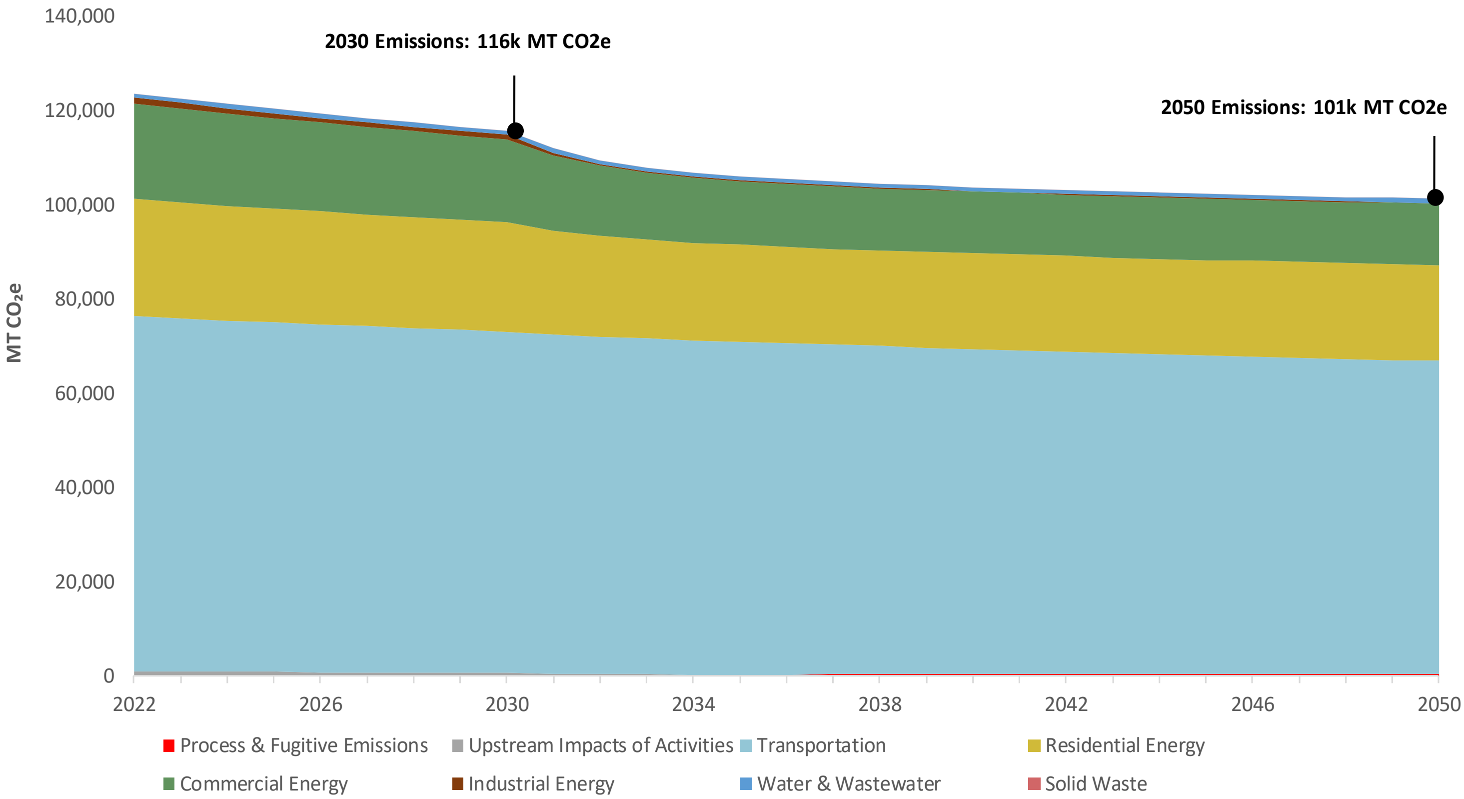


FIGURE 12. Business as Usual Emissions Forecast

Emission Reduction Strategies

As a tool relying on quantifiable solutions, ClearPath modeling leans on strategies, such as heat pump installations and electric vehicle adoption, that have clear measurable impact on emissions. There are many other actions a community can take to reduce emissions in addition to, or as an alternative to, the modeled reduction strategies (such as facilitating walking and biking). In order for Freeport to achieve net zero emissions by 2050, the Town will employ actionable and measurable emission reduction strategies that result in reduced community emissions. While some strategies focus on directly reducing the consumption of fossil fuels, others focus on increasing energy efficiency.

	Stationary Energy Strategies
Installing Heat Pumps	Heat pumps are electric HVAC systems that can heat and cool buildings. Heat pumps displace the need for on-site fossil fuels, like propane or fuel oil. Heat pumps vary considerably in the amount of area they can heat and the cost to install. For this report, a typical heating capacity of 2,000 square feet was used to determine the annual number of heat pump installations needed to reach emission reduction targets.
Weatherizing Buildings	Weatherization projects reduce the amount of heat lost from a building by updating the building's infrastructure. By retaining heat inside the building longer, less energy is required to maintain the temperature, thereby reducing emissions. Updating or adding insulation is one method of improving energy efficiency. Updating windows, or utilizing additional window insulation in the winter, can also improve energy efficiency. While weatherization projects have a smaller effect on reducing emissions than other strategies, they provide other benefits, such as long term energy cost savings and maintaining inside temperatures longer during power outages.
Producing Solar Energy	Switching to renewable energy sources is the most direct way to reduce emissions resulting from buildings. The modeling software used for this inventory only allows for solar energy to be accounted for in the emissions forecast scenario, but other types of renewable energy could be used to displace fossil fuels. Solar systems come in many kW capacities and sizes. ClearPath's modeling uses a 4 kW solar panel system as a standard size, since that size could be utilized as a rooftop panel or in a larger solar field. A 4 kW system, on average, is 269 square feet and can produce half the annual energy needs for a Freeport household. The kW capacity added is a more flexible metric to track, as that can be related to any form of renewable energy, and directly correlates to fossil fuel energy displaced.

Tracking Progress

Freeport is already taking steps to reduce greenhouse gas emissions and implement climate action strategies. However, an effective plan to reduce greenhouse emissions will require tracking and monitoring. To ensure that the town stays on track to meet its emissions reduction targets, GPCOG recommends that Freeport update its greenhouse gas emissions inventory every three years. In addition to updating the inventory, there are additional metrics ('indicators') described below that the town can track on a yearly basis to assess progress between inventory assessments. Indicators detailed below relate to the sectors that most directly contribute to emissions, but indicators in other strategy areas like natural resources and public health are also important for measuring progress towards Climate Action Plan goals. Further indicators and details on additional climate actions are included in the Climate Action Plan.

The models and assumptions used to create these indicators were based on the best-available data at the time this inventory was authored. However, it is crucial to keep in mind that both population trends and technological developments can experience drastic and unpredictable changes within the forecasted period. Cumberland County's population grew 2.1% between 2020 and 2021, more than double its average annual change for the preceding 5 years [17]. Maine experienced a population boom in 2020, largely from an increase in the remote worker population due to the COVID-19 pandemic [18]. Similarly, Maine is likely to experience an influx in population of "climate migrants"- individuals from vulnerable areas seeking a more resilient community- as climate hazards intensify [19]. To incorporate flexibility into the planning process, it is better to evaluate the targets as a percentage of the population at set intervals (5-10 years). For example, assess the number of residential heat pumps as a percentage of homes every 5 years from 2031 through 2050. The Town of Freeport will reassess these indicators regularly as new population and technology information becomes available.

Measuring Climate Action

ClearPath's emissions reduction calculator provides a list of essential strategies to help reach reduction targets, such as residential electrification. These numbers are not a hard-set guide, but an attempt to illustrate possible pathways to achieving reduction targets.

The following tables show the essential strategies needed to reach the net zero community target through residential and commercial energy. The emissions presented here do not include upstream losses/fugitive emissions, which is why they differ slightly from values presented earlier in the report. **In 2019, the stationary energy and transportation emissions total was 125,367 MT CO_2e.**

17 https://data.census.gov/table/ACSDP5Y2015.DP05?q=cumberland%20county,%20maine
18 https://www.pressherald.com/2023/12/10/pandemic-gave-maine-a-population-boom-will-climate-change-be-next/
19 https://d3esu6nj4wau0q.cloudfront.net/documents/NOAA_NEST_REPORT_2023.pdf

Stationary Energy

TABLE 17. Residential Essential Strategies Needed to Reach Targets

Strategy	2024-2030	2031-2050	Total
Heat Pumps (Households Electrified)	51% 6.5% per year	40% 2% per year	90%
Weatherization (Households)	9% 1.3% per year	15% 0.7% per year	24% have undergone 1 weatherization upgrade
Solar Energy (# of 4kW Solar Panels Installed at Homes)	350 50 per year	7,500 375 per year	7,850
Solar Energy (kW Capacity Added to Households)	1,400 200 per year	30,000 1,500 per year	31,400

TABLE 18. Commercial Essential Strategies Needed to Reach Targets

Strategy	2024-2030	2031-2050	Total
Heat Pumps (Installations)	1,200 171 per year	225 11 per year	1,425
Weatherization (Businesses)	43% (210) 30 per year	5% (25) 1 per year	48% (235)
Solar Energy (# of 4kW Solar Panels Installed at Businesses)	525 15 per year	1,500 75 per year	2,025
Solar Energy (kW Capacity Added to Businesses)	2,100 57 per year	6,000 300 per year	8,100

Heat Pump Installations

Tracking heat pump installations can be an effective way to measure progress towards reducing overall greenhouse gas emissions. Heat pumps use electricity to move heat from one place to another rather than generating heat directly, typically between two units inside and outside of a building, making them highly efficient and a low-emissions alternative to traditional heating and cooling systems [20]. Heat pump installations can help reduce the Town's overall consumption of fossil fuels used for heating in the winter and electricity consumption for cooling in the summer. The Town can get a sense of overall heat pump adoption within the community by tracking the total amount of Efficiency Maine rebates. Additionally, the municipality might consider tracking the energy savings achieved by heat pump installations within its own buildings to inform future policy decisions and local incentive programs for further adoption.

Through Efficiency Maine in 2022, Freeport received 292 residential heat pump rebates.

Weatherization Rebates

Similar to heat pump installation, tracking weatherization rebates can be an opportunity to show how many residents are taking advantage of Efficiency Maine programs, and working to reduce energy usage within homes.

In 2022, Freeport installed 56 weatherization measures through Efficiency Maine rebates.

Household Energy Burden

Household energy burden is a term used to describe the percentage of a household's income that is spent on energy bills. It's a key indicator of energy affordability and is becoming increasingly important to consider as households struggle to afford necessities, including utilities. A household's energy burden can be impacted by several factors such as a home's energy efficiency, the cost of electricity and heating fuel, and the household's income.

According to the US Department of Energy's Low Income Energy Affordability Data (LEAD) Tool, in 2020 Freeport residents spent an average of 4% of household income on home energy bills compared to Maine's state average of 5% [21]. A high energy burden is considered to be anything above 6% and a severe energy burden above 10%.

Transportation

In 2019 the Freeport municipal vehicle fleet was responsible for emitting 1,072 MT CO2e and community transportation emissions were responsible for 76,619 MT CO2e. Measuring and tracking emissions from the transportation sector is important for developing effective strategies to reduce GHG emissions and mitigate the impacts of climate change.

Some examples of ways Freeport can track its community's progress towards more sustainable transportation methods may include the total number of registered electric vehicles, the number of EV charging ports, and transit ridership frequency.

20 https://www.efficiencymaine.com/heat-pumps/
21 https://www.energy.gov/scep/slsc/lead-tool

TABLE 19. Transportation Essential Strategies Needed to Reach Targets

Strategy	2024-2030	2031-2050	Total
Electric Vehicle Transition	45% 7% per year	45% 2.3% per year	90% of community gasoline vehicles replaced with EVs [22]
Bus Conversion to Electric/Alternative Fuels[23]	100% of gasoline and diesel buses		
Transit Expansion/ Vehicle Miles Traveled (VMT) Reduced	Decrease community VMT by 10%	Maintain 10% decrease in community VMT	

Number of Registered Electric Vehicles (EVs) and Hybrid-electric Vehicles

Battery electric vehicles produce zero tailpipe emissions, and plug-in hybrid electric vehicles emit significantly less emissions than traditional gasoline-powered cars. This means that as the total number of EVs on the road increases, there will be a corresponding reduction in transportation emissions. By tracking the total number of EVs on the road, it is possible to measure how much progress is being made in reducing transportation-related emissions. For the purpose of this inventory, an EV is classified as any vehicle which has the capability to plug into an EV charging station. This includes battery electric vehicles, and plug-in hybrid vehicles. Although gasoline hybrid vehicles still utilize an electric drivetrain and emit significantly fewer overall emissions than their traditional combustion engine counterparts, they are classified as hybrids, not electric vehicles.

In 2022, there were 10,972 vehicles registered in Freeport [24]. Of vehicles registered, 3% are gasoline hybrid, 1% are plug-in hybrids, and 1% are battery vehicles.

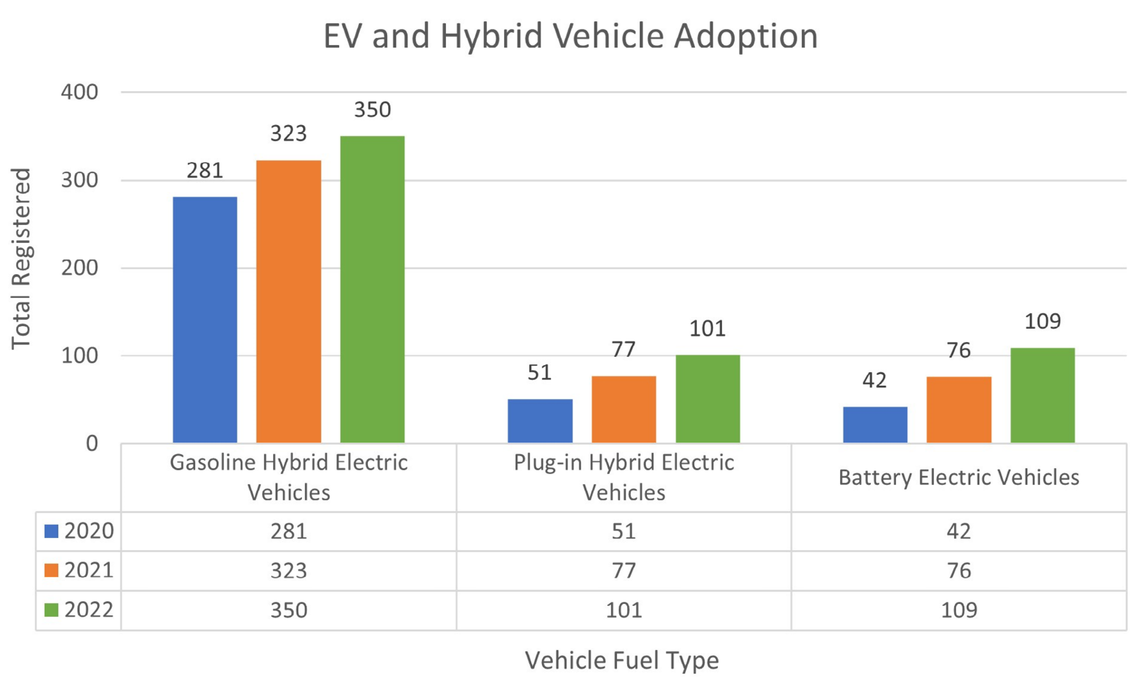


FIGURE 13. Electric and Hybrid Vehicle Registrations in Freeport, 2020-2022 Data from Maine Department of Environment Protection Vehicle Emissions and Greenhouse Gas Data[25]

22 Up to 30% plug-in hybrid electric vehicles.
23 Includes both school and public transit buses. The Town of Freeport does not have direct control over regional public transit vehicles or the school fleet but can advocate for alternative fuel public transit in the region.
24 https://www.freeportmaine.com/sites/g/files/vyhlif4436/f/uploads/freeport_2022_annual_report_-_web.pdf
25 https://www.maine.gov/dep/air/mobile/vehicle-data.html

Public EV Charging Ports [26]

The availability of EV charging stations within a community can be an effective way to encourage more people to switch to electric vehicles, as it provides a convenient and reliable network to recharge their EVs. According to the US Department of Energy, nearly 80% of EV owners charge their vehicles at home, so this indicator relates more to facilitating a wide-spread adoption of EVs, including among non-residents and for renters. Freeport currently has 5 public EV charging stations [27].

TABLE 21. Total Number of Public Charging Ports in Freeport, 2023

EV Charging Types	Total Number of Charging Ports (2022)
Level 2 Charging	8
DC Fast Charging	0
Tesla Super Chargers	8

Municipal Operations

Suggested targets have also been developed to guide the Town of Freeport in achieving their municipal operations emissions goal of net zero by 2040. The following table outlines a possible approach the municipality could take to reduce greenhouse gas emissions from buildings and facilities, the municipal vehicle fleet, and waste from operations.

TABLE 24. Municipal strategy areas needed to reach targets

Subsector	Strategy	2024-2030	2031-2040	Result
Buildings and Facilities	Electrify heating sources	• Prioritize buildings using propane and fuel oil. Transition 1 building per year.	• Transition 7 buildings from natural gas heating to electrified heat or other non-fossil heat.	100% electricity-based heating by 2040.
	Increase energy efficiency	• Perform energy efficiency upgrades (update insulation, install new windows, etc.) on 1 building every year. Prioritize municipal buildings by use, age, and condition.		Reduced emissions and heating costs for all municipal buildings by 2040.
Fleet	Fleet Vehicles	• Prioritize gasoline cars and light-duty trucks. Replace 3 of these vehicles every year.	• Transition medium- and heavy-duty trucks. Displace/ replace 2 vehicles every year.	100% clean-fuel municipal on-road fleet by 2040.
Waste	Reduce waste volume	• Pursue recyclable and compostable materials for municipal operations. • Increase recycling and composting drop-off availability in public municipal-owned spaces.		Reduce solid waste from municipal operations.

26 A port is a single outlet which one electric vehicle uses at a time. A charging station may have multiple ports.
27 https://www.efficiencymaine.com/charging-station-locator/#/find/nearest?location=freeport,%20maine&page=1

Climate Action Plan

The Town of Freeport's Climate Action Plan used this inventory and modeling pathway as a guide to develop tailored strategies and actions the Town can take to reach its targets, as well as broader goals for community resilience to climate change. The Plan includes recommended metrics to track that indicate progress over time. This Inventory will serve as the foundation of data to update over time paired with a review and update of CAP actions.