City of Rockland Greenhouse Gas Emissions Inventory

Baseline Year 2018

Department of Economic & Community Development

October 2023

Acknowledgments

Glossary of Acronyms

GHGe: greenhouse gas emissions

MCOG: Midcoast Council of Governments

MT: metric tons

GWP: global warming potential

CO2: carbon dioxide

CO2e: carbon dioxide equivalent

CMP: Central Maine Power

WWTP: Wastewater Treatment Plant

RTS: Rockland Transfer Station

KWH: kilowatt hour(s)

EPA: Environmental Protection Agency

VMT: vehicle mile(s) traveled

ORT: on-road transportation

T&D: transmission and distribution

AFOLU: agriculture, forestry and other land uses

LEARN: Land Emissions and Removals Navigator

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Inventory Purpose

A greenhouse gas emissions (GHGe) inventory provides a baseline for measuring progress towards emissions reduction goals. In Rockland's case, Rockland City Council established two emissions reduction goals in 2019 (Resolve #31 "Supporting a Climate Action Plan for Rockland"):

"By 2025, the City of Rockland will obtain 100% of municipal electricity from renewable sources."

"By 2045, the entire community of Rockland will be carbon neutral."

This inventory will be a valuable tool to help us measure our progress toward these goals. It visualizes emissions across sectors, and will help identify opportunities for emissions reduction. Categorizing emissions by scope allows us to identify immediate-term priority areas (generally scope 1) and areas for longer-term focus (generally scope 2 and 3). This inventory will also aid the City when competing for grant funds, because it provides a way to measure the emissions impact of particular programs and activities.

ICLEI Local Governments for Sustainability and the Midcoast Council of Governments (MCOG) were both consulted in the creation of this inventory. Their contributions ensure that the methodology used follows standard practice and complements the efforts of neighboring communities. This approach will aid the City in measuring progress towards goals, both individually and as a region.

Rockland Community Greenhouse Gas Emissions Summary

163,729 metric tons (MT) of CO2e were emitted by our community in 2018, Rockland's baseline inventory year.

SOLID WASTE | 21,491 MT CO2e (13.1%)

- 20,748 MT CO2e as methane gas from the decomposition of waste in the Rockland landfill
- 743 MT CO2e through the incineration of our community's waste at EcoMaine

WASTEWATER TREATMENT | 1,539 MT CO2e (0.0%)

- 1,400 MT CO2e from energy used in processing wastewater at the Wastewater Treatment Plant*
- 139 MT CO2e was emitted from residential septic systems, aerobic digestion, and effluent discharge

INDUSTRIAL ENERGY | 35,358 MT CO2e (21.6%)

- 2,941 MT CO2e from electricity used in industrial facilities
- 32,417 MT CO2e from the only Rockland facility required to report emissions data to the EPA Greenhouse Gas Reporting Program

COMMERCIAL ENERGY | 23,483 MT CO2e (14.3%)

- 14,265 MT CO2e from electricity used in commercial buildings
- 9,218 MT CO2e from fuel combusted in commercial buildings

RESIDENTIAL ENERGY | 27,399 MT CO2e (16.7%)

- 5,952 MT CO2e from electricity used in Rockland residences
- 21,447 MT CO2e from fuel combusted in Rockland residences

TRANSPORTATION | 55,859 MT CO2e (34.1%)

- 36,354 MT CO2e from fuel combusted by passenger vehicles
- 15,668 MT CO2e from fuel combusted by commercial vehicles
- 2,370 MT CO2e from fuel combusted by the Maine State Ferry Service's routes serving Rockland
- 1,113 MT CO2e from fuel combusted by harbor craft in Rockland Harbor
- 354 MT CO2e from fuel combusted by cruise ships hoteling in Rockland Harbor

FORESTRY & LAND USE | -11,865 MT CO2e

- 11,865 MT CO2e sequestered by forests and trees**
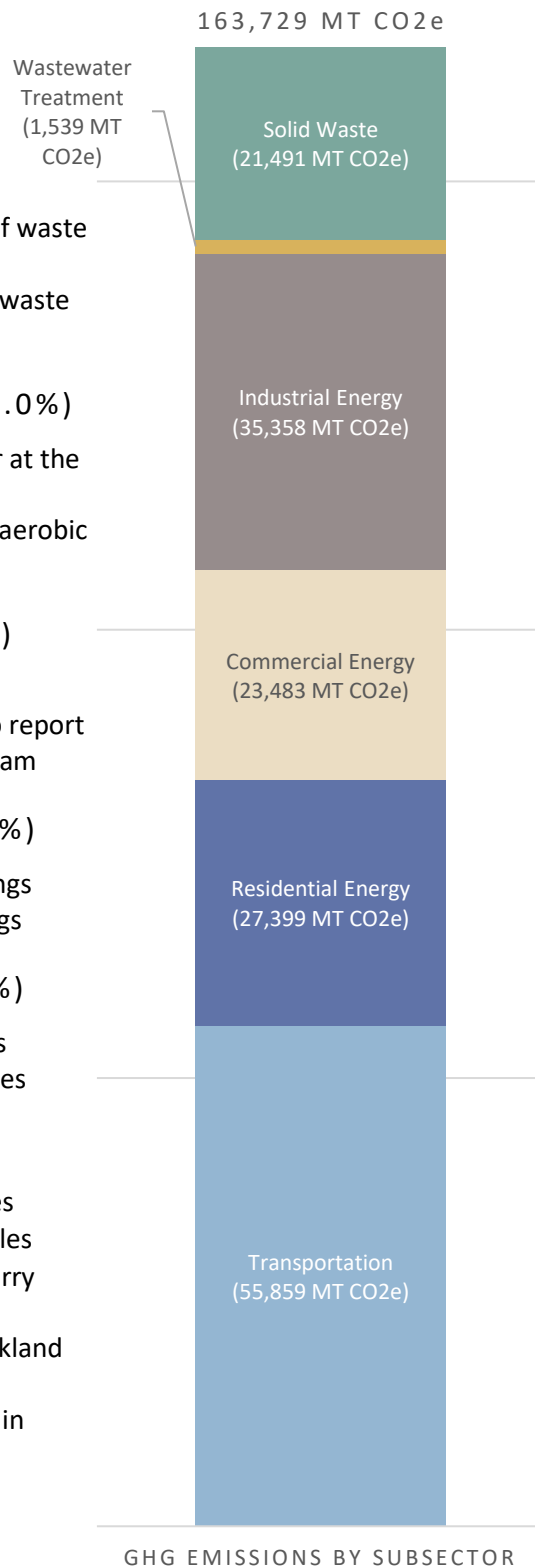
Excluded from total count to avoid double counting stationary commercial energy
Excluded from total count to maintain representation of gross emissions

163,729 MT CO2e

Wastewater Treatment (1,539 MT CO2e)

Solid Waste (21,491 MT CO2e)

Industrial Energy (35,358 MT CO2e)

Commercial Energy (23,483 MT CO2e)

Residential Energy (27,399 MT CO2e)

Transportation (55,859 MT CO2e)

GHG EMISSIONS BY SUBSECTOR

Introduction

How emissions are measured

A greenhouse gas emissions (GHGe) inventory uses both real consumption data and standardized modeling practices to take stock of a community's greenhouse gas emissions in a given year. This inventory is separated into a community inventory, which accounts for the entire community's GHG emissions, including municipal emissions, and a municipal inventory, which uses the City's real consumption data to provide a macro-level account of GHG emissions related to municipal functions.

2018 was used as the inventory year for Rockland's GHGe inventory. ICLEI recommends using any year between 2016 and 2019 as a baseline inventory year. 2018 was chosen for Rockland because it is just prior to the Council's community-wide carbon neutrality goal being set. In 2019, the City implemented energy efficiency and power purchase decisions that have resulted in both cost and emissions savings. Using the baseline year of 2018 also allows the City to understand the emissions impact of those decisions.

Greenhouse gas emissions are measured by their carbon dioxide equivalent, or CO2e. This is a standardized measurement that allows different greenhouse gasses to be added together based on their global warming potential (GWP).

Measurements of CO2e in this inventory are in metric tons. To put that into perspective: on average, one metric ton of CO2e is emitted for every 113 gallons of gasoline consumed (about 7 full tanks). 10 metric tons of CO2e are emitted in one year by the average home. A mature live tree can absorb about 48 pounds of CO2e per year— about 46 mature live trees can absorb 1 metric ton of CO2e per year.

Emissions scopes

Greenhouse gas emissions are classified into three emissions scopes. Emissions scopes relate to different sources of greenhouse gas emissions.

- **Scope 1 emissions** physically occur within Rockland. Driving a gas-powered car within Rockland or heating our homes with oil involves the combustion of fuel, which emits greenhouse gasses. Emissions from these sources fall into scope 1.
- **Scope 2 emissions** don't physically occur within Rockland, but are caused by energy use in Rockland. Grid-supplied electricity is the primary source of scope 2 emissions: we aren't physically emitting any greenhouse gasses when we turn on a light in Rockland, but there are indirect emissions associated with our electricity use that come from the production and delivery of our electricity.
- **Scope 3 emissions** occur outside of Rockland's boundary but are driven by activities within the community, such as ferry or car trips to and from Rockland.

Measuring emissions is an imperfect process. Uncertainty is inherent and double counting is common. This inventory has been completed using standard assumptions, conversion factors, and methodologies. We offer the caveat that even with following the most up-to-date practices, the estimates provided in this inventory are not perfect accounts. We focused on clarity about data quality, included and excluded subsectors, and emissions sources to provide a comprehensive picture of Rockland's emissions profile.

Downtown Rockland | Photo by Rachel Winslow

Community-wide Inventory

Overview

Rockland's community-wide GHGe inventory accounts for greenhouse gas emissions that are attributable to the community. This inventory estimates 163,729 MT CO2e were emitted in 2018, from sources including actions like home heating, getting to, from, and around Rockland, commercial operations, and the management of waste generated in our community. This estimate includes municipal emissions, which are also detailed in depth in the municipal inventory (p.13).

Methodology

This inventory was completed using ICLEI ClearPath, the industry-standard software platform for completing municipal greenhouse gas inventories. Two protocols were relied on in the creation of this inventory. The 2019 ICLEI U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions provided national standards, which were adopted. The 2021 Southern Maine Planning and Development Commission (SMPDC) Greenhouse Gas Inventory Protocol provided local context. ICLEI reviewed the data presented for quality assurance.

Data quality is ranked as high, medium, or low. High-quality data is detailed activity data that uses specific emissions factors. Medium-quality data involves modeled activity data, using well-established assumptions, and more general emissions factors. Low-quality data is highly modeled or based on uncertain activity data, and uses default emissions factors.

Some sources of emissions have been excluded from this inventory due to data availability. These include emissions related to waste hauled by private haulers to areas outside of Rockland's boundaries, cruise ship maneuvering, emissions from other ships that passed through but did not fuel up in Rockland, upstream emissions associated with the production of goods consumed in Rockland, and emissions that occur outside of Rockland's boundaries that are associated with the consumption habits of Rockland residents, such as air travel.

Inventory

This inventory includes three sectors, each of which is separated into more specific subsectors and end uses that illustrate the energy sources and processes contributing emissions to each subsector.

Table 1: Sectors and Subsectors Included in Rockland's Community GHG Emissions Inventory.

Sector	Subsector	Emissions Sources	Energy Type/End Use
Stationary Energy	Residential	Energy used in residential buildings, as well as transmission and distribution losses from electric supply	Fuel, Electricity
	Commercial	Energy used in commercial, government, and institutional buildings, as well as transmission and distribution losses from electric supply	Fuel, Electricity
	Industrial	Energy used in manufacturing and industrial facilities, as well as transmission and distribution losses from electric supply	Natural Gas, Fuel, Electricity
Transportation	Passenger Vehicles	Fuel combusted by all passenger vehicle trips attributable to Rockland	Gasoline, Diesel
	Commercial Vehicles	Fuel combusted by all commercial vehicle trips attributable to Rockland	Gasoline, Diesel
	Maine State Ferry Service	Fuel combusted by Maine State Ferry Service's operations serving Rockland	Diesel
	Harbor Craft	Fuel combusted by commercial and recreational ocean-going vessels registered in Rockland	Gasoline, Diesel
	Hoteling Cruise Ships	Fuel combusted by cruise ships while hoteling in Rockland Harbor	Diesel
Waste	Wastewater Treatment	Emissions from wastewater treated at Rockland Wastewater Treatment Plant (WWTP), and from wastewater in residential septic systems in Rockland	Aerobic and Anaerobic Digestion, Effluent Discharge Emissions
	Municipal Solid Waste	Emissions from the incineration of solid waste generated by residential, commercial and industrial sources in Rockland, and from the decomposition of waste-in-place in Rockland's landfill	Incineration Emissions, Methane Gas (Converted to CO2e)

Stationary Energy

Emissions related to stationary energy come from electricity use and the combustion of fuel for the operation of manufacturing facilities, businesses, and residential energy uses such as home heating. Direct emissions from the combustion of fuel are included as scope 1 emissions. Indirect emissions from the consumption of electricity are included as scope 2 emissions, and transmission and distribution (T&D) losses from electricity supply are included as scope 3 emissions. A total of 86,240 MT CO2e were estimated to be emitted in this sector in 2018.

Table 2: Rockland Community Stationary Energy Subsectors.

Subsector	Emissions Sources	Energy Type/End Use	Scope	Data Source	Data Quality
Residential	Energy used in residential buildings, as well as T&D losses from electric supply	Fuel Oil, Wood, Tank/LP	1	Scaled-down fuel consumption data from state datasets	Low
		Electricity	2 and 3	Real consumption data from Central Maine Power (CMP)	High (Use) Low (T&D)
Commercial	Energy used in area lighting, commercial, government, and institutional buildings, as well as T&D losses from electric supply	Fuel	1	Scaled-down fuel consumption data from state datasets	Low
		Electricity	2 and 3	Real consumption data from Central Maine Power (CMP)	High (Use) Low (T&D)
Industrial	Energy used in manufacturing and industrial facilities, as well as T&D losses from electric supply	Natural Gas	1	Real emissions data from the EPA Greenhouse Gas Reporting Program	Medium
		Fuel	1	Real emissions data from the EPA Greenhouse Gas Reporting Program	Medium
		Electricity	2 and 3	Real consumption data from Central Maine Power (CMP)	High (Use) Low (T&D)

Methodology

Emissions data in the stationary energy residential and commercial subsectors are based on a combination of scaled-down census data and real consumption data, and were calculated in ICLEI ClearPath. In the residential subsector, data on heating sources from the American Community Survey was used to estimate emissions from fuel. The American Community Survey measures fuel in multiple categories, including wood, oil, and LP gas.

In the commercial subsector, Maine Industry Employment and Wages data derived from Maine's Quarterly Census of Employment and Wages program was used to estimate fuel emissions. Due to the nature of this data, some industrial activity is included in this subsector's fuel oil end use.

Rockland's one EPA-recognized Large Emitting Facility is the only facility included in the stationary energy industrial subsector. This subsector reflects data from the Environmental Protection Agency's Greenhouse Gas Reporting Program.

Community-wide electricity usage data separated by subsector was provided in kilowatt-hours (KWH) for the 2018 calendar year by Central Maine Power.

Table 3: Rockland Community Stationary Energy Emissions by Subsector and End Use.

Subsector	Emissions (MT CO2e) and Percent of Stationary Energy Emissions	End Use	Emissions (MT CO2e) and Percent of Stationary Energy Emissions
Residential	27,399 (31.8%)	Fuel Oil	16,567 (19.2%)
		Wood	383 (0.4%)
		Tank/LP	4,497 (5.2%)
		Electricity	5,952 (6.9%)
Commercial	23,483 (27.2%)	Fuel Oil*	9,218 (10.7%)
		Electricity	14,265 (16.5%)
Industrial	35,358 (40.9%)	Natural Gas	30,537 (35.4%)
		Fuel Oil	1,880 (2.2%)
		Electricity	2,941 (3.4%)

Modeled combined commercial/industrial data

Rockland Main Street | Photo by Rachel Winslow
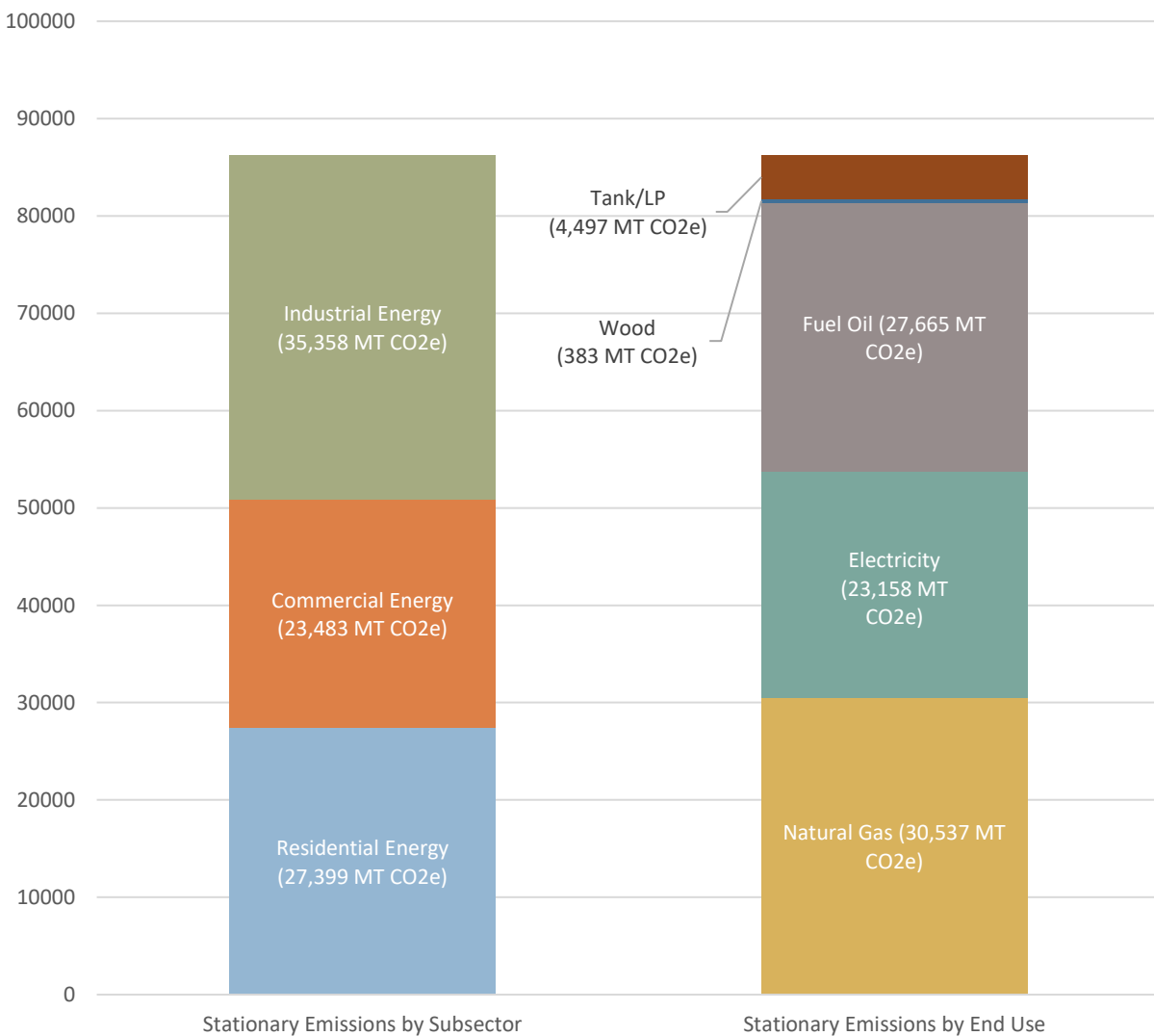
Transportation

Transportation emissions come from on-road vehicle trips to, from, and within Rockland, on-water harbor craft trips by boats in Rockland Harbor, cruise ship hoteling, and Maine State Ferry Service trips to and from Rockland. On-road and on-water trips occurring within Rockland's boundaries are categorized as scope 1 emissions, as well as cruise ship hoteling. On-road and on-water trips occurring outside of Rockland's boundaries, but driven by activity within Rockland, are categorized as scope 3 emissions. A total of 55,859 MT CO2e were estimated to be emitted in this sector in 2018. Freight rail, cruise ship maneuvering, and large ships that did not purchase fuel in Rockland were excluded due to low data availability. Aviation and passenger rail were omitted due to low relevance.

Table 4: Rockland Community Transportation Subsectors.

Subsector	Emissions Sources	Energy Type/End Use	Scope	Data Source	Data Quality
Passenger Vehicles	Fuel combusted by all passenger vehicle trips attributable to Rockland	Gasoline, Diesel, Electricity	1 and 3	Modeled energy consumption based on real activity data	Medium
Commercial Vehicles	Fuel combusted by all commercial vehicle trips attributable to Rockland	Gasoline, Diesel, Electricity	1 and 3	Modeled energy consumption based on real activity data	Medium
Maine State Ferry Service	Fuel combusted by the Maine State Ferry Service's routes serving Rockland	Diesel	1 and 3	Modeled energy consumption based on Maine State Ferry Service vessel and schedule data	Low
Harbor Craft	Fuel combusted by recreation and commercial vessels in Rockland Harbor	Diesel	1 and 3	Modeled energy consumption based on aggregated fuel sales data	Low
Hoteling Cruise Ships	Fuel combusted by cruise ships hoteling in Rockland Harbor	Diesel	1	Modeled energy consumption based on cruise ship characteristics	Low

Methodology

On-road transportation (ORT) emissions are reflected in the passenger and commercial vehicles subsectors, and were calculated in SMPDC's ORT emissions calculator using activity-based vehicle miles traveled (VMT) data and local vehicle population data. VMT were calculated using Streetlight Data, a cloud-based transportation data analysis platform. Consistent with SMPDC's Protocol, 50% of VMT

related to vehicle trips within Streetlight Data's boundary area that began or ended in Rockland were attributed to Rockland, and vehicle trips that passed through Rockland without stopping were excluded. Data quality for these two subsectors is medium, due to the modeling required to estimate emissions from real, activity-based VMT data and real vehicle population data.

The harbor craft subsector includes commercial, recreation, and transient vessels that fuel up in Rockland Harbor. Emissions in this subsector were calculated in ICLEI ClearPath using modeled fuel consumption based on scaled-up fuel sales data at Rockland Harbor. This method does not capture emissions from vessels that passed through Rockland Harbor but did not purchase fuel here.

Maine State Ferry Service emissions were calculated based on an estimate of the Maine State Ferry Service's annual fuel consumption, scaled down to reflect fuel consumption by ferry routes serving Rockland. As the Ferry Service operates between jurisdictions, 50% of emissions related to ferry trips serving Rockland are included in this estimate.

Cruise ship-related emissions reflect energy used during hoteling, the phase of cruising when the ship is berthed and using power to maintain the ship's hotel functions. Emissions related to maneuvering within the harbor have been excluded, due to a lack of data availability. Emissions were calculated using established assumptions based on ship and visit characteristics.

Data quality across all on-water transportation subsectors is low, due to the high level of uncertainty and modeling involved in calculating these emissions.

Table 5: Rockland Community Transportation Emissions by Subsector.

Subsector	Emissions (MT CO2e)	Percent of Transportation Emissions (%)
Passenger Vehicles	36,354	65.1%
Commercial Vehicles	15,668	28%
Maine State Ferry Service	2,370	4.2%
Harbor Craft	1,113	1.3%
Hoteling Cruise Ships	354	0.4%

Table 6: Rockland Community Transportation Emissions by End Use.

End Use	Emissions (MT CO2e)	Percent of Transportation Emissions (%)
Gasoline	37,458	67.1%
Diesel	18,401	32.9%
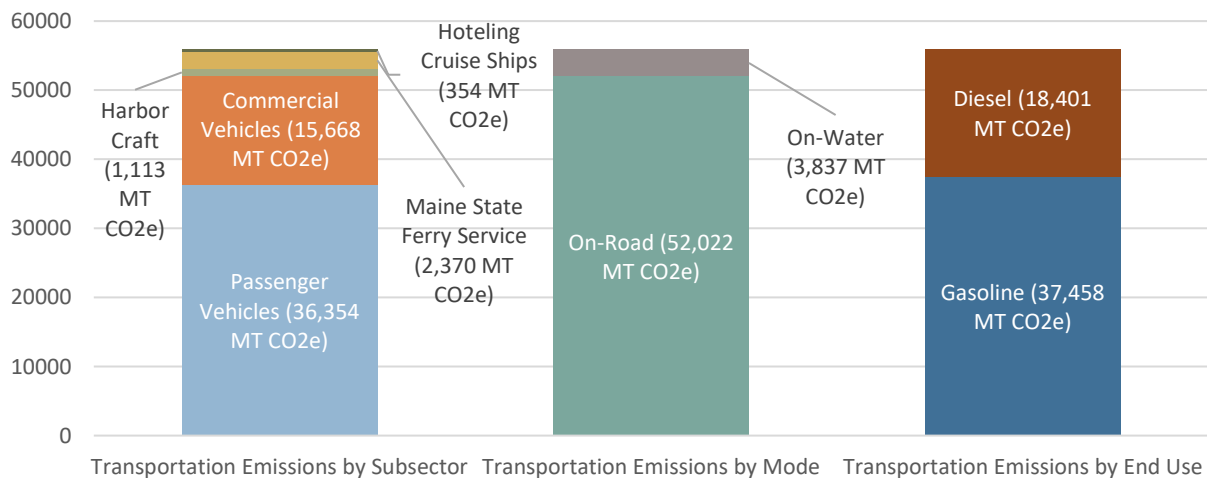
Rockland Quarry Landfill | Photo by City of Rockland

Waste

Emissions in the waste sector come from energy and processes used in both septic and public wastewater treatment, emissions from waste-in-place at Rockland's landfill, and emissions from the incineration of the community's waste at Ecomaine. All wastewater treatment emissions are categorized as scope 1 emissions, as they physically occur within Rockland's boundaries. Emissions of methane from the landfill in Rockland are also considered scope 1 emissions. Incineration emissions from Rockland's waste burned at Ecomaine are categorized as scope 3 emissions, as they do not physically occur within Rockland, but are created by waste generated in Rockland. A total of 21,630 MT CO2e were estimated to be emitted in this sector in 2018.

Table 7: Rockland Community Waste Subsectors.

Subsector	Emissions Sources	Energy Type/End Use	Scope	Data Source	Data Quality
Wastewater Treatment	Emissions from the treatment of wastewater at WWTP	Aerobic Digestion	1	Modeled emissions data based on population and the number of sewer connections in Rockland	Low
	Emissions from the decomposition of wastewater in Rockland septic systems	Aerobic and Anaerobic Digestion	1	Modeled emissions data based on the number of septic systems in Rockland	Low
Municipal Solid Waste	Methane produced by anaerobic decomposition of landfill waste in place	Methane gas (converted to CO2e)	1	Modeled emissions data based on landfill waste in place	Low
	Emissions from the incineration of solid waste generated in Rockland and sent to an incineration plant	Incineration Emissions	3	Modeled emissions data based on tons of waste transferred from Rockland to EcoMaine	Low

Methodology

Emissions data in the wastewater treatment subsector was modeled based on the population of Rockland, the number of sewer connections in Rockland, and the number of septic systems in Rockland. Solid waste emissions were modeled based on the recorded tons of waste hauled to Ecomaine for incineration in 2018 by the Department of Public Services, and on an estimation of the amount of waste-in-place at Rockland's landfill. Data quality across all emissions sources in this sector is low, due to the significant amount of modeling required to estimate emissions in this sector.

Table 8: Rockland Community Waste Emissions by Subsector and End Use.

Subsector	Emissions (MT CO2e) and Percent of Waste Emissions	End Use	Emissions (MT CO2e) and Percent of Waste Emissions
Wastewater Treatment	139 (0.6%)	WWTP Aerobic Digestion	10 (0.0%)
		Effluent Discharge	14 (0.0%)
		Septic Aerobic and Anaerobic Digestion	115 (0.5%)
Municipal Solid Waste (MSW)	21,491 (99.4%)	Methane Gas	20,748 (95.9%)
		Incineration	743 (3.4%)
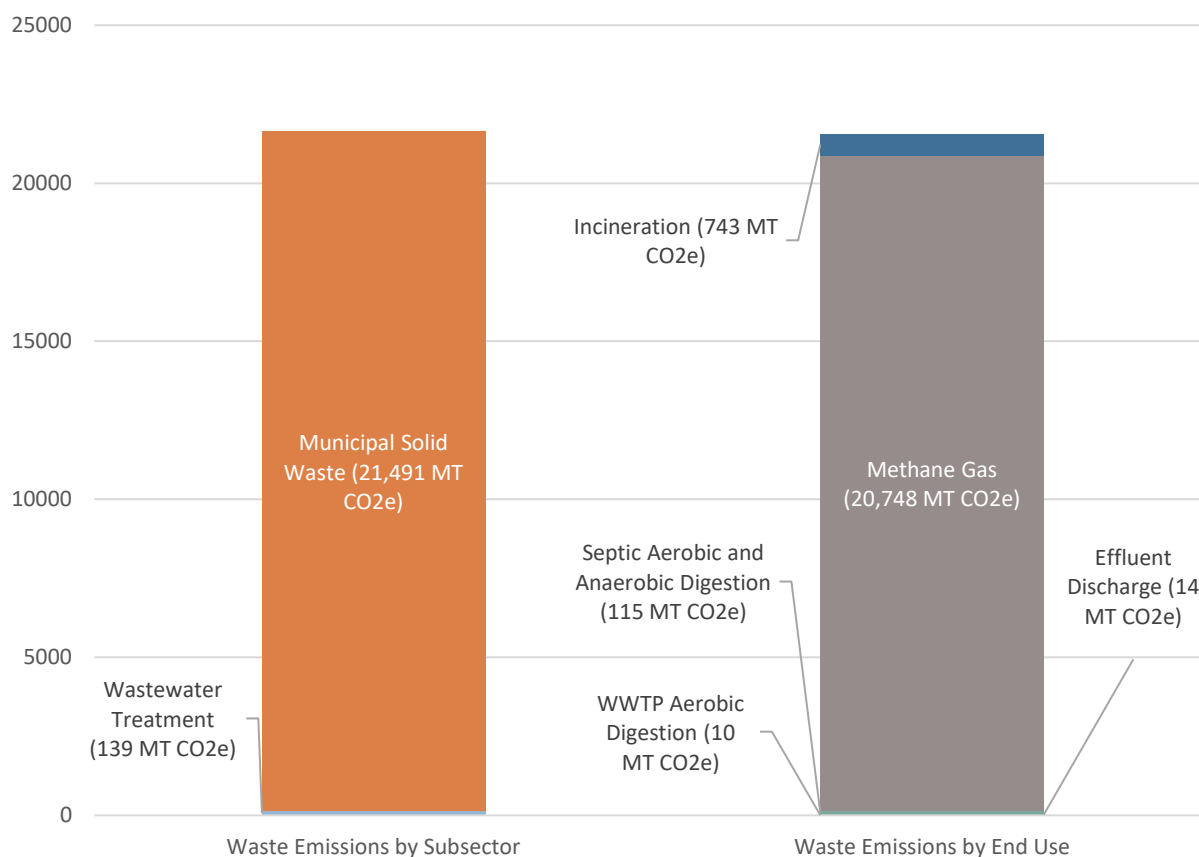
Municipal Inventory

Overview

Rockland's municipal greenhouse gas emissions inventory accounts for greenhouse gasses emitted in 2018 due to the municipal operations of the City of Rockland. Overall, an estimated 23,853 MT CO2e were emitted in association with municipal functions, accounting for about 11.1% of total community emissions. Municipal emissions estimates are based on real consumption data maintained by the City of Rockland.

Methodology

Rockland's municipal inventory was developed in ICLEI ClearPath and adheres to ICLEI's 2010 Local Government Operations Protocol for the quantification and reporting of greenhouse gas emissions inventories.

Emissions related to employee commutes were not included in the municipal inventory, due to low data availability. The City of Rockland did not operate a transit fleet or generate power in 2018, so those subsectors have been omitted due to low relevance.

Emissions were calculated by multiplying collected activity data by corresponding emission factors. Real consumption data was obtained from utility vendors to provide high-quality emissions estimates.

Inventory

The municipal inventory is a subset of the community inventory, and reports emissions in the same three sectors. Each sector is separated into specific subsectors and end uses to demonstrate the energy sources and processes that contribute emissions to each sector.

Table 9: Sectors and Subsectors Included in Rockland's Municipal GHG Emissions Inventory.

Sector	Subsector	Emissions Sources	Energy Type/End Use
Stationary Energy	Buildings and Facilities	Energy used in offices, fire and police stations, recreation facilities, and public works facilities	Electricity, Fuel
	Streetlights and Traffic Signals	Energy used in public lighting and traffic signals	Electricity
Transportation	Vehicle Fleet	Fuel combusted by City-owned or leased vehicles	Gasoline, Diesel
Waste	Wastewater Treatment	Energy used and emissions produced from the treatment of wastewater at Rockland's Wastewater Treatment Plant (WWTP)	Electricity, Fuel, Aerobic Digestion, Effluent Discharge
	Municipal Solid Waste	Methane produced by the decomposition of landfill waste-in-place, and emissions from the incineration of the community's waste at EcoMaine	Methane gas (converted to CO2e), Incineration Emissions

Stationary Energy

Municipal stationary energy emissions come from energy use by municipal buildings and facilities, streetlights, and traffic signals. Direct emissions from the combustion of fuel are included as scope 1 emissions. Indirect emissions from the consumption of electricity are included as scope 2 emissions, and T&D losses from electricity supply are included as scope 3 emissions. 534 metric tons of CO_2e emissions were associated with stationary energy in 2018. Stationary energy accounts for 2.2% of total municipal emissions.

*Table 10: Rockland Municipal Stationary Energy Subsectors.*

Subsector	Emissions Sources	Energy Type/End Use	Scope	Data Source	Data Quality
Buildings and Facilities	Energy used in offices, fire and police stations, recreation facilities, and public works facilities	Electricity	2 and 3	Real consumption data from Central Maine Power	High (use) Low (T&D)
		Fuel	1	Real consumption data from vendor invoices	High
Streetlights and Traffic Signals	Energy used in public lighting and traffic signals	Electricity	2 and 3	Real consumption data from Central Maine Power	High (use) Low (T&D)

Methodology

The City's stationary energy use data was collected from fuel vendor invoices and real consumption data provided by Central Maine Power. Data quality for municipal stationary energy emissions is high, due to the use of real consumption data in stationary energy emissions calculations.

Table 11: Rockland Municipal Stationary Energy Emissions by Subsector and End Use.

Subsector and End Use	Emissions (MT CO_2e)	Percent of Stationary Energy Emissions
Buildings and Facilities – Electricity	120	22.5%
Buildings and Facilities – T&D Losses	24	4.5%
Buildings and Facilities – Fuel	305	57.1%
Street Lights & Traffic Signals – Electricity	85	15.9%
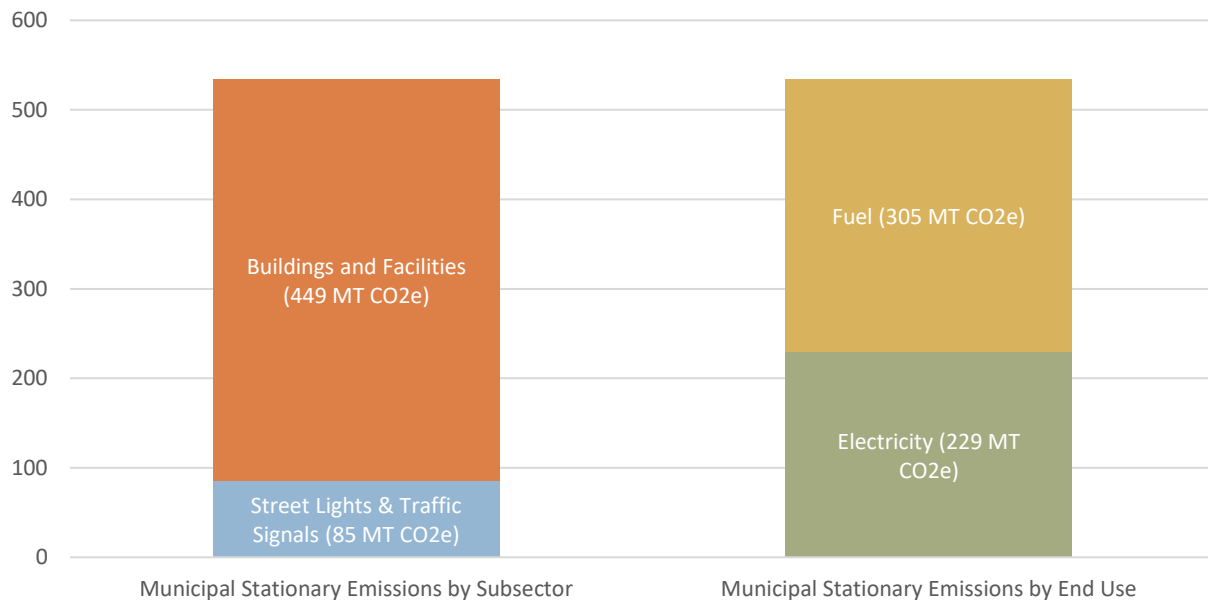
Transportation

Municipal transportation emissions come from fuel combusted by City-owned or leased vehicles. All municipal transportation emissions are categorized as scope 1 emissions, as they occur largely within Rockland's boundaries and are related directly to the operations of the municipality. An estimated 404 metric tons of CO2e were emitted in 2018 in this sector, accounting for 1.7% of total municipal emissions.

Table 12: Rockland Municipal Transportation Subsector.

| Subsector	Emissions Sources	Energy Type/End Use	Scope	Data Source	Data Quality
Vehicle Fleet	Fuel combusted by municipally-owned or leased vehicles	Gasoline, Diesel	1	Real consumption data from municipal fuel purchasing account statements	High

Methodology

Municipal fuel purchasing account statements were used to calculate the number of gallons of diesel and gasoline combusted by City vehicles. Associated emissions were calculated in ICLEI ClearPath.

Table 13: Rockland Municipal Transportation Emissions by Subsector and End Use.

Subsector and End Use	Emissions (MT CO2e)	% of Transportation Emissions
Vehicle Fleet – Diesel	222	55%
Vehicle Fleet – Gasoline	182	45%

Table 14: Rockland Municipal Transportation Emissions by City Department.

Department	Emissions (MT CO2e)	% of Transportation Emissions
Police	105	26%
WWTP	22	5.2%
Fire	55	14%
Harbor	4.3	0.1%
Public Works	217	54%
Transfer Station	0.6	0%
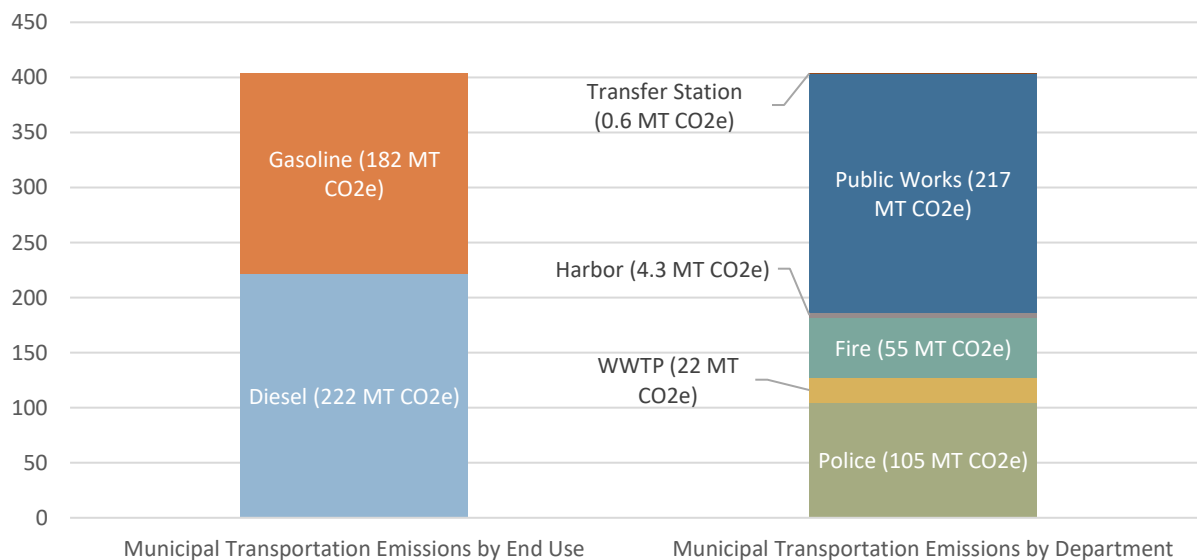
Waste

Municipal waste emissions come from energy used by the Wastewater Treatment Plant (WWTP) to process wastewater, the digestion of waste at WWTP, the decomposition of waste-in-place at Rockland's landfill, and incineration of solid waste sent by the Rockland Transfer Station (RTS) to EcoMaine.

Excluding electricity, all wastewater treatment and landfill emissions are categorized as scope 1 emissions, as they physically occur within Rockland's boundaries. Emissions associated with WWTP's electricity use are categorized as scope 2 emissions. Emissions associated with T&D losses from electricity supply are categorized as scope 3 emissions. Incineration emissions from Rockland's waste burned at EcoMaine are categorized as scope 3 emissions, as they do not physically occur within Rockland, but are created by waste generated in Rockland.

An estimated 22,915 metric tons of CO2e emissions were associated with waste in 2018. Waste accounts for 96.1% of total municipal emissions.

*Table 15: Rockland Municipal Waste Subsectors.*

Subsector	Emissions Sources	Energy Type/End Use	Scope	Data Source	Data Quality
Wastewater Treatment Plant (WWTP)	Emissions from the treatment of wastewater at WWTP	Aerobic Digestion and Effluent Discharge	1	Modeled emissions data based on population and the number of sewer connections in Rockland	Low
	Energy used in wastewater processing at Rockland WWTP	Fuel	1	Real consumption data from vendor invoices	High
		Electricity	2 & 3	Real consumption data from Central Maine Power	High (use) Low (T&D)
Municipal Solid Waste (MSW)	Methane produced by anaerobic decomposition of landfill waste in place	Methane gas (converted to CO2e)	1	Modeled emissions data based on landfill waste in place	Low
	Emissions from the incineration of solid waste generated in Rockland and sent to an incineration plant	Incineration Emissions	3	Modeled emissions data based on tons of waste transferred from Rockland to EcoMaine	Low

Methodology

Emissions data in the wastewater subsector was modeled based on the population of Rockland, the number of sewer connections in Rockland, and an industrial commercial discharge multiplier. Solid waste emissions were modeled based on the recorded tons of waste hauled to EcoMaine for incineration in 2018 by the Department of Public Services, and on an estimation of the amount of waste-in-place at Rockland's landfill. Emissions associated with energy used at WWTP, but not at RTS, are included in this sector. RTS energy use is instead included in the buildings and facilities subsector in the municipal stationary energy sector, as the RTS is part of the Department of Public Services. Data quality across all emissions sources in this sector except energy usage, which is high-quality, is low, due to the significant amount of modeling required to estimate emissions in this sector.

Table 16: Rockland Municipal Waste Emissions by Subsector and End Use.

Subsector	Emissions (MT CO2e) and Percent of Waste Emissions	End Use	Emissions (MT CO2e) and Percent of Waste Emissions
Wastewater Treatment Plant	1,424 (6.2%)	WWTP Aerobic Digestion	10 (0.0%)
		Effluent Discharge	14 (0.0%)
		WWTP Electricity	1,053 (4.6%)
		WWTP T&D Losses	63 (0.3%)
		WWTP Fuel	284 (1.2%)
Municipal Solid Waste (MSW)	21,491 (93.8%)	Methane Gas	20,748 (90.5%)
		Incineration	743 (3.2%)
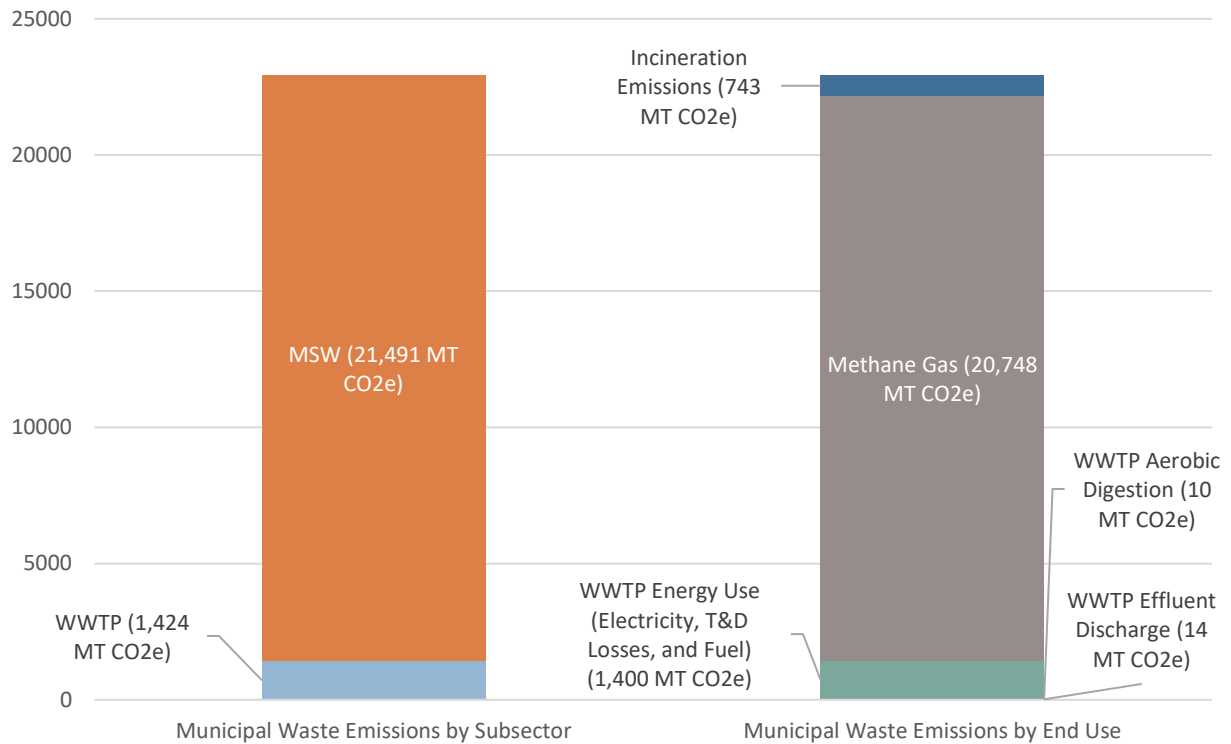
Carbon Removals of Note

Carbon removal is the process of removing CO2 from the atmosphere, through natural processes found in forests, soils, and waterways, or through carbon capture and storage technologies. There are no carbon capture and storage operations in Rockland, so this section focuses on the impacts of Rockland's natural carbon sinks. The data presented in this section is not included in this inventory's total emissions estimate, which represents gross emissions. When factored in, the net removal represented in this section results in a net community emissions estimate of 203,213 MT CO2e.

Agriculture, Forestry, and Other Land Uses (AFOLU)

This sector accounts for CO2e emissions or removals associated with livestock, cropland and forestry management, and land use conversion. Activities that impact this sector include clearing forested areas, converting grassland to forested land, and planting trees. Rockland does not have a significant livestock population, so emissions related to livestock management have been excluded due to low relevance. All emissions and removals in this sector are categorized as scope 1 emissions, as they physically occur within Rockland. Emissions in this sector are estimated at 1,194 MT CO2e. Removals in this sector are estimated at -13,059 MT CO2e, resulting in a net removal of -11,865 MT CO2e.

Table 17: AFOLU Emissions and Removal Sources.

| Emissions or Removal Sources	End Use	Scope	Data Source	Data Quality
Forest land remaining forest land	CO2 removals due to undisturbed forest	1	Modeled with ICLEI LEARN Tool based on land cover over time	Low
Non-forest land converted to forest land	CO2 removals due to reforestation	1	Modeled with ICLEI LEARN Tool based on land cover over time	Low
Trees outside of forests	CO2 emissions or removals due to tree maintenance outside of forests	1	Modeled with ICLEI LEARN Tool based on land cover over time	Low
Forest land converted to non-forest land	CO2 emissions due to deforestation	1	Modeled with ICLEI LEARN Tool based on land cover over time	Low
Forest disturbances	CO2 emissions due to forest fire, wood harvesting, or pests	1	Modeled with ICLEI LEARN Tool based on land cover over time	Low

Methodology

Emissions and removals related to land use were estimated for Rockland using ICLEI's Land Emissions and Removals Navigator (LEARN) Tool, which measures forest cover, trees outside of forests, land use changes, and their associated emissions or removal impacts within a given boundary and timeframe. Outputs from LEARN are provided as information only, and not included in total emissions estimates. A significant amount of modeling is required to estimate emissions and removals in this sector, so data quality is low.

Table 18: AFOLU Emissions and Removals by Source.

Emissions or Removals Sources	End Use	Emissions (+) and/or removals (-) (MT CO2e)
Forest land remaining forest land	CO2 sequestration due to undisturbed forest	-11,094
Non-forest land converted to forest land	CO2 sequestration due to reforestation	-138

Trees outside of forests	CO2 sequestration due to tree maintenance outside of forests	-1,827 (removals) 36 (emissions)
Forest land converted to non-forest land	CO2 emissions due to land use conversion	659
Forest disturbances	CO2 emissions due to forest fire, wood harvesting, or pests	500
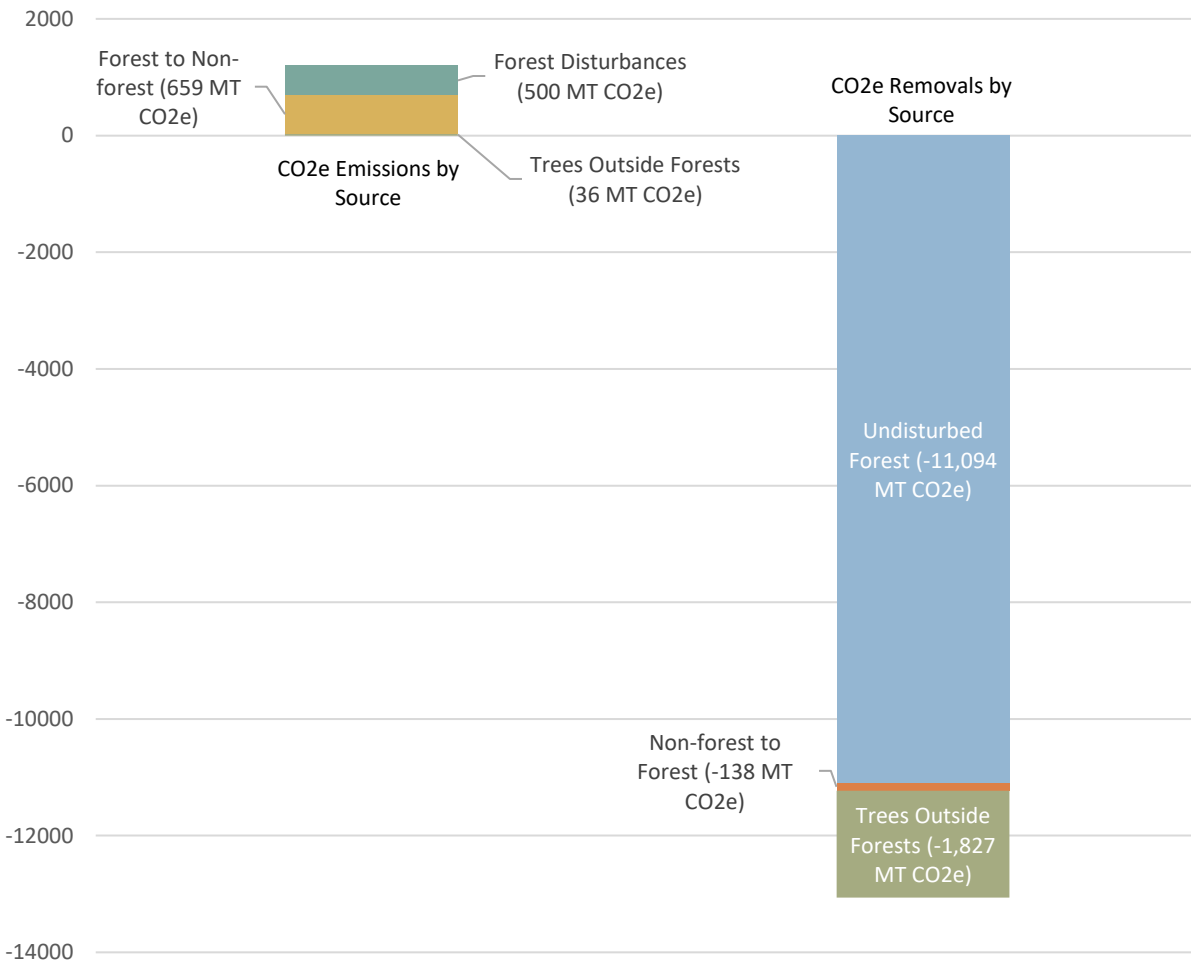
Conclusion

This greenhouse gas emissions inventory identifies sources of Rockland's 2018 CO2e emissions at both a community and a municipal scale. The creation of this baseline allows the City to measure progress toward its 2019 emissions reduction goals. It will aid the City in competitions for grant funding, and provide insight on the emissions impact of particular programs and activities.