GREENHOUSE GAS INVENTORY

Town of Kennebunk

Prepared by Southern Maine Planning & Development Commission

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Contents

Executive Summary

The Town of Kennebunk is already experiencing the effects of climate change and is taking steps to address its causes and impacts. Municipal climate action is guided by the Kennebunk Climate Action Plan (CAP), adopted by the Select Board on May 14, 2024. The CAP was completed in partnership with Southern Maine Planning and Development Commission (SMPDC) as part of a four-community CAP Cohort (Biddeford, Kennebunk, Kennebunkport, and Kittery). It contains 22 strategies that assist the Town in guiding future policy development to reduce the vulnerability to impacts of climate change, enhance community resilience, and reduce Kennebunk's contribution to greenhouse gas emissions. In June of 2024, the Select Board created the Kennebunk Climate Action Committee to oversee the implementation of these strategies. In 2022 Kennebunk also joined the Community Resilience Partnership, a program through the State of Maine that assists communities in addressing climate change. Through this program, Kennebunk has been awarded funding for projects including solar panel installation on the town's Waterhouse Center.

This greenhouse gas (GHG) inventory report builds upon the 2018 Baseline Greenhouse Gas Inventory used in Kennebunk's CAP process. The report includes a 2022 GHG inventory and provides a comparison of the 2022 inventory to an updated 2018 inventory. It identifies the activities and major sources of emissions, and details how these emissions have changed over the four-year period.

This report contains a *community-wide inventory* for the Town of Kennebunk conducted by SMPDC. The community-wide inventory estimates the GHG emissions due to Kennebunk's sources and activities, including those of Kennebunk's residents, workforce, visitors, and economy. It was conducted using the methodology laid out in the SMPDC Greenhouse Gas Inventory Protocol for Southern Maine Cities and Towns.

Community-wide emissions for Kennebunk in 2022 are estimated as 175,527 Metric Tons CO_2 equivalent (Metric Tons CO_2e; Figure A). The majority of these emissions (59.15%) come from transportation emissions sources including passenger vehicles, commercial

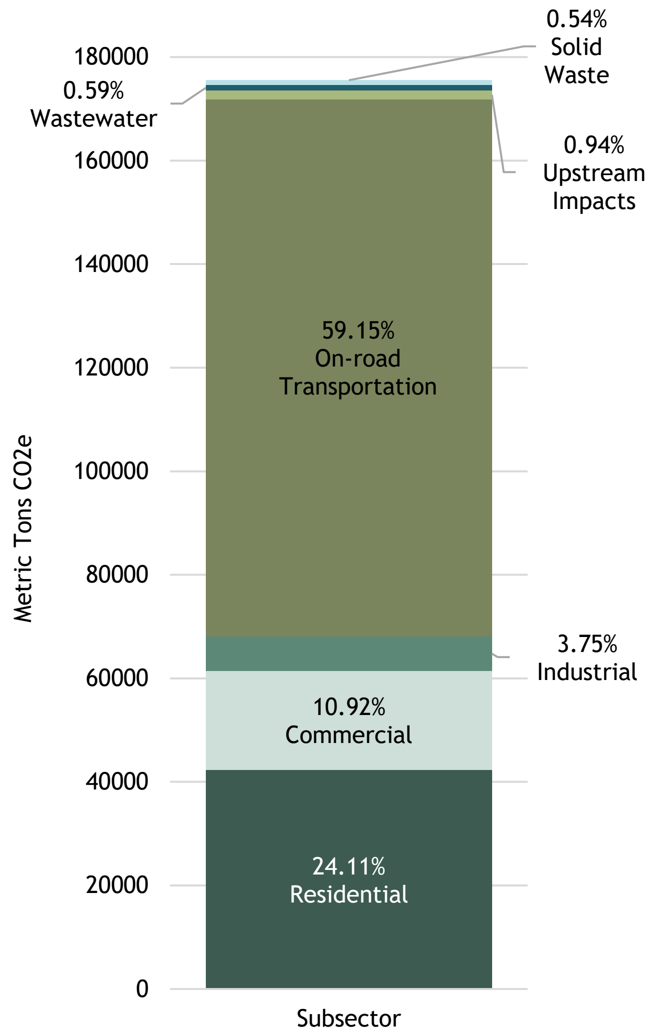

FIGURE A. KENNEBUNK 2022 COMMUNITY-WIDE GHG INVENTORY vehicles, and public transit. The second largest category is stationary emissions sources (39.72%) including residential, commercial, and industrial electricity and heating fuel use. Waste emissions from municipal solid waste and wastewater make up only 1.13% of the community-wide inventory.

From 2018 to 2022, Kennebunk's community-wide emissions increased 2.12% (Figure B). This increase is driven by increases in on-road transportation emissions. The waste and residential sectors saw very small decreases in emissions over this period. In Kennebunk's CAP, the town set a goal to "strive to meet the Maine Climate Council's goal of 45% emissions reduction by 2030 and an 80% reduction by 2050." Based on this inventory, there is much work to be done for the Town to reach these goals.

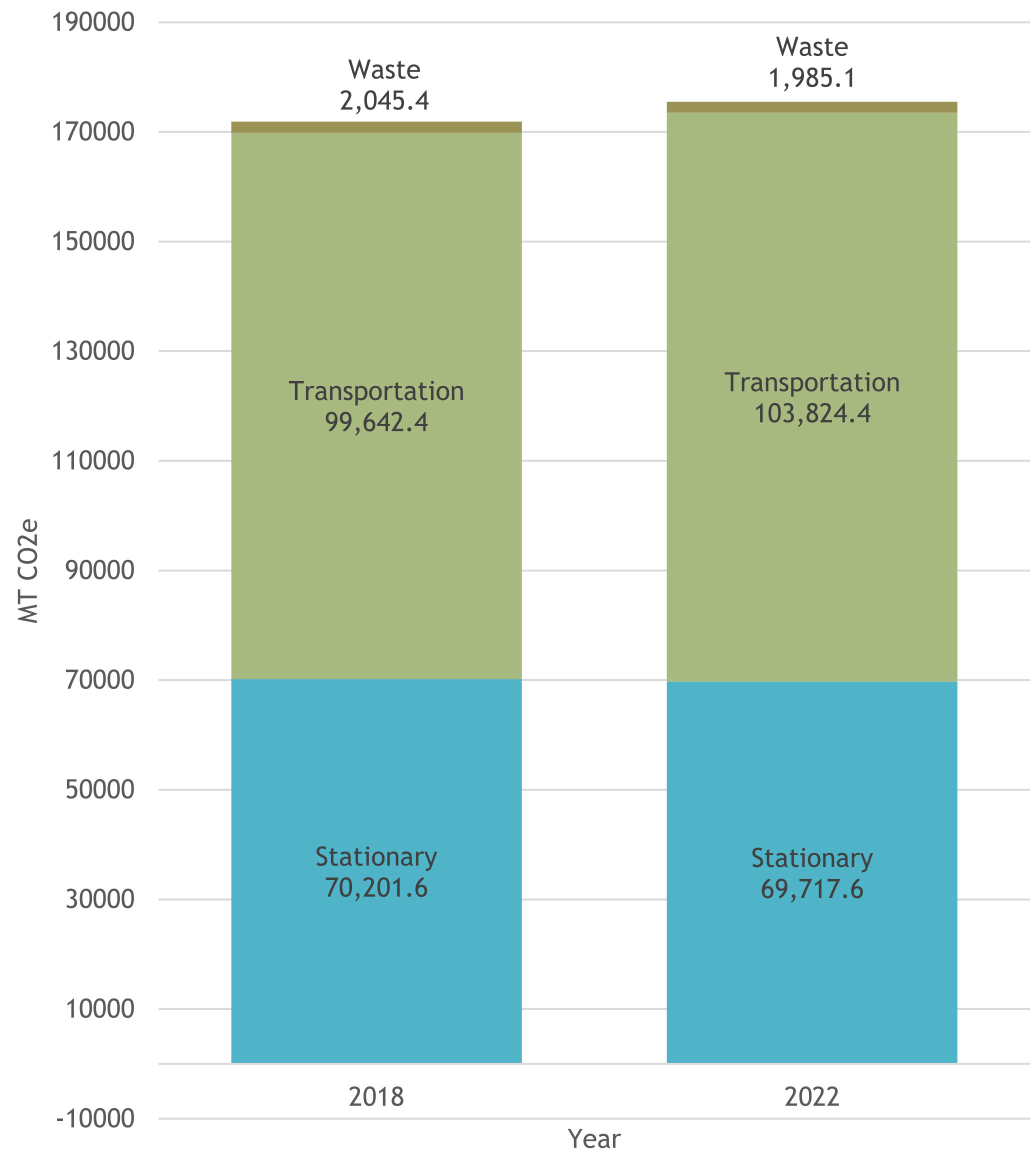

FIGURE B. COMPARISON OF KENNEBUNK'S 2018 AND 2022 COMMUNITY-WIDE INVENTORIES.

Key takeaways from the GHG inventory can be used to prioritize future climate action efforts. These key takeaways include:

1. Despite small increases in fuel efficiency, increased vehicle travel to, from, and within Kennebunk resulted in more emissions from on-road transportation.

Transportation emissions make up the majority (59.15%) of Kennebunk's community-wide emissions. Kennebunk has made strides in increasing EV and hybrid vehicle adoption in the community; however, these vehicles still make up only a small percentage (4% combined) of the vehicles belonging to the town's residents, businesses, and visitors. This suggests that promoting alternative transportation, encouraging EV adoption, and making Kennebunk friendly to visiting EVs is paramount for meaningful reductions in Kennebunk's GHG emissions.

2. Kennebunk's residential energy use is staying relatively stable, despite increases in housing units.

From 2018 to 2022, total residential energy use stayed approximately the same. During this period, the number of estimated households in Kennebunk increased by 170 households from 4,966 to 5,136[1]. To reduce residential emissions, Kennebunk should consider strategies to both increase fuel switching and encourage new homes to be built with heat pumps rather than propane heating systems. While new homes tend to be more energy efficient, weatherization of existing homes remains an important strategy for reducing home heating emissions.

3. Kennebunk's per household electricity usage is increasing.

Between 2016 and 2023, Kennebunk's per household electricity usage increased at a rate of 260 KWH per year. While it is expected that household electricity usage will go up as the community electrifies, efforts to reduce electricity use through energy efficiency measures (i.e., weatherization, smart thermostats, reducing plug load) will help reduce emissions overall and have the co-benefit of reducing strain on the electric grid.

4. Kennebunk's growth is putting pressure on emissions reduction efforts.

Between 2018 and 2022, Kennebunk saw increases in number of households, number of commercial/industrial establishments, and vehicle-miles-travelled from trips to, from, and within Kennebunk. This highlights how efforts to reduce emissions should take into account future development and growth and ensure that future growth is aligned with the community's energy priorities.

5. The energy used by Kennebunk residents, visitors, and business for transportation and building heating/electricity make up over 98% of Kennebunk's GHG inventory.

There is no single strategy that will address the majority of Kennebunk's GHG emissions. However, strategies targeting Kennebunk's buildings and the vehicles on its roads will have a significant impact.

[1] American Community Survey 5-year estimates

These strategies should consider the energy use of not just Kennebunk's residents, but its businesses and visitors as well.

6. Alternative indicators can be used to identify other strategies to reduce emissions that are not captured in the inventory

Because it is difficult to quantify the specific impact of many mitigation efforts (especially activities like education, community building, and environmental justice initiatives), alternative indicators may be used to develop emissions reduction initiatives and set measurable goals without the need to quantify their impact in MT CO_2e.

7. Future GHG inventories can be used to evaluate Kennebunk's progress on emissions reduction efforts.

Ongoing GHG inventories will help Kennebunk assess progress toward its emissions reduction goals, as well as evaluate and prioritize specific strategies in the Kennebunk CAP. Subsequent inventories may be conducted every 4-5 years to continue to monitor progress on climate action. Appendix B includes a list of recommendations to improve the quality of a future GHG inventory.

Introduction

Climate Action in Kennebunk

The Town of Kennebunk, founded in 1820, is a coastal community with an area of approximately 44 square miles and a population of 11,566[2]. A popular tourist destination, Kennebunk experiences a large influx of visitors and seasonal residents over the summer months. The town's scenic beaches and coastline are central to the town's identity and contribute substantially to the town's tax-based revenue.

Kennebunk is already experiencing the impacts of climate change, particularly from coastal flooding due to sea level rise and more frequent and more intense coastal storms. Because of these impacts and community concerns about greenhouse gas emissions, Kennebunk has made substantial progress in laying the foundation to address both the causes and impacts of climate change. In 2018, the town joined the Global Covenant of Mayors for Climate and Energy (GCOM). In 2019, Kennebunk joined a coalition of six towns in coastal York County to create the Regional Sustainability and Resilience Program in partnership with Southern Maine Planning and Development Commission (SMPDC). Kennebunk joined the Community Resilience Partnership in 2022, a program through the State of Maine that assists communities to reduce carbon emissions, transition to clean energy, and become more resilient to climate change effects. On May 14, 2024, Kennebunk's Select Board adopted the town's Climate Action Plan (CAP), completed in partnership with SMPDC as part of the four-community CAP Cohort (Biddeford, Kennebunk, Kennebunkport, and Kittery). In June of 2024, the Select Board created the Kennebunk Climate Action Committee to oversee the implementation of these strategies.

Kennebunk's CAP set a goal to "strive to meet the Maine Climate Council's goal of 45% emissions reduction by 2030 and an 80% reduction by 2050." Kennebunk's CAP contains 22 strategies that assist the Town in guiding future policy development to not only reduce the town's contribution to GHG emissions but also to reduce the town's vulnerability to impacts of climate change and enhance community resilience. These strategies are grouped under five topic areas: Buildings and Energy; Transportation and Infrastructure; Land Use and Natural Environment; Health, Safety, and Well-Being; and Leadership and Capacity. The CAP, its strategies, and implementation efforts can be found on the Kennebunk Climate Action Committee website.

[2] According to 2022 5-year population estimates from the American Community Survey. data.census.gov

Why Greenhouse Gas Inventories Matter

The Town of Kennebunk is already experiencing the impacts of climate change, including warmer air and ocean temperatures, shorter winters, and new pests and diseases.[3] These changes are primarily driven by an increase in carbon dioxide (CO_2) and other greenhouse gases (GHGs) in the atmosphere, largely due to the combustion and use of fossil fuels. These GHGs trap heat in the Earth's atmosphere. They let short-wave sunlight pass through the atmosphere but prevent some of the long-wave radiation emitted from the earth from leaving, thereby warming the atmosphere. As we burn more and more fossil fuels, GHGs continue to build up in the atmosphere, trapping an ever-greater amount of heat.

A greenhouse gas inventory is an account of all the GHG emissions from sources within a community. It is a tool to help communities:

- Understand ongoing activities and major sources of emissions
- Identify areas to focus emissions reduction efforts
- Establish goals and track progress towards those goals
- Facilitate decision-making about future policies and strategies

An inventory is usually calculated for a specific analysis year. Subsequent inventories every 3-5 years can aid local decision-makers and municipal staff in prioritizing and evaluating emissions reduction strategies.

This report contains the 2022 *community-wide inventory* for the Town of Kennebunk. A community-wide GHG inventory estimates the amount of GHG emissions associated with community sources and activities, meaning those of a municipality's residents, workforce, visitors, and economy. The report also includes updated data for the 2018 community-wide inventory. This allows for the comparison of emissions over time to better help the Town prioritize emissions reduction efforts.

The community-wide GHG inventory presented here is a *sector-based* inventory, which categorizes emissions based on their source. As a result, the inventory excludes many of the direct and lifecycle GHG emissions of the goods and services consumed by Kennebunk's residents and economy (such as food, clothing, electronic equipment, etc.). It is likely that the GHG emissions impact of Kennebunk's consumption is even greater than the emission estimates reported here. Therefore, the emissions estimates presented in this report can be considered a lower bound of Kennebunk's true impact on the generation of GHG emissions within and beyond Kennebunk. The inventory can provide guidance as to where the municipality and community may effectively direct emissions reductions efforts but

[3] MCC STS. 2020. *Scientific Assessment of Climate Change and Its Effects in Maine*. A Report by the Scientific and Technical Subcommittee (STS) of the Maine Climate Council (MCC). Augusta, Maine. 370 pp. http://climatecouncil.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF_STS_REPORT_092320.pdf

should not limit emissions reduction efforts in areas where there are known to be significant, but difficult to quantify emissions (i.e., food waste, air travel, behavioral change, etc.).

This report does not include a municipal inventory for the Town of Kennebunk. According to the 2018 GHG inventory baseline report, municipal emissions in Kennebunk only make up approximately 2% of all community-wide emissions. Table 1 describes the pros and cons of community-wide and municipal GHG inventories. To assist with prioritizing strategies for Kennebunk's CAP, this inventory focuses on the community-wide emissions and how those have changed over time. While municipal emissions are not specifically identified, emissions from municipal building energy use, vehicle use, and waste are accounted for in the community-wide inventory.

TABLE 1. PROS AND CONS OF COMMUNITY-WIDE AND MUNICIPAL GHG INVENTORIES

	Community-wide GHG inventory	Municipal GHG inventory
Pros	• Comprehensive view of all emissions occurring in the community • Provides insight into regulatory/educational/community emissions reduction strategies • Helps set community-wide targets and strategies that can be implemented by the local government, residents, businesses, and region	• Provides clear picture of emissions directly controlled by the local government • Leads to concrete and implementable strategies for reducing municipal emissions • Easier and faster to complete
Cons	• More complex and time consuming to complete • Relies more heavily on modeled data and regional/national averages, as opposed to actual energy use data in the community	• Only a small portion of a community's overall emissions are quantified • Limited impact of resulting emissions reduction strategies on community-wide emissions • Doesn't provide insight on regulatory/educational/community emissions reduction strategies

What Greenhouse Gases are Included

The primary GHGs included in a GHG inventory are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Each GHG contributes differently to warming in the atmosphere, where some are far more potent than others in the same quantities.[4] Because CH_4 and N_2O absorb far more energy than CO_2 in the atmosphere, global warming potentials (GWP) are needed to account for the warming impact of each gas. A GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of CO_2. To show the total

[4] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

emissions impact, emissions of CH_4 and N_2O are converted to metric tons of CO_2 equivalent (MT CO_2e) using each gas' GWP.

There are many other types of greenhouse gases, including perfluorocarbons, hydrofluorocarbons, sulfur hexafluoride, and nitrogen trifluoride. This protocol does not address these gases because they occur in much smaller quantities and are difficult to estimate for community-wide and municipal sources.

Emission Scopes

GHG emissions are also categorized by scope. Scopes designate the location and control of the emissions. Emission scopes aid communities in understanding emission sources and in inventory reporting and disclosure. They are defined as follows:[5]

Scope 1 emissions are those that physically occur within the boundary of the community or municipality's operations (such as the combustion of fossil fuels for home heating).

Scope 2 emissions are those that result from energy use within the boundary of the community or municipal operations but whose emissions occur outside the boundary (such as grid-supplied electricity).

Scope 3 emissions occur outside of the community or municipal operations boundary but are driven by activities within the community (such as landfilling community waste outside the community).

[5] Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories, Greenhouse Gas Protocol, 2014. https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Community-wide Inventory

Overview

The community-wide inventory estimates the GHG emissions due to Kennebunk's sources and activities, including those of Kennebunk's residents, workforce, visitors, and economy. It was estimated using the following inventory boundaries.

Inventory Year: This inventory was calculated for all emissions activities occurring in calendar year 2022, and in some cases, fiscal year 2022 (July 1, 2021 to June 30, 2022). The time periods used for each data source are identified in appendix A.

Inventory Boundary: The inventory boundary is the geographic extent of Kennebunk's jurisdictional boundary. All emissions that originated inside Kennebunk's jurisdictional boundary are included and classified as Scope 1. All emissions that happened outside the jurisdictional boundary as a direct result of community activity within the boundary (i.e., electricity use, landfilling of waste) are also included in the inventory, but classified as either Scope 2 or Scope 3. One exception to this was made in the case of the Kennebunk Service Plaza. Transportation emissions that occurred due to trips visiting the service plaza but NOT the Town of Kennebunk were excluded from the community-wide inventory. Including transportation emissions from trips to and from the Kennebunk Service Plaza would have overwhelmed all other emissions in the inventory.

Methodology

This inventory was conducted using the methodology laid out in the SMPDC Greenhouse Gas Inventory Protocol for Southern Maine Cities and Towns. This is a standardized and simplified protocol for community-wide GHG inventories. The protocol is based on the 2021 Global Protocol for Community-Scale Greenhouse Gas Inventories. It is also informed by the ICLEI – Local Governments for Sustainability U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, and the Metropolitan Area Planning Council Greenhouse Gas Inventories for Massachusetts Cities and Towns. The ICLEI ClearPath reporting platform was used for emissions calculations and accounting.

Community-wide GHG emissions may be either directly created (e.g., through household heating or vehicle fuel combustion) or indirectly created (e.g., through grid electricity use) by community members. For the inventory, emission types are divided into different sectors and subsectors. Table 2 shows the sectors and subsectors *included* in the Kennebunk GHG inventory.

There are several sectors and subsectors of emission sources that were *excluded* from Kennebunk's community-wide inventory (Table 3). In some cases, it is because these categories are not applicable to the Town of Kennebunk. In others, it is because data for emissions in those categories are less readily available, are likely inaccurate given current methodologies, and/or have little relevance to municipal climate action planning. For accurate comparison between the 2022 and 2018 inventory, some emission sources that were originally included in the 2018 inventory were removed in this report. Explanations for the update to the 2018 inventory are presented in the following sections.

TABLE 2. SECTORS AND SUBSECTORS INCLUDED IN THE KENNEBUNK COMMUNITY-WIDE GHG INVENTORY.

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE/END USE
STATIONARY ENERGY	Residential	Energy used in buildings as well as losses from distribution systems	Electricity
		Energy used in buildings	Discrete Fuel and Natural Gas
	Commercial	Energy used in commercial, government, and institutional buildings as well as losses from distribution systems	Electricity
		Energy used in commercial, government, and institutional buildings	Discrete Fuel and Natural Gas
	Industrial	Energy used in manufacturing and industrial facilities as well as losses from distribution systems	Electricity
		Energy used in manufacturing and industrial facilities	Discrete Fuel and Natural Gas
TRANSPORTATION	Passenger Vehicles	Fuel combusted from all passenger vehicle trips that are attributable to the community	Gasoline, Diesel, Electricity
	Commercial Vehicles	Fuel combusted from all commercial vehicle trips that are attributable to the community	Gasoline, Diesel, Electricity
	Public Transit	Fuel combusted due to passenger miles traveled on public transit	Gasoline, Diesel, Electricity
WASTE	Municipal Solid Waste - Landfill	GHG emissions resulting from the landfilling of all trash generated by residential and commercial activity in the community.	Landfill Emissions
	Compost	GHG emissions resulting from the breakdown of all composted material generated by residential, commercial, and schools	Aerobic and Anaerobic Digestion
	Wastewater – Septic	Emissions from wastewater processed in Kennebunk Septic Systems	Aerobic and Anaerobic Digestion
	Wastewater – Wastewater Treatment Plant	Emissions from wastewater treated at Kennebunk Sewer District Plant	Aerobic and Anaerobic Digestion
	Wastewater- Effluent Discharge	Emissions from wastewater effluent from Kennebunk Sewer District Plant	Aerobic and Anaerobic Digestion

TABLE 3. SECTORS AND SUBSECTORS **EXCLUDED** FROM THE KENNEBUNK COMMUNITY-WIDE GHG INVENTORY.

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE/ END USE	REASON
STATIONARY EMISSIONS	Upstream impacts of discrete fuel use	Emissions from the processing and transportation of natural gas and discrete fuels used for heating	Natural gas, Fuel Oil, Propane, etc.	Data quality, methodology. *Removed from the 2018 inventory
TRANSPORTATION	Passenger Rail	Fuel combusted due to passenger miles traveled on passenger rail	Gasoline, Diesel, Electricity	Not applicable in Kennebunk
	Freight Rail	Emissions from the movement of freight on rail lines through a community	Gasoline, Diesel, Electricity	Data availability, not relevant for municipalities
	Off-Road Equipment	Emissions that result from airport equipment, agricultural tractors, chain saws, forklifts, snowmobiles, etc.	Gasoline, Diesel, Electricity	Data availability
	Aviation	Fuel combusted from passenger and commercial air travel	Jet Fuel	Data availability
	Marine Vessels	Fuel combusted by boats that are refueled at community harbors	Gasoline, Diesel	Data availability
WASTE	Municipal Solid Waste - Incineration	Landfill gas emissions resulting from the incineration of trash generated by residential and commercial activity in the community and sent to an incineration plant	Landfill Gas	Not applicable in Kennebunk
INDUSTRIAL	Industrial Process Emissions	Process and fugitive emissions from industrial facilities	Combustion and other Chemical Emissions	Data availability
	Product Use	Emissions from the use of products such as refrigerants, foams, or aerosol cans	Combustion and other Chemical Emissions	Data availability
AGRICULTURE, FORESTRY, MARINE	Livestock	Emissions from manure management and enteric fermentation	Enteric fermentation and manure management	Data availability
	Land	Emissions and sequestration of GHGs from land use changes	Soil and Land Management Changes	Data availability, methodology
CONSUMPTION - BASED EMISSIONS	Not applicable	Emissions from the consumption of goods and services by Kennebunk's residents	Life cycle emissions	Data availability *Removed from the 2018 inventory

Collecting the data

Community-wide emissions are calculated for each activity by multiplying activity data (e.g., fuel consumption) by the corresponding emission factors (e.g., tons CO_2 emitted per gallon of fuel combusted). The quality and availability of fuel consumption data varies across sectors and subsectors. This inventory is based on the highest quality data available according to the following hierarchy:

1. Real consumption data for each fuel type or activity, disaggregated by subsector.
2. A representative sample set of real consumption data from surveys.
3. Modeled energy consumption/activity data.
4. Regional or national fuel consumption data scaled down using population or other indicators.

The quality of available data may reduce the confidence in the GHG emissions estimate for some subsectors of emissions. Similarly, the current scientific understanding and/or simplifications that must be made may also reduce confidence in the emissions factors used to convert activity data to emissions estimates (particularly for waste and electricity end uses as well as transmission and distribution losses). To provide a broad measure of these uncertainties, the level of confidence of the data quality in each subsector is indicated as either low, medium, or high according to the guidelines provided in the 2021 Global Protocol for Community-Scale Greenhouse Gas Inventories (Table 4).

TABLE 4. DATA QUALITY DESCRIPTIONS FROM TABLE 5.3 IN 2021 GLOBAL PROTOCOL FOR COMMUNITY-SCALE GREENHOUSE GAS INVENTORIES.

Data Quality	Activity Data	Emission Factor
High	Detailed activity data	Specific emission factors
Medium	Partial or modeled activity data using robust assumptions	More general emission factors
Low	Highly-modeled or uncertain activity data	Default emission factors

2022 Community-wide Inventory

Summary

Figure 1 summarizes Kennebunk's 2022 community-wide GHG inventory. Community-wide emissions for 2022 are estimated as 175,527 Metric Tons CO_2 equivalent (MT CO_2e). The majority of these emissions (59.15% – shown in orange) come from transportation emissions sources. Stationary emissions (commercial, industrial, and residential – in green) are the second largest sector at 39.72% of the total emissions inventory. Waste emissions (in blue) from municipal solid waste and wastewater only make up 1.13% of the inventory.

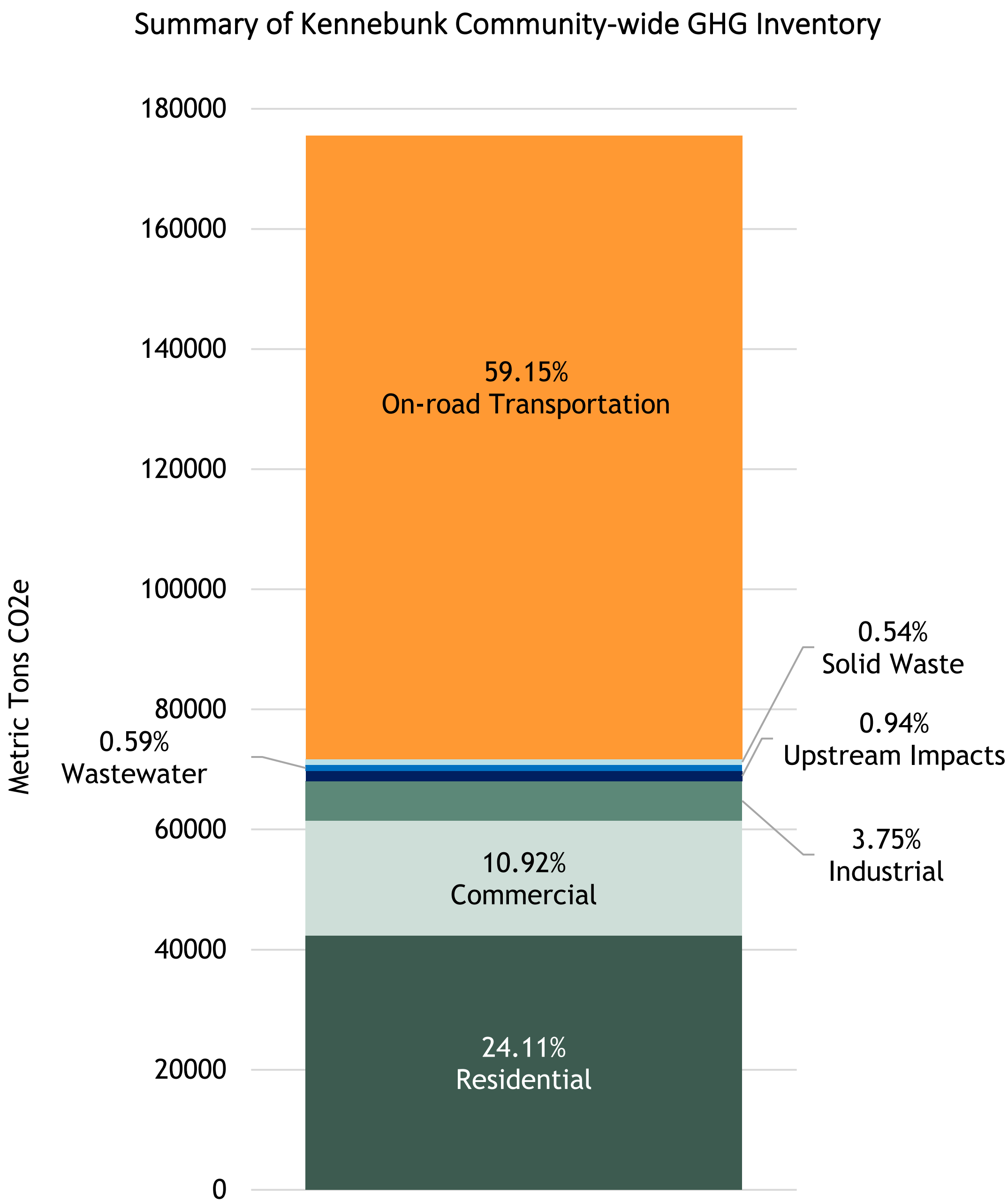

FIGURE 1. KENNEBUNK 2022 COMMUNITY-WIDE GHG INVENTORY GROUPED BY SUBSECTOR

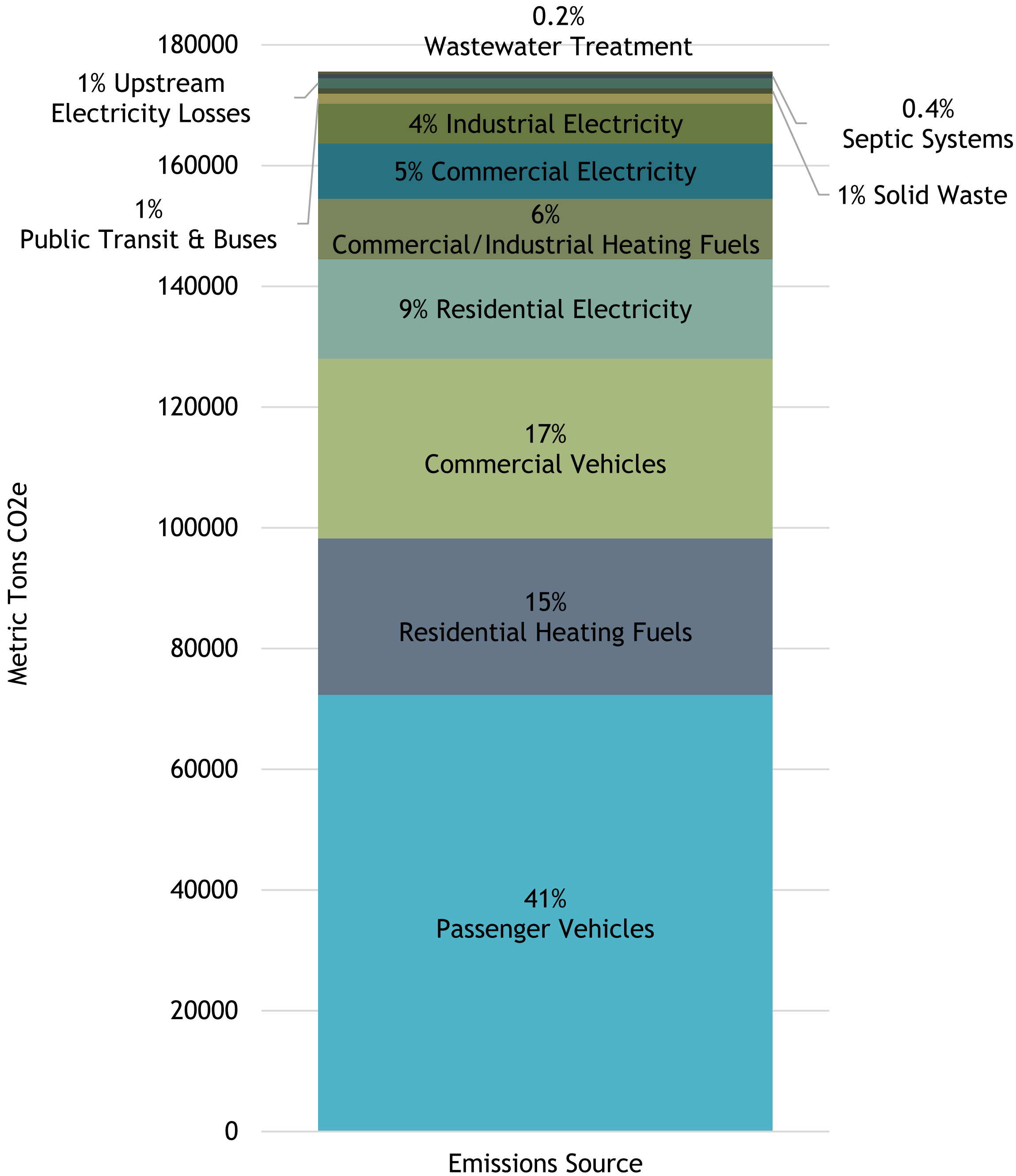

FIGURE 2. KENNEBUNK 2022 COMMUNITY-WIDE GHG INVENTORY GROUPED BY END USE OR EMISSION SOURCE

Figure 2 shows emissions grouped by end use or emission source. By far, passenger vehicle emissions from diesel and gasoline fuel combustion are the largest source of emissions (41%), followed by commercial vehicles (17%). The next highest sources are residential heating emissions from the combustion of home heating fuels (15%) and residential electricity use (9%). These are followed by commercial/industrial heating fuel used for building heating (6%) and commercial building electricity use (5%) and industrial building electricity use (4%).

When allocated based on year-round resident population, Kennebunk's Community-wide GHG emissions are estimated as 15.2 MT CO_2e per capita. However, this measure does not necessarily paint a realistic picture of emissions per person. First, many of the emissions from building electricity use, heating fuel use, and transportation are the result of the activities of seasonal residents and tourists who are not included in the year-round resident population. Second, because the community-wide inventory is a *sector-based* inventory, it excludes many of the direct and lifecycle GHG emissions of the goods and services consumed by Kennebunk's residents and visitors (such as food, clothing, electronic equipment, etc.). Though it is difficult to quantify the true GHG emissions impact of each Kennebunk resident, visitor, or employee, emissions reduction strategies should be developed to target each of these populations rather than just residents alone.

Comparison between 2022 and 2018 Community-wide inventories

To estimate progress on the Town of Kennebunk's GHG emissions reduction goals, the 2022 GHG inventory was compared to the 2018 GHG inventory. To provide a more accurate comparison, the following updates to the 2018 inventory were made:

- **Recalculated the on-road transportation emissions** using a refined on-road transportation emissions methodology available through the Streetlight Data platform. The same methodology was used for both the 2022 and 2018 inventories.
- **Moved water pumping electricity emissions to the Commercial sector** to create a waste-specific sector, in alignment with the 2021 Global Protocol for Community-Scale Greenhouse Gas Inventories.
- **Removed natural gas fugitive emissions** due to their low data quality, low emissions factor quality, and negligible amount.
- **Removed upstream impact emissions for all heating fuels** due to their low data quality and low emissions factor quality. The exception to this is transmission and distribution emissions from electricity, which were included in the inventory because of its high data quality and medium quality emissions factor.
- **Removed consumption-based emissions**. The data used to calculate consumption-based emissions has not been updated since 2013, so there was no way to update it for 2022 for comparison to the 2018 estimate.
- **Updated the landfill emissions calculation** based on new calculation methodology available through the ICLEI ClearPath platform.
- **Corrected an error in the residential home heating fuel estimate.** The original 2018 estimate underestimated home heating fuel use because it was calculated for an incorrect number of households. The number of households was based on the census data for "Kennebunk Census Designated Place", not the "Town of Kennebunk".
- **Recalculated commercial heating fuel use** using the methodology set out in the Southern Maine GHG Inventory Protocol, which combines commercial and industrial heating fuel use.

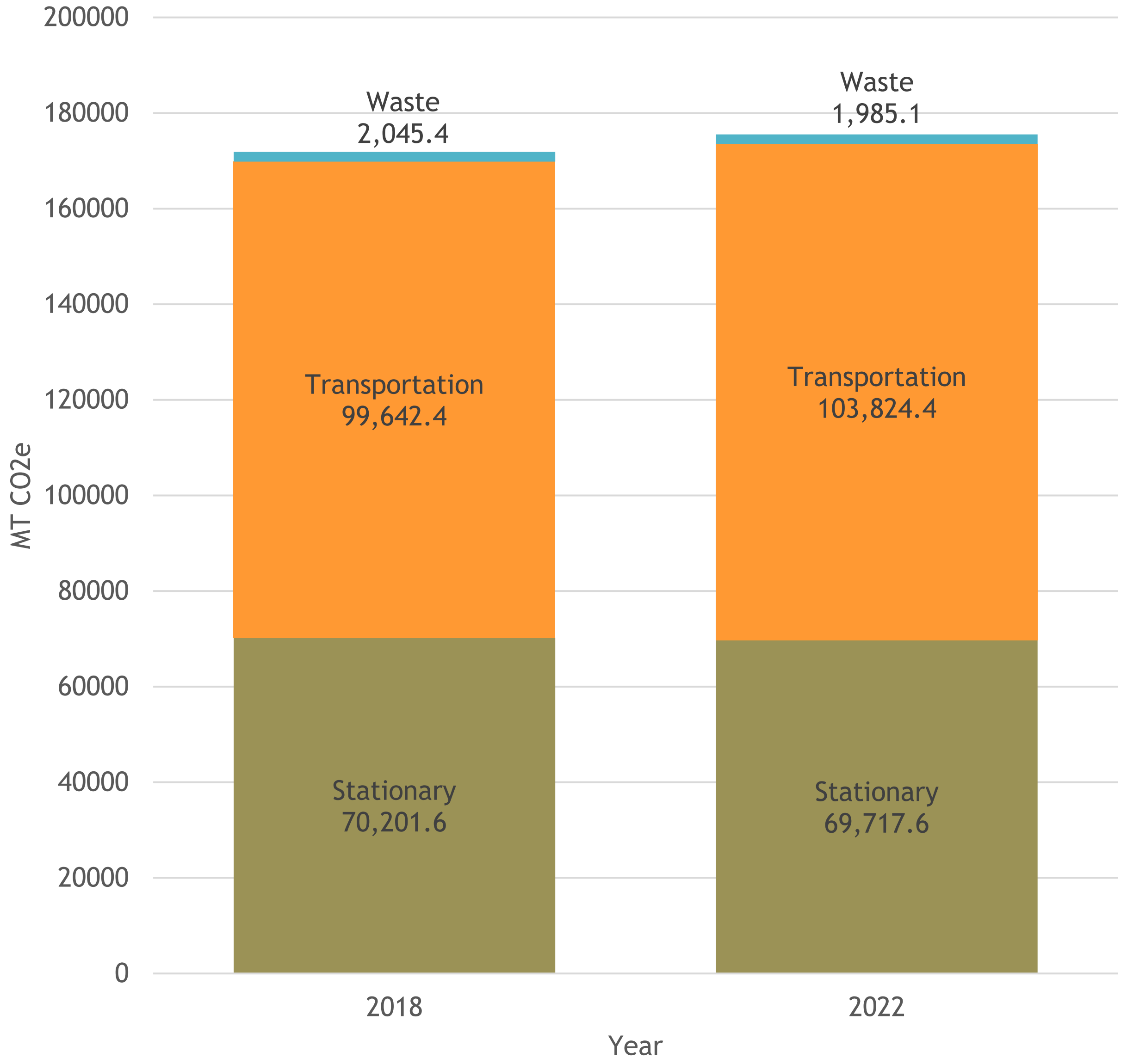

FIGURE 3. COMPARISON OF 2018 AND 2022 COMMUNITY-WIDE GHG INVENTORY

Figure 3 shows the comparison of the 2018 and 2022 Kennebunk community-wide GHG inventories. Stationary emissions decreased 0.69% and waste emissions decreased 2.95%. However, transportation emissions increased 4.20%. Taken together, these resulted in a 2.12% increase in emissions for the Town of Kennebunk from 2018 to 2022. Emissions per capita were 14.95 MT $CO2_2e$ in 2018 and 15.18 MT $CO2_2e$ in 2022, a 1.5% increase.

The following sections provide an overview of the emissions in each sector. They compare sub-sector emissions between 2018 and 2022 and provide some insight into the causes of the increase from 2018 to 2022.

Stationary Energy

The Stationary Energy sector includes GHG emissions resulting from energy use by buildings and industries. It includes the direct emissions from the combustion of fossil fuels (Scope 1) and the indirect emissions from the consumption of grid-supplied electricity (Scope 2). It also includes the losses from the transmission and distribution systems of grid-supplied electricity (Scope 3). Data Sources for Kennebunk's Stationary Energy sector are presented in Table 5.

Kennebunk's Stationary Energy emissions are 69,717.6 MT CO_2e, 39.7% of all community-wide emissions. Overall, the residential subsector (i.e., building heating and cooling) is responsible for 60.7% of Kennebunk's Stationary energy emissions (Figure 4 and Table 6). Residential discrete fuel use for home heating, including heating oil, propane, wood, and natural gas, is the largest source of Stationary Energy emissions. Heating oil is the most common residential heating fuel and is the largest emissions source in the Stationary Energy Sector (27.7%). The second largest end use in the stationary sector is residential electricity use (23.6%).

Due to data limitations, commercial and industrial heating fuel use are combined in Kennebunk's GHG inventory. Together, commercial/industrial heating fuel use (both discrete fuels and natural gas) are the third largest source of emissions in the stationary energy category, accounting for 14.3% of emissions. Commercial electricity use from private buildings is much larger than in public facilities, making up 11.4 % of the stationary energy emissions vs only 1.8% for public buildings.

TABLE 5. STATIONARY ENERGY SUBSECTORS AND DATA SOURCES

SUBSECTOR	EMISSIONS SOURCES	END USE/ENERGY TYPE	SCOPE	DATA SOURCE	DATA QUALITY
RESIDENTIAL	Energy used in buildings as well as losses from distribution systems	Electricity	2 and 3	Real consumption data from Central Maine Power (CMP)	High (use) Low (losses)
	Energy used in buildings	Discrete Fuel and Natural Gas	1	Scaled down fuel consumption data from state datasets and real consumption data from Unitil	Low (discrete fuel) High (natural gas)
COMMERCIAL	Energy used in commercial, government, and institutional buildings as well as losses from distribution systems	Electricity	2 and 3	Real consumption data from Central Maine Power (CMP)	High (use) Low (losses)
	Energy used in commercial, government, and institutional buildings	Discrete Fuel and Natural Gas	1	Scaled down fuel consumption data from state datasets. Includes industrial discrete fuel use	Low
INDUSTRIAL	Energy used in manufacturing and industrial facilities as well as losses from distribution systems	Electricity	2 and 3	Real consumption data from Central Maine Power (CMP)	High (use) Low (losses)

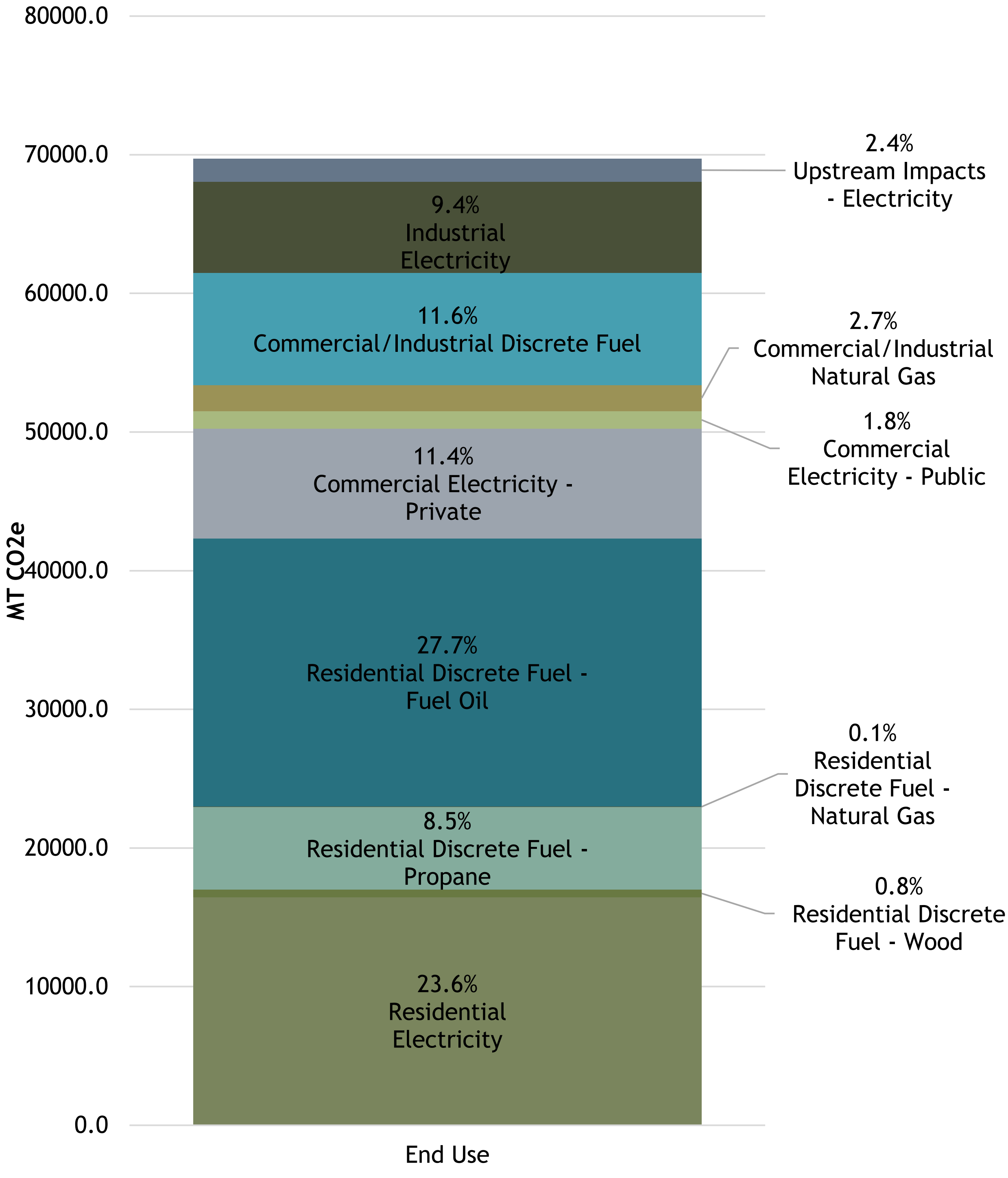

FIGURE 4. 2022 KENNEBUNK COMMUNITY-WIDE STATIONARY EMISSIONS.

TABLE 6. STATIONARY EMISSIONS BY END USE AND SUB-SECTOR FOR 2018 AND 2022. GREEN ROWS HIGHLIGHT AREAS WHERE THERE APPEARS TO BE A NOTABLE DECREASE IN EMISSIONS, WHILE TAN ROWS HIGHLIGHT AREAS WHERE THERE APPEARS TO BE A NOTABLE INCREASE IN EMISSIONS.

	2018		2022	
End Use and subsector	Emissions (MT CO_2e)	Percent of stationary emissions (%)	Emissions (MT CO_2e)	Percent of stationary emissions (%)
Residential Electricity	15,130.3	21.6%	16,455.1	23.6%
Residential Discrete Fuel - Natural Gas	25.9	0.0%	40.2	0.1%
Residential Discrete Fuel - Fuel Oil	22,795.4	32.5%	19,325.9	27.7%
Residential Discrete Fuel - Wood	573.9	0.8%	539.9	0.8%
Residential Discrete Fuel - Propane	4,021.3	5.7%	5,958.6	8.5%
Commercial Electricity - Public	1,321.0	1.9%	1,247.8	1.8%
Commercial Electricity - Private	9,811.1	14.0%	7,934.7	11.4%
Commercial/Industrial Natural Gas	2,280.5	3.2%	1,880.8	2.7%
Commercial/Industrial Discrete Fuel	7,041.3	10.0%	8,096.2	11.6%
Industrial Electricity	5,883.3	8.4%	6,582.0	9.4%
Upstream Impacts - Electricity	1,317.8	1.9%	1,656.3	2.4%
TOTAL	**70,201.6**		**69,717.6**	

Table 6 shows how emissions by subsector and end use changed between 2018 and 2022. Overall, the decrease in stationary emissions from 2018 to 2022 is 0.69%, likely within the margin of error for these calculations and therefore negligible. While residential fuel oil use decreased, residential electricity use and emissions increased, as did propane use. During this time period, the number of estimated households in Kennebunk increased by 170 households from 4,966 to 5,136[6], which is likely driving the increases in propane emissions compared to fuel oil. Commercial electricity emissions show a decrease from 2018 to 2022. At the same time, the number of commercial and industrial establishments increased by 111 establishments from 578 to 689[7].

Data Quality Considerations

While data quality for electricity and natural gas is high, data quality for discrete fuel use is low. This is because the discrete fuel use estimates are based on statewide energy use data and national survey results.

[6] American Community Survey 5-year estimates

[7] According to Maine Center for Workforce Research and Information Quarterly and Annual Employment and Wages

Transportation

The Transportation sector includes emissions from all on-road transportation sources, including passenger vehicles, commercial vehicles, and public transit. Due to limited data availability or lack of applicability, it excludes emissions from marine vessels, freight rail, passenger rail, off-road equipment, and aviation. There is currently no quality data source for freight rail or off-road equipment for Maine communities. Passenger rail emissions are not relevant to the Town of Kennebunk where there is no passenger rail service. Aviation and marine emissions are excluded as well due to lack of data. Data sources for Kennebunk's Transportation sector are presented in Table 7 and emissions estimates are presented in Figure 5 and Table 8.

On-road transportation emissions are divided into scope 1 emissions (those miles driven within Kennebunk's jurisdictional boundary) and scope 3 emissions (those miles driven outside of Kennebunk's jurisdictional boundary). On-road transportation emissions were calculated using modeled vehicle milage data and regional vehicle population data. This methodology is detailed in the report Estimating On-Road Transportation Emissions in York County, Maine. Under this methodology, the emissions estimate is based on all trips that occur because of people travelling to, from, and within a community. It specifically excludes emissions from vehicles that pass through – but do not stop in – the community.

For the Town of Kennebunk, a modification was made to this methodology to account for the Kennebunk Service Plaza. The service plaza is located within the jurisdictional boundary of the Town; however, many vehicles stop at the service plaza on their way to other locations in the state or the broader New England region. This emissions inventory excludes emissions from the majority of trips that either stop or end at the Kennebunk Service Plaza. Trips to or from the service plaza that start or end in the Town of Kennebunk are included. This modification drastically reduces the on-road transportation emissions estimate for the Town, which otherwise would be dominated by service plaza-related trips.

Emissions from Transportation sources are estimated as 103,824 MT CO_2e, 59.15% of all community-wide emissions. Emissions from passenger vehicles account for most transportation emissions (69.7%). Passenger vehicle emissions from both gasoline and diesel fuel use are the largest single source of emissions in the community-wide inventory, accounting for 41% of community-wide emissions. High passenger vehicle emissions are common for most Maine communities. Throughout southern Maine, high community passenger vehicle emissions are due to the high daily travel volumes of passenger vehicles, as well as the dominance of low fuel efficiency SUVs and light-duty trucks in the region's vehicle population. Commercial vehicles were the second largest source of transportation emissions (28.7%). Public transit only accounted for a small fraction (1.6%) of the transportation emissions. Emissions from the public transit subsector likely come from school buses and tour or charter buses, as there are limited bus services in Kennebunk.

TABLE 7. TRANSPORTATION EMISSIONS SUBSECTORS AND DATA SOURCES.

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE	SCOPE	DATA SOURCE	DATA QUALITY
TRANSPORTATION	Passenger Vehicles	Fuel combusted from all passenger vehicle trips that are attributable to the municipality	Gasoline, Diesel, Electricity	1 and 3	Modeled energy consumption/ activity data based on real activity data	Medium
	Commercial Vehicles	Fuel combusted from all commercial vehicle trips that are attributable to the municipality	Gasoline, Diesel, Electricity	1 and 3	Modeled energy consumption/ activity data based on real activity data	Medium
	Public Transit	Fuel combusted due to passenger miles travelled on public transit	Gasoline, Diesel, Electricity	1 and 3	Modeled energy consumption/ activity data based on real activity data	Medium

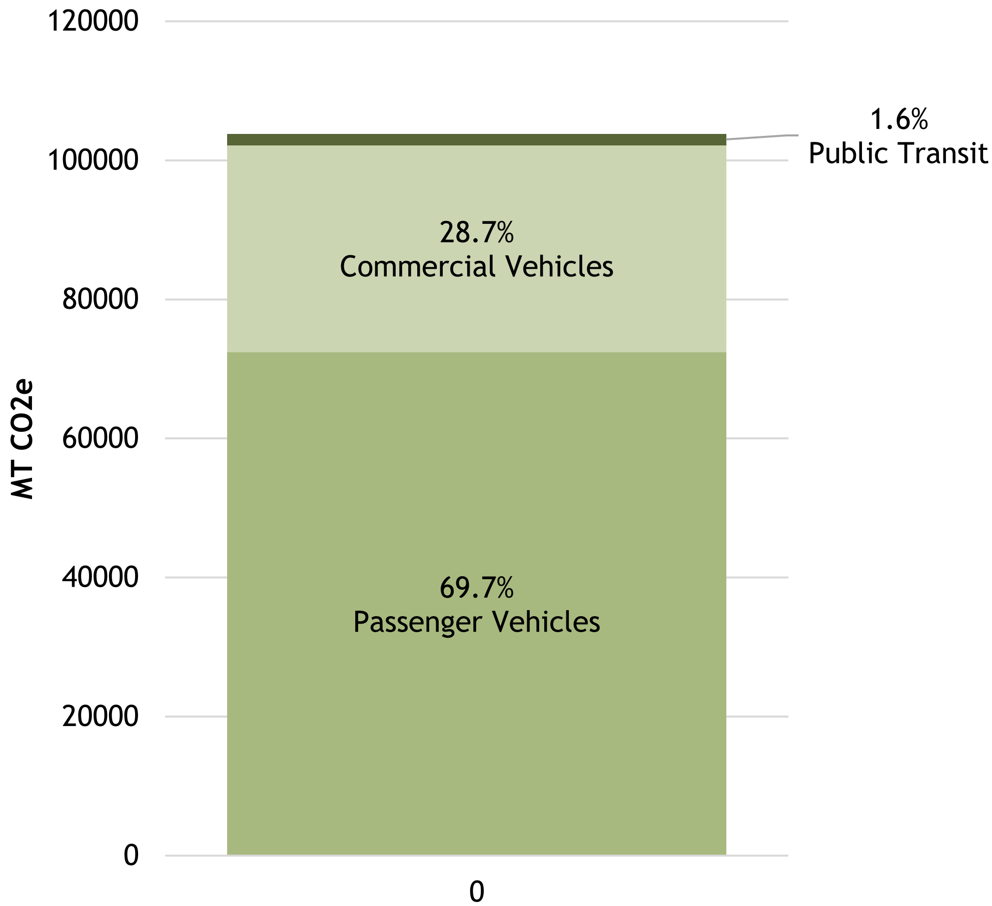

Figure 5. 2022 Kennebunk Community-wide Transportation Emissions

Table 8 details the transportation emissions by sub-sector in 2018 and 2022. Over this time period, on-road transportation emissions increased 4.20% (4,182.1 MT). This increase occurred because of an 8.4% increase in vehicle-miles-travelled attributed to Kennebunk from 2018 to 2022. The increase in vehicle-miles-travelled is somewhat offset by increases in vehicle fuel efficiency. The on-road transportation emissions estimate utilizes national fuel efficiency data that includes gasoline, diesel, hybrid, and electric vehicle fuel use estimates. New England specific fuel efficiency estimates are not available. Between 2018 and 2022, fuel efficiency increased across all vehicle types except motorcycles. Fuel efficiency for all motor vehicles increased from an average of 18.2 mpg to 18.5 mpg. For passenger vehicles, fuel efficiency increased from 22.5 mpg to 22.8 mpg.

TABLE 8. TRANSPORTATION EMISSIONS BY SUBSECTOR FOR 2022 AND 2018.

	2018		2022	
Subsector	Emissions (MT CO_2e)	Percent of transportation emissions (%)	Emissions (MT CO_2e)	Percent of transportation emissions (%)
Passenger Vehicles	68,634.8	68.88%	72,381.5	69.7%
Commercial Vehicles	29,503.6	29.61%	29,821.1	28.7%
Public Transit	1,504.0	1.51%	1,621.8	1.6%
TOTAL	**99,642.4**		**103,824.4**	

Data Quality Considerations

SMPDC's approach to modelling vehicle miles traveled using Streetlight Data allows for a fuller and more accurate measure of on-road transportation emissions assigned to the Town of Kennebunk. However, without the inclusion of other forms of transportation, the picture of Kennebunk's transportation emissions remains incomplete. Aviation is likely a significant source of Scope 3 emissions from the air travel of Kennebunk's residents and visitors. Aviation emissions may be estimated using a community-wide survey question asking about annual air travel by residents. An alternative metric for understanding the impact of aviation emissions could be the average or median number of flights flown by Kennebunk residents each year. Off-road and marine transportation emissions are also likely relevant but might be harder to ascertain without regional or state-wide data.

Waste

The management of solid waste and wastewater results in GHG emissions through the decay of waste with biologic constituents or the burning of waste. The Waste sector includes all emissions from the disposal and treatment of waste generated within the Town of Kennebunk, whether treated inside or outside of the municipal boundary. Data sources for Kennebunk's Waste sector are presented in Table 9. The Town of Kennebunk disposes of municipal solid waste (MSW) through landfilling, composting, and recycling. MSW – Landfill emissions include those from trash generated by residents that is picked up curbside and transferred to landfills by Casella. Emissions avoided from recycling are excluded from this inventory because they are minimal and difficult to quantify. Wastewater treatment emission sources in Kennebunk include septic systems, the Kennebunk Sewer District Plant, and effluent discharge from the Kennebunk Sewer District Plant.

Figure 6 and Table 10 show the emissions estimates for the Waste sector. Waste emissions are estimated as 1,985.1 MT CO_2e, making up just 1.1% of Kennebunk's community-wide GHG emissions. Most waste emissions (45.7%) are from the landfilling of municipal solid waste. The second largest waste subsector is septic system emissions (33.2%). Greenhouse gas emissions per septic system far exceed emissions per sewer connection. In Kennebunk, the emissions per septic system are 0.27 MT CO_2e (resulting from methane production during the breakdown of waste). In comparison, wastewater emissions per sewer connection are 0.063 MT CO_2e, over four times less than for a septic system.

TABLE 9. WASTE EMISSIONS SUBSECTORS AND DATA SOURCES.

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE	SCOPE	DATA SOURCE	DATA QUALITY
WASTE	Municipal Solid Waste - Landfill	GHG emissions resulting from the landfilling of all trash generated by residential and commercial activity in the community.	Landfill Emissions	Municipal Solid Waste - Landfill	GHG emissions resulting from the landfilling of all trash generated by residential and commercial activity in the community.	Landfill Emissions
	Compost	GHG emissions resulting from the breakdown of all composted material generated by residential, commercial, and schools	Aerobic and Anaerobic Digestion	Compost	GHG emissions resulting from the breakdown of all composted material generated by residential, commercial, and schools	Aerobic and Anaerobic Digestion
	Wastewater – Septic	Emissions from wastewater processed in Kennebunk Septic Systems	Aerobic and Anaerobic Digestion	Wastewater – Septic	Emissions from wastewater processed in Kennebunk Septic Systems	Aerobic and Anaerobic Digestion
	Wastewater – Wastewater Treatment Plant	Emissions from wastewater treated at Kennebunk Sewer District Plant	Aerobic and Anaerobic Digestion	Wastewater – Wastewater Treatment Plant	Emissions from wastewater treated at Kennebunk Sewer District Plant	Aerobic and Anaerobic Digestion

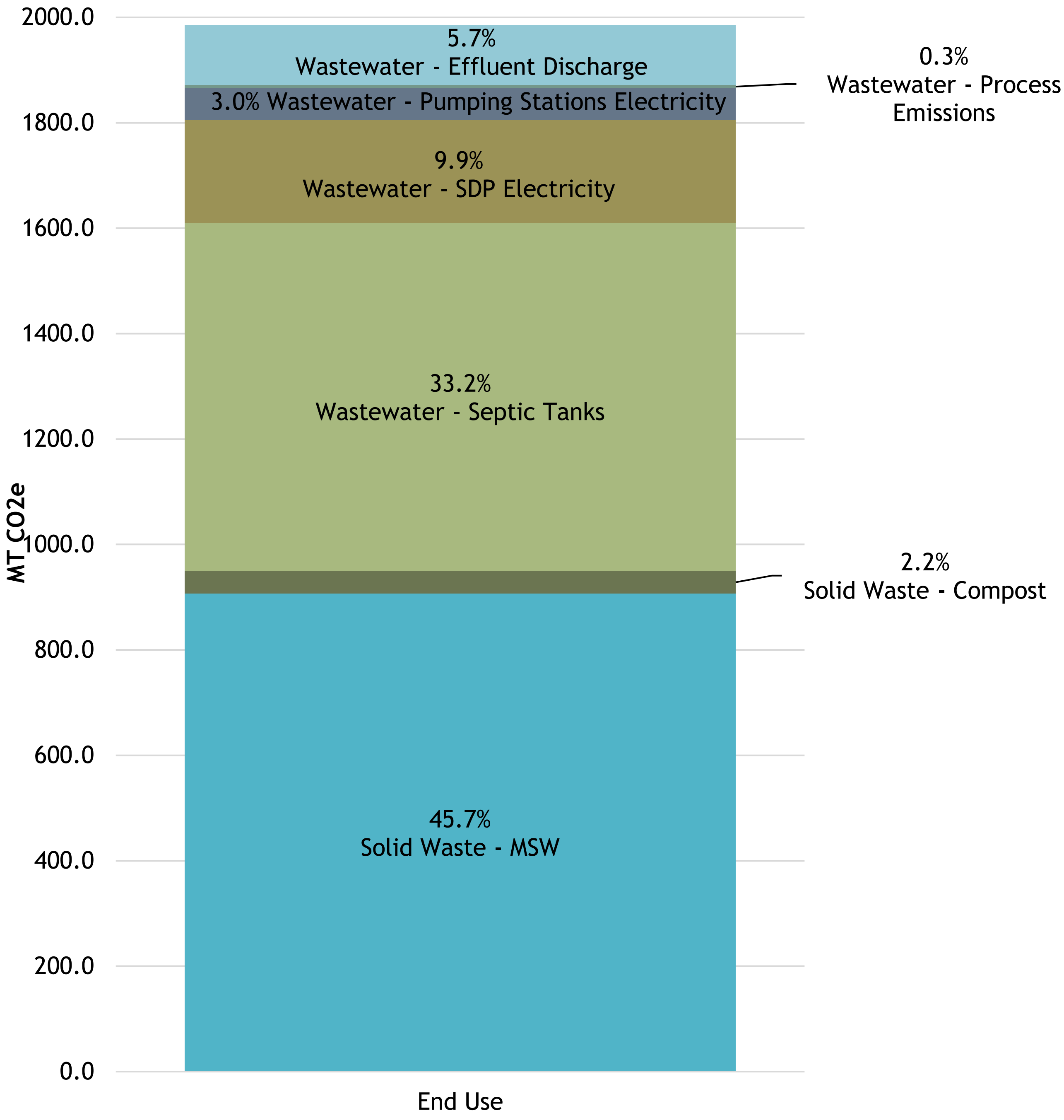

FIGURE 6. SUMMARY OF WASTE EMISSIONS FOR KENNEBUNK'S 2022 COMMUNITY-WIDE GHG INVENTORY

TABLE 10. WASTE EMISSIONS BY SUBSECTOR FOR 2022 AND 2018

	2018		2022	
Subsector	Emissions (MT CO_2e)	Percent of Waste emissions (%)	Emissions (MT CO_2e)	Percent of Waste emissions (%)
Wastewater - Pumping Stations Electricity	72.5	3.5%	60.1	3.0%
Wastewater - SDP Electricity	232.0	11.3%	196.5	9.9%
Wastewater - Process Emissions	20.0	1.0%	5.9	0.3%
Wastewater - Effluent Discharge	52.9	2.6%	113.5	5.7%
Wastewater - Septic Tanks	351.0	17.2%	659.0	33.2%
Solid Waste - Compost	67.7	3.3%	43.7	2.2%
Solid Waste - MSW	1,249.2	61.1%	906.5	45.7%
TOTAL	**2,045.4**		**1,985.1**	

Table 10 shows waste emissions by sub-sector for 2018 and 2022. Overall, waste emissions decreased 2.95% between 2018 to 2022. Reductions in electricity emissions are likely driven by lower electricity emissions factors as well as possible energy efficiency improvements. Solid waste emissions were reduced due to a significant decrease in reported waste tonnage from 1,912.5 Tons in 2018 to 1,387.83 Tons in 2022.

Data Quality Considerations

Emissions data from waste tend to be low quality due to both lack of activity data and uncertainty in emissions calculations. Because municipalities are responsible for transfer stations, residential waste options, and wastewater treatment plants, they often have good records of residential MSW and wastewater volumes. However, it is often unclear how much of the commercial and industrial waste streams are captured in municipal MSW. To get a clearer picture of commercial waste volumes, Kennebunk could survey businesses about their waste volumes and management practices.

Additional Indicators of Climate Action

The process of calculating and inventorying GHG emissions from community-wide activities is a vital step for communities to understand the sources of their emissions and identify priority actions for reducing emissions. But due to the need to sometimes rely on statewide, national, or modelled data for GHG inventories, it can be hard to quantify the specific impact of mitigation efforts on the emissions calculated in the inventory. This is especially true for those efforts that have an indirect impact on emissions, such as activities like educating residents and businesses about renewable energy or community building and environmental justice initiatives. These are critical activities that research has shown are vital to driving down GHG emissions across many sectors.

Additional Indicators of Climate Action are alternative metrics that may be used to develop emissions reduction initiatives and set measurable goals without the need to quantify their impact in MT CO_2e. These additional indicators support Kennebunk's community-wide inventory and provide a broader picture of climate action within the community.

Stationary Energy

Indicators for stationary energy can help guide community efforts to increase energy efficiency and reduce reliance on fossil fuels in homes and businesses.

Electricity use per household

Tracking electricity use per household can help Kennebunk set goals for energy efficiency. Average annual household electricity use for the Town of Kennebunk was 13,073 KWH per year for 2022. This is higher than the U.S. national average of 10,791 KWH per year in 2022. It is higher than the Maine statewide average of 6,840 KWH per year in 2020[8]. Household annual electricity increased in Kennebunk from 2016-2023 at a rate of 260 KWH per year.

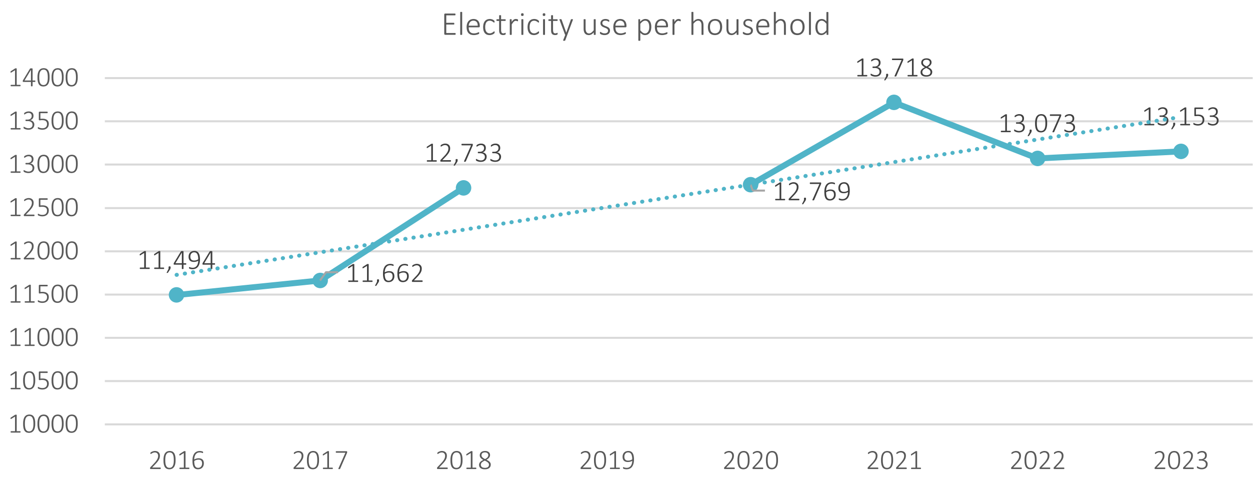

FIGURE 7. AVERAGE ANNUAL HOUSEHOLD ELECTRICITY USAGE FOR THE TOWN OF KENNEBUNK. DATA OBTAINED FROM CENTRAL MAINE POWER AND KENNEBUNK LIGHT AND POWER DISTRICT.

[8] Source: https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

Solar array installation

Solar panels offset grid-supplied electricity with zero-emission solar energy. Kennebunk's code enforcement office recently began tracking solar permit applications. In 2024 Kennebunk issued **11 building permits for solar panels**.

Transportation

Indicators for transportation can help the community track efforts to increase electric vehicle adoption, walk/bike-ability, and use of public transit.

Number of EVs and hybrids in local vehicle population

The number of electric vehicles (EVs) and hybrids registered in Kennebunk may be used to track community efforts to increase the number of residents or businesses driving EVs. Different types of EVs and hybrids include:

- **Battery Electric Vehicle (BEV)** - A full all electric vehicle that runs strictly on a battery system that must be charged with a plug.
- **Plug-in Electric Vehicle (PHEV)** - Can be operated with both gasoline and electricity from a battery system that must be charged by plugging it in. Some plug-in models can travel over 70 miles on electricity alone. All plug-in models can operate solely on gasoline when necessary.
- **Hybrid Electric Vehicle (HEV)** - A hybrid car is fueled strictly by gasoline. Electrification technology is used to recapture some energy during braking and store it as electricity which it uses to help power the car at very low speeds and stops. Hybrids are not plugged in.
- **Neighborhood Electric Vehicle (NEV)** - Are full battery electric car capable of traveling at low speeds generally around 25 miles per hour (mph). NEV's must be plugged in to recharge.
- **Neighborhood Motorcycle Electric (NME) -** A full battery electric motorcycle (scooter types) capable of traveling at low speeds generally around 25 miles per hour (mph). NME's must be plugged in to recharge.

From 2020 to 2024, Kennebunk saw a significant increase in the number of electric vehicles and hybrids. The number of registered BEVs increased from 17 to 128 (752%). Hybrid vehicles registered in Kennebunk increased from 294 to 434 vehicles (158%). The number of registered PHEVs increased from 31 to 111 (358%). In 2023, EVs and PHEVs made up **only 1.6%** of Kennebunk's registered vehicle population (179 of 11,345 vehicles total[9]). Standard hybrid cars make up 3.4% of Kennebunk's 2023 vehicle population.

[9] Based on Maine DEP vehicle population data for 2023. Total excludes trailers and vehicles registered as antiques.

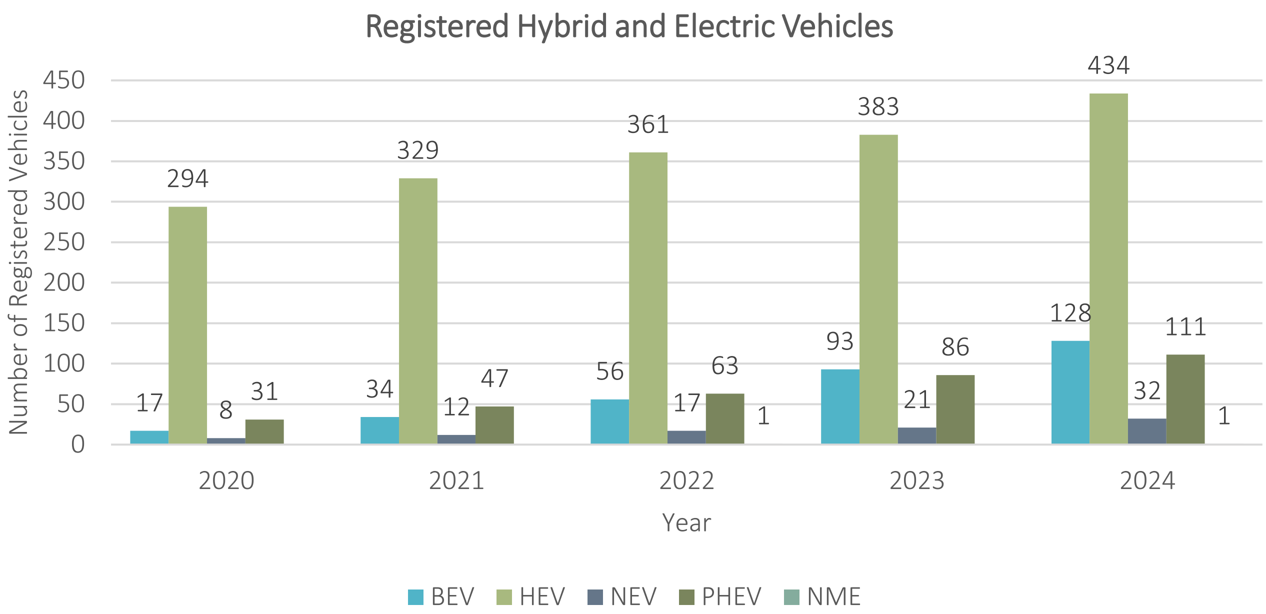

FIGURE 8. NUMBER OF ELECTRIC VEHICLES (EVS) AND PLUG-IN HYBRID ELECTRIC VEHICLES (PHEVS) REGISTERED IN THE TOWN OF KENNEBUNK BY YEAR. DATA OBTAINED FROM THE MDEP VEHICLE POPULATION AND GREENHOUSE GAS DATA PORTAL.

Number of public EV charging stations

Kennebunk's accessibility to EV drivers may be estimated based on the number of public EV charging stations. There are **8 public EV charging locations** in Kennebunk as of June 2025. These include:

- Kennebunk Service Plaza - North: pay per KWH level 3 chargers
- Kennebunk Service Plaza - South: pay per KWH level 3 chargers
- Inn at English Meadows (level 2, Tesla): $20 for non-guests
- Kennebunk Inn (level 2): guests only
- KKA Chamber of Commerce (level 2): Free
- Kennebunk Light & Power (level 2): Free
- Washington Hose Fire Station in Lower Village – behind the building (level 2): Free
- White Barn Inn (level 2, Tesla): guests only

Average commutes

The average commute of residents and local employees can help to track initiatives to improve workforce/affordable housing as well as remote work initiatives. According to the American Community Survey, the **5-year average commute for Kennebunk residents in 2022 was 28.3 minutes**. This is slightly higher than the Maine average commute of 24.7 minutes and the U.S. average commute of 26.7 minutes. While the average commute is a few minutes longer than in previous years, the increase is within the margin of error of the survey data.

Waste

Municipal solid waste disposal and wastewater treatment only account for 1.1% of Kennebunk's emissions. However, reducing, reusing, and recycling waste are vital strategies for reducing or avoiding emissions from the consumption of goods and foods which have impacts beyond Kennebunk's waste sector of the GHG inventory. Indicators for waste management can help Kennebunk track efforts to reduce consumption and increase waste diversion.

Percentage of Municipal Solid Waste recycled

Recycling prevents waste from entering the landfill and reduces the production of new materials. The materials Kennebunk recycled in 2022 are in Table 11. When combined with the MSW collected curbside and at the Sea Road Transfer Station, Kennebunk created 1,966.7 tons of waste (excluding compost). Based on these estimates, **29% of Kennebunk's non-composted waste was sent to be recycled.** Household recyclables appear to make up only a small fraction of the recycled materials.

TABLE 11. MATERIALS RECYCLED IN KENNEBUNK IN FY 2022.

Material	Amount recycled (tons)
Mixed recyclables	19.9
Cardboard	30.8
White Goods/Metals	127
Asphalt Shingles	49.8
Ferrous Metals	128
Rocks, soil concretes, and bricks	233.4
TOTAL	**578.9**

Composting programs

Composting is an effective way to eliminate waste, and in particular food waste, from the MSW stream. There is currently no curbside composting service offered in Kennebunk. The town does offer kitchen composting at the Sea Road Transfer station and run by Agri-Cycle in conjunction with CPRC (the operators of the Town's Transfer Station).

Conclusion

The Town of Kennebunk's GHG inventory report summarizes the ongoing activities and the major sources of emissions in the community and how they have changed between 2018 and 2022. Community-wide emissions were estimated as 175,527 MT CO_2e, equivalent to 40,943 passenger cars driven for one year or 406,382 barrels of oil consumed.[10] From 2018 to 2022, Kennebunk's community-wide emissions increased 2.12%. This increase is driven by increases in on-road transportation emissions. The waste and residential sectors saw very small decreases in emissions over this period. In Kennebunk's CAP, the town set a goal to "strive to meet the Maine Climate Council's goal of 45% emissions reduction by 2030 and an 80% reduction by 2050." Based on this inventory, there is much work to be done for the Town to reach these goals.

Key takeaways from the GHG inventory can be used to prioritize future climate action efforts. These key takeaways include:

1. Despite small increases in fuel efficiency, increased vehicle travel to, from, and within Kennebunk resulted in more emissions from on-road transportation.

Transportation emissions make up the majority (59.15%) of Kennebunk's community-wide emissions. While national fuel efficiency increased slightly from 2018 to 2020, an 8.4% increase in vehicle-miles-travelled attributed to Kennebunk because of trips to and from the town resulted in an overall increase in emissions. Kennebunk has made strides in increasing EV and hybrid vehicle adoption in the community; however, these vehicles still make up only a small percentage (4% combined) of the vehicles belonging to the town's residents, businesses, and visitors. This suggests that promoting alternatives to single-passenger vehicle trips, encouraging EV adoption and making Kennebunk friendly to visiting EVs are paramount for meaningful reductions in Kennebunk's GHG emissions.

2. Kennebunk's residential energy use is staying relatively stable, despite increases in housing units.

From 2018 to 2022, total residential energy use stayed approximately the same. The residential stationary emissions data show that decreases in heating oil use were offset by increases in electricity usage and propane emissions. During this period, the number of estimated households in Kennebunk increased by 170 households from 4,966 to 5,136[11]. This aligns with our understanding in Maine that while homes primarily heated with heating oil are making the switch to heat pumps, new homes continue to be built with propane heating systems. To reduce residential emissions, Kennebunk should consider strategies to both increase fuel switching and encourage new homes to be built with heat pumps rather than propane heating systems. While new homes tend to be more energy efficient, weatherization of existing homes remains an important strategy for reducing home heating emissions.

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[10] US Environmental Protection Agency, Greenhouse Gas Equivalencies Calculator. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[11] American Community Survey 5-year estimates

3. Kennebunk's per household electricity usage is increasing.

Between 2016 and 2023, Kennebunk's per household electricity usage increased at a rate of 260 kwh per year. Some of this increase could be due to the electrification of heating and other appliances as well as the charging of electric vehicles at home. Increases in electricity use could also be due to increased air conditioning usage during the summer months. While it is expected that household electricity usage will go up as the community electrifies, efforts to reduce electricity use through energy efficiency measures (i.e., weatherization, smart thermostats, reducing plug load) will help reduce emissions overall and have the co-benefit of reducing strain on the electric grid.

4. Kennebunk's growth is putting pressure on emissions reduction efforts.

Between 2018 and 2022, Kennebunk saw increases in number of households, number of commercial/industrial establishments, and vehicle-miles-travelled from trips to, from, and within Kennebunk. Each new building or vehicle trip increases the number of emissions-causing activities in the Town, which can counter efforts to reduce emissions from already present buildings and vehicles. This highlights how efforts to reduce emissions should take into account future development and growth and ensure that future growth is aligned with the community's energy priorities.

5. The energy used by Kennebunk residents, visitors, and business for transportation and building heating/electricity make up over 98% of Kennebunk's GHG inventory

There is no single strategy that will address the majority of Kennebunk's GHG emissions. However, strategies targeting Kennebunk's buildings and the vehicles on its roads will have a significant impact. These strategies should consider the energy use of not just Kennebunk's residents, but its businesses and visitors as well.

6. Alternative indicators can be used to identify other strategies to reduce emissions that are not captured in the inventory.

Because it is difficult to quantify the specific impact of many mitigation efforts (especially activities like education, community building, and environmental justice initiatives), alternative indicators may be used to develop emissions reduction initiatives and set measurable goals without the need to quantify their impact in MT CO_2e. Areas to consider for additional alternative indicators and associated strategies include:

- Private EV charging stations (using data from code enforcement)
- Business waste management practices (using a survey of businesses)
- Number and attendance of public engagement events on climate or energy topics (through event tracking)

7. Future GHG inventories can be used to evaluate Kennebunk's progress on emissions reduction efforts.

Ongoing GHG inventories will help Kennebunk assess progress toward its emissions reductions goals and as well as evaluate and prioritize specific strategies in the Kennebunk CAP. Subsequent inventories may be conducted every 4-5 years to continue to monitor progress on climate action. Appendix B includes a list of recommendations to improve the quality of a future GHG inventory.

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Appendix A – Community-wide GHG inventory data table

ClearPath Inventory Record	ClearPath Calculator Used	ClearPath Category	Record time period	Sector	Subsector	End use	Scope	CO2 (MT)	CH4 (MT)	N2O (MT)	CO2e (MT)	Data Quality	Notes
Wastewater - Electricity - pumping stations	Emissions from Wastewater Treatment Energy Use (USCP Recommended)	Water & Wastewater	CY 2022	Waste	Wastewater	Electricity	Scope 2	59.64	0.01	0.00	60.07	High	Electricity used for pumping stations for wastewater treatment in 2022. Data supplied by the Town of Kennebunk.
Wastewater - Electricity - WWTP	Emissions from Wastewater Treatment Energy Use (USCP Recommended)	Water & Wastewater	CY 2022	Waste	Wastewater	Electricity	Scope 3	195.05	0.02	0.00	196.47	High	Electricity used by SDP for wastewater treatment in 2022. Data supplied by Town of Kennebunk.
Wastewater - fugitive emissions - septic systems	Fugitive Emissions from Septic Systems	Water & Wastewater	CY 2022	Waste	Wastewater	Septic Tank Emissions	Scope 1	0.00	23.53	0.00	658.95	Low	Emissions calculated based on estimate of population served by septic systems in Kennebunk. According to Kennebunk 2022 Comp. Plan, 52% of Kennebunk households are served by the Kennebunk WWTP, making 48% served by septic. Used ACS 2022 5-year estimates of the number of households and average household size to estimate population served by septic.
Wastewater - Sewer District Process N2O Emissions	Process N2O Emissions from Wastewater Treatment (USCP Recommended)	Water & Wastewater	CY 2022	Waste	Wastewater	Process Emissions	Scope 1	0.00	0.00	0.02	5.89	Low	Emissions calculated based on estimate of population served by the Sewer District in Kennebunk. Population served, industrial-commercial discharge multiplier, and details about the facility were provided by the Town of Kennebunk
Wastewater - Sewer District Process N2O From Effluent Discharge	Process N2O from Effluent Discharge to River, Ocean, or Deep Well Injection (USCP Recommended, where applicable)	Water & Wastewater	CY 2022	Waste	Wastewater	Effluent Discharge Emissions	Scope 1	0.00	0.00	0.43	113.53	Low	Emissions calculated based on estimate of population served by the Sewer District in Kennebunk. Population served, industrial-commercial discharge multiplier, and details about the facility were provided by the Town of Kennebunk
Residential - electricity - CMP & KLPD combined	Emissions from Grid Electricity (USCP Required)	Residential Energy	CY 2022	Stationary Energy	Residential	Electricity	Scope 2	16336.81	1.92	0.24	16455.11	High	2022 electricity usage data provided by Central Maine Power and Kennebunk Light and Power District.
Residential - Stationary energy - natural gas	Emissions from Stationary Fuel Combustion (USCP Required)	Residential Energy	CY 2022	Stationary Energy	Residential	Natural Gas	Scope 1	40.04	0.00	0.00	40.17	High	2022 natural gas usage data provided by Unitil.
Residential - Stationary energy - no. 2 fuel oil	Emissions from Stationary Fuel Combustion (USCP Required)	Residential Energy	CY 2022	Stationary Energy	Residential	Fuel Oil	Scope 1	19197.05	2.82	0.19	19325.89	Low	Estimated using EIA Table C5. Residential Sector Energy Consumption Estimates, 2022 and ACS home heating fuel estimates for the 2022 5-year average for Maine and the Town of Kennebunk.
Residential - Stationary energy - wood	Emissions from Stationary Fuel Combustion (USCP Required)	Residential Energy	CY 2022	Stationary Energy	Residential	Wood	Scope 1	0.00	17.13	0.23	539.93	Low	Estimated using EIA Table C5. Residential Sector Energy Consumption Estimates, 2022 and ACS home heating fuel estimates for the 2022 5-year average for Maine and the Town of Kennebunk.

Residential - Stationary energy - propane	Emissions from Stationary Fuel Combustion (USCP Required)	Residential Energy	CY 2022	Stationary Energy	Residential	Propane	Scope 1	5901.12	1.06	0.11	5958.63	Low	Estimated using EIA Table C5. Residential Sector Energy Consumption Estimates, 2022 and ACS home heating fuel estimates for the 2022 5-year average for Maine and the Town of Kennebunk.
Commercial - Electric - CMP & KLPD Public Service/Street and Area Lighting	Emissions from Grid Electricity (USCP Required)	Commercial Energy	CY 2022	Stationary Energy	Commercial	Electricity	Scope 2	1238.83	0.15	0.02	1247.80	High	2022 electricity usage data provided by Central Maine Power and Kennebunk Light and Power District.
Commercial - Electric - CMP & KLPD Commercial Buildings	Emissions from Grid Electricity (USCP Required)	Commercial Energy	CY 2022	Stationary Energy	Commercial	Electricity	Scope 2	7877.70	0.93	0.12	7934.74	High	2022 electricity usage data provided by Central Maine Power and Kennebunk Light and Power District.
Commercial and Industrial - Stationary fuel - natural gas	Emissions from Stationary Fuel Combustion (USCP Required)	Commercial Energy	CY 2022	Stationary Energy	Commercial	Natural Gas	Scope 1	1874.94	0.18	0.00	1880.82	High	2022 natural gas usage data provided by Unitil.
Commercial and industrial - stationary fuel - no 2. fuel oil	Emissions from Stationary Fuel Combustion (USCP Required)	Commercial Energy	CY 2022	Stationary Energy	Commercial	Discrete Fuel	Scope 1	8042.20	1.18	0.08	8096.17	Low	Calculated discrete fuel use for commercial and industrial users in Kennebunkport for 2022. Assumed all C/I customers heat with fuel oil, which does not accurately account for buildings using propane for heating or cooking.
Transportation - passenger vehicles - all fuels	On Road Transportation (USCP Required)	Transportation & Mobile Sources	CY 2022	Transportation	On-road Transportation	Gasoline and Diesel	Scope 1 and 2	72132.21	3.08	0.62	72381.53	Medium	Calculated using SMPDC's On-road transportation emissions methodology for Kennebunk using 2022 data.
Transportation - commercial vehicles - all fuels	On Road Transportation (USCP Required)	Transportation & Mobile Sources	CY 2022	Transportation	On-road Transportation	Gasoline and Diesel	Scope 1 and 2	29722.50	1.22	0.24	29821.12	Medium	Calculated using SMPDC's On-road transportation emissions methodology for Kennebunk using 2022 data.
Transportation - buses and public transit - all fuels	On Road Transportation (USCP Required)	Transportation & Mobile Sources	CY 2022	Transportation	On-road Transportation	Gasoline and Diesel	Scope 1 and 2	1616.39	0.07	0.01	1621.77	Medium	Calculated using SMPDC's On-road transportation emissions methodology for Kennebunk using 2022 data.
Solid Waste - compost - yard waste	Biologic Treatment of Solid Waste (Composting)	Solid Waste	CY 2022	Waste	Solid Waste	Compost emissions	Scope 3	0.00	1.36	0.02	43.70	Medium	Based on Jan 2022-Dec 2022 data from Transfer station Annual DEP report.
Solid waste - MSW - FY 2022	Landfilled Waste (USCP Required, Preferred, where applicable)	Solid Waste	FY 2022	Waste	Solid Waste	Landfill Emissions	Scope 3	0.00	32.38	0.00	906.51	Medium	Data provided by the town of Kennebunk for MSW collected curbside and at 36 Sea Rd. Transfer station. used FY 2022 data as this is the way it is tracked by the Town.
Industrial - Electric - CMP & KLPD Industrial Buildings	Emissions from Grid Electricity (USCP Required)	Industrial Energy	CY 2022	Stationary Energy	Industrial	Electricity	Scope 2	6534.69	0.77	0.10	6582.01	High	2022 electricity usage data provided by Central Maine Power and Kennebunk Light and Power District.
Upstream impacts - Electricity- T&D Losses CMP & KLPD	Emissions from Electric Power Transmission and Distribution Losses	Upstream Impacts	CY 2022	Stationary Energy	Upstream Impacts	Electricity	Scope 3	1644.38	0.19	0.02	1656.29	Medium	2022 electricity usage data provided by Central Maine Power and Kennebunk Light and Power District.

Appendix B – Recommendations to improve the GHG inventory

A future GHG inventory in three - five years may be used to evaluate Kennebunk's progress on emissions reductions efforts and toward identified goals. The following is a list of recommendations to improve the quality of a future GHG inventory:

Community-wide GHG inventory

- Survey residents to get a better estimate of annual discrete fuel use for home heating and other purposes (Stationary Energy – Residential Discrete Fuel Use).
- Survey businesses to get a better estimate of annual discrete fuel use for building heating and other purposes (Stationary Energy – Commercial and Industrial Discrete Fuel Use).
- Survey residents to get an estimate of annual air travel (Transportation – Aviation).
- Survey businesses about their waste volumes and management practices to improve estimates of MSW.
- Consider using ICLEI LEARN tool or other method to estimate emissions and sequestration of GHG from land use changes (Agriculture, Forestry, Marine – Land).
- Collect data on more *Additional Indicators of Climate Action*, including:
    - Hours of use of public EV charging stations (using data from EV charging station providers)
    - Number of private EV charging stations (using data from code enforcement)
    - Number of residents composting at home (using a survey)
    - Reuse economy statistics (using data from re-use businesses)
    - Business waste management practices (using a survey of businesses)