GREENHOUSE GAS INVENTORY

Town of Topsham

Prepared by Midcoast Council of Governments

December 2024

Contents

Executive Summary

The Greenhouse Gas (GHG) Inventory for the Town of Topsham provides an overview of the town's emissions sources. The inventory was conducted to support the community's climate action plan update. This report breaks down emissions into three major categories: stationary energy, transportation, and waste, with transportation and energy use in buildings being the largest contributors.

Topsham's total community-wide emissions are estimated at 108,080 metric tons of CO2e (carbon dioxide equivalent) annually. Stationary energy, which includes energy used in homes, businesses, and industrial facilities, accounts for 49.5% of emissions. Transportation, including emissions from passenger and commercial vehicles, represents 48.1%, while waste management contributes a smaller amount, at 2.3%. The report provides detailed insights into the types of energy used, such as electricity, natural gas, and fuel oil, and their relative contributions to overall emissions.

The inventory also analyzed the town's municipal operations, which produce approximately 748 metric tons of CO2e annually. The municipal vehicle fleet, particularly the Public Works and Police Departments, is the largest source of emissions, followed by energy use in municipal buildings.

Introduction

Greenhouse gases, such as carbon dioxide, methane, nitrous oxide, and fluorinated gases, trap heat in the Earth's atmosphere, keeping it warm enough to support life. However, activities like burning fossil fuels, agriculture, and industrial processes have increased these gases, contributing to climate change. A greenhouse gas (GHG) inventory is a detailed count of the GHG emissions from various activities within an area or organization. This type of inventory is crucial for identifying where emissions are highest and tracking progress over time. It gives us the data needed to make smart decisions on how to reduce emissions effectively. By participating in this effort, the Topsham community can ensure that our town remains resilient, our environment stays healthy, and we can enjoy the benefits of a more sustainable future.

Conducting a GHG inventory strengthens the community by highlighting ways of improving health and the environment through better air quality, making us more resilient to climate change impacts, and saving money by using less energy. It brings people together, as residents and businesses work towards common sustainability goals. Additionally, it boosts the local economy by attracting green businesses and creating jobs, promotes sustainable practices, and builds a positive reputation. Overall, the community becomes more vibrant, healthy, and economically strong.

Community-Wide Inventory

Overview

A community-wide Greenhouse Gas (GHG) inventory is a detailed report that measures the amount of gases, like carbon dioxide and methane, released into the air by different activities in a community as a whole. These activities include driving cars, using electricity in homes, commercial buildings, schools and government offices, managing waste, and industrial work. By tracking these emissions over a certain period, the inventory shows where most of the greenhouse gases are coming from.

Methodology

This inventory was done using Southern Maine Planning and Development Commission's Greenhouse Gas Inventory Protocol (SMPDC's Protocol) and ClearPath software for calculations. ClearPath is a comprehensive tool designed to help local governments measure and manage their GHG emissions. Developed by ICLEI - Local Governments for Sustainability USA, ClearPath aligns with international standards and protocols for GHG accounting, ensuring credible and comparable inventories and reports. See Appendix D – Community-Wide and Municipal GHG Inventory Data Tables for details.

Inventory

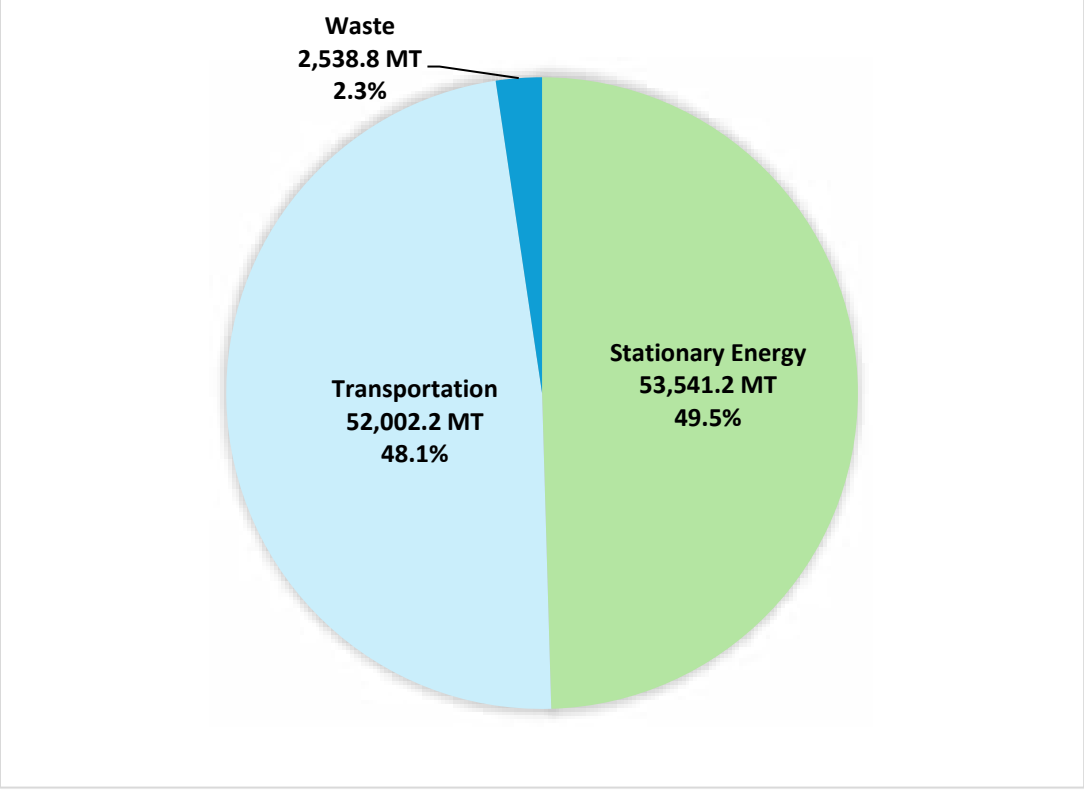
Summary

Topsham produces approximately 108,080 metric tons (MT) of greenhouse gases each year, measured in CO2 equivalent (CO2e). These emissions come from three main sources:

- Stationary Energy - energy used to power residential, commercial, governmental and industrial buildings and the activities that take place within them.
- Transportation - energy used to power passenger and commercial vehicles, school buses and public transportation.
- Waste - emissions from municipal solid waste, and wastewater treatment.

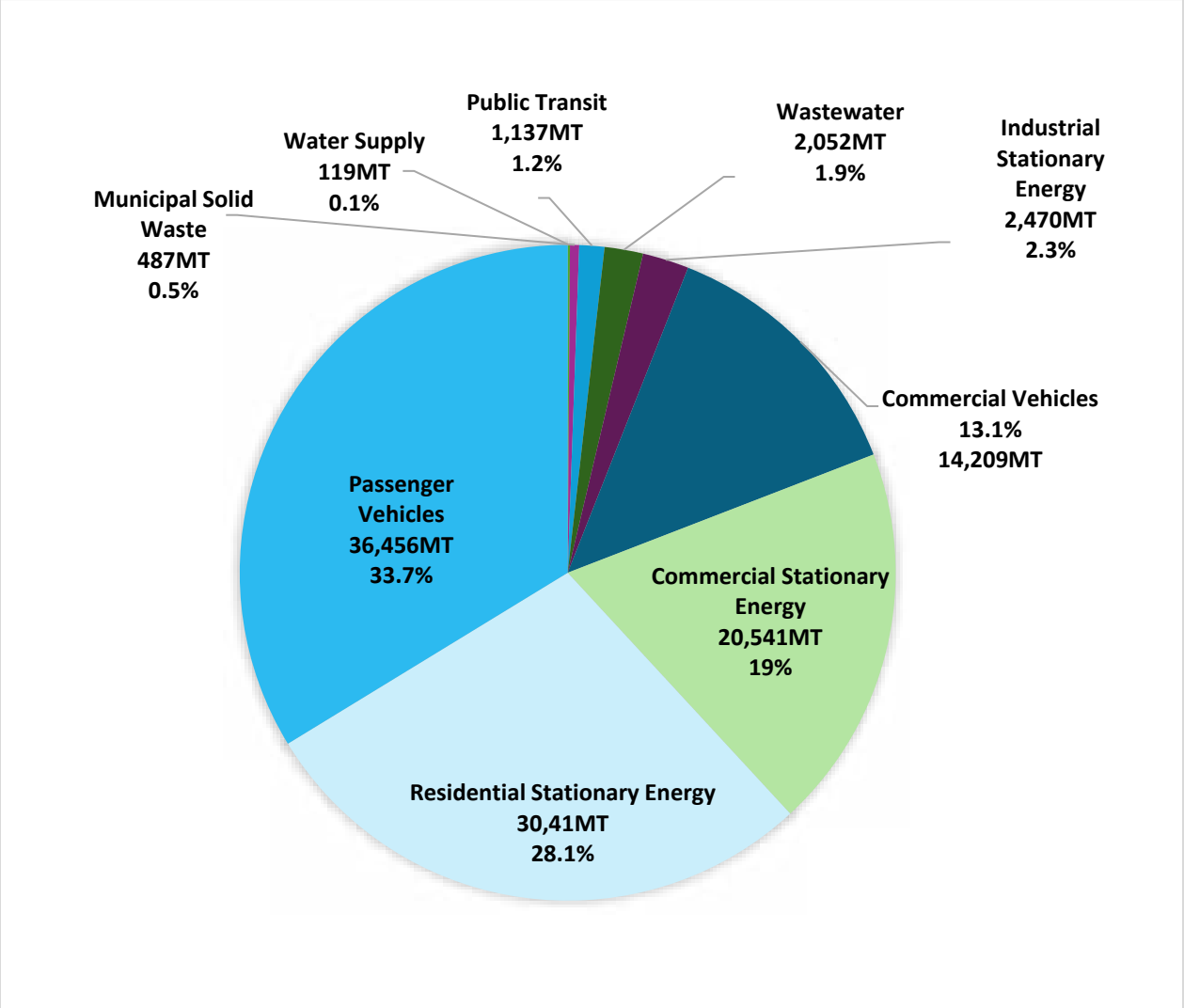
Figure 1 shows the percentages of CO2 equivalent (CO2e) emissions from each sector.

FIGURE 1: Community-Wide GHG Inventory Grouped by Sector
Total Community Wide CO2e: 108,080 MT



Each sector can be analyzed in greater detail by breaking them down into subsectors to identify the sources of emissions. Figure 2 below shows the breakdowns. The highest greenhouse gas emissions stem from residential energy use and passenger vehicles. These are followed by commercial energy use and commercial vehicles. Industrial energy use, wastewater treatment, municipal solid waste, and municipal water supply contribute comparatively smaller amounts of emissions.

Figure 2: Percentage of Emissions by subsector
Total Community Wide CO2e: 108,080 MT



Stationary Energy Use

In a GHG inventory, stationary energy use refers to the consumption of energy in fixed locations, such as buildings and facilities. This includes energy used for heating, cooling, lighting, and operating appliances and equipment. The emissions from stationary energy

use are typically categorized by the type of fuel consumed, such as electricity, natural gas, and “discrete fuels” including propane, fuel oil, and wood.

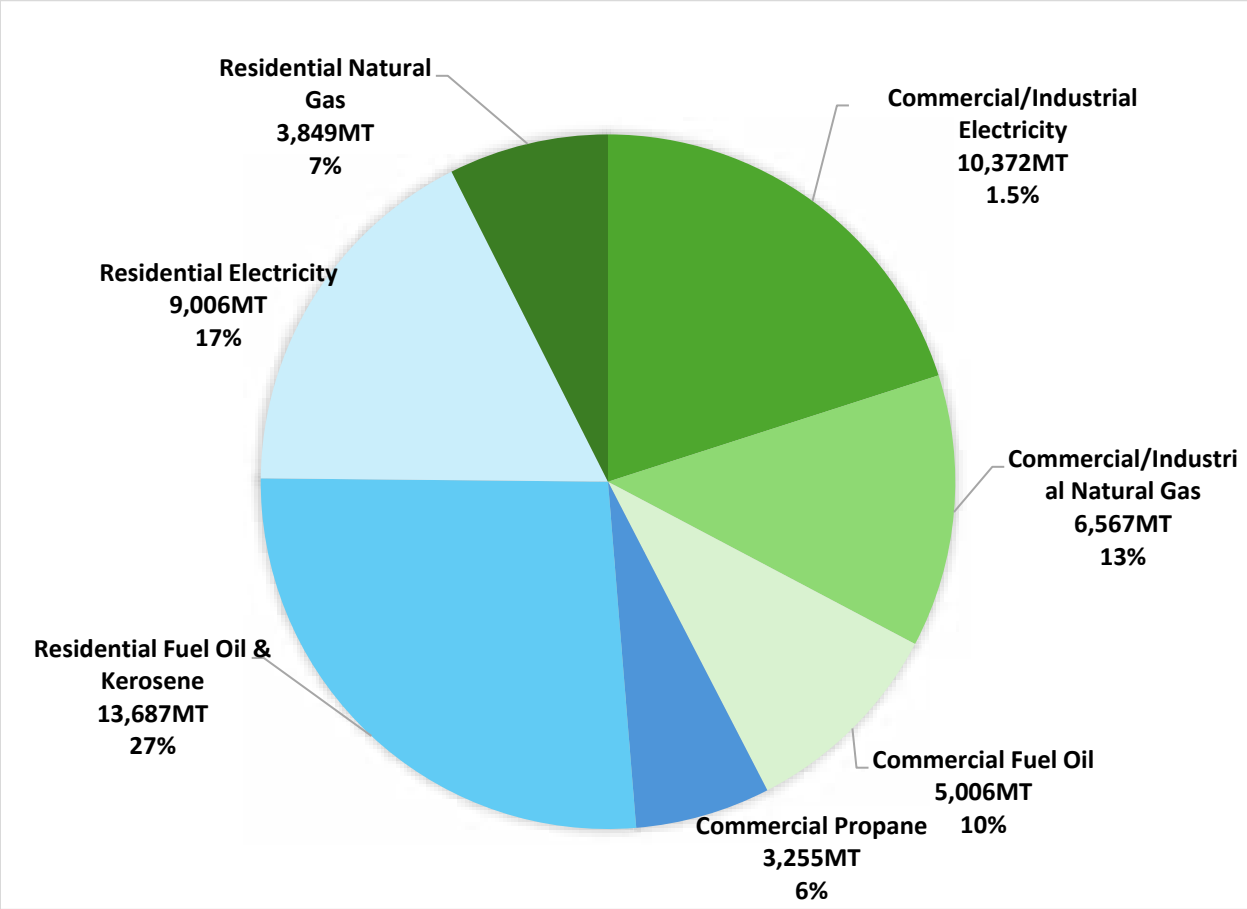
Table 1: Stationary Energy Subsectors, Sources, Energy Types and Data Sources

SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE	DATA SOURCE
Residential	Energy used in buildings, losses from distribution system	Electricity	Consumption data from Central Maine Power
		Natural Gas	Consumption data from Maine Natural Gas
	Energy used in buildings	Discrete Fuel	US Census Bureau
Commercial	Energy used in commercial, government and institutional buildings, and losses from distribution system	Electricity	Consumption data from Central Maine Power
		Natural Gas	Consumption data from Maine Natural Gas
		Discrete Fuel	US Census Bureau. Downscaled by commercial sector job count
Industrial	Energy used in manufacturing and industrial facilities and losses from distribution system	Electricity	Consumption data from Central Maine Power
		Natural Gas	Consumption data from Maine Natural Gas

Residential fuel oil and kerosine use contribute the highest percentage of Topsham’s stationary energy emissions.

Figure 3 below summarizes the greenhouse gas emissions from various types of stationary energy use. Residential fuel oil and kerosene account for the largest share of emissions at 25%. This is followed by commercial/industrial electricity at 19% residential electricity use at 16%. The other sources contribute smaller but significant portions to the overall stationary emissions.

Figure 3:Percentage of Stationary Energy Emissions by Type
Total Stationary Energy CO2e: 55,390 MT



Transportation

In a GHG inventory, transportation refers to the emissions generated by vehicles used for the movement of people and goods. This includes emissions from passenger vehicles, commercial vehicles, school buses and public transit systems. The transportation sector is a significant contributor to greenhouse gas emissions due to the combustion of fossil fuels in engines.

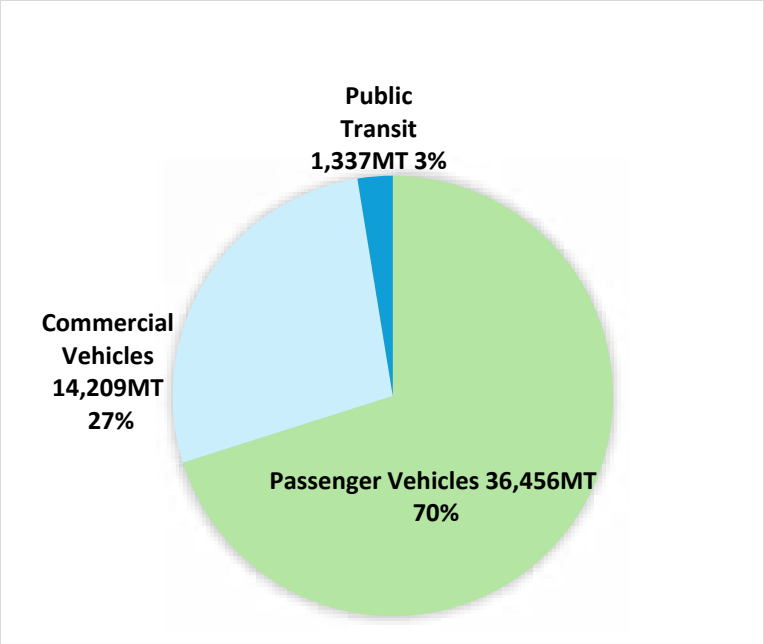
Passenger vehicles account for 70% of Topsham's transportation emissions.

Table 2: Transportation Subsectors, Sources, Energy Types and Data Sources

SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE	DATA SOURCE
Passenger Vehicles	Fuel combusted from all passenger vehicle trips within municipal boundary.	Gasoline, diesel	Maine Department of Transportation, Maine Department of Environmental county-level data downscaled by population.
Commercial Vehicles	Fuel combusted from all passenger vehicle trips within municipal boundary.	Gasoline, diesel	Maine Department of Transportation, Maine Department of Environmental Protection county-level data downscaled by population.
Public Transportation	Fuel combusted due to passenger miles traveled on school buses and public transportation	Gasoline, diesel	Maine Department of Transportation, Maine Department of Environmental Protection county-level data downscaled by population.

Figure 4 illustrates the distribution of greenhouse gas emissions from the transportation sector. Passenger vehicles are the dominant source, accounting for 70% of total transportation emissions. Commercial vehicles contribute 27%, while public transit systems make up a smaller portion at 3%.

Figure 4: Percentage of Transportation Emissions by Type
Total Transportation CO2e: 502,002 MT



Waste

In a GHG inventory, waste refers to emissions resulting from the management and disposal of various types of waste materials. This includes emissions from the treatment and handling of wastewater, as well as the decomposition of municipal solid waste in landfills. These emissions are typically measured as methane (CH4) and carbon dioxide (CO2) released during waste processing and decomposition.

Topsham's wastewater treatment processes (septic tanks, wastewater treatment facilities and effluent discharge) account for 81% of community waste emissions.

Table 3: Waste by Subsector, Emissions Sources, Energy Type and Data Source

SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE	DATA SOURCE
Municipal Solid Waste	Emissions resulting from landfilled waste	Landfilled[1] and flaring emissions[2]	Casella Waste Systems and downscaled data from Juniper Ridge Landfill
Wastewater - Septic	Emissions from Topsham septic systems	Aerobic and Anaerobic Digestion	Modeled emissions based on number of septic systems
Wastewater Treatment Plant	Emissions from wastewater processed from Topsham Sewer District	Aerobic and Anaerobic Digestion[3]	Brunswick Sewer District data downscaled by ratio of Topsham residents served to overall population served
Wastewater Effluent Discharge	Emissions from wastewater effluent discharge from Brunswick Sewer District	Aerobic and Anaerobic Digestion[4]	Brunswick Sewer District data downscaled by ratio of Topsham residents served to overall population served[5]

[1] Landfilled emissions include greenhouse gases released because of the decomposition of organic materials (like food scraps, paper, and yard waste) in the landfill used to dispose of Topsham's municipal solid waste. These emissions primarily occur over time as waste breaks down in anaerobic (low-oxygen) conditions typical in landfills.

[2] Flaring is done to convert methane into CO_2 through combustion. While CO_2 is still a greenhouse gas, it has a much lower global warming potential compared to methane. This process reduces the overall climate impact of the landfill gases.

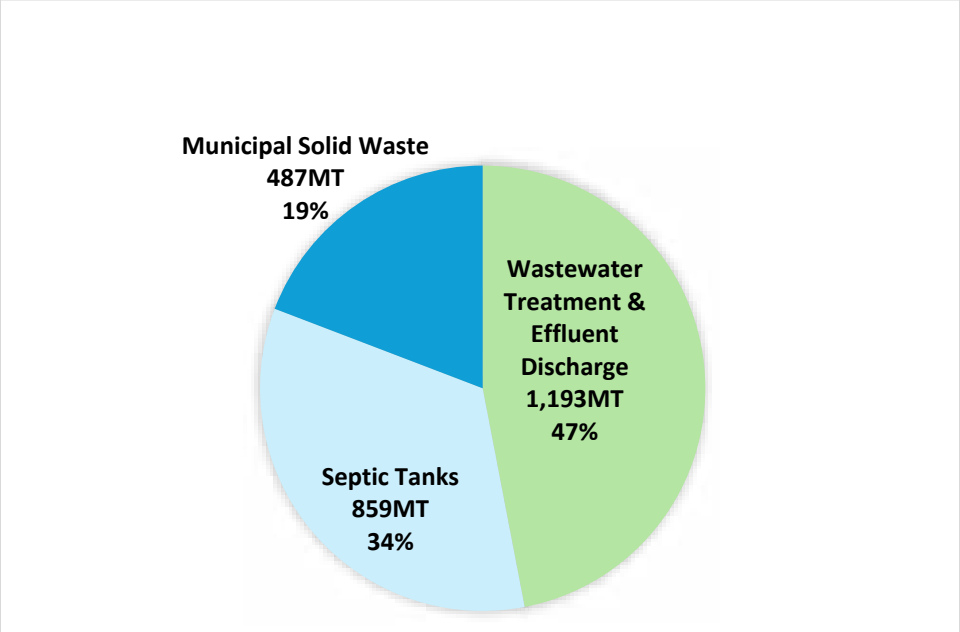
[3] Emissions occurring due to wastewater treatment in wastewater treatment lagoons.

[4] Effluent discharge refers to treated wastewater that flows from a treatment facility into waterways. Conventional wastewater treatment plants cannot remove all the nitrogen content from the wastewater. When nitrogen-containing effluent enters a natural watershed, indirect N_2O emissions can occur through side reactions. See SMPDC's Protocol under "Wastewater."

[5] Information from the Topsham Sewer District was not available.

Topsham's total CO2e from waste is 2,539 MT. Figure 5 shows the greenhouse gas emissions from different waste management subsectors. Wastewater treatment is the largest source, with nearly half coming from wastewater treatment and effluent discharge, while septic tanks account for 34%. Municipal solid waste accounts for 19% of the total.

Figure 5: Percentage of Waste Emissions by Type
Total Waste CO2e: 2,539 MT



Reducing household waste can help lower GHG emissions.

Municipal Inventory

Overview

Conducting a GHG inventory of a town's municipal operations offers several key benefits. It helps identify the main sources of emissions within government activities, such as energy use in buildings, vehicle fleets, and waste management. This information allows the town to implement targeted strategies to improve energy efficiency and reduce costs, leading to financial savings. The inventory also sets a positive example for the community, demonstrating the government's commitment to sustainability and encouraging broader community participation in environmental initiatives. Overall, it leads to a healthier, more sustainable, and economically efficient municipal operation.

Municipal greenhouse gas emissions refer to those directly from the operations and activities conducted by a municipal government. These emissions come from the following departments and facilities:

- Administration
- Public Works
- Solid Waste
- Fire Department
- Police Department
- Recreation
- Library

One significant emissions source is the energy use in municipal buildings and facilities, which includes emissions from consuming electricity, natural gas, heating oil, and other fuels for heating, cooling, and powering these buildings. Another major source of municipal GHG emissions is the municipal vehicle fleet, which consists of fuel combustion in vehicles owned and operated by the local government, such as cars, trucks, and specialized equipment like fire engines and maintenance vehicles. Additionally, emissions come from street lighting, traffic signals, and recreational field lights, which consume energy for public lighting and traffic control systems.

By understanding and managing GHG emissions, municipal governments can develop effective strategies to reduce their carbon footprint and promote sustainability within the community. By tracking and reporting these emissions, municipalities can identify key areas for energy efficiency improvements, renewable energy adoption, and other strategies to reduce their carbon footprint and contribute to broader climate action goals.

Note: Community solid waste disposal, municipal water/wastewater and school-related emissions were calculated under the Community-Wide Inventory because these entities are not operated by Topsham’s municipal government.

Methodology

The methodology used for the community-wide inventory was adapted to estimate municipal GHG emissions. It included activities directly controlled by the municipal government. Activities outside of the town's direct control, such as schools, water supply, and wastewater treatment facilities, which operate under their own oversight bodies, were not included. This approach was chosen to focus on actions the town government could take to improve energy efficiency, save taxpayer dollars, and lower GHG emissions.

Inventory

Summary

Topsham's total municipal GHG emissions are approximately 748 MT per year. Similarly to community-wide GHG emissions, Topsham's municipal emissions are almost evenly split between the stationary energy sector (53%) and transportation sector (47%).

FIGURE 6: Topsham Municipal GHG Inventory Grouped by Sector
Total Municipal CO2e: 748 MT

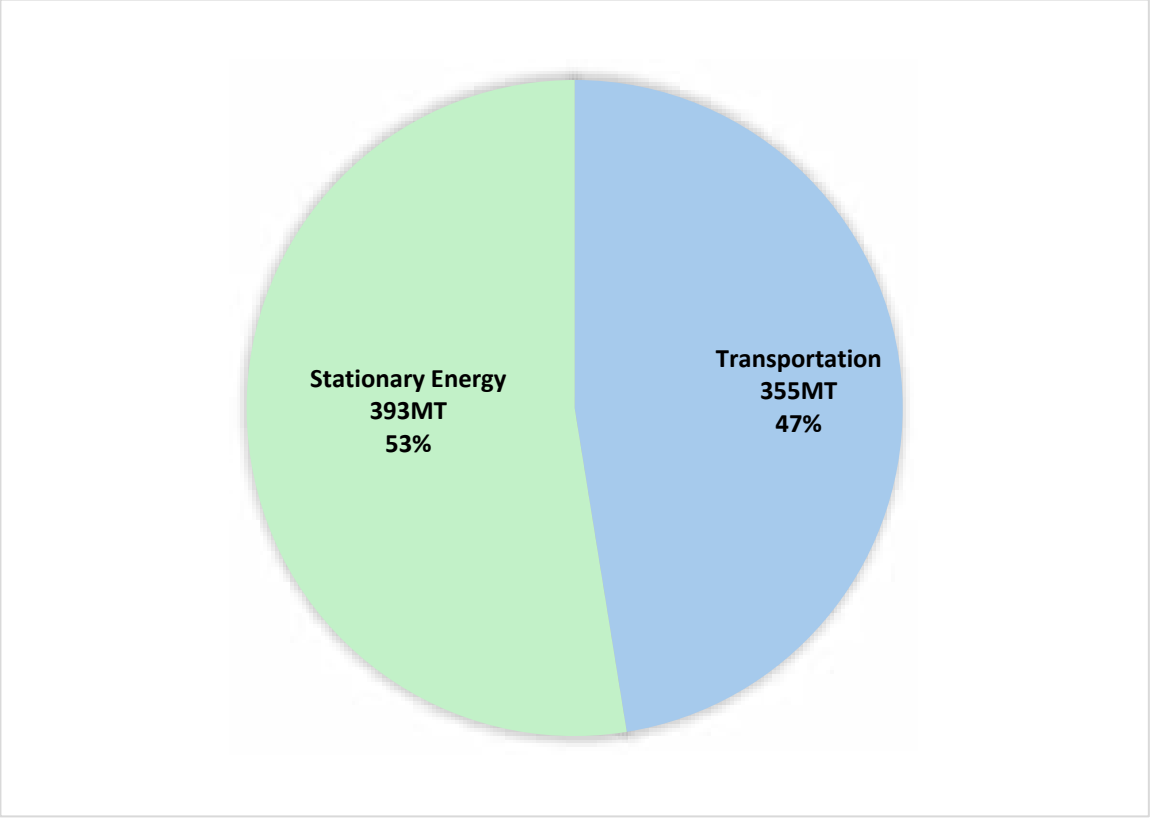
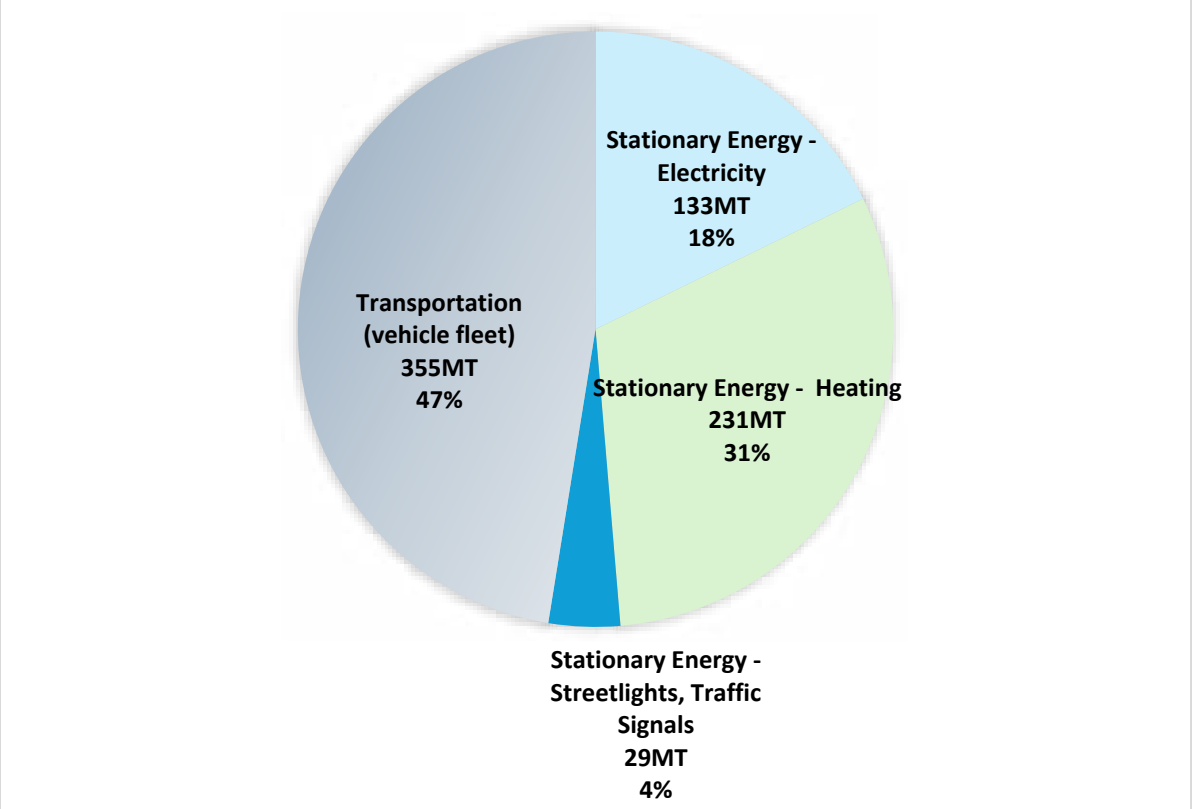


Table 4: Municipal Subsector, Emissions Sources, Energy Type and Data Source

SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE	DATA SOURCE
Stationary Energy	Energy used in buildings and facilities including town offices, fire station, police station, parks and recreation facilities and public works facilities	Electricity	Consumption data from vendor invoices
		Natural Gas	Consumption data from vendor invoices
		Discrete Fuels	Consumption data from vendor invoices
	Energy used in town street lighting and traffic signals	Electricity	Consumption data from Central Maine Power
Transportation	Fuel combusted by municipally owned vehicles	Gasoline, diesel	Consumption data from vendor invoices

The breakdown of Topsham's Municipal GHG inventory is shown in Figure 7. The town's vehicle fleet was responsible for the most emissions (47%), followed by stationary energy consumption for heating (31%) and stationary energy consumption for electricity (18%). Stationary energy to power streetlights and traffic lights contributes 4%.

FIGURE 7: Topsham Municipal GHG Inventory Grouped by Sector
Total Municipal CO2e: 748 MT

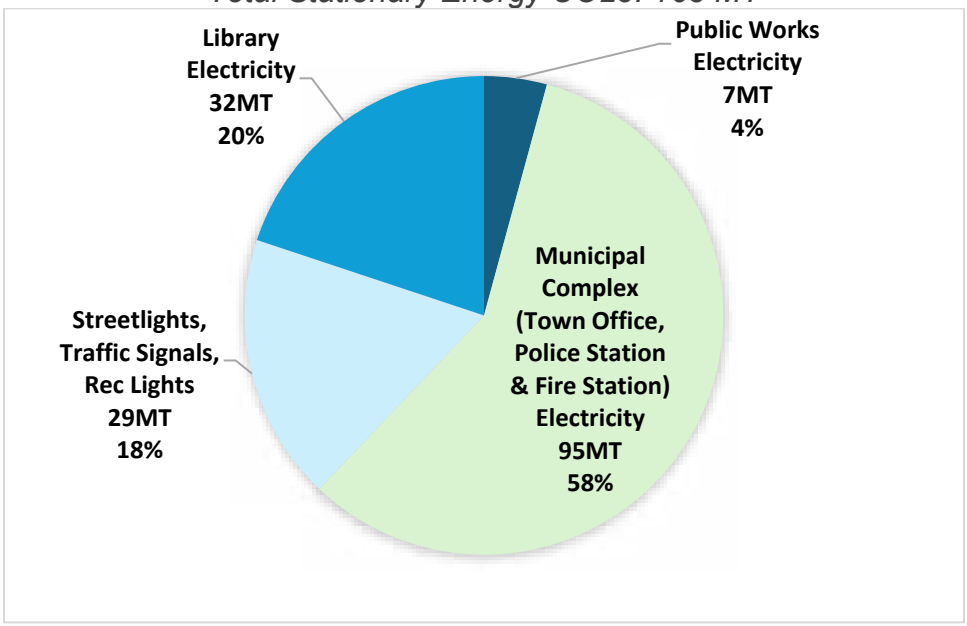


Topsham's municipal office complex includes the town office, fire station and police station.

Stationary Energy

Municipal electricity use emits 163 metric tons of CO2 per year. The Municipal Complex (town office, police station and fire station) generates the most GHG as shown in Figure 8.

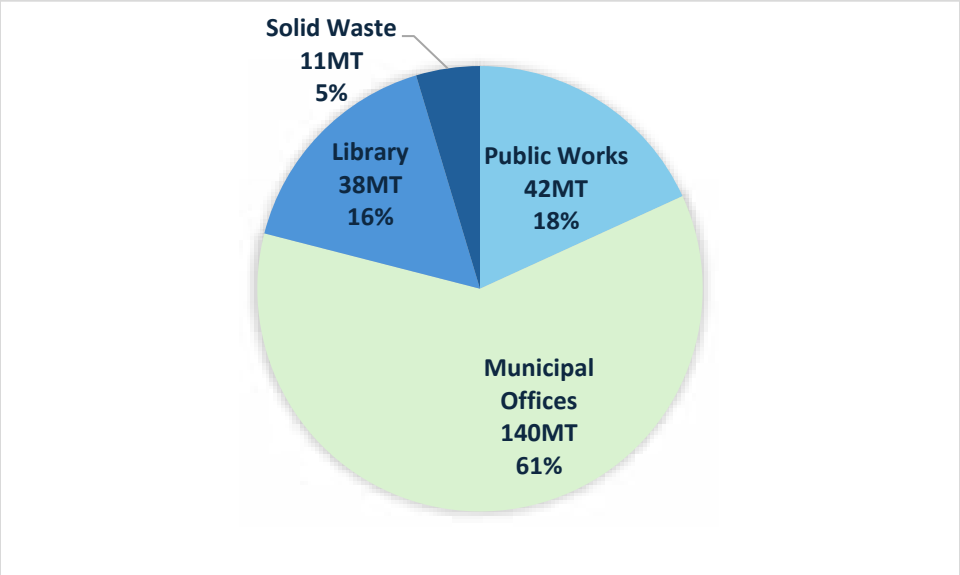
FIGURE 8: Percentage of Electricity Emissions Use by Facility/Department
Total Stationary Energy CO2e: 163 MT



The Town of Topsham has a power purchase agreement (PPA) with a solar farm located in Skowhegan. While this PPA does not eliminate the town's electrical emissions under the current methodology because Renewable Energy Credits are not retained under the agreement, it still offers important benefits. A PPA increases demand for solar electricity and supports the growth of clean energy, which speeds up the move to a cleaner energy system. The financial savings from the PPA also lowers municipal energy costs.

Another way to look at the municipal data is to look at emissions from heating and cooling systems as show in Figure 9. Again, the municipal offices are the largest source (61%), followed by public works (18%), the library (16%) and Solid Waste (5%).

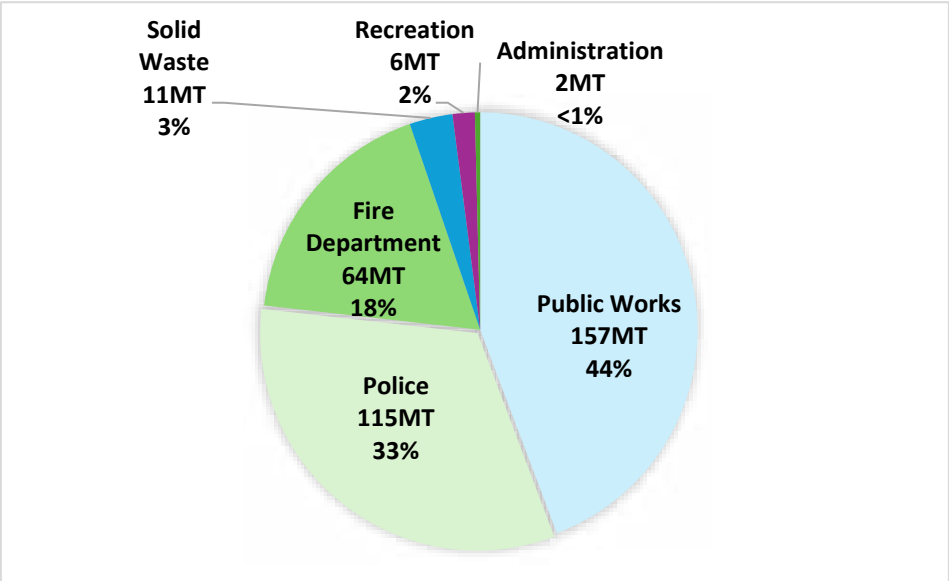
FIGURE 9: Percentage of Heating and Cooling Emissions by Facility/Department
Total Heating and Cooling CO2e: 231 MT



Transportation

Municipal vehicles emit 355 metric tons of CO2e per year. The Public Works department generates the largest share (44%) followed by the police department (33%) and Fire Department (18%) as shown in Figure 10.

FIGURE 10: Percentage of Vehicle Emissions by Department
Total Municipal Transportation CO2e: 355 MT



Conclusions

The GHG inventory for Topsham provides a comprehensive overview of the town's emissions sources, offering a valuable foundation for the development of a climate action plan. By identifying these primary sources of emissions, the town can target actions that are likely to yield the most significant impact in reducing its carbon footprint.

Using this data, the climate action plan can establish measurable goals for reducing emissions over time. Setting specific targets for reductions in each sector provides a clear path for progress. The inventory also enables tracking and reporting on these goals, helping the community monitor progress and adjust strategies as needed.

In addition, this data facilitates decision-making about future policies and strategies. The insights gained from the GHG inventory empower stakeholders to evaluate various options, prioritize actions, and develop policies that align with Topsham's sustainability goals. As a result, the community can make informed choices about investments in infrastructure, renewable energy, and transportation, ensuring that policies are effective in reducing emissions while supporting long-term resilience and sustainability.

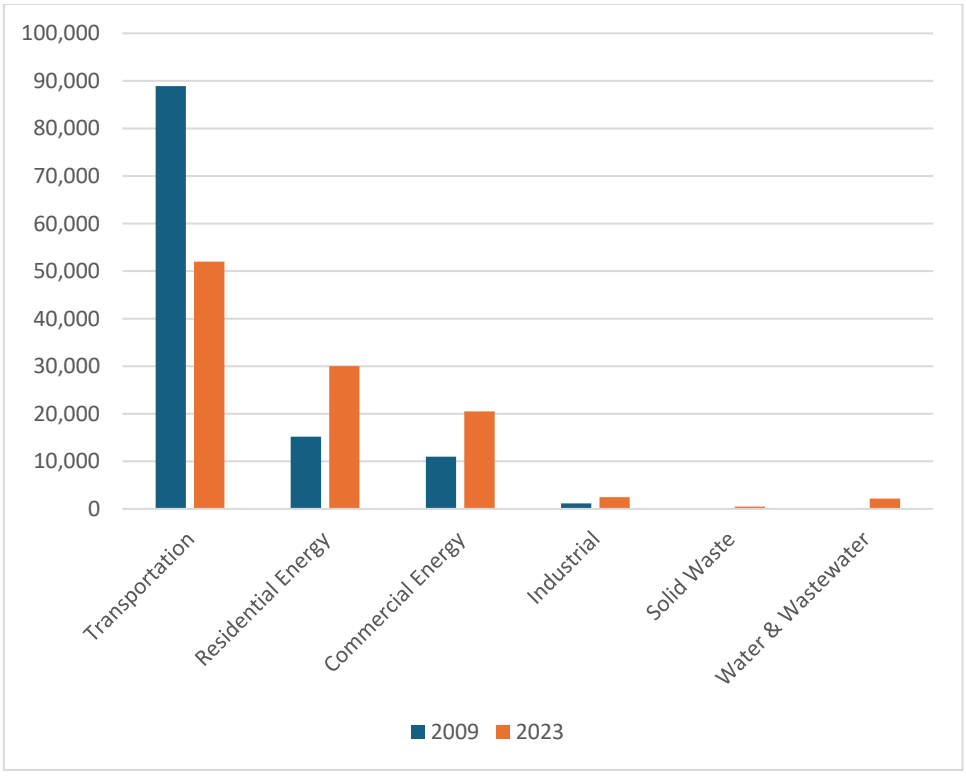
Appendix A –2009 Greenhouse Gas Inventory Comparison

Community-Wide GHG Inventory:

A GHG inventory was done for the baseline year of 2009 as part of Topsham's Climate Action Plan. The 2009 inventory showed total emissions 125,970 tons of CO2e. In 2023, total community emissions are estimated to be 108,080 tons CO2e, or a decrease of approximately 14%.

However, when comparing the two inventories by sector, the differences point to likely differences in the methodology and data used to calculate emissions instead of in actual CO2e differences. For example, Figure 1 shows a comparison by sector. The decrease in transportation emissions is likely due to differences in data gathering rather than a decrease in GHG emissions. Similarly, the increases in energy consumption may also be due to the data included in the methodology used for each inventory. Therefore, a direct "apples-to-apples" comparison is not possible.

FIGURE 1: 2009 and 2023 Community-Wide Emissions Comparison by Sector



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Municipal Comparison

The municipal GHG inventory showed a significant decrease between 2009 and 2023. While differences in data included in the inventory contributed to this reduction (the 2009 municipal inventory included schools and sewer and water districts which were covered in the community-wide inventory under the 2021 protocol), the town has also made substantial efforts to increase energy efficiency. The municipal government has implemented various measures, such as upgrading to LED lighting, improving heating systems, piloting the use of a hybrid electric vehicle and purchasing electric equipment. Figure 2 and Figure 3 show how these actions have impacted GHG emissions.

FIGURE 2: 2009 and 2023 Municipal GHG Emissions Comparison by Sector

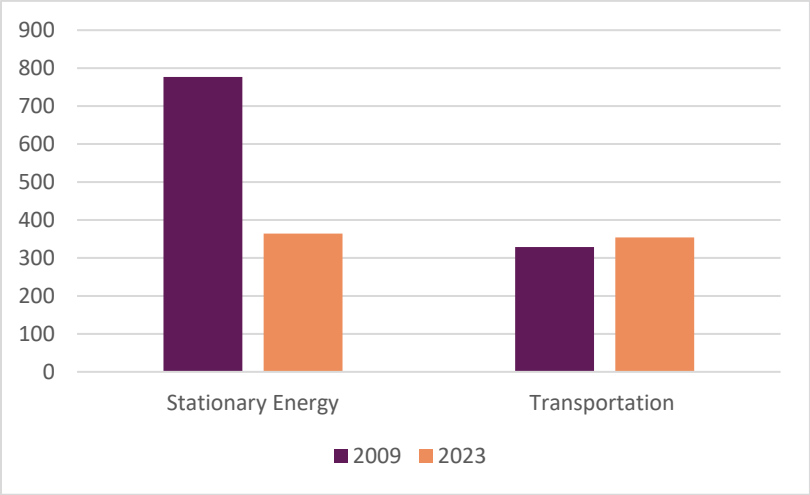
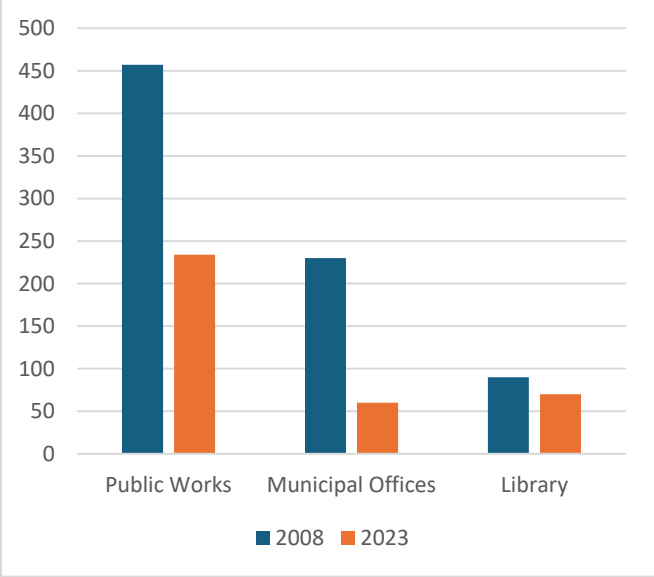


FIGURE 3: 2009 and 2023 Municipal GHG Emissions Comparison by Department/facility



There is another factor worth highlighting which may account for some of the decrease in municipal emissions: the grid transition to clean energy. In Maine, the increase in solar electricity generation has helped lower greenhouse gas (GHG) emissions by replacing fossil fuel-based electricity sources, such as natural gas and oil, with clean, renewable energy. Solar panels convert sunlight into electricity without burning fuel or releasing emissions, reducing the demand for conventional power plants that emit carbon dioxide (CO2) and other pollutants. As more solar installations are connected to the grid, the overall carbon intensity of electricity decreases, helping the state transition to a cleaner energy mix and reducing its contribution to climate change

Conclusion

In conclusion, Appendix A highlights the comparison between the 2009 and 2023 greenhouse gas (GHG) inventories for the Town of Topsham. While the overall reduction in emissions is notable, with a decrease of approximately 14%, the comparison reveals that much of the difference in emissions may be attributed to changes in data collection methodologies rather than actual reductions in emissions.

Key differences include the exclusion of certain facilities in the 2023 inventory that were included in 2009, such as schools and sewer and water districts, which were included in the community-wide inventory because the municipal government does not have direct control over these entities. Despite the challenges in comparing data, the town has made significant progress in energy efficiency. Additionally, the transition to cleaner grid energy in Maine has also contributed to lower emissions in electricity production. This comparison underlines the importance of continuous improvement in data accuracy and energy efficiency to further reduce emissions and meet long-term climate goals.

Appendix B. Sectors and Subsectors *Included in Inventory*

Table 1: Sectors and Subsectors INCLUDED in Topsham's Community-Wide GHG Inventory

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE
STATIONARY ENERGY	Residential	Energy used in buildings, losses from distribution systems	Electricity
			Natural Gas
		Energy used in buildings	Propane, Kerosene, Wood
	Commercial	Energy used in commercial, government and institutional buildings, losses from distribution systems	Electricity
			Natural Gas
		Energy used in commercial, government and institutional buildings	Propane, Kerosine, Wood
	Industrial	Energy used in manufacturing and industrial facilities and losses from distribution system	Electricity
			Natural Gas
		Energy used in manufacturing and industrial facilities	Propane, Kerosene, Wood
TRANSPORTATION	Passenger Vehicles	Fuels combusted from all passenger vehicle trips within municipal boundary	Gas, Diesel
	Commercial Vehicles	Fuels combusted from all passenger vehicle trips within municipal boundary	Gas, Diesel
	Public Transit	Fuel combusted due to passenger miles traveled on public transportation	Gas, Diesel
WASTE	Municipal Solid Waste - Landfilled	Emissions resulting from landfilled waste	Emissions resulting from landfilled waste
	Wastewater – Septic	Emissions from wastewater processed in Topsham septic systems	Aerobic and Anaerobic Digestion
	Wastewater Treatment Plant	Emissions from wastewater processed in wastewater treatment facilities	Aerobic and Anaerobic Digestion
	Wastewater Effluent Discharge	Emissions from wastewater effluent	Aerobic and Anaerobic Digestion

Appendix C. Mt. Ararat High School Student Energy Survey, Energy Use and Efficiency and Forest Carbon Study.

Appendix D. Community-Wide and Municipal GHG Inventory Data Tables