

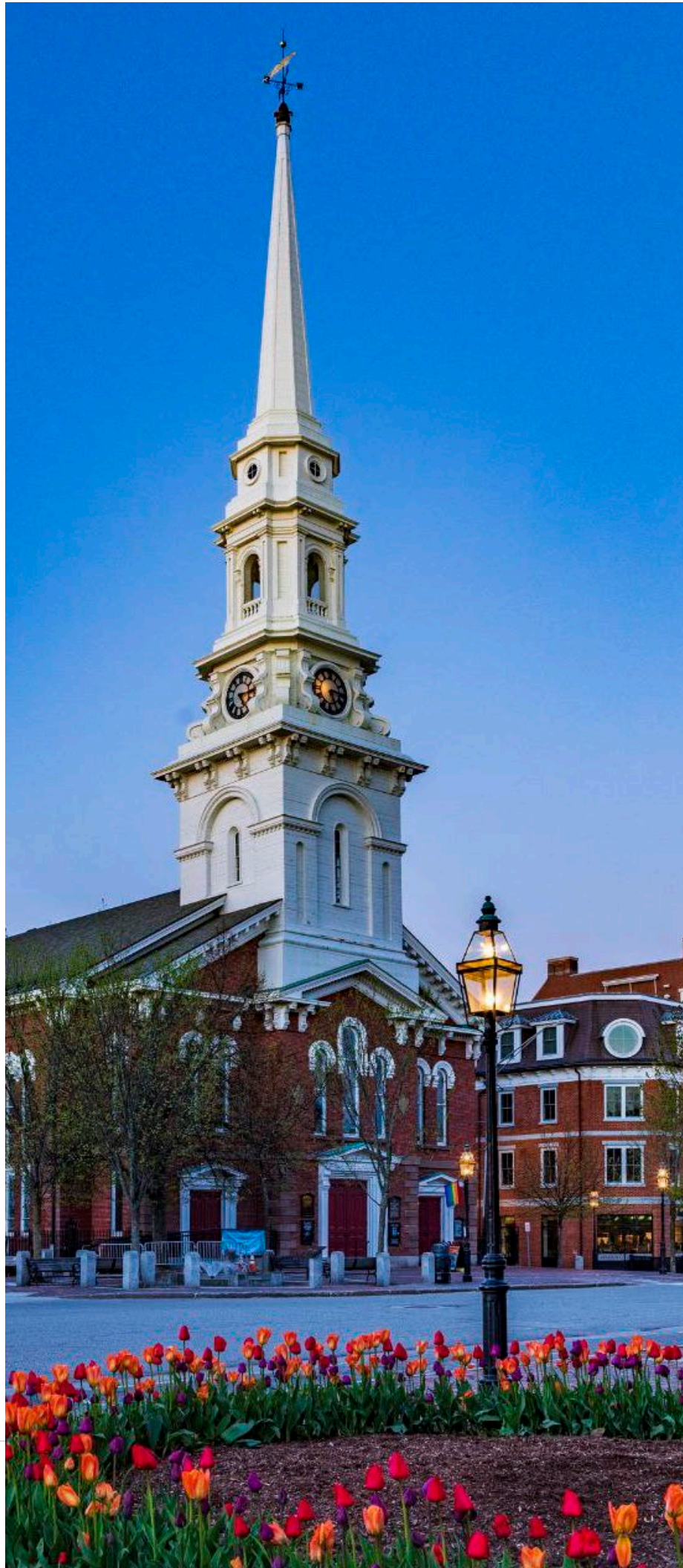


City of Portsmouth, NH

Greenhouse Gas Inventory

2025 Report on Municipal & Community Operations

August 2026



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Executive Summary

With growing emissions, cities play an active role in combatting the climate crisis and have a responsibility to manage emissions. To begin to understand how cities can take strides to reduce their emissions, those emissions must first be tracked and analyzed. This report updates past inventories: 2006¹, 2012², 2018³, and 2021⁴. This inventory aims to inform the City Council of Portsmouth's progress towards net-zero goals set in *Portsmouth's Climate Future: Climate Action Plan*⁵ updated in 2024, as well as to provide residents, property owners, and business owners with a transparent understanding of Portsmouth's greenhouse gas emissions throughout 2025.

Conducting a greenhouse gas (GHG) inventory aims to:

- Build upon previous inventories to show a trend in emissions and to further report on a city's progress towards carbon reduction and net-zero goals
- Identify opportunities for sector-based solutions
- Demonstrate climate change leadership through the development of reduction targets
- Increase the transparency and consistency of GHG reporting amongst municipalities

This carbon inventory was conducted through ICLEI Local Governments for Sustainability's ClearPath 2.0 software. The inventory is categorized by sectors defined by their corresponding scope within the municipality and community. The sectors analyzed within the municipality included stationary fuel and purchased electricity for municipal buildings and facilities, municipal fleet and outsourced transit fleet fuel consumption, employee commuting, and water and wastewater treatment facilities. Within the community, residential, commercial, and industrial stationary fuel and purchased electricity data were used to estimate sectors for heating and cooling for community spaces. Transportation throughout the City was also analyzed within the community sector. Waste generated was also reported on. Additionally, case studies for school cafeteria food and home heating fuel usage are provided.

¹ 2006 Greenhouse Gas Inventory [2006_ICLEI_Inventory_w_appdx.pdf](#)

² 2012 Greenhouse Gas Inventory [Portsmouth_2012_GHG_Inventory_w_appendix.pdf](#)

³ 2018 Municipal & Community Greenhouse Gas Inventory [2018_GHG_Portsmouth_Final.pdf](#)

⁴ 2021 Greenhouse Gas Inventory [CAP_November_Update.pdf](#)

⁵ Portsmouth's Climate Future: Climate Action Plan: Section 3. [CAP_November_Update.pdf](#)

Overall, municipal operations generated 11,557 metric tons of carbon dioxide equivalent (MTCDE) and the community generated 668,391 MTCDE.

This inventory also includes the ongoing and implemented initiatives across Portsmouth, aimed at reducing emissions, as well as reduction scenarios that the City, Schools, and community could pursue. It concludes with recommendations for streamlining data collection for future inventories, as well as ideas regarding additional initiatives that could help the City reach net zero carbon emissions.

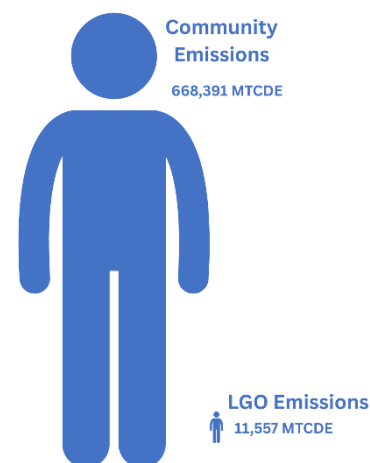


Figure 1. Municipality versus community emissions

Introduction

In November 2007, the Portsmouth City Council passed a resolution to become an Eco-municipality, formally committing to the principles of sustainability. The following goals depict how the City intends to become more sustainable through this commitment:

1. Reduce dependence upon fossil fuels and extracted underground metals and minerals
2. Reduce dependence on chemicals and other manufactured substances that can accumulate in nature
3. Reduce dependence on activities that harm life-sustaining ecosystems
4. Meet the hierarchy of present and future human needs fairly and efficiently

These goals are continued through the Portsmouth 2025 Master Plan⁶, published in 2017, highlighting five main principles to improve the quality of life for Portsmouth residents both present and future, including themes of vibrancy, authenticity, diversity, connectedness, and resilience. Under the theme “Resilient,” *Portsmouth’s Climate Future*, updated in 2024, addresses the long-term health of our natural and built environments. In an effort to measure its progress towards sustainability, the Portsmouth City government periodically analyzes its municipal and community-wide greenhouse gas (GHG) emissions.

⁶ Portsmouth 2025 Master Plan [City of Portsmouth - Portsmouth 2025 Master Plan - Page 90-91 - Created with Publitas.com](#)

To date, the City of Portsmouth has developed five GHG emission inventories — 2006, 2012, 2018, 2021, and now 2025.

Emission Reduction Goals

The City of Portsmouth is committed to reducing its GHG emissions in the municipal and community sectors. In 2024, Portsmouth adopted its Climate Action Plan, titled *Portsmouth's Climate Future*, and set two net zero goals, with net zero defined as consuming only as much energy as is produced⁷:

1. Reach net zero within the community by 2050
2. Reach net zero within municipal operations by 2040

The City has targets to remain vibrant, authentic, diverse, connected, and resilient across all three pillars of sustainability: the economy, the community, and the environment. Not only is there a global context urging these changes, but also national and local support. On a state level, *The State of New Hampshire Priority Climate Action Plan*⁸, published in 2024, includes strategies and actions to reduce GHG emissions and enhance the state's resilience to climate change, with a focus on energy efficiency, renewable energy, and sustainable land use, all initiatives that support net zero goals.

Methodology

Data for this inventory was collected and processed using methodologies outlined in ICLEI's Local Government Operations Protocol⁹ and the framework published by the Greenhouse Gas Protocol for Community-Scale Greenhouse Gas Inventories, as well as guidance from the ICLEI US Community Protocol for Accounting & Reporting GHG Emissions.

This carbon inventory was conducted using ICLEI Local Governments for Sustainability's ClearPath 2.0 software. For the community inventory, data was entered under ICLEI US Community Protocol (USCP), which is tailored for US local governments with detailed methodologies and best practices adapted to US data availability, jurisdictional structures, and policy contexts. It is part of ICLEI USA's *Sustainable*

⁷ Definition pulled from EPA: Net Zero [Net Zero | US EPA](#)

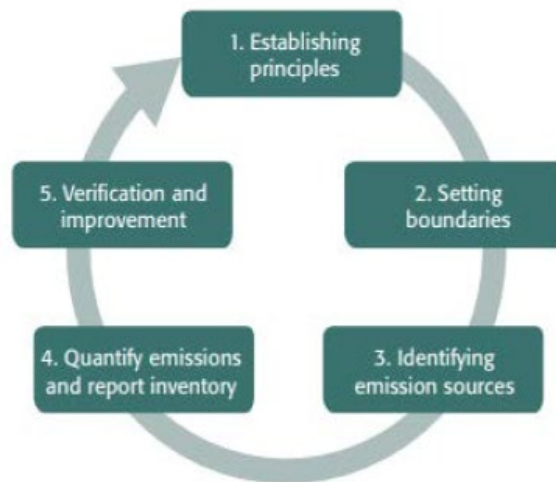
⁸ *The State of New Hampshire Priority Climate Action Plan* [state-of-new-hampshire-priority-climate-action-plan.pdf](#)

⁹ Local Government Operations Protocol: *For the quantification and reporting of greenhouse gas emissions inventories*

*Communities Suite*¹⁰, which also includes equity, adaptation, and mitigation analysis. While both protocols align with the refinements to the 2006 IPCC Guidelines, the USCP is best suited for US communities wanting a US-specific and comprehensive suite that integrates GHG accounting with equity, adaptation, and mitigation analysis.

To simplify data collection, most data were entered in their original units and then converted to metric tons of carbon dioxide equivalent (MTCDE).

Figure 2. Major steps for GHG inventories



Emission Factors

Emissions vary by the type of activity data: the mix of fuel used by an electricity provider, or in the case of vehicles, by the make and model year. ICLEI software uses regional electricity grid factors as most recently published by the U.S. Environmental Protection Agency (EPA)¹¹. The EPA emission factors were most recently updated in 2023.

Emission factors for each inventory differ (Table 1). Whereas the emission factors for 2025 are based on the most recent EPA New England Grid factors, previous values are based on their most recent emission factors from various sources. In 2012, values were calculated using local New Hampshire electrical production data. The factors for 2021, 2018, and 2006 were based on EPA NEWE estimates, like the current inventory. It is likely that if the 2012 emission factors were calculated based on the NEWE grid source, the CO₂ emissions reported would have been reduced.

¹⁰ICLEI USA <https://icleiusa.org/>

¹¹ EPA Emission Factors [Summary Data](#) | [US EPA](#)

Table 1. Electricity emission factors for Portsmouth, NH GHG Inventory (lbs/MWh)

	CO₂	N₂O	CH₄
2006*	709.500	0.144	0.113
2012**	1,300.400	0.088	0.029
2018*	522.3	0.011	0.082
2021*	539	0.009	0.072
2025*	544	0.008	0.063

*Emission factors were based on EPA eGRID estimates.

**Emission factors were calculated using the fuel mix published in PSNH's 2012 Disclosure Label and the Clean Air-Cool Planet Software's Custom Fuel Mix worksheet

Scope of Inventory

The geographic scope of this project is within the City of Portsmouth, New Hampshire boundary. The municipality area encompasses 16.82 sq. miles and is home to approximately 22,332 people according to the 2023 5-Year American Community Survey (ACS). Situated on the seacoast just south of Maine and along the well-traveled I-95 corridor, the City is working to create a more sustainable community for residents and tourists. This inventory focuses on the GHG emissions produced from municipal operations and from the community sector for the 2025 calendar year (January 1st, 2025, to December 31st, 2025) and uses the ICLEI Local Governments for Sustainability ClearPath 2.0 Tool to model reported emissions. All greenhouse gases measured, including carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) will be normalized and reported in metric tons (MT) of CO₂ equivalent (CO₂e).

Emission Scopes

Established by the Greenhouse Gas Protocol, emission scopes are a method of categorizing emissions by the activities that create them. Scopes are defined by where the activity occurs and how it relates to the supply chain (Table 2). Based on these definitions, emissions from the sectors can be categorized by scope for community and municipal emissions (Table 3).

Table 2. Definitions of Scope 1, 2, and 3 emission categories¹²

Scope	Description
1	Direct emissions from sources within city boundary
2	Emissions from the consumption of grid-supplied electricity within city boundary
3	Indirect emissions that are the consequence of the organization's operation

Table 3. Emission sectors categorized by scope for community and municipal operations

Municipal Emissions				Community Emissions			
Sectors	Scope 1	Scope 2	Scope 3	Sectors	Scope 1	Scope 2	Scope 3
Buildings & Facilities				Residential Energy			
Municipal & Transit Fleet				Commercial & Industrial Energy			
Solid Waste & Wastewater Facilities				Transportation & Mobile Sources			
Streetlights & Traffic Signals				Solid Waste			
Employee Commuting							
School Cafeteria Food							

Disclaimers & Updates

Since Portsmouth's 2006 baseline inventory, greenhouse gas accounting software, data availability, and estimation methods have improved. However, these improvements have not been applied consistently across every sector or inventory year. The 2021 inventory was prepared using SIMAP, software designed primarily for higher education institutions, whereas the 2025 inventory uses ICLEI ClearPath 2.0. The 2012 and 2018 reports used ICLEI ClearPath 1.0, an earlier version of the 2.0 software used for this inventory. The 2018 inventory omitted substantial data from several sectors, and the 2012 inventory used sound methods but relied on less-developed estimation resources, resulting in potential over- and underestimation. Consequently, complete sector-by-sector comparisons across all inventory years would not be methodologically sound.

Historical information can still be pieced together where individual sectors used sufficiently similar boundaries, activity data, and calculation methods. These comparisons may help identify broad

¹² Definitions of scopes <https://climate.mit.edu/explainers/scope-1-2-and-3-emissions>

directional trends, but they should be interpreted cautiously because differences in data completeness, emission factors, estimation tools, and sector definitions may influence the results. The 2025 inventory also includes activities that were not consistently reported in earlier inventories, increasing reported emissions in both the community and local government operations inventories while providing a more complete representation of Portsmouth's activities. Comparisons with 2012 are generally the most informative where methodologies and data coverage align, while comparisons with 2021 are not possible due to differences in methodology and possible inaccuracies in calculations. Accordingly, the following report presents only comparisons that are reasonably compatible with appropriate caveats and establishes the 2025 inventory as the new baseline for future tracking.

Updates to 2018 Local Government Operations Inventory

Within the **Buildings and Facilities** sector, methodologies remained the same. This data was retrieved from the Department of Public Works (DPW), the Public Library, the Fire Department, the Recreation Department and the School Department.

In the **Municipal Fleet** sector, the PHA category was omitted as these vehicles are not City-owned and should not have been included in previous inventories. Otherwise, methodologies remained the same and data was sourced from DPW records.

The **Transit Fleet** sector was newly added. This includes data from the school bus fleet servicing Portsmouth schools, which was retrieved from the contracted company.

In the **Water and Wastewater** sector, fugitive emissions from the treatment facilities were expanded. This new category captures emissions associated with wastewater treatment that were not included in previous inventories due to construction at the Peirce Island Wastewater Treatment Plant. Emissions from stationary fuel combustion and process emissions continue to be reported. However, data for propane used for heating was not included due to lack of submission.

In **Municipal Lighting**, traffic light data was not reported due to a lack of data collection for 2025. Emissions from streetlights continue to be reported.

The **Employee Commute** sector was calculated using a similar survey method as in past inventories. The scale factor differed with this inventory due to the difference in employee responses.

The **School Cafeteria Food** sector was newly added as a case study.

Updates to 2018 Community Inventory

Within the **Community Heating** sector, data was still acquired from Unitil utility bills, as in past inventories, but estimations for alternative fuel usage were performed through calculations in newly added ICLEI software. These estimations pulled data from New Hampshire State 2023 ACS 5-Year Survey data¹³.

In the **Community Electricity** sector, data was still acquired from Eversource. However, due to Eversource data sharing restrictions, data for the fiscal year of 2026 (July – December 2025) was given instead of the full calendar year. Electricity data from the Community Power Coalition of New Hampshire (CPCNH) calendar year 2025 was used to project estimated values for the months of January through June, for which no Eversource data was provided. These projections were performed for Residential and Commercial sectors. Since CPCNH does not supply Industrial customers, the Eversource data for fiscal year of 2026 was used.

The **Waste** inventory continues to report waste emissions under waste generated. Data for this category included the total tonnage for each waste category. Wood and brush were added as a new category, and landfill waste emissions were calculated under waste exported for disposal in landfill with gas recovery.

The **Transportation** sector differed from previous inventories due to an upgrade in the transportation model written by the Rockingham Planning Commission. The upgrade included using more accurate data and estimation software.

The **Home Heating** sector was newly added as a case study.

Data Accuracy

While there is reliable methodology available for greenhouse gas inventories, each inventory presents new challenges. Each activity has its own level of uncertainty, which can be increased by lack of documentation, feasibility of data sources, and the lack of open-source utility data. These uncertainties underscore the importance of clearly documenting assumptions, data gaps, and methodological choices so that results remain transparent, reproducible, and appropriately contextualized. Acknowledging these limitations not only strengthens the credibility of the inventory but also helps decisionmakers interpret the findings with an informed understanding of confidence levels.

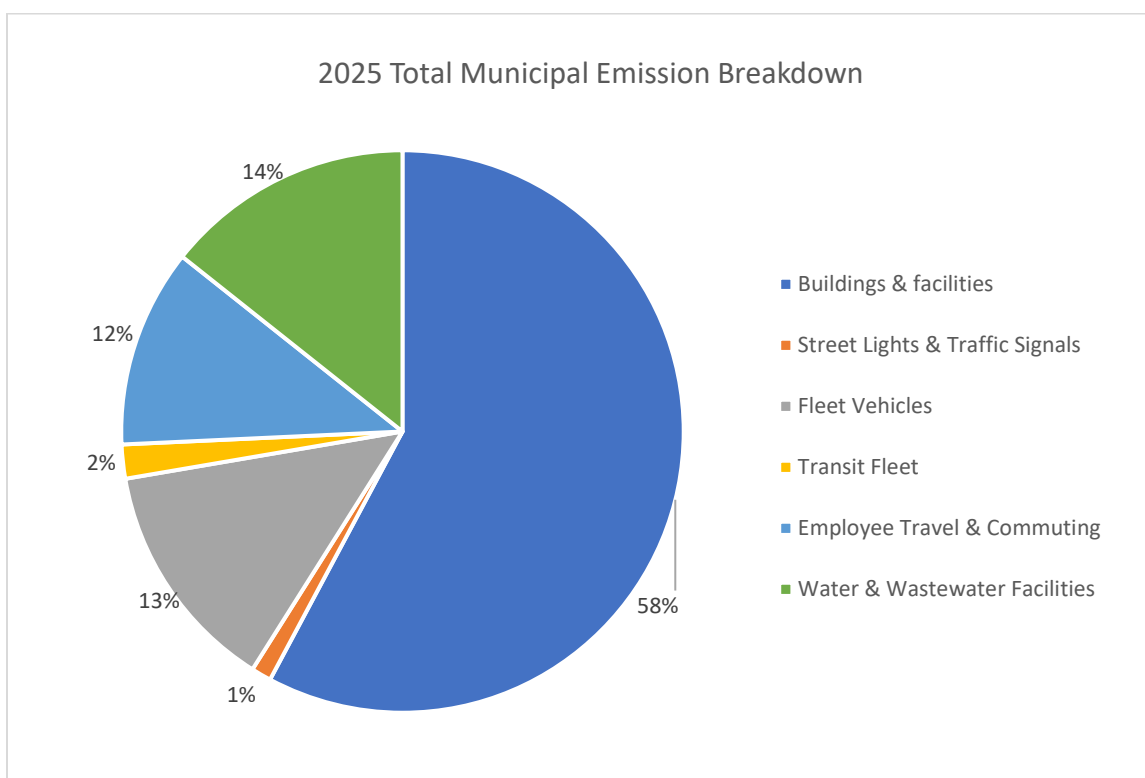
¹³ United States Census: 2023: ACS 1-Year Estimates Tables B25024 and B25040

Municipal Inventory

For local government operations, the 2025 GHG inventory includes all emissions resulting from energy consumption within City-owned buildings and facilities, government-operated or contracted vehicles, street and traffic lights, and water and wastewater infrastructure. It also includes generated emissions from employee commuting and a case study on emissions from school cafeteria food. This inventory does not account for fugitive emissions from refrigerants and fire suppression equipment, nor does it include emissions from employee business travel. This is due to an incomplete dataset for this category and the reliance on imprecise estimations for these activities.

In 2025, total local government operations emissions amounted to approximately 11,557 MTCDE, representing nearly 1.72% of community emissions. As shown in Figure 3, the largest source of emissions was from buildings and facilities, accounting for over half of emissions. Water and wastewater facilities, along with emissions from the municipal fleet, accounted for the next two largest portions of the inventory.

Figure 3. Breakdown of Local Government Operations (LGO) emissions from 2025



Buildings & Facilities

Within the built environment sector for the municipal report, stationary energy and electricity consumption emissions were analyzed, consisting of energy and fuel usage across municipally owned and operated spaces. Fuel usage from natural gas and electric utilities was reported in full. Therefore, the inventory does not provide a split between buildings that may have AC, mini splits, or heat pumps.

In total, buildings and facilities produce the most emissions (MTCDE) or approximately 58% of the total for local government operations. Emissions by source are shown in Figure 4.

In 2023, the City Manager approved a new purchasing plan that guides all municipal construction and major renovation projects to include energy-efficient technologies and utilize sustainable practices, such as the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED) Silver equivalent certification for all new municipal building projects. The Library, Middle School, Fire Station 2, and the Madbury Water Treatment Plant, which is analyzed under the Water & Wastewater section, are all LEED Silver¹⁴. These initiatives improve the

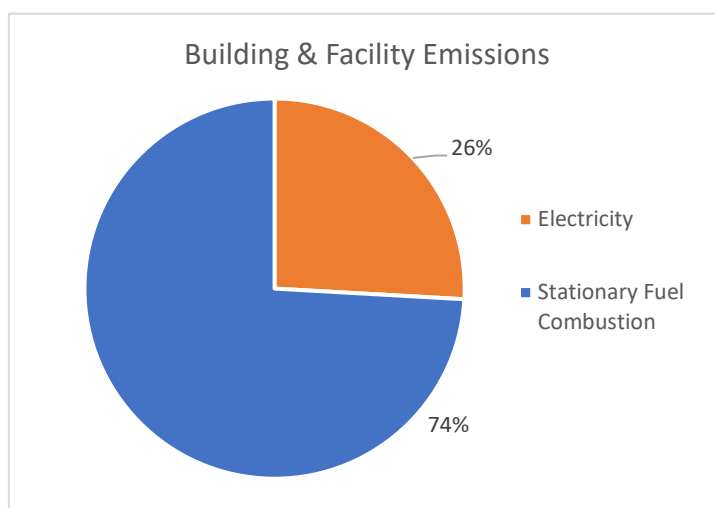


Figure 4. Building & Facilities emissions by activity type



Figure 5. The Portsmouth Public Library (left), NH's first municipal building to receive LEED Silver certification for its design and construction in energy conservation, recycling, lighting, and use of local materials. In 2011, Fire Station 2 (right) was recognized as LEED Silver

¹⁴ LEED Silver Certifications for municipal buildings <https://www.portsmouthnh.gov/sustainability/green-buildings>

efficiency of buildings and can decrease total emissions, as seen in the reduction of emissions between 2012 and 2018.¹⁵

One large contributor of emissions for municipally owned and controlled buildings is the School Department. Portsmouth High School used the most natural gas of any municipal building, with Dondero Elementary following behind. Dondero Elementary has the lowest heating efficiency, likely due to the inefficiency of boiler usage (Figure 6)¹⁶. In 2017, a solar array was installed at Portsmouth High school. However, due to the contract agreement, the City does not retain the renewable energy credits (RECs) for this building and so cannot be counted towards the overall decrease in emissions for this inventory. However, if RECs were included, this would generate about 13% of the school's energy needs and decrease total emissions for the High School by approximately 76 MTCDE (Figure 7)¹⁷ according to the energy generation reports for 2025.

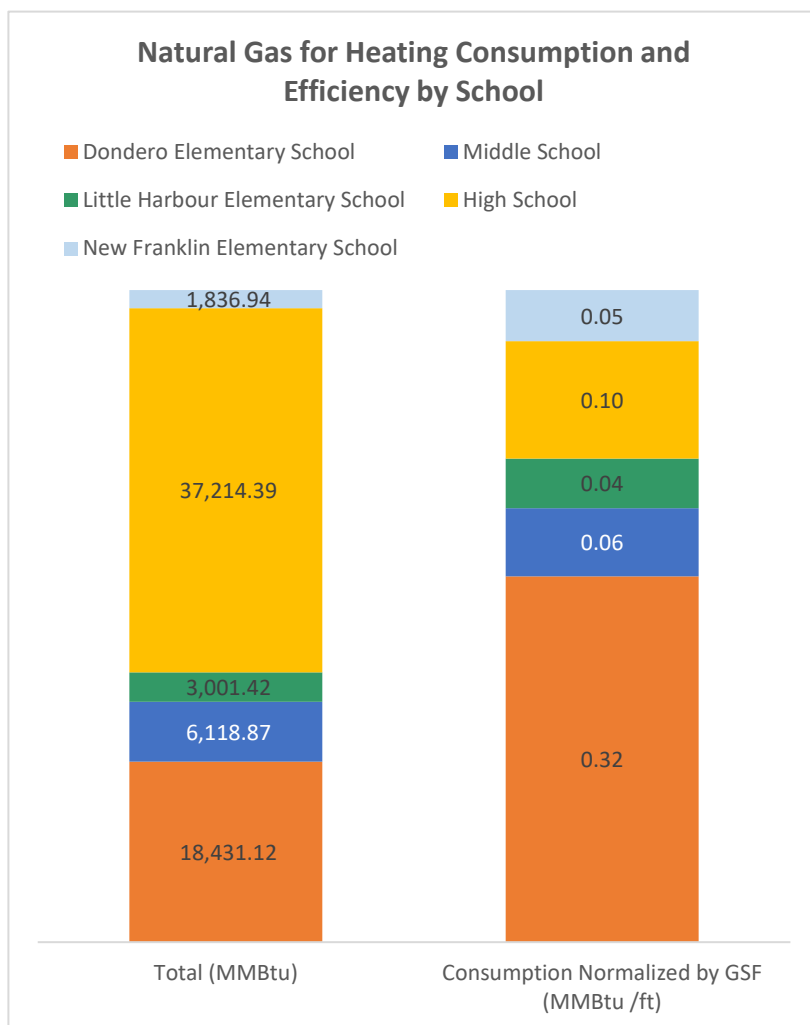


Figure 5. Heating efficiency throughout Portsmouth schools highlighting total consumption of natural gas used for heating and fuel efficiency, normalized by gross square footage (GSF) for each school

Consistent with its commitment to reducing emissions, the City continues to seek projects to reduce emissions similar to the High School solar arrays that were installed in 2017. A recent Municipal Building

¹⁵ Pictures are from City of Portsmouth website <https://www.portsmouthnh.gov/>

¹⁶ GSF numbers provided by City of Portsmouth School Department

¹⁷ Portsmouth High School Solar Dashboard
<https://apps.alsoenergy.com/kiosk/38998?dashkey=2a566973506447444a43554b772b71633d&tag=997501>

Audit identified priority facilities for energy upgrades; recommended strategies appear in the Local Government Operations GHG Forecasts section.

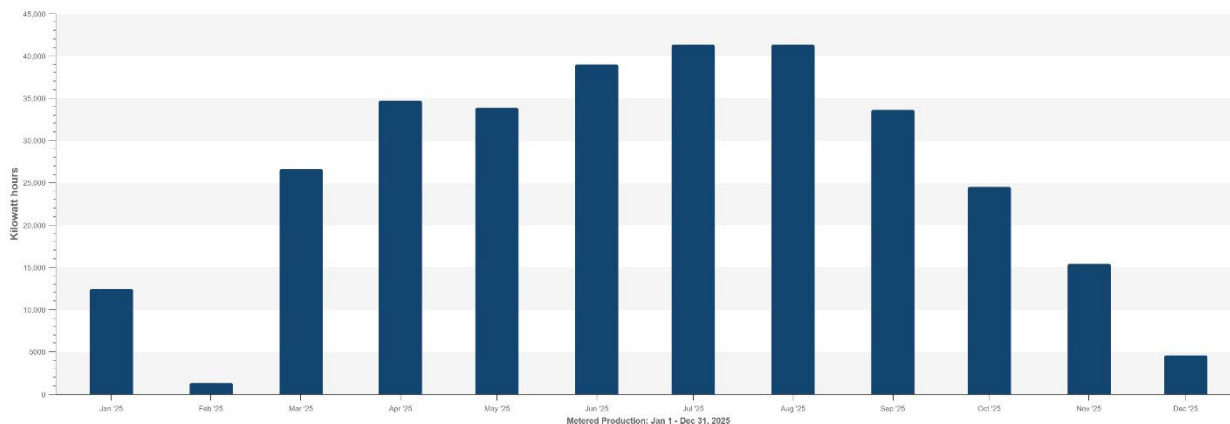


Figure 6. Portsmouth High School solar generation from 252 kW system, generating a total of 308,628 kWh for 2025¹¹

Water & Wastewater

The water and wastewater sector is the second-largest emitter, contributing approximately 14% of total emissions for municipal operations. Including emissions from stationary fuel, electricity consumption and process emissions from the wastewater treatment plants, the water and wastewater treatment sector produced approximately 1,655 MTCDE. A breakdown is shown in Figure 9.



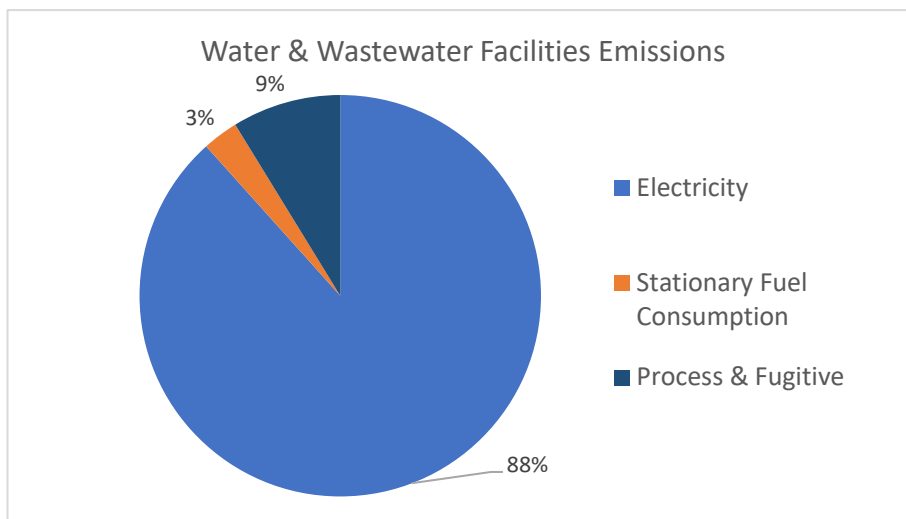
Figure 7. Aerial view of the Peirce Island Wastewater Treatment Plant

Within this category, emissions from both wastewater treatment plants (Pease and Peirce Island), both drinking water treatment facilities (Pease and Madbury) and supporting water treatment and sewer facilities (sewer pumps and stations) were examined. Methodology differences between previous reports and this update result in the inability to accurately compare data.

Overwhelmingly, electricity consumption across buildings and facilities dominates emissions, contributing approximately 88% of total emissions. This includes energy usage at all treatment facilities, supporting drinking water treatment facilities, freshwater pumps, and sewer pump stations. Data was entered fully, without a complete breakdown of the purpose of the electricity. Without knowing the

complete breakdown, there still may be an opportunity for gross energy reduction at the Madbury Water Treatment Plant, by considering an addition or upgrade to the solar field array onsite. Currently, the City does not retain the renewable energy credits (RECs) from the constructed solar field on the property, per the power purchase agreement made. However, the City would decrease emissions by approximately 77 MTCDE by retaining RECs in the future¹⁸. This is based on 2024 solar data, the most current full calendar year available, which shows the array generating approximately 77% of electricity needs for the plant (Figure 10). Additionally, several pump house locations have heat pumps and mini splits installed and 18 are set to be converted from electric resistance heating to heat pumps in 2026. This will reduce emissions as the City moves towards more efficient heating sources.

Figure 8. Breakdown of emissions within the water and wastewater facility sector



¹⁸ Madbury Drinking Water Treatment Plant Solar Dashboard
<https://apps.alsoenergy.com/kiosk/39089?dashkey=2a5669735064576e4943454b772b716f3d&tag=937696>

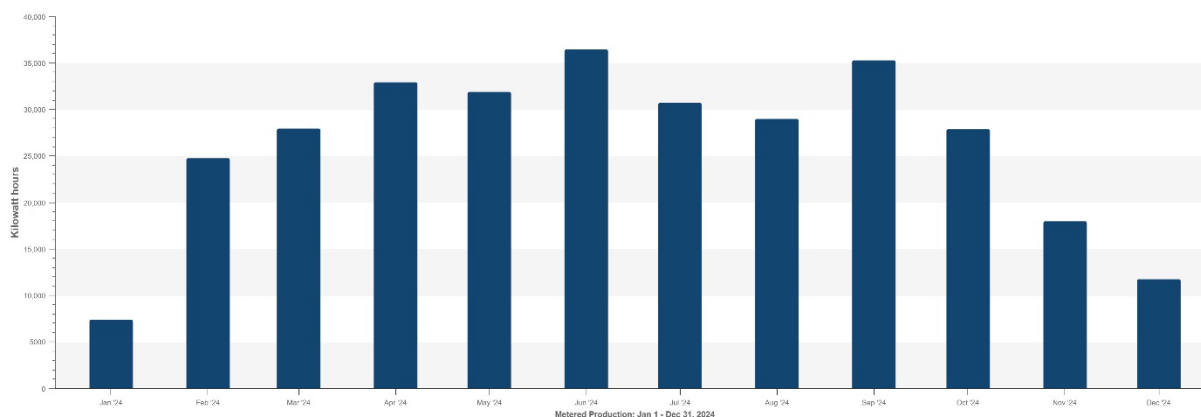


Figure 9. Madbury Drinking Water Treatment Plant solar generation from 222 kW system, generating a total of 313,909 kWh for the calendar year 2024*

Stationary fuel made up 3% of total emissions for the water and wastewater treatment sector (Figure 9). This includes natural gas usage for sewer pumps. Treatment plants are heated with propane; however, 2025 usage data could not be included in this inventory.

Process emissions made up 9% of total emissions (Figure 9). Process emissions were not calculated for the water treatment plants, per ICLEI and GHG Protocol guidelines; they were calculated only for wastewater. Emissions from the Peirce Island and Pease wastewater plants are from nitrification and denitrification processes and fugitive emissions from effluent discharge. Nitrification and denitrification processes are two essential biological processes in wastewater treatment that remove nitrogen compounds, protecting water quality and meeting regulatory standards. However, emissions occur as a byproduct from these processes. Using data from both wastewater treatment plants and corresponding methodology from Community Protocol Appendix F¹⁹, the total estimated annual emissions for Pease WWTP were 39 MTCDE and 106 MTCDE for Peirce Island (Figure 11). In the 2018 inventory, the Peirce Island plant was under construction and so process and fugitive emissions were not reported.

*2024 has the most current full year solar generation data

¹⁹U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions Appendix F: Wastewater and Water Emission Activities and Sources

Figure 10. Emissions breakdown for wastewater treatment plants operated by the city

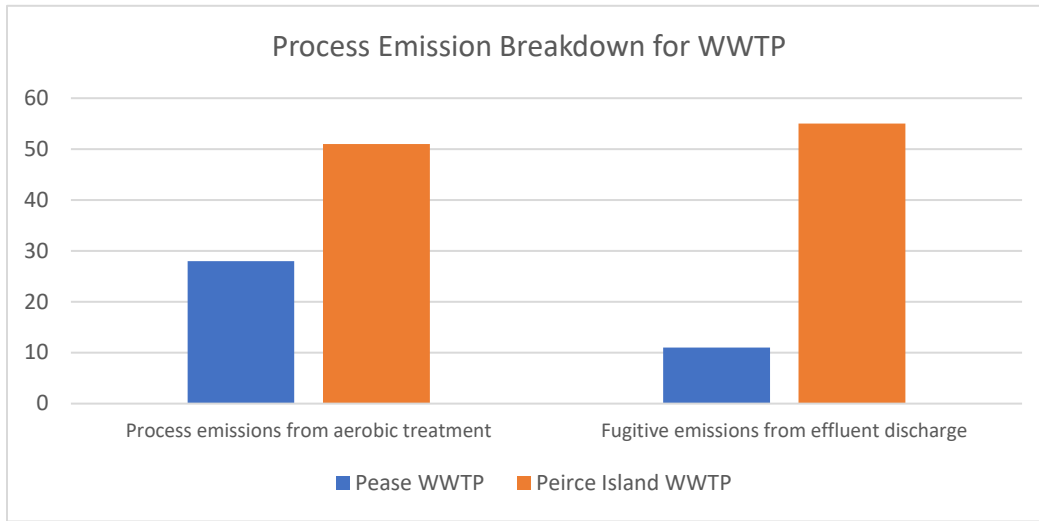


Table 4. Emissions normalized by served population for both plants controlled by the city

Emissions Normalized by Served Population²⁰					
	Process Emissions	Fugitive Emissions	Total Emissions (MTCDE)	Total Population Served	Normalized (MTCDE/pop)
Pease WWTP	51.0125	27.825	78.8375	12,000	0.00657
Peirce Island WWTP	55.39024	10.68295	66.07319	22,000*	0.003003

*Served population includes residents from New Castle

Employee Commuting

The employee commuting sector has consistently contributed a significant amount of greenhouse gas emissions. Employee commuting emissions were calculated based on a survey administered to all City employees, including the School Department, the Fire Department, the Police Department, and all other municipal employees in City Hall and working for the Department of Public Works. Questions ranged from total vehicle miles traveled (VMT) to the number of estimated working days per week.

Overall, the number of City employees has decreased since 2012. In 2012, there were 884 total employees reported working under the City and in 2018, 970 employees. In 2025, 734 employees were

²⁰ Served population data given by Wastewater Treatment Facilities

reported. Due to this decrease and continued improvements in fuel efficiency, emissions decreased by approximately 18% from 2012 to 2025 (Table 5).

Table 5. Employee commuting inventory comparison

	Reported Emissions	% Decrease
2025	1,319	-0.13
2018	1,519	-5.54
2012	1,606	

*Although emissions are compared, surveys distributed to employees for 2012 and 2018 vary slightly

Results showed an overwhelmingly high employee population driving to work alone, with a few reporting carpooling or biking to work some months out of the year. Among those who drive to work, gasoline-powered cars overwhelmingly dominated the total annual miles reported by employees, followed by hybrid gasoline cars, as shown in Table 6. Carpooling incentive programs could work to reduce future emissions.

Table 6. Breakdown for reported emissions based on fuel type and extrapolated mileage from survey results

Fuel	Extrapolated Annual Miles	MTCDE	% of Total
Gasoline	4,182,090	1,170	88.7
Hybrid Gasoline	455,685	127	9.7
Diesel	51,688	14	1.1
Electric	92,364	8	0.6
No emission source	7,120	-	-
Totals	4,788,948	1,319	100%

Municipal & Transit Fleet

The municipal fleet sector represents fuel consumption for municipally owned vehicles by the Fire, Highway, Parking, Police, School, Sewer, Stormwater, and Water departments, as well as Prescott Park and City Hall. Gallon data for unleaded gasoline and diesel fuel was acquired from purchasing records in the City's Gasboy tracking system, which was then converted to MTCDE using respective EPA emission factors, as shown in Table 7.

Table 7. Emission factors for mobile fuels in kg CO₂ per gallon as stated in the 2025 updated EPA GHG emission factors²¹

	CO ₂	N ₂ O	CH ₄
Motor Gasoline: Unleaded Gasoline	8.78	0.38	008
Mobile Diesel Fuel	10.21	-	-

*Mobile diesel fuel emission factors were only listed for CO₂

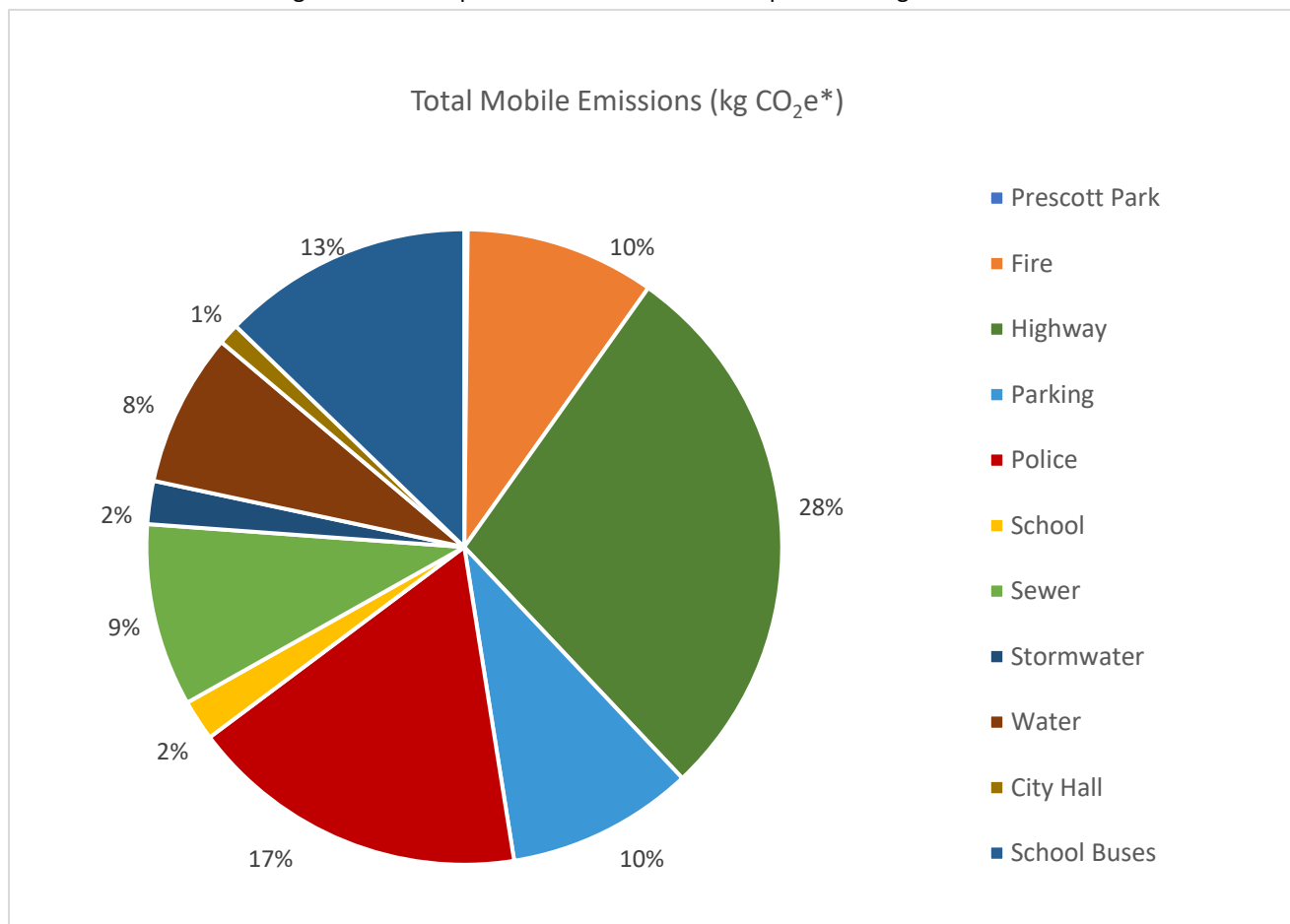
The City's vehicle fleet consumed 42,387 gallons of gasoline and 66,885 gallons of diesel fuel. In total, the municipal vehicle fleet produced 1,543 MTCDE, 13% of the total. In past inventories, biodiesel was reported upon. However, in recent years, the City has since ceased using a biodiesel mix in the fleet.

The Highway Department produced roughly a third of the total emissions, with the Police Department the second-highest emitter despite not using any diesel fuel (Figure 12).

School buses in the City of Portsmouth are outsourced through a company that uses diesel buses, and so are reported under Transit Vehicles. However, for the sake of comparison, they are shown in Figure 13. In total, buses supporting Portsmouth school children produced 226 MTCDE, 2% of total emissions and 13% of mobile emissions when compared against municipal fleet vehicles.

²¹ EPA Emission factors for mobile fuel <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

Figure 11. Municipal vehicle fleet emissions expressed in kg CO₂e



*1 metric ton equals 1,000 kilograms, but percentages remain the same despite difference in units

Figure 12. Municipal vehicle fleet fuel consumption by type

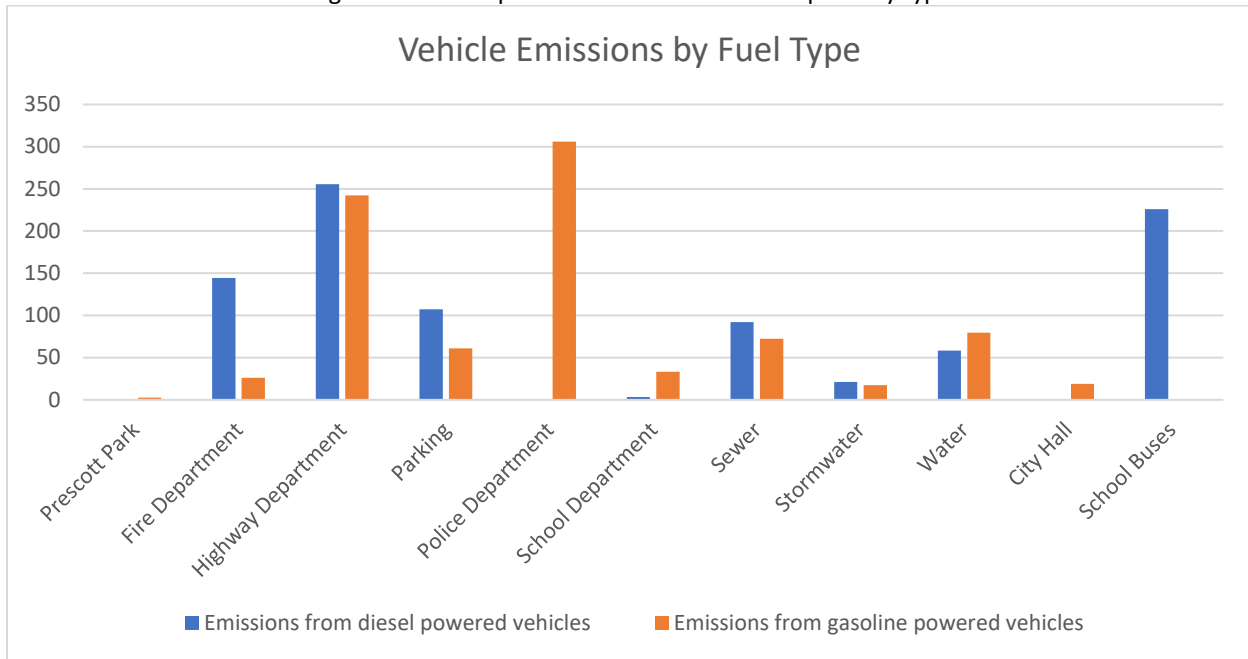


Table 8. Municipal breakdown of fleets and comparisons across years

	2025 (MTCDE)	% of Total	% Change	2018 (MTCDE)	% Change	2012 (MTCDE)	% Change	2006 (MTCDE)
Prescott Park	3	0.17	-0.27	4				
Fire	171	10	0.00	171	0.19	144	0.04	139
Highway	498	28	-0.19	618				
Parking	168	10	2.51	48				
Police	306	17	0.03	296	-0.06	316	-0.16	376
School Department	37	2			-1.00	59	0.44	41
Sewer	164	9	0.25	131				
Stormwater	39	2						
Water	138	8	-0.01	140				
City Hall	19	1						
School Buses	226	13				250		
Public Works*	303*		0.12	271.113*	-0.61	699	-0.02	712

*Public Works was a category reported in the 2012 and 2006 inventories but not for 2018 or originally for 2025. The category includes Water and Sewer which were reported separately for the sake of comparing 2018 to 2025.

Streetlights

The streetlight and traffic light sector remains the least impactful sector in terms of municipal emissions.

Overall, this sector contributed 133 MTCDE. The City of Portsmouth has seen a dramatic decrease in emissions within the municipal lighting sector from overall grid improvements and the transition to

more efficient lighting with LEDs. From 2016 to 2017, the entire streetlight system was upgraded to LEDs, contributing largely to the overall reduction.

Traffic light data has been reported in the past, however due to lack of collection, it could not be included in this inventory.

Municipal Summary

Municipal emissions make up 1.72% of total emissions, with buildings and facilities as the largest contributor. The City has improved building efficiency through green design and LEED Silver certifications. Further reductions could come from upgrading aging heating and ventilation systems and retaining renewable energy credits for the solar arrays at Portsmouth High School and the Madbury Water Treatment Plant. Right-sizing the municipal fleet and replacing retired vehicles with electric models could further reduce emissions.

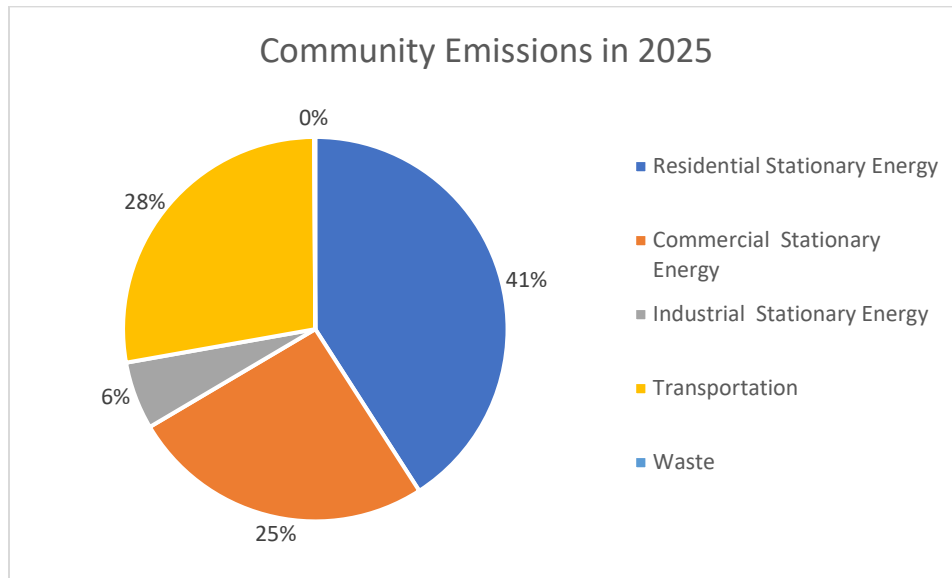
Community Inventory

The community portion of the 2025 GHG inventory includes emissions generated from electricity, natural gas, and other fuel consumption within the residential, commercial, and industrial sectors. It also includes transportation emissions resulting from on-road vehicle miles traveled within the City of Portsmouth's jurisdictional limits, waste generated from within the City, and land-based emissions and removals. It does not account for emissions from aviation, waterborne, or railway navigation, or industrial processes and product use. An example of unaccounted emissions sectors in the community includes the Portsmouth International Airport at Pease and Pease Air National Guard Base in addition to the NH Port Authority Terminal on the Piscataqua River in Portsmouth. These omissions are due to feasibility and lack of reliable estimation data.

In 2025, total community-wide emissions amounted to 668,391 MTCDE, 57 times the size of municipal emissions. The breakdown of sector emissions is shown in Figure 14, highlighting residential energy as the highest contributor. If net-sinks calculated by ICLEI's Learn Tool were added, the total number of emissions would decrease by 3,008 MTCDE. However, for the sake of maintaining calculated values, the net sink is not subtracted. A net-sink absorbs more carbon dioxide from the atmosphere than released.

Figure 13. Community emissions in 2025

*Note that waste generates such little emissions it is represented as 0% on the graph, truly it is 0.1%



Residential Energy

Residential energy accounts for 41% of total emissions. This sector includes data collected from utilities, as well as energy projections and fuel estimations for alternative home heating. Natural gas data was collected directly from utilities. Residential electricity was determined from utility data and projections using data from CPCNH and a restricted dataset sent by Eversource. The remainder of the data for home heating and cooling, and other appliances, was estimated from federal and state ACS 5-year survey data.

Out of the total residential energy use, fuel and energy consumption in the residential heating sector made up the majority of emissions at approximately 72%, which includes single- and multi-family homes heated with natural gas, oil, propane, and electric heating (Figure 15). Other residential appliances also made up a significant portion as well. This includes electric cooking stoves, gas cooking stoves, and other electricity, natural gas, and oil use. Residential cooling, only making up 1% of total emissions, was

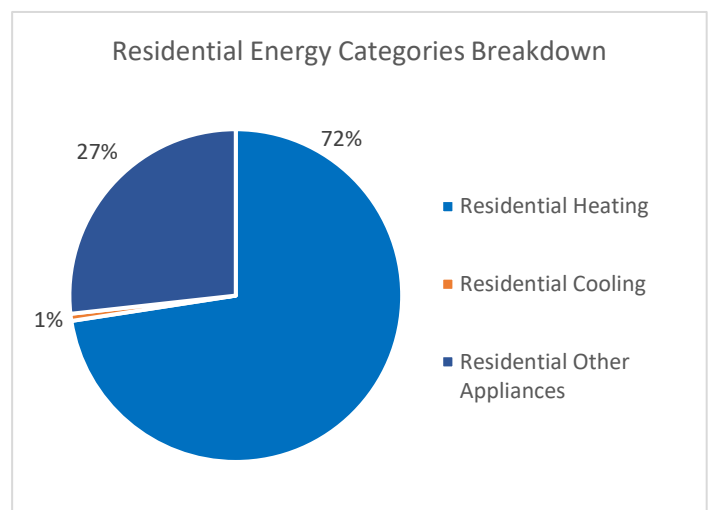


Figure 14. Residential energy categories

not a collected data category, but rather estimated by ACS data. Residential cooling includes single- and multi-family homes cooled using AC.

Due to differences in methodology, residential data cannot be compared to past years. A breakdown of fuel type across heating, cooling, and other appliances is shown in Table 9.

Table 9. Fuel breakdown for residential energy across heating, cooling, and other appliances sectors for 2025 estimated by ICLEI ClearPath 2.0 using data from the 2023 ACS 5-year survey

	Amount	Unit	MTCDE
Electricity	73,778,985	kWh	18,170
Natural gas	2,945,821	MMBtu	156,465
Oil	1,248,878	MMBtu	95,047
Propane	58,995	MMBtu	3,723

Commercial Energy

Commercial energy consumption made up 25% of total community emissions. Natural gas and electricity utility data reports were used with New Hampshire 2023 ACS 5-Year Survey data to create a holistic picture of commercial energy. As was the case with residential use, only half of electricity data was obtained from Eversource and so projections using CPCNH data were made.

The breakdown of each sector is shown in Table 10, showing commercial heating as the largest contributor of emissions. Since methodology changed from past inventories, a year-to-year comparison cannot be made.

Table 10. Commercial stationary energy use by sector and fuel type estimated by ICLEI ClearPath 2.0 using data from the 2023 ACS 5-year

		Amount	Unit	MTCDE
Heating 55%	Electric	21,649,696	kWh	5,332
	Natural Gas	1,184,811	MMBtu	62,930
	Oil	502,303	MMBtu	40,159
	Propane	65,144	MMBtu	4,112
Cooling 3%	Commercial buildings cooled with AC	23,797,277	kWh	5,861
Other Appliances	Electric cooking stoves	7,257,870	kWh	1,787

42%	Gas cooking stoves	3,801	MMBtu	202
	Other Electricity	195,703,273		48,198
	Other natural gas use	876	MMBtu	47
	Other oil use	545	MMBtu	41
	Other propane use	38,697	MMBtu	2,442

Industrial Energy

Industrial energy contributed approximately 38,115 MTCDE or 6% of the total community emissions. Emissions were determined by electricity and natural gas utility bills and then extrapolated using New Hampshire 2023 ACS 5-Year Survey data for a more accurate picture. For reporting, ICLEI recommends using the EPA FLIGHT tool to estimate process emissions from industrial plants within the City boundary. However, these data have not been recently updated and so were omitted.

Due to the difference in methodology from past inventories, industrial energy use cannot be accurately compared. Table 6 shows the breakdown of industrial emissions.

Table 11. Industrial energy use by fuel type estimated using ICLEI ClearPath 2.0 and data from the 2023 ACS 5-year survey

	Amount	Unit	MTCDE
Electricity Use	73,512,100	kWh	18,105
Natural Gas Use	376,745	MMBtu	20,011

Transportation & Mobile Sources

Overall, on-road transportation generated 185,050 MTCDE, 28% of total community emissions. Transportation values were derived from models created by the Rockingham Planning Commission for 2025. The model used traffic count data from each Department of Transportation (DOT) counting site within Portsmouth and data from TomTom, a navigation, mapping, and location technology company. For each count station, total counts were averaged across all days overlapping with TomTom's interface. Concurrent data from TomTom was averaged to get an average traffic count for each site. For each site, the difference between the DOT average and TomTom average was calculated to produce a scaling factor, which was pooled together to average across all sites. The scaling factor was used to scale up TomTom's total travel distance across Portsmouth for 2025 to an approximate DOT total travel distance, producing an estimated DOT Vehicle Miles Traveled (VMT) within the City boundary.

From the 2018 inventory, emissions have increased by 25% but decreased from 2012 numbers (Table 13). This model includes more accurate estimation technologies than previous inventories and reported 334,566,540 total VMT. The breakdown of the percentage of vehicle type by total emission contribution, as shown in Table 12, was produced using a combination of the total Rockingham Planning Commission VMT number and state averages within ICLEI ClearPath 2.0 software. In past inventories, this breakdown had been produced using averages generated in the 2012 report, which is an outdated methodology and therefore was not used for this report.

Table 12. Percentage breakdown of vehicles mapped driving through Portsmouth in 2025 estimated using Rockingham Planning commission numbers with ICLEI ClearPath 2.0 calculations

ICLEI Vehicle Type Breakdown	Estimated On-road Mileage	% of Total
Pure electric vehicles	2,843,816	0.9
Diesel cars	4,483,192	1.3
Gasoline cars	289,801,572	86.6
Gasoline motorcycles	2,107,769	0.6
Gasoline heavy duty vehicles	1,338,226	0.4
Diesel heavy duty vehicles	33,991,965	10.2
Totals	334,566,540	100%

Table 13. On-road transportation totals from 2012-2025 with comparisons

	2025			2018			2012	
Vehicle Type	Vehicle Miles Traveled	MTCDE	% Change in Emissions	Vehicle Miles Traveled	MTCDE	% Change in Emissions	Vehicle Miles Traveled	MTCDE
Total	334,566,540	185,050	25	322,049,171	147,725	-88	2,115,652,184	1,209,093

Waste

Municipal solid waste generated by residents of Portsmouth is sent to Turnkey Landfill in Rochester, NH. Turnkey Landfill is a waste-to-energy facility, converting methane gas produced from waste to usable electricity. However, the City of Portsmouth neither owns nor controls this entity. Therefore, landfill emissions are not reported in this inventory. Generated solid waste from the City was reported under Scope 3 as disposed waste. There was one entry for recycling waste and one for solid waste sent to a waste-to-energy facility. In total, waste makes up a very small percentage of total emissions, contributing only approximately 707 MTCDE, which is an 80% emission decrease from 2018 numbers.

The 2018 methodology most closely resembles the 2025 methodology. Both estimate emissions for landfills, recycling and food waste. However, in 2025 wood and brush were entered as a category. The 2025 categories are shown in Table 14. The main reason emissions in 2018 are so much larger is that the data entry did not consider the gas recovery capabilities at Turnkey, which significantly reduces total emissions for landfill waste exported. Table 15 shows the breakdown of waste exported to Turnkey Landfill from the Portsmouth community compared to the 2018 inventory results.

The total waste emissions only represent approximately 0.1% of total community emissions. However, these emissions are not insignificant. 707 MTCDE is the same as the yearly electricity use of 150-170 U.S. homes.

Table 14. Breakdown of solid and biological waste generated by the Portsmouth community in 2025

Waste category	Waste Type	Tonnage	MTCDE
Solid Waste	Recycling	2,242	43
	Landfill	5,032	619
Biological Treatment of Waste	Food waste	30	5
	Wood/Brush	300	41
	Totals	7,604	708

Table 15. Emissions from waste exported in 2025 compared to 2018

	MTCDE		% change in emissions
	2025	2018	
Solid waste	661.91	3,549.00	-81
Biological treatment of waste	45.75	248.00	
Total	707.66	3,797.00	

Land-Use

Agriculture, Forestry, and Other Land Uses (AFOLU) GHG reporting covers land-based GHG emissions and removals, including forest growth and conversions. ICLEI's Learn Tool was used to estimate total emissions, and net-sinks from forests and wetlands in City bounds. This estimate was created using the

most current data (2021–2023). Based on the report, there was a reported net-sink of 7,008 MTCDE (Figure 16). The full report is found in Appendix A.

Figure 15. AFOLU total emissions and removal summary

	Removals(t CO2e/yr)	Emissions(t CO2e/yr)
Undisturbed Forest	-6,791	
Fire		0
Insect/ Disease		0
Harvest/Other		1,038
Trees outside of forests		5,118
Forest to Grassland		0
Forest to Cropland		0
Forest to Wetland		257
Forest to Settlement		990
Forest to Other		0
Harvested Wood Products	0	
Trees outside of forests	-7,611	
Non-Forest to Forest	-8	
TOTAL	-14,410	7,402
Net GHG balance	-7,008	

Community Summary

Community-wide emissions are substantially higher than those generated by municipal operations, roughly 57 times greater. This imbalance highlights where the most meaningful reductions can occur. While municipal actions matter, the community sector represents the largest opportunity for transformative change. Among these, the residential sector contributes the largest share of emissions, underscoring the importance of household-level efficiency, building performance, and clean energy adoption.

Case Studies

School Cafeteria Food

Within the boundaries for a city-wide greenhouse gas report, food emissions are not a mandated reported activity source. Especially for a city as large as Portsmouth, with five separate primary schools, exact data collection for food is often not possible. However, emissions from food represent a large portion of total emissions in the City of Portsmouth and an estimate of this number has been included in this report.

Portsmouth schools are serviced by multiple food accounts with separate entities. Not all these account logs have pertinent information to be able to enter food data for each campus. However, data from the largest account was entered for each campus (ex. weights, volumes, standardized sizing). Totals were extrapolated from only a few months' data, as per food reporting standards²². In Figure 17 below, the data show that the Portsmouth Middle School contributed the most emissions from food of any of the local schools, followed closely by Portsmouth High School.

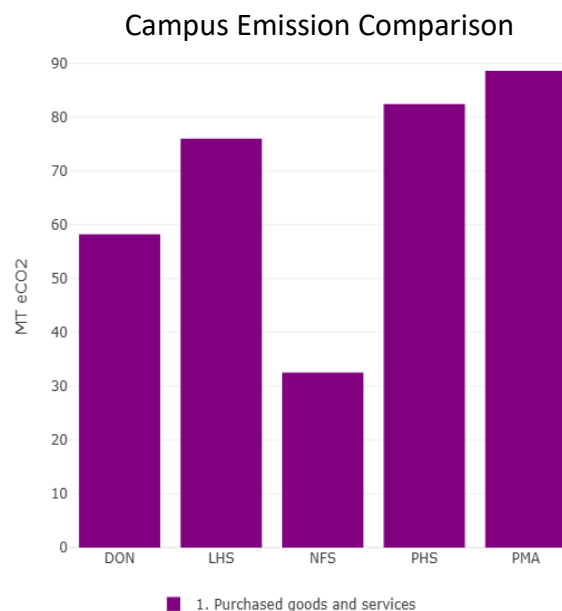


Figure 16. Emissions from food weight across Portsmouth primary schools

Food data calculations were performed using SIMAP, a carbon accounting platform designed for higher education GHG inventories²³. Food data was entered under Scope 3, purchased goods and services category, as a weight-based calculation. Total weight for each line item in each invoice was totaled and entered for each campus. As shown in Figures 18-19, a breakdown of each campus is provided. Food emissions are calculated based on weight and respective emission factors, dictated by how energy intensive the item is. Meat has the highest emission factor, while fruit and vegetables have the lowest, due to a lower energy intensive cultivation process.

Total food weight does not necessarily correspond to the largest carbon footprint. Schools can reduce food-related emissions by purchasing and serving lower-carbon foods. Meat has the highest carbon

²² SIMAP food report standards and general proceedings <https://unhsimap.org/cmap/resources/food-report>

²³ SIMAP [SIMAP | University of New Hampshire](https://unhsimap.org/)

intensity, followed by dairy, while fruits and grains have the lowest. Strategies include adopting “Meatless Monday” programs and sourcing local or organic products.

Figure 17. Food Weight by campus

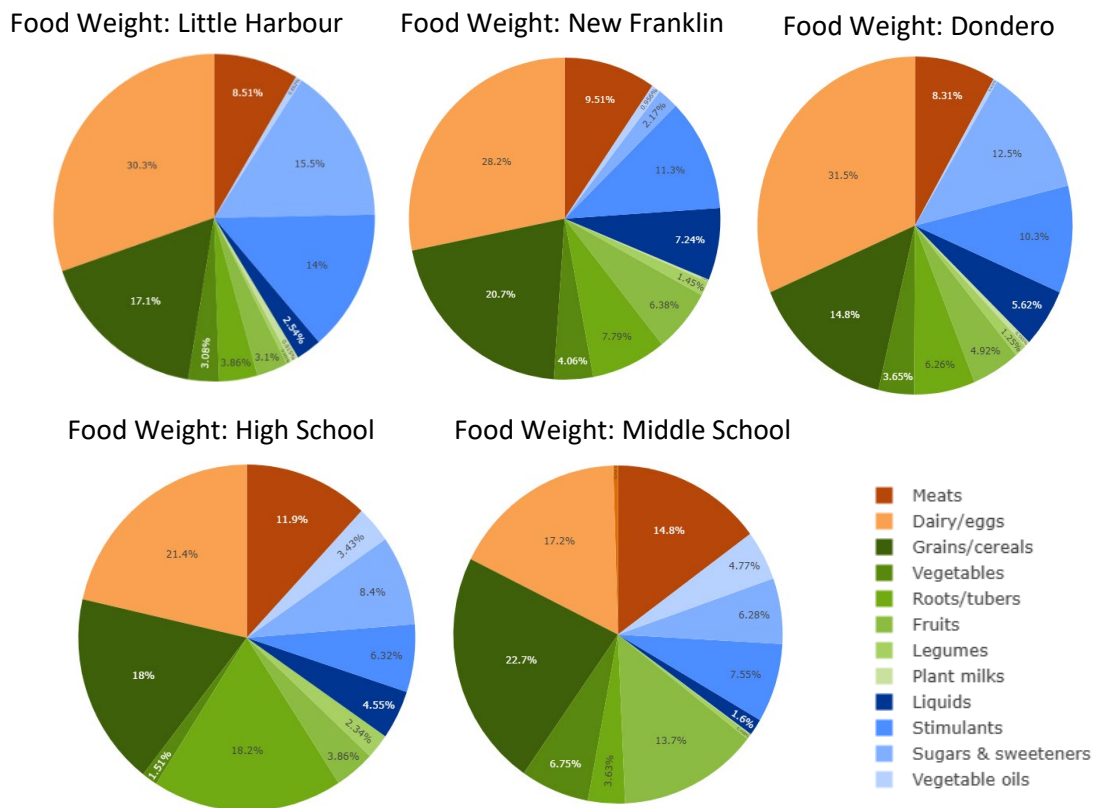


Figure 18. Carbon footprint calculated from food weight and emission factors by campus

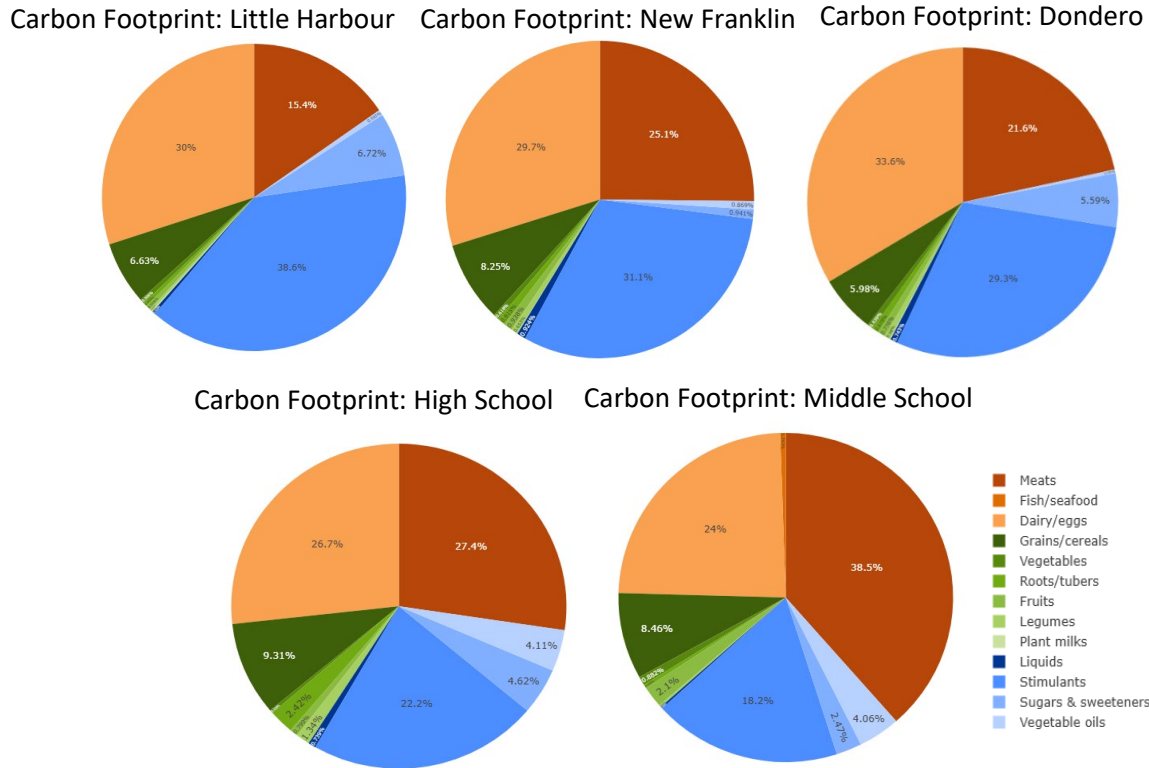


Table 16. Carbon footprints for each school normalized by the current student enrollment show an individual student at each school contributing from approximately 0.078 to 0.19 MTCDE a year. This is equivalent to an estimated 1 to 2.5 months of electricity for an average US household.

Campus	Total Weight Calculated (MT)	Total Emissions Calculated (MTCDE)	Student Population ²⁴	Carbon Footprint Normalized by Student Population
Little Harbour Elementary School	20.05	75.99	410	0.19
New Franklin Elementary School	8.57	32.50	263	0.12
Dondero Elementary School	15.9	58.24	324	0.18
Portsmouth High School	27.6	82.41	1051	0.078
Portsmouth Middle School	21.28	88.59	524	0.17

²⁴ Student population given by the School Department

Alternative Home Heating

Residential home heating data is limited by the feasibility of accessing such accounts due to the wide variety of home heating choices, both by type and provider. In this inventory, residential fuel usage is calculated by a series of estimations from state and federal census data. However, this leaves a large margin of error due to outdated surveys and the nature of projections. To attempt a more accurate dataset of residential fuel for Portsmouth users, a survey was sent out to Portsmouth residents asking questions on fuel consumption throughout the year. This survey was made available in an online format through Microsoft Forms. It was only distributed through a weekly newsletter and was open from June 29 to August 16. The survey generated 180 responses which were then scaled to estimate the entire residential population in Portsmouth. Based on these results, the following projection can be made for Portsmouth residents (Figure 20). Natural gas makes up the majority of the distribution, which is consistent with results from data estimated in the 2025 report. Heating oil is the second-largest category, whose data we could not gather at this time. This residential heating data was instead produced in the 2025 inventory via estimations using state and federal census data.

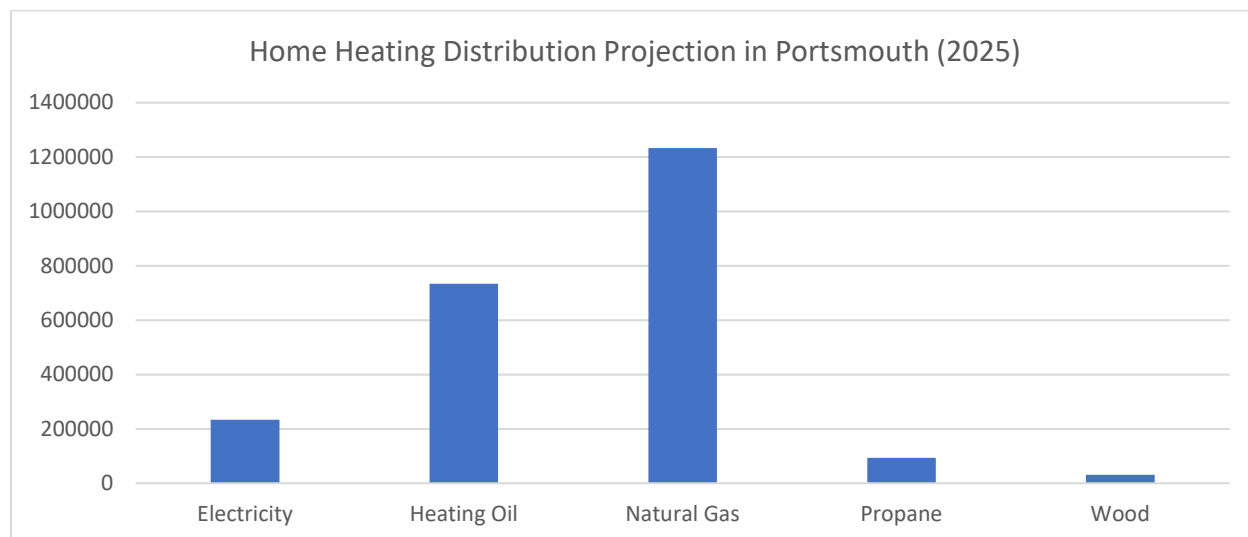


Figure 19. Residential home heating use projections generated from survey results

Based on these results, it would be prudent to look at heating oil use in Portsmouth as a future case study. Out of the total people who responded to the survey, 31% responded that they use heating oil as their primary fuel source. Within this group there was a wide range of the quantity of heating oil that residents reported using each year. The range was as low as 275 gallons and up to 1800 gallons of heating oil used in one calendar year. Based on these numbers, the average responder used

approximately 747 gallons of heating oil, which produces approximately 8 MTCDE a year. With 23.3 k residents in Portsmouth, this could account for nearly 178,000 MTCDE in 2025 solely from heating oil consumption. The following table breaks down approximate emissions for a Portsmouth household based on the survey results that uses heating oil to heat as the primary heating source.

Figure 20. Home heating oil survey results, highlighting the minimum and maximum generated from results

Per Year	Quantity Used (gallons)	Total Emissions (MTCDE)	Equivalent Distance You Can Drive in a Typical Gasoline Car
Average usage	747	8	20,000 miles
Estimated Minimum Use	275	3	7,500 miles
Estimated Maximum Use	1800	18	45,000 miles

Per Month	Quantity Used (gallons)	Total Emissions (MTCDE)	Equivalent Distance You Can Drive in a Typical Gasoline Car
Average usage	107	1	2,500 miles
Estimated Minimum Use	50	0.5	1,250 miles
Estimated Maximum Use	300	3	7,500 miles

Residents have a personal responsibility to meet city-wide net zero targets. Residential heating makes up a significant portion of total community emissions and could be a great target for community-wide upgrades to more efficient home heating systems.

Emission Forecasts and GHG Reduction Scenarios

Ongoing Initiatives

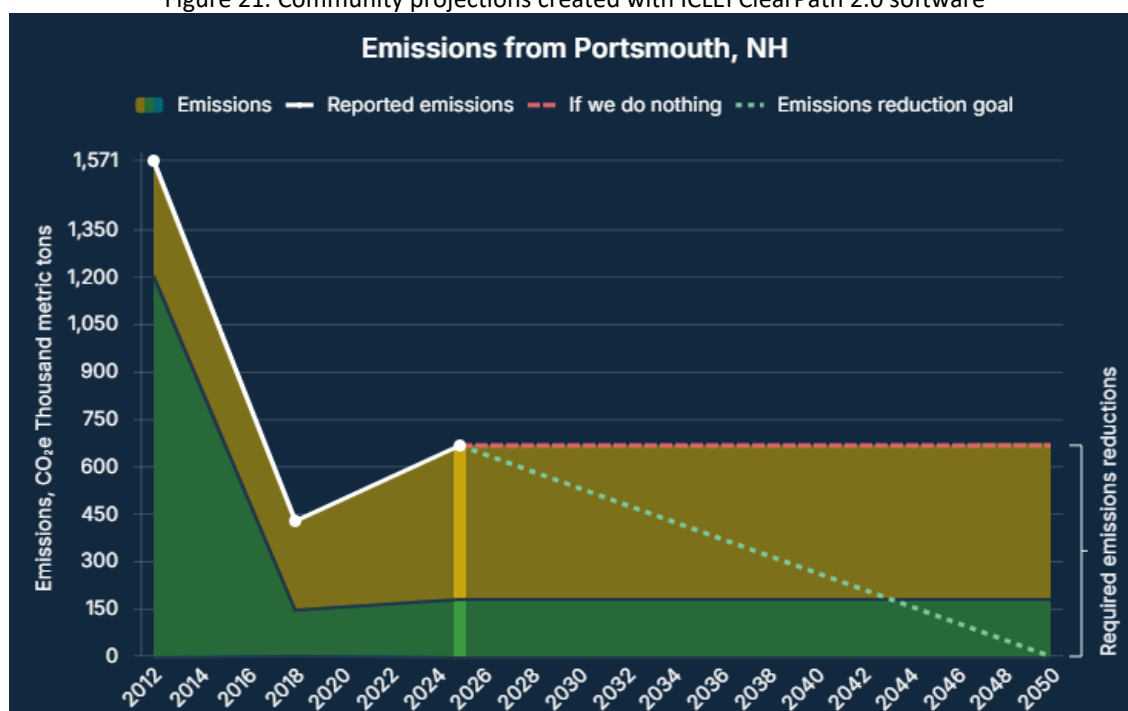
The City's climate action plan (CAP), called Portsmouth's Climate Future, establishes clear greenhouse gas emission reduction targets for the Portsmouth community and the local government. In addition to targets, the CAP has strategic action items for both the community and the municipality to take up

which will help to accomplish emissions reductions. In adopting Portsmouth’s Climate Future, Portsmouth’s City Council set net zero targets for the municipality and community. These targets were established to advance the City’s sustainability efforts to reach net-zero and should continue to be pursued, funded and updated to ensure steady growth towards a sustainable future and a reduction of emissions.

Business-as-Usual Forecast

Business-as-usual (BAU) forecasts were prepared to project emission trends for local-government and community operations if no significant action were to be taken to reduce them. These forecasts were created using ICLEI software (Figures 22–23). The red dashed line in these figures illustrates the case where no improvements are made. The green dashed line illustrates reductions needed in order to reach net zero goals.

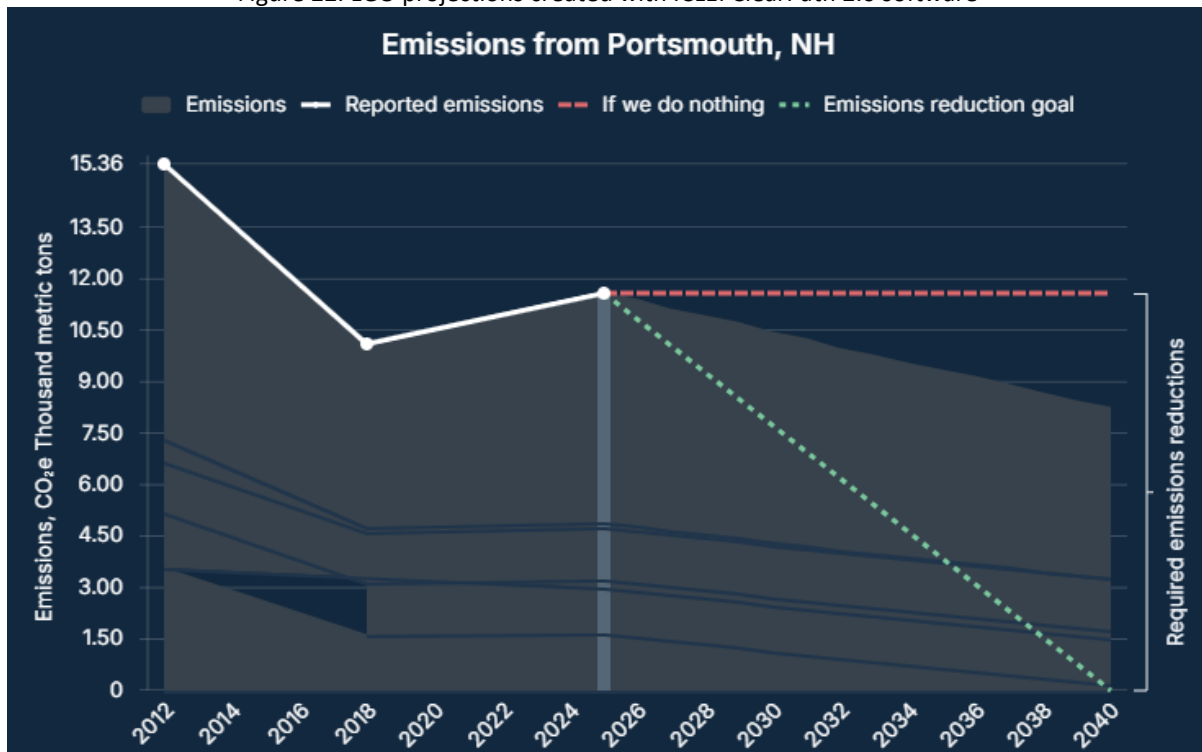
Figure 21. Community projections created with ICLEI ClearPath 2.0 software



Note: Due to incomplete data 2018 total emissions appear smaller than should be

Stationary Energy
Transportation
Waste (represents too small of a portion to be shown)

Figure 22. LGO projections created with ICLEI ClearPath 2.0 software



Note: Due to incomplete data 2018 total emissions appear smaller than should be

*Categories from bottom to top: Water & Wastewater Treatment Facilities, Employee Travel, Transit Fleet, Vehicle Fleet, Street & Traffic Lights, Buildings & Facilities

Local Government Operations GHG Forecasts

Based on the CAP goals, the local government strives to reach net zero by 2040. In order to do so, serious progress needs to be made. The CAP along with the recent Municipal Building Audit highlighted the most cost-effective and emission-efficient efforts to meet these net zero goals.

The Buildings and Facilities sector has historically contributed to a larger proportion of emissions when compared to other categories. Within Buildings and Facilities, stationary fuel consumption contributes more than electricity use. Already, solar arrays exist at the Portsmouth High School and the Madbury Drinking Water Treatment Facility. Currently, RECs for both are not retained. However, both arrays offer the opportunity to decrease overall emissions for both buildings by decreasing dependence on imported grid electricity. The Municipal Building Audit assessed feasibility for roof solar at various municipal buildings and concluded that future solar arrays at Public Works, City Hall, Fire Station 2 and 3, Public Library and the Community Campus would be the most beneficial to the municipality in terms of

emissions reductions when compared to other projects listed in the audit such as the fire stations, especially Fire Station 2 as it is already LEED Silver certified. Suggested solar projects are listed in Table 17, which are supported within the CAP under RE-7. Beyond solar, upgrades to building efficiency stand to significantly reduce emissions. For most buildings, upgrading ventilation systems to either VRF or ground source heat pump systems offers significant reductions in emissions. Within Community Campus, upgrades to the HVAC system offer reductions up to 209 MTCDE. As suggested in BE-6 of the CAP, conducting a more thorough American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) energy audit for each municipal facility would better inform City officials of the most impactful projects.

The Building and Facilities sector contributes the most emissions for the municipal inventory, which also means that it offers the greatest opportunities for reductions. The City of Portsmouth's existing commitment to sustainability, demonstrated by its LEED Silver-certified buildings, Eco-Municipality mindset and commitment to net zero by 2040 provides a strong foundation for future progress.

Table 17. Solar implementation breakdown as reported in the Municipal Building Audit performed by Energy Efficient Investments, Inc. (EEI). Rooftop solar at Public Works offers the largest MTCDE reduction.

	Estimated Budget Cost	Estimated Grants, Rebates, Credits	Estimated Annual Utility Bill Saving	Estimated Annual CO₂ Reduction (MTCDE)
Public Works	\$840,000	\$215,000	\$56,000	51.17
City Hall	\$223,000	\$57,000	\$13,000	12.11
Fire Station 2	\$243,000	\$62,000	\$14,000	12.89
Fire Station 3	\$105,000	\$27,000	\$5,000	4.61
Community Campus	\$451,000	\$115,000	\$28,000	15.61
Library	\$220,000	\$56,000	\$12,000	11.22

Across the municipal transportation system, including employee commuting and the municipal and transit fleets, decarbonization offers the clearest path to emissions reductions. CAP action DTS-7 calls for developing and implementing a fleet decarbonization plan for municipal fleets that considers vehicle electrification and renewable fuels. This plan should assess future charging needs by department and vehicle use type, including the appropriate deployment of Level 2 (240-volt) and direct-current fast-charging (480-volt) stations. Combined with DTS-8, which directs the City to right-size its municipal fleet

so that the number of vehicles does not exceed operational needs, these measures could substantially reduce fleet emissions. DTS-9 further recommends working with the School Department to electrify the school bus fleet, which would significantly lower school transportation emissions. Employee commuting also presents an opportunity for improvement: few survey respondents reported carpooling to work. A citywide carpooling program could reduce single-occupancy vehicle trips, vehicle miles traveled, and associated emissions.

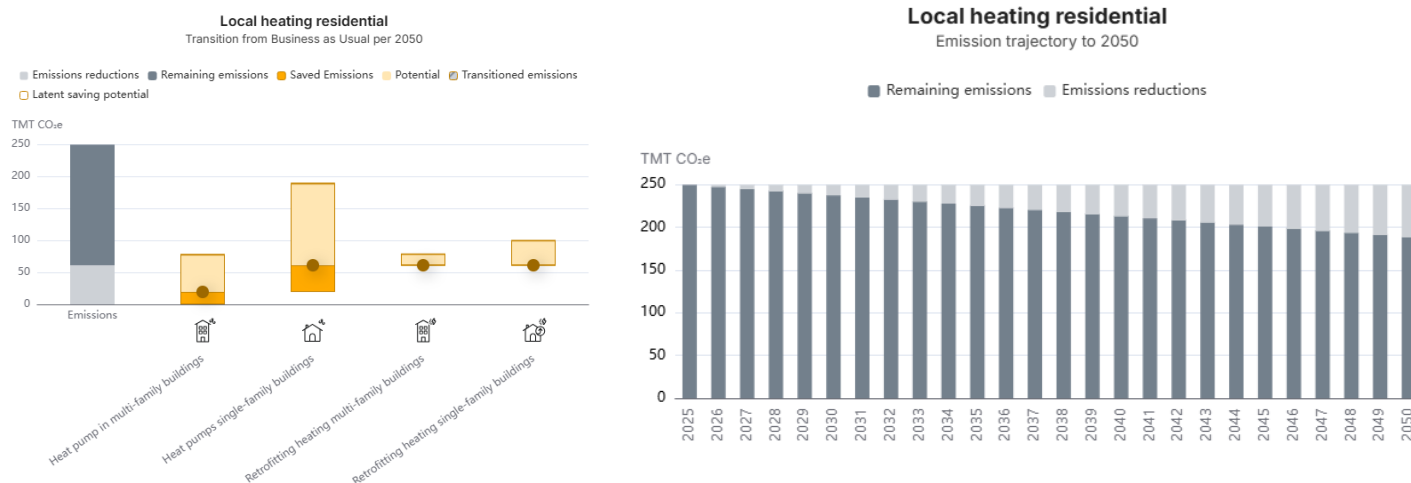
Community GHG Forecasts

Community emissions far outweigh municipal emissions by a factor of 57. With community net zero goals set for 2050, Portsmouth residents have the most opportunity to decrease their own emissions through decarbonization in heating, cooling, transportation, and sustainable waste management.

The ICLEI ClearPath 2.0 transition tool helps show various transitions and their overall effect on total emissions moving forward. These transitions highlight the most beneficial reduction strategies.

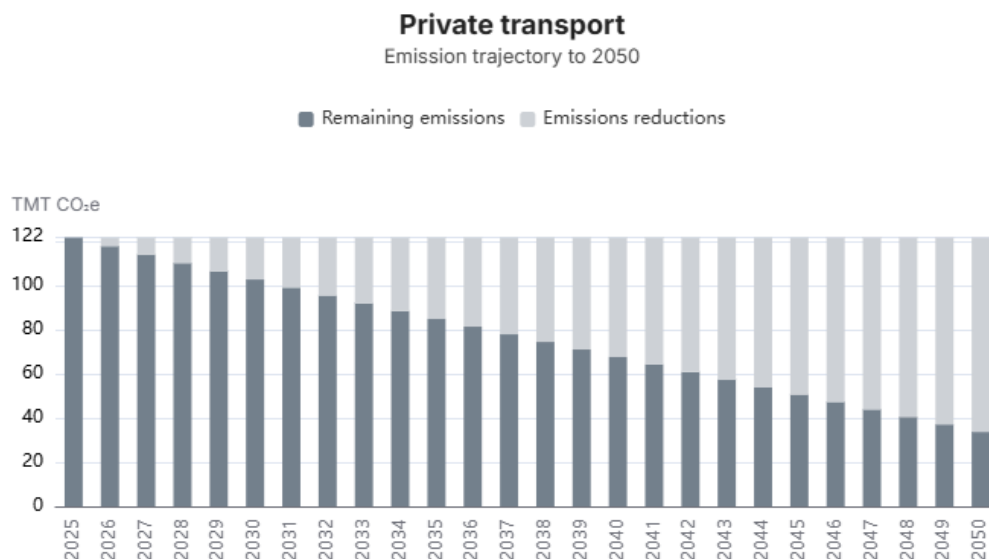
Within community emissions, residential heating made up the largest portion. From ICLEI estimated results using ACS data and data from the home heating survey, natural gas is the largest heat fuel type, followed by home heating oil for both single- and multi-family homes. As shown in Figure 24, if 25% of single and multi-family homes add heat pumps to their homes, total emissions for residential heating could decrease by over 50 TMTCDE, which is 4.5 times the size of all municipal emissions.

Figure 23. Local residential heating forecast representing 25% of single and multi-family homes switching to heat pumps



Within community transportation, there are two paths to decarbonization: through personal transportation and through freight transport, which includes on-road heavy duty vehicles. Personal transport produced over double the total emissions when compared to the road freight category. Over time there has been an increase in fuel efficiency, which has helped personal vehicles produce fewer emissions. As of 2025, there are 647 electric vehicles registered in the City of Portsmouth and 247 plug-in vehicles²⁵. Increasing the number of Portsmouth-based electric vehicles could mean significant reductions in overall emissions on the community side. Figure 25 shows a forecast with the scenario of increasing current electric vehicles on the road by 50% and increasing ride sharing by 10%. These two switches alone could decrease emissions for personal transport by approximately 82 TMTCDE. Coupled with the City’s continued efforts to transform the City of Portsmouth into a multi-modal City, these strategies could significantly decrease emissions. DTS-1 of the CAP outlines continued efforts to implement the recommendations of the City’s updated Bicycle and Pedestrian Plan, which shall support the creation of a viable alternative transportation network that reduces the community’s dependence on motor vehicles. DTS-3 calls for expanding public transportation within Portsmouth and improving connections to regional routes, making public transit a more attractive alternative to personal vehicles and increasing shared ridership.

Figure 24. Private transport emission forecast with scenario of on-road electric cars increasing by 50% and journey sharing increasing by 10%. Overall, changes reduce emissions by 82 TMTCDE



²⁵ Data from City of Portsmouth’s Assessor Office

Waste represents only a small share of total emissions. However, emissions generated from exported waste are not insignificant. In terms of the CAP, WM-1 outlines a Zero Waste Plan for community

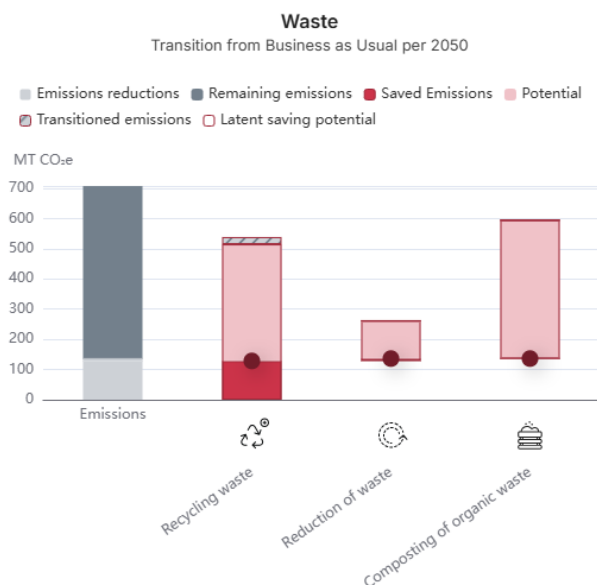


Figure 25. Waste forecast with scenario for a 25% increase on recycling waste and a 5% decrease of overall waste, which yields over 100 MTCDE reduction

residents to reduce, reuse, recycle, and compost at least 90% of solid waste. Supporting this action the Sustainability Task force has a zero waste team dedicated to this effort. Additionally, WM-2 calls for a ban against single-use plastics, which would reduce total discarded plastics. Other states and communities have already implemented such programs in order to decrease waste sent to the landfills. The City of Portsmouth has already adopted a Skip the Stuff Policy²⁶ which encourages local businesses to only distribute single-use food service-ware upon request. The City can also support the expansion of curbside food waste collection and composting programs, to reduce usable food waste discarded as landfill waste.

Although agriculture, forestry, and other land use (AFOLU) emissions were not quantified in this inventory, the sector offers opportunities to offset community-wide emissions through carbon sequestration. CAP action CSLU-2 calls for identifying publicly owned land and privately owned land that may be suitable for acquisition, where greenhouse gas sequestration could be established or enhanced. Reforestation, improved forest management, and wetland restoration are among the strategies that could expand Portsmouth’s natural carbon sinks and help offset the community’s overall emissions.

Discussion and Conclusion

Limitations of Report

This report is not all-encompassing and lacks information that may be useful to Portsmouth City officials.

²⁶ “Skip the Stuff” Policy [2024-01 - Single-Use Service-ware Reduction or Skip the Stuff Polciy.pdf](#)

The ICLEI ClearPath emissions scenarios are helpful for projecting what emissions might be in the future. However, uncertainty of emissions estimates is not quantified within the model, meaning that there is some risk that these emissions are inaccurate. The model did not calculate a 95% confidence interval or a range of possible emissions. Future analyses may consider using an uncertainty analysis to provide policymakers with more insight into their GHG inventories.

The ICLEI Learn Tool was the only method used to calculate land-based carbon storage and sequestration. This tool is limited because it only measures CO₂ removals and emissions from forests, trees outside of forests, and forest-related land use change. This means that emissions and removals from agricultural land, wetlands, grasslands, and other green spaces are not calculated or compiled into this inventory. This means that a complete estimation of AFOLU emissions sources and sinks needs to be calculated outside of the tool.

In addition, a cost-benefit analysis of the mitigation strategies was not fully addressed in this report. All recommendations are therefore based on what strategies will reduce the most GHG emissions to meet the City's climate goals. Further research must be completed to assess the cost of investing in decarbonized transportation, sustainable waste management programs, land use management initiatives, and incentives for community decarbonization.

Final Thoughts

Portsmouth, New Hampshire, is among many U.S. municipalities taking responsibility for tracking greenhouse gas emissions and using those findings to guide measurable improvements. By establishing a consistent emissions baseline, identifying the highest-emitting sectors, and evaluating targeted reduction strategies, the City can prioritize investments and measure progress toward its municipal and community-wide net zero goals. Continued inventories will provide the accountability and evidence needed to refine these strategies over time.

Reaching Portsmouth's net zero goals will require sustained investment in decarbonization across municipal and community sectors. By commissioning this inventory and implementing sustainability initiatives, the City has established a foundation for action; the next step is to prioritize funding the

strategies with the greatest emissions-reduction potential and tracking the results through future inventories.

Appendix A: Agriculture, Forestry, and Other Land Use Report

Summary Report

GHG Inventory for Forests and Trees Outside Forests, (2021-2023) Portsmouth, NH

Forests and trees play a key role in mitigating climate change, yet they are often not included in local greenhouse gas (GHG) inventories or climate action plans. Data in this report helps users take the first step towards understanding how local changes in land use and tree canopy have contributed to the city's net greenhouse gas profile and may suggest mitigation activities to explore in more depth. Unlike other sectors, land use (in this case, forests and trees) not only emits GHGs, but also remove CO₂ from the atmosphere through photosynthesis, playing a critical role in regulating the planet's climate. The information contained in this summary report can be useful when designing climate actions that reduce GHG emissions and/or increase removals of GHGs from the atmosphere. For more information on LEARN's data and methods, please consult the technical note.

Key Findings:

- Over the period 2021 to 2023, emissions from forests and trees were 7,402 t CO₂e per year.
- Over the period 2021 to 2023, the net GHG balance of forests and trees was -7,008 t CO₂e per year.
- Roughly 25% of Portsmouth's total land base of 4,342 hectares (10,730 acres) is forest. Many areas outside of forests are also covered by trees, including an average of nearly 26.9 percent tree canopy on lands outside of forest areas.
- Over the same period, annual CO₂ removals from forests and trees were -14,410 t CO₂e per year. (Carbon removals are represented by negative values.)
- Removals could be increased if additional forests/trees were added to its land base.
- Forest disturbances caused emissions of 1,256 t CO₂e per year averaged over the inventory period.
- Total GHG emissions for Portsmouth across all sectors could be reduced if the area affected by disturbance were lessened, and/or if losses of forests to other land uses or losses of trees outside forests were reduced.

Table 1. Portsmouth's GHG – emissions and removals from forests and trees for inventory period 2021- 2023 values reported in t CO2e per year

	Removals(t CO2e/yr)	Emissions(t CO2e/yr)
Undisturbed Forest	-6,791	
Fire		0
Insect/Disease		0
Harvest/Other		1,038
Trees outside of forests		5,118
Forest to Grassland		0
Forest to Cropland		0
Forest to Wetland		257
Forest to Settlement		990
Forest to Other		0
Harvested Wood Products	0	
Trees outside of forests	-7,611	
Non-Forest to Forest	-8	
TOTAL	-14,410	7,402
Net GHG balance	-7,008	

Data Inputs

Data used as inputs into the GHG emission and removal calculations are described below.

Land and Forest Cover

GHG inventories for lands are reported in six "land use" categories: forest land, grassland, cropland, wetland, settlement and other land (barren, snow, ice). Portsmouth total land base is approximately 4,342 hectares (10,730 acres), with nearly 62.7% settlement (i.e. developed areas of varying intensity), around 25.3% forest, 0.8% grassland (which includes hay/pasture, shrub/scrub and other herbaceous cover), 0% cropland, 11.2% wetland and 0% other land.

Figure 1. Land cover in Portsmouth from the National Land Cover Database, 2023

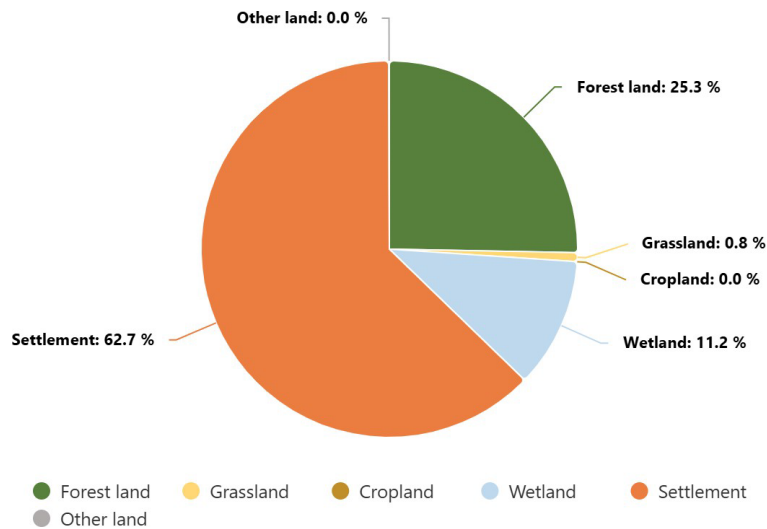
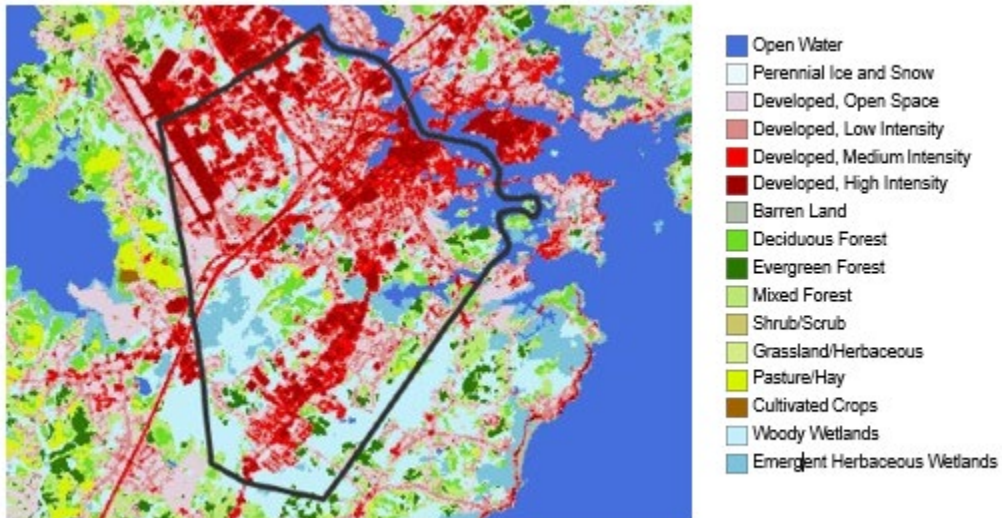


Figure 2. Land cover in Portsmouth from National Land Cover Database, 2023



Mature & Old Growth Forests

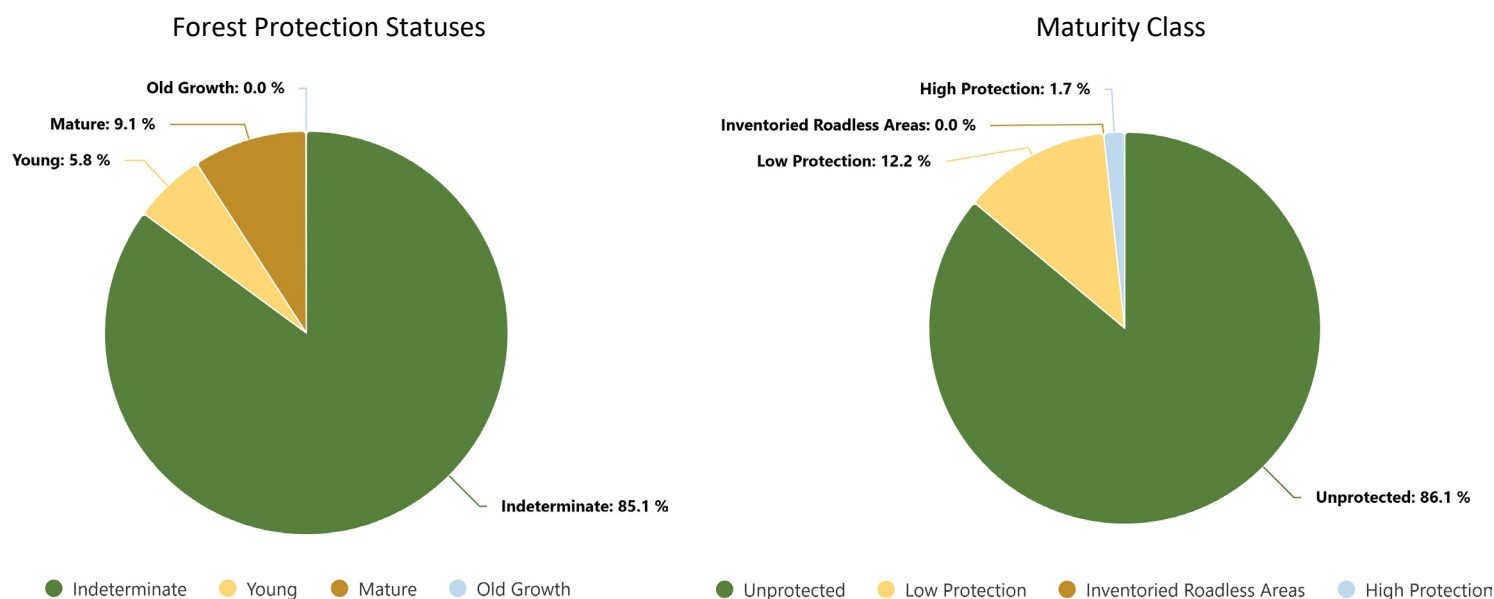
Forests were divided by age and protected status based on data from 2021 to 2023. Of the 871 hectares of forest in Portsmouth in 2023, 1 are old growth, 396 are mature, 250 are young, and 3,695 are of an indeterminate age. Of the same 871 hectares of forest, 75 are highly protected, 530 are in inventoried roadless areas, 0 are under low protection, and 3,738 are unprotected.

Table 2. Forest area by maturity class and GAP protection status

Forest Area (ha) by Maturity and Protection Status	Unprotected	Low Protection	Inventoried Roadless Areas	High Protection	Totals
Young	180	68	0	3	250
Mature	265	115	0	16	396
Old Growth	1	0	0	0	1
Indeterminate	3,292	347	0	56	3,695
Totals	3,738	530	0	75	4,343

Note: Forest area estimates in this table may not match area estimates based on NLCD data because the underlying datasets differ.

Figure 3. Proportions of area within each maturity and GAP protection status



Forest Cover Change

Generating GHG estimates requires data on land use areas and how they have changed over time. Between 2021 and 2023, Portsmouth lost around 9 hectares (23 acres) of forest land, largely conversion to settlement. Over the same period, Portsmouth gained around 1 hectare (3 acres) of forest land, largely from grassland. It is often the case that forest cover indicates changes from forest to settlement and settlement to forest, but that these changes are temporary loss of tree cover from forest remaining forest following disturbance or harvesting.

Figure 4. Loss of forest to other land use types between 2021 and 2023 (ha)

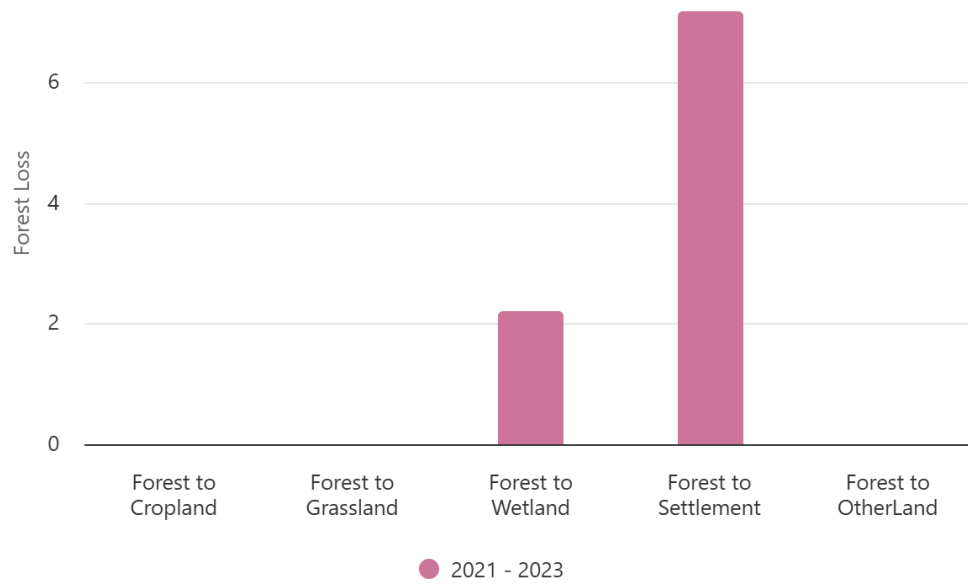
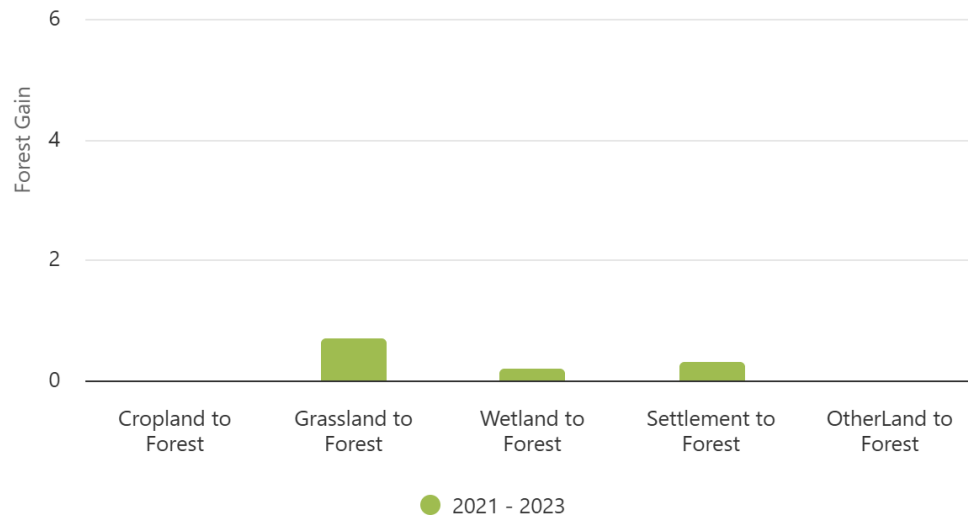


Figure 5. Gain of forest from other land use types between 2021 and 2023



Forest Disturbances

Over the inventory period 2021 to 2023, forest disturbance affected a total of 95 hectares (234 acres) of Portsmouth. Forest disturbance from harvests was the most significant disturbance in Portsmouth, affecting 95 hectares (234 acres), followed by fires, which affected 0 hectares (0 acres) and insects, which affected 0 hectares (0 acres).

Harvest Disturbance Breakdown

Low intensity harvest was the largest source of harvest emissions. Low intensity harvest occurred over 89 ha, or 94.7% of the harvest area, and created 717 t CO₂e, or 69.1% of the total emissions from harvest activities.

Figure 6. Harvest area by disturbance severity (ha)

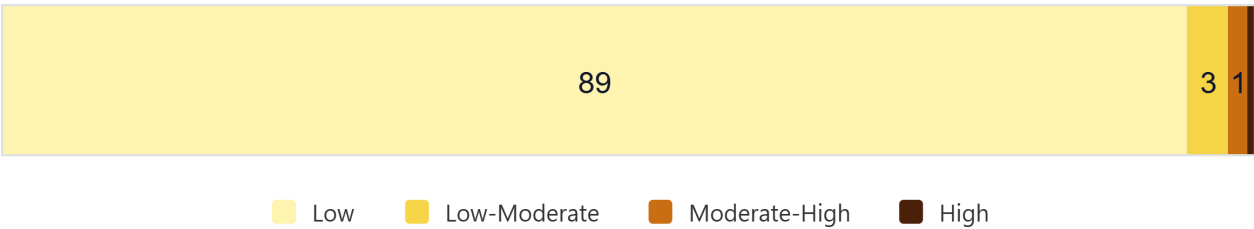
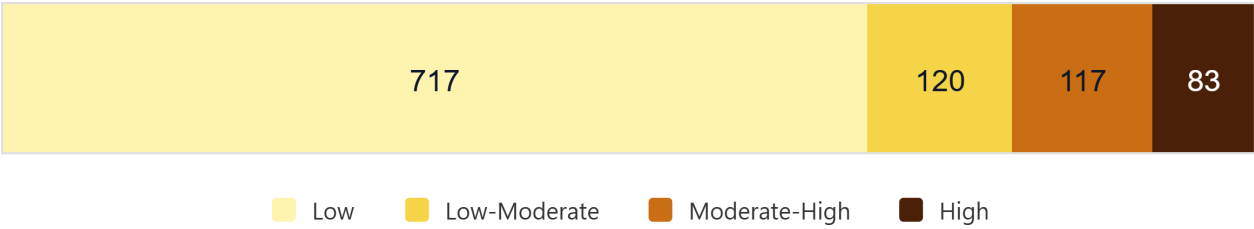


Figure 7. Harvest emissions by disturbance severity (t CO₂e)



Harvest disturbance intensity is defined by the percentage of canopy cover lost within areas mapped as harvest disturbance over the inventory period:

- Low: 0 to <25 pp decreases in tree canopy cover
- Low-Moderate: 25 to <50 pp decreases in tree canopy cover
- Moderate-High: 50 to <75 pp decreases in tree canopy cover
- High: 75 to 100 pp decrease in tree canopy cover

Trees Outside Forests

Figure 8 shows tree canopy captured by the NLCD tree canopy data. (Note that some areas with high tree canopy in Figure 8 overlap with the NLCD forest class shown in Figure 2.)

Over the time period 2021 to 2023, Portsmouth had an average of 871 hectares (2,153 acres) of tree canopy outside forests. Between 2021 and 2023, 8 hectares per year of tree canopy were lost, for a total of 40 hectares (98 acres) of tree canopy loss over the year period. Most of this loss occurred within the Settlement class.

Figure 8. Tree canopy 2023 (Source: National Land Cover Data Base)

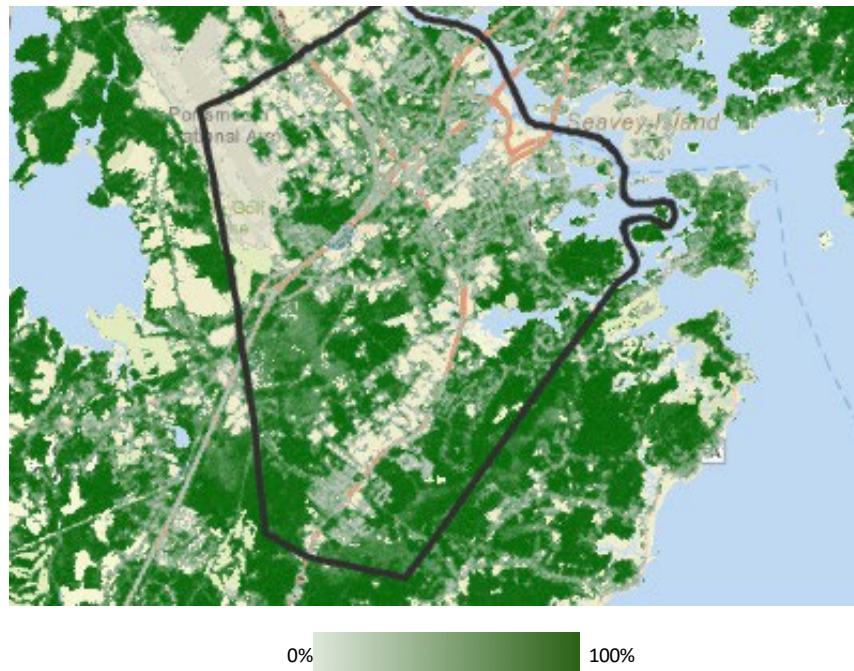
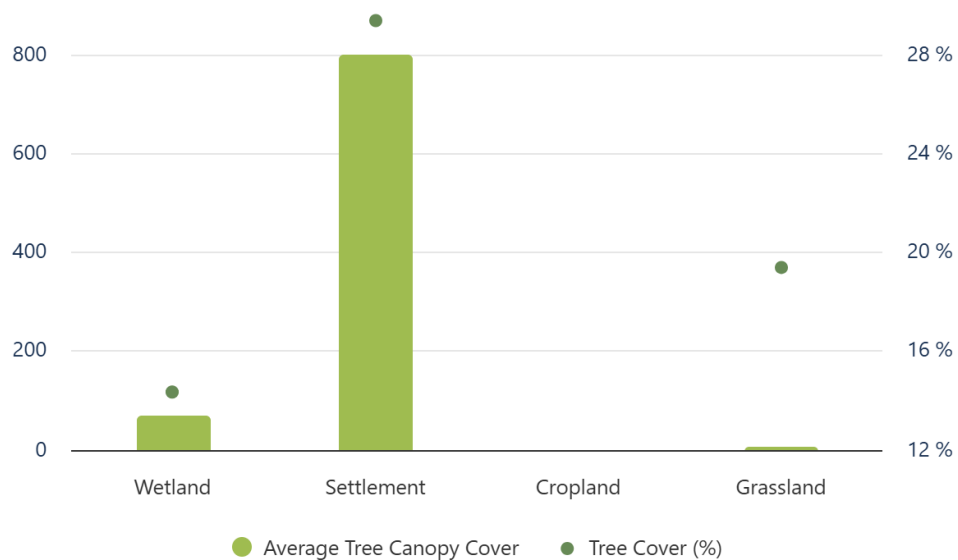
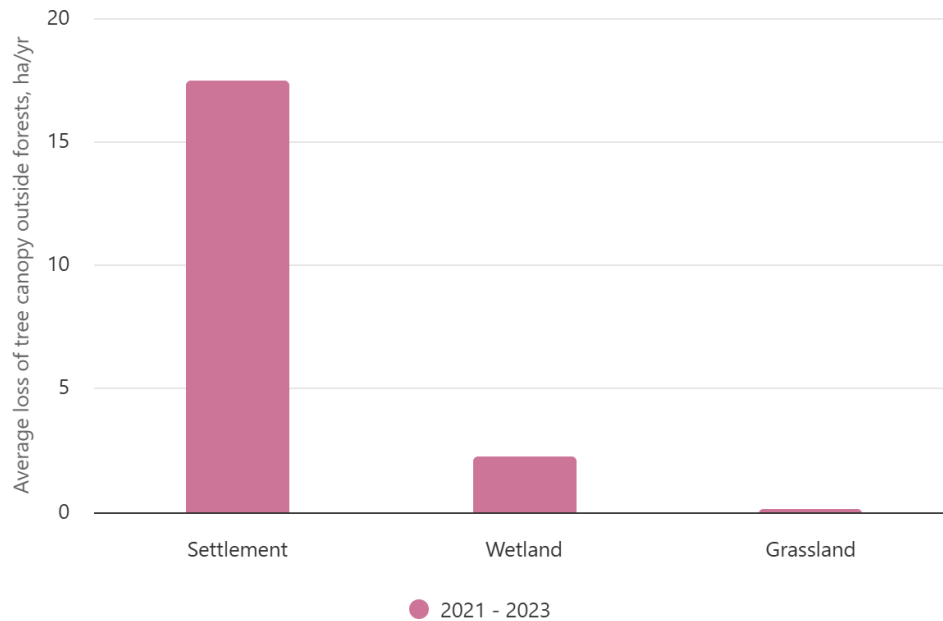


Figure 9. Average tree canopy (in hectares) and % tree canopy in different non-forest land use categories in Portsmouth for time period 2021-2023.



Note: bars relate to tree canopy area (left vertical-axis, hectares) and dots are the % of tree cover per land use category (right vertical-axis). "Other" category not shown due to low area.

Figure 10. Average area of tree canopy loss in different non-forest land use categories in Portsmouth over the period 2021-2023 (hectares per year).



Note: other category not shown due to very low area

Table 3. Full NLCD land cover change matrix for 2021 to 2023. All area in hectares

2023: Across 2021: Down	Deciduous Forest	Evergreen Forest	Mixed Forest	Woody Wetlands	Cultivated Crops	Pasture/Hay	Grassland/Herbaceous	Shrub/Scrub	Open Water	Emergent Herbaceous Wetlands	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Barren Land	Perennial Ice/Snow	Total
Deciduous Forest	127	0	0.1	0	0	0	0	0	0.2	0	1	1	2	0	0	0	131
Evergreen Forest	0	96	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	96
Mixed Forest	0.4	0.1	159	0	0	0	0	0	0.1	0	0.7	0	0	0	0	0	160
Woody Wetlands	0	0	0	716	0	0	0	0	0	2	2	0.1	0	0	0	0	719
Cultivated Crops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pasture/Hay	0	0	0	0	0	15	0	0	0	0	0.2	0	0.2	0	0	0	15
Grassland/Herbaceous	0.2	0	0	0	0	0.1	15	0	0.3	0	1	0.4	2	0	0.2	0	19
Shrub/Scrub	0.3	0	0.2	0	0	0	0	3	0	0	0	0	0	0	0	0	3
Open Water	0	0	0	0	0	0	0.1	0	264	0.4	0	0.4	0	0	0	0	265
Emergent Herbaceous Wetlands	0	0	0	0.2	0	0	0	0	0.9	216	0.2	0	0	0	0	0	217
Developed, Open Space	0.3	0	0	0	0	0	0	0	0.3	0	706	2	0.8	0	0	0	710
Developed, Low Intensity	0	0	0	0	0	0	0	0	2	0.1	4	807	2	0.1	0	0	816
Developed, Medium Intensity	0	0	0	0	0	0	0	0	0.9	0	0	9	756	0.8	0	0	767
Developed, High Intensity	0	0	0	0	0	0	0	0	0	0	0	0	0.9	422	0	0	423
Barren Land	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0	2	0	2
Perennial Ice/Snow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	128	96	159	716	0	15	15	3	270	218	715	821	764	423	2	0	0

Table 4. Simplified land cover change matrix for 2021-2023. All areas are in hectares.

2023: Across 2021: Down	Forest Land	Cropland	Grassland	Wetland	Settlement	Other Land	Total
Forest Land	1,098	0	0	2	7	0	1,107
Cropland	0	0	0	0	0	0	0
Grassland	0.7	0	32	0.3	3	0.2	37
Wetland	0.2	0	0.1	481	0.6	0	482
Settlement	0.3	0	0	4	2,712	0	2,716
Other Land	0	0	0	0.4	0	2	2
Total	1,099	0	32	487	2,723	2	0

Emission and Removal Factors

Table 5. Summary of the emission and removal factors

	Emission Factor (t C/ha)	Removal Factor (t C/ha/yr)
Forest Change		
Deforestation		
To Cropland	0.00	
To Grassland	0.00	
To Settlement	75.87	
To Wetland	64.74	
To Other	0.00	
Reforestation (Non-Forest to Forest)		
		-1.97
Forest Remaining Forest		
Undisturbed		
		-1.84
Disturbed		
Fire	0	
Insect/Disease		
Harvest/Other	5.98	
Harvest: High	84.22	
Harvest: High Moderate	44.29	
Harvest: Low Moderate	21.96	
Harvest: Low	4.39	
Trees Outside Forest		
Tree canopy loss	70.20	
Canopy maintained/gained		-2.38

Harvested Wood Products

Harvested wood products (HWP) temporarily store carbon from the forest ecosystem as the wood goes through a series of production processes and end-uses, with eventual disposal (and emission to the atmosphere). The delay represents a net benefit to the atmosphere in the short term. The period of storage varies from long-lived solid wood products that remain in use for long periods of time to products that are quickly disposed of in landfills.

In the web tool, the HWP Calculator tracks carbon in harvested wood through four different "fates," from harvest to timber products to primary wood products to end-use to disposal, applying best estimates for product ratios and half-lives at each stage. Based on user inputs entered about annual harvest volumes in Custom uploaded polygon, the change in the harvested wood pool over the inventory period 2021 to 2023 is estimated as 0 t CO₂e per year.

Caveats

The LEARN tool is intended to provide communities and land managers with a quick and straightforward method to estimate and understand GHG fluxes from forests and trees and how they are changing over time. These estimates can help identify the role that existing forests and trees play in a community's overall GHG inventory and where policies may be designed to reduce net GHG emissions from forests and trees. The LEARN tool is limited in scope to assessing land-use changes involving forests and TOFs and does not currently address other major land uses that can have significant GHG emissions, such as cropland and pasture.

The LEARN tool is designed to save users the significant time and effort of conducting their own GHG inventory for forests and trees. Additionally, the tool's standardized methodology facilitates regional and temporal consistency in GHG reporting and can be used to create data-oriented benchmarks for reducing net GHG emissions. However, there are some limitations to the scope and applicability of these estimates.

Information obtained from the LEARN tool should be understood and applied in the context of its intended uses and scope of analysis. There are potential sources of error and uncertainty in these estimates, given the modeled nature of many of the datasets used. At the time of publication, the LEARN tool cannot be used to generate or verify carbon credits. In general, we recommend that users conduct additional analysis and verification when seeking to use results

in policy or land management decisions and take care to understand and communicate the limitations of LEARN estimates.

The LEARN tool uses the best available nationally consistent operational datasets. Nevertheless, varying degrees of accuracy and uncertainty are associated with each of these datasets. When multiple spatial datasets with distinct inaccuracies and imprecisions are combined in an analysis, errors may be compounded. Although individual uncertainties for data inputs may be estimated, there is no standardized method for reporting uncertainty in final calculations that can be applied automatically across all potential scales of analysis. While uncertainties can be high, the estimates can still provide useful information on the relative magnitude and importance of such GHGs; subsequent analyses can also provide information on the directionality of emissions and removals from land management.

Because the majority of LEARN data inputs are at a 30-meter or coarser resolution, applicability at smaller scales (areas less than one hectare) may be limited. For example, the resolution of land cover change analyzed in the LEARN tool may be too coarse to accurately characterize fluxes on individual parcels or groups of parcels under similar management. When using remote sensing products and geographic information systems, errors tend to normalize at larger scales of analysis. Smaller scales may be subject to larger uncertainties and are less suitable for analysis using the automated LEARN tool.

Estimates of emissions from forest disturbances may also be subject to further uncertainty. Because no national operational data product currently exists to track disturbances from harvest, areas of harvest are delineated based on key assumptions. The logic for defining areas of harvest assumes that any tree cover loss in forests remaining forests that are not characterized as fire or insect and disease are likely to represent harvest, though there will be occasions when the true disturbance is wind or weather. This logic compounds potential errors in the fire, insect and disease, and tree cover loss datasets. We suggest that communities seeing significant areas of harvest disturbance conduct additional analysis to investigate the cause of disturbances in these errors and make informed policy decisions.

Mature and Old Growth Forest Definitions

Young: This age class generally includes forests that have been recently harvested, severely disturbed, or planted, and are growing up to the age of physiological maturity. For this tool, we use data from DellaSala et al. (2022) to delineate young, forested areas based on relatively low values of remotely sensed forest structure parameters (canopy height, canopy cover, and biomass), which act as a proxy for young age class characteristics. See DellaSala et al. (2022) for more details on this methodology.

Mature: This age class consists of physiologically mature forests that are not recently harvested, severely disturbed, or planted, but which lack structural characteristics of old growth. In the data used here, this is defined based on intermediate values of remotely sensed forest structure parameters from DellaSala et al. (2022) and corresponds to the age class titled "intermediate" in that dataset.

Old Growth: Definitions of old growth are highly variable by region and even species, but in general this category attempts to capture forests that have not been harvested for a long time and have old, well-established trees and related structural attributes. In this tool 'old growth' is defined based on relatively high values of remotely sensed forest structure parameters, which act as a proxy for characteristics corresponding to this age class. See DellaSala et al. (2022) for more details on this methodology (note that this category corresponds to the category labeled 'mature' in the paper).

Indeterminate: the original analysis (DellaSala et al. 2022) could not specify a maturity class for this area.

Protection Status Definitions

Unprotected: there are no known protections from non-forest land use, land-use change, timber harvest, or forest management practices.

Low Protection: USGS Gap Status 3-4 areas lack full protection from land conversion, with Gap 3 allowing extractive uses like logging or mining while protecting endangered species, and Gap 4 having no mandates preventing habitat conversion, often involving private or developed lands.

Inventoried Roadless Areas: U.S. Forest Service Inventoried Roadless Areas currently have protections from land conversion as well as from most road building and timber harvesting, but allow for moderate use and management, including some wildfire management activities and hard rock mining, as well as mineral leasing with prohibitions on use of the land surface.

High Protection: USGS Gap Status 1-2 areas have permanent protection from land conversion, but while Gap 1 maintains a natural state with minimal interference, Gap 2 allows some uses that may degrade natural communities.

Appendix B: Commuting Survey Results

City Employee Commuting Survey

These questions are regarding your daily commute to work for 2025. The data will be used in the updated citywide greenhouse gas inventory. A greenhouse gas inventory measures the amount of greenhouse gas emissions from various sources, including the emissions associated with city employees commuting to work!

* Required

1. Did you work for the city of Portsmouth in 2025? *

☐ Yes

☐ No

2. What department do you work in? *

3. From the remaining days not spent telecommuting (if any) on an average week, how many days per week do you...

Should add up to no more than 5 *

	0	1	2	3	4	5
Drive your own car	☐	☐	☐	☐	☐	☐
Carpool	☐	☐	☐	☐	☐	☐
Use public transportation	☐	☐	☐	☐	☐	☐
Ride your bicycle	☐	☐	☐	☐	☐	☐
Walk	☐	☐	☐	☐	☐	☐
Telecommute	☐	☐	☐	☐	☐	☐

4. What type of vehicle did you primarily drive to work in 2025? *

- ☐ Passenger car
- ☐ Light truck/SUV/Pickup/Van
- ☐ Heavy duty truck (trucks w/ 2 axles & 6 or more tires or a gross vehicle weight exceeding 10,000 lbs, Example: Ford F250 or F350)
- ☐ Motorcycle
- ☐ Other

5. What type of fuel does your primary vehicle use? *

- ☐ Gasoline
- ☐ Diesel
- ☐ Hybrid gasoline
- ☐ Hybrid diesel
- ☐ Biodiesel/ethanol
- ☐ Electric
- ☐ None
- ☐ Other

6. How many miles do you drive to work on an average one-way trip? *

7. If electric, do you use on-site chargers for your primary charging source? *

- ☐ Yes
- ☐ No
- ☐ N/A

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Appendix C: Heating Survey Results

Residential Home Heating Survey

This survey is anonymous and results will not be shared

* Required

1. Do you live in Portsmouth, NH? *

☐ Yes

☐ No

2. What do you primarily heat your house with? *

☐ Natural Gas (therms or BTU)

☐ Electricity (kWh)

☐ Propane (gallons)

☐ Heating Oil (gallons)

☐ Wood and Pellets (per bag or per ton)

☐ N/A (I do not pay for heating)

☐ Other

3. Approximately how many months out of the year do you heat your house? *

- ☐ 1 month
- ☐ 2 months
- ☐ 3 months
- ☐ 4 months
- ☐ 5 months
- ☐ 6 months
- ☐ 7 months
- ☐ 8 months
- ☐ 9 months
- ☐ 10 months
- ☐ 11 months
- ☐ 12 months

4. Approximately how much heating fuel did you purchase in 2025? (typical units of consumption are included in question 2 for clarity)

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