

Summary of Findings from Durham's Community-Wide Greenhouse Gas Inventory

Note: This document is meant to provide a high-level overview of findings. A more in-depth analysis of these inventories is included in the [Community-Wide Greenhouse Gas Inventory Report](#)¹ as well as the [Land Use Greenhouse Gas Inventory Report](#).²

Background

The Town of Durham, New Hampshire, is committed to being a leader in sustainability in the face of climate change, making numerous efforts to reduce emissions and increase the Town's resiliency to climate change.

In January 2021, Durham joined the Global Covenant of Mayors for Climate and Energy (GCoM), where the Town pledged to reduce greenhouse gas (GHG) emissions and prepare for the impacts of climate change.³ Within the first three years, Durham is required to complete:

- Community-Wide Greenhouse Gas Inventory
- Emission Reduction Targets (based on inventory findings)
- Climate Risk and Vulnerability Assessment
- Risk Reduction Goals (based on assessment findings)
- Climate Action Plan

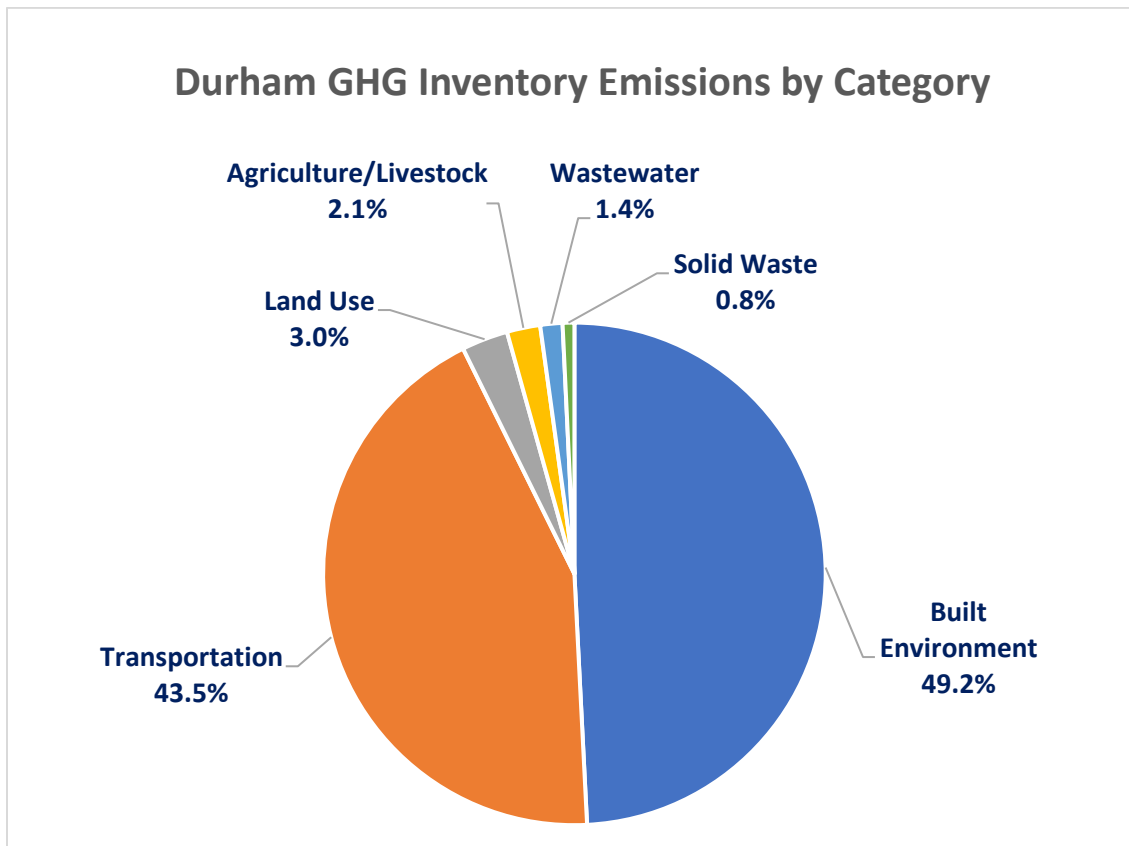
In 2021, a Community-Wide Greenhouse Gas Inventory was completed by UNH Sustainability Fellows Emily Mello and Cathy Fletcher. This inventory included the measurement of greenhouse gas emissions and removals from following sectors: Built Environment, Transportation, Wastewater, Solid Waste, Agriculture/Livestock, and Land Use. The first four sectors are required under GCoM, while Agriculture/Livestock and Land Use are optional. By including land use within its inventory, Durham is acknowledging the importance of nature-based solutions in mitigating the effects of climate change.

Results from these inventories will help Durham create emission reduction targets and inform policy decisions and mitigation action items to include in its Climate Action Plan. Units of measurement are in metric tons of carbon dioxide equivalents (noted as tCO₂e), which is the universal unit for comparing emissions of different greenhouse gases in terms of the global warming potential of one unit of carbon dioxide.⁴

Findings

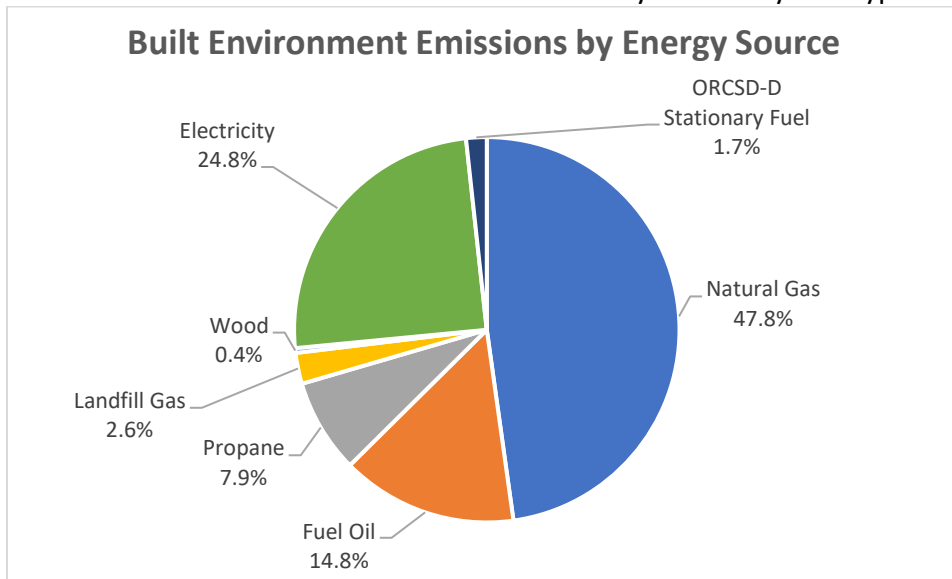
An overview of GHG emissions and removals from Durham’s categories is included in the table below. All results refer to emissions and removals within Durham’s Town boundary. The Built Environment, Transportation, Wastewater, Solid Waste, and Agriculture/Livestock emissions are based on 2019 data, while Land Use is based on the average emissions and removals from 2006 until 2016.

Category	Emissions/Removals (tCO ₂ e)	Percentage of Total Emissions
Built Environment	44,403	49.2%
Transportation	39,258	43.5%
Solid Waste	680	0.8%
Wastewater	1,290	1.4%
Agriculture/Livestock	1,935	2.1%
Land Use Emissions	2,691	3.0%
Total Emissions	90,257	--
Land Use Removals	-28,161	31.2%
Total Removals	-28,161	--

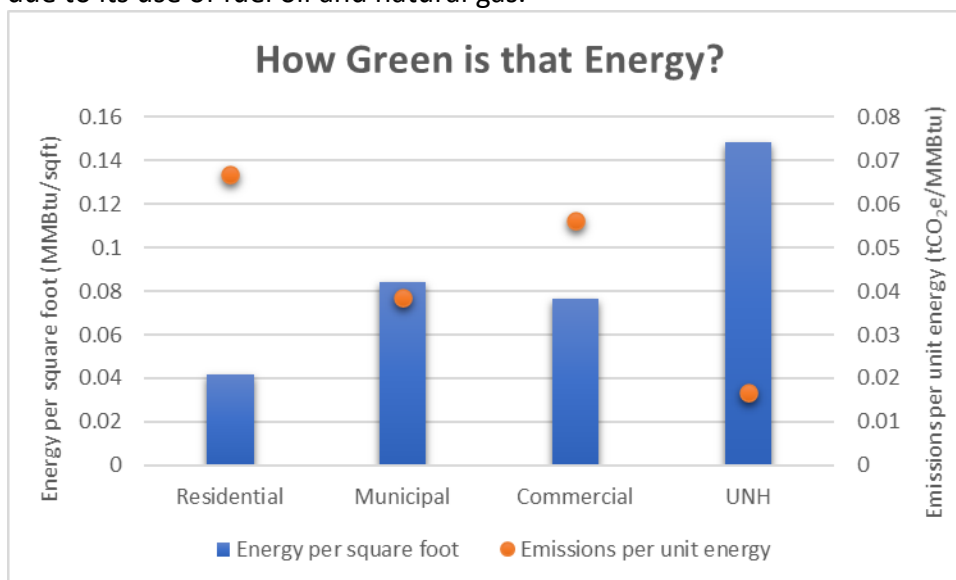


Built Environment Emissions (49.2% of Community-Wide Emissions)

Emissions within the Built Environment were due to energy usage of stationary fuel (natural gas, fuel oil, propane, landfill gas, and wood) and electricity (including transport and distribution losses). Within the Built Environment, 75.2% of total emissions were due to stationary fuel, while 24.8% of emissions were due to electricity. The following figure breaks down the Built Environment emissions by energy source with the exception of the ORCSD-D, which was not able to be broken down further by stationary fuel type.

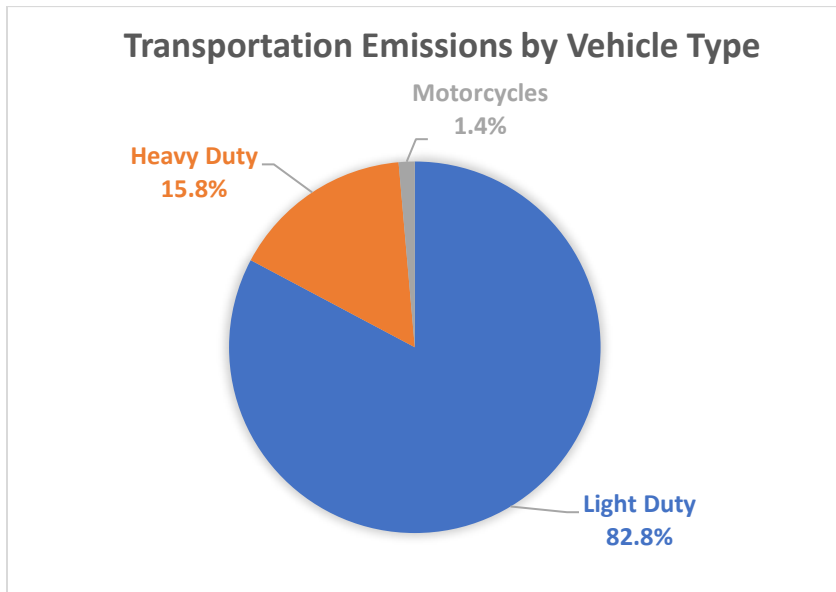


Contributions to the Built Environment emissions were from the following sectors: UNH (41.1%), Residential (30.7%), Commercial (24.0%), ORCSD (2.7%), and Municipal (1.6%). However, energy source plays a key role in emissions. The following figure provides an overview the amount of energy used per unit area and the emissions per unit area. UNH sourced the “greenest” energy, largely due to their energy sourced from recaptured landfill gas and their use of Renewable Energy Credits, and the Residential sector had the least green energy, largely due to its use of fuel oil and natural gas.

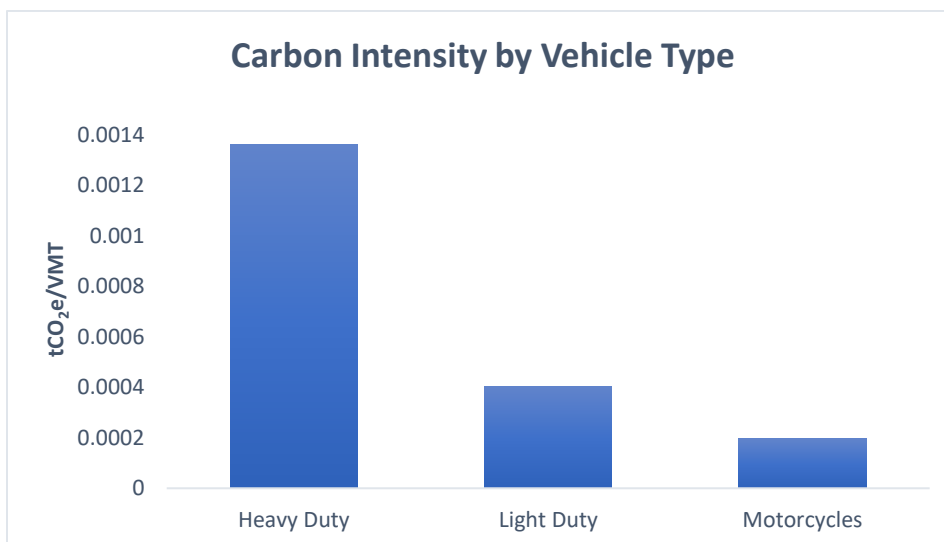


Transportation Emissions (43.5% of Community-Wide Emissions)

Emissions within the Transportation category were due to Durham residents as well as commuters coming into Durham and passing through Durham on Route 4. Based on a National Vehicle Mix estimates, Durham motor vehicles were separated into three categories: Light Duty Vehicles (sedans, coups, SUVs, small vans, and pickup trucks), Heavy Duty Vehicles (large vans, buses, commercial trucks, and semi-trucks), and Motorcycles (motorcycles and mopeds). Data sources for Durham that exclude pass-through traffic were not available at the completion of this inventory. Emissions from electricity used for electric vehicles were included within Built Environment emissions.



The assumed vehicle composition in Durham was as follows: 92% Light Duty vehicles, 16% Heavy Duty vehicles, and 1% Motorcycles. However, vehicle type can largely impact emissions. Heavy Duty vehicles had the highest emissions per vehicle mile traveled (VMT), followed by Light Duty vehicles and lastly Motorcycles.



Land Use Emissions (3.0% of Community-Wide Emissions)

Emissions from land use occur when Forest Land is converted to Non-Forest land, Trees outside forests are removed, or when forested lands are disturbed by events such as harvesting, insects, and disease. The following table provides an overview of land use emission sources within Durham.

47.9%	Forest Land being converted to Non-Forest Land (Grassland, Settlement, and Wetland)
43.1%	Forest Disturbances (43.0% from harvesting/other and 0.1% from insects/disease)
9.0%	Tree Canopy loss in Trees Outside Forests

Durham’s land use emissions were contributed by the following landowners: State-owned land (14.2%), UNH-owned land (14.0%), Town-owned land (6.9%), and Other-owned land (land not owned by the first three ownership categories) (64.8%).

Agriculture/Livestock Emissions (2.1% of Community-Wide Emissions)

Emissions from agriculture and livestock within Durham were only calculated for those owned and used by UNH. Accurate data for these emission sources off-campus were not readily available at the time of inventory completion and were assumed to be small compared to UNH.

64.6%	Dairy Cows
31.3%	Organic Dairy Cows
1.8%	Organic Fertilizer
1.5%	Horses
0.8%	Synthetic Fertilizer

Wastewater Emissions (1.4% of Community-Wide Emissions)

Wastewater emissions occur from fugitive methane released from septic tank usage and the treatment of wastewater at Durham’s Wastewater Treatment Plant (WWTP). Most emissions (85.6%) were due to septic tank usage, with the remaining emissions (14.4%) from the WWTP. The WWTP has high levels of nitrogen removal, helping to keep its emissions low.

Solid Waste Emissions (0.8% of Community-Wide Emissions)

100% of Solid Waste emissions were from solid waste generated within the community and sent to the Turnkey Landfill in Rochester, NH. Solid waste generated by UNH, the Durham Community (which includes residential, municipal, businesses, and commercial), and the ORCSD accounted for 36.5%, 36.3%, and 27.2% of solid waste emissions, respectively. These emissions are kept relatively low because of the Turnkey Landfill’s ability to capture methane and pipe it to UNH to power their Co-generation plant. Without this recapture system, solid waste emissions would be 5,492 tCO₂e – 807% higher than in 2019.

Land Use Removals (equivalent to 31.2% of Community-Wide Emissions)

When considering land use, the only removal sources are from trees remaining as trees or from non-tree areas being converted to tree areas. Trees remove CO₂ from the atmosphere by converting it during photosynthesis and into stored carbon as they grow.⁴ The following table provides an overview of land use removal sources.

78.6%	Forest Land remaining undisturbed
20.0%	Trees Outside Forests increasing in numbers or being maintained
1.4%	Reforestation (Non-Forest Land to Forest Land)

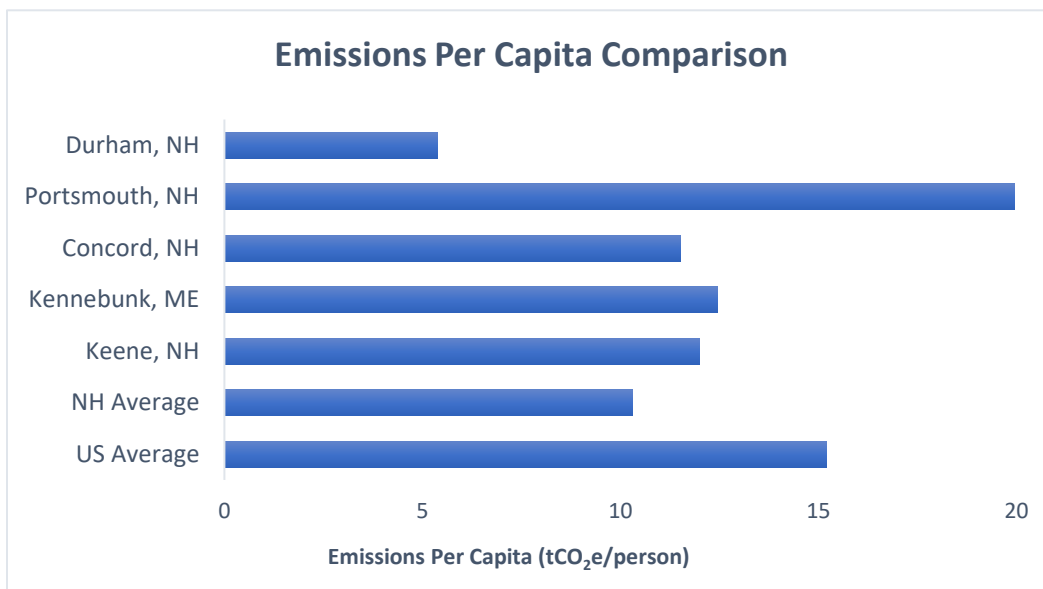
Durham’s land use removals were contributed by the following landowners: Other-owned land (74.0%), UNH-owned land (12.0%), State-owned land (8.0%), and Town-owned land (6.1%).

Durham’s only sources of GHG removals in this inventory were from Forests and Trees Outside Forests. It is important to note that forests and trees should not be considered as direct carbon offsets in climate mitigation efforts because doing so underestimates the actual reductions communities need to make to meet reduction targets. In addition to this, carbon sequestration is part of Earth’s natural carbon cycle that regulates climate and makes the planet habitable. Therefore, associating all carbon sequestration with offsetting anthropogenic emissions disregards this natural balance.

Findings in Context

Like many other communities, the built environment and transportation were Durham's highest emitting sectors, accounting for a combined 92.7% of Durham's community-wide emissions. Similar to the broader US, Durham's forests and trees have greater greenhouse gas removals than emissions, making them a net sink.⁴

Durham's emissions per capita (5.4 tCO₂e/person), which excludes land use for comparison purposes, is lower than many other NH communities as well as the state and national averages, as shown on the following figure. This is largely due to Durham's and UNH's numerous emission reduction efforts already taken to date as well as UNH not being in session year-round, which causes Durham's population to vary within each year.



To put Durham's removals from forests and trees (-28,161 tCO₂e/yr) into context, it is equivalent to each of the following:¹⁰

- Avoiding GHG emissions from 6,124 Passenger vehicles driven for one year
- Avoiding CO₂ emissions from 3,391 homes' energy use for one year
- Avoiding CO₂ emissions from 5,115 homes' electricity use for one year
- GHG emissions avoided by 5.9 wind turbines running for a year
- GHG emissions avoided by 1,067,330 Incandescent lamps switched to LEDs each year

Recommendations

The Community-Wide GHG Inventory had the following recommendations:

- Continue regularly reporting a community-wide greenhouse gas inventory to track Durham's progress. Under GCoM, this must be completed every two years after the completion of a Durham Climate Action Plan.
- Prioritize reducing emissions from Durham's largest emitting sectors, transportation and the built environment, and complete a consumption-based GHG inventory to educate residents on their emission impacts.
 - o Increase energy efficiency and switch electricity generation from fossil fuels to greener power sources. Durham's Energy Committee is already pursuing Community Power Aggregation, where residential electricity would be sourced from renewable energy rather than fossil fuels. Similar efforts should be undertaken to further reduce emissions from the Built Environment and other sectors.
 - o Provide incentives for residents and business owners to switch from fuel oil and natural gas to electricity powered energy.
 - o Continue encouraging no-carbon modes of transportation, such as biking and walking, and low-carbon modes, such as public transportation.
- Increase resiliency of Town's sustainability efforts through ensuring steady funding sources and designating staff to oversee the efforts. Funding sources may be through savings from sustainability improvements, grants, and state and federal funding.
- Continue to promote forest conservation by enacting policy that avoids forest land fragmentation, limits the conversion of Forest Land to other land use types, prioritizes new development in Settlement over other land use classes, and incentivizes landowners to take advantage of federal and other programs that support forest conservation.
- Maintain and improve carbon sequestration capabilities of Durham's land and increase land resilience to climate change through creating an updated forest inventory and determining forest management scenarios that optimize carbon sequestration and decrease ongoing climate change threats. These efforts, particularly the forest inventory, may be an opportunity to partner with experts from UNH and can be used to guide policy around land in Durham.
- Leverage community involvement and promote social equity by developing and improving relationships with community groups interested in sustainability, involving the public in decision-making processes for future GCoM deliverables, providing forest management services to forest landowners, and balancing forest conservation with land affordability. It is also recommended to engage the public in determining how Durham will take climate action. Suggestions for public engagement include Friday Updates, regular updates to Sustainable Durham, surveys and community information sessions and workshops.
- In future inventories, when possible, include a component to better understand unknowns or estimates from this inventory, such as use of natural gas and estimates of pass-through traffic.

References

1. Emily Mello. *2019 Community-Wide Greenhouse Gas Inventory*. UNH Sustainability Institute, Town of Durham, 2021.
2. Cathy Fletcher. *Exploring Land Use as an Aspect of Community Climate Action*. UNH Sustainability Institute, Town of Durham, 2021.
3. Global Covenant of Mayors for Climate and Energy. URL: <https://www.globalcovenantofmayors.org/>
4. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.2. July 2019.