Tracking Emissions for Regional Climate Action

A report on the greenhouse gas emissions inventory developed for the New Haven, Hartford and Bridgeport areas of Connecticut

Prepared By:

Peiyao Zhao
Graduate Research Assistant

Jimi Oke, PhD
Assistant Professor

Networks for Accessibility, Resilience and Sustainability Laboratory
Department of Civil and Environmental Engineering
University of Massachusetts Amherst
130 Natural Resources Road, Amherst, MA 01003

February 2024

Sponsors:
South Central Regional Council of Governments (SCRCOG)
Connecticut Metropolitan Council of Governments (MetroCOG)
Capitol Region Council of Governments (CRCOG)

Project Partners:
Center for Resilient Metro-Regions
Landscape Architecture and Regional Planning
Camille Barchers, PhD, AICP

Acknowledgments

We would like to thank the South Central Regional Council of Governments (SCRCOG), the Connecticut Metropolitan Council of Governments (MetroCOG) and the Capitol Region Council of Governments (CRCOG) for supporting this project and for providing feedback on the results during the course of the research. We would also like to thank Dr. Camille Barchers, Landscape and Regional Planning professor her support. Finally, we thank the studio class (Fall 2023), in particular Joseph Mega and Hunza Irfa, for their feedback and contributions.

Disclaimer

Table of Contents

List of Acronyms

Acronym	**Expansion**
VMT	Vehicle Miles Travelled
MPG	Miles per Gallon
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
GHG	Greenhouse Gases
EFs	Emissions Factors
LGGIT	Local Government Greenhouse Gas Inventory Tool
FLIGHT	Facility Level Information on GreenHouse gases Tool
GHGRP	Greenhouse Gas Reporting Program
MSA	Metropolitan Statistical Area
DEEP	Department of Energy & Environmental Protection
ACS	American Community Survey
USDA	United States Department of Agriculture
NPDES	National Pollutant Discharge Elimination System
CTDOT	Connecticut Department of Transportation
DOT	U.S. Department of Transportation

1.0 Background

Connecticut has been a pioneer in addressing global warming and climate change through its extensive effort in greenhouse gas tracking and reduction spanning two decades. According to the latest Greenhouse Gas Emissions Inventory report from the Department of Energy & Environmental Protection (DEEP), the key sectors that contribute to the GHG emissions are transportation, electric power, waste, stationary combustion, agriculture[1]. The transportation sector, also referred to as "mobile combustion," was the largest emitter over the past 30 years, contributing to 40% of the total emissions in 2019. Following closely is the stationary combustion (residential, commercial, and industrial), accounting for 40% of total emissions, while electric power sector witnessed a decline due to the expansion of nuclear energy. Emissions from agricultural and waste sectors play a relatively smaller role. Lastly, 60% of the land in this state comprises forest land which serves as a large carbon dioxide sequestration reservoir. According to the statistics, forests can absorb between 4 and 40 tons of carbon dioxide per year per hectare. In the United States, 16% of total carbon dioxide emissions are absorbed by the forestland[2]. The goal of this study is to estimate GHG emissions in Connecticut from a regional and local level and to show the emissions breakdown and trajectory forecasting, which is important to for identifying factors that more relevant to emissions in each sector and proposing mitigation strategies to reduce the emissions.

2.0 Data and Methodology

2.1 Study area

The inventory is prepared for three metropolitan statistical areas (MSAs) and five towns that are outside of the studied MSAs in Connecticut. The MSAs are New Haven-Milford (New Haven area), Hartford-east Hartford-Middletown (Hartford area), and Bridgeport-Stamford-Norwalk (Bridgeport area). The five towns are Colchester, Lyme, Old Lyme, Bridgewater, and New Milford. Colchester, Old Lyme, and Lyme are included in the Hartford area while Bridgewater and New Milford are included in the Bridgeport area.

The state of Connecticut is in the Northeastern region of the United States, with a total population of 3,611,317 and total housing units of 1,531,332 in 2022[3]. Figure 1 displays a heat map illustrating the population distribution of each town in the state. The black lines delineate the boundaries of each MSA. The Bridgeport area is situated in the southwestern part of Connecticut. It encompasses cities such as Bridgeport, Stamford, and Norwalk, and is positioned along the Long Island Sound coastline. The Hartford area is in the central and central-northern part. It includes cities such as Hartford, East Hartford, and Middletown, situated within the broader region of central Connecticut. The New Haven area, situated in the south-central part of Connecticut, is the last but certainly not the least. This region includes the city of New Haven and surrounding areas, and the south of it is also positioned along the Long Island Sound. The New Haven area is known for its cultural and educational institutions, including Yale University, and it serves as an important economic and cultural hub in the state[4]. The table below lists the total population and total housing units of the three areas and Connecticut state.

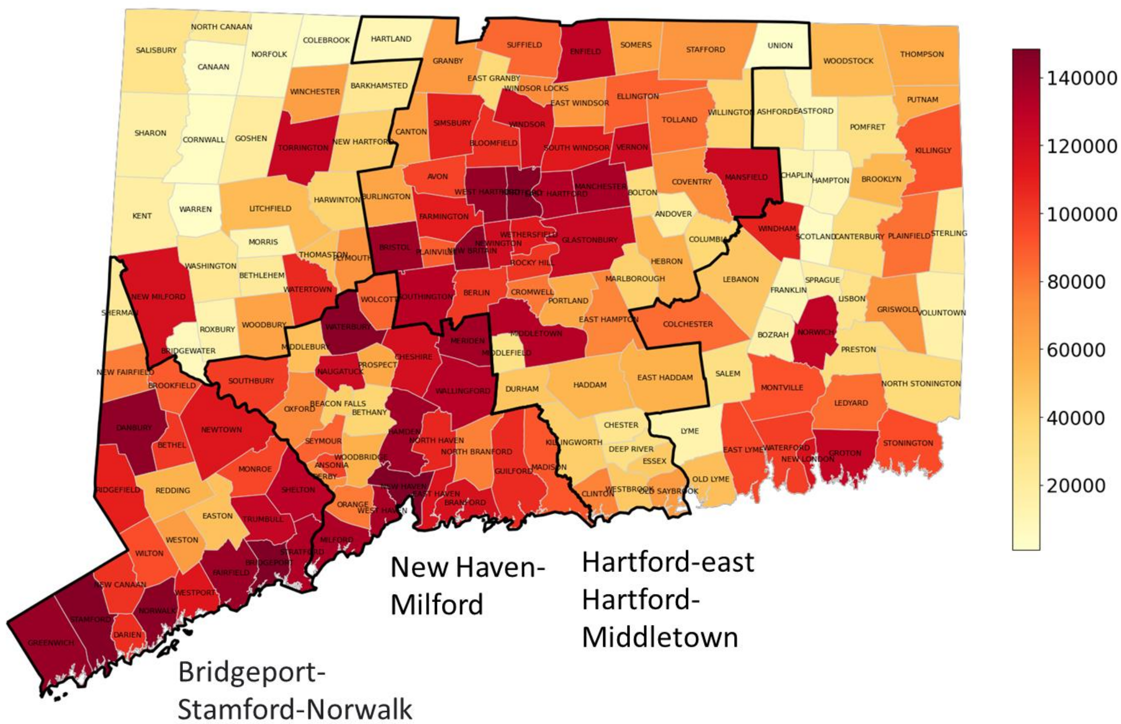

Figure 1. Connecticut town population heat map (the following towns are added into the following MSA in our emissions calculation: Bridgewater and New Milford to the Bridgeport MSA. Colchester, Lyme, and Old Lyme to the Hartford MSA.

Table 1. Comparison of the geographical information of the three MSAs in 2021.

Area	Total population	Total housing units
Bridgeport	986,344	389,620
Hartford	1,238,888	533,689
New Haven	864,751	368,720
Statewide	3,605,330	152,703,9

2.2 Data collection

Emissions-related data were gathered for the seven sectors defined by the EPA and shown in Table 2. Corresponding data sources are also shown in this table.

Table 2. Emissions sectors and data sources

Sector	Activity data	Source
1. Mobile Combustion	Vehicle miles travelled	Requested from CTDOT[5]
	Statewide vehicle type distribution	FHWA, DOT[6]
	Vehicle fuel efficiency	LGGIT Mobile Combustion Section
2. Electric Power Consumption	Electricity consumption	Energize CT[7]
3. Solid Waste (Landfills)	Landfill methane emissions	FLIGHT[8]
	Fuel combustion	FLIGHT[8]
4. Stationary combustion	Household heating fuels consumption	EIA[9]
	Household heating fuels type	ACS[3]
	OSMnx package for commercial building footprint	OSMnx[10]
	Statewide commercial emissions	DEEP[1]
	Large industrial facility emissions	FLIGHT[8]
5. Agriculture & land management	Area of land using certain type of fertilizer	USDA[11]
	Nitrogen content and lose in each type of fertilizer	LGGIT
	Statewide agricultural emissions data	DEEP[1]
6. Wastewater treatment	Number of wastewater treatment facilities	Connecticut NPDES Permits[12]
	Statewide wastewater emissions data	DEEP[1]
7. Urban forestry	Forestry area	2015 Land Cover Number and Charts (University of Connecticut)[13]
	Carbon sequestration factor	LGGIT

2.3 Emissions estimation methods

Where possible, we used bottom-up approaches to estimate emissions for a given sector. Generally, for a given activity (e.g. miles driven by a certain vehicle powertrain type, or amount of electricity consumed), the relevant emissions factor (EF) was multiplied to obtain the greenhouse gas emissions estimate. In cases where low-level activity data were not available, we downscaled statewide emissions for that sector using a relevant proportion of an indicator in the area relative to the state (e.g. fertilizer-treated land, number of wastewater treatment facilities).

2.3.1 Mobile combustion

Mobile combustion emissions were calculated from the activity data—vehicle-miles traveled (VMT)—of each vehicle type, the number of each vehicle type, and fuel economy (in miles per gallon) of each vehicle type, and emissions factors. Table 3 shows the VMT for each MSA, while Table 4 shows the statewide vehicle (automobiles, trucks, buses, motorcycle) distribution. We computed the mobile combustion based on the following assumptions:

- All the automobiles are passenger cars, trucks are light trucks, buses are heavy duty.
- Automobiles and motorcycles consume gasoline, trucks and buses consume diesel.

We used VMT and MPG to compute the fuel consumption and applied the fuel specific EFs to calculate the CO_2 emissions E_{CO_2} as follows:

$$E_{CO_2} = \frac{VMT}{eco} \times \frac{f_{CO_2}}{1000}$$

where:

– VMT: vehicle miles traveled (miles)
– f_{CO_2}: emissions factor for carbon dioxide ($kgCO_2$/gallon)
– eco: fuel economy (miles per gallon)

We computed the CH_4 and N_2O emissions by VMT and vehicle specific EFs from the following equations:

$$E_{CH_4} = VMT \times \frac{f_{CH_4}}{1 \times 10^6}$$

$$E_{N_2O} = VMT \times \frac{f_{N_2O}}{1 \times 10^6}$$

where f_{CH_4} and f_{N_2O} , both in g/mile, are the emissions factors for methane (CH_4) and nitrogen dioxide (N_2O), respectively.

Then, we converted the CH_4 and N_2O emissions into carbon dioxide equivalent using the global warming potential (GWP) for CH_4, and N_2O[1], which were 25 and 298, respectively:

$$E_{total} = E_{CO_2} \times 1 + E_{CH_4} \times 25 + E_{N_2O} \times 298$$

Table 3. Vehicle miles travelled in each county and area.

Area	Place	VMT (billion miles)
Bridgeport	Fairfield County. Bridgewater, New Milford Town	7.1
Hartford	Hartford, Middlesex, Tolland County. Colchester, Lyme, Old Lyme Town	10.5
New Haven	New Haven	6.9

Table 4. Statewide vehicle type distribution.

Types	Vehicle Total	Proportion of total (%)
Automobiles	1,119,278	40.6
Trucks	1,543,765	56.0
Buses	10,222	0.4
Motorcycle	83,220	3.0

The fuel specific and vehicle specific EFs are obtained from the sheet "Factors – FormulaText" of the LGGIT.

2.3.2 Electric power consumption

The GHG emissions from electric power consumption were calculated using the electricity consumption at residential and industrial/commercial sectors and regional emissions factors for CO_2, CH_4 and N_2O obtained from LGGIT/EPA. Table 5 shows the electricity consumption in residential and commercial/industrial obtained from Energize CT website. The following equation describes the calculation details:

$$E_g = \frac{e \times f_{e,g}}{2{,}204.62}$$

$$E_{total} = E_{CO_2} \times 1 + E_{CH_4} \times 25 + E_{N_2O} \times 298$$

Where:

- e: amount of electricity consumed (MWh)
- $f_{e,g}$: emissions factors for the greenhouse gas in eGRID (lbs/MWh)
- $g \in$ CO2, CH4, N2O

Table 5. Electricity consumption (TWh) in each subsector in each area.

Subsector	New Haven	Hartford	Bridgeport	Statewide
Residential	2.48	3.55	3.51	11.33

Commercial/Industrial	2.85	3.71	3.46	13.04
Total	5.33	7.26	6.97	24.37

2.3.3 Solid waste

The GHG emissions in Landfills are obtained from FLIGHT website[8], which include the emissions from landfills methane release and fuel combustions. There are no active landfills that accept municipal solid waste; however, methane is emitted from the existing trash. There are two municipal waste landfills and two solid waste combustion facilities in Hartford reporting GHG emissions to GHGRP. Among municipal waste landfills, one of them is Manchester landfill, whose emissions include stationary fuel combustion emissions and methane generation. Another one is Windsor Bloomfield landfill, whose emissions only include methane generation. Mid-Connecticut Resources Recovery Facility and COVANTA BRISTOL, INC are two waste combustion facilities for energy generation. In Bridgeport area, A trash-to-energy facility called Wheelabrator Bridgeport L.P. released emissions during the stationary combustion of fuel. No landfills or waste-to-energy facility report GHG emissions in the New Haven area.

Table 6 Greenhouse gas emissions from each solid waste facility in 2021.

Waste facility	Area	Solid waste combustion (TMTCO2e)	Landfills emissions (TMTCO2e)
Wheelabrator Bridgeport L.P	Bridgeport	290,551	0.00
Manchester landfill	Hartford	507	84,866
Windsor Bloomfield landfill	Hartford	0	2,728
Mid-Connecticut Resources Recovery Facility	Hartford	204,065	0
COVANTA BRISTOL, INC	Hartford	84,853	0

2.3.4 Stationary combustion

Stationary combustion includes emissions from equipment that provide heating and kinetic energy for residential, commercial, and industrial sectors through the combustion of fuels. In the residential sector, the detailed data collected mainly includes household fuel consumption distribution, the statewide fuel consumption, emissions factors for each fuel type (natural gas, propane, heating oil). To calculate the consumption of each heating fuel at each MSA, we applied the ratio of households utilizing a specific fuel type to the total number of households to the statewide fuel consumption. Thus:

$$Q_{f,M} = \frac{H_{f,M}}{H_{f,S}} \times Q_{f,S}$$

where

- Q : amount of fuel consumed (gallons)
- f: type of fuel consumed (natural gas, propane, heating oil)
- M: metropolitan statistical area
- S: statewide
- H : number of households using a certain type of fuels

Table 7 and table 8 show the number of households using a particular fuel and the amount of heating fuel consumed for residential heating at each MSA, respectively. After obtaining the fuel consumption at each MSA, we then computed the emissions from EFs and the amount of fuel consumed, as detailed in the following equation:

$$E_g = \frac{Q_{fuel,\,MSA} \times f_{e,\,g}}{1000}$$

- $f_{e,\,g}$: emissions factors for the greenhouse gas of each heating fuel (kg /gallons)
- $g \in$ CO2, CH4, N2O

The total emissions are then obtained from the summation of all the greenhouse gases converted to carbon dioxide equivalent:

$$E_{total} = E_{CO_2} \times 1 + E_{CH_4} \times 25 + E_{N_2O} \times 298$$

Table 7. Number of households using a particular fuel type at each area.

Area	Natural gas	Propane	Fuel Oil
Bridgeport	140,333	15,921	132,639
Hartford	190,782	22,904	184,976
New Haven	134,167	11,823	119,116
Statewide	495,646	64,356	551,817

Table 8. Total consumption of residential heating fuels at each area

Area	Natural Gas (million cf)	Propane (million gal)	Fuel Oil (million gal)
Bridgeport	10,447	13	83
Hartford	14,203	19	116
New Haven	9,989	10	75
Statewide	36,900	54.3	345.7

In the commercial sector, we computed the emissions by scaling down statewide commercial building emissions based on the proportion of the commercial building footprint at each MSA compared to the statewide total. We obtained the distribution of commercial building types at each MSA from the OSMnx Python package. The data is illustrated in Figure 2.

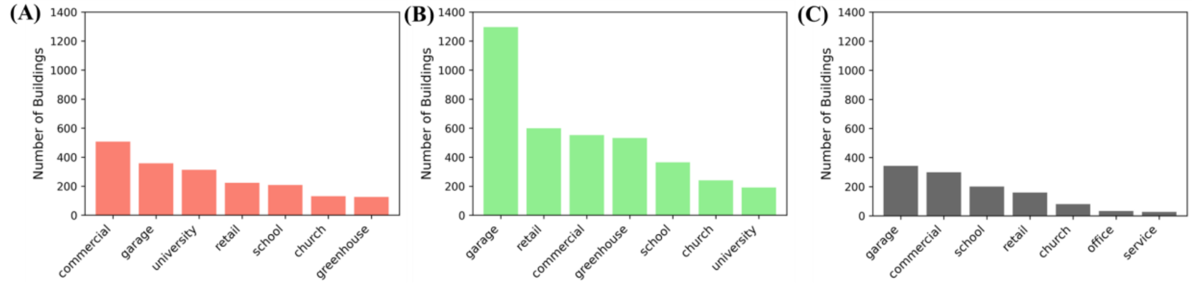

Figure 2 Distribution of top seven commercial building types in each MSA: New Haven (A); Hartford (B) and Bridgeport (C).

The following equations show the detailed computation:

$$E = \frac{FP_M}{FP_s} \times E_s$$

where

- M: metropolitan statistical area
- S: statewide
- E_s : statewide greenhouse gas emissions ($MMTCO_2e$)
- FP: footprint of commercial building (sq ft)

In the industrial sector, we obtained the emissions directly from FLIGHT. Table 9 shows the emissions from large industrial facilities reported to GHGRP.

Table 9 Greenhouse gas emissions ($MMTCO_2e$) from large industrial facilities at each area.

Subsector	Bridgeport Area	Hartford Area	New Haven Area
Petroleum & Natural Gas	0.05	0.16	0.14
Other	0.05	0.18	0.19
Pulp and Paper	0	0.02	0
Total emissions	0.1	0.36	0.33

2.3.5 **Agricultural & land management**

One of the main sources of NH_3 and N_2O emissions is the agricultural sector. We obtained the land area treated by different fertilizers (organic, manure, and synthetic), as illustrated in table 10, and the statewide agricultural emissions data and calculated the emissions based on the following assumptions:

- The agricultural emissions at each MSA are directly proportional to the area of land under fertilizer treatment.
- Only fertilizer emissions are considered.

Firstly, we define the effectiveness (F_f) by the proportion of nitrogen loss in one type of fertilizer to the nitrogen loss in all types of fertilizer.

$$F_f = \frac{N_{c,f} \times N_{l,f}}{\sum_f N_{c,f} \times N_{l,f}}$$

- $N_{c,f}$: percent of Nitrogen in the fertilizer
- $N_{l,f}$: percent of nitrogen lost in due to volatilization in the fertilizer.
- f: {manure, organic, synthetic fertilizer}

Then, we computed the agricultural land emissions by downscaling the statewide emissions with percentage of effective land area (effectiveness times the land area) treated by fertilizer at each MSA.

$$E_M = \frac{\sum_f Q_{M,f} \times F_f}{\sum_f Q_{S,f} \times F_f} \times E_S$$

- M: metropolitan statistical area
- S: statewide
- Q : the area of land covered by a type of fertilizer, [acres]
- E_S: statewide agricultural land greenhouse gas emissions, [MMTCO2e]

Table 10. The area of land that is treated by different fertilizers at each area.

Area	Manure fertilizer (acres)	Organic fertilizer (acres)	Synthetic fertilizer (acres)
Bridgeport	306	193	1,849
Hartford	8,619	604	21.949
New Haven	1,125	173	3,764

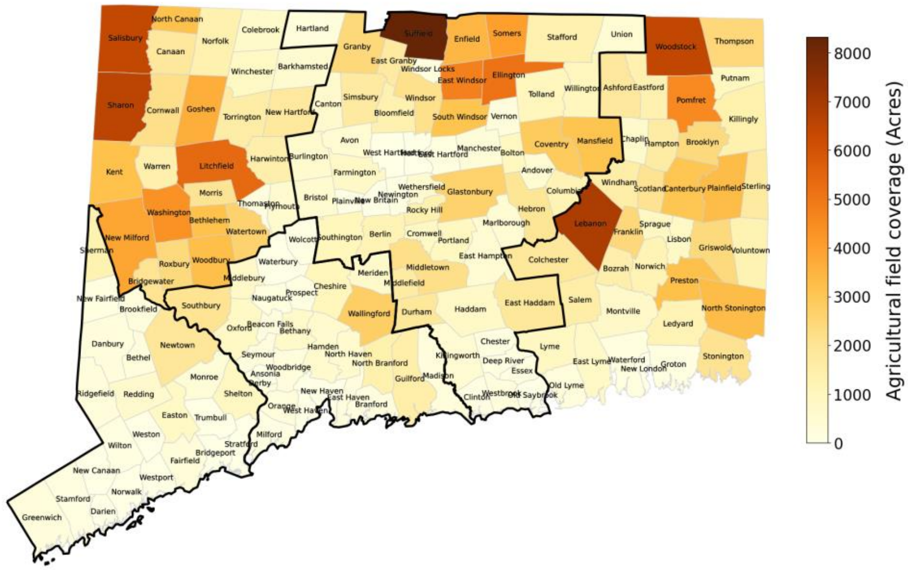

Figure 3. Agricultural land heat map. The following towns are added into the following MSA in our emissions calculation: Bridgewater and New Milford to the Bridgeport MSA. Colchester, Lyme, and Old Lyme to the Hartford MSA.

2.3.6 **Wastewater treatment**

Wastewater treatment emissions, E_M, were calculated by downscaling the statewide wastewater emissions by the proportion of facilities at each MSA with respect to the state total. Thus:

$$E_M = \frac{N_M}{N_S} \times E_S$$

where

- N: number of wastewater treatment facilities
- E_S: wastewater treatment GHG emissions, [MMTCO2e]
- M: metropolitan statistical area
- S: statewide

2.3.7 **Task 5. Urban forestry**

The Connecticut forests cover around 60% of the total land area and can sequester between 4 and 40 tons of carbon dioxide every year per hectare[2]. Figure 4 describes the forest land coverage at each MSA. Figure 5 depicts the heat map of forest land coverage in the entire Connecticut.

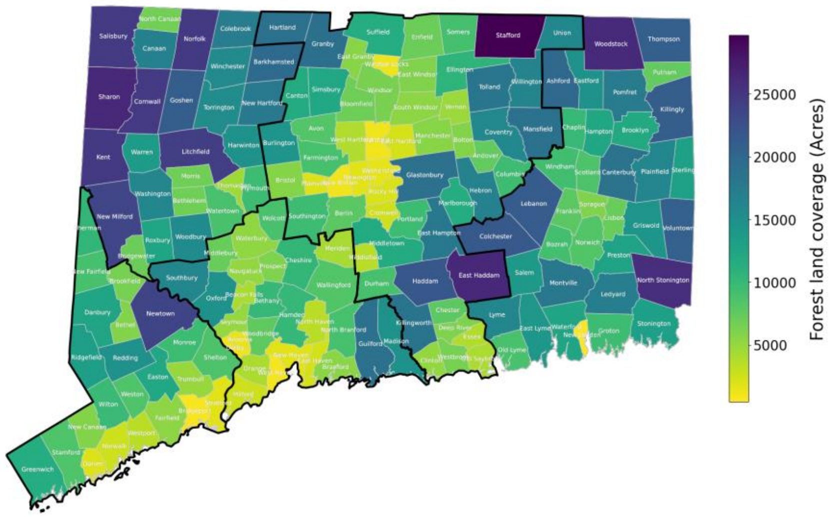

Figure 4. Forest land area/coverage statewide heat map. The following towns are added into the following: MSA in our emissions calculation: Bridgewater and New Milford to the Bridgeport MSA. Colchester, Lyme, and Old Lyme to the Hartford MSA.

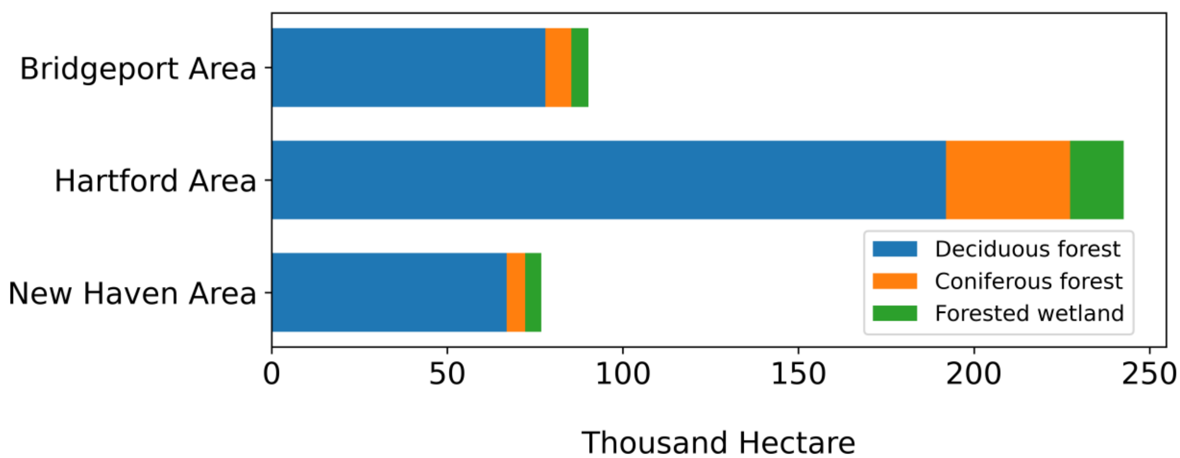

Figure 5. Forest land area/coverage at each MSA.

The amount of carbon sequestrated is calculated by the following equation:

$$M_C = A_{forest,M} \times R_c \times C$$

where

- M_C : the amount of carbon dioxide sequestrated ($MTCO_2$)
- R_c: equals 2.23, carbon sequestration factor ($MTCO_2$ /hectare)
- $A_{forest,M}$: total area of the forest at each MSA (hectare)
- $C =$ 3.67 is the ratio of carbon dioxide to carbon.

3.0 Results and discussion

Figure 6 and Figure 7 show the total emissions of 6.42, 8.45, and 6.21 $MMTCO_2e$ for NHM, HEM, and BSN, respectively. Mobile emissions are highest in each MSA, constitute 52%, 47%, and 48% of total emissions in HEM, NHM, BSN, respectively, followed by stationary and electric power emissions. Emissions from solid waste, wastewater, and agricultural are nearly negligible.

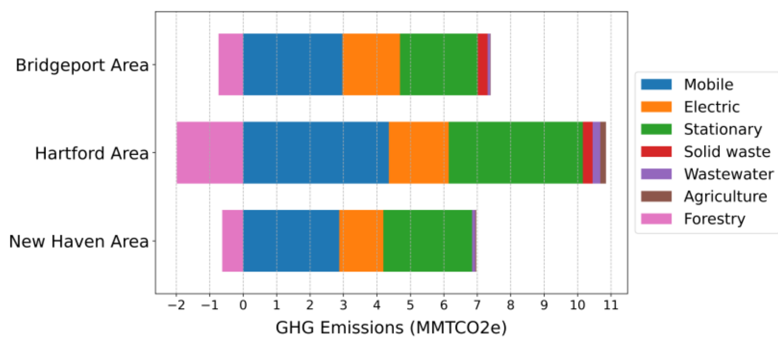

Figure 6. GHG emissions from each sector in each area.

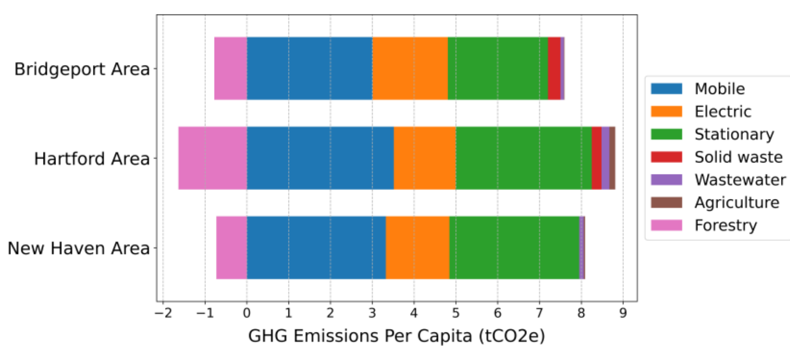

Figure 7. GHG emissions per capita from each sector in each area.

3.1 Mobile combustion

Emissions from diesel vehicles are consistently greater than those from gasoline vehicles. According to Figure 6, diesel emissions are around 30% higher than gasoline emissions in all MSAs, which indicates that prioritizing electrification of diesel vehicles may yield greater emissions reductions. Figure 7 suggests that Emissions per capita are positively correlated with the VMT per capita.

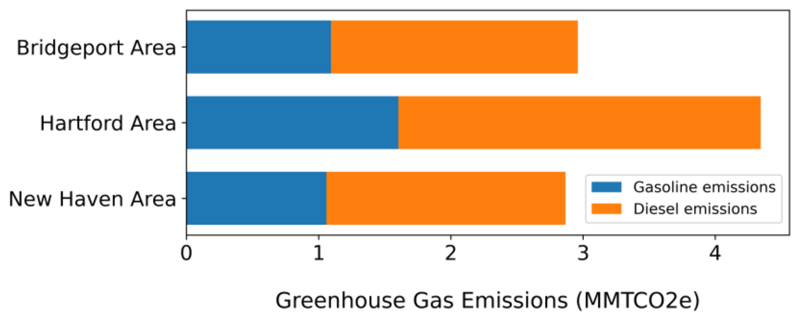

Figure 8. Emissions from diesel and gasoline-fueled vehicles.

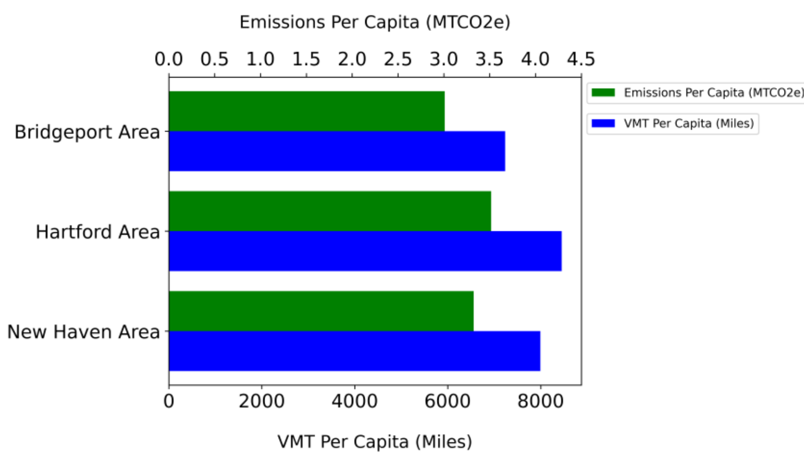

Figure 9. Emissions per capita and VMT per capita in each area.

3.2 Electricity consumption

Emissions from electricity consumption in the Hartford area is slightly higher than Bridgeport area and around 30% higher than New Haven area. Each MSA shares the same amount of emissions intensity. As for the emissions per capita, Bridgeport area BSN is the highest while New Haven and Hartford area are similar.

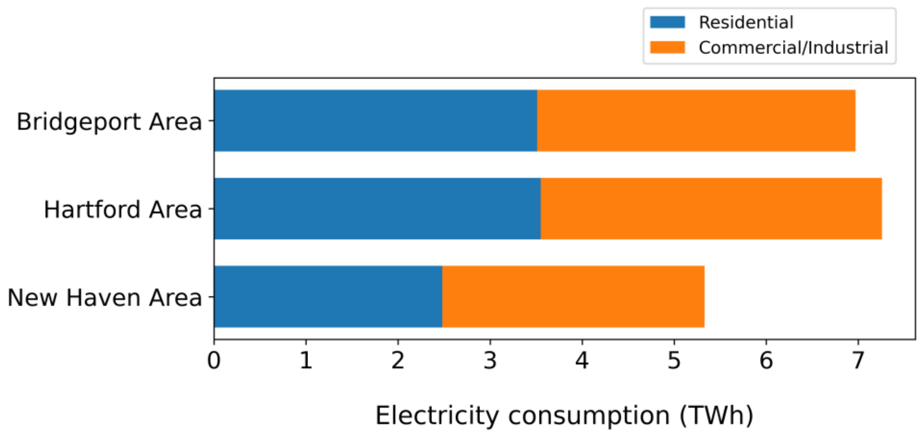

Figure 10. Electricity consumption emissions from different subsectors in each area

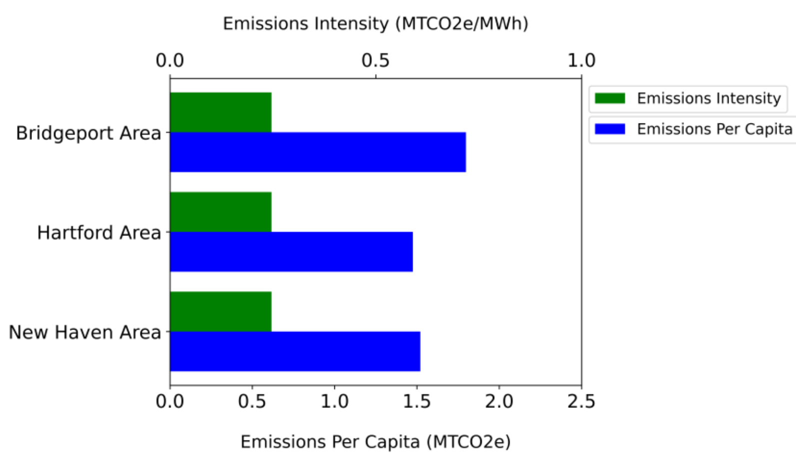

Figure 11. Emissions per capita and emissions intensity in each area.

3.3 Solid waste

Table 11 shows the total GHG emissions from the landfills in the Hartford area over the past seven years.

Table 11 Greenhouse gas emissions from solid waste facility in 2021.

Area	Solid waste combustion (TMTCO2e)	Landfills emissions (TMTCO2e)	Total Emissions (MMTCO2e)
New Haven	0.00	0.00	0
Hartford	289,425	87,594	0.38
Bridgeport	290,551	0.00	0.30

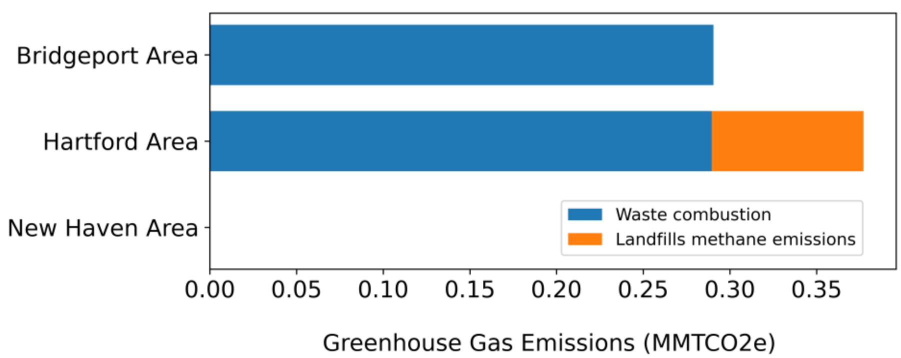

Figure 12.GHG emissions from solid waste combustion facilities and landfills.

3.4 Stationary Combustion

3.4.1 **Residential**

Among all the residential heating fuel sources, fuel oil is the largest emitter for residential heating, followed by natural gas and propane.

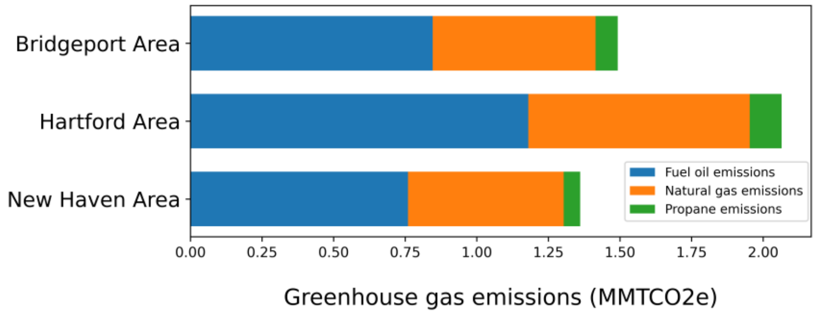

Figure 13. Emissions from residential heating fuel sources in each area.

3.4.2 **Commercial**

Commercial building emissions in the Hartford area are twice as large as those in New Haven area.

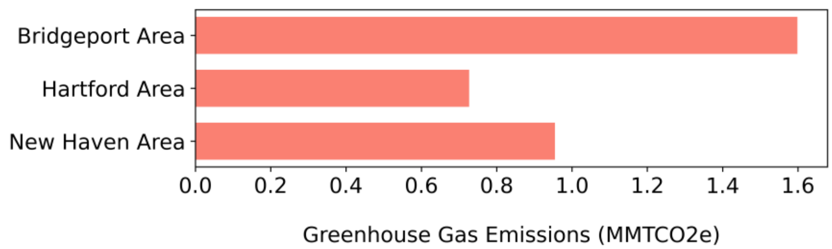

Figure 14. Emissions from commercial buildings in each area.

3.4.3 **Industrial**

The New Haven area has similar industrial emissions to the Hartford area.

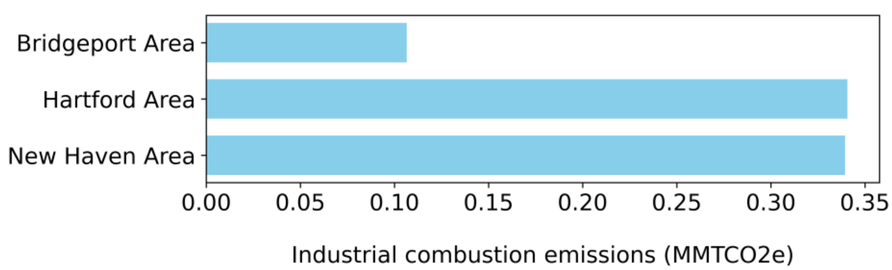

Figure 15. Emissions from large industrial facilities in each area.

3.5 Agricultural and land management

Agricultural emissions in the Hartford area are 74% higher than the two MSAs combined (Figure 15). Figure 16 shows that the emissions per acre are almost the same at all the MSAs.

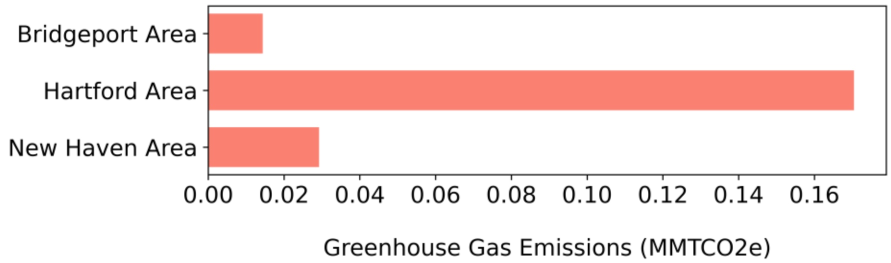

Figure 16. Emissions from agricultural land at each area.

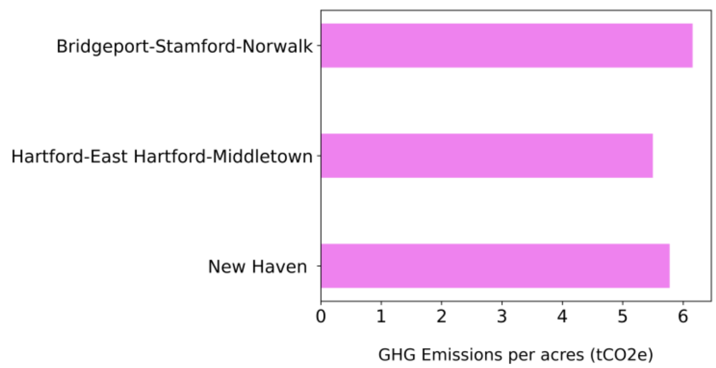

Figure 17. Emissions per acres.

3.6 Wastewater treatment

Figure 17 shows the wastewater emissions at each MSA, indicating emissions in Hartford area is 25% higher than the rest two MSAs combined.

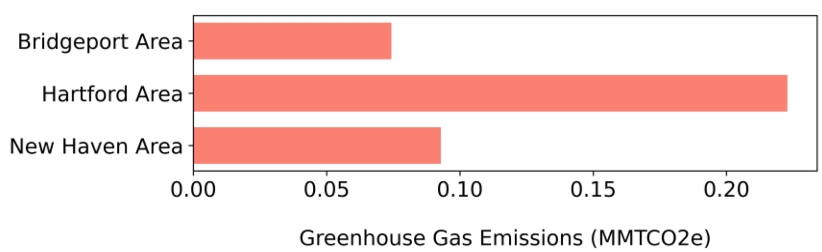

Figure 18. Emissions from wastewater treatment at each area.

3.7 Urban forestry

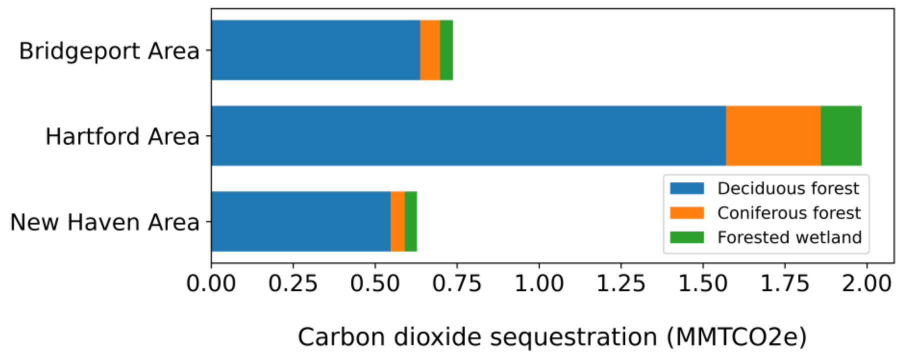

Figure 19. Carbo dioxide sequestrated by forest land at each area.

3.8 Summary

Figure 19 shows the summary of subsector emissions in New Haven area. Trucks contributes to the highest emissions, followed by residential heating and automobile emissions. The emission from residential heating exceeds the total of electricity consumption, which suggests adopting renewable heating technologies for house heating such as heat pump, solar water heating.

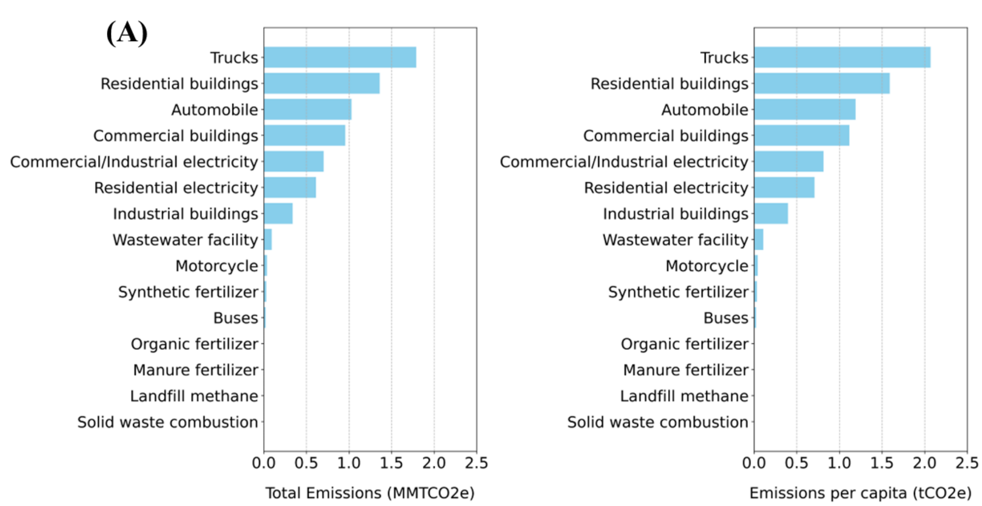

Figure 20. Subsector emissions in the New Haven area

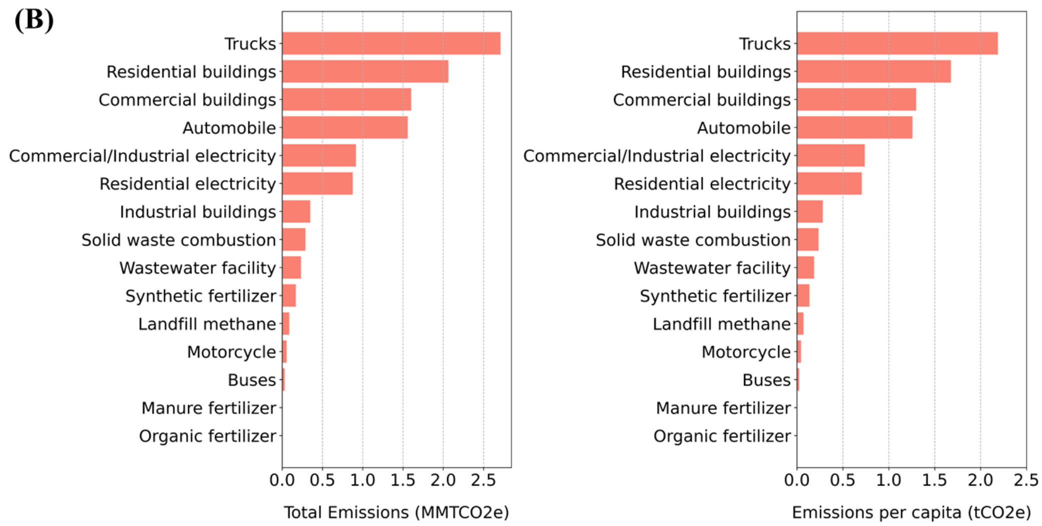

Figure 21. Subsector emissions in the Hartford area

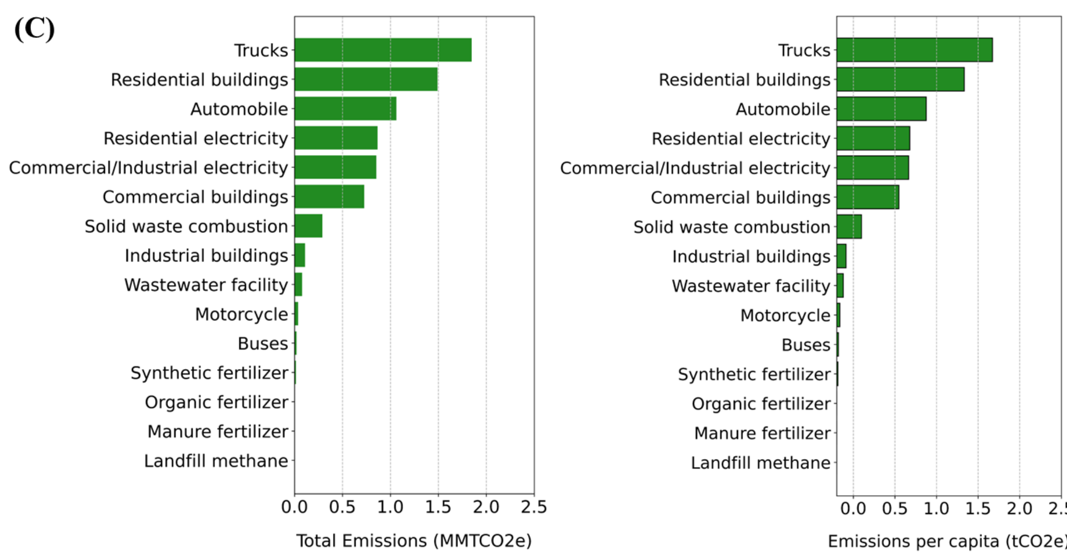

Figure 22. Subsector emissions in the Bridgeport area

Figure 12. Summary of emissions in each sector

Area / (MMTCO2e)	New Haven	Hartford	Bridgeport
Mobile Combustion	2.88	4.36	2.97
Electric Power Consumption	1.31	1.79	1.72
Solid Waste	0.00	0.38	0.29
Residential Building	1.36	2.06	1.49
Commercial Building	0.96	1.60	0.73
Industrial Facility	0.34	0.35	0.11
Agriculture & land management	0.03	0.17	0.01
Wastewater treatment	0.09	0.23	0.08
Urban forestry	-0.63	-1.98	-0.74
Total	6.34	8.95	6.67

4.0 References

[1] "CT Greenhouse Gas Inventory Reports," CT.gov - Connecticut's Official State Website. Accessed: Jan. 10, 2024. [Online]. Available: https://portal.ct.gov/DEEP/Climate-Change/CT-Greenhouse-Gas-Inventory-Reports

[2] "The Role of Forests in Carbon Sequestration and Storage." Accessed: Jan. 10, 2024. [Online]. Available: https://www.ncsl.org/environment-and-natural-resources/the-role-of-forests-in-carbon-sequestration-and-storage

[3] "American Community Survey (ACS)." Accessed: Jan. 10, 2024. [Online]. Available: https://www.census.gov/programs-surveys/acs

[4] "Economic Impact | Office of New Haven Affairs." Accessed: Jan. 11, 2024. [Online]. Available: https://onha.yale.edu/initiatives/economic-impact

[5] "2030 VMT Goals and Strategies," CT.gov - Connecticut's Official State Website. Accessed: Jan. 11, 2024. [Online]. Available: https://portal.ct.gov/DOT/PP_Bureau/2030-VMT-Goals-and-Strategies

[6] "Table MV-1 - Highway Statistics 2021 - Policy | Federal Highway Administration." Accessed: Jan. 11, 2024. [Online]. Available: https://www.fhwa.dot.gov/policyinformation/statistics/2021/mv1.cfm

[7] "CEC TownData." Accessed: Jan. 11, 2024. [Online]. Available: https://www.ctenergydashboard.com/CEC/CECTownData.aspx

[8] "EPA Facility Level GHG Emissions Data." Accessed: Jan. 11, 2024. [Online]. Available: https://ghgdata.epa.gov/ghgp/main.do#/facility/?q=Find%20a%20Facility%20or%20Location&st=&bs=&et=&fid=&sf=11001100&lowE=-20000&highE=23000000&g1=1&g2=1&g3=1&g4=1&g5=1&g6=0&g7=1&g8=1&g9=1&g10=1&g11=1&g12=1&s1=1&s2=1&s3=1&s4=1&s5=1&s6=1&s7=1&s8=1&s9=1&s10=1&s2

01=1&s202=1&s203=1&s204=1&s301=1&s302=1&s303=1&s304=1&s305=1&s306=1&s307=1&s401=1&s402=1&s403=1&s404=1&s405=1&s601=1&s602=1&s701=1&s702=1&s703=1&s704=1&s705=1&s706=1&s707=1&s708=1&s709=1&s710=1&s711=1&s801=1&s802=1&s803=1&s804=1&s805=1&s806=1&s807=1&s808=1&s809=1&s810=1&s901=1&s902=1&s903=1&s904=1&s905=1&s906=1&s907=1&s908=1&s909=1&s910=1&s911=1&si=&ss=&so=0&ds=E&yr=2022&tr=current&cyr=2022&ol=0&sl=0&rs=ALL

[9] "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." Accessed: Jan. 11, 2024. [Online]. Available: https://www.eia.gov/consumption/residential/data/2020/index.php?view=state#ce

[10] "OSMnx 1.8.1 documentation." Accessed: Jan. 11, 2024. [Online]. Available: https://osmnx.readthedocs.io/en/stable/

[11] "USDA/NASS QuickStats Ad-hoc Query Tool." Accessed: Jan. 11, 2024. [Online]. Available: https://quickstats.nass.usda.gov/results/C02AC8A9-A90D-3D2A-ABA6-98BC8A87838A

[12] "Connecticut NPDES Permits | US EPA." Accessed: Jan. 11, 2024. [Online]. Available: https://www.epa.gov/npdes-permits/connecticut-npdes-permits

[13] "2015 Land Cover Numbers and Charts | Center for Land Use Education and Research." Accessed: Jan. 11, 2024. [Online]. Available: https://clear.uconn.edu/projects/landscape/ct-stats/lc2015/