Village of Larchmont
2023 Community Greenhouse Gas (GHG) Emissions Inventory

January 05, 2024

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Introduction

Climate Change is acknowledged to be the biggest issue of our time. A number of disasters (storms, hurricanes, droughts, flooding, etc.) that have caused great harm to human longevity, health, and our economy have been traced to Climate Change as contributing to their severity. Human-caused emissions of greenhouse gases (GHGs) into the atmosphere has caused their levels to increase to historical levels in the atmosphere. More GHGs in the atmosphere results in more rays from the Sun being trapped and released as heat in our atmosphere than ever before, causing a historic rise in global temperatures, as well as the secondary effects. It is agreed that such adverse Climate Change impacts can be lessened if humans reduce the amount of GHGs emitted into the atmosphere from their activities. The Village of Larchmont, NY wishes to do its part by determining the GHG emissions coming from the Village itself and use that information to develop strategies for residents, businesses, and government to use to reduce the rate of GHG emissions.

The Village of Larchmont wishes to join New York State's Climate Smart Communities (CSC), a program that demonstrates its commitment to addressing climate change issues. CSC catalogs local governments who not only commit to act on Climate Change but also complete and document a series of actions that mitigate and adapt to Climate Change at the local level.

One of the actions that CSC offers is the preparation of a Community GHG Emissions Inventory. This is a science-based estimate of the GHGs emitted into the atmosphere within a municipality based on its specific characteristics (population, businesses, etc.). The information gleaned from the Community GHG Emissions inventory can be useful in determining emissions trends, developing strategies and policies, and assessing progress.

This report quantifies GHG emissions from the Village of Larchmont community, including governments, education, residents, non-profits, and businesses. This inventory estimates GHG emissions released within the Village's geographic boundary, plus some emissions that occur outside the boundary but are associated with the Village, such as waste disposal.

Protocol

The procedure for preparing this Community GHG Emissions Inventory for the Village of Larchmont, NY derives from the publication: *New York Community and Regional GHG Inventory Guidance, September 2015, Version 1.0*, from Climate Smart Communities, NYSERDA Communities Team, Albany, NY and from *ICLEI U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, July 2019, Version 1.2*.

In terms of which compounds should be covered by this emissions inventory, the UN Intergovernmental Panel on Climate Change (IPCC) states that six GHGs should be included in an emissions inventory: carbon dioxide (CO_2), nitrous oxide (N_2O), methane

(CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For ease of analysis, all the emissions are converted into an equivalent amount of CO_2 (CO_{2e}) based on each GHG's published Global Warming Potential (GWP) and reported as metric tons of carbon dioxide equivalent (Mtons CO_{2e}).

The IPCC also defines different scopes or categories to describe GHG emissions. There are three scopes of emissions:

- *Scope 1* - All direct GHG emission sources from activities taking place within the village's geopolitical boundary.
- *Scope 2* - Energy-related indirect GHG emissions that result as a consequence of consumption of grid-supplied electricity, heating and/or cooling, within the village's geopolitical boundary.
- *Scope 3* - All other indirect emissions that occur as a result of activities within the village's geopolitical boundary. An example is GHG emissions from waste disposal of Village residents processed outside the Village boundary.

Estimations of GHG emissions from activities are determined by emission factors, the amount of GHG emissions associated with a unit of activity. Some examples, 371.0 kg CO_{2e} is emitted per kWh electricity used in Larchmont; 8.96 kg CO_{2e} emitted per gallon of gasoline consumed**.**

For the Community GHG emissions inventory, GHG emissions will be estimated from activities within the Village of Larchmont classified into six main sectors:

- Stationary energy
    - Residential buildings
    - Commercial and institutional buildings and facilities
    - Manufacturing industries and construction
    - Energy industries
    - Agriculture, forestry, and fishing activities
    - Non-specified sources
    - Fugitive emissions from mining, processing, storage, and transportation of coal
    - Fugitive emissions from oil and natural gas systems
- Transportation
    - On-road
    - Railways
    - Waterborne navigation
    - Aviation

    - Off-road
- Waste
    - Solid waste disposal
    - Biological treatment of waste
    - Incineration and open burning
    - Wastewater treatment and discharge
- Industrial processes and product use (IPPU)
- Agriculture, forestry, and other land use (AFOLU)
- Emissions occurring outside the geographic boundary as a result of Village activities.

Facts About the Village of Larchmont

A map of the Village of Larchmont with borders is below.

Figure 1: Map of the Village of Larchmont

Larchmont is found in Westchester County in New York State. The maps below show where the Village of Larchmont is located within Westchester County (left) and Westchester's location in the State of New York.

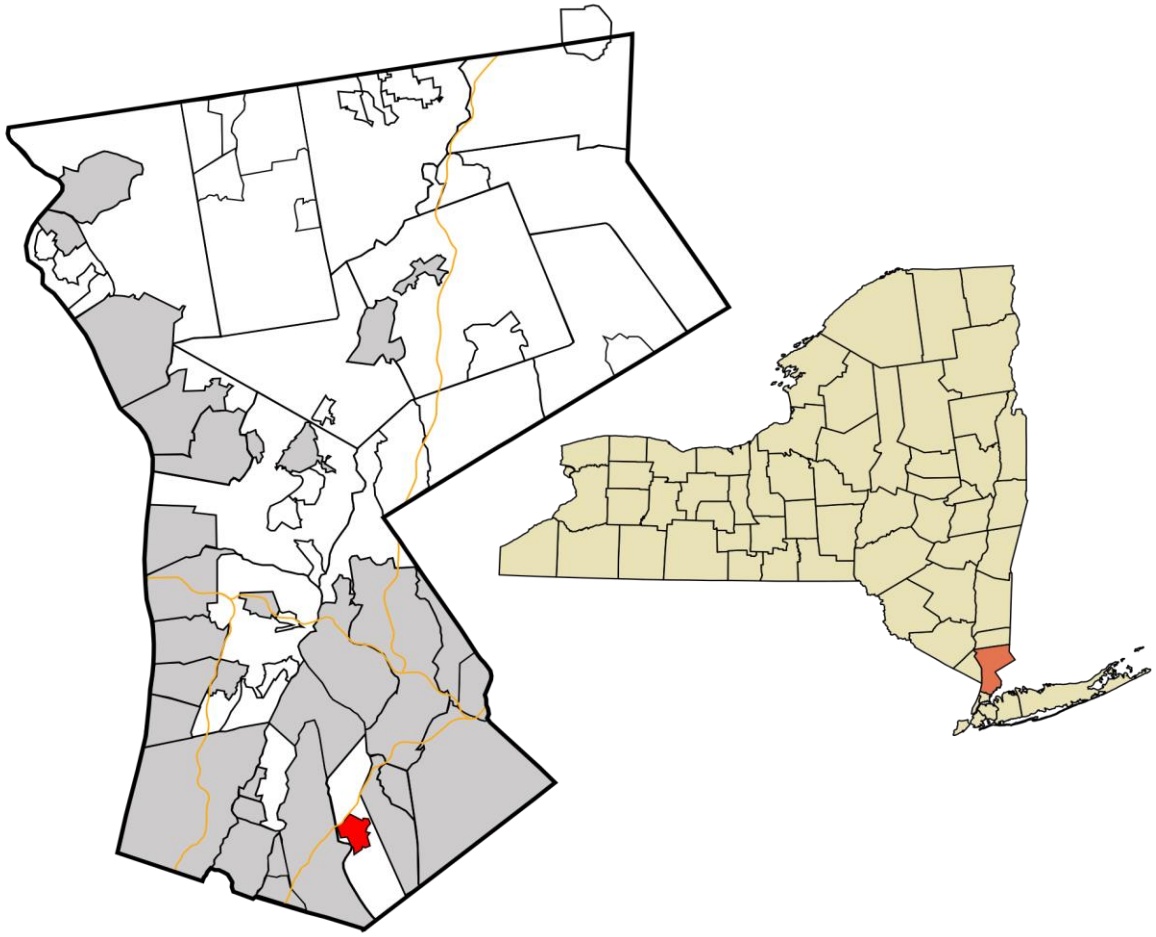

Figure 2: Maps of Westchester County and New York State, with the Village of Larchmont and Westchester County highlighted in each map, respectively

The following are basic facts about the Village of Larchmont, NY that are pertinent to the preparation of the Community GHG Emissions Inventory:

- Population: 6,488 (US Census, July 2021)
- Area: 1.1 sq. miles
- Residential parcels: ~1,800 residential parcels (1,662 households plus multifamily).
- Businesses: Based on energy data, there were about 316 commercial (small and larger businesses) that used electricity in the Village of Larchmont in 2020.
- Power plants: none
- Agriculture: none,
- Industrial and related manufacturing facilities: none

Community GHG Emissions Inventory for Larchmont

A GHG emissions inventory for the Village of Larchmont was prepared. Earlier in this report, different categories of activities were listed. Please note that the Village of Larchmont has no power plants within its boundaries, no regional landfills or waste incinerators, no wastewater treatment plants or septic systems, no industrial (manufacturing) facilities, and no agricultural activities. Removing these sources from the inventory, the following activities were grouped together in the 3 Scopes required for preparing such an inventory.

Scope 1 (direct GHG emissions)

- Direct emissions from natural gas, fuel oils, wood, and propane consumed within the Village boundary (residential and commercial).
- Direct fugitive emissions of natural gas that leaks from the gas transmission and distribution system within the Village boundary.
- Direct emissions from on-road vehicles within the Village boundary.
- Direct emissions from off-road equipment (construction, agricultural, lawn care, etc.) within the Village boundary.
- Direct emissions from rail locomotives within the Village boundary.
- Direct emissions from boats including private craft on lakes and rivers, and commercial shipping operating on rivers and around ports.

Scope 2 (indirect GHG emissions)

- Indirect emissions attributed to electricity consumption within the Village boundary (residential and commercial).

Scope 3 (other indirect, upstream, or lifecycle emissions)

- Indirect (community-induced) emissions from on-road vehicles and from rail caused by a community.
- Indirect emissions attributed to regional domestic and international air travel demand.
- Indirect emissions attributed to communities based on the amount of solid waste they create within the Village boundary.

Please note that the first two bulleted items of Scope 3 (emissions from on-road vehicles, rail, and air travel) will be excluded from this Community GHG Emissions Inventory because of the lack of available data required to determine induced travel by residents. In addition, many other municipalities in New York State have not included these values in their inventories. Given the small size of the Village relative to Westchester County and the broader travelling public, GHG emissions from these two sources are undoubtedly very low and would not affect the total GHG emissions from the Village.

Summary of Community GHG Emissions for Village of Larchmont, NY

Category	CO_{2e} Emissions (metric tons/year)
Natural gas consumed	**12,965**
Natural gas leakage	**0.38**
On-road vehicles	**7,416**
Off-road vehicles	**5,507**
Rail locomotives	**165**
Boats on lakes, rivers, ports	**3.9**
Electricity consumed	**8,077**
Indirect – solid waste creation	**2,803**
	Total: 36,937

Table 1: Summary of Community GHG Emissions for Village of Larchmont, NY

Scope 1 Community GHG Emissions

1. Direct GHG emissions from natural gas was obtained from aggregated usage data collected from Consolidated Edison, the utility that supplies natural gas to the Village. The latest available data was from 2020. The tables below show natural gas usage for residences, businesses (small business and commercial activities), and total natural gas consumption within the Village.

Residential Natural Gas Consumption		
Month	**Therms**	**# of Accounts**
January	323,623	1,545
February	324,596	1,544
March	232,682	1,547
April	187,484	1,546
May	138,951	1,549
June	56,094	1,553
July	43,297	1,553
August	48,622	1,547
September	42,240	1,546
October	71,959	1,551
November	143,329	1,554
December	303,247	1,557
	1,916,124	1,549

Table 2: Residential Natural Gas Consumption

Business Natural Gas Consumption		
Month	**Therms**	**# of Accounts**
January	83,104	290
February	77,381	291
March	62,782	287
April	45,642	287
May	43,228	284
June	19,119	279
July	18,831	279
August	18,155	285
September	22,837	284
October	27,780	278
November	38,255	276
December	74,784	272
	531,898	283

Table 3: Business Natural Gas Consumption

Total Natural Gas Consumption		
Month	**Therms**	**# of Accounts**
January	406,727	1,835
February	401,977	1,835
March	295,464	1,834
April	233,126	1,833
May	182,179	1,833
June	75,213	1,832
July	62,128	1,832
August	66,777	1,832
September	65,077	1,830
October	99,739	1,829
November	181,584	1,830
December	378,031	1,829
	2,448,022	1,832

Table 4: Total Natural Gas Consumption

Total natural gas consumption in 2020 in the Village of Larchmont was 2,448,022 therms / year. The GHG emissions factor for natural gas published by Climate Smart Communities is 5.296 kg CO_{2e} / therm. Thus, GHG emissions from natural gas consumption in the Village is **12,965 metric tons (Mtons) CO_{2e} per year**.

2. Fugitive emissions of natural gas that leaks during transmission was estimated based on Con Edison's estimate of their total of 230 Mtons CO_{2e} / year lost in 2020 throughout the entire service area of 660 square miles. Given that the Village of Larchmont covers 1.1 square miles, its share of that total is **0.38 Mtons CO_{2e} per year.**

3. Direct emissions from on-road vehicles within the Village's boundary was estimated.

   Private Car, Local Transportation

   The Village of Larchmont has three major streets that run through it that draw the vast majority of local automobile traffic: Boston Post Road, Chatsworth Avenue, and Palmer Avenue. According to a NYSDOT 2019 study, an estimated that automobiles per day (both directions) or 3.65 million vehicles per year travel along the Chatsworth Avenue corridor and 13,000 automobiles per day travel along Boston Post Road in Larchmont. There is no published estimate of vehicle travel for Palmer Avenue. However, since it is a one-lane road running parallel to Boston Post Road (two lanes each way) and does not have the number of destinations (retail and related stores) that Boston Post Road has, it will be assumed that vehicular traffic is one-quarter of the amount on Boston Post Road or 915,000 vehicles per year. See table below to view vehicle miles traveled (VMT) per year for Larchmont.

Street	# Vehicles / Year	Length (miles)	VMT
Boston Post Rd.	4,475,000	2.2	9,845,000
Chatsworth Ave.	3,650,000	1.2	4,380,000
Palmer Ave.	915,000	1.2	1,098,000
		Total:	**15,323,000**

Table 5: Total Estimated Vehicle Miles Traveled (VMT) per year for Larchmont

The next determinant is the cross-section of types of vehicles driven in Larchmont. Being a residential community, the vast majority of vehicles driven in the Village are standard automobiles (sedans) and large automobiles (SUVs). Some trucks drive through to get to commercial businesses, but this is a small minority. See table below for analysis of fuel usage and CO_{2e} emissions.

Auto Type	Fuel	Miles/Gallon	Percent Use	VMT	CO_{2e} Emissions/Yr.
Standard auto	Gasoline	23.5	75%	11,500,000	4,385 mTons
Large auto	Gasoline	17.2	20%	3,000,000	1,563 mTons
Truck	Diesel Oil	5.9	5%	766,000	1,353 mTons
				Total:	**7,300 mTons**

Table 6: Analysis of Fuel Usage and Corresponding CO2e Emissions

GHG emission factors used to compute CO_{2e} emissions are 8.96 kg CO_{2e} / gallon of gasoline and 10.42 kg CO_{2e} per gallon of diesel oil (Climate Smart Communities).

Public (Bus) Transportation

Four public "Bee Line" bus routes (operated by Westchester County) travel through the Village. Estimated bus route mileage is estimated by multiplying the one-way linear miles of each route through the Village multiplied by the number of scheduled trips annually. See the table below.

Bus Route #	Linear Miles	No. Trips / Week	Miles Traveled / Year
60	1.5	443	34,554
61	0.4	230	4,784
70	0.4	30	624
71	2.9	15	2,262
		Total:	**42,224**

Table 7: Estimated Trip Miles Traveled per Year by Westchester County Bee Line Busses within the Village of Larchmont

According to federal energy data, transit buses run on about 3.26 miles per gasoline gallon equivalent (source: https://afdc.energy.gov/data/10310). Therefore, gasoline usage for public transportation buses through the Village is 12,952 gallons of gasoline equivalent per year. Given the GHG emission factor of 8.96 kg CO_{2e} per gallon above, bus transportation accounts for 116.0 mTons of CO_{2e} per year.

Total CO_{2e} emissions from private and public (bus) transportation through the Village of Larchmont is 7,416 mTons of CO_{2e} per year.

4. Direct emissions from off-road equipment within the Village's boundary is defined as agricultural machinery, construction, and maintenance vehicles, lawn and garden equipment, and other vehicles that use transportation fuels but do not operate on roads. It is not possible to count off-road transportation fuel use in a ground-up way. Therefore, NYSDEC's Non-Road GHG data for off-road equipment found in Table A-4 of NYSDEC's Climate Smart Communities 2015 Inventory Guidance was used. Larchmont's proportion was 1.1 / 660 sq. miles. Among the fuel sources used was liquified petroleum gases (LPG) and compressed natural gas (CNG).

Fuel Source	Usage in Larchmont	CO_{2e} Emission Factor (kg / unit)	GHG Emissions (mTons / year)
Gasoline (E-10)	219 gallons	8.96	1,962
Diesel Fuel Oil	330 gallons	10.42	3,439
LPG	18.3 gallons	5.80	106
CNG	4.43 scf	0.0556	0.25
		Total:	**5,507**

Table 8: Direct Emissions from Off-Road Equipment

5. Direct emissions from rail locomotives within the Village's boundary is estimated based on diesel oil usage by Metro North in 2002. There are 76 miles of tracks in Westchester County, of which under 1 mile passes through Larchmont. 1,202,206 gallons of diesel fuel oil is attributed to Metro North usage in Westchester County. Given the proportion of tracks in Larchmont, 15,819 gallons can be attributed to Larchmont. Diesel fuel oil has a CO_2 emission factor of 10.21 kg / gallon. CO_{2e} is 98% CO_2. Therefore, the CO_{2e} emission factor is 0.01042 metric tons CO_{2e} / gallon. **165 mTons CO_{2e} per year** is emitted in Larchmont based on Metro North rail traffic. This is believed to be very conservative as Metro North has electrified the rail system greatly since 2002 and few, if any, Metro North trains combust any fuel at the present time.

6. Direct emissions from boats including private craft on lakes and rivers, and commercial shipping operating on rivers and around ports was estimated. There is

no commercial shipping in Larchmont's waters. There is roughly 60 miles of coastline of Westchester County (without counting inlets), bordering Long Island Sound and the Hudson River. Out of that, about 1.5 miles is in the Village of Larchmont. Based on Table A-4 of NYSDEC's Climate Smart Communities 2015 Inventory Guidance, 14,085 gallons of gasoline (E-10) and 2,897 gallons of diesel fuel oil was used in Westchester County for boats (pleasure craft) in 2010. Assuming the proportion of the County total is applied to Larchmont commensurate with the relative shorelines and given the CO_{2e} emission factors for these fuels used above, then total CO_{2e} emissions from usage of boats in the Village of Larchmont is **3.9 mTons CO_{2e} per year**.

Scope 2 Community GHG Emissions

Indirect emissions from electricity usage was obtained from aggregated data collected by the utility that delivers electricity to the Village of Larchmont, Consolidated Edison. The latest data available was 2020. The tables below show natural gas usage for residences, businesses (small business and commercial activities), and total electricity consumption within the Village.

Residential Electric Consumption		
Month	**MWh**	**# of Accounts**
January	1,492	1,724
February	1,316	1,726
March	1,215	1,724
April	1,202	1,726
May	1,274	1,729
June	1,668	1,725
July	2,675	1,726
August	2,325	1,720
September	1,993	1,722
October	1,361	1,725
November	1,281	1,724
December	1,642	1,725
Total:	19,444	1,725

Table 9: Residential Electricity Consumption

Business Electric Consumption		
Month	**MWh**	**# of Accounts**
January	717	315
February	754	314
March	656	316
April	535	316
May	583	313
June	690	316
July	910	316
August	821	320
September	865	317
October	690	316
November	622	317
December	709	317
	8,552	316

Table 10: Business Electricity Consumption

Total Electric Consumption		
Month	MWh	# of Accounts
January	2,209	2,039
February	2,070	2,040
March	1,871	2,040
April	1,737	2,042
May	1,857	2,042
June	2,358	2,041
July	3,585	2,042
August	3,146	2,040
September	2,858	2,039
October	2,051	2,041
November	1,903	2,041
December	2,351	2,042
	27,996	2,041

Table 11: Total Electricity Consumption

Total electricity consumption in 2020 in the Village of Larchmont was 27,996 megawatt-hours (MWh) / year. GHG emissions factors for CO_2, CH_4, and N_2O for electricity usage in the NYC/Westechester area from eGRID in 2020 was used. GHG emissions from total electricity usage in the Village is **8,077 Mtons CO_{2e} per year**.

Scope 3 Community GHG Emissions

Indirect emissions based on solid waste generation is the only relevant category for the Village. Solid waste from Larchmont is taken to a regional incinerator in northern Westchester County. Please note that Village residents divert about 35 tons per year of food waste from the general solid waste stream for composting. In addition, the Village has active recycling and yard waste pick up programs.

The Village has 1,570 residential and 139 commercial/institutional stops for its solid waste collection. On average, each stop picks up two containers of 35 gallons of solid waste each. Each stop in Larchmont gets garbage picked up 2x weekly year-round. Therefore, total solid waste generated in the Village is 70 gallons of solid waste / stop X 1,709 stops / collection X 104 collections / year = 12,441,520 gallons solid waste / year. Assuming an average density of 1.21 lbs. per gallon, the Village generates 7,527 (short) tons of solid waste per year.

Given a CO_2 emission factor of 365 kg / ton combusted (solid waste without scrap tires, Table 3-30, "Inventory of US GHG Emissions and Sinks", 2023, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021) and CO_2 comprises 98% of GHGs from this combustion source, GHG emissions from solid waste for the Village of Larchmont is **2,803 mTons CO_{2e} per year**.