The Village of Hamilton, NY
2018 Municipal and Community Greenhouse Gas Inventory

Completed by Makenna Bridge, Kate Conlan, Alexander Hansen, Tyler Pantle, & Marybeth Wisdo

Supervised and edited by Pamela Gramlich, Dr. Andrew Pattison, & John Pumilio

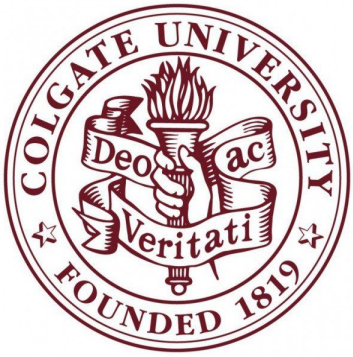

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Table of Contents

List of Tables

List of Figures

Acknowledgements

Andy Pattison
Colgate University Assistant Professor of Environmental Studies

Pamela Gramlich
Colgate University Environmental Studies & Sustainability Office Program Coordinator

Nancy Mitchell
Village of Hamilton Clerk

John Pumilio
Colgate University Director of Sustainability

Executive Summary

The following document is a municipal and community-wide greenhouse gas (GHG) inventory for the Village of Hamilton, NY. Conducting a GHG inventory is amongst the first steps toward the Village of Hamilton becoming a Climate Smart Community (CSC) through New York State's Climate Smart Communities Certification program. This report begins with introductions of the CSC program and the framework behind a GHG inventory. A brief explanation of key spatial components and geographical boundaries is provided, as well as descriptions of important decisions made during the creation of this inventory. Additionally, a description of how GHG emissions are classified by scope is included. In these sections key concepts are explained, which aid understanding of the complexities of an emissions inventory.

This report quantitatively details GHG emissions from Village municipal operations, followed by community-wide emissions. Sources of GHG emissions are broken down into sectors – for municipal operations, these include buildings and facilities, transportation, and wastewater management, to name a few. The community inventory includes sectors (many of which are analogous to municipal sectors) such as buildings and facilities, product use, transportation, and wastewater management. Each sector has its own complexities, therefore any important factors to consider when calculating the emissions from that sector are provided in the corresponding sections.

The emissions from each sector were calculated separately and are reported below, along with the data sources used and methodology. Calculations were completed using a GHG emissions calculator in Excel. This calculator was set up by a former Colgate University student, and has since been modified by multiple individuals, namely Pamela Gramlich, Colgate University's Assistant Director of Sustainability and Environmental Studies Program Coordinator, John Pumilio, Director of Sustainability at Colgate University, and Andy Pattison, Assistant Professor of Environmental Studies at Colgate University. After calculations by sector, emissions are then summed to obtain total emissions for the community and municipal operations.

The total estimated GHG emissions for the Village of Hamilton municipal operations inventory is 513.16 metric tons of CO_2 equivalents ($MTCO_2e$). The community emissions estimate is 17,816 $MTCO_2e$. The Buildings and Facilities sector accounts for the largest percentage of total community emissions at 71%, indicating this may be an area to consider closely for emissions reductions. For the municipal operations, the transportation sector is responsible for the largest portion of emissions, at 78.9%. This section could also be an area of focus for emissions reductions.

These data are reported in the table below, alongside emissions of other nearby localities to provide a point of reference. When looking at these emissions, it is important to consider the size of the localities in relation to their emissions. The Town of Hamilton has a population of 6,690[1], the Town of Cazenovia has a population of 7,086[2], and the City of Oneida has a population of

[1] Includes 4,239 residents living in the Village of Hamilton.
[2] Includes 2,835 residents living in the Village of Cazenovia.

11,390. The Village of Hamilton sits somewhere in the middle among these other localities, with a population of 4,239. All population data is from the 2010 census.

Table 1: Summarized Emissions Compared to Nearby Localities

Locality	**Municipal Emissions ($MTCO_2e$)**	**Community Emissions ($MTCO_2e$)**	**Total Emissions ($MTCO_2e$)**
Village of Hamilton (2018)	513.7	17,816.4[3]	17,816.4
Town of Hamilton (2017)	215.3	43,198.0[4]	43,413.3
Town of Cazenovia (2014)	469.0	41,092.0	41,561.0
City of Oneida (2013)	2,353.0	106,831.0	109,184.0

This report ends with recommendations for future actions and potential methods to decrease GHG emissions. The most immediate next steps are to set a goal for emissions reductions – both a quantity of GHGs to be eliminated and a timeframe in which to get there. These reductions targets are often released along with a Climate Action Plan (CAP), which is another necessary step toward the Village becoming a certified CSC.

[3] Includes Colgate University's emissions from heating, cooling, and electricity consumption.
[4] Includes the Village of Hamilton's Municipal and Community-wide emissions.

Introductions

Climate Smart Communities Program Overview

The Climate Smart Communities (CSC) program was launched in 2009 with the goal of encouraging local governments to enact programs and policy to address climate change (climatesmart.ny.gov, 2018). This New York State (NYS) program assists and incentivizes communities to reduce GHG emissions and adapt to changing conditions. While the Department of Environmental Conservation (DEC) acts as the lead administrator for the program, it is jointly sponsored by an additional five New York State agencies: the Department of Public Service; the Energy Research and Development Authority (NYSERDA); the Department of Transportation; the Department of State; and the Department of Health (climatesmart.ny.gov, 2018). For a community to become a Certified CSC, they must first adopt a 10-point pledge, then complete and document a series of actions to combat the effects of climate change. The 10 pledge elements include the following:

1. Build a climate-smart community
2. Inventory emissions, set goals, and plan for climate action
3. Decrease energy use
4. Shift to clean, renewable energy
5. Use climate-smart materials and management
6. Implement climate-smart land use
7. Enhance community resilience to climate change
8. Support a green innovation economy
9. Inform and inspire the public
10. Engage in an evolving process of climate action

The CSC Certification program works to educate and engage with NYS communities, as well as provide a framework which local governments can use to guide their efforts in becoming a CSC. Additionally, successful communities can receive recognition and rewards for their climate-conscious actions. The program allows communities to achieve three levels of certification awards: bronze, silver, and gold Climate Smart Communities. Bronze certification is the standard – to achieve higher certifications, the community must complete and document additional climate-conscious actions. There are currently 32 bronze-certified communities, 2 silver, and no gold-certified communities. As an additional incentive, the DEC's Climate Smart Communities Grant Program offers funding for local governments to implement climate change adaptation and mitigation projects (DEC, 2018).

In 2017, the Village of Hamilton pledged to become a CSC, and therefore must conduct an inventory of GHG emissions to complete the second pledge element. This report has been constructed to satisfy that requirement, and allow the Village community to then formulate and establish a climate action plan (CAP). The following report details the processes and findings of the Village of Hamilton municipal and community GHG inventories, with the goal of determining where the most effective and efficient emissions reductions can be made.

Greenhouse Gas Inventory Framework

A GHG inventory is a survey and analysis of total GHG emissions broken down by sectors and sources within an established boundary. Typically, inventories calculate total emissions over the period of one calendar year, though other time frames may be used. The purpose of conducting a GHG inventory is often to establish a baseline of emissions, upon which communities can adopt a target reductions goal and develop equitable strategies to most efficiently reduce emissions. By dividing GHG emissions into sectors and sources, government officials can easily identify areas of priority concern and act accordingly.

Many inventories are specific to either municipal operations or community-wide emissions. Municipal GHG inventories focus on emissions produced from governmental operations, such as electricity and gas for police stations, municipal libraries, and office buildings, as well as emissions from municipal fleets, waste management facilities, and streetlights. Community-wide inventories include emissions from commercial and residential activities, as well as any school operations. Emissions in a community-wide inventory may come from sources such as personal travel, home heating and electricity usage, and landfill waste. The following document contains a GHG emissions inventory for both municipal and community operations within the Village of Hamilton, NY.

An important factor to keep in mind when viewing a GHG inventory is that emissions are not directly measured (Boswell et al., 2012). Emissions quantities are calculated using other data, such as kilowatt hours of electricity consumed or miles traveled by car. From these data, emissions can be extrapolated by multiplying them by an emissions factor, which is specific to the type of fuel used. Additionally, the standard unit for reporting GHG emissions is metric tons of carbon dioxide equivalents ($MTCO_2e$). This is because different greenhouse gases trap different amounts of heat in the atmosphere. An example is methane, a GHG that is 28 times more potent than carbon dioxide. To convert methane emissions into carbon dioxide equivalents, multiply the mass of methane emissions by 28, otherwise known as the Global Warming Potential (GWP). A table of GWPs of common GHGs is provided below.

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_2O)	265
Sulfur Hexafluoride (SF_6)	23,500
Hydrofluorocarbons (HFCs)	4 - 12,400
Perfluorocarbons (PFCs)	6,630 - 11,100

Figure 1: Global Warming Potentials for Common GHGs
Adapted from IPCC AR5 (2013)

Geographic Boundaries and Spatial Components

The Village of Hamilton, located within the Town of Hamilton, has a population of 4,239 as of the 2010 census. The Village covers a total area of 2.51 square miles and contains Colgate University and Hamilton Central School, whose emissions are included in this inventory. A map of the boundaries of the Village is provided in the Appendix A.

Inventory Guidance and Decisions Made

This inventory was constructed relying heavily on the framework laid out in the 2014 CSC *Greenhouse Gas Inventory Guide for Local Government Operations* and 2015 CSC *New York Community and Regional GHG Inventory Guidance* (V1.0). These documents provided guidance with identifying sectors and determining what data needed to be collected. These documents provide information on emission scopes, standard units, a reporting format.

Additionally, the community and municipal GHG inventories previously completed for the Town of Hamilton were used for guidance. Some data sources and emission factors were obtained from these documents, while any remaining emissions factors were obtained from the EPA's Emissions Factors for Greenhouse Gas Inventories, last updated in March 2018. Data specific to municipal operations was provided by Nancy Mitchell, Village of Hamilton Clerk.

Methods for organizing the inventory process were influenced by the writings of Boswell et al. (2012), specifically chapter four. This chapter is a guide that explains generally how to conduct a GHG inventory from start to finish, including potential next steps and recommendations.

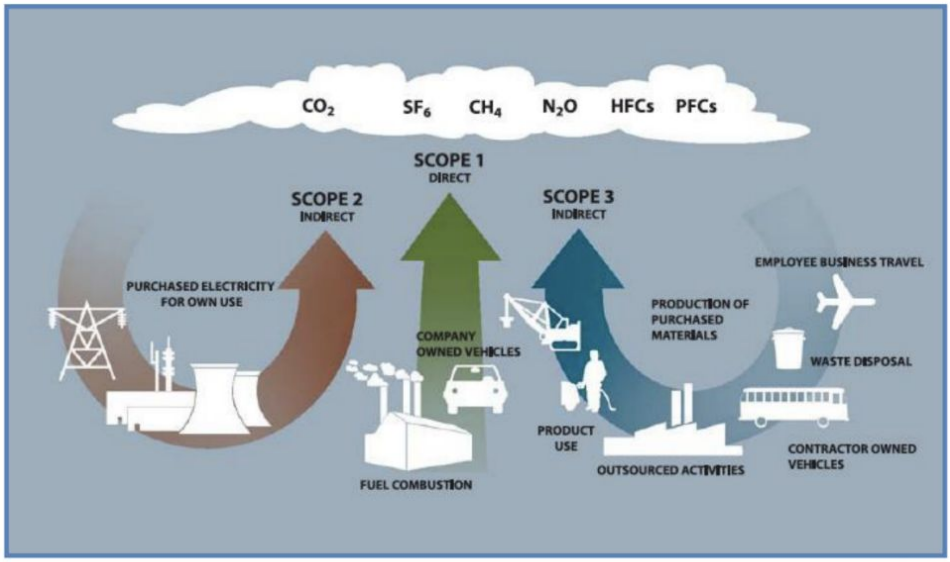
Census data was necessary for calculating certain emissions. All census data used in this document is from the 2010 census. Estimates of some census data for 2017 exists, however the decision was made to use the most recent definitive census data (2010) to avoid using estimated numbers, and to keep the data as consistent as possible.

Classifying Emissions

In order to address the growing issue of climate change, the most productive strategy is to adopt a two-pronged approach by mitigating emissions and adjusting infrastructure and society to the prevalent changes. This report was created to better quantify a baseline of GHG emissions for the Village of Hamilton, NY. The municipal inventory and community inventory that are included in this report include the residences and buildings that are within the Village of Hamilton boundaries.

Scopes of Emissions: Direct and Indirect Emissions

To better understand the sources of GHG emissions it is useful to identify the different scopes of the sources. Direct emissions pertain to those that are a direct result of some action by the subject consuming a source of energy. Indirect emissions, on the other hand, pertain to emissions that are a result of an activity which requires energy but the actual source of the emissions is owned by another player. The differences between direct and indirect sources are better characterized by separating them into 3 different scopes: Scope 1, 2, and 3. The following illustration (Figure 2) visually lays out these differences. These scopes are useful and essential to this inventory because they provide means to isolate emissions to better inform policy and community actions towards mitigating overall emissions.



Source: WRI/WBCSD GHG Protocol Corporate Standard, Chapter 4 (2004)

Figure 2: GHG Emissions Scopes

The source of Scope 1 emissions is directly from the party who is reporting the emissions. Examples of activities within this scope for the municipal inventory are the direct consumption of fuels and emissions that result from any municipal facility or fleet vehicles within the Village

of Hamilton. For the community inventory, emissions in the scope are exemplified the burning of gasoline and fuel in personal vehicles for the community and the resulting emissions therein.

Scope 2 emissions are a form of indirect emissions that a middle party who energy has been purchased through emits. Within the municipality, this usually takes the form of energy that is consumed by purchasing electric, heating, and cooling services. An example of this is purchasing energy from the local grid which obtains its energy from some external combustion location.

Scope 3 emissions are another form of indirect emissions but pertain to anything that is outsourced and where the emissions are not directly emitted into the community or area in which it is being used. An example of a Scope 3 emissions is if a product is purchased outside of the village then all of the emissions that were produced in getting the product to the final location within the village count towards this scope.

While these scopes are important to recognize, this report will also include the varying levels of sources and sectors of these emissions to provide the Village with a more comprehensive report of the entire community. The setup of this inventory will detail the methods and results by sector and scope for both the municipal and community inventory.

Municipal GHG Emissions by Sector

Buildings and Facilities

Data and Methods

Scope 1

Heating Oil and Natural Gas Consumption for Municipal Facilities

The buildings and facilities that are included within the Village of Hamilton municipality include 16 different units including some water and sewer pumps, wastewater treatment plant, and administrative buildings. The natural gas data below is from village reports from fiscal year (FY) 2018. These emissions fall under scope one as they are being directly combusted and used in each municipal location.

Table 2: Scope 1 Emissions Attributed to the Building and Facilities Sector

	Total Consumption	**Emissions Factor**	**GHG Emissions ($MTCO_2e$)**
Natural Gas	974.4(MMBtu)	0.054494 $MTCO_2e$/ MMBtu	53.07
Fuel Oil #2	669.4 (gallons)	0.010484 $MTCO_2e$/gallon	7.02
Total	--	--	60.09

Scope 2

Electricity Consumption for Municipal Facilities

The Village of Hamilton operates on its own municipal electricity source which differs from the Town of Hamilton which instead draws from the New York State Energy and Gas Corporation (NYSEG). This difference means that the Village electrical calculations must be done with an independent emissions factor in mind. In FY 2018, the emission factor for the Village of Hamilton was .0000163 $MTCO_2e$/ kWh (Appendix B).

Table 3: Scope 2 Emissions Attributed to the Buildings and Facilities Sector

	Electricity Consumption (kWh)	**Emissions Factor ($MTCO_2e$/kWh)**	**Total Emissions ($MTCO_2e$)**
Municipal Electricity	2,684,900	0.0000163	43.76
Total	2,684,900	--	43.76

In 2018, municipal operations in the Village of Hamilton consumed 2,684,900 kWh of electricity resulted in 43.76 $MTCO_2e$.

Results

Table 4: Total Buildings and Facilities Emissions for Municipality

Scope	**Emissions ($MTCO_2e$)**
Scope 1	60.9
Scope 2	43.76
Total	103.85

Outdoor Lighting

Outdoor lighting includes streetlights, lights in parking lots, and Village Park lights. These lights run off purchased electricity, just as the buildings and facilities previously described, therefore these emissions are considered scope 2 emissions. Traffic lights are managed and run by the NYS government, and therefore will not be accounted for here. Streetlights are currently in the process of being converted to LEDs (light emitting diodes).

Data and Methods

Emissions associated with outdoor lighting are calculated using electricity consumption in kWh.

Table 5: Total Emissions Associated with Outdoor Lighting

Light Type	Electricity Consumption (kWh)	Emissions Factor ($MTCO_2e$/kWh)	Total Emissions ($MTCO_2e$)
Street & Park Lights	186,907	0.0000163	3.05
Total	186,907	--	3.05

Results

Total emissions associated with outdoor lighting in the Village for FY 2018 is 3.05 $MTCO_2e$.

Transportation

Transportation in an inventory is typically broken down into on-road mobile, off-road mobile, and rail and air. Municipal transportation, however, only includes on-road mobile emissions in the form of the Village-owned vehicle fleet as well as Village employee commutes and business travel. We did not have access to this information for FY 2018. The information below reflects FY 2017. We believe the difference in emissions from FY 2017 to FY 2018 would be de minimis as no major changes were made in operations related to the vehicle fleet or employee transportation.

On-Road Mobile

Data and Methods

On-road municipal transportation data includes the Village vehicle fleet as well as Village employee business travel and commuting. The Village vehicle fleet is made up of 27 vehicles and is broken down as such:

- Electric/Water Companies: 7 vehicles
- Natural Gas Company: 5 vehicles
- Fire Department: 5 vehicles
- Police Department: 4 vehicles
- Department of Public Works: 4 vehicles
- Wastewater Treatment Plant: 2 vehicles

Data on this fleet was collected from the Village in the form of gallons of gasoline and diesel fuel consumed. Gasoline and diesel are both fuels used in vehicles and, while similar, there are

differences between the two. For the purposes of this report, the only noteworthy differences are that diesel is cleaner and more energy-dense than gasoline. As a result, there are fewer emissions associated with diesel fuel and it also achieves greater fuel economy than gasoline. There are also different emissions factors applied to the different fuel types.

Employee business travel and commuting data were obtained through a survey given to Village employees. Employee business travel is classified as scope 1 emissions and employee commuting is classified as scope 3. Below is the survey given to employees:

Please fill out the following survey regarding the vehicle you used to drive to work from Jan 2015-Jan 2016. Please fill out and return to the Town Office ASAP.

Year, Make & Model of Vehicle: _____

Fuel Type (circle one): *Gasoline, Diesel, Other*

Average MPG: _____

Distance of commute (one way): _____

Number of days per week on average you commute to work: _____

At the time when this survey was distributed, it was believed that calculations would be done based on calendar year data rather than fiscal year data which is why the time period of January 2015 - January 2016 was used. Once information was obtained regarding miles traveled, gallons of gasoline could be calculated using the miles per gallon reported by employees.

Table 6: Village of Hamilton-Owned Vehicle Fleet Scope 3 Emissions

Fuel Type	**Fuel Consumption (Gallons)**	**Emissions Factor**	**Total Emissions ($MTCO_2e$)**
Gasoline	14,369	0.009099034	130.74
Diesel	21,552	0.010347846	223.02
Total	35,921	--	353.76

Table 7: Village of Hamilton Employee Commute and Business Travel Scope 1 Emissions

Fuel Type	Fuel Consumption (Gallons)	Emissions Factor	Total Emissions ($MTCO_2e$)
Gasoline	5,690	0.009099034	51.77
Diesel	0	0.010347846	0
Total	5,690		51.77

Results

The Village's vehicle fleet emissions contributed 353.761 $MTCO_2e$ in FY 2017. There are few Village employees, all of whom live very close to their work. The total emissions for both employee commutes and business travel are 51.77 $MTCO_2e$. Total municipal transportation emissions were 405.531 $MTCO_2e$. We did not have access to this information for FY 2018 so we have used FY 2017 information in its place as no major changes were made in operations related to the vehicle fleet or employee transportation.

Off-Road Mobile

Data and Methods

The Town of Hamilton GHG Inventory extrapolated emissions from the Madison County GHG Inventory by scaling down per capita emissions. However, within the Village of Hamilton, there are no significant off-road mobile transportation emissions due to the lack of farming, water sports, or other off-road vehicular activity. As a result, data from the Madison County GHG did not need to be scaled down to the Village because it would be an inaccurate representation of the Village's GHG emissions.

Air and Rail Travel

Data and Methods

While there once was a rail line with a depot located in the village, it has since been removed and replaced with hiking and walking trails. Today, there are no rail lines within the Village of Hamilton and thus there are no emissions attributed to the Village as a result of the use of rail lines. Because of this, it is not necessary to include figures and results showing rail emissions because there is no data.

There is no data for municipal air travel within the Village of Hamilton. The airport sells fuel for personal air travel, however that is not counted in this inventory as outlined on Page 21-20.

Solid Waste Management

GHG emissions from waste solid management can be separated into both Scope 1 and Scope 3 emissions. Scope 1 emissions from solid waste management come from the emissions released from a landfill. These scope 1 emissions can only be attributed to a community if the landfill lies within the community boundaries. Since all solid waste from the Village of Hamilton is disposed of in the Madison County landfill, beyond village boundaries, the Village itself does not have any Scope 1 emissions from solid waste management. Scope 3 emissions from solid waste management include emissions that result from the solid waste that a community produces that is disposed of outside of the community conducting the GHG inventory. Thus, the Village of Hamilton must account for Scope 3 solid waste emissions in its GHG inventory. It is important to note that the Madison County Landfill does not differentiate between the waste that comes from the municipal side of the Village and the community of the village so the overall calculations for Village waste include both municipal and community waste.

Data and Methods

According to communications done by Gilgore et al. (2017), the Madison County Department of Solid Waste and Sanitation collected solid waste data for the Village in 2015. It is the most recent and accurate measure of solid waste for the Village of Hamilton, so we will be using this data in lieu of any other data. The Village of Hamilton, as a whole, generated 1,984 tons of waste in FY 2015. The emissions factor for Madison County's methane recovery and electricity generation system is -0.03 MTeCO2/short ton resulting in emissions of -60 $MTCO_2e$. This data, however, will not be counted towards the municipality's emissions since the municipal and community waste cannot be separated. All emissions from solid waste will be counted towards the community emissions. Since the emissions are negative, this will not hinder the municipal inventory or make municipal emissions seem to be lower than they actually are.

Results

There are no solid waste emissions associated with the Village of Hamilton municipality.

Wastewater Management

The Village of Hamilton relies on an aerobic municipal wastewater treatment plant that falls under Scope 1. These types of wastewater treatment plants release methane and nitrous oxide during their treatment process. There are seven municipal buildings (Village Office, Library, Police Department, Fire Department and Municipal Airport, Village Courthouse, Hamilton Central School) in the Village and for this inventory, we assume that all of them rely on the municipal wastewater treatment plant.

Data and Methods

Table 8: Total Emissions Associated with Wastewater Management

	Gallons of Water	**$MTCO_2e$/ Gallon of Water**	**Municipal Buildings using WWTP**	**Total Emissions ($MTCO_2e$)**
Wastewater	3,145,340	0.0000004	7	1.26

Results

Assuming that all seven Village of Hamilton municipal buildings use the wastewater treatment plant and not some other wastewater management technique such as a septic tank, the total $MTCO_2e$ emissions from the Village municipal is 1.258.

Water Delivery

The Village of Hamilton's Water Department provides the community with water for daily use. The department treats the water and pressurizes the distribution system. Total water purchased by the Village in 2017 was 5,454,795 gallons. Water is sourced from a nearby aquifer. Emissions associated with water delivery includes the electricity used to move the water to and from the Water Department facility, located at 81 College Street. The total electricity consumption (including that needed to run the pump) for 81 College Street was accounted for in the previous "buildings and facilities" section. Therefore, those emissions are not listed in this section to avoid double counting.

Grounds and Maintenance

Emissions associated with grounds and maintenance can arise from fertilizer use. Fertilizers can be either organic, such as manure, or inorganic. Emissions from organic fertilizers arise when nitrogen in the fertilizer is not taken up by plants, it is often lost to the atmosphere as nitrous oxide (N_2O) (Millar et al. 2014). The Village of Hamilton uses very little fertilizer, so the emissions associated with the use of fertilizer can be considered de minimis, and therefore were omitted from this report.

Airport

The Hamilton Municipal Airport, owned by the municipality, services commercial and private aircrafts and provides them with both aviation gasoline and Jet Fuel A fuel types.

Data and Methods

While there are emissions factors associated with both aviation gasoline and Jet Fuel A, these fuels are not used to power aircraft that are being used by the municipality so are not being factored into the emissions inventory.

Results

There are no emissions coming from fuel sold by the Hamilton Municipal Airport that count towards this inventory.

Overall Municipal Emissions

The table below shows the overall municipal emissions in $MTCO_2e$ for each sector of municipal operations.

Table 9: Total Municipal Emissions by Sector and Scope

Sector	**Scope 1 ($MTCO_2e$)**	**Scope 2 ($MTCO_2e$)**	**Scope 3 ($MTCO_2e$)**	**Total Emissions by Sector ($MTCO_2e$)**
Buildings and Facilities	60.09	43.76	--	103.85
Outdoor Lighting	--	3.04	--	3.04
Transportation	353.76	--	51.77	405.53
Wastewater	1.26	--	--	1.26
Total Emissions by Scope ($MTCO_2e$)	414.59	46.80	51.77	513.70

Total municipal emissions are calculated to be 513.70 $MTCO_2e$. The sector with the highest emissions is transportation and the sector with the lowest emissions is wastewater.

Community GHG Emissions by Sector

Buildings and Facilities

This section includes both Scope 1 and 2 emissions within the community of Hamilton from buildings that are either residential or commercial. It is important to note that while the CSC guide suggests including emissions associated with industrial sectors, the Village of Hamilton does not have an industrial sector. Scope 1 emissions include carbon released from fuel oil, wood, and other sources of energy that are being consumed in residential or commercial units within the Village. The Scope 2 emissions in this section include those from electricity purchases and consumption. The CSC New York Community and Regional GHG Inventory Guide provided the guidelines for how sectors were selected for this inventory and how to measure them.

Data and Methods

To ensure that the data collected was the most accurate available, direct consumption data was used from the Village of Hamilton. This data was available for some of the sectors that are included in this inventory but not in all cases. Most consumption emissions data for fuels such as biomass, propane, and fuel oil is not available at the Village level and thus steps must be made to estimate these emissions. The accepted method of still generating this data is to scale down the emissions from a state or county-wide level in order to provide a relative estimate for the Village. This inventory will include both direct data when it is available and downscaled data when reports are still required but data was not able to be obtained.

Scope 1: Heat Energy (Biomass, Natural Gas, Fuel Oil, Propane)

Residential Biomass Emissions

The emissions that come from the burning of wood contributes to the short carbon cycle and therefore are not included in the footprint of the Village because that carbon would have been released naturally through decomposition at some point in time. The protocols being used for this inventory suggest that these emissions be recorded but kept separate from other fuel sources.

Table 10: Residential and Commercial Community Emissions from Biomass FY 2018

	Residential	**Commercial**			**Total ($MTCO_2e$)**
	Village of Hamilton	**Village of Hamilton**	**Village Municipality**	**Colgate University**	
Units	MMBtu	MMBtu	Tons	Tons	--
Consumption	4,620,000.00	No Data	No Data	11,040.00	4,631,040.00
Emissions Factor	1.64	1.64	1.64	1.64	--
Total Emissions ($MTCO_2e$)	7,574,524.47	0.00	0.00	18,100.16	7,592,624.63

Residential Fuel Emissions (Fuel oil, Propane, Natural Gas)

Direct heat energy consumption was not available for all fuels in the Village of Hamilton. To estimate emissions for fuel oil # 2 and propane, we followed protocols outlined in the ICLEI Accounting and Reporting of Greenhouse Gas Emissions. Amanda Mazzoni from the Central New York Regional Planning & Development Board provided us with a workbook that allowed us to determine fuel fuel oil and propane usage for the Village of Hamilton. These estimates reflect 2017 numbers (Appendix C). We were able to obtain natural gas data for FY 2018 from the Village of Hamilton, however we were unable to parse out residential vs. commercial numbers, so we determined it would be most appropriate to include all natural gas numbers in the commercial section seeing as, according to the Village, at that time, most of the natural gas usage was from business along Broad Street and Colgate University, not households.

Table 11: Scope 1 Emissions from Residential Heating Fuels

Fuel Type	**Fuel Oil (Gallons)**	**LPG (Propane) (Gallons)**	**Natural Gas (MMBtu)**	**Total ($MTCO_2e$)**
Consumption	125,490.08	32,279.33	Incl. in Commercial	
Emissions Factor	0.010484	0.005741	0.054494	--
Total Emissions ($MTCO_2e$)	1,315.64	185.32	Incl. in Commercial	1,500.96

Commercial/Institutional Emissions

Following ICLEI protocols, and the workbook provided by Amanda Mazzoni, (Appendix C) we were able to estimate propane and fuel oil usage for the Village of Hamilton Commercial Operations. Information from Colgate University was used for Kerosine. Natural Gas information was collected directly from the Village's utility and includes Colgate and Village municipal operations for FY 2018. Natural gas numbers below also include residential natural gas usage as stated above.

Table 12: Scope 1 Emissions From Commercial Heating Fuels

Fuel Type	**Fuel Oil (Gallons)**	**Propane (Gallons)**	**Kerosene (Gallons)**	**Natural Gas (MMBtu)**	**Total**
Consumption	93,089.18	15,601.09	83.00	166,201.00	
Emissions Factor	0.010484	0.005741	0.010484	0.054494	--
Total Emissions ($MTCO_2e$)	975.95	89.57	0.87	9,056.96	10,123.34

Table 13: Residential and Commercial Community Emissions from Natural Gas FY 2018

	Residential	**Commercial**			**Total**
	Village of Hamilton	**Village of Hamilton**	**Village Municipality**	**Colgate University**	
Consumption (MMBtu)	Incl. in Commercial	73,604	974	91,623	166,201
Emissions Factor	0.054494	0.054494	0.054494	0.054494	--
Total Emissions ($MTCO_2e$)	Incl. in Commercial	4,010.98	53.08	4,992.90	9,056.96

Scope 2: Electricity

Residential and Commercial Electricity Emissions

The Village of Hamilton operates on its own municipal electricity source which differs from the Town of Hamilton which instead draws from NYSEG. This difference means that the Village electrical calculations must be done with an independent emissions factor in mind. More information about the Village of Hamilton's Electricity and Emission Factor calculations can be found in Appendix A.

Direct electricity usage was through the clerk's office in the Village of Hamilton in a document called "Village Meters Consumption." This document included codes for commercial and residential meters that we separated and displayed below:

Table 14: Scope 2 Emissions Associated with Electricity Consumption FY 2018

	Residential	**Commercial**			
	Village of Hamilton	**Village of Hamilton**	**Village Municipality**	**Colgate University**	**Total**
Consumption (kWh)	14,745,440	10,037,529.80	2,871,807	29,588,539.20	57,243,316
Emissions Factor	0.0000163	0.0000163	0.0000163	0.0000163	
Total Emissions ($MTCO_2e$)	240.35	163.61	46.81	482.29	933.07

Results

The total emissions for Buildings and Facilities in the Village of Hamilton for FY 2018 was 12,557.35 $MTCO_2e$ (Table 15). This includes both heating from residential and commercial sectors and the emissions from electricity consumption from both of those sectors.

Table 15: Total Community Emissions Associated with the Buildings and Facilities Sector

Source of Emissions	Village of Hamilton	Colgate University	Total Emissions ($MTCO_2e$)
Commercial Heat Energy	2,343.27	7,780.07	10123.34022
Residential Heat Energy	1,500.95	--	1,500.95
Residential Electricity	240.35	--	240.35
Commercial Electricity	210.42	482.29	692.71
Total Emissions (MTCO2e)	4,294.99	8,262.36	12,557.35

Product Use

Industrial processes, including the manufacturing of products, can emit GHG by-products as a result of the production process. For example, typical GHGs, such as CO_2, will be emitted during these production processes, but other, more potent GHGs can be also be emitted by large factories. These more potent pollutants are counted separately from fossil fuel emissions in this inventory. As outlined by the New York GHG Inventory Guide, these processing emissions include CO_2, CH_4, N_2O, perfluorocarbons (PFCs) and NF_3.

In accordance with the Mandatory Reporting Rules, any large facilities emitting GHGs greater than 25,000 $MTCO_2e$ must report their emissions to the EPA. Within the Village of Hamilton, there are no facilities producing this amount of emissions.

While there are no large facilities producing the above-mentioned GHGs, there is still product use of ozone-depleting substitutes (ODSs) within the Village of Hamilton from sources such leaking refrigeration and air conditioning units. These ODSs include, SF_6, hydrofluorocarbons (HFCs), and other refrigerants. The leakage of these ODSs into the atmosphere is accounted for in this inventory and outlined below.

Data and Methods

As stated in the Town of Hamilton GHG Inventory, industrial processes emissions have been confirmed to be zero. Measuring ODSs within a community cannot be done on a per capita basis within the community and instead is done scaling national ODS emissions down to the community. National ODS emissions are scaled down to national per capita emissions. National per capita emissions are then multiplied by the population of the Village of Hamilton to estimate per capita emissions within the Village as shown in Tables 16 and 17.

Table 16: United States ODS Emissions (HFCs) per Capita Based on 2010 Census Data

	Totals
U.S. ODS Emissions ($MTCO_2e$)	114,600,000
U.S. Population	308,745,538
U.S. Emissions per Capita ($MTCO_2e$/Capita)	0.37

Source: Town of Hamilton GHG Inventory

Table 17: Village of Hamilton ODS Emissions (HFCs)

	Totals
ODS per Capita ($MTCO_2e$/Capita)	0.37
Village of Hamilton Population	4,239
Village of Hamilton ODS Emissions ($MTCO_2e$)	1,572.67

Source: Town of Hamilton GHG Inventory

Table 18: Colgate University ODS Emissions

Refrigerant	Refrigerant Loss (lbs)	Emissions Factor	GHG Emissions ($MTCO_2e$)
HFC-134a	30	0.648637089	19.46
HCFC-22	--	0.82100219	0
R-407C	59.0	.8045762	47.47
R-404A	3.0	1.78	5.34
R-10A	2.5	.95	2.37
R-414B	3.0	n/a	--
Total	30	--	74.64

Source: Colgate University GHG Inventory

Table 19: SF_6 Emissions Rates Based on 2010 Census Data.

	Units	Consumption
U.S. SF_6 Emissions	$MTCO_2e$	11,800,000
U.S. Electricity Consumption	MMBTU	12,810,300,000
SF_6 Emissions per MMBTU consumed	$MTCO_2e$/MMBTU	0.0009211

Source: NYSERDA Communities Team, 2015, Table 12.

Table 20: SF_6 Emissions for the Village of Hamilton, Including Colgate University

	Village of Hamilton	Colgate University	Total
Consumption (kWh)	27,666,276.80	29,588,539.20	57,254,816.00
MMBTU/1 kWh	0.0034121	0.0034121	--
Total MMBTU	94,401.28	100,960.31	195,361.59
$MTCO_2e$/MMBTU	0.0009211	0.0009211	--
SF_6 Emissions ($MTCO_2e$)	86.95	92.99	179.95

*SF_6 was calculated using the same methods as the Town of Hamilton GHG Inventory, however, that method of calculation is being re-examined for accuracy and thus this total is subject to change.

Results

The total product use emissions for the Village of Hamilton are estimated to be 1,827.25 $MTCO_2e$ with the breakdown of emissions shown in Table 21 below.

Table 21: Total Product Use Emissions for the Village of Hamilton, Including Colgate University

	Village of Hamilton	**Colgate University**	**Total Emissions ($MTCO_2e$)**
HFC	1,572.67	--	1,572.67
Refrigerants	--	74.64	74.64
SF_6	86.95	92.99	179.94
Total ($MTCO_2e$)	1,659.62	167.63	1,827.25

*Subject to change.

Transportation

In this inventory, transportation is broken down into on-road mobile, off-road mobile, and air and rail emissions. On-road mobile emissions include those from cars, motorcycles, buses, etc. Off-road mobile emissions include those from farming equipment, dirt bikes, ATVs, boats, and other pleasure craft. Air and rail emissions include those from air travel at the Hamilton Municipal Airport and any rail systems, of which there are none in the Village. Transportation often accounts for 20-25% of a community's GHG inventory (NYSERDA Community Team, 2015).

On-road Mobile

Data and Methods

Total on-road mobile emissions were measured by obtaining Annual Average Daily Traffic (AADT) counts where available and multiplying by the total length of roads within the Village of Hamilton. AADT data was obtained from the New York Department of Transportation (NYDOT) Traffic Data Viewer. The total length of road within the Village was reported in the Madison County Hazard Mitigation Plan according to the Department of Public Works. Multiplying AADT by the total road length within the Village provides an estimate for Daily Vehicle Miles Traveled (DVMT). This number was then multiplied by 365 to estimate the

Annual Vehicle Miles Traveled (AVMT). The final total was then converted to emissions by multiplying by emissions factors for gasoline, ethanol, and diesel.

The Association of Municipalities of Ontario produced a set of guidelines that outline how to estimate AADT data for roads that do not have AADT data available. These guidelines, titled the *Minimum Maintenance Standards Regulation 239/02*, state that the number of houses located on a road should be multiplied by a factor of 6 for rural areas and 10 for urban areas.

This method was applied to all roads within the Village for which an AADT count was provided upon measurement of the roads with AADT counts, it was estimated that 3.31 miles of the 9.36 miles within the Village had AADT counts provided. This is because the NYDOT only provides AADT counts for majors roads and does not include side roads or smaller residential streets. According to the 2010 US Census, there are 947 occupied households in the Village. It is assumed that all 947 households are not located on the main roads with AADT data and by multiplying 947 households by the factor of 6, an estimated AADT count of 5,682 was obtained for the 6.05 miles of road without AADT data. From this, an average AADT can be estimated in order to calculate vehicle miles traveled (VMT). This was done by dividing 5,682 by the 6.05 miles of uncounted road and yielded an average AADT of 939 and applies to all roads which were not initially counted.

It should be noted that there is some potential error involved in this method, given the assumptions made. First, this method is meant to be applied to dead-end streets but this report has applied it to all streets without AADT data. Second, it was assumed that all residents live on streets for which AADT counts were not available but that might not be entirely accurate within the Village. It is not realistic and very time- and resource-consuming, however, to count each household located on streets with AADT counts and then subtract that number from the total number of households in the Village. The total VMT calculated for on-road mobile transportation is meant to serve as a general estimate and not an exact calculation. While there is some amount of error associated with this method of data calculation, it is also the most accurate method given the data and resources that we were provided with.

The total, annual VMT for the Village of Hamilton was calculated to be 7,200,331. Using methods listed in the CSC Community GHG Inventory Guide, annual VMT and fuel use was used to determine the total emissions from on-road mobile transportation. Different vehicle types achieving different MPG ratings were also taken into account and results were multiplied by emissions factors for gasoline, diesel, and ethanol which was assumed to be a 10% adder to gasoline. This method also assume that all vehicles use conventional gasoline which is the recommended assumption for communities which have not yet created their own vehicle mix table including vehicles which use alternative fuel sources.

The Village of Hamilton does not have its own vehicle mix so the Village's vehicle mix has been assumed in accordance with the recommended mix given for the Central New York region in the New York CSC GHG Inventory Guide. Using this recommended vehicle mix, the total emissions for transportation in the Village were calculated for gasoline, ethanol, and diesel to be 3486 MTCO2e. Since ethanol was assumed to be a 10% adder to gasoline, it should be noted that, of that total, 299 $MTCO_2e$ is considered biogenic CO_2 meaning it came from ethanol.

Results

The total on-road mobile transportation emissions for the Village of Hamilton were calculated to be 3486 $MTCO_2e$ with 2982 $MTCO_2e$ attributed to gasoline, 504 $MTCO_2e$ attributed to diesel, and 299 $MTCO_2e$ attributed to ethanol.

Off-road Mobile

The Town of Hamilton GHG Inventory extrapolated emissions from the Madison County GHG Inventory by scaling down per capita emissions. However, within the Village of Hamilton, there are no significant off-road mobile transportation emissions due to the lack of farming, water sports, or other off-road vehicular activity. As a result, data from the Madison County GHG did not need to be scaled down to the Village because it would be an inaccurate representation of the Village's GHG emissions.

Rail and Air Emissions

As mentioned above, there are no rail lines within the Village of Hamilton and thus there are no emissions attributed to the Village as a result of the use of rail lines. Because of this, it is not necessary to include figures and results showing rail emissions because there is no data.

As mentioned in the municipal 'Airport' section (Page 20) the Village of Hamilton sells fuel at the airport for personal air travel, however these sales are not counted in this inventory.

Solid Waste Management

GHG emissions from waste solid management can be separated into both Scope 1 and Scope 3 emissions. Scope 1 emissions from solid waste management come from the emissions released from a landfill. These scope 1 emissions can only be attributed to a community if the landfill lies within the community boundaries. Since all solid waste from the Village of Hamilton is disposed

of in the Madison County landfill, beyond village boundaries, the Village itself does not have any Scope 1 emissions from solid waste management. Scope 3 emissions from solid waste management include emissions that result from the solid waste that a community produces that is disposed of outside of the community conducting the GHG inventory. Thus, the Village of Hamilton must account for Scope 3 solid waste emissions in its GHG inventory. It is important to note that the Madison County Landfill does not differentiate between the waste that comes from the municipal side of the Village and the community of the village so the overall calculations for Village waste include both municipal and community waste.

Data and Methods

According to communications done by Gilgore et al. (2017), "solid waste data was collected for the Village and Colgate University for the year 2015 from the Madison County Department of Solid Waste and Sanitation" (20). The data gathered by Gilgore et al. is broken down into Town, Village, and University. It is the most recent and accurate measure of solid waste for the Village of Hamilton, so we will be using this data in lieu of any other data.

Decomposing landfill solid waste emits methane. According to Gilgore et al. (2017), the Madison County Landfill began using methane capture technologies in 2010. These technologies help avoid releasing the methane gas that is produced by the landfill from being released into the atmosphere. Due to an electric generation system installed by the Landfill in 2012, there is now a negative emissions factor for the Madison County Landfill, specifically -0.03 $MTCO_2e$/short ton (Gilgore et al, 2017). This is because recaptured methane is converted into energy to power the landfill. Solar panels were also installed to produce energy to power the landfill.

Table 22: Total Emissions Associated with Solid Waste Management

	Solid Waste (tons)	**Emissions Factor**	**Total Emissions $MTCO_2e$**
Village of Hamilton	1,954.92	-0.03	-58.64
Colgate University	823.08	-0.03	-24.69
Total	2,778.00	-0.03	-83.33

Created with information from Gilgore et al. (2017)

Results

The total emissions from the solid waste sector are -83 $MTCO_2e$ which includes the Village of Hamilton (-59 $MTCO_2e$) and Colgate University (-25 $MTCO_2e$).

Wastewater Management

The Village of Hamilton relies on an aerobic municipal wastewater treatment plant within Scope 1. These types of wastewater treatment plants release methane and nitrous oxide during their treatment process. According to data from the 2010 census report, 4,239 people live in the Village of Hamilton and are assumed to be using the wastewater treatment plant.

Data and Methods

To measure the emissions in this section, we looked at emissions of process and fugitive N2O given off by the wastewater treatment plant. We also used the U.S. census information for the Village from 2010 so we could assume the number of residents using the wastewater treatment plant.

Table 23: Total Emissions Associated with Wastewater Management

	Emissions ($MTCO_2e$)	**Emissions per capita**	**Population using WWTP**	**Village Emissions ($MTCO_2e$)**
Process N2O	33.6	0.0009909	4,239	4.20
Fugitive N2O	81.4	0.0024007	4,239	10.18
Total	115	0.0033916	4,239	14.38

Created with information from Gilgore et al. (2017)

Results

Assuming that all 4,239 Village of Hamilton residents use the wastewater treatment plant and not some other wastewater management technique such as a septic tank, the total $MTCO_2e$ emissions from the Village community is 14.38 $MTCO_2e$.

Overall Community Emissions

The table below shows the community-wide emissions in $MTCO_2e$ for each sector and scope of community operations. The below information includes emissions related to Village municipal operations and Colgate University.

Table 24: Total Community Emissions by Sector and Scope

Sector	**Scope 1 ($MTCO_2e$)**	**Scope 2 ($MTCO_2e$)**	**Scope 3 ($MTCO_2e$)**	**Total Emissions by Sector ($MTCO_2e$)**
Buildings and Facilities	11,624.29	933.25		12,557.54
Product Use			1,841.81	1,841.82
Transportation	3,486.00			3,486.00
Wastewater	14.38			14.38
Solid Waste			-83.33	-83.33
Total Emissions by Scope ($MTCO_2e$)	15,124.67	933.25	1,758.49	17,816.41

The sector with the highest emissions is buildings and facilities and the sector with the lowest emissions is solid waste.

Recommendations and Conclusions

The first step that needs to be taken is to finish this GHG inventory for both the municipality and the community of the Village of Hamilton. In all the above sections, methods are laid out and data tables have been prepared. Once information is attained, these tables can be completed and the final GHG emissions report for the Village can be completed. For the time, we offer a few more general suggestions for the Village moving forward. We recommend that emissions from Hamilton Memorial Hospital are distinguished either in the next GHG inventory, or in an updated version of this inventory. We also recommend that effort is made to identify more scope 3 emissions that could potentially be included so that the Village has a more holistic understanding of their carbon footprint.

The next step is to set goals for emissions reductions. It is important that the Village chooses an attainable emissions target – doing so will help maintain community morale and will prevent residents from feeling as though this task is hopeless. However, it is still critical to the well-being of the planet that substantial GHG emissions reductions are made. For the Village to help make a difference, finding the right balance between an overly ambitious goal and an overly conservative goal is key. To do so, it is wise to carefully examine each sector and source to find specific places where emissions can be cut. A timeframe within which the goal will be achieved is necessary.

Once the Village has set emissions reductions goals, the process of creating a Climate Action Plan can begin. This will lay out the Village's vision for the future, and detail how they intend to move toward the emissions reductions target. The CAP is often broken down into sectors similar to that of the inventory, which is a strategy we recommend for maintaining consistency as well as clarity. It is important that the CAP is intelligible for the public. Actions the Village intends to complete from the CSC list should be included in the CAP.

When the Climate Action Plan is finished, the Village can move on to point 3 of the CSC 10-point pledge, and begin completing actions. We recommend that the Village prioritize the mandatory actions from the CSC list. Additionally, the Village should consider what level of certification they want to obtain from the CSC – bronze, silver, or gold. We recommend focusing on reform within the buildings and facilities sector, as this sector is responsible for a large portion of total emissions. Additionally, we recommend considering the establishment of a carpool for Village employee's commute to work, if this is feasible – we understand it might not be. Continued utilization of Colgate students for implementing the plans outlined in the CAP is also recommended. It may also be worth the time to consider how students at Hamilton Central School can become involved with this process.

Finally, we recommend that the Village apply for the CSC grant funding through the DEC. Obtaining this funding would be highly beneficial for implementing further adaptation and mitigation strategies that can benefit the community. We hope this document serves as a helpful tool for the Village in the pursuit of building a more climate-conscious future.

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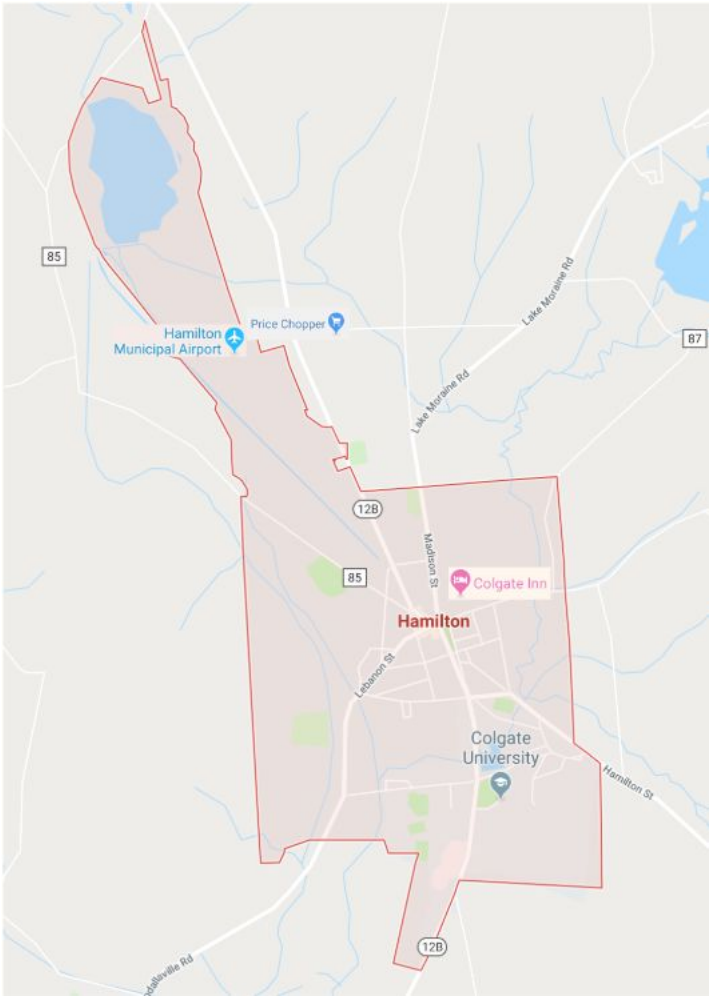
Appendix A

Village of Hamilton Boundaries



Appendix B

Village of Hamilton electricity generation mix and emissions factors.

SOURCE		**CY 2014:% total supply**	**CY 2014: % non-hydro supply**	**CY 2016: % total supply**
NYMPA	Hydro (NYMPA)	83%	N/A	95%
NYSEG	Coal	1%	6%	0.29% (5% * 6%)

	Natural Gas	8%	47%	2.4% (5% * 47%)
	Nuclear	7%	41%	2.1% (5% * 41%)
	Other Renewables	1%	6%	0.3% (5% * 6%)
Total		**100%**	**100%**	**100%**
CY 2014: 1,111.7 lb CO2/MWh * 9% (electricity supply from fossil fuels) = 100.05 lb CO2/MWh = 0.00004538 MT CO2/kWh				
CY 2016: 1,111.7 lb CO2/MWh (held constant from 2014) * 2.69% (electricity supply from fossil fuels) = 29.43 lb CO2/MWh = 0.00001356 MT CO2/kWh				
In calendar year ("CY") 2016, 95% of Colgate's power came from NYMPA-contracted hydro and 5% came from other non-hydro generation resources supplied through NYSEG. The non-hydro mix consisted of coal, nat gas, nuclear, and other renewables. The preliminary emissions factor to use for Colgate's TOTAL grid electricity consumption is 0.00001356 MTeCO2/kWh for calendar year 2016. Assuming this emissions factor for grid electricity purchased in CY17, for FY17 Colgate consumed 28,808,072 kWh x 0.00001356 MTeCO2/kWh = **390.64 MTeCO2**.				

Year	VOH NYMPA Hydro %	VOH NYSEG Market %	Emissions Rate (lb/MWh)	Emissions Rate (MT/kWh)
2016	95%	5%	22.44	0.0000102
2017	91%	9%	40.39	0.0000183
2018	92%	8%	35.90	0.0000163

2018 Update: NYS's electricity grid continues to reduce its carbon intensity/MWh. eGrid was updated in 2016 and we received updated emissions factors for 2016-2018. The next eGrid update is anticipated in early 2020.

Appendix C

FY 2018 Village of Hamilton Utility Meters Consumption

https://drive.google.com/file/d/1AyB2GYIpoTWeFqZvKBq8JG88Z_5FCw-i/view?usp=sharing