Village of Rhinebeck

The Doughboy statue and memorial. Photo by Vanessa Bertozzi.

Inventory of Government Operations Greenhouse Gas Emissions for Fiscal Year 2019

JULY 2023

Prepared by the Village of Rhinebeck's Climate Smart Task Force with Assistance from *the Hudson Valley Regional Council and* ICLEI – Local Governments for Sustainability USA

Credits and Acknowledgements

Gary Bassett, Mayor

Vanessa Bertozzi, Village Trustee

Michael Forlenza, Climate Smart Task Force Member

Krissy Denu, Deputy Clerk

Karen McLaughlin, Treasurer

Kyle Eighmy, Superintendent of Public Works

Martina McClinton, Clerk

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Village of Rhinebeck incorporated in 1834. Photo by Michael Forlenza.

Executive Summary

The Village of Rhinebeck recognizes that greenhouse gas (GHG) emissions from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community.

The Village achieved bronze certification in New York State's Climate Smart Communities (CSC) program in March 2020, and the Village's Climate Smart Task Force has been working towards silver certification. The CSC Task Force, a group of dedicated volunteers, is led by its Coordinator, Trustee Vanessa Bertozzi. We are grateful for the support of the Village Board in pursuing actions to characterize and reduce our GHG emissions, address climate resiliency, especially to flooding, and engaging with our local community. You can learn more about the Village's CSC projects and activities via www.climatesmartrhinebeck.org, where you can find the Annual Climate Progress Reports among lots of other information.

Climate Smart Bronze Certification for the Village of Rhinebeck. Photo by Vanessa Bertozzi.

This inventory report was prepared to characterize the GHG emissions related to Village government operations and to activities for the baseline year of June 2018 to May 2019, the Village's fiscal year. Information sources used to develop this inventory included administrative records, utility bills, personal reporting, and science-based estimates.

The findings from the inventory indicate that approximately 594 metric tons of carbon dioxide equivalent (CO_2e) were emitted by Village operations during the baseline year. A metric ton equals 2,205 pounds. These GHG emissions are related to the burning of fossil fuels, electricity usage, and miscellaneous related activities. The Village burns fossil fuel for the heating of buildings and the operation of motor vehicles. Suppliers of electricity generate GHGs during the generation and transmission of power.

The largest portions of Village GHG emissions are related to operations of the Water and Wastewater Treatment plants and the heating and cooling of buildings and facilities. Compiling this baseline inventory is the first step in a process to track and manage progress toward GHG emissions reductions and achievement of net zero emissions.

Key Findings

Using available administrative records and the online ClearPath software tool developed by ICLEI, the Village compiled a GHG inventory for the emissions related to government operations during the base fiscal year 2019 year. Figure 1 shows operations emissions across seven sectors equaling a total of 594 metric tons of carbon dioxide equivalent (CO2e).

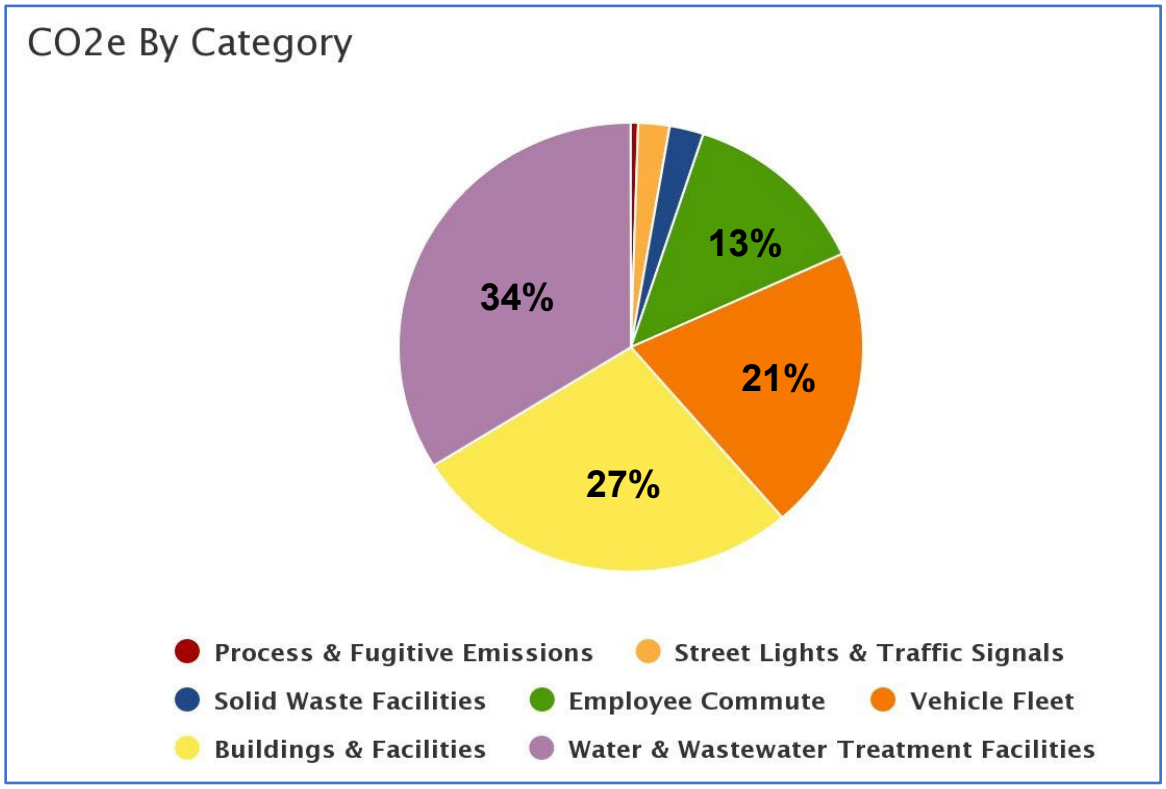


Figure 1: Village of Rhinebeck Government Operations Emissions by Sector

Emissions associated with the Water and Wastewater Treatment Facilities account for the largest portion (34% of the total or 201 metric tons) of the Village government's emissions. The second largest contributor is Buildings & Facilities (27% of the total or 163 metric tons). Together, these two sources contribute approximately two thirds (61%) of the Village government's GHG emissions. Actions to reduce emissions from these two sectors will be a key part of any future climate action plan developed by the Village of Rhinebeck.

The next largest contributor is the vehicle fleet (21% of total or 122 metric tons), followed by employee commute, which though relatively smaller, was still a significant contributor (13% of the total or 78 metric tons). Streetlights, solid waste, and fugitive emissions were responsible for the remainder (about 5% the total) of local government operations emissions.

The Inventory Results section of this report provides a detailed profile of emissions sources within the Village of Rhinebeck's government operations; information that is key to guiding local reduction efforts. The Inventory Results section also details any challenges in tracking data, such as solid waste. The GHG emissions inventory data will also provide a baseline against which the Village will be able to compare future performance and demonstrate progress in reducing emissions. Typically, a municipality our size updates its GHG emissions inventory once every five years.

The Village government selected the fiscal year June 2018 - May 2019 (FY2019) as a base year to draw on pre-pandemic data. Additionally, the year FY2019 pre-dates the recent billing and data accounting anomalies that Central Hudson Gas & Electric Corporation (Central Hudson) has experienced. Central Hudson, a regulated transmission and distribution utility, provides grid-based electrical power to the Village of Rhinebeck. Hopefully, Central Hudson will have worked out their issues by the time the Village government completes another GHG emissions inventory.

Waterfall at Asher Dam on Crystal Lake, Rhinebeck, NY. Photo by Michael Forlenza.

Introduction to Climate Change

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and other purposes, which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise, threatening the safety, quality of life, and economic prosperity of global communities. Although the natural greenhouse effect is needed to keep the earth warm, a human enhanced greenhouse effect with the rapid accumulation of GHG in the atmosphere leads to too much heat and radiation being trapped. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report confirms that human activities have unequivocally caused an increase in carbon emissions[1]. Many regions are already experiencing the consequences of global climate change, and the Village of Rhinebeck is no exception.

Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. At the current rate of increase, global warming is likely to reach 1.5°C in the period between 2030 and 2052. Warming from anthropogenic emissions from the pre-industrial period to the present will persist for centuries to millennia and will continue to cause further long-term changes in the climate system. These changes will include sea level rise, with associated flooding impacts. Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, but lower than at 2°C. These risks depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options[2].

[1] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

[2] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

According to the 2018 Fourth National Climate Assessment, the northeast U.S. will experience potentially devastating impacts from seasonal changes and hazards occurring at unprecedented magnitudes. "By 2035, and under both lower and higher scenarios (RCP4.5 and RCP8.5), the Northeast is projected to be more than 3.6°F (2°C) warmer on average than during the preindustrial era. This would be the largest increase in the contiguous United States and would occur as much as two decades before global average temperatures reach a similar milestone."

Rhinebeck Dutch Reformed Church, Mill Street. Photo by Michael Forlenza.

The Hudson Valley, including Village of Rhinebeck, is at particular risk from sea level rise along the Hudson River. The Village's Water Treatment Plant is located adjacent to the Hudson River in Rhinecliff. Additionally, localized flooding, erosion, heat emergencies, habitat loss, and drought present risks to the Village as weather patterns become more intense. "With little redundancy in their infrastructure and, therefore, limited economic resilience, many rural communities have limited ability to cope with climate-related changes." (2018 Fourth National Climate Assessment).

Many people visit and move to this region to enjoy the beautiful landscape and fresh local food, but the local agriculture and farm workers are at extreme risk due to increasingly intense and abnormal weather patterns. Beyond agriculture, changing climate threatens many sectors within the Village of Rhinebeck and the greater region, most notably tourism and public health with our aging demographic[3].

"Changing climate threatens the health and well-being of people in the Northeast through more extreme weather, warmer temperatures, degradation of air and water quality, and sea level rise. These environmental changes are expected to lead to health-related impacts and costs, including additional deaths, emergency room visits and hospitalizations, and a lower quality of life." (2018 Fourth National Climate Assessment)

[3] U.S. Global Change Research Program. 2018. National Climate Assessment – Ch 18: Northeast. Retrieved from https://nca2018.globalchange.gov/chapter/18/

Many communities in the United States have started to take responsibility for addressing climate change at the local level. Energy efficiencies and reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents, governments, and businesses. Retrofitting homes and businesses to be more efficient creates local jobs. In addition, when residents save on energy costs, they are more likely to spend the savings at local businesses supporting the local economy. Reducing fossil fuel use improves air quality and increases opportunities for walking and bicycling, improving residents' health.

Rhinebeck Village Hall and Fire Department, East Market Street. Photo by Michael Forlenza.

Greenhouse Gas Inventory as a Step Toward Carbon Neutrality

Facing the climate crisis requires the concerted efforts of local governments and their partners, those that are close to the communities directly dealing with the effects of climate change. Cities, towns, and counties are well placed to define coherent and inclusive plans that address integrated climate action — climate change adaptation, resilience, and mitigation. Existing targets and plans need to be reviewed to bring in the necessary level of ambition and outline how to achieve net-zero emissions by 2050 at the latest. Some of the benefits and pathways of accelerated climate action are indicated in Figure 2. Creating a roadmap for climate neutrality requires the Village of Rhinebeck to identify priority sectors for action, while considering climate justice, inclusiveness, local job creation and other benefits of sustainable development.

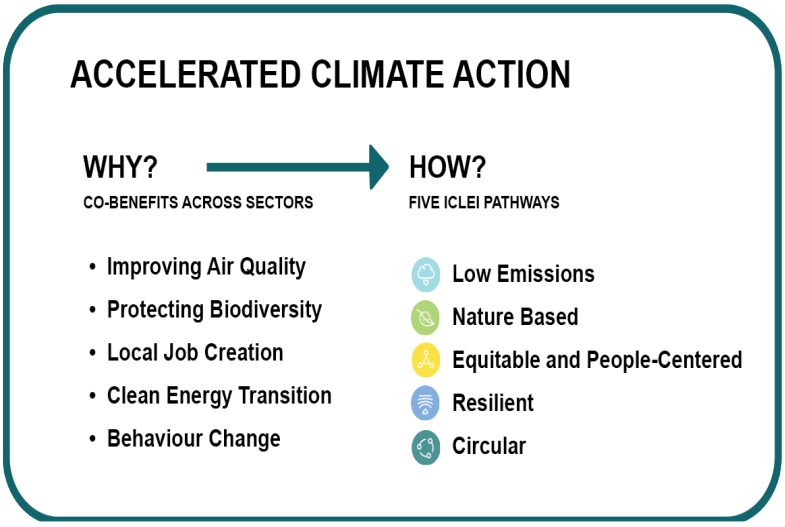


Figure 2: Benefits of Accelerated Climate Action

To complete this inventory, the Village of Rhinebeck joined eight other local municipal governments under the Dutchess County Climate Action Planning Institute (CAPI). Dutchess CAPI is a project of the Hudson Valley Regional Council and is funded by the DEC Climate Smart Communities Grant Program. Dutchess CAPI is supported by the International Council for Local Environmental Initiatives (ICLEI). ICLEI, the first and largest global network of local governments devoted to solving environmental challenges, provides tools and guidelines to help municipalities reach sustainability goals and carbon neutrality. ICLEI provides authoritative direction for greenhouse gas emissions accounting and defines carbon neutrality as:

> *The targeted reduction of greenhouse gas (GHG) emissions and GHG avoidance in government operations and across the community in all sectors toward an absolute net-zero emission level at the latest by 2050. In parallel with this, it is critical for communities to adapt to climate change and enhance climate resilience across all sectors, in all systems and processes.*

To achieve ambitious emissions reduction, and move toward carbon neutrality, the Village of Rhinebeck will need to set a clear goal and act rapidly following a holistic and integrated approach. Accelerated climate action is an opportunity for our community to experience a wide range of co-benefits, such as creating socio-economic opportunities, reducing poverty and inequality, local job creation, protecting biodiversity, enhancing sustainability, reducing risks to our built environment, and improving the health of people and nature.

ICLEI Climate Mitigation Milestones

In response to the climate emergency, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries, as well as influencing regional emissions through partnerships and advocacy. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts.

ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions. This methodology is organized along Five Milestones:

Figure 3: Climate Milestones

1. Conduct a local government operations inventory and forecast of local government greenhouse gas emissions;
2. Establish a greenhouse gas emissions target;
3. Develop a government operations climate action plan for achieving the emissions reduction target;
4. Implement the climate action plan; and,
5. Monitor and report on progress.

These milestones form an iterative process that kicks off with local leadership commitment. Figure 3 presents a diagram of the mitigation milestone process. This inventory report represents the completion of ICLEI's Climate Mitigation Milestone One and provides a foundation for future work to identify, plan, and reduce government operations greenhouse gas emissions in the Village of Rhinebeck.

Inventory Methodology

Understanding a Greenhouse Gas Emissions Inventory

The first step toward achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels and sources and activities generating emissions in the community. This report presents emissions from operations of the Village of Rhinebeck government. The government operations inventory is mostly a subset of the community-wide inventory. Figure 4 illustrates that government operations account for only a small portion of overall community emissions. For example, data on commercial energy use by the community would include energy consumed by municipal buildings, and community vehicle-miles-traveled estimates include miles driven by municipal fleet vehicles.

Figure 4: Relationship of Community Emissions to Government Operations Emissions

As local governments continue to join the climate protection movement, the need for a standardized approach to quantify GHG emissions has proven essential. This inventory uses the approach and methods provided by the U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (Community Protocol) and the Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions (LGO Protocol), both of which are described below.

Three greenhouse gases are included in this inventory: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Many of the charts in this report represent emissions in "carbon dioxide equivalent" (CO2e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the IPCC 5th Assessment Report. Table 1 indicates the far greater GWP of methane and nitrous oxide as compared to carbon dioxide.

Table 1: Global Warming Potential Values of Greenhouse Gases (IPCC, 2014)

Greenhouse Gas	Global Warming Potential
Carbon Dioxide (CO2)	1
Methane (CH4)	28
Nitrous Oxide (N2O)	265

Local Government Operations (LGO) Protocol

In 2010, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released Version 1.1 of the LGO Protocol.4 The LGO Protocol serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The purpose of the LGO Protocol is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory.

The following sectors were included in the Village of Rhinebeck GHG emissions inventory:

- Energy use from buildings & facilities.
- Streetlights & traffic signals.
- Water and Wastewater treatment processes.
- On-road transportation from employee commute and vehicle fleet.
- Collection and mulching of yard waste.
- Fugitive emissions from work uniforms.

Note that the inventory did not include refrigerants. However, the Village government has no major cooling facilities, only a refrigerator in the Firehouse, minifridges for staff, and various window AC units.

Quantifying Greenhouse Gas Emissions

Sources and Activities

Governments contribute to greenhouse gas emissions in many ways. Two central categorizations of emissions are used in the local government inventory:

[4] ICLEI. 2008. Local Government Operations Protocol for Accounting and Reporting Greenhouse Gas Emissions. Retrieved from http://www.icleiusa.org/programs/climate/ghg-protocol/ghg-protocol

1) GHG emissions produced by "sources" under the Village government's control (e.g., furnaces and vehicles), and
2) GHG emissions produced as a consequence of operations and "activities" (e.g., the use of fossil fuel generated grid electricity).

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere	The use of energy, materials, and/or services by employees and officials of the government that results in the creation of GHG emissions.

Base Year

The inventory process requires the selection of a base year with which to compare current emissions. The Village of Rhinebeck's GHG emissions inventory utilizes the fiscal year June 2018 to May 2019 as its baseline year, for which the necessary data are available. This base year was selected as a typical pre-pandemic year. The fiscal year was used rather than a calendar year because administrative records for fuel and electrical purchases are maintained on a fiscal year basis. Inventories conducted for future years will use the Village fiscal year for comparison purposes.

Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.

- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

Activity Data x Emission Factor = Emissions

Most emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see appendices for a detailed listing of the activity data used in creating this inventory.

Known emission factors are used to convert energy usage or other activity data into associated quantities of GHG emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g., pounds of CO2e per kWh of electricity used). For this inventory, calculations were made using ICLEI's web based ClearPath tool. https://icleiusa.org/clearpath/

East Market Street, Rhinebeck, NY. Photo by Vanessa Bertozzi

Government Operations Emissions Inventory Results

The results for the calculations for the government operations emissions inventory for the FY2019 base year are presented in the following sections.

Table 2: Local Government Operations Inventory

Sector	Fuel or source	FY2019 Usage	Usage unit	FY2019 Emissions ($MTCO_2e$)
Buildings & Facilities	Electricity	98,982	kWH	10.5
	Fuel Oil	14,985	gallons	152.2
			Buildings & Facilities Total	**162.7**
Streetlights & Traffic Signals	Electricity	121,857	kWH	12.9
			Streetlights & Traffic Signals Total	**12.9**
Vehicle Fleet	Wastewater Depart. - gasoline	501.8	gallons	4.4
	General Fleet - gasoline	7,520.6	gallons	66.5
	General Fleet - diesel	4,229.2	gallons	43.2
	Water Depart. - gasoline	1,035.8	gallons	9.1
			Vehicle Fleet Total	**123.2**
Employee Commute	Water Department	1,584.8	gallons	14.0
	Police Department	1,459.2	gallons	12.9
	Village Hall	2,378.2	gallons	21.05
	Wastewater Department	450.8	gallons	3.99
	Fire - Volunteer	1,381.5	gallons	12.24
	Highway Department	1,532	gallons	13.57
	Electric/EV – Village Hall workers	1.57	MMBtus	0.05
			Employee Commute Total	**77.85**
Solid Waste	Yard Waste Mulching/Composting (curbside collection)	200	tons	13.93
			Solid Waste Total	**13.93**
Water and wastewater	Water Treatment Plant - electricity	466,880	kWh	49.4
	Wastewater Treatment Plant – N2O Emissions	2,000	persons	1.48
	Septic Systems – Fugitive Emissions	12	persons	1.46
	Wastewater Treatment Plant – N2O Effluent to Surface Water	2,000	persons	98
	Wastewater Treatment Plant - Electricity	489,996	kWh	51.84
			Water and Wastewater Total	**202.2**
Process & Fugitive Emissions	Fugitive Emissions Related the Purchase of Work Uniforms	3,577	$	2.7
			Process & Fugitive Emissions Total	**2.7**
			Total Local Government Emissions	**594**

The relative portions of GHG emissions among the seven sectors tracked in the baseline inventory are illustrated in Figure 5. The operations of the Water and Wastewater plants comprise the largest sector of Village government GHG emissions. This is followed by Buildings & Facilities and Vehicle Fleet sectors. Employee Commute is the fourth largest contributor. Streetlights, Solid Waste, and Process and Fugitive emissions account for a small portion of GHG emissions. The findings for each sector are discussed in greater detail in the following sections.

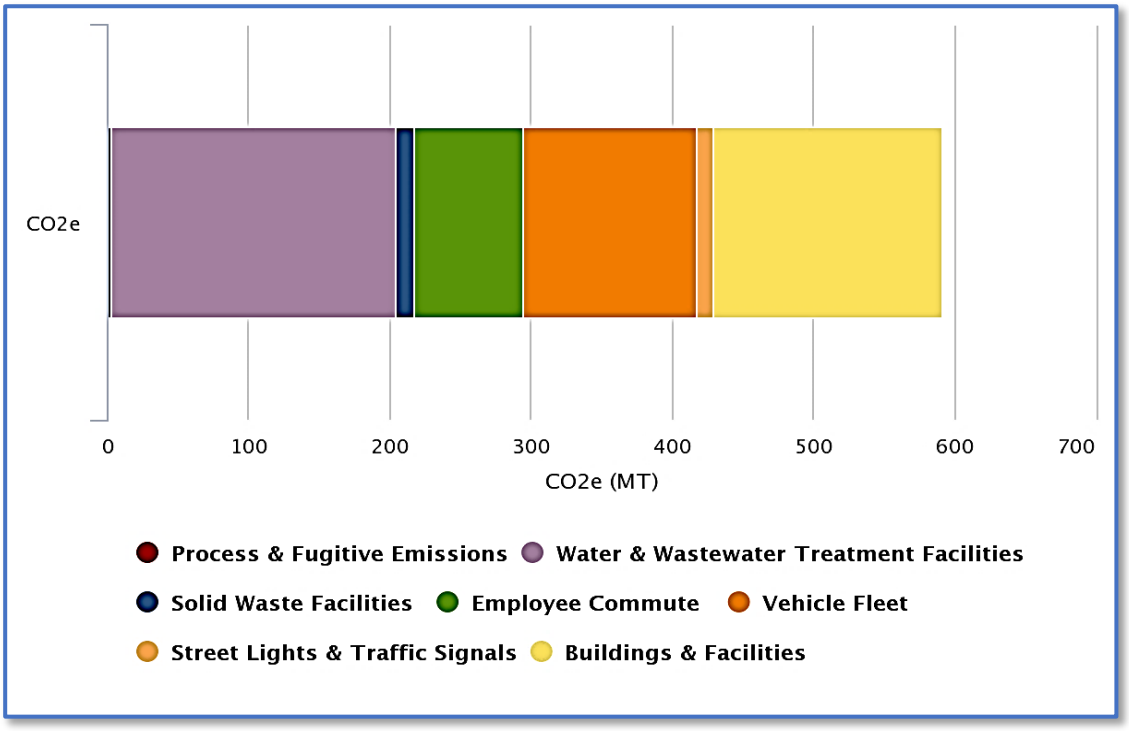
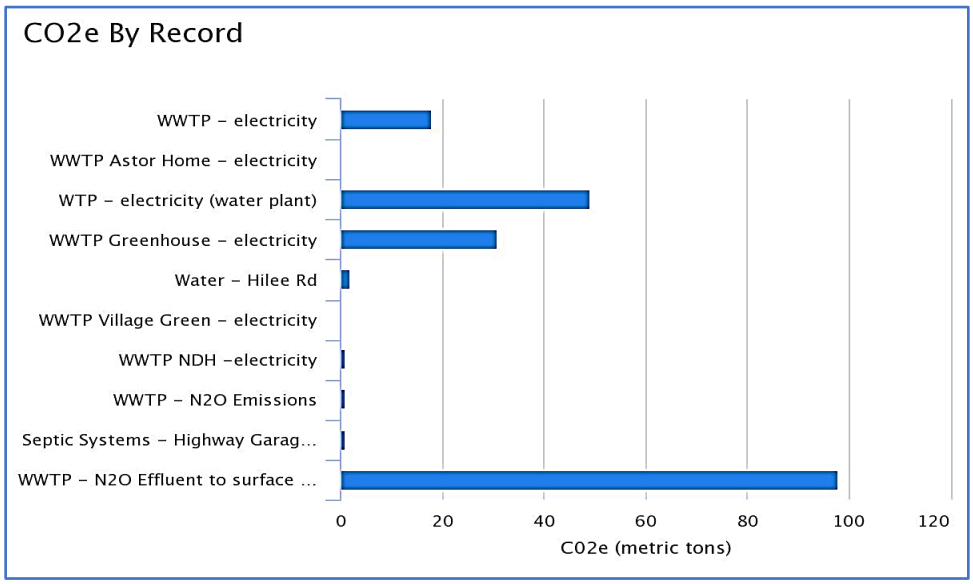


Figure 5: Village of Rhinebeck FY2019 GHG Emissions Inventory by Sector

Water Treatment and Wastewater Treatment



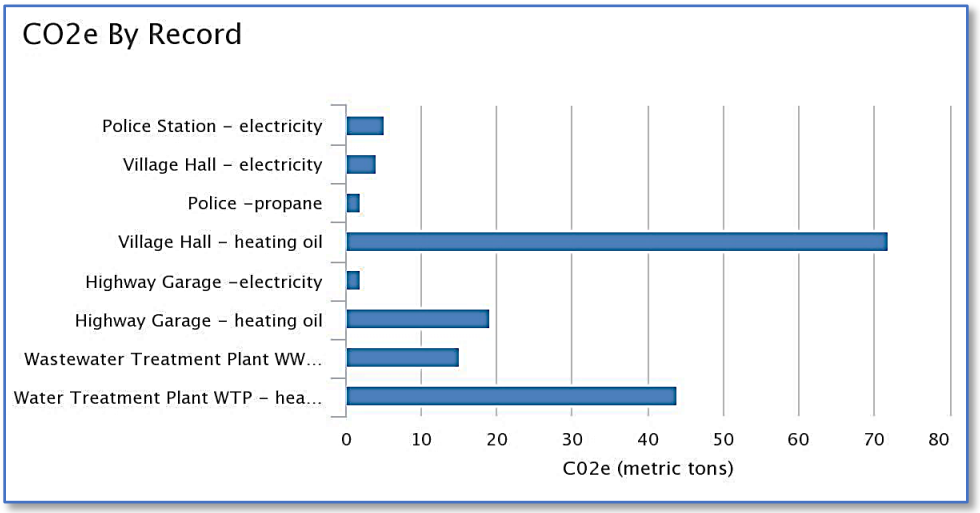
The Village of Rhinebeck Wastewater Treatment Plant serves the core Village business district and some residences including the Woods condominium development, the Garden condominium development, the Village Green apartments, Northern Dutchess County Hospital, and Tops shopping center. The plant discharges treated wastewater into the Rhinebeck Kill which flows to the Hudson River.

The Water Treatment plant treats and distributes drinking water to approximately 6,000 people throughout the village and some neighboring areas. The Water Treatment plant draws raw water from the Hudson River. The treatment process generates sludge material which is discharged to an impoundment lagoon. The quantity of potential GHG emissions related to this sludge material was not able to be calculated for this inventory because site specific testing (e.g., biological oxygen demand (BOD)) has not been conducted.

Electrical consumption for lighting, air conditioning, ancillary equipment, and treatment processes (e.g., pumping equipment) at the Water Treatment and Wastewater Treatment facilities are metered together. Accordingly, electrical use at these locations cannot be parsed between treatment processes and non-treatment uses related to the buildings. Accordingly, the electricity usage specifically associated with wastewater and water treatment processes could not be calculated. However, we know that the pumping equipment and treatment processes related to water and wastewater consume large amounts of electricity. The processing and treatment equipment is dated. Upgrades to the system and process equipment are planned or now under discussion. The Village Board should emphasize to the designers and engineers during any upgrades and renovations that energy efficiency is a priority. Note that the WWTP system, which was constructed in 1984 and has four related pumping stations, has 526 service accounts and serves about 2,000 people. Wastewater treatment demand is expected to increase with Village growth. The Village's Comprehensive Plan Committee is currently discussing ways to encourage increased density within the Village to address the housing affordability crisis.

The treatment of wastewater and the discharge of treated wastewater to surface water (Rhinebeck Kill) generates the greenhouse gas nitrous oxide (N2O) through various processes. N2O is a particularly potent greenhouse gas having a GWP 265 times greater than the warming potential of CO2. Thus, a small about of N2O emissions can equal a large value in the CO2e total of the baseline inventory. The inventory calculation indicates that the N2O release related to the discharge of wastewater effluent to surface water is the largest GHG component in the Water and Wastewater Treatment sector. Additional data and site-specific measurements may provide a better understanding of this component in the future.

Buildings and Facilities



The GHG emissions related to Village buildings and facilities were calculated by a review of records for electrical use and purchases of fuels (heating oil and propane) for heating and hot water. Electrical usage at the Water and Wastewater Treatment facilities were tallied under the Water and Wastewater sector because the machinery used to process water and wastewater operate on electricity. As each facility has only one electric meter, the electrical usage of the treatment processes could not be separated from the electrical usage for building operations such as lighting, air conditioning, etc. However, heating oil use at the Water and Wastewater facilities was tallied under the Buildings and Facilities sector since that emissions source is more related to the heating of the space and water for employees. The largest contributor to GHG emissions in the Buildings and Facilities sector was the burning of heating oil at the Village Hall. The Village Hall building additionally houses the Rhinebeck Volunteer Fire Department.

The burning of heating oil for the Village Hall's heating alone accounts for the emission of over 72 metric tons of CO2e. Each metric ton equals 2,205 pounds. The New York State Energy Research and Development Authority (NYSERDA) describes the potential benefits of switching from / discontinuing the use of combustion for heating:

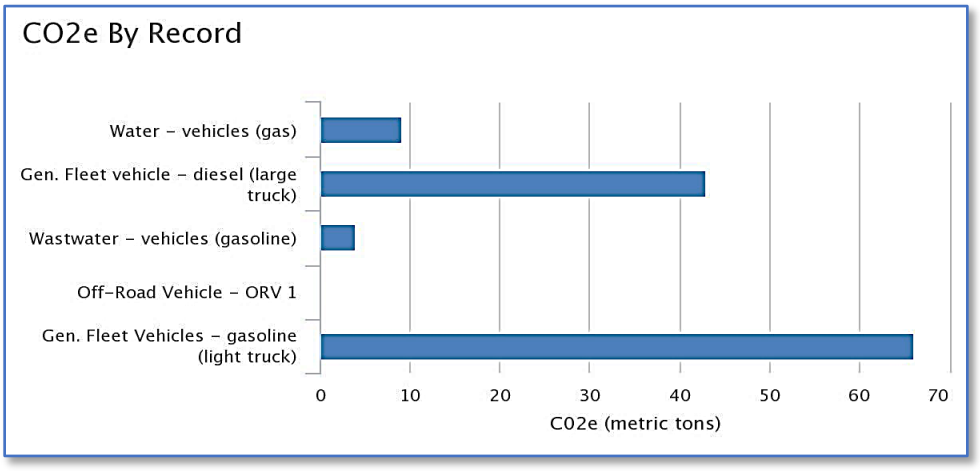
"Currently, fossil-fuel based thermal energy – primarily natural gas, propane, and heating oil – is the main energy source for space heating and domestic hot water in the residential and commercial sectors. It is responsible for about one-third of New York's energy-related greenhouse gas emissions. Clean heating and cooling technologies such as ground- and air-source heat pumps provide environmental benefits, energy bill savings, increased comfort levels and health benefits compared to conventional heating and cooling technologies. Local governments can lead by example and play an important role in encouraging adoption of ground- and air-source heat pump systems."

Converting Village Hall from an oil burning furnace and window unit ACs to a variable refrigerant flow (VRF) HVAC system could reduce the significant GHG emissions related to the operation of this building. Additionally, this climate-forward conversion/upgrade of an important public building would allow the Village to demonstrate leadership to our community. Village Hall already had a roof-mounted solar array, installed pre-FY2019, that partially offsets use of grid-based electricity. Upgrading or expanding the solar array can be assessed during future climate action planning.

The first set of government-owned EV charging stations in the village were installed in 2018 at the Village Hall. The electricity usage for these EV charging stations is metered through the neighboring Police Station.

Solar Panels on Rhinebeck Village Hall. Photo by Vanessa Bertozzi

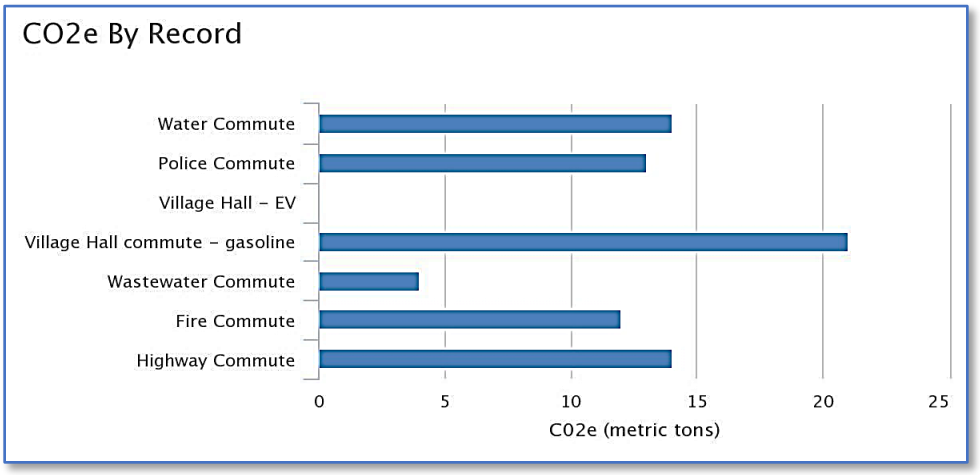
Vehicle Fleet



Findings from the Village's Inventory indicate that General Fund vehicles are responsible for the largest portion of the fleet GHG emissions. These vehicles include both the police cars and Fire/EMS vehicles, as well as Highway Department equipment. The Village has done a fleet inventory, and the Village Board has been discussing the need to transition to EVs. The transition has been slowed by the by the lack of make/model options available for pickup trucks, one of the main types of vehicles the Village should plan to replace.

Another challenge to conversion to EVs is the particular requirements of vehicles in the police car fleet. On-board computers in police vehicles draw a large amount of electricity and the cars need to be outfitted with custom interiors including rear passenger doors that do not open from inside. An EV car company that offered customized vehicles for law enforcement service would find a large, underserved market. Trustee Bertozzi has been in touch with an organization that uses a tool to help in planning the transition to electrified vehicles: www.electrificationcoalition.org/resource/drve.

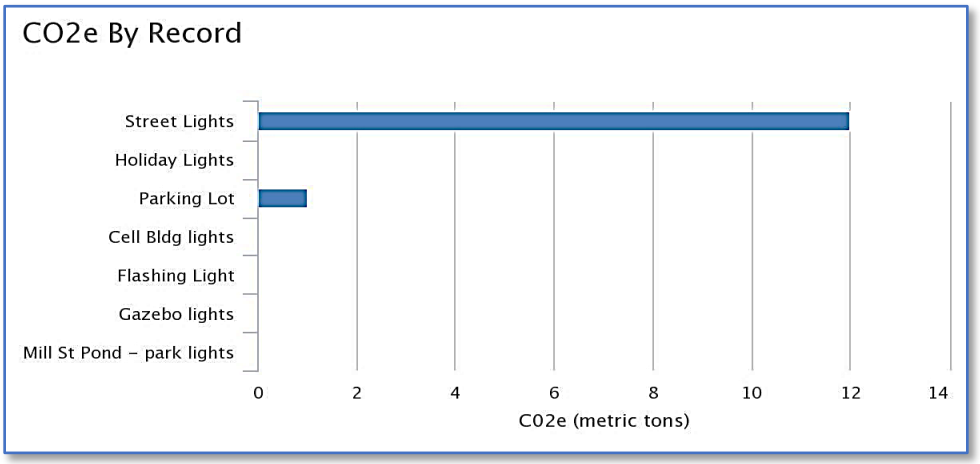
Employee Commute



Employee commute information was gathered by surveying Village Hall employees and officials. Department heads or point people facilitated the collection and development of this information by gathering data on staff commutes. For example, the Chief Water Plant Operator collected the information from the Water Department employees, and the Police Clerk gathered all the information from the police officers.

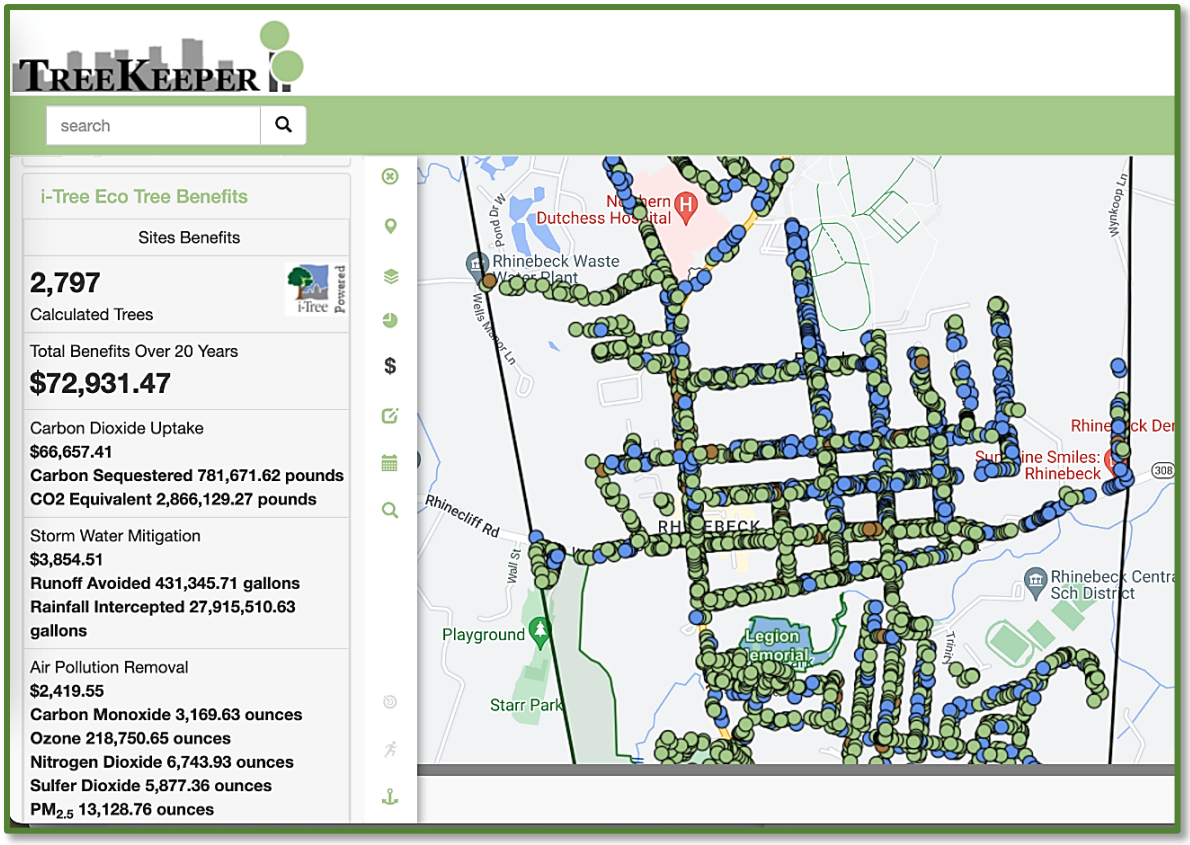
Employee commuting information calculations for the Fire Department presented an interesting challenge as the volunteer firefighters and EMS personnel may have been anywhere before responding to a call, necessitating a proxy. For this Inventory, we decided to simply calculate these potential commutes based on their home address, actual data of the number of calls they responded to during the year, plus the weekly meeting at the firehouse. In FY2019, we did have a few employees/officials who were driving EVs, hybrids, or lived close enough to walk to work.

Streetlights



The Village converted our Streetlights to light emitting diodes (LEDs) after 2019 which was after this baseline emissions inventory was compiled. LEDs provide more efficient lighting that is expected to result in energy savings reflected in subsequent GHG emissions inventories.

Urban Forest



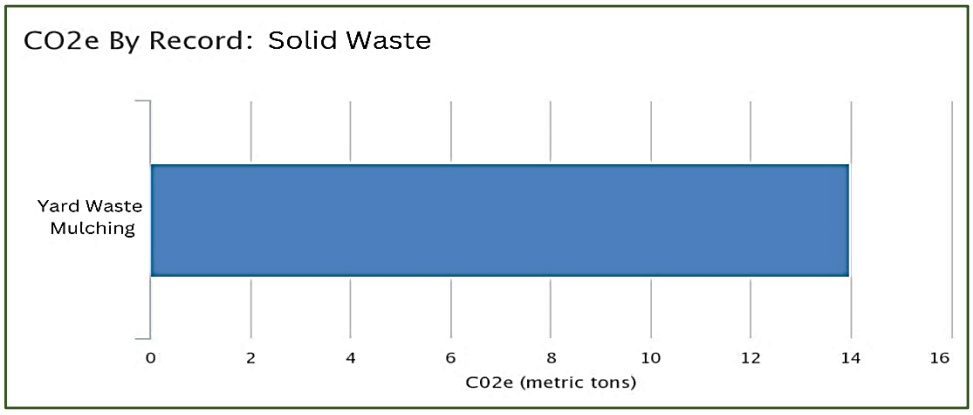
The Village is proud of our continuing status as a Tree City USA for 13 years. The Village has a local law overseeing the management of our urban forest, including the planting of trees in the public right of way and in some cases, beyond the right of way. Trees provide many environmental benefits such as removing hazardous pollutants from the air, absorbing and sequestering CO2 in their wood, controlling stormwater runoff by intercepting and absorbing rainfall, and providing cooling shade in the summer months that can reduce residential cooling demands.

The Rhinebeck Village Tree Commission oversees our urban forest and uses TreeKeeper software to track tree planting activities, tree locations and status, and tree health and diversity. TreeKeeper also includes calculations using i-Tree for a quantitative look at nature-based benefits of the street trees. The TreeKeeper inventory for the Village indicates that our nearly 3,000 street trees account for a total uptake of 2,866,129 pounds (approximately 1,300 metric tons) of CO2 Equivalent over a 20-year period. Note that this inventory does not include the numerous trees located throughout the Village on private property.

These results indicate that maintaining a healthy and diverse urban forest plays an important role in mitigating GHG emissions at the local level. However, because the TreeKeeper calculations are based on a 20-year period, the effect on the FY2019 baseline single year inventory could not be directly calculated. Calculating the value of CO2e removal is not as straightforward as simply dividing the total value by 20 to get an annual amount (65 metric tons) because the TreeKeeper calculation considers the growth rates and the characteristics of individual tree species.

For this reason, we did not include the potential CO2e reduction from our trees into the ClearPath tool and the baseline inventory. However, we hope that TreeKeeper will develop the ability to track this data in annual slices by the time we do our next GHG emissions inventory. We believe it's critically important to invest in and manage our urban forest, not only for GHG removal but also for shade/cooling, flood water absorption, traffic calming, biodiversity/habitat conservation, scenic beauty, pedestrian comfort, and general well-being. Street trees make vital contributions toward long-term sustainability goals. The Village's TreeKeeper dashboard can be viewed on the Village's website at:
https://rhinebeckny.treekeepersoftware.com/index.cfm?deviceWidth=1236

Solid Waste



The Village government does not own or operate a solid waste landfill or facility, but instead contracts for solid waste disposal with private hauler Welsh Sanitation. According to the Rhinebeck Village Climate Smart Task Force's research on Welsh: approximately 50% of the garbage is hauled to a "burn plant" in Poughkeepsie, the WinWaste / Wheelabrator facility, where it is incinerated. The remaining 50% is hauled to landfills in Syracuse or Ontario. Data are not available to quantify the solid waste the Village collects from the Big Bellies (public trash bins) or solid waste from Village municipal buildings. A municipal solid waste audit would be needed to understand the tonnage and the breakdown between garbage versus recycling from Village operations.

The Village conducts curbside collection of vegetative yard waste from residential properties and recycles the collected material into mulch. An estimated 200 tons of green waste was collected for processing. The collected materials are shredded, mulched, and composited at the Village Highway Department

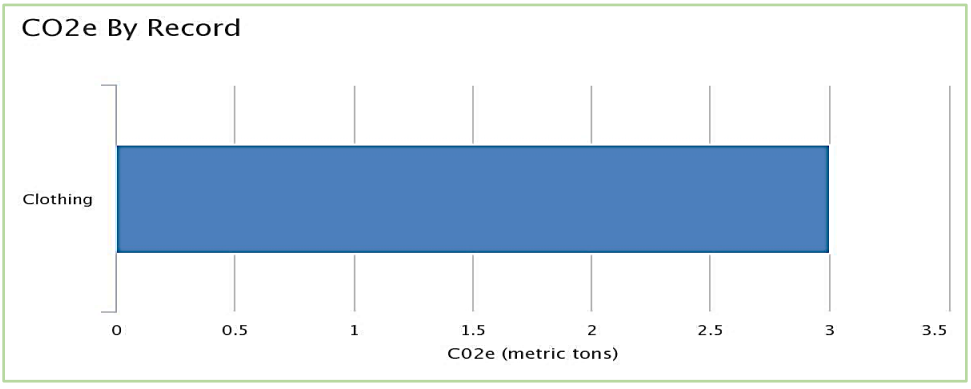
facility. The Village sells processed mulch/compost for use in gardens and landscapes. Emissions related to the composting of 200 tons of green waste are calculated in the ClearPath tool using ClearPath's factor set. The factor set draws from the USEPA's Waste Reduction Model (WARM) tool (version 15, November 2020), and documentation can be found in Chapter 2 on Yard Trimmings: www.epa.gov/sites/default/files/2020-12/documents/warm_organic_materials_v15_10-29-2020.pdf.

Note that the ClearPath factor set considers the vehicle emissions associated with bringing the yard trimmings to a processing site. This calculation may result in a small amount of the Highway Department fleet fuel usage being counted twice. However, emissions related to yard waste mulching operations were included in the inventory to present a comprehensive calculation of government operations emissions for the base year. Interestingly, the WARM model also includes emissions offsets related to "increases in soil carbon storage" and "avoided synthetic fertilizer use due to land application of compost." The WARM tool calculates that the net emissions from landfilling yard waste are four times greater than the emissions related to the composting/mulching these materials.

Currently, the Village government is attempting to create a municipal food waste composting program, and hopefully by our next GHG emissions inventory the benefits of that program can be calculated. When conducting a community-wide GHG emissions inventory, the Village should try to understand the quantity of backyard composting being conducted by residents.

Village generated solid waste can include construction and demolition materials from renovation projects. These projects are conducted by Village staff or by contracted workers. GHG emissions related to the disposal of these waste materials were not tracked and were not included in the baseline inventory. Going forward, the disposal of materials related to Village construction and demolition projects can be tracked for GHG emission inventories.

Process and Fugitive Emissions



Process and fugitive emissions related to Village operations are difficult to quantify. For the FY2019 baseline inventory, emissions associated with the manufacture and distribution of work clothing purchased for the Village's uniform program were estimated based on the annual purchase cost. We used

the default setting available in the ClearPath tool (Clothing: 750 kg CO2e/$), which is based on a factor set from University of California, Berkeley's Cool Climate research: https://coolclimate.org. During FY2019, Fire/EMS and Police had not purchased new turnout gear, so the baseline record year only represents uniform purchases for the Water, Wastewater, and Highway Departments.

Next Steps:

The findings from the baseline local government operations emissions inventory points out a need for:

- Retrofitting heating, ventilation, and air conditioning (HVAC) systems for buildings and facilities - in particular, improvements to heating for Village Hall/Firehouse stands out as high potential for cost savings and reducing emissions.
- Upgrades to our Water and Wastewater Plants – the processes themselves can be made more energy efficient with the replacement of old pumps, etc. The Village is undertaking upgrades to the WTP starting in 2024 and deciding improvements to the WWTP.
- Tracking emissions associated with the management of river water sludge deposited to the WTP lagoon. A test of the BOD5 costs $30.
- Developing a Fleet Efficiency Policy and Fleet Rightsizing Program – The Village government already maintains a Fleet Inventory. We should plan for transitioning our fleet, particularly as a greater range of EV models become available for police cars, pickup trucks, and heavy-duty vehicles: www.electrificationcoalition.org/resource/drve.
- Employee commute – The Village Board could consider incentives for employees and officials to switch to EVs.
- Conducting Government operations waste audit – to better understand the quantities of solid waste (garbage) the Village government is producing and collecting.
- Tracking Construction and Demolition - the Village government could start tracking emissions related to construction and demolition. The transportation and disposal of waste generated during these activities can be evaluated. The production and use of concrete for construction generates a large amount of GHG emissions. Hastings-on-Hudson has successfully incorporated the use of low-carbon concrete into municipal projects.
- Solar arrays for electrical generation – facilities and operations such as the Village Hall or the Water Treatment Plant may benefit from the increased use of solar arrays for electrical power generation. A cost/benefit analysis can be a part of future planning.
- Further research on nature-based solutions related to our urban forest.

Conclusion

This inventory marks the completion of Milestone One of the Five ICLEI Climate Mitigation Milestones. The findings from the inventory indicate that approximately 594 metric tons of carbon dioxide equivalent (CO2e) were emitted by Village operations across seven sectors during the baseline year. The next steps are to forecast emissions, set an emissions-reduction target, and build upon the Village's existing Climate Smart efforts with a more robust climate action plan that identifies specific quantified strategies that can cumulatively meet that target.

The Intergovernmental Panel on Climate Change (IPCC) states that to meet the Paris Agreement commitment of keeping warming below 1.5°C, we must reduce global emissions by 50% by 2030 and reach carbon neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%. More than ever, it is imperative that countries, regions, and local governments set targets that are ambitious enough to slash carbon emissions between now and mid-century.

Science-Based Targets are calculated climate goals, in line with the latest climate science, that represent a community's fair share of the global ambition necessary to meet the Paris Agreement commitment. To achieve a science-based target, community education, involvement, and partnerships will be instrumental. The Village Board will be discussing setting a target through its participation in the CAPI program.

The FY2019 baseline inventory will form the basis for comparisons to GHG emissions calculations conducted for subsequent years and the starting point for a comprehensive climate action plan. The Village of Rhinebeck will continue to track key energy use and emissions indicators on an on-going basis and develop updated inventories on a regular basis. This tracking of emission trends is needed to assess the progress and goal achievement of any planning.

This inventory shows that efficiency improvements to our Water and Wastewater Plants, transitioning our fleet to EVs, and retrofitting our buildings to modern HVAC systems will make important progress toward sustainability goals. Through these efforts and others, the Village of Rhinebeck can achieve environmental, economic, and social benefits beyond reducing emissions.

Appendix: Methodology Details

Energy

The following tables show each activity, related data sources, and notes on data gaps.

Energy Data Sources

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Electricity consumption	Village Clerk	Assumption: the electrical meters in place at Village facilities are accurately and completely measuring electrical consumption.
Propane consumption	Village Clerk	Used at Police Station only for space heating.
Grid Electricity	Village Clerk/ Central Hudson	Central Hudson has experienced metering and billing anomalies during the last few years. These irregularities may cause data tracking challenges for future GHG inventories.

Emissions Factors for Electricity Consumption

Year	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
2018	253.11	18.0	2.0

Transportation

Transportation Data Sources

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Government vehicle fleet	Village Clerk	Fuel use/consumption was tracked by bulk fuel purchases for gasoline and diesel. Additional administrative efforts would be required to track fuel use by vehicle to evaluation potential future efficiencies.

Employee commute	Village Clerk	Assumption: the employee commuting data was accurately captured through self-reporting and estimates. Employee commuting information can be more accurately tracked going forward while maintaining employee confidentiality.

For vehicle transportation, it is necessary to apply average miles per gallon and emissions factors for CH4 and N2O to each vehicle type. The factors used are shown in Table 6.

MPG and Emissions Factors by Vehicle Type

Fuel	Vehicle type	MPG	CH_4 g/mile	N_2O g/mile
Gasoline	Passenger car	Vehicle use, fuel consumption, and miles per gallon were not tracked for the FY2019 baseline inventory. Vehicle fleet emissions were tracked by totaling the volume of gasoline and diesel purchased and consumed during the year. Going forward, individual vehicle fuel use and mileage could be tracked if this information is needed. Individual tracking would require additional administrative efforts.		
Gasoline	Light truck			
Gasoline	Heavy truck			
Gasoline	Motorcycle			
Diesel	Passenger car			
Diesel	Light truck			
Diesel	Heavy truck			

Wastewater

Wastewater Data Sources

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Nitrogen Discharge	WWTP Operations/ ClearPath Calculations	N2O discharges to air and surface water related to wastewater treatment plant operations are not well understood. Additional testing and monitoring may provide more accurate calculations.
Energy used in wastewater facilities	WWTP Operations	Separate electrical metering would allow an understanding of the electrical power requirements of the treatment processes separate from the electrical power requirements of the building operations related to lighting, heating, and cooling.

Potable Water

Potable Water Data Sources

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Potable water treatment	WTP operations	The potential GHG emissions related to the generation and discharge of residual sludge from raw water purification has not been addressed. The residual sludge is currently discharged and stored in an impoundment lagoon.
Water Treatment Operations	WTP Operation	Grid electrical use for the water treatment processes and the building lighting and cooling are tracked on a single meter. Separate metering would allow a greater understanding of the electrical use, and possible efficiencies, of the water treatment and distribution processes.

Solid Waste

Solid Waste Data Sources

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Solid Waste Generation	Estimate	Solid waste disposal from Village government facilities is conducted by a private contractor. Solid waste generated at Village government facilities is not tracked separately. Mulch sales were used to estimate the quantities of green waste collected curbside from residential properties.

Fugitive Emissions

Fugitive Emissions Data Sources

Activity	Data Source	Data Gaps/Assumptions
Local Government Operations		
Purchase and use of clothing for Village workers	Village Clerk	Purchases for Fire Department and Police Department clothing and protective gear did not occur during the base year.

Inventory Calculations

The FY2019 inventory was calculated following the US Community Protocol and ICLEI's ClearPath software tool. As discussed in Inventory Methodology, the IPCC [Intergovernmental Panel on Climate Change] 6th Assessment Report was used for global warming potential (GWP) values to convert methane and nitrous oxide to CO2 equivalent units (CO2e). ClearPath's inventory calculators allow for input of the sector activity data in various forms (i.e., gallons of fuel use, kilowatt hours, or vehicle miles travelled) with appropriate emission factors to calculate the final CO2e emissions.