Local Government Greenhouse Gas Emissions Study

NEW YORK
STATE OF
OPPORTUNITY.
Climate Smart Communities

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Prepared for the
Village of Lancaster, NY

Prepared by
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Figure 1 Lancaster Opera House Photo Credit: V. Keicher, 2021.

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Executive Summary

The Village of Lancaster joined The New York Climate Smart Communities program in June 2016. Climate Smart Communities supports local municipalities in reducing Greenhouse Gas (GHG) emissions. This study inventoried GHG emissions by examining records of electricity, natural gas, unleaded gasoline, and diesel fuel usage for Village government operations. The analyses quantified GHG emissions using data from the years 2016 and 2019.

In this report, GHG emissions are expressed as Metric Tons of CO2 equivalent (MTCO2e). This metric accounts for the generation of carbon dioxide, methane, and nitrous oxide.

The first step in this study was to review utility bills for natural gas and electricity usage in 2016 and 2019 in the Village of Lancaster's Municipal Building, Public Works Building, and North End Fire Department Building. Usage data were analyzed using the EPA Energy Star Portfolio manager.

GHG emissions from electricity usage at the Municipal Building were approximately 15.8 MTCO2e in 2016 and 11.9 MTCO2e in 2019. At the Public Works Building, GHG emissions for electricity were approximately 11.8 MTCO2e in 2016 and 12.1 MTCO2e in 2019. At the North End Fire Station, GHG emissions for electricity usage were approximately 4.2 MTCO2e in 2016 and 3.6 MTCO2e in 2019.

GHG emissions for natural gas usage at the Municipal Building were approximately 88.6 MTCO2e in 2016 and 84.3 MTCO2e in 2019. At the Public Works Building, GHG emissions for natural gas usage were approximately 117.2 MTCO2e in 2016 and 128.3 MTCO2e in 2019. GHG emissions for natural gas usage at the North End Fire Department were approximately 14.3 MTCO2e in 2016 and 15.8 MTCO2e in 2019.

The next step was to review fuel logs to determine unleaded gasoline and diesel fuel usage in 2016 and 2019 by the Village Department of Public Works and Fire Department vehicles. Usage data were analyzed using the GHG Performance Calculator.

GHG emissions from usage of unleaded gasoline by the Department of Public Works vehicles were approximately 41.7 MTCO2e in 2016 and 41.5 MTCO2e in 2019. GHG emissions from usage of unleaded gasoline by Fire Department vehicles were approximately 17.9 MTCO2e in 2016 and 14.4 MTCO2e in 2019.

GHG emissions from usage of diesel fuel by Public Works vehicles were approximately 72.3 MTCO2e in 2016 and 67.4 MTCO2e in 2019. GHG emissions from usage of diesel fuel by Fire Department vehicles were approximately 7.1 MTCO2e in 2016 and 7.0 MTCO2e in 2019.

The last step was to analyze electricity usage for streetlighting. The Village of Lancaster installed over 2000 LED streetlights by early 2021. This project has reduced annual GHG emissions for streetlights from 77.51 MTCO2e to approximately 24.63 MTCO2e.

1. Introduction to the Study

Students from the University of Buffalo developed a government operations Greenhouse Gas (GHG) emissions inventory for the Village of Lancaster, New York. The purpose of this study was to examine the consumption of electricity and natural gas from Village structures, the consumption of unleaded gasoline and diesel fuel from Village vehicles, and the consumption of electricity from streetlighting. The results of the study have been included in this report and are intended to assist the Village of Lancaster in further reducing its government operations GHG emissions.

The results of this study are based on raw data provided by the Village of Lancaster for 2016 and 2019. More specifically, 2016 is considered the baseline year, as it was the year in which the Village joined the New York Climate Smart Communities program. The comparison year is 2019, since the most recent 2020 data were atypical due to the suspension of many office and project activities in response to the global COVID-19 pandemic.

GHG emissions are a concern for the Village because they contribute to climate change, which ultimately increases the likelihood of extreme weather events such as severe storms or extreme temperatures that could negatively impact residents. According to the U.S. Environmental Protection Agency (EPA): "Greenhouse gases from human activities are the most significant driver of observed climate change since the mid-20th century."[1]

Reducing GHG emissions in the Village of Lancaster will help achieve the state and national and international GHG emissions reduction goals.[2] [3] [4]

State, National, and International Context

New York State passed the Climate Leadership and Community Protection Act in 2019 requiring reduction of GHG emissions to no less than 85 percent of 1990 levels by 2050.

The United States has set a goal of reducing GHG emissions by 50 percent from 2005 levels by 2030.

The International Paris Climate Agreement was adopted by nearly every nation to address climate change; it aims to substantially reduce GHG emissions to limit global

Beyond this introduction, the report includes:

- Information about the Village of Lancaster, including its current GHG reduction efforts.
- A brief description of greenhouse gases.
- An overview of the approach used to calculate GHG emissions.

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[1] USEPA. 2020. Retrieved March 12, 2021 from: Climate Change Indicators: Greenhouse Gases | Climate Change Indicators in the United States | US EPA.

[2] New York State Climate Act. Retrieved April 26, 2021 from: New York's Climate Leadership and Community Protection Act (CLCPA) (ny.gov).

[3] "Biden feels heat on emissions goal as climate summit nears." *AP News*, https://apnews.com/article/summits-climate-business-environment-and-nature-government-and-politics-c02ea56b944d01c812644900fce803e7

[4] NRDC. 2021. Retrieved April 26, 2021 from: Paris Climate Agreement: Everything You Need to Know | NRDC

- Details about the approach used to estimate GHG emissions from Village government structures.
- Results of the evaluation of GHG emissions from Village government structures.
- Details about the approach used to estimate GHG emissions from Village government vehicles.
- Results of the evaluation of GHG emissions from Village government vehicles.
- GHG emissions reductions because of a recent Village street lighting project.
- A brief discussion of potential GHG emission reduction actions.

2. Village of Lancaster Greenhouse Gas Reduction Efforts

The Village of Lancaster is in Western New York, about 11 miles east of Buffalo in the Town of Lancaster in Erie County. The Village covers about 2.7 square miles and had an estimated population of approximately 10,206 residents in 2010.[5]

The Village of Lancaster joined the New York Climate Smart Communities Program in June 2016, by adopting a resolution aiming to reduce GHG emissions. The resolution highlights that the Village adopted the NYS Climate Smart Communities Pledge, to contribute to the development of a more energy-independent, secure, healthy, and resilient community[6].

This Government Operations GHG Inventory is one of the crucial Climate Smart Communities Certification Actions, which would allow the Village of Lancaster to gain more points towards receiving the Climate Smart Certification[7]. The Village has already completed various Certification Actions:

- In 2017, the Village of Lancaster conducted an energy study that led to numerous recommendations for reduction of electricity and natural gas usage in Village structures including interior and exterior lighting upgrades, building envelope improvements, and replacement of heating and air conditioning systems.[8] Since 2017, the Village has upgraded boilers in its Department of Public Works and Municipal buildings as well as the roof-top cooling units at the Municipal Building. This report provides evidence that these upgrades are reducing GHG emissions.
- In 2021, the Village completed a project to upgrade street lighting.[9] This report estimates the reduction in GHG emissions, due to electricity consumption, resulting from this upgrade.

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[5] US Census Bureau. 2010. Retrieved March 12, 2021 from: https://data.census.gov/cedsci/table?q=village of Lancaster village, New York&tid=DECENNIALAIAN2010.HCT4&hidePreview=false

[6] Climate Smart. "State Support for Local Climate Action." *Climate Smart NY*, NY State, 2021, https://climatesmart.ny.gov/. Accessed 13 April 2021.

[7] "Certification Actions," *Climate Smart Communities*, https://climatesmart.ny.gov/actions-certification/actions/

[8] Bottita, Steve. December 2017. Detailed Energy Audit Final Report submitted to the Village of Lancaster.

[9] (Village of Lancaster. 2020. Retrieved March 12, 2021 from: West Main Street Road Extension - Village of Lancaster, NY (lancastervillage.org))

The Village of Lancaster was also able to collaborate with the Town of Lancaster to address GHG emissions through other projects. These include plans for Main Street improvements,[10] a tree management plan,[11] plans for enhanced bike lanes,[12] and the construction of roundabouts in downtown Lancaster.[13]

3. Greenhouse Gases

This study is based on data provided by the Village of Lancaster about the consumption of electricity, natural gas, unleaded gasoline, and diesel fuel for government operations. Usage of each of these types of energy generates greenhouse gases.

The findings of this study account for carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).[14] These three greenhouse gases make up approximately 97 percent of the greenhouse gases released into the atmosphere. More specifically, CO_2 makes up approximately 80 percent, while CH_4 and N_2O account for approximately 17 percent.[15] As explained previously, the calculations of GHG emissions are based on the consumption of electricity, natural gas, unleaded gasoline, and diesel fuel by the Village structures, vehicles, and street lighting.

For this study, two different applications were used to calculate GHG emissions. The EPA Energy Star Portfolio Manager[16] was used to examine consumption of electricity and natural gas in Village government structures. The unpublished GHG Performance Calculator[17] was used to examine consumption of unleaded gasoline and diesel fuel by Village government vehicles and by streetlights. ICLEI-Local Governments for Sustainability's Local Government Operations Protocol (LGOP) and the US Community Operations Protocol were used for reference while analyzing the data.

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[10] Village of Lancaster. 2020. Retrieved March 12, 2021 from: West Main Street Road Extension - Village of Lancaster, NY (lancastervillage.org)
[11] Village of Lancaster. 2020. Retrieved March 12, 2021 from Tree Mgmt Plan - Village of Lancaster, NY (lancastervillage.org)
[12] WIVB Channel 4. 2020. Retrieved March 12, 2021 from: Work on new bike lanes in Village of Lancaster starts Monday | News 4 Buffalo (wivb.com)
[13] Village of Lancaster. 2020. Retrieved March 12, 2021 from: Downtown Lancaster Roundabout - Village of Lancaster, NY (lancastervillage.org)
[14] USEPA. 2020. Retrieved March 12, 2021 from: Overview of Greenhouse Gases | Greenhouse Gas (GHG) Emissions | US EPA.
[15] USEPA. 2020. Retrieved March 12, 2021 from: Overview of Greenhouse Gases | Greenhouse Gas (GHG) Emissions | US EPA.
[16] USEPA. 2020. Retrieved March 12, 2021 from: Portfolio Manager | ENERGY STAR
[17] Carroll, Terrance. Unpublished. GHG Performance Calculator. Developed for the Cornell Cooperative Extension of Tompkins County and the New York State Department of Environmental Conservation.

The unit of measurement in which GHG emissions are reported is "Metric Tons Carbon Dioxide equivalent" ($MTCO_2e$), "a universal unit of measure that combines the quantity and global warming potential of each greenhouse gas."[18]

The $MTCO_2e$ Metric

One $MTCO_2e$ is equivalent to 1,081 smart phones being charged or to 9.8 pounds of coal being burned.

One hundred $MTCO_2e$ are produced by an average car driving 251,320 miles.

Source: EPA. 2018. Greenhouse Gas Equivalencies Calculator | Energy and the Environment | US EPA

4. Greenhouse Gas Emissions from Structures - Study Approach

The raw data provided by the Village of Lancaster for the study were electric bills from the New York State Electric and Gas Corporation (NYSEG) and natural gas bills from National Fuel from 2016 and 2019. This study used the EPA Energy Star Portfolio Manager® (Portfolio Manager) to estimate GHG emissions due to usage of electricity and natural gas by the Village of Lancaster to heat, cool, and operate its three government structures.[19] Those structures are the Municipal Building, the Department of Public Works Building, and the North End Fire Department Building.

Using Portfolio Manager, information about the three structures was entered in a table specifying the name of the structure, the address, the approximate year built, and the gross square floor area of the structure. This basic structure information is displayed in Table 1.

Table 1 Village of Lancaster Structures

Structure	Address	Approximate Year Built	Gross Square Floor Area
Municipal Building	5423 Broadway	1940	21,282
Department of Public Works Building	5200 Broadway	1940	18,426
North End Fire Department Building	24 W. Drullard	1960	4,653

The raw data provided by the Village were organized into an Excel spreadsheet highlighting the month of each utility bill and the consumption of electricity or natural gas that month. Electricity usage was measured in kilowatt hours (kWh), and natural gas usage was measured in hundred cubic feet (CCF). Data were missing for January 2019 for all three structures, for September 2019 for the Department of Public Works Building, and for November 2019 for the Municipal Building. Estimates for usage during those months were calculated using bills from the subsequent months assuming rates charged for electricity or natural gas remained constant during the two months.

[18] USEPA. 2020. Glossary. Retrieved April 17, 2021 from: ENERGY STAR Portfolio Manager.
[19] Use Portfolio Manager | ENERGY STAR Buildings and Plants | ENERGY STAR

The Excel spreadsheet was utilized to transfer the electricity and natural gas data to Portfolio Manager, which generated the GHG emissions estimates. Table 2 summarizes the usage totals entered in Portfolio Manager to calculate GHG emissions.

Table 2 Summary of Electricity and Natural Usage

Structure	Annual Electricity Usage (kWh)		Annual Natural Gas Usage (CCF)	
	2016	2019	2016	2019
Municipal Building	136,953	103,222	16,259	15,464
Department of Public Works Building	102,720	105,156	21,500	23,552
North End Fire Department Building	36,080	30,890	2,624	2,908
Total	275,753	239,268	40,383	41,924

As shown in Table 2, the total annual electricity usage for the entire building portfolio decreased from approximately 275,753 kWh in 2016 to approximately 239,268 kWh in 2019. While the annual electricity usage for the Municipal Building and the Fire Department Building declined from 2016 to 2019, the usage increased for the Department of Public Works Building. Figure 2 displays electricity usage by each of the three structures in both 2016 and 2019.

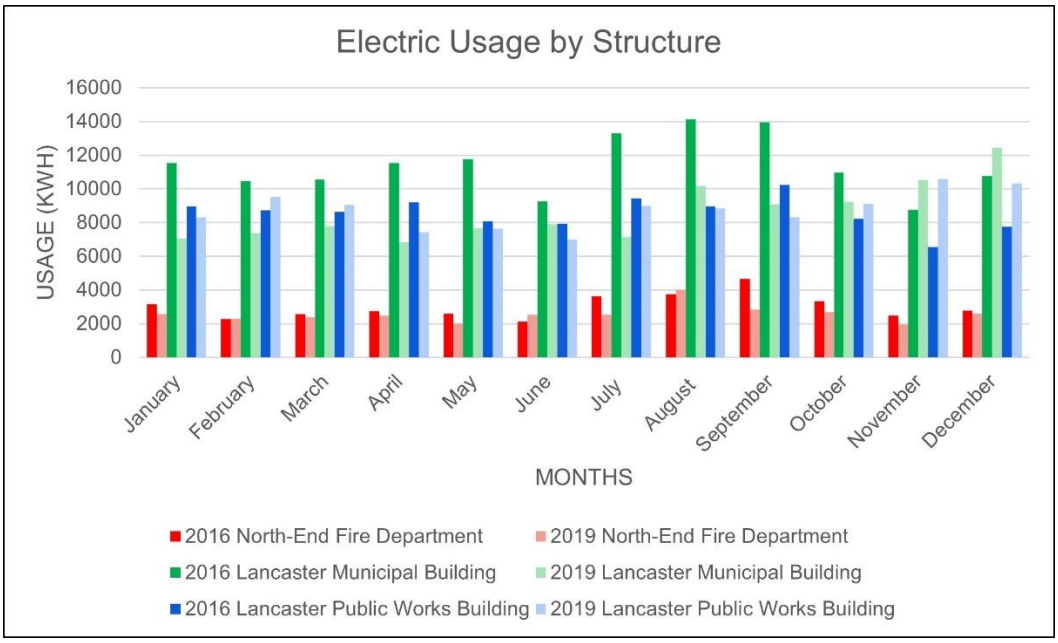

Figure 2 Electricity Usage by Structure

The total annual natural gas usage increased from approximately 40,383 CCF in 2016 to approximately 41,924 CCF in 2019. While the annual natural gas usage declined for the Municipal Building between 2016 and 2019, the usage increased for the Department of Public Works Building and the Fire Department Building. Figure 3 displays natural gas usage by each of the three structures in both 2016 and 2019.

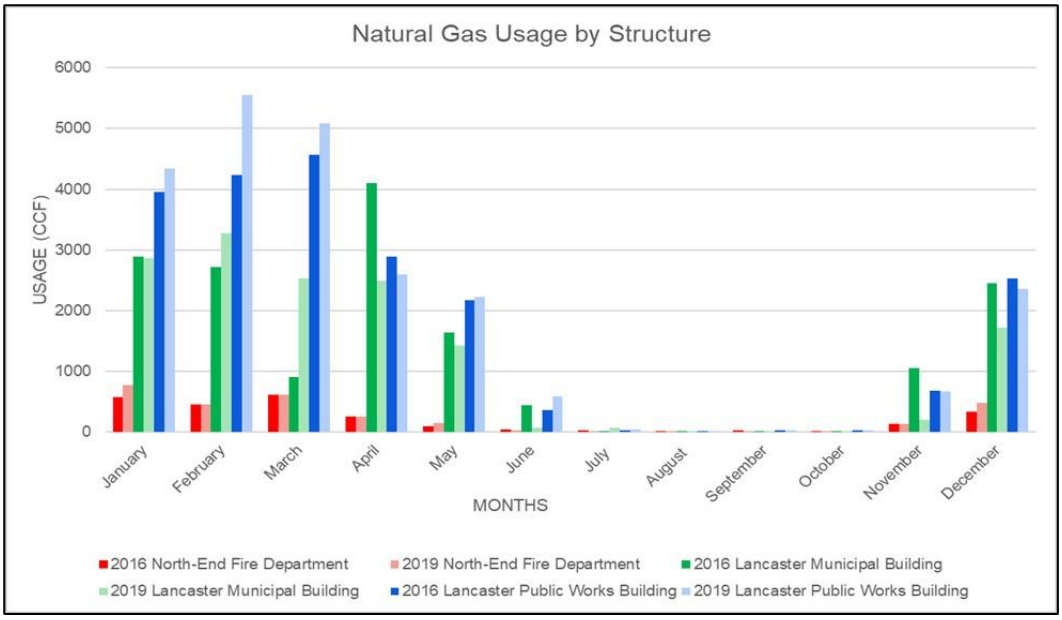

Figure 3 Natural Gas Usage by Structure

Portfolio Manager uses built-in assumptions and some default values to generate estimates of GHG emissions. The analysis is built on the assumptions that each location consists of a structure of which more than 50% of the area can be both heated and cooled. Portfolio Manager also assumed that the Municipal Building and Department of Public Works Building were fully occupied during the business week and that the North End Fire Department Building on West Drullard Avenue was not generally occupied. This can be attributed to the fact that the structure is a volunteer department. Portfolio Manager uses default values based on gross floor area to estimate the number of staff and the number of computers in use during the work week.

a. Municipal Building

Figure 4 is an image of the Village of Lancaster Municipal Building.

Figure 4 Municipal Building Photo Credit V. Keicher, 2021

Figure 5 displays the electricity consumption, by month, at the Municipal Building in 2016 and 2019. The unit of measurement for electricity usage is kWh. As shown, the electricity usage at the Municipal Building declined between 2016 and 2019 during most months. This may be attributed to the Village roof-top cooling unit upgrades made between 2016 and 2019.

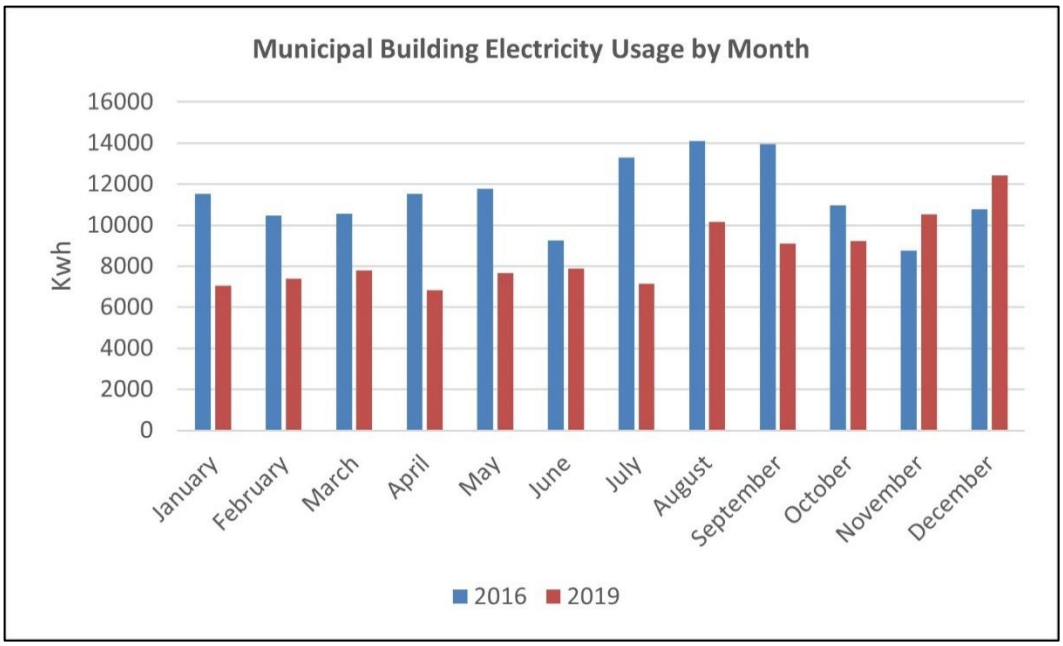

Figure 5 Municipal Building Electricity Usage

Figure 6 displays the natural gas consumption, by month, at the Municipal Building in 2016 and 2019. The unit of measurement for natural gas usage is CCF. Natural gas usage at the Municipal Building declined between 2016 and 2019. This may be attributed upgrades to the Village boilers that occurred between 2016 and 2019.

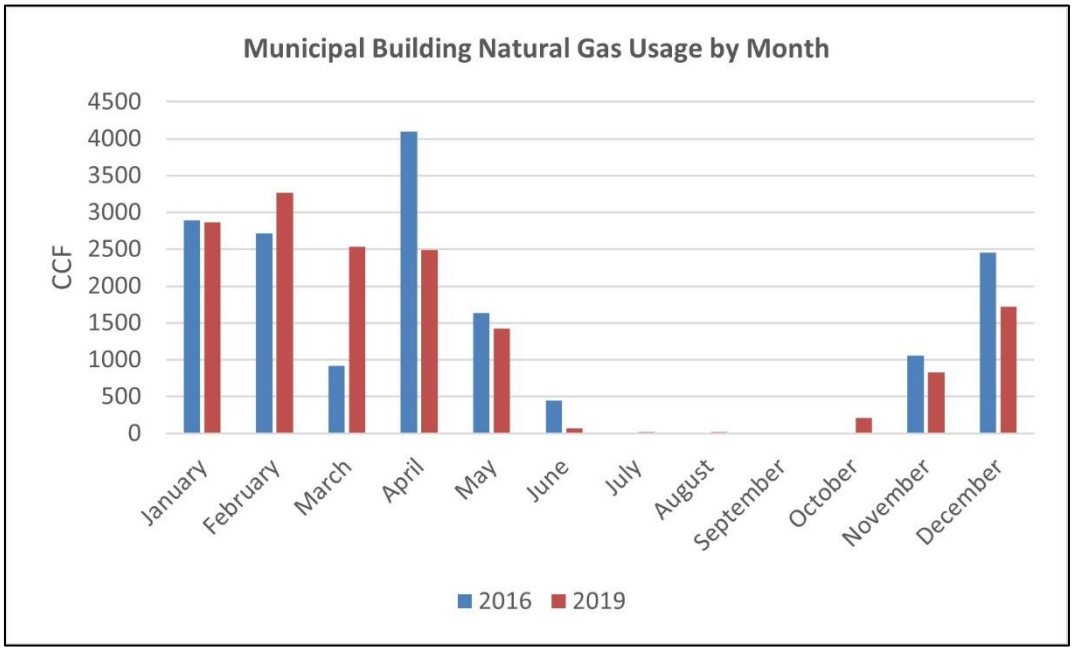

Figure 6 Municipal Building Natural Gas Usage

b. Department of Public Works Building

Figure 7 is an image of the Department of Public Works Building.

Figure 7 Department of Public Works Building. Photo Credit J. Draksic, 2021

Figure 8 displays the electricity consumption, by month, at the Department of Public Works Building in 2016 and 2019. The unit of measurement for electricity usage is kWh. As shown, the electricity usage at the Department of Public Works Building increased from 2016 to 2019. The largest differences between 2016 and 2019 occurred during the last three months of the year.

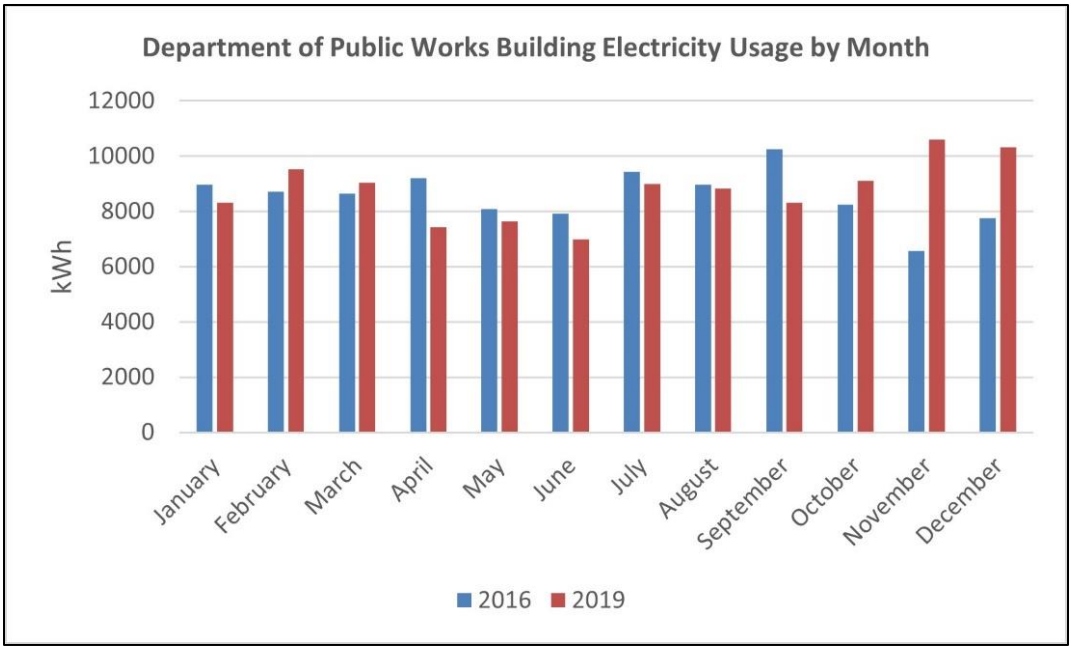

Figure 8 Department of Public Works Building Electricity Usage

Figure 9 displays the natural gas consumption, by month, at the Department of Public Works Building in 2016 and 2019. The unit of measurement for natural gas usage is CCF. As shown, the natural gas usage at the Department of Public Works Building increased from 2016 to 2019. This is primarily attributed to the increase in natural gas usage during the first three months of the year, between 2016 and 2019.

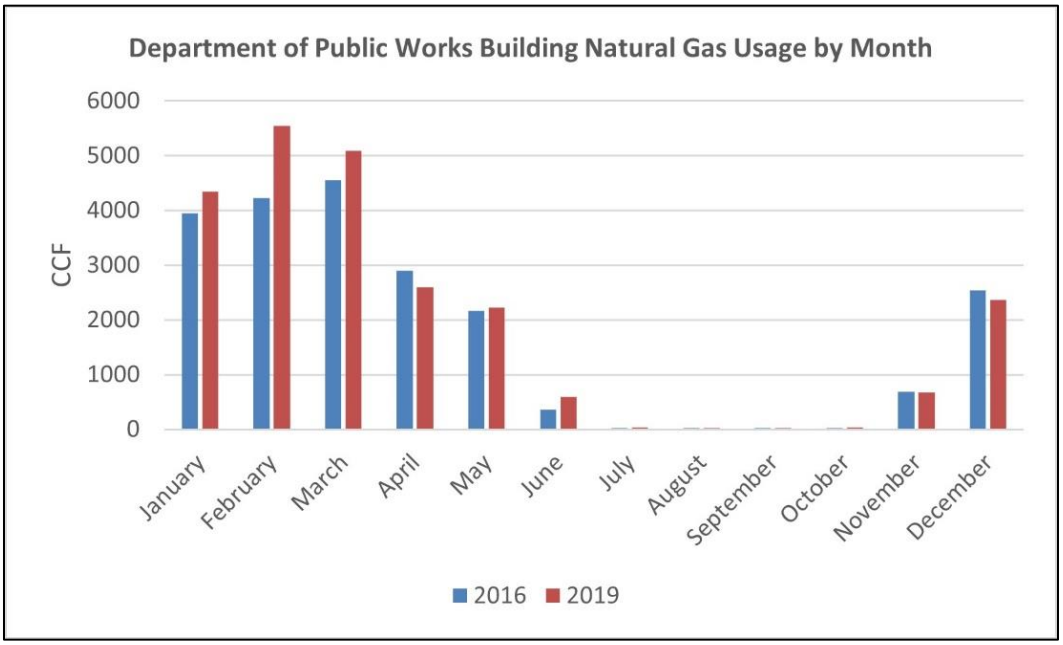

Figure 9 Department of Public Works Building Natural Gas Usage

c. North End Fire Department Building

Figure 10 is an image of the North End Fire Department Building.

Figure 10 North End Fire Department Building. Photo Credit L. Bruso, 2021.

Figure 11 displays the electricity consumption, by month, at the North End Fire Department Building in 2016 and 2019. The unit of measurement for electricity usage is kWh. As shown, the electricity usage at the North-End Fire Department Building decreased from 2016 to 2019. This is primarily attributed to the decline in electricity usage during January, July, September, October, and November, between 2016 and 2019.

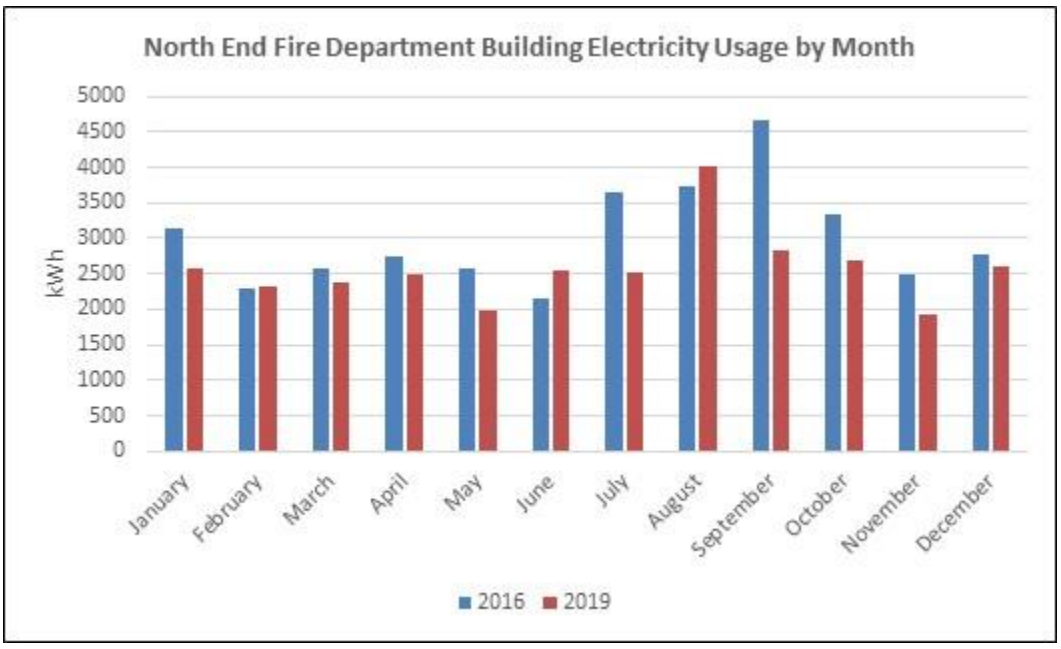

Figure 11 North End Fire Department Building Electricity Usage

Figure 12 displays the natural gas consumption, by month, at the North End Fire Department Building in 2016 and 2019. The unit of measurement for natural gas usage is CCF. As shown, the natural gas usage at the North End Fire Department Building increased from 2016 to 2019. This is primarily attributed to the increase in natural gas usage during January, March, May, and December between 2016 and 2019.

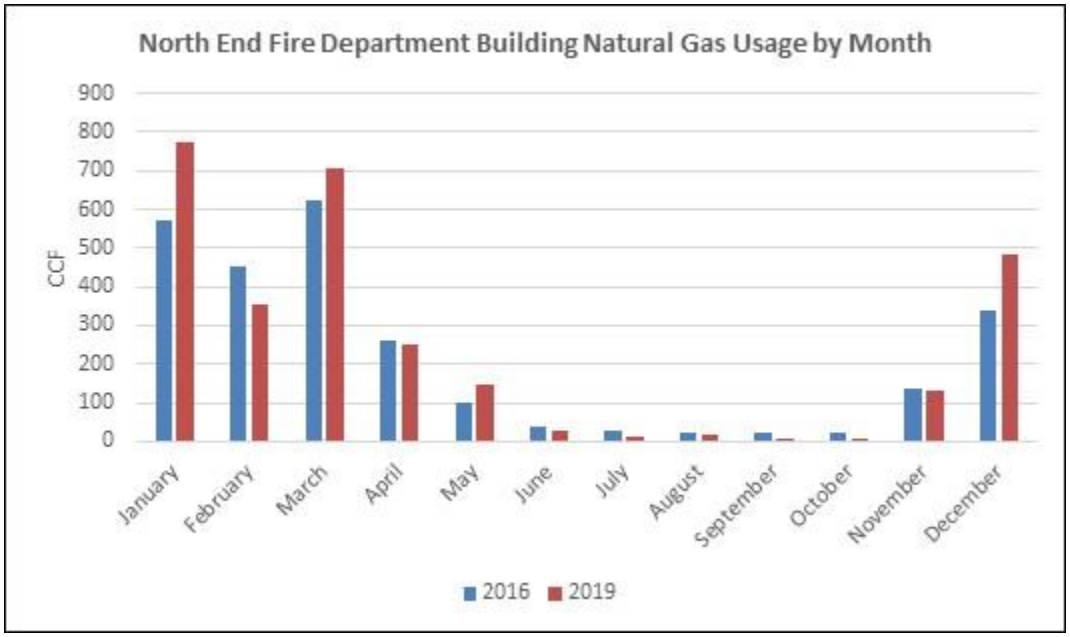

Figure 12 North End Fire Department Building Natural Gas Usage

5. Greenhouse Gas Emissions from Structures - Results of Data Analysis

GHG emissions from structures are reported in Metric Tons of Carbon Dioxide Equivalent ($MTCO_2e$). In this report, GHG emissions are reported to one decimal place because this is how Portfolio Manager reports results.

Table 3 summarizes the total GHG emissions resulting from electricity and natural gas consumption for the three Village structures in 2016 and 2019.

Table 3 Summary of Electricity and Natural Gas Total GHG Emissions

Structure	Total GHG Emissions - Electricity (MTCO2e)		Total GHG Emissions - Natural Gas (MTCO2e)	
	2016	2019	2016	2019
Municipal Building	15.8	11.9	88.6	84.3
Public Works Building	11.8	12.1	117.2	128.3
North End Fire Department Building	4.2	3.6	14.3	15.8
Total	**31.8**	**27.6**	**220.1**	**228.4**

As shown in Table 3, the total GHG emissions from electricity in 2016 for the entire building portfolio, is approximately 31.8 $MTCO_2e$, and the total GHG emissions from electricity in 2019 is approximately 27.6

$MTCO_2e$. The decline in GHG emissions from electricity could be attributed to the decline in GHG emissions for the Municipal Building and North End Fire Department Building.

As shown in Table 3, the total GHG emissions from natural gas in 2016 is approximately 220.1 $MTCO_2e$, and the total GHG emissions from natural gas in 2019 is approximately 228.4 $MTCO_2e$. This increase in the total GHG emissions from natural gas could be attributed to the increase in total GHG emissions for the Department of Public Works Building and North End Fire Department Building.

Figure 13 displays the GHG emissions from electricity usage for the three Village structures in 2016 and 2019.

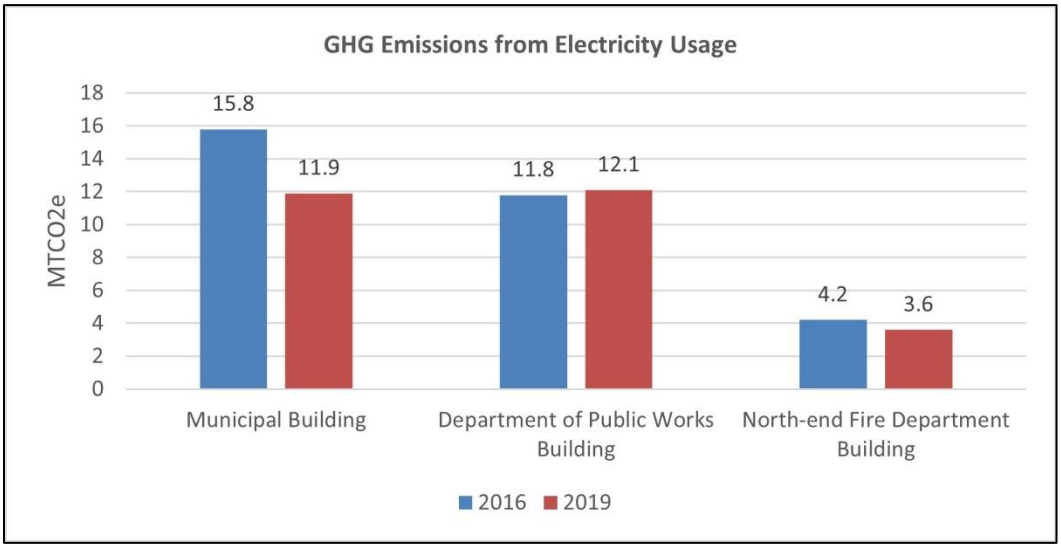

Figure 13 GHG Emissions from Electricity Usage

The most notable change in GHG emissions from electricity usage between 2016 to 2019 is the decline in emissions associated with the Municipal Building where emissions declined from approximately 15.8 $MTCO_2e$ to approximately 11.9 $MTCO_2e$.

Figure 14 displays the GHG emissions from natural gas usage for the three Village structures, in 2016 and 2019.

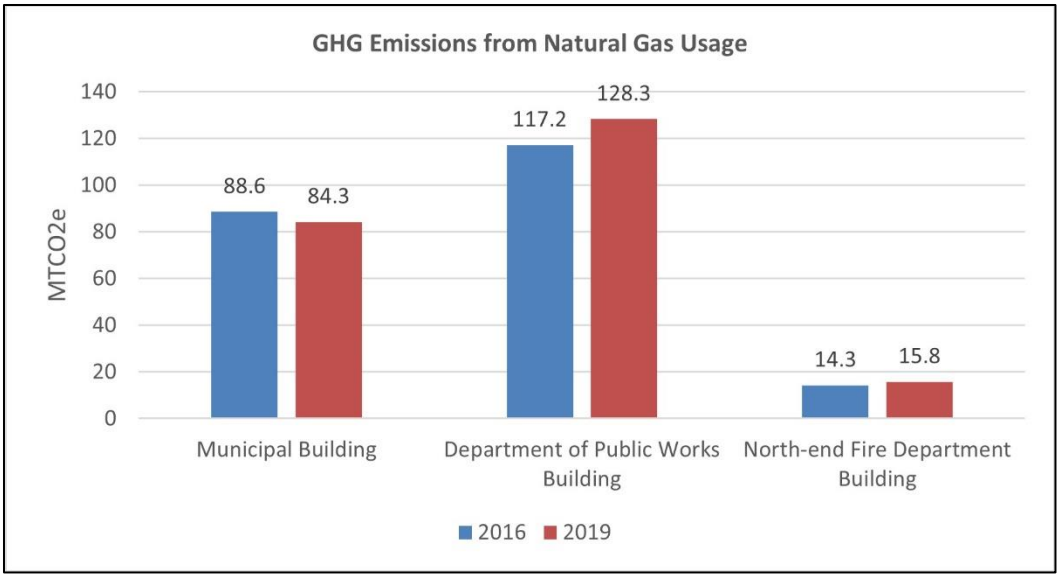

Figure 14 GHG Emissions from Natural Gas Usage

The greatest change from 2016 to 2019 for GHG emissions from natural gas usage .is the increase in emissions associated with the Department of Public Works Building where emissions increased from 117.2 $MTCO_2e$ to 128.3 $MTCO_2e$.

6. Greenhouse Gas Emissions from Vehicles – Study Approach

To examine consumption of unleaded gasoline and diesel fuel in 2016 and 2019, it was necessary to organize the raw data first. The data provided by the Village of Lancaster were for the Department of Public Works and the Fire Department vehicles. The Department of Public Works vehicle consumption data were obtained from the unleaded gasoline and diesel fuel logs provided by the Village of Lancaster. These bills indicated the month, the vehicle number, and the number of gallons consumed. The main limitation of the logs was that they were handwritten and approximately 15 of the over 1,100 entries indicating consumption of unleaded gasoline or diesel fuel were not included in the analysis, due to being unclear.

Fire Department vehicle data were obtained using the appropriation code “A.3411.0416” from the Village of Lancaster Accounting Department information. By referring to this appropriation code in the tabulated data, the vehicle number and number of gallons consumed were recorded. Unlike the Department of Public Works vehicle data, the Fire Department vehicle data were typed.

The vehicle types for the Department of Public Works vehicles were obtained from the vehicle number key provided by the Village of Lancaster.

For the 2019 unleaded gasoline data for the Fire Department vehicles, a separate set of bills was provided by the Village of Lancaster. More specifically, these bills contained the vehicle numbers, vehicle types, and gallons consumed by each vehicle, for every month of the year.

To calculate the total GHG emissions from vehicles used by the Department of Public Works and the Fire Department, the Climate Smart Communities GHG Performance Calculator was used. The GHG Performance Calculator is an unpublished tool that was prepared by Cornell Cooperative Extension

Service and the New York State Department of Environmental Conservation to examine GHG emissions by vehicles for which the fuel efficiency has been estimated.[20] Equipment such as lawn mowers and snow blowers were omitted from the calculations since their fuel efficiency cannot be estimated.

Like Portfolio Manager, the GHG Performance Calculator uses certain assumptions to complete its calculations. The Calculator utilizes built-in fuel economy assumptions about light trucks and heavy-duty vehicles. It assumes that pickup trucks use 17.4 gallons of unleaded gasoline per mile on average and that heavy-duty vehicles use 5.29 gallons of diesel fuel per mile on average. The GHG Performance Calculator also uses emissions factors based on the region of the state within which the community is located. Since the Village of Lancaster is in Western New York, the Calculator uses assumptions based on this region.

The fuel consumption for the vehicles of the Fire Department and Department of Public Works can be attributed to specific vehicles, using the identification numbers assigned by the Village of Lancaster for its vehicles. To generate results using the GHG Performance Calculator, vehicles were identified as belonging in one of two categories. Generally, vehicles that consume unleaded gasoline were pickup trucks or SUVs, and these were categorized as Light Trucks. Generally, vehicles that consume diesel fuel were dump trucks or fire engines, and these were categorized as Heavy-Duty vehicles.

a. Department of Public Works Vehicles

Table 4 shows a comprehensive list of all 2016 and 2019 vehicles included in the calculations for the Department of Public Works.

Table 4 Vehicles Used in 2016 and 2019 by Department of Public Works

Vehicle Description	Vehicle Year	Type of Fuel Used
Chevrolet Pickup Truck	2012	Unleaded Gasoline
Chevrolet Pickup Truck	2013	Unleaded Gasoline
Chevrolet Pickup Truck	2013	Unleaded Gasoline
Chevrolet Pickup Truck	2015	Unleaded Gasoline
Chevrolet Pickup Truck	2016	Unleaded Gasoline
Chevrolet Utility Truck	2005	Unleaded Gasoline
Chevrolet Tahoe	2015	Unleaded Gasoline
Ford Pickup Truck	2008	Unleaded Gasoline
Ford Pickup Truck	2008	Unleaded Gasoline
Ford Pickup Truck	2013	Unleaded Gasoline
Ford Medium Dump Truck	1994	Unleaded Gasoline
Ford Medium w/ Hood	1995	Unleaded Gasoline
Dodge Pickup Truck	2002	Unleaded Gasoline
Freightliner	2018	Unleaded Gasoline
Peterbilt Dump Truck	2001	Diesel Fuel

[20] Carroll, Terrance. Unpublished. GHG Performance Calculator. Developed for the Cornell Cooperative Extension of Tompkins County and the New York State Department of Environmental Conservation.

Peterbilt Dump Truck	2003	Diesel Fuel
Peterbilt Dump Truck	2006	Diesel Fuel
Kenworth Salt Truck	2014	Diesel Fuel
Kenworth Dump Truck	2017	Diesel Fuel
Chevrolet Dump Truck	2007	Diesel Fuel
Ford Medium Dump Truck	2014	Diesel Fuel
International Bucket Truck	2009	Diesel Fuel
Freightliner	2010	Diesel Fuel
Freightliner Street Sweeper	2010	Diesel Fuel
Large Dump Truck	Not Available	Diesel Fuel

The Department of Public Works vehicles consumed 4,730 gallons of unleaded gasoline in 2016 and 4,701 gallons of unleaded gasoline in 2019. Figure 15 illustrates the monthly consumption of unleaded gasoline by Department of Public Works vehicles in 2016 and 2019.

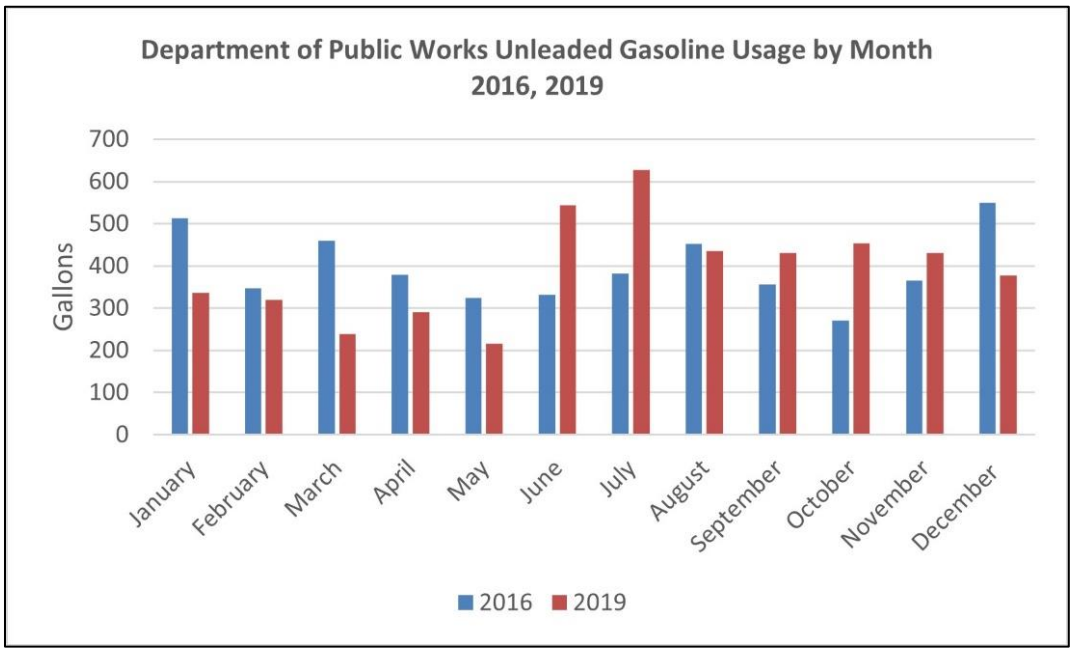

Figure 15 Unleaded Gasoline Usage by Department of Public Works by Month

The Department of Public Works vehicles consumed 7,080 gallons of diesel fuel in 2016 and 6,598 gallons of diesel fuel in 2019. Figure 16 illustrates the monthly consumption of diesel fuel by Department of Public Works vehicles in 2016 and 2019.

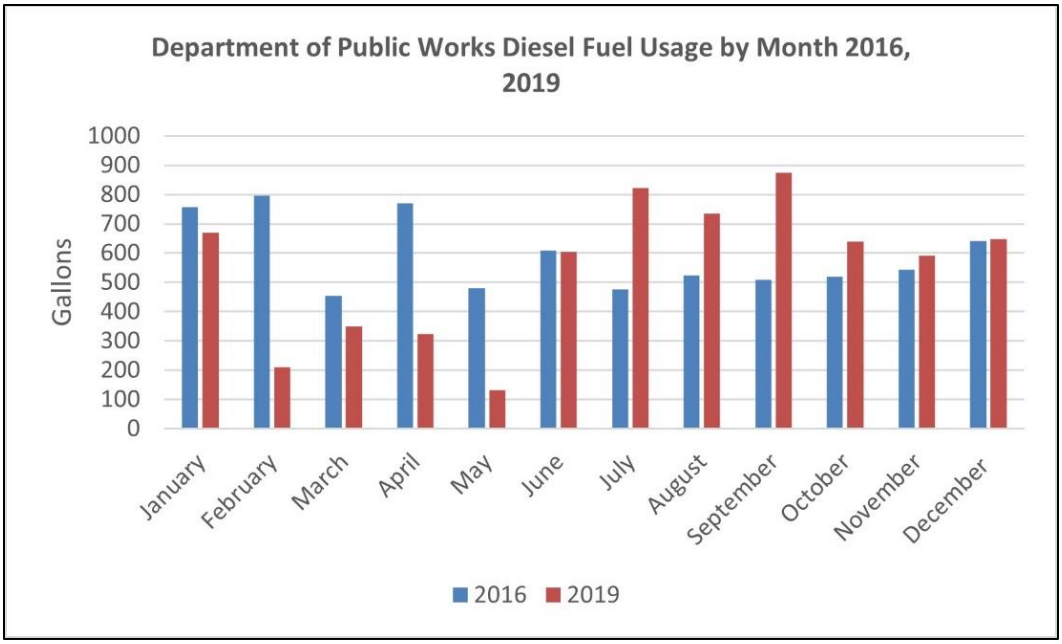

Figure 16 Diesel Fuel Usage by Department of Public Works by Month

b. Fire Department Vehicles

Table 5 shows a comprehensive list of all 2016 and 2019 vehicles included in the calculations for the Fire Department.

Table 5 Vehicles Used in 2016 and 2019 by Village Fire Department

Vehicle Description	Vehicle Year	Type of Fuel Used
Chevrolet Van	2002	Unleaded Gasoline
Chevrolet Tahoe	2002	Unleaded Gasoline
Chevrolet Tahoe	2007	Unleaded Gasoline
Chevrolet Tahoe	2009	Unleaded Gasoline
Chevrolet Tahoe	2010	Unleaded Gasoline
Ford Pickup Truck	2003	Unleaded Gasoline
Cube Van	2000	Unleaded Gasoline
Engine 1	Not Available	Diesel Fuel
Engine 2	Not Available	Diesel Fuel
Engine 5	Not Available	Diesel Fuel
Ladder Truck	Not Available	Diesel Fuel

Fire Department vehicles consumed 2,030 gallons of unleaded gasoline in 2016 and 1,638 gallons of unleaded gasoline in 2019. Figure 17 illustrates the monthly consumption of unleaded gasoline by Fire Department vehicles in 2016 and 2019.

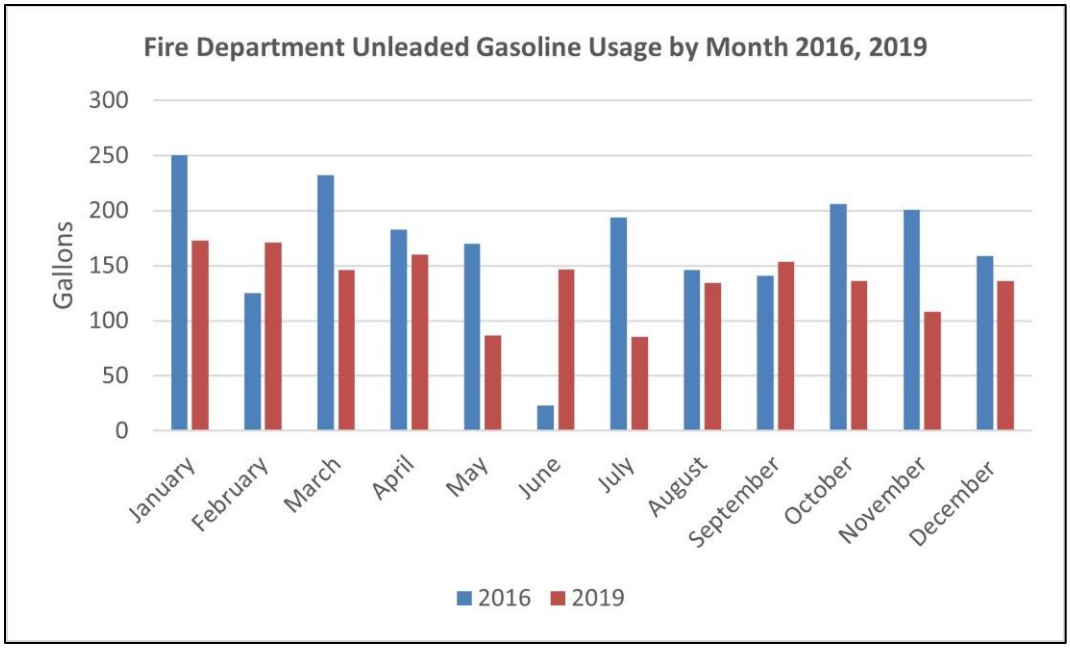

Figure 17 Unleaded Gasoline Usage by Fire Department by Month

Fire Department vehicles consumed 695 gallons of diesel fuel in 2016 and 686 gallons of diesel fuel in 2019. Figure 18 illustrates the monthly consumption of diesel fuel by Fire Department vehicles in 2016 and 2019.

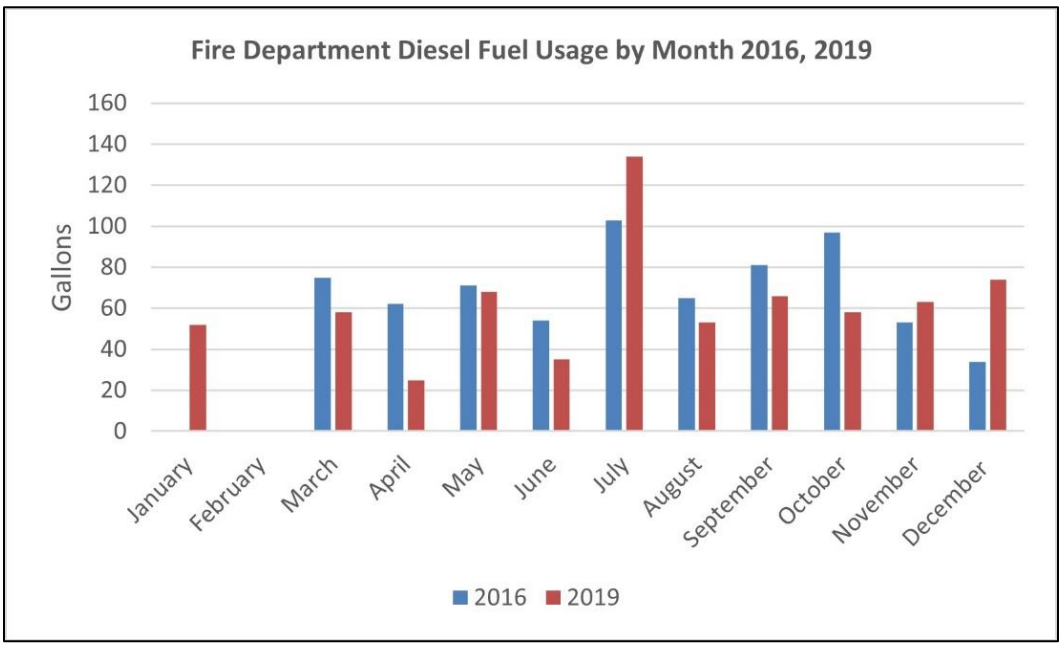

Figure 18 Diesel Fuel Usage by Fire Department by Month

7. Greenhouse Gas Emissions from Vehicles – Results of Data Analysis

GHG emissions from vehicles are reported in Metric Tons of Carbon Dioxide Equivalent ($MTCO_2e$). Results for total GHG emissions have been rounded to one decimal place.

Table 6 summarizes the total GHG emissions resulting from unleaded gasoline and diesel fuel consumption for the Department of Public Works and Fire Department vehicles in 2016 and 2019.

Table 6 Summary of Unleaded Gasoline and Diesel Fuel Total GHG Emissions

Department	**Total GHG Emissions – Unleaded Gasoline ($MTCO_2e$)**		**Total GHG Emissions – Diesel Fuel ($MTCO_2e$)**	
	2016	**2019**	**2016**	**2019**
Department of Public Works	41.7	41.5	72.3	67.4
Fire Department	17.9	14.4	7.1	7.0
Total	59.6	55.9	79.4	74.4

The total GHG emissions from unleaded gasoline in 2016 for the entire building portfolio, is approximately 59.6 $MTCO_2e$, and the total GHG emissions from unleaded gasoline in 2019 is approximately 55.9 $MTCO_2e$. The decline in GHG emissions from unleaded gasoline could be attributed to the decline in GHG emissions for both the Department of Public Works and Fire Department vehicles.

The total GHG emissions from diesel fuel in 2016 is approximately 79.4 $MTCO_2e$, and the total GHG emissions from diesel fuel in 2019 is approximately 74.4 $MTCO_2e$. This decrease in the total GHG emissions from diesel fuel could be attributed to the decrease in total GHG emissions for both the Department of Public Works and Fire Department vehicles.

Figure 19 displays the total GHG emissions from unleaded gasoline consumption for the Department of Public Works and Fire Department vehicles in 2016 and 2019.

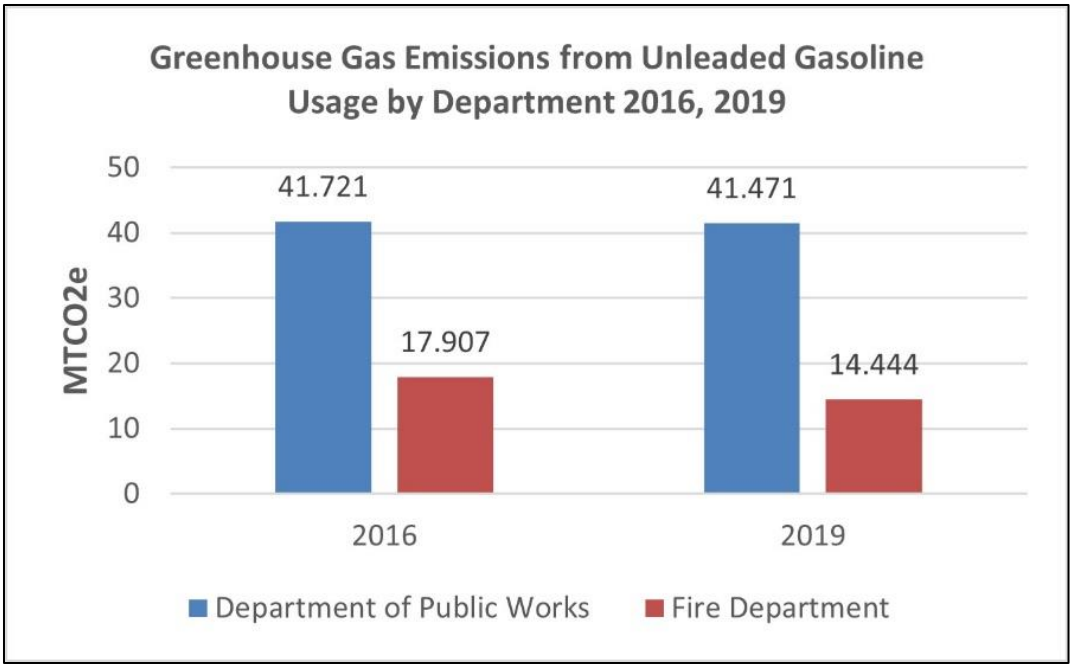

Figure 19 GHG Emissions from Unleaded Gasoline Usage

The most notable change in total GHG emissions from unleaded gasoline from 2016 to 2019 can be attributed to the Fire Department, as emissions declined from approximately 17.9 $MTCO_2e$ to approximately 14.4 $MTCO_2e$. The Department of Public Works total GHG emissions decreased slightly from approximately 41.7 $MTCO_2e$ in 2016 to approximately 41.5 $MTCO_2e$ in 2019.

Figure 20 displays the total GHG emissions from diesel fuel consumption for the Department of Public Works and Fire Department vehicles in 2016 and 2019.

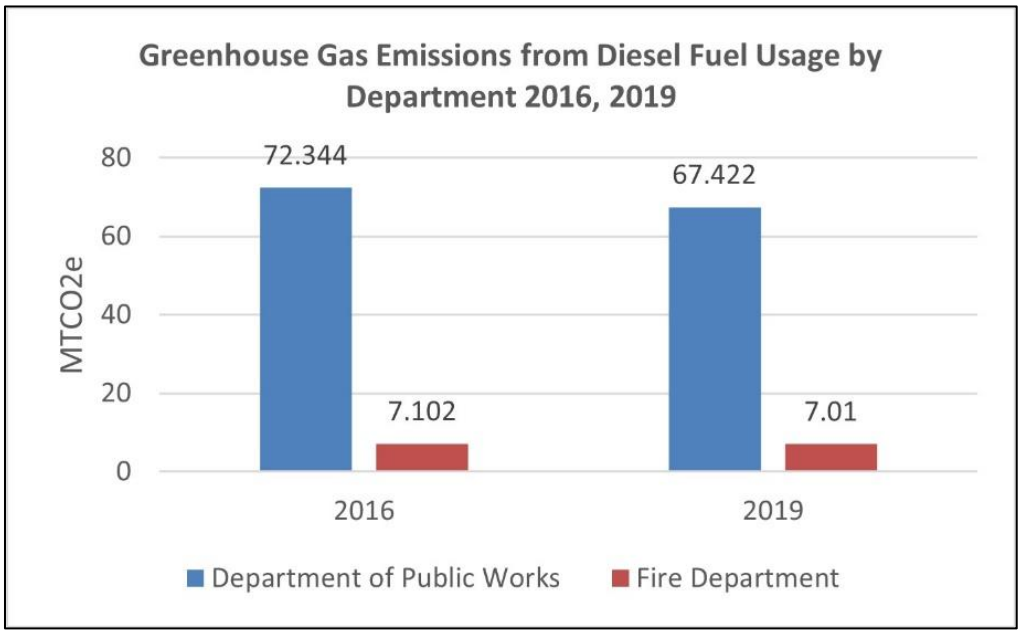

Figure 20 GHG Emissions from Diesel Fuel Usage

The most notable change in total GHG emissions from diesel fuel from 2016 to 2019 can be attributed to the Department of Public Works for which emissions declined from approximately 72.3 $MTCO_2e$ to approximately 67.4 $MTCO_2e$. The Fire Department total GHG emissions decreased slightly from approximately 7.1 $MTCO_2e$ in 2016 to approximately 7.0 $MTCO_2e$ in 2019.

8. Greenhouse Gas Emissions from Street Lighting Reduced

In recent efforts to reduce GHG emissions, the Village of Lancaster installed more efficient street lighting[21]. According to data provided by the Village, electricity usage for street lighting averaged 577,602 kilowatt-hours (kWh) per year prior to the installation of new Light-Emitting Diode (LED) streetlights. Figure 21 is an image of one of the streets in the center of the Village of Lancaster displaying the street lighting in the Village streets.

Figure 21 Village of Lancaster Streets. Photo Credit J. Draksic, 2021

After the installation of new LED streetlights, street lighting is expected to consume about 183,546 kWh per year as illustrated in Figure 22.

[21] Lancaster Bee. "LED street lighting comes to Lancaster Village. March 4, 2021. Retrieved March 24, 2021 from https://www.lancasterbee.com/articles/led-street-lighting-comes-to-lancaster-village/.

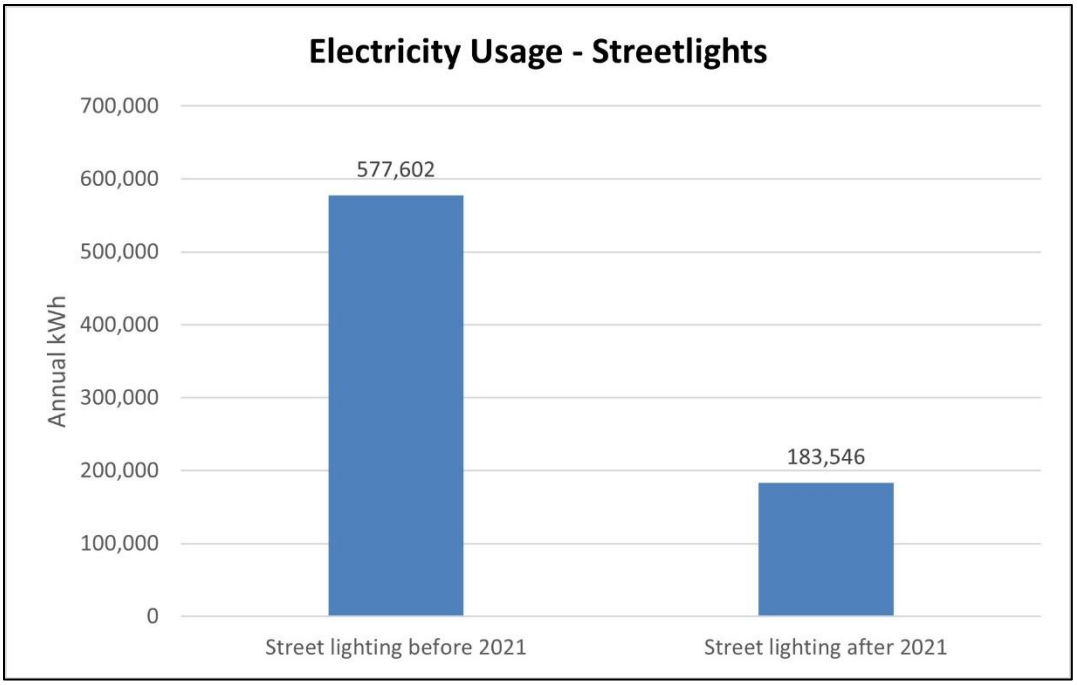

Figure 22 Electricity Usage by Streetlights

The GHG Performance Calculator was used to quantify GHG emissions attributable to street lighting. Street lighting generated an annual amount of about 77.51 $MTCO_2e$ prior to the installation of new LED streetlights. After the installation of the new LED streetlights, street lighting is estimated to generate approximately 24.63 $MTCO_2e$ per year as illustrated in Figure 23.

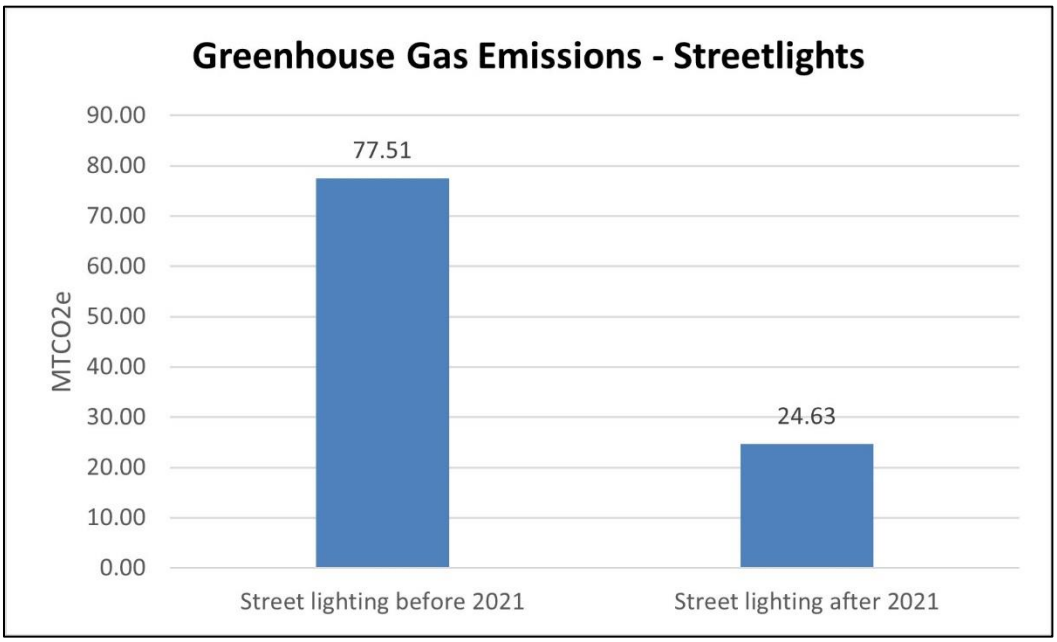

Figure 23 GHG Emissions by Streetlights

Not only will the installation of more efficient street lighting reduce GHG emissions, but, according to the Village government, it will also reduce the annual electricity costs from approximately $47,881 to approximately $16,034 per year.

9. Recommendations for Further Greenhouse Gas Emissions Reduction

There are many ways in which the Village of Lancaster can continue to reduce GHG emissions attributable to government activities.

The Village could adopt an energy benchmarking requirement for government structures to continue to track energy consumption by Village structures. Findings from energy benchmarking would further inform decision-making processes.

The Village could continue to implement recommendations presented in its 2017 energy report to further decrease consumption of electricity and natural gas in Village-managed structures such as installing automated lighting that will turn off lights when a room or an area is not occupied to save energy and reduce the cost of electricity.

The Village could eventually reduce its consumption of natural gas for heating by installing a ground-source or air-source heat pump or other geothermal technology, as reasonable, at existing facilities. A ground-source or air-source heat pump can be used to cool, heat, and supply hot water to Village structures, meaning that it can be considered a two-in-one heating/cooling solution. Furthermore, heat pumps improve air quality and maintain indoor air temperature. Although the upfront investment is substantial, these systems may provide over twenty years of service.[22]

To reduce consumption of unleaded gasoline or diesel fuel by government vehicles, the Village could adopt a village fleet efficiency policy that would require the eventual replacement of older vehicles with more energy-efficient vehicles.

Funding programs that may be available when the Village is prepared to implement one of these GHG emissions reduction strategies include Climate Smart Communities or NY State Energy Research and Development Clean Energy Communities grants, the NY Department of Environmental Conservation Zero Emission Rebate for purchase of light duty vehicles, or the NY Truck Voucher Incentive Program for replacement of heavy-duty vehicles.

10. Conclusion

This report identified current Village accomplishments that are consistent with New York Climate Smart Communities program goals.

[22] 2021. *Energy.Gov*. https://www.energy.gov/sites/prod/files/guide_to_geothermal_heat_pumps.pdf.

The report quantified GHG emissions caused by electricity and natural gas usage in the Village of Lancaster's Municipal Building, Department of Public Works Building, and North-end Fire Department Building.

The report quantified GHG emissions attributable to unleaded gasoline and diesel fuel usage by Village vehicles.

The report quantified the GHG emission reductions realized by the streetlighting project in the Village of Lancaster. Table 7 summarizes GHG emissions using the most recent data used in the study. Figure 24 displays the same information in a pie chart.

Table 7 Summary of GHG Emissions for Most Recent Data

Usage	MTCO2e
Natural Gas (based on 2019 data)	228.4
Electricity (structures – based on 2019 data)	27.6
Unleaded Gasoline (based on 2019 data)	55.9
Diesel Fuel (based on 2019 data)	74.4
Electricity (streetlights – based on 2021 predictions)	24.63

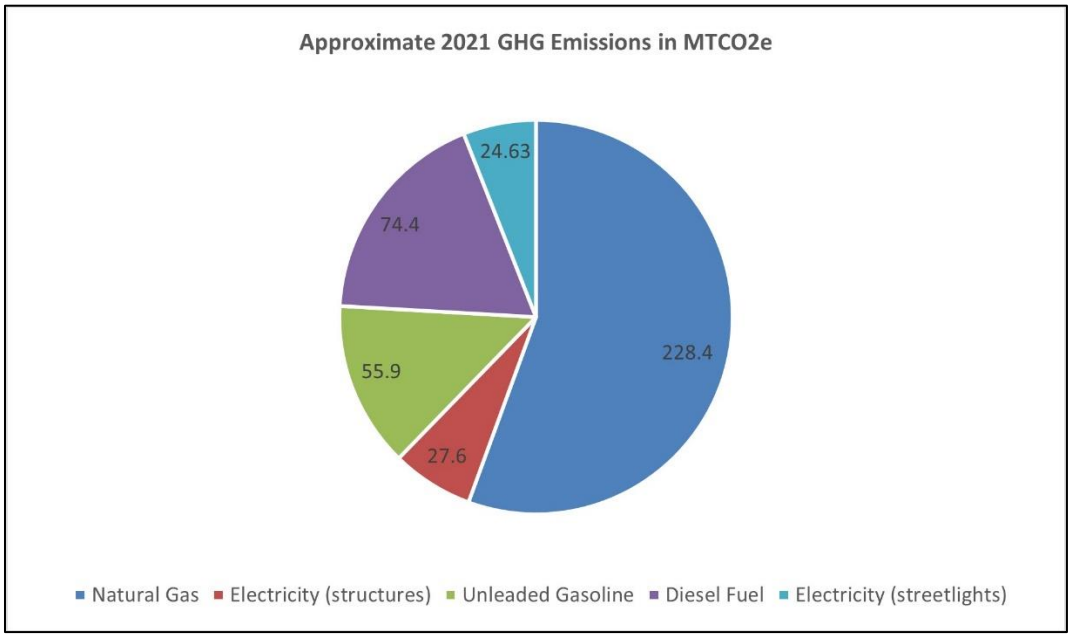

Figure 24 Current Estimates of GHG Emissions

Reductions in energy consumption will not only reduce GHG emissions and, in turn, help the environment but will eventually result in cost savings to the Village of Lancaster.

We recommend that the Village review energy consumption data again in a year or two to begin to establish trends and to document decreases in GHG emissions as various structural projects are implemented and as older vehicles are replaced with more energy-efficient models.