Town of Ithaca
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New York

Town of Ithaca

2019 Greenhouse Gas Inventory

Government Operations

Adopted May 2021

ACKNOWLEDGEMENTS

Town Board

Rod Howe, Town Supervisor
Bill Goodman, Deputy Town Supervisor
Rich DePaolo
Pamela Bleiwas
Tee-Ann Hunter
Pat Leary
Eric Levine

Report Authors

Terry Carroll, Clean Energy Communities Coordinator, Cornell Cooperative Extension of Tompkins County

Nick Goldsmith, Sustainability Planner, Town of Ithaca and City of Ithaca

Brian Toy, Climate Smart Communities Outreach Specialist, Cornell Cooperative Extension of Tompkins County

Gretchen Worth, Project Director, Susan Christopherson Center for Community Planning

Report Design

Theodora Weatherby, Clean Energy Communities Content, Media, and Outreach Manager, Cornell Cooperative Extension of Tompkins County

The Town thanks the following individuals who provided data, reviewed drafts, or otherwise contributed to this document. All individuals are affiliated with the Town of Ithaca unless otherwise noted.

Robert Howarth, Cornell University

Debby Kelley

Darby Kiley, Tompkins County

Carl (CJ) Kilgore, Ithaca Area Wastewater Treatment Facility

Laura Pastore

Glenn Ratacjzak, Bolton Point

Steve Riddle, Bolton Point

Donna Shaw

Mike Smith

Gregg Weatherby, Bolton Point

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EXECUTIVE SUMMARY

The 2019 Town of Ithaca Greenhouse Gas Inventory for Government Operations provides an update to the Town's 2009 inventory. Data from 2017 is also referenced; the full 2017 results are included under Appendix H – 2017 GHG Inventory Calculations and Results. The scope of the inventory includes emissions from areas under the Town's financial control, such as the Town of Ithaca buildings, streetlights and traffic signals, water delivery facilities, wastewater facilities, vehicle fleet, and employee commutes.

When viewed by sector, wastewater facilities produced the greatest share of Town emissions in 2019 at 35%. This was followed by the vehicle fleet, water delivery facilities, employee commute, buildings, and finally streetlights and traffic signals. Each sector can have multiple sources of emissions, and the greatest share of emissions by source was gasoline, contributing 25% of overall Town emissions, followed by electricity and natural gas. The inventory also accounts for carbon sequestered by urban forestry. In 2019, tree cover on Town-managed land sequestered 603 metric tons of CO_2 equivalent, enough to offset 29% of Town emissions.

Methods of accounting for greenhouse gas emissions are currently undergoing a paradigm shift; thus the 2019 greenhouse gas inventory includes calculations using two different methodologies. The traditional methodology as outlined by the Local Government Operations Protocol (LGOP) allows comparison to the Town's 2009 greenhouse gas inventory. Results using the traditional methodology to compare to past results show the Town emitted 2,085 metric tons of CO_2 equivalent in 2019 as compared to 3,928 metric tons of CO_2 equivalent in 2009, a decrease of 1,843 metric tons of CO_2 equivalent or a 47% decrease. These results indicate the Town met its goal of reducing greenhouse gas emissions by 30% from 2009 levels by 2020. See pages 11-14 for more information.

A new methodology described here as the Advanced Methane Accounting Method (AMAM) was also used; it accounts for methane leakage and uses a 20-year global warming potential for methane. Language in the New York State Climate Leadership and Community Protection Act (CLCPA) indicates that this emerging methodology may become the standard for future greenhouse gas inventories. Incorporating this methodology in the 2019 inventory enables the Town to look toward the future and provides a useful baseline for the next inventory. The results using this methodology paint a different picture than results from the traditional LGOP methodology, with the Town emitting 3,944 metric tons of CO_2 equivalent in 2019. While it is not possible to compare to the 2009 inventory due to methodological differences, these results indicate there is still much work to be done to reduce Town emissions, especially when accounting for methane leakage. See pages 24-29 for more information.

Comparing the results from the 2009 inventory to the 2019 inventory provides insights about trends in Town emissions, which decreased over the past decade. Factors identified as the causes for the decrease in emissions include:

- An increased mix of renewables in the Upstate New York Electric Grid, which contributed to decreased emissions from Town buildings, streetlights and traffic signals, water

EXECUTIVE SUMMARY, CONTINUED

delivery facilities, and wastewater facilities, all of which are major users of electricity
- Changes in Town operations, such as the percentage of the Town's use of the Ithaca Area Waste Water Treatment Facility (IAWWTF)
- Differences in methodology; for example, the 2009 inventory attributed 100% of emissions from Bolton Point to the Town of Ithaca, even though it is jointly owned and operated by multiple municipalities, while the 2019 inventory accounts for 51% of emissions from Bolton Point, which is the Town's ownership share of the plant
- Sustainability efforts of the Town and its partner agencies.

See pages 16-22 for more information.

Moving forward, the Town should plan to update its GHG inventories more often, which will allow the Town to better track progress and adjust planning and resource allocation accordingly. Through an iterative process of measurement, planning, and action, the Town will be well-poised to meet its ambitious Green New Deal (GND) goal of achieving an equitable transition to carbon neutrality by 2030.

INTRODUCTION

Even amidst a worldwide pandemic, climate change may be the most urgent, pressing issue faced by the global community. Although the Earth's climate has changed throughout history, never before have we seen such rapid, significant disruptions to the systems that make life on this planet possible. Human-caused climate change is resulting in an increase in extreme weather events that threaten human life, healthy communities, and critical infrastructure.

The 2016 Paris Agreement, joined by most countries in the world, including the United States, set the goal of limiting global warming to 2 degrees Celsius maximum, with a strong preference not to exceed 1.5 degrees Celsius. However, the Trump Administration withdrew the U.S. from the Paris Agreement and removed many of the environmental protections put in place by presidents of both political parties dating back to the 1960s. At the State, County, and local level, efforts have been made to fill the vacancy in climate leadership left by the federal government. (As of January 20, 2021, the U.S. has re-entered the Paris Agreement.)

New York State has committed to working aggressively to reduce greenhouse gas (GHG) emissions and becoming a hub of the new clean energy economy. The Climate Leadership and Community Protection Act (CLCPA), adopted in 2019, mandated several state goals, including one to reach carbon neutrality by 2050. The City of Ithaca, Tompkins County, and several local municipalities have adopted goals and taken climate action. The Town of Ithaca adopted a Green New Deal (GND) in early 2020 calling for an equitable transition to carbon neutrality by 2030. Carbon neutrality means that at least as many GHG emissions are sequestered or removed from the atmosphere as are emitted into the atmosphere.

A GHG emissions inventory is an assessment of the activities that cause or release greenhouse gases. Many inventories, like this one, also contain information about energy usage – the main driver of GHG emissions – and energy costs. It is recommended that GHG inventories be conducted every few years to allow tracking of these data points.

The Town's first GHG inventory for government operations provided baseline data from 2009. This inventory, which covers the years 2017 and 2019, allows the Town to:

- Track progress toward Town GND goals and other climate-related goals
- Monitor the impact of past sustainability initiatives
- Identify and prioritize areas for reducing GHG emissions, energy use, and energy cost
- Guide planning and policy decisions in a quantifiable and transparent way
- Recognize and build public support for its sustainability initiatives.

METHODOLOGY

The calculations in this report were performed using the Local Government Greenhouse Gas Accounting Tool, provided by the Environmental Protection Agency (EPA). The tool is based on the Local Government Operations Protocol (LGOP), which serves as a national standard for municipal greenhouse gas inventories across the country. The LGOP was developed by the California Climate Action Registry, the California Air Resources Board, ICLEI Local Governments for Sustainability, and The Climate Registry.[1]

Data for this government operations emissions inventory was collected from all sectors and sources of emissions within the Town's organizational and geopolitical boundaries, as detailed in Table 1. Emissions to be inventoried were determined based on financial control. For facilities solely owned and operated by the Town of Ithaca, 100% of emissions were accounted for. For facilities jointly-owned and controlled, emissions were prorated based on the percentage of operational costs contributed to the facility or, for the Ithaca Area Waste Water Treatment Facility (IAWWTF), based on usage.

Table 1: Sector Details for 2019 Inventory

Sectors	2019 Details	Emission Source
Buildings	Town Hall	Natural Gas and Electricity
	Public Works (Office Building, Town Barn, Salt Shed)	
Streetlights and Traffic Signals	10 Lighting Districts	Electricity
	2 School Crossing Lights	
Water Delivery Facilities	Bolton Point Facility (51.9% share)	Natural Gas and Electricity
	4 Pump Stations	
	17 Pump Houses and Tanks	
Wastewater Facilities	Ithaca Area Wastewater Treatment Facility (37.3% share)	Natural Gas, Electricity, and Methane
	15 Pump Houses	
Vehicle Fleet	86 Vehicles and Equipment	Gasoline, Diesel, Nitrous Oxide, and Methane
	13 Bolton Point Vehicles	
Employee Commute	83 Employee Vehicles from Town Hall, Public Works, and Bolton Point	Gasoline and Diesel

Buildings

Building energy usage data was collected from the accounting department of the Town of Ithaca. The data on the spreadsheets provided by the accounting department was subjected to random checks with the Town's New York State Electric and Gas Corporation (NYSEG) Energy Service Company (ESCO) portal. Building emissions were derived from electricity and natural gas usage for each individual building. In total, the Buildings entry for the Town of Ithaca consists of four accounts using natural gas and five accounts using electricity.

[1] You can read more about the LGOP here: https://www.theclimateregistry.org/tools-resources/reporting-protocols/local-goverment-operations-protocol/ and download the EPA's tool here: https://www.epa.gov/statelocalenergy/local-greenhouse-gas-inventory-tool.

Streetlights and Traffic Signals

Streetlight and Traffic Signal energy usage data was collected from the accounting department of the Town of Ithaca. In total, there were 10 different entries under streetlights: nine lighting districts and one category of "streetlights at large" that captured individual lights and traffic signals. Additionally, there were two accounts for school crossing lights included in this sector.

Water Delivery Facilities

Utility information was collected via a spreadsheet from Bolton Point staff for the plant itself and the Town of Ithaca accounting department for the Town's pump stations and pump houses and then compiled for a total in metric tons. The Town of Ithaca is part of the Southern Cayuga Lake Intermunicipal Water Commission, which operates the Bolton Point water treatment plant. The Bolton Point plant is jointly owned by five municipalities in Tompkins County. In 2019, the Town of Ithaca had a 51.9% ownership share of the plant. Because the Town of Ithaca is only partly responsible for the emissions from Bolton Point, this inventory calculated the total emissions from Bolton Point and then prorated that total to account for the Town's ownership share. This is a marked departure from the Town's 2009 GHG inventory report where 100% of Bolton Point's emissions were attributed to the Town of Ithaca.

Bolton Point's emissions are from stationary combustion (natural gas) and electricity. In addition to the water treatment plant, the Town has four pump stations and 17 pump houses and tanks to deliver water to residents. Total energy usage was adjusted to reflect the Town's ownership share of 51.9% of Bolton Point to arrive at greenhouse gas emissions from Water Delivery Facilities.

Wastewater Facilities

Utility information was collected for the Ithaca Area Wastewater Treatment Facility (IAWWTF) and the pump houses via the Town of Ithaca accounting department and compiled together for emissions in metric tons. Like Bolton Point, the IAWWTF is a shared resource that provides wastewater treatment services to three municipalities, including the Town of Ithaca. IAWWTF is jointly owned by these three municipalities, and the Town of Ithaca usage share in 2019 was 37.3%. Therefore, this inventory accounts for the Town's 37.3% share of IAWWTF emissions. In addition to the IAWWTF itself, the Town owns and operates 15 pump houses for wastewater services. This inventory accounts for 100% of emissions from these Town-owned pump houses.

Emissions from the IAWWTF come from stationary combustion (natural gas), electricity, and process emissions from the facility's activities. Process emissions include methane emissions from the incomplete combustion of digester gas, methane emissions from anaerobic and facultative waste water treatment lagoons, and nitrogen oxide emissions associated with nitrification and denitrification.

As stated above, a 37.3% share of emissions from the IAWWTF was combined with emissions from Town-owned pump houses for wastewater services to calculate the final energy emissions total for Wastewater Facilities. For process emissions, site-specific data was collected via conversations with IAWWTF managers. The information collected can be found in Appendix C - Ithaca Area Wastewater Treatment Facility Process Emissions. The information was entered into the Local Government Greenhouse Gas Accounting Tool and the total emissions calculated by

that tool were again broken out to account for the Town's 37.3% ownership share of emissions.

Vehicle Fleet

Vehicle data was collected through municipal gas consumption logs, fuel deliveries, and annual vehicle tracking lists for both the Town of Ithaca's fleet and the Bolton Point fleet. The Town of Ithaca 2019 fleet consists of 86 vehicles and associated equipment. Bolton Point's 2019 fleet accounts for 13 vehicles. The Town of Ithaca has an ownership share of 51.9% of Bolton Point, thus vehicle emissions from its fleet were adjusted accordingly.

Separate entries were created for each of the Town's vehicles and pieces of equipment utilizing data fields of vehicle type, model year, fuel consumption, and vehicle miles traveled for emissions calculations. For Bolton Point, a single entry titled "Bolton Point Vehicles" was created using a single vehicle type selection (Light Truck) and a 51.9% share of the gasoline to reflect the Town's ownership share of Bolton Point.

Employee Commute

To better understand commuting patterns and account for emissions derived from employee commuting, a survey was conducted of employees at Town Hall, Public Works, and Bolton Point. The survey of 83 employees across the three sites included questions about mode of commute, distance traveled to work, and vehicle make and model. A copy of the survey is included in Appendix D – Employee Commute Survey Questions and Results. Of the Town's and Bolton Point's 83 employees, a total of 57 employees responded to the survey for a 69% survey response rate.

Responses were broken down by work location: Bolton Point, Public Works, and Town Hall. Each response was synthesized to reflect modes of transportation, days per week using each mode of transportation, miles traveled for commute, vehicle utilized, average vehicle mileage, and fuel source for primary commute. Each survey entry was then adjusted to account for total vehicle miles traveled (VMT) for each vehicle mode of transportation.[2] Utilizing VMT and fuel type, the data was then entered into a tool in development by New York's Department of Environmental Conservation for its Climate Smart Communities program, which allowed for a more detailed calculation of employee commute emissions for the survey entries.

For each work location, an "average emissions" per employee was calculated. The average emissions of each work location were then multiplied by the respective number of employees that did not respond to the survey. This allowed the inventory to extrapolate survey responses to cover the Town's entire employee base and not just survey respondents.

This methodology was a departure from the method and calculations utilized by the EPA's Local Government Greenhouse Gas Accounting Tool. It was decided to deviate from the Tool's methodology in hopes of creating a more accurate and granular representation of the Town's employee commute emissions. The emissions for employee commute calculated by the Local Government Greenhouse Gas Accounting Tool were calculated as a comparison for

[2] An assumption of 48 working weeks was utilized for two reasons. First, to match the 2009 inventory to allow for better comparison, and, second, to reflect the Town's two-week annual vacation policy and the two weeks of federal/state holidays each employee receives per year.

quality control and can be found in Appendix E – EPA GHG Inventory Tool Employee Commute Calculation Results.

Urban Forestry

The Town land use cover dataset was provided by the Town of Ithaca Planning Department and used to calculate areas with tree cover on Town-managed property. Land use forest categories of deciduous, coniferous, forest plantation, and mixed forest were included in the tree cover calculations. There were 153 acres of forest on Town-managed land in 2017 and 183 acres of forest on Town-managed land in 2019. Final carbon sequestration calculations were completed using the EPA's Local Government GHG Accounting Tool.

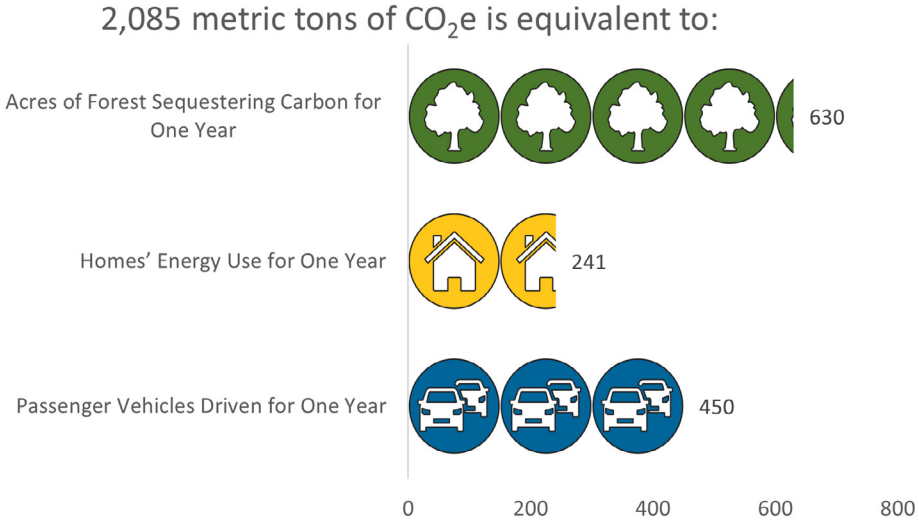
RESULTS

Between mid-2020 and early 2021, the Town of Ithaca, with generous guidance and assistance from Cornell Cooperative Extension of Tompkins County and the Susan Christopherson Center for Community Planning, completed an inventory to measure greenhouse gas emissions from government operations for the year 2019. This inventory is an update to the Town's greenhouse gas emissions inventory for 2009. The following section provides the findings of the 2019 emissions inventory by sector and source. In 2019, the Town of Ithaca emitted approximately 2,085 metric tons of CO_2e (carbon dioxide equivalent). The gross emissions are partially offset by 603 metric tons of CO_2e due to forest land cover within the Town. Net emissions in the year 2019 equal 1,482 metric tons of CO_2e. The Town met its goal of a 30% reduction in GHG emissions from 2009 levels by 2020.

Table 2: Gross GHG Emissions vs. Net GHG Emissions

	Metric Tons of CO_2e
Gross Emissions	2,085
Urban Forestry Carbon Sequestration	-603[1]
Net Emissions	**1,482**

[1] Urban forestry sequesters carbon, represented here as negative emissions.



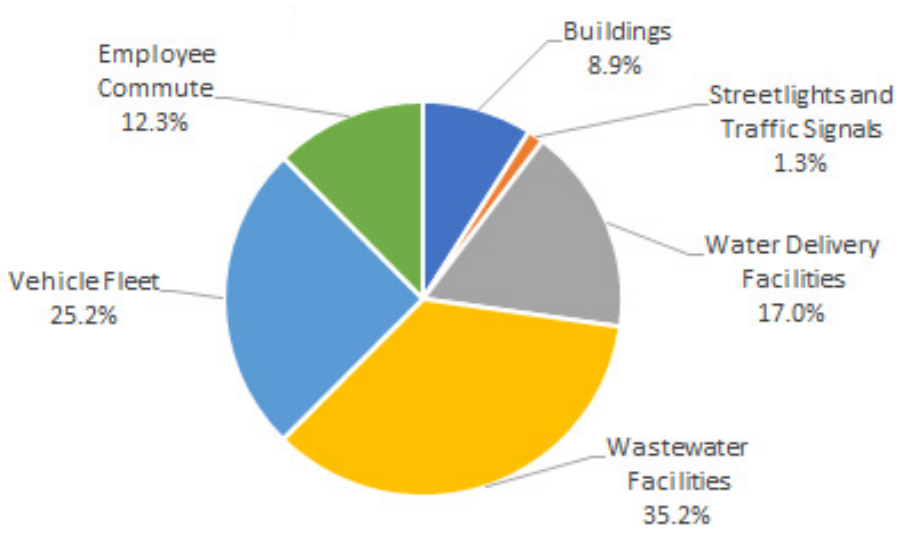


Figure 1: Percent of Gross GHG Emissions by Sector

Table 3: GHG Emissions by Sector (gross emissions)

Sectors	Percent of Total	Metric Tons of CO_2e	Energy (MMBtu)	Cost ($)
Buildings	8.90%	186	3,845	52,739.13
Streetlights and Traffic Signals	1.30%	28	814	48,313.85
Water Delivery Facilities	17.00%	354	10,029	210,589.07
Wastewater Facilities	35.20%	734	75,481[1]	69,340.67
Vehicle Fleet	25.20%	526	7,286	113,286.52
Employee Commute	12.30%	257	2,133	46,924.63[2]
Gross Total	**100%**	**2,085**	**31,655**	**541,193.87**

[1] Energy from Wastewater Facilities includes only natural gas and electricity, and does not include process emissions from the IAWWTF.

[2] Cost of Employee Commute calculated using New York State Energy Research & Development Authority (NYSERDA) monthly average motor gasoline prices for 2019.

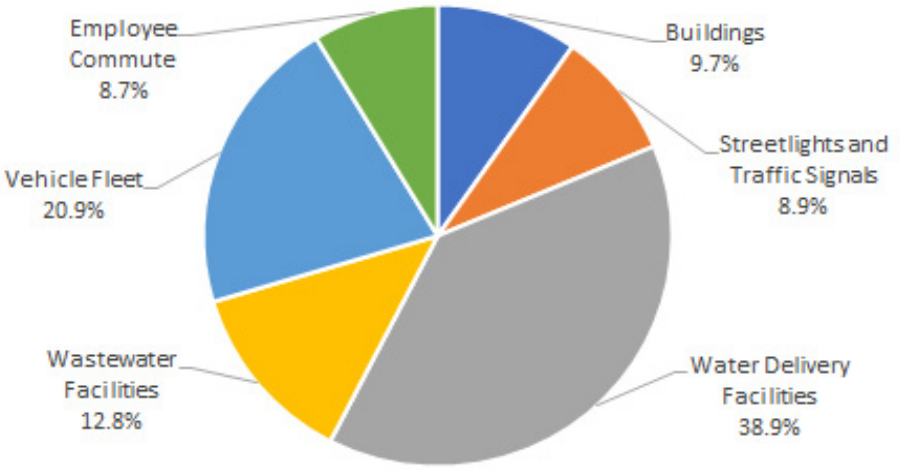


Figure 2: Percentage of Total Cost by Sector

Buildings

The Town of Ithaca's buildings (see Table 3) were responsible for 8.9% of overall emissions. Emissions totaled 186 metric tons of CO_2e and the buildings used 3,845 MMBtu of energy. This 3,845 MMBtu of energy used can be broken down into 2,928 MMBtu from natural gas and 268,806 kwh from electricity.

Streetlights and Traffic Signals

The Town of Ithaca's streetlights and traffic signals (see Table 3) were responsible for 1.3% of overall emissions, emitting 28 metric tons of CO_2e. Streetlights and traffic signals in the Town also used 814 MMBtu of energy, which equates to 238,511 kwh of electricity.

Water Delivery Facilities

Emissions from water delivery facilities (see Table 3) were 354 metric tons of CO_2e, making up 17% of the Town's total emissions. Water delivery facilities also used 10,029 MMBtu of energy, made up of 806 MMBtu of natural gas and 2,703,161 kwh of electricity.

Wastewater Facilities

Emissions from wastewater facilities (see Table 3) were 35.2% of total emissions, equating to 734 metric tons of CO_2e. Wastewater facilities also used 7,548 MMBtu of energy consisting of 4,887 MMBtu of natural gas and 779,864 kwh of electricity. Process emissions consist of methane and nitrous oxide released during the wastewater treatment process. Emissions from the wastewater treatment process total 385 metric tons of CO_2e while emissions from electricity and natural gas equate to 349 metric tons of CO_2e.

Vehicle Fleet

Emissions from the Town and Bolton Point fleets (see Table 3) account for 25.2% of the Town's total emissions which are 526 metric tons of CO_2e and 7,286 MMBtus of energy. The Vehicle Fleet used 31,683 gallons of gasoline and 24,079 gallons of diesel fuel.

Employee Commute

Emissions from employee commutes (see Table 3) were 12.3% of total Town emissions. This equates to 257 metric tons of CO_2e and 2,222 MMBtu of energy usage.

Table 4: GHG Emissions by Source (gross emissions)

Source	Percent of Total	Metric Tons of CO_2e
Diesel	12.70%	265
Electricity	22.10%	460
Gasoline	24.70%	516
Methane	16.40%	341
Natural Gas	21.90%	457
Nitrous Oxide	2.20%	46
Total	**100%**	**2,085**

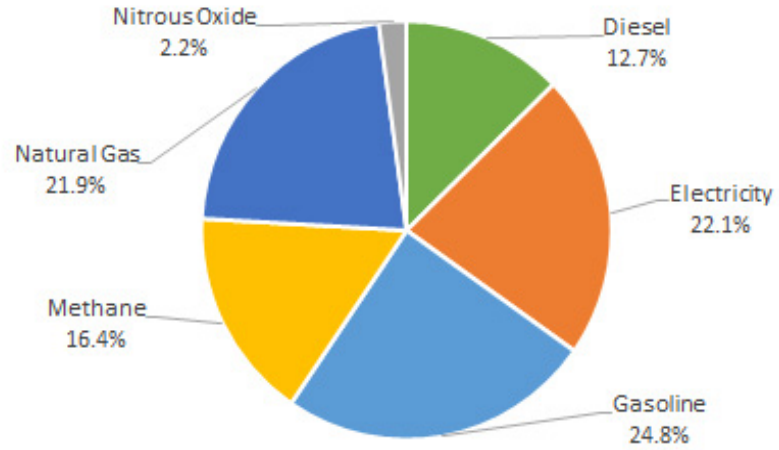


Figure 3: Percent of Gross GHG Emissions by Source

Looking at emissions by source, gasoline is the biggest driver of Town carbon emissions at 24.8%. This is closely followed by emissions from the electricity grid, at 22.1%, and natural gas, at 21.9%. Altogether these three sources make up 1,433 metric tons of CO_2e and almost 70% of the Town's emissions. Other sources include methane that is mostly derived from process

emissions at the Ithaca Area Wastewater Treatment Facility at 16.4% of the Town's emissions, diesel used by the vehicle fleet, at 12.7%, and nitrous oxide mostly derived from tailpipe emissions at 2.2%.

COMPARISON OF 2009, 2017, & 2019

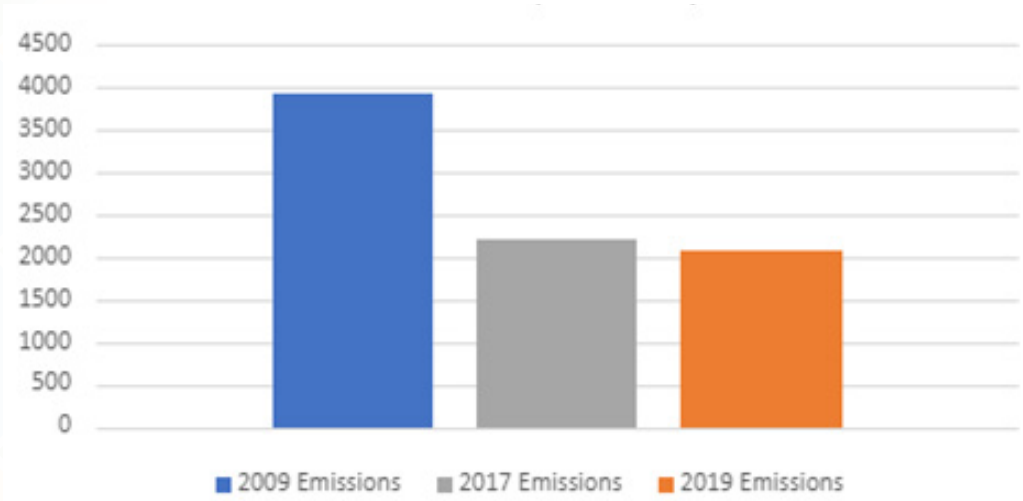


Figure 4: Comparison of 2009, 2017, and 2019 Gross Total Emissions ($MTCO_2e$)

Gross total emissions from the Town of Ithaca decreased from 2009 to 2019. Including emissions from 2017 provides an extra check that emissions from the Town of Ithaca are decreasing. Gross emissions decreased from 3,928 $MTCO_2e$ in 2009 to 2,225 $MTCO_2e$ in 2017 to the current level of 2,085 $MTCO_2e$ in 2019 (see Figure 4 and Table 5).

Table 5: Comparison of 2009, 2017, and 2019 Gross Emissions and Energy Use

	2009	2017	2019	Absolute Change 2009-2019	Percent Change 2009-2019
Gross Emissions ($MTCO_2e$)	3,928	2,225	2,085	↓1,843	↓46.9%
Energy Use (MMBtu)	46,548	32,604	31,655	↓14,893	↓32%

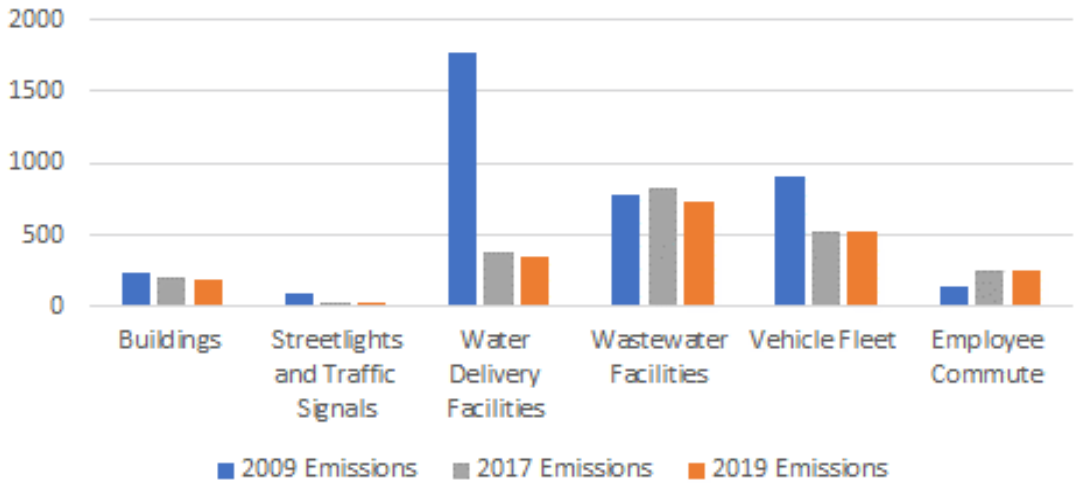


Figure 5: Comparison of 2009, 2017, 2019 Gross Emissions by Sector ($MTCO_2e$)

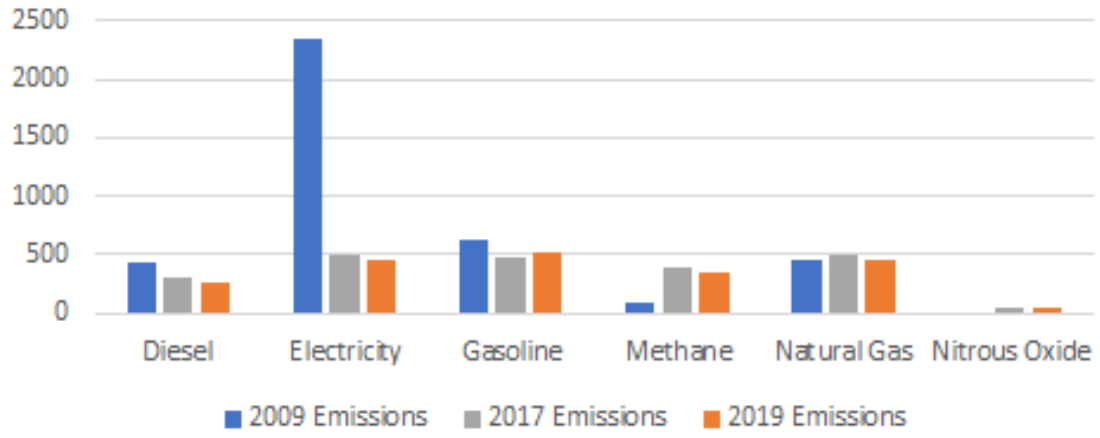


Figure 6: Comparison of 2009, 2017, 2019 Gross Emissions by Source ($MTCO_2e$)

Probable Reasons for Emissions Changes Between 2009 and 2019

Gross emissions for the Town of Ithaca decreased from 3,928 Metric Tons of CO_2 equivalent to 2,085 $MTCO_2e$ from 2009 to 2019. This difference of 1,843 metric tons is equivalent to a 46.9% decrease in greenhouse gas emissions from government operations. Some probable reasons for the decrease in emissions include:

Increased Share of Renewables on the Upstate New York Electric Grid

The 2009 Upstate New York Electric Grid was comprised of 36.3% combustion-based generators and 63.7% non-combustion-based generators. In contrast, the 2019 Upstate New York Electric Grid was comprised of 29.2% combustion-based generators and 70.8% non-combustion-based generators.[3] Furthermore, in 2009 coal and oil made up 15.4% of the grid's resource mix, while in 2019 that percentage had fallen to 1.4%. The vast majority of that usage had been converted to natural gas, increasing from 18.9% in 2009 to 25.9% in 2019. Natural gas, while still a fossil fuel, emits fewer greenhouse gas emissions during electricity generation than coal and oil.[4] These changes resulted in a 2019 grid that produced less greenhouse gas emissions than the 2009 grid for the same amount of electricity used. Graphs showing changes in the Upstate NY Electric Grid mix can be found in Appendix I – Additional Graphs and Charts.

This "greening" of the electricity grid meant that major users of electricity, including the Town's Water Delivery Facilities, Streetlights and Traffic Signals, and Buildings, saw decreased emissions from their electricity usage beyond what would be expected from simple efficiency improvements between 2009 and 2019. As an example, in 2009 Streetlights and Traffic Signals used 254,176 kWh and emitted 92 $MTCO_2e$. In 2019, this sector used 238,511 kWh, a decrease of 6.2% in electricity usage. However, emissions for 2019 were only 28 $MTCO_2e$ – a decrease of almost 70%.
It's clear that one of the major probable causes for the decrease in GHG emissions for the Town's

[3] These numbers are based on figures from the EPA eGrid data tables published in 2009 for the 2009 inventory year and 2018, representing the 2019 inventory. Combustion-based generation is primarily derived from fossil fuels, including coal, natural gas and oil. Non-combustion includes hydropower, nuclear and other renewables like solar and wind.

[4] This changes dramatically when accounting for the lifecycle emissions of natural gas, as discussed in our Advanced Methane Accounting Method (AMAM) below.

operations comes in large part from the closing of coal power plants coupled with the growth of renewable generators in the Upstate New York Electric Grid from 2009 to 2019.

Changes in Town Operations

Differences in results between the 2009 GHG Inventory and 2019 GHG Inventory can partially be attributed to changes in Town operations. Significant changes include the percentage of the IAWWTF used by the Town of Ithaca, the fleet size, and workforce size. In 2009, the Town accounted for 42% of emissions from the IAWWTF, while in 2019 it accounted for 37% of emissions from the IAWWTF due to changes in usage. This operational change is reflected in the number of gallons treated (see Table 9), which nearly equates to the difference in emissions from 2009 to 2019.

The fleet size increased from 73 vehicles and pieces of equipment in 2009 to 86 vehicles and pieces of equipment in 2019. Although methodology changes produced a counterintuitive decrease in emissions, the increase in fleet size is reflected by the increase in gasoline and diesel gallons of fuel consumed from 2009 to 2019. There is no specific indicator in the comparison tables reflecting the increase in workforce due to methodology questions, but it should be noted the workforce increased from 72 employees across Town Hall, Public Works, and Bolton Point in 2009 to 83 employees across these three locations in 2019.

Sustainability Efforts Since 2010

Since 2010, the Town's sustainability efforts have included energy improvements to facilities under its full- or partial-control, including Town Hall and the Ithaca Area Wastewater Treatment Facility. For example, some efforts are still in progress, such as the LED streetlight upgrade. Others involve the Ithaca community rather than government operations, such as the adoption of solar energy regulations to facilitate development and operation of solar systems. Finally, some are planning related, such as the inclusion of a chapter on energy and climate protection in the 2014 Comprehensive Plan, and so do not result in direct emissions reductions.

Another sustainability initiative is the Town's purchase of renewable energy certificates (RECs) to offset emissions from electricity use in select years; however, no RECs were purchased in 2017 or 2019, the years inventoried in this report. Nonetheless, the Town's current electricity contract, which started in late 2019, includes bundled RECs, meaning that emissions will decrease significantly starting in 2020.

Changes in GHG Inventory Methodology

Greenhouse gas inventories are largely comprised of estimations. While exact figures can be captured for the gallons of gas Town vehicles used, or the amount of electricity street lights used, some data points are harder to measure. A good example of this is the employee commute. There is no way to quantify exactly how many gallons of gas and diesel, or electrons to power EVs, were used by employees as they drove to their Town jobs. However, it is still important to acknowledge that emissions from employee commutes occur and that a figure is ascribed to that sector so that comparisons from previous, and to future, inventories can be made.

In 2019, the Town worked with CCE-Tompkins to use a methodology for calculating employee commute emissions that differs from that used in 2009. We believe that this new method yields

a more accurate figure because it uses more individual data than the 2009 method and avoids the generalizations of the EPA Local Government Greenhouse Gas Accounting Tool that was used. Results utilizing other methods for both the 2009 and 2019 inventories can be found in Appendix F – 2009/2019 Commuter GHG Emissions Summary Chart by Methodology. We believe this new methodology, while providing more accurate results, has led to an increase in emissions from employee commutes.

Finally, a major difference between the 2009 and 2019 inventories is within the accounting method utilized for calculating emissions from Bolton Point. The 2009 inventory attributed 100% of the emissions from Bolton Point to the Town of Ithaca. This inventory attributes only 51.87% of Bolton Point emissions to the Town of Ithaca, which is equivalent to the Town's ownership share of the plant. Emissions from water delivery facilities decreased significantly as a result of this methodological change.

Buildings

Table 6: Comparison of GHG Emissions in Buildings, 2009 vs. 2019

	2009	2019	Nominal Change 2009-2019	Percent Change 2009-2019
Emissions ($MTCO_2E$)	229	186	↓43	↓18.8%
Electricity Use (kwh)	278,276	268,806	↓9,470	↓3.4%
Natural Gas Use (MMBtu)	2,183	2,928	↑745	↑34.1%
Total Energy Use (MMBtu)	**3,133**	**3,845**	**↑712**	**↑22.7%**

Buildings in the Town of Ithaca used 712 MMBtu more energy in 2019 than in 2009. There is not a clear explanation for this difference, as the Town accounted for the same buildings in the 2009 inventory as the 2019 inventory. Emissions from buildings decreased by 43 $MTCO_2e$ from 2009 to 2019. These emissions from buildings come solely from natural gas and electricity, and the grid providing these energy sources has become more efficient and uses an increased percentage of renewable energy. This may explain the discrepancy between increased energy usage and decreased emissions.

Streetlights and Traffic Signals

Table 7: Comparison of GHG Emissions in Streetlights and Traffic Signals, 2009 vs. 2019

	2009	2019	Nominal Change 2009-2019	Percent Change 2009-2019
Emissions ($MTCO_2E$)	92	28	↓65	↓69.6%
Electricity Use (kwh)	254,176	238,511	↓15,665	↓6.2%
Total Energy Use (MMBtu)	**867**	**814**	**↓53**	**↓6.1%**

Streetlights and traffic signals in the Town of Ithaca used 15,665 less kwh of energy in 2019 than in 2009. There does not appear to be a particular reason to which this slight decrease can be attributed. As expected, the decrease in energy usage from 2009 to 2019 by streetlights and traffic signals resulted in a decrease in emissions as well. However, the decrease in emissions is much larger than the decrease in energy usage (a 6.1% decrease in energy usage versus a 69.6%

decrease in emissions). Streetlights and traffic signals use only electricity, so this large decrease can again be attributed to the increased mix of renewables in the grid.

Water Delivery Facilities

Table 8: Comparison of GHG Emissions in Water Delivery Facilities[1] , 2009 vs. 2019

	2009	2019	Nominal Change 2009-2019	Percent Change 2009-2019
Emissions ($MTCO_2E$)	1,774	354	↓1,420	↓80%
Gallons of Water Treated (MG)	922	489	↓433	↓47%
Electricity Use (kwh)	4,648,883	2,703,161	↓1,945,722	↓41.9%
Natural Gas Use (MMBtu)	1,433	806	↓627	↓43.8%
Total Energy Use (MMBtu)	**17,300**	**10,029**	**↓7,271**	**↓42%**

[1] Water delivery facilities include only the share of Bolton Point attributed to the Town of Ithaca for 2019 data, which is 51.9%

The decrease in energy usage by water delivery facilities from 2009 to 2019 is significant at 7,271 MMBtu. A large part of the explanation for this is the difference in methodologies used in 2009 and 2019. The Town of Ithaca accounted for 100% of the energy usage and emissions from Bolton Point in 2009, assuming that other municipalities would not incorporate Bolton Point into their potential GHG inventories. To more accurately reflect Bolton Point's energy usage and emissions attributable to the Town of Ithaca, this inventory accounts for 51.9% of energy use and emissions, which is equivalent to the Town's ownership share. This explains the dramatic decrease in energy use seen in the Water Delivery Facilities (Table 8). However, energy use dropped only 42%, which is less than the approximately 49% drop in energy usage expected. This could indicate that Bolton Point is using more energy in 2019 than in 2009 even though the portion of energy and emissions attributed to the Town of Ithaca is less.

Emissions from water delivery facilities decreased 1,420 $MTCO_2e$, or 80%, from 2009 to 2019. A large portion of this decrease can be attributed to the different methodologies, with the additional decrease possibly explained by the increased share of renewables in the grid, as water delivery facilities used only energy from natural gas and electricity.

Wastewater Facilities

Table 9: Comparison of GHG Emissions in Wastewater Facilities, 2009 vs. 2019

	2009	2019	Nominal Change 2009-2019	Percent Change 2009-2019
Emissions ($MTCO_2E$)	784	734	↓50	↓6.5%
Gallons of Water Treated (MG)	934	866	↓68	↓7.3%
Process Emissions[1] ($MTCO_2E$)	N/A	385	N/A	N/A
Electricity (kwh)	1,263,073	779,864	↓483,209	↓38.3%
Natural Gas (MMBtu)	3,938	4,887	↑949	↑24.1%
Total Energy Use (MMBtu)	**8,249**	**7,548**	**↓701**	**↓8.5%**

[1] Process emissions are methane and nitrous oxide emissions from the wastewater treatment process.

Energy use from electricity decreased by 483,209 kwh while energy use from natural gas increased by 949 MMBtu for a net decrease of 701 MMBtu of energy. While there is no immediate explanation for the reason electricity usage decreased and natural gas usage increased, one possible reason for the slight net decrease is the percent of energy use and emissions attributed to the Town of Ithaca from the IAWWTF. In 2009, the Town of Ithaca usage share of the IAWWTF was 42%, while in 2019 the Town usage share was 37.3%.

Similar to energy usage, emissions from wastewater facilities attributed to the Town of Ithaca decreased slightly from 2009 to 2019, which can be expected due to the small drop in energy usage. The increased share of renewables in the grid does not have as much effect on wastewater facilities emissions, because the majority of these emissions come from the wastewater treatment process in the form of methane and nitrous oxide.

Vehicle Fleet

Table 10: Comparison of GHG Emissions in the Vehicle Fleet, 2009 vs. 2019

	2009	2019	Nominal Change 2009-2019	Percent Change 2009-2019
Emissions[1] ($MTCO_2E$)	915	526	↓389	↓42.5%
Gasoline (gal)	23,624	31,683	↑8,059	↑34.1%
Diesel (gal)	20,316	24,079	↑3,763	↑18.5%
Total Energy Use (MMBtu)	**11,486**	**7,286**	**↓4,200**	**↓36.6%**

[1] Electric vehicle emissions are captured under the buildings sector and not under the vehicle fleet sector.

There are unexplained results relating to the vehicle fleet, whose energy usage comes from gasoline and diesel fuels. Fleet energy usage decreased by 4,200 MMBtu from 2009 to 2019, which equates to a 36.6% reduction. This contrasts with an 8,059-gallon increase in gasoline consumption and a 3,763-gallon increase in diesel consumption from 2009 to 2019. Emissions from the vehicle fleet decreased by 389 $MTCO_2e$ from 2009 to 2019.

The increase in gallons appears to be in direct contradiction with the decrease in energy usage. Similarly, the increase in fleet size and equipment number runs contrary to the decrease in GHG emissions. It's possible both contradictions are a result in differences in methodology between the 2009 and 2019 inventories.

Employee Commute

Table 11: Comparison of GHG Emissions in Employee Commutes, 2009 vs. 2019

	2009	2019	Nominal Change 2009-2019	Percent Change 2009-2019
Emissions ($MTCO_2E$)	134	257	↑123	↑91.8%
Gasoline (gal)	30,665	16,439	↓14,226	↓46.4%
Diesel (gal)	1,429	1,136	↓293	↓20.5%
Total Energy Use (MMBtu)	**5,512**	**2,133**	**↓3,379**	**↓61.3%**

Energy use from employee commutes decreased by 3,379 MMBtu, or 61.3%, from 2009 to 2019. This result is counterintuitive as the total number of employees working for the Town of

Ithaca increased from 2009 to 2019. Although energy use decreased, emissions from employee commutes increased by 123 $MTCO_2e$ from 2009 to 2019. Methodological differences between the 2009 and 2019 inventories appear to be the most likely reason for these counterintuitive results.

Table 12: Town of Ithaca Gross GHG Emissions by Source, 2009 vs. 2019

	2009	**2019**	**Absolute Change 2009-2019**	**Percent Change 2009-2019**
Gross Emissions ($MTCO_2E$)	3,928	2,085	↓1,843	↓46.9%
Diesel ($MTCO_2E$)	422	265	↓157	↓37.2%
Electricity ($MTCO_2E$)	2,342	460	↓1,882	↓80.4%
Gasoline ($MTCO_2E$)	627	516	↓111	↓17.7%
Methane ($MTCO_2E$)	94	341	↑247	↑262.8%
Natural Gas ($MTCO_2E$)	443	457	↑14	↑3.2%
Nitrous Oxide ($MTCO_2E$)	N/A	46	N/A	N/A

RESULTS USING ADVANCED METHANE ACCOUNTING METHODOLOGY

Due to a changing paradigm in how greenhouse gas emissions are accounted for, this section looks at the Town's emissions relating to methane through a new lens. New York's 2019 Climate Leadership and Community Protection Act (CLCPA) requires New York State's Department of Environmental Conservation (DEC) to publish a greenhouse gas inventory that includes "information relating to fugitive and vented emissions from systems associated with the production, processing, transport, distribution, storage, and consumption of fossil fuels, including natural gas." We anticipate that it may become the default standard for New York State GHG inventories and want to ensure this inventory will be useful for comparison with future inventories.

Because the State has not completed the new methodology regarding methane emissions, the Town has decided to follow the protocol established by Tompkins County, with the assistance of Cornell University Professor Dr. Robert Howarth, in its 2016 and 2019 inventories.[5] The resulting methodology, referred to here as the Advanced Methane Accounting Methodology (AMAM), is different than the traditional LGOP methodology in two ways:

1. AMAM involves a new lifecycle method that accounts for methane leakage during production and distribution.
2. AMAM uses the 20-year Global Warming Protocol (GWP)[6] for methane in place of the traditionally used 100-year GWP. The 20-year GWP for methane (86) is significantly higher than the 100-year GWP (28), revealing the outsized, but often obscured, role of methane in global warming.

We follow Tompkins County in utilizing a 3.6% leakage rate suggested by Professor Howarth in order to calculate upstream methane emissions resulting from natural gas extraction, transportation and distribution. For context, a 2019 MIT study found a range of leakage rates ranging from 1.5% to 4.9%.[7] Further information on the methodology used can be found in Appendix G – Advanced Methane Accounting Methodology (AMAM).

Because the 2019 GHG inventory was completed in the middle of the development of a new protocol at global, national and state levels, it includes results from both the traditional LGOP methodology and the new AMAM methodology. The traditional methodology enables a comparison to the previous 2009 Town of Ithaca Greenhouse Gas Inventory while the inclusion of AMAM calculations will enable the Town to compare this inventory to future inventories that use the updated methane accounting.

Emissions from the Town of Ithaca are significantly different using the Advanced Methane Accounting Methodology (AMAM). Using this new methodology, in 2019, the Town of Ithaca emitted approximately 3,944 metric tons of CO_2e (carbon dioxide equivalent). This emissions

[5] The Tompkins County 2019 Greenhouse Gas Inventory uses a different method for calculating upstream lifecycle emissions of methane versus the 2016 inventory. For this inventory, we utilized the 2019 inventory method.

[6] According to the EPA, "Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases." Carbon Dioxide is used as the baseline, with a GWP of 1. Methane, by contrast, is a more potent greenhouse gas - meaning it traps heat in the atmosphere more effectively - and thus has a higher GWP. Using the 20-year GWP, methane is considered 86 times more potent than a similar amount of carbon dioxide.

[7] Magdalena M Klemun and Jessika E Trancik 2019 Environ. Res. Lett. 14 124069 https://iopscience.iop.org/article/10.1088/1748-9326/ab2577/pdf

total is partially offset by 603 metric tons of CO_2e due to forest land cover within the Town. Net emissions in the year 2019 equal 3,341 metric tons of CO_2e.

Table 13: Gross GHG Emissions vs. Net GHG Emissions (both using AMAM)

	Metric Tons of CO_2e
Gross Emissions	3,944
Urban Forestry Carbon Sequestration	- 6031[1]
Net Emissions	**3,341**

[1] Urban forestry sequesters carbon, represented here as negative emissions.

GHG Equivalents

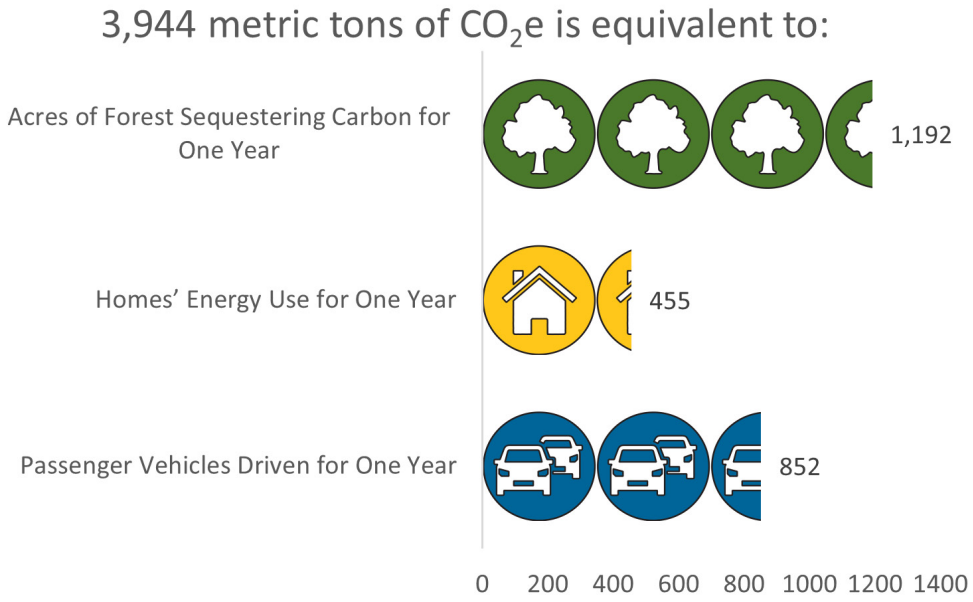


Table 14: GHG Emissions by Sector (gross emissions) using AMAM

Sectors	**Percent of Total[1]**	**Metric Tons of CO_2e**	**Energy (MMBtu)**	**Cost ($)**
Buildings	10.30%	404	3,845	52,739.13
Streetlights and Traffic Signals	1.50%	60	814	48,313.85
Water Delivery Facilities	19.50%	768	10,029	210,589.07
Wastewater Facilities	48.90%	1,928	75,481	69,340.67
Vehicle Fleet	13.40%	527	7,286	113,286.52
Employee Commute	6.50%	257	2,133	46,924.63[2]
Gross Total	**100%**	**3,944**	**31,655**	**541,193.87**

[1] Energy from Wastewater Facilities only includes natural gas and electricity and does not include process emissions from the IAWWTF.

[2] Cost of employee commute calculated using NYSERDA monthly average motor gasoline prices for 2019.

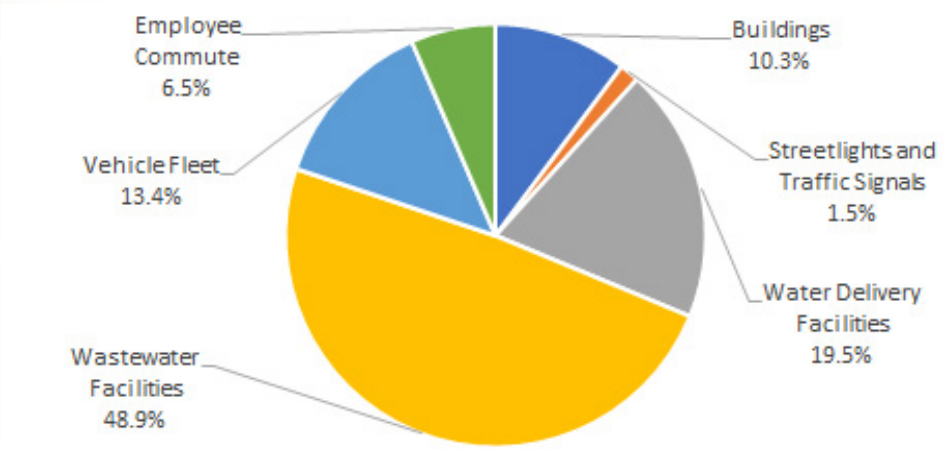


Figure 7: GHG Emissions by Sector (percent of gross emissions) using AMAM

Table 15: Comparison of Gross GHG Emissions by Sector using LGOP and AMAM

Sectors	**Local Government Operations Protocol (LGOP) ($MTCO_2e$)**	**Advanced Methane Accounting Methodology (AMAM) ($MTCO_2e$)**
Buildings	186	404
Streetlights and Traffic Signals	28	60
Water Delivery Facilities	354	768
Wastewater Facilities	734	1,928
Vehicle Fleet	526	527
Employee Commute	257	257
Total	**2,085**	**3,944**

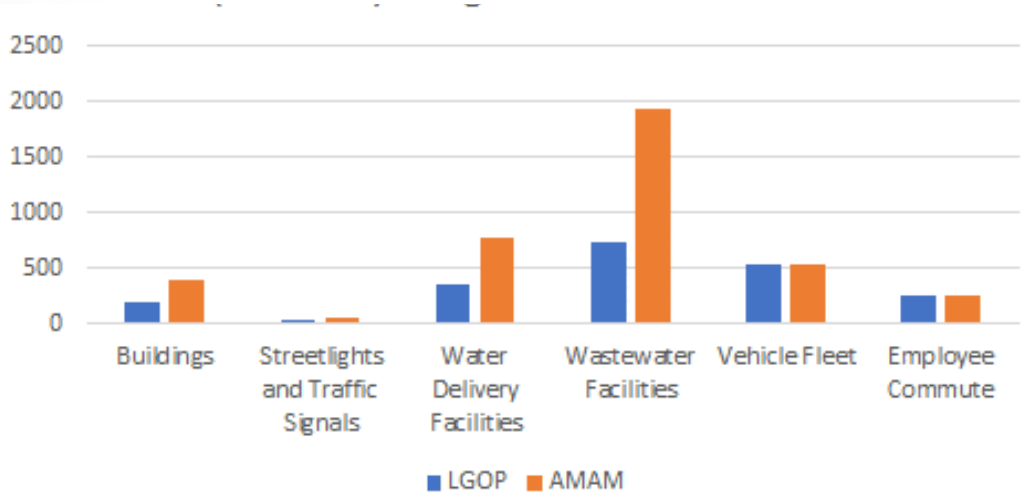


Figure 8: Comparison of 2019 Gross Emissions by Sector ($MTCO_2e$) using LGOP versus AMAM

Buildings

Buildings owned and operated by the Town were responsible for 8.9% of overall emissions using the LGOP methodology, while they were responsible for 10.3% of overall emissions using the AMAM methodology. Emissions totaled 186 metric tons of CO_2e under the LGOP methodology as compared to 404 metric tons of CO_2e using the AMAM methodology. The AMAM methodology resulted in increased emissions from both building electricity and natural gas, leading to a higher overall emissions number.

Streetlights and Traffic Signals

Lighting districts and school crossing lights under the jurisdiction of the Town of Ithaca were responsible for 1.3% of the Town's overall emissions using the LGOP methodology and 1.5% of emissions using the AMAM methodology. While the percentages are similar, Town streetlights and traffic signals emitted 28 metric tons of CO_2e under the LGOP methodology versus 60 metric tons of CO_2e under the AMAM methodology.

Water Delivery Facilities

Emissions from water delivery facilities were 354 metric tons of CO_2e using the LGOP methodology versus 768 metric tons of CO_2e using the AMAM methodology. The LGOP methodology results in water delivery facilities accounting for 17.0% of the Town's total emissions while the AMAM methodology results in water delivery facilities accounting for 19.5% of the Town's total emissions.

Wastewater Facilities

Emissions from wastewater facilities were 35.2% of total emissions using the LGOP methodology as compared to 48.9% of total emissions using the AMAM methodology. This equates to 734 metric tons of CO_2e under the LGOP methodology and 1,928 metric tons of CO_2e under the AMAM methodology. The reason for this significant increase is likely due to the increased global warming potential of methane under the AMAM methodology. Most wastewater treatment process emissions come from methane, resulting in increased emissions using this higher global warming potential number. Furthermore, wastewater facilities also have emissions from natural gas and electricity, both of which have increased due to accounting for methane leakage.

Vehicle Fleet

Emissions from the Town and Bolton Point fleets account for 25.2% of the Town's total emissions under the LGOP methodology versus 13.4% of total emissions under the AMAM methodology. The results in absolute metric tons of CO_2e are similar using both methodologies, with 526 metric tons of CO_2e under the LGOP methodology and 527 metric tons of CO_2e under the AMAM methodology. The decrease in the vehicle fleet's total emissions percentages is due to significant increases in emissions in other sectors using the AMAM methodology.

Employee Commute

From the data collected through the employee commute survey, greenhouse gas emissions from employee commutes were 12.3% of total Town emissions in 2019 using the LGOP

methodology versus 6.5% of total emissions using the AMAM methodology even though there was no change in the absolute value of metric tons of CO_2e at 257. Like the vehicle fleet, the employee commute percentage decreased due to increases in other sectors.

Table 16: GHG Emissions by Source (gross emissions) using AMAM[1]

Source	Percent of Total	Metric Tons of CO_2e
Diesel	6.70%	265
Electricity	25.30%	996
Gasoline	13.10%	516
Methane	29.80%	1,174
Natural Gas	24%	947
Nitrous Oxide	1.20%	46
Total	**100%**	**3,944**

[1] Upstream methane leakage from electricity generation and natural gas production and distribution is included in the electricity and natural gas categories. The methane category includes process emissions from the IAWWTF.

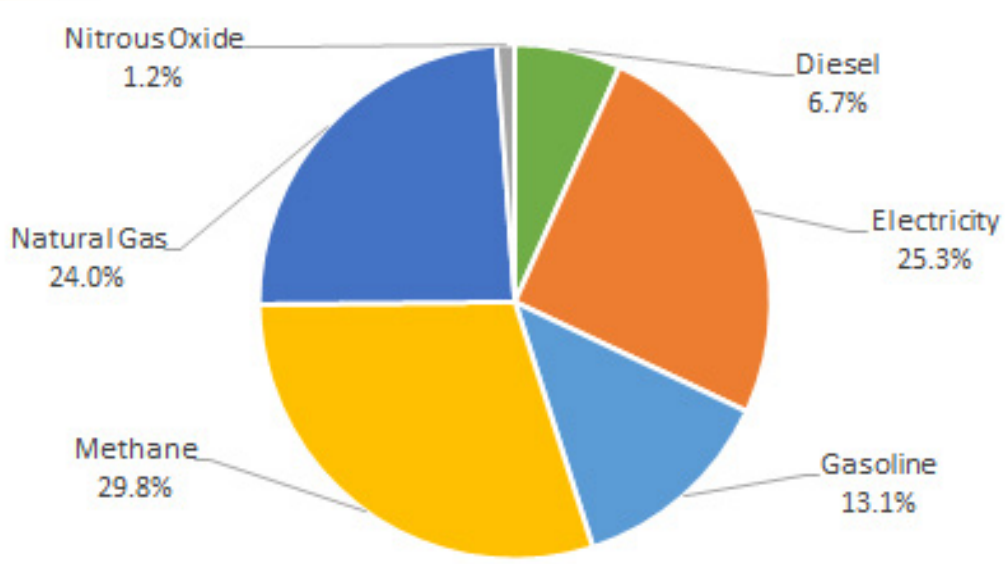


Figure 9: GHG Emissions by Source (percent of gross emissions) using AMAM

The emissions by source under the AMAM are drastically different than those under more traditional methodologies. Now, methane is the biggest source of greenhouse gas emissions, contributing 1,174 tons of CO_2e and almost 30% of the Town's total emissions. This is a direct result of the methodology using the 20-year global warming potential of methane versus the 100-year global warming potential used in the conventional inventory and demonstrates the potency of methane as a greenhouse gas in the short-term.

Electricity and natural gas are once again the second- and third-highest sources of GHG emissions while gasoline is now the fourth-highest greenhouse gas emissions source. While electricity and natural gas remain in their respective spots, both emissions sources have dramatically increased compared to the conventional inventory methodology. Electricity contributes 460 metric tons of CO_2e in the conventional methodology but increases to 996

metric tons CO_2e under the advanced methane accounting methodology. Similarly, natural gas emissions increase from 257 metric tons CO_2e to 947 metric tons CO_2e. This has a dramatic impact on the inventory overall, as previously discussed, but also could point to specific areas of priority when considering future actions.

Finally, because the vehicle fleet is mainly comprised of gasoline and diesel vehicles, the increased impact of methane via AMAM has a minimal impact on both of those sources of emissions as well as on nitrous oxide.

CONCLUSION & NEXT STEPS

This inventory accounts for 2017 and 2019 GHG emissions from all sectors of Town of Ithaca operations. The inventory uses the emerging best practice of accounting for carbon sequestered by trees on Town-managed property. The results of the inventory were calculated in two ways, one following the traditional LGOP methodology and one following the new Advanced Methane Accounting Methodology, which reflects emerging global thinking. The results using the LGOP methodology can be compared to the 2009 GHG inventory results, showing that the Town met its goal of reducing emissions 30% by 2020 from 2009 levels. However, it should be noted that emissions in 2019 are significantly higher using the AMAM methodology versus the LGOP methodology. This is to be expected, and reflects the importance of considering the true contribution of methane to global warming, especially in the short term.

The inventory has identified the sectors of Town operations and the energy sources that contribute the most to Town GHG emissions, highlighting opportunities to meet the GHG emissions reduction goals of the Town's Green New Deal and to reduce energy usage and cost. Results from this inventory should be used to inform the Town's Green New Deal action plan for government operations and other planning processes.

Later in 2021, the Town plans to conduct a similar update to its GHG inventory for the community; the Town's first (and only) community inventory used 2010 data.

Moving forward, the Town should plan to update its GHG inventories more often. Many municipalities provide annual or biennial updates. More frequent updates will allow the Town to better track progress and adjust planning and resource allocation accordingly. Through an iterative process of measurement planning, and action, the Town will be well-poised to meet its ambitious goal of achieving an equitable transition to carbon neutrality by 2030.

APPENDIX

Appendix A- Glossary

AMAM – Advanced Methane Accounting Method

The Advanced Methane Accounting Method is the shorthand assigned to the methodology used in this inventory that accounts for upstream leakage of natural gas and utilizes methane's 20-year global warming potential value versus the more commonly used 100-year value to account for the lifecycle emissions of methane. This method was developed to help examine the outsized impact of methane due to the increasing body of evidence that inventories should use the 20-year global warming potential for greenhouse gases which have a shorter lifespan in the atmosphere than carbon dioxide. This methodology also aligns with that used in the Tompkins County GHG inventory. More information on the parameters used by the advanced methane accounting method can be found in APPENDIX G.

CLCPA – Climate Leadership and Community Protection Act

A New York State legislative act mandating several state goals regarding climate change. These goals include a formal commitment for the state to reach net zero emissions by 2050. The Act also outlines a target of 40% emissions reduction in absolute terms from 1990 levels by 2030 and an 85% reduction from 1990 levels by 2050. Carbon offsets may be used to net zero emissions by 2050. (source: https://www.nrdc.org/experts/miles-farmer/unpacking-new-yorks-big-new-climate-bill-primer-0).

CO_2e – Carbon Dioxide Equivalent

A carbon dioxide equivalent is the unit used to report greenhouse gas emissions or reductions. Greenhouse gases are converted to CO_2e by multiplying emissions by their respective Global Warming Potential (GWP, see below). The CO_2e allows for reporting of overall greenhouse gas emissions in one standardized value and aids in greenhouse gas emission comparisons. Every greenhouse gas -- carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur Hexafluoride (SF6) -- has different physical properties. For convenience and simplicity, it is conventional to express all gas emissions in "equivalent amounts of carbon dioxide," where "equivalent" means "having the same warming effect over a period of 100 years."

IPCC – Intergovernmental Panel on Climate Change

The IPCC is the leading international body for the assessment of climate change. Comprised of a group of scientists from around the world, it was formed in 1988 to provide policymakers with objective information regarding climate change. The IPCC convenes approximately every five or six years to update the science and recommendations.

GWP – Global Warming Potential

Each greenhouse gas has a different potential to trap heat in the atmosphere. The GWP is the measure of the heat trapping ability of a particular gas relative to CO2, typically reported over a 100-year period.

ICLEI – Local Governments for Sustainability

ICLEI is a membership association of local governments committed to advancing climate protection and sustainable development. Since its inception in 1990, ICLEI has grown to include over 1,100 cities in the world, more than 600 of which are in the U.S. ICLEI's mission is to build, serve, and drive a movement of local governments to advance deep reductions in greenhouse gas emissions and achieve tangible improvements in local sustainability.

LGOP – Local Government Operations Protocol

The Local Government Operations Protocol (Protocol) is designed to provide a standardized set of guidelines to assist local governments in quantifying and reporting greenhouse gas emissions associated with their government operations. The LGOP was used for this inventory and the Town's previous inventory.

Metric Ton -

The metric ton is the unit of measurement of emissions for greenhouse gas inventories and carbon offset projects. One metric ton is equal to 1000 kilograms and to 1.102 short tons.

MMBtu - Million British Thermal Units (BTU)

MMBtu is a standard unit of measurement that denotes both the amount of heat energy in fuels and the ability of appliances and air conditioning systems to produce heating or cooling. A BTU is the amount of heat required to increase the temperature of a pint of water (which weighs exactly 16 ounces) by one degree Fahrenheit. A wooden kitchen match produces approximately 1 BTU, and air conditioners for household use typically produce between 5,000 and 15,000 BTU. MMBTU stands for one million BTUs.

Appendix B- Data Sources and Contacts

Buildings and Facilities
Natural gas and electricity consumption for the Town's buildings and facilities is tracked and maintained by the Town of Ithaca Accounting Department. Debby Kelley is the primary contact for this data, as well as for Streetlights and Traffic Signals, and water and sewer pump stations.

Debby Kelley, Bookkeeper to the Supervisor, Town of Ithaca
607-273-1721 x114 dkelley@town.ithaca.ny.us

Streetlights and Traffic Signals
Electricity consumption for all streetlights and traffic signals is maintained by the Town of Ithaca Accounting Department.

Debby Kelley, Bookkeeper to the Supervisor, Town of Ithaca
607-273-1721 x114 dkelley@town.ithaca.ny.us

Water Delivery Facilities
Bolton Point provided natural gas and electricity data for the main facility and the three main pump stations, as well as gallons of water treated. The Town of Ithaca tracks the individual pump stations, which use only electricity. Most of the energy consumption is the electricity used to power the pumps. Natural gas is used for space heating in the main facility.

Debby Kelley, see above for contact (water pump station utility data)

Glenn Ratacjzak, Production Manager, Bolton Point (all other utility data)
607-277-0660 x241 gratajczak@boltonpoint.org

Steve Riddle, General Manager, Bolton Point (Bolton Point operational data)
607-277-0660 x229 sriddle@boltonpoint.org

Donna Shaw, Budget Officer, Town of Ithaca (Bolton Point ownership share data)
607-273-1721 x113 dshaw@town.ithaca.ny.us

Wastewater Treatment Facilities
Ithaca Area Wastewater Treatment Facility (IAWWTF) provided data on natural gas and electricity consumption from the plant, as well as operational characteristics like gallons treated and process emissions data (see Appendix C – Ithaca Area Wastewater Treatment Facilities). The Town of Ithaca maintains the data for the sewer pumps in the Town.

Debby Kelley, see above for contact (sewer pump station data)

Carl (CJ) Kilgore, Chief Operator, IAWWTF (all other utility and operations data)
607-273-8381 CKilgore@cityofithaca.org

Donna Shaw, Budget Officer, Town of Ithaca (IAWWTF ownership share data)
607-273-1721 x113 dshaw@town.ithaca.ny.us

Vehicle Fleet
Laura Pastore provided data on Town vehicle/equipment model year and make, gasoline and diesel fuel consumption, and overall spending on fleet fuel. Gregg Weatherby provided similar information for Bolton Point.

Laura Pastore, Engineering Technician, Town of Ithaca Public Works
607-273-1656 x230 lpastore@town.ithaca.ny.us

Gregg Weatherby, Distribution Manager, Bolton Point
607-277-0660 gregg@boltonpoint.org

Employee Commute
A survey designed by Cornell Cooperative Extension of Tompkins County and the Town of Ithaca was distributed electronically and on paper to employees of the Town of Ithaca, Public Works, and Bolton Point by Nick Goldsmith. The survey response rate was 69%, which was then scaled to 100%.

Nick Goldsmith, Sustainability Planner, Town of Ithaca
607-273-1721 x136 ngoldsmith@town.ithaca.ny.us

Forestry
Mike Smith, Senior Planner, Town of Ithaca
607-273-1721 x123 msmith@town.ithaca.ny.us

Advanced Methane Accounting Methodology
Dr. Robert Howarth, David R. Atkinson Professor of Ecology and Environmental Biology, Cornell University
607-255-6175 howarth@cornell.edu

Appendix C- Ithaca Area Wastewater Treatment Facility Process Emissions

Below is the data entered in the EPA Greenhouse Gas Inventory tool to determine the process emissions for the Ithaca Area Wastewater Treatment Facility (IAWWTF) in 2019. It was based on information collected from conversations with IAWWTF managers.

Wastewater - Entry

Information on population served by various systems.

Population Served by Facilities with Nitrification/Denitrification	45,000	people
Population Served by Anaerobic Treatment Facilities	45,000	people
Population Served by Aerobic Treatment Facilities	45,000	people
Population Served by Septic Systems	-	people

Site-Specific Data Collected

Digester Biogas Produced Daily	110,000	ft3/day
Percentage of CH_4 in Biogas (measured)	68%	
System BOD_5 Input	3,265.9	kg BOD_5 / day
Percentage of BOD_5 Removed in Primary Treatment	95%	
Average Total Nitrogen Discharged (measured)	362.87	kg N/day

Appendix D- Employee Commute Survey Questions and Results

Town of Ithaca 2019 Employee Commute Survey

Town of Ithaca 2019 Employee Commute Survey

Thank you for participating in this survey. The results will be extremely useful as we update the Town's Greenhouse Gas Emissions Inventory for government operations, which will support our goal of reaching carbon neutrality by 2030 and will help us develop a Green New Deal Action Plan for the Town.

If you are able, please complete this survey online at the following link (it was also emailed): https://tinyurl.com/y6n4z7e8.

If you are unable to complete it online, use this hard copy. Submit completed paper surveys by emailing a photo or a scan of all pages to ngoldsmith@town.ithaca.ny.us. You may also submit completed paper surveys in the collection box at your workplace.

Please complete and submit the survey by Friday, August 7th.

This survey is completely anonymous. All information will be aggregated, and we will not collect or report data on any individuals who respond to the survey.

How did you commute in 2019?

In 2019, what was your primary work place?

- ○ Town Hall
- ○ Public Works
- ○ Bolton Point
- ○ I did not work for the Town of Ithaca or Bolton Point in 2019

If you did not work for the Town of Ithaca in 2019, please skip down to the "Additional Questions" Section and answer the questions there.

In 2019, how many days per week did you work at your primary work location (Town Hall, Public Works, Bolton Point)?

- ○ 1 Day
- ○ 2 Days
- ○ 3 Days
- ○ 4 Days
- ○ 5 Days
- ○ 6 Days
- ○ 7 Days

What modes of transportation did you use for your commute in 2019? (Select all that apply)

- ☐ Drive alone
- ☐ Carpool
- ☐ Motorcycle or Scooter
- ☐ Transit Service (Bus)
- ☐ Bike
- ☐ Walk
- ☐ Work from home

In 2019, how many days per week did you commute using each of these modes of transportation? (Select all that apply)

	One Day	Two Days	Three Days	Four Days	Five Days	Six Days	Seven Days
Drive alone	○	○	○	○	○	○	○
Carpool	○	○	○	○	○	○	○
Motorcycle or Scooter	○	○	○	○	○	○	○
Transit Service (Bus)	○	○	○	○	○	○	○
Bike	○	○	○	○	○	○	○
Walk	○	○	○	○	○	○	○
Work from home	○	○	○	○	○	○	○

In 2019, how many miles did you commute (one-way) to your primary work-place? You may use Google Maps to calculate this.

_____

Please answer the following questions if, in 2019, you commuted driving alone, carpooling or riding a motorcycle or scooter. If not, please skip down to the "Additional Questions" Section

What type of vehicle was your primary mode of transportation when commuting to work in 2019?

- ○ Passenger Vehicle (Sedan)
- ○ Sport Utility Vehicle (SUV) or Truck
- ○ Motorcycle or Scooter
- ○ Other _____

In 2019, what was the make, model, and model year of the primary vehicle you commuted with? For example, a 2013 Honda Accord.

_____

In 2019, what fuel type did your primary commuter vehicle use?

- ○ Gasoline
- ○ Diesel
- ○ Electricity - Battery-Electric Vehicle (BEV)
- ○ Gasoline and Electricity - Plug-in Hybrid Electric Vehicle (PHEV)
- ○ Other/Not Sure _____

Answer the following question ONLY if your primary commuter vehicle in 2019 strictly used gas or diesel as a fuel type.

In 2019, what was the estimated miles per gallon (mpg) for your commute?

_____

Answer the following question only if you carpooled to work in 2019

In 2019, when you carpooled, how many other passengers were typically in the vehicle with you?

- ○ 1 other passenger
- ○ 2 other passengers
- ○ 3 other passengers
- ○ 4 other passengers
- ○ 5 other passengers
- ○ 6 other passengers

Additional Questions Section

Did you know Town employees can charge their personal electric vehicle (EV) at Town Hall for free?

- ○ Yes
- ○ No

How likely is it that your next vehicle purchase will be an electric vehicle (EV)?

- ◯ Extremely likely
- ◯ Somewhat likely
- ◯ Neither likely nor unlikely
- ◯ Somewhat unlikely
- ◯ Extremely unlikely

Do you think your commute will change post-Covid-19 or when you return to working at your office/work location? If so, how? (Optional)

____

Please share any additional information, questions, or concerns related to your commute or the Town's sustainability efforts. If you would like a response, please include your name here. (Optional)

____

Your survey is complete. Thank you for your participation!

Email Nick Goldsmith at ngoldsmith@town.ithaca.ny.us with any questions.

Learn more about Town sustainability efforts using the link below:

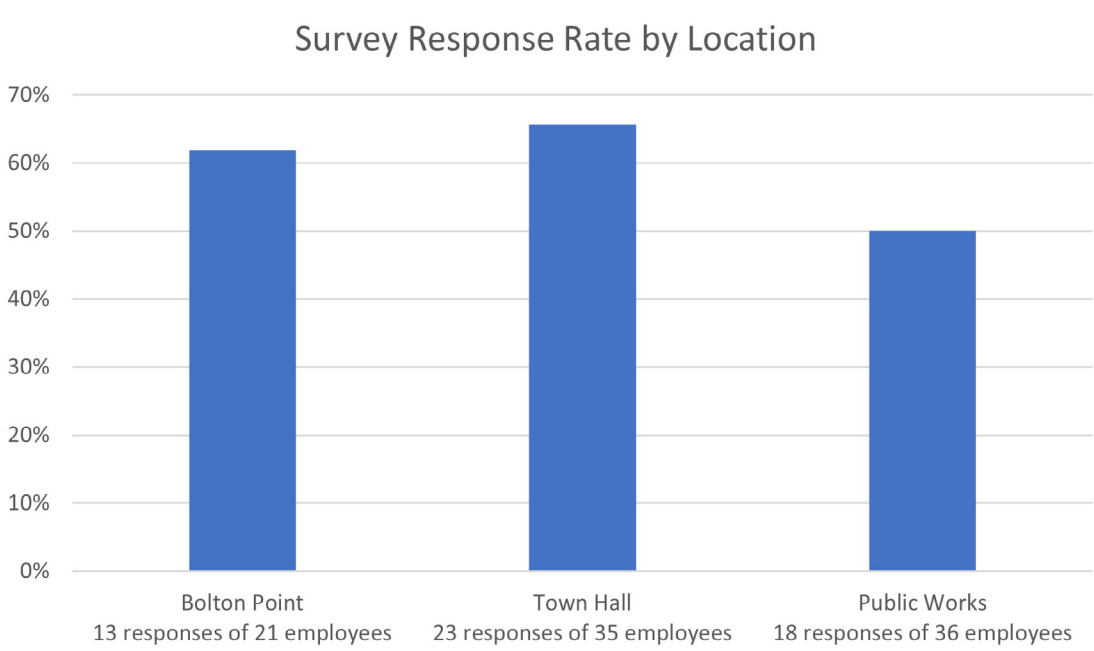
Town of Ithaca Sustainability webpage: http://www.town.ithaca.ny.us/sustainability

Survey Results Summary

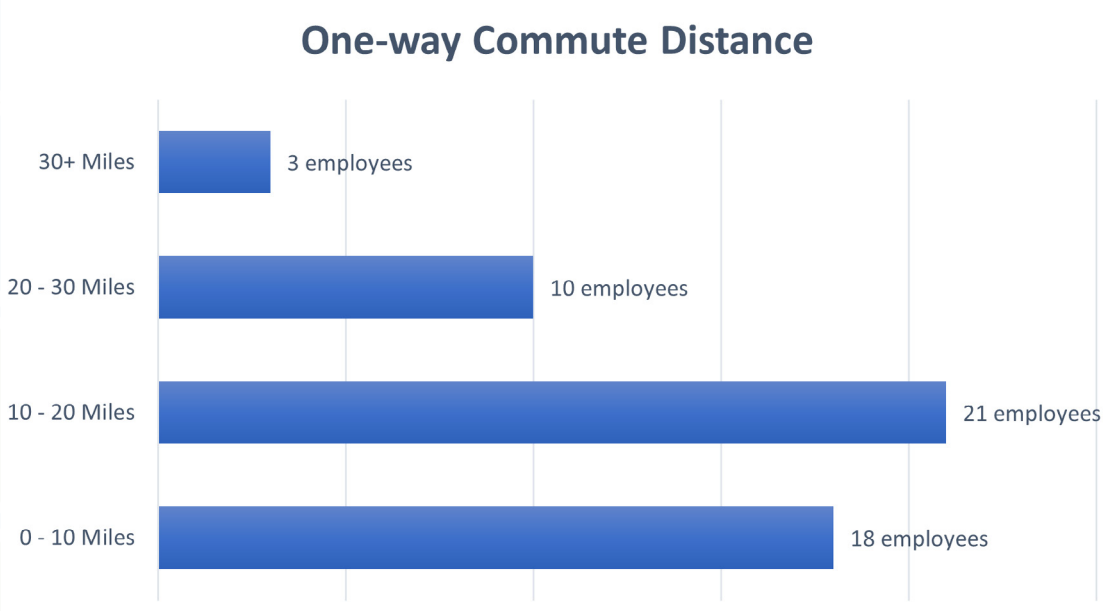
Town of Ithaca Employee Commute Survey Results

In August 2020, The Town of Ithaca conducted an employee commute survey for the year 2019, as part of the Town's greenhouse gas inventory update. Employees at Public Works, Town Hall, and Bolton Point were surveyed. Below are some of the results.

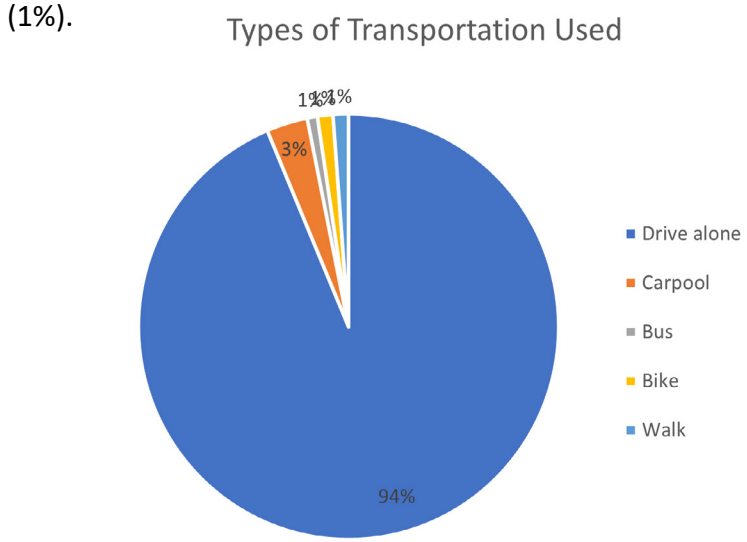
We had an overall response rate of 62%. Thank you to all who participated!



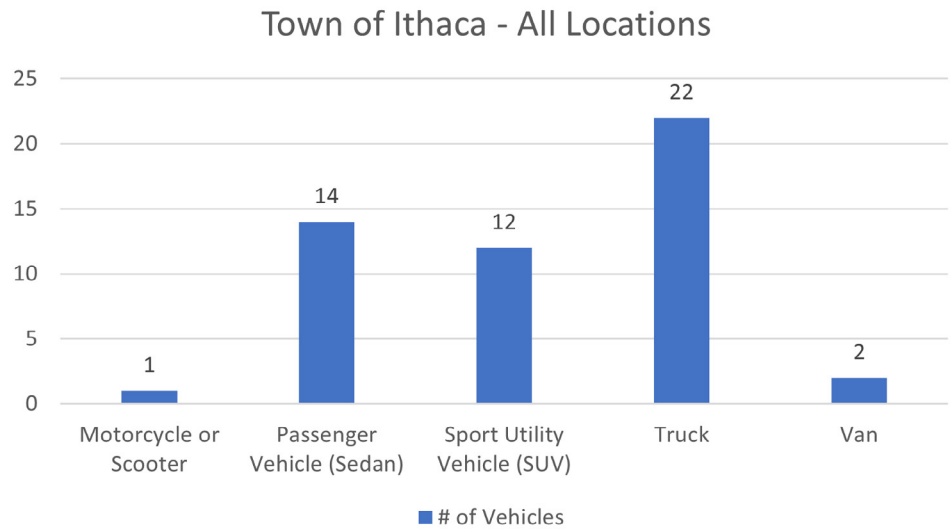
Employee commute distances range from 0.4 miles to 52 miles, with an average of 14 miles.



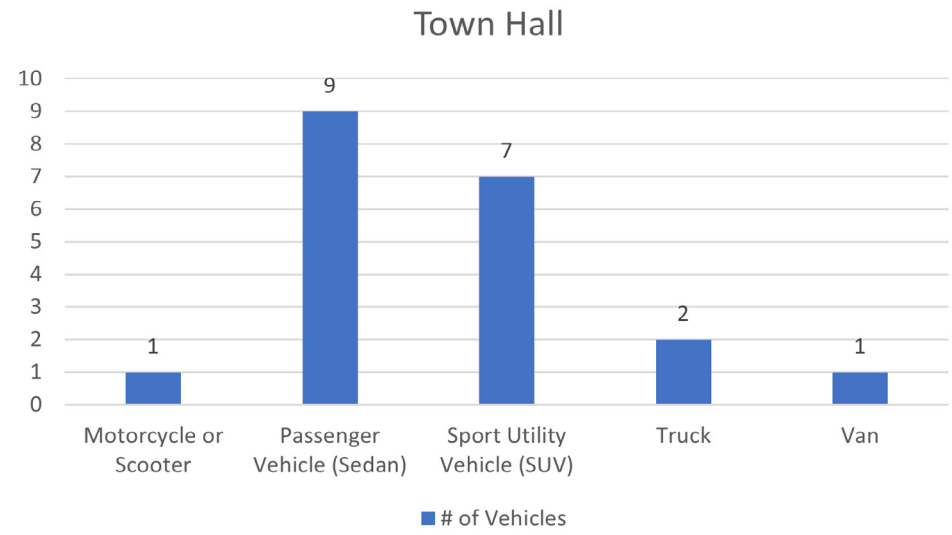
Most employees drive alone to work. Very few employees take the bus (1%), bike (1%), or walk (1%).

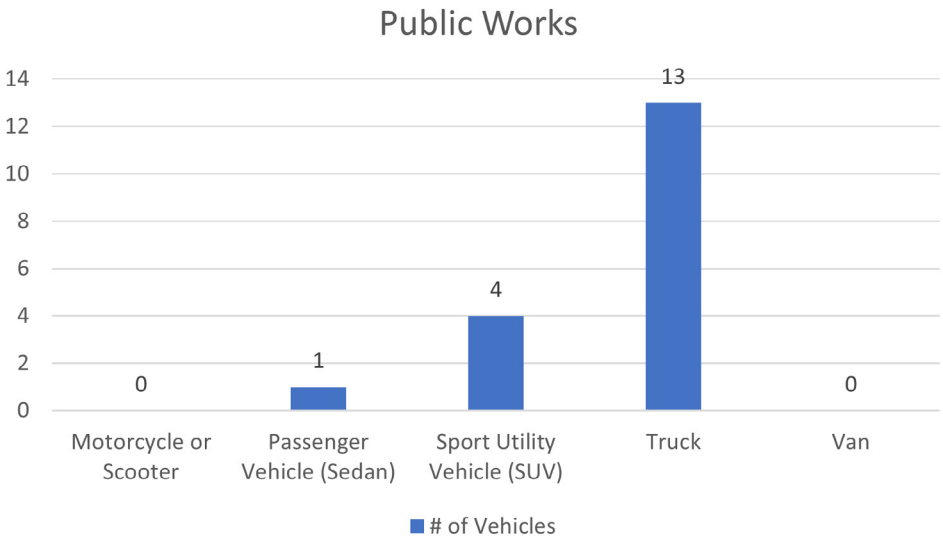


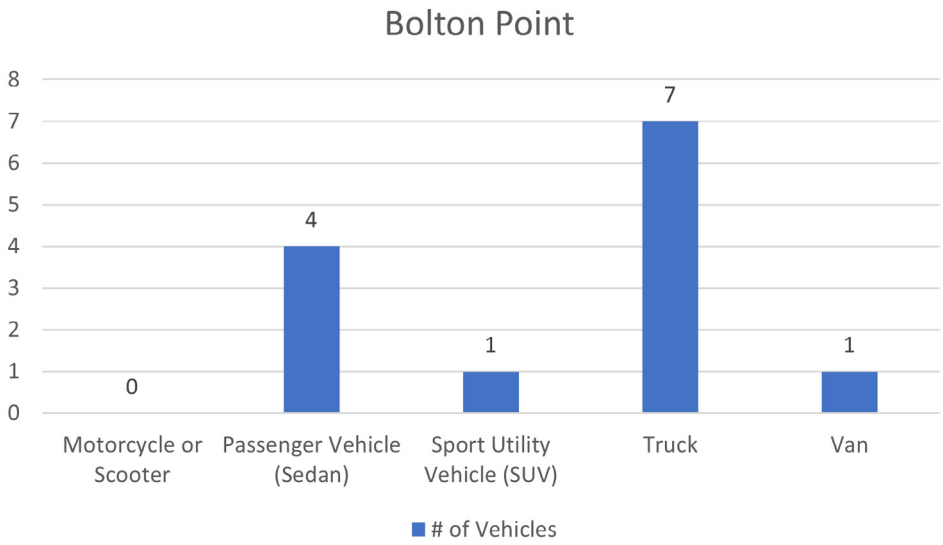
The types of vehicles that employees drive vary significantly by location. The first chart shows all three locations combined. The following charts show the individual locations.



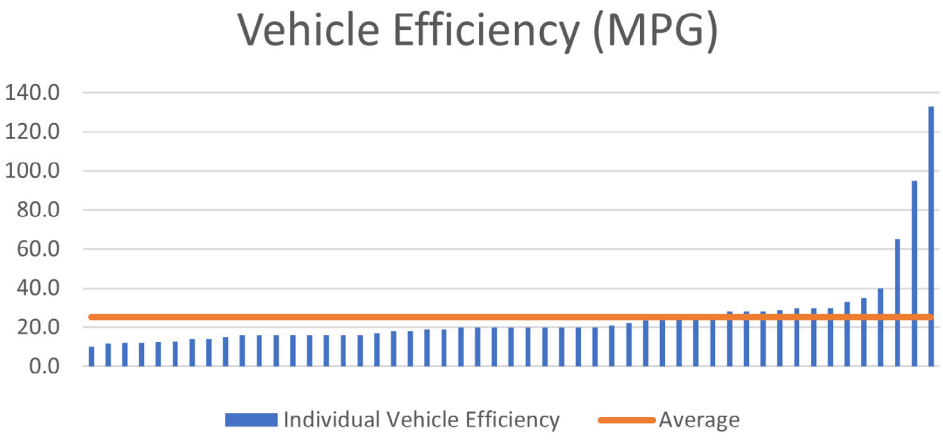
Employee vehicle types by location are shown in the next three charts.



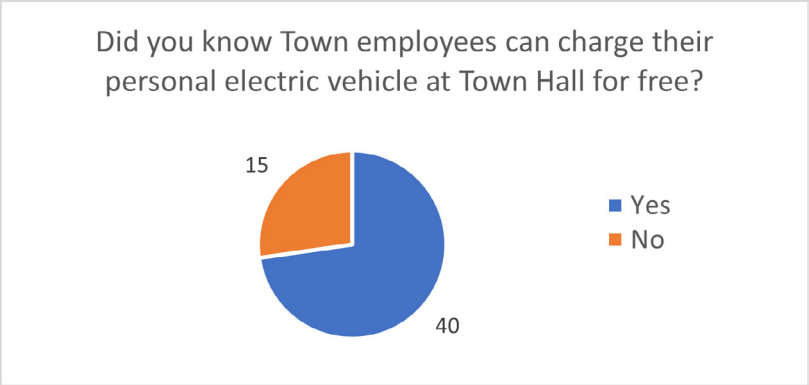




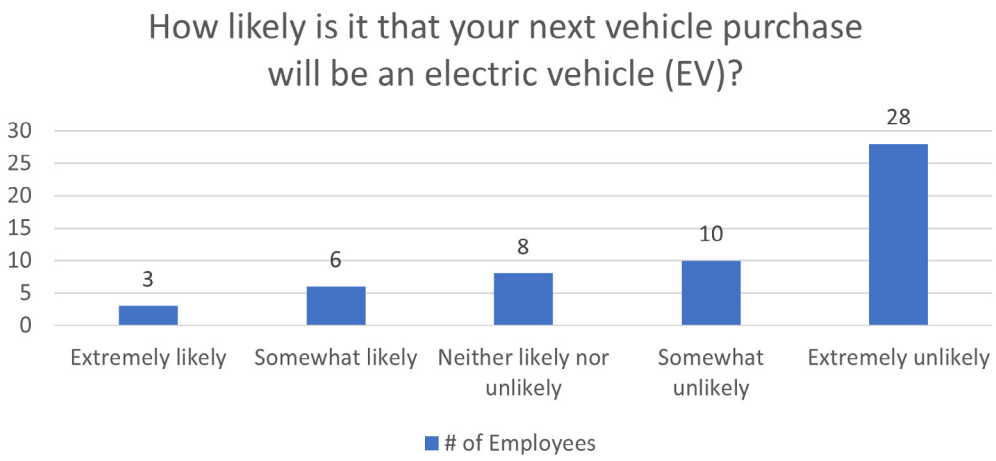
Vehicle efficiency varies widely; each blue line in the chart below shows the efficiency of one employee vehicle. The average efficiency is about 25 miles per gallon, the lowest is 10 MPG, and the highest is 133 MPGe (MPG equivalent, the combined gas and electric efficiency of a plug-in hybrid electric vehicle, or PHEV).



Two questions focused on employee ownership and use of electric vehicles (EV). About three quarters of employees know that free EV charging is available at Town Hall for employee vehicles.



Two employees drive personal EVs, and the Town fleet now includes EVs. However, most employees said it was unlikely that their next vehicle purchase would be an EV. Two reasons are mentioned in the survey comments: the purchase cost and the lack of options for trucks, which are popular among Town employees.

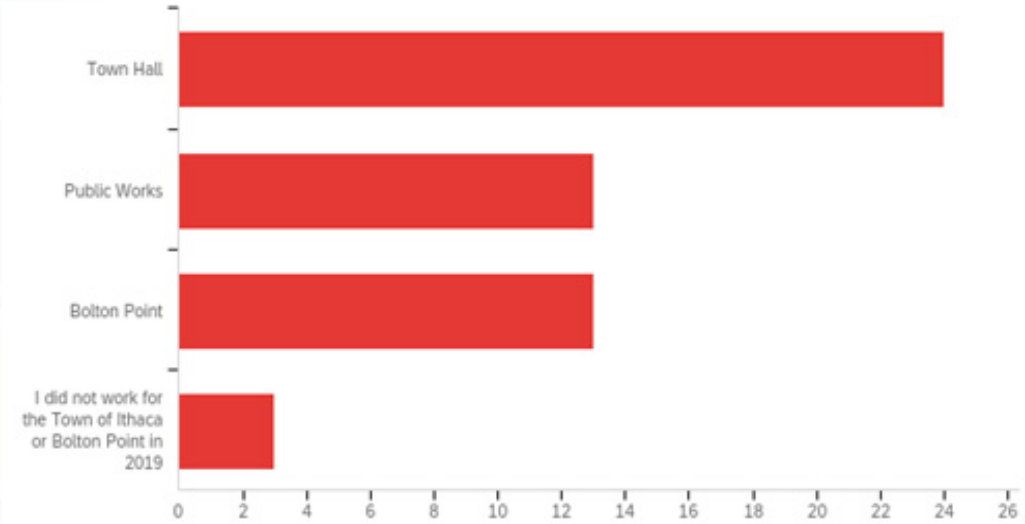


Thanks for reading! Contact Sustainability Planner Nick Goldsmith with questions or comments.

Survey Results

Town of Ithaca 2019 Employee Commute Survey

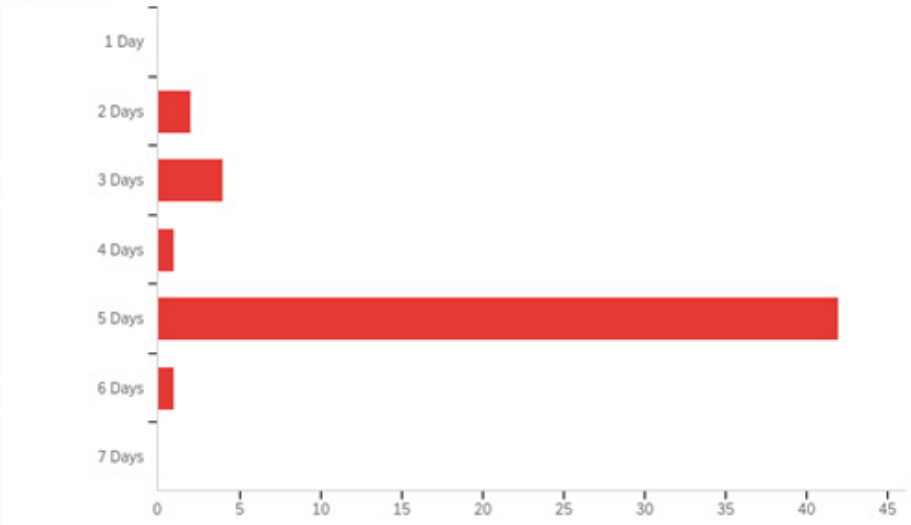
Q17 - In 2019, what was your primary work place?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	In 2019, what was your primary work place?	1.00	4.00	1.91	0.96	0.92	53

#	Answer	%	Count
1	Town Hall	45.28%	24
2	Public Works	24.53%	13
3	Bolton Point	24.53%	13
4	I did not work for the Town of Ithaca or Bolton Point in 2019	5.66%	3
	Total	100%	53

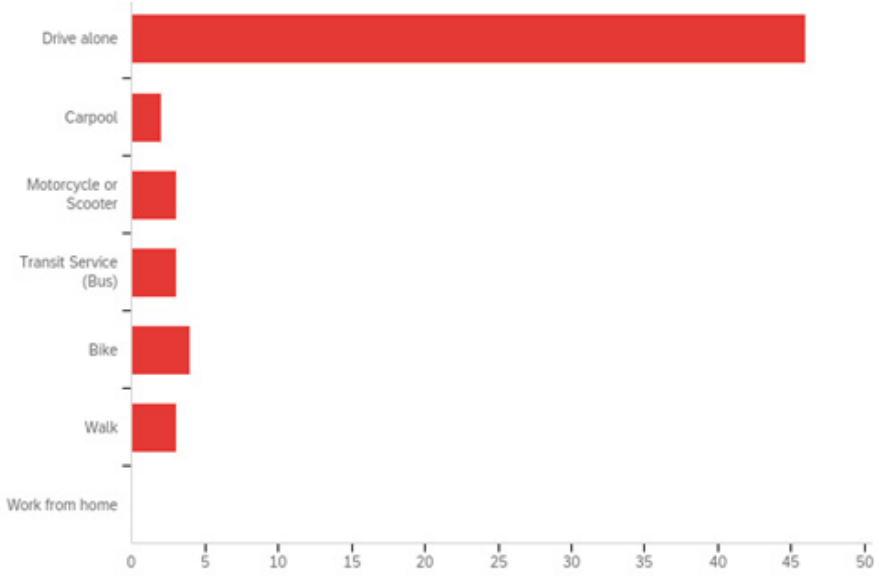
Q1 - In 2019, how many days per week did you work at your primary work location (Town Hall, Public Works, Bolton Point)?



#	Field	Mini-mum	Maxi-mum	Mean	Std Deviation	Variance	Count
1	In 2019, how many days per week did you work at your primary work location (Town Hall, Public Works, Bolton Point)?	2.00	6.00	4.72	0.80	0.64	50

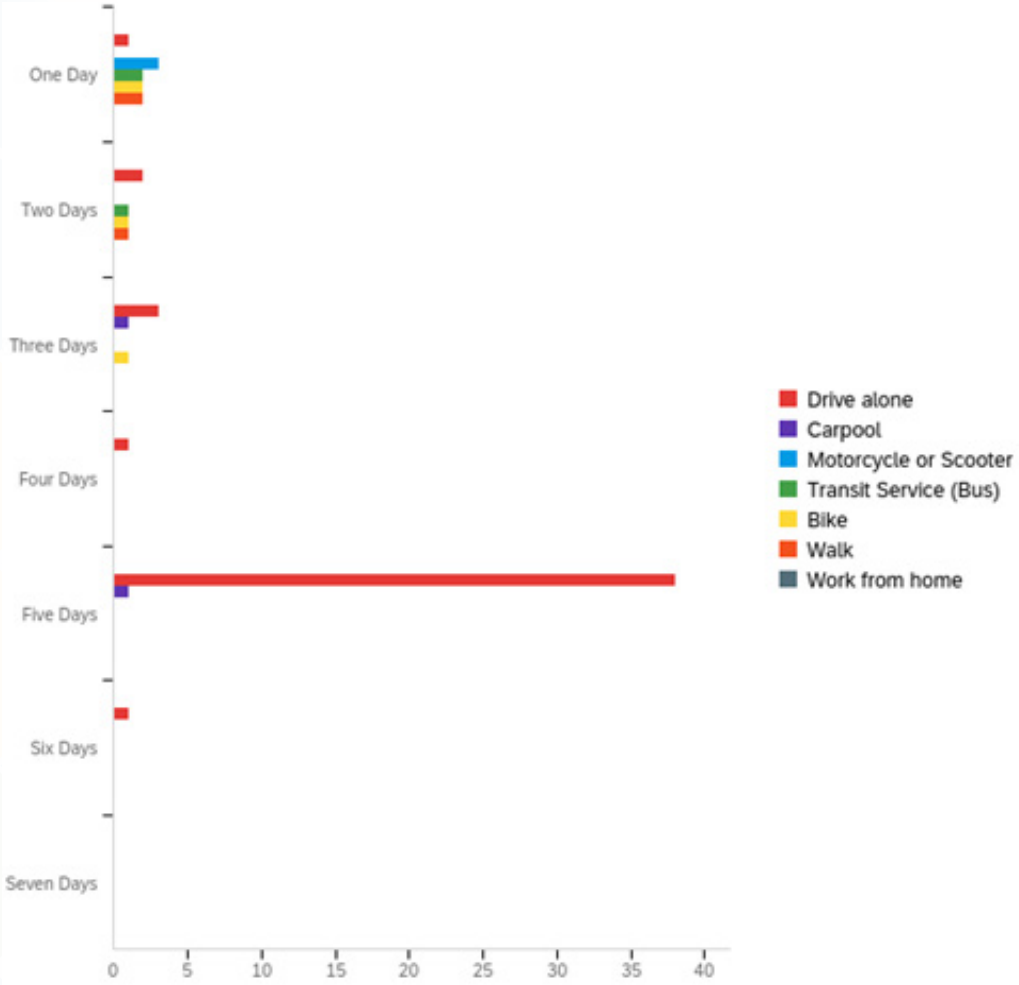
#	Answer	%	Count
1	1 Day	0.00%	0
2	2 Days	4.00%	2
3	3 Days	8.00%	4
4	4 Days	2.00%	1
5	5 Days	84.00%	42
6	6 Days	2.00%	1
7	7 Days	0.00%	0
	Total	100%	50

Q2 - What modes of transportation did you use for your commute in 2019?



#	Answer	%	Count
1	Drive alone	75.41%	46
2	Carpool	3.28%	2
3	Motorcycle or Scooter	4.92%	3
4	Transit Service (Bus)	4.92%	3
5	Bike	6.56%	4
6	Walk	4.92%	3
7	Work from home	0.00%	0
	Total	100%	61

Q4 - In 2019, how many days per week did you commute using each of these modes of transportation?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Drive alone	1.00	6.00	4.65	0.96	0.92	46
2	Carpool	3.00	5.00	4.00	1.00	1.00	2
3	Motorcycle or Scooter	1.00	1.00	1.00	0.00	0.00	3
4	Transit Service (Bus)	1.00	2.00	1.33	0.47	0.22	3
5	Bike	1.00	3.00	1.75	0.83	0.69	4
6	Walk	1.00	2.00	1.33	0.47	0.22	3
7	Work from home	0.00	0.00	0.00	0.00	0.00	0

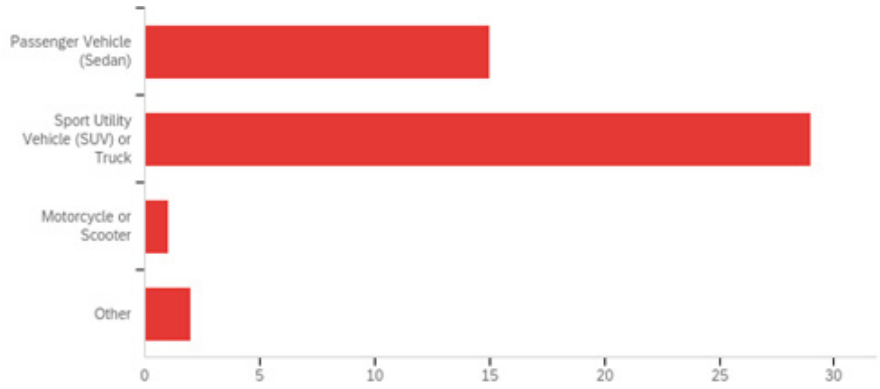
#	Ques-tion	One Day		Two Days		Three Days		Four Days		Five Days		Six Days		Seven Days		To-tal
1	Drive alone	2.17%	1	4.35%	2	6.52%	3	2.17%	1	82.61%	38	2.17%	1	0.00%	0	46
2	Carpool	0.00%	0	0.00%	0	50.00%	1	0.00%	0	50.00%	1	0.00%	0	0.00%	0	2
3	Motor-cycle or Scooter	100.00%	3	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	3
4	Transit Service (Bus)	66.67%	2	33.33%	1	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	3
5	Bike	50.00%	2	25.00%	1	25.00%	1	0.00%	0	0.00%	0	0.00%	0	0.00%	0	4
6	Walk	66.67%	2	33.33%	1	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	3
7	Work from home	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0

Q5 - In 2019, how many miles did you commute (one-way) to your primary work-place? You may use Google Maps to calculate this.

In 2019, how many miles did you commute (one-way) to your primary work-place? You may use Google Maps to calculate this.

3.5	35	9	3000
10 miles	4.4 miles	6 miles	52
10	12 miles	18	5
25	21	28	18
4	15 miles	3	25
26	6	8	4,000 miles
5	12miles approx	6	31
7.5	10	5	10
3	16.9	25	14
3250	5.3 miles	18	15
2	16.1 miles	21.4	0.4 miles
10 miles	13.3	22	2

Q7 - What type of vehicle was your primary mode of transportation when commuting to work in 2019?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What type of vehicle was your primary mode of transportation when commuting to work in 2019?	1.00	4.00	1.79	0.68	0.47	47

#	Answer	%	Count
1	Passenger Vehicle (Sedan)	31.91%	15
2	Sport Utility Vehicle (SUV) or Truck	61.70%	29
3	Motorcycle or Scooter	2.13%	1
4	Other *	4.26%	2
	Total	100%	47

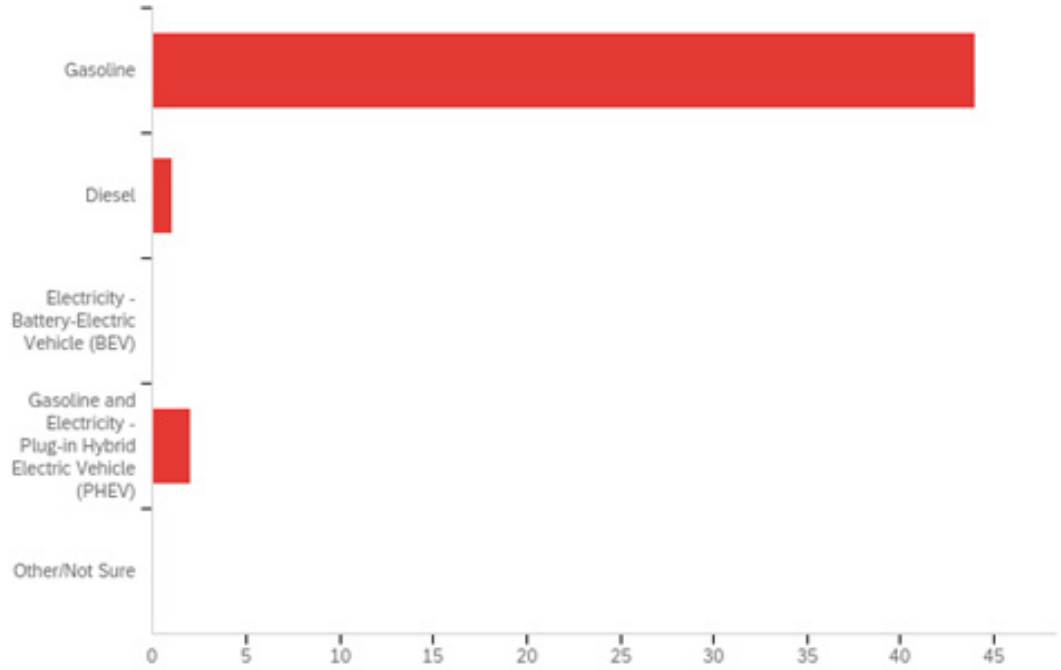
*Other - Text: Mini-van; Passenger Van

Q8 - In 2019, what was the make, model, and model year of the primary vehicle you commuted with? For example, a 2013 Honda Accord.

In 2019, what was the make, model, and model year of the primary vehicle you commuted with? For example, a 2013 Honda Accord.

2018 Toyota Prius Prime	2019 Ram 1500	2016 Dodge Ram	2010 Vespa GTS300
2019 Chevy Silverado	2019 Subaru Legacy	2011 ford f250	2006 BMW
2004 Honda Civic	Nissan frontier	2020 Toyota Tundra	2013 Jeep Wrangler
2014 Subaru Legacy	2018 Chevrolet Silverado	2015 Cadillac ATS AWD	2011 kia sportage
30 mpg	08 Toyota Tacoma	2019 Chevy Silverado	Ford F250
2017 Hyundai Sonata	2017 Toyota Highlander	F-350	2018 Ford F350
2013 Mazda Mazda5	2015 Chevy Trax	2017 BMW X3	2016 Jeep Compass
2016 Subaru Forester	2012 ford f250	2017 Subaru Forester	2009 VW GLI
2014 Toyota Prius	2015 Chevy Equinox	2017 Chevrolet Silverado 2500hd	Chevy 2500
2012 VW Jetta	2012 Town and Country	2018 Honda Civic	2019 chevy traverse
2013 Volkswagon Passat	2018 Ford -150 Truck	2012 Nissan Frontier	2015 Ford Behemoth
2018 GMC Acadia	2015 Toyota Sienna Van	2011 Dodge Dakota	

Q13 - In 2019, what fuel type did your primary commuter vehicle use?



#	Field	Mini-mum	Maxi-mum	Mean	Std De-viation	Variance	Count
1	In 2019, what fuel type did your primary commuter vehicle use?	1.00	4.00	1.15	0.62	0.38	47

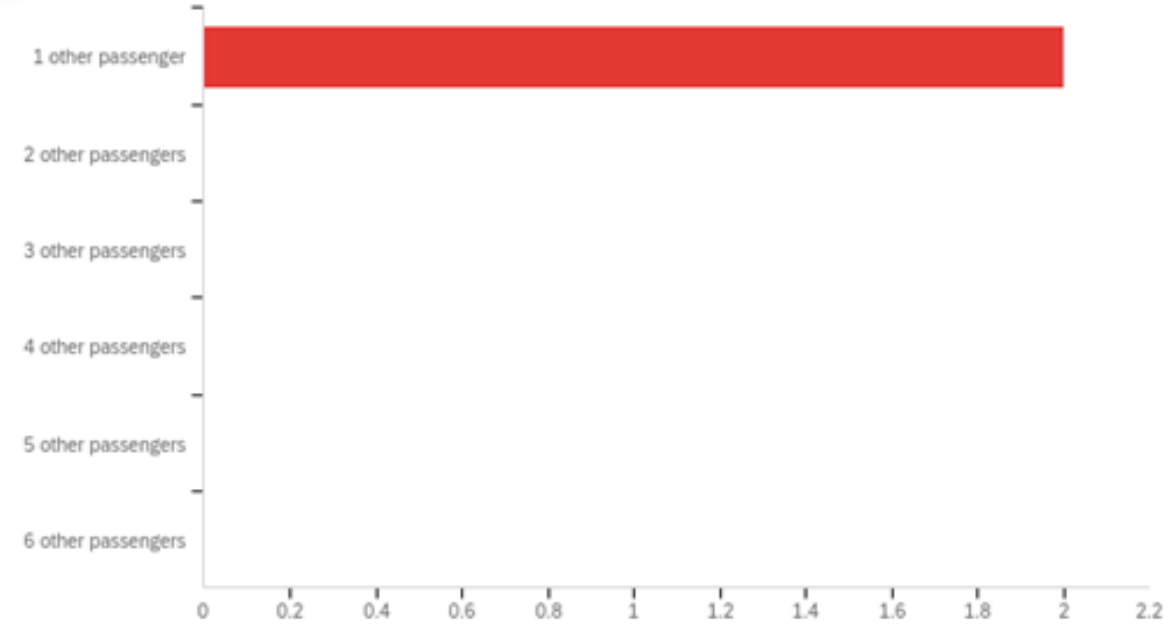
#	Answer	%	Count
1	Gasoline	93.62%	44
2	Diesel	2.13%	1
3	Electricity - Battery-Electric Vehicle (BEV)	0.00%	0
4	Gasoline and Electricity - Plug-in Hybrid Electric Vehicle (PHEV)	4.26%	2
5	Other/Not Sure	0.00%	0
	Total	100%	47

Q14 - In 2019, what was the estimated miles per gallon (mpg) for your commute?

In 2019, what was the estimated miles per gallon (mpg) for your commute?

16 mpg	16 mpg	16	15	17
28	20	23.6	20	20
21	20 mpg	16	13	65
30	19	10	12.6	16
30	29+/-	20	25	26
28	12	20	18	18
30	25	12	11.7	25 mpg
28	20	40	20	20
35	16 ?	14	22	

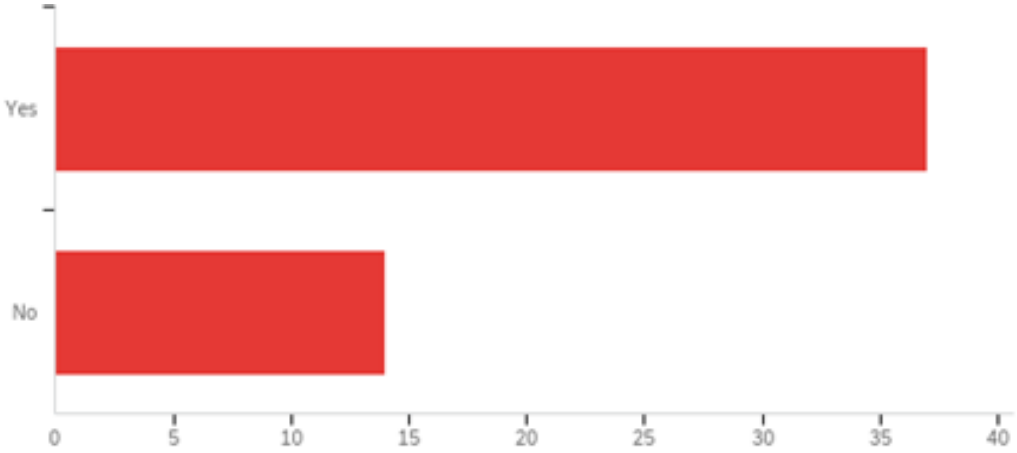
Q9 - In 2019, when you carpooled, how many other passengers were typically in the vehicle with you?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	In 2019, when you carpooled, how many other passengers were typically in the vehicle with you?	1.00	1.00	1.00	0.00	0.00	2

#	Answer	%	Count
1	1 other passenger	100.00%	2
2	2 other passengers	0.00%	0
3	3 other passengers	0.00%	0
4	4 other passengers	0.00%	0
5	5 other passengers	0.00%	0
6	6 other passengers	0.00%	0
	Total	100%	2

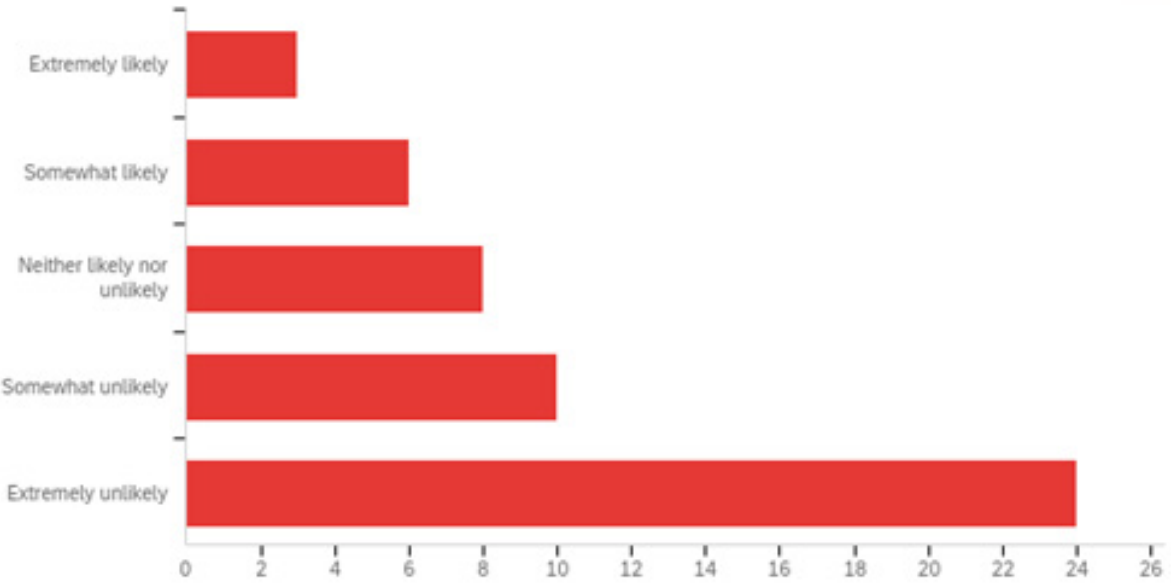
Q19 - Did you know Town employees can charge their personal electric vehicle (EV) at Town Hall for free?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Did you know Town employees can charge their personal electric vehicle (EV) at Town Hall for free?	1.00	2.00	1.27	0.45	0.20	51

#	Answer	%	Count
1	Yes	72.55%	37
2	No	27.45%	14
	Total	100%	51

Q16 - How likely is it that your next vehicle purchase will be an electric vehicle (EV)?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How likely is it that your next vehicle purchase will be an electric vehicle (EV)?	1.00	5.00	3.90	1.27	1.62	51

#	Answer	%	Count
1	Extremely likely	5.88%	3
2	Somewhat likely	11.76%	6
3	Neither likely nor unlikely	15.69%	8
4	Somewhat unlikely	19.61%	10
5	Extremely unlikely	47.06%	24
	Total	100%	51

Q11 - Do you think your commute will change post-Covid-19 or when you return to working at your office/work location? If so, how? (Optional)

Less often
No change
“No” – 30 respondents
Continued remote work is likely for at least a couple days/week.
might work from home 1 day week
If there's more work at home days for me and my wife, one of us may not always be working on site during a certain day.
No - people need to be smart of surroundings
Possibly new vehicle
No still working 5 days a week
It has not changed.
potential to work from home a couple days per week
YES - I plan to work from home more, which means I won't use any vehicles at all.
I am now taking public transport

Q18 - Please share any additional information, questions, or concerns related to your commute or the Town’s sustainability efforts. If you would like a response, please include your name here. (Optional)

Me: lack of affordable (under $30K) AWD electric or hybrid vehicles, no hybrid/electric Subaru models, one-time cost of installing charger, garage space likely to be occupued by (wife's) gasoline car. Other: cost of housing in Ithaca results in unavoidable long commutes, often from areas where transit service is infrequent or unavailable. I feel lucky that I
Too expensive to move closer to work and electric vehicles are way overpriced
traffic lights and lanes

None
35.5 miles one-way in summer
I found it difficult to choose my mode of transport in this survey, as I don't always drive, bike or walk. I use all of the services listed...
I ride share as much as possible

Appendix E- EPA GHG Inventory Tool Employee Commute Calculation Results

1. Enter the Number of Employees

	Number of Employees
Town	83

2. Enter the Proportion of Employees Traveling by Mode

Mode	Employees who use mode (%)
Single Occupancy Vehicle	90.4%
Carpool	4.0%
Motorcycle	2.4%
Transit	1.2%
Bike	1.2%
Walk	0.8%
Total	100%

3. Enter Average One-Way Commute Length

Average One-Way Commute Length (miles)	14

4. Enter Number of Workdays per Year

Workdays per Year	240

5. Emissions from Employee commute

	Metric Tons of CO2 Equivalent
Town	211.42

Appendix F- 2009/2019 Commuter GHG Emissions Summary Chart by Methodology

Comparing commuter methods between 2009 and 2019 proved challenging due to methodological differences between the inventories. The Town was unable to discern the exact methodology utilized in the 2009 inventory compiled with the assistance of ICLEI software. For 2019, the Town employed a new tool and method in development by Terry Carroll (Cornell Cooperative Extension) and the New York Department of Environmental Conservation for use by the Climate Smart Communities program. This methodology, combined with a comprehensive commuter survey, allowed for a more granular calculation of emissions resulting from employee commutes.

Although unsure of the exact methodology used to calculate 2009 commuter emissions, we nonetheless wanted to compare commuting emissions in 2009 and 2019. The tables below show the emissions results using the different methods: the 2009 Inventory using ICLEI software; the 2009 and 2019 inventories using the EPA Local Government Operations Greenhouse (LGOP) Gas Inventory tool; and the 2009 and 2019 inventories using the Climate Smart Communities tool that was ultimately used for the 2019 inventory.

Commuter Emissions Summary by Methodology Method- Emissions in Metric Tons CO_2e				
2009 Inventory	2009 CSC Tool	2009 LGOP Tool	2019 CSC Tool	2019 EPA LGOP
134	296.201	178.56	257.29	211.42

2009 Inventory Method vs. 2019 CSC Inventory Method			
2009	2019	Difference in MT	% Difference
134	257.29	123.29	92%

2009 vs. 2019 EPA Local Government Operations Protocol Tool			
2009	2019	Difference in MT	% Difference
178.56	211.42	32.86	18%

2009 vs. 2019 CSC Tool			
2009	2019	Difference in MT	% Difference
296.201	257.29	-38.911	-13%

Appendix G- Advanced Methane Accounting Methodology (AMAM)

Background on Method

The Advanced Methane Accounting Methodology (AMAM) was created to ensure that the full lifecycle emissions from methane are accounted for. This is mainly accomplished by using a generalized leakage rate that estimates the amount of methane (CH4) leaked into the atmosphere from the production, distribution and combustion of natural gas. AMAM also recognizes the outsized impact that methane as a greenhouse gas has in our atmosphere compared to a similar amount of carbon dioxide (CO2). It does this by using a 20-year global warming potential value of 84 versus the more traditionally utilized 100-year value of 25 used in the EPA Local Government Operations Greenhouse Gas (GHG) Inventory Tool.

AMAM, although not referred to as such, was pioneered by Tompkins County and Professor Bob Howarth (Cornell University) in Tompkins County's 2014 GHG Inventory. Since that time, it has undergone modifications to both methods and assumed values. Leakage rates utilized by the County for the 2014 inventory are now seen as estimations and have changed as additional research has pointed to a lower value than that used for the 2014 inventory. Professor Howarth suggested they be revised to a leakage rate of 3.6% in the County's 2019 GHG Inventory and we have followed his advice for our version of AMAM.

Another major deviation from the County's methodology is the treatment of methane leakage from electricity emissions. The electricity grid generates power from a variety of different energy sources. In the 2014 inventory, the County's methodology took the percentage of electricity generated by natural gas and applied the emissions factor to that number to determine emissions from methane leakage. In consultation with Professor Howarth, however, we were concerned that this was an inaccurate representation. In terms of combustion resources, which are the sources of generation contributing to the Emissions & Generation Resource Integrated Database (eGrid) emissions factor, natural gas makes up over 88% of electricity generation. On consultation with Professor Howarth it was suggested that, rather than applying the emissions factor to natural gas as a percentage of generation, we assume natural gas is the sole source contributing to the eGrid emissions factor. Under this advice, the entirety of emissions from the electric grid is utilized when calculating methane leakage from electricity grid emissions.

Below is an example of how emissions are calculated using AMAM. We also include the tables generated using an Excel calculator to apply methane leakage to the electric grid and natural gas combustion sources in the 2019 inventory. The calculator can be made available by request to the Town of Ithaca.

AMAM Examples

Electric Grid AMAM- Applying AMAM using the Town of Ithaca's Building Sector 2019 usage as an example.

- Determine electricity usage by sector or specific building; for the Town of Ithaca's 2019 building sector electricity usage was 268,806 kWh or 268.81 MWh
- Apply the emissions factor (253.90 lb CO_2e/MWh) to the usage and convert to metric tons:

268.81*253.90/2205 = 30.95 Metrics Tons CO_2e ($MTCO_2e$)

- Determine the amount of methane that was combusted in order to create that amount of emissions by dividing the amount of emissions created from the electricity grid by the molar mass of carbon dioxide (44 g/mol) and then multiplying by the molar mass of methane (16 g/mol):
  (30.952/44)*16 = 11.26 MT
- Use the assumed leakage rate (3.6% or 1.037) to calculate how much methane was produced upstream for the amount of methane that was ultimately combusted (11.26):
  11.255*1.0366 = 11.67 MT
- Calculate the amount of methane that was leaked to the atmosphere between production (11.67) and combustion (11.25):
  0.42 tons
- Apply the 20-year global warming potential of methane (86) to the amount of methane leaked (.42):
  86*.42 = 36.15 MT
- Add the emissions from combustion (30.95) and the emissions from methane leakage (36.15) for the total emissions from buildings using AMAM
  67.10 MT CO_2e

Natural Gas Combustion AMAM – Applying AMAM using the Town of Ithaca's Building Sector 2019 usage as an example.

- Determine natural gas usage by sector or specific building; for the Town of Ithaca's 2019 building sector natural gas usage was 29,280 therms or 2,928 MMBtus
- Apply the emissions factor (53.11 kg/MMBtu) to the usage and convert to metric tons:
  2928*53.11/1000 = 155.51 Metrics Tons (MT)
- Determine the amount of methane that was combusted in order to create that amount of emissions by dividing the amount of emissions created from the electricity grid divided by the molar mass of carbon dioxide (44 g/mol) and then multiplying by the molar mass of methane (16 g/mol):
  (53.11/44)*16 = 56.55 MT
- Use the assumed leakage rate (3.6% or 1.037) to calculate how much methane was produced upstream for the amount of methane that was ultimately combusted (56.55):
  56.55 *1.0366 = 58.66 MT
- Calculate the amount of methane that was leaked to the atmosphere between production (58.66) and combustion (56.55):
  2.11 tons
- Apply the 20-year global warming potential of methane (86) to the amount of methane leaked (.42):
  86*2.11 = 181.61 MT
- Add the emissions from combustion (155.51) and the emissions from methane leakage (181.61) for the total emissions from buildings using AMAM
  337.12 MT CO_2e

2019 GHG Inventory AMAM Calculator Results

Calculating GHG Emissions w/ Leakage for Buildings	
Leakage Rate (as %)	3.6%
"True" Production Rate	96.4%
eGrid region	NYUP

2019 Electricity Grid AMAM Results

Building (Name)	Electricity Used (kWh)	CO_2 Emissions (w/o Leakage)	Metric Tons CH_4 Leaked (from Electricity Generation)	CO_2e Emissions (from leaked CH_4)	CO_2e Emissions (w/ Leakage)
Buildings	268,806	30.952	0.420	36.15	67.100
Water Delivery Facilities	2,703,161	311.262	4.227	363.51	674.773
Wastewater Facilities	779,864	89.799	1.219	104.87	194.672
Streetlights and Traffic	238,511	27.464	0.373	32.07	59.538
	kWh	Metric Tons CO_2	Metric Tons CH_4	Metric Tons CO_2e	MT CO_2e
Total	3,990,342.000	459.477	6.240		996.083

2019 Natural Gas Combustion AMAM Results

Building (Name)	Natural Gas Used (MMBtu)	CO_2 Emissions (w/o Leakage)	Metric Tons CH_4 Leaked (from Nat. Gas Production and Distribution)	CO_2e Emissions (from leaked CH_4)	Total CO_2e Emissions (including Leakage)
Buildings	2,928	155.506	2.112	181.610	337.116
Water Delivery Facilities	806	42.807	0.581	49.992	92.799
Wastewater Facilities	4,487	238.305	3.236	278.307	516.611
Streetlights and Traffic	-	-	-	-	-
	MMBTU	Metric Tons CO_2	Metric Tons CH_4	Metric Tons CO_2e	MT CO_2e
Total	8,221.000	436.617	5.929	509.908	946.526

Appendix H- 2017 GHG Inventory Calculations and Results

Between mid-2020 and early 2021, the Town of Ithaca, with generous guidance and assistance from Cornell Cooperative Extension of Tompkins County and the Susan Christopherson Center for Community Planning, completed an inventory to measure greenhouse gas emissions from government operations for the year 2017 to supplement the results of the 2019 inventory. This appendix provides the findings of the 2017 emissions inventory by sector and source. In 2017, the Town of Ithaca emitted approximately 2,225 metric tons of CO_2e (carbon dioxide equivalent). The total emissions are partially offset by 507 metric tons of CO_2e due to forest land cover within the Town. Net emissions in the year 2017 equal 1,718 metric tons of CO_2e.

GHG Equivalents

2,225 metric tons of CO_2e is equivalent to:
481 Passenger Vehicles Driven for One Year
257 Homes' Energy Use for One Year
672 Acres of Forest Sequestering Carbon for One Year

GHG Emissions by Sector (gross emissions)

Sectors	Percent of Total[1]	Metric Tons of CO_2e	Energy (MMBtu)	Cost ($)
Buildings	9.1%	201	4,072	47,207.50
Streetlights and Traffic Signals	1.4%	30	822	44,993.70
Water Delivery Facilities	16.9%	377	9,930	248,388.21
Wastewater Facilities	37.3%	830	8,2721	71,748.98
Vehicle Fleet	23.8%	529	7,305	96,791.57
Employee Commute	11.6%	257	2,133	43,059.18[2]
Gross Total	100%	2,225	32,534	552,188.14

[1.] Energy from Wastewater Facilities includes only natural gas and electricity and does not include process emissions from the IAWWTF.

[2.] Cost of employee commute calculated using NYSERDA monthly average motor gasoline prices for 2017.

GHG Emissions by Source

Source	Percent of Total	Metric Tons of CO_2e
Diesel	13.8%	307
Electricity	22.3%	496
Gasoline	21.5%	477
Methane	17.4%	387
Natural Gas	22.7%	505
Nitrous Oxide	2.3%	51
Total	100%	2,225[1]

[1] The total emissions number was manually modified from 2,223 $MTCO_2e$ to 2,225 $MTCO_2e$ to align with the total emissions by sector table, the slight difference being due to rounding.

Gross GHG Emissions vs. Net GHG Emissions

	Metric Tons of CO_2e
Gross Emissions	2,225
Urban Forestry Carbon Sequestration	-507[1]
Net Emissions	1,718

[1.] Urban forestry sequesters carbon, represented here as negative emissions.

Buildings

The Town of Ithaca owns and operates four buildings, which are Town Hall, Public Works, Public Works Annex, and Salt Shed. These four buildings were responsible for 9.1% of overall emissions. Emissions totaled 201 metric tons of CO_2e and the buildings used 4,072 MMBtu of energy in 2017. This 4,072 MMBtu of energy used can be broken down into 3,191 MMBtu from natural gas and 258,083 kwh from electricity.

Streetlights and Traffic Signals

There are ten lighting districts and two school crossing lights under the jurisdiction of the Town of Ithaca in 2017. These streetlights and school crossing lights were responsible for 1.4% of the Town's overall emissions, emitting 30 metric tons of CO_2e. Streetlights and school crossing lights in the Town also used 822 MMBtu of energy in 2019, which equates to 241,003 kwh of electricity.

Water Delivery Facilities

Emissions from water delivery facilities in 2017 were 377 metric tons of CO_2e, making up 16.9% of the Town's total emissions. Water delivery facilities also used 9,930 MMBtu of energy, made up of 820 MMBtu of natural gas and 2,670,086 kwh of electricity.

Wastewater Facilities

Emissions from wastewater facilities in 2017 were 37.3% of total emissions, equating to 830 metric tons of CO_2e. Wastewater facilities also used 8,272 MMBtu of energy consisting of 5,514 MMBtu of natural gas and 808,236 kwh of electricity. Process emissions consist of methane and nitrous oxide released during the wastewater treatment process. Emissions from the wastewater treatment process total 436 metric tons of CO_2e while emissions from electricity and natural gas equate to 394 metric tons of CO_2e.

Vehicle Fleet

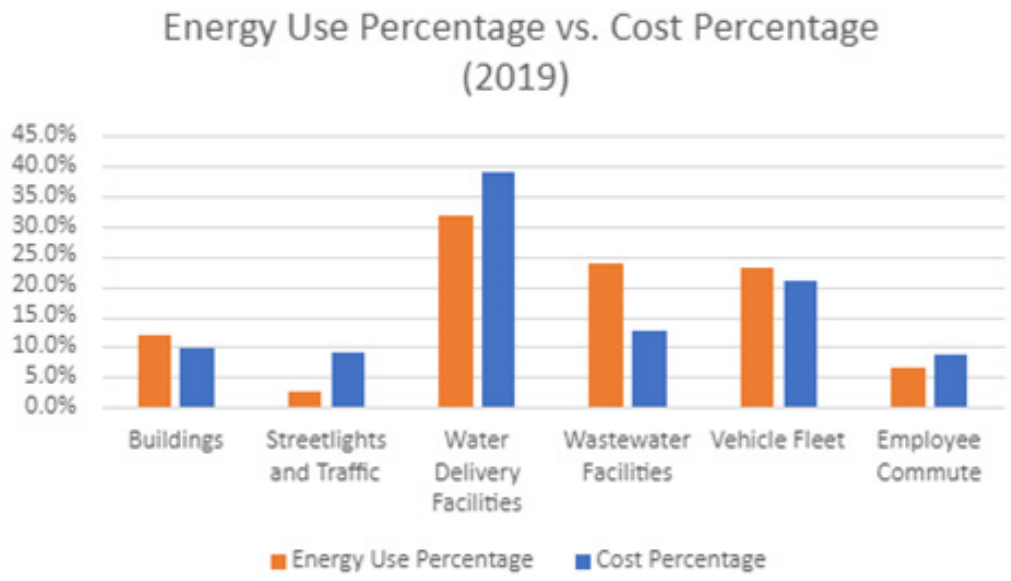
Emissions from the Town and Bolton Point fleets account for 23.8% of the Town's total emissions in 2017, which is 529 metric tons of CO_2e and 7,305 MMBtus of energy. In 2017, the Vehicle Fleet used 27,247 gallons of gasoline and 28,236 gallons of diesel fuel.

Employee Commute

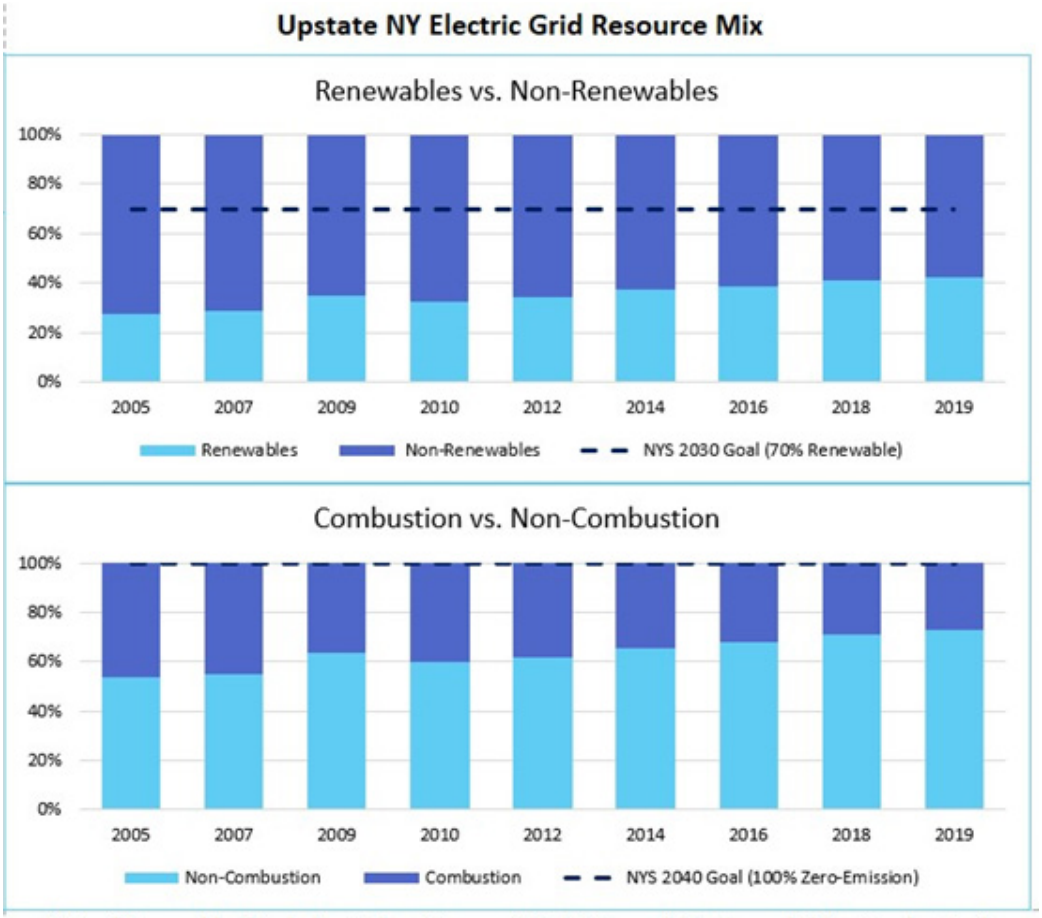
To better understand commuting patterns and account for emissions derived from employee commuting, a survey was conducted of employees at Town Hall, Public Works, and Bolton Point. The survey of 83 employees across the three sites included questions about mode of commute, distance traveled to work, and vehicle make and model. From the data collected through this survey, greenhouse gas emissions from employee commutes were 11.6% of total Town emissions in 2017. This equates to 257 metric tons of CO_2e and 2,222 MMBtu of energy usage.

Appendix I- Additional Graphs and Charts

Energy Use Percentage vs. Cost Percentage (2019)



Upstate NY Electric Grid Resource Mix Chart



Note: "Renewables" includes Hydro, Biomass, Wind, Solar and Geothermal. "Non-Combustion" includes Nuclear, Hydro, Wind, Solar and Geothermal. **Data Source**: EPA eGRID - www.epa.gov/egrid