



**City of Kingston
Information Report to Council
Report Number 24-008**

To: Mayor and Members of Council
From: Paige Agnew, Commissioner, Growth & Development Services
Resource Staff: Julie Salter-Keane, Manager, Climate Leadership
Date of Meeting: January 9, 2024
Subject: 2022 Corporate Greenhouse Gas (GHG) Emissions Inventory

Council Strategic Plan Alignment:

Theme: 2. Lead Environmental Stewardship and Climate Action

Goal: 2.1 Reduce carbon footprint of City operations.

Executive Summary:

This report provides a summary of the 2022 Corporate Greenhouse Gas (GHG) Emissions Inventory report.

Corporate emissions are those created by municipal operations including water and wastewater treatment. Community emissions are those created from our entire community. The Climate Leadership Plan included a commitment to monitor community and corporate GHG emissions on an annual basis, with a target for a reduction of 15% of 2018 levels by 2022.

In Q4 2022, staff reported on the 2020 and 2021 Corporate GHG Emissions Inventory ([Report Number 22-275](#)), showing a 9% reduction in 2021 from 2018 base year emissions. Reporting for the 2022 Corporate GHG Emissions Inventory is now available.

An inventory of estimated corporate GHG emissions for 2022 (Exhibit A) has been completed for the City of Kingston by a specialist consulting firm using 2018 data as the baseline year. Graphs and tables that illustrate the sources of emissions by municipal sector and energy source are provided within an Executive Summary of the consultant's inventory report, attached. Information on the methods used for reporting and future methodological recommendations are contained in the supplemental information report for 2022 (Exhibit B), related to the

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enhancement of waste emissions in future inventory reporting. The corporate emissions inventory includes the impact of water and wastewater operations, conducted by Utilities Kingston on the City's behalf.

For the year 2022, corporate annual GHG emissions totalled 22,079 tonnes of carbon dioxide equivalent (CO₂e), marking an increase from 2021 of 1.8% or 1,252 tonnes (CO₂e), but still remaining, 8% lower than 2018 base year levels, corresponding to 1646 tonnes CO₂e above the target of 20,433 tonnes CO₂e. This is primarily due to operations and activities within city facilities returning to normal, pre-pandemic levels.

The target reduction of 15% of 2018 levels by 2022 was not met overall. Despite the number of municipal buildings increasing in 2022, leading to an 8% overall rise in emissions from facilities, energy consumption per square foot has decreased among all City-owned and operated buildings. This 13.8% per square foot reduction suggests that ongoing energy retrofit initiatives are having a significant impact on facility-related emissions. Furthermore, the continued electrification of Kingston Transit, and optimization of the City's fleet, including the use of biodiesel for transit buses, which is innovative for municipalities, comprise significant opportunities for emissions reductions and will continue to be a focus to meet future reduction targets outlined in the Climate Leadership Plan.

Recommendation:

This report is for information only.

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Authorizing Signatures:

ORIGINAL SIGNED BY COMMISSIONER

**Paige Agnew, Commissioner,
Growth & Development Services**

ORIGINAL SIGNED BY CHIEF

ADMINISTRATIVE OFFICER

**Lanie Hurdle, Chief
Administrative Officer**

Consultation with the following Members of the Corporate Management Team:

Jennifer Campbell, Commissioner, Community Services Not required

Neil Carbone, Commissioner, Corporate Services

David Fell, President & CEO, Utilities Kingston

Peter Huigenbos, Commissioner, Major Projects & Strategic Initiatives Not required

Brad Joyce, Commissioner, Infrastructure, Transportation
and Emergency Services

Desirée Kennedy, Chief Financial Officer & City Treasurer

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Options/Discussion:

2022 Corporate GHG Emissions Inventory and Reduction Targets

An inventory of estimated GHG emissions from municipal operations (corporate emissions) for 2022 has been completed for the City of Kingston by a local consulting firm, Greenscale Inc., who specializes in carbon accounting. For 2022, corporate annual GHG emissions totalled 22,079 tonnes of carbon dioxide equivalent (CO₂e), marking an increase from 2021 of 1.8% or 1,252 tonnes (CO₂e), but remaining, 8% lower than the 2018 base year levels.

This 1.8% increase from 2021 is partly attributable to continued recovery of municipal operations post-pandemic. This trend is shown in Figure 1 below, which illustrates how emissions fell considerably in 2020, and have risen slowly to 2022, while remaining lower than 2018 base year levels.

The 2022 GHG emissions inventory shows that the City has fallen short of the reduction target of 15% or 20,433 tonnes CO₂e by 2022, by some 1646 tonnes CO₂e, relative to 2018 levels.

Figure 1. Annual Total GHG emissions at the Corporate Scale from 2018 to 2022

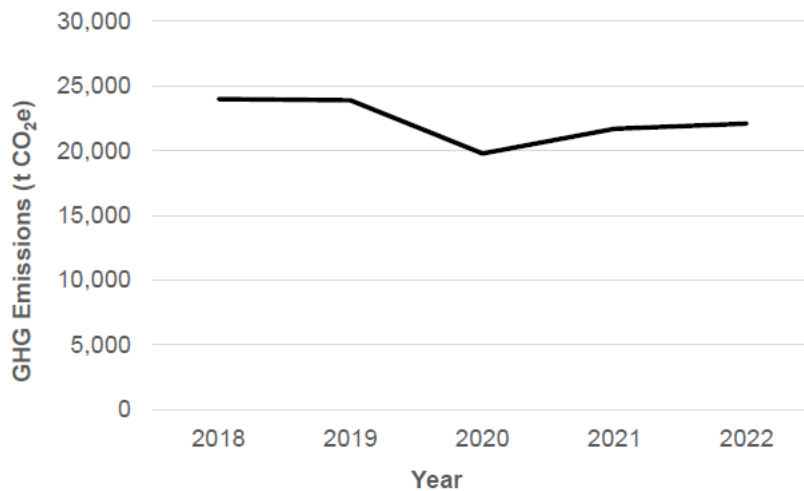


Figure 1. Annual total GHG emissions at the corporate scale from 2018 to 2022.

In order to meet Council’s target of 15% reduction by 2022, the City had to decrease its corporate emissions by a net total of 3,605 tonnes CO₂e from 2018 levels by 2022, which is an average of 901 tonnes per year from 2019 to 2022. This translates into a “carbon budget” of allowable tonnes of emissions for each year to keep pace to reach the target as indicated within the table below.

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Table 1. Current Corporate GHG Emissions (T CO₂e) with Actual Estimated Emissions, Carbon Budget and Net Difference to be Offset to Year 2022

	2018 Base Year	2019	2020	2021	2022
Actual Estimated Emissions (T CO₂e)	24,037	23,937	19,627	21,693	22,079
Budgeted Emissions to Achieve 15% Reduction Target (T CO₂e) by 2022	24,037	23,136	22,235	21,334	20,433
Net Difference to be Offset (T CO₂e)	0	801	0 (*2608 below target)	359	1646
Actual Estimated Emissions Reduction Relative to Base Year, Expressed as a Percentage	0%	-.3%	-18.3%	-9.75%	-8%

2023 Corporate GHG Emissions Inventory Takeaways

For the first time, the 2022 Corporate GHG Inventory Report utilized transportation data from the Geotab Telematics Platform implemented by the City’s Corporate Asset Management & Fleet Department, providing detailed operational insights for the 329 vehicles in the City’s fleet currently operating on the platform. This data enabled the application of specific emission factors, which refined the transportation emissions estimate to be approximately 4% lower than previously calculated. As more vehicles are added to the platform in the coming years, the accuracy of GHG estimates will improve, enhancing future planning and strategy development.

Analysis from the Geotab data identifies potential fuel savings by transitioning to more efficient vehicles. The average fuel consumption of all gasoline vehicles was 20.78 L/100 km, compared to just 6.43 L/100km for hybrids. It should be noted that this gasoline consumption data includes all vehicle categories such as light duty and super-duty pickup trucks, sedans, cross-over sport-utility vehicles and cargo vans. In the coming years, as hybrid and electric pick-up truck and cargo van options become more readily available there will be increased opportunity to reduce fuel use. Moreover, the granularity of data gathered from the Geotab Platform doesn't only

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allow for a more accurate assessment of GHG emissions, but it also enables the City to make more informed decisions regarding sustainability and to strategically address climate change challenges, such as prioritizing the transitioning of vehicles with the highest utilization to electric.

The report provides the following key conclusions:

- Diesel, Gasoline, and Natural Gas were used for approximately 61% of all the energy consumed at the corporate level but contributed more than 88% of all the emissions in 2022.
- Electricity was responsible for more than 11% of energy sector GHG emissions but was used for more than 38% of all energy consumption, highlighting the lower emissions associated with using electricity for energy compared with fossil fuels.
- Heating oil use decreased by 69% but the cost only decreased by 47%. The increasing cost of fossil fuels means that fuel use reductions have significant financial implications for annual budgets, beyond the advantage of GHG reduction. Despite the number of municipal buildings increasing (13% increase in total floor area), leading to an 8% rise in emissions from facilities, energy consumption per square foot has decreased 13.8% overall for City-owned and operated buildings.
- Heating degree days (HDD) saw a near 8% increase from 2021, reflecting a colder winter on average, yet natural gas usage only went up by 3%, and heating oil usage significantly decreased by 69%. This pattern suggests that the City's transition to alternative heating solutions and improvements in building energy efficiency are beginning to have a measurable effect.
- While cooling degree days (CDD) fell by 18% from the previous year, reflecting more moderate summer temperatures on average, electricity consumption increased by around 10%. This increase in consumption is partially due to some facilities not being affected by CDD, including arenas and pools which have very energy intensive processes. GHG emissions from electricity only increased by about 8%, further illustrating the impact of shifting heating methods to electricity, coupled with the lower GHG emissions associated with electrical power—meaning that increases in electrical use are not resulting in proportional increases in GHG emissions.
- The transportation and transit sectors remain the largest contributors to corporate emissions, accounting for 56% of the total. Yet, there was a marginal decline in emissions from gasoline and diesel, by 1.6% and 0.14% respectively.

Graphs and tables that illustrate the sources of emissions by service area and energy types are provided within the consultant's inventory report (Exhibit A), with further details in the supplementary report (Exhibit C). The complete corporate emissions inventory report is available, along with reports for previous years, through the City of Kingston's website at: <https://www.cityofkingston.ca/residents/environment-sustainability/climate-change-energy/greenhouse-gas-emissions>.

While emissions for 2022 show more consistent and reliable results due to the return to more normal operation of corporate services and facilities following the COVID-19 Pandemic, they will still fluctuate due to various factors as outlined within Table 2.

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Table 2. Annual Influences on CO₂e Emissions and their Impact on Corporate GHGs (Greenhouse Gas)

Source of Influence	Impact on Emissions	Magnitude of Impact	Explanation
Hot summer	Increase	Low to Moderate	Increases electric energy consumption for air conditioning.
Cool summer	Decrease	Low	Decreases electric energy consumption for air conditioning.
Increased electricity generation from fossil fuels	Increase	Low to Moderate	Higher carbon intensity of provincial electricity grid from more use of natural gas power plants. Increases emissions from electricity consumption and EV (Electric Vehicle) charging.
More EV charging (more EVs (Electric Vehicles) in fleet)	Decrease	Low to Moderate	Higher electricity consumption but lower fossil fuel use overall.
Cold winter	Increase	Moderate	Increased use of fossil fuels for space heating.
Warm winter	Decrease	Moderate	Decreased use of fossil fuels for space heating.
New/expanded facilities	Increase	Low to Moderate	Increase in electricity and natural gas consumption.
New additions to fleet of vehicles (non-EVs)	Increase	Moderate to High	More gasoline and diesel fuel consumption.

Facilities Management & Construction Services (FMCS) has been implementing an energy and asset management program to reduce GHG emissions, energy consumption and associated operating costs for corporate facilities. Initiatives to date have included removing all fuel oil

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heating infrastructure, targeted replacement of aging equipment with more efficient technologies, building automation system upgrades, LED lighting retrofits, building recommissioning, as well as energy modelling of facilities to optimize the scope of capital projects to achieve maximum impact for the facilities portfolio overall. Work is currently underway to review various GHG reduction scenarios and associated electrification demand for all corporate facilities. This work will be used to establish potential costs of meeting facility related GHG reduction targets. Various scenarios and findings will also be reviewed with Utilities Kingston to understand the full impacts of electrification on the local grid and to assist with long-term planning.

The Climate Leadership Division will continue to work with all City departments to identify, advance and support additional viable projects that reduce corporate emissions, as outlined in the approved [Climate Leadership Plan 2021](#) and Council's Strategic Plan 2023-2026. With the implementation of the Climate Lens Framework Tool, communication to Council will take a consistent form, and using a phased approach, will move from qualitative impact assessments to more detailed quantitative assessments.

Actions will be assessed by using a triple bottom line approach to ensure that financial, service, and environmental accountability are factored into decision-making regarding emission reductions from municipal operations. This will include consideration of best management practices implemented by other municipalities.

Once emissions reduction actions are fully implemented by the City, municipal buildings and vehicles will still require energy to provide services to the community. Remaining emissions reductions to achieve carbon neutrality can be achieved through a mix of future technologies, shifts in provincial energy policy, purchasing clean energy and carbon offsets.

Reporting for the 2023 Corporate GHG Emissions Inventory is expected by Q3 2024, pending data released by Statistics Canada.

Staff will also be reporting in Q1 2024 to Council on the impact and options to increase the current corporate carbon budget of 30% by 2030 to 40-50% by 2030 as outlined in Council's Strategic Plan, 2.1.1.

Existing Policy/By-Law:

None

Notice Provisions:

None

Accessibility Considerations:

None

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Financial Considerations:

The creation of GHG emission inventory reports for future years is expected to require approximately \$7,000 per reporting year which has been reflected within the capital budget of the Climate Leadership Division.

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Paul MacLatchy, Environment Director, Business, Real Estate & Environment

Ian Semple, Director, Transportation and Transit

Hugh McLaren, Energy Analyst, Water and Wastewater Treatment Operations, Utilities Kingston

Exhibits Attached:

Exhibit A City of Kingston Corporate GHG Inventory Report - 2022

Exhibit B City of Kingston Corporate GHG Inventory Report - 2022 – Supplemental Information

City of Kingston Corporate GHG Inventory Report – 2022

November 13, 2023

Prepared By:

Greenscale Inc.

Nathan C. Manion

Prepared For:

City of Kingston

Julie Salter-Keane, Manger, Climate Leadership



Executive Summary

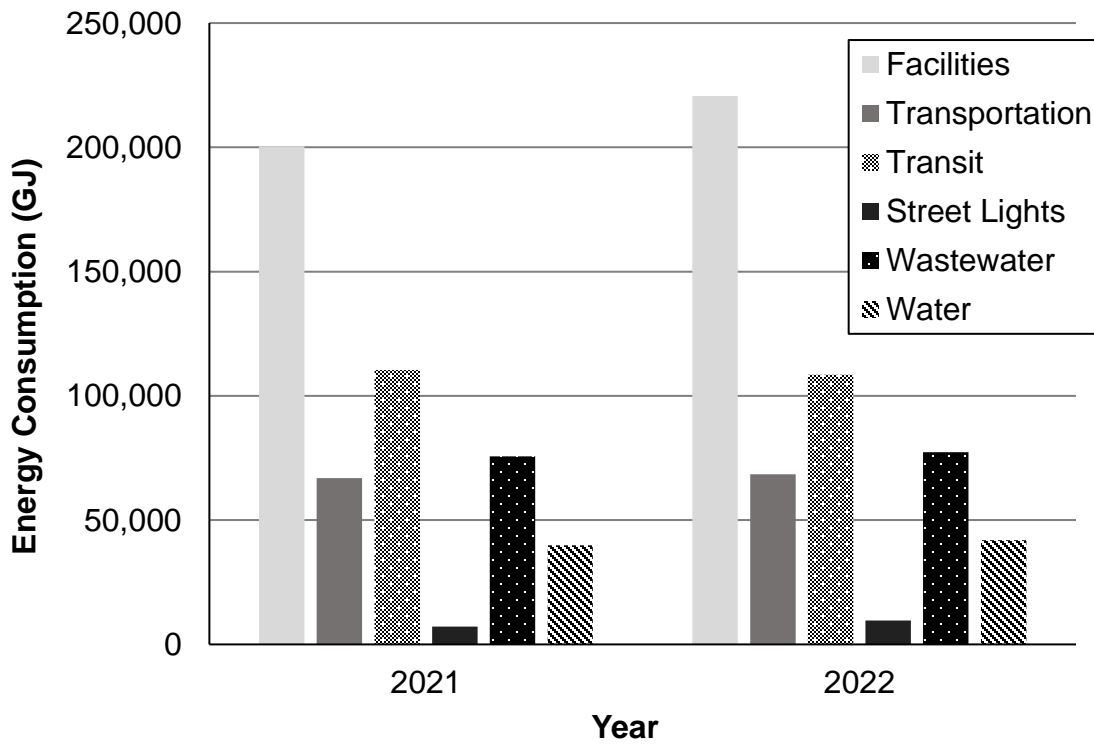
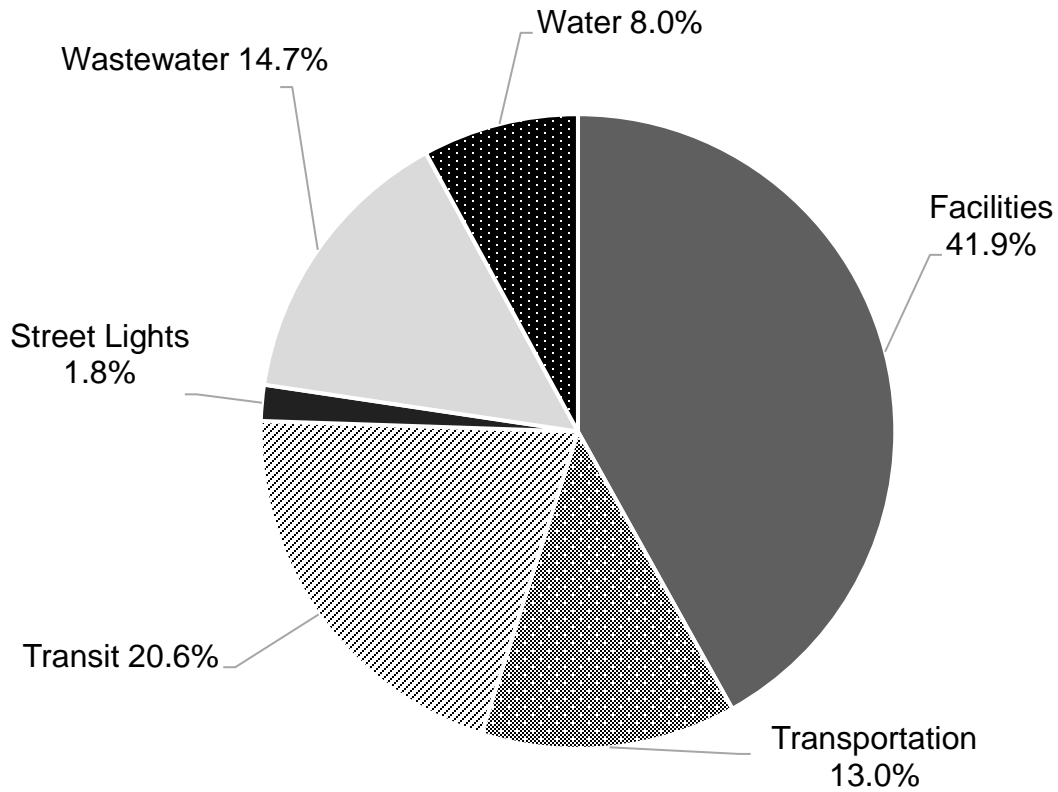
This report outlines the most recent greenhouse gas (GHG) emissions inventory for the Corporation of the City of Kingston, encompassing the years 2021 and 2022. It includes municipal operations by the Corporation and services conducted by Utilities Kingston in the areas of water and wastewater management. Data regarding energy consumption was sourced from both the City of Kingston and Utilities Kingston. This report measures the city's environmental impact in terms of total energy consumption (gigajoules, GJ), total GHG emissions (tonnes CO₂ equivalent, tCO₂e), and the cost of energy use (dollars, \$). For a thorough understanding of the methodologies, data, and emission factors used, please refer to the detailed Supplemental Information Report.

The 2022 corporate data highlights a substantial enhancement in the level of detail available from the Transportation Department. The implementation of electronic monitoring systems for fuel consumption and distance traveled in municipal vehicles has begun, which offers a more granular look at emissions and the potential for targeted reduction strategies. This precision in data collection permits the application of more precise emission factors for various vehicle types, providing clearer insights into potential emissions reductions for short- to medium-term targets. A concise summary of the corporate results for 2022 follows below:

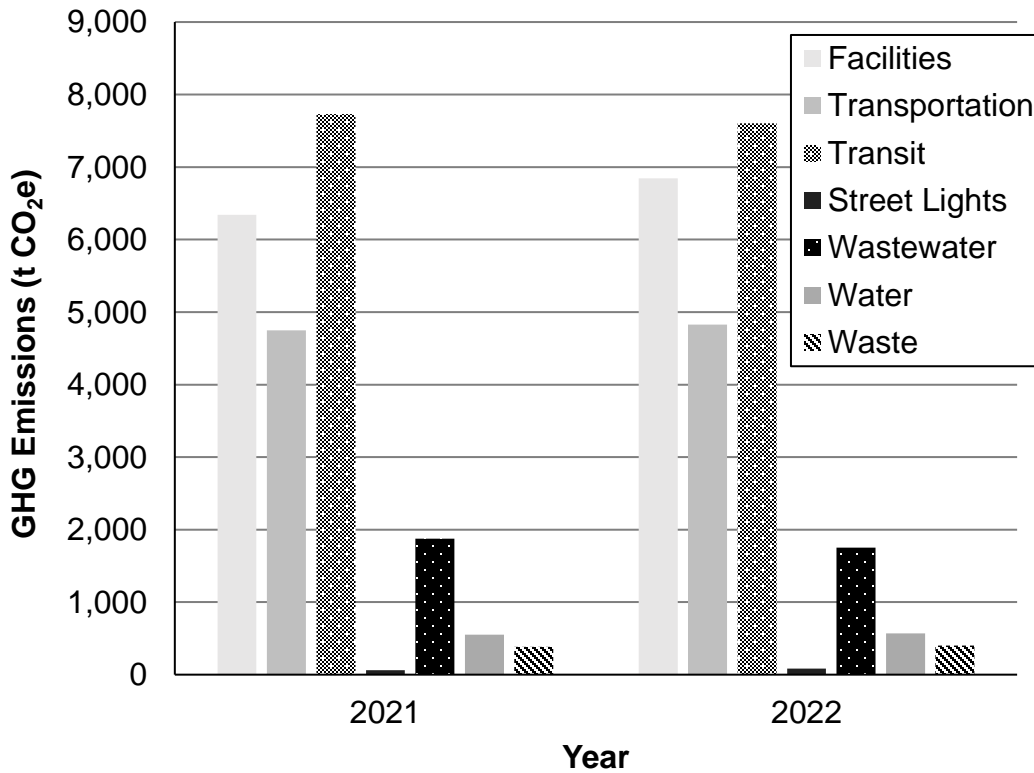
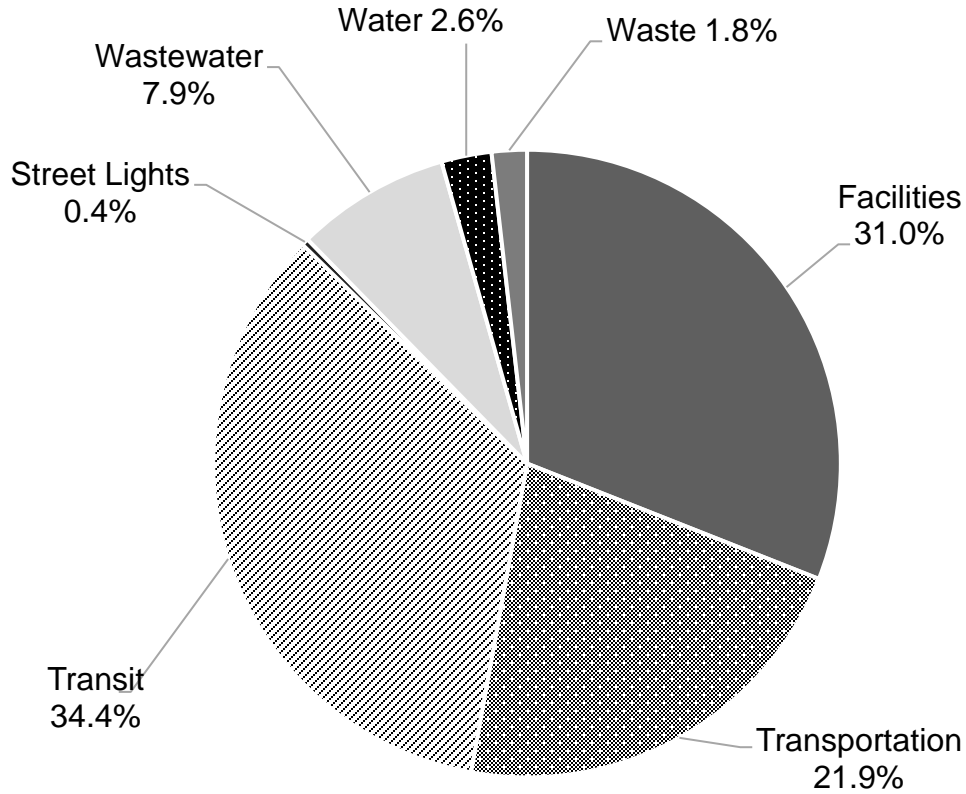
Summary of Results

1. Annual corporate GHG emissions have decreased by 8% since the 2018 baseline year.
2. The average GHG footprint for buildings operated by facilities in 2022 was 2.76 kg CO₂e/ft². This represents a 13.8% reduction from 2018 levels when the average GHG footprint of buildings was 3.2 kg CO₂e/ft².
3. Diesel, Gasoline, and Natural Gas were used for approximately 61% of all the energy consumed at the corporate scope, but contributed more than 88% of all the emissions in 2022.
4. Electricity was responsible for more than 11% of energy sector GHG emissions, but was used for more than 38% of all energy consumption, highlighting the lower emissions associated with using electricity energy compared with fossil fuels.
5. Heating oil use decreased by 69% but its cost only decreased by 47%. The increasing cost of fossil fuels means that fuel use reductions have significant financial implications for annual budgets.

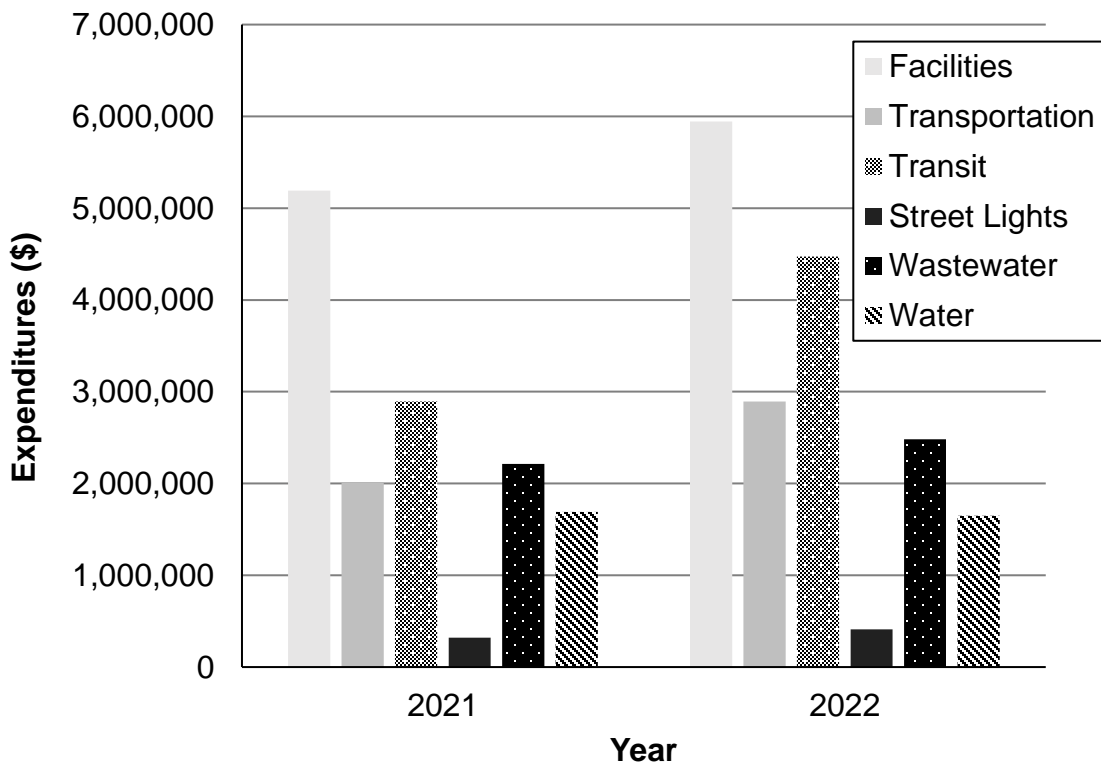
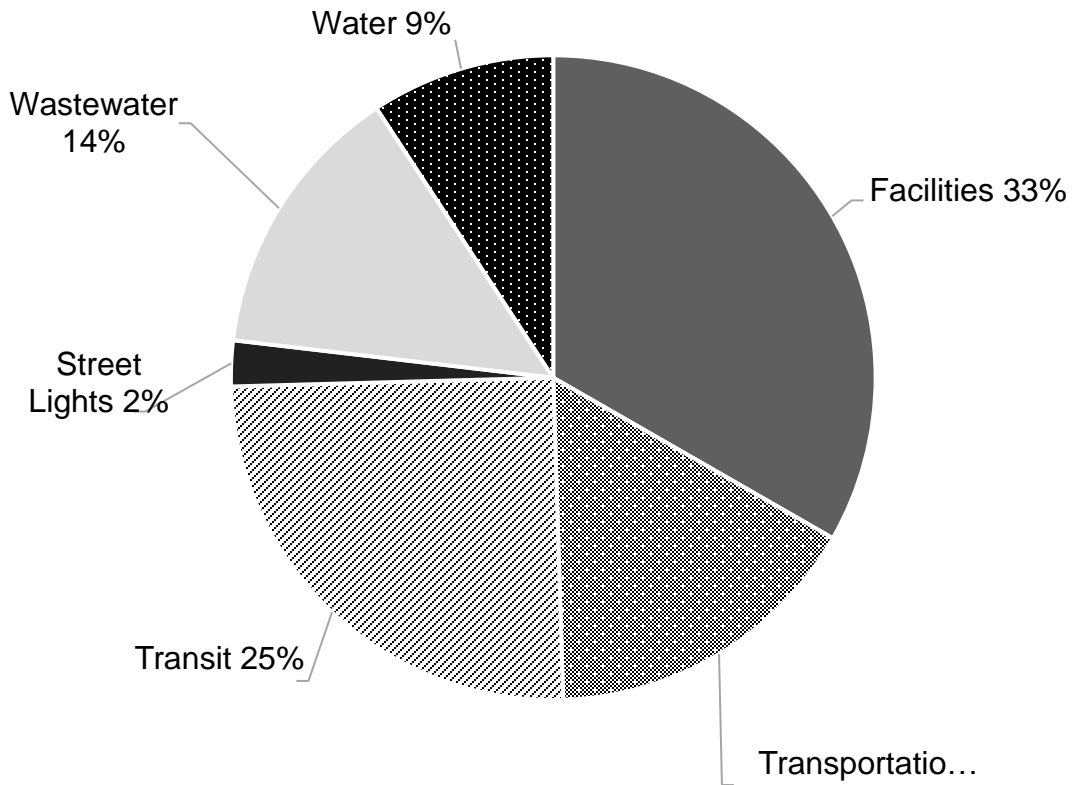
2022 Energy Consumption by sector (total: 526,513 GJ) and historical trend



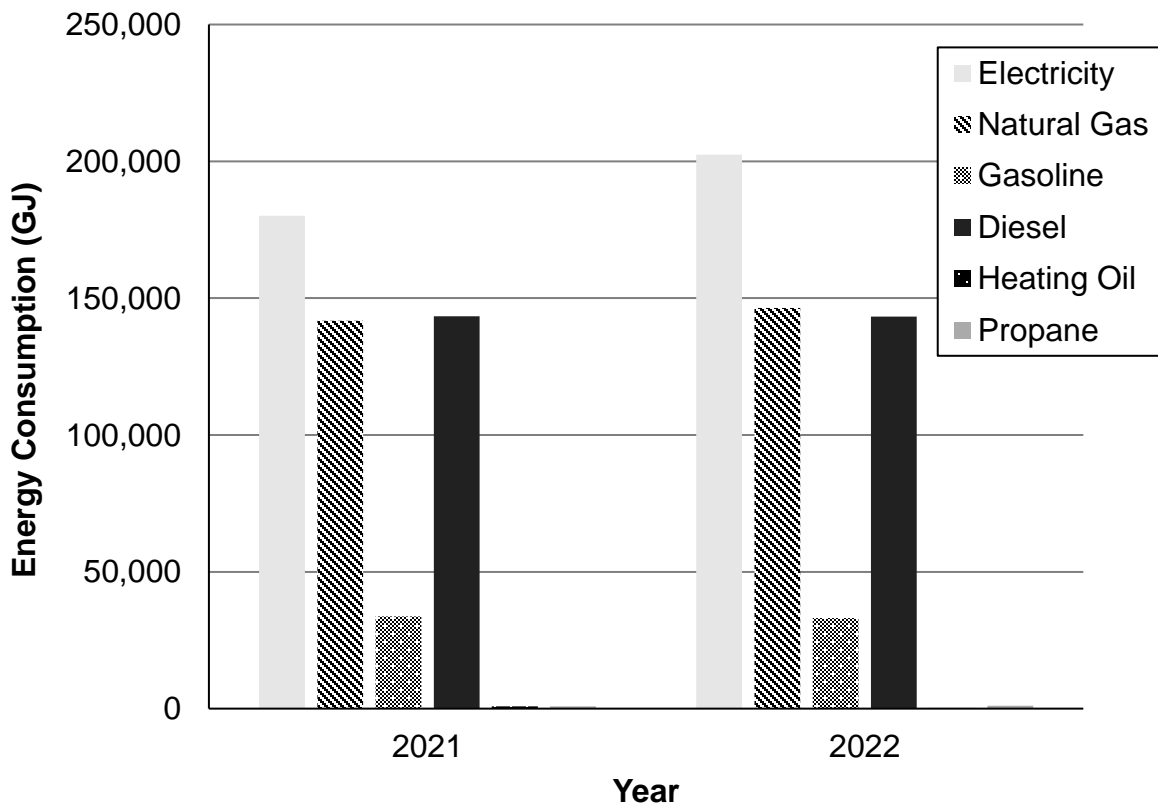
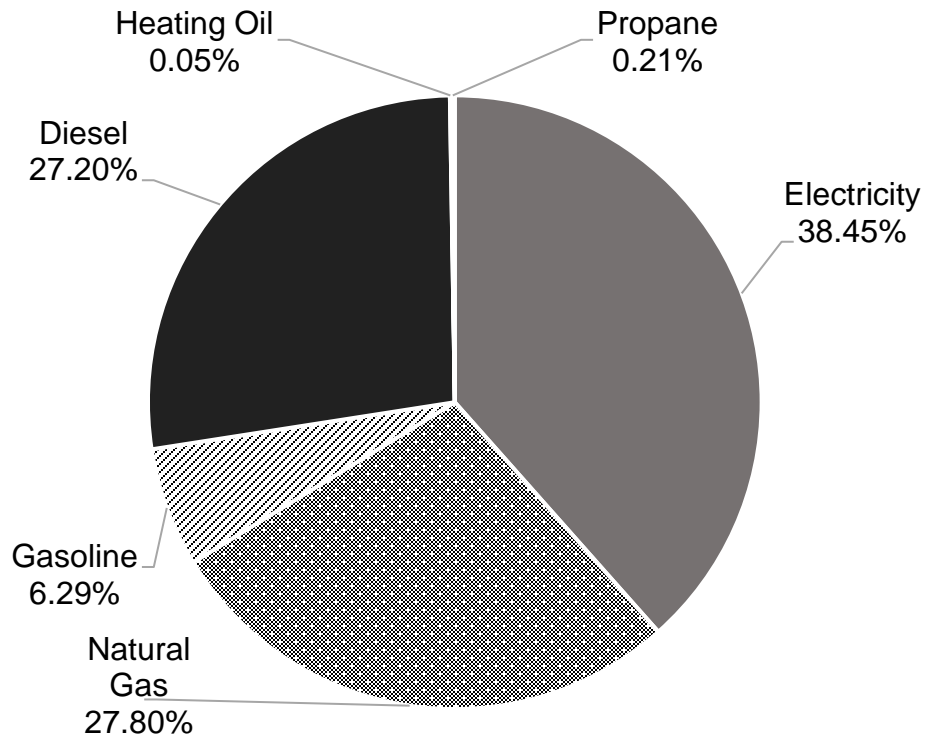
2022 GHG Emissions by sector (total: 22,796 tonnes CO₂e) and historical trend



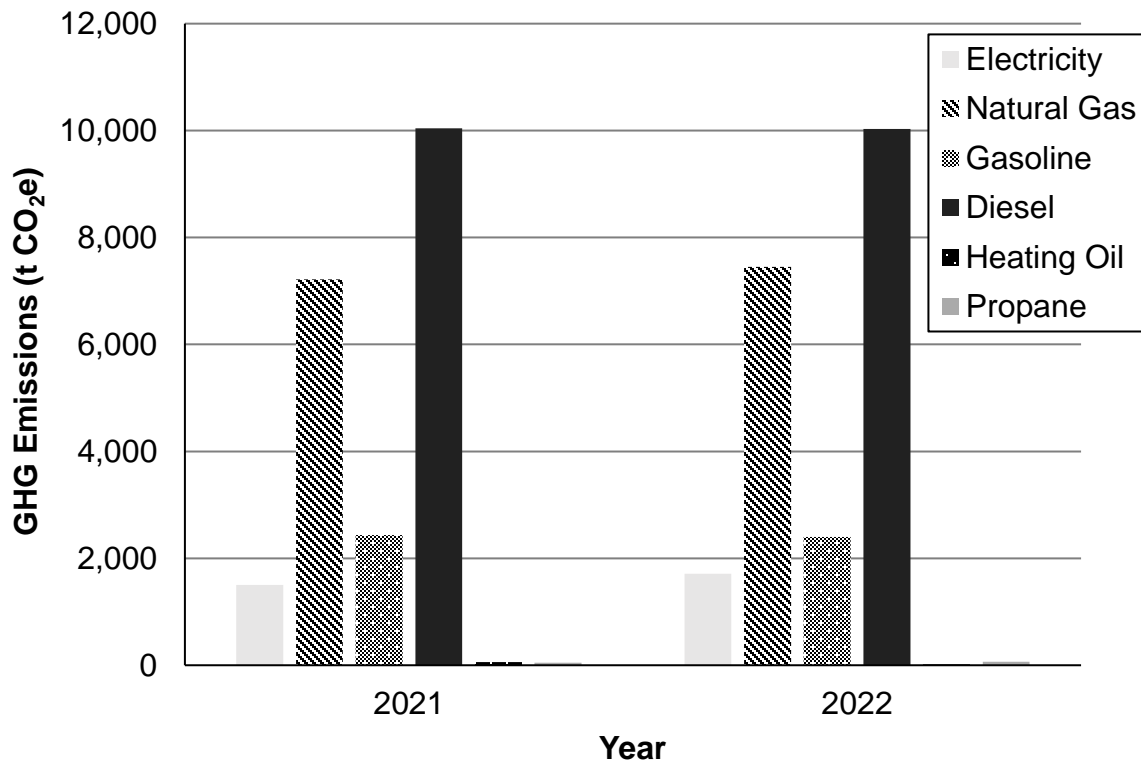
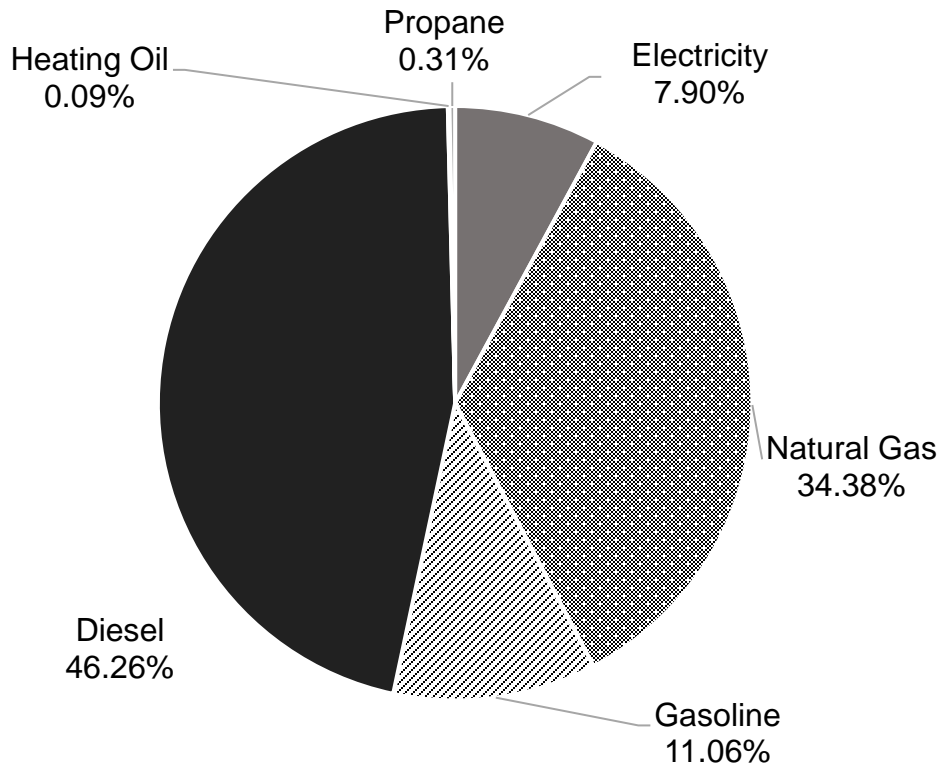
2022 Expenditures by sector (total: \$17,855,189) and historical trend



2022 Energy Consumption by source (total: 526,513 GJ) and historical trend



2022 GHG Emissions by source (total: 22,560 tonnes CO₂e) and historical trend



2022 Expenditures by source (total: \$17,855,189) and historical trend

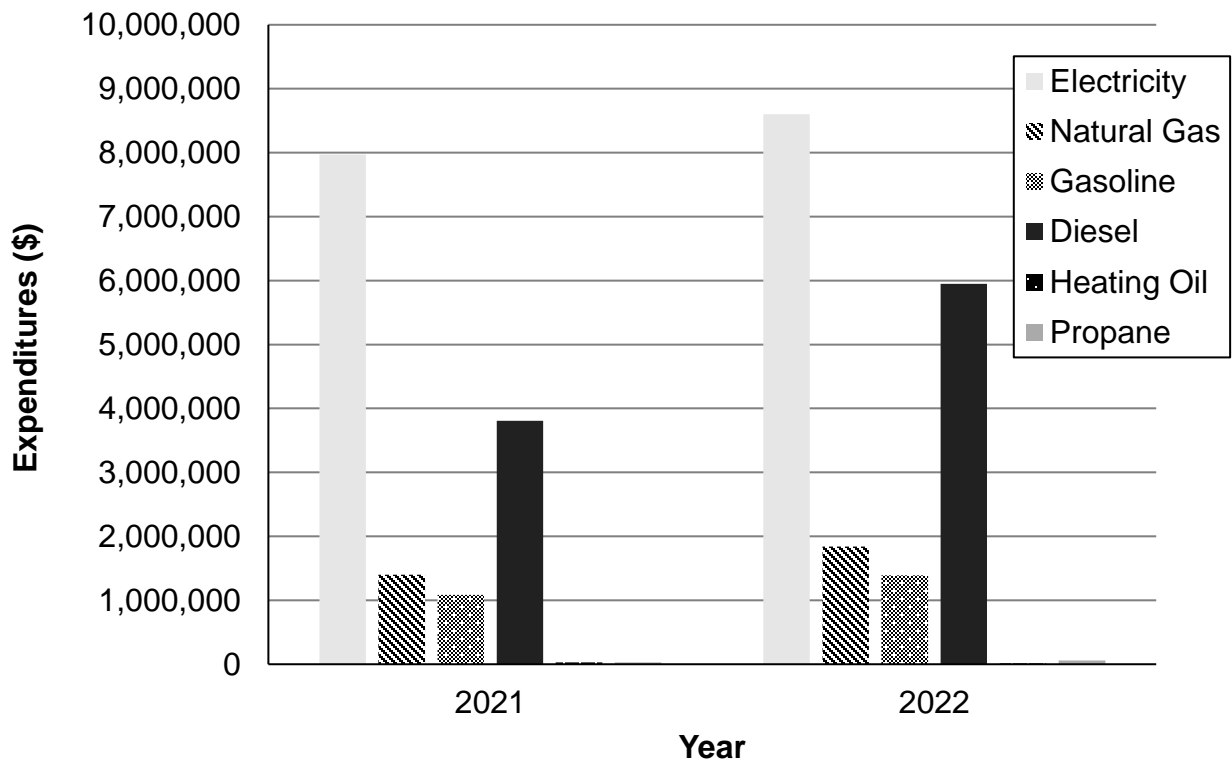
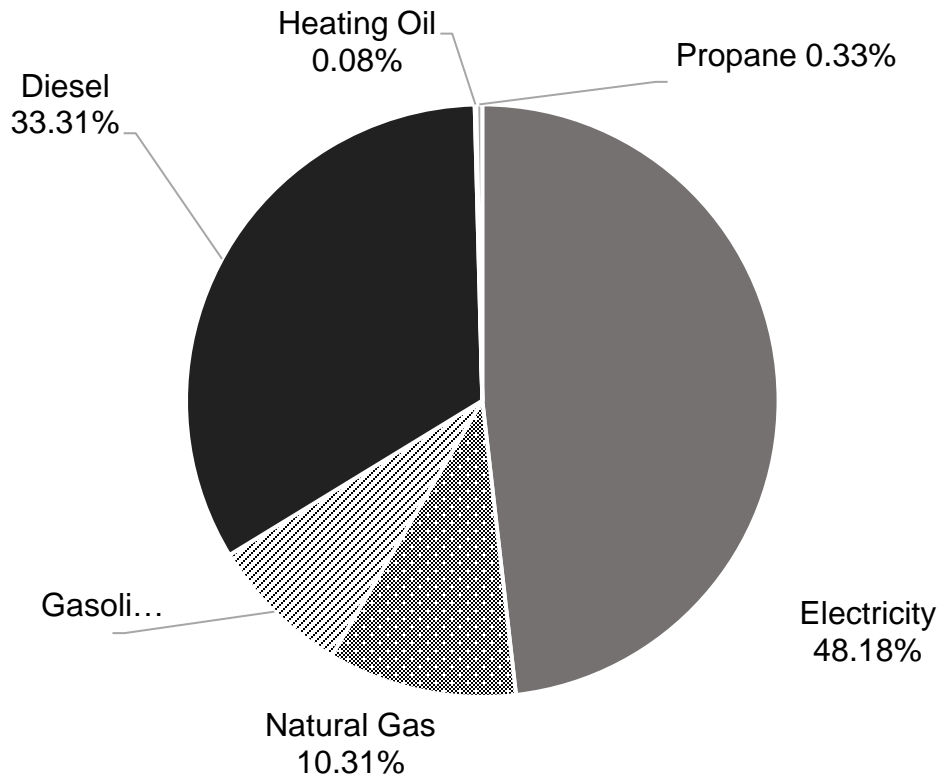


Table 1. Summary of energy consumption (GJ), GHG emissions (tCO₂e), & expenditure (\$) of 2021 - 2022 for all sectors.

Sector Source	2021			2022			Energy Consumption Change (GJ)	GHG Emissions Change (tCO ₂ e)	Change (\$)
	Energy Consumption (GJ)	GHG Emissions (t CO ₂ e)	Expenditure (\$)	Energy Consumption (GJ)	GHG Emissions (t CO ₂ e)	Expenditure (\$)			
Facilities	200,475	6,340	5,191,819	220,685	6,843	5,945,138	20,210	502	753,319
Transportation	66,860	4,748	2,009,321	68,451	4,829	2,894,966	1,591	81	885,645
Transit	110,421	7,733	2,893,048	108,550	7,603	4,473,398	-1,871	-130	1,580,350
Street Lights	7,223	60	320,806	9,623	81	409,219	2,399	21	88,413
Wastewater	75,661	1,874	2,214,532	77,322	1,752	2,483,006	1,661	-122	268,474
Water	39,915	552	1,689,163	41,882	571	1,649,462	1,967	19	-39,701
Waste	0	386	0	0	400	0	0	14	0
TOTAL	500,556	21,693	14,318,690	526,513	22,079	17,855,189	25,957	386	3,536,500

Table 2. Summary of energy consumption (GJ), GHG emissions (tCO₂e), & expenditure (\$) of 2021 - 2022 for energy sources.

Energy Source	2021			2022			Energy Consumption Change (GJ)	GHG Emissions Change (tCO ₂ e)	Change (\$)
	Energy Consumption (GJ)	GHG Emissions (t CO ₂ e)	Expenditure (\$)	Energy Consumption (GJ)	GHG Emissions (t CO ₂ e)	Expenditure (\$)			
Electricity	180,142	1,501	7,970,284.01	202,463	1,714	8,603,269.19	22,321	212	632,985
Natural Gas	141,757	7,218	1,397,732.74	146,383	7,454	1,840,766.18	4,626	236	443,033
Gasoline	33,658	2,436	1,084,660.16	33,112	2,397	1,389,898.01	-546	-39	305,238
Diesel	143,406	10,043	3,808,059.16	143,205	10,029	5,948,128.09	-201	-14	2,140,069
Heating Oil	809	61	28,105.50	250	19	14,818.77	-559	-42	-13,287
Propane	784	47	29,848.15	1,100	67	58,309.03	315	19	28,461
TOTAL	500,556	21,308	14,318,690	526,513	21,679	17,855,189	25,957	371	3,536,500

Report Takeaways

- The City of Kingston’s 2022 annual corporate GHG emissions are 8% lower than in 2018 but show a 1.8% increase compared to 2021. This rise in emissions is partly attributed to the resurgence of municipal operations following the pandemic, as the four-year trend of annual GHG emissions presented in Figure 1 indicates.

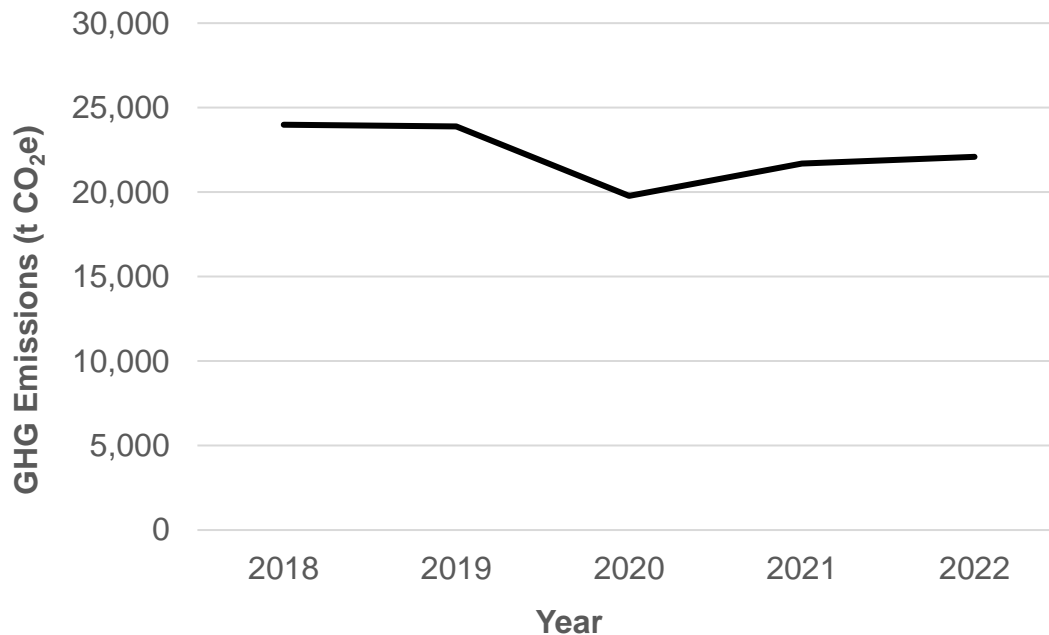


Figure 1. Annual total GHG emissions at the corporate scale from 2018 to 2022. Emissions in 2022 are 8% lower than in 2018.

- Despite the number of municipal buildings increasing, leading to an 8% rise in emissions from Facilities compared to 2021, energy consumption per square foot has actually decreased among all City-owned and operated buildings over time. In 2018, the average GHG footprint for buildings operated by facilities was approximately 3.2 kg CO₂e/ft² and in 2022 that footprint was only 2.76 kg CO₂e/ft². This decrease represents nearly a 13.8% decrease in GHG emissions per area of buildings operated.
- Heating degree days (HDD) saw a near 8% increase from 2021, yet natural gas usage only went up by 3%, and heating oil usage significantly decreased by 69%. This pattern suggests that the City's transition to

alternative heating solutions and improvements in building energy efficiency are beginning to have a measurable effect.

- While cooling degree days (CDD) fell by 18% from the previous year, electricity consumption increased by around 10%. GHG emissions from electricity only increased by about 8%, further illustrating the impact of shifting heating methods to electricity, coupled with the lower GHG emissions associated with electrical power—meaning that increases in electrical use are not resulting in proportional increases in GHG emissions.
- Although there was a 69% decrease in heating oil usage, the cost of heating oil only fell by 47%. This gap highlights the rising costs of fossil fuels and underscores the economic benefits of shifting away from such fuels, beyond the advantage of GHG reduction.
- The transportation and transit sectors remain the largest contributors to corporate emissions, accounting for 56% of the total. Yet, there was a marginal decline in emissions from gasoline and diesel, by 1.6% and 0.14% respectively.
- For the first time, transportation data from the Geotab Telematics Platform was utilized, with 329 City vehicles providing detailed operational insights. This data enabled the application of specific emission factors, which refined the transportation emissions estimate to be approximately 4% lower than previously calculated. As more vehicles are added to the platform in coming years, the accuracy of GHG estimates will improve, enhancing future planning and strategy development.
- Analysis from the Geotab data also identified significant fuel savings potential by transitioning to more efficient vehicles. The average fuel consumption of gasoline vehicles was 20.78 L/100 km, compared to just 6.43 L/100km for hybrids. By converting the current fleet of gasoline vehicles to hybrids, the City could realize a fuel use reduction of nearly 60%. Moreover, the granularity of data gathered from the Geotab Platform doesn't only allow for a more accurate assessment of GHG emissions, but it also enables the City to make more informed decisions regarding sustainability and to strategically address climate change challenges.

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Cover photo: By Andrew MacKinnon - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=206641>

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City of Kingston Corporate GHG Inventory Report – 2022 – Supplemental Information

November 13, 2023

Prepared By:
Greenscale Inc.
Nathan C. Manion

Prepared For:
City of Kingston
Julie Salter-Keane, Manger, Climate Leadership



1. Wastewater & Water Sector Methods

Consumption data for electricity and natural gas for the years 2021 and 2022 were provided by the Utilities Kingston for buildings associated with wastewater and water management services. This data was converted into energy usage, measured in gigajoules (GJ), following the conversion factors outlined by the Canada Energy Regulator (CER 2022). Greenhouse gas emissions, quantified in tonnes of CO₂ equivalent (tCO_{2e}), were calculated using the emission factors for natural gas and electricity as indicated for the years 2021 and 2022 in the National Inventory Reports (ECCC 2022; ECCC 2023). Emission factors for all energy sources are listed in Appendix 1.

Expenditure data for natural gas and electricity in 2021 and 2022 were also provided by the City. The average cost per kilowatt-hour for electricity and per cubic meter for natural gas, as determined from the bills of wastewater and water utilities, was applied to calculate expenditures for other sectors where specific expenditure data was not available.

2. Facilities Sector Methods

Consumption data for electricity, natural gas, fuel oil, and propane in 2021 and 2022 were provided by Utilities Kingston for all buildings and streetlights under municipal management. This consumption data was converted into energy usage (GJ) using the conversion standards from the Canada Energy Regulator (CER 2022). Greenhouse gas emissions, quantified in tonnes of CO₂ equivalent (tCO_{2e}), were determined using emission factors for natural gas and electricity from the National Inventory Reports for the respective years (ECCC 2022; ECCC 2023). Expenditure estimates for natural gas and electricity for 2021 and 2022 were derived using calculations from the wastewater and water sector methods. Total area of all facilities buildings was also provided.

3. Street light Sector Methods

Electricity consumption data for streetlights in 2021 and 2022 was provided by the City of Kingston. This data was transformed into energy use (GJ) based on energy conversion factors from the Canada Energy Regulator (CER 2022), and greenhouse gas emissions (tCO_{2e}) were assessed using emission factors from the National Inventory Reports for the respective years (ECCC 2022; ECCC 2023). The expenditure for streetlight electricity was derived using the average electricity price calculated for the wastewater and water sector.

4. Transportation Methods

The City of Kingston supplied data on total diesel and gasoline consumption for the municipal fleet for the years 2021 and 2022. Additionally, information on electricity usage from electric vehicle (EV) charging stations with dedicated meters was provided. An estimate of the share of electricity consumed by EV chargers connected to the meters of City-owned facilities was also made available. This consumption data was translated into energy usage (GJ) using conversion factors from the Canada Energy Regulator (CER 2022). Greenhouse gas emissions (tCO_{2e}) were deduced by applying emission factors from the National Inventory Reports corresponding to 2021 and 2022 (ECCC 2022; ECCC 2023). Expenditure data for gasoline and diesel was directly provided by the city. For EV charging in 2021 and 2022, expenditures were estimated using the average price per kWh extracted from the city's electricity billing information.

5. Waste Methods

For the corporate inventory, the established emission factor of 0.5 tonnes of CO₂ equivalent (tCO_{2e}) per tonne of waste was utilized. This factor is consistent with the one previously applied in community inventories. Additionally, it was assumed that 0.5 tonnes of waste is generated per employee.

6. Reporting Methods

This section refers to the findings detailed in Table 1 and Table 2 within the Corporate GHG Inventory Report. Table 1 organizes emissions data by sector, revealing the sectors with the highest emissions impact. Conversely, Table 2 details the emissions associated with each sector by the type of energy source utilized. The greenhouse gas emissions totals presented in Table 1 of the Corporate GHG Inventory Report are slightly higher than those in Table 2. This is because Table 1 encompasses emissions from the Waste sector, which primarily originate from biological processes leading to methane generation, as opposed to emissions generated from consuming energy resources such as natural gas or electricity, which are accounted for in Table 2.

7. Future Methodological Recommendations

- The existing approach to estimating waste emissions applies a uniform emission factor across all waste types generated by the City. To improve the accuracy of the City's waste emissions profile, it is advised that the waste emissions methodology be refined by initiating comprehensive tracking of both the volume and the variety of waste produced. This will allow for the application of distinct emission factors tailored to each waste category, yielding a more precise representation of the City's waste-associated greenhouse gas contributions.

Appendix 1. GHG Emission Factors used and their sources.

Emission Source	Unit	2021	2022	Sources
Electricity	g CO ₂ e/kWh	30.00	30.00	ECCC 2023, IESO 2021
Natural Gas	g CO ₂ /m ³	1888	1921	ECCC 2023
	g CH ₄ /m ³	0.037	0.037	
	g N ₂ O/m ³	0.035	0.035	
	g CO ₂ e/m ³	1899	1932	
Light Fuel Oil	g CO ₂ /L	2753	2753	ECCC 2023
	g CH ₄ /L	0.026	0.026	
	g N ₂ O/L	0.031	0.006	
	g CO ₂ e/L	2763	2755	
Propane	g CO ₂ /L	1515	1515	ECCC 2023
	g CH ₄ /L	0.027	0.027	
	g N ₂ O/L	0.108	0.108	
	g CO ₂ e/L	1548	1548	
Gasoline	g CO ₂ /L	2307	2307	ECCC 2023
	g CH ₄ /L	0.210	0.210	
	g N ₂ O/L	0.660	0.660	
	g CO ₂ e/L	2509	2509	
Diesel	g CO ₂ /L	2681	2681	ECCC 2023
	g CH ₄ /L	0.140	0.140	
	g N ₂ O/L	0.082	0.082	
	g CO ₂ e/L	2708	2708	

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