St. John's Energy and Greenhouse Gas Inventory

(2018)

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Executive Summary

The City of St. John's is part of the Federation of Canadian Municipalities' (FCM) Partners for Climate Protection (PCP) Program (since 2000), which outlines a five-step Milestone Framework that guides municipalities as they improve sustainability and reduce greenhouse gas emissions (GHGs) (Figure 1).

This document presents the results of the PCP Framework's Milestone 1, which sets the baseline by estimating current energy use and greenhouse gas (GHG) emissions from the whole community of the City of St. John's and the corporate operations of the City of St. John's. The GHG inventory was prepared in conformance with PCP Guidance and is ISO 14064-1 compliant. This milestone is an important first step which identifies sources of emissions and tracks cost of energy used to enable planning to lower energy use, costs, and GHG emissions.

Figure 1 PCP five milestone framework.

In 2018, the Community of the City of St. John's consumed approximately 14.4 million gigajoules (GJ) of energy, which emitted 667 thousand tonnes of carbon dioxide equivalents (tCO_2e). Electricity, gasoline, and fuel oil contributed the most to the energy used (44%, 39%, and 15% respectively). Gasoline, fuel oil, propane, and the GHGs produced in the generation and transmission of the electricity contributed approximately 91% of the total GHG emissions (56%, 24%, 11% respectively). Transportation consumed approximately 41% of the energy use (gasoline and diesel) and emitted 59% of the community's GHGs. The institutional/commercial/industrial sector consumed 31% of the energy and emitted 23% of the GHG emissions.

Corporately in 2018, the City of St. John's operations and services consumed 365,624 GJ of energy, which emitted 12,457 tCO_2e (approximately 2% of the community inventory). Electricity, diesel and fuel oil contributed the most to the corporate energy consumption (60%, 20%, and 12% respectively). The City of St. John's water, facilities, and transportation consumed 30%, 26% and 24% of the energy used in 2018. Streetlights contributed the most to the cost of energy (32%). Diesel and fuel oil contributed 41% and 26% to the corporate GHG emissions. The corporate transportation sector accounted for 48% of the total GHG emissions of the corporate City of St. John's. Emissions from the operations of facilities accounted for 25% and drinking water infrastructure (production and distribution) accounted for 13%.

In a business-as-usual scenario, the community energy use is estimated to increase to approximately 15,152,184 GJ (+5.5%), while GHG emission decrease to 628,925 tCO2e (- 5.7%) by 2030. Corporately, energy consumption is estimated to rise to approximately 385,584 GJ (+5%) by 2030, while GHG emissions decreasing to 10,549 tCO2e (-15.3%). In this scenario, gasoline and fuel oil consumption are assumed to remain as the major sources of GHG emissions for both community and corporate inventories. The reductions in GHG emissions in these projections are due to the Province's electric generation changed to hydropower in the lower Churchill River.

Background

The City of St. John's is home to over 108,860 people (2016 census) in over 47,625 households. The City released the 2019-2029 Strategic Plan setting the vision of St. John's being progressive, shaped by its geography and history, and a place where people want to live and feel they belong. The Strategic Plan sets four Strategic Directions, including St. John's becoming "A Sustainable City".

The City of St. John's has been part of the Federation of Canadian Municipalities' (FCM) Partners for Climate Protection (PCP) Program since 2000. This is a five-step Milestone Framework that guides municipalities as they improve sustainability and reduce greenhouse gas emissions (GHGs). This document presents the results of the quantification of the current energy use and GHG emissions from the corporate operations of the City of St. John's. This corresponds to Milestone 1 in the five milestone PCP framework. The insights available in this report serve as a foundation to inform energy efficiency and climate change actions, as well as supporting monitoring within the City. The five milestones are:

Milestone 1 — Create a baseline emissions inventory and forecast
Milestone 2 — Set emissions reduction targets
Milestone 3 — Develop a local action plan
Milestone 4 — Implement the local action plan
Milestone 5 — Monitor progress and report results

What is Climate Change?

Climate change is a term used to describe changes in long-term weather patterns (for example the difference between weather events in 1948 and 2016). Global warming usually refers to the increased average temperature of the air on earth due to climate change.

Human activities in the last 100 years, like burning of fossil fuels and significant changes in land use, increased GHGs in the air. While GHG levels may have been higher on our planet in the past, current GHG levels are the highest in millions of years and the highest levels in human history (Our species, *Homo sapiens*, evolved around 300,000 years ago) . In May 2019 global levels of carbon dioxide reached a 3 million-year record high.

This increase means more heat from the sun stays within our planet. This energy circulates in our systems (air, ocean, land, ice, etc.) and we see it as increases in temperature of the air and ocean, melting of icecaps, strengthening of hurricanes, changes in flows of air (e.g., polar vortex), etc. It is estimated that the last time carbon dioxide in the atmosphere was as high as it is currently, the Antarctica was plant-covered, sea levels were 10 to 20 meters higher, and global temperatures were an average of 2 to 3 degrees Celsius warmer. In the Arctic, summer temperatures were approximately 14 degrees higher.

Concentrations this high of GHGs can cause among other things, an increase in air pollution-related deaths (e.g., asthma, bronchitis, allergies, lung and heart disease), slowing of human's mental capacity, and climate change. Not everywhere in the world is affected in the same way, and the scientific community studies these changes to help us understand what we can expect for the near, medium, and long-term future. This report outlines how the City operations and services contribute to the emission of GHGs.

What is Climate Action?

Climate action or Climate Change Action involves two broad responses:

- **Mitigation**: lowering greenhouse gases (GHGs) in the air; which contribute to air, water and the overall environment's pollution, as well as climate change.
    - For example: using public transportation, cycling or walking more, lowering use of fossil fuels (diesel, gasoline, oil, propane), protecting the natural environment.
- **Adaptation:** preparing for and dealing with the impacts of the already existing and projected increases in GHGs, like climate change.
    - For example: infrastructure upgrades, conserving and restoring our natural resources, local innovation and social networks, planning for disaster response, local foods, etc.

Climate Action by The City of St. John's

Although this report initiates the current process of quantifying energy use and emissions of the City's operations, the City of St. John's ongoingly pursues energy efficiency and implements sustainable practices that result in mitigation of GHG emissions and adaptation to climate change impacts, past actions include:

- Riverhead Anaerobic Digester and re-use of biogas
- Robin Hood Bay Landfill Gas capture and destruction
- Geothermal and heat recovery systems for City owned facilities
- Natural area stewardship
- Implementation of updated provincial floodplain mapping
- Emergency Management and Plan updates
- Save a Drop Water Conservation Order
- National Water Benchmarking Initiative
- Robinhood Bay Recycling
- Christmas Tree Recycling
- Backyard Composting information sessions
- Implementation of roundabouts
- Winter maintenance benchmarking
- Sustainable transportation: Bike St. John's Master Plan, Market Assessment and Strategic Directions Study

What is an Energy and Emission Inventory?

An energy and emission inventory estimates the energy use and GHG emissions generated because of a local government's operations and services within a specific time period. In this case the year 2018 was selected as a baseline year. This represents the energy use and emissions of the City of St. John's that we see today and seek to improve.

Purpose of The Inventory

The ultimate purpose of this inventory is to mitigate the impacts of climate change. The inventory is a management tool that is used to:

- **Set a reference point**, which helps in the establishment of an ambitious but realistic corporate GHG reduction target.
- **Take action** by identifying significant sources of GHG emissions and energy use. This is necessary to inform sustainability planning and to support evidence-based decision making.
- **Save money** by tracking dollars spent on energy. The inventory can reveal opportunities for investment in energy efficiency and co-benefits for resilience. It improves the characterization of the opportunities and that way opens funding opportunities for energy and resilience projects (e.g., FCM's Green Municipal Fund, NL Climate Change Challenge Fund).
- **Potentially participate in carbon trading**. A verifiable GHG emissions inventory helps the municipality in participating in the voluntary carbon trading market and may be required in future regulated markets.

Method

The City of St. John's Energy and Greenhouse Gas Inventory for 2018 report was prepared in conformance with the CSA/ISO 14064-1 standard. The inventory follows requirements of the Partners for Climate Protection (PCP) Protocol and incorporates refinements from the 2019 IPCC Guidelines for National Greenhouse Gas Inventories and the Greenhouse Gas Protocol (e.g., Global Warming Potential for Methane is 28 and Global Warming Potential for Nitrous Oxide is 265).

Community Energy and Emissions Inventory (2018)

What is Included in the Community Inventory?

This chapter focuses on the community inventory. A community inventory measures the energy use and GHG emissions generated by key activities within the selected boundary of the City of St. John's. This would include items such as energy consumption in residential and commercial buildings, industrial processes, on-road transportation (including public transit), and overall emissions generated from waste water and solid waste. The relationship between the two types of inventories is shown in Figure 2.

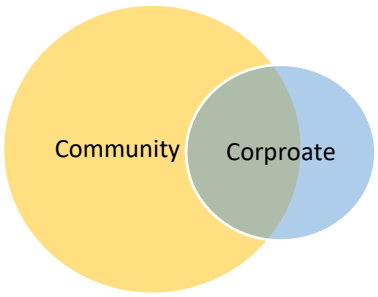

Figure 2 Source: Relationship between Community and Corporate Energy and Emissions Inventories.

The community inventory boundaries were defined in accordance to the guideline of the PCP program. The inventory is reported in four sectors due to data availability and analysis limitations. A significantly greater effort would be required to further quantify sub-sectors within the entire community's energy use and GHG emissions. The data is reported in the following sectors:

- Residential
- Institutional/Commercial/Industrial (ICI)
- Transportation
- Waste

It is best practice to refer to the energy use and emission sources as "Scopes". There are 3 Scopes in the most common inventory frameworks. Based on the PCP protocol, the community inventory sets out to quantify energy use and GHG emissions of Scopes 1 and 2 for which reliable data was available. Future versions of the inventory may incorporate other aspects of the community as data availability and methods are available for the community.

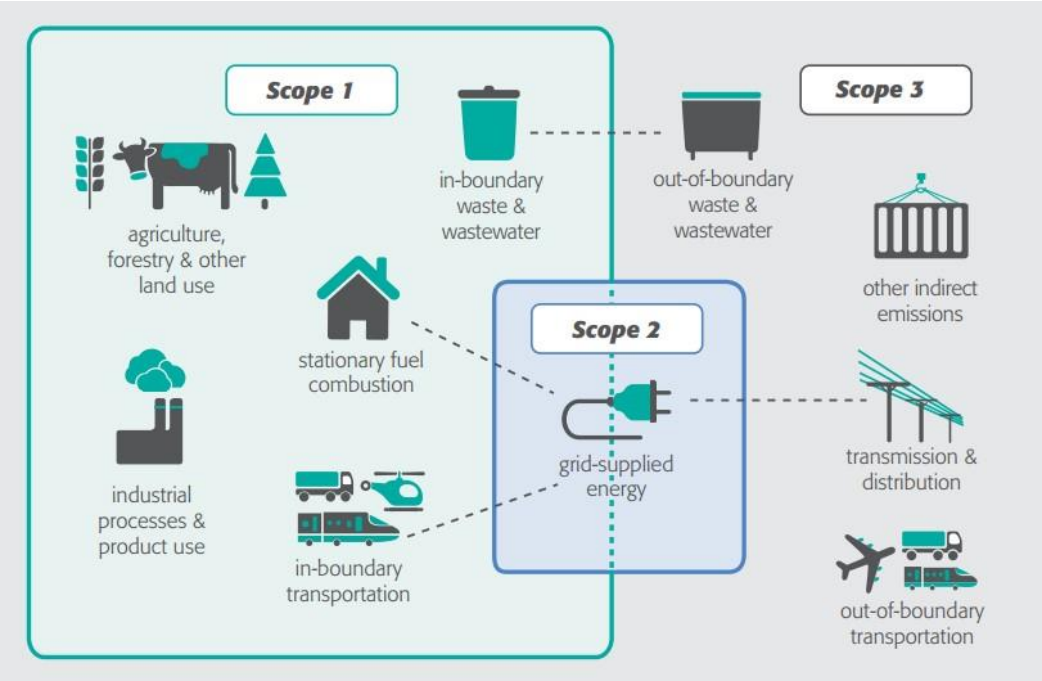

Figure 3 Emissions Scopes for Communities (Source: Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories)

Table 1 Community energy and GHG inventory boundary and scope.

2018 Inventory		**Details**
Protocol		Sectors: residential, industrial, commercial, institutional, transportation, and waste.
Boundary	Geo-political	All emissions associated with activities within the boundary of the Municipality of the City of St. John's
Scope	S1 & S2	Stationary: S1: Decentralized fuel consumption S2: Decentralized electricity consumption Transport: S1: Tailpipe from on-road vehicles Solid Waste: S1: Emissions from landfilled solid waste (portion contributed by geo-political boundary) Waste water: S1: Emissions from waste water (portion contributed by geo-political boundary)

Data Sources

Table 2 Summary of inventory data sources and data quality.

Source	Confidence	Data Sources
Electricity	High	Newfoundland Power; St. John's City Census 2016; NL Department of Finance Population Projections
Fuel Oil	Medium	NRCAN Comprehensive Energy Use Database table for NL; Electricity Consumption within City Boundary; St. John's City Census 2016; NL Department of Finance Population Projections
Propane	Low	NRCAN Comprehensive Energy Use Database table for NL; Electricity Consumption within City Boundary; St. John's City Census 2016; NL Department of Finance Population Projections
Gasoline	High	Kent Marketing fuel volumes; St. John's City Census 2016; NL Department of Finance Population Projections
Diesel	High	Kent Marketing fuel volumes; St. John's City Census 2016; NL Department of Finance Population Projections
Waste	Medium	On-site measurements; St. John's City Census 2016; NL Department of Finance Population Projections
Waste water	High	On-site measurements; St. John's City Census 2016; NL Department of Finance Population Projections

*Legend: High – Actual usage data from a credible collection method and/or provider.
Medium – Actual usage complemented with assumptions to make it relevant to the geographic boundary selected.
Low – Actual usage complemented with assumptions to make it relevant to the geographic boundary selected, but with greater variability.

Overall Analysis for Community of CSJ

In 2018, the Community of the City St. John's consumed approximately 14,367,865 GJ of energy. Electricity, fuel oil and gasoline contributed the most to the energy consumption (44%, 15%, 39% respectively) and to the energy cost, which was estimated to be approximately $502 million. The Community of the City of St. John's emitted approximately 667,113 tCO_2e. Fuel oil, gasoline, propane, and the GHGs produced in the generation and transmission of the electricity contributed approximately 91% of the total emissions.

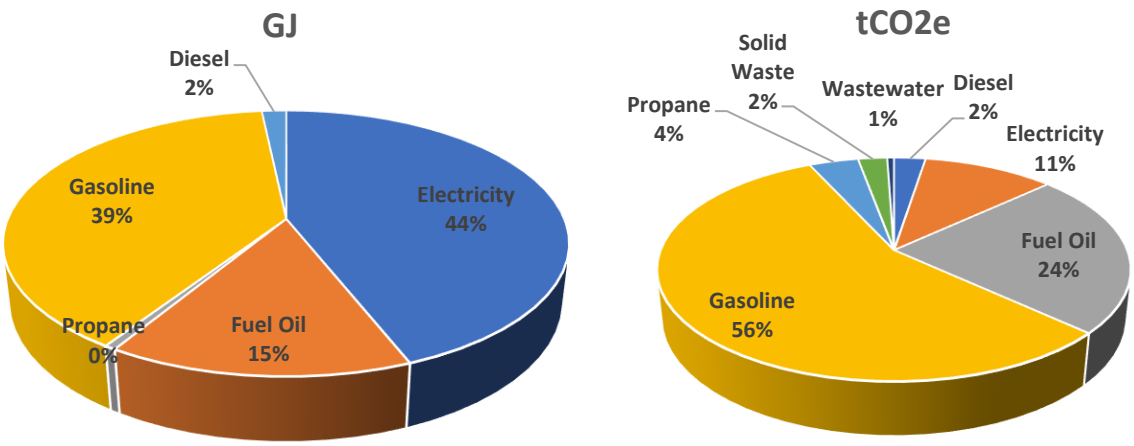

Figure 4 Overall energy use and greenhouse gas emission by energy source for the community of St. John's.

Table 3 Energy Consumption, Cost, and GHG Emissions by Energy Source

Sector	GJ	tCO_2e	Cost ($M)
Electricity	6,322,320	70,743	$212
Fuel Oil	2,106,466	158,061	$53.4
Propane	79,974	26,434	$ 14
Gasoline	5,619,768	375,638	$214
Diesel	239,337	16,945	$8.6
Total	**14,367,865**	**667,113**	**$502**

From a sector perspective, transportation sector with a consumption of 5.8 million GJ in fossil fuels and 392 thousand tonnes of CO_2e. The Institutional/Commercial/Industrial (ICI) sector consumed 4.5 million GJ of energy and emitted approximately 153,208 tonnes of CO_2e. The residential sector was third with a consumption of 4 million GJ, which emitted approximately 102,029 tonnes of CO_2e.

The provincial estimates for energy use and emissions for fuel oil and propane of the Institutional/ Commercial/ Industrial (ICI) sector are not available from the NRCAN Comprehensive Energy Use Database or other datasets. In order to fill this gap, electricity consumption data for this sector within the City boundary was used to estimate the respective fuel oil and propane consumption. This was done by applying the ratios estimated from the Atlantic Canada NRCAN dataset to City electricity data. The ratios for energy use applied were as follows:

Table 4 Ratios of Energy Use for Propane and Fuel Oil in the ICI sector

Energy Source	% of Electricity Energy Use
Propane	1.6%
Fuel Oil	4.0%

Source: NRCAN Comprehensive Energy Use Database table for NL

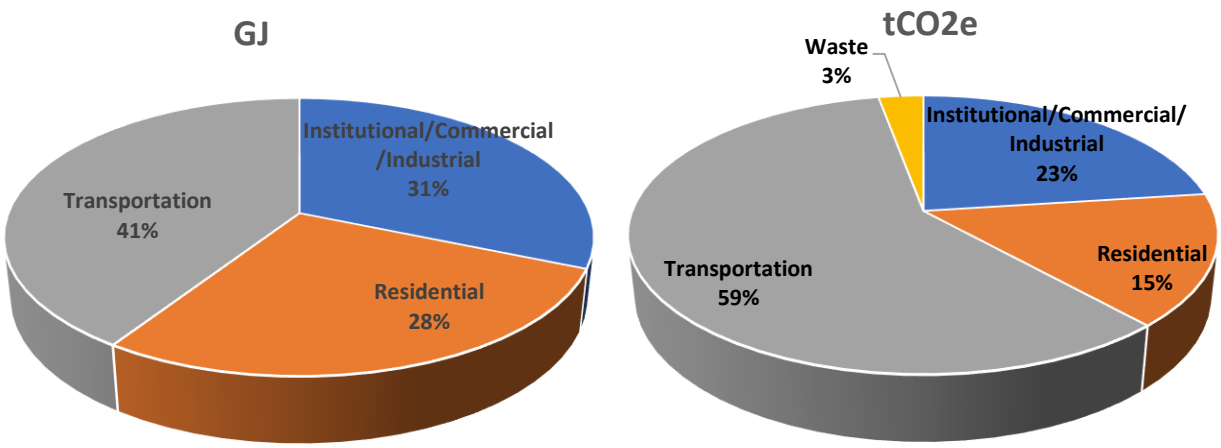

Figure 5 Overall energy use and greenhouse gas emission by sector for the community of St. John's.

Table 5 Energy Consumption, Cost, and GHG Emissions by Energy Source.

Sector	GJ	tCO_2e	Cost ($M)
Waste	-	19,294	$ -
Transportation	5,859,105	392,583	$ 223
Institutional/Commercial/Industrial	4,499,073	153,208	$ 151
Residential	4,009,686	102,029	$ 127
Total	**14,367,865**	**667,113**	**$ 502**

Community Sector Based Analysis

Waste

Waste was incorporated as a source of emissions within the 2018 inventory. This sector refers to the emissions related to the landfill gases generated by landfilled solid waste, as well as the biogas generated through the treatment of waste water. In 2018, this sector accounted for approximately 3% of the community's emissions.

Source	tCO_2e
Solid waste	15,631
Waste water	3,662
Total	**19,294**

Transportation

The transportation sector consumed 41% of the total energy in the community of the City of St. John's. This was mostly (96%) in the form of gasoline. This energy usage emitted approximately 59% of the total community of St. John's emissions, which can mostly be attributed to gasoline use (96%).

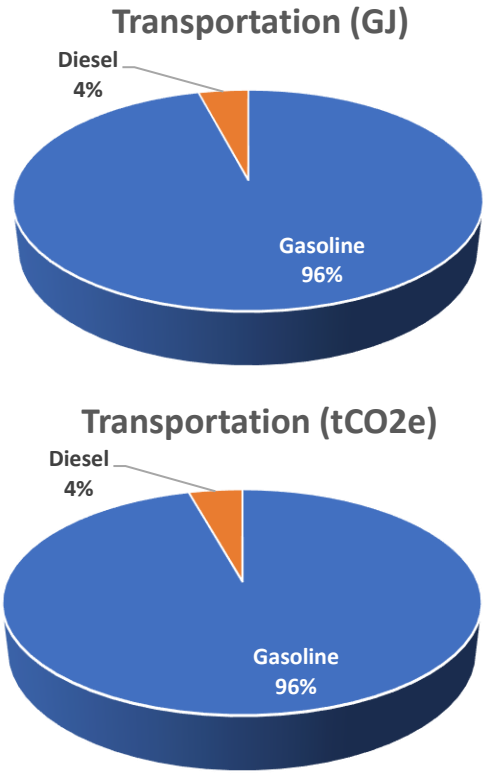

Figure 6 Overall energy use and greenhouse gas emission for the transportation sector of the community of St. John's.

Table 6 Energy Consumption, Cost, and GHG Emissions by Energy Source.

Energy Source	GJ	tCO_2e
Diesel	239,337	16,945
Gasoline	5,619,768	375,638
Total	**5,859,105**	**392,582**

Institutional/Commercial/Industrial

The Institutional/Commercial/Industrial sector (ICI) consumed 31%% of the total energy in the community of the City of St. John's. This sector's energy usage emitted approximately 23% of the total community of St. John's emissions, which can mostly be attributed to fuel oil (62%). This percentage is expected to increase as the emissions associated with electricity production and transmission are reduced. Further information is provided in the community projections.

Metrobus

In 2018, Metrobus consumed 79,786 GJ of energy and emitted 5,012.8 tonnes of Carbon Dioxide Equivalents (tCO2e). This is approximately 1.28% of the Transportation sector, and 0.75% of the entire Community's emissions.

Metrobus' emissions come mostly from Diesel (97%) consumed entirely by the fleet, the geothermal and fully electric LEED-certified Depot contributes under 2% of the emissions (118.9 tCO2e).

Energy Use

- 86% Diesel
- 1% Gasoline
- 13% Electricity

Emissions

- 97% Diesel
- 1% Gasoline
- 2% Electricity

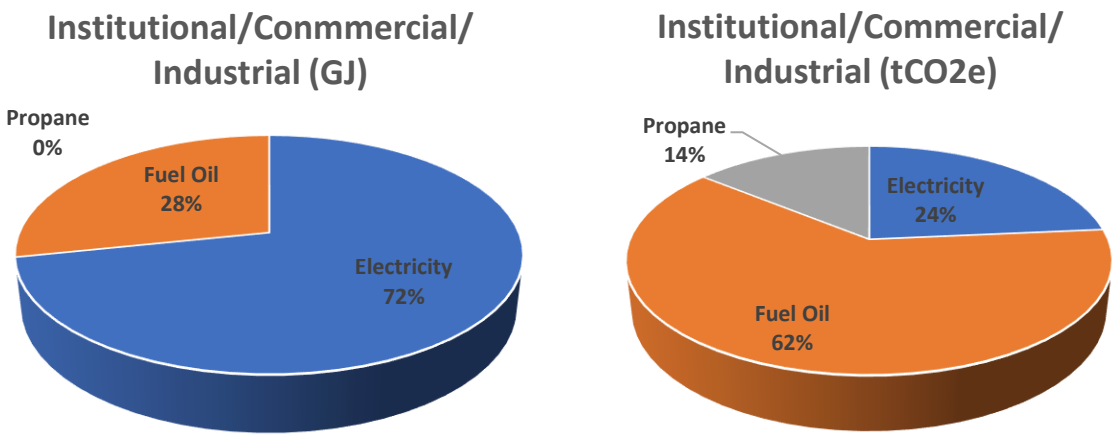

Figure 7 Overall energy use and greenhouse gas emission for the ICI sector of the community of St. John's.

Table 7 Energy Consumption, Cost, and GHG Emissions by Energy Source.

Energy Source	GJ	tCO_2e
Electricity	3,226,320	36,101
Fuel Oil	6,577,469	95,463
Propane	2,703	21,644
Total	**4,499,073**	**153,208**

Residential

The residential sector consumed 28% of the total energy in the community of the City of St. John's. This was mostly (77%) in the form of electricity, and fuel oil for heating (21%). This sector's energy usage emitted approximately 15% of the total community of St. John's emissions, which can mostly be attributed to fuel oil use (61%). This percentage is expected to increase (>90%) as the emissions associated with electricity production and transmission are reduced. Further information is provided in the community projections.

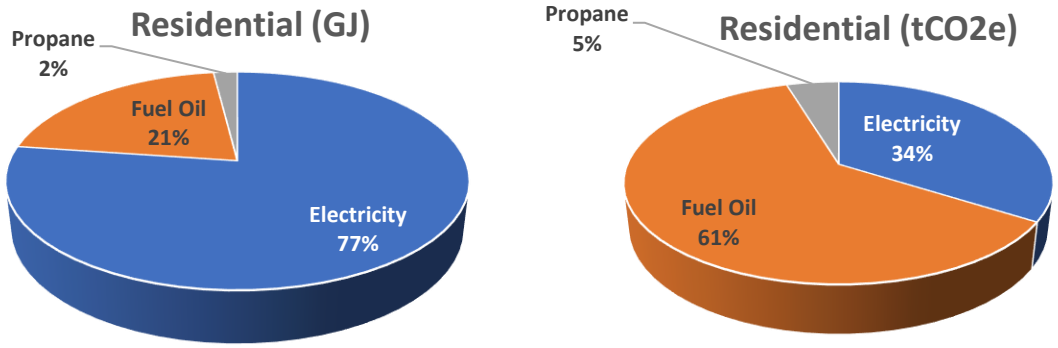

Figure 8 Overall energy use and greenhouse gas emission for the residential sector of the community of St. John's.

Table 8 Energy Consumption, Cost, and GHG Emissions by Energy Source.

Energy Source	GJ	tCO_2e
Electricity	3,096,000	344,642
Fuel Oil	834,235	62,598
Propane	79,451	4,789
Total	**4,009,686**	**412,029**

The Average Household Emissions

In 2018, St. John's had approximately 52,783 private dwellings. According to the Newfoundland and Labrador Conservation Potential Study[1], St. John's likely has approximately 72% of its homes heated with electricity or wood burning systems, and approximately 28% heated with fuel oil systems. Based on this, estimates were developed for two "average" households in the City of St. John's. A third type may be a household heated by wood, which would have a similar emission profile to an electric heated home for the purpose of this inventory (emissions from biomass are considered of biogenic source and therefore usually not reported in GHG inventories), therefore, it was not fully estimated in this report.

The household estimates presented here were developed through a mix of local (electricity, gasoline), provincial (fuel oil and propane), and regional (waste and wastewater) data and assumptions for illustration purposes. More household information is needed to accurately understand the complete emissions of a household and the costs associated with them.

Table 9 Estimated Energy Requirements for Households (1,500 Sq Ft) in St. John's.

Heated by Electricity	Heated with Oil
Electricity - 12,880 kWh (56%) space heating - 10,120 kWh (44%) other electricity uses	Fuel Oil - 1,465.9 L [a] Electricity - 10,120 kWh Electricity
Propane - 58.8 L per year Gasoline - 2,150.3 L per year [b] Solid Waste - 30.7 m^3 of Landfill Gases produced per year [c] Wastewater - 430,103 L per year [d]	

[a] Assuming 56 GJ of energy needed to heat a home, an 80% efficient system and an energy conversion of 36.72 GJ/m^3 of oil.
[b] Assuming 70% of gasoline consumption in the Transportation sector is used by households.
[c] Assuming 34% of the landfill gas production is due to residential waste (Source: https://www.engagenl.ca/sites/default/files/nl_waste_management_strategy_2002.pdf).
[d] Assuming 474 L/capita/day (Source: https://www150.statcan.gc.ca/n1/daily-quotidien/190611/dq190611b-eng.htm) plus 13% leakage (https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf), 2.2 people per household (based on Census 2016) and an emission factor of 0.0000908 tCO2e/L for process based emissions at the treatment facility.

Table 10 Estimated energy use, emissions and annual cost for a 1,500 sqft electricity heated household.

Source	Energy Use	2018 Emissions (tCO2e)	Annual Cost ($)
Electricity	23,000 kWh	0.93	$ 2,774
Fuel Oil	-	-	$ -
Propane	59 L	0.09	$ 48
Gasoline	2,150.27 L	4.98	$ 2,839
Solid Waste	30.69 m^3	0.30	$ -
Wastewater	430,103 L	0.04	$ -
Total		6.34	$ 5,661

[1] Dunsky Energy Consulting. 2019. Newfoundland and Labrador Conservation Potential Study [2020-2034] - Volume 1 and 2. Submitted to Newfoundland Power Inc. and Newfoundland and Labrador Hydro.

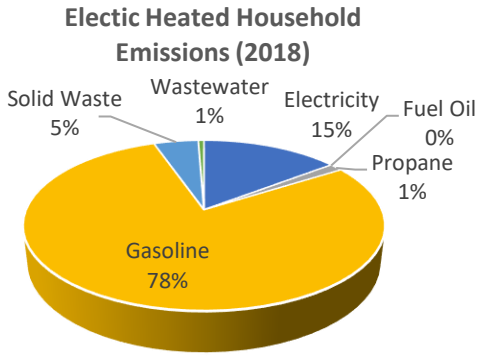

Figure 9 Overall greenhouse gas emissions for electric heated household.

Table 11 Estimated energy use, emissions and annual cost for a 1,500 sqft Fuel Oil heated household.

Source	Energy Use	Emissions (tCO2e)	Annual Cost ($)
Electricity	10,120 kWh	0.41	$ 1,220
Fuel Oil*	1,466 L	4.04	$ 1,420
Propane	59 L	0.09	$ 48
Gasoline	2,150 L	4.98	$ 2,839
Solid Waste	30.69 m^3	0.3	$ -
Wastewater	430,103 L	0.04	$ -
Total		9.86	$ 5,527

**Assuming an Annual Furnace Efficiency (AFUE) of 80%.*

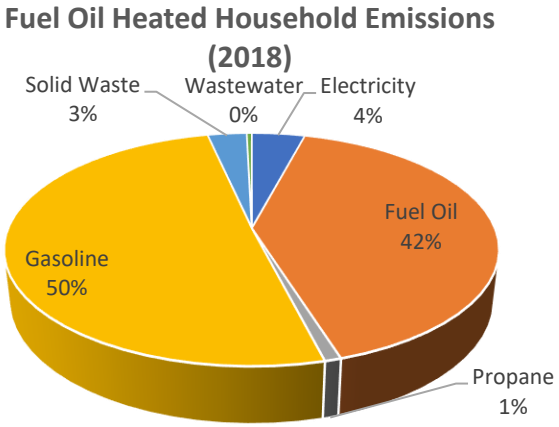

Figure 10 Overall greenhouse gas emissions for fuel oil heated household.

Based on these scenarios, each household spends an average of $460-470 per month on energy. The electric heated household emits 30-40% less per year than the Fuel Oil heated household. Household-specific data is needed to ground truth these estimates and to validate any potential GHG reductions and costs. In this scenario we assumed electric baseboards or a new oil furnace (AFUE of 80%). However, an AFUE of 80% for a Fuel Oil furnace assumes near-perfect conditions.

Corporate Energy and Emissions Inventory (2018)

What is Included in the Corporate Inventory?

This chapter focuses on the corporate inventory, a subsector of the broader community emissions. The corporate inventory boundaries were defined in accordance to the guideline of the PCP program, which recommends that the inventory be defined by the concept of "Operational Control Approach".

It includes the energy use and GHG emissions generated by the provision of six traditional local government services (For more information see "The Workbook: Helping Local Governments Understand How to be Carbon Neutral in their Corporate Operations") including:

- Administration and governance
- Drinking, storm, and waste water
- Fleet, solid waste collection, and waste diversion
- Roads and traffic operations
- Arts, recreation and cultural services
- Fire protection

The energy use and emissions associated with the provision of the services was separated into the following sectors: transportation, facilities, water, waste water, solid waste, streetlights.

Operational Control Approach

A local government is considered to have operational control if it has the full authority to introduce and implement operating policies at the operations. This is typically established by:

- Local government wholly owns the operation, facility or sources; or
- The municipality has full authority to implement operational and health, safety and environmental policies.

PCP Framework

It is best practice to refer to the energy use and emission sources as "Scopes" to attribute ownership of emissions. As this inventory is focused on operational control, it sets out to quantify energy use and GHG emissions of Scopes 1 and 2. Some scope 3 (business purpose mileage [not all business travel was included due to data limitations, commuting was also excluded]) energy use and emissions were included due to the nature of the emissions being somewhat within the City's control and commonly in municipal corporate inventories.

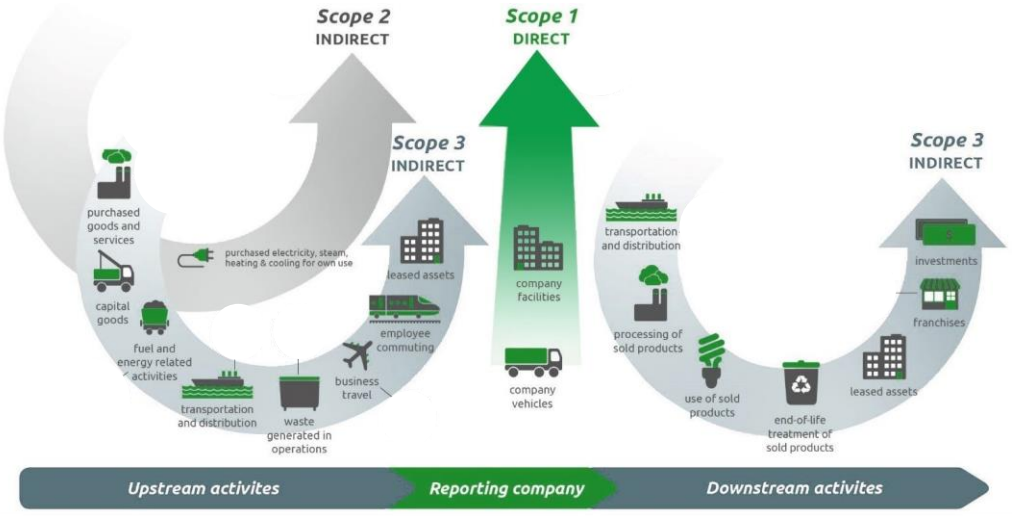

Figure 11 Example of Scope 1,2, and 3 Emissions in Corporate Emission Inventories (Source: GHG Protocol).

What is Not Included?

Emissions from St. John's Sports and Entertainment, St. John's Transportation Commission, and other emissions from the Community (e.g., vehicles, housing, buildings, solid waste generated by the Community). The emissions from these operations were included in the Community portion of the inventory. Scope 3 emissions are not included (e.g. shipping, business travel, international travel, purchased goods and services) in this inventory due to data availability, however, they may be incorporated in future updates to the inventory as more reliable data becomes available.

Data Sources

Data was collected from available sources of energy data including bills, the City's expense tracking system, and fuel market prices, estimates using a combination of data sources were used to fill data gaps where necessary.

Table 12 Data sources for energy use and cost.

Source	Confidence	Data Sources
Gasoline	High	Supplier Bills; City Budget, expense reports, and fuel pump data
Diesel	High	Supplier Bills; City Budget, expense reports, and fuel pump data
Electricity	High	Newfoundland Power; City Budget and expense reports
Fuel Oil	High	Supplier Bills; City Budget and expense reports
Propane	Medium	Supplier Bills; City Budget and expense reports
Biogas	High	Meters On-Site
Solid Waste	Low	Contract; Provincial Buildings Waste Audit

Overall Analysis for Corporate CSJ

In 2018, the City consumed approximately 365,624 GJ of energy (approximately 1.6% of total community energy use). Electricity, diesel and fuel oil contributed the most to the energy consumption (60%, 20%, and 12% respectively) and to the energy cost, which was estimated to be approximately $12 million. The City of St. John's emitted approximately 12,458 tCO_2e (approximately 1% of total community GHG emissions), which is equivalent to driving a car to Vancouver and back 3,500 times (assuming a vehicle fuel efficiency of 7.8 km/l) . Diesel, fuel oil and the GHGs produced in the generation and transmission of the electricity contributed the most to the energy consumption (41%, 26%, and 20% respectively).

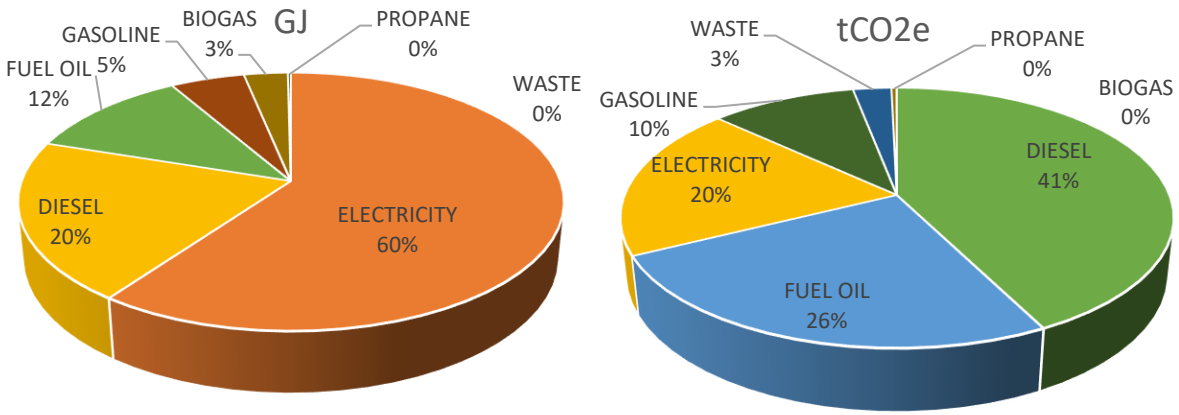

Figure 12 Comparison of Energy Consumption and GHG emissions by Energy Source

Table 13 Comparison of Energy Consumption by Energy Source

Energy	tCO2e	GJ	Cost ($M)
FUEL OIL	3,180	42,281.5	$0.9
ELECTRICITY	2,454	219,322.6	$8.6
DIESEL	5,184	73,403.4	$1.7
GASOLINE	1,255	18,769.4	$0.5
WASTE	336.3	-	-
PROPANE	45.5	755.6	$0.02
BIOGAS	2.7	11,092.1	-
Total	**12,458**	**365,624.6**	**$12**

From a sector perspective, water, facilities, and transportation were the highest energy consumers in 2018, followed by waste water and streetlights. However, streetlights contributed the most to the cost of energy used (32%). Billing for streetlighting from the local utility is based on a monthly rate and not a per-kWh rate. This means that there are other factors embedded in the cost for streetlighting, and the price is based on a variety of factors including the poles, the type of light (e.g., High Pressure Sodium vs Light Emitting Diode).

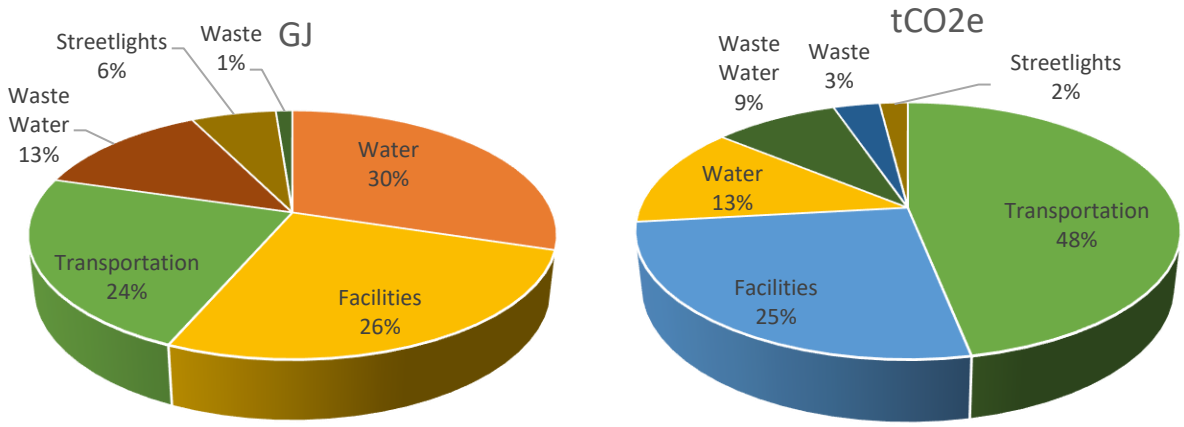

Figure 13 Comparison of Energy Consumption and GHG Emissions by Sector

Table 14 Comparison of Energy Consumption and GHG Emissions by Sector

Sector	tCO2e	GJ	Cost ($M)
Facilities	3,126	95,436	$2.3
Transportation	5,923	85,037	$2.4
Water	1,622	109,839	$2.5
Waste Water	1,118	48,116	$0.9
Waste	413	4,427	$0.1
Streetlights	253	22,768	$3.9
Total	**12,458**	**365,625**	**$12**

The Transportation sector (this sector includes the corporate fleet as well as some miscellaneous use of fossil fuels) accounted for 48% of the total GHG emissions of the corporate operations and services of the City of St. John's. Emissions from the operations of Facilities accounted for 25%, and the emissions

associated with Water (production and distribution) accounted for 13%. More detail is provided in each sector's analysis section in this report.

Corporate Sector Analysis

Transportation

In 2018, the transportation sector accounted for 24% of the total corporate energy use (85,037 GJ) and 48% of the total corporate GHG emissions (5,923 tonnes). This sector includes the corporate fleet as well as some miscellaneous use of fossil fuels (e.g., propane used by forklifts, propane for maintenance of roads and sidewalks, estimate of fuel consumed by staff in personal vehicles as needed for municipal operations [excludes commuting and long travel], and other miscellaneous uses of gasoline and diesel fuels). This sector's energy consumption was mostly diesel (78%) and gasoline (22%). This produced 5,919 tonnes of GHG emissions 78% from diesel and 22% from gasoline. Diesel in the Transportation sector accounted for 37% of the total corporate GHG emissions, while gasoline accounted for 10%.

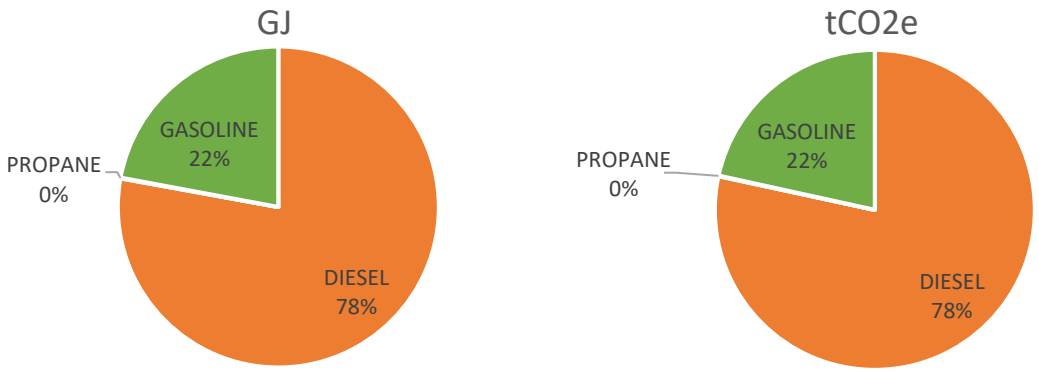

Figure 14 Comparison of GHG Emissions by Energy Source.

Table 15 Energy Consumption, Cost, and GHG Emissions by Energy Source

Energy	GJ	tCO2e	Cost ($M)
DIESEL	66,207.9	4,665	1.5
GASOLINE	18,769.4	1,255	0.4
PROPANE	60.0	3.6	<0.002
Total	**85,037.3**	**5,923**	**1.9**

The largest energy user in the transportation sector in 2018 was the Heavy-Duty Diesel fleet. This includes vehicles used for large and essential municipal operations such as snow clearing, garbage collection, and landfill management. The GHG emissions follow the same pattern, Heavy-Duty vehicles emitted 72% and Light-Duty vehicles emitted 21% (diesel and gasoline) of the Transportation sector GHG emissions (Figure 15). Estimated costs in this sector showed the following breakdown: diesel for Heavy-Duty vehicles was approximately 72% and gasoline for Light-Duty vehicles was 18% of the total cost ($2.3 M). Heavy-Duty diesel vehicles account for 34% of the total corporate GHG emissions, while Light-Duty accounts for 10%.

Table 16 Energy Consumption, Cost, and GHG Emissions by Category

Description	GJ	tCO2e	% Corp. Total GHGs
Heavy-Duty	60,709	4,275	34%
Light-Duty	18,331	1,239	10%
Fire Protection	2,618	181	1.4%
Miscellaneous	1,872	126	1%
Rentals	1,508	101	>1%
Total	**85,037**	**5,923**	**48%**

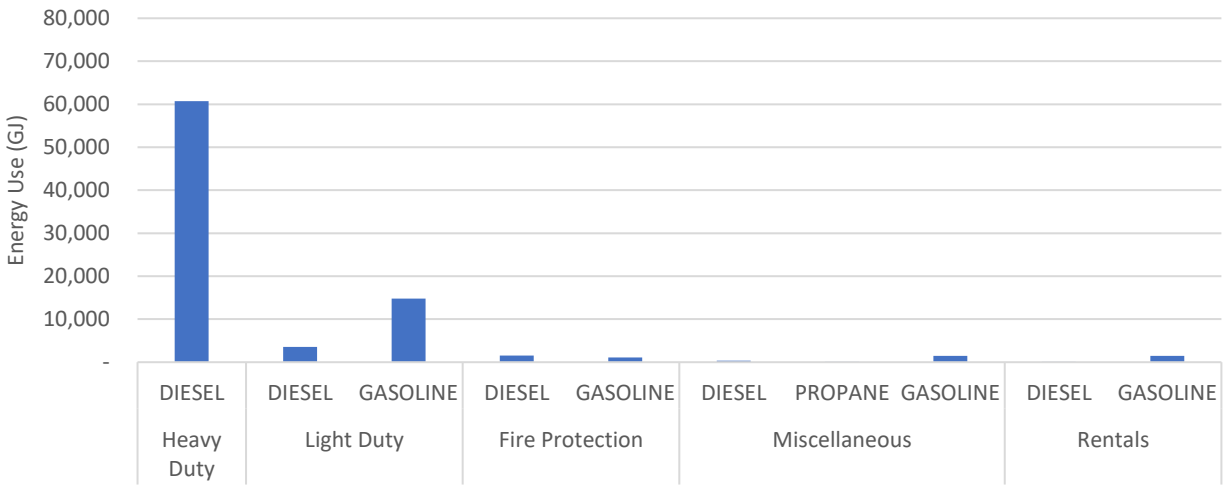

Figure 15 Comparison of Energy Consumption and Cost by Energy Source for each Category.

Facilities

In 2018, the facilities of the City of St. John's used 27% of the total energy used by the corporate City of St. John's (98,436 GJ) and emitted 25% of the total corporate GHG emissions (3,126 tonnes). Electricity was 66% of the facilities' energy use, fuel oil was the second largest energy use (heating) at 33%. Electricity and fuel oil account for 97% (75% and 22% respectively) of all GHG emissions from facilities. Diesel use was about 1% of the energy use and was mostly related to the maintenance and operation of backup power generators at the various facilities (e.g., fire stations, recreation facilities, and city hall).

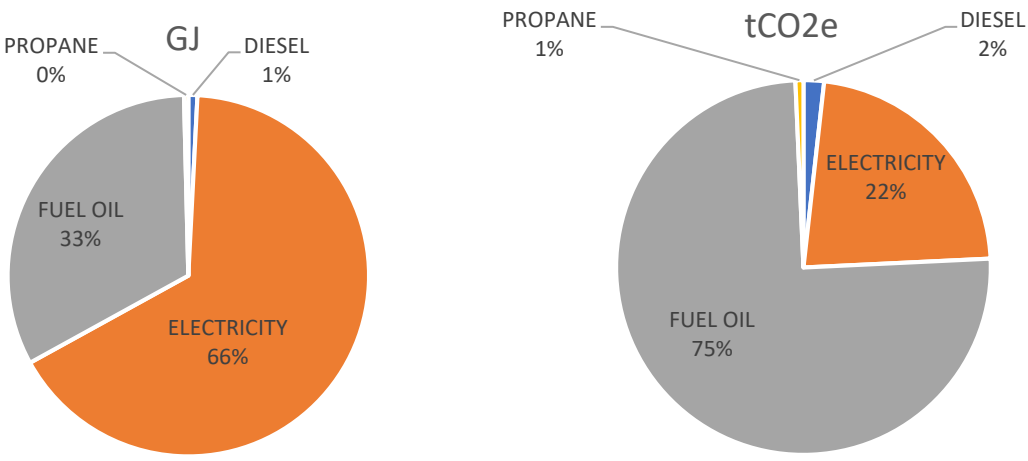

Figure 16 Comparison of GHG Emissions by Energy Source

Table 17 Energy Consumption, Cost, and GHG Emissions by Energy Source

Energy	GJ	tCO2e	Cost ($M)
ELECTRICITY	63,165.0	706	1.6
FUEL OIL	31,134.8	2,341	0.7
DIESEL	772.1	56	0.02
PROPANE	364.2	22	<0.01
Total	**95,436**	**3,126**	**2.3**

The facilities sector includes over 53 different facilities. The category of City Buildings within this sector includes: the regional fire department (fire stations in the city of St. John's and the broader regional service in Paradise and Mount Pearl); administration/operation buildings include buildings like City Hall, the Maintenance Depot, and the Archives Building; community/recreation facilities include facilities like the Mews Centre, and the various Community Centers.

Administration/Operation, and Community/Recreation Facilities account for 77% of the total energy use, and 76% of the GHG emissions for this sector. Administration/ Operations buildings account for 45% of the energy use, 42% of the cost, and 60% of the sector's GHG emissions. Community and recreation facilities account for 29% of the energy use, approximately 30% of the cost, and 20% of the GHG emissions.

Table 18 Energy Consumption and GHG Emissions by Category

Description	GJ	tCO2e	Cost ($M)	% Corp. Total GHGs
Administration/Operations	44,766.6	1,902	1.0	15%
Community/Recreation Facility	27,608.5	654	0.7	5%
Regional Fire Department	12,490.9	345	0.3	3%
NPH Rental Units	5,816.8	66	<0.2	>1%
Parks	4,753.2	159	0.1	1%
Total	**98,436.1**	**3,126**	**2.3**	**25%**

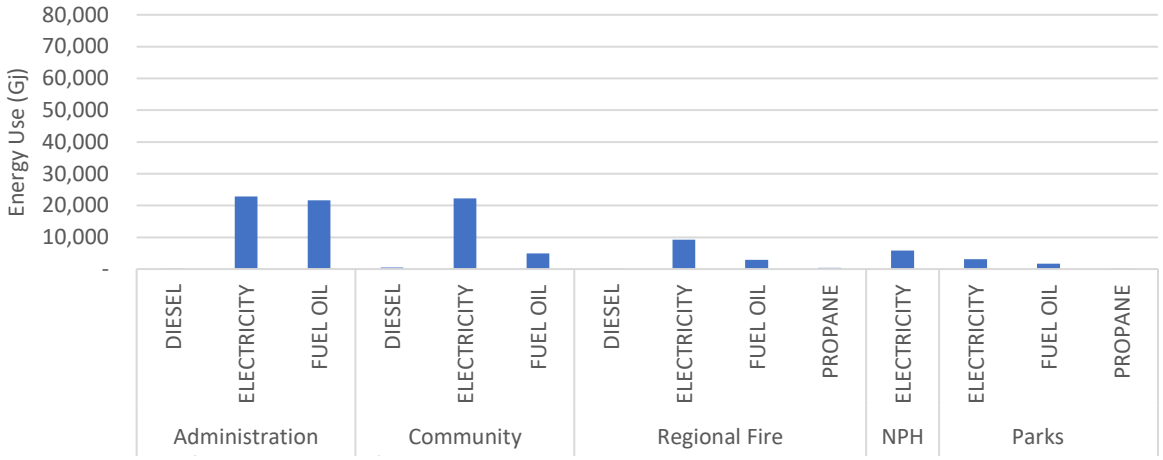

Figure 17 Comparison of Energy Consumption and Cost by Energy Source for each Category.

Fuel Oil in facilities accounts for approximately 12% of the total corporate emissions and 33% of the facilities sector emissions. Table 19 shows a breakdown of emissions from fuel oil by facility.

Table 19 Facilities by tCO2e emitted from Fuel Oil Energy

Facilities	tCO2e	% Corp. Total GHGs
Works Depot Maintenance	1,258	10%
245 Freshwater Road	300	2%
H.G.R. Mews Centre	292	2%
Central Fire Station	177	1%
Bowring Park Bldg. Maintenance	124	1%
Buckmasters Rec. Centre	79	1%
Animal Control Shelter Mtce.	74	1%
Kent's Pond Fire Station	31	0%
Brookfield Rd. Fire Station.	8	0%
West End Fire Station	<1	0%
Total:	**2,344**	**19%**

Note: *Diesel or Fuel Oil are also used for heating in Bay Bulls Big Pond, Riverhead, and Robinhood Bay. This section deals mostly with Administration, Community, NPH, and Parks.*

Water

In 2018, the water sector used 30% of the total energy used by the corporation (109,839 GJ) and generated 13% of the total corporate GHG emissions (1,622 tonnes). Electricity contributed 94% of all energy use, which accounts for 71% of GHG emissions from water. Diesel was the second largest energy use (6%) and produces 29% of the GHG emissions from water (Figure 18 and Table 20).

Figure 18 Comparison of Energy Consumption and GHG Emissions by Energy Source.

Table 20 Energy Consumption, Cost, and GHG Emissions by Energy Source

Energy	GJ	tCO2e	Cost ($M)
ELECTRICITY	103,379.0	1,157	2.3
DIESEL	6,423.4	463	0.2
PROPANE	36.5	2.2	<0.2
Total	**109,839.0**	**1,622**	**2.5**

The City of St. John's operates three water treatment plants and provides freshwater for the region. This sector was divided in 4 categories which include three water treatment facility systems (which includes the main site, as well as associated metering stations, CSOs and/or pumping stations where reasonable) and the distribution system (composed of PRVs and pumping stations). The treatment plants of Bay Bulls Pond and Winsor Lake accounted for 92% of the energy consumption and 93% of the GHG emissions in this sector. Electricity at Bay Bulls Big Pond Water Treatment Plant was the greatest energy use (75,337 GJ) and cost in this sector; it corresponds to 74% of the GHG emission in this sector. Windsor Lake Water Treatment Plant is the second energy user and uses mostly electricity and accounts for 19% of the GHG emission in this sector. Small amounts of propane are used in this sector during the winter to maintain the freshwater distribution system flowing during very cold days, however, this use was minimal (Table 21 and Figure 19). Diesel at Bay Bulls Big Pond is used to provide heating to the facility, but only used for backup generators at the other facilities.

Table 21 Energy Consumption, Cost, and GHG Emissions by Category

Category	GJ	tCO2e	Cost ($M)
Bay Bulls Big Pond WTP	75,337.4	1,185	1.7
Winsor Lake WTP	25,357.3	300	0.6
Long Pond WTP	7,151.2	86	<0.2
Distribution	1,993.1	24	<.06
Total	**109,839.0**	**1,596**	**2.5**

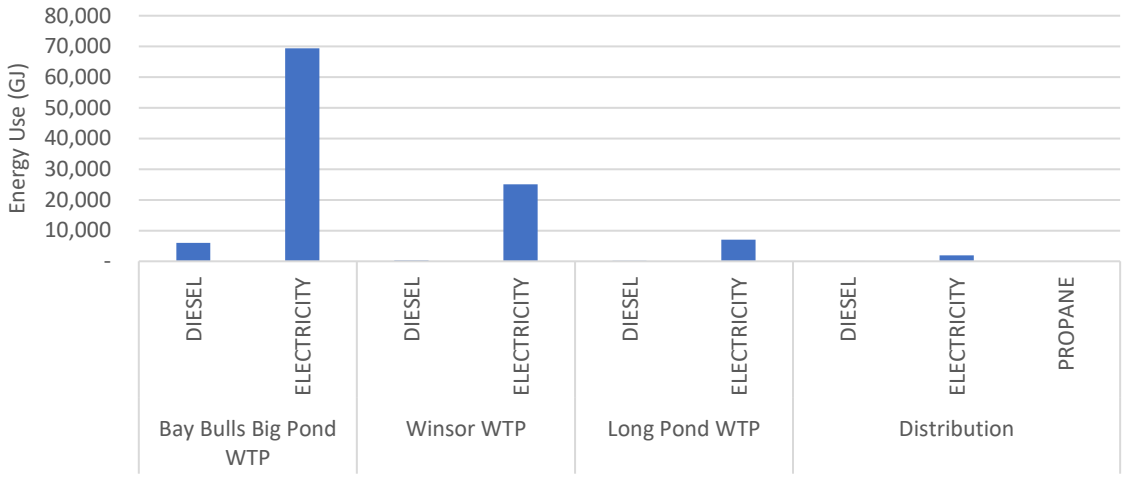

Figure 19 Comparison of Energy Consumption and Cost by Energy Source for each Category.

Waste Water

In 2018, the waste water sector used 13% of the total energy used by the corporation (48,116.4 GJ) and emitted 13% of the total corporate GHG emissions (1,117 tonnes). Electricity was the largest energy source (54%), followed by fuel oil (22%). The regional waste water treatment facility (Riverhead Treatment Facility) uses biogas produced by the anaerobic digester that is part of waste water process to power the facility's boilers when possible, this bio-energy displaces the use of fuel oil for heating. Biogas provided 23% of the energy used by this sector, almost equal in energy value (GJ) to fuel oil. The majority of the GHG emissions from this sector were from fuel oil (73%), followed by 26% from electricity. Propane was used in small amounts to maintain the pilot of the boilers.

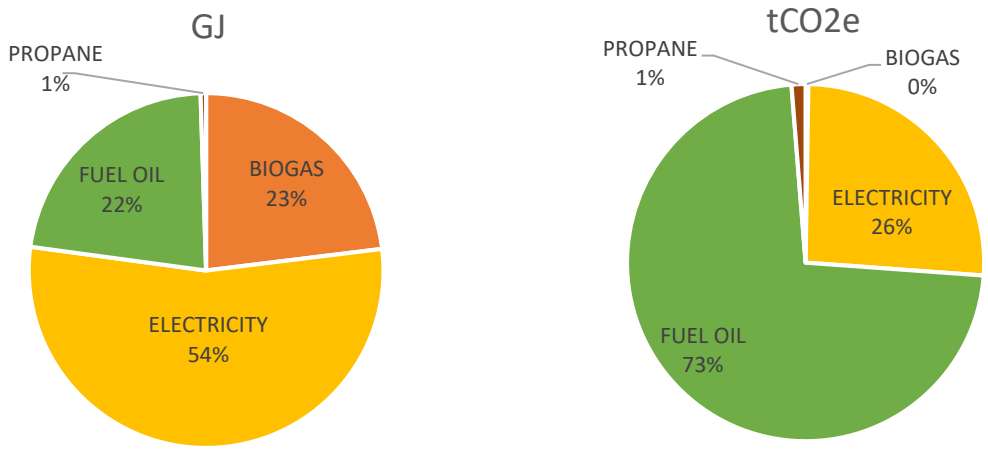

Figure 20 Comparison of GHG Emissions and GHG Emissions by Energy Source

Table 22 Energy Consumption, Cost, and GHG Emissions by Energy Source

Energy	GJ	tCO2e	Cost ($M)
ELECTRICITY	26,024.6	291	0.6
BIOGAS	11,092.1	3	0
FUEL OIL	10,760.7	809	<0.3
PROPANE	239.0	14	<0.01
Total	**48,116.4**	**1,117**	**<0.9**

The sector of waste water was split in two categories: Riverhead treatment facility, and the collection system (mainly lift stations). The collection system functions on electricity and accounts for 11% of the total electricity usage in this sector, about 3% of the GHG emissions and 67% of the sector's energy cost. Riverhead treatment facility operated mostly on electricity, used fuel oil for heating, and displaced fuel oil with biogas from the water treatment process, some propane was also used. Fuel oil accounts for 33% of the energy cost and 74% of the GHG emissions from this facility, while electricity accounts for the 23% of the GHG emission from the facility (Table 23 and Figure 21).

Table 23 Energy Consumption, Cost, and GHG Emissions by Category

Category	GJ	tCO2e	% Total Corp. GHGs
Riverhead Treatment Facility	45,228.5	1,085	8.7%
Collection	2,887.9	32.	0.2%
Total	**48,116.4**	**1,117**	**8.9%**

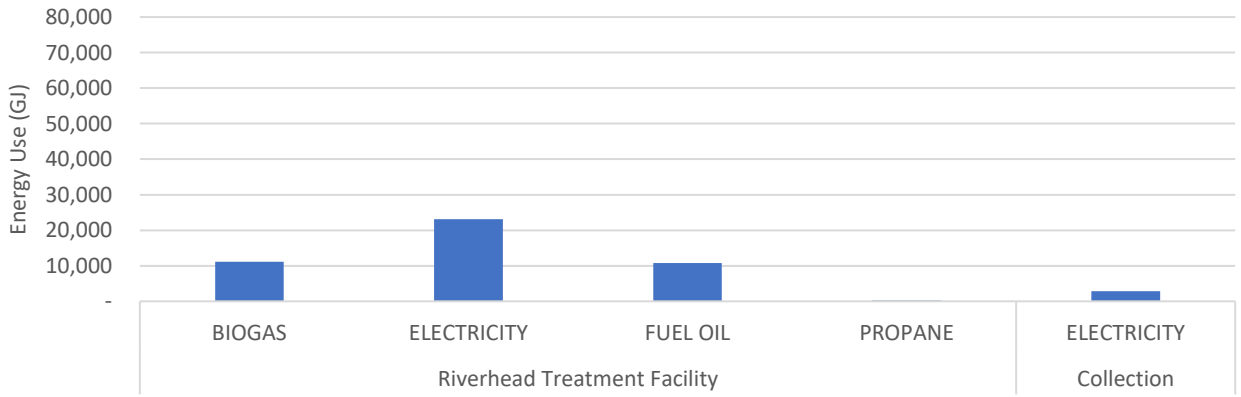

Figure 21 Comparison of Energy Consumption and Cost by Energy Source for each Category.

Solid Waste

The waste sector contributes to approximately 1% of the total energy consumption of the City (4,427 GJ) and approximately 3% of the total corporate emissions (336.3 tonnes) once the decomposition of solid waste generated by operations is included. In 2018, the City of St. John's did not have a system in place to track the tonnage of solid waste sent to landfill or recycled in a manner that made it possible to

separate the corporate solid waste from the broader community solid waste. The volume of the bins collected at the city facilities and operations was used to develop an estimate (with a conservative assumption that they are 80% full every time they are expected to be collected). The composition of the waste was estimated using the "Guiding our Province to a Greener Future" waste audit completed by the Government of Newfoundland and Labrador (source: https://www.exec.gov.nl.ca/exec/occ/publications/waste-audit-report.pdf). This enabled the city to estimate diversion vs disposal waste and ultimately develop an estimate of GHG emissions from corporate solid waste.

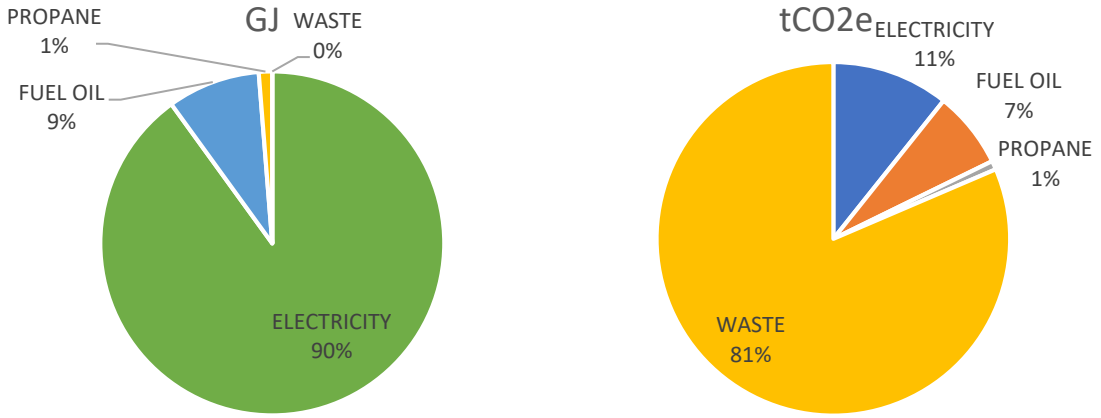

Figure 22 Comparison of GHG Emissions by Energy Source, including decomposition of Corporate Solid Waste.

Electricity composed 90% of the total energy consumption for this sector, however, it produces only 11% of the GHG emission. Fuel oil is 9% of the total energy consumption and produced 7% of the sector GHG emissions. Most of the emission 81% for this sector are from the GHGs embedded in the estimated corporate waste, which is landfilled at Robinhood Bay. The corporate waste generated in 2018 produced approximately 336.3 tonnes of GHG emissions. The Robinhood Bay landfill has a methane capture system, assumptions based on the management of the landfill and methane capture in 2018 were included in the GHG emissions calculations.

Table 24 Energy Consumption and GHG Emissions by Energy Source

Energy	GJ	tCO2e	Cost ($M)
ELECTRICITY	3,985.4	45	0.1
FUEL OIL	386.0	29	0.008
PROPANE	56.0	3	0.001
WASTE	-	336	-
Total	**4,427.4**	**413**	**0.1**

Approximately 77% of the energy cost in this sector is electricity use at the buildings (Table 25 and Figure 23), Fuel oil is second in use and cost (approximately 7%). Use of fuel oil at Robin Hood Bay accounted for 3% of the total corporate GHG emissions.

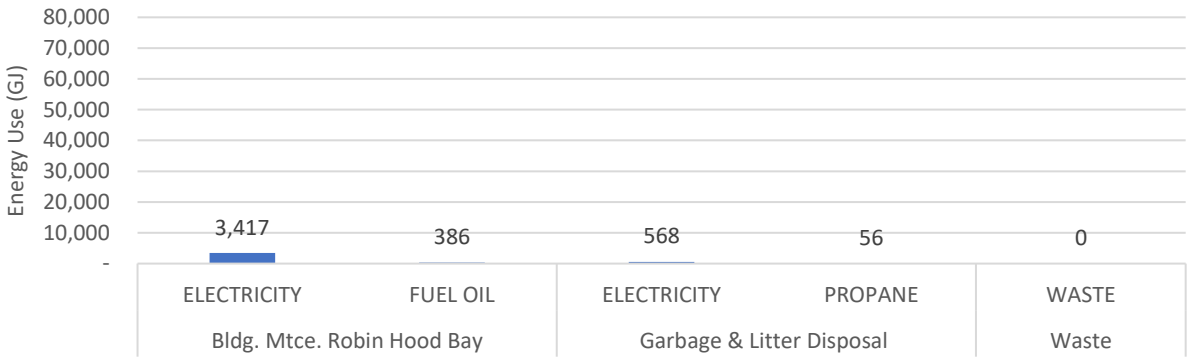

Figure 23 Comparison of Energy Consumption and Cost by Energy Source for each Category.

Table 25 Energy Consumption, Cost, and GHG Emissions by Category

Description	GJ	tCO2e	% Total Corp. GHGs
Bldg. Robin Hood Bay	3,803.1	67	0.5%
Garbage & Litter Disposal	624.4	7	>0.01%
Waste	-	336	2.6%
Total	**4,427.4**	**410**	**3.2%**

Streetlights

In 2018, streetlights consumed approximate 22,768 GJ and accounted for 6% of the total corporate energy consumption. Streetlights accounted for 2% of the total corporate GHG emissions (253 tonnes).

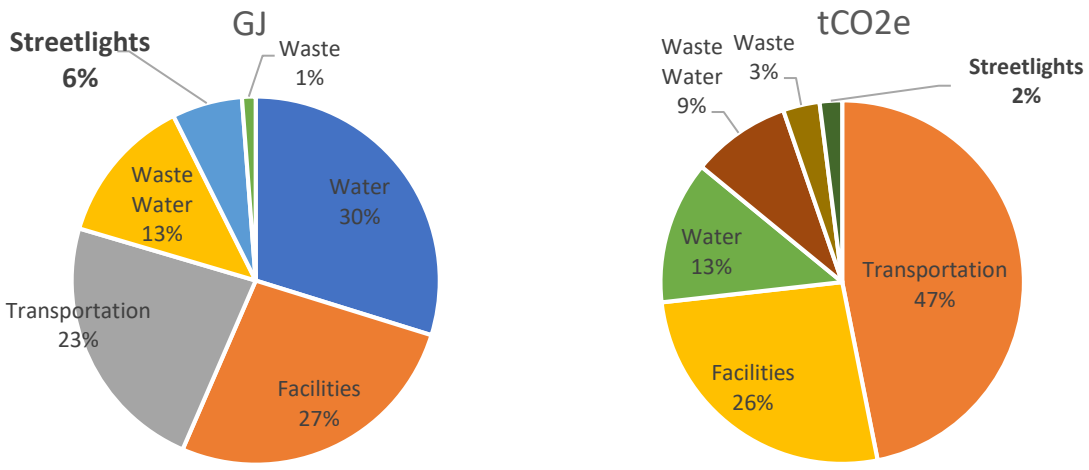

Figure 24 Comparison of Energy Consumption and GHG Emissions by Sector.

The City pays for approximately 12,269 streetlights of various types. Table 26 provides an approximate breakdown of the number of streetlights by type, style and wattage.

Table 26 Count of Streetlights by Type

Light (Type-Style-Watts)	**Count**
HP PST 100	50
HP SEN 100	4
HP STD 100	9041
HP STD 150	1958
HP STD 250	620
HP STD 400	141
LED2ES 113	10
LED2ES 158	8
LED2ES 41	146
LED2ES 52	117
LED2ES 54	65
LED2ES 69	43
LED2ES 80	29
LED3LB 41	2
LED3LB 52	1
LEDR2M 54	33
LEDR3M 54	1
Total	**12,269**

Note: HP = High Pressure Sodium
LED= Light Emitting Diode
2ES, 3LB, and R2M refer to LED light styles

Cost of streetlighting (electricity) is approximately 46% (Figure 25) of the total corporate electricity cost. However, billing for streetlighting from the local utility is based on a monthly rate and not a per-kWh rate. This means that there are other factors embedded in the cost for streetlighting (this includes type of light, wattage, operation, capital cost, installation, etc).

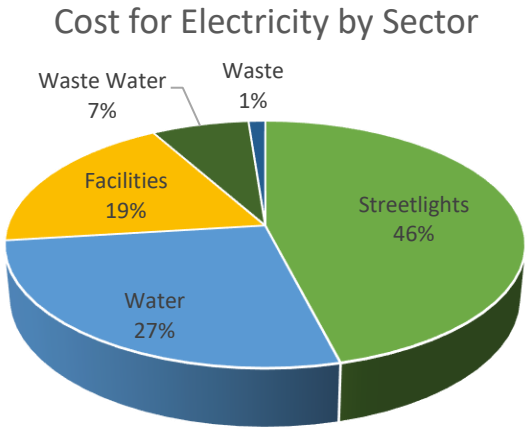

Figure 25 Comparison of Annual Cost of Electricity by Sector.

Table 27 Comparison of Cost of Electricity by Sector

Sector	Cost ($M)	% by Sector
Streetlights	4.0	46%
Water	2.3	27.1%
Facilities	1.6	18.8%
Waste Water	0.6	7.0%
Waste	0.1	1.2%
Total	**8.6**	**100%**

The embedded costs are obvious when comparing cost per GJ to the cost of electricity in other sectors within the corporation, which is usually approximately $22-26/GJ after HST (Figure 26).

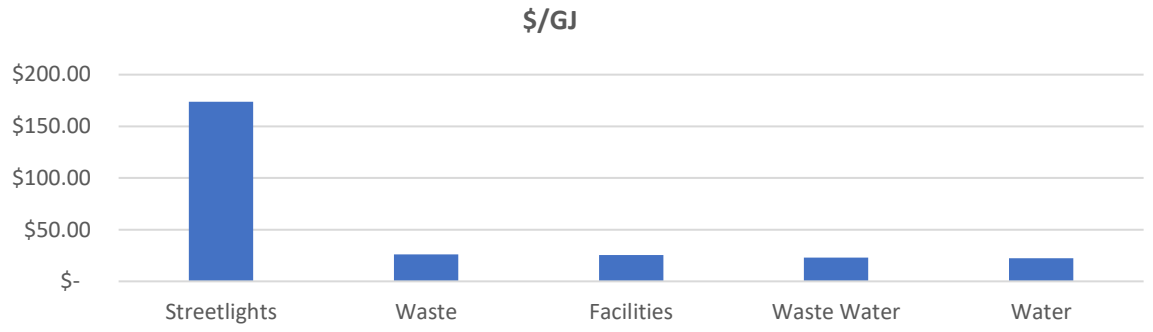

Figure 26 Comparison of Cost per Gigajoule by Sector.

Impact of Weather

Weather is different than climate, weather is the short-term condition and climate is the average daily weather for an extended period of time. One of the most important factors influencing the corporate and community energy use and emissions is weather. This is because, among other things, day to day weather affects how much cooling or heating is used in a community. Warmer years result in different energy use and GHG emissions than cooler years because of this.

The impact of weather on energy use is often quantified as indicators of heating and cooling degree days (HDD an CDD). A heating degree day is the number of degrees that a day's average temperature is below 18 C. This is attempting to indicate the amount of energy needed to heat building during that day. Similarly, a cooling degree day counts the number of degrees above the same threshold. In 2018, St. John's had 4,686 HDD and 84 CDD. It is important that over time this is monitored to contextualize changes in energy use and emissions, as it can provide information on how energy sources are used and how needs change over time (e.g., increases in use of air conditioning and decreases in need for heating).

Energy Use and GHG Emissions Corporate Municipal Comparison

Comparing corporate energy use and GHG emissions from municipal inventories is challenging, most municipalities are different from each other in some significant way when comparing energy use or

GHGs. Differences can be rooted in the role of the municipality within its region, infrastructure age, size, role, climate, weather, and socio-economic climate. For example, the City of St. John's operates various facilities that provide regional service (e.g., fire department, water supply, waste water treatment, solid waste management).

Simply for the purpose of providing context, an attempt was done to compare the energy intensity of the City of St. John's (GJ per capita) and the GHG emission (tCO_2e per capita). Most municipalities reported energy intensity for Buildings and fleet, so these were compared (this excludes water, waste water, and solid waste). A total GHG emission per capita is illustrated, however, this value is not trully comparable across municipalities.

Table 28 Comparison of Municipal Energy Intensity and GHG Emissions sorted by Corporate Buildings + Fleet GJ per capita.

Municipality	Population (2016)	Corporate Buildings + Fleet GJ per capita*	Total tCO2e per capita**	Source
Stratford, PEI	9,706	0.53	0.10	http://www.townofstratford.ca/UserFiles/Servers/Server_11992779/File/Residents/Naturally%20Stratford/Community%20Energy%20Plan/GHG-Emission-Inventory-Draft.pdf
Oakville, ON	193,832	0.92	0.06	https://www.oakville.ca/assets/general%20-%20environment/Milestone1OakvilleGHGEmissionsInventory.pdf
Township of Langley, BC	117,285	0.95	0.04	https://www.toolkit.bc.ca/sites/default/files/GHG%20Inventory.pdf
St. John's, NL	**108,860**	**1.66**	**0.11**	**Corporate 2018 St. John's Energy and Greenhouse Gas Inventory**
Saskatoon, SK	246,376	2.57	0.43	https://www.saskatoon.ca/sites/default/files/documents/corporate-performance/environmental-corporate-initiatives/2014_saskatoon_greenhouse_gas_emissions_inventory.pdf
Nelson, BC	10,572	2.65	0.13	https://www.nelson.ca/DocumentCenter/View/313/Corporate-Greenhouse-Gas-Reduction-Plan-PDF?bidId=
Revelstoke, BC	7,547	3.79	0.21	http://www.cityofrevelstoke.com/DocumentCenter/View/282/COR-GHG-inventory-April-11-2011?bidId=
Leduc, AB	29,993	3.96	1.68	https://www.leduc.ca/sites/default/files/Leduc%20Final%20GHG%20Inventory%20Report%20%28April%202019%29final.pdf
Fernie, BC	5,249	4.20	0.20	https://fernie.civicweb.net/document/68079
Cambridge, ON	129,920	-	0.05	https://www.cambridge.ca/en/learn-about/resources/City-of-Cambridge-GHG-Reduction-Energy-Management-Plan-Update-2014.pdf
Corner Brook, NL	19,806	-	0.08	http://www.cornerbrook.com/wp-content/uploads/2017/01/CornerBrook_PCP-Milestone-1-2.pdf
Grand Bay-Westfield, NB	4,964	-	0.08	http://www.town.grandbay-westfield.nb.ca/wp-content/uploads/2018/10/corp-action-plan.pdf
West Vancouver, BC	42,473	-	0.09	https://westvancouver.ca/sites/default/files/GHG_REPORT_FINAL_.pdf
Rothesay, NB	11,659	-	0.14	https://www.rothesay.ca/wp-content/uploads/2019/05/2018OctClimateChange.pdf
Moncton, NB	71,889	-	0.19	http://www5.moncton.ca/docs/Corporate_GHG_Inventory_Report.pdf
Windsor, ON	217,188	-	0.20	https://www.citywindsor.ca/residents/environment/Environmental-Master-Plan/Goal-D-Use-Resources-Efficiently/Documents/City%20of%20Windsor%27s%20greenhouse%20gas%20inventory.pdf
Hampton, NB	4,289	-	0.26	https://www.townofhampton.ca/assets/2014-Uploads-Megan/2015-Uploads-Megan/Milestone-1-Corporate-Inventory.pdf
Cochrane, AB	25,853	-	0.26	https://www.cochrane.ca/DocumentCenter/View/496/Cochrane-PCP-Final-Report-Dec-10-07?bidId=
Saint John, NB	67,575	-	0.35	https://pub-saintjohn.escribemeetings.com/filestream.ashx?DocumentId=267
Ottawa, ON	934,243	-	0.37	http://ottwatch.ca/meetings/file/193386

*GJ per capita only able to be calculated if inventory report provides enough information; Only considers building and fleet energy (excludes streetlights, water, waste water). If not explicitly stated but sufficient information was provided, GJ value was calculated using factors from https://apps.neb-one.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA

**Total tCO2e stated by each municipality, regardless of sectors included or excluded

Projections

Simple projections were developed to help understand the energy supply that may be necessary to support the services and operations of the City of St. John's and the energy use and emissions from the community as a whale in the year 2030. This estimate was generated through the application of a simple ratio energy unit per capita. The emission factor of electricity was adjusted to zero tCO2e per kWh, as per the Government of Newfoundland and Labrador Climate Lens Guidance. Population projections are based on a medium growth scenario from the Economic and Project Analysis Division of the Department of Finance.

Population Projections

Population projections are based on a medium growth scenario from the Economic and Project Analysis Division of the Department of Finance.

Table 29 Growth Population Projection 2018-2030

2018	Growth by 2030[2]		
	Low	Medium	High
109,633	+3.6%	+5.5%	+7.4%

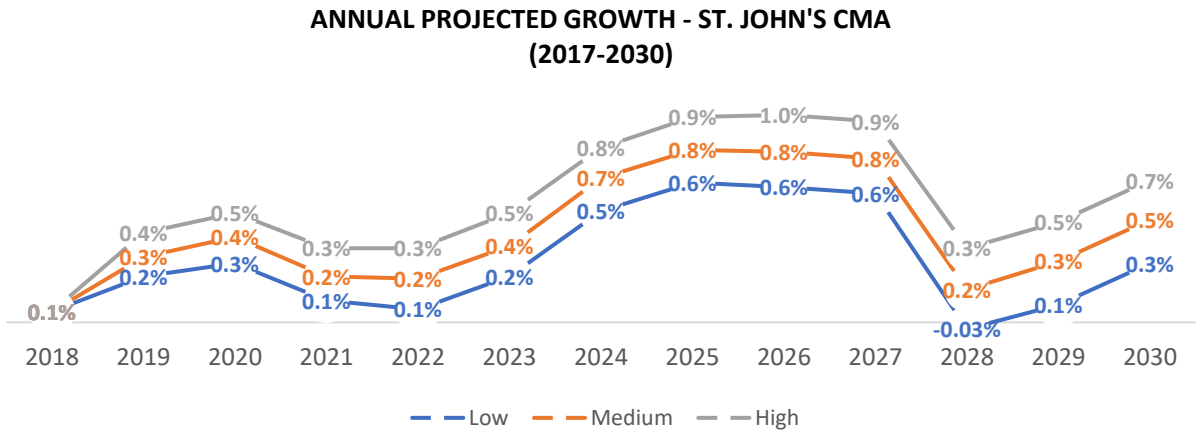

Figure 27 Annual Population Growth for St. John's CMA.

Community Projections

In a business-as-usual scenario, it can be conservatively assumed that the energy consumption of the community may follow the population growth trends. The analysis in the following sections presents estimated based on a medium population growth scenario (+5.5% from 2018's population by 2030). The community projections of greenhouse gas (GHG) emissions incorporate a projected decrease in emissions due to hydropower capacity in the province, even when increases in population and energy use may occur.

[2] **Note:** Estimates based Population Projections for Newfoundland from the Economic and Project Analysis Division of the Department of Finance (Low, Medium and High Scenario). The population model utilizes historical population data from Statistics Canada for St. John's CMA from 1986 to 2018: https://www.fin.gov.nl.ca/fin/economy/populationprojections.html

Community Projections by Energy Source

Table 30 Community Emissions Projection by Energy Source 2018-2030

Source	2018 (GJ)	2018 ($tCO2_e$)	2030 (GJ)	2030 ($tCO2_e$)	% Change Energy Use	% Change Emissions
Electricity	6,322,320	70,743	6,667,446	-	+5.5%	-100.0%
Gasoline	5,619,768	375,638	5,926,542	396,143	+5.5%	+5.5%
Fuel Oil	2,106,466	158,061	2,221,454	166,689	+5.5%	+5.5%
Diesel	239,337	16,945	252,402	17,870	+5.5%	+5.5%
Propane	79,974	26,434	84,339	27,877	+5.5%	+5.5%
Waste	-	19,294	-	20,347	-	+5.5%
Total	**14,367,865**	**667,113**	**15,152,184**	**628,925**	+5.5%	**-5.7%**

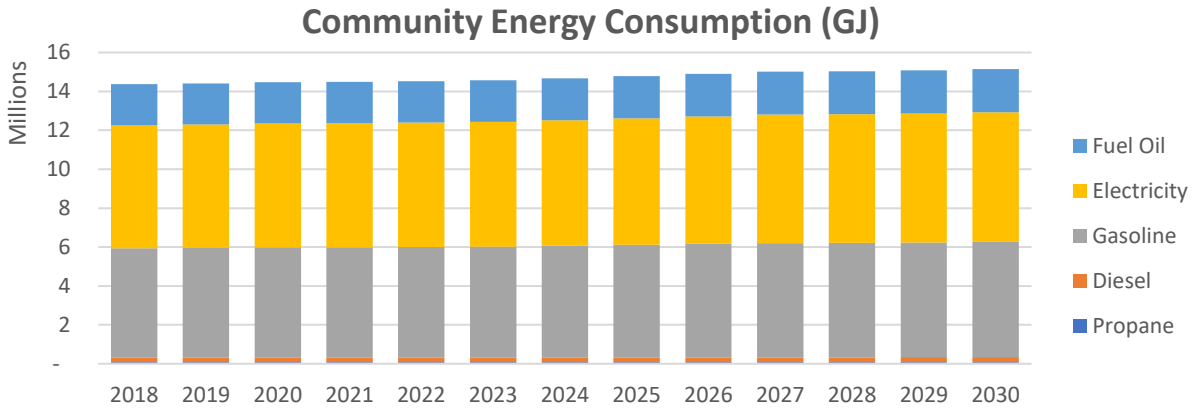

Figure 28 Annual projections of energy consumption by energy source.

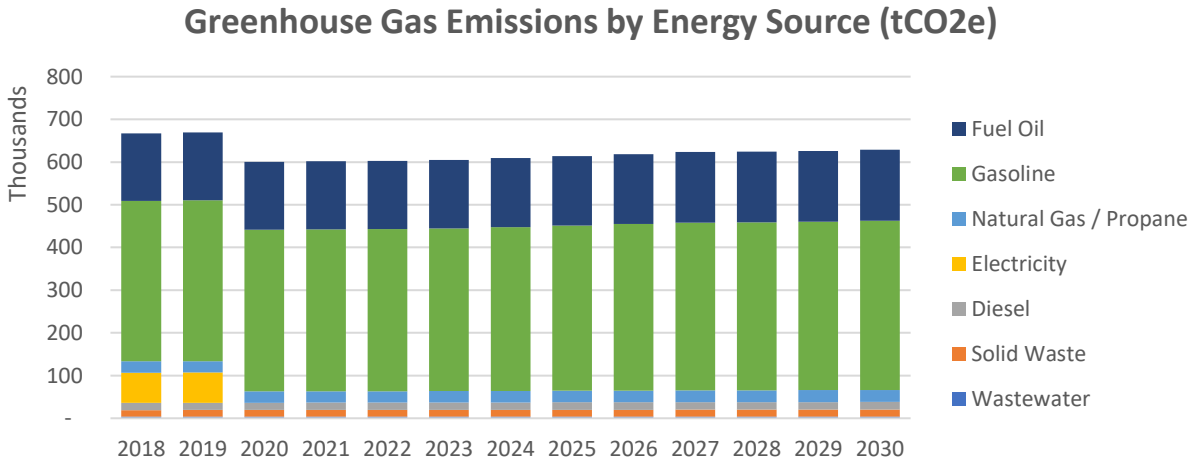

Figure 29 Annual projections of emissions by energy source.

Community Projections by Sector

Table 31 Community Emissions Projection 2018-2030 by Sector

Source	2018 (GJ)	2018 ($tCO2_e$)	2030 (GJ)	2030 ($tCO2_e$)	% Change Energy Use	% Change Emissions
Transportation	5,859,105	392,583	6,178,945	414,013	5.5%	5.5%
Residential	4,009,686	102,029.25	4,228,569	71,065	5.5%	-30.3%
Institutional/Commercial/ Industrial	4,499,073	153,208	4,744,671	123,420	5.5%	-19.4%
Waste	-	19,294	-	20,347	-	5.5%
Total	**14,367,864**	**667,113**	**15,152,184**	**628,925**	+5.5%	**-5.7%**

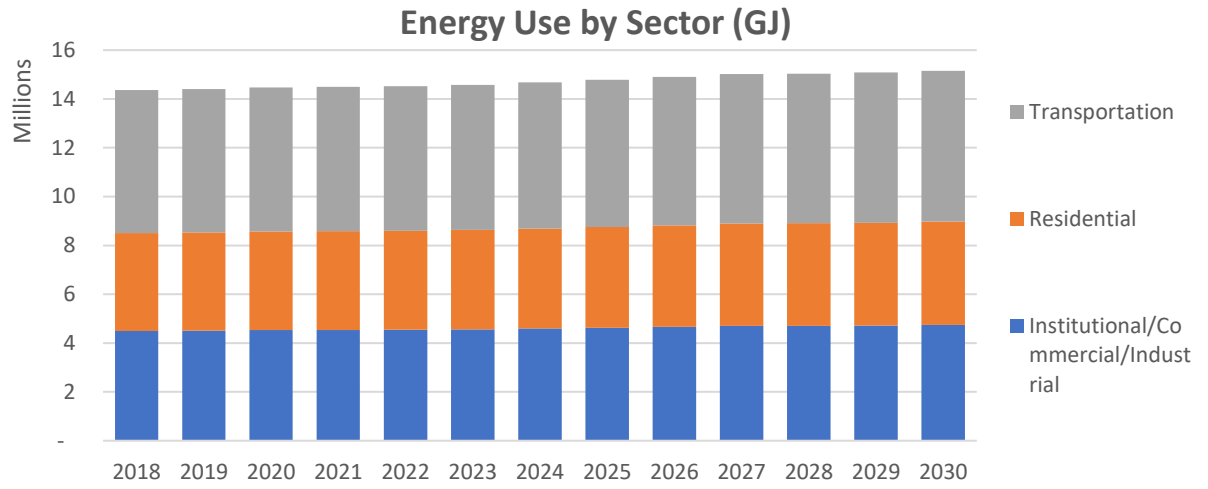

Figure 30 Annual projections of energy use by sector in the community.

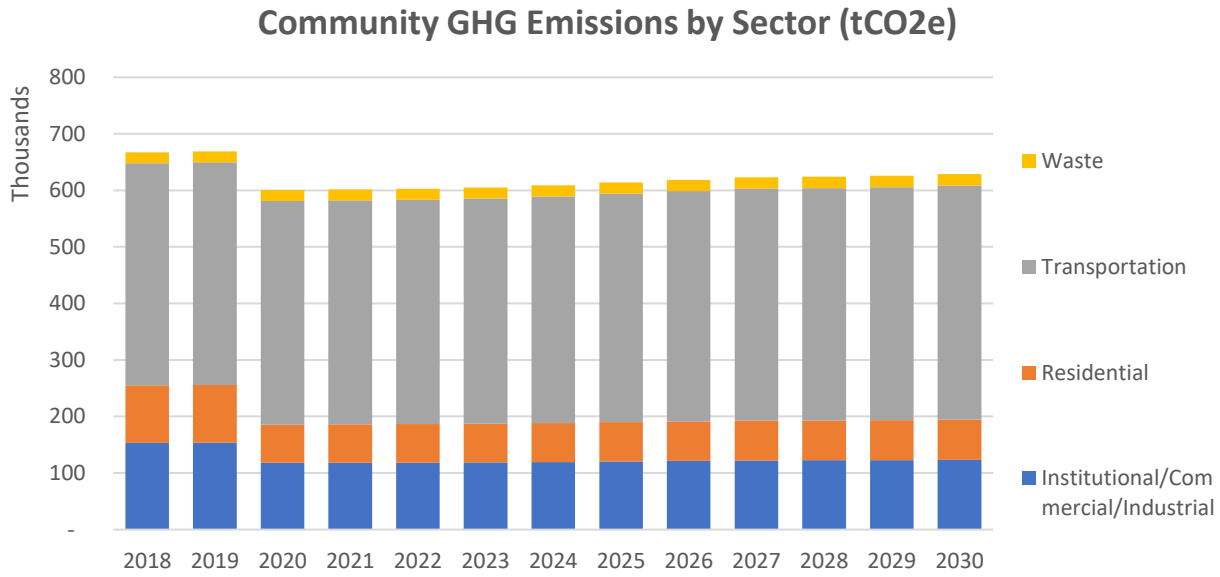

Figure 31 Annual projections of emissions by sector in the community.

Corporate Projections

In a business-as-usual scenario, it can be conservatively assumed that the energy consumption of the corporation may follow the population growth trends. The analysis in the following sections presents estimated based on a medium population growth scenario (+5.6% from 2018's population by 2030). The energy consumption per energy source is estimated in Table 32 and Figure 32.

The changes in emissions due to hydropower capacity in the province may result in reduced emission, even when increases in population and service could be required. Biogas shows an increase; however, this is partially due to how small the value is and its sensitivity to change. Also, it is likely that the increase in Biogas consumption would result in some displacement of fuel oil use.

Corporate Projections by Energy Source

Table 32 Comparison of 2018 and Projected (2030) Energy Consumption and Emissions by Energy Source.

Energy	GJ (2018)	tCO2e (2018)	GJ (2030)	tCO2e (2030)	Change in GJ	Change in tCO2e
ELECTRICITY	219,323	2,454	231,295.6	0	5.5%	-100.0%
FUEL OIL	42,281	3,180	44,589.7	355	5.5%	5.5%
DIESEL	73,403	5,184	77,410.6	5,467	5.5%	5.5%
GASOLINE	18,769	1,255	19,794.0	1,323	5.5%	5.5%
WASTE	-	336	-	354.6	-	5.5%
PROPANE	756	45	796.8	48	5.5%	5.6%
BIOGAS	11,092	2.7	11,697.6	2.9	5.5%	7.0%
Total	**365,625**	**12,458**	**385,584.5**	**10,549**	**5.5%**	**-15.3%**

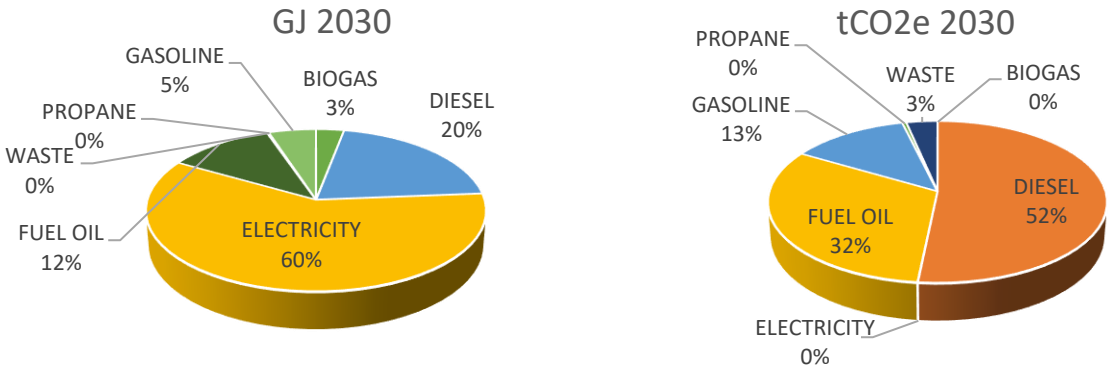

Figure 32 Comparison of Projected Energy Use and GHG Emissions by Energy Source.

Corporate Projections by Sector

The predicted overall increase in energy use across all sectors is likely conservative, as several sectors do not require a linear increase in energy use to provide adequate service the projected increase in population. The sectors that have the greatest share of their energy consumption coming from electricity would see the most benefit with regards to GHG emissions reductions from hydropower generation. Streetlights, for example, only use electricity as energy and therefore see a decrease in emissions of nearly 100%. Water would be a close second due to 94% of its energy usage being from electricity.

Table 33 Comparison of 2018 and Projected (2030) Energy Consumption and Emissions by Sector.

Row Labels	GJ (2018)	tCO2e (2018)	GJ (2030)	tCO2e (2030)	Change in GJ	Change in tCO2e
Streetlights	22,768	255	24,011.4	0.0	5.5%	-100.0%
Water	109,839	1,622	115,835.2	491	5.5%	-56.1%
Waste Water	48,116	1,117	50,743.1	871	5.5%	-46.3%
Facilities	95,436	3,126	100,646.1	2,551	5.5%	-18.2%
Waste	4,427	413	4,669.1	389	5.5%	-5.9%
Transportation	85,037	5,939	89,678.6	6,246	5.5%	5.5%
Total	**365,624.6**	**12,457**	**385,584.5**	**10,549**	**5.5%**	**-15.3%**

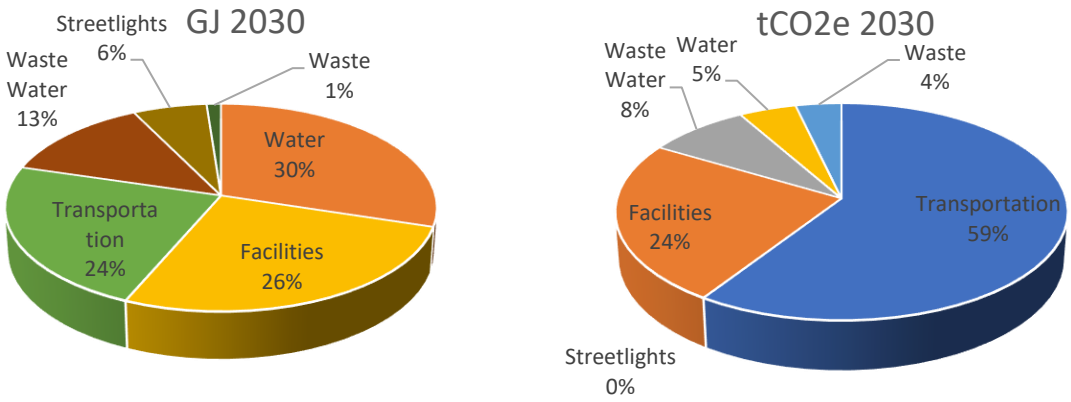

Figure 33 Comparison of Projected Energy Consumption and GHG Emissions by Sector.

Appendix A – Assumptions Community Inventory

This section lists assumption that were made and necessary to develop energy use comparisons, estimate emissions, and to provide a rough estimate of waste produced by corporate operations (Table 39 to Table 41).

Table 34 Assumption for solid waste management at the landfill.

Waste Management Assumptions	
Methane Generation Potential	0.07
Methane Recovery Fraction	0.623
Oxidation Factor	0.1

Table 35 Global Warming Potential.

Global Warming Potential		
Greenhouse Gas	**GWP**	**Source**
CO2	1	Fifth Assessment Report (AR5)
CH4	28	
N2O	265	

Table 36 GJ per unit of energy.

Energy Source	Conversion Factor		Source
ELECTRICITY	0.0036	Gj/kWh	https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/nl-eng.html (National energy Board)
HEATING OIL	36.72	Gj/m3	https://apps.neb-one.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA
PROPANE	25.62	Gj/m3	https://apps.neb-one.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA
NATURAL GAS	0.0373	Gj/m3	https://apps.neb-one.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA
DIESEL	38.68	GJ/m3	https://apps.neb-one.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA
GAS	34.66	GJ/m3	https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels (Source BC LCFS)
Biogas	0.025	GJ/m3	https://biogasassociation.ca/images/uploads/documents/2014/biogas_study/Canadian_Biogas_Study_Technical_Document_Dec_2013.pdf (Biogas 22–27 MJ/m3)

Table 37 Cost per energy source unit.

Energy Source	Cost $	Units	Source
Fuel Oil	0.9312	$/L	Public Utility Board - Avalon Peninsula
Electricity	0.1206	$/kwh	Newfoundland Power (2018) with basic charge included
Diesel	1.3913	$/L	Public Utility Board - Northeast Avalon Peninsula
Gasoline	1.3202	$/L	Public Utility Board - Northeast Avalon Peninsula
Propane	0.8182	$/L	Public Utility Board - Northeast Avalon Peninsula

Table 38 Emission factors per energy unit.

Energy Souce	CO2	CH4	N2O	CO2e	Notes
Electricity (t/kWh)	0.000040	0.0000000006	0.000000001	0.000040	Canada National Inventory Report 1990-2017 Part 3 Table A13-2.
Fuel Oil (t/L)	0.00275	0.000000026	0.000000006	0.00276	Canada National Inventory Report 1990-2017 Part 2 Table A6-4 (Residential).
Propane (t/L)	0.001515	0.000000027	0.000000108	0.00154	Canada National Inventory Report 1990-2017 Part 2 Table A6-3 (Residential).
Gasoline (t/L)	0.002307	0.000000140	0.000000022	0.00232	Canada National Inventory Report 1990-2017 Part 2 Table A6-13 (Light-Duty, Tier 2).
Diesel (t/L)	0.002681	0.000000068	0.000000210	0.00274	Canada National Inventory Report 1990-2017 Part 2 Table A6-13 (Light-duty, Moderate Control).
Solid Waste (t/m3)	-	0.000131221	0.000000002	0.0033	GHG emissions estimate for Environment and Climate Change Canada Reporting.
Wastewater (Flared) (t/m3)	-	0.0002	-	0.0059	Estimate from biogas production at Riverhead Facility (Methane Component Flared - 65% of Digester Gas is Methane, 50% Combustion Efficiency using Open Flare).

Appendix B – Assumptions Corporate Inventory

This section lists assumption that were made and necessary to develop energy use comparisons, estimate emissions, and to provide a rough estimate of waste produced by corporate operations (Table 39 to Table 41).

Table 39 Gigajoule conversion factors.

Energy Type	Conversion Factor	
Electricity	0.0036	GJ/kWh
Oil	36.72	GJ/m^3
Propane	25.62	GJ/m^3
Natural gas	0.0373	GJ/m^3
Diesel	38.68	GJ/m^3
Gas	34.66	GJ/m^3
Biogas	0.025	GJ/m^3

Table 40 Assumption for solid waste management at the landfill.

Waste Management Assumptions	
Methane Generation Potential	0.07
Methane Recovery Fraction	0.623
Oxidation Factor	0.1

Table 41: Assumptions of solid waste composition (Source: IPCC 2019. Refinement to the 2006 IPCC Guidelines for national greenhouse gas inventories. Table 2A.2. Canada)

Waste Type	%
Food	18.8
Garden	5.6
Paper/Carboard	32.3
Wood	0
Textile	0

Table 42 Emission factors for various energy types.

Energy Source	Unit of Fuel	tCO2/Unit of Fuel	tCH4/Unit of fuel	tN20/Unit of Fuel	tCO2e/Unit of Fuel	Source
Gas (Light Duty)	**L**	0.002307	0.00000014	0.000000022	0.00232	Canada National Inventory Report 1990-2017 Part 2 Table A6-13 (Light-Dugty Gasoline Trucks).
Fuel Oil	L	0.00275	0.000000026	0.000000031	0.00276	Canada National Inventory Report 1990-2017 Part 2 Table A6-4 (Commercial).
Propane	L	0.001515	0.000000027	0.000000108	0.00154	Canada National Inventory Report 1990-2017 Part 2 Table A6-3 (Residential).
Electricity	kwh	0.000040	0.0000000006	0.000000001	0.00004	Canada National Inventory Report 1990-2017 Part 3 Table A13-2.
Solid Waste	tonnes		-		-	Estimated (See Sheet Waste2) Estimated based on volume of solid waste According to PCP Guidance Step 5 calculations based on solid waste volume sent to landfill.
Diesel (Heavy Duty)	L	0.002681	0.0000001100	0.0000001510	0.00272	Canada National Inventory Report 1990-2017 Part 2 Table A6-13 (Heavy-Duty).
Diesel (Light Duty)	L	0.002681	0.0000000680	0.0000002100	0.00274	Canada National Inventory Report 1990-2017 Part 2 Table A6-13 (Light-Duty).
Diesel (Stationary)	L	0.0026810000	0.0000001330	0.0000004000	0.00279	Canada National Inventory Report 1990-2017 Part 2 Table A6-4 (Diesel).

Appendix C – Corporate Water System

Category	Description
BAY BULLS BIG POND WTP	Main Site (70 Southern Shore Highway)
BAY BULLS BIG POND WTP	BBBP DAF Sludge Lagoons
BAY BULLS BIG POND WTP	Ruby Line Pump Station
BAY BULLS BIG POND WTP	Kenmount Pump Station
BAY BULLS BIG POND WTP	Galway Pump Station
BAY BULLS BIG POND WTP	Trans Canada Highway Meter Chamber
BAY BULLS BIG POND WTP	Paradise Pump Station
PETTY HARBOUR LONG POND WTP	Main Site
WINDSOR LAKE WTP	Main Site
WINDSOR LAKE WTP	High Zone Pumping Station
WINDSOR LAKE WTP	Little Power's Pond Pumping Station
WINDSOR LAKE WTP	Autumn Drive Reservoir
WINDSOR LAKE WTP	Portugal Cove Road Meter House
WINDSOR LAKE WTP	Shea Heights Pumping Station
WINDSOR LAKE WTP	Shea Heights Reservoir
WINDSOR LAKE WTP	Signal Hill Rd
WINDSOR LAKE WTP	Windsor Lake
DISTRIBUTION	Gills Cove (WTR CHBR) FLOW
DISTRIBUTION	Water St (WTR CHBR) FLOW
DISTRIBUTION	Barton's Road PRV
DISTRIBUTION	PRV Chamber Port Cove Pl PRV aka Bell's Turn
DISTRIBUTION	4122 HIGGINS LINE PRV
DISTRIBUTION	Kenmount Road VOCM PRV
DISTRIBUTION	187 Kenmount Rd (ICON) PRV
DISTRIBUTION	39 Janeway Pl PRV
DISTRIBUTION	Logy Bay Road PRV
DISTRIBUTION	Road De Luxe PRV
DISTRIBUTION	Rawlins Cross PRV
DISTRIBUTION	55 Bonaventure Ave aka Holy Heart PRV
DISTRIBUTION	Columbus @ Bay Bulls PRV
DISTRIBUTION	Portugal Cove Rd St. John's NEW 2019
DISTRIBUTION	Old Topsail Road/Craigmillar PRV
DISTRIBUTION	Goldstone PRV
DISTRIBUTION	Connolly Lane Pump Stn
DISTRIBUTION	Old Petty Harbour Rd - DENSMORE'S LANE Pump Stn
DISTRIBUTION	Autumn Drive Pump Stn
DISTRIBUTION	85 Jensen Camp Pl Pump Pump Stn
DISTRIBUTION	TRANS CANADA HWY Water flow meter (export to other munic)
DISTRIBUTION	JENSEN CAMP RD (water reservoir)
DISTRIBUTION	GEORGES POND RD (water reservoir)
DISTRIBUTION	1 DUNNS LANE (export to CMP)
DISTRIBUTION	DOYLES RD (water flow meter)

Appendix D – Corporate and Community Emissions Tables

Community

Sector	Energy Source	GJ	tCO_2	tCH_4	tN_2O	tCO_2e
Residential	Electricity	3,096,000	34,400	0.5	0.9	34,642
	Fuel Oil	834,235	62,544	0.6	0.1	62,597
	Propane	79,451	4,698	0.1	0.3	4,789
Institutional/Commercial/Industrial	Electricity	3,226,320	35,848	0.5	0.9	36,100
	Fuel Oil	1,272,230	95,382	0.9	0.2	95,462
	Propane	523	21,232	0.4	1.5	21,644
Transportation	Gasoline	5,619,768	374,056	22.7	3.6	375,637
	Diesel	239,337	16,589	0.4	1.3	16,945
Waste	Solid Waste	-	-	625	0.0	15,631
	Waste water	-	-	1,562	0.0	3,662
	Total	14,367,864	644,749	2,213.1	8.8	667,109

Corporate

Energy Source	GJ	tCO_2	tCH_4	tN_20	tCO_2e
Biogas	11,092.14	-	0.08	0.00	2.74
Diesel	73,403.43	5,087.76	0.21	0.34	5,183.99
Electricity	219,322.56	2,436.92	0.04	0.06	2,454.09
Fuel oil	42,281.51	3,169.97	0.03	0.04	3,180.27
Gasoline	18,769.40	1,249.31	0.08	0.01	1,254.59
Propane	755.59	44.68	0.00	0.00	45.55
Waste	-	-	12.01	-	336.33
Total	**365,624.64**	**11,988.64**	**12.44**	**0.45**	**12,457.55**

Metrobus

Sector	GJ	tCO_2	tCH_4	tN_20	tCO_2e
Transportation	69,157.37	4,791.78	0.12	0.37	4,893.92
Facilities	10,628.28	118.09	0.00	0.00	118.92
Total	**79,785.65**	**4,909.88**	**0.12**	**0.38**	**5,012.85**

Energy Source	GJ	tCO_2	tCH_4	tN_20	tCO_2e
Diesel	68,549.44	4,751.32	0.12	0.37	4,853.29
Electricity	10,628.28	118.09	0.00	0.00	118.92
Gasoline	607.93	40.46	0.00	0.00	40.64
Total	**79,785.65**	**4,909.88**	**0.12**	**0.38**	**5,012.85**