



2024 Corporate Energy Management Plan

The Corporation of the City of Markham

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1. Executive Summary

This Corporate Energy Management Plan (CEMP) was prepared for the Corporation of the City of Markham (Markham) in compliance with O.Reg. 25/23 and serves as the latest update to the City's energy management planning and performance achievement. It provides an overview of total City energy consumption and prior year energy performance and sets out potential energy reduction goals and pathways to achieve them.

Data from 2017 to 2023 was provided by the City for all utilities contributing to total energy consumption, including electricity, natural gas, and district hot water and chilled water. This information was contextualized with additional building data including classification, layout, as-builts, and prior reports to develop a summary of City energy use by both energy and building type. The most significant output of this analysis is the determination that the City's community centres together account for roughly 75% of all energy usage and carbon emissions, with the remainder split out amongst all other building types.

A summary of the City's existing strategies and plans was performed using context from multiple City-generated documents spanning 2011 to 2022, and a comparison of the City's performance against the targets set out in these prior plans was developed, as summarized below:

2019 CEMP Performance Results					
Measure Description	2017 Baseline	Target Reduction (%)	2022 Target	2022 Actual	Achieved Reduction (%)
Corporate Facility Energy Intensity	42 ekWh/ft ² /year	5% Reduction	40 ekWh/ft ² /year	37 ekWh/ft ² /year	12% Reduction
Streetlighting Energy Intensity	491 kWh/fixture/year	5% Reduction	466 kWh/fixture/year	426 kWh/fixture/year	13% Reduction
Municipal Operations GHG Emissions Intensity	34 kg GHG/person/year	5% Reduction	32 kg GHG/person/year	29 kg GHG/person/year	15% Reduction

Table 1: 2019 CEMP Target Performance Summary



Facility Energy and GHG reductions were 22% and 15% respectively in the year 2022 when compared with the new 2018 baseline. Over the period covered by the 2019 CEMP an estimated utility cost savings of \$6.1 million (based on average utility rates) and avoidance of 7,231 tCO_{2e} GHG emissions were achieved. It is expected that some portion of these savings are the result of COVID related impacts on operations and energy use, however preliminary review of 2023 data suggests sustained savings of ~16% and ~10% respectively for facility energy and municipal operations GHG emissions. In addition to the above savings, the City was able to secure in excess of \$7.2 million in grant and incentive funding for energy efficiency and decarbonization related projects. Facility Energy and Facility GHG reduction targets have been generated through review and compilation of the estimated savings from energy efficiency and GHG reduction projects for which the City has committed funding and resources towards (Summarized in Section 4.4). A summary of these targets can be found in the following table:

Period	Facility Energy Reduction	Facility GHG Reduction	Fleet Electrification
2022 - 2026	5%	7%	9% ICE vehicle reduction

Table 2: Recommended Performance Targets

This report subsequently provides an overview of energy consumption by the City, details progress from the 2019 CEMP, and provides targets for the next CEMP reporting period.



2. Introduction and Background Information

2.1 Organization Background

The Corporation of the City of Markham (Markham) is the largest municipality in York Region and home to over 353,000 residents. Founded in 1792, Markham is renowned for its rich historical heritage and diverse, vibrant community. Markham is a major employer in York Region, with a staff of over 1,500 employed by the City in operational, administrative, and other support functions.

Markham manages and operates over 95 facilities across its complete portfolio, including core civic function and administration centres, community spaces and activity centres, emergency services buildings, cultural centres, and others. The current combined area of Markham's portfolio spans around 177,000 m² (1.9 million ft²), with a total annual energy use of 255,000 GJ, spread across electricity, natural gas, and district energy sources.

Over the past decade, Markham has made significant improvements in energy efficiency, reducing energy intensity by 8% for corporate facilities, 29% for streetlights, and 14% for municipal operations from 2014-2019. Markham has set ambitious targets to further improve its energy performance, aiming to reach net zero carbon emissions by 2050.

2.2 Report Objective

The objective of this report is to present an updated Corporate Energy Management Plan (CEMP) which summarizes prior energy conservation work performed by the City, outlines recommended targets for future energy conservation, and provides a reasonable pathway to achieve these targets.

A secondary goal of this effort will be to ensure alignment of any work with the Energy Conservation and Demand Management Plan requirement outlined in Ontario Regulation 25/23, Section 9¹.

¹ <https://www.ontario.ca/laws/regulation/r23025>



3. Energy Consumption Overview

3.1 Energy Consumption Data Summary

Data for each in-scope building was provided by the City, including building area, monthly utility consumption for natural gas, electricity, district heating, and district cooling (covering 2017 to 2023), building classification, as-built drawings, and other reporting data such as previous year CEMPs. This data was collated and analyzed in order to review current City-wide energy performance and understand how this performance generally varies across different building parameters.

Utility consumption data was received for 73 facilities, the ten largest of which account for 76.5% of total facility energy consumption and 74.5% of total carbon emissions. A distribution of energy usage at the facilities can be seen in the following figure:

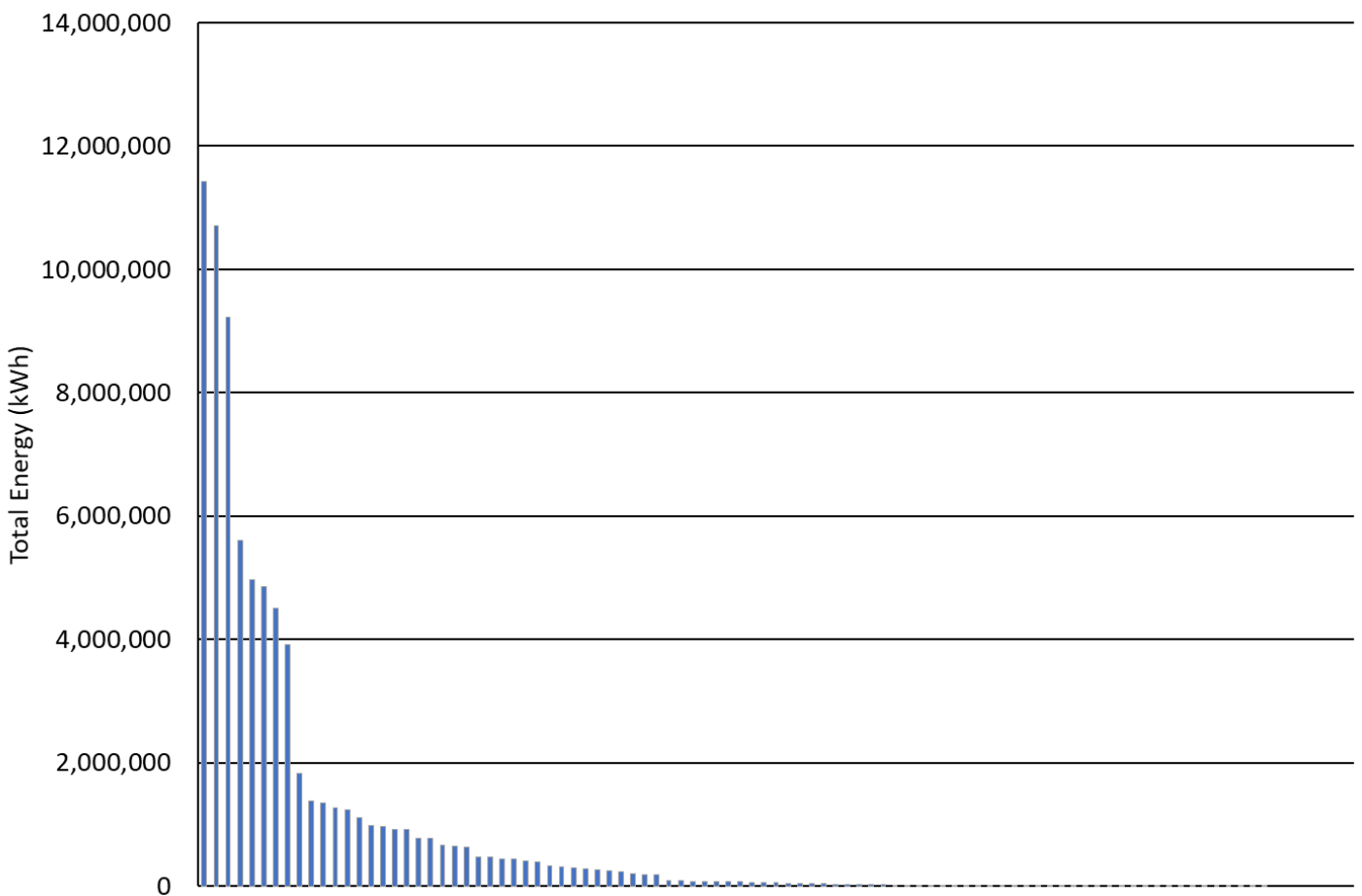


Figure 1: City-Wide Building Energy Use Distribution

In total, 46 of the 66 assessed facilities each contribute less than 1% of Markham’s total energy use each and when combined only account for 10.1% of the portfolio’s total energy use and 10.9% of total carbon emissions. Energy consumption across City buildings is therefore concentrated at its larger buildings with the remaining 20 facilities accounting for nearly 90% of energy use and carbon emissions.



Building energy use shows a fairly strong association with building size. The relationship between building area and annual total energy consumption can be seen in the following figure:

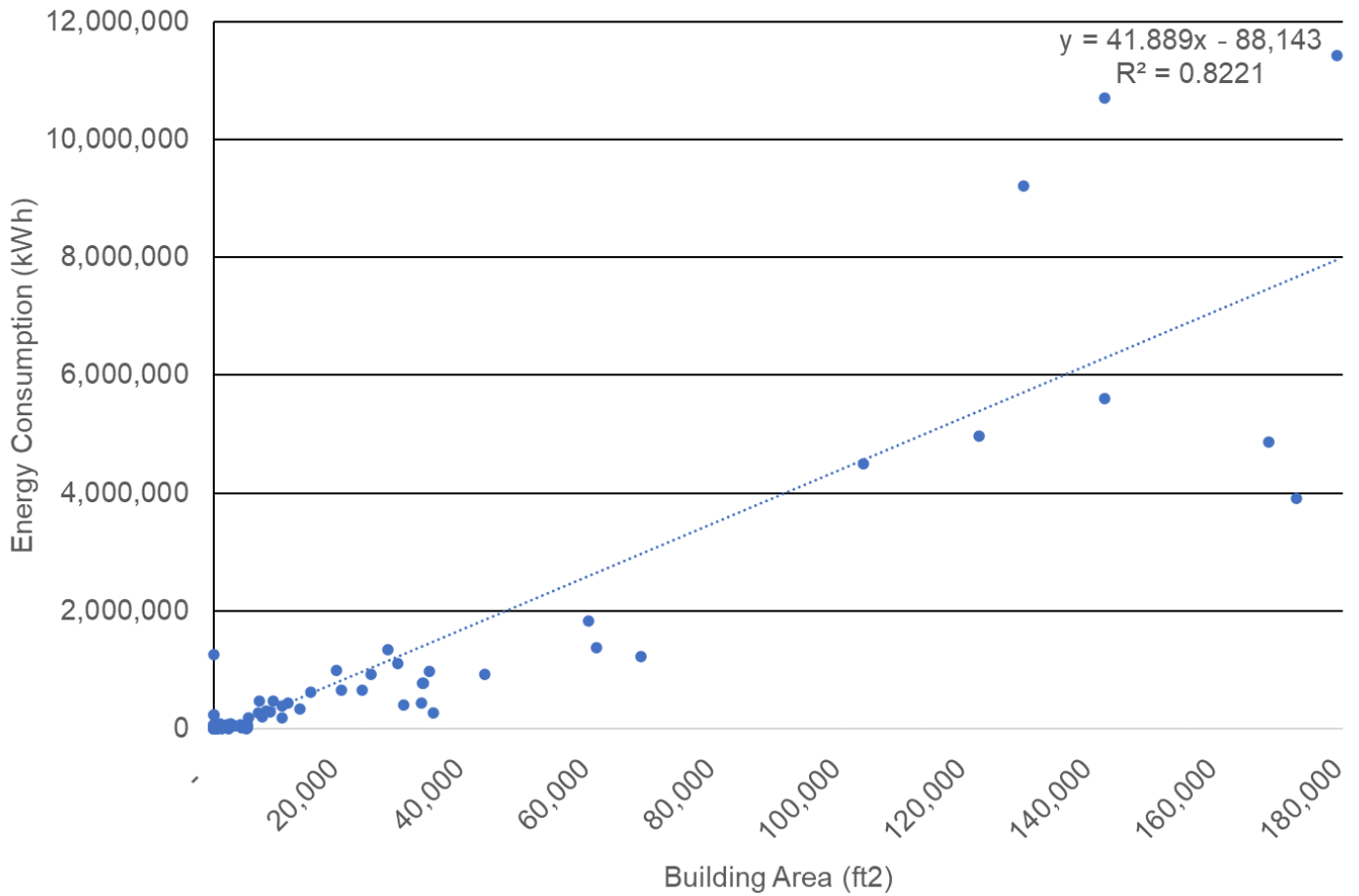


Figure 2: Area vs Energy Consumption

While energy consumption across the portfolio does not scale directly in proportion to building area, these factors do appear to be correlate somewhat strongly as indicated by the R^2 of ~82%. It is expected that building age, equipment condition, and building use provide strong influences on energy use which likely explain the observed variation.

The major building categories used to review energy usage across the City's complete portfolio were assigned as follows:



Facility Category	Facility Name
Administrative Offices	Community & Fire Services Administration (8100 Warden)
	Markham Civic Centre
Community Centres (Community rooms and gymnasiums)	Angus Glen Tennis Centre
	Armada Community Centre
Community Centres 1 (Pools, community rooms and gymnasiums)	Aaniin Community Centre
	Cornell Community Centre
	Pan Am Community Centre
	Rouge River Community Centre
Community Centres - 2 (Ice rinks, pools, community rooms and gymnasiums)	Angus Glen Community Centre/Arena
	Centennial Community Centre
	Milliken Mills Community Centre
	Thornhill Community Centre
Community Centres - 3 (Ice rinks)	Markham Village Community Centre/Arena
	Crosby Community Centre/Arena
	R.J. Clatworthy Arena
	Mount Joy Community Centre/Arena
Community Pools	Morgan Pool
	Thornlea Pool
Cultural Facilities & Art Galleries	Flato Performing Arts Theatre
	Markham Museum
	Varley Art Gallery
Fire Stations	Fire Station #91
	Fire Station #92
	Fire Station #93
	Fire Station #94
	Fire Station #95
	Fire Station #96
	Fire Station #97
	Fire Station #98
	Fire Station #99
	John Street Fire Training Centre
Operations Facilities	Fleet Maintenance Works Yard- Main Building
	John St Land fill
	Milne Parks Yard Shop
	Parks Department Maintenance Building
	Princess Parks Shop
	West Parks Yard Shop
Public Libraries	Markham Village Library
	Thornhill Village Library
	Unionville Library
Soccer Domes	Milliken Mills Soccer Dome & Clubhouse
	St Robert's Soccer Dome
Wastewater Facilities	(Kennedy) Milliken Mills Sewage Lift Station
	14TH AVE MILLIKEN MILLS PARK PUMP STAT
	4228 14TH AVE PUMP STN
	7956 9th Line Water Stn
	Enterprise Dr. Stormwater Pumping Station
	Rougecrest Sewage Lift Station

Table 3: Facility Categorization



Note that the Community Centres category is broken up as follows:

- Community Centre: Buildings with community rooms and gymnasiums
- Community Centre – 1: Buildings with community rooms, gymnasiums, and pools
- Community Centre – 2: Buildings with community rooms, gymnasiums, pools, and ice rinks
- Community Centre – 3: Buildings with ice rinks and few rooms

Energy consumption varies significantly with building use and size. The highest energy intensities in the building portfolio are seen in buildings categorized as “Community Centers – 1” and in Wastewater facilities which can be seen in the following table:

Archetype Class	Number of Facilities	Total Energy (kWh)	Total Carbon (tCO2e)	Energy Intensity (kWh/ft2)	Carbon Intensity (kgCO2e/ft2)
Community Centres - 2	4	26,406,090	3,545	44.6	6.0
Community Centres - 1	4	25,544,494	2,223	61.8	5.4
Administrative Offices	3	5,762,478	349	24.7	1.5
Community Centres - 3	4	4,038,495	363	23.5	2.1
Fire Stations	10	3,348,331	425	34.9	4.4
Cultural Facilities & Art Galleries	5	2,607,187	280	20.3	2.2
Soccer Domes	2	1,890,729	315	30.1	5.0
Other	12	2,183,191	140	181.6	10.0
Public Libraries	3	1,377,374	135	36.7	3.6
Community Pools	2	1,342,578	250	40.8	7.6
Operations Facilities	7	1,178,259	117	25.0	2.5
Community Centres	4	995,583	143	14.8	2.1
Wastewater Facilities	6	148,524	4	49.9	1.4
Totals		76,823,312	8,289	40.3	4.3

Table 4: Facility Type Energy Breakdown

The highest carbon intensities are observed in community pools, fire stations and soccer domes. These are not always directly proportional to energy intensities as the carbon intensity depends heavily on the types of energy used.



The following graph depicts how the energy consumption is distributed across the city, where each column represents a facility type:

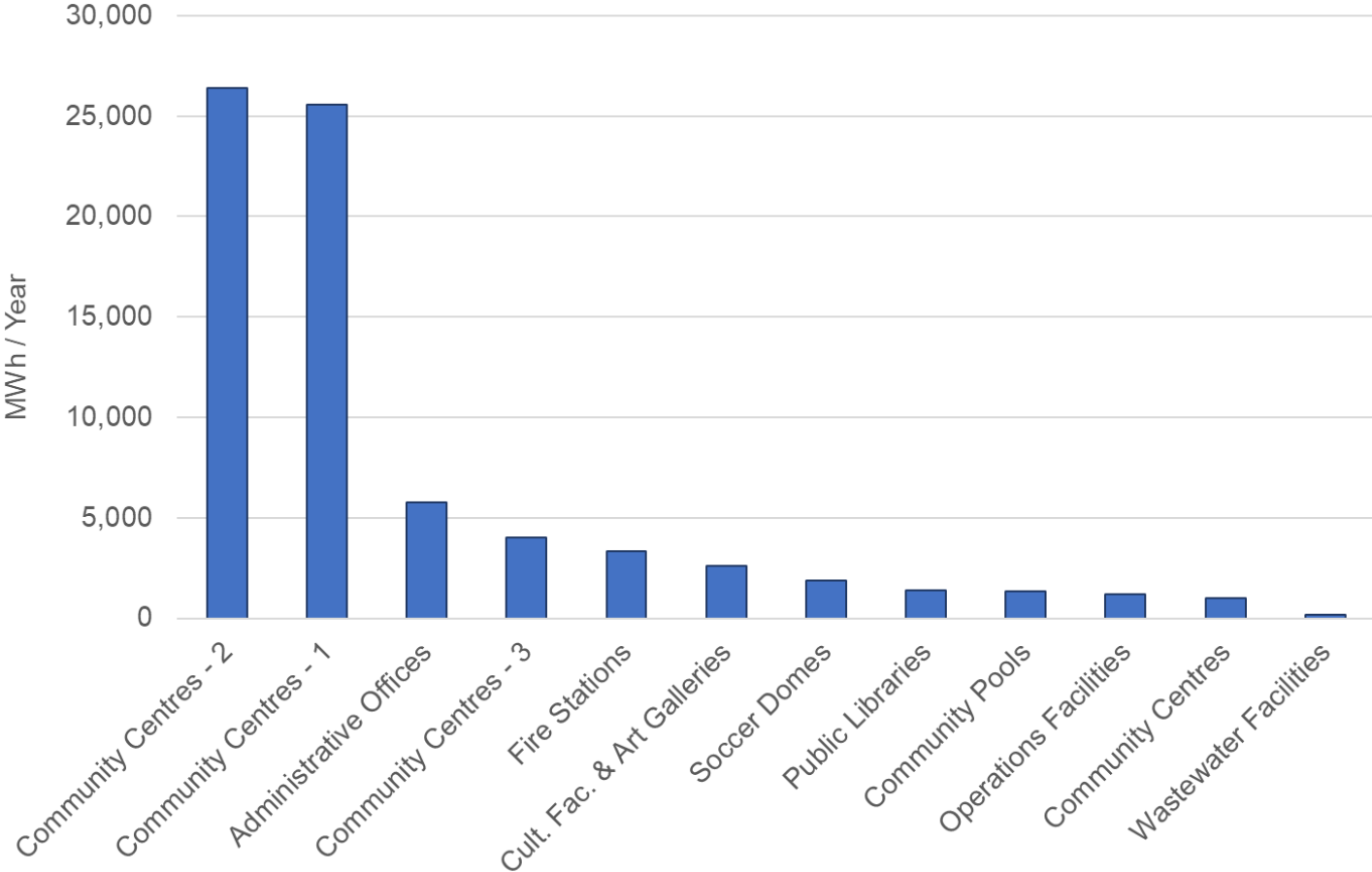


Figure 3: Total Energy Use per Building Category

Community Centres 1 and 2 contribute the most towards the City’s energy usage of all building types; these categories also include several of the City’s largest facilities.



In addition to building utility data, information for fleet and streetlight energy consumption was provided, which was combined with building data to yield the following energy breakdown:

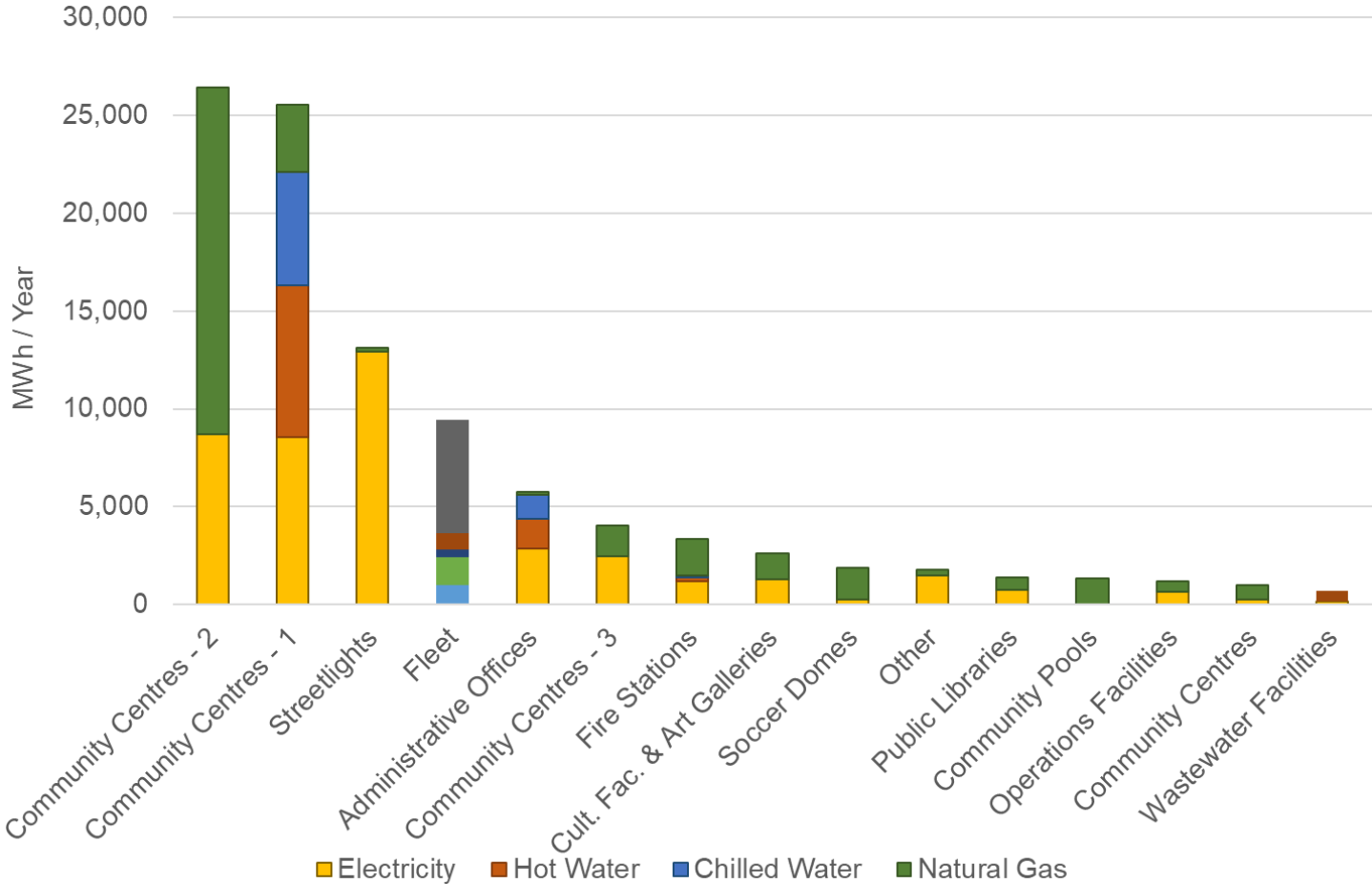


Figure 4: Portfolio Energy Use Breakdown

Community Centres 1 and 2 represent most of the energy use compared with other categories, with electricity and natural gas being the largest contributors towards energy use for buildings in these categories. Streetlighting and fleet fuel contribute more towards portfolio energy consumption than all facility types except for Community Centres 1 and 2.



Emissions in this report are classified into two categories: Scope 1 and Scope 2 emissions, which are defined as follows:

- **Scope 1 emissions** refer to direct emissions from sources owned by the City, such as the combustion of natural gas,
- **Scope 2 emissions** are indirect emissions resulting from the City’s procurement and consumption of energy, which produces emissions during its generation, such as electricity derived in part from natural gas.

A breakdown of the City’s GHG emissions including fleet and streetlighting can be seen in the following figure, breaking out Scope 1 and Scope 2 emissions:

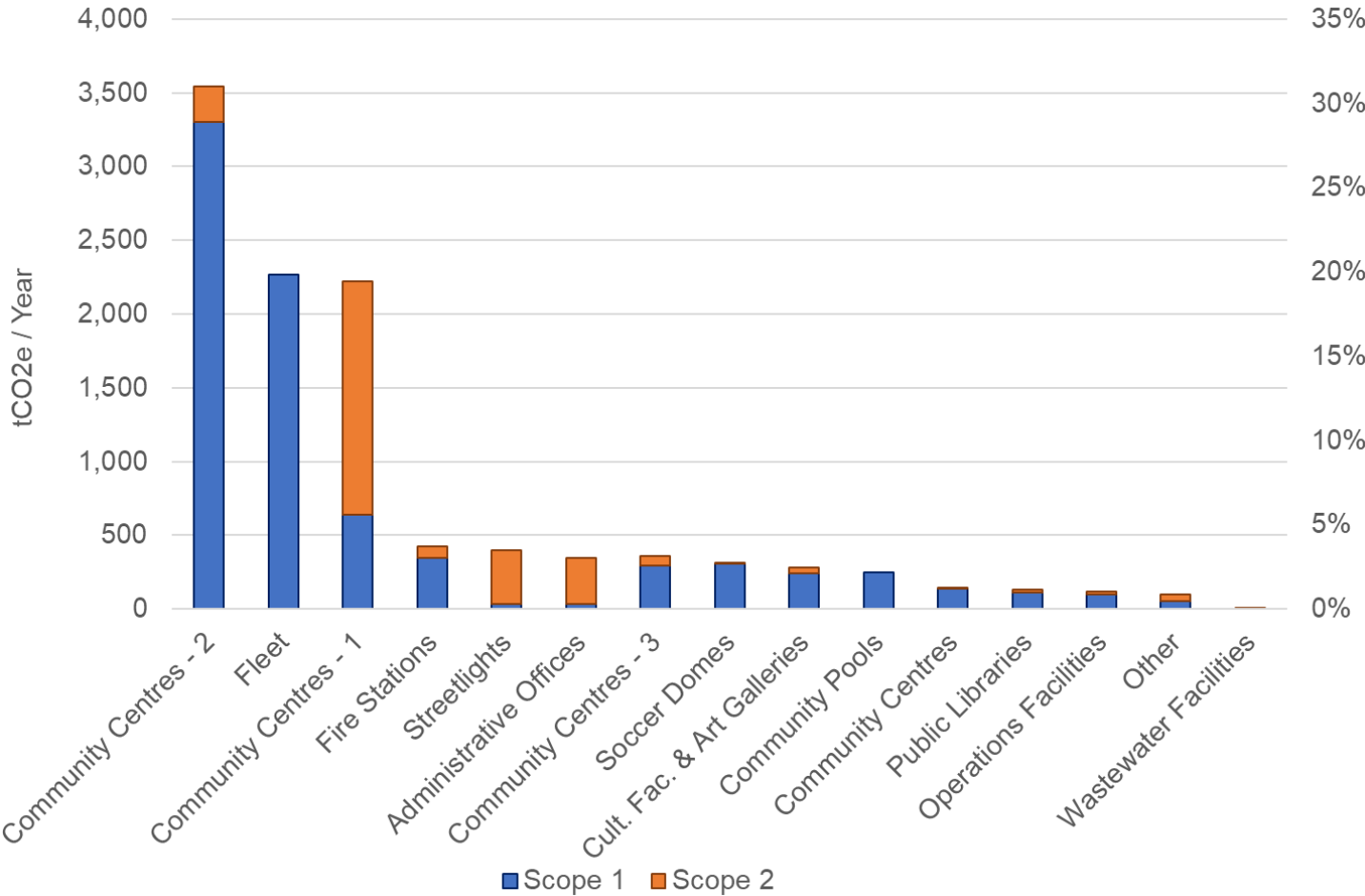


Figure 5: Portfolio Carbon Breakdown

In contrast to the energy use breakdowns, Scope 1 emissions stemming from natural gas use and fleet fuels dominates the emissions share, accounting for 73% of total GHG emissions, and despite being somewhat close in usage to electricity, highlighting the relatively clean electricity grid in Ontario.



Generally, the energy and carbon breakdowns align closely except for streetlights, which strictly use electricity and as such account for very little carbon emissions in relation to their energy demand due to the relatively clean electricity grid in Ontario.

In 2023, community centres (incl. categories 1, 2 & 3) were the largest energy use category, responsible for 72% of electricity usage, 72% of natural gas, and 74% of utility carbon emissions. This was somewhat disproportionate to total building area as they accounted for ~62% of total portfolio area. Community Centres 2 was responsible for the majority of community centre-related energy use and emissions.

After Community Centres, Administrative Offices were the next largest energy consumer accounting for 7% of energy and % of emissions.

The overall breakdown of energy use by type can be seen in the following figure:

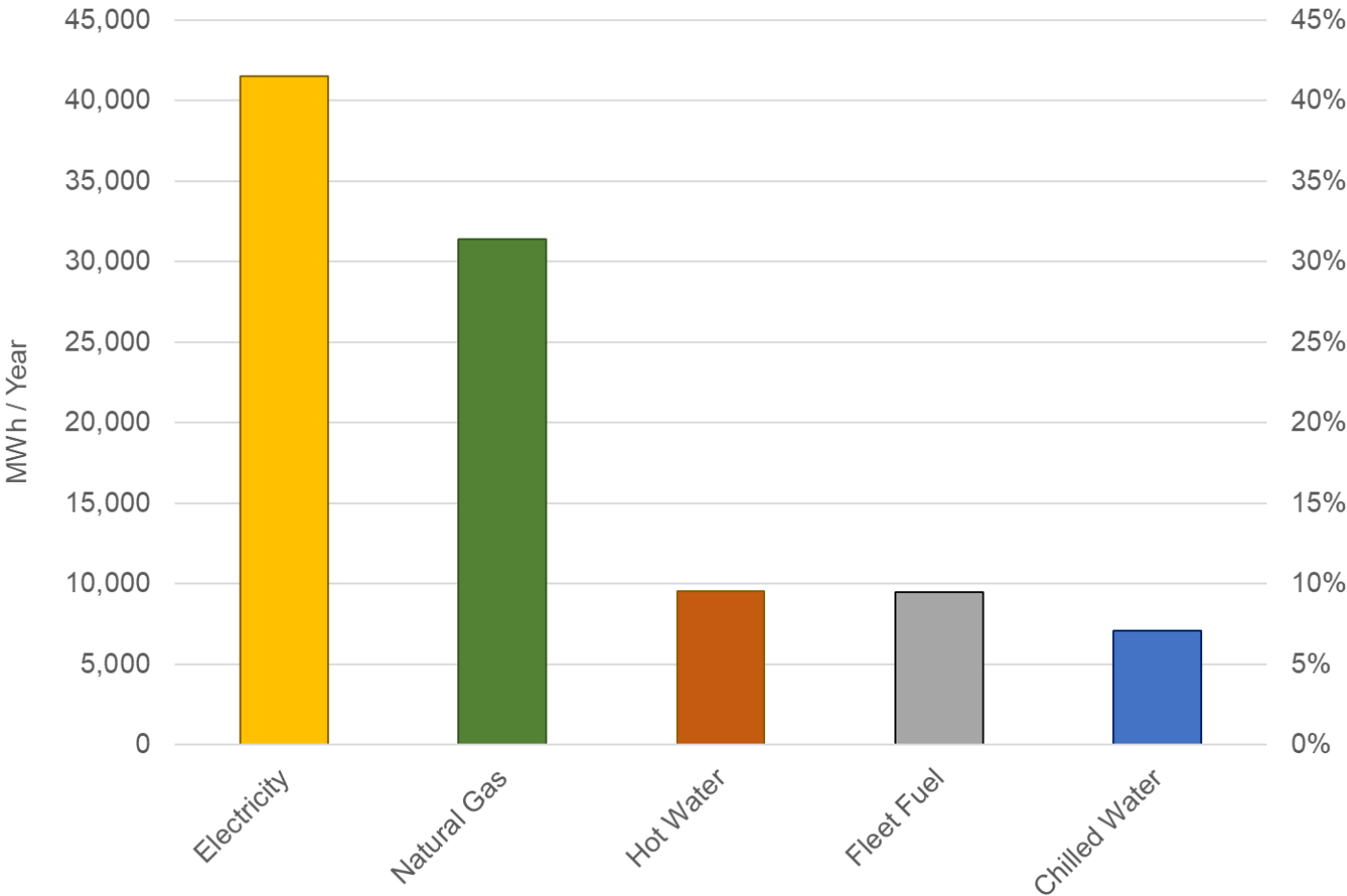


Figure 6: Energy Type Breakdown

With natural gas and electricity accounting for 73% of portfolio energy use.



The overall breakdown of carbon emissions by type is depicted in the following graph.

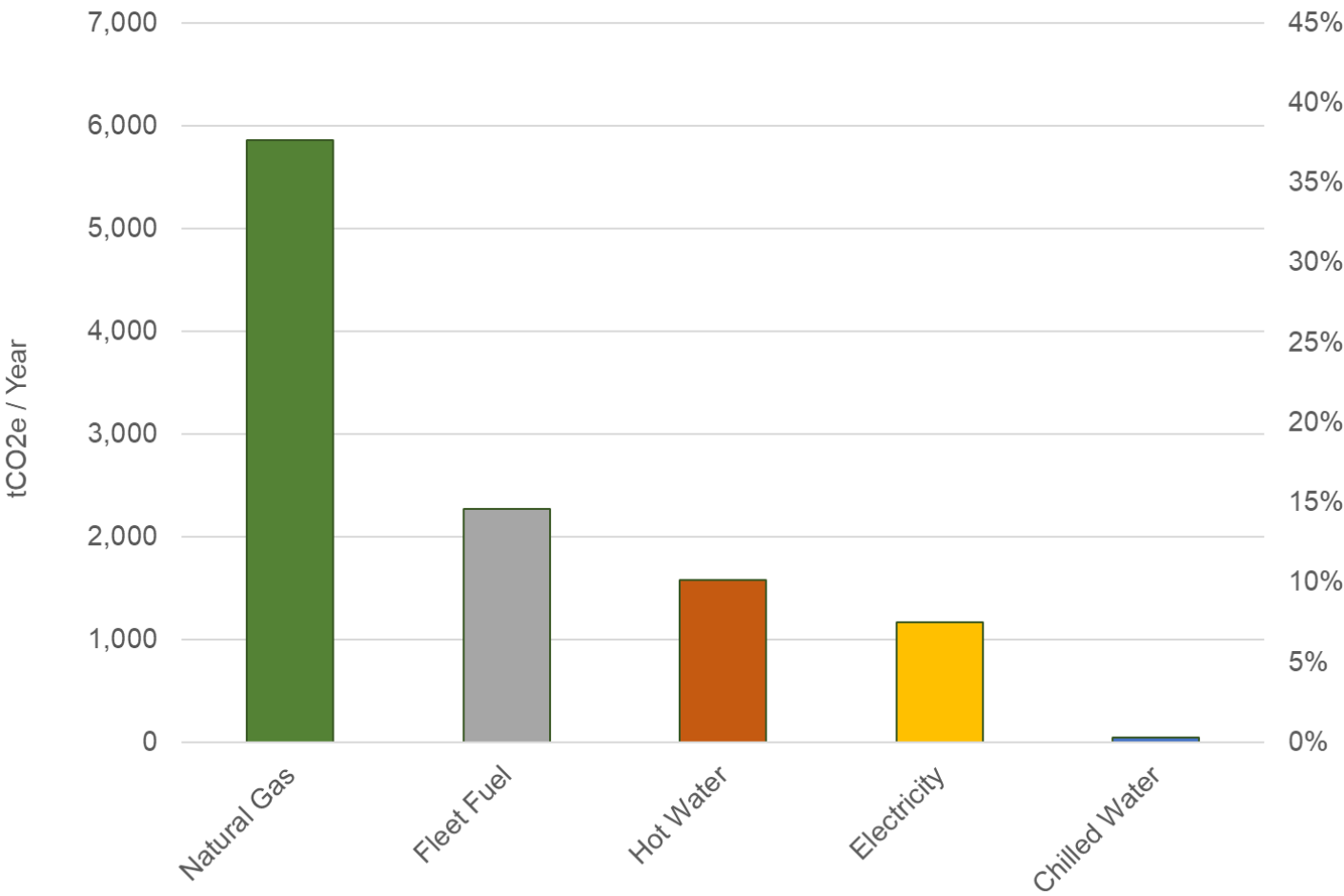


Figure 7: Carbon Emissions Type Breakdown



The breakdown of fleet fuel balance by fuel type is summarized in the following figure:

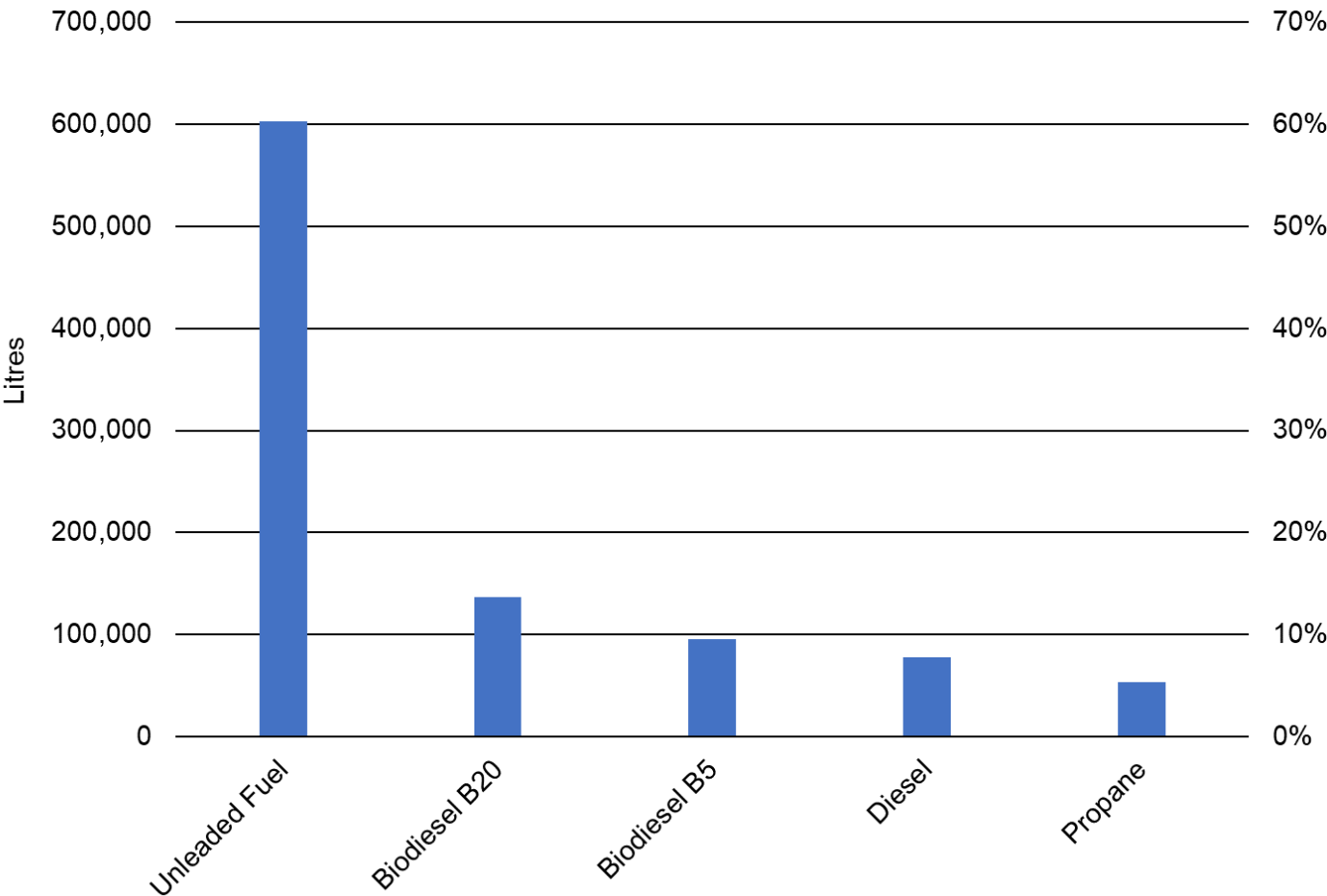


Figure 8: Fleet Fuel Breakdown

As would be expected, unleaded gasoline accounts for the largest proportion of fleet fuel usage.



A breakdown of fleet fuel GHG emissions by fuel type is summarized in the following figure:

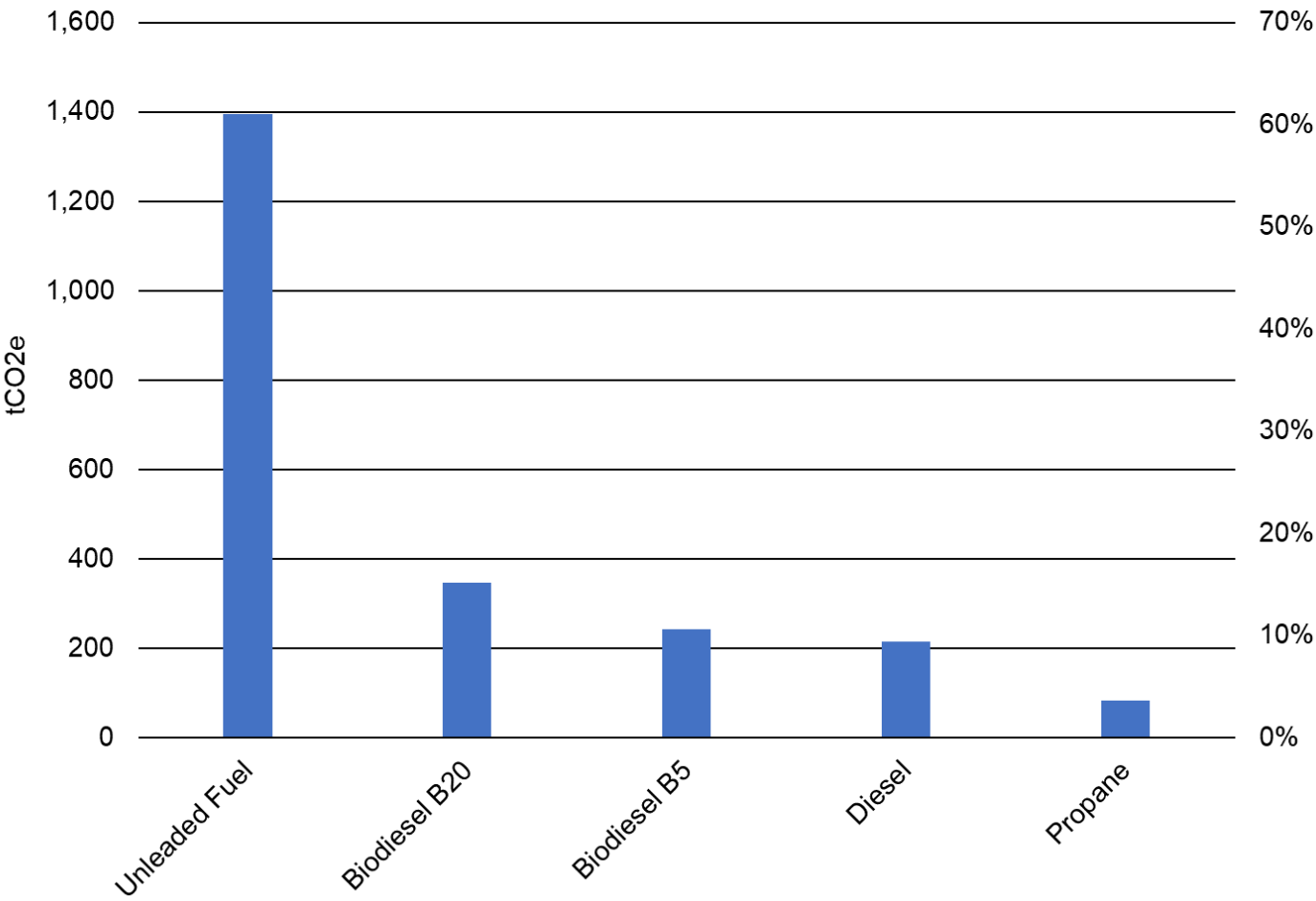


Figure 9: Fleet Emissions Breakdown

Emissions by fuel type closely mirrors fuel consumption with minor variances based on the relative emissions factor of each fuel type, with diesel variants having higher emission intensity per volume.



3.2 Renewables Summary

3.2.1 Solar

Existing renewables are summarized in the following table:

Markham Installed Solar Capacity		
Location	Array Size (kW)	Est. Annual Production (kWh/yr)
8100 Warden	250	272,500
Civic Centre	9.6	10,464
FS 99	10	10,900
Angus Glen CC	250	326,070
Milliken Mills CC	100	132,993
Mount Joy CC	285	360,713
RJ Clatworthy	120	157,660
Thornhill CC	350	453,622
Pan-Am Centre	450	624,576
Aaniin CC	300	335,700
Total	2,125	2,685,198

Table 5: Existing Installed Solar Capacity

The following sites have been assessed for potential solar installation:

Markham Potential Future Solar Projects		
Facility Name	Array Size (kW)	Est. Annual Production (kWh/yr)
Crosby CC	88	106,010
Markham Village Arena	225	248,663
Rouge River CC	22	28,236
Varley Art Gallery	18	22,163
Centennial CC	80	100,668
Fire Station 91	30	37,873
Fire Station 92	43	54,313
Fire Station 93	27	34,130
Fire Station 94	40	49,489
Fire Station 95	43	53,432
Fire Station 96	20	25,368
Fire Station 97	14	17,524
Fire Station 98	34	42,635
Cornell Community Centre	193	211,681
Theatre	71	90,007
Totals	947	1,122,192

Table 6: Potential Future Solar Projects



3.2.2 Geothermal

Geothermal systems exist in the following buildings:

Markham Installed Geothermal Systems		
Location	Count	Total System Size
Fire Station #93	2 x Water Source Heat Pump	26.7 Tons (Cooling)
Markham Museum	12 x Water Source Heat Pump	50 Tons (Cooling)

Table 7: Existing Geothermal Systems

3.3.3 Air Source

Air source heat pumps will be implemented at Mount Joy CC, RJ Clatworthy Arena, Thornhill CC, and Fire Station 97 as part of the Net Zero retrofits detailed in Section 4.4.



4. Performance Target Overview and Update

4.1 Actual vs. Target Performance

The City of Markham set out the following energy targets in its 2019 CEMP:

Measure Description	2017 Baseline	Target Reduction (%)	2022 Target
Corporate Facility Energy Intensity	42 ekWh/ft ² /year	5% Reduction	40 ekWh/ft ² /year
Streetlighting Energy Intensity	491 kWh/fixture/year	5% Reduction	466 kWh/fixture/year
Municipal Operations GHG Emissions Intensity	34 kg GHG/person/year	5% Reduction	32 kg GHG/person/year

Table 8: 2019 CEMP Targets

To progress towards these targets, the city identified 40 measures which included both discrete and ongoing measures. A summary table of all proposed measures, along with their current status, is detailed in Section 4.2. Of the measures identified, 28 are in progress, with 26 of the 28 expected to either be ongoing with no final completion date or completed after the 2024 CEMP. Two measures were deferred due to COVID and a shift in City priorities.

Through implemented measures and other energy related activities, the city has improved energy performance and achieved the targets set in the 2019 CEMP with results outlined in the following table:

2019 CEMP Performance Results					
Measure Description	2017 Baseline	Target Reduction (%)	2022 Target	2022 Actual	Achieved Reduction (%)
Corporate Facility Energy Intensity	42 ekWh/ft ² /year	5% Reduction	40 ekWh/ft ² /year	37 ekWh/ft ² /year	12% Reduction
Streetlighting Energy Intensity	491 kWh/fixture/year	5% Reduction	466 kWh/fixture/year	426 kWh/fixture/year	13% Reduction
Municipal Operations GHG Emissions Intensity	34 kg GHG/person/year	5% Reduction	32 kg GHG/person/year	29 kg GHG/person/year	15% Reduction

Table 9: 2019 CEMP Target Performance Comparison



The City of Markham’s 2019 CEMP performance results outlined above uses the 2017 baseline to evaluate energy performance in the year 2022. Corporate facility energy intensity demonstrated an approximately 12% reduction, with streetlighting energy intensity similarly displayed a 13% reduction, and municipal operations GHG emissions intensity demonstrated an approximately 15% reduction. Review of 2023 suggests that roughly half the decrease in corporate facility energy and approximately a third of the reduction in municipal operations GHGs are the result of COVID related impacts with no identified COVID impacts on streetlighting intensity.

The City’s 2014 CEMP targets and performance are included below to provide further context and illustrate the City of Markham’s success in setting and achieving energy performance targets:

2014 CEMP Performance Results					
Measure Description	2012 Baseline	Target Reduction (%)	2017 Target	2017 Actual	Achieved Reduction (%)
Corporate Facility Energy Intensity	35 ekWh/ft ² /year	10% Reduction	31 ekWh/ft ² /year	32 ekWh/ft ² /year	8% Reduction
Streetlighting Energy Intensity	694 kWh/fixture/year	20% Reduction	555 kWh/fixture/year	491 kWh/fixture/year	29% Reduction
Municipal Operations GHG Emissions Intensity	39.7 kg GHG/person/year	5% Reduction	37.7 kg GHG/person/year	34 kg GHG/person/year	14% Reduction

Table 10: 2014 CEMP Target Performance Comparison

The City of Markham’s 2014 CEMP performance results were measured from its 2012 baseline to the year 2017. Corporate facility energy intensity demonstrated an approximate 8% reduction, slightly smaller than the target of 10%. Streetlighting energy intensity demonstrated an approximate 29% reduction, significantly more than the target of 20%. Municipal operations GHG emissions intensity demonstrated an approximate 14% reduction, almost three times more than the target of 5%. In the 2014 CEMP, streetlighting and municipal operations GHG emissions intensity significantly surpassed target reductions, whereas corporate facility energy intensity achieved was slightly lower than the target.



4.2 2019 CEMP Measures Progress

#	2019 CEMP Measure	Proposed Length	Actual Length	Results	Status
1	Obtain FCM's PCP Milestones 4 & 5 award	2019-2020	2019-2023	Completed	Completed
2	Earn industry-esteemed awards	Ongoing	Ongoing	Eight awards have been earned since the 2019 CEMP.	Ongoing / Achieved
3	Study and Model Fleet Vehicle Net-Zero Carbon Emissions	2019-2020	Ongoing	Currently underway, to be completed by mid 2024.	Ongoing
4	Improve system efficiencies and expand MDE to buildings, where feasible	Ongoing	Ongoing	Ongoing	Ongoing
5	Investigate and implement district energy carbon reduction strategies, where feasible	Ongoing	Ongoing	Markham District Energy investigating the feasibility of 4 major carbon reduction projects, estimated to reduce emissions by 55% - 60%.	Ongoing
6	Develop Corporate NZEE 2050 study scope with short to medium to long-term reduction strategies including recommendations and solutions	2020	Ongoing	The City has already completed NZEE report for 3 fire stations, along with Low Carbon Roadmaps for 4 community centres. An NZEP report with a long-term vision of getting to Net-Zero is currently in progress.	Ongoing
7	Launch Corporate NZEE 2050 study and identify resources (i.e. Staff, funding) required to implement the NZEE 2050 plan	2021-2023	2021-2023	Net-zero emissions plan expected to be completed mid-2024. Two staff hired in 2023 to help implement net-zero projects.	Ongoing
8	Evaluate feasibility of adding facility Level 2 energy audits and/or re-commissioning studies to Capital Lifecycle Plan, and perform energy audits prior to major facility upgrades, as necessary	2023-2024 Ongoing	Ongoing	7 completed Net-Zero studies covering 14+ facilities.	Ongoing / Achieved



#	2019 CEMP Measure	Proposed Length	Actual Length	Results	Status
9	Re-commission buildings, as applicable	Ongoing	Ongoing	Recommissioning for 3 facilities to be completed by end of 2024. 4 more to be investigated by end of 2024 and recommissioned by 2026.	Ongoing
10	Enroll eligible facilities in Enbridge's Run it Right program	2019-2023	2019-2023	Nine facilities participated in the program.	Completed
11	Apply for utility incentives on eligible projects	Ongoing	Ongoing	Over \$7.2 million in grants and incentives received since 2019.	Ongoing
12	Recruit staffing resource to effectively utilize and manage metering tools to identify energy and cost savings	2019 - Recruit Ongoing	Ongoing	Energy and GHG analyst was added to the team in 2021.	Completed
13	Develop M&V plans, and utilize/add metering tools for project M&V to secure incentive funding	Ongoing	Ongoing	Utilized metering tools to satisfy reporting requirements laid out in M&V plans, securing over \$620k in incentives at Angus Glen CC.	Ongoing
14	Study and develop city-wide metering program and standardized specifications	2019-2020	Ongoing	Completed	Completed
15	Standardize and centralize metering monitoring and management at largest facilities, if feasible	2021-2024	Ongoing	Added 46 existing meters to centralized metering platform.	Ongoing
16	Upgrade whole-building Alectra electricity meters to hourly interval meters, and obtain remote access capability	Ongoing	Ongoing	8 meters have been upgraded to interval meters.	Completed



#	2019 CEMP Measure	Proposed Length	Actual Length	Results	Status
17	Upgrade whole-building Enbridge Gas meters to hourly interval meters, and obtain remote access capability	Ongoing	Ongoing	One meter has been updated at Angus Glen CC.	Ongoing
18	Complete utility bill audits; identify and implement cost savings	2019-2020 Annual	Ongoing	Over \$42k in savings achieved through utility bill audits.	Ongoing
19	BAS and HVAC training	Ongoing	Ongoing	BAS Training was successfully completed for 3 facilities. Additional training has been provided on select items.	Ongoing
20	Utility Management System and metering training	Ongoing	Ongoing	New staff are trained on utility management system and metering tools as part of onboarding.	Ongoing
21	Study best practice operating procedures for major equipment, and update Battle of the Buildings engagement tools	2020 2021	Ongoing	Deferred due to Covid and shift in priorities	Ongoing
22	Re-launch competition with new baseline, improved measures and tools	2021-2024 Annual	Ongoing	Deferred due to Covid and shift in priorities	Ongoing
23	Increase Demand Response participation, where feasible	Ongoing	Ongoing	Cancelled	Cancelled
24	Investigate demand management opportunities	2022	Ongoing	Ongoing	Ongoing
25	Support lifecycle upgrades with funding, incentives, and studies	Ongoing	Ongoing	Over \$7.2M secured in grants and incentives since 2021 to implement upgrades.	Ongoing
26	BAS Preventative Maintenance Contracts	Ongoing	Ongoing	Completed	Completed
27	Implement BAS Standards and optimize BAS at major facilities	Ongoing	Ongoing	11 buildings have been recommissioned to meet new standards.	Ongoing



#	2019 CEMP Measure	Proposed Length	Actual Length	Results	Status
28	Install CHP at Angus Glen Community Centre. Review CHP performance against study baseline	2019 2019-2020		Achieved \$70k of savings in excess of the projected savings over the first two years of operation.	Completed
29	Evaluate CHP business cases, and install where feasible	2021 - 2023	Completed	Evaluated business cases at 3 other facilities (Centennial, Milliken, Thornhill). Determined not to pursue further.	Completed
30	Design all new buildings with at minimum LEED™ Silver. Study and model Net-Zero business cases for proposed new construction projects	Ongoing	Ongoing	Ongoing	Ongoing
31	Investigate converting the remaining HPS decorative streetlights to LED	Ongoing	Ongoing	Ongoing	Ongoing
32	Evaluate solar PV system business cases, and install where feasible	2019-2020 Ongoing	Ongoing	New solar PV system added to Aaniin CC. Preliminary engineering studies completed at 15 other locations.	Completed
33	Evaluate business cases and install solar thermal systems, where feasible	2019-2020	2013-2023	Investigated solar walls and solar hot water systems.	Completed
34	Evaluate business cases and add renewable energy, where feasible	Ongoing	Ongoing	GSHP business case completed for Centennial CC.	Ongoing
35	Evaluate business cases and install heat recovery, where feasible	Ongoing	Ongoing	Waste heat recovery systems added for two pools.	Ongoing
36	Support additional special events to promote energy awareness	Ongoing	Ongoing	Ongoing	Ongoing
37	Share project successes, awards, and best practices	Ongoing	Ongoing	Ongoing	Ongoing



#	2019 CEMP Measure	Proposed Length	Actual Length	Results	Status
38	Increase webpage awareness	Ongoing	Ongoing	Ongoing	Ongoing
39	Create revised corporate energy management plan	2018-2019	Ongoing	Completed	Completed
40	Internally and externally report annually on energy consumption and GHG emissions	Ongoing	Ongoing	Results illustrated through annual energy and GHG reports.	Ongoing

Table 11: 2019 CEMP Measures Progress Summary



4.3 Target Update Recommendation

Facility Energy and Facility GHG reduction targets have been generated based on funding that the City has committed towards energy and GHG reduction projects which is detailed in Section 4.4. These targets are relative to 2022 utility data, normalized for energy intensity and weather in line with the City’s baseline, and are summarized in the following table:

Metric	Baseline	Target Reduction	2026 Target (Normalized to 2022)*
Facility Energy Reduction	2022 Energy relative to 2018 baseline	5% (2022) 25% (2018 Baseline)	3,550,000 kWh/year
Facility GHG Reduction	2022 GHG relative to 2018 baseline	7% (2022) 22% (2018 Baseline)	2,100 tCO _{2e} /year
Fleet Electrification	% ICE share relative to 2023 baseline	9% city owned fleet vehicles	21 additional vehicles transitioned

Table 12: Recommended Energy Performance Targets

* Values normalized to weather, building area, and fleet size in 2022.

The 2026 Target Reductions shown above are provided both against 2022 consumption, and in comparison, with the 2018 baseline to demonstrate prior performance achievements made by the City. For context, over the period covered by the 2019 CEMP, facility Energy and GHG reductions were 21% and 16% respectively compared with the 2018 baseline achieving a cumulative utility cost savings of \$6.1 million and avoidance of 7,231 tCO_{2e} GHG emissions.

The fleet electrification target includes both Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs), excludes historic vehicles, and is net of BEV and PHEV vehicles scheduled for retirement prior to, or in 2026. EV share in 2023 was 12 of 225 city owned fleet vehicles (5.3%) with seven EVs scheduled for retirement in or prior to 2026 requiring an incremental EV transition of 21 vehicles plus replacement of seven existing EVs.



4.4 2024 CEMP Planned Measures

Project	Description	Expected Electricity Savings (MWh/year)	Expected Natural Gas Savings (m ³ /year)	Expected Cost Savings (\$/year)	Estimated Cost (\$)	Expected GHG Reduction (tCO _{2e} /year)	Timeline
Mount Joy CC net zero retrofit	<p>Upgrades include:</p> <ul style="list-style-type: none"> ➤ Adding heat recovery, VFDs, and controls optimization to the refrigeration plant. ➤ Replacement of rooftop units (RTUs) and boilers with heat pumps utilizing heat recovery from the refrigeration plant. ➤ LED lighting retrofit. ➤ Building envelope improvements. ➤ Installation of BAS system and complete recommissioning of controls sequences. 	438	59,981	\$114,024	\$3,258,900	130.0	December 2025
Markham Museum	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences.	70	9,350	\$14,266	\$194,027	20.0	July 2026
FS 99	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences.	10	-	\$1,557	\$147,400	0.3	Jan 2026



Project	Description	Expected Electricity Savings (MWh/year)	Expected Natural Gas Savings (m ³ /year)	Expected Cost Savings (\$/year)	Estimated Cost (\$)	Expected GHG Reduction (tCO _{2e} /year)	Timeline
Varley Art Gallery	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences.	41	6,730	\$8,783	\$307,485	14.2	April 2026
Thornhill CC net zero retrofit	Upgrades include: <ul style="list-style-type: none"> ➤ Complete recommissioning of controls sequences. ➤ Install low-flow water fixtures and spa covers. ➤ Replace natural gas-fired RTUs with air source heat pumps (ASHPs). ➤ LED lighting retrofit. ➤ Replace natural gas rink heaters with electric models. ➤ Replace natural gas boilers with ASHP boilers. ➤ Replace domestic hot water (DHW) heaters with ASHP. ➤ Replace makeup air unit (MAU) with energy recovery ventilator (ERV). ➤ Reduce infiltration. ➤ Replace window/door seals. 	-304	209,451	\$1,544	\$3,110,890	405.0	December 2025
Armadale CC	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences.	23	4,534	\$5,067	\$159,834	9.4	April 2026
Markham Village Library	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences.	51	4,413	\$9,686	\$274,846	10.0	July 2026



Project	Description	Expected Electricity Savings (MWh/year)	Expected Natural Gas Savings (m ³ /year)	Expected Cost Savings (\$/year)	Estimated Cost (\$)	Expected GHG Reduction (tCO _{2e} /year)	Timeline
RJ Clatworthy Arena net zero retrofit	Upgrades include: <ul style="list-style-type: none"> ➤ Install low-flow showerheads. ➤ Adding exterior insulation. ➤ Replacing windows with triple-pane windows. ➤ Improve heat recovery capabilities of the refrigeration plant. ➤ Replace existing furnace with high-efficiency air handling unit (AHU) utilizing waste heat from the refrigeration plant. ➤ Replace natural gas radiant heaters with electric models. ➤ Replace electric baseboards with ASHP. ➤ LED lighting retrofit. ➤ Replace DHW heaters with ASHP. ➤ Complete recommissioning of controls sequences. 	-56	29,901	-\$1,136	\$1,647,889	56.4	December 2025
FS 97 net zero retrofit	Upgrades include: <ul style="list-style-type: none"> ➤ LED lighting retrofit. ➤ Improved lighting controls. ➤ Replace furnace with heat pump. ➤ Replace DHW heater with heat pump DHW heater. ➤ ERV implementation. ➤ Air curtain implementation. ➤ Apparatus bay heating conversion. ➤ Infiltration reduction. Replacing window/door seals.	-0.87	19,192	\$3,165	\$824,415	36.8	July 2025
8100 Warden	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences. Conversion of pneumatic controls to DDC.	83	-	\$13,541	\$732,505	2.3	June 2025



Project	Description	Expected Electricity Savings (MWh/year)	Expected Natural Gas Savings (m ³ /year)	Expected Cost Savings (\$/year)	Estimated Cost (\$)	Expected GHG Reduction (tCO _{2e} /year)	Timeline
FS 93	Upgrade and recommissioning of building automation systems (BAS) to improve energy efficiency and occupant comfort by optimizing HVAC control sequences,	15	209	\$2,538	\$162,074	0.8	Jan 2026

Table 13: 2024 CEMP Planned Measures



5 Conclusion

Utility data spanning the period covered by the 2019 Corporate Energy Management Plan (CEMP) and including some additional years was reviewed in conjunction with building and fleet information, current and planned projects, and previously completed energy and GHG reduction measures to evaluate performance against 2019 CEMP targets and provide targets for the 2024 CEMP.

Based on the analysis performed, the City of Markham outperformed the Energy and GHG reduction targets defined in its 2019 CEMP, achieving an estimated utility cost savings of \$6.1 million (based on average utility rates) and avoidance of 7,231 tCO_{2e} GHG emissions over the span of 2019 - 2022.

Energy and GHG reduction projects that were identified as projects for which the City had allocated resources or had developed a plan to allocate resources for were reviewed to determine reasonable targets for the reporting period covered by the 2024 CEMP. The following table demonstrates the energy performance targets proposed for both facilities and fleet:

Metric	Baseline	Target Reduction	2026 Target (Normalized to 2022)*
Facility Energy Reduction	2022 Energy relative to 2018 baseline	5% (2022) 25% (2018 Baseline)	3,550,000 kWh/year
Facility GHG Reduction	2022 GHG relative to 2018 baseline	7% (2022) 22% (2018 Baseline)	2,100 tCO _{2e} /year
Fleet Electrification	% ICE share relative to 2023 baseline	9% City Owned Fleet Vehicles	21 additional vehicles transitioned

Table 14: Recommended Energy Performance Targets

The outcome of this effort would however significantly reduce the energy impact of the City, and would position Markham as a leading municipality globally with respect to sustainability performance.



Appendix A – Complete Facilities List and Energy Summary

Property Name	Address	City	Property GFA (m ²)	Primary Property Type	Electricity Use - Grid Purchase (GJ)	Natural Gas Use (GJ)	District Hot Water Use (GJ)	District Chilled Water Use (GJ)	Site Energy Use (GJ)	Site EUI (GJ/m ²)	Weather Normalized Site Energy Use (GJ)	Weather Normalized Site EUI (GJ/m ²)	Location-Based GHG Emissions (tCO ₂ e)	Location-Based GHG Emissions Intensity (kgCO ₂ e/m ²)
Aaniin Community Centre	5665 14TH AVE	Markham	11,334	Other - Recreation	6,620	9,189	N/A	N/A	15,808	1.39	16,169	1.43	514	45
Angus Glen Community Centre/Arena	3990 MAJOR MACKENZIE DR	Markham	16,630	Ice/Curling Rink	5,162	36,007	N/A	N/A	41,168	2.48	41,168	2.48	1,851	111
Angus Glen Tennis Centre	3970 Major Mackenzie Dr E	Markham	2,829	Other - Stadium	N/A	946	N/A	N/A	946	0.32	1,150	0.39	48	16
Armada Community Centre	2401 DENISON ST	Markham	2,189	Social/Meeting Hall	885	1,474	N/A	N/A	2,359	1.08	2,543	1.16	81	37
Buttonville Women's Institute Community Hall	8931 Woodbine Avenue	Unionville	498	Social/Meeting Hall	24	223	N/A	N/A	246	0.49	280	0.56	11	23
Centennial Community Centre	8600 McCowan Rd	Markham	13,192	Social/Meeting Hall	9,889	10,433	N/A	N/A	20,321	1.54	20,607	1.56	601	46
Community & Fire Services Administration Building	8100 WARDEN AVE	Markham	7,862	Office	3,065	407	1,238	1,701	6,412	0.82	6,568	0.84	267	34
Cornell Community Centre	3201 Bur Oak Avenue	Markham	14,266	Other - Recreation	12,665	N/A	11,529	9,001	33,194	2.33	32,969	2.31	1,696	119
Crosby Community Centre/Arena	210 Main St	Unionville	3,186	Social/Meeting Hall	2,170	1,330	N/A	N/A	3,500	1.10	3,667	1.15	84	26
Fire Station #91	7801 Bayview Avenue	Thornhill	776	Fire Station	422	689	N/A	N/A	1,111	1.43	1,237	1.59	38	49
Fire Station #92	10 Riviera Dr	Markham	1,432	Fire Station	803	1,460	N/A	N/A	2,262	1.58	2,559	1.79	80	56
Fire Station #93	2930 MAJOR MACKENZIE DR E	Markham	1,007	Fire Station	570	76	N/A	N/A	646	0.64	668	0.66	8	8
Fire Station #94	7300 Birchmount	Markham	664	Fire Station	352	657	N/A	N/A	1,008	1.52	1,112	1.68	36	54
Fire Station #95	316 Main Street	Unionville	1,101	Fire Station	483	1,081	N/A	N/A	1,564	1.42	1,742	1.58	58	53
Fire Station #96	5567 14th Avenue, Milliken	Markham	830	Fire Station	315	740	N/A	N/A	1,054	1.27	1,168	1.41	40	48
Fire Station #97	209 Main Street, Markham	Markham	713	Fire Station	243	486	N/A	N/A	729	1.02	793	1.11	26	37
Fire Station #98	650 Bur Oak Avenue, Markham	Markham	873	Fire Station	509	1,198	N/A	N/A	1,707	1.95	1,902	2.18	64	74
Fire Station #99	3255 Bur Oak Avenue, Markham	Markham	1,007	Fire Station	326	20	754	297	1,396	1.39	1,433	1.42	72	71
Flato Performing Arts Theatre	171 TOWN CENTRE BLVD	Markham	2,806	Performing Arts	1,279	147	N/A	N/A	1,426	0.51	1,426	0.51	17	6
Fleet Maintenance Works Yard- Main Building	555 Miller Avenue	Markham	3,066	Repair Services (Vehicle, Shoe, Locksmith, etc.)	1,565	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
John Street Fire Training Centre	438 John Street	Thornhill	514	Fire Station	201	440	N/A	N/A	640	1.25	717	1.39	24	46
Markham Civic Centre	101 Town Centre Blvd	Markham	14,485	Office	7,130	-	4,402	2,556	14,087	0.97	15,134	1.04	604	42
Markham Museum	9350 HIGHWAY 48	Markham	6,318	Museum	2,047	2,301	N/A	N/A	4,348	0.69	4,706	0.74	132	21
Markham Village BIA	132 ROBINSON ST	Markham	59	Office	14	56	N/A	N/A	70	1.20	80	1.36	3	50
Markham Village Community Centre/Arena	6041 Highway 7	Markham	4,014	Social/Meeting Hall	1,747	1,527	N/A	N/A	3,273	0.82	3,503	0.87	90	23
Markham Village Library	6031 Highway 7	Markham	3,493	Library	1,786	1,729	N/A	N/A	3,515	1.01	3,729	1.07	101	29
McKay House	197 MAIN ST	Markham	290	Museum	26	139	N/A	N/A	164	0.57	185	0.64	7	25
Milliken Mills Community Centre	7600 Kennedy Rd	Markham	9,610	Social/Meeting Hall	5,400	10,561	N/A	N/A	15,961	1.66	16,839	1.75	573	60
Milliken Mills Soccer Dome & Clubhouse	7700 Kennedy Rd	Markham	3,101	Other - Stadium	861	1,945	N/A	N/A	2,806	0.90	3,120	1.01	105	34
Milne Parks Yard Shop	8251 MCCOWAN RD Milne Park	Markham	120	Repair Services (Vehicle, Shoe, Locksmith, etc.)	2	N/A	N/A	N/A	2	0.02	2	0.02	-	0
Mount Joy Community Centre/Arena	6140 16th Ave	Markham	5,671	Social/Meeting Hall	3,184	1,788	N/A	N/A	4,973	0.88	5,310	0.94	115	20
Old Unionville Library Community Centre	221 Main Street	Unionville	313	Social/Meeting Hall	18	171	N/A	N/A	189	0.60	214	0.68	9	28
Pan Am Community Centre	16 Main St Unionville	Markham	13,657	Social/Meeting Hall	9,790	20	16,511	11,870	38,190	2.80	38,383	2.81	2,294	168
Parks Department Maintenance Building	4415 14th Avenue, Milliken	Markham	674	Repair Services (Vehicle, Shoe, Locksmith, etc.)	195	1,219	N/A	N/A	1,414	2.10	1,414	2.10	63	93
Pingle House	4022 Major Mackenzie Drive	Markham	409	Social/Meeting Hall	N/A	85	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Princess Street Parks Shop	6 Princess Street, Markham	Markham	89	Repair Services (Vehicle, Shoe, Locksmith, etc.)	159	N/A	N/A	N/A	159	1.78	180	2.02	1	14
R.J. Clatworthy Arena	2400 John St	Markham	3,092	Ice/Curling Rink	1,730	1,027	N/A	N/A	2,757	0.89	2,884	0.93	65	21
Rouge River Community Centre	120 Rouge Bank Dr	Markham	1,886	Social/Meeting Hall	770	1,575	N/A	N/A	2,345	1.24	2,509	1.33	85	45
St. Robert's Soccer Dome	8101 LESLIE-ST	Markham	2,727	Stadium (Closed)	4	4,113	N/A	N/A	4,117	1.51	4,861	1.78	207	76
Thornhill Community Centre	7755 Bayview Ave	Markham	15,621	Social/Meeting Hall	10,889	6,432	N/A	N/A	17,321	1.11	18,143	1.16	408	26
Thornhill Village Library	10 Colborne St	Thornhill	398	Library	117	99	N/A	N/A	215	0.54	238	0.60	6	15
Unionville Library	15 Library Lane	Markham	1,267	Library	868	339	N/A	N/A	1,207	0.95	1,314	1.04	24	19
Unionville Train Station Community Centre	7 STATION LANE	Markham	184	Social/Meeting Hall	13	251	N/A	N/A	264	1.43	298	1.62	13	69
Varley Art Gallery	216 Main St	Unionville	2,323	Museum	1,205	2,014	N/A	N/A	3,219	1.39	3,266	1.41	111	48
Warden House	8840 Warden Avenue	Markham	492	Social/Meeting Hall	63	N/A	N/A	N/A	63	0.13	71	0.14	1	1
West Parks Yard Shop	428 John Street	Markham	253	Repair Services (Vehicle, Shoe, Locksmith, etc.)	117	161	N/A	N/A	278	1.10	307	1.22	9	36

