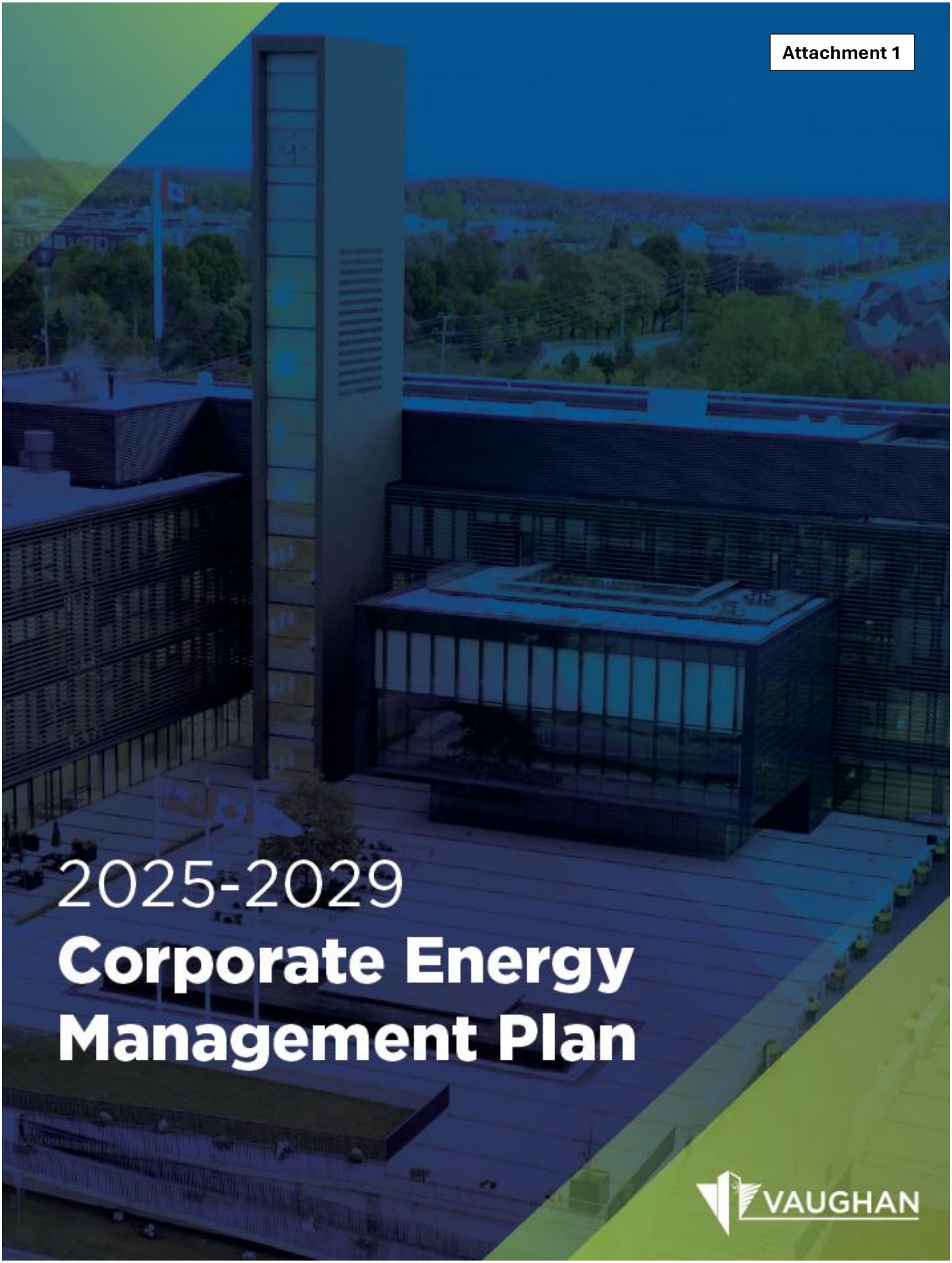
Attachment 1



2025-2029

Corporate Energy Management Plan

VAUGHAN

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Land Acknowledgement

We respectfully acknowledge that the City of Vaughan is situated in the Territory and Treaty 13 lands of the Mississauga of the Credit First Nation. We also recognize the traditional territory of the Huron-Wendat and the Haudenosaunee. The City of Vaughan is currently home to many First Nations, Métis and Inuit people today. As representatives of the people of the City of Vaughan, we are grateful to have the opportunity to work and live in this territory.

2024 Corporate Energy Management Plan EXECUTIVE SUMMARY

The City of Vaughan Corporate Energy Management Plan (CEMP) 2025–2029 outlines the City's commitment to reducing energy use and greenhouse gas (GHG) emissions across City-owned buildings, fleet and streetlights. This executive summary provides a high-level overview of energy performance and GHG data, along with conservation achievements and targets for the short term (2025–2029), mid term (2030–2035) and long term (2050).

ENERGY USED, 2022

36,462,905 kWh
of electricity used

41,807,942 ekWh
of natural gas used

ENERGY CONSUMPTION BY BUILDING TYPE

BUILDING	2022	2024
Administration	19%	22%
Recreation	70%	68%
Fire station	5%	5%
Libraries	6%	6%
TOTAL	100%	100%

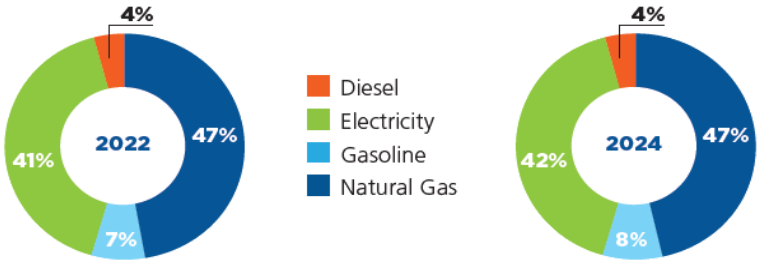
Note: Some numbers may not add up due to rounding.

2019-2024 BASELINE 2022 vs. NOW OVERALL

FOR ALL ASSETS (BUILDING, FLEET, LIGHTING)	
Reduction in consumption (ekWh)	3%
Reduction GHG (tCO2)	2%
FOR BUILDING GHG REDUCTION	
Reduction in electricity	-18%
Reduction in natural gas	-19%

LEGEND:
kWh: kilowatt hours
ekWh: equivalent kilowatt hours
tCO2e: tonnes of carbon dioxide equivalent

How did we use energy?



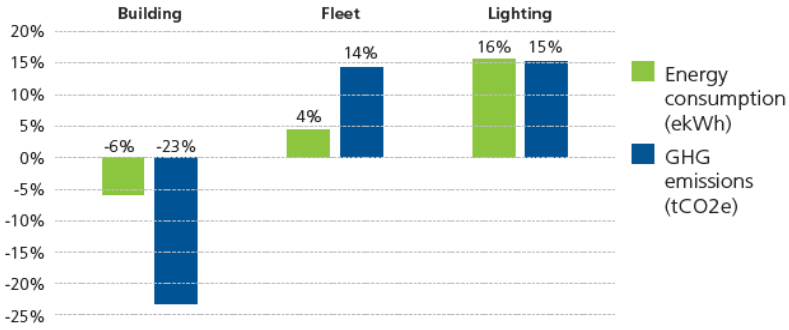
Where did our GHG emissions come from?



Buildings by fuel source



Percentage change in energy consumption and GHGs, 2019-2024



TARGETS

Short-term (2029)

Energy consumption and GHG reduction targets for facilities to 2029 and 2035

Long-term

2050 target

TARGET BUILDING EUI* BY TYPE – 2029	
Administration	23 ekWh/sq.ft.
Fire station	24 ekWh/sq.ft.
Library	21 ekWh/sq.ft.
Community centre with pool	29 ekWh/sq.ft.
Community centre with arena	37 ekWh/sq.ft.
Community centre with pool and arena	29 ekWh/sq.ft.

* EUI: Energy Use Intensity in equivalent kilowatt hours per square foot (ekWh/sq.ft.)

ENERGY CONSUMPTION TARGETS

2029

Reduce electricity consumption
10% below 2024 levels

Reduce natural gas consumption
10% below 2024 levels

2035

Reduce electricity consumption
10% below 2029 levels

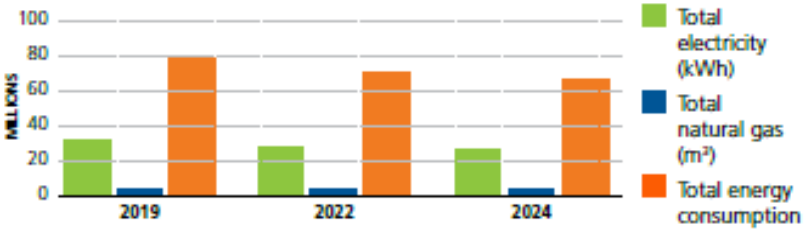
Reduce natural gas consumption
30% below 2029 levels

2050

Eliminate GHG emissions associated with building operations for all facilities

Buildings: 2019-2024

How energy consumption has changed



-6% Reduction in fuel consumption + **-23%** Reduction in GHG emissions + **-7%** Reduction in electricity consumption = **$425,414** Utility cost savings

THIS INCLUDED MORE THAN 65 PROJECTS RELATED TO ENERGY SAVING	
Invested 65+ projects	$3,434,587
In annual savings	$264,917
Received in incentives (electric vehicle chargers included)	$271,300

All leading to the creation of the corporate energy fund.

Fleet: 2019-2024

4% increase in fuel consumption
14% increase in GHG emissions
4 electric vehicles (EV) as of 2024 Corporate Fleet Inventory

Corporate Green Fleet Strategy is under development.

Street lighting

16% increase of electricity consumption of street light inventory
15% increase in GHG emissions
NOTE: **40% increase** in reported inventory from 2019

City-wide LED streetlight retrofit

93% conversion to LED
38 ekWh/light anticipated reduction

What's next: 2025+

Annual progress updates on EMP implementation, to be aligned with BPS reporting by **10 policy, seven retrofit and five engagement recommendations**.

VAUGHAN

List of Recommendations

Energy Management Plan Recommendation 2024

Corporate Energy Management Plan, 2024		
2024 EMP Recommendations		
Category	**Action**	**Timeline**
Policies	Continue participation in the Mayors' Megawatt Challenge by entering at least two additional facilities, specifically City Hall and the newly opened Carrville Community Centre, expanding on the five buildings already enrolled and maintaining regular progress reporting as part of the City's commitment to energy performance improvement.	**Immediate**
	Ensure maintenance of the Corporate Energy Fund to continue its growth.	**Immediate**
	Assist the Fleet Division with the review and implementation of the Green Fleet Strategy update.	**Immediate**
	Implement an enhanced energy management strategy by utilizing digital portals to efficiently monitor and track utility bill data. This approach will leverage RETScreen energy tracking software to support accurate data collection, analysis, and reporting.	**Short term**
	Explore the potential to transition the existing Corporate Energy Fund into a comprehensive energy account that captures and reinvests retrofit cost savings to future low-carbon investments and avoids costs resulting from energy conservation measures.	**Short-medium term**
	Implement a tracking system to monitor the energy consumption and operating costs of all EV chargers across City facilities, enabling accurate reporting, performance evaluation, and informed decision-making for future expansion.	**Short-medium term**
	Evaluate opportunities to revise and modernize the City's Corporate Green Building Policy to incorporate higher-performance building standards, with a focus on enhanced energy efficiency.	**Short-medium term**
	Evaluate opportunities to incorporate fuel consumption and GHG emissions from waste collection vehicles into the City's fleet inventory, for the 2030 renewal of the Corporate Energy Management Plan.	**Medium-term**

	Explore integrating the targets of the Energy Management Plan into the City's Asset Management Plans so replacements and costs estimates reflect corporate energy reductions' needs.	**Short term**
	Adopt a policy that commits the City to constructing all new municipal facilities to meet net-zero energy ready standards in the short term and Passive House standards in the medium term.	**Short-medium and ongoing in Long term**
Retrofits	Initiate a Request for Information (RFI) process to explore solar photovoltaic (PV) and battery storage solutions potential at existing municipal building assets, enabling the City to identify and assess viable implementation opportunities.	**Immediate**
	Assess and pursue opportunities to leverage solar-ready rooftops and geothermal systems at City facilities to maximize the use of on-site renewable energy.	**Short term**
	Execute a new round of facility energy audits in 2026–2027 to enhance ongoing performance tracking and uncover further opportunities for energy and emissions reductions.	**Short term**
	Execute the LED streetlight retrofit project to 100%	**Short term**
	Implement energy conservation measures (ECMs) based on findings and recommendations from Facility Energy Audits.	**Short term and ongoing in Long term**
	Develop tailored energy plans for each City facility to achieve energy consumption and GHG reduction targets, incorporating smart metering to monitor and manage performance in real time.	**Medium term**
	Upgrade building envelopes across City facilities, including insulation, windows, and doors, to improve thermal performance, reduce energy loss, and enhance occupant comfort.	**Medium/Long**
Engagement	Engage Facility staff throughout the energy management process to enhance communication, streamline incentive tracking and savings verification, and leverage their on-the-ground expertise to identify site-specific challenges and solutions. Link to the Save on Energy Retrofit Program.	**Immediate-Short**

	Participate in LAS Facility Operations training workshops, as well as MMC and other relevant webinars offered through the IESO. Training is required for operations and maintenance to ensure ongoing high performance of low-carbon buildings and infrastructure.	**Short term and ongoing in Long term**
	Initiate a Community Centre Energy Savings Challenge.	**Short term**
	Develop a communications and engagement plan to publicly report on the City's new construction, host public demonstrations, and share information on the results and payback for sustainable design features.	**Short term**
	Work with Human Resources to have all new hires at the Director and Deputy City Manager levels attend individual energy and sustainability onboarding meetings with the Environmental Sustainability team. Have all new hires attend a mandatory virtual training on the City's sustainability initiatives and how to incorporate environmental sustainability into their work. Sessions to be held quarterly by the Environmental Sustainability team.	**Immediate**

1.0 Introduction

The City of Vaughan Corporate Energy Management Plan (CEMP) 2025-2029, was prepared for the Corporation of the City of Vaughan in compliance with O.Reg. 25/23. It serves as the latest update to the City's energy management strategy and performance achievements, providing an overview of total energy consumption and prior-year results. The City of Vaughan Corporate Energy Management Plan (CEMP) 2025-2029, hereafter referred to as 'The Plan', summarizes energy conservation results and recommends short-term (i.e., 2030 and 2035) and long-term (i.e., 2050) targets for continued energy savings and reductions in greenhouse gas (GHG) emissions at City facilities. A high-level summary of energy consumption and GHG emissions across three asset types: buildings, fleet, and lighting along with associated targets, is presented on pages 4-5. A summary of key recommendations is provided on pages 6-8.

1.1 Policy Direction

In 2009, the *Green Energy Act* and its regulation, Ontario Regulation (O. Reg.) 397/11, required broader public sector (BPS) organizations in Ontario, including municipalities, to publicly report on energy consumption and associated GHG emissions annually. The regulation also requires publishing and implementing five-year energy conservation and demand management plans (energy management plans) related to the assets and operations of the organization.

Municipalities are mandated to develop and update a corporate energy management plan every five years. This requirement is established under Ontario Regulation 507/18: Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans.

Royal Assent on Bill 34, the *Green Energy Repeal Act* was received on December 6, 2018. However, certain provisions of the *Green Energy Act*, including O. Reg. 397/11, were retained and reintroduced in the *Electricity Act, 1998* under what is now O. Reg. 507/18. As such, the City of Vaughan continues to report annually on its energy consumption and associated GHG emissions and continues to develop and implement an energy management plan every five years.

An Energy Management Plan (EMP) typically includes:

- Conservation goals and objectives
- Proposed conservation measures
- Cost and savings estimates
- A description of any renewable energy generation facilities, including the amount of energy generated annually

In July 2014, the City of Vaughan submitted and made publicly available its first EMP. The updated 2025-2029 Plan provides a comprehensive overview of City operations relevant to energy management (e.g., municipal facilities, streetlighting, etc.) and discusses retrofits and conservation measures that could be implemented to reduce energy consumption. The Plan outlines a target to reduce energy consumption by 10% over the 5 years, measured in equivalent kilowatt hours per square foot (ekWh/ft^2), for both electricity and natural gas. This Plan serves as an update to the 2019–2024 Plan, aligning with the requirements of O. Reg. 507/18, and provides:

- An update of the energy consumption target
- A GHG emissions reduction target
- An implementation plan to reach the new targets (i.e., identified energy conservation programs and measures)
- Financial implications (i.e., costs and savings associated with implementing measures)

Energy reporting and conservation planning are beneficial because it will help:

- Optimize energy use and costs
- Demonstrate service excellence for citizens
- Identify best practices and energy-saving opportunities
- Find ways to reduce GHG emissions to contribute to a low-carbon economy
- Evaluate results by comparing similar facilities across the province
- Provide a benchmark to set goals
- Measure improvement over time

1.2 Progress to Date

Since 2019, the City has invested over $3,000,000 to implement over 65 energy savings retrofit projects in several facilities and parks through the Save On Energy program. This capital investment of retrofit projects helps to avoid over $260,000 in annual energy costs and has resulted in the receipt of over $270,000 in incentives from the Provincial Save On Energy program. Overall, energy consumption has decreased by 4,923,028 ekWh (4,923 MWh) from 2019 to 2024 representing an approximate 15% reduction.

Table 1: How Energy Consumption and GHG Emissions Have Changed

Table 1: How Energy Consumption and GHG have changed		
2019-2024		
% CHANGE ENERGY CONSUMPTION & GHGs		
	Energy Consumption (ekWh)	GHG Emissions (tCo2e)
Building	**-6%**	**-23%**
Fleet	**4%**	**14%**
Lighting	**16%**	**15%**

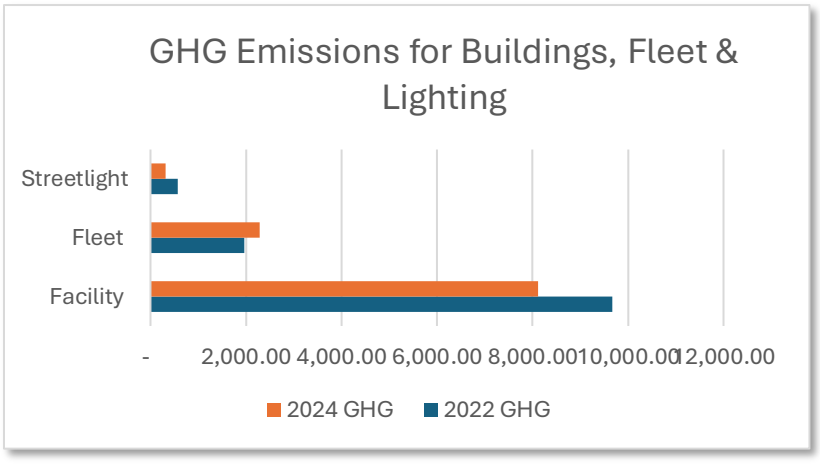


Figure 1: Corporate GHG Emissions By Asset Type 2022 vs. 2024

2. Energy and Climate Drivers

2.1 Sustainable Development Goals (SDGs)

UN Sustainable Development Goals



In 2015, the United Nations announced the 2030 Agenda for Sustainable Development, which introduced 17 Sustainable Development Goals (SDGs) and 169 targets. The SDGs build upon the previous Millennium Development Goals (MDGs) and aim to stimulate critical action over a period of 15 years in the three key pillars of sustainable development: economic, social, and environmental.

Governments and private sector corporations are demonstrating alignment with the SDGs. While energy management plan benchmarking and targets will also be driven by other related urgencies and issues, this Plan is part of the City's contribution towards meeting the following SDGs:

SDG 7 - Affordable and Clean Energy



- By 2030, increase substantially the share of renewable energy in the global energy mix.
- By 2030, double the global rate of improvement in energy efficiency.

SDG 9 – Industry, Innovation, and Infrastructure



- By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.

SDG 11 – Sustainable Cities and Communities



- By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.
- By 2020, the number of cities and human settlements will substantially increase and adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels.

SDG 12 – Responsible Consumption and Production



- By 2030, achieve sustainable management and efficient use of natural resources.
- Encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

SDG 13 – Climate Action



- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

2.2 World Council on City Data (WCCD)

The City joined the World Council on City Data (WCCD) in 2011, becoming only the second Canadian city to join at that time. The WCCD provides a global platform for standardized City data and acts as a hub to help strengthen partnerships across cities, international organizations, corporate partners, and academia. Standardized indicators and membership with the WCCD enable the City to assess its performance, measure progress toward the UN SDGs, and draw comparative lessons from other cities both locally and globally.

Energy is a focus of one of the 18 WCCD themes that align with the UN SDGs. While most indicators under the energy theme relate to community energy rather than corporate energy consumption, indicators 7.3 and 7.4 are relevant to this Plan:

- 7.3 Energy consumption of public buildings per year (kWh/m^2)
- 7.4 Percentage of total energy derived from renewable sources, as a share of City's total energy consumption

ISO 50001 – Energy Management System



Figure 2: ISO 50001 Key Steps

ISO 50001:2018 provides a framework of requirements for organizations to:

- Develop a policy for more efficient use of energy
- Fix targets and objectives to meet the policy
- Use data to better understand and make decisions about energy use
- Measure the results
- Review how well the policy works
- Continually improve energy management

Like all ISO management system standards, ISO 50001 has been designed for implementation by any organization in the public or private sector, whatever its size, activity or geographical location. ISO 50001 does not fix targets for improving energy performance, which is left up to the user organization or regulatory authorities. This means that any organization, regardless of its current level of energy performance, can implement ISO 50001 to establish a baseline and improve at its own rate.

International and Federal Targets

The 2018 report of the Intergovernmental Panel on Climate Change (IPCC) evaluates climate action needed to avoid a 1.5-degree Celsius increase in global atmospheric temperatures. The 2018 IPCC report calls for immediate and deep climate action: global net anthropogenic carbon dioxide (CO2) emissions must decline by about 45% from 2010 levels by 2030, reaching net-zero around 2050. This target can be interpreted for the purposes of municipal facilities, fleet, and other pertinent assets, described in more detail in Section 7.0 of this Plan.

The United Nations Environment Programme (UNEP) Emissions Gap Report 2018 provides a similar GHG emissions reduction target. It is noted that 2017 global emissions were 53.5 giga tonnes of CO2 equivalents (GtCO2e) and that "global GHG emissions in 2030 need to be approximately 25% and 55% lower than in 2017 to put the world on a least-cost pathway to limiting global warming to 2°C and 1.5°C respectively."

The Canadian federal commitment to the 2015 United Nations Climate Change Conference (COP21) Paris Agreement has a target of 523 MtCO2 by 2030 from projected Business-as-Usual (BAU) 2030 emissions of 742 Mt. This represents a 30% change from BAU. By contrast, the "Deadline 2020" report of the C40 Cities identifies the need for almost 70% emissions reductions from BAU by 2030 to avoid a 1.5-degree Celsius increase in global temperatures. This is translated to an approximate 25% emissions savings from the 2015 baseline by 2030.

In 2019, Environment and Climate Change Canada (ECCC) released the Canada's Changing Climate Report, the first major report of the current National Assessment (Environment and Climate Change Canada)[1]. The report found that the average temperature in Canada is 1.7 degrees Celsius higher today than it was 70 years ago, while the average global temperature increased by 0.8 degrees Celsius. Both past and future warming in Canada is, on average, about double the magnitude of global warming. Shortly after the release of this Report, ECCC also released the updated National Inventory Report for 2017, which shows that in 2017, nationally, Canada reduced its GHG emissions by about 2% below 2005 levels.[2]

Provincial Targets

In November 2015, the Ontario Provincial government released a Climate Change Strategy to set the long-term vision to meet GHG reduction targets. These targets were in line with actions taken by other provinces and states, and with global objectives. Ontario committed to reduce GHG emissions by 15% in 2020, 37% in 2030 and 80% in 2050, compared to 1990 levels.

In November 2018, the newly elected Provincial government released the Made-in-Ontario Environment Plan[3] which revised Ontario's GHG targets. Now, Ontario aims to reduce emissions by 30% below 2005 levels by 2030, consistent with the target adopted by the Federal government under the COP21 Paris Agreement.[4] This target is less ambitious than the goal set by the former Provincial government in 2015; setting ambitious GHG emission

[1] Environment and Climate Change Canada, Canada's Changing Climate Report, 2019, https://changingclimate.ca/site/assets/uploads/sites/2/2019/03/CCCR_ExecSummary.pdf

[2] Environment and Climate Change Canada, 2019, National Inventory Report: GHG Sources and Sinks in Canada: En81-4-2019-1-eng.pdf ; En81-4-2019-2-eng.pdf; En81-4-2019-3-eng.pdf

[3] A Made- in- Ontario Environment Plan https://prod-environmental-registry.s3.amazonaws.com/2018-11/EnvironmentPlan.pdf

[4] Canada's 2017 Nationally Determined Contribution Submission to the United Nations Framework Convention on Climate Change (UNFCC), 21st Session of the Conference of the Parties (COP21) in Paris, https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Canada%20First/Canada%20First%20NDC Revised%20submission%202017-05-11.pdf

reduction targets for the 2030 and 2050 horizon provides support for municipalities, businesses, and residents to explore the potential innovation, partnerships and investments needed to build climate-resilient and low- carbon communities.

2.3 Partners for Climate Protection (PCP)

Since 2011, the City has been a member of the Federation of Canadian Municipalities (FCM) Partners for Climate Protection (PCP) program. This is a network of over 500 Canadian municipalities, who have committed to a five-milestone program to reduce both corporate and community emissions. Vaughan's status is summarized in Table 2:

Table 2: City of Vaughan PCP Milestone Status

Table 2: City of Vaughan PCP Milestone Status		
PCP Milestone		City Status (Corporate & Community)
1	Create a baseline emissions inventory and forecast	Completed
2	Set emissions reduction targets	Completed
3	Develop a local action Plan	Completed
4	Implement the local action Plan	In progress
5	Monitor progress and report results	In Progress

The Plan will update targets for the City's corporate operations and help inform the next submission to PCP for Milestone 4 recognition, which is scheduled to be submitted in late 2030.

2.4 Zero Carbon Buildings

The World Green Building Council's (WorldGBC) Net-Zero Carbon Buildings Commitment calls on businesses, organizations, cities, states, and regions to reach net-zero carbon operating emissions within their portfolios by 2030, and to advocate for all buildings to be net-zero carbon in operation by 2050. The Commitment seeks to recognize and promote advanced climate leadership in decarbonizing the built environment, to inspire others to take similar action, and to remove barriers to implementation. It aims to maximize the chances of limiting global warming to below 2°C and reduce operating emissions from buildings (currently 39% of energy-related global CO_2 emissions).

The Canada Green Building Council (CaGBC) has put forward a Zero-Carbon Building Standard. A zero-carbon building is defined as one that is highly energy-efficient and produces on-site, or procures, carbon-free renewable energy in an amount sufficient to offset the annual carbon emissions associated with operations. There are eight program requirements that apply to new construction, and some apply to existing buildings. The Zero-Carbon Building Standard is not a commitment or pledge but reiterates the WorldGBC objective to eliminate GHG emissions associated with the operations of new buildings by 2030 and eliminate GHG emissions from all buildings by 2050.

The City of Toronto's commitment to energy conservation and greenhouse gas (GHG) reduction through its 2024-2030 Energy Conservation and Demand Management (ECDM) Plan (PDF) reflects a steadfast dedication to sustainability and climate action. Building upon the foundation laid by previous initiatives, this plan supports the City's Corporate Strategic Plan, specifically the strategic priority to tackle climate change and build resilience. All the while, working towards achieving ambitious Net Zero targets by 2040, accelerating efforts in response to both local imperatives and global climate urgency.

Enerlife developed the 2014-2019 City of Toronto Energy Conservation and Demand Management Plan, applying an evidence-based approach to establishing savings potential across over 500 City of Toronto buildings, including administration, library, police, recreation and fire department facilities. We provided a systematic assessment of the overall potential for reducing energy use, emissions and utility costs for use by senior management and Council in setting policy and goals. It also provided the platform for the City's ongoing strategy and planning for achieving the savings.

2.5 Project Drawdown Solutions

Project Drawdown, a nonprofit organization made up of academics, entrepreneurs, and advocates, is mapping and measuring the potential of solutions to reach 'drawdown.' Drawdown is the point in time when the concentration of atmospheric GHGs begins to decline on an annual basis. Project Drawdown identifies several ranked solutions for climate mitigation. Project Drawdown has updated its climate solutions rankings since 2019, leading to changes in the prioritization of various initiatives related to municipal corporate energy management. The updated rankings (aligned with a 2˚C temperature rise by 2100) are as follows:

- Refrigerant Management and the Kigali Accord ranked #1
  This solution remains a top priority, now listed as Alternative Refrigerants with a potential reduction of 42.73 gigatons CO_2 equivalent from 2020 to 2050.
- Rooftop Solar: Formerly ranked #10
  This solution is now categorized as Distributed Solar Photovoltaics, with an updated impact of 26.65 gigatons CO_2 equivalent reduced/sequestered.
- Electric Vehicles: Previously at #26
- District Heating: Formerly ranked #27
- Alternative Cement: Previously at #36
- Solar Water: Formerly ranked #41
- Heat Pumps: Previously at #42
- LED Lighting – Commercial: Formerly ranked #44
- Building Automation: Previously at #45.
- Cogeneration: Formerly ranked #50

3. Co-Benefits

3.1 Alignment with City Plans, Policies, and Commitments

To successfully foster a culture of sustainability throughout the City, it is important to demonstrate leadership in sustainability within the Corporation. Effective energy management provides a broad range of co-benefits (see Figure 3), including environmental, economic, and broader strategic planning, such as contributing to the goals of the following existing and upcoming City plans, policies, and commitments:

- Strategic Plan
- Official Plan
- Service Excellence Strategy
- Corporate Asset Management Policy
- Green Directions Vaughan
- Municipal Energy Plan
- Green Fleet Strategy
- Partners for Climate Protection Membership
- World Council on City Data Membership

Green Directions Vaughan (GDV), the City's community sustainability plan, outlines broader sustainability goals and assigns Department-specific actions that contribute to the achievement of these goals. One of the main goals of GDV is "to significantly reduce our use of natural resources and the amount of waste we generate." Under this goal, the main objective is to:

- Reduce GHG emissions and move towards carbon neutrality for the City of Vaughan's facilities and infrastructure.

Beneath this objective are department-specific actions, many of which align with the Plan, and will be identified throughout this document where applicable. The carbon neutrality target outlined was taken into consideration when setting targets for the Plan to ensure alignment across City goals.

3.2 Environmental

Reducing energy consumption, improving energy efficiency, and investing in alternative, renewable energy sources all have clear and positive impacts on the environment, which include:

- Mitigating the effects of climate change by reducing GHG emissions
- Conserving limited natural resources
- Improving air quality and protecting ecosystems

3.3 Economic

Reducing energy consumption and finding ways to use energy more efficiently makes financial sense. Investing in energy efficient equipment and retrofits saves more money in the long run. In some instances, the upfront capital cost of an energy efficient technology can be higher; despite this, the savings from the operation overtime are far greater and result in much quicker payback. In addition, the life cycle of energy efficient equipment tends to be longer than standard equipment.



Figure 3: Co-Benefits of Sustainable Energy Management

Energy management is a cross-cutting issue that impacts numerous departments and divisions within a corporation. Aside from simply being of concern to Environment/Sustainability teams (e.g., reduced GHG emissions resulting from improved energy efficiency), it is also important for Facility Management (improved productivity in buildings), Finance (cost savings, implications for future budgets), Human Resources (improved air quality, health and safety) and Economic Development (fostering innovation and strengthening partnerships).

4. Energy Management Approach

This Plan revision emphasizes a performance-based approach to energy conservation and carbon emissions reduction for City infrastructure. This approach relies on categorizing assets (i.e. building types) based on similarity and then benchmarking data from all the comparable assets to identify those that are most energy efficient (i.e. the top performers) in each category. This then helps form a target for the other assets of the same group to strive towards.

Figure 4, taken from the City of Toronto's corporate energy plan, depicts the performance-based conservation approach. This is an adaptive management framework where lessons learned are incorporated into the workflow, including assessment, identification, implementation and verification of specific actions. Figure 4:[5]

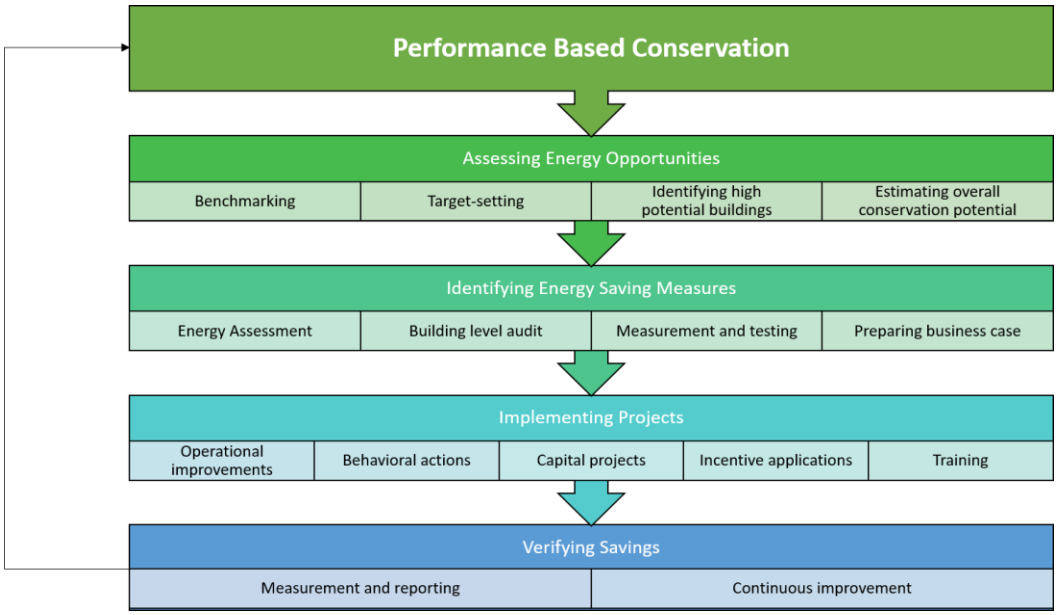


Figure 4: Performance Based Conservation

Based on above the outlined performance-based conservation process, the City of Vaughan is actively aligning with this framework by utilizing RETScreen software to report on energy performance at both the individual asset level and by asset type (e.g., community centres, fire halls). This approach supports the full cycle of conservation planning—assessing energy opportunities, identifying savings measures, implementing projects, and verifying savings.

[5] City of Toronto ECDM (2014-2019), Figure 2.

5. Plan Development

The first version of the City's Energy Management Plan, approved in 2014, served as a starting point in the development of this Plan update. Additionally, this Plan is the result of the following research and consultation efforts:

- A jurisdictional scan to determine the best municipal practices on key components, baseline and target development, and actions
- Provincial policy review
- Utility data collection and analysis
- Internal departmental consultations
- External consultations with community partners

5.1 Stakeholder Consultation

Multiple City departments and staff, in addition to key external stakeholders, were involved in developing this plan. They will continue to be instrumental in initiating and implementing the associated energy management initiatives across the organization.

Corporate Energy Team

Effective energy management is a shared responsibility that impacts many divisions and departments within the City. As such, the core Corporate Energy Team is comprised of staff from the following departments and external stakeholders:

- Facility Management Operations
- Transportation and Fleet Management Services
- Financial Planning and Development Finance
- Infrastructure Delivery
- Infrastructure Planning and Corporate Asset Management
- Office of the Chief Information Officer (IT/Data Management)
- Policy Planning and Special Programs

Facility Management Operations took the lead in updating the Corporate Energy Plan. Staff from the relevant departments listed above meet regularly—typically on a monthly basis—to collaboratively review ongoing energy retrofit projects, address energy management topics such as data tracking, and identify opportunities and challenges in formalizing and embedding energy management practices across City operations. The Corporate Energy Team serves as the governing body of the Energy Management Plan (EMP), supporting both the development and implementation of its goals and actions.
In addition, internal stakeholders are important to fulfill the goals of the plan:

Vaughan Council

Vaughan Council, comprised of the Mayor, four Regional Councillors and five Local Councillors, have a crucial role to play in setting the direction for corporate energy and environmental sustainability planning. Demonstrating the City's commitment to environmental sustainability and sustainable development, Council first approved GDV (Green Direction Vaughan issued in 2009) update in 2019 and the first plan in 2014.

Council continues to support the update of the Corporate Energy Management Plan to align with the Green Directions framework and advance progress toward energy savings and the City's net-zero targets.

Executive Leadership Team

The Executive Leadership Team is responsible for creating the administrative framework and for providing leadership to City staff in the ongoing effort to fulfill the broader goals of the Energy Management Plan and to support the development and implementation of energy initiatives resulting from this Plan.

IESO, Alectra Utilities and Enbridge Gas

The Independent Electricity System Operator (IESO) Save on Energy Retrofit Program, served through Alectra Utilities for the City of Vaughan, provides incentives for projects that show sustainable, measurable and verifiable reductions in peak electricity demand and electricity consumption. Project examples include:

- Lighting retrofits
- Chiller replacements
- HVAC upgrades
- Variable-speed drives
- Implementation of new operating procedures required either to obtain or increase the effectiveness of an energy management system or building automation system, including the installation of equipment such as:
    - an energy management system
    - building automation systems
    - sensors
    - control equipment
    - metering equipment
    - related communication systems

Since 2019, the City has registered over 65 energy projects through the Save on Energy program. Alectra Utilities is a key partner and resource when it comes to the plan implementation; not just in terms of incentive programs, but for technical knowledge, support, and ideas sharing.

Similarly, Enbridge Gas also provides opportunities to receive incentives for natural gas saving retrofits. Natural gas saving measures are especially important due to the higher GHG savings potential. Enbridge and Alectra are also key partners in terms of data tracking and ensuring we have accurate and up to date utility bill data.

The City has received multiple grants through the following programs to support its energy and sustainability initiatives:

- The Zero Emission Vehicle Infrastructure Program (ZEVIP) (2023) – $230,000 for Phase 1 of the EV charging infrastructure
- The Atmospheric Fund– $11,000 to support the installation of an EV charging station in Kleinburg
- Green Municipal Fund (2020) – $20,300 to hire a consultant for a feasibility study on energy-efficient building renewal at Fire Hall 7-1
- Enbridge Municipal Energy Incentive Offer (2020) – $10,000 provided to TRCA to educate homeowners on energy retrofits as part of the Thornhill SNAP program

Municipal Energy Managers Network

Through the Clean Air Partnership (CAP), the City regularly participates and engages in a Municipal Energy Managers Network comprised of Energy Managers from several Greater Toronto and Hamilton Area (GTHA) municipalities. The Municipal Energy Managers group held regular meetings during the Plan's development and were consulted often. The group is a valuable resource to share ideas and advice on all aspects of the Plan, including baselines and targets, key actions, best practices, and lessons learned from previous plan development. The IESO supports this network by facilitating working sessions with peer municipalities and encouraging collaboration and discussion in alignment with the Municipal Energy Plan Program (MEPP) Guidelines.

ClimateWise Business Network — MEMBER

Inspired by the Sustainable Waterloo Region program, the Windfall Ecology Centre established the ClimateWise Business Network in partnership with Green Economy Canada in 2016. ClimateWise is a network of leading businesses and organizations operating in and around York Region who re setting and achieving sustainability goals. This Network allows the City to engage with local businesses and find opportunities to collaborate.

The City of Vaughan, along with Alectra Utilities, Lake Simcoe Region Conservation Authority and York Region, is a founding member of ClimateWise and participates in their framework for emissions reduction, which is based on the global GHG Protocol standard. The City has aligned the baseline and targets developed for this Plan with its ClimateWise guideline.

5.2 Energy Audits

In preparation for the current energy management plan update, the City initiated a new round of energy audits beginning in January 2019. These 2019 ASHRAE Level II audits covered 30 facilities—including administrative buildings, community centres, fire stations, libraries—and identified targeted retrofit opportunities and broader strategies to reduce energy consumption and enhance efficiency in City-owned buildings. These retrofits will directly support the reduction targets established in this Plan.

As part of the energy management plan update, the City plans to conduct new energy audits for all assets with audits older than five years to ensure that energy conservation strategies remain current and actionable. Recommendations from these audits will be integrated into the Plan and used to inform the City's annual capital budgeting process for energy-related projects.

6. Baseline and Now

As part of the development of this Plan, we have adopted 2022 as the baseline year for our energy performance analysis. This decision aligns with the best practices recommended through the Mayor's Megawatt Challenge, which encourages the use of either 2022 or 2023 as baseline years due to the irregularities in energy consumption data caused by the COVID-19 pandemic.

Using 2022 ensures a more accurate representation of typical operational conditions, as energy usage in prior years (particularly 2020 and 2021) was significantly impacted by pandemic-related closures and reduced facility occupancy. Establishing 2022 as the baseline supports credible benchmarking, goal setting, and measurement of energy conservation progress in a post-pandemic context.

In comparison to 2022 to 2024, energy consumption has decreased by 2,374,586 ekWh (2,375 MWh) representing an approximate 3% reduction.

The GHG variance between 2022 and 2024 is a reduction of 1,488 tCO_2e, representing a 13% decrease. Figure 1 illustrates GHG emissions across the three asset categories for both years, with buildings accounting for over 76% of the total emissions.

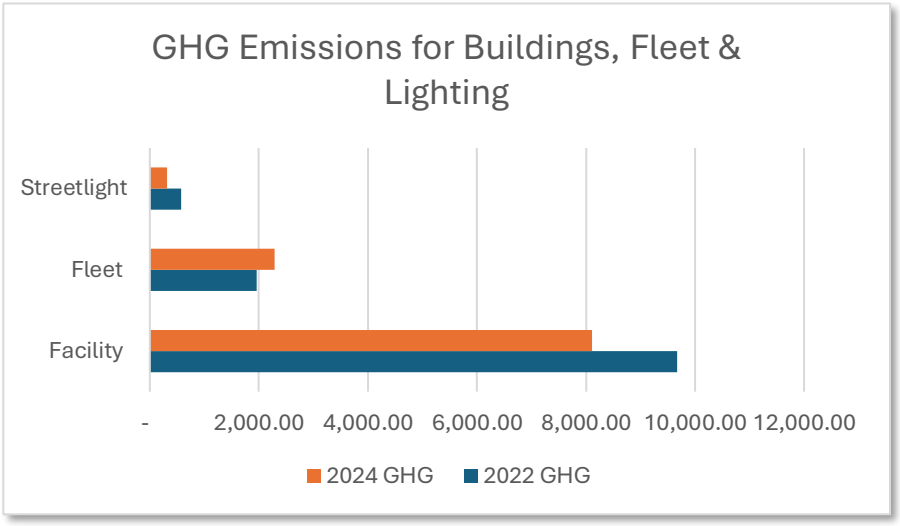


Figure 5: Corporate GHG Emissions by Asset Type, 2022 vs. 2024

A summary of the change in overall energy consumption, in equivalent kilowatt hours (ekWh), for energy management plan assets (Buildings, Fleet, Lighting) related to the implementation of plan, 2022 vs. 2024 is provided in Table 3. More detailed data and analysis on these figures for each type of city owned assets can be found in Section 6 part 2-4 of this Plan. The next table represents an overall GHG emissions reduction of 13% from 2022-2024.

Table 3: How Energy Consumption and GHG Emissions Have Changed

Table 3: How Energy Consumption and GHG Emissions Have Changed 2022 vs. 2024					
	Buildings	**Fleet**	**Lighting**	**Total**	**Variance**
Total Energy (ekWh)	-3,970,773.27	218,867.07	1,377,319.88	**-2,374,586.33**	**-3%**
GHGs (tCO_2e)	(1,552.08)	321.07	(256.55)	**-1,487.57**	**-13%**
(-) = % decrease; (+) = % increase The increase of GHG emissions for Fleet & Lighting, in energy consumption, is due to the increase in the asset counts.					

6.1 City of Vaughan Energy Profile

An overview and breakdown of City assets that fall within the scope of this Plan is provided in Table 4. City facilities were categorized based on their primary use (e.g. administration, community centre, fire station, library). Community centres (CC) were further broken down by their key energy-using features (e.g. swimming pool, arena, etc.). Other City assets include Fleet and Streetlight.

Table 4: City of Vaughan - EMP Assets Breakdown

Table 4: City of Vaughan - EMP Assets Breakdown		
Buildings	Administration	City Hall
		Joint Operations Centre
	Community Centres with Pool	Chancellor Community Centre+ Library
		Dufferin Clark Community Centre + Library
		North Thornhill Community Centre + Library
		Villore Village Community Centre + Library
	Community Centres with	Rosemount Community Centre
	Community Centres with Pool & Arena	Al Palladini Community Centre
		Father Ermanno Bulfon Community Centre
		Garnet A. Williams Community Centre
		Maple Community Centre + Library
		Woodbridge Memorial Pool and Arena
	Outdoor Pools	Thornhill Outdoor Pool
	Fire Stations	7-1
		7-2
		7-3
		7-4
		7-5
		7-6
		7-7
		7-8
		7-9
		7-10
	Libraries (standalone)	Bathurst Clark Library
		Civic Centre Resource Library
		Kleinburg Library
		Pierre Berton Resource Library
		Woodbridge Library
	Miscellaneous	Heritage Buildings
		Parks Buildings
		Sport Buildigns
		Senior Clubs
	Work Yards	East District Parks Yard
		Woodbridge Yard
Fleet		
Outdoor Lighting	Streetlights	
	Parks	

Utility Costs – Buildings

In 2019, utility costs for buildings were approximately $5,359,840 for electricity, and $1,021,762 for natural gas. In 2022, utility costs for buildings were approximately $4,361,183 for electricity, and $1,425,842 for natural gas. In 2024, utility costs for buildings were approximately $4,035,254 for electricity, and $1,431,878 for natural gas. Although utility costs have fluctuated over time (Figure 6), overall electricity spending has increased from 2019 to 2024, despite a reduction in consumption, due to rising electricity rates.
It should be noted that the data examined only considers the City's major facilities (i.e. administration buildings, community centres, fire stations, and libraries) in addition to Fleet and Lighting (parks and streets).

Figure 7 presents the corresponding ekWh consumption from 2019 to 2024.

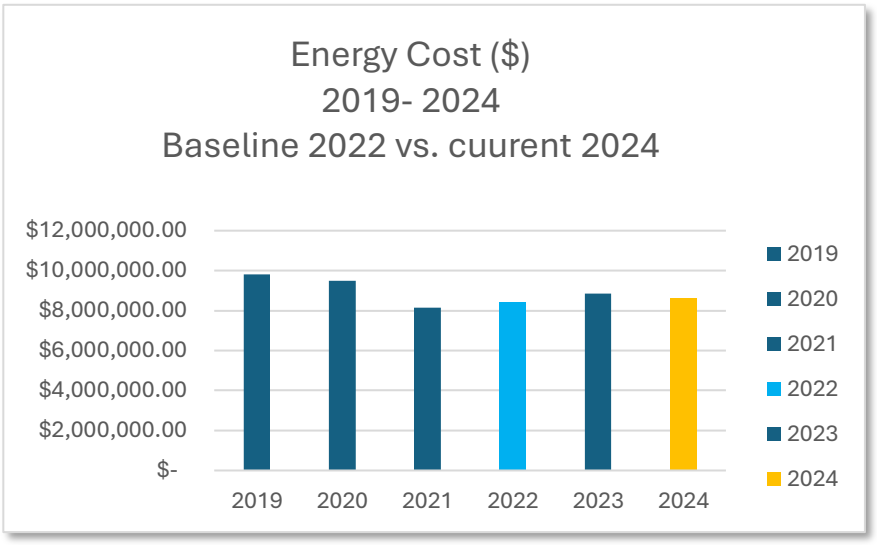


Figure 6: Annual Energy Costs for Building, Fleet & Lighting, 2019 – 2024.

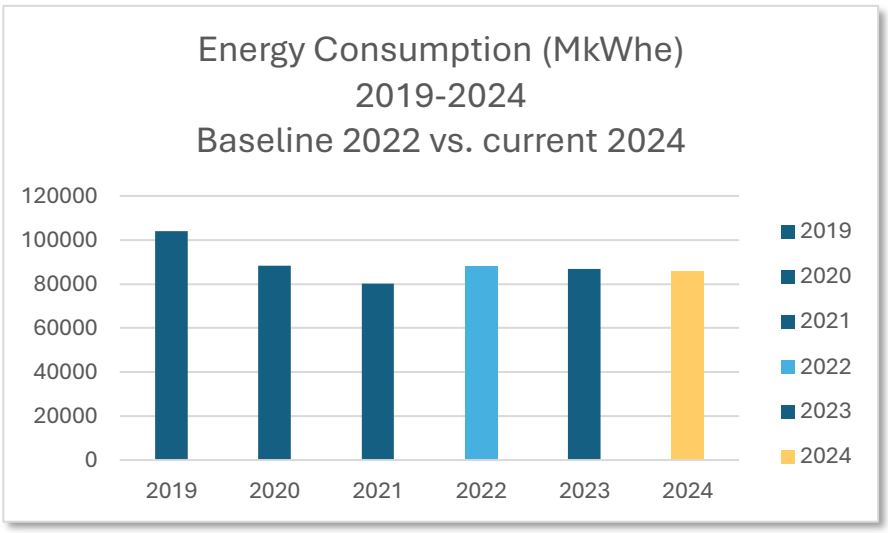


Figure 7: Annual Energy Consumption for Buildings, Fleet & Lighting, 2019-2024

Figures 8 and 9 illustrate the comparison of energy consumption and costs between the baseline year (2022) and 2024.

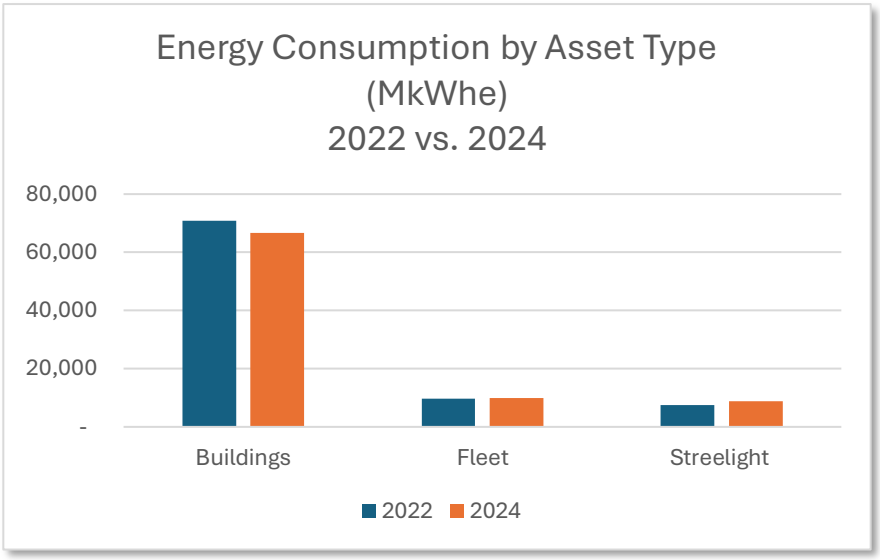


Figure 8: Energy Consumption by Asset Type, 2022 vs. 2024

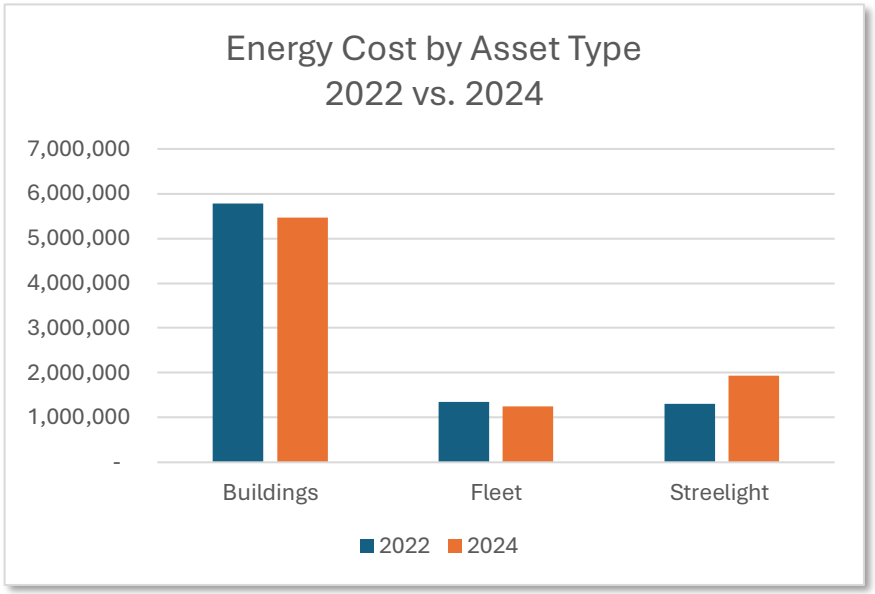


Figure 9: 2022 vs. 2024 Energy Cost, by Asset Type

6.2 Buildings

For the purposes of this Plan, 77 buildings are considered in the City portfolio, including two administrative buildings, two work yards, 11 community centres/recreation facilities, ten fire stations, five standalone libraries and the sport village as the major group, along with 19 heritage buildings, six sport buildings, seniors' clubs and other miscellaneous buildings. The City also has 15 water/wastewater pumping stations, which are not analyzed in this Plan due to a lack of data.

Baseline: 2022 Buildings Energy Profile

2022 was used as a baseline year for this Plan update, and as shown in Table 5, baseline data was further broken- down based on major asset class:
A comparison of Tables 5 and 6 shows a reduction in consumption of over **5%** (a variance of 3,971 ekWh)**,** reflecting the difference between the baseline year and the current year, with 2022 consumption at 70,748 ekWh and 2024 consumption at 66,777 ekWh.

Table 5: 2022 Building Energy Profile

Table 5: 2022 Building Energy Profile

Building Type	Total Electricity Consumption (kWh)	Total Natural Gas Consumption (m3)	Total Energy Consumption (ekWh)	Total GHG Emissions (tCO2e)
Administration	5,774,972	567,542	11,806,695	1,287.10
CC with pool only	6,396,416	1,179,972	18,936,922	2,476.84
CC with Arena only	2,019,175	316,356	5,381,346	674.85
CC with pool & Arena	7,164,809	1,123,835	19,108,703	2,397.09
Libraries	2,035,610	175,236	3,897,983	406.37
Fire Stations	901,156	203,933	3,068,516	420.82
Outdoor pool	145,504	73,806	929,900	145.89
Sport Village	4,114,909	232,809	6,589,157	589.96
Yards	387,529	60,339	1,028,799	128.80
TOTAL	**28,940,080**	**3,933,828**	**70,748,022**	**8,528**

Full baseline data for each individual building, including Energy Use Intensity (EUI) for each building, can be found in Appendix B and is summarized as % per type in Figure 10.

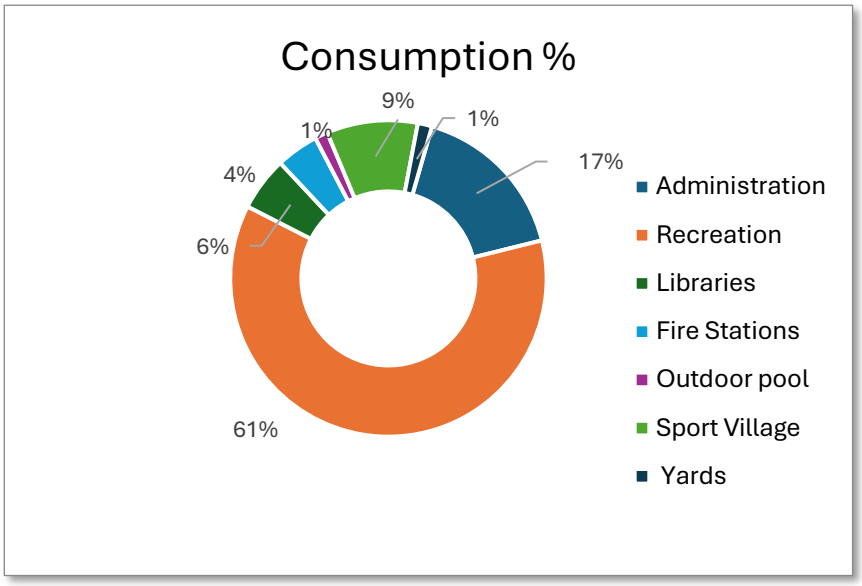


Figure 10: 2022 Energy Consumption (ekWh) – Building Type

2024 Buildings Energy Profile

The year 2024 consists of the most recent and complete utility dataset shown in Table 6 and represent the most recent reference year ("now") in comparison to the 2022 baseline. Figure 11 provides the breakdown of energy consumption by facility type for 2024 and is summarized as a percentage by building type.

Table 6: 2024 Building Energy Profile

Table 6: 2024 Building Energy Profile

Building Type	Total Electricity Consumption (kWh)	Total Natural Gas Consumption (m3)	Total Energy Consumption (ekWh)	Total GHG Emissions (tCO2e)
Administration	6,221,911	567,097	12,248,905	1,302.12
CC with pool only	5,201,041	944,553	15,239,562	1,985.55
CC with Arena only	2,058,380	253,675	4,754,388	556.74
CC with pool & Arena	6,956,482	1,064,665	18,271,528	2,276.87
Libraries	1,689,321	154,167	3,327,777	353.91
Fire Stations	773,060	194,037	2,835,246	397.40
Outdoor pool	104,462	20,359	320,833	42.53
Sport Village	3,664,309	497,454	8,951,151	1,078.54
Yards	177,162	61,226	827,859	123.02
TOTAL	**26,846,128**	**3,757,233**	**66,777,249**	**8,116.68**

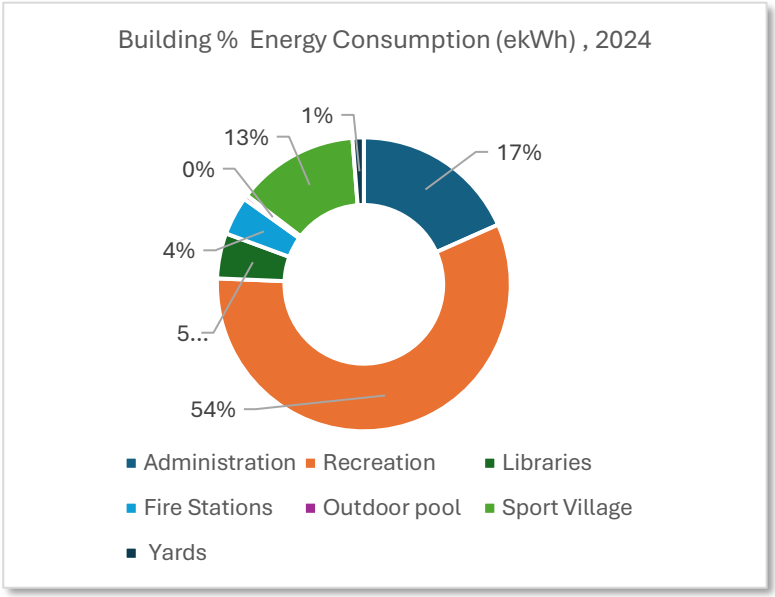


Figure 11: % of 2024 Energy Consumption (ekWh) – Breakdown by Building Type

A review of Tables 5 and 6, Figures 10 and 11, supported by detailed data in Appendix B (Tables B-2 and B-5 for 2022, and Tables B-8 and B-9 for 2024), highlights the variances in energy consumption between 2022 and 2024. The type and use of each building, along with peak operating hours, play a significant role in these changes. Some buildings experienced an increase in consumption, such as the Admin. Building, which rose by 3.7%, and the Sport Village, which increased by 35.8%. Conversely, several buildings saw a reduction in consumption: the Community Centre decreased by 11.9%, Libraries by 14.6%, and Fire Stations by 7.6%. These differences are also influenced by building design, including utility systems, window configurations, façade characteristics, and overall architectural features

Similar to energy consumption, GHG emissions (tCO_2e) were also impacted accordingly. In Appendix B, Table B-2, the variances between 2022 and 2024 show that some buildings experienced an increase in emissions, such as the Admin Building, which rose by 1.2%, and the Sport Village, which increased by 82.8%. Conversely, several buildings saw a reduction in GHG emissions: the Community Centre decreased by 13.1%, Libraries by 12.9%, and Fire Stations by 5.6%.

Changes can be noted, however, comparing 2022 to 2024 total energy consumption and GHG emissions based on building type. Since 2022, total energy use of City buildings (including both electricity and natural gas, in ekWh) has decreased by approximately 10% (see Figure 12 and Table 7). Community centres and administration buildings also demonstrated GHG emissions, whereas libraries, fire stations, and the City's outdoor pool facility show an increase in GHG emissions during the same period. The building inventory has been updated to cover the period from 2019 to 2024, which includes the addition of one library **(**Civic Centre Resource Library**)** and the relocation of a fire station **(**FH 7-4**),** as well as several expansions at existing community centres. Overall, GHG emissions from buildings decreased by 21% from 2022 to 2024**.**

Some of the energy savings are attributed to a decrease in heating degree days (HDD) from 3,881 in 2022 to 3,528 in 2024[7] (HDD refers to the number of degrees that a day's average temperature is below 18ºC, requiring heating). This accounts for some of the 11% decrease in natural gas use in City buildings. However, most of the energy savings are attributed to building improvements such as Building Automation Systems (BAS) upgrades, LED lighting retrofits, HVAC replacements and other retrofits targeting electricity conservation. The upgrades have helped achieve electricity savings of about 2,685,000 kWh (2,685 MWh), or 9% savings between 2022 and 2024 Figure 12 and Table 7.

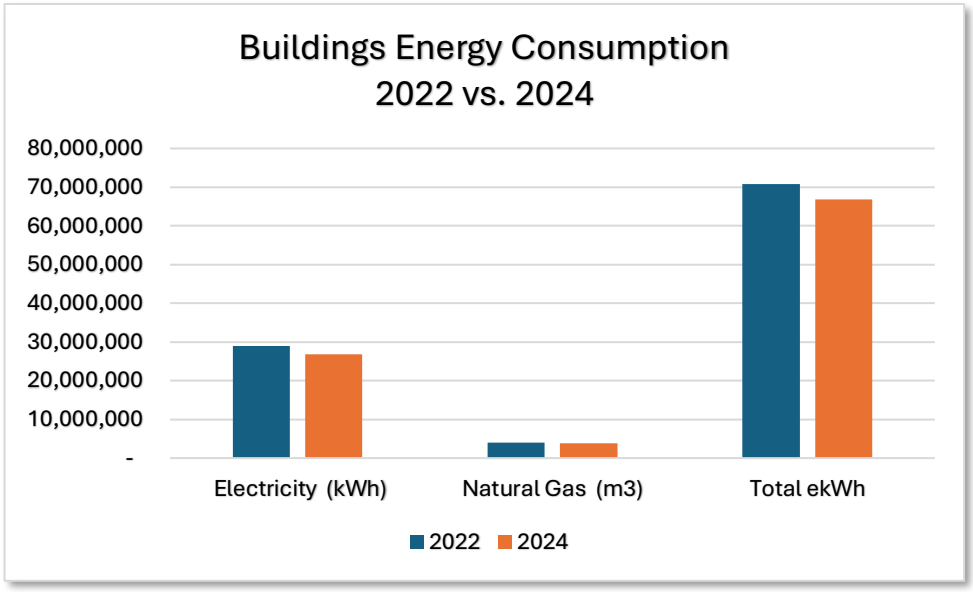


Figure 12: Buildings Energy Consumption, 2022 vs. 2024

Table 7: Buildings Energy Consumption, 2022 vs. 2024

Table 7: Buildings Energy Consumption, 2022 vs. 2024			
Energy Type	**2022**	**2024**	**%**
Electricity (kWh)	28,940,080	26,846,128	-8%
Natural Gas (m3)	3,933,828	3,757,233	-5%
Total ekWh	70,748,022	66,777,249	-13%

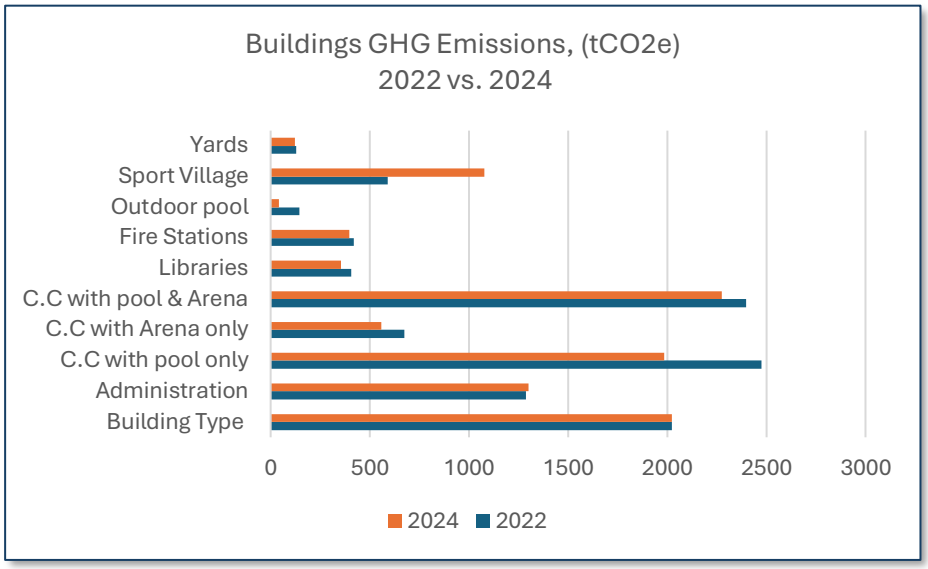


Figure 13: Buildings GHG Emissions, Breakdown by Building Type, 2022 vs. 2024

Figure 13 presents the GHG emissions in 2022 versus 2024, showing mostly slight reductions across buildings, except for the Sport Village. This data can inform potential planning to optimize the HVAC systems and building envelope of the Sport Village, while also providing insights for improving energy performance across the entire asset portfolio. It serves as a useful starting point for targeted energy efficiency interventions.

As seen in Table 6, in 2024, buildings used 26,846,128 kWh of electricity in comparison to 3,757,233 m3, or 66,777,249 ekWh, of natural gas. Due to the increased impact on GHG emissions from natural gas (see Figure 14), as well as the fact that when compared in ekWh, natural gas consumption is over 4,000,000 ekWh higher than electricity consumption, it is critical to achieve savings in natural gas use to achieve the short and long-term savings targets outlined in this Plan.

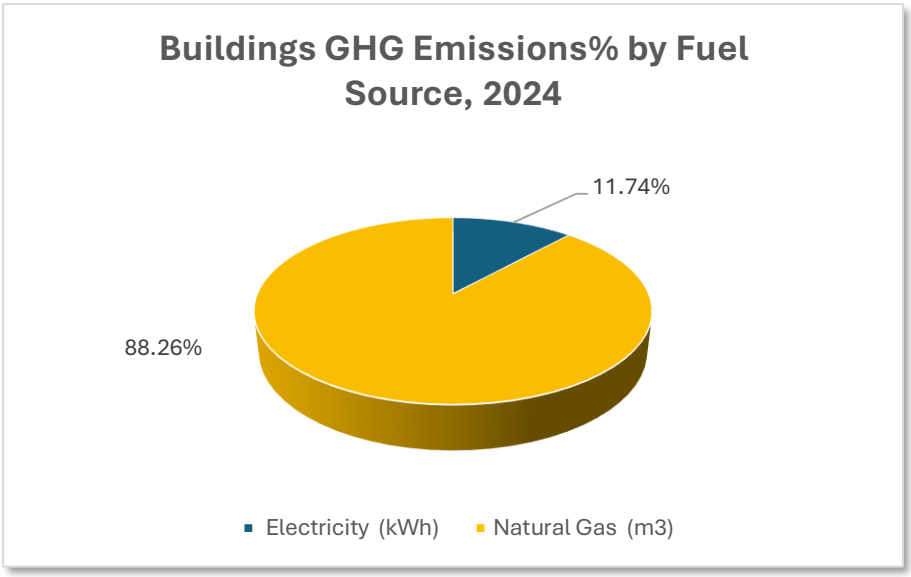


Figure 14: Buildings GHG Emissions by Fuel Source, 2024

6.3 Fleet

The City's Corporate Fleet consists of a total of 505 vehicles as of 2024. This includes vehicles used by the Vaughan Fire and Rescue Services and other City-wide Departments. A breakdown of vehicle types and quantities is provided in Table 8:

Table 8: City of Vaughan Corporate Fleet Inventory, 2024

Table 8: Corporate Fleet Inventory, 2024								
Vehicle Type	Motorcycle	Sedan	SUV	Truck Heavy Duty	Truck Light Duty	Truck Medium Duty	Van	Fire Trucks
Quantity in Fleet	3	23	88	13	256	35	57	30

In 2018, the City added its first fully electric vehicle (EV), a Nissan Leaf, into its corporate Fleet. Currently, the City has six fully electric vehicles.

Currently the City has 18 EV charging connectors across five locations which are accessible to the City's Corporate Fleet and the public. These stations include eight at City Hall, two at the Civic Centre Resource Library, two at the Bathurst Clark Resource Library, two at Pierre Berton Art Centre, and four at the Joint Operations Centre. Further, there are three more EV charging connectors dedicated only for Corporate Fleet at Joint Operations Centre. As such, currently the City has a total of 19 EV charging connectors. 40 more EV charging connectors are expected to be installed by Q3 2025. Phase 2 of the EV charging expansion—comprising 40 new connectors—is planned to begin in Q4 2025.

Table 9 shows how the City's Fleet inventory has changed from 2022 to 2024.

Table 9: Fleet Inventory by Fuel Type, 2022 vs. 2024

Table 9: Fleet Inventory by Fuel Type, 2022 vs. 2024			
Year	**Number of Vehicles**		
	Diesel	**Gas***	**Electric**
2022	99	386	2
2024	96	403	6

*Hybrid vehicles operating on Gas fuel included

It should be noted that this Plan supports the Sustainability Action 1.1.5 in Green Directions Vaughan to "update and implement the 'Green Fleet Strategy' to optimize fleet use and vehicle type, identify fuel switching for low carbon mobility and minimize environmental impacts." There is a need to revise the City's Green Fleet Strategy and to further explore and implement low-carbon options for Corporate Fleet. This can include procuring more EVs and alternative-fuel vehicles, expanding upon and improving EV charging infrastructure for City-wide Fleet, and exploring the development of GHG emissions reduction targets specifically for Fleet. The Green Fleet Strategy update is in progress and scheduled to be finished in 2025.

Table 10 shows the 2022 (baseline) and 2024 fuel consumption data for the Corporate Fleet; between this time, Fleet increased its fuel consumption by approximately 2% and saw no reduction in GHG emissions. Figure 6 of section 6.5 shows that Fleet vehicles accounted for approximately 21% of the City's corporate GHG emissions in 2024. Opportunities for significant GHG reductions will be targeted through the revision of the Green Fleet Strategy, to be led by Fleet Management Services.

Table 10: Fleet Fuel Consumption & GHG Emissions, 2022 vs. 2024

Table 10: Fleet Fuel Consumption & GHG Emissions, 2022 vs. 2024				
Year	**Diesel Consumption (L)**	**Gasoline Consumption (L)**	**Total Fuel Consumption (ekWh)**	**GHG Emissions (tCO2e)**
2022	334,191.05	584,696.30	**9,775,950.63**	**2,242.94**
2024	320,816.29	618,643.40	**9,994,817.70**	**2,285.65**

Chart 6.10 shows the Fuel Consumption for the past six years. It should be noted that the fleet size has also increased from 487 assets in 2022 to 505 assets in 2024.

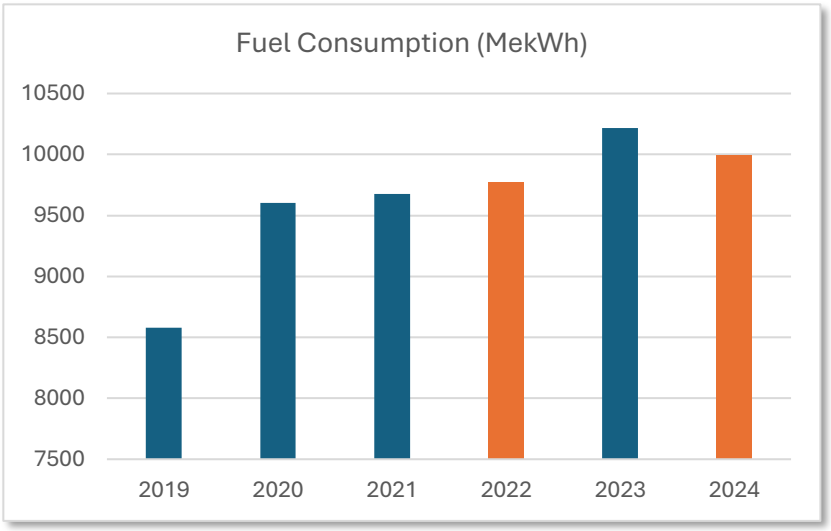


Figure 15 - Total Fuel Consumption (M ekWh)

6.4 Lighting

Between 2022 and 2024, the City experienced an 18% increase in streetlight electricity costs. That increase was largely due to a retroactive Alectra streetlight LED conversion credit applied during the months of 2021 through 2022.

The lighting energy consumption rose from 7.52 million kWh in 2022 to 8.9 million kWh in 2024. That increase occurred despite the ongoing LED streetlight retrofit program, which is expected to reduce energy use and costs. It can be noted however, some of the rise can also be attributed to the addition of 3,000 new streetlights to the Alectra billing records due to more accurate inventory counts.

Table 11: Lighting Electricity Consumption & GHG Emissions, 2022 vs. 2024

Table 11: Lighting Electricity Consumption & GHG Emissions, 2022 vs. 2024						
Year	**LED Counts**	**HPS Counts**	**Total Electricity (kWh)**	**Total GHG Emissions (tCO2e)**	**$/Light**	**kWh/Light**
2022	24,458	1,387	7,522,825	267	4	23
2024	26,717	2,160	8,900,145	316	6	26

Referring to Table 11 above, for comparative purposes, the analysis is based on the normalized energy consumption and cost per light. A summation of LED Retrofit Progress and Counts:

- LED light counts increased from 24,458 in 2022 to 26,717 in 2024, a 9.2% increase in LED numbers.
- The LED retrofit coverage increased only marginally from 89% in 2022 to 92% in 2024, a 3% improvement.
- HPS (High-Pressure Sodium) lights, which are less efficient, also increased in number (from 1,387 in 2022 to 2,160 in 2024), contributing to the noted higher energy usage and increase in GHG emissions.

Streetlight Retrofit

By the end of 2024, the City had substantively advanced its LED Streetlight Retrofit project—initiated in 2019—resulting in 93% of the streetlight network being converted to LED. This milestone involved replacing more than 20,000 high-pressure sodium (HPS) fixtures with energy-efficient LED units.

Table 12: Performance Metrics (Per Light)

Table 12 - Performance Metrics (Per Light)			
Metric	**2022**	**2024**	**Change**
$/Light	$4	$6	50%
kWh/Light	23 kWh	26 kWh	13%
GHG Emissions	267 tCO_2e	316 tCO_2e	18.40%

Despite the apparent jump in the metrics from 2022 to 2024 as shown in Table 12, a comparison of the $/Light and kWh/Light figures from 2019 (pre-conversion) compared to 2024 shows a better picture of a reduction of $5 from $11 to $6 between 2019 to 2024, and a reduction of 38 kWh from 64 kWh to 26 kWh between 2019 to 2024. The retroactive Alectra LED conversion billing credit applied to 2021/2022 distorted the per unit metrics for 2022. In other words, $4/light is not truly indicative of the unit cost for that year.

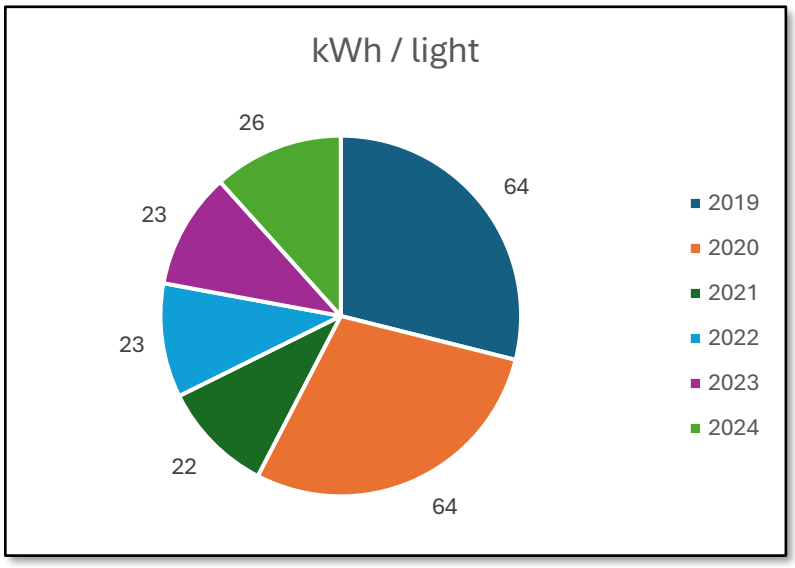


Figure 16: Streetlight energy consumption (kWh)/light

In Figure 16 and 17 the trend of the six years of data demonstrate the favorable energy savings for both consumption and cost.

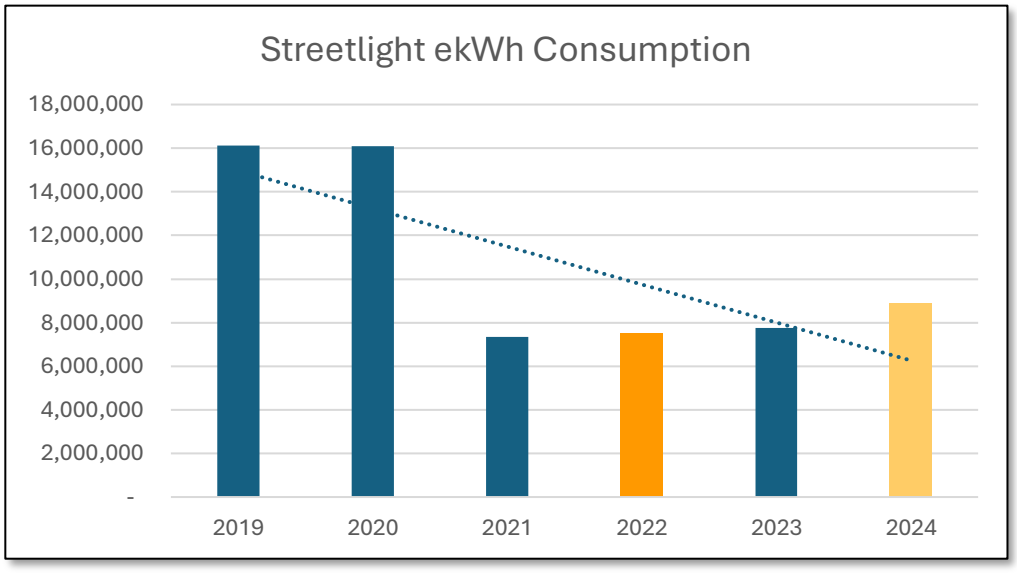


Figure 17: Streetlight kWh Consumption

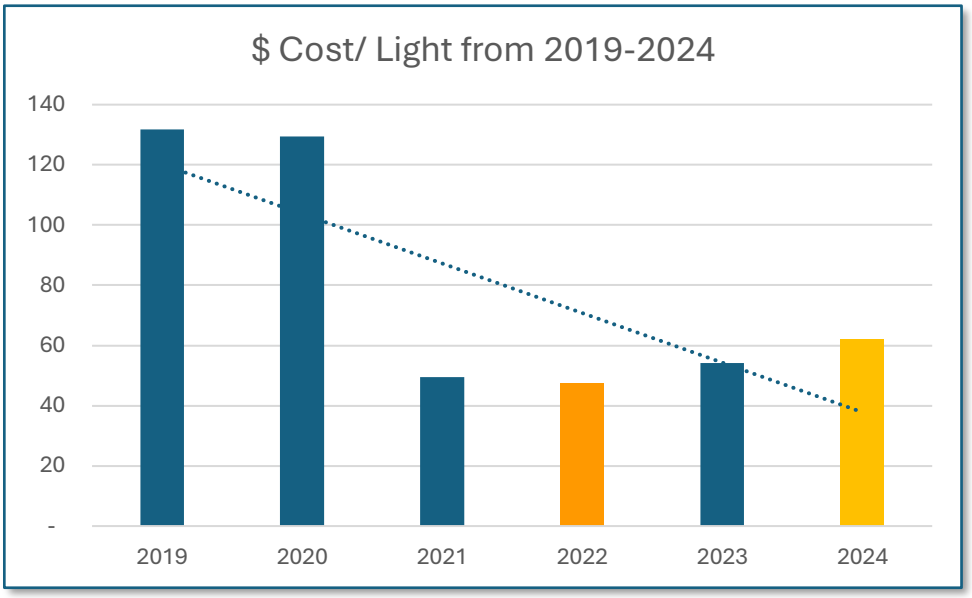


Figure 18: Streetlight Electricity Cost

6.5 Summary of Findings

Between 022 (baseline) and 2024, the City of Vaughan achieved an overall 3% reduction in total energy consumption (a decrease of over 2.37 million ekWh) and a 13% reduction in GHG emissions, primarily driven by efficiency improvements in buildings. Notably:

- Buildings saw a significant decrease in both energy use (3.97 million ekWh) and GHG emissions (1,552 tCO_2e).
- Fleet and lighting both recorded increases in energy consumption and GHG emissions, attributed to the growth in asset counts, such as expanded fleet inventory and increased outdoor lighting infrastructure.

Table 13: How Energy Consumption and GHG Emissions Have Changed 2022 vs. 2024

Table 13: How Energy Consumption and GHG Emissions Have Changed 2022 vs. 2024					
	Buildings	**Fleet**	**Lighting**	**Total**	**Variance**
Total Energy (ekWh)	-3,970,773.27	218,867.07	1,377,319.88	**-2,374,586.33**	**-3%**
GHGs (tCO_2e)	(1,552.08)	321.07	(256.55)	**-1,487.57**	**-13%**
(-) = % decrease; (+) = % increase The increase of GHG emissions for Fleet & Lighting, in energy consumption, is due to the increase in the asset counts.					

When comparing 2024 to 2022:

- Overall total energy consumption remained virtually unchanged (0% variance), with a marginal net increase of ~10,700 ekWh.
- Despite stable energy use, GHG emissions decreased by 12%, reflecting improved energy efficiency and cleaner fuel or operational transitions—again led by reductions in building emissions.

These trends suggest that while energy consumption from newer assets has grown, the City has made progress in decarbonizing its energy use—particularly through retrofits, operational optimization, and possible electrification measures.

Table 14: How GHG Emissions Have Changed 2019 vs. 2024

Table 14: How GHG Emissions Have Changed 2019 vs. 2024					
	Buildings	**Fleet**	**Lighting**	**Total**	**Variance**
Total Energy (ekWh)	8,116.68	2,285.65	315.96	**10,718.28**	**0%**
GHGs (tCO_2e)	(1,552.08)	321.07	(256.55)	**-1,487.57**	**-12%**
(-) = % decrease; (+) = % increase The increase of GHG emissions for Fleet & Lighting, in energy consumption, is due to the increase in the asset counts.					

In 2024, the majority of corporate GHG emissions originated from facility operations, which accounted for 76% of total emissions. Fleet activities contributed 21%, reflecting increased vehicle usage and expansion of services. Meanwhile, streetlighting represented the smallest share at 3%, indicating continued progress in energy-efficient lighting retrofits. These proportions highlight that facilities remain the primary focus for emissions reduction initiatives, while fleet and lighting require targeted strategies due to rising asset counts.

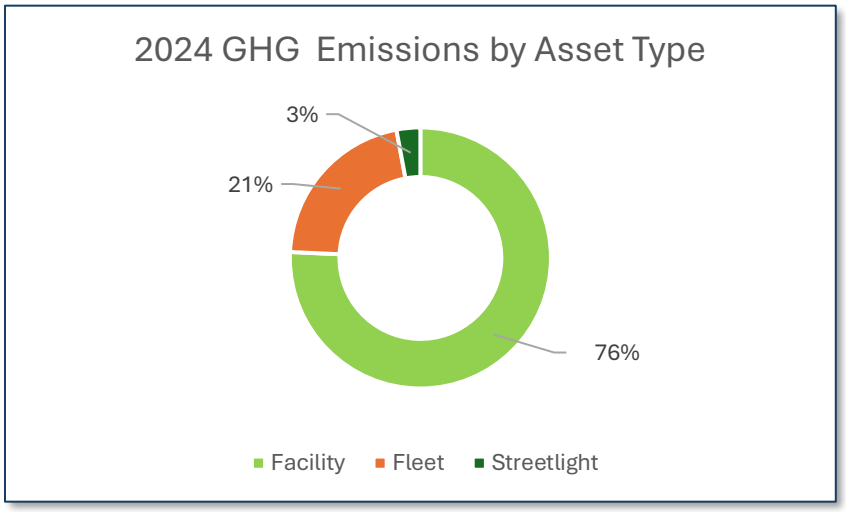


Figure 19: 2024 GHG Emissions by Asset Type

7. Targets

The City of Vaughan is committed to achieving long-term energy sustainability and emissions reduction through the implementation of its this Plan. This Plan outlines a strategic framework to guide municipal energy performance improvements across three key time horizons: a short-term GHG reduction target of 20% by 2030, a mid-term target of 35% by 2035, and a long-term target extending to 2050.

This Plan establishes clear benchmarks and measurable targets to reduce GHG emissions and enhance energy efficiency across all corporate facilities. A central focus of the mid-term goal is the reduction of natural gas consumption by 20% from 2024 levels by 2030. Achieving this would result in an overall reduction of facility-related emissions to just 20% of their 2024 levels, a significant milestone in the City's climate action journey.

To support these efforts and identify opportunities for exceeding reduction targets, the City will leverage insights from the 2019 facility energy audits. These audits offer valuable guidance for prioritizing high-impact retrofits and conservation measures. The City will also continue to utilize tools such as RETScreen software to monitor, assess, and verify energy savings and GHG reductions. Figure 21 outlines the facility-level emissions targets for 2030, providing a transparent view of the City's mid-term performance objectives.

By embedding energy efficiency and emissions reductions into municipal operations, the City of Vaughan is laying the foundation for a more sustainable, resilient, and low-carbon future. The RETScreen report, including the established targets for facilities, fleet, and lighting following this plan.

7.1 Long-Term Targets

Long-term energy and GHG emissions targets are based on the CaGBC Zero-Carbon Building Standard to eliminate GHG emissions associated with the operations of new buildings by 2030 and eliminate GHG emissions from all buildings by 2050. For the purposes of this report, the long- term GHG reduction target is interpreted as follows:

- *Eliminate GHG emissions associated with the operations of buildings by 2050 for all City facilities*.

This target aligns with the GDV target to reduce GHG emissions and move towards carbon neutrality for the City of Vaughan's facilities and infrastructure. Specific actions to achieve the long-term target are not described in detail in this Plan. Technology and costs will change over this time horizon. However, the types of GHG emissions reduction actions to explore will include high-performance building envelopes, fuel switching from natural gas to electricity use, on-site renewable energy generation, thermal energy networks, geothermal heating and cooling, and forms of energy storage and microgrids.

7.2 Short-Medium Term Targets

For the Short-Term target, The Mayors' Megawatt Challenge provides an approach to set short-term energy and GHG emissions reduction targets to 2030 based on best practices review and benchmarking (TRCA and Enerlife Consulting, 2016). Public reporting of building energy use in Ontario to the Broader Public Sector (BPS) registry offers a database for benchmarking by comparing the City's portfolio of buildings to the most efficient buildings of similar typology.

The City's short- and mid-term targets are as follows:

- Reduce energy consumption by 10% of 2024 levels by 2030.
- Reduce natural gas consumption in facilities by 20% between 2024 to 2030.
- Reduce natural gas consumption in facilities by 35% between 2024 to 2035.

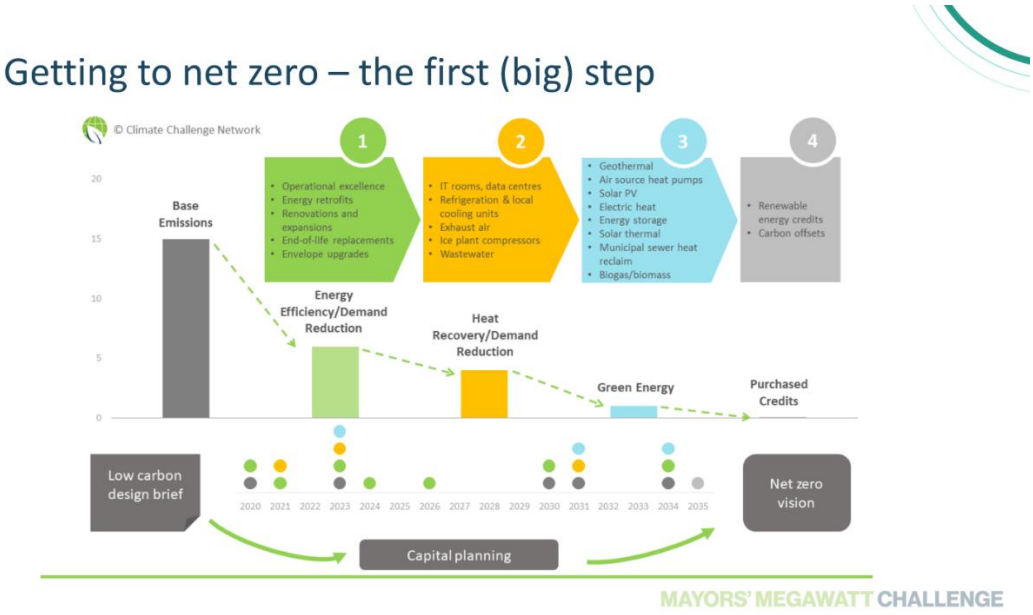


Figure 20: Map to Net Zero

7.2.1 Energy Intensity Targets - Benchmarking to the Top Quartile of Public Buildings

A sample of energy consumption reporting of BPS facilities in southern Ontario was used to inform the energy intensity targets for City facilities. Weather normalization is not required as the facilities are in the same general climatic conditions. The energy targets derived from the top quartile of sampled buildings using this approach are described in more detail in Appendix C and listed below as follows:

- 20.0 ekWh/ft^2 for Administration buildings[6]
- 21.8 ekWh/ft^2 for Community Centres (without a pool or arena)[7]
- 42.0 ekWh/ft^2 for Community Centres with a pool[8]
- 27.9 ekWh/ft^2 for Community Centres with an arena, or a stand-alone arena[9]
- 35.0 ekWh/ft^2 for Community Centres with a pool and arena[10]
- 27.5 ekWh/ft^2 for Fire Stations[11]
- 19.4 ekWh/ft^2 for Libraries[12]

These targets are based on the top quartile performance of sampled buildings and serve as benchmarks for energy efficiency across City facilities. While specific updates to these targets since 2019 are not detailed in the available information, they continue to guide energy management practices within the City. For the most current and detailed information, consulting the City's latest energy management documentation or the Ontario Ministry of Energy's resources is recommended.

[6] based on the TRCA and Enerlife 2015 report for the Mayors' Megawatt Challenge
[7] based on the 2016 TRCA and Enerlife report for Mayors' Megawatt Challenge
[8] based on a sample of 15 facilities
[9] based on a sample of 28 facilities
[10] based on a sample of 18 facilities
[11] based on a sample of 60 facilities
[12] based on a sample of 40 facilities

7.2.2 Savings Potential to Short-term Energy Intensity Targets

The savings potential can be determined by calculating the actual energy intensity of City facilities less the target energy intensity derived from the best practices approach. The facility energy audits will inform us of the specific actions that can be taken to achieve the energy efficiency targets.

Considering the actual energy consumption for 2024, some facilities are already operating at or below the target energy intensity (Figure 20). In these cases, energy savings will be pursued through ongoing improvement to operations as well as optimizing energy and water savings opportunities through regular life cycle equipment replacement.

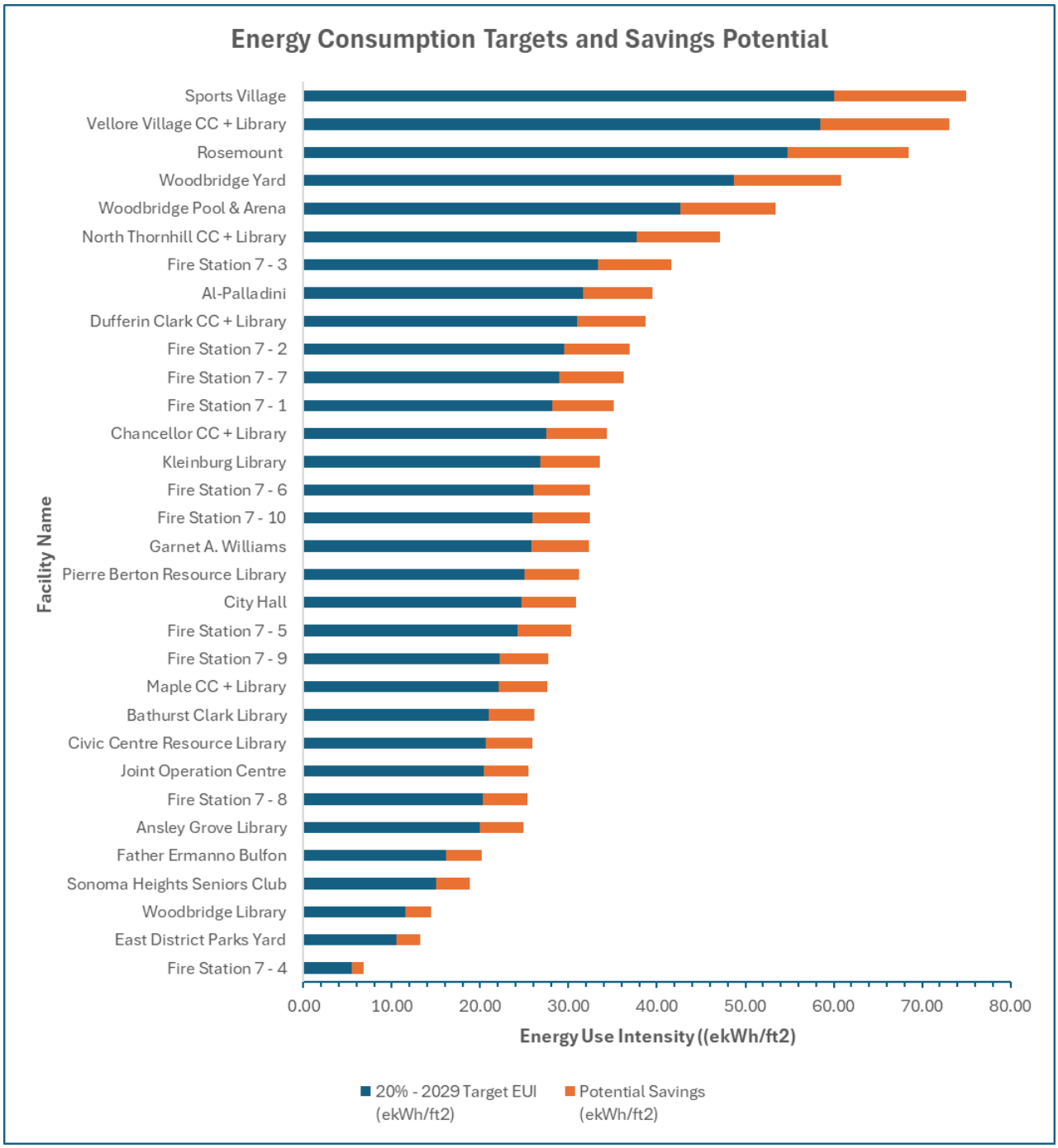


Figure 21: Energy Consumption Targets and Savings Potential

7.2.3 2030 Savings Targets and Potential GHG Reduction - Facilities (2030)

As of 2024, City facilities are responsible for approximately 76% of total corporate GHG emissions, equating to roughly 8,120 tonnes of CO_2e annually. With some facilities already meeting electricity consumption benchmarks, reducing natural gas usage by 20% of 2024 levels by 2030 would bring facility-related emissions to 20% of their 2024 levels. To identify opportunities for exceeding this reduction target, the City will rely on insights from the 2019 facility energy audits. Figure 21 outlines the 2030 emissions targets by facility using the RETScreen software.

Table 15: 2030 Savings Targets for Natural Gas and Electricity and GHG Reductions

Type	Facility	2030 Target - 20%		
		Electricity (kWh)	Natural Gas (m^3)	Predicted GHG Emissions (tCO_2e)
Admin Building	City Hall	4,033,818	350,415	811
Admin Building	Joint Operations Centre (JOC)	943,710	103,262	230
Community Centre (CC) (With Pool)	Chancellor CC + Library	735,576	86,174	190
Community Centre (With Pool)	Dufferin Clark CC + Library	978,193	151,653	324
Community Centre (With Pool)	North Thornhill CC + Library	1,536,400	193,026	423
Community Centre (With Pool)	Vellore Village CC + Library	1,675,115	324,790	679
Community Centre (With Pool & Arena)	Al-Palladini CC	1,992,999	240,210	529
Community Centre (With Pool & Arena)	Father Ermanno Bulfon CC	868,424	106,541	234
Community Centre (With Pool & Arena)	Garnet A. Williams CC	1,436,286	173,117	381
Community Centre (With Pool & Arena)	Maple CC + Library	1,619,295	183,938	408
Community Centre (With Pool & Arena)	Woodbridge Pool & Arena	843,175	147,819	312
Community Centre (With Arena)	Rosemount CC	1,646,704	202,940	445
Fire Station	7-1	76,978	17,277	36
Fire Station	7-2	93,984	18,745	39
Fire Station	7-3	122,176	25,312	53
Fire Station	7-4	20,815	3,327	7
Fire Station	7-5	61,218	9,436	20
Fire Station	7-6	44,192	11,053	23
Fire Station	7-7	60,240	10,276	22
Fire Station	7-8	107,008	16,526	35
Fire Station	7-9	94,560	19,435	40
Fire Station	7-10	50,592	12,885	26
Library	Bathurst Clark Library	516,773	27,454	71
Library	Kleinburg Library	51,259	10,177	21
Library	Pierre Berton Resource Library	403,940	39,798	90
Library	Civic Centre Resource Library	320,527	48,747	104
Library	Woodbridge Library	138,049	3,471	12
Total Target saving		**5,118,002**	**634,451**	**5,565**

7.2.4 2030 Savings Targets and Potential GHG Reduction for Facilities (2035)

Limiting the natural gas savings to 10% of the 2024 consumption by 2024 shifts most of the effort for GHG emissions reduction to the time period between 2025 and 2030. The estimated GHG reduction for 2030 is about 1,800 tonnes CO2e, compared to 650 tonnes CO2e by 2024. For some facilities, the required natural gas savings in the 2024 to 2030 time period represents over 40% of the 2024 annual consumption and is on average about 24% of the 2024 consumption for all facilities. Table 16 shows the 2035 targets by facility. The short-term energy savings and GHG reduction targets to 2030 and 2035 will be revised based on the findings of the facility energy audits to shift more of the energy savings, and cost savings, to the 2024 time period where feasible.

Table 16: 2035 Savings Targets for Natural Gas and Electricity and GHG Reductions

Type	Facility	2035 Target - 35%		
		Electricity (kWh)	Natural Gas (m^3)	Predicted GHG Emissions (tCO_2e)
Admin Building	City Hall	3,277,477	284,712	659
Admin Building	Joint Operations Centre (JOC)	766,765	83,901	187
Community Centre (With Pool)	Chancellor CC + Library	597,655	70,016	155
Community Centre (With Pool)	Dufferin Clark CC + Library	794,782	123,218	263
Community Centre (With Pool)	North Thornhill CC + Library	1,248,325	156,834	343
Community Centre (With Pool)	Vellore Village CC + Library	1,361,031	263,892	551
Community Centre (With Pool & Arena)	Al-Palladini CC	1,619,311	195,170	430
Community Centre (With Pool & Arena)	Father Ermanno Bulfon CC	705,595	86,564	190
Community Centre (With Pool & Arena)	Garnet A. Williams CC	1,166,983	140,657	310
Community Centre (With Pool & Arena)	Maple CC + Library	1,315,677	149,450	332
Community Centre (With Pool & Arena)	Woodbridge Pool & Arena	685,080	120,103	253
Community Centre (With Arena)	Rosemount CC	1,337,947	164,889	362
Fire Station	7-1	62,545	14,037	29
Fire Station	7-2	76,362	15,230	32
Fire Station	7-3	99,268	20,566	43
Fire Station	7-4	16,912	2,703	6
Fire Station	7-5	49,739	7,667	16
Fire Station	7-6	35,906	8,980	18
Fire Station	7-7	48,945	8,349	18
Fire Station	7-8	86,944	13,427	29
Fire Station	7-9	76,830	15,791	33
Fire Station	7-10	41,106	10,469	21
Library	Bathurst Clark Library	419,878	22,306	57
Library	Kleinburg Library	41,648	8,269	17
Library	Pierre Berton Resource Library	328,202	32,336	73
Library	Civic Centre Resource Library	260,428	39,607	85
Library	Woodbridge Library	112,165	2,820	9
Total Target saving		**8,956,503**	**1,110,289**	**4,522**

7.3 General Recommendations for Conservation Action

The consideration of energy consumption by end use provides general guidance to prioritize energy conservation actions. The energy breakdown shown in Figure 7 and Figure 7 are provided in the Ontario Municipal Energy Profile Report (ICF Canada, 2018) prepared for the IESO. The detailed facility energy audits characterize process energy loads and will differ from the general end use breakdown provided by the IESO (IESO, 2017).

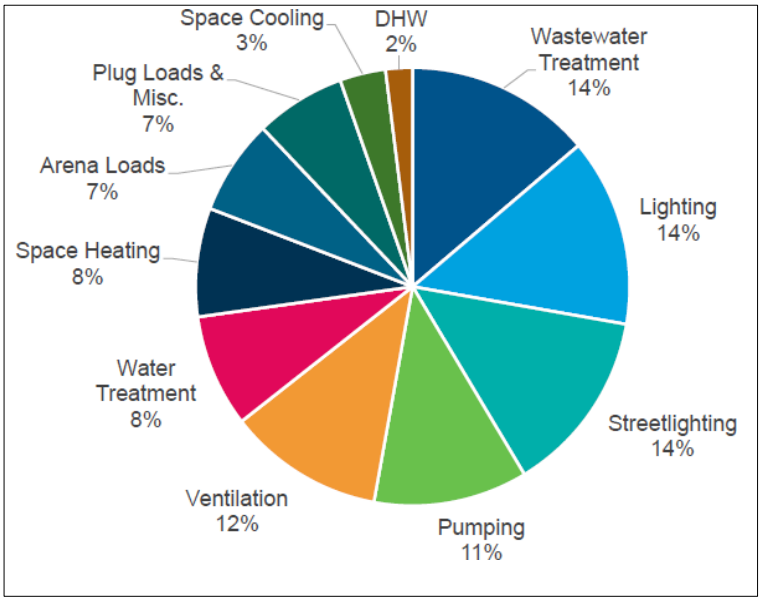


Figure 22 Municipal Electricity End Use Breakdown 2014 By IESO

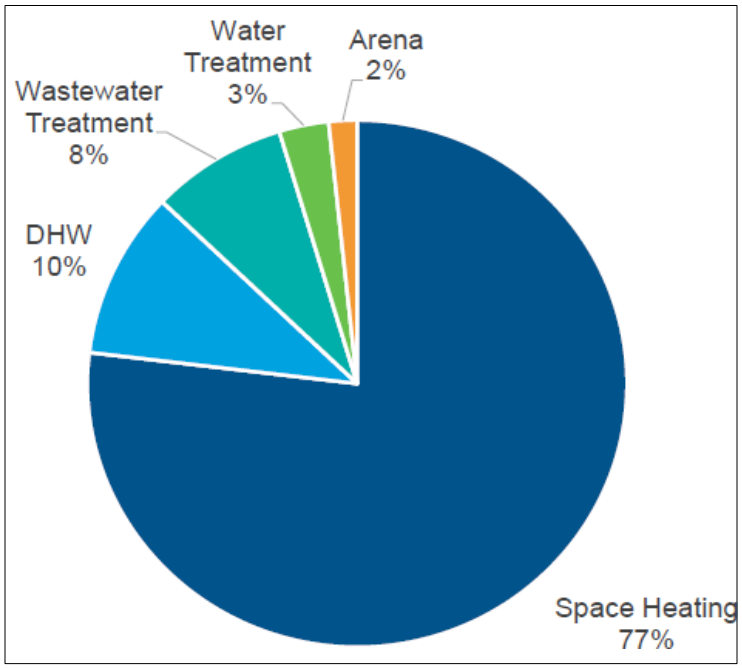


Figure 22:Municipal Natural Gas End Use Breakdown 2014

8. Implementation Plan

8.1 Financial Framework

8.1.1 Corporate Energy Fund

In 2023, the City recognized and acted on the need for a Corporate Energy Fund to financially support and implement energy retrofit projects. Initial steps undertaken to establish the Fund included conducting a municipal scan to research the approach of other municipalities, and partnering with relevant internal stakeholders, including the Finance and Facility Management teams.

Currently, the Fund is primarily supported by utility incentives, notably through the IESO's Save on Energy program. Additional funding sources, such as rebates from Enbridge Gas, may also be allocated to the Fund. Moving forward, the City will explore transitioning this fund into a comprehensive energy account designed to reinvest utility cost savings and avoid costs from energy conservation projects. This approach aims to:

- Enable support for projects with longer payback periods
- Increase transparency and accountability through rigorous tracking and verification
- Strengthen financial reporting by linking investments to measurable outcomes
- Enhance eligibility for external funding by demonstrating a track record of leadership and results

To complement these efforts, the City leverages RETScreen software for energy data analysis and performance tracking. To improve the accuracy and efficiency of utility bill management and the verification of energy savings, the City may consider enhancing RETScreen' s functionality or integrating it with additional software or third-party solutions. This initiative would involve engagement with Financial Services and the Office of the Chief Information Officer to assess technical and financial feasibility.

In Summary:

Table 17: Recommendation

#	Recommendation	Description
1	**Establish a Transitioning Energy Fund**	Create a dedicated financial mechanism to support energy efficiency projects and low-carbon upgrades.
2	**Implement Conservation & Efficiency Measures**	Apply recommendations from facility energy audits to reduce energy use and optimize building operations.
3	**Investigating Renewable Energy Opportunities**	Explore solar PV, geothermal, and other renewable technologies for integration across City facilities.
4	**Update Green Building Policy**	Revise policies to incorporate climate-forward strategies and Drawdown-aligned low-carbon solutions.

The 2025–2029 Corporate Energy Management Plan includes key initiatives to improve energy efficiency, reduce greenhouse gas emissions, and promote sustainable operations across City facilities. The total estimated cost to implement and maintain the plan over the five-year period is approximately **$25.5 million**.

Major components include:

- **HVAC and BAS Retrofits** in 15 buildings ($12–15M)
- **Solar PV Installations** at 6 community centres ($4–6M)
- **Energy Audits** for 30 facilities ($300K–$500K)
- **EV Charger Installations** at 10 sites ($1.2–1.5M)

Funding will be sourced from approved capital budgets, utility incentives, and external grants (e.g., NRCan, IESO, FCM). While minor adjustments to the capital plan may be required, the long-term cost savings and operational benefits justify the investment.

8.2 Organizational Strategies

Energy management strategies generally involve at least one of three components: conservation, efficiency, and renewable technology (see Figure 8). Conservation comes first; it is the easiest starting point because it involves examining existing systems, behaviors, and practices, and finding ways to reduce the amount of energy used day-to-day. During discussions with Facility staff, which were held to gather input on short-term target setting, the importance of actions to target and encourage change in behavior was emphasized and confirmed that a significant percentage of the reduction target could be achieved through simple measures like regulating thermostat temperatures and other operations efficiencies.

Measures to increase energy efficiency come next; this involves finding products and services to reduce the amount of energy required to do something. Once conservation and efficiency measures have been implemented and the amount of energy needed has been reduced, renewable energy sources can be used to generate clean energy.

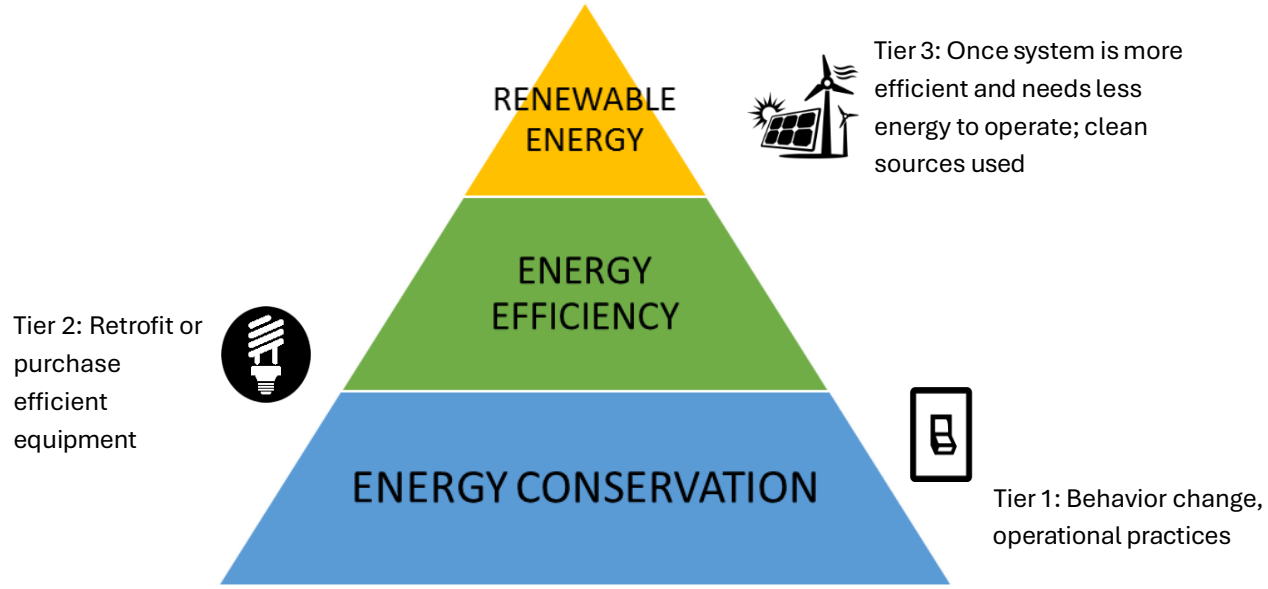


Figure 23:Energy Management Pyramid

8.2.1 Energy Conservation Measures by Asset Class

Specific energy conservation measures (ECMs) were identified through the completion of 2019 facility energy audits.

8.2.2 New Construction Standards

Considering expected population growth, from about 350,723 now to 424,500 by 2031[17], the City continues to invest in its parks, recreation, and library infrastructure to meet increasing needs and pressures on existing and proposed recreation and library facilities.

While the City currently has a Corporate Green Building Policy that requires all new City buildings to be built to LEED Gold at minimum, there is a need to update it to identify specific energy, water, and resiliency performance standards. This not only demonstrates that the City is leading by example, but also future proofs the City against rising energy costs either from potential electricity or natural gas price increases and strengthens the City's energy security.

The City's Active Transportation Master Plan (ATMP) identifies, for both the short-to-medium and long terms, the need for the following new recreation related buildings to accommodate upcoming growth and community development, between 2019-2031:

- Six branch libraries and one storefront library
- Four community centres
    - Three indoor pools
    - Two ice pad arenas
    - Four-five outdoor rinks or skating trails
- 15 waterplay facilities

Considering the future additions to the City's buildings and infrastructure portfolio, newer and better construction standards are needed and should include considerations of the standards listed below (Figure 8 explains the differences between common types of green buildings).

Passive House

The Passive House high-performance building standard is an internationally recognized and science-based energy standard in construction, to build for comfort, affordability, and energy efficiency of residential, institutional, and commercial buildings through all stages of design, construction, and livability. The primary goal of a Passive House building is to achieve a well- insulated building envelope and then introduce fresh air through a high-efficiency heat recovery ventilation system. Renewable energy technologies can be, and are often, installed on Passive House buildings as well.

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[17] City of Vaughan, 2018 ATMP Review & Update; population growth estimate includes institutional adjustment and undercount, based on 45% scenario prepared by the Region in November 2015, adjusted to remove growth in Vaughan's Whitebelt.

Zero Carbon Building Approach

A Zero-Carbon Building (ZCB) is characterized mainly by demonstrating a zero-carbon balance in its operations, i.e., it produces zero emissions over the course of a year. This can be achieved primarily through on-site carbon reduction actions but may require offsetting emissions (e.g. through purchasing renewable energy). A "net-zero" building is simply one which produces as much energy as it uses.

The CaGBC report on the business case for ZCBs found that ZCBs are both technologically feasible and financially viable.[18] More specifically, when evaluated over a 25-year life-cycle, the ZCB archetypes studied can provide a positive financial return of 1% and require a modest 8% capital cost premium, along with 24% annual operating savings. Although energy intensive recreation buildings were not included as one of the studied archetypes, the CaGBC study found that "mid- rise offices, and likely for other larger buildings or buildings with higher energy costs, life-cycle costs are much more sensitive, overall, to energy costs than to either capital costs or the cost of carbon." That is, for the most energy-intensive buildings in the City's portfolio, a ZCB approach is likely to demonstrate overall life-cycle savings from energy and maintenance savings that outweigh up front capital costs.

A key recommendation of this Plan is to, firstly, further explore and research standards such as Passive House, ZCB and Net-Zero, among others, to determine what is best to incorporate into a renewed Corporate Green Building Policy for the City; and, secondly, to establish an updated, higher-performance building standard for the City's Corporate Green Building Policy based on the research findings. The establishment of a revised standard will require collaboration amongst various departments, including Facility Management Operations, Infrastructure Delivery, Infrastructure Planning and Corporate Asset Management, Financial Planning and Development Finance, and Policy Planning and Environmental Sustainability. Higher performance building standards may need to be phased over time and will be a consideration in the revision of the Corporate Green Building Policy.

[18] Making the Case for Building to Zero Carbon, https://www.cagbc.org/makingthecase

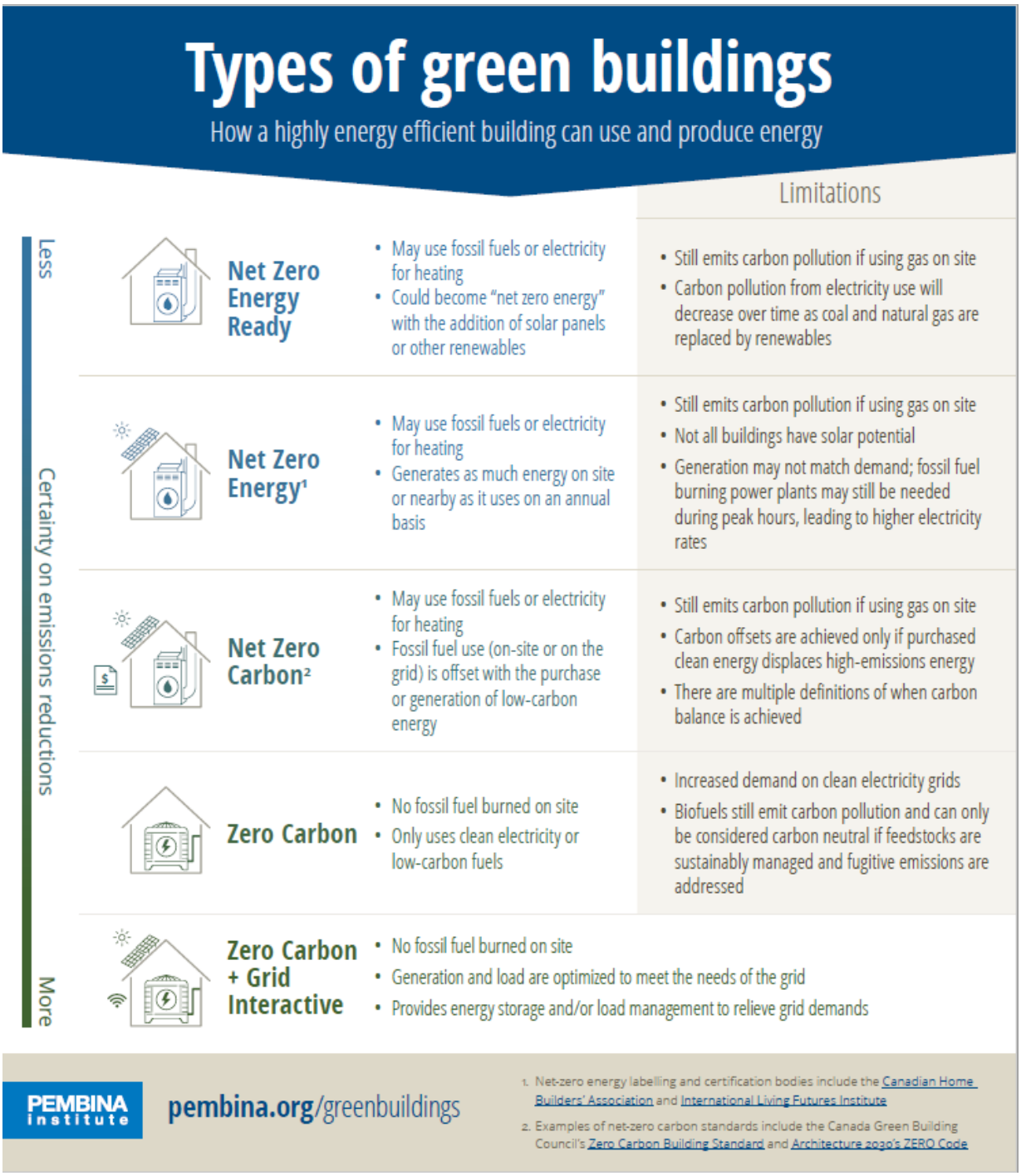


Figure 24:Types of green buildings.

8.2.3 Renewable Energy and Future Technologies

Drawdown Solutions for Buildings

The Drawdown Project identifies several solutions for reducing carbon emissions from buildings. A description of each solution can be found on the Drawdown website. Of the ten Drawdown solutions for buildings, seven are noted below that are pertinent to City facilities:

- **BAS:** Automation systems, through controls and sensors, can program different set points depending on time and utilization.
- **Green Roofs and Cool Roofs:** Green and cool roofs reduce energy loads of the associated building for both heating and cooling. Green roofs, in addition, reduce neighborhood cooling loads through evapotranspirative cooling effects.
- **Heat Pumps:** When paired with renewable energy sources and building structures designed for efficiency, heat pumps could eliminate almost all emissions from heating and cooling for buildings.
- **Insulation:** Improved building envelopes are a first strategy to reduce energy demand. The Vancouver Zero Emissions Building Plan[19] requires all new city owned buildings to meet Passive House Certification, as well as the requirement to use only low carbon fuel sources unless both or either is deemed unviable. Passive House certification strives for very efficient building envelopes.
- **LED Lighting:** Upgrading to LED lights has been a common energy retrofit in City facilities given the proven savings.
- **Smart Glass:** Various measures can improve a window's efficiency: layered panes, reflective low-emissivity coatings, insulating gas between panes and tightly sealed frames. More adaptive technologies, dubbed 'smart glass,' make windows responsive in real time to sunlight and weather, reducing a building's energy load for lighting and improving heating and cooling efficiency.
- **Solar Hot Water:** In commercial buildings, water heating can be roughly 12% of energy loads. Solar water heating—exposing water to the sun to warm can reduce fuel consumption by 50 to 70%.

Distributed Energy Resources (DERs)

The City is aware of technologies and integrated design approaches that can be grouped under the heading of distributed energy resources (DERs). The City will evaluate these approaches for both major renovations and new construction. Some of these technologies are described below.

Solar Photovoltaic (PV)

There are two main types of solar energy: solar PV cells (solar panels), and solar-thermal. Solar PVs produce electricity directly from sunlight, and solar thermal technologies use sunlight to first generate heat and then generate electricity.

In 2017, the City completed roof upgrades—originally identified through 2016 assessments—to support the potential installation of solar panels at six community centres: Chancellor CC, Dufferin Clark CC, Father Ermanno Bulfon CC, Garnet A. Williams CC, Maple CC, and North Thornhill CC. This Plan recommends exploring how to best leverage this opportunity, as all six roofs are suitable for solar PV technology.

Geothermal Energy

Geothermal energy is another type of renewable energy that is generated through the Earth's internal heat. Thermal energy that is contained below the Earth's crust (in underground reservoirs of steam and hot water) can be tapped into to generate electricity or to directly heat and cool buildings.



Why Geothermal?

It is renewable – With proper management, the rate of energy extraction can be balanced with a reservoir's natural heat recharge rate.

It is reliable – Geothermal power plants produce electricity consistently, running 24 hours per day / 7 days per week, regardless of weather conditions. It also has the ability to produce more electricity over the same time period than coal, natural gas, nuclear or large hydro stations.

It has a small footprint–Geothermal power plants are compact; using less land per GWh (404 m2) than coal (3642 m2) wind (1335 m2) or solar PV with center station (3237 m2).*

It is clean – Modern closed-loop geothermal power plants emit no greenhouse gasses. Geothermal power plants consume less water on average over the lifetime energy output than the most conventional generation technologies.

It is versatile - Geothermal power facilities produce useful by-product heat that can be integrated with greenhouses, fish farms, and food processing; you can also directly drill for heat.

Source: Enbridge Gas

McMaster Innovation Park (MIP) in Hamilton, Ontario undertook an innovative application of such technologies that the City can also consider exploring. The MIP district heating system combines geo-exchange (geothermal heat pump technology), solar thermal, and boilers in a cascaded loop to supply space heating and domestic hot water to all the buildings at the park.[13]

Microgrids

The illustration (Figure 8)[14] shows how a customized energy-management software program, developed for Alectra Utilities by GE Digital Energy, will route electricity from the company's existing generation to power the building's various electrical loads during phase one of the trial.

[13] http://www.districtenergy-digital.org/districtenergy/2017q1?pg=9#pg9

[14] Alectra_GREATCentre_Microgrid_2020-07-15.pdf

Alectra Utilities' Microgrid Project

The Alectra Utilities Microgrid project will supply electricity for the company's lighting, air conditioning and refrigeration (loads') at its office in Vaughan.

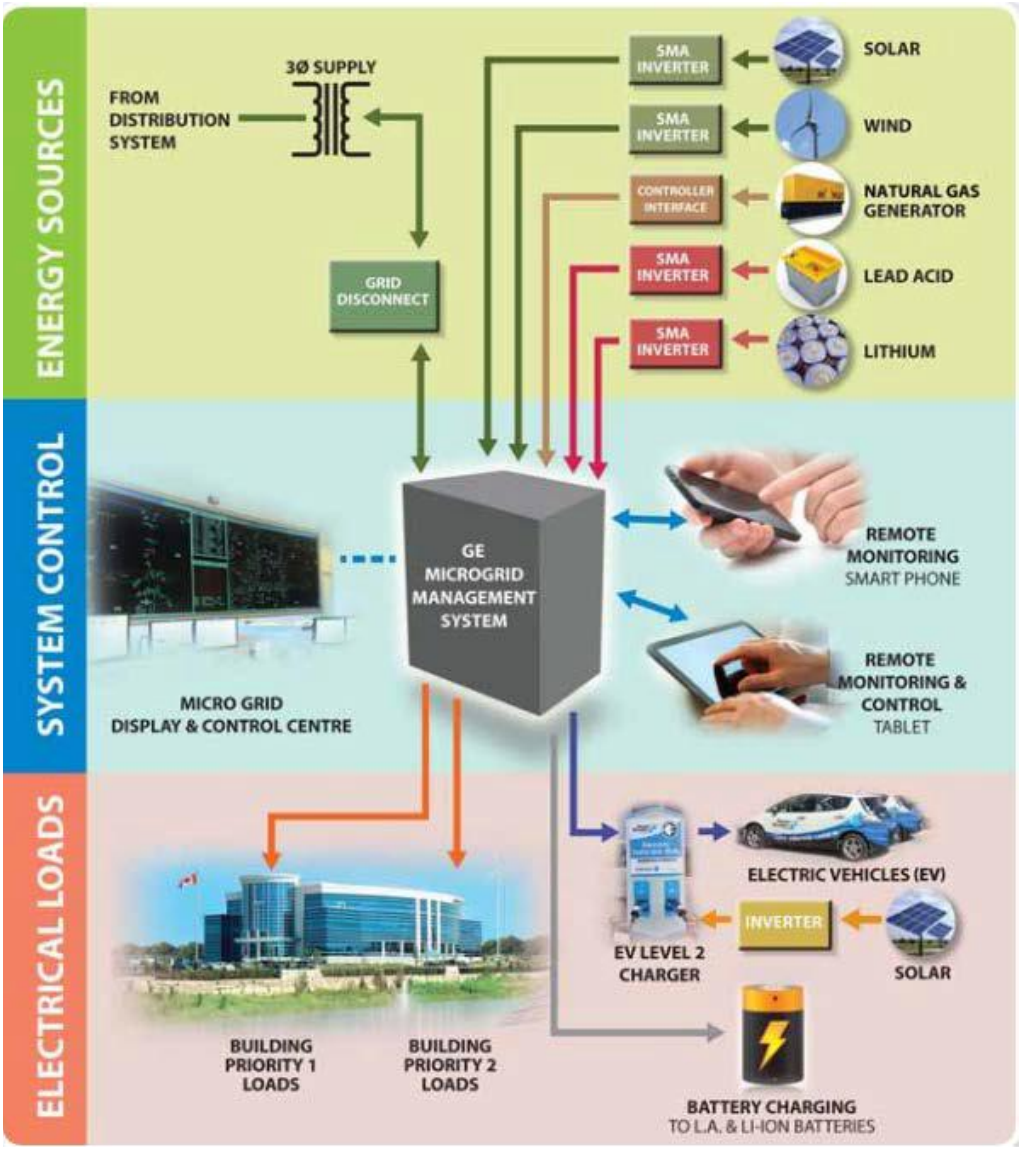


Figure 25:Alectra Utilities' Microgrid Project

Combined Heat and Power (CHP)
Combined heat and power systems generate electricity and thermal energy simultaneously from a single fuel source. Waste heat from the generation of electricity can be used directly as hot air for heating buildings, for drying purposes, or to produce steam, hot water or chilled water for heating, cooling or industrial processes.

In February 1995 a 1,030 ekWh reciprocating engine CHP scheme was commissioned at York University. This provides 60% of the campus electrical demands and 20% of the annual heat requirement, including all heating and hot water needs from June to October. Heat is provided at up to 127˚C from the reciprocating engine. Installation was straightforward and initial operating experience showed over 97% availability at an average load factor of 85%. The initial capital cost was paid back in around 3.5 years with subsequent years' savings going directly towards running the university. The CHP unit saves around 14% of the overall annual energy bill.

Low-Carbon Thermal Energy Networks
Sewer heat recovery, lake water cooling and geo-exchange are examples of heat transfer in a thermal energy network. The Enwave deep lake water cooling infrastructure in Toronto is an example of a thermal energy network. The City of Hamilton is studying the expansion of the McMaster Innovation Park with new geothermal fields, solar thermal absorption and solar PV electric-driven chillers, upgraded distribution infrastructure and additional conventional backup.[23]

8.2.4 Training and Capacity Building
As shown in Figure 8 earlier, behavior change and shifting operational practices are arguably the most important strategies to begin any energy management program. This includes training and educating staff about the importance of sustainable energy management and of things they can do as individuals to contribute to the City's corporate goals. Because energy conservation relies heavily on individual behavior, it is important for staff to be a part of the process from the start.

Staff Training and Ongoing Engagement
A critical contributor to the goals outlined in this Plan are Facility staff working in and responsible for individual buildings; an important recommendation is therefore to continue to seek and involve Facility staff in all stages of the energy management process. This includes providing training opportunities, as well as drawing on their knowledge as experts of their facilities to understand both site-specific problems and solutions, not just for their own facilities, but also as lessons learned that can be applied to and shared with other sites.

Local Authority Services (LAS), created by the Association of Municipalities of Ontario (AMO), is a non-profit organization that works with Ontario municipalities and the BPS. Some of their offerings include energy training opportunities, which should be further pursued, such as:

Energy Efficient Building Operations 101
Customizable sessions for facilities and operators, designed to provide flexible, on-site technical training specific to a broad range of municipal facilities that will be both cost effective and time efficient. Operations 101 workshops are eligible for incentives through the IESO.

Employee Engagement Workshop
Employee engagement alone can achieve 3-5% energy savings and is crucial to maintaining the savings related to most equipment and technology upgrades. This workshop provides a Facility Scan, Staff Awareness Survey, workshop time covering Energy 101, Understanding Your Bill, Ways to Save at Work & Home, and a Follow-Up Survey.

Peer-to-peer Learning
Continuous engagement with and participation in groups such as the Mayor's Megawatt Challenge (MMC) network, the CAP Energy Manager's group, and other similar networks is important for continuous improvement. A specific recommendation of this Plan is for the City to join the MMC and submit data for at least two facilities, including City Hall.

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Appendix B – Energy Consumption Data

Source of Equations, Formulas, and Conversion Factors:

Natural Resources Canada (NRCan), RETScreen Expert Software, IPCC Guidelines for National Greenhouse Gas Inventories, and relevant standards from Measurement Canada and Environment and Climate Change Canada (ECCC).

Table B-1: Source of Equations and Legend

GHG Emissions Quantification Methodology				
	CO2e Emission Factors			
2019-2024 Reporting Year	**Electricity**	0.0355	tCO2e/MWh	**Note:** Source of these factors from RETScreen Energy software
	Natural gas	0.1794	tCO2e/MWh	
	Gasoline	0.2383	tCO2e/MWh	
	Diesel	0.2574	tCO2e/MWh	
Source: Government of Canada, NRC offers The *RETScreen® Clean Energy Management Software* platform enables low-cost energy planning, implementation, monitoring and reporting.				
Methodology to calculate CO2e				
Note: values below are shown for the 2018 Reporting year, and both sets of emission factors above include these calculations for their respective years				
The use of natural gas, gasoline, and diesel also releases nitrous oxide (N2O) and methane (CH4) in addition to CO2. As such, the emission factors above include the following considerations:				
Each gas has a unique global warming potential (GWP) relative to CO2; GWP is a measure of how much heat a greenhouse gas traps in the atmosphere for a given time period, relative to carbon dioxide, where the GWP of CO2 is 1. The GWP for the 3 major gases are:				
	CO2	1		Source: Government of Canada, 2018. National Inventory Report, 1990– 2016: Greenhouse Gas Sources and Sinks In Canada. Table 1-1. (References IPCC Fourth Assessment Report)
	CH4	25		
	N2O	298		
CO2e = [(mass CO2 x 1) + (mass CH4 x 25) + (mass N2O x 298)]				
Natural Gas	1.888 kg CO2/m3			
	+ 0.00049 kg CH4/m3			
	+ 0.000049 kg			
	= [(1.888)+(0.00049 x 25)+(0.000049 x 298)]			
	= **1.915**			
Gasoline	2.307 kg CO2/L			**Note:** Using CH4 and N2O emission factors for Tier 2 Light-Duty Gasoline Vehicles **Fleet are using 2.31 Factor reference to Fleet strategy 2025**
	+ 0.00014 kg CH4/L			
	+ 0.000022 kg N2O/L			
	= [(2.307)+(0.00014 x 25)+(0.000022 x 298)]			
	= **2.317**			
Diesel	2.681 kg CO2/L			**Note:** Using CH4 and N2O emission factors for Light Duty Diesel Vehicles – Uncontrolled **Fleet are using 2.67 Factor reference to Fleet strategy 2025**
	+ 0.00010 kg CH4/L			
	+ 0.00016 kg N2O/L			
	= [(2.681)+(0.00010 x 25)+(0.00016 x 298)]			
	= **2.731**			

kWh = Electricity Consumption (in kilowatt hours)	**m^3 = Natural Gas Consumption (in cubic metres)**
ekWh = Total Energy Consumption (in equivalent kWh)	
EUI = Energy Use Intensity (in ekWh per square foot (ft^2))	**tCO_2e = GHG Emissions (in tonnes of carbon dioxide equivalent)**
1m^3 of Natural gas = 10.6278 kWh per m^3	

Table B-2: Consumption (ekWh) & GHG for 2022 and 2024

Corporate Energy Consumption Summary	2022		2024	
	Total ekWh	GHGs (tCO2e)	Total ekWh	GHGs (tCO2e)
Buildings	70,748,022	8,456	66,777,249	8,117
Fleet	9,775,951	2,516	9,994,818	2,573
Lighting	7,522,825	267	8,900,145	316
Total:	**88,046,797**	**11,239**	**85,672,211**	**11,005**
Buildings Breakdown by Type	**Total ekWh 2022**	**GHGs (tCO2e)**	**Total ekWh 2024**	**GHGs (tCO2e)**
Admin	11,806,695.19	1,287.10	12,248,904.51	1,302.12
Community Centres with Pool (no Arena)	18,936,922.49	2,476.84	15,239,561.67	1,985.55
Community Centres with Pool and Arena	5,381,346.37	674.85	4,754,387.51	556.74
Community Centres with Pool & Arena	19,108,702.75	2,397.09	18,271,528.23	2,276.87
Libraries	3,897,983.31	406.37	3,327,776.93	353.91
Fire Stations	3,068,516.40	420.82	2,835,246.42	397.40
Outdoor Pool	929,899.61	145.89	320,833.31	42.53
Sports Village	6,589,156.50	589.96	8,951,150.91	1,078.54
Yards	1,028,799.36	128.80	827,859.22	123.02

Table B-3: % change 2022 vs. 2024 in Consumption (ekWh) and GHG

2022 vs. 2024, % Change				
	Buildings	**Fleet**	**Lighting**	**Total**
Total Energy Consumption (ekWh)	-6%	2%	18%	**15%**
GHG Emissions (tCO2e)	-4%	2%	18%	**17%**
(-) = % decrease (+) = % increase				
*Lighting emissions reduction is so significant due to the change in emission factor (Provincial phase out of coal, completed in 2014)				

Table B-4: % change 2022 vs. 2024 by Energy source type

Buildings – Energy Consumption Breakdown, 2022-2024						
	Total Energy Consumption (ekWh)	**% Change in Total Energy Consumption**	**Electricity Consumption (kWh)**	**% Change in Electricity Consumption**	**Natural Gas Consumption (m^3)**	**% Change in Natural Gas Consumption**
2022	70,748,022	-6 %	28,940,080	-9.28 %	3,933,828	-4 %
2024	66,777,249		26,846,128		3,757,233	

Table B-4: change 2022 vs. 2024 by building profile

How our building profile has changed	2022	2024	
Admin	2	2	* From 2019-2024, the City has expanded several community centres, decommissioned 1 fire station, and constructed one new fire stations, five libraries are included as attached with community centres. ** Standalone building count.
Service Yards	3	3	
Community Centres	10	10	
Outdoor Pools	1	1	
Fire Stations	10	10	
Libraries**	5	5	
Total number of buildings:	**31**	**31**	

Table B-5: Baseline: 2022 Energy Consumption by Building Type

Admin Buildings	Building Size (ft^2)	Electricity (kWh)	Natural gas (m^3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft^2)	GHG Emissions (tCO_2e)
City Hall	314,341	4,669,365	420,779	4,471,955	9,141,320	29	968
JOC	100,137	1,105,608	146,763	1,559,768	2,665,376	27	319
Total	**414,478**	**5,774,972**	**567,542**	**6,031,723**	**11,806,695**	**28**	**1,287**

Community Centres (with only Pool)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Chancellor CC + Library	60,117	865,490	148,861	1,582,065	2,447,555	41	315
Dufferin Clark CC + Library	83,602	1,281,167	245,791	2,612,218	3,893,384	47	514
North Thornhill CC + Library	95,035	2,137,160	416,454	4,425,990	6,563,150	69	870
Vellore Village CC + Library	87,651	2,112,599	368,866	3,920,234	6,032,833	69	778
Total	**326,405**	**6,396,416**	**1,179,972**	**12,540,506**	**18,936,922**	**56**	**2,477**

Community Centres (with only Arena)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Rosemount CC	69,426	2,019,175	316,356	3,362,172	5,381,346	78	675

Community Centres (with Pool & Arena)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Al-Palladini CC	143,685	2,562,073	285,595	3,035,247	5,597,320	39	635
Father Ermanno Bulfon CC	124,015	1,057,532	150,366	1,598,060	2,655,592	21	324
Garnet A. Williams CC	126,884	606,867	240,024	2,550,927	3,157,794	25	479
Maple CC + Library	161,921	2,035,883	261,535	2,779,542	4,815,424	30	571
Woodbridge Pool & Arena	56,544	902,453	186,315	1,980,119	2,882,572	51	387
Total	**613,049**	**7,164,809**	**1,123,835**	**11,943,894**	**19,108,703**	**33**	**2,397**

Outdoor Pools	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Thornhill Outdoor Pool	4,349	145,504	73,806	784,395	929,900	214	146

Fire Stations	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
7-1	9,269	85,801	23,772	252,644	338,445	37	48
7-2	9,943	117,573	26,598	282,678	400,252	40	55
7-3	13,843	168,160	36,008	382,686	550,846	40	75
7-4	10,258	17,335	5,756	61,174	78,508	8	12
7-5	7,622	70,667	16,989	180,556	251,223	33	35
7-6	6,222	56,360	16,107	171,182	227,542	37	33
7-7	6,663	72,000	15,996	170,002	242,002	36	33
7-8	13,939	127,200	26,410	280,680	407,880	29	55
7-9	13,584	110,580	29,691	315,550	426,130	31	61
7-10	7,233	75,480	6,606	70,208	145,688	20	15
Total	**98,576**	**901,156**	**203,933**	**2,167,360**	**3,068,516**	**31**	**421**

Libraries (Standalone)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Bathurst Clark Library	35,882	645,966	34,317	364,714	1,010,680	28	88
Kleinburg Library	5,593	64,073	12,721	135,196	199,270	36	27
Pierre Berton Resource Library	33,002	504,926	49,747	528,701	1,033,627	31	113
Civic Centre Resource Library	35,586	400,659	60,934	647,594	1,048,253	29	130
Woodbridge Library	10,198	172,561	4,339	46,114	218,675	21	14
Total	**120,261**	**1,788,185**	**162,058**	**1,722,320**	**3,510,505**	**29**	**372**

Yards	Building Size (ft^2)	Electricity (kWh)	Natural gas (m^3)	Natural gas (ekWh)	Total ekWh	EUI ($ekWh/ft^2$)	GHG Emissions (tCO_2e)
East District Parks Yard	11,000	240,904	15,393	163,594	404,497	37	38
Woodbridge Yard	11,616	146,625	44,946	477,677	624,302	54	91
Total	**22,616**	**387,529**	**60,339**	**641,271**	**1,028,799**	**45**	**129**

Table B-6: Fleet consumption and GHG -2022

Fleet	L	Total ekWh	GHG Emissions (tCO_2e)
Diesel	334,191.05	3,555,425.16	**892.29**
Gasoline	584,696.30	6,220,525.47	**1,350.65**
Total	**918,887.35**	**9,775,950.63**	**2,242.94**

Table B-7: Streetlight consumption and GHG -2022

Lighting	kWh	Total ekWh	GHG Emissions (tCO2e)
Streetlighting	7,522,825	7,522,825	267.06
Total	**7,522,825**	**7,522,825**	**267.06**

Assumptions/Calculation Methodology

- Data is primarily from the Internal Energy Dashboard system, which uses utility billing data.
- For Rosemount CC and Thornhill Outdoor Pool, data is taken from BPS Reporting due to gaps in Dashboard
- Fleet data is received directly from the Fleet Services division

Calculation to convert m^3 to ekWh:

1 m^3 = 37 MJ and 1 kWh = 3.6 MJ

1 m^3 * 37 MJ / 3.6 MJ = 10.27777 ekWh

To convert Fleet data to ekWh:

Diesel (L) * 10.74 = ekWh

Gasoline (L) * 9.63 = ekWh

Source: Natural Resources Canada, Energy Efficiency in Buildings, Table 1
https://www.nrcan.gc.ca/energy/publications/efficiency/buildings/5985

2022 Consumption Summary Corporate Energy Consumption - 2022	(ekWh)
Total Electricity	29,669,095
Total Natural Gas	43,389,592
Total Diesel	3,555,425
Total Gasoline	6,220,525

Corporate GHG Emissions – 2022 (tCO2e)	
Buildings	8,837.35
Fleet	2,516.33
Lighting	267.06
Total	**11,620.74**

Building's Energy Consumption Breakdown - 2022	
Electricity (kWh)	29,669,094.66
Natural Gas (m^3)	4,082,650.43
Natural Gas (ekWh)	43,389,592.28
Total Energy (ekWh)	**73,058,686.93**

Table B-8: 2024 Energy Consumption by Building Type

Admin Buildings	Building Size (ft^2)	Electricity (kWh)	Natural gas (m^3)	Natural gas (ekWh)	Total ekWh	EUI ($ekWh/ft^2$)	GHG Emissions (tCO_2e)
City Hall	314,341	5,042,273	438,019	4,655,178	9,697,451	31	1,014
JOC	100,137	1,179,638	129,078	1,371,815	2,551,453	25	288
Total	**414,478**	**6,221,911**	**567,097**	**6,026,993**	**12,248,905**	**28**	**1,302**

Community Centres (with only Pool)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Chancellor CC + Library	60,117	919,470	107,717	1,144,795	2,064,265	34	238
Dufferin Clark CC + Library	83,602	1,222,741	189,566	2,014,670	3,237,411	39	405
North Thornhill CC + Library	95,035	1,920,500	241,283	2,564,307	4,484,807	47	528
Vellore Village CC + Library	87,651	2,093,894	405,987	4,314,749	6,408,643	73	848
Total	**326,405**	**6,156,605**	**944,553**	**10,038,520**	**16,195,126**	**48**	**2,019**

Community Centres (with only Arena)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Rosemount CC	69,426	2,058,380	253,675	2,696,007	4,754,388	68	557

Community Centres (with Pool & Arena)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Al-Palladini CC	143,685	2,491,248	300,262	3,191,124	5,682,373	40	661
Father Ermanno Bulfon CC	124,015	1,085,531	133,310	1,416,795	2,502,325	20	293
Garnet A. Williams CC	126,884	1,795,358	216,396	2,299,813	4,095,171	32	476
Maple CC + Library	161,921	2,024,119	229,923	2,443,576	4,467,694	28	510
Woodbridge Pool & Arena	56,544	1,053,969	184,774	1,963,741	3,017,710	53	390
Total	**613,049**	**8,450,225**	**1,064,665**	**11,315,049**	**19,765,274**	**35**	**2,330**

Outdoor Pools	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Thornhill Outdoor Pool	4,349	119,504	20,359	216,371	335,875	77	43

Fire Stations	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
7-1	9,269	96,222	21,596	229,518	325,740	35	45
7-2	9,943	117,480	23,431	249,020	366,500	37	49
7-3	13,843	152,720	39,838	423,390	576,110	42	81
7-4	10,258	26,019	4,159	44,201	70,220	7	9
7-5	7,622	76,522	14,500	154,103	230,625	30	30
7-6	6,222	55,240	13,816	146,834	202,074	32	28
7-7	6,663	75,300	15,640	166,219	241,519	36	32
7-8	13,939	133,760	20,657	219,538	353,298	25	44
7-9	13,584	118,200	24,294	258,192	376,392	28	51
7-10	7,233	63,240	16,106	171,171	234,411	32	33
Total	**98,576**	**914,703**	**194,037**	**2,062,186**	**2,976,890**	**30**	**402**

Libraries (Standalone)	Building Size (ft2)	Electricity (kWh)	Natural gas (m3)	Natural gas (ekWh)	Total ekWh	EUI (ekWh/ft2)	GHG Emissions (tCO2e)
Bathurst Clark Library	35,882	597,547	32,195	342,162	939,709	26	83
Kleinburg Library	5,593	53,539	12,179	129,436	182,975	33	25
Pierre Berton Resource Library	33,002	540,880	46,074	489,665	1,030,545	31	107
Civic Centre Resource Library	35,586	387,278	47,125	500,835	888,113	25	104
Woodbridge Library	10,198	111,955	3,287	34,934	146,889	14	10
Total	**120,261**	**1,691,199**	**140,860**	**1,497,032**	**3,188,231**	**26**	**329**

Yards	Building Size (ft^2)	Electricity (kWh)	Natural gas (m^3)	Natural gas (ekWh)	Total ekWh	EUI ($ekWh/ft^2$)	GHG Emissions (tCO_2e)
East District Parks Yard	11,000.00	12,207.00	12,506.00	132,911.27	145,118.27	13.19	24.28
Woodbridge Yard	11,616.00	188,959.98	48,720.00	517,786.42	706,746.40	60.84	99.60
Total	**22,616.00**	**201,166.99**	**61,226.00**	**650,697.68**	**851,864.67**	**37.02**	**123.88**

Table B-9: Fleet consumption and GHG 2024

Fleet	Liter (L)	Total ekWh	GHG Emissions, (tCO_2e)
Diesel	320,816	3,413,132	857
Gasoline	618,643	6,581,685	1,429
Total	**939,460**	**9,994,818**	**2,286**

Table B-10: Streetlight consumption and GHG -2024

Lighting	kWh	Total ekWh	GHG Emissions (tCO_2e)
Streetlighting	8,900,145	8,900,145	316
Total	**8,900,145**	**8,900,145**	**316**

Assumptions/ Methodology Notes	
• Data is primarily from the Internal Energy Dashboard system, which uses utility billing data. • Fleet data is received directly from the Fleet Services division • Fire Station 7-3 was decommissioned and re-opened at a new location in April 2017	
Calculation to convert m^3 to ekWh: 1 m^3 = 37 MJ and 1 kWh = 3.6 MJ 1 m^3 * 37 MJ / 3.6 MJ = 10.27777 ekWh	
To convert Fleet data to ekWh: Diesel (L) * 10.74 = ekWh Gasoline (L) * 9.63 = ekWh	Natural Resources Canada, Energy Efficiency in Buildings, Table 1 https://www.nrcan.gc.ca/energy/publications/efficiency/buildings/5985

2024 Consumption Summary

Corporate Energy Consumption - 2024	Consumption (ekWh)
Electricity	31,208,931.58
Natural Gas	40,684,801.94
Diesel	3,413,132.43
Gasoline	6,581,685.27
Total	**81,888,551.22**

Type	Corporate GHG Emissions - 2024 (tCO_2e)
Buildings	8,406.77
Fleet	2,572.67
Lighting	315.96
Total	**11,295.39**

Buildings Energy Consumption Breakdown - 2024	
Total Electricity Consumption (kWh)	31,208,931.58
Total Natural Gas Consumption (m^3)	3,828,149.00
Total Natural Gas in ekWh	40,684,801.94
Total Energy Consumption (ekWh)	**71,893,733.52**

Table B-11: Energy Consumption & GHG Reduction Targets

2024 Annual Energy Consumption					Targets		
Facility Name	Electricity (kWh)	Natural Gas (m^3)	Total Energy Use (ekWh)	EUI ($ekWh/ft^2$)	20% - 2029 Target EUI ($ekWh/ft^2$)	Potential Savings ($ekWh/ft^2$)	Natural Gas (ekWh)
City Hall	5,042,273	438,019	9,697,451	31	24.68	6.17	4655178.328
Joint Operation Centı	1,179,638	129,078	2,551,453	25	20.38	5.10	1371815.168
Al-Palladini	2,491,248	300,262	5,682,373	40	31.64	7.91	3191124.484
Father Ermanno Bulf	1,085,531	133,310	2,502,325	20	16.14	4.04	1416794.675
Garnet A. Williams	1,795,358	216,396	4,095,171	32	25.82	6.45	2299813.409
Woodbridge Pool & A	1,053,969	184,774	3,017,710	53	42.70	10.67	1963741.117
Rosemount	2,058,380	253,675	4,754,388	68	54.79	13.70	2696007.165
Dufferin Clark CC + L	1,222,741	189,566	3,237,411	39	30.98	7.74	2014669.535
North Thornhill CC +	1,920,500	241,283	4,484,807	47	37.75	9.44	2564307.467
Vellore Village CC + L	2,093,894	405,987	6,408,643	73	58.49	14.62	4314748.639
Maple CC + Library	2,024,119	229,923	4,467,694	28	22.07	5.52	2443575.659
Chancellor CC + Libr	919,470	107,717	2,064,265	34	27.47	6.87	1144794.733
Fire Station 7 - 1	96,222	21,596	325,740	35	28.11	7.03	229517.9688
Fire Station 7 - 2	117,480	23,431	366,500	37	29.49	7.37	249019.9818
Fire Station 7 - 3	152,720	39,838	576,110	42	33.29	8.32	423390.2964
Fire Station 7 - 4	26,019	4,159	70,220	7	5.48	1.37	44201.0202
Fire Station 7 - 5	76,522	14,500	230,625	30	24.21	6.05	154103.1
Fire Station 7 - 6	55,240	13,816	202,074	32	25.98	6.50	146833.6848
Fire Station 7 - 7	75,300	15,640	241,519	36	29.00	7.25	166218.792
Fire Station 7 - 8	133,760	20,657	353,298	25	20.28	5.07	219538.4646
Fire Station 7 - 9	118,200	24,294	376,392	28	22.17	5.54	258191.7732
Fire Station 7 - 10	63,240	16,106	234,411	32	25.93	6.48	171171.3468
Ansley Grove Library	120,000	13,307	261,424	25	19.94	4.98	141424.1346
Bathurst Clark Librar	597,547	32,195	939,709	26	20.95	5.24	342162.021
Civic Centre Resourc	419,261	47,125	920,096	26	20.68	5.17	500835.075
Kleinburg Library	58,085	12,179	187,521	34	26.82	6.71	129435.9762
Pierre Berton Resour	540,880	46,074	1,030,545	31	24.98	6.25	489665.2572
Woodbridge Library	111,955	3,287	146,889	14	11.52	2.88	34933.5786
Sonoma Heights Sen	17,062	5,018	70,392	19	15.03	3.76	53330.3004
Sports Village	4,372,962	497,454	9,659,804	75	60.03	15.01	5286841.621
East District Parks Ya	12,207	12,506	145,118	13	10.55	2.64	132911.2668
Woodbridge Yard	188,960	48,720	706,746	61	48.67	12.17	517786.416
	30,240,744	**3,741,892**	**70,008,826**				**40768785.5**

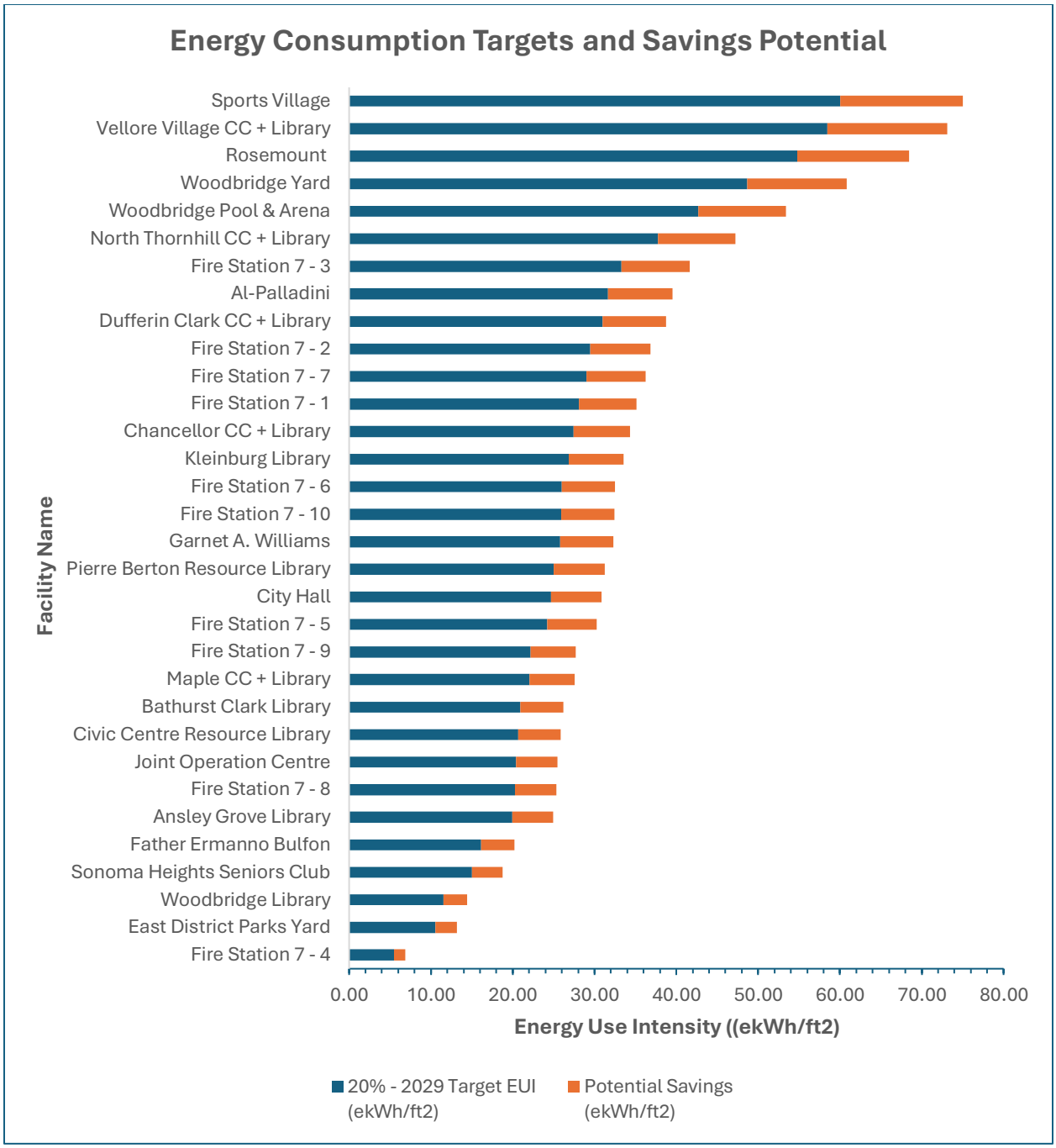


Figure Appendix B-1: Energy Consumption ekWh/ft2 Reduction Targets

Appendix C – Target Setting Methodology

Determining Energy Intensity Targets for City Facilities

Research undertaken in support of the Mayors' Megawatt Challenge program provides approaches to set near-term (i.e., to 2024) and medium-term (i.e., to 2030) energy intensity targets for facilities (TRCA and Enerlife 2015, TRCA and Enerlife 2016).

Top Quartile Benchmark

A sample of building energy consumption filed to the Broader Public Sector (BPS) for facilities in southern Ontario municipalities was used to inform the energy targets for City facilities. Weather normalization is not required as the facilities are in the same general weather conditions. A summary of the top quartile results is provided below and the data is shown in Table C-1.

27.5 ekWh/ft^2 for Fire Stations, based on a sample of 60 facilities.
19.4 ekWh/ft^2 for Libraries, based on a sample of 40 facilities.
20 ekWh/ft^2 for administration building based on the TRCA and Enerlife Report for the Mayors' Megawatt Challenge
21.8 ekWh/ft^2 for community centres (without a pool or arena) based on the 2016 TRCA and Enerlife report for the Mayors' Megawatt Challenge
41.7 ekWh/ft^2 for community centres with a pool based on a sample of 15 facilities.
27.9 ekWh/ft^2 for community centres with an arena or a stand-alone arena based on a sample of 28 facilities.
35.1 ekWh/ft^2 for community centres with a pool and arena based on a sample of 18 facilities.

Energy Savings Potential

Based on the approach recommended by TRCA and Enerlife, a savings potential can be calculated by applying the 'top quartile' energy intensity targets by asset types with similar typologies. More detailed analysis in the facility energy audits allows for specific energy conservation measures to be planned and budgeted to achieve the savings potential.

Table C - 1
Savings potential for Vaughan facilities based on 'top-quartile' energy use intensity (EUI) targets

Facility Type	Facility Name	2024 Actual EUI	2029 Target	2029 Savings Potential
Admin	City Hall	30.85	24.68	6.17
Admin	Joint Operation Centre	25.48	20.38	5.10
Community Centre	Al-Palladini	39.55	31.64	7.91
Community Centre	Father Ermanno Bulfon	20.17	16.13	4.03
Community Centre	Garnet A. Williams	32.27	25.82	6.45
Community Centre	Woodbridge Pool & Arena	53.37	42.70	10.67
Community Centre	Rosemount	38.83	31.07	7.77
Community Centre	Dufferin Clark CC + Library	38.72	30.98	7.74
Community Centre	North Thornhill CC + Library	47.19	37.75	9.44
Community Centre	Vellore Village CC + Library	73.12	58.49	14.62
Community Centre	Maple CC + Library	27.59	22.07	5.52
Community Centre	Chancellor CC + Library	34.34	27.47	6.87
Fire Station	Fire Station 7 - 1	35.14	28.11	7.03
Fire Station	Fire Station 7 - 2	36.86	29.49	7.37
Fire Station	Fire Station 7 - 3	35.32	28.26	7.06
Fire Station	Fire Station 7 - 4	6.85	5.48	1.37
Fire Station	Fire Station 7 - 5	26.49	21.19	5.30
Fire Station	Fire Station 7 - 6	32.48	25.98	6.50
Fire Station	Fire Station 7 - 7	31.79	25.43	6.36
Fire Station	Fire Station 7 - 8	25.35	20.28	5.07
Fire Station	Fire Station 7 - 9	27.71	22.17	5.54
Fire Station	Fire Station 7 - 10	32.41	25.93	6.48
Libraries	Ansley Grove Library	21.83	17.46	4.37
Libraries	Bathurst Clark Library	24.09	19.27	4.82
Libraries	Civic Centre Resource Library	23.48	18.78	4.70
Libraries	Dufferin Clark Library	10.57	8.46	2.11
Libraries	Kleinburg Library	33.53	26.82	6.71
Libraries	Pierre Berton Resource Library	28.09	22.48	5.62
Libraries	Pleasant Ridge	0.00	0.00	0.00
Libraries	Vellore Village Library	0.00	0.00	0.00
Libraries	Woodbridge Library	14.40	11.52	2.88
Sport Building	Sports Village	75.04	60.03	15.01
Yard	East District Parks Yard	13.19	10.55	2.64
Yard	Woodbridge Yard	60.84	48.67	12.17

Limited or No Savings Potential Based on the Top Quartile Approach

Some facilities are already operating at or below the recommended near-term energy intensity targets. For these facilities, energy conservation measures can focus on operating procedures and optimize retrofits as part of regular lifecycle replacement. These energy conservation measures are identified and prioritized in the facility energy audit reports.

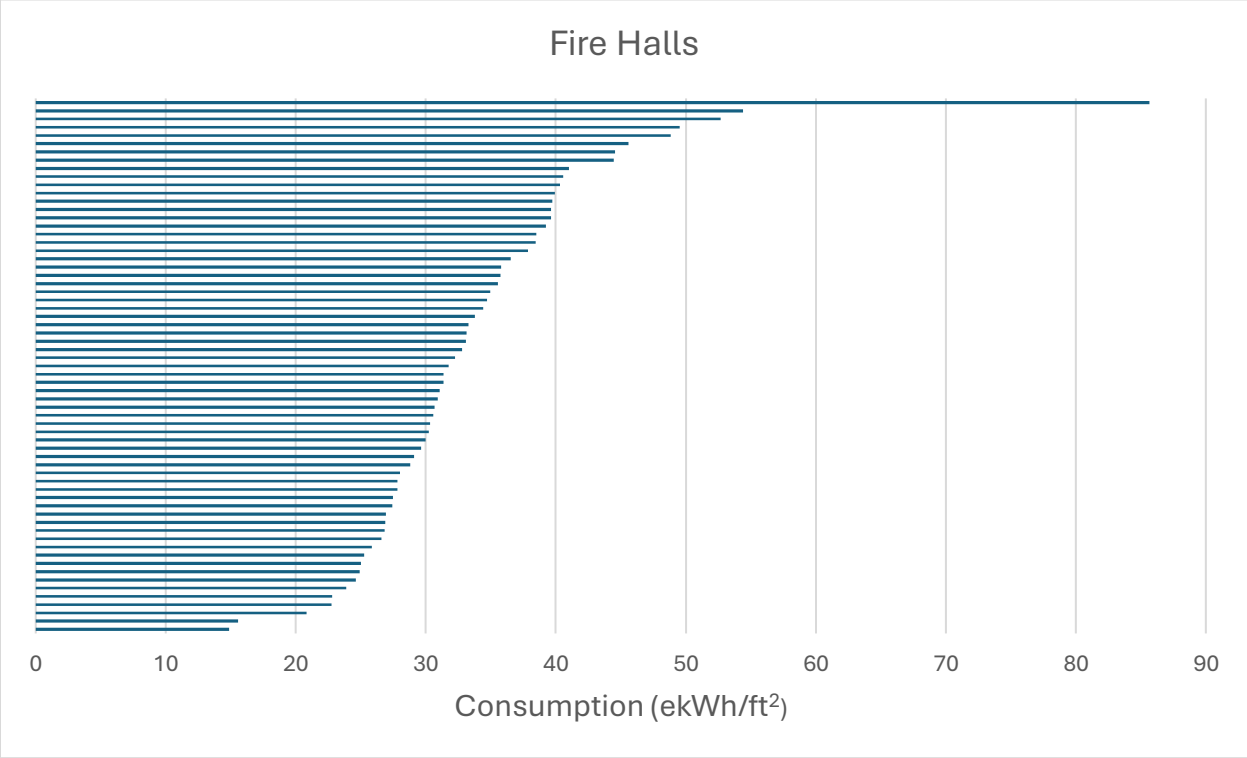
Facilities with Larger Savings Potentials

A number of City facilities have significant savings potential. These should be prioritized for immediate retrofit opportunities and operational improvements. Third-party initiatives such as the Mayor's Megawatt Challenge and Enbridge's custom retrofit program should also be pursued to ensure a holistic, systems approach to energy management.

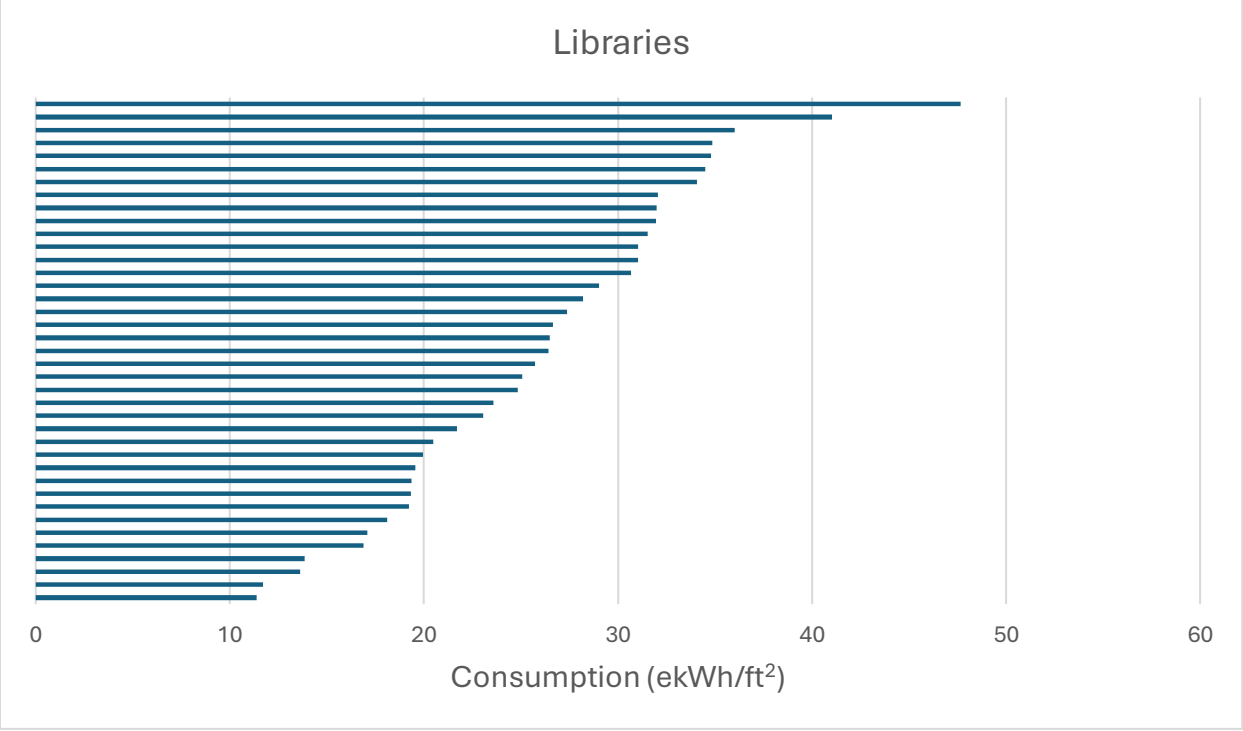
The following quartile charts were collected by the Broader Public Sector (BPS) for facilities in southern Ontario municipalities to develop a statistical quartile analysis. The purpose is to measure the mean performance by building type and establish a benchmark for comparison. The vertical axis represents the number of buildings, while the horizontal axis shows the energy intensity (ekWh/ft^2).

Energy Performance by Facility Type:

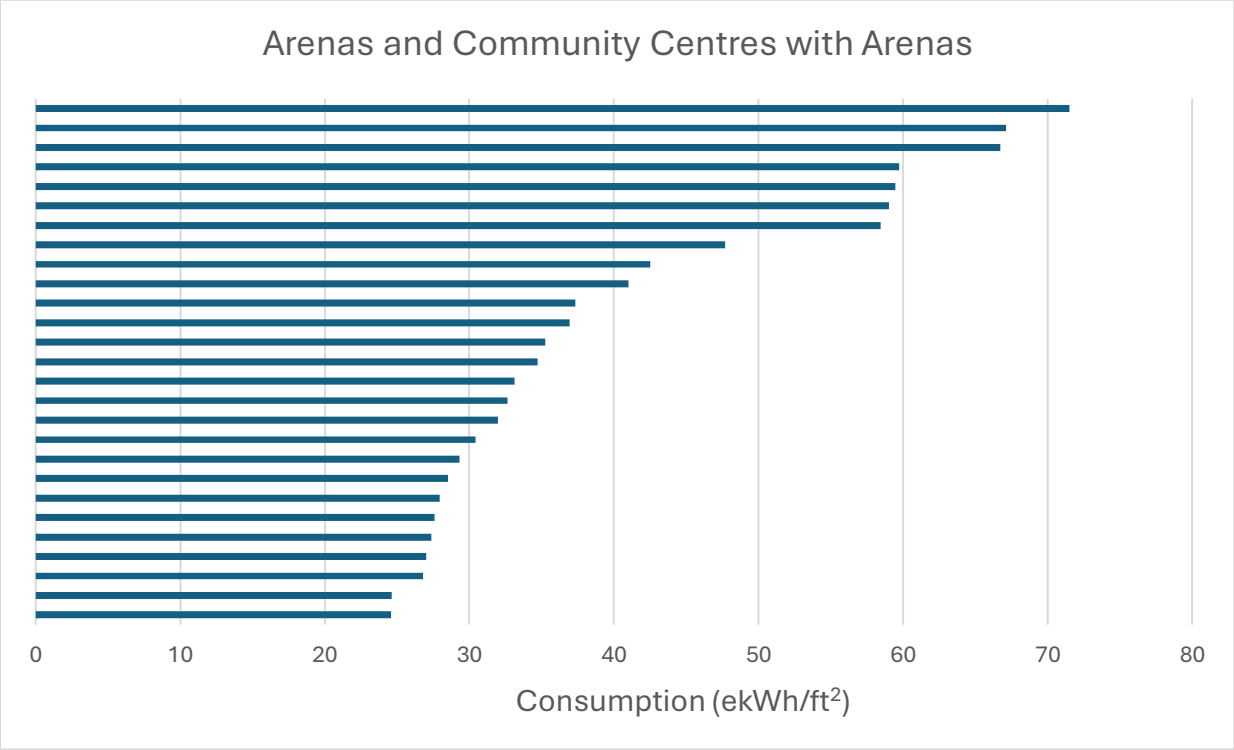
FIRE HALLS: Top quartile of a sample of over 60 fire halls is 27.5 ekWh/ft^2



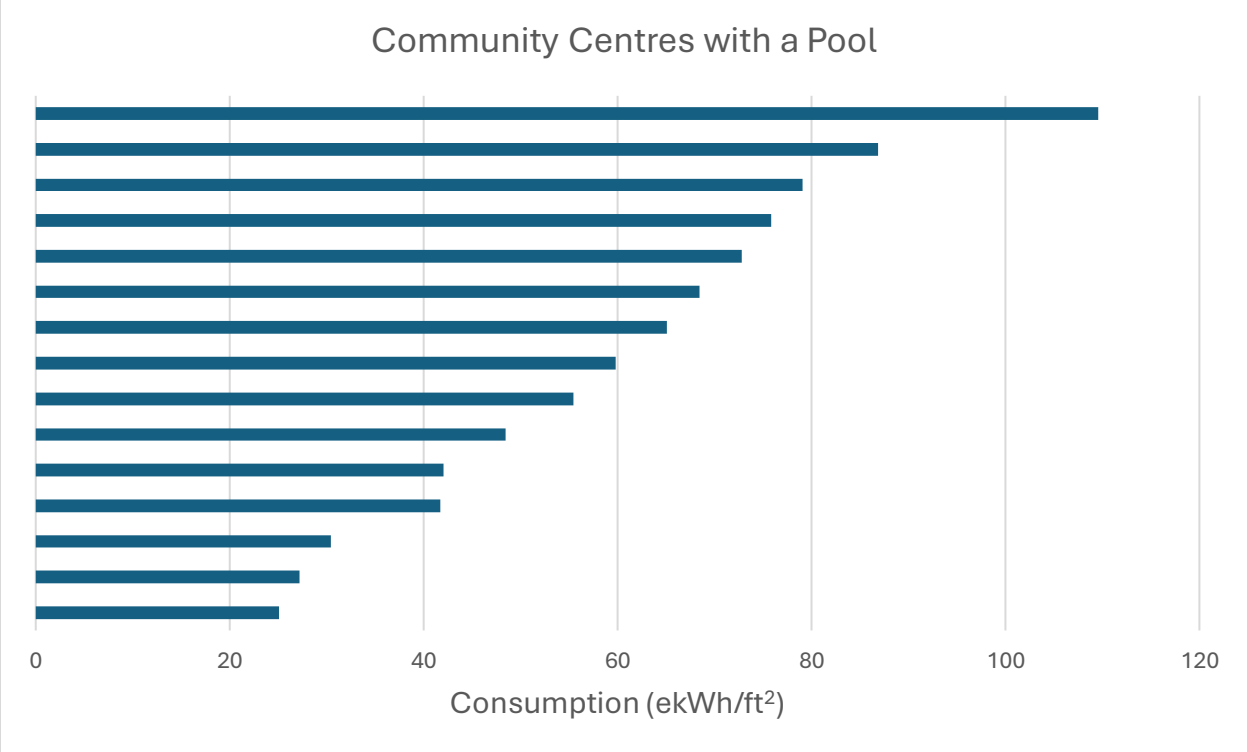
LIBRARIES: Top quartile of a sample of over 40 libraries 19.4 ekWh/ft^2



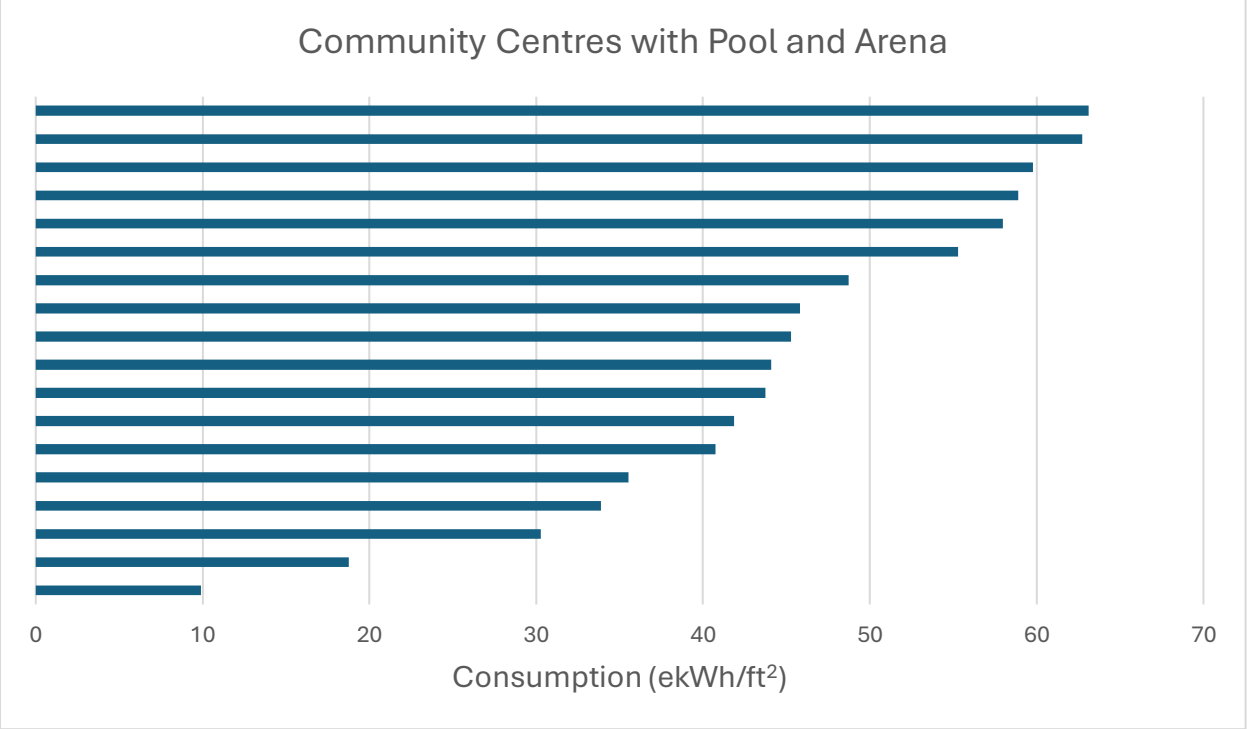
Community Centres with an Arena and Stand-Alone Arenas:
Top quartile of a sample of 28 facilities is 27.9 ekWh/ft^2



Community Centres with Pool: Top quartile of a sample of 15 facilities is 41.7 ekWh/ft^2



Community Centres with Pool and Arena: Top quartile of a sample of 18 facilities is 35.1 ekWh/ft^2



C-1 Target Breakdown by Energy Type and Facility Type

A breakdown by energy sources provides further refinement to set energy performance targets using top quartile of facilities as a benchmark. The analysis by energy source allows the City to set near-term energy performance targets to 2024 and medium-term energy performance targets to 2030, putting the City on a pathway to zero carbon facilities by 2050.

C-1. A Target and Energy consumption by source for Administration Buildings.

Table C.1.A.a: 2024 energy consumption by energy source for Vaughan administrative buildings										
Administrative Buildings	Building Area (ft^2)	Electricity Consumption (kWh)	Natural Gas Consumption (m^3)	Natural Gas Consumption (ekWh)	Total Energy (ekWh)	Electricity EUI (kWh/ft^2)	Natural Gas EUI (ekWh/ft^2)	Electricity GHG Emissions (tCO_2e)	Natural Gas GHG Emissions (tCO_2e)	Total GHG Emissions (tCO_2e)
City Hall	314,341.00	5,042,273.00	438,019.00	4,655,178.33	9,697,451.33	16.04	14.81	179.00	835.14	1,014.14
Joint Operations Centre (	100,137.00	1,179,638.01	129,078.00	1,371,815.17	2,551,453.18	11.78	13.70	41.88	246.10	287.98
Total	**414,478.00**	**6,221,911.01**	**567,097.00**	**6,026,993.50**	**12,248,904.51**			**220.88**	**1,081.24**	**1,302.12**

Table C.1.A.b: 2029 energy source and GHG emission reduction potential									
Administrative Buildings	Electricity Potential Savings (kWh)	Electricity EUI Potential Savings (kWh/ft^2)	Potential GHG Reduction from Electricity Savings (tCO_2e)	Natural Gas Potential Savings (m^3)	Natural Gas Potential Savings (ekWh)	Natural Gas EUI Potential Savings (ekWh/ft^2)	Reduction from Natural Gas Savings (tCO_2e)	Total Energy Potential Savings (ekWh)	Total GHG Reduction from all Energy Sources (tCO_2e)
City Hall	4,033,818.40	12.83	143.20	350,415.20	3,724,142.66	11.85	668.11	7,757,961.06	811.31
Joint Operations Centre (	943,710.41	9.42	33.50	103,262.40	1,097,452.13	10.96	196.88	2,041,162.55	230.38
Total	**4,977,528.81**		**176.70**	**453,677.60**	**4,821,594.80**		**864.99**	**9,799,123.61**	**1,041.70**

Table C.1.A.c: 2029 (Near-Term), 2035 (Medium-Term) and 2050 (Long-Term) Electricity Reduction Targets							
Administrative Buildings	**2024: Electricity Consumption (kWh)**	**2029: Near-Term Electricity Reduction Target (kWh)**	**2035: Medium-Term Electricity Reduction Target (kWh)**	**2050: Long-Term Electricity Reduction Target (kWh)**	**2029: Near-Term Electricity GHG Emission Reduction Target (tCO_2e)**	**2035: Medium-Term Electricity GHG Emission Reduction Target (tCO_2e)**	**2050: Long-Term Electricity GHG Emission Reduction Target (tCO_2e)**
City Hall	5,042,273.00	4,033,818.40	3,025,363.80	-	143.20	107.40	-
Joint Operations Centre (	1,179,638.01	943,710.41	707,782.81	-	33.50	25.13	-
Total	**6,221,911.01**	**4,977,528.81**	**3,733,146.61**	**-**	**176.70**	**132.53**	**-**

Table C.1.A.d: 2029 (Near-Term), 2035 (Medium-Term) and 2050 (Long-Term) Natural Gas Reduction Targets							
Administrative Buildings	**2024: Natural Gas Consumption (ekWh)**	**2029: Near-Term Natural Gas Reduction Target (ekWh)**	**2035: Medium-Term Natural Gas Reduction Target (ekWh)**	**2050: Long-Term Natural Gas Reduction Target (ekWh)**	**2029: Near-Term Natural Gas GHG Emission Reduction Target (tCO_2e)**	**2035: Medium-Term Natural Gas GHG Emission Reduction Target (tCO_2e)**	**2050: Long-Term Natural Gas GHG Emission Reduction Target (tCO_2e)**
City Hall	4,655,178.33	3,724,142.66	2,793,107.00	-	668.11	501.08	-
Joint Operations Centre (	1,371,815.17	1,097,452.13	823,089.10	-	196.88	147.66	-
Total	**6,026,993.50**	**4,821,594.80**	**3,616,196.10**	**-**	**864.99**	**648.75**	**-**

Analysis C.1.:

The Mayors' Megawatt Challenge recommends a total energy intensity target of 20 ekWh/ft^2 for administrative buildings. Based on 2024 energy consumption data for Vaughan's City Hall and Joint Operations Centre (JOC), the combined energy intensity is currently 29.56 ekWh/ft^2—comprised of 15.02 ekWh/ft^2 from electricity and 14.54 ekWh/ft^2 from natural gas. This indicates a significant opportunity to reduce both electricity and natural gas use to align with high-performance building standards.

To support this transition, the City has established specific near- and medium-term reduction targets through to 2035, outlined below:

Electricity Reduction Targets:

Near-Term (2030):
City Hall: 4,033,818 kWh (20% reduction from 2024)
JOC: 943,710 kWh (20% reduction from 2024)

Medium-Term (2035):
City Hall: 3,025,364 kWh (40% reduction from 2024)
JOC: 707,783 kWh (40% reduction from 2024)

Natural Gas Reduction Targets:

Near-Term (2030):
City Hall: 3,724,143 ekWh (20% reduction from 2024)
JOC: 1,097,452 ekWh (20% reduction from 2024)

Medium-Term (2035):
City Hall: 2,793,107 ekWh (40% reduction from 2024)
JOC: 823,089 ekWh (40% reduction from 2024)

While the target reductions are significant, particularly for natural gas, the approach is designed to be realistic and phased. Natural gas savings, in particular, often yield longer simple paybacks (typically greater than 10 years). To balance ambition with feasibility, a 10% near-term reduction from 2024 levels may be used as a conservative starting point, with ramp-up to 20% and beyond as capital investments are made.

By aiming to meet these targets, Vaughan's administrative buildings will be positioned to operate within the top quartile of comparable facilities in Ontario by 2035. The approach also aligns with corporate GHG reduction goals, integrating fossil fuel reduction into the broader Corporate Energy Management Plan (CEMP) strategy.

C.2.A Targets and Energy Consumption by Source for Community Centres with Pool-no Arena

Table C.2.A.a: 2024 energy consumption by energy source for Vaughan Community Centres with Pools.

Community Centres with Pool (No Arena)	Building Area (ft^2)	Electricity Consumption (kWh)	Natural Gas Consumption (m^3)	Natural Gas Consumption (ekWh)	Total Energy (ekWh)	Electricity EUI (kWh/ft^2)	Natural Gas EUI (ekWh/ft^2)	Electricity GHG Emissions (tCO_2e)	Natural Gas GHG Emissions (tCO_2e)	Total GHG Emissions (tCO_2e)
Chancellor CC + Library	60,117.00	919,469.83	107,717.00	1,144,794.73	2,064,264.56	15.29	19.04	32.64	205.38	238.02
Dufferin Clark CC + Libra	83,602.00	1,222,741.37	189,566.00	2,014,669.53	3,237,410.90	14.63	24.10	43.41	361.43	404.84
North Thornhill CC + Libra	95,035.00	1,920,499.64	241,283.00	2,564,307.47	4,484,807.10	20.21	26.98	68.18	460.04	528.21
Vellore Village CC + Libra	87,651.00	2,093,894.36	405,987.00	4,314,748.64	6,408,643.00	23.89	49.23	74.33	774.07	848.40
Total	**326,405.00**	**6,156,605.19**	**944,553.00**	**10,038,520.37**	**16,195,125.57**			**218.56**	**1,800.91**	**2,019.47**

Table C.2.A.b: 2029 energy source and GHG emission reduction potential

Community Centres with Pool (No Arena)	Electricity Potential Savings (kWh)	Electricity EUI Potential Savings (kWh/ft^2)	Potential GHG Reduction from Electricity Savings (tCO_2e)	Natural Gas Potential Savings (m^3)	Natural Gas Potential Savings (ekWh)	Natural Gas EUI Potential Savings (ekWh/ft^2)	Potential GHG Reduction from Natural Gas Savings (tCO_2e)	Total Energy Potential Savings (ekWh)	Total GHG Reduction from all Energy Sources (tCO_2e)
Chancellor CC + Library	735,575.86	12.24	26.11	86,173.60	915,835.79	15.23	164.30	1,651,411.65	190.41
Dufferin Clark CC + Libra	978,193.09	11.70	34.73	151,652.80	1,611,735.63	19.28	289.15	2,589,928.72	323.87
North Thornhill CC + Libra	1,536,399.71	16.17	54.54	193,026.40	2,051,445.97	21.59	368.03	3,587,845.68	422.57
Vellore Village CC + Libra	1,675,115.49	19.11	59.47	324,789.60	3,451,798.91	39.38	619.25	5,126,914.40	678.72
Total	**4,925,284.15**		**174.85**	**755,642.40**	**8,030,816.30**		**1,440.73**	**12,956,100.45**	**1,615.58**

Table C.2.A.c: 2029 (Near-Term), 2035 (Medium-Term) and 2050 (Long-Term) Electricity Reduction Targets							
Community Centres with Pool (No Arena)	**2024: Electricity Consumption (kWh)**	**2029: Near-Term Electricity Reduction Target (kWh)**	**2035: Medium-Term Electricity Reduction Target (kWh)**	**2050: Long-Term Electricity Reduction Target (kWh)**	**2029: Near-Term Electricity GHG Emission Reduction Target (tCO_2e)**	**2035: Medium-Term Electricity GHG Emission**	**2050: Long-Term Electricity GHG Emission Reduction Target**
Chancellor CC + Library	919,469.83	735,575.86	551,681.90	0.00	26.11	19.58	0.00
Dufferin Clark CC + Libra	1,222,741.37	978,193.09	733,644.82	0.00	34.73	26.04	0.00
North Thornhill CC + Libr	1,920,499.64	1,536,399.71	1,152,299.78	0.00	54.54	40.91	0.00
Vellore Village CC + Libra	2093894.365	1,675,115.49	1,256,336.62	0.00	59.47	44.60	0.00
Total	**6,156,605.19**	**4,925,284.15**	**3,693,963.12**	**0.00**	**174.85**	**131.14**	**0.00**

Table C.2.A.d: 2029 (Near-Term), 2035 (Medium-Term) and 2050 (Long-Term) Natural Gas Reduction Targets							
Community Centres with Pool (No Arena)	**2024: Natural Gas Consumption (ekWh)**	**2029: Near-Term Natural Gas Reduction Target (ekWh)**	**2035: Medium-Term Natural Gas Reduction Target (ekWh)**	**2050: Long-Term Natural Gas Reduction Target (ekWh)**	**2029: Near-Term Natural Gas GHG Emission Reduction Target (tCO_2e)**	**2035: Medium-Term Natural Gas GHG Emission Reduction Target**	**2050: Long-Term Natural Gas GHG Emission Reduction Target (tCO_2e)**
Chancellor CC + Library	1,144,794.73	915,835.79	686,876.84	0.00	164.30	123.23	0.00
Dufferin Clark CC + Libra	2,014,669.53	1,611,735.63	1,208,801.72	0.00	289.15	216.86	0.00
North Thornhill CC + Libr	2,564,307.47	2,051,445.97	1,538,584.48	0.00	368.03	276.02	0.00
Vellore Village CC + Libra	4314748.639	3,451,798.91	2,588,849.18	0.00	619.25	464.44	0.00
Total	**10,038,520.37**	**8,030,816.30**	**6,023,112.22**	**0.00**	**1,440.73**	**1,080.55**	**0.00**

Analysis C.2.:

Total Energy Consumption across the four community centres was 16.2 million ekWh, with natural gas accounting for ~62% of total energy use.

Total GHG emissions in 2024 were 2,019.47 tCO_2e, with natural gas emissions making up 89% of that total.

Energy intensity exceeded the recommended 35 ekWh/ft^2 threshold in multiple facilities, driven primarily by high gas consumption.

Electricity & Natural Gas Use Intensity (EUI):

Highest Electricity EUI: *Vellore Village CC + Library* at 23.89 kWh/ft^2

Highest Natural Gas EUI: *Vellore Village CC + Library* at 49.23 kWh/ft^2

All centres exceed the natural gas intensity target of 17.5 kWh/ft^2, highlighting a key area for efficiency improvements.

GHG and Energy Reduction Potential by 2030:

Electricity savings potential: 4.93 million kWh, resulting in 174.85 tCO_2e avoided.

Natural gas savings potential: 8.03 million ekWh, resulting in 1,440.73 tCO_2e avoided.

Total GHG reduction potential from all sources by 2030: 1,615.58 tCO_2e

Reduction Targets:

Electricity Reduction Targets

Period	Reduction Target (kWh)	GHG Reduction (tCO_2e)
2030 (Near-Term)	4,925,284	174.85
2035 (Medium-Term)	3,693,963	131.14
2050 (Long-Term)	Not specified	0.00

Natural Gas Reduction Targets

Period	Reduction Target (ekWh)	GHG Reduction (tCO_2e)
2030 (Near-Term)	8,030,816	1,440.73
2035 (Medium-Term)	6,023,112	1,080.55
2050 (Long-Term)	Not specified	0.00

Key Observations & Recommendations:

Vellore Village CC + Library has the highest energy and GHG intensity across all centres and presents the largest opportunity for reductions.

Chancellor CC + Library is closer to target thresholds and has a more modest reduction outlook.

All centres would benefit from natural gas efficiency improvements, including:

HVAC upgrades

Pool heating optimization

Insulation or envelope improvements

C.3.A Targets and Energy Consumption by Source for Community Centres with a Pool and Arena.

Table C.3.A.a: 2024 energy consumption by energy source for Vaughan Community Centres with Pool and Arena

Community Centres (With Pool & Arena)	Building Area (ft^2)	Electricity Consumption (kWh)	Natural Gas Consumption (m^3)	Natural Gas Consumption (ekWh)	Total Energy (ekWh)	Electricity EUI (kWh/ft^2)	Natural Gas EUI ($ekWh/ft^2$)	Electricity GHG Emissions (tCO_2e)	Natural Gas GHG Emissions (tCO_2e)	Total GHG Emissions (tCO_2e)
Al-Palladini CC	143,685.00	2,491,248.27	300,262.00	3,191,124.48	5,682,372.75	17.34	22.21	88.44	572.49	660.93
Father Ermanno Bulfon C	124,015.00	1,085,530.60	133,176.00	1,415,367.89	2,500,898.49	8.75	11.41	38.54	253.92	292.45
Garnet A. Williams CC	126,884.15	1,795,357.92	216,396.00	2,299,813.41	4,095,171.33	14.15	18.13	63.74	412.59	476.32
Maple CC + Library	161,921.00	2,024,118.62	229,923.00	2,443,575.66	4,467,694.28	12.50	15.09	71.86	438.38	510.23
Woodbridge Pool & Arena	56,544.01	1,053,969.31	184,774.00	1,963,741.12	3,017,710.43	18.64	34.73	37.42	352.30	389.71
Total	**613,049.16**	**8,450,224.72**	**1,064,531.00**	**11,313,622.56**	**19,763,847.28**			**299.98**	**2,029.66**	**2,329.65**

Table C.3.A.b: 2029 energy source and GHG emission reduction potential

Community Centres (With Pool & Arena)	Electricity Potential Savings (kWh)	Electricity EUI Potential Savings (kWh/ft^2)	Potential GHG Reduction from Electricity Savings (tCO_2e)	Natural Gas Potential Savings (m^3)	Natural Gas Potential Savings (ekWh)	Natural Gas EUI Potential Savings ($ekWh/ft^2$)	Potential GHG Reduction from Natural Gas Savings (tCO_2e)	Total Energy Potential Savings (ekWh)	Total GHG Reduction from all Energy Sources (tCO_2e)
Al-Palladini CC	1,992,998.62	13.87	70.75	240,209.60	2,552,899.59	17.77	457.99	4,545,898.20	528.74
Father Ermanno Bulfon C	868,424.48	7.00	30.83	106,540.80	1,132,294.31	9.13	203.13	2,000,718.79	233.96
Garnet A. Williams CC	1,436,286.34	11.32	50.99	173,116.80	1,839,850.73	14.50	330.07	3,276,137.06	381.06
Maple CC + Library	1,619,294.90	10.00	57.48	183,938.40	1,954,860.53	12.07	350.70	3,574,155.42	408.19
Woodbridge Pool & Arena	843,175.45	14.91	29.93	147,819.20	1,570,992.89	27.78	281.84	2,414,168.34	311.77
Total	**6,760,179.77**		**239.99**	**851,624.80**	**9,050,898.05**		**1,623.73**	**15,811,077.82**	**1,863.72**

Table C.3.A.c: 2029 (Near-Term), 2035 (Medium-Term) and 2050 (Long-Term) Electricity Reduction Targets

Community Centres (With Pool & Arena)	2024: Electricity Consumption (kWh)	2029: Near-Term Electricity Reduction Target (kWh)	2035: Medium-Term Electricity Reduction Target (kWh)	2050: Long-Term Electricity Reduction Target (kWh)	2029: Near-Term Electricity GHG Emission Reduction Target (tCO_2e)	2035: Medium-Term Electricity GHG Emission	2050: Long-Term Electricity GHG Emission Reduction Target
Al-Palladini CC	2,491,248.27	1,992,998.62	1,494,748.96	0.00	70.75	53.06	0.00
Father Ermanno Bulfon C	1,085,530.60	868,424.48	651,318.36	0.00	30.83	23.12	0.00
Garnet A. Williams CC	1,795,357.92	1,436,286.34	1,077,214.75	0.00	50.99	38.24	0.00
Maple CC + Library	2024118.62	1,619,294.90	1,214,471.17	0.00	57.48	43.11	0.00
Woodbridge Pool & Arena	**1,053,969.31**	843,175.45	632,381.58	0.00	29.93	22.45	0.00
Total	**8,450,224.72**	**6,760,179.77**	**5,070,134.83**	**0.00**	**239.99**	**179.99**	**0.00**

Table C.3.A.d: 2029 (Near-Term), 2035 (Medium-Term) and 2050 (Long-Term) Natural Gas Reduction Targets

Community Centres (With Pool & Arena)	2024: Natural Gas Consumption (ekWh)	2029: Near-Term Natural Gas Reduction Target (ekWh)	2035: Medium-Term Natural Gas Reduction Target (ekWh)	2050: Long-Term Natural Gas Reduction Target (ekWh)	2029: Near-Term Natural Gas GHG Emission Reduction Target (tCO_2e)	2035: Medium-Term Natural Gas GHG Emission Reduction Target (tCO_2e)	2050: Long-Term Natural Gas GHG Emission Reduction Target (tCO_2e)
Al-Palladini CC	3,191,124.48	2,552,899.59	1,914,674.69	0.00	366.39	274.79	0.00
Father Ermanno Bulfon C	1,415,367.89	1,132,294.31	849,220.74	0.00	162.51	121.88	0.00
Garnet A. Williams CC	2,299,813.41	1,839,850.73	1,379,888.05	0.00	264.06	198.04	0.00
Maple CC + Library	2,443,575.66	1,954,860.53	1,466,145.40	0.00	280.56	210.42	0.00
Woodbridge Pool & Arena	1,963,741.12	1,570,992.89	1,178,244.67	0.00	225.47	169.10	0.00
Total	**11,313,623**	**9,050,898**	**6,788,174**	**0.00**	**1,299**	**974.24**	**0.00**

Analysis C.3.:

2024 Energy Use Summary

Total Energy Consumption across five facilities: 19.76 million ekWh
Natural Gas Contribution: 57% of total energy use
Total GHG Emissions: 2,329.65 tCO_2e
Natural Gas Emissions: 2,029.66 tCO_2e (87% of total)
Electricity Emissions: 299.98 tCO_2e
Energy Intensity Observations
All centres exceed the benchmark of 35 ekWh/ft^2, largely due to natural gas use.
Highest Electricity EUI: *Woodbridge Pool & Arena* – 18.64 kWh/ft^2
Highest Natural Gas EUI: *Woodbridge Pool & Arena* – 34.73 kWh/ft^2
Every facility exceeds the natural gas EUI target of 17.5 kWh/ft^2, indicating clear opportunities for energy efficiency upgrades.

2030 GHG and Energy Reduction Potential

Electricity Savings Potential: 6.76 million kWh
GHG Avoided: 239.99 tCO_2e
Natural Gas Savings Potential: 9.05 million ekWh
GHG Avoided: 1,623.73 tCO_2e
Total GHG Reduction Potential (All Sources): 1,863.72 tCO_2e

Reduction Targets

Electricity Reduction Targets

Period	Reduction Target (kWh)	GHG Reduction (tCO_2e)
2030	6,760,180	239.99
2035	5,070,135	179.99
2050	Not specified	0.00

Natural Gas Reduction Targets

Period	Reduction Target (ekWh)	GHG Reduction (tCO_2e)
2030	9,050,898	1,299.00
2035	6,788,174	974.24
2050	Not specified	0.00

Key Observations & Recommendations

Al Palladini CC has the highest GHG emissions (660.93 tCO_2e) and the largest single-site reduction potential (528.74 tCO_2e).
Maple CC + Library and Garnet A. Williams CC also represent major opportunities for energy and GHG reductions.
Woodbridge Pool & Arena, with the highest energy intensity, requires urgent attention for mechanical and thermal system improvements.
Recommendations for all centres:
Prioritize natural gas efficiency:
Replace aging HVAC systems
Improve pool heating technologies
Upgrade building envelope insulation
Consider controls and automation to optimize operation schedules.

The following additional assumptions inform the savings targets:

Father Ermanno Bulfon Community Centre:
• 15% natural gas savings by 2024 from scheduled capital upgrades to heating units
• 10% electricity savings from the replacement of two main cooling units.

Maple Community Centre + Library:
• 10% natural gas savings and 10% electricity savings from scheduled replacement of a cooling tower and a portion of 37 heat pumps

Al Palladini Community Centre:
• 10% electricity savings from a planned refrigeration plant replacement

Garnet A. Williams Community Centre:

- 10% natural gas savings expected from boiler upgrades planned for completion by 2025
- 8% electricity savings from energy-efficient lighting and ventilation system retrofits.

Woodbridge Pool & Arena:

- 10% natural gas savings projected from improvements to pool water heating systems
- 10% electricity savings from installation of variable frequency drives (VFDs) and improved building automation.

References

Toronto and Region conservation Authority and Enerlife Consulting; Town Hall Challenge 20 by '15: Achieving the Energy Target 20 ekWh/ sq.ft./ year by 2015 in Town and City Halls REALPAC/Enerlife Consulting White Paper

Toronto and Region conservation Authority and Enerlife Consulting 2016: Using best Practice Targets to Achieve the Energy Conservation Potential in Community Centres. Methodology white paper, Mayor Megawatt Challenge – Toronto Ontario.

Acronyms and Definitions

BAS: Building Automation System

CEMP: Corporate Energy Management Plan

ECM: Energy Conservation Measure

EUI: Energy Use Intensity

EV: Electric Vehicle

ekWh: Equivalent Kilowatt-hour – a unit of energy that standardizes different energy sources (e.g., gas, steam, electricity) into a common measurement of kilowatt-hours.

GHG: Greenhouse Gas

HVAC: Heating, Ventilation, and Air Conditioning

IESO: Independent Electricity System Operator

kWh/ft^2: Kilowatt-hour per Square Foot – a measure of energy consumption.

MMC: Mayor's Megawatt Challenge – a collaborative program

SDG: Sustainable Development Goals

tCO_2e: Tonne of Carbon Dioxide Equivalent

WCCD: World Council on City Data.

ZEVIP: Zero Emission Vehicle Infrastructure Program

Appendix D – RETScreen Report (All Assets)

See Attachment

Energy Portfolio

Facility Management Operations



Performance Analysis

Prepared for:

Dave Merriman, Director
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Prepared by:

Lamya Baraam, Energy Project Manager
Facility Management Operations

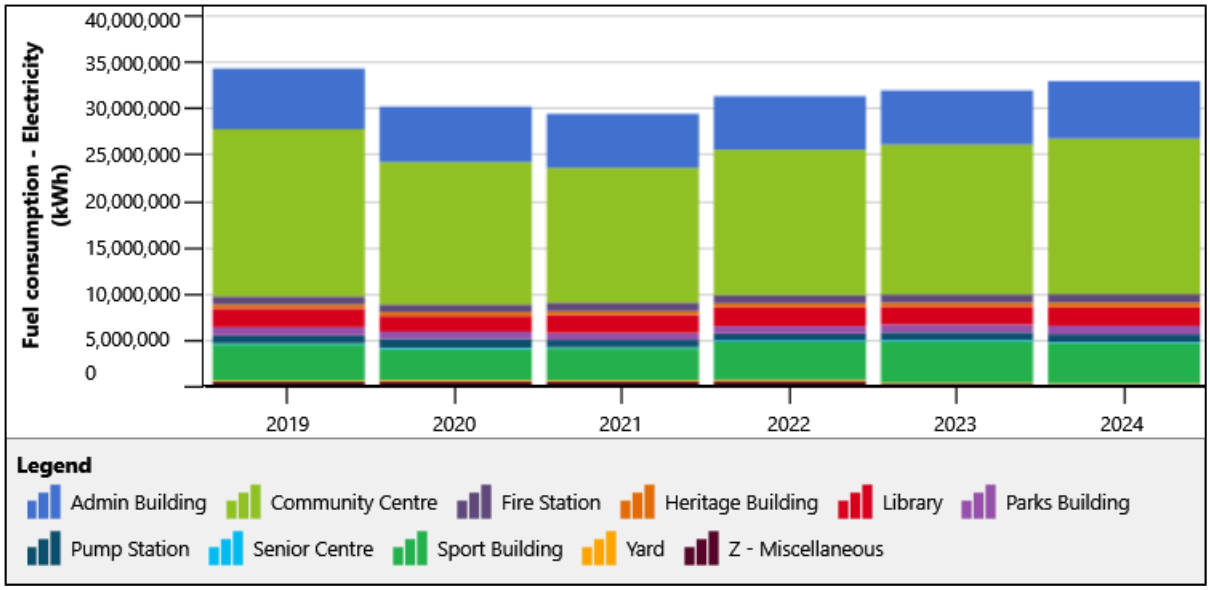
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Executive Summary

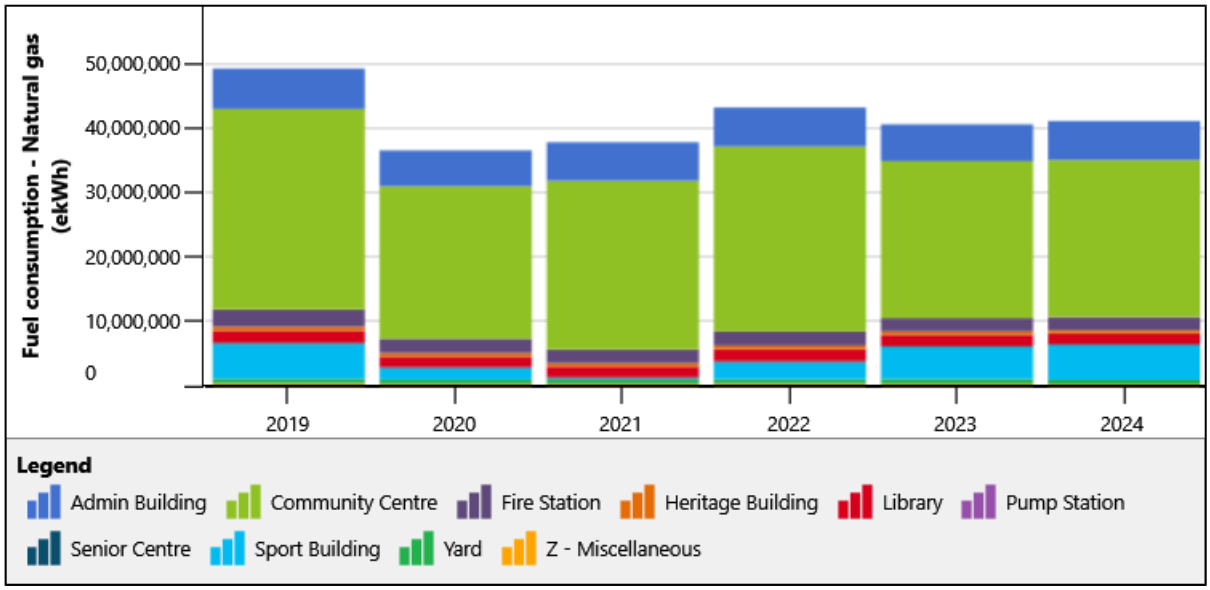
This report was prepared using the RETScreen Clean Energy Management Software. The key findings and recommendations of this analysis are presented below:

Automated Energy Portfolio - Fuel Consumption - Electricity



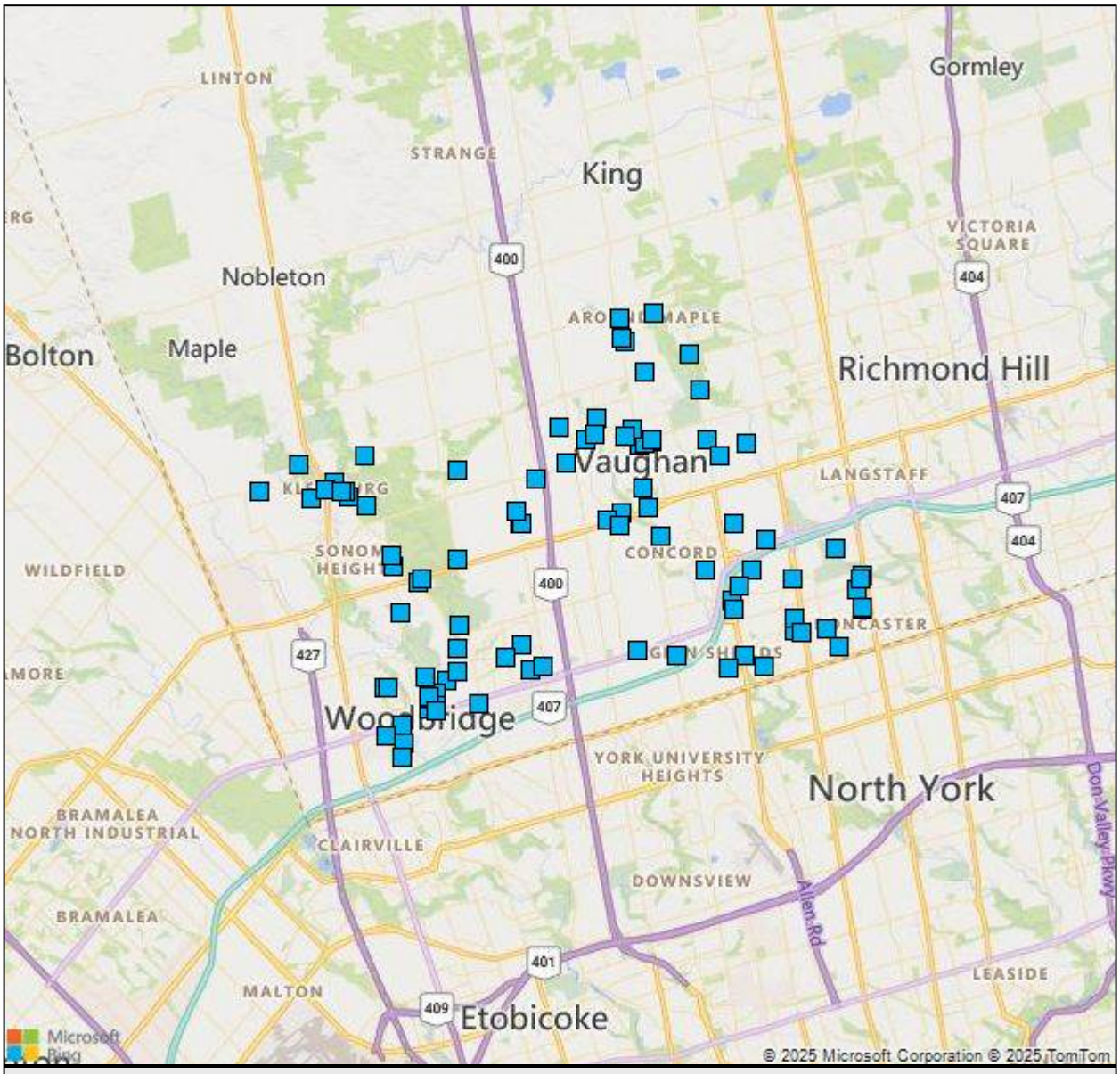
The main results are as follows:

Automated Energy Portfolio - Fuel Consumption - Natural Gas



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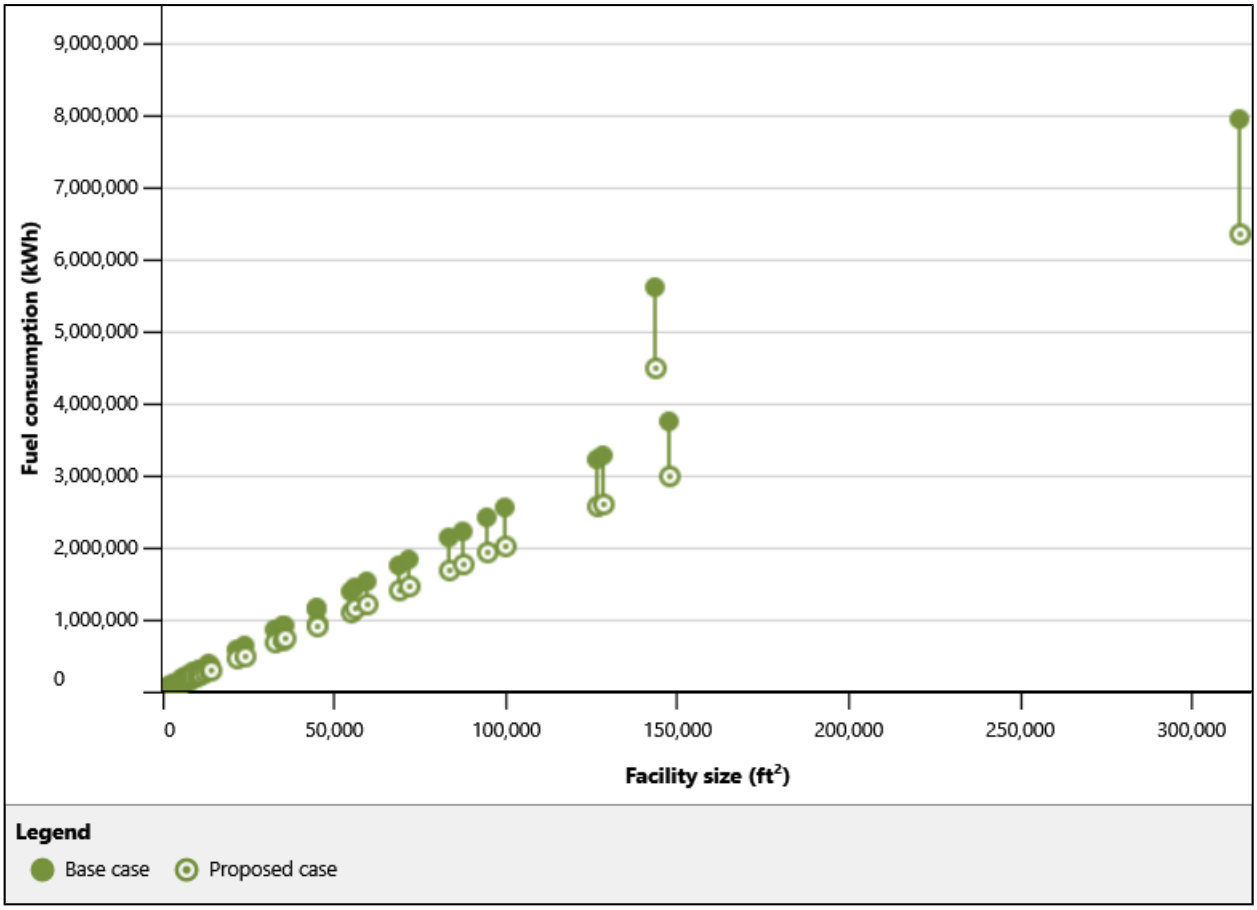
Map



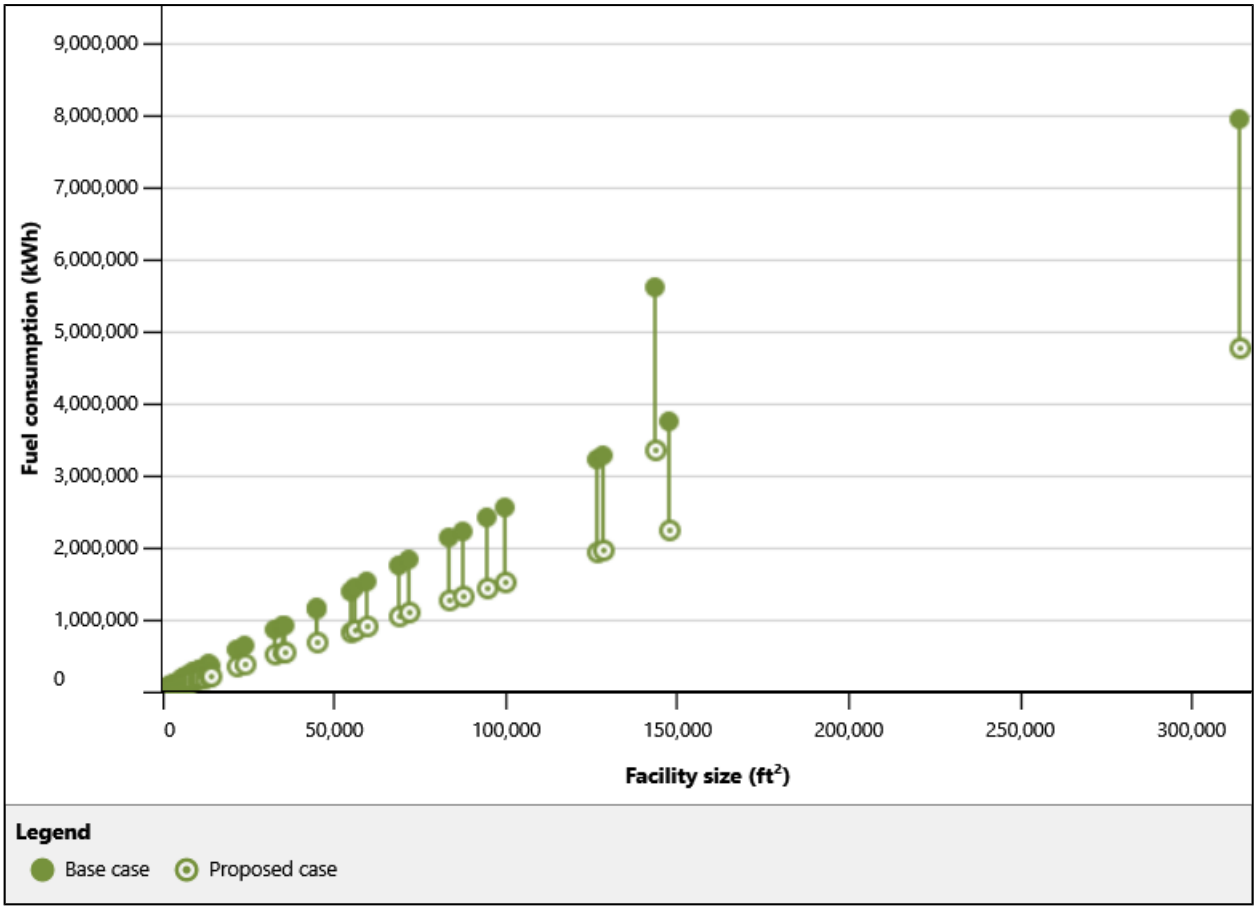
Facility Type

- Power plant
- Power | Heating | Cooling
- Power | Storage | Off-grid
- Industrial
- Commercial/Institutional
- Residential
- Meter
- Agricultural
- Military
- Individual measure
- Other
- Transportation
- User-defined

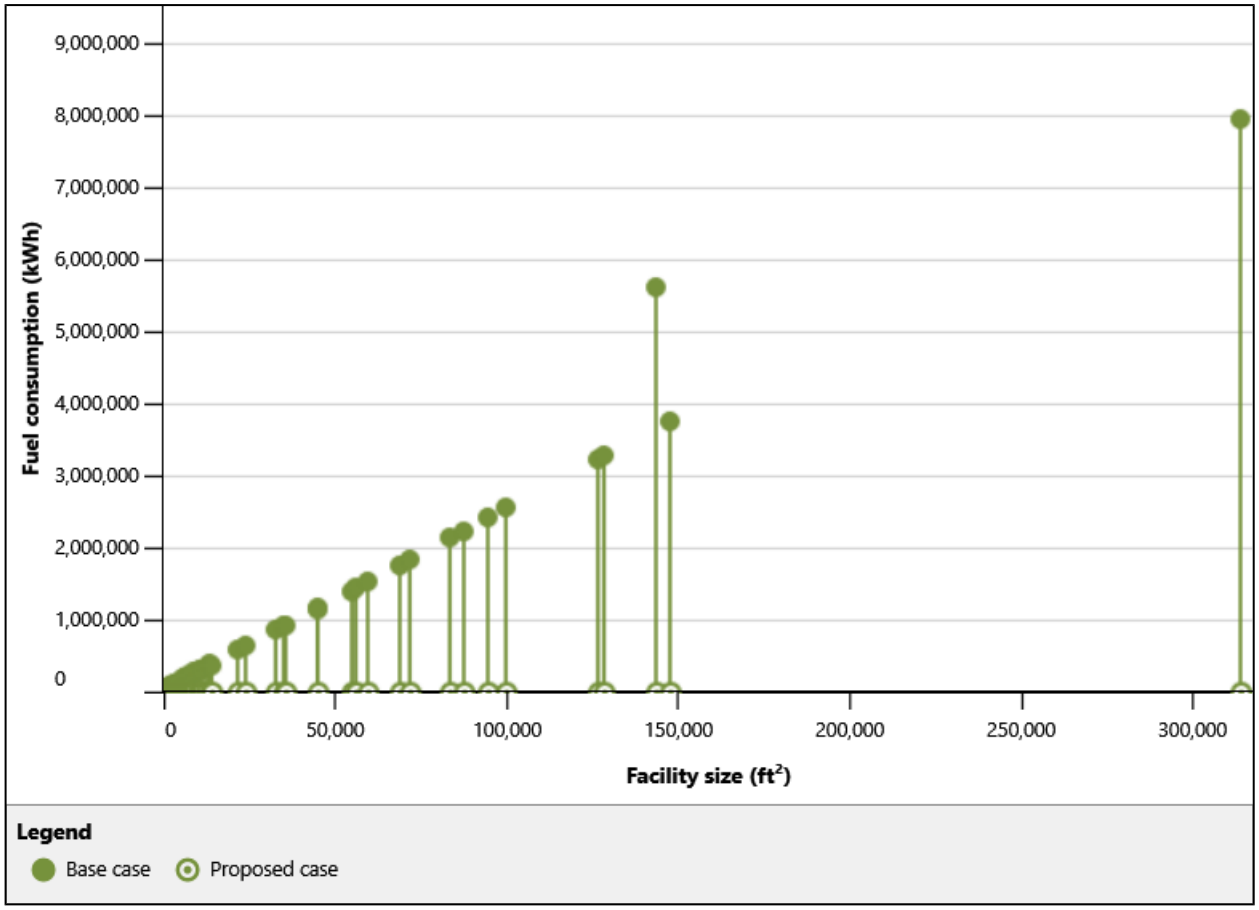
Benchmark - Automated Energy Portfolio - Target 1 - 20%



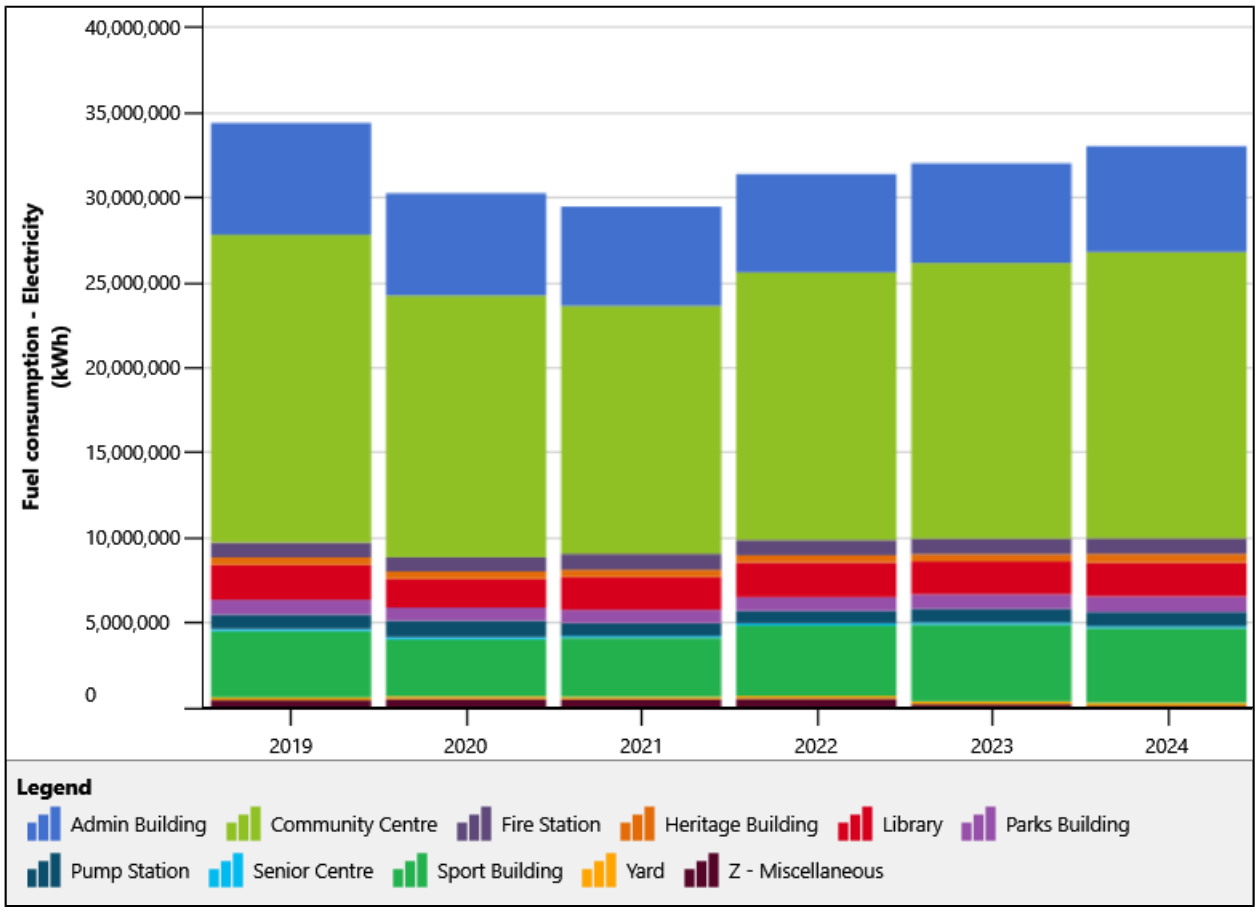
Benchmark - Automated Energy Portfolio - Target 2 - 40%



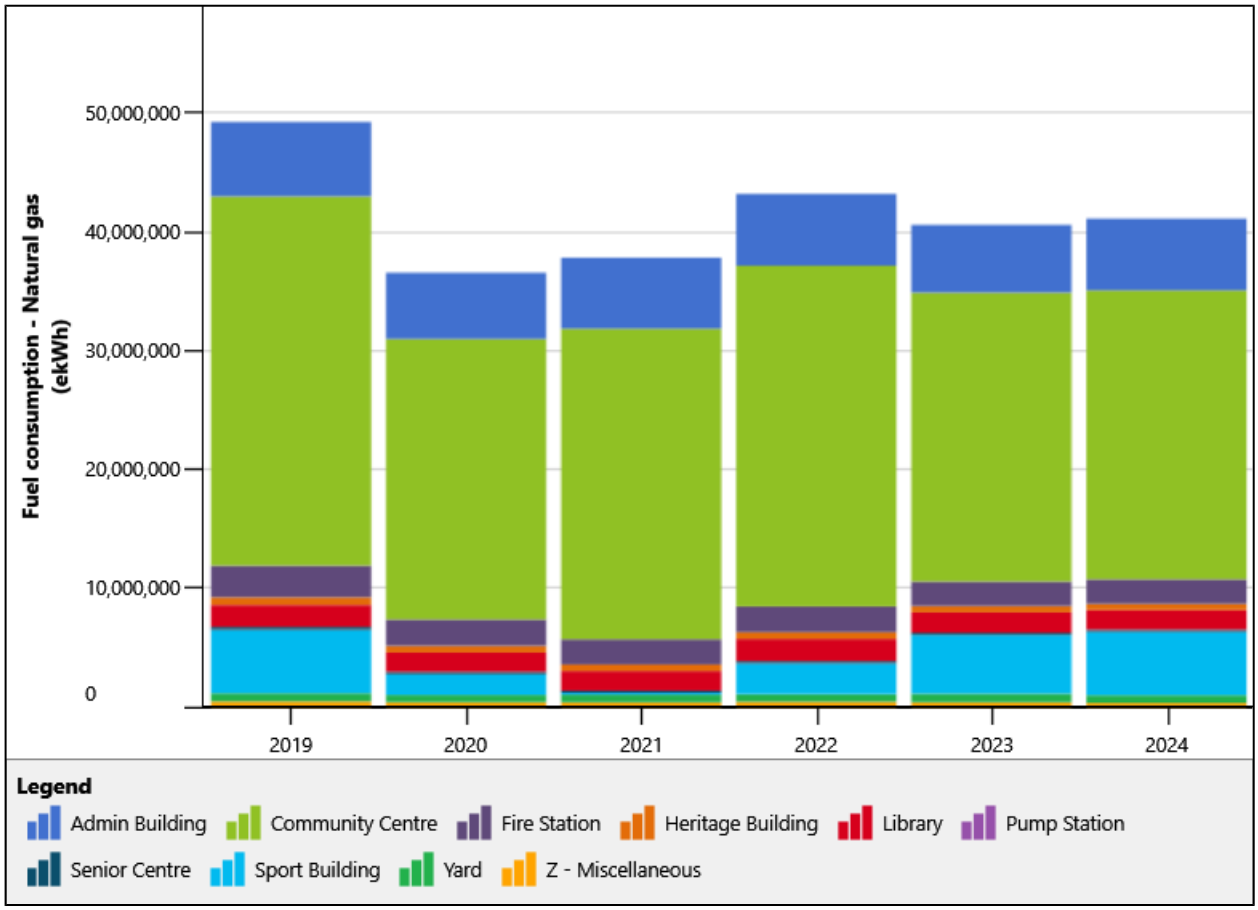
Benchmark - Automated Energy Portfolio - Target 3 - 100%



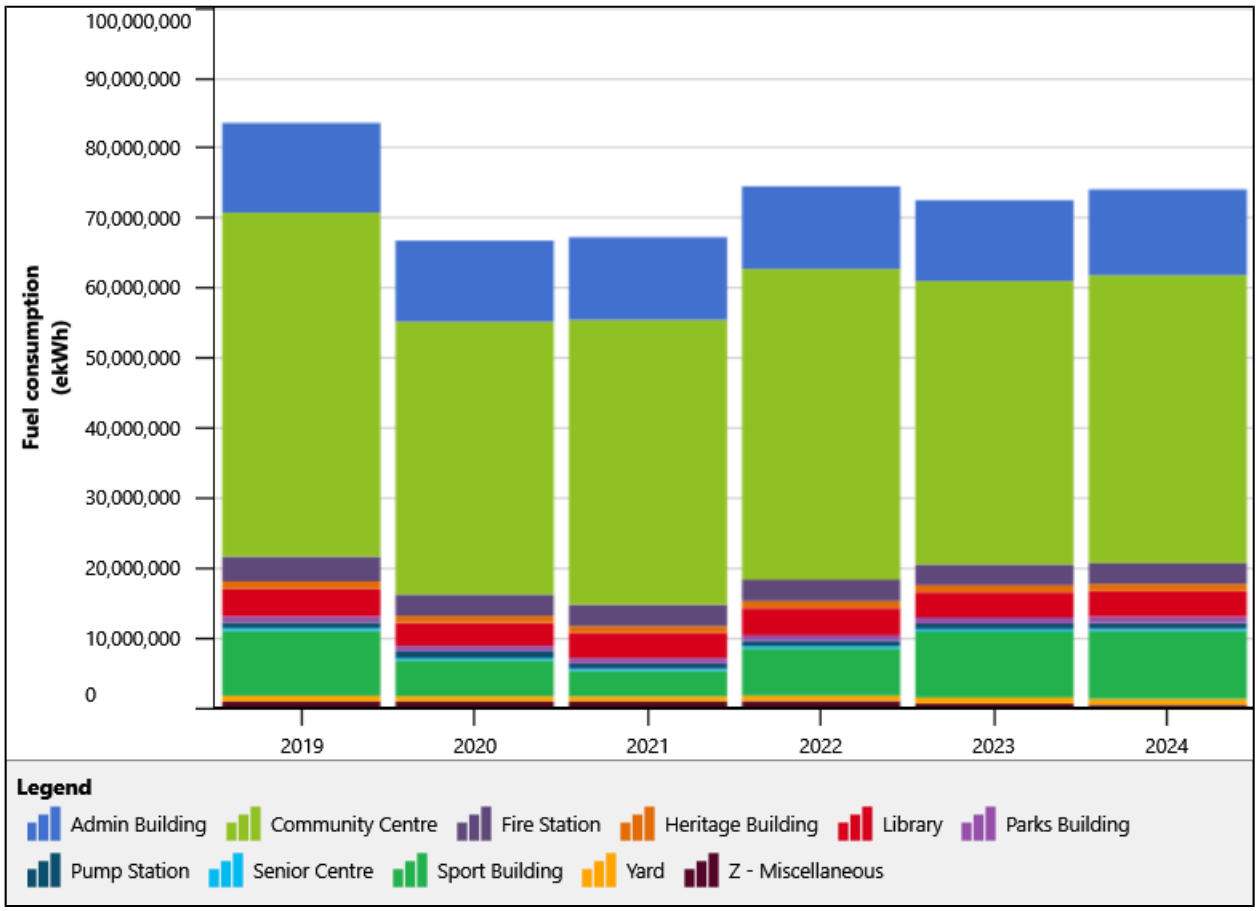
Performance - Automated Energy Portfolio - Fuel Consumption - Electricity



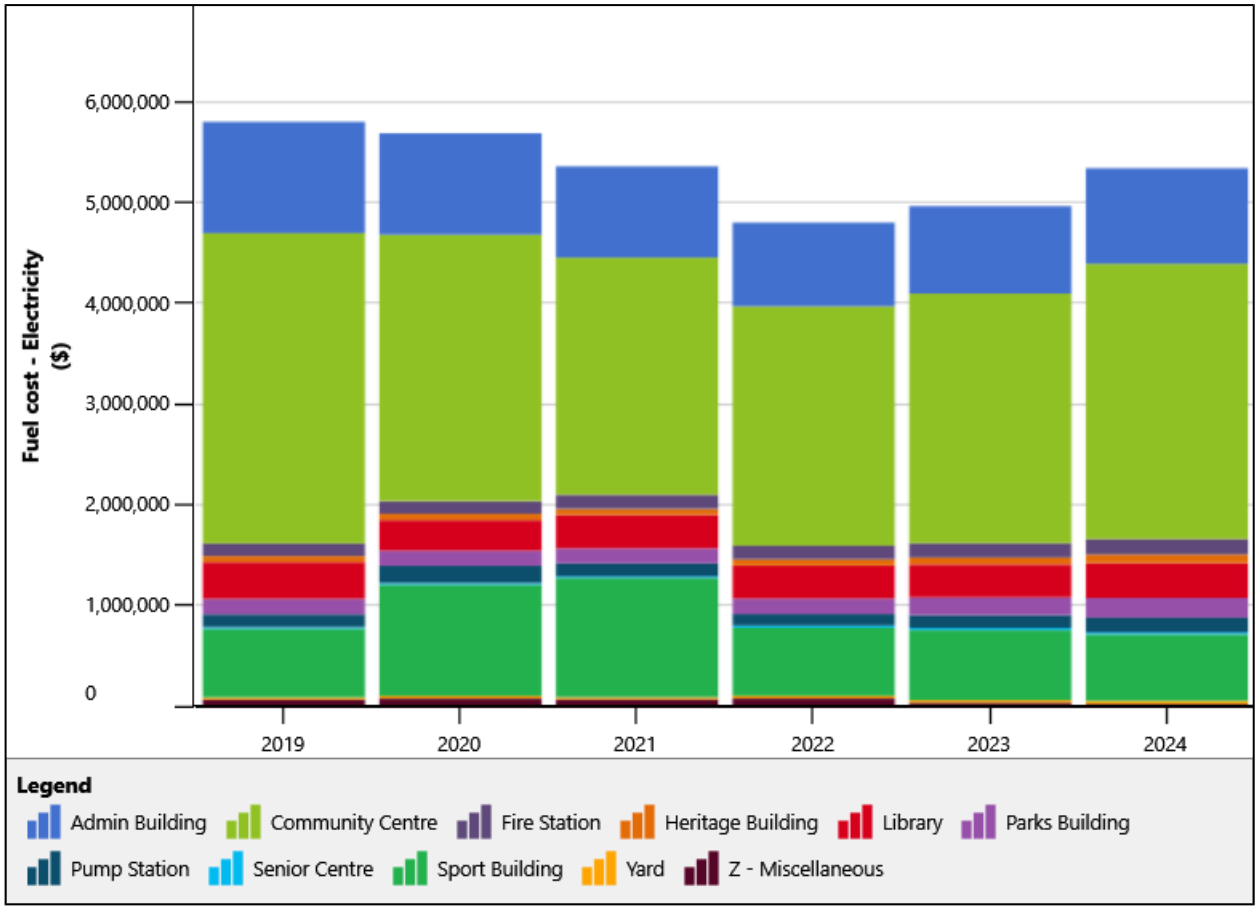
Performance - Automated Energy Portfolio - Fuel Consumption - Natural Gas



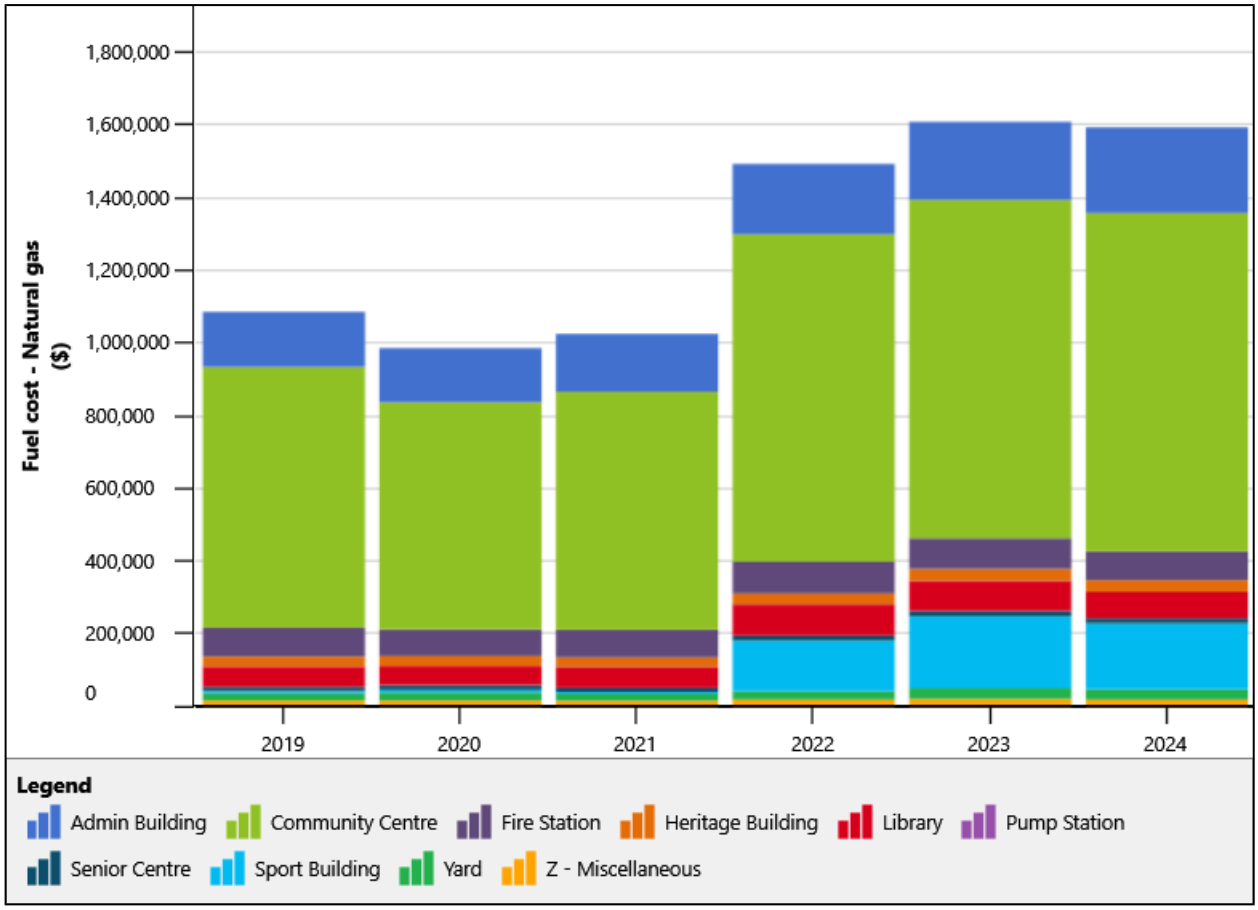
Performance - Automated Energy Portfolio - Fuel Consumption - Electricity, Natural Gas



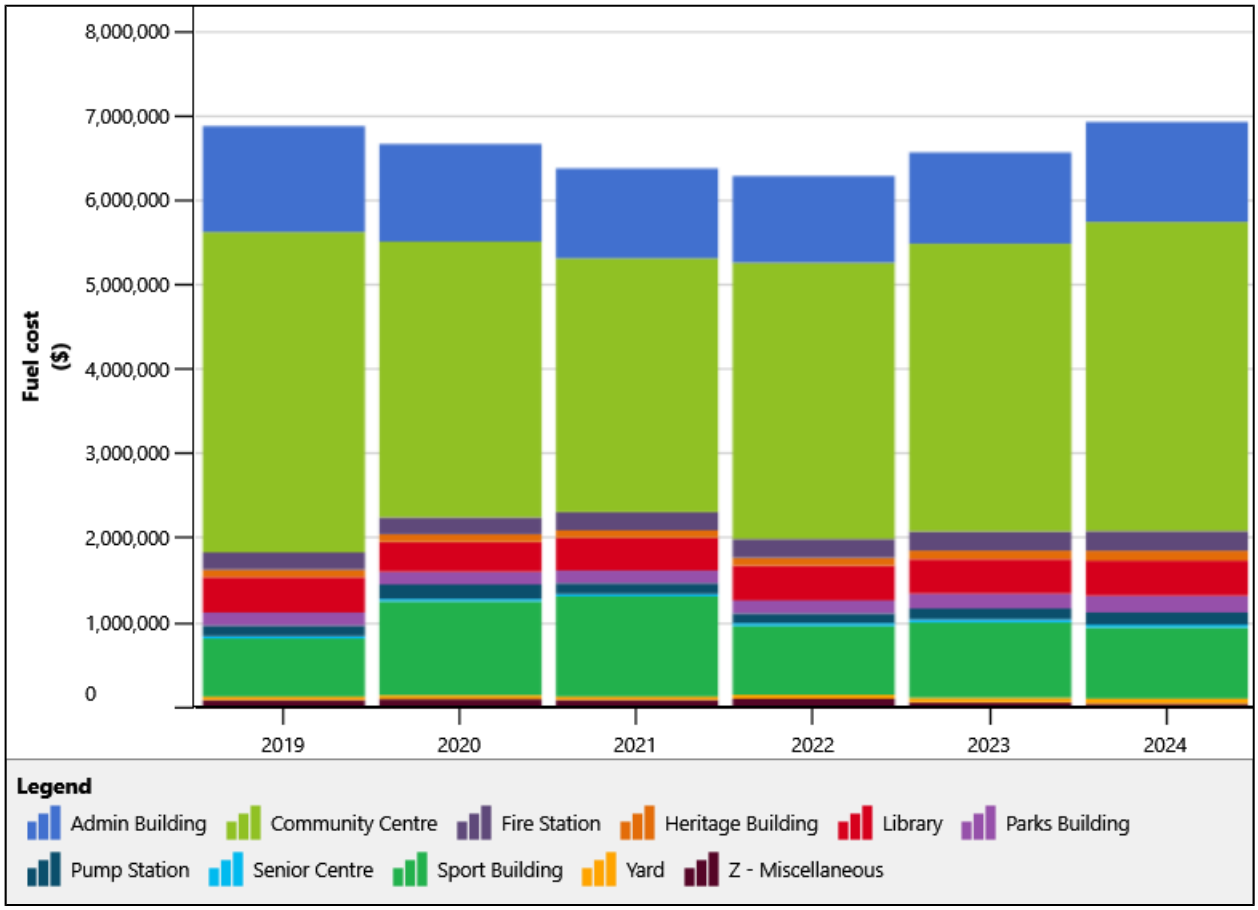
Performance - Automated Energy Portfolio - Fuel Cost - Electricity



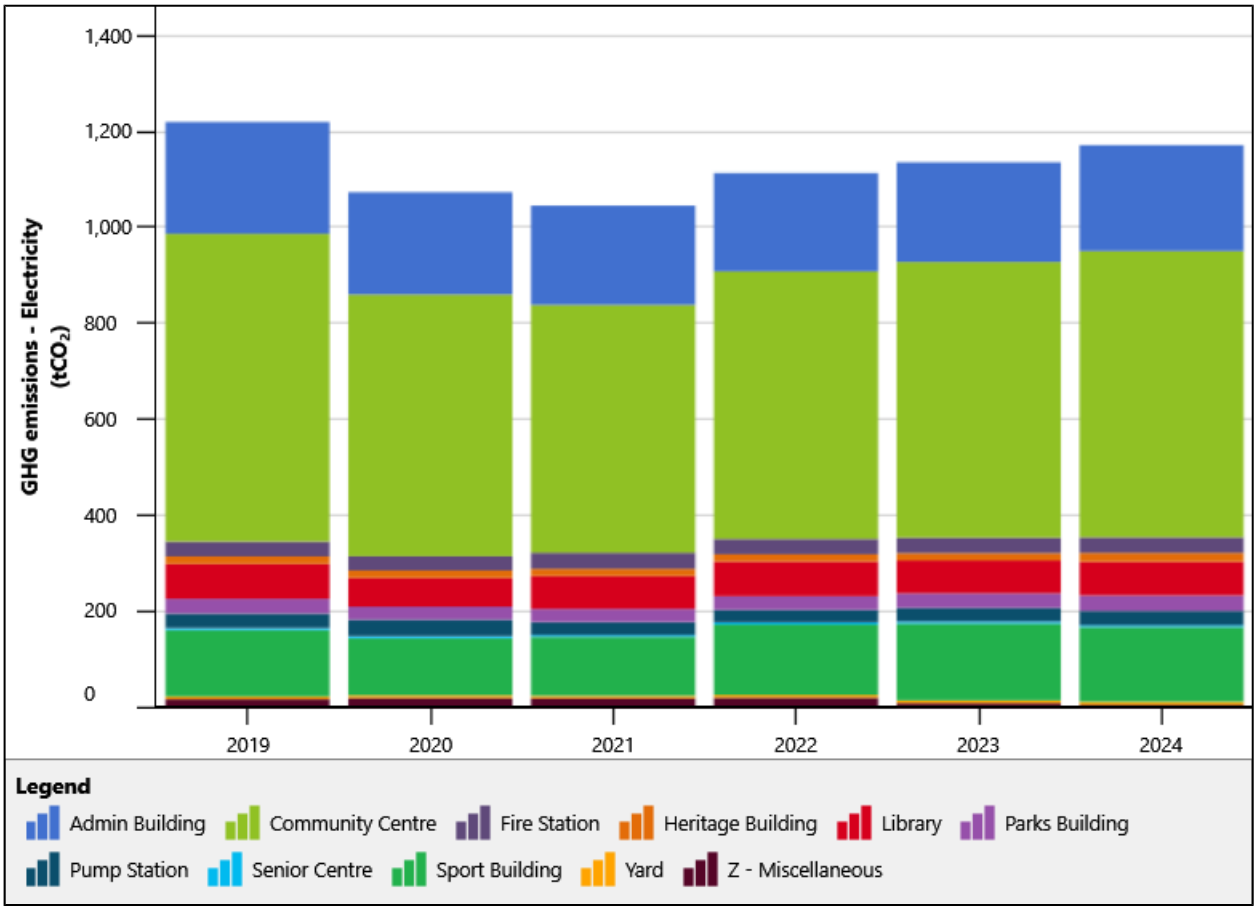
Performance - Automated Energy Portfolio - Fuel Cost - Natural Gas



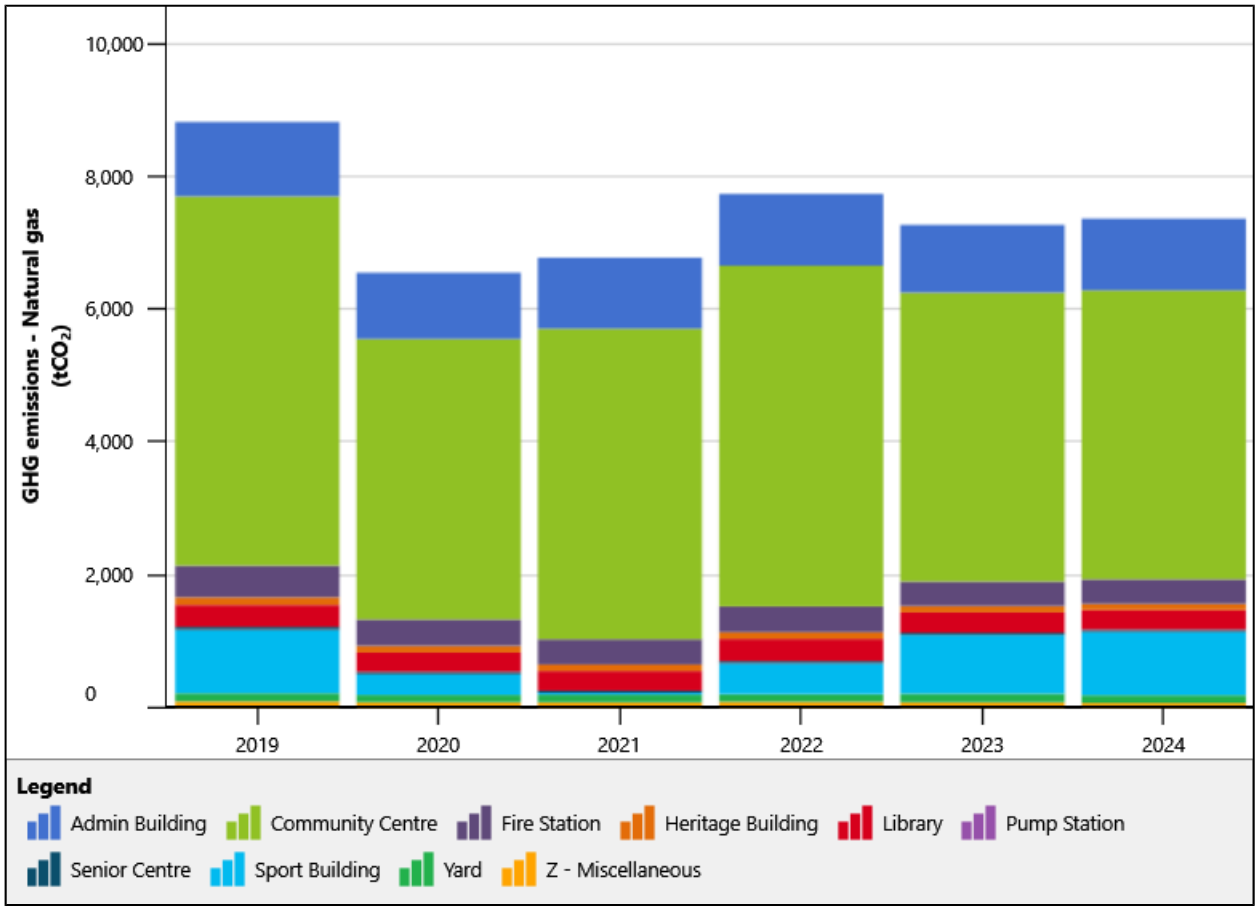
Performance - Automated Energy Portfolio - Fuel Cost - Electricity, Natural Gas



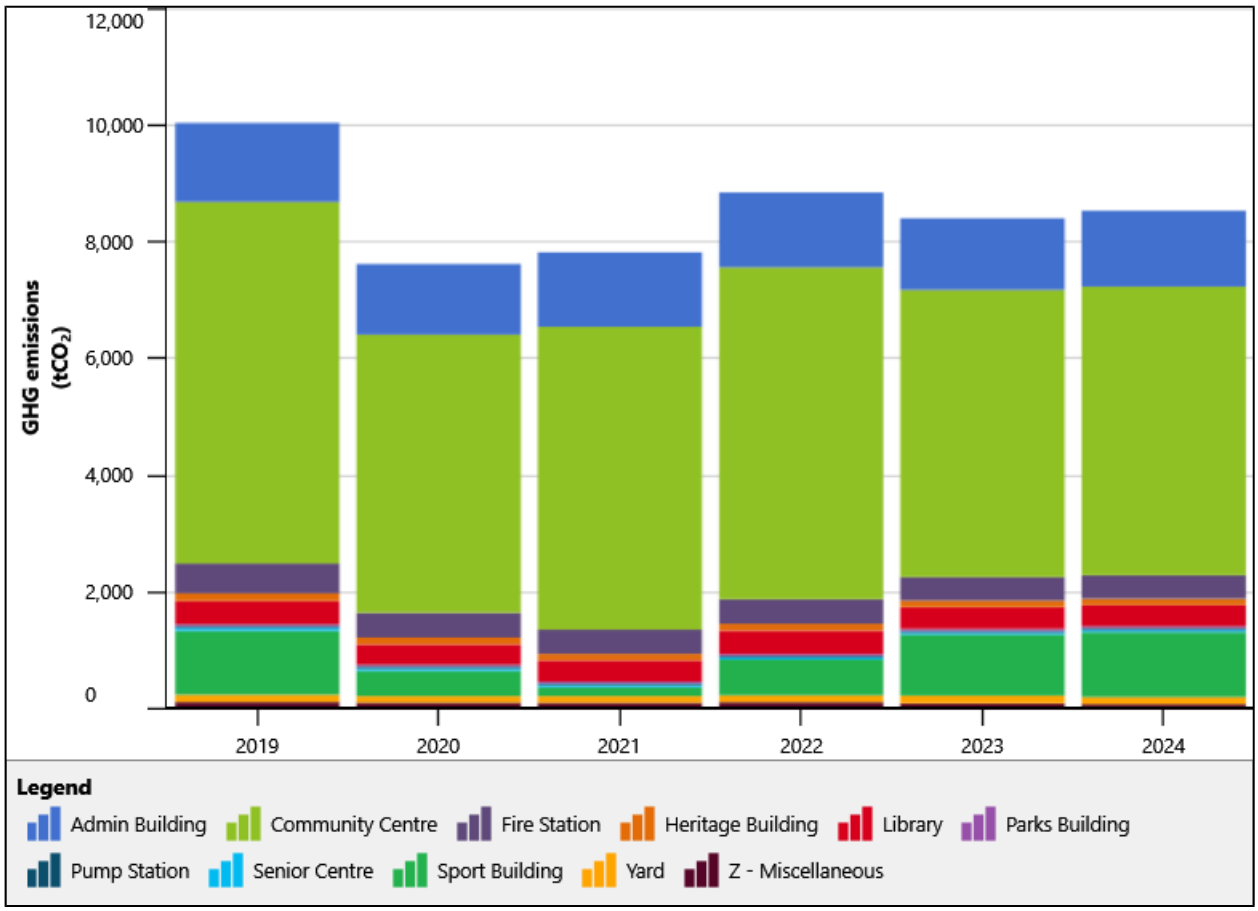
Performance - Automated Energy Portfolio - GHG Emissions - Electricity



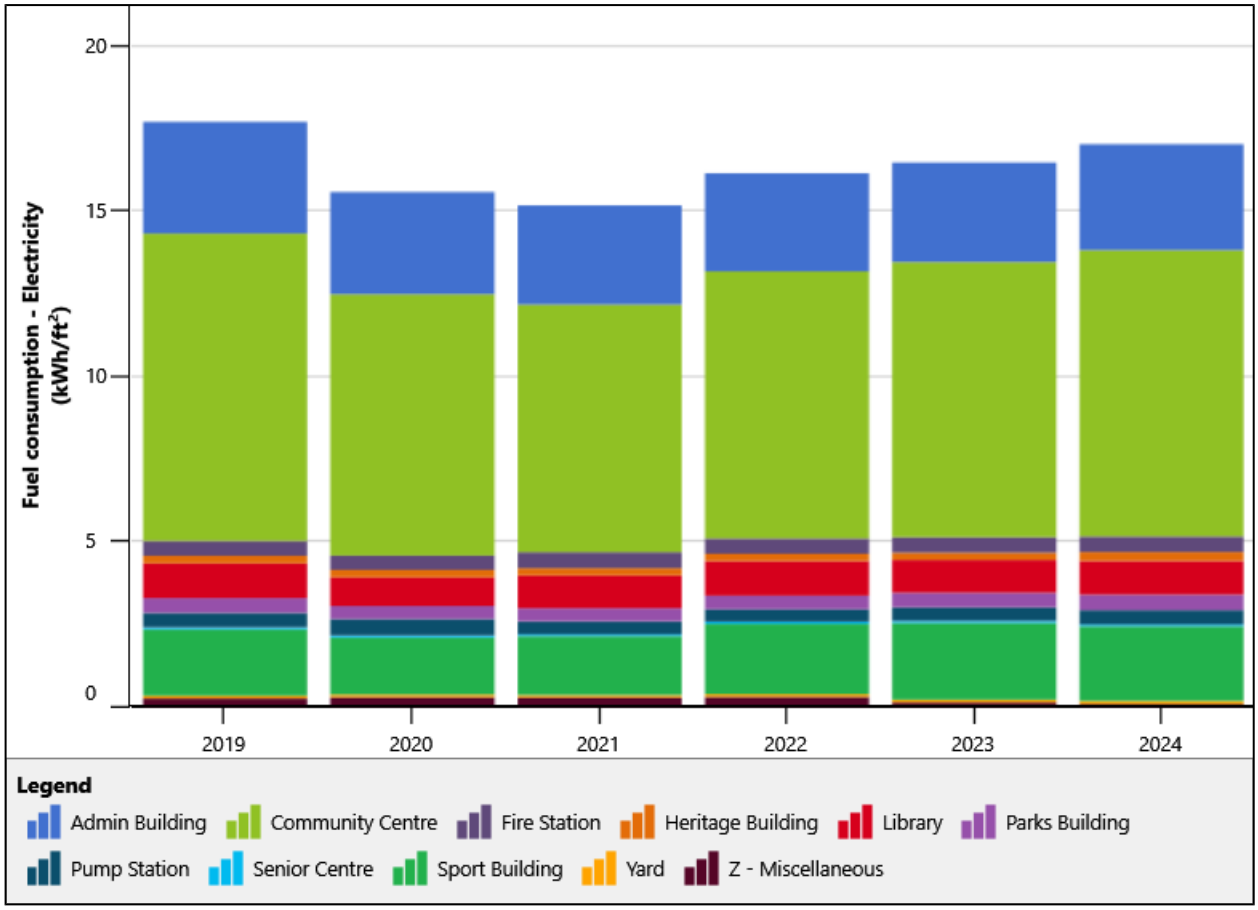
Performance - Automated Energy Portfolio - GHG emissions - Natural Gas



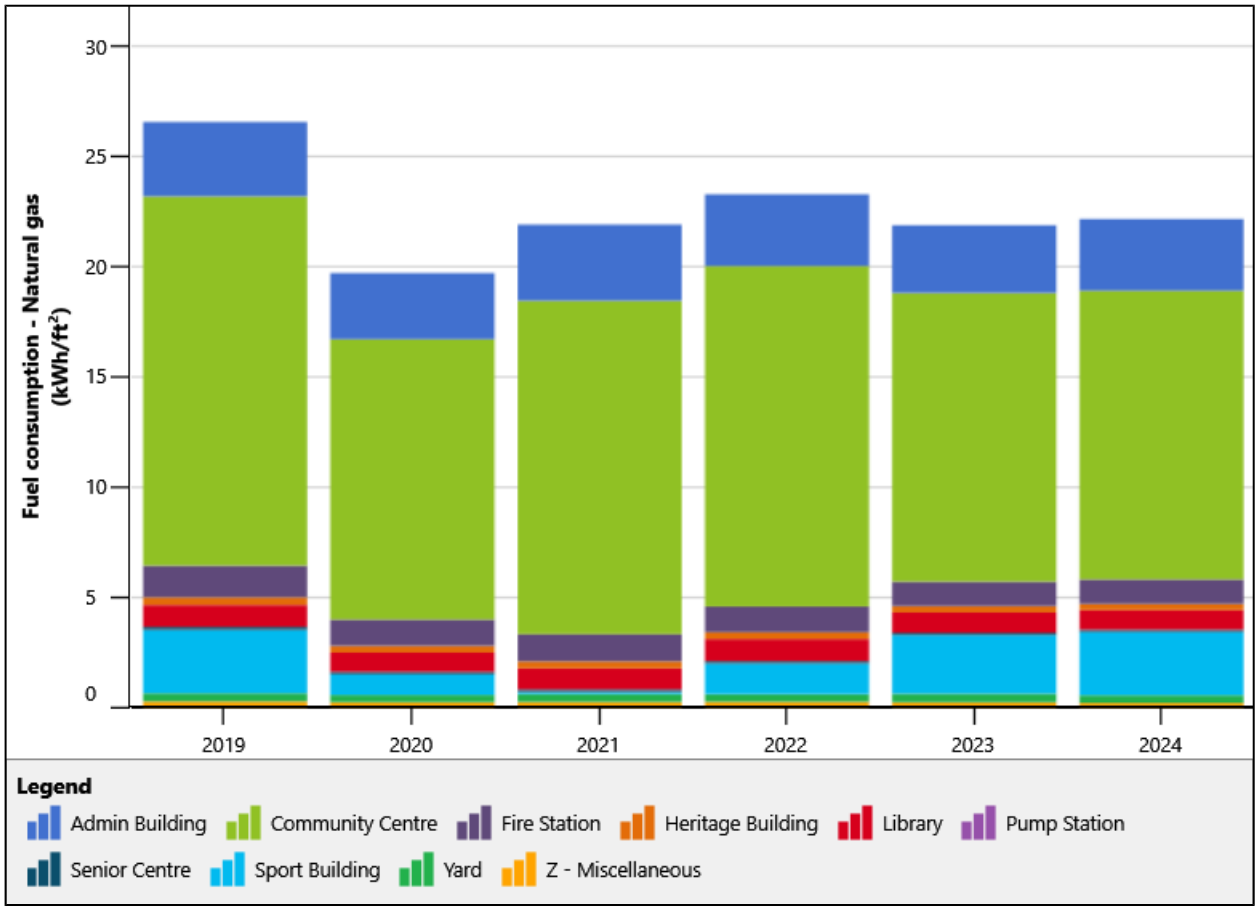
Performance - Automated Energy Portfolio - GHG emissions - Electricity, Natural Gas



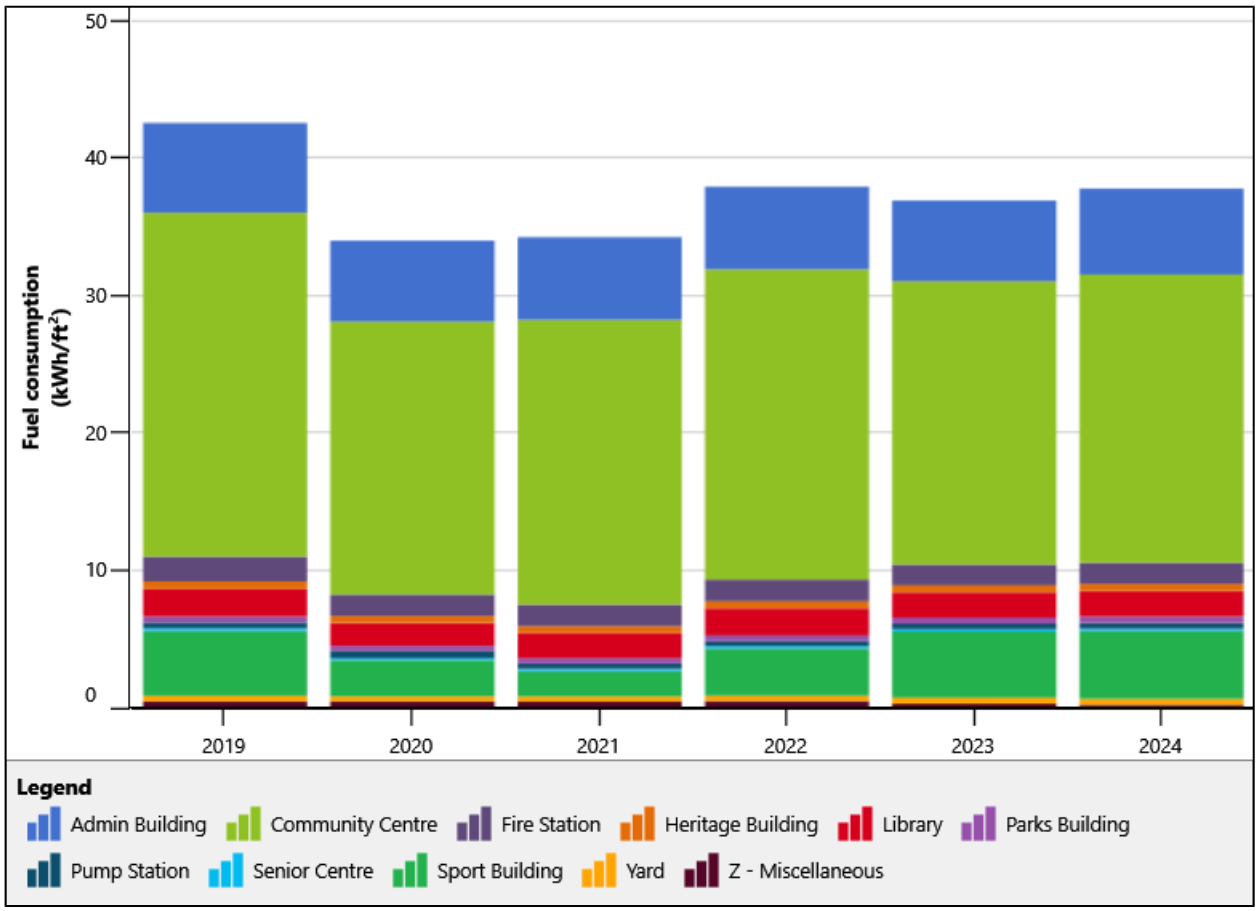
Performance - Automated Energy Portfolio - EUI (kWh/ft²) - Electricity



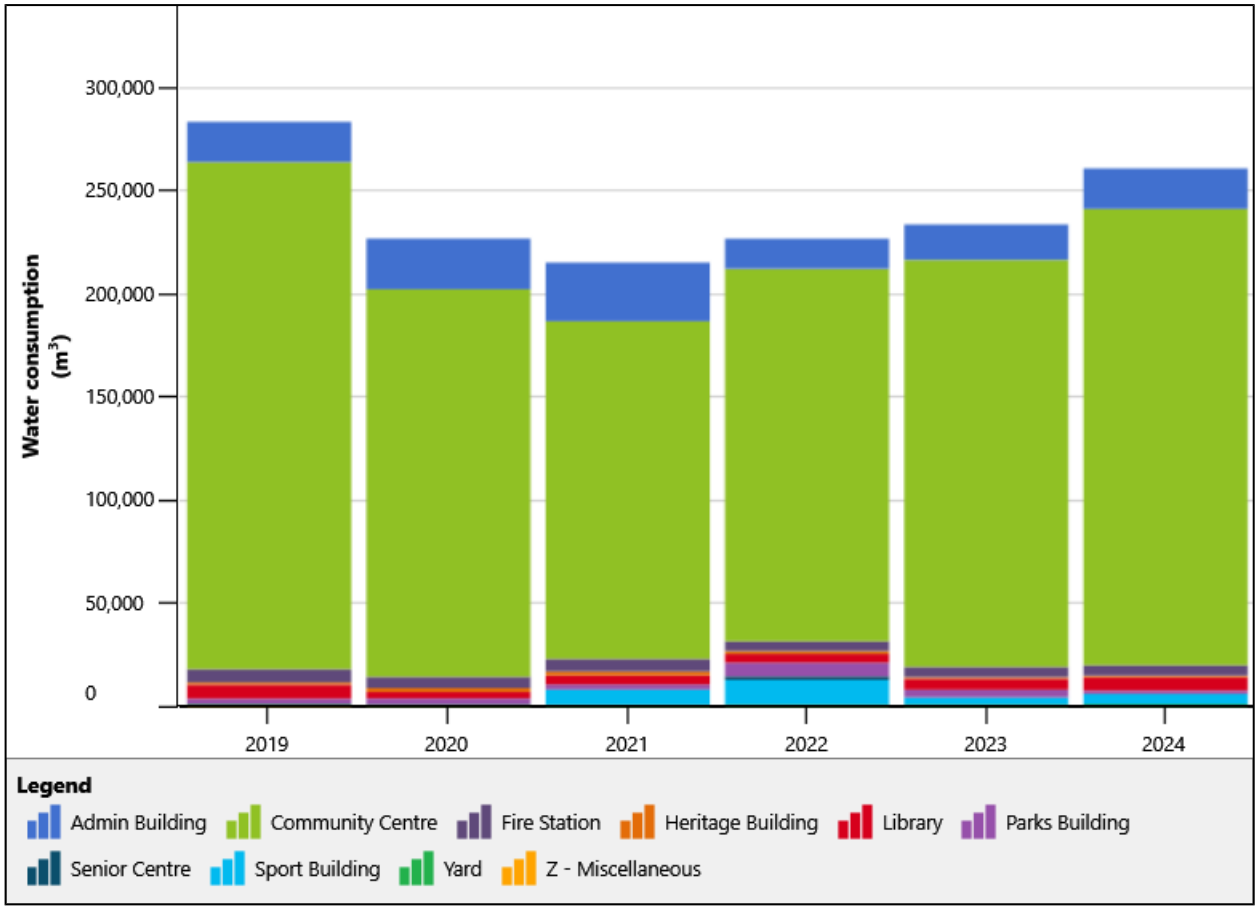
Performance - Automated Energy Portfolio - EUI (kWh/ft²) - Natural Gas



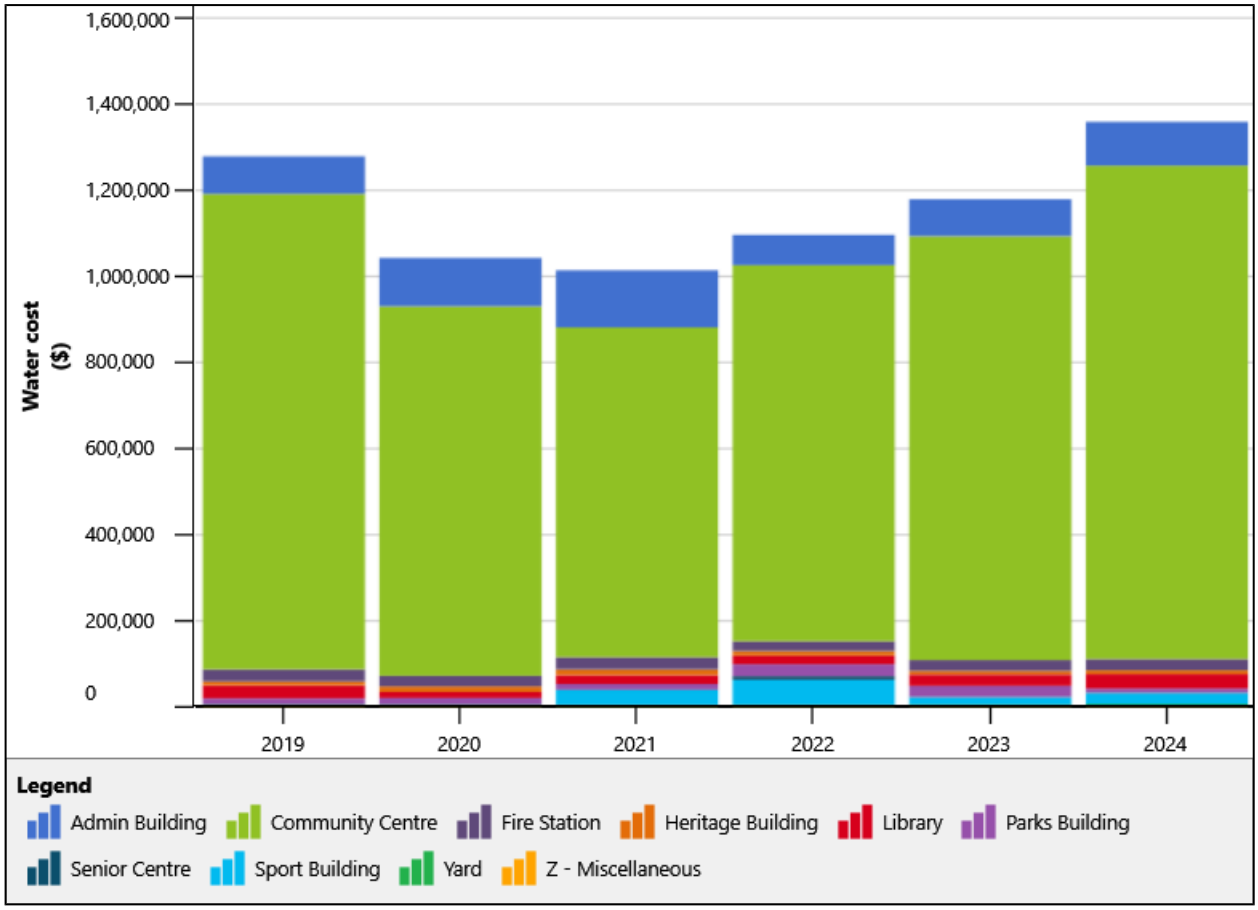
Performance - Automated Energy Portfolio - EUI (kWh/ft²) - Electricity, Natural Gas



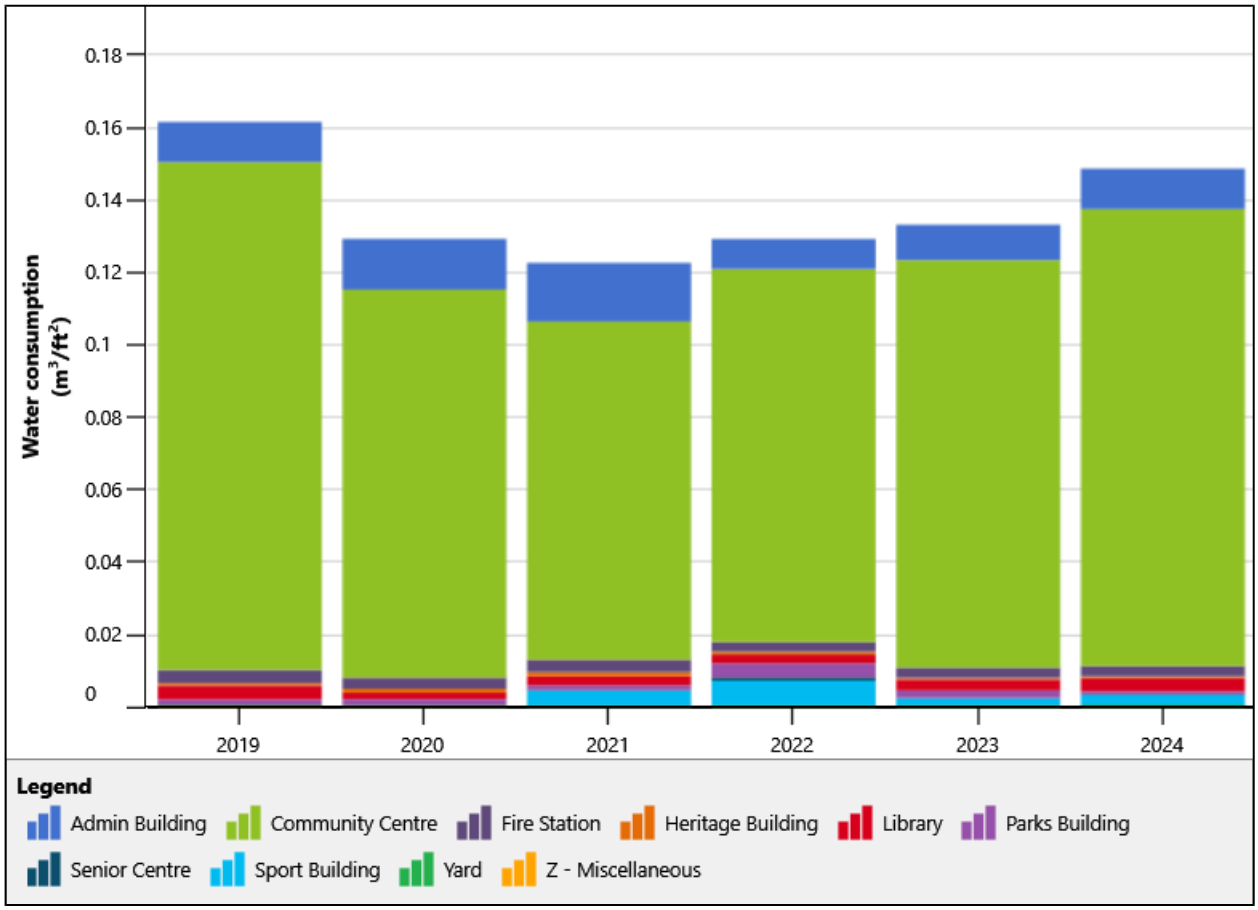
Performance - Automated Energy Portfolio - Water Consumption



Performance - Automated Energy Portfolio - Water Cost



Performance - Automated Energy Portfolio - Water Use Intensity (m3/ft²)



Analysis Type

Portfolio



Subscriber: City of Vaughan - Professional

Fleet

Facility Management Operations



Performance Analysis

Prepared for:

Dave Merriman, Director
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Prepared by:

Lamya Baraam, Energy Project Manager
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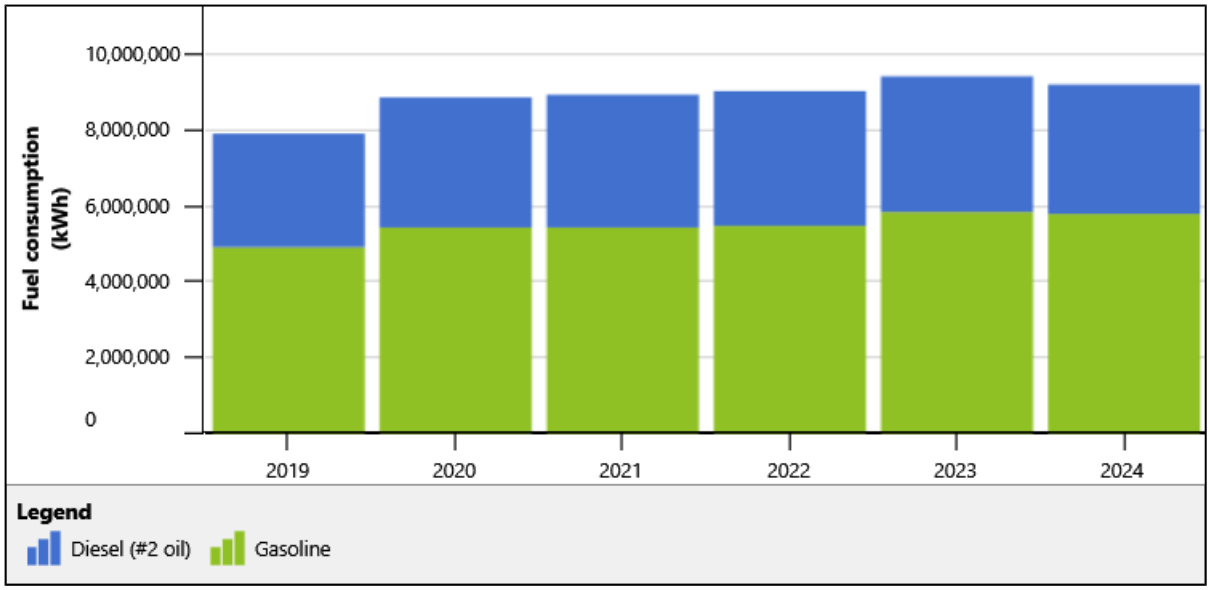
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Executive Summary

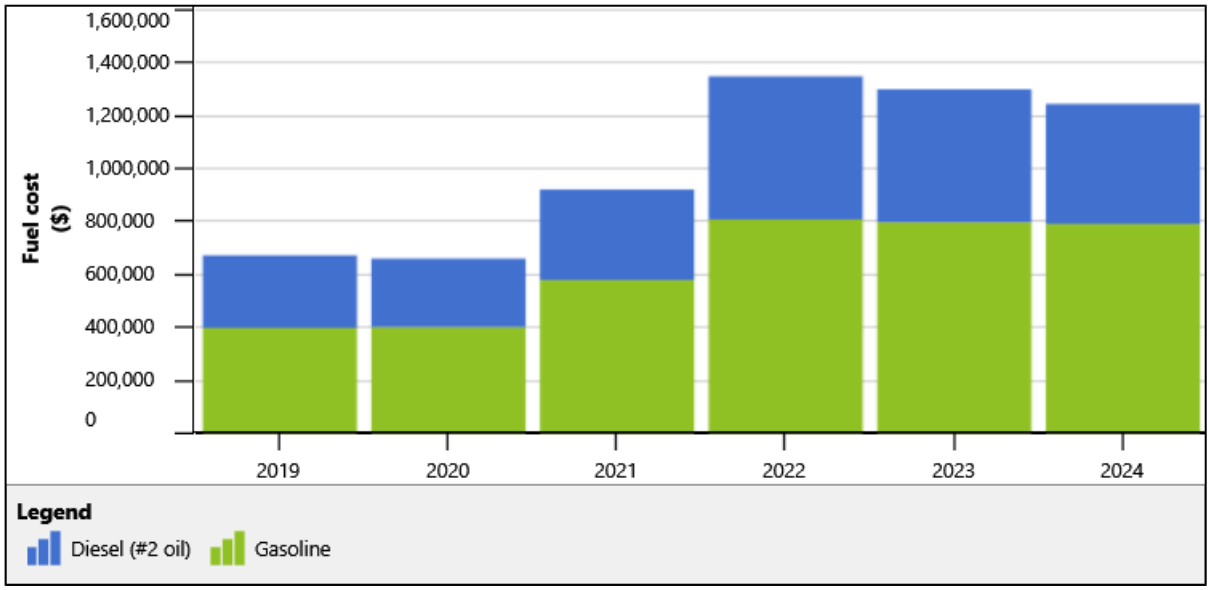
This report was prepared using the RETScreen Clean Energy Management Software. The key findings and recommendations of this analysis are presented below:

Fleet - Fuel Consumption - Diesel, Gasoline



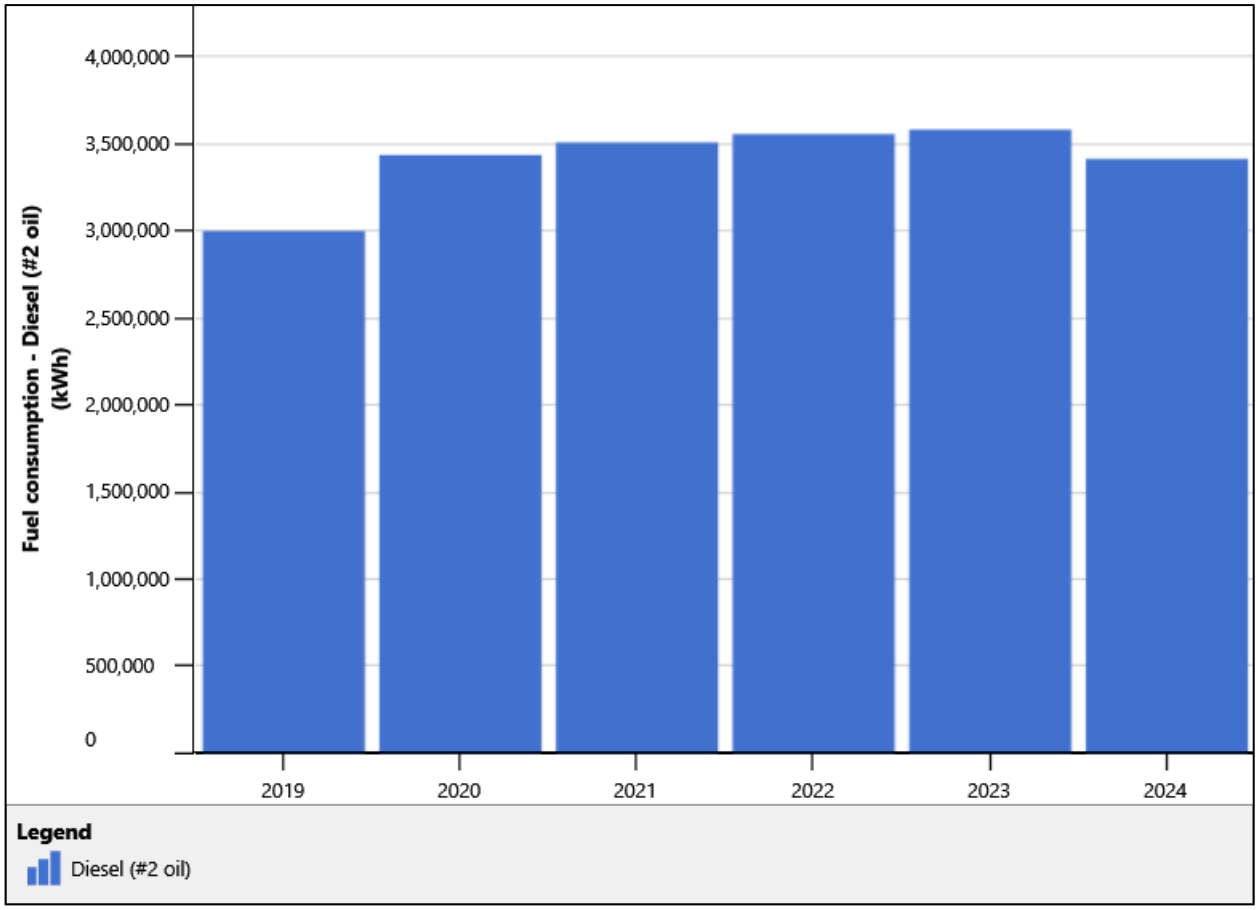
The main results are as follows:

Fleet - Fuel Cost - Diesel, Gasoline

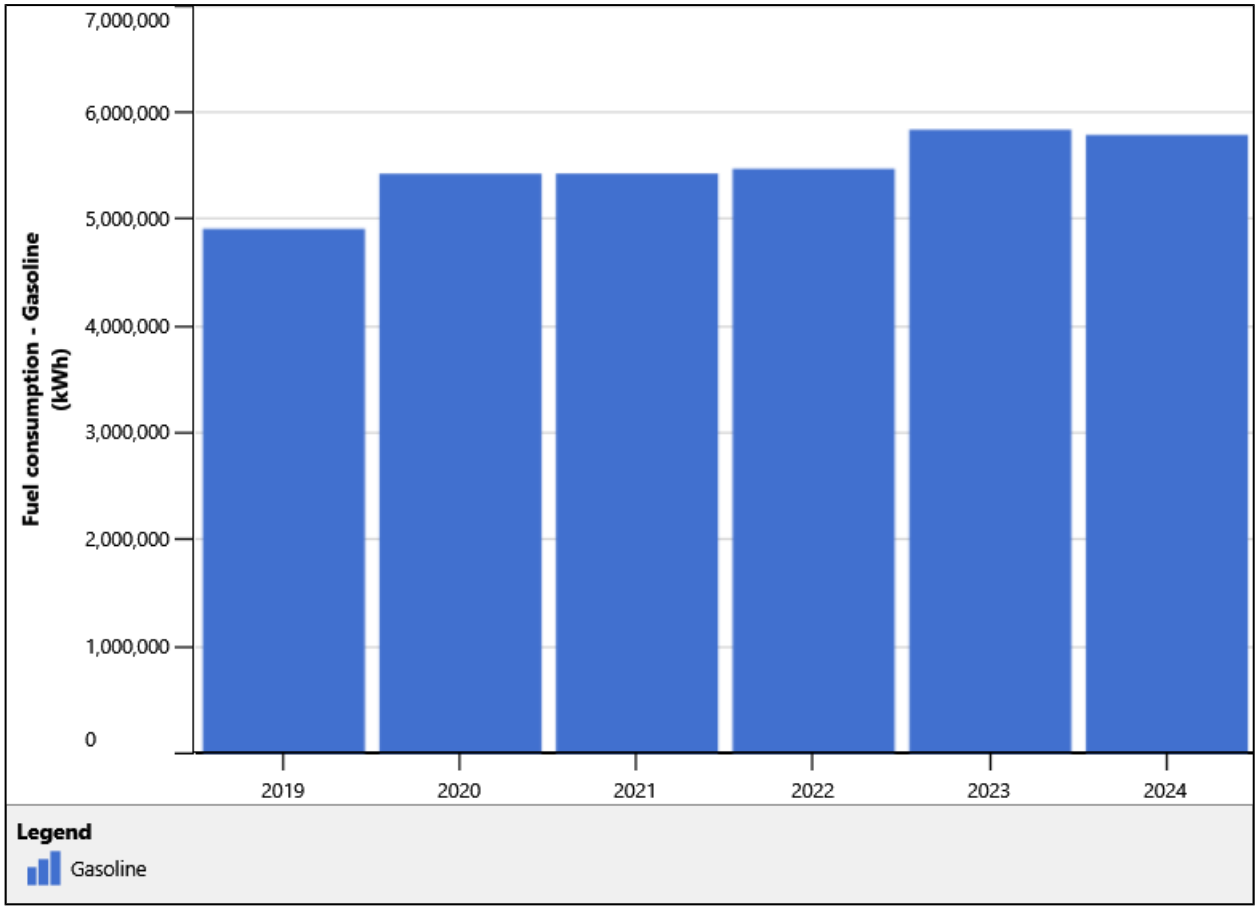


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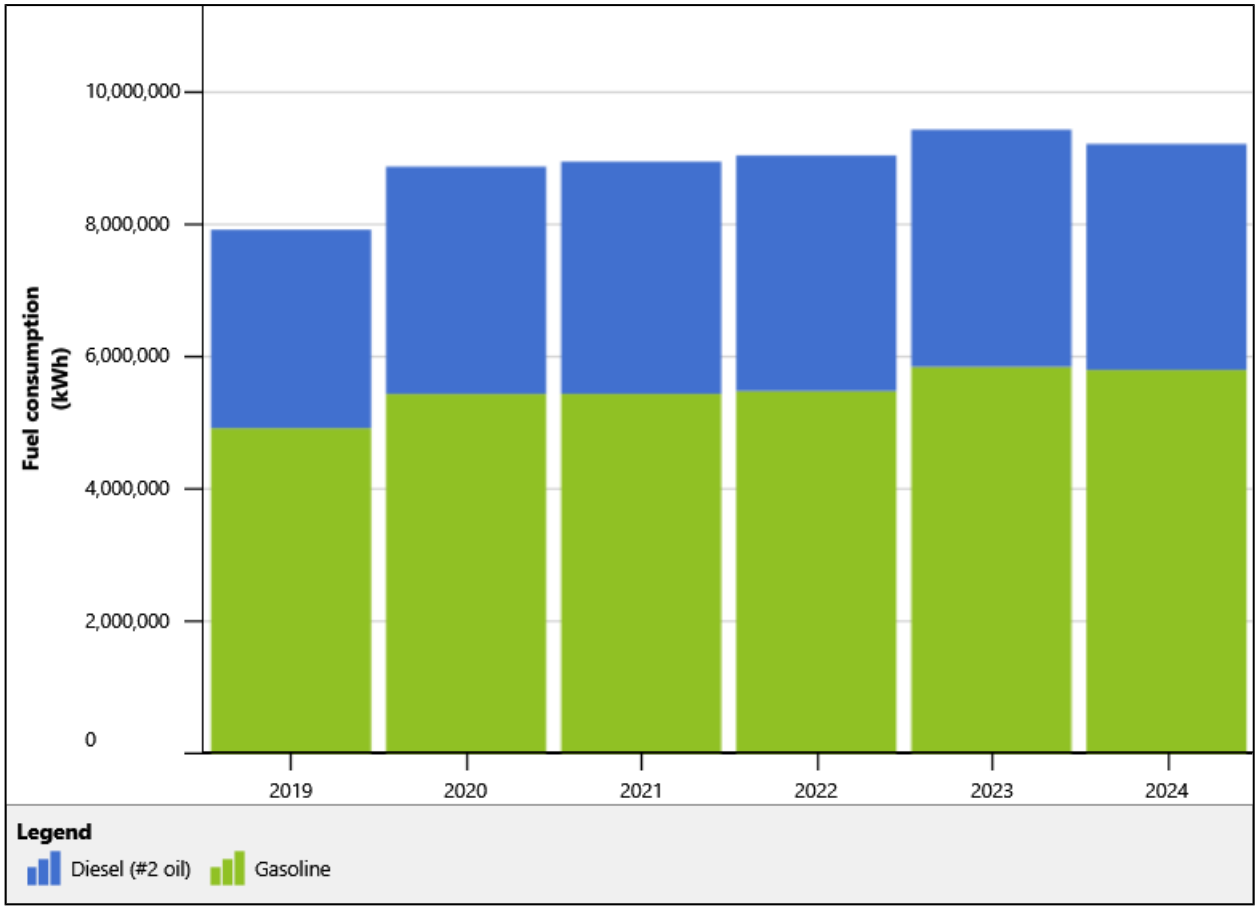
Performance - Fleet - Fuel Consumption - Diesel



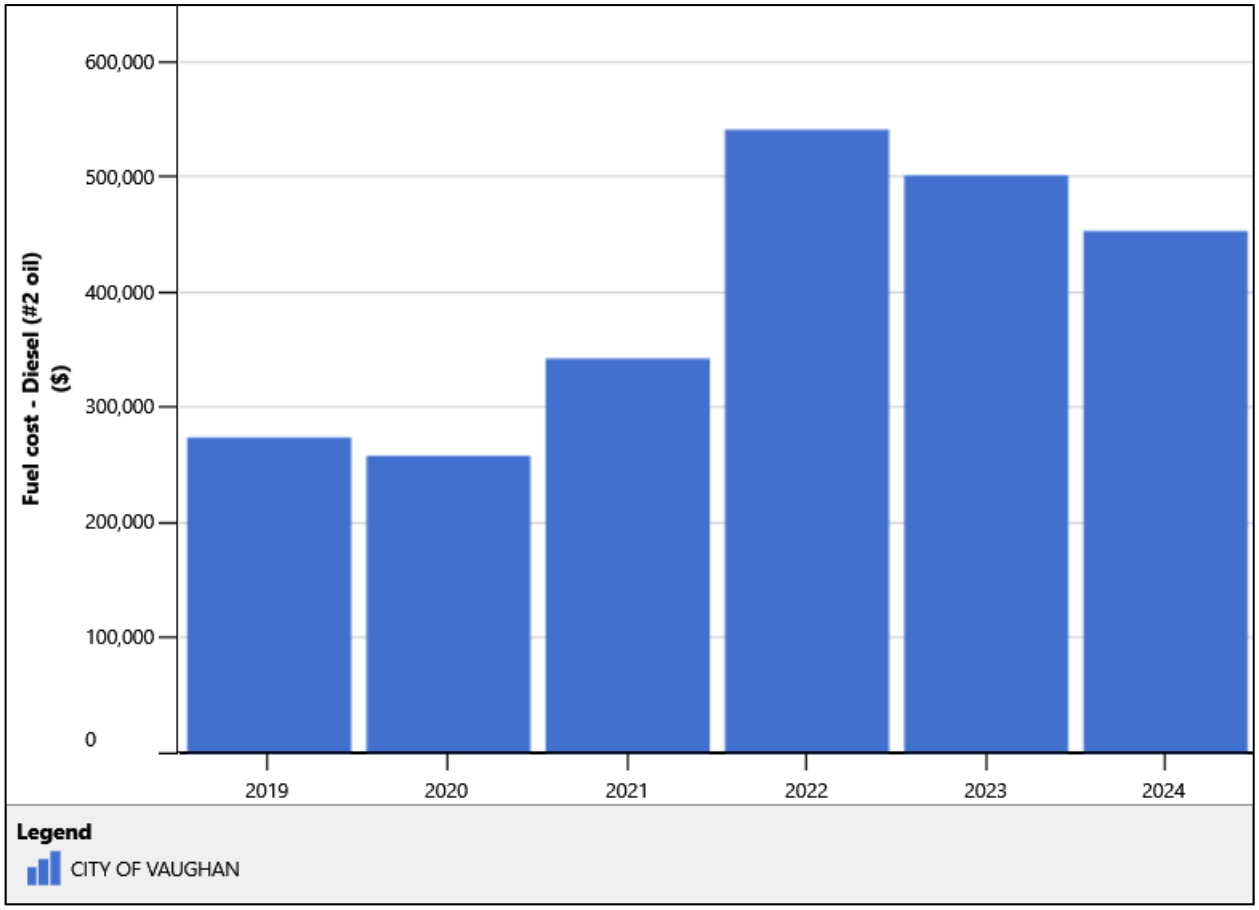
Performance - Fleet - Fuel Consumption - Gasoline



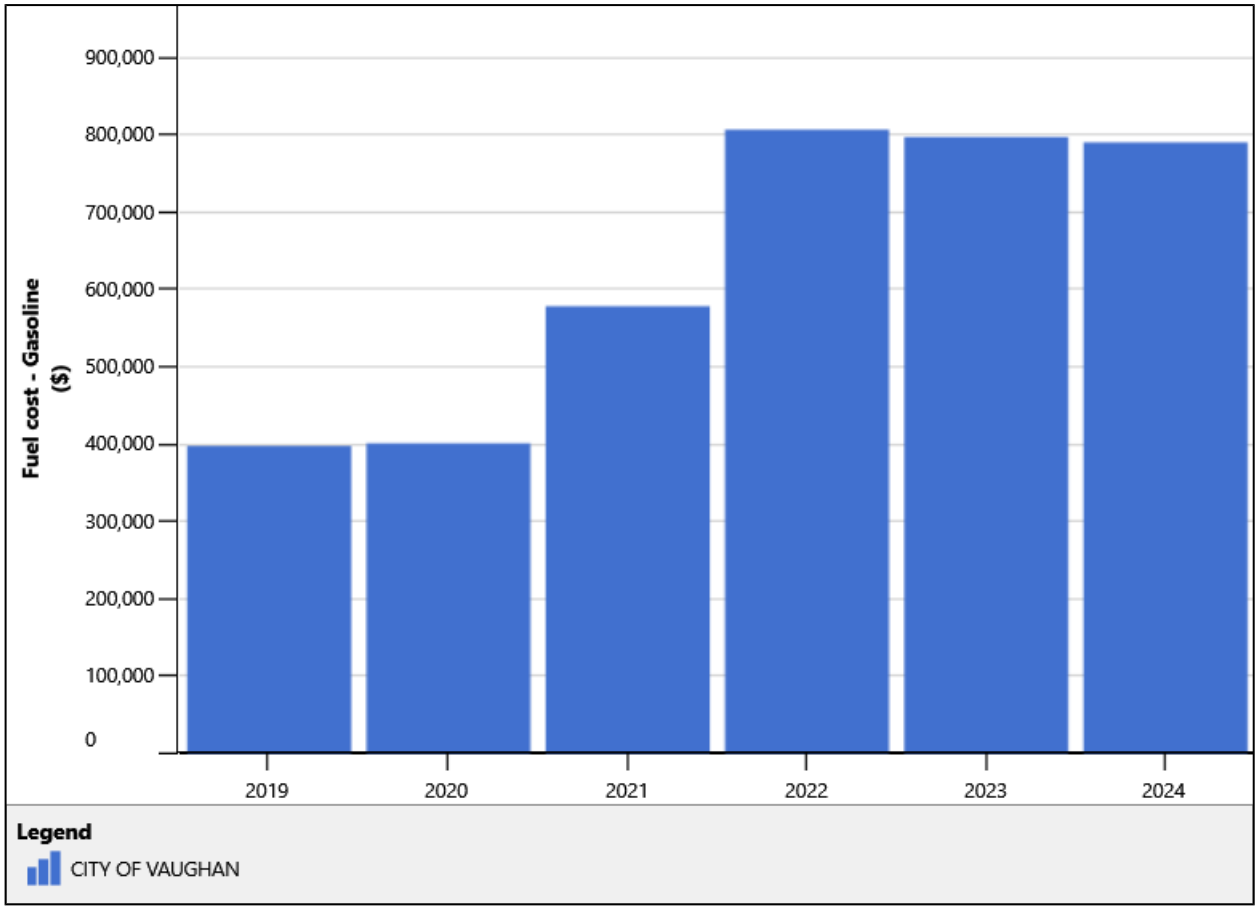
Performance - Fleet - Fuel Consumption - Diesel, Gasoline



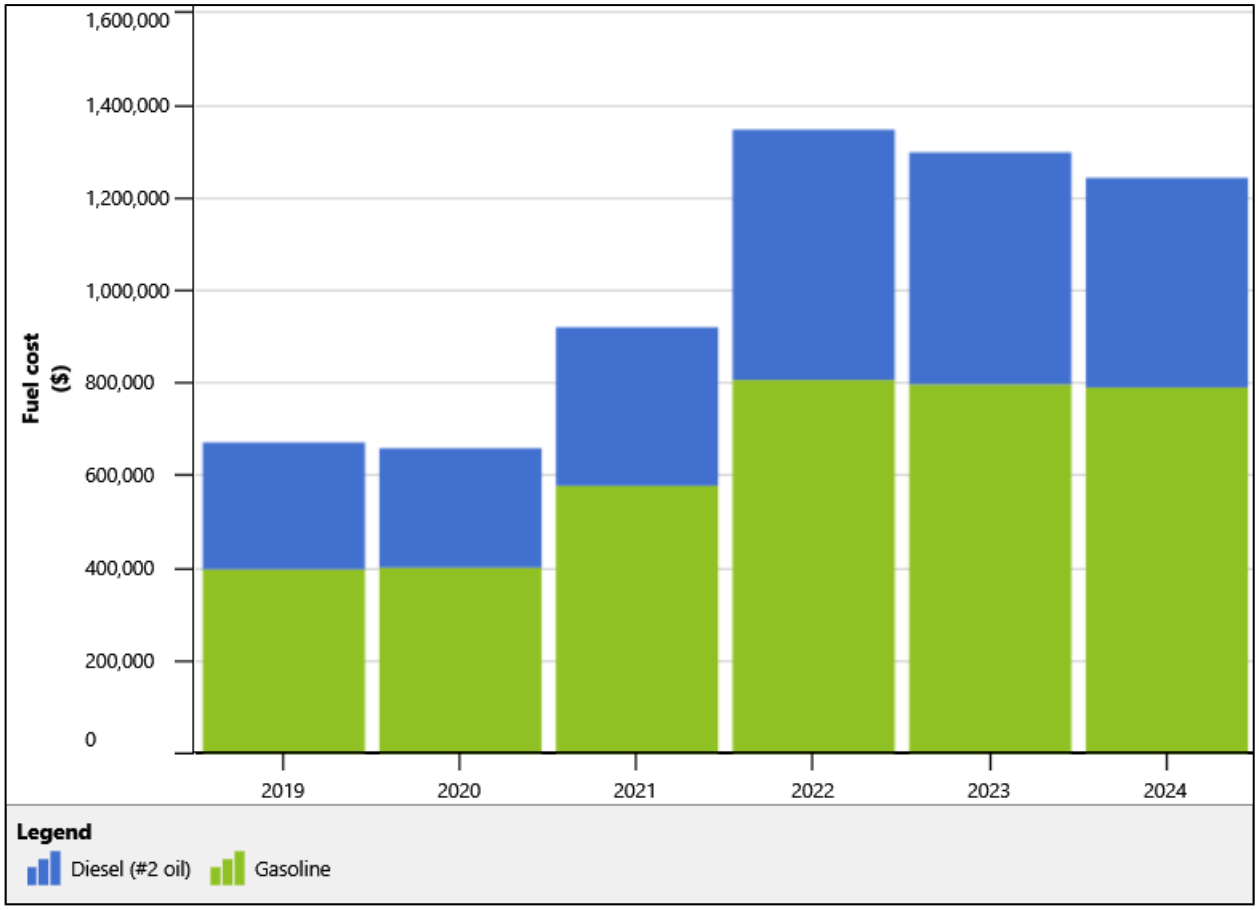
Performance - Fleet - Fuel Cost - Diesel



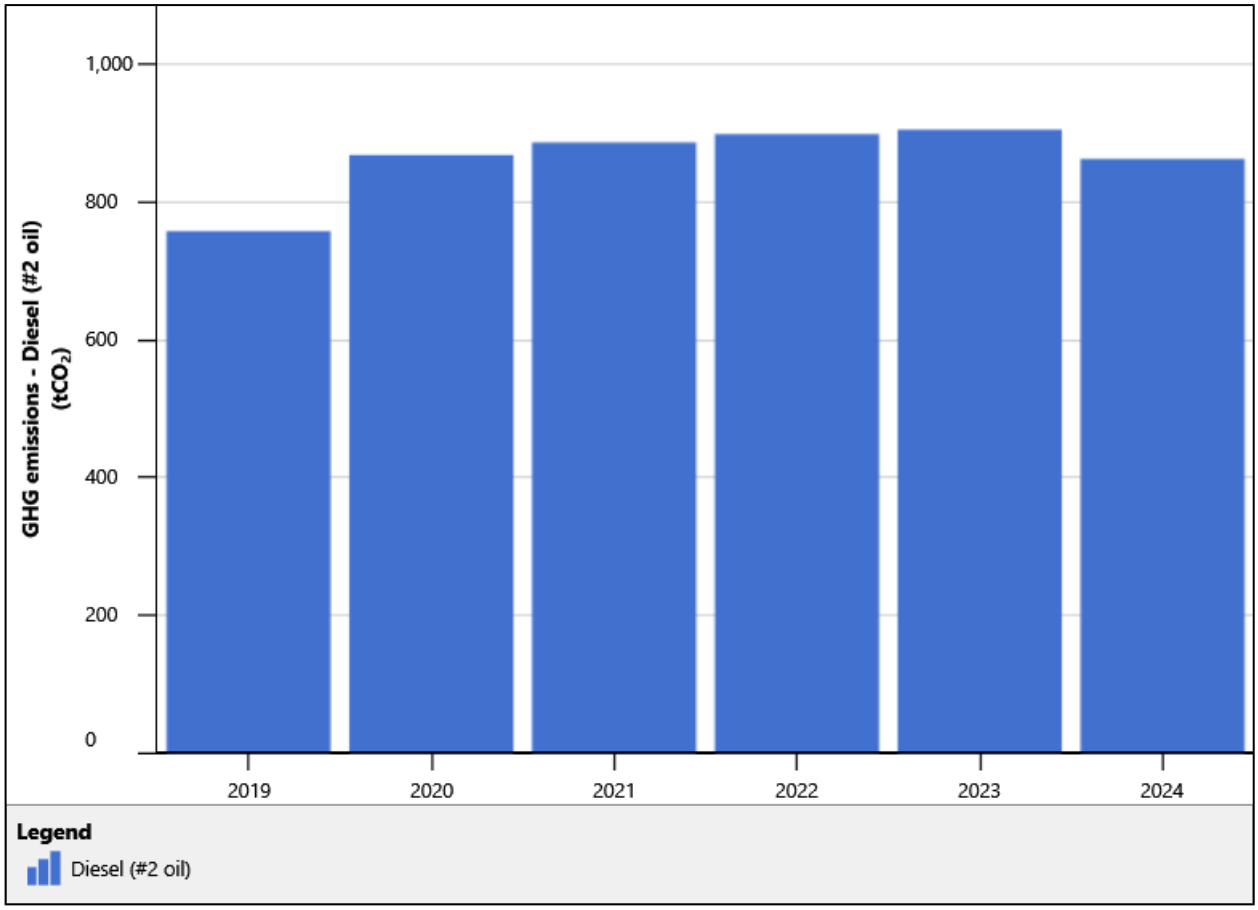
Performance - Fleet - Fuel Cost - Gasoline



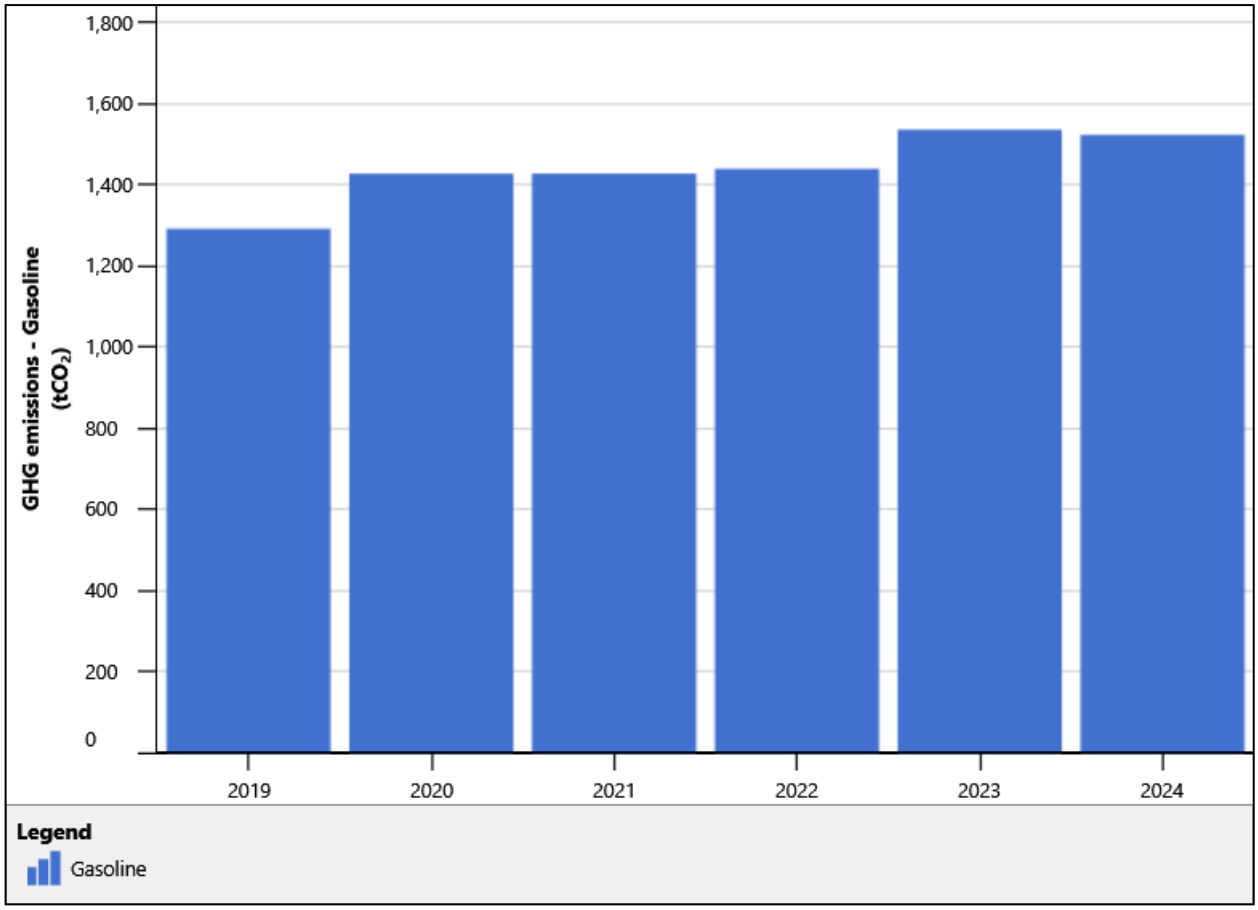
Performance - Fleet - Fuel Cost - Diesel, Gasoline



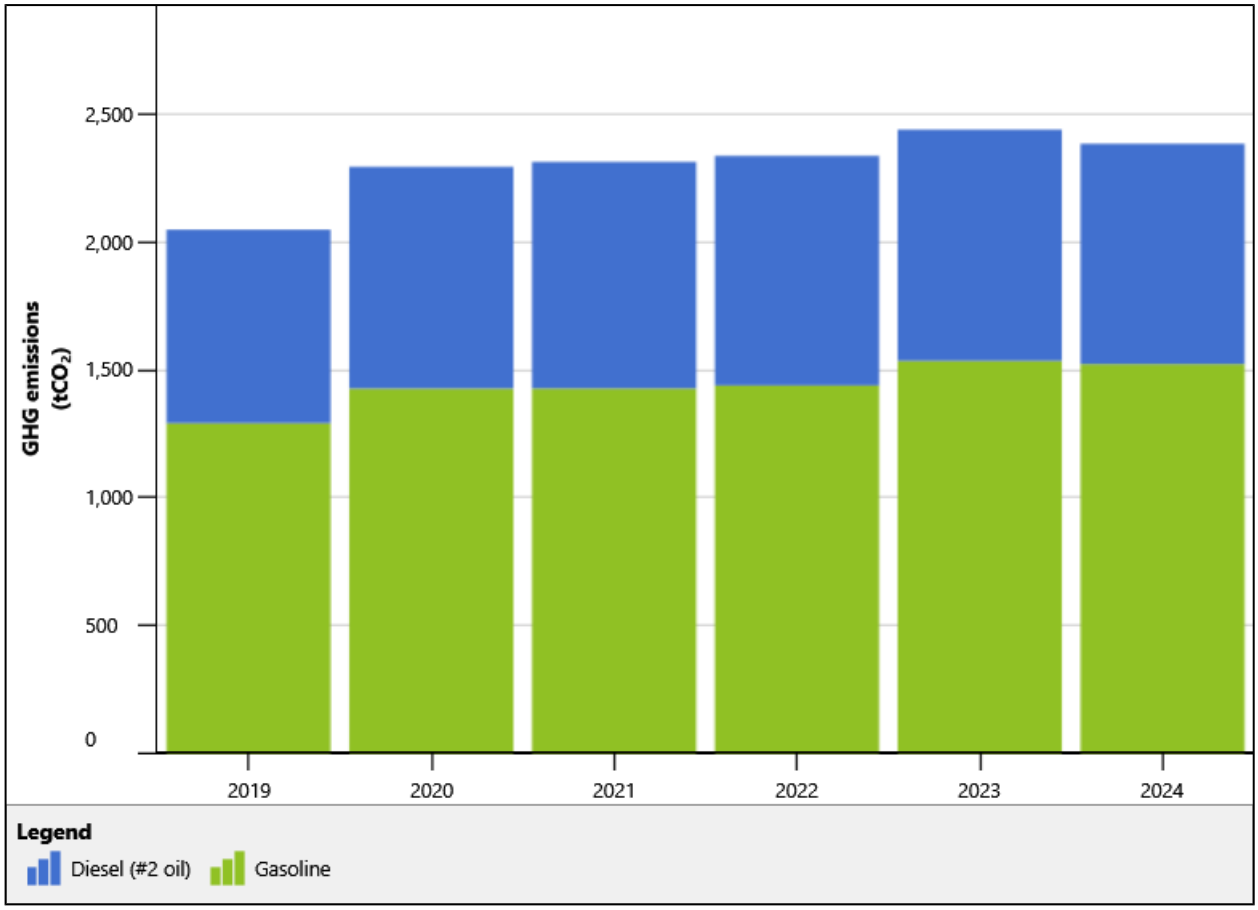
Performance - Fleet - GHG Emissions - Diesel



Performance - Fleet - GHG Emissions - Gasoline



Performance - Fleet - GHG Emissions - Diesel, Gasoline



Analysis Type

Portfolio



Subscriber: City of Vaughan - Professional

Streetlight

Facility Management Operations



Performance Analysis

Prepared for:

Dave Merriman, Director
Facility Management Operations

City of Vaughan
2141 Major Mackenzie Drive
Vaughan, Ontario L6A 1T1

dave.merriman@vaughan.ca

Prepared by:

Lamya Baraam, Energy Project Manager
Facility Management Operations

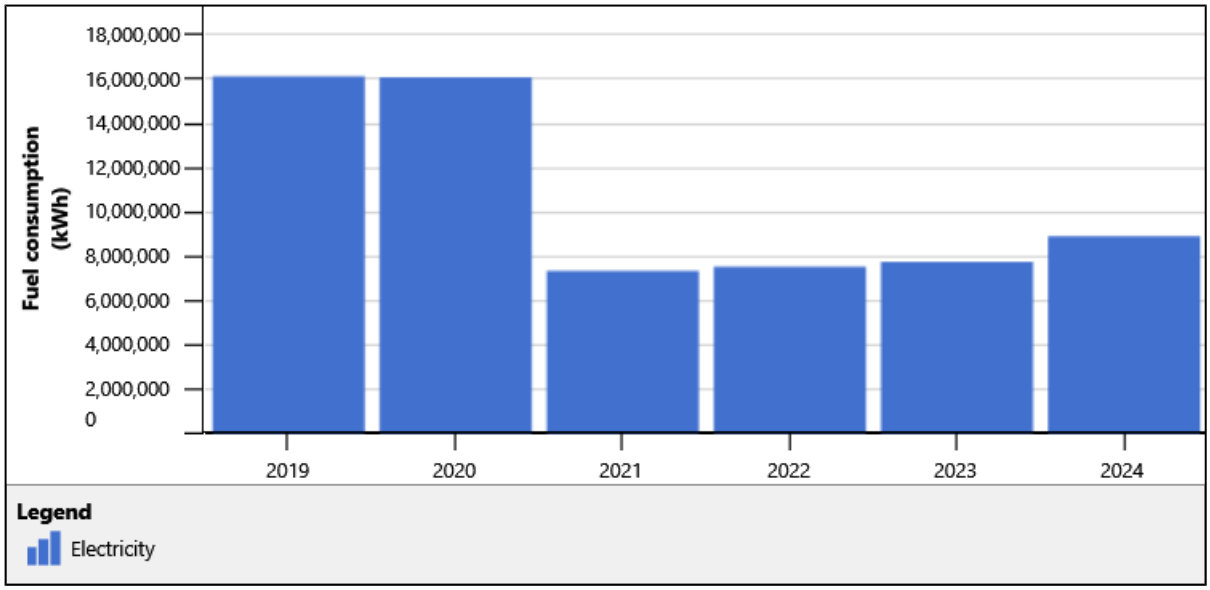
City of Vaughan
2141 Major Mackenzie Drive
Vaughan, Ontario L6A 1T1

lamya.baraam@vaughan.ca

Executive Summary

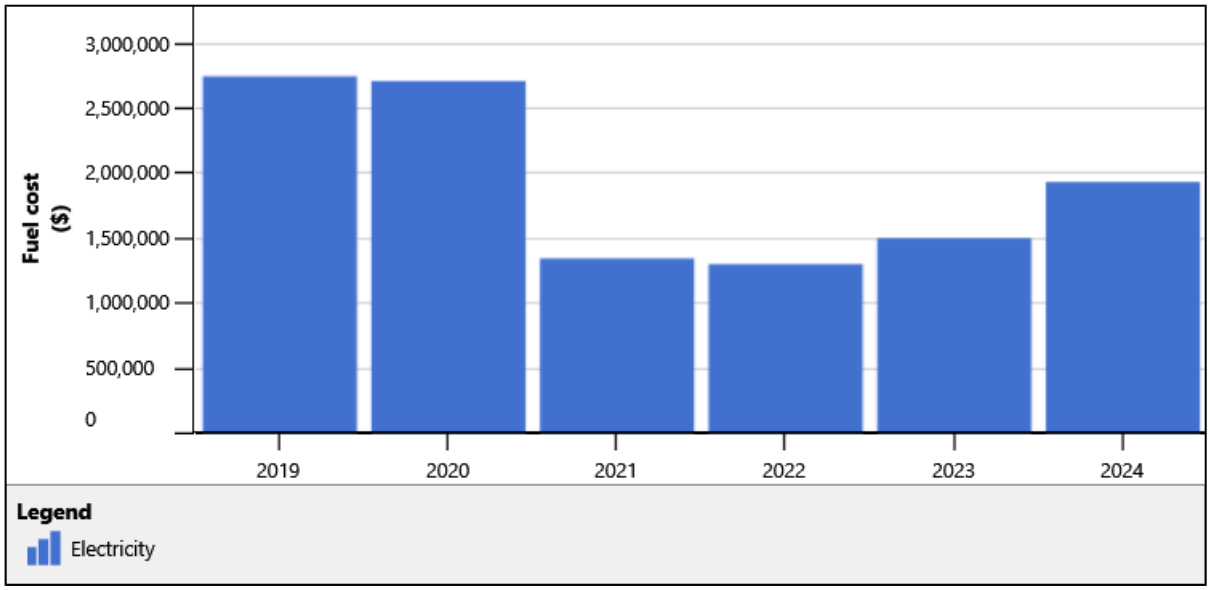
This report was prepared using the RETScreen Clean Energy Management Software. The key findings and recommendations of this analysis are presented below:

Streetlight - Fuel Consumption - Electricity



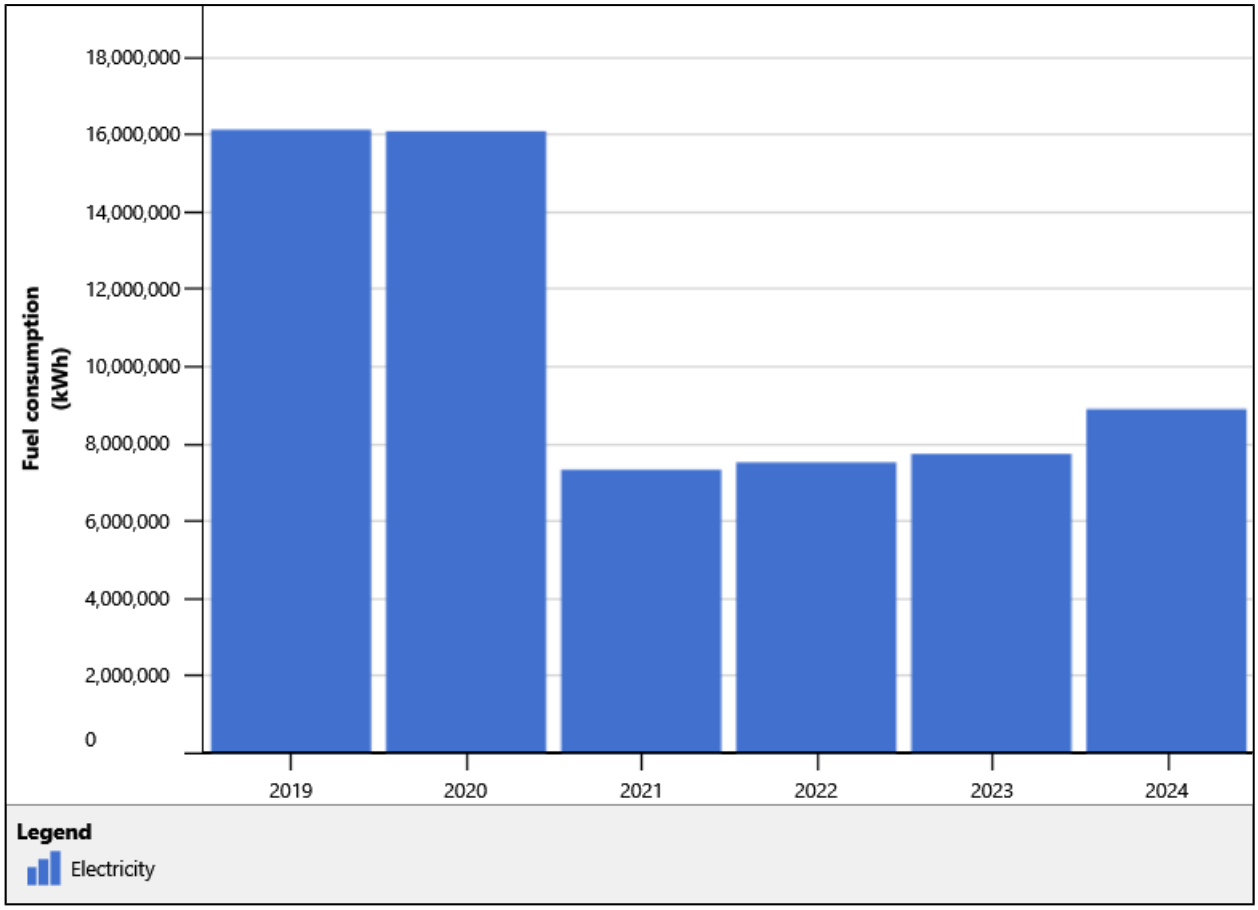
The main results are as follows:

Streetlight - Fuel Cost - Electricity Cost

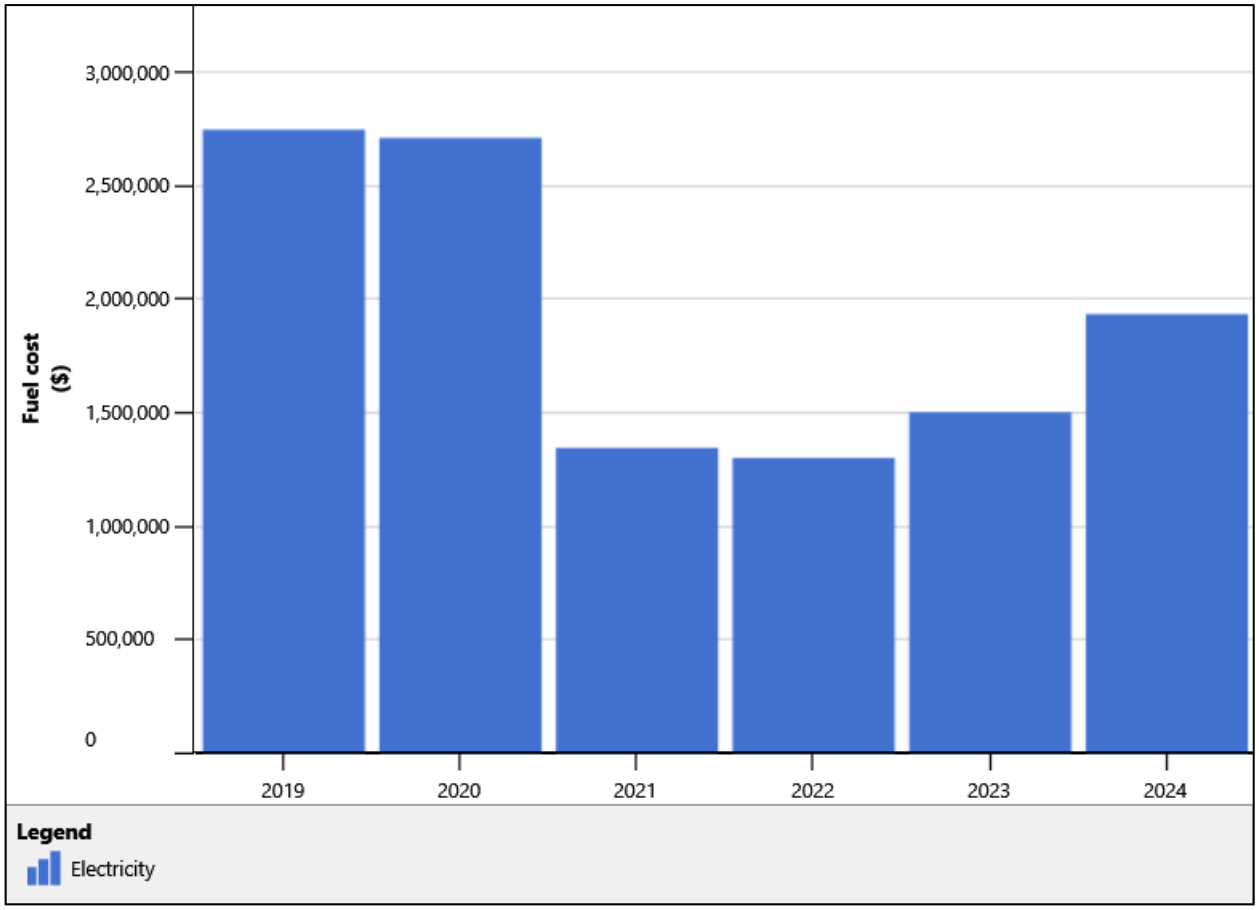


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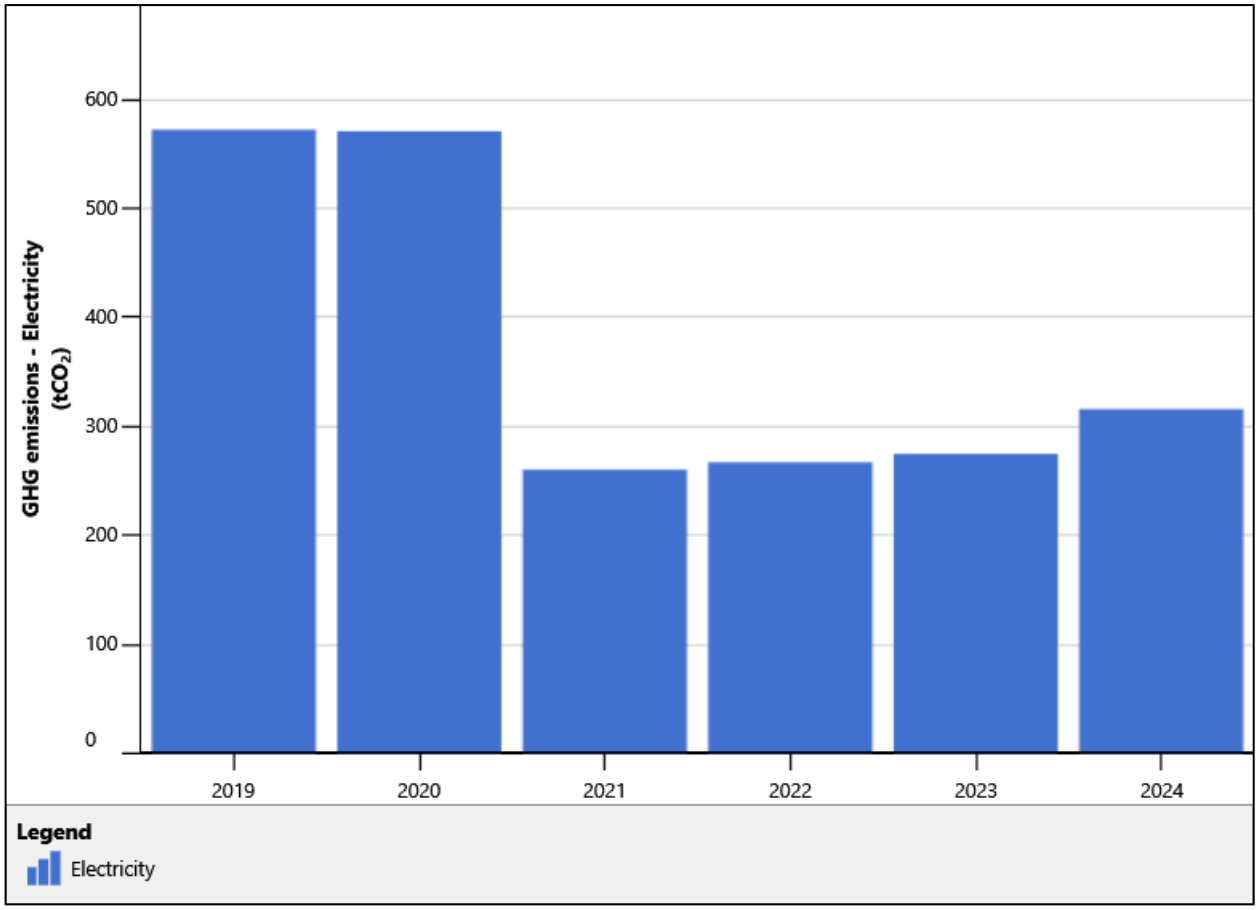
Performance - Streetlight - Fuel Consumption - Electricity



Performance - Streetlight - Fuel Cost - Electricity Cost



Performance - Streetlight - GHG Emission - Electricity



Analysis Type

Portfolio



Subscriber: City of Vaughan - Professional

EV Chargers

Facility Management Operations



Performance Analysis

Prepared for:

Dave Merriman, Director
Facility Management Operations

City of Vaughan
2141 Major Mackenzie Drive
Vaughan, Ontario L6A 1T1

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Prepared by:

Lamya Baraam, Energy Project Manager
Facility Management Operations

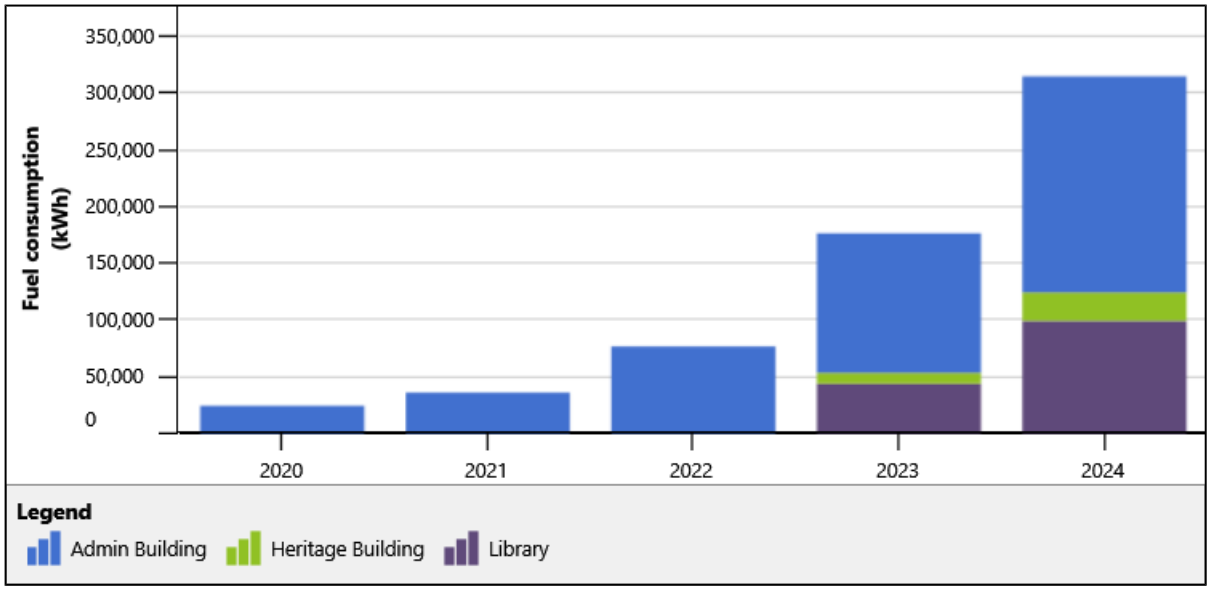
City of Vaughan
2141 Major Mackenzie Drive
Vaughan, Ontario L6A 1T1

lamya.baraam@vaughan.ca

Executive Summary

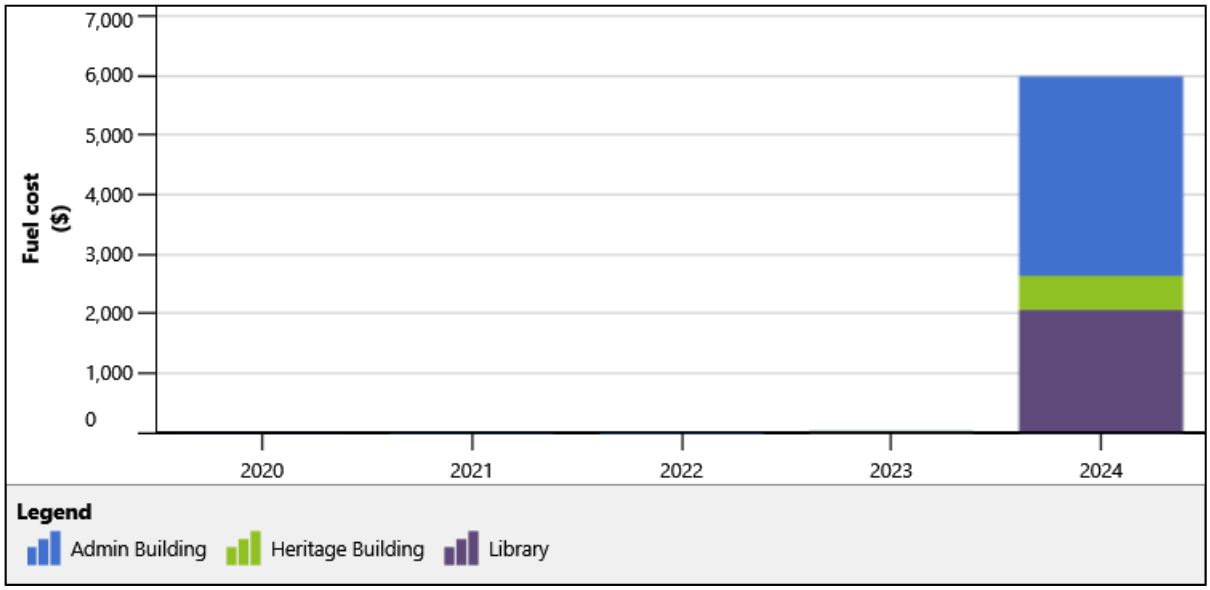
This report was prepared using the RETScreen Clean Energy Management Software. The key findings and recommendations of this analysis are presented below:

EV Chargers - Fuel Consumption - Electricity (kWh)



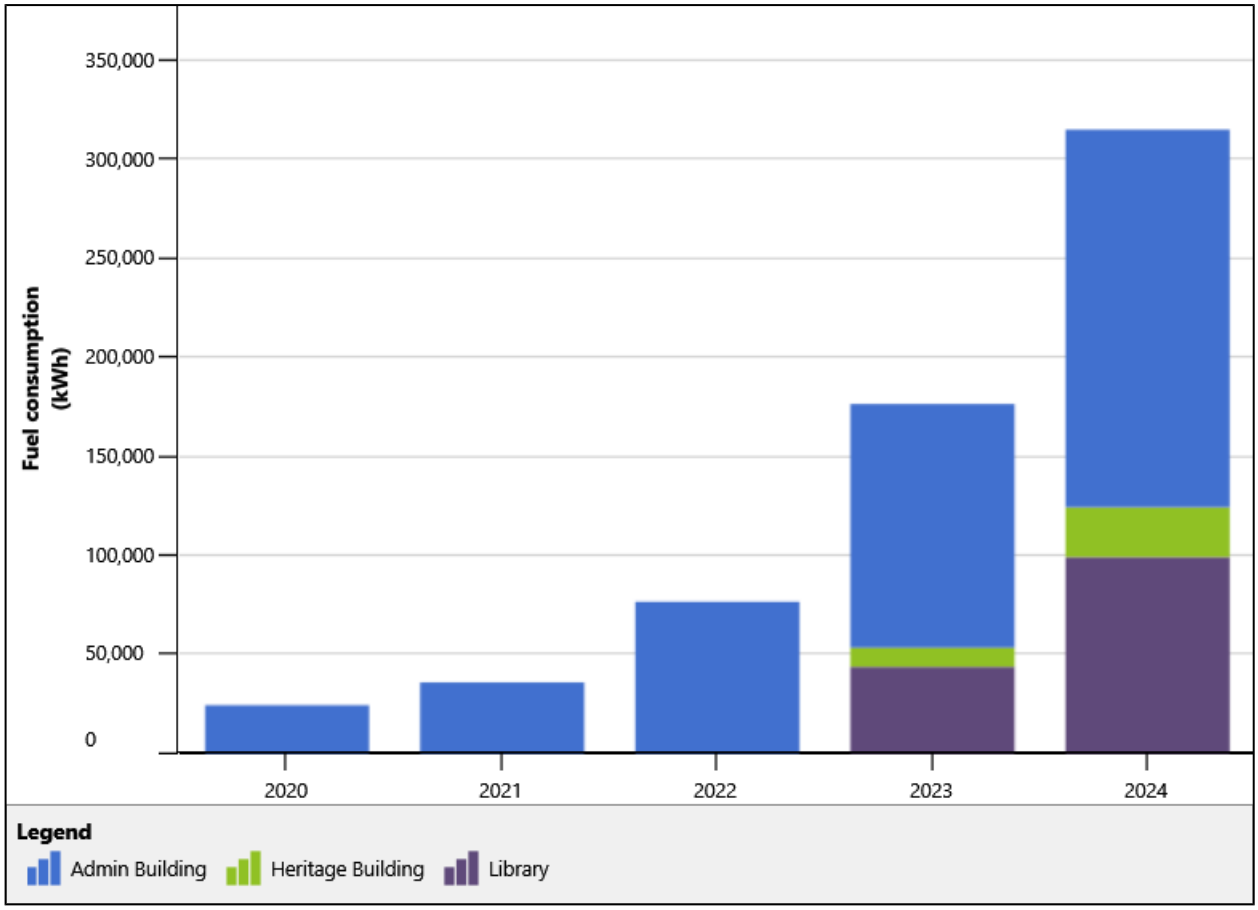
The main results are as follows:

EV Chargers - Fuel Cost

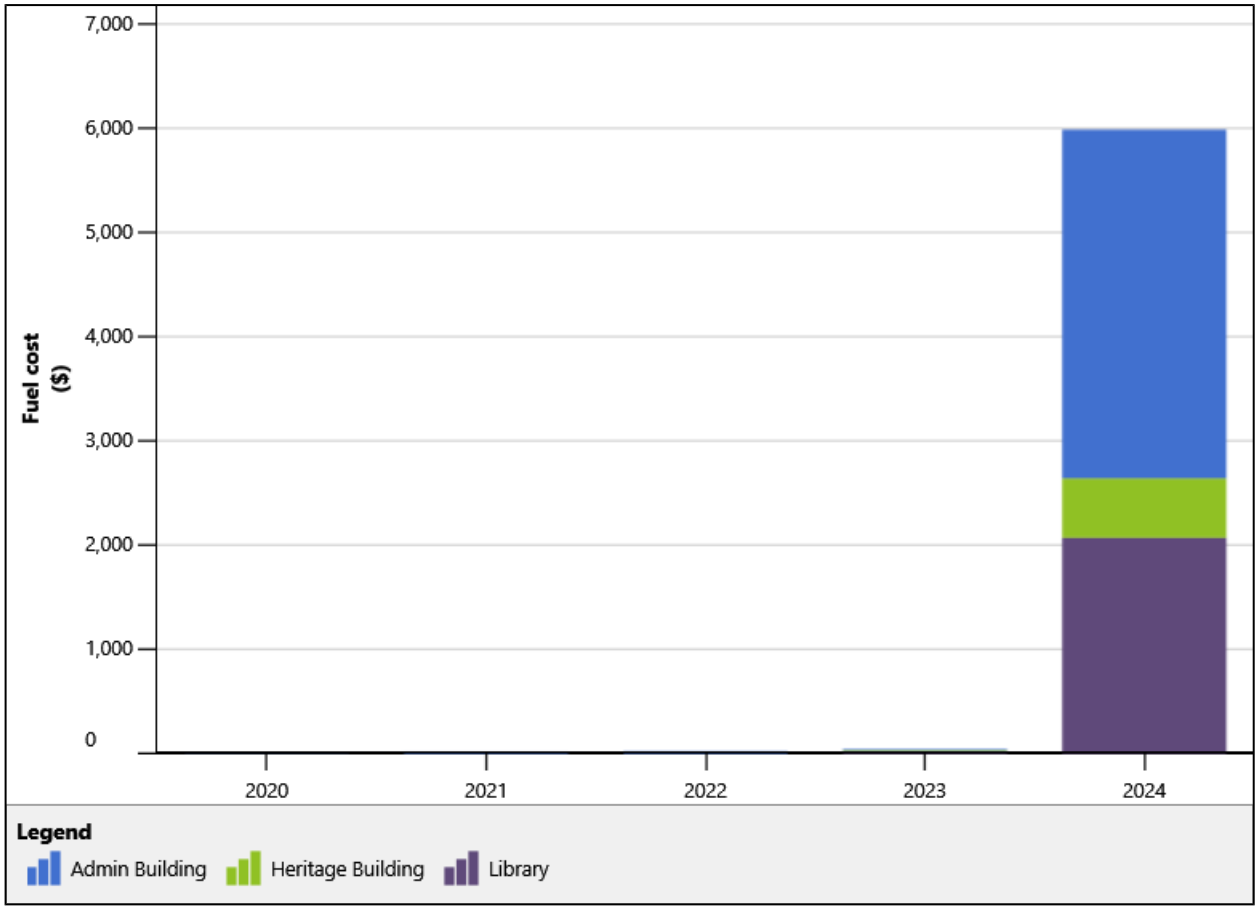


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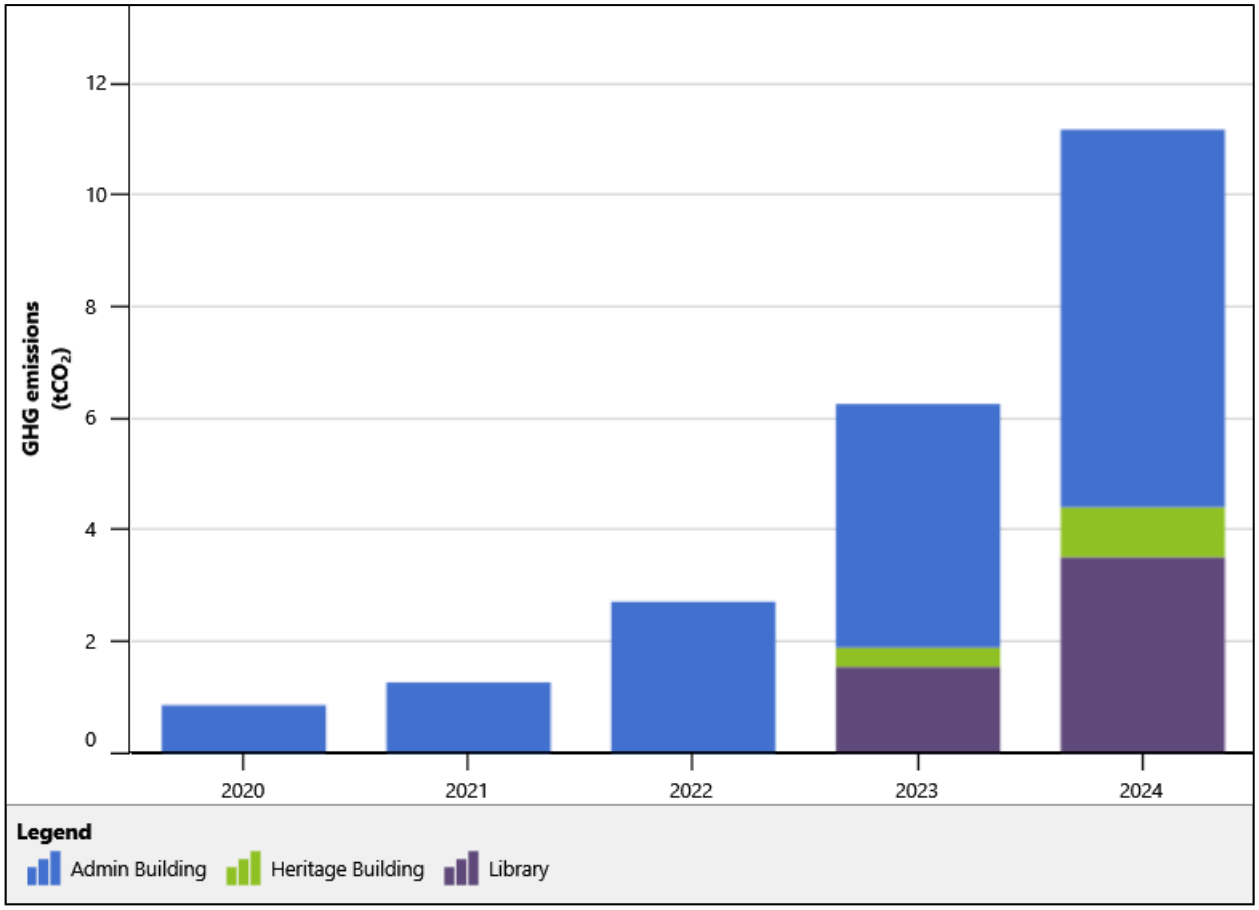
Performance - EV Chargers - Fuel Consumption - Electricity (kWh)



Performance - EV Chargers - Fuel Cost



Performance - EV Chargers - GHG Emissions

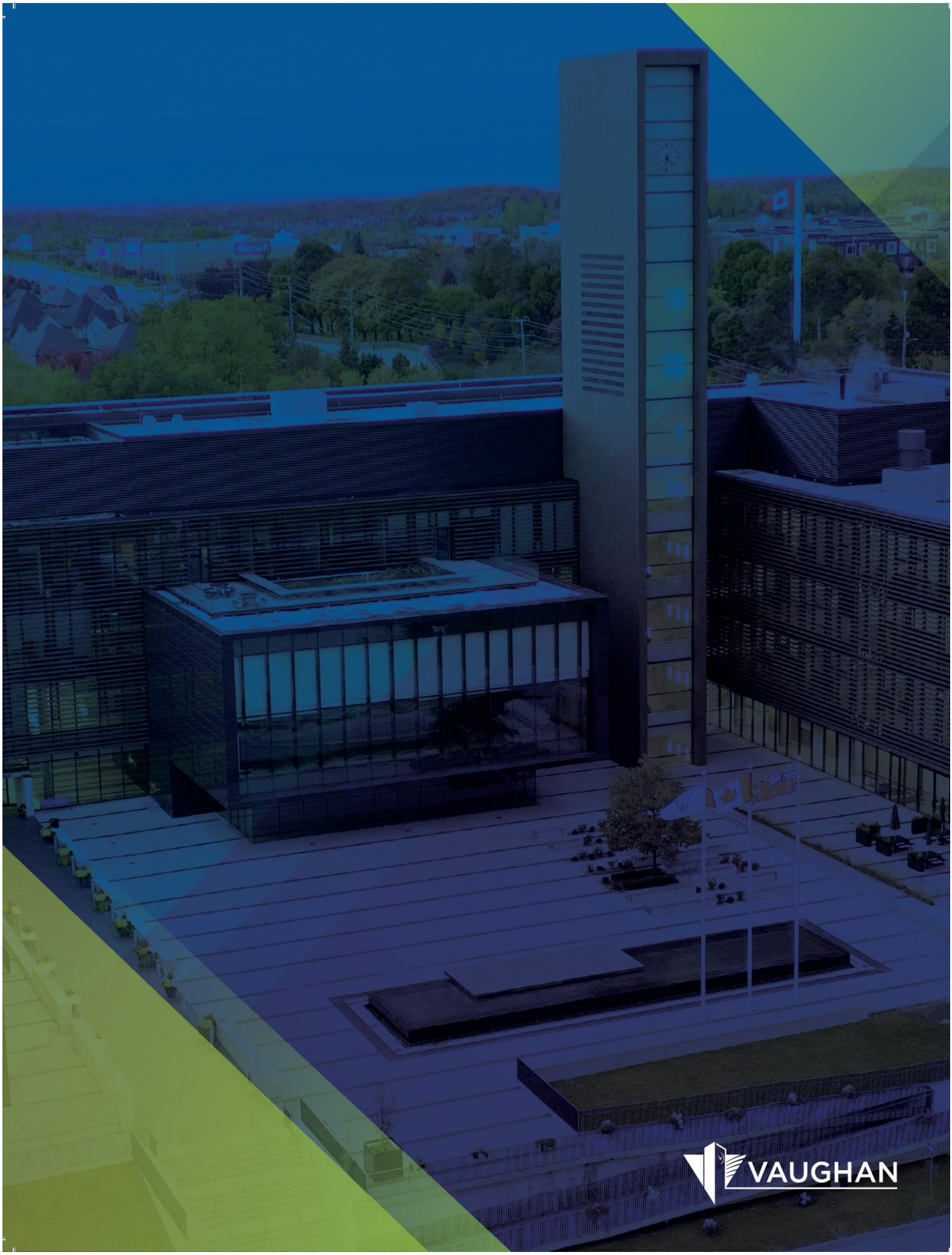


Analysis Type

Portfolio



Subscriber: City of Vaughan - Professional


VAUGHAN