

The Corporation of the City of Guelph

Local Government Energy Management System at the City of Guelph



Guelph Transit Electric Bus

Case Study Snapshot

Industry	Municipality
Product/Service	Local Government/Municipal Services
Location	Guelph, Ontario, Canada
Energy performance improvement percentage (over the improvement period)	- 8% reduction in total energy consumption (2023 vs. 2022 as improvement period data) - 16% reduction in total energy consumption (2023 vs. 2018 baseline period)
Total energy cost savings (over the improvement period)	- USD 171,260 (2023 vs. 2022) - USD 3,118,839 (Cumulative energy cost savings over the period from 2019 to 2023 with each year compared against the 2018 baseline year)
Cost to implement Energy Management System (EnMS)	USD 466,777 (incurred cost from 2021 to 2023)
Total energy savings (over the improvement period)	12,064MWh (2023 vs. 2022; 2022 is the period when the corporate-wide EnMS was assessed for full readiness) Cumulative energy savings of 84,219MWh over the period from 2019 to 2023 with each year compared against 2018 energy consumption; 2018 is the energy baseline year for the Corporation’s EnMS
Total CO₂-e emission reduction (over the improvement period)	702 Metric Tons (2023 vs. 2022); Cumulative reduction of 6,164 Metric Tons (2019 to 2023 vs. 2018)

Organization Profile / Business Case

The City of Guelph, one of the first planned towns in Canada, is a single-tier municipality in the province of Ontario, Canada with a population of approximately 150,000 people. Guelph’s municipal boundary spans an area of 87 square kilometers. Guelph, located on land held as the treaty lands and territory with the Mississaugas of the Credit First Nation, lies directly adjacent to the Haldimand Tract and is part of a long-established traditional hunting ground for the Six Nations of the Grand River and has served as traditional lands and a place of refuge for many peoples over time, but more specifically the Attiwonderonk, and the Haudenosaunee.

The City's administration is represented by the Corporation of the City of Guelph (henceforth referred to as 'the Corporation' in this document). The City owns and operates various physical assets comprising of facilities, equipment, and vehicles (over 100+ facilities and approximately 900 fleet vehicles) to provide municipal services to the public. These public services include water supply, wastewater management, stormwater management, waste management, road maintenance, traffic management, public street lighting, bus transit, police, fire, and ambulance services, as well as access to cultural facilities, indoor recreational facilities, and community centers. With such a diverse asset portfolio to deliver the various public services, the Corporation recognized the importance of thinking holistically and taking a systematic approach towards managing energy performance across City assets.

The Energy and Climate Change group, a staff department under the Corporation, was tasked with overall responsibility for developing, establishing, and implementing an organization-wide energy management system and over the last years, staff have been working towards delivering on this endeavor. In 2018, City Council approved a goal for the Corporation to achieve 100 per cent of its energy needs through renewable sources by 2050 (designated as the '100RE target') becoming the second municipality in the province to do so. The City, a designated member of the Cities Race to Zero global campaign, has pledged, as affirmed by Council approval of a motion declaring support for the Race to Zero campaign brought forward in 2021, to achieve net zero greenhouse gas emissions (designated as the 'Race to Zero target') in the 2040s or sooner, or by mid-century at the latest, in line with global efforts to limit warming to 1.5 degree Celsius. The City has also set an interim science-based target to reduce community greenhouse gas emissions by 63% by 2030. Towards achieving the 100RE and Race to Zero targets, through concerted collaboration by City staff and with ongoing support from City Council and the Corporation's top management, the Corporation has implemented an energy management system compliant with the globally recognized ISO 50001 standard. Following from a readiness self-assessment in 2022 indicating a pass score, in 2023, the City sought third party accredited certification for its corporate-wide energy management system. The third-party certification was achieved in 2023 with Guelph becoming the first municipality in Canada to achieve this distinction at a Corporate-wide level.

“Guelph is the first Canadian municipality to be certified at a Corporate-wide level to ISO 50001. This means we are improving how we use energy through all municipal operations and reducing greenhouse gas emissions while lowering our energy costs. A win-win-win!”

—Cam Guthrie, Mayor of Guelph

Business Benefits

In 2021, the Government of Canada approved funding of \$200,000 through its Natural Resources Canada's Energy Efficiency for Buildings program, for Guelph to implement an ISO 50001 compliant energy management system. The City also contributed funding towards the project (see news release - <https://www.canada.ca/en/natural-resources-canada/news/2021/07/canada-invests-in-guelphs-energy-saving-efforts.html>). Energy management system implementation cost, based on cost incurred during the period from 2021 to 2023, totaled US\$466,777.

By implementing an ISO 50001 standard compliant energy management system, the Corporation has set clear objectives and energy targets for the whole organization that support climate change mitigation efforts in everyday operations, continuously monitors and evaluates the organization's energy consumption and greenhouse gas emissions, and uses data to understand and make informed decisions to improve energy performance resulting in actions such as improving equipment energy efficiency, fleet electrification, fuel switching, and installing renewable energy generating systems. Through these various actions, the Corporation has achieved reduction in energy consumption and greenhouse gas emissions. In 2023, year-over-year energy savings totaled 12,064,465 kWh equivalent resulting in US\$171,260 in energy cost savings and year-over-year greenhouse emissions dropped by 702 tonnes of carbon dioxide equivalent. Non-energy benefits achieved include lower maintenance costs (for example, as

a result of fleet electrification or switching to LED fixtures), reduction in emissions, and increase in two-way staff engagement on the topic of energy management.

Through implementing an energy management system adopting the ISO 50001 plan-do-check-act framework, this has enabled bringing focus, rigor, and accountability towards improving energy performance across City assets and is in alignment with the value of environmental stewardship in the City's Community Plan and the objective of becoming a leader in climate action included in the City's 2024 to 2027 Strategic Plan. Dissemination of awareness of the energy management system across the Corporation, on an ongoing basis, and being proactive in communications related to energy performance is ensured with working under the ISO 50001 framework.

Plan

The Corporation provides municipal services to City residents covering various areas from potable water supply, sanitary wastewater collection/treatment, solid waste management, public transit, road maintenance, operating community centers, fire and emergency services and more. This and the City's 100RE and Race to Zero objectives set the basis for defining the scope and organizational limit of the Corporation's energy management system. The scope includes the Corporation's activities, operations, and services that are associated with energy use and generation covering electricity, fossil fuels (natural gas, propane, gasoline, diesel), and renewable energy sources (solar, biogas). Utility and fossil fuel accounts under the Corporation's energy information system, covering City-owned physical assets comprising of the facilities and vehicle fleet that support the delivery of municipal services, and energy generation sites owned by the City, constitute the boundary (organizational limit) covered under the Corporation's energy management system.

Being able to take a systematic approach to energy management based on the plan-do-check-act continual improvement framework and recognizing ISO 50001 as a global standard were the key drivers in developing the Corporation's energy management system to meet the requirements of the standard. Top management, with delegated authority from City Council, defined, approved, and implemented the Corporation's Energy Policy in 2021, demonstrating leadership and affirming the establishment of the Corporation's energy management system scope and boundaries and the Corporation's commitment with respect to achieving continual improvement of its energy performance. Top management support, vital to successful uptake of an ISO 50001 based energy management system, was available right from inception, and support continues to be provided by the Corporation's management beyond the initial commitment.

A funding strategy in early development stage is in place to invest in energy efficiency projects and initiatives as the City costs out the long-term initiatives planned. The project to implement an ISO 50001 compliant energy management system was funded from federal and City funding sources. The Energy and Climate Change group has the authority and responsibility, assigned by top management, for the following key tasks in relation to the energy management system:

- Ensuring that the energy management system is established, implemented, maintained, and continually improved including through implementing action plans,
- Establishing criteria and methods needed for effective operation and control of the energy management system,
- Ensuring that the energy management system conforms to the ISO 50001 standard, and
- Reporting on the performance of the energy management system to top management at a minimum on an annual basis.

Through the Corporation's Energy Policy, the Corporation has committed to striving towards its objectives and energy targets by minimizing negative environmental impact from the Corporation's activities, operations, and services, reducing energy consumption and greenhouse gas emissions, meeting energy needs from renewable energy sources, tracking and reporting on progress, and fostering a culture of conservation and environmental sustainability.

ISO 50001 Energy Management System – Case Study

2024

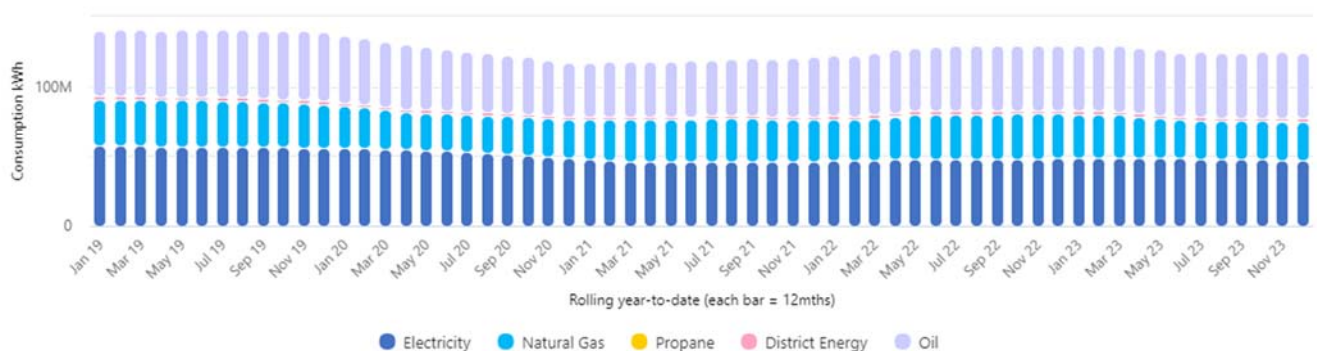
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A central component of the Corporation’s energy management system is data analysis and extended to monitoring, measurement, and analysis of performance. Facility level monthly energy consumption and cost data across the Corporation’s entire portfolio of energy using physical assets is collated using an energy information system portal thereby enabling continual tracking and an energy review. This data repository is accessed for conducting various data analysis including trend analysis, site benchmarking, site ranking, and normalization of performance. Major energy consuming accounts include fleet, wastewater treatment, streetlighting, waste management, operation of recreation centers, and water treatment.

Using information from the energy review, appropriate energy performance indicators for measuring and monitoring energy performance have been established against the baseline period selected as the year 2018. Examples of the established energy performance indicators include corporate greenhouse gas emissions per capita, site energy use intensity, count of electrified fleet vehicles, and wastewater treatment plant energy consumption normalized to effluent flow. A list of methods (as presented in the table below) has been established by the Corporation to identify energy performance improvement opportunities.

Method	Method Pathways	Expected Outcomes
Benchmarking	(a) BPS reporting (b) ENERGY STAR® Portfolio Manager	Comparing energy performance of buildings under the EnMS boundary to similar buildings provincially or nationwide
Energy assessment/Design review	(a) Facility level assessment (b) System analysis	(1) Design inputs for new builds (2) Renovation or replacement of existing energy equipment (3) Identifying and implementing improved operational and maintenance practices (4) Identifying energy waste reduction opportunities
Operational and maintenance staff suggestions	Collate O and M staff suggestions through a suggestion system	(1) Identifying and implementing improved operational and maintenance practices (2) Identifying energy waste reduction opportunities
Utility account representatives	Engage assigned representatives from Enbridge and Alectra Utilities	Information on available utility rates and incentives, new technologies promoted by the utility, and fuel switching opportunities
Energy equipment vendors	Contact the equipment manufacturer to access their technical support	Information on new equipment or best available technologies
Energy equipment maintenance contractors	Contact the contracted service provider to access their technical support	Information on O and M improvements
Equipment standards	Review the latest energy standards	Information on minimum energy efficiency requirements
Municipal best practices forum	Learn from sharing of ideas by other municipalities	Information on lessons learnt and best practices
Facility Life Cycle Renewal Capital Budget Planning (annual cycle)	Identify planned capital projects and department synergies for energy performance improvement opportunities	Life cycle renewal projects with energy performance improvement tie-ins
FEM coordination meetings (monthly cycle)	Discuss and identify department synergies for energy performance improvement opportunities	Identifying synergies for energy performance improvement opportunities for active projects
100RE Initiatives Capital Budget Planning (annual cycle)	Capital planning for energy performance improvement opportunities	Capital outlay for energy performance improvement projects
CECC team meetings	Weekly meetings involving CECC team members	Continuous improvement of active energy performance improvement projects

Consumption Trend
City of Guelph
January 2019 - December 2023



Downloaded from NUSdirect

Energy Consumption Trending Downwards (Period 2019 – 2023)

Based on reviewing the outcomes collated through the methods listed above, a final list of energy performance improvement opportunities is compiled for prioritization. Prioritization is based on criteria aligned with the Corporation’s targets and objectives such as energy savings potential, estimated greenhouse gas reduction, or lifecycle assessment. This prioritization exercise determines the energy projects that receive the greenlight to proceed.

“The City of Guelph’s energy management system enables us to integrate the continual improvement of energy performance into our organization’s day-to-day operations, programs, and services. Through this system - based on the ISO 50001 framework - we have identified and implemented projects that support the reduction of our overall energy consumption and greenhouse gas emissions, including the electrification of our transit fleet, the installation of more energy efficient heat pump systems and solar PV systems, and our commitment to designing new City facilities to Zero Carbon Building Standards.”

—Jayne Holmes, Deputy Chief Administrative Office of Infrastructure, Development and Environment

Do, Check, and Act

The Corporation considers energy performance improvement opportunities and operational controls during design, retrofit, or upgrade of sites, equipment, systems, or processes that fall within the energy management system scope and that can significantly impact energy performance. The Energy and Climate Change group, supplemented by personnel in specialized functions and personnel familiar with operations and maintenance, spearheads the execution of the action plans related to the energy management system. A master log of energy management system related active projects is reviewed and updated on a weekly basis. The log also includes the project titles, action items against each project, their respective due by dates and status, and assigned project manager responsible for the project.

Over the last several years, the Corporation has implemented various projects covering energy conservation, improving energy efficiency, and increasing renewable energy sourcing. A sample list of the various project types is provided below:

- Installation of submetering systems
- Building envelope (roof, fenestration, walls) repair and upgrades
- Lighting upgrade to LED technology across several sites (building interior and exterior lighting, parking lots)
- Replacement of high-pressure sodium streetlights to LED technology (over 13,000 fixtures replaced)
- Process and control improvements (e.g., floating head pressure control strategy in arenas, ice resurfacing using cold water, aeration blower upgrade, ice rink chiller upgrades, variable frequency drive control for well and pool pumps, BAS upgrades)
- Upgrade of HVAC equipment (e.g., switching from conventional gas rooftop units to heat pump rooftop units, replacing standard efficiency water heater with high efficiency ENERGY STAR® certified water heater)
- Heat recovery (e.g., pool drain heat recovery, integrated energy recovery ventilator for heat pump rooftop units)
- Installation of solar PV systems (around 334 kW cumulative solar PV capacity currently operational across various City owned sites)
- Installation of electric vehicle fleet charging stations and converting to electric vehicles

The Corporation monitors, and where applicable measures, analyzes, and evaluates key characteristics related to its energy management system including action plans, energy performance indicators, significant energy uses, energy consumption, and staff awareness training. Methods to verify energy performance improvement have been

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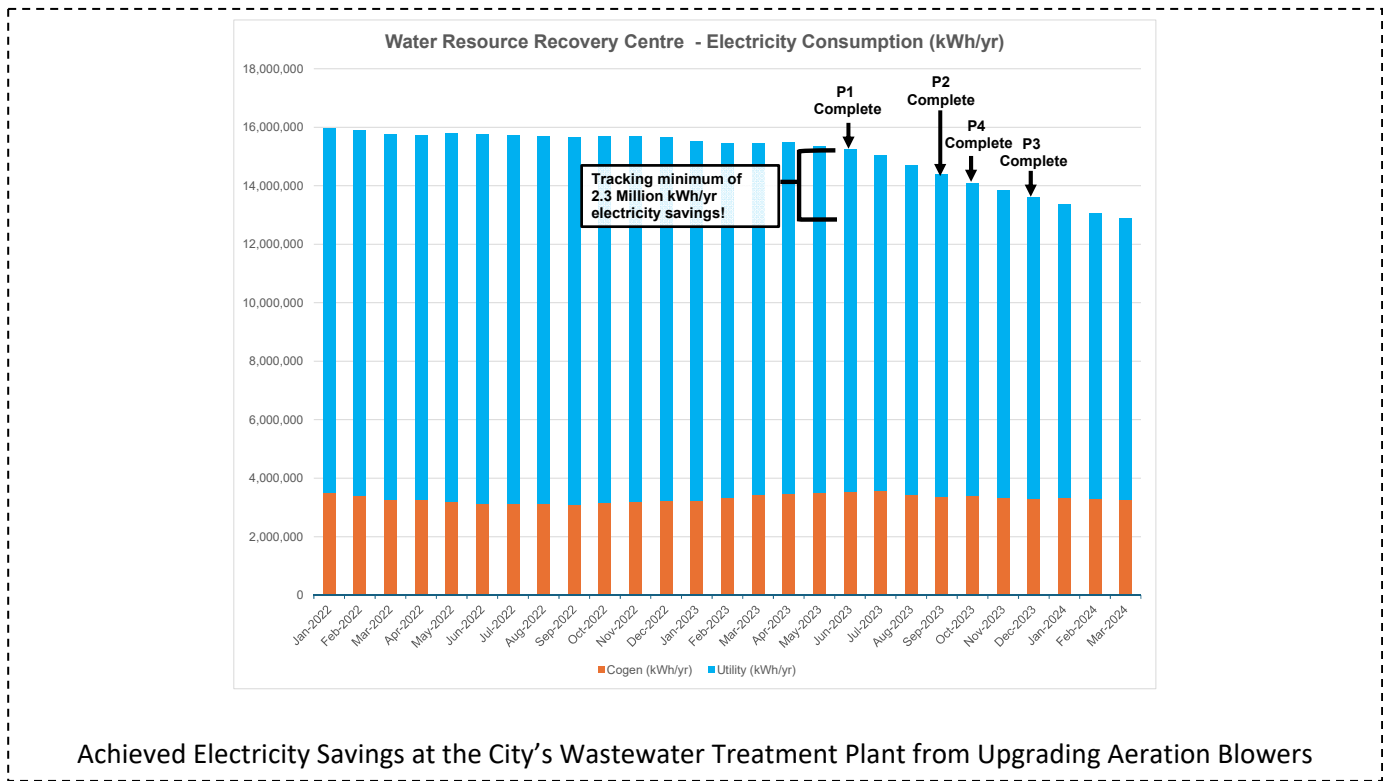
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identified and include retrofit isolated measurement, whole facility level measurement, or computer simulation modeling with calibration to utility billing data.

Most of the energy targets set for the year 2023 have been achieved. These and some of the achieved energy performance improvements in 2023 versus the 2018 baseline period currently set for the Corporation’s energy management system are presented in the tables below.

2023 Energy Targets Status			
	2018	2023	Remarks
Converting 200 high intensity discharge streetlights to LED	N/A	220	Target met
Reducing electricity consumption at Waste Resource Recovery Centre by 25% compared to 2018 baseline	12,885,065 kWh	10,040,171 kWh	Achieved reduction of 22%; projected to cross 25% in 2024
Replacing 55 IC engine fleet vehicles with electrified* vehicles	40	60	Target met
Replacing 20 natural gas fired HVAC units with heat pumps	0	20	Target met
<i>*includes hybrid electric vehicles</i>			

Energy Performance Improvement Status - 2023 versus 2018			
	2018	2023	Remarks
Corporate greenhouse gas emissions per capita indicator (tonnes CO ₂ e)	0.14	0.12	Indicator improved
Streetlighting electricity consumption (kWh)	10,317,443	3,550,455	Indicator improved
WRRC electricity consumption (kWh)	12,885,065	10,040,171	Indicator improved



Achieved Electricity Savings at the City’s Wastewater Treatment Plant from Upgrading Aeration Blowers

Where it has been established that variables affect energy consumption, normalization to the relevant variable is applied to derive a more meaningful performance indicator. For example, as observed in the table provided earlier, the Corporation’s total greenhouse gas emissions, calculated from multiplying annual consumption of each fuel type with the corresponding emission factors and further summing all these values, is normalized to population to calculate the corporate greenhouse gas emissions per capita performance indicator. The performance indicator referred to as site energy consumption intensity, derived by dividing total site energy consumption with facility gross floor area, is yet another example where normalization is applied. Other examples of relevant variables that affect the Corporation’s energy consumption include operational hours, weather (heating and cooling degree days), and process loading. Examples of high-level equations the Corporation uses for calculating energy savings and energy performance improvement are depicted below.

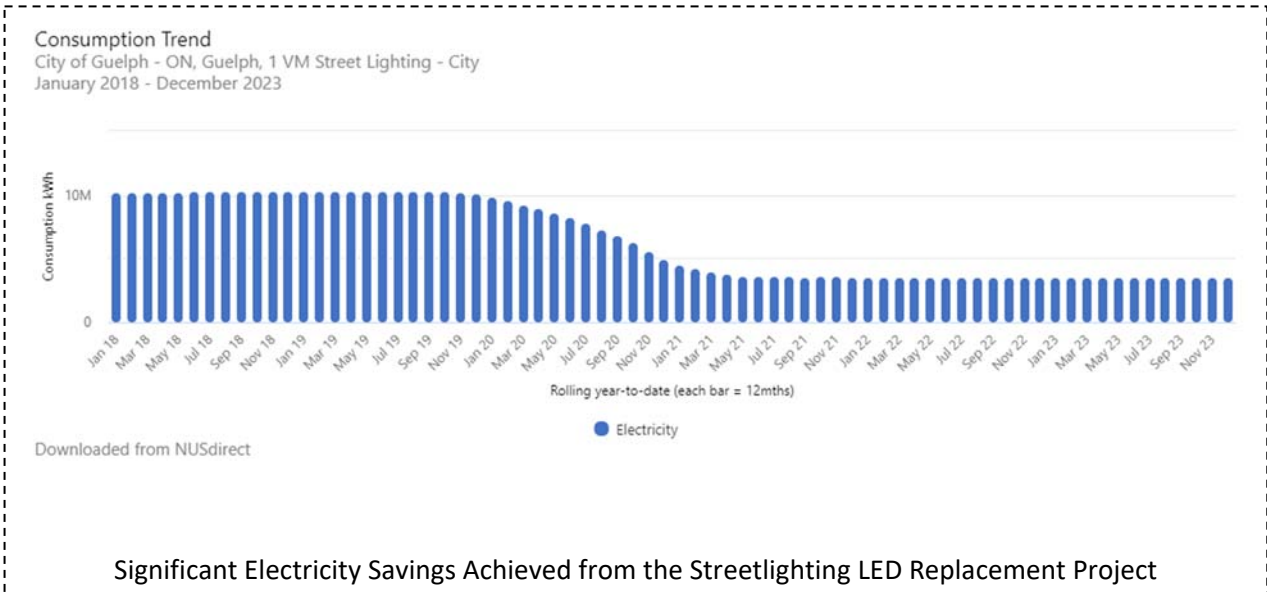
$$\% \text{ Energy Performance Improvement} = \frac{\text{Total energy consumption in 2022} - \text{Total energy consumption in 2023}}{\text{Total energy consumption in 2022}} \times 100\%$$

$$\text{Total energy savings over improvement period (2023 vs. 2022)} = \text{Total energy consumption in 2022} - \text{Total energy consumption in 2023}$$

$$\text{Facility energy consumption normalized to gross floor area} = (\text{Total electricity consumption} + \text{Total natural gas consumption}) \div \text{Building Gross Floor Area}$$

High-Level Equations for Energy Consumption and Savings Calculation

Tools that assisted with implementation of the energy management system include the RETScreen® Clean Energy Management Software platform, NUS Consulting Group’s energy information system, Building Automation System for access, control and monitoring of building systems, and Supervisory Control and Data Acquisition (SCADA) systems for controlling, monitoring, and analyzing equipment and processes. The Corporation performs an internal audit every year for an assessment of whether its energy management system is effectively implemented and maintained and if it meets the minimum requirements of the ISO 50001 standard. The Corporation’s top management annually reviews the organization’s energy management system to ensure its continuing suitability, adequacy, effectiveness, and alignment with the Corporation’s Strategic Plan.



ISO 50001 Energy Management System – Case Study

2024

Canada

Transparency

In 2023, the City of Guelph became the first municipality in Canada to be certified under the ISO 50001 standard for its corporate-wide energy management system. This achievement was publicly announced through a news release on the City's public portal (see link - <https://guelph.ca/2023/11/city-of-guelph-first-municipality-in-canada-to-earn-corporate-wide-energy-management-certification/>) as well notified through the City's various social media accounts. A certificate of registration was formally handed over by BSI Canada (third-party certification body) at the Committee of the Whole Meeting in the Council Chambers at City Hall on November 6, 2023. City staff recently presented at an Energy Management Association webinar event sharing insights into the Corporation's ISO 50001 certification journey (<https://www.energymgmt.org/events/energizing-excellence-unveiling-the-iso-50001-success-story-of-the-city-of-guelph/>).

What We Can Do Differently

Reflecting on the Corporation's journey towards implementing an energy management system, what the Corporation would consider doing differently is planning for more time and resources towards staff engagement and awareness training and factoring in change management principles. One key takeaway from the implementation experience is the pivotal importance of good data management, data collation done in real-time, translating gathered data to meaningful representation to inform valuable analysis, and ensuring data quality and validity. Among near term planned actions towards continual improvement earmarked as priority, the Corporation will continue to progress building retro-commissioning activities and building automation system standardization, upgrades, and optimization. This year, the Corporation will also be completing the annual surveillance audit of its energy management system to be conducted by the third-party certification body.



156kW Rooftop Solar PV System at one of the City-owned facilities



The Energy Management Leadership Awards is an international competition that recognizes leading organizations for sharing high-quality, replicable descriptions of their ISO 50001 implementation and certification experiences. The Clean Energy Ministerial (CEM) began offering these Awards in 2016. For more information, please visit www.cleanenergyministerial.org/EMAwards.