University of Waterloo - Energy Conservation and Demand Management Plan 2024

June 2024

Introduction

The University of Waterloo is a large and growing research intensive post-secondary institution. With facilities for approximately 42,000 faculty, students, and staff, encompassing multiple campuses, the annual cost of energy is a major concern.

Under Ontario Regulation 507/18, the Ontario Government requires all Broader Public Sector institutions to update their 2019 energy conservation and demand management plan. The Act has two main focuses. The first is to have organizations formalize their energy plans; the second is to encourage organizations to install renewable energy generation.

Energy Consumption

For the operating year May 2022 to April 2023, the University of Waterloo used a total of 1,065,638 GJ of energy; 57.6% was from natural gas, the balance was electricity. With a total building area of 788,228 m^2, the energy intensity was 1.36 GJ/m^2.

University Of Waterloo has developed a Climate and Energy Action Plan which will guide efforts towards a carbon neutral campus by 2050, with interim targets for 2025 and 2030. A sizable portion of the climate action plan focuses on energy efficiency through traditional and innovative energy conservation measures, as well as electrification.

This updated plan will use the calendar year (rather than fiscal year) to better align with other Provincial and Federal reporting requirements.

Goals and Objectives

1) Minimize energy consumption and environmental impact while ensuring the needs of the university community are met.
2) Support a culture of efficiency and sustainability by converting theory into practical, cost-effective actions.
3) Ensure that everyone on campus is aware of the need and does their part to conserve energy.

Organizational Energy Measures

1) **Net-Zero ready for new construction.** Waterloo has developed high-performance design standards for all new construction, bringing passive design principles including maximum EUI/TEDI/GHG intensity targets for each different type of building. The standard prioritizes a maximum window-wall ratio and design of mechanical systems to accept future lower-temperature hot water from a district energy system. The standard is already being implemented on multiple buildings that are in design.
   Cost: 5% above base project cost. Annual Savings: 50-75% annual operating utility costs. Lifespan: indefinite.

2) **Develop a lighting control plan.** The University operates virtually 24 hours a day. There are no formal policies or methodologies relating to the operation of interior lights. This measure will encompass a detailed campus audit to develop a plan to address this situation. The resulting plan should include a technical measure (lighting automation) and a behavioral measure.
Cost: Internal. Annual Savings: None directly. Lifespan: indefinite.

3) **Exterior lighting conversion.** This is an ongoing measure. Currently, about 60% of the exterior lights have been upgraded to a modern energy-efficient style. As opportunities and capital are available, work will continue. Note that as new bulb and fixture technologies become available, the design and implementation will change.
Cost: Varies. Annual Savings: Variable. Lifespan: 15 years.

4) **Building lighting conversion.** This is an ongoing measure. There are still large areas of building spaces containing fluorescent T12 bulbs and incandescent bulbs. As opportunities and capital become available, work will continue. An $875,000 project to convert to LED bulbs is currently underway.
Cost: Varies. Annual Savings: Variable. Lifespan: 10 years.

5) **Renovation guidelines.** Develop a policy for stringent mechanical and electrical designs with respect to renovations. It is common for lab spaces to be over engineered with regards to estimated heat loads, electrical loads, and cooling loads. Oversizing HVAC equipment leads to short cycling, poor overall equipment performance, and high electrical demand spikes. Ensuring the optimum sizing of equipment and infrastructure leads to a better overall performance of the space as well as more satisfied occupants. This organizational measure requires enhanced communication between the space occupant, designer, and operator.
Cost: Internal. Annual Savings: unknown. Lifespan: indefinite.

6) **Fume hood design.** The industry standard for fume hood design is 100 fpm face velocity. Makeup air for fume hood needs is a large energy use for buildings with labs. This organizational measure is to develop a set of design criteria for all new fume hoods. Recent research into containment velocities will be used and evaluate the cost benefit of monitored demand-based fumes hoods.
Cost: Completed in-house. Annual Savings: TBD. Lifespan: 20 years.

7) **Residence energy efficiency behaviors.** Improved marketing of energy conservation at student residences and on campus with attention to plug loads. This will be a broad-based behavioral measure to ensure students and employees are more aware of the energy impacts of various choices that they face on a day-to-day basis, including lighting management in suites, leaving appliances running, phantom power, and use of windows/curtains. Cost: Internal. Annual Savings: unknown. Lifespan: 5 years.

8) **Improved electrification in CLVN and CLVS.** CLVN needs to coordinate with property management company to reduce the gas consumption and summer fan energy consumption. The idea is to install air source heat pump for CLVN houses. This will reduce the gas consumption by 50%. For CLVS the control over the baseboard heater with smart thermostat will save the electricity in winter.

   Cost: Varies Potential Savings: 15-20% Savings Lifespan: Indefinite

9) **Demand Control Ventilation based Lab controls.** Our campus has many wet labs and dry labs fed by dedicated outside air units which condition the air before it is fed to the lab space. By installing indoor air quality sensors, we can monitor the air quality and bring in fresh air as per the requirement of the space. This will save lots of energy in gas and electricity consumption.

   Cost: Varies Potential Savings: 10-15% Lifespan: Indefinite

10) **Summer steam shutdown plan.** Waterloo operates its central steam plant year-round. Under this initiative, there will be a gradual process to identify all baseload non-space heating steam loads and develop alternative options to supply steam. For example, this would begin converting current DHW systems from steam to either local electric hot water tanks or air/water source heat pumps. Other non-heating steam loads can be switched to more localized steam generation.
    Cost: Varies Potential Saving: 1.3-million meter cube of gas Lifespan: indefinite.

__Technical Energy Measures__

11) **Door and Window sealing**: This initiative is to fix gaps in caulking and seals in doors and windows in two pilot buildings. This will preserve thermal energy by reducing the dissipation through leaks.
    Cost: $200,000. Annual Savings: 2% - 3%. Lifespan: indefinite.

12) **Steam trap repairs**: This is the final phase of a multi-year project to replace failed steam traps with to improve the condensate return performance of the steam system. The full project is expected to reduce central plant gas consumption by approximately 7%.
    Cost: $550,000. Annual Savings: 7% - 8%. Lifespan: 10 years

13) **Submetering project**: This project involves installing electricity, steam, gas, chilled water, and DHW meters for all buildings connected to the University's central plant and district energy system. These meters are essential to more accurately calculate the energy consumption at the building level and identify key performance indicators like Energy Usage Intensity. It supports efforts to benchmark energy usage across the campus and guide to take informed decisions on our net zero path, such as understanding more accurate thermal peak loads and identifying areas of simultaneously heating and cooling.
    Cost: $7 Million. Annual Savings: NA Lifespan: indefinite.

14) **Re-commission building mechanical systems**. Develop and implement a systematic, documented process for optimizing existing system performance. Systems will be compared to the original design intent and improved where cost effective changes can be made.
    Cost: $150- 200k/year. Savings: 2-3% of operating cost of building. Lifespan: 7 years. 2-3% savings are likely if a building is recommissioned every 7 years.

15) **Battery storage**: Waterloo will explore opportunities to install a battery within the campus grid, to be utilized to manage peak demand, convert solar power into a dispatchable source, provide resiliency benefits, and deliver other grid services.
    Cost: TBC Potential Savings: Unknown Lifespan: Indefinite

16) **MC QNC Heat Recovery Chiller:** A new heat recovery chiller is set to be installed and operational by the end of 2025 in the penthouse mechanical room of the Quantum Nano Centre (QNC). This chiller is designed to serve as the primary cooling source for the Graham Data Centre, located in the Math and Computers (MC) building. All heat from the chiller's condenser will be used to heat the year-round booster hydronic heating loop in QNC. The heat recovery chiller has a cooling capacity of 1,000 kWt and a heating capacity of 1,650 kWt. The heating from the heat recovery chiller will offset the need for heating from the campus steam central plant, thereby reducing natural gas consumption and lowering carbon emissions.
    Cost: $.TBC Annual Savings: 7% Lifespan: 15 years

17) **Steam condensate insulation.** The campus has a central steam district energy system. High-pressure steam is distributed from the steam plant to most buildings within the Ring Road. While most of the condensate and high-pressure steam piping are currently insulated, many parts remain uninsulated. Insulating these uninsulated sections would save energy by reducing heat loss in the distribution network.

    Cost: $ 599,007. Annual Savings: 439,000 M^3 of gas. Lifespan: indefinite.

Renewable Energy Sources

60 kW solar collector EV3 – Refurbished in 2019.

University of Waterloo - Energy Conservation and Demand Management Plan 2024

June 2024

Summary

The University is managing existing infrastructure renewal and strategically investing into energy improvements within limited budgets. Physical growth of the University, to address changing demands for academic excellence, continue and contributes to overall energy consumption. New construction standards have been put in place to ensure energy efficiency for new infrastructure, and renovation guidelines are being developed.

Approval

Draft dated 28th June, 2024. Waiting VPAF approval.

June 2024

Appendix A – Energy calculations

All information was based on fiscal year (May-April). Current data has switched to calendar year to align with other government submissions. 2013/2014 is the base year for reference. 0.0036 GJ/kWh; 0.0389 GJ/m^3.

Year	Gross Area (m^2)	Hydro ('000 kWh)	Gas ('000 m^3)	Total Energy (GJ)	Energy Intensity (GJ/m^2)
2002/2003					1.44
2003/2004					1.32
2004/2005					1.27
2005/2006					1.39
2006/2007					1.45
2007/2008					1.43
2008/2009					1.41
2009/2010					1.36
2010/2011					1.49
2011/2012					1.34
2012/2013					1.64
2013/2014	647,485	115,465	17,973	1,114,824	1.72
2014/2015	661,371	116,077	18,940	1,154,643	1.75
2015/2016	681,754	121,360	16,325	1,071,939	1.57
2016/2017	694,555	130,149	17,366	1,144,074	1.65
2017/2018	712,478	132,421	19,113	1,220,211	1.71
2018/2019	773,557	137,025	18,496	1,212,795	1.57
2019	788,228	133,396	19,260	1,229,440	1.56
2020	788,228	115,072	17,363	1,089,680	1.38
2021	788,228	120,938	17,197	1,104,340	1.40
2022	788,228	129,550	17,672	1,153,821	1.46
2023	788,228	125,508	16,200	1,065,638	1.35
2024					