CORPORATE POLICY

Policy Title:	**Green Building Policy for City-Owned Buildings**
Policy Category:	**Administration Policy**
Policy No.:	A-033
Department:	Community Services
Approval Date:	September 24, 2018
Revision Date:	April 25, 2022
Author:	Scott Prevost, Energy Program Manager, Facility Design and Management Services
Attachments:	None
Related Documents/Legislation:	CORP2018-067, COM2021-027
Key Word(s):	Green Building, Greenhouse Gas, Carbon, Energy Efficiency, Sustainability

POLICY STATEMENT:

The City of Waterloo is committed to reducing Greenhouse Gas (GHG) emissions associated with all City-owned buildings. Reducing building GHG emissions provides significant environmental benefits at a local and global level, as well as social and financial benefits.

The City of Waterloo has committed to reducing community GHG emissions 50% by 2030 and 80% by 2050 relative to 2010 absolute emission levels. These reduction targets have also been set for City-owned buildings. This Policy has been updated to incorporate building principles to aid in achieving these goals.

The Policy is divided into three (3) sections that cover the life cycle of buildings as experienced by the City including:

- New Building Construction and Expansion
- Existing Building Major Retrofits
- Building Operation, Maintenance, and Renewals

PURPOSE:

Mandatory Policy, *Municipal Act*: No
Policy Administration Team, Review Date: February 28, 2022
Corporate Management Team, Review Date: March 30, 2022

The City of Waterloo's Green Building Policy (GBP) for Corporately Owned Buildings provides a framework for new building construction and expansion, existing building major retrofits, and building maintenance of existing (and new) corporately owned buildings to achieve low carbon or zero carbon (ready) operation. In May of 2021, City of Waterloo Council endorsed TransformWR, a framework for reducing community GHG emissions (relative to 2010 levels) by the following:

- 50% reduction by 2030.
- 80% reduction by 2050.

With endorsement from Council, City staff have adopted these same targets for corporately owned buildings.
The Green Building Policy was developed to support meeting these targets at corporately owned buildings.

Looking within the City's operations as a municipality, corporately owned buildings make-up approximately 70% of total corporate City of Waterloo GHG emissions. These emissions represent the largest opportunity for GHG emissions reductions within City operations. The GBP provides a framework to guide 1) new building construction and expansion, 2) existing building major retrofits, and 3) existing building maintenance to achieve these GHG emissions.

These three (3) aspects encompass typical operations/phases City buildings experience and by addressing them, the City can incorporate GHG reductions into planning, design, construction, and operation of buildings.

DEFINITIONS:

"Building Performance" refers to the qualitative or comparative evaluation of the building's total energy use intensity, thermal demand intensity, greenhouse gas intensity, and/or water efficiency.

"Carbon Dioxide Equivalent (CO_2e)" is a term used to define greenhouse gases that have different global warming potentials to a standard unit of global warming impact, in units of carbon dioxide equivalent.

"Dedicated Outdoor Air System (DOAS)" is HVAC equipment that supplies 100% outdoor air to the served spaces only (no return air is mixed into the supply air).

"Electrification" refers to replacing natural gas fuelled heating systems to electrically powered systems.

"Embodied Carbon" is the carbon dioxide equivalent emissions associated with the building construction including manufacturing, transportation, installation, maintenance, and disposal of building materials.

"Global Warming Potential (GWP)" is a measure of how much energy the emission of one (1) tonne of gas will absorb over a period of time, relative to how much energy the emission of one (1) tonne of carbon dioxide will absorb over the same period of time. The higher the global warming potential, the more heat the gas will trap within the earths' atmosphere.

"Greenhouse Gas (GHG)" are gases that trap heat in the atmosphere. Gases other than carbon dioxide can be categorized as greenhouse gases, including methane, refrigerants, nitrous oxides, and others.

"Greenhouse Gas Intensity (GHGI)" is defined as the annual Scope 1 and Scope 2 emissions in units of kilograms per carbon dioxide equivalent (kg/CO2e) emitted from the building per unit building gross area.

"Gross Area" of a building is defined as the sum of every building floor area above grade.

"Heat Recovery Ventilator (HRV)" is HVAC equipment that transfers energy from the exhaust air stream to the ventilation (outdoor) air stream thus recovering energy that would otherwise be directly exhausted and lost to the ambient.

"Like-for-similar" refers to replacing existing equipment with a modern equivalent or accepted alternative that serves the same purpose and function, using the same sources of energy, delivery methods, etc.

"Renewable Energy Credit (REC)" is a certificate associated with the production of a unit of energy from a renewable generation source, such as solar photovoltaic electricity or wind power that entitles the certificate holder to claim an equal amount of energy (consumed by the holder) was generated by renewable sources.

"Representative Concentration Pathway (RCP)" is a trajectory scenario of greenhouse gas concentrations in the earth's atmosphere. Different scenarios are used to model different levels of possible global emissions that would lead to different (increased) greenhouse gas concentrations as a way to model future climate.

"Scope 1 Emissions" are direct greenhouse gas emissions from the building, such as natural gas combustion in building equipment for heating.

"Scope 2 Emissions" are indirect emissions from the generation of purchased energy that is consumed onsite, such as importing electricity from the grid that was generated at a natural gas powered generating station.

"Scope 3 Emissions" are all indirect emissions, not captured in Scope 2, resulting from upstream and downstream activities.

"Thermal Energy Demand Intensity (TEDI)" is defined as the annual heating energy, from all heating sources, delivered to the building per unit building gross area.

"Total Energy Use Intensity (TEUI or EUI)" is defined as the annual amount of energy, from all energy sources, delivers to the buildings per unit building gross area.

"Zero Carbon Building (ZCB)" is a highly energy efficient building that produces onsite, or procures, carbon-free renewable energy or high-quality carbon offsets in an amount sufficient to offset the annual carbon emissions associated with building materials and operations (Zero Carbon Building Design Standard Version 2, Canadian Green Building Council).
"Zero carbon ready" refers to a building that is highly energy efficient with the goal or intent of becoming a zero carbon building at some point in the future, typically through the addition of renewable energy generation, such as solar photovoltaic panels or solar thermal heating, and/or the purchase of renewable energy credits or carbon offsets. Zero carbon ready buildings do not require overhauls to their building enclosure, mechanical, or electrical systems to become zero carbon.

SCOPE:

This policy applies to all City staff, consultants, contractors, vendors, and any parties involved in the design, construction, or servicing of all City owned buildings.

This policy includes three (3) sections:

1. NEW BUILDING CONSTRUCTION AND EXPANSION.

2. EXISTING BUILDING MAJOR RETROFITS.

3. BUILDING OPERATION, MAINTENANCE, AND RENEWALS

Within those sections, targets and thresholds for GHG emissions, embodied carbon, energy efficiency, renewable energy generation, water conservation/efficiency, and electric vehicle infrastructure are provided.

Where not specifically falling under the GBP, the lens and intent of the GBP will be applied to all building work and projects.

POLICY COMMUNICATION:

This Policy will be posted on the City's website and intranet. City staff will be advised of the new Policy via distribution to the Leadership Team.
POLICY:

The City of Waterloo Green Building Policy for City-Owned Buildings is a divided into three (3) categories, representing cycles experienced by City buildings. A framework is

provided within each category to provide direction and targets for City staff to adhere to and meet when constructing, retrofitting, or maintaining buildings.

This policy is design to align with published zero carbon building standards, including (but not limited to):

- Canadian Green Building Council's (CaGBC) Zero Carbon Building Design Standard Version 2.
- CaGBC's Zero Carbon Building Performance Standard Version 2.
- Published municipal green building policies/standards, such as City of Toronto's Green Building Standard.
- City of Waterloo's Corporate Greenhouse Gas and Energy Roadmap – Phase 1 (COM2021-027).

NEW BUILDING CONSTRUCTION AND EXPANSION

1. Purpose

    1.1. The purpose of the NEW BUILDING CONSTRUTION AND EXPANSION section is to provide a framework to build zero carbon ready buildings from initial construction.

2. Application

    2.1. Applies to all corporately owned new buildings or expansions (excluding storage and non-occupied buildings) greater than or equal to 100 square meters (1,076 square feet) in gross building area, excluding storage or unoccupied buildings except where specifically indicated.

    2.2. New buildings or expansions with gross building area less than 100 square meters or classified as storage or non-occupied shall have electric space and water heating where heating is required.

    2.3. Storage and unoccupied buildings shall have electric space and water heating (electrification).

3. Zero carbon ready building process

    3.1. New building construction or expansion shall be executed according to the following process:

        3.1.1. Zero carbon ready feasibility study (complexity will vary based on building complexity).

        3.1.2. Selection of zero carbon ready pathway.

        3.1.3. Building engineering and architectural design.

        3.1.4. Construction.

        3.1.5. Commissioning.

        3.1.6. Measurement and verification.

    3.2. A zero carbon ready feasibility study shall be completed according to the requirements set out in this Policy.

    3.3. The zero carbon ready feasibility study may occur after an initial needs assessment or building feasibility study, that determines the general shape, size, and operation of the building, or during/be part of schematic design phase to inform design. The zero carbon ready design may evolve during the design, based on project constraints or performance and proper measures will be in place to identify and rectify unforeseen developments.

3.4. Results of the zero carbon ready may be presented to Council for direction on how to proceed with a zero carbon ready building design approach. Different building GHG scenarios with associated costs shall be included to allow Council to make an informed decision. Council may or may not be engaged for medium or small value projects, or projects that follow a previously demonstrated approach.

3.5. When a direction is received from Council, that direction shall guide the design of the building systems to achieve the desired GHG emissions levels and energy performance.

3.6. An integrated design approach incorporating all designers and stakeholders shall be utilized.

3.7. An energy modelling consultant shall be retained to ensure the design process reflects the performance desired from the carbon study. Deviation from the GHG emissions targets, demonstrated through energy modelling, shall be addressed at that time.

3.8. A carbon/energy consultant may be retained to provide carbon expertise during the project and ensure the project mandates are met with respect to GHG emission reductions and energy conservation.

3.9. A building science consultant may be retained.

3.10. The roles of the energy modelling consultant, carbon/energy consultant, and building science consultant shall be further defined depending on and for each project. For larger projects, it is expected the consulting roles for energy modeller, carbon/energy consultant, and building science consultant will be retained.

3.11. An independent Commissioning (Cx) Provider and Building Envelope Commissioning (BECx) shall be retained by the City to commission the building.

3.12. Post project Measurement and Verification (M&V) shall be completed according to the requirements set out in this Policy.

4. Energy and GHG incentives

4.1. The City will apply for all available energy incentives including electricity, natural gas (if applicable), renewable energy generation, and water.

4.1.1. There has been historically limited opportunity for substantial energy based incentives through existing on-going programs (such as SaveOnEnergy and Enbridge administered programs).

4.2. Contractors performing work for the City shall provide documentation to support the incentive applications including quotes, invoices, and specification sheets.

5. Greenhouse gas and energy requirements

5.1. New building construction or expansion shall be required to meet one of the following:

5.1.1. Canadian Green Building Council Zero Carbon Building Design Standard Version 2.

- Registration and certification shall be not an absolute requirement.

5.1.2. Building energy/GHG performance as defined in Table 1 with the intent of being zero carbon ready:

Table 1: Building performance requirements

Building type	**EUI (kWh/m^2/year)**	**TEDI (kWh/m^2/year)**
Arenas, Recreation	Case-by-case	Case-by-case
Fire station	75	25
Library	75	25
Office	75	25
Unoccupied/storage	50	15

5.1.3. New arena and recreation facilities may vary considerably with respect to function, space, size, systems, and other factors. Targets will be set on a case-by-case basis, based on current (at that time) standards, technology, industry accepted metrics, and the City's own past experiences.

5.1.4. Greenhouse Gas Intensity (GHGI) metrics are intentionally omitted to reflect the anticipated zero carbon ready building efficiency approach of 1) Efficient building enclosure and mechanical/electrical systems 2) Renewable energy generation to the extent possible 3) Renewable Energy Credit (REC) or carbon offsets (which are not required). Remaining building carbon emissions will be due to grid electricity (and embodied carbon).

5.1.5. Multi-use buildings shall meet the requirements set out in Table 1 for the applicable areas.

5.2. Space and water heating systems shall be electrically powered/fueled.

5.2.1. Natural gas shall not be permitted for general commercial space and water heating.

5.3. Natural gas shall be permitted for process systems (kitchen range for example), excluding water heating for ice resurfacing.

5.4. Scope 1 and Scope 2 emissions shall be included when calculating building performance requirements in Table 1.

6. Renewable energy

6.1. Renewable energy generation systems that will be considered include:

6.1.1. Solar Photovoltaic (PV).

6.1.2. Solar thermal air heating.

6.1.3. Solar thermal water heating.

6.1.4. Wind.

6.2. Buildings shall be built “solar ready” following principles from:

6.2.1. Solar Ready Buildings Planning Guide (Technical Report NRLE/TP-7A2-46078) published by National Renewable Energy Laboratory (NREL).

6.2.2. Design processes shall allow the building to readily accept the required solar PV array in the future, which includes:

- Proper structural support of roof areas designated to support solar.
- Required electrical conduit and infrastructure including panels, meters, controls, and transformers required to be compatible with the solar PV array.

6.3. Solar PV array size should supply at least 20% of total building electricity needs or cover at least 75% of suitable roof area.

6.3.1. In addition, optimum solar PV array size will also be determined through:

- Estimated total building electricity use.
- Suitable roof and parking lot area to install an array.
- Available grants and solar PV incentive programs, including net metering.

- Life Cycle Assessment (LCA) showing that the installation meets current City financial goals and requirements for GHG reduction targets/projects.

6.3.2. When building/site conditions and budget permit, virtual net metering will be considered (if a virtual net metering program exists).

7. Renewable energy credits and carbon offsets

7.1. The City shall not be required to purchase Renewable Energy Credits (RECs) or carbon offsets to offset GHG emissions unless specifically directed to do so.

7.1.1. Funds that would have been used to purchase RECs could potentially be used at existing City-owned buildings to directly reduce GHG emissions and energy requirements, while also reducing utility costs and addressing infrastructure requirements.

7.1.2. Installing solar PV arrays provides an on City buildings/property provides an alternative to purchasing RECs that also yields a positive Return on Investment (ROI). GHG reductions through solar PV depend on the carbon intensity of the Ontario electricity grid.

8. Zero carbon ready feasibility study

8.1. A zero carbon ready feasibility study shall be undertaken as per the process outlined in this Section.

8.2. Specific terms of reference for the study shall be developed and issued at that time that account for building type and function. Study complexity will vary according to building complexity.

8.3. The study shall evaluate multiple measures and scenarios to achieve a zero carbon ready building design and operation.

8.4. Measures shall include active, passive, renewable energy generation, and on-going building operations.

8.5. A building energy model shall be created to model building performance. Acceptable energy modelling software and standards shall be defined in the terms of reference. Energy modelling will consider electricity carbon emission factors depending on time of day (marginal emission factors).

8.6. Energy model may consider additional parametric weather files based on projected Representative Concentration Pathway (RCP) scenarios.

8.7. A LCA shall be included to account for all costs including capital, operation, maintenance, utility, and operational carbon (from energy use). A separate LCA scenario will account for embodied carbon/GHG emissions.

8.8. A table summarizing different zero carbon ready design scenarios shall be included.

8.9. The study shall be completed within a time frame that is acceptable to inform building design.

9. Energy modelling

9.1. The City shall an independent energy modeler to simulate building performance, which may include additional parametric weather files based on different RCP scenarios.

9.2. Energy models will generally align with:

9.2.1. Schematic design phase.

9.2.2. Detailed design phase.

9.2.3. Changes from detailed design during construction or shop drawing review that could have positive or negative impacts.

9.2.4. As-built construction.

9.3. Deviation (poor performance) from the intended building performance shall be addressed and rectified at that time.

10. Embodied carbon

10.1. An embodied carbon reduction of at least 20% compared to a baseline building will be investigated.

10.2. A separate LCA will include embodied carbon of the construction project including manufacturing, transport, use, and end-of-life building materials, in addition to the operational carbon.

10.3. Embodied carbon assessment shall meet at a minimum the requirements outlined in the current version of CaGBC Zero Carbon Building Design Standard, including a LCA from a suitable software that demonstrates all life cycle components have been accounted for in the LCA.

10.4. The City shall not be required to purchase RECs or carbon offsets to offset embodied carbon if the 20% reduction is not met.

10.5. If/when virtual net metering is available, the City may utilize virtual net metering as identified in this Policy.

11. Commissioning

11.1. An independent Cx Provider and BECx Provider shall be retained by the City to provide services during the design, construction, and post construction phases.

11.2. Cx and BECx will align with the latest versions of industry Cx and BECx standards, that may include standards from American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE), Canadian Standards Association (CSA), American Society for Testing and Materials (ASTM), North American Industry Classification System (NIBS), etc.

11.3. Building airtightness performance will be dependent on building type and size, but will target air leakage rates of 1 L/s/m2 at 75 Kilopascal (kPa) or better.

12. Measurement and verification

12.1. All new occupied building construction and expansion, excluding storage, shall be provided with a Building Automation System covering, at the least, Heating Ventilation and Air Conditioning (HVAC) systems, lighting, refrigeration, equipment, pool equipment, and any other major systems the building may be equipped with.

12.2. The Energy Management System (EMS) shall be integrated with the BAS or a stand-alone EMS utilized by the City.

12.3. The EMS should provide measurement points that are capable of estimating Thermal Energy Demand Intensity (TEDI).

12.4. One (1) year post construction M&V reporting shall:

12.4.1. Report on Energy Use Intensity (EUI).

12.4.2. Report on TEDU to the extent possible.

12.4.3. Report on Greenhouse Gas Intensity (GHGI).

12.4.4. Report on performance of major HVAC and electrical systems.

12.4.5. Provide a snapshot of the current BAS scheduling and control set points.

12.4.6. Provide a course of action (and explanation) to improve building performance if EUI is worse than modelled and cannot be reasonably explained. Corrective action may include:

- Reconducting building airtightness test.
- Reprogram or modify BAS settings.

- Recommission certain aspects of the building.

12.4.7. Report on water use.

12.5. M&V reporting will generally align with (including the above):

12.5.1. ASHRAE Guideline 14

12.5.2. Most appropriate International Performance Measurement and Verification Protocol (IPMVP) Option

12.6. If zero carbon certification is required, it must be directed at the onset of the project. The project would then follow the current version of CaGBC ZCB-Design during design and CaGBC Zero Carbon Building - Performance (ZCB-Performance) will be followed.

13. Water conservation

13.1. Water and plumbing will be designed to minimize water consumption on-site and water run-off from the building footprint.

13.2. A green roof should be considered, secondary to solar PV installations, on available space.

14. Electric vehicle infrastructure

14.1. When new parking lots are constructed as part of the building construction or expansion, a certain percentage of parking spaces shall be constructed as "Electric Vehicle (EV) ready". EV ready is generally defined as:

14.1.1. Ensuring propelectrical infrastructure is provided for future use.

14.1.2. Underground conduits are run to future spots to avoid excavation in the future.

14.1.3. Proper wire is installed in conduit.

14.1.4. Communication is available to connect EV chargers to controls systems.

14.1.5. Electrical panels and transformers do not require replacement or modifications to accommodate EV chargers.

14.2. The percentage of “EV ready” parking spaces will be determined at the time in coordination with broader City policy

EXISTING BUILDING MAJOR RETROFITS

1. Purpose

    1.1. The purpose of the EXISTING BUILDING MAJOR RETROFITS section is to provide a framework to convert existing buildings and/or building systems to energy efficient low carbon replacements aligning with required major overhauls/rehabilitation of infrastructure, inline with meeting City-owned building GHG emission reduction targets.

2. Application

    2.1. Applies to all Deep Energy Retrofits (DERs) of corporately owned buildings, excluding storage or unoccupied buildings.

        2.1.1. DER refers to a holistic retrofit of a building or building system(s) with the intent of achieving significant GHG emission and energy use reductions.

        2.1.2. DER projects are generally aligned with large capital replacement projects.

        2.1.3. DER is categorized as a non-routine replacement/upgrade of an entire building or building system(s).

    2.2. Storage and unoccupied buildings shall have electric space and water heating (electrification).

3. Heritage buildings

    3.1. Heritage building exterior building enclosure or interior systems may or may not be altered at the direction of the heritage committee in accordance with heritage status.

    3.2. When exterior building enclosure systems cannot be substantially altered, retrofits of heritage buildings will focus on:

        3.2.1. Retrofits of interior perimeter wall and roof systems.

        3.2.2. Mechanical and electrical systems.

        3.2.3. Controls.

        3.2.4. Renewable energy generation.

        3.2.5. Building airtightness.

        3.2.6. Energy efficient cladding, windows, roofing that replicates existing heritage properties (where possible).

4. Deep energy retrofit process

    4.1. A DER study, as defined in this Policy, will be undertaken prior to a DER project of sufficient size, complexity, and scope.

        4.1.1. DER study requirements will also depend on internal City capacity and successfully implemented projects of similar size, complexity, and scope.

    4.2. The results of the DER study may be presented to Council for endorsement of a specific pathway to achieve deep GHG and energy savings or zero/low carbon operation of the building.

    4.3. The endorsed pathway from the DER shall be used to inform design.

    4.4. An energy modelling consultant may be retained to ensure the building redesign reflects the desired performance from the DER.

    4.5. An energy/carbon consultant may be retained to ensure the GHG emissions reduction are met.

    4.6. A building science consultant may be retained for major building enclosure upgrades.

    4.7. The City shall retain an independent Cx Provider for the project.

    4.8. Post DER project M&V shall be undertaken according to this Policy.

5. Energy and GHG incentives

    5.1. The city will apply for all available energy and GHG incentives including electricity, natural gas (if applicable), renewable energy generation, and water.

    5.2. Contractors performing work for the City shall provide documentation to support the incentive applications including quotes, invoices, specification sheets, and proof of disposal.

6. Greenhouse gas and energy requirements

    6.1. DER projects will generally target the following energy and GHG performance improvements:

        6.1.1. 50% - 70% reduction in building EUI.

        6.1.2. For projects involving building enclosures, a 25% - 50% reduction in TEDI.

        6.1.3. 80% reduction in GHGI.

6.2. In subsequent Policy updates, absolute targets for EUI and TEDI for existing buildings will be provided to account for differing building construction, vintages, and to ensure GHG emission reduction targets are met. For example:

6.2.1. The City has five (5) arena/recreation buildings, however only two (2) resemble similar construction and function while the remainder differ considerably. Therefore, individual metrics will be set for arena and recreation facilities (along with the other facilities).

7. Deep energy retrofit feasibility study

7.1. A specific scope of work shall be developed for the DER study at the time of the project.

7.2. DER projects will target absolute EUI and TEDI values specific to the building. This will result in a range of percent improvements in building performance, depending on how efficient the building performance was initially.

7.3. For large holistic projects, the DER study shall conform to, at a minimum, Federation of Canadian Municipalities' (FCM's) GHG Reduction Pathway Feasibility Study Guidance Document.

7.3.1. Study requirements may be altered to conform to existing incentive programs available.

7.4. Multiple scenarios/pathways shall be assessed to achieve the targeted GHG emissions reduction.

7.5. A LCA shall be included to account for all costs including capital, operation, maintenance, utility, and operational carbon (from energy use). A separate LCA scenario will account for embodied carbon/GHG emissions.

7.6. Regardless of the scope of the DER construction project, the DER study will evaluate all building systems for future planning.

7.7. Study shall be detailed enough to inform engineering and architectural design.

7.8. Whole building energy modelling software shall be used to simulate building performance. Energy modelling will consider electricity carbon emission factors depending on time of day (marginal emission factors).

7.9. Multiple parametric weather files based on different RCP scenarios may be assessed.

7.10. Schematic level design and Class C or better cost estimating shall be included.

7.11. Study shall propose an appropriate M&V plan at a high level.

8. Lighting

8.1. Applies to interior and exterior lighting in a DER project.

8.2. All lighting will be converted to Light Emitting Diode (LED) lighting.

8.3. Fixture replacement and/or fixture layout redesign shall be considered in addition to LED lamp replacements.

8.4. All lighting products shall be:

8.4.1. Energy Star Certified and include the product identification number; or

8.4.2. Design Lighting Consortium (DLC) qualified and include the product identification number.

9. Renewable energy

9.1. Renewable energy generation systems to be considered include:

9.1.1. Solar PV.

9.1.2. Solar thermal air heating.

9.1.3. Solar thermal water heating.

9.1.4. Wind power.

9.2. When the existing building roof is structurally adequate, solar PV arrays will be considered to cover at least 75% of the building's suitable roof area or 20% of building electricity use.

9.2.1. When the existing building roof is not structurally adequate, it will be determined at that time if increasing structural load capacity is financially feasible or appropriate to allow solar PV array installation.

9.3. Optimum solar PV array size will be determined through:

9.3.1. Estimated total building electricity use.

9.3.2. Suitable roof and parking lot area to install an array.

9.3.3. Available grants and solar PV incentive programs, including net metering.

9.3.4. LCA showing the installation meets current City financial goals and requirements for GHG reduction targets/projects (which would include costing for structural modification if required).

9.4. LCA should be performed on renewable energy or include renewable energy as part of the overall project to determine the most effective way forward.

9.5. When building/site conditions and budget permit, virtual net metering will be considered (if a virtual net metering program exists).

10. Renewable energy credits and carbon offsets

10.1. The City shall not be required to purchase RECs or carbon offsets when undertaking a DER construction project, unless:

10.1.1. It is mandated by Council.

10.1.2. The project requires CaGBC Zero Carbon Building – Performance (ZCB-Performance) certification.

11. Energy modelling

11.1. Building energy modelling shall be carried throughout the duration of the DER project.

11.2. In addition to the DER study, energy modelling will be conducted at:

11.2.1. Detailed design phase.

11.2.2. Changes from detailed design during construction or shop drawing review that could have positive or negative impacts.

11.2.3. As-built construction.

11.3. Deviation (poor performance) from the intended building performance shall be addressed and rectified at that time.

12. Commissioning and building enclosure airtightness

12.1. An independent Cx Provider shall be retained by the City to provide services during the design, construction, and post construction phases.

12.2. If the DER project involved significant building enclosure retrofits or modifications, an independent BECx Provider shall be retained by the City to provider services during the design, construction, and post construction phases.

12.3. Cx and BECx will align with the latest versions of industry Cx and BECx standards that may include standards from ASHRAE, CSA, ASTM, NIBS, etc.

13. Measurement and verification

    13.1. Whole building M&V shall be reported after one year of operation using:

        13.1.1. ASHRAE Guideline 14 – Measurement of energy, demand, and water savings.

        13.1.2. Most appropriate IPMVP option.

    13.2. One (1) year post construction M&V reporting shall:

        13.2.1. Report on EUI.

        13.2.2. Report on TEDI (to the extent possible).

        13.2.3. Report on GHGI.

        13.2.4. Report on performance of major HVAC and electrical systems.

        13.2.5. Include recommended actions in the event the building is not performing as expected.

    13.3. If zero carbon certification is required post DER, then the current version of CaGBC Zero Carbon Building Performance Standard shall be followed.

14. Water conservation

    14.1. When water and plumbing systems are in scope, water and plumbing shall be designed to minimize water consumption on-site using best practices.

    14.2. The DER should consider a green roof secondary to solar PV if applicable.

15. Electric vehicle infrastructure

    15.1. When new parking lots are constructed, or existing parking lots are excavated, a certain percentage of parking spaces should be provided as “EV ready”. EV ready is generally defined as:

        15.1.1. Ensuring proper electrical infrastructure is provided for future use.

        15.1.2. Underground conduits are run to future spots to avoid excavation in the future.

        15.1.3. Proper wire is installed in conduit.

        15.1.4. Communication is available to connect EV chargers to controls systems.

        15.1.5. Electrical panels and transformers do not require replacement or modifications to accommodate EV chargers.

15.2. The percentage of “EV ready” parking spaces will be determined at the time in coordination with broader City policy.

BUILDING OPERATION, MAINTENANCE AND RENEWALS

1. Purpose

    1.1. The purpose of the BUILDING OPERATION, MAINTEANCE, and AND RENEWAL section is to provide a prescriptive approach to ensure routine building maintenance, equipment replacement, and building operations are energy efficiency and low carbon, in line with meeting City-owned building GHG emission reduction targets.

        1.1.1. Operation relates to on-going operation of the building through controls, schedules, set points, and procedures. Optimizing and improving operation will lead to energy and GHG reductions.

        1.1.2. Maintenance relates to improvements through repairs or (minor) rebuilds. Items such as Light Emitting Diode (LED) lamp replacements and ensuring HVAC cooling equipment has proper refrigerant charge.

        1.1.3. Renewals relates to replacement or total overhaul of equipment or system components. This involves end of life or schedule replacement of HVAC units, pumps, fans, boilers, and others.

2. Application

    2.1. Applies to building energy systems and equipment under normal operation and equipment replaced on a routine end of life or planned replacement basis.

    2.2. In general, replacement equipment shall meet or exceed energy requirements set out in ASHRAE 189.1 – Standard for the design of high performance green buildings.

3. Planning

    3.1. FDMS staff shall develop a plan to convert natural gas fueled heating equipment and systems to electric powered based on replacement schedules.

    3.2. Plan should include:

        3.2.1. Identifying where engineering designs will be required and preparing those to be in place or completed in the event of unplanned failure.

        3.2.2. Addressing electrical infrastructure capacity issues.

3.2.3. Pathway to convert to electric power in the event converting to electric power is not feasible in the replacement time frame or at the existing building.

3.3. Solar PV strategy

3.3.1. FDMS staff shall develop a solar PV strategy including identifying and prioritizing roof areas suitable for solar PV arrays, identifying and assessing any other City owned areas suitable for solar PV arrays, total solar PV generation potential, and cost-benefit analysis projections to aid in decisions of when, where, and the magnitude of solar PV to add to a project.

4. Energy incentives

4.1. The City will apply for all available energy incentives including electricity, natural gas (if applicable), renewable energy generation, and water.

4.2. Contractors performing work for the City shall provide documentation to support the incentive applications including quotes, invoices, specification sheets, and proof of disposal.

5. New technologies

5.1. The City will strive to identify, assess, and pilot out new and emerging technologies that have significant GHG reduction potential or offer significant benefit to the building's energy and/or infrastructure performance. Pilots will be carried out on a case-by-case basis.

5.2. Successfully demonstrated and proven technologies can be incorporated into new building construction and expansion, existing building major retrofits, or building operation, maintenance, and renewals.

6. Building equipment and system types

6.1. Heating, ventilation, and air conditioning

6.1.1. Dedicated Outdoor Air Systems (DOAS)

- When replacing DOAS units, also referred to as make-up air units, heat pump operation shall be the primary mode of heating with natural gas fired heating provided as back-up or auxiliary heat only.

- Solar thermal air heating systems (referred to as solar walls) will be considered to provide renewable heating energy to DOAS units.

6.1.2. Furnaces

- Applies to all residential and light commercial style forced air natural gas fired furnaces.
- Furnaces shall be replaced with Air Source Heat Pumps (ASHPs) with electric resistive heat.
- Heat pumps providing outdoor air ventilation shall be equipped with Energy Recovery Ventilators (ERVs) or Heat Recovery Ventilators (HRVs) as applicable.
- When the building served by the furnace is connected to the City's BAS, new furnaces shall be connected to the BAS.

6.1.3. Infrared heaters

- Applies to all natural gas fired infrared tube heaters.
- Where the electrical infrastructure capacity exists, natural gas fired infrared tube heaters with a heat output equal to or less than 20 kilowatts (kW) shall be converted to electrical infrared heaters. Where multiple heaters serve an area and the combined output is greater than 20 kW, an assessment will be made on a case-by-case basis.
- Natural gas fired infrared tube heaters serving arena (ice rink) stands shall be converted to electrical infrared heaters, regardless of heating output capacity.

6.1.4. Rooftop units/air handling units – Built up

- Applies to all built up, constant volume or variable volume, hydronic or natural gas heat/electric or hydronic cool Air Handling Units (AHUs).
- Built up replacements will consider:
    - Converting constant volume units to variable volume, which may include adding Variable Frequency Drives (VFDs), pressure transmitters, and modulating dampers.
    - Conversion of hydronic heating coils to water-to-air heat pump heating coils.
    - When AHU heating coils are natural gas fired, and the building is served by a hydronic heating system, it will be investigated if the hydronic heating system can be

connected to a water-to-air heat pump heating coil to serve the AHU heating loads.

- Incorporating energy or heat recovery.

6.1.5. Rooftop units/air handling units – Packaged

- Applies to all commercial packaged, constant or variable volume, gas heat/electric cool Rooftop Units (RTUs).
- RTUs shall be replaced with ASHPs with electric auxiliary heat as back-up.
- Incorporating energy recovery in the RTU will be considered on a case by case basis according to the amount of ventilation air and operating schedule of the RTU.
- Where existing electrical infrastructure is insufficient and cost prohibitive to upgrade, the unit will be replaced like-for-similar in accordance to this Policy.

6.1.6. Unit heaters

- Applies to all natural gas fired unit heaters with heating output equal to or less than 20 kW.
- Natural gas fired unit heaters shall be replaced with electric resistive unit heaters, electric infrared heaters, or ductless split ASHP systems.

6.2. Cooling plants

6.2.1. Chilled water plants

- Applies to chilled water plants, including both air cooled and water cooled plants.
- Primary only chilled water systems will have a plan to convert to variable flow where possible
- Control valves will be converted from three-way valves to two-way valves as part of the plan.
  - Chilled water pumps shall be retrofitted with Variable Frequency Drives (VFDs).
- Floating head pressure on condensers will be implemented where possible.

- Chilled water supply temperatures will be reset based on outdoor conditions and building load.
- Chiller plant optimization may be investigated for chiller plants of sufficient size.
- Where simultaneous heating and cooling is required, heat recovery chillers will be investigated for planned replacement. Heat recovery chillers will be prioritized over free cooling chillers.

6.2.2. Refrigeration plants

- Applies to all refrigeration plants serving ice rinks and arenas, excluding the mobile refrigeration plant serving the outdoor rink in Uptown Waterloo.
- Total refrigeration plant optimization will be investigated.
- Evaporative condensers shall be retrofitted with floating head pressure controls and evaporative condenser fans shall be retrofitted with VFDs.
- Refrigeration plans shall incorporate heat recovery from the high pressure refrigerant discharge.
- Heat recovery heat exchangers shall be sized to incorporate heat recovery for future uses including domestic water preheating, ice resurfacing water preheating, building heating loops, geothermal fields (if applicable), and snow melt pits.

6.2.3. Heating plants

- Applies to all natural gas fired boilers serving building space heating and/or connected to domestic water heating systems.
- The following will be considered when replacing natural gas fired boilers with electrically powered systems:
    - Heat output requirements.
    - Existing building electrical infrastructure capacity.
    - Changes to utility classification should an electric boiler be installed.
    - Timing of potential DER projects to the building.

- Natural gas boilers will be considered for replacement with or supplemented by air-to-water heat pumps, Ground Source Heat Pumps (GSHPs), or electric resistive heating where permissible.

6.2.4. Lighting

- Applies to exterior wall packs. Exterior pole lighting, and interior lamps.
- Exterior wall packs shall be replaced with LED equivalent.
- Exterior pole mount lighting shall be replaced with Led equivalent.
- Exterior lighting shall be controlled through a programmable timer reset based on season or through photocells.
- Interior bulbs, including incandescent, Compact Fluorescent Light (CFL), and pressure sodium, shall be replaced with LED equivalents.
- Interior fluorescent lamps (T8) shall be replaced with T8 LED tubes.
- Light fixtures, when replaced, shall be replaced with LED fixtures.
- Lighting controls shall be converted over to controls required by the current version of ASHRAE 189.1 as an on-going process.

6.2.5. Service water heating

- Domestic water heating
    - Residential style natural gas fired service water heaters shall be replaced with either a combination heat pump/electric resistive service or electric resistive service water heater.
    - Commercial style natural gas fired service water heater shall be replaced with either:
    - Combination air or water source heat pump with electric resistive.
    - Electric resistive.

Like-for-similar if electrical infrastructure cannot supply an electric powered service water heater. In this event, a design will be undertaken to convert to electric service water heating.

- Ice resurfacing water heating
    - Applies to water heaters providing hot water for ice resurfacing purposes.
    - Water heaters shall be replaced with condensing natural gas fired water heaters when unplanned failure occurs.
    - Make-up water to water heaters shall, at the least, be pre-heated through desuperheater heat exchangers in the refrigeration plant.
    - Water heating systems will be assessed to be connected to the refrigeration plant heat recovery system through water-to-water source heat pumps as means to electrically heat ice resurfacing water.

6.3. Building automation systems

6.3.1. Applies to all buildings and systems controlled by a centrally accessible Building Automation System (BAS).

6.3.2. BAS controls, scheduling, and set points shall be determined by building, zone, and system type, and reviewed on an annual basis.

6.3.3. Each BAS will have in place:

- Default schedules for zones controlled by the BAS.
- Default control set points, such as temperature and relative humidity, for zones controlled by the BAS.
- List of operators with privileges

6.3.4. A process will be established to identify and address changes to defaults BAS controls, set points, and schedules. Any operational changes will be reviewed with a plan in place to revise the default setting or revert back to the existing default setting.

6.3.5. Recommissioning projects should include addressing BAS to improve building performance through identifying faulty controls, or controls that are not operating as intended or applicable, and by improved and updated sequences and set points.

POLICY UPDATES

Revisions to the Policy will be summarized and provided to Council in the annual Green Building Policy report.

COMPLIANCE:

In cases of policy violation, the City may investigate and determine appropriate corrective action.