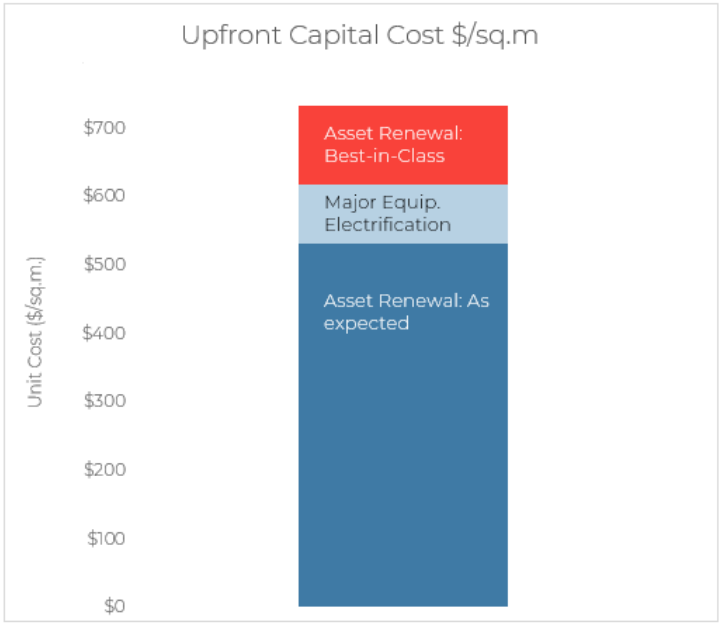
Prepared by WSP Canada for City of Ottawa, April 2023

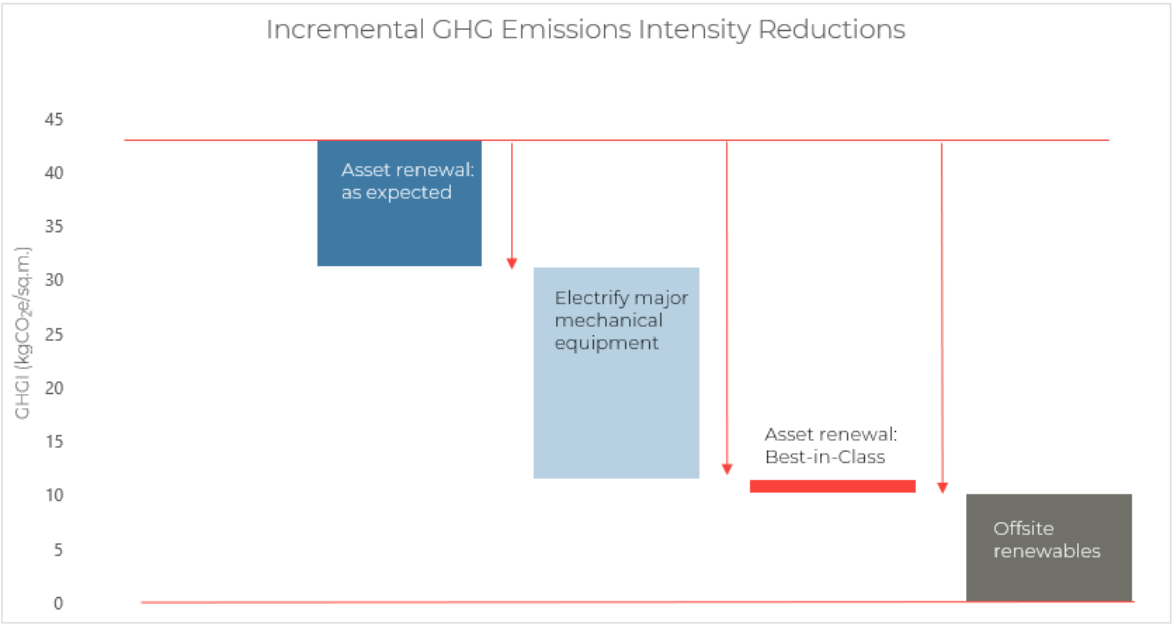
LOW RISE OFFICE BUILDINGS

CITY OF OTTAWA: ZERO CARBON READY RETROFIT PATHWAY

Low rise office buildings for commercial and industrial purposes were mostly built around 1970. There are an average of 35 suites in this archetype with a gross floor area of approximately 2,452 sq.m.

The charts below depict the upfront capital and greenhouse gas (GHG) intensity reduction of three progressive retrofit pathways, as defined below.





In fully transitioning to Zero Carbon Ready, the analysis shows the following incremental costs vs asset renewal as expected:

UPFRONT CAPITAL COST		ENERGY COST SAVINGS		GHG EMISSIONS REDUCTION		LIFE-CYCLE COST PER TONNE CO_2e SAVED (OVER 25-YEARS)	
$202/m²	+38%	$7/m²/year	-20%	20 kg CO_2e/m²/yr	-68%	$-100/t CO_2e	-115%

Building System Upgrade Matrix:

	BUILDING SUB-SYSTEM	EXISTING/TYPICAL	DEEP RETROFIT UPGRADE
Low rise office buildings	Enclosure	Roofs and walls with minimal or no insulation. Windows are double-glazed and have often been replaced at least once but may soon be ready for renewal again.	Reclad exterior walls with additional insulation up to R-20 continuous. Install roof insulation including re-insulating & expanding parapets. New best-in-class double-glazed windows in thermally-broken frames, insulated and air-sealed doors. New vestibules, where feasible
	HVAC Delivery Systems	Space heating is delivered by hot water baseboards or fan-coil systems. Typically, no central cooling. Pressurized corridor ventilation system. Building automation systems are simple, if present.	Dedicated outdoor air systems (DOAS) with energy recovery and enhanced controls.
	Fuel switching	Heating systems are gas-fired hot water boilers, typical efficiency (80%).	Best-in-class rooftop units with variable-speed fans and cold climate air-source heat pumps. Back-up electric resistance heaters
	Domestic Hot Water Heating & Appliances	Domestic hot water boilers are similar to (or the same as) main heating ones. Appliances and faucets are tenant-selected, so a mix of quality/efficiency.	Air-source heat pump hot water heating systems.
	Solar Photovoltaic (PV)	No renewable power systems.	Install a solar array covering 50% of roof area.

Important Life-cycle Cost & Carbon Analysis Assumptions:

Electricity Rate 11-15 ¢/kWh; Electricity Escalation 2.0%

Natural Gas Rate 19-24¢/m3; Natural Gas Escalation 2.0%

The cost of carbon timeline aligns with the November 2020 announcement by the federal government to escalate the carbon tax to $170/tonne to 2030 and was projected to stay flat until 2050

Discount rate 2.5%; Inflation 1.9%

What are the holistic benefits of the Deep Retrofit package?

Climate Resilience & Occupant Comfort. Enclosure & ventilation system upgrades prepare a facility for future extreme weather and energy-related risks (e.g. power outages) as well as improving indoor air quality and thermal comfort.

Alignment with space transformation. Transformation is occurring in the office building sector which will offer opportunities to align greening/decarbonization of space with needed renewal, and allow landlords to offer tenants more than just a reconfigured space in the post-COVID world.

Added Property Value. Through a comprehensive analysis of 2020-2022 property values and high-level costing of implementing deep energy retrofits to meet the City of Ottawa's Energy Evolution objectives we can conclude with regards to rental office properties, the incremental life-cycle cost to reach Energy Evolution is estimated at 8-11% of rental value over 25 years. The projected incremental value in the form of increased lease rates in the KPMG analysis is 16%. Office buildings in major cities like Ottawa currently have more vacancies and are not in any immediate risk of tenants facing an eviction due to rental rate increase. In fact, it's more likely owners would absorb the cost of the work to retain tenants or fill vacancies from the smaller pool of available tenants.

How do I go about implementing such a big project?

Capital Plan Alignment. The most important way to avoid additional capital costs for deep retrofit projects is to align them with existing, planned renewal for overlapping systems. For low-rise office buildings, the key milestones are:

- Storefront window and façade refresh/upgrades and roof renewal projects,
- Upgrades of rooftop heating and cooling equipment,
- When upgrading ventilation systems to improve air-quality, and
- When upgrading/replacing electricity vaults that are outdated.

Timing Envelope & HVAC Improvements. Completing enclosure upgrades (i.e. walls, roof, windows) before fuel-switching heating/cooling equipment or installing new PV is a best practice to avoid oversizing equipment and adding costs to other maintenance activities down the road. That said, oversizing rooftop equipment slightly to account for fewer enclosure upgrades not completed prior to fuel-switching may not have a significant impact on the life-cycle cost of the holistic project.

Alternate Pathways. Some facilities may struggle to implement all the recommended measures included in the Zero Carbon Ready package due to budget constraints, local electricity grid limitations, heritage concerns, etc. Of course, the package of measures is flexible, despite being holistic. For low-rise office buildings, if alternative pathways are required, it's important to remember:

- Switching away from fossil fuel heating systems will be required and some improvement to enclosure may likely be needed to avoid prohibitive increases in electricity service to the site. Analysis of the site power capacity vs. available HVAC heating load reduction is important. Site power management technologies such as battery energy storage may be worthwhile to investigate as well, particularly if they help to optimize the cost-benefit of on-site renewable systems.

- Where enclosure upgrades and controls improvements are not enough to allow for full fuel-switching using air-source heat pump technology, opportunities may exist to install geo-exchange systems or connect to low-carbon district energy systems. Geo-exchange is particularly viable for low-rise retail if parking renewal and/or new electrical services to charging stations are also planned. For potential district energy system connection opportunities, speak to a City of Ottawa or Ottawa Hydro representative for support.

Canada Infrastructure Bank - Green Infrastructure. The CIB can provide low-interest loans (e.g. as low as 1% for a minimum 50% GHG reduction) to support investment, especially where other lenders are involved and projects aggregate to over $25M in financing.
A list of updated CIB aggregators and their offerings are provided on Ottawa's Better Buildings webpage.

Enbridge Gas Incentives & Rebates. Enbridge offers a variety of equipment-based and custom incentives for retrofit projects and equipment. A recent set of revised incentives have been approved by the Ontario Energy Board and are being rolled out by Enbridge in early 2023. Of unique importance is that those seeking incentives do not need to Enbridge customers, allowing facilities planning to fuel switch to electric heat pumps, for example, to access relevant incentives as well.

IESO's Save on Energy Programs. The Independent Electricity System Operator (IESO) offers complimentary incentives and rebates for electrical equipment and systems, or for wholistic facility-wide improvements as may be required for a deep retrofit project. Incentives for HVAC redesign, variable-speed motors, chiller upgrades and unitary heat pump equipment may be particularly useful to those engaging in deeper retrofits or installing facility-wide cooling for the first time alongside their decarbonization retrofits.

Where should I look for more information?

City of Ottawa - Energy Evolution
City of Toronto - Net Zero Existing Buildings
Canada Green Building Council - Decarbonizing Canada's Large Buildings
Transition Accelerator – Building Decarbonization Alliance