MAKING THE CASE FOR BUILDING TO ZERO CARBON

Canada Green Building Council®

APPENDIX

NOTE

This is the Appendix for the Making the Case for Building to Zero Carbon report that can be accessed separately here or online at cagbc.org/MakingtheCase.

Photo Credits: Ema Peters

ISBN: 978-0-9813298-5-7

TABLE OF CONTENTS

APPENDIX A

STUDY METHODOLOGY

A-1 ARCHETYPE ASSUMPTIONS AND DETAILS

The modeling assumptions for each archetype, along with proposed improvements that form the ZCB packages, are described in detail below, along with a summary of the energy end-use breakdown by fuel of each archetype baseline and ZCB simulation. The following text provides details of how the archetypes were selected and modified for the study.

ARCHETYPE SELECTION AND SITING

This study leveraged the work of National Resources Canada (NRCan), who developed models for each of the sixteen different Commercial Prototype Building Models developed by the US DOE[1]. The table below shows all sixteen archetypes and highlights the ones selected / modified for this study.

Building Type Name	Floor Area (m^2)	Number of Floors
Large Office	498,588	12
Medium Office	53,628	3
Small Office	5,500	1
Warehouse	52,045	1
Stand-alone Retail	24,962	1
Strip Mall	22,500	1
Primary School	73,960	1
Secondary School	210,887	2
Supermarket	45,000	1
Quick Service Restaurant	2,500	1
Full Service Restaurant	5,500	1
Hospital	241,351	5
Outpatient Health Care	40,946	3
Small Hotel	43,200	4
Large Hotel	122,120	6
Midrise Apartment	33,740	4

[1] https://www.energy.gov/eere/buildings/commercial-reference-buildings

To address the desire to include a larger and a smaller apartment building, the mid-rise archetype was stretched upward 6 floors (to 10) to create a second, larger MURB and the window to wall ratio was increased. The final summary of archetype descriptions are:

- **Mid-rise Office:** 500,000 ft² (46,350 m²), 12-storey office building with a window-to-wall area ratio of 40%. Such a large area over 12 storey results in a relatively deep floor plate.
- **Low-rise Office:** 53,620 ft² (4,982 m²), 3-storey roughly-square building with a window-to-wall ratio of 33%.
- **Mid-rise Multi-Unit Residential Building (MURB):** 84,350 ft² (7,830 m²), 10-storey building with window-to-wall ratio of 40%.
- **Low-rise Multi-Unit Residential Building (MURB):** 33,750 ft² (3,135 m²), 4-storey square building with 8 residential units and window-to-wall ratio of 20%.
- **Big Box Retail (Retail):** 24,689 ft² (2,294 m²) stand-alone, big-box style retail facility with a window-to-wall ratio of 7.2%.
- **Primary School (School):** 73,932 ft² (6,871 m²) 1-storey primary school with a window¬-to-wall ratio of 35%, heated and cooled year-round, which is representative of the average, but not all, educational buildings.
- **Warehouse:** 49,500 ft² (4,600 m²) 1-storey building. The building contains an office area that is 5% of the total area. The building has a window-to-wall ratio of less than 1% and 68 m² of skylights. The warehouse is heated and cooled to reflect the market-wide blend of heated-only, heated/cooled and refrigerated warehouse facilities.

The amount of area surrounding the building is also an important factor in this analysis. Based on patterns of urban development, the mid-rise office and residential archetypes are assumed to have a site area roughly equal to the building footprint, while the other archetypes assume a 2:1 site to building footprint ratio (recognizing the need for parking and a more sub-urban location). This means that the amount of site area available for renewable technologies like PV panels will be limited for tall buildings and they will need to rely more on procurements of renewable energy to achieve Zero Carbon.

NECB 2011 BASELINE

The 2011 version of the National Energy Code of Canada for Buildings (NECB 2011) was used to set up the reference buildings in this study, with HVAC configuration assumptions aligned with baseline generation work conducted by the National Research Council.

NECB 2011 provides minimum requirements for the design and construction of energy-efficient buildings and covers the building envelope, systems and equipment for heating, ventilating and air-conditioning, service water heating, lighting, and the provision of electrical power systems and motors. It applies to new buildings and additions.

The intention for the reference buildings was to have HVAC system configurations set up independently of any specific proposed design; an approach that is a departure from the normal NECB system selection process. To better align with typical industry practice (i.e. for more accurate costing), in some cases design assumptions were made that do not directly fit the NECB 2011 baseline requirements. For example:

- The large office is assumed to be served by compartment units on each floor, which receive ventilation from a central MAU (instead of self-contained VAV units for each floor with independent OA intakes).
- The school is assumed to have packaged VAV systems serving multiple zones, instead of numerous packaged single zone systems as prescribed by NECB 2011.
- Ventilation effectiveness of 0.5 is assumed for MURBs where corridor pressurization is used to satisfy OA requirements for suites, while the suites have FCUs with hydronic heating and small split DX cooling (to align with NECB).

The NECB also prescribes different levels of envelope performance depending on the climate zone. To simplify the cost analysis, all baseline archetypes regardless of climate zone are based on the Toronto requirements. This means that baseline costs for colder regions are underestimated while those for warmer regions are overestimated. The opposite is true for the cost of the ZCB scenarios.

The table below provides the regional requirements of the NECB-2011.

	HDD18	CDD10	Glazing Area	Glazing U-value	Wall R-value	Roof R-value
Vancouver	2825	853	40%	U-0.42	R-18	R-25
Calgary	500	648	33%	U-0.39	R-27	R-35
Toronto	3520	1317	40%	U-0.39	R-20.4	R-31
Ottawa	4440	1136	37%	U-0.39	R-23	R-31
Montreal	4200	1192	39%	U-0.39	R-23	R-31
Halifax	4000	813	40%	U-0.39	R-23	R-31

Design Days in each location represent the peak outdoor conditions that an HVAC system should be designed to accommodate, while maintaining desired indoor conditions. Standard Design Day values from ASHRAE are shown below:

	January		July 2.5%	
	2.5%	1%	Dry-bulb	Wet-bulb
Vancouver	-7	-9	28	20
Calgary	-30	-32	28	17
Toronto	-18	-20	31	23
Ottawa	-25	-27	30	23
Montreal	-23	-26	30	23
Halifax	-16	-18	26	20

ARCHETYPES IN PRACTICE

The archetype approach is commonly used for large whole-sector studies such as this, as well as Energy Code comparisons (Provincial Authorities use this approach to update building code cycles). While the approach reduces complexity and effort, it introduces several limitations discussed below.

Energy Codes differ across Canada: The study uses the NECB 2011 as the baseline level of performance and cost. This means that in jurisdictions that have more stringent energy codes, such as BC, ON, Vancouver and Toronto, the baseline construction cost is underestimated, while the cost to achieve ZCB is inflated. Similar studies have been done by Toronto[2] and BC[3] which are useful references to understand specifics in these locations.

Market rate buildings differ from archetypes: There are always differences between an archetype and any specific project, but this difference is exaggerated for the mid-rise office and mid-rise MURB buildings which can be significantly taller in most cities, particularly in Toronto and Vancouver. This size difference affects the costing analysis since the surface to volume ratios differ, with the largest impact on envelope costs. Taller buildings have less roof area per volume (and corresponding energy demand), which can limit capacity for deployment of renewables, and make it more difficult to achieve a zero carbon balance. Further study of tall buildings (i.e. above 20 storeys) is warranted for those seeking to align the results of this study with such buildings.

Actual baseline envelope performance can be significantly worse than modeled: The skylines of most Canadian cities are dotted with highly-glazed curtainwall and window-wall clad office and residential towers. An exceedingly small number of these buildings achieve the level of envelope thermal performance prescribed by the NECB and used in the archetypes. For example, the NECB Toronto mid-rise MURB has an area-weighted whole-wall R-value of 5.4 (based on 40% glazing, window U-value of 0.39 and opaque wall R-value of 20). By comparison, a typical market rate condo with 60% double-glazing and conventional curtainwall (which is a poor-performing cladding system due to large thermal breaks) achieves a whole-wall R-value of only 3.4, a reduction of almost 40%. This means that the baseline cost for the office and MURB archetypes to achieve the prescribed performance (i.e. R-5.4) is underestimated. In WSP's experience, the combined savings of going to a 40% window to wall ratio and cost of achieving a true R-10 to R-15 overall can cancel each other out. The savings on windows pay for the improved thermal performance of the enclosure. This assertion is not universally true, but is assumed to hold for this study where we have not explored window to wall ratios beyond 40%.

Regardless of current design practices and approaches, stringent new energy codes in jurisdictions like Toronto and Vancouver, as well as updates in the newest versions of the NECB and ASHRAE 90.1, have strict requirements for envelope performance. These changes will begin to close the gap between market and archetype envelope performance.

Functional programs can vary greatly: Minor variations in floor area, massing, functional program and actual operations are understandably typical of these studies, but some functional program differences can be very large. Examples include pools in schools and residential buildings, data centres in office buildings, speciality lighting in retail and process loads in warehouses. All of these fairly common loads and systems tend to increase energy use (e.g. a data centre's energy intensity can be 100x higher than a typical office space). This means that the raw costs to achieve ZCB for buildings with unique energy-intensive equipment will be underestimated. That said, such equipment may be a source of heat that can be used to balance heat loss throughout the facility and improve the cost and effectiveness of geo-exchange systems.

[2] https://www.toronto.ca/wp-content/uploads/2017/11/9875-Zero-Emissions-Buildings-Framework-Report.pdf

[3] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/reports/bc_energy_step_code_metrics_research_report_full.pdf

ALTERNATE DESIGNS FOR RETAIL AND WAREHOUSE

The same carbon reduction measures were applied to all archetypes. Further refinements were necessary for retail and warehouses to ensure the carbon reduction measures were appropriate for these archetypes. Specifically, the window, heating/cooling delivery, and fuel switching bundles were removed and the amount of onsite solar photovoltaics (PV) was increased to take greater advantage of the roof space available. These modifications significantly decreased the incremental capital and life-cycle costs of the ZCB designs and are better aligned with the approach likely to be seen in the market.

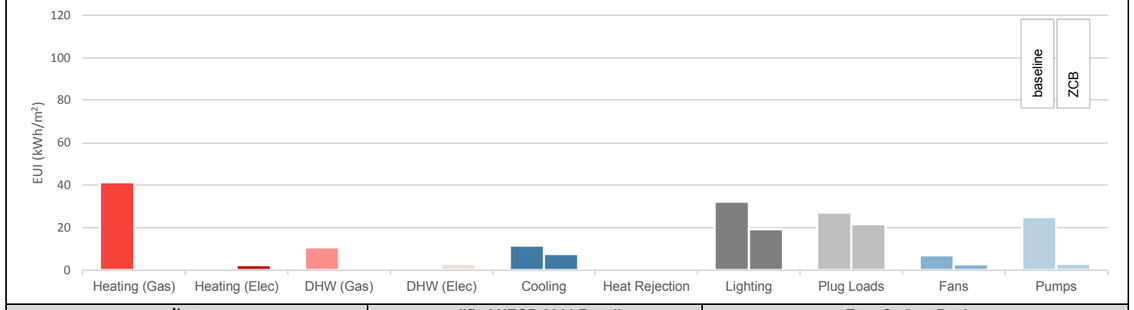
Mid-Rise Office Archetype

Key Building Characteristics

The mid-rise office archetype represents a rectangle 500,000 ft² (46,450 m²), 12-storey building with a wall-to-roof area ratio of 3.25. The window-to-wall area ratio is 40%. The exterior façade is comprised of curtain wall, with continuous interior insulation on the inboard side of metal spandrel panel assemblies. There is one below-grade level containing mechanical and back-of-house spaces, as well as 1 unconditioned parking level. Each floor is divided into 6 zones, and 3 space types, including office, M&E spaces, and core&support spaces. A set of 4 elevators and 2 exit stairwells serve the building access and egress requirements.

BASELINE HVAC: The HVAC system includes 13 built-up variable air volume (VAV) compartment systems with hydronic heating and cooling, serving each floor. Ventilation is provided to each compartment unit by a central make-up air unit on the roof. Two natural gas boiler provides heating. Two water-cooled scroll chiller provides cooling. One open cooling tower cools the chiller condensers.

ZERO CARBON DESIGN: Involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for roof-mounted PV. Mechanically, this package involves separating perimeter and core systems, using a dedicated outdoor air system, ventilation delivered through an underfloor system (with occupancy sensor control), and includes radiant heating/cooling for perimeter zones. This package also further improves exhaust heat recovery, and introduces a central ground source heat pump (GSHP) system (supplemented by a biomass boiler).



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	100%	0%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	40.0%					Same as Baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.6					0.270
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule A					Same as Baseline
Lighting	Office: 1.022 W/ft² Other (avg): 1.25 W/ft²					40% reduction (fully addressable LED, with advanced controls)
Equipment density	Office: 0.697 W/ft² Mech: 0.093 W/ft²; Server: 1.506 W/ft²					22% reduction (outlet controls, process savings, etc.)
Infiltration	0.05 cfm/ft2 of total wall and roof areas					15% reduction for wall/roof interface detailing 20% reduction for window frame interface detailing

Mid-Rise Office Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	13 built-up VAV systems with reheat	Central DOAS serving perimeter zones Central VAV serving core zones
Principle Heating Fuel Type	Natural Gas	Electricity - GSHP Radiant heating loops for perimeter zones
Cooling Source	Water cooled chiller and cooling tower	Electricity - GSHP Radiant cooling loops for perimeter zones
Supply Air Temperature Control	Cooling: 13°C (55°F) Heating: 35°C (95°F) Control: warmest; reset priority: airflow first	Cooling: 16°C (60°F) with reset Heating: tempered OA with radiant heating
Fan Power	Supply/Return fan: Total static (inches water gauge):4/1 Total efficiency: 0.55/0.3	DOAS supply/return Total static (inches water gauge): 3/1 Total efficiency: equal to baseline Multiple fan configuration (min flow: 10%) Fans/ductwork oversized by 30%
Outside Air	Variable supply of OA	Underfloor ventilation with DCV Ev/Ez: 1.0/1.2
Fan Curve (VAV only)	VFD on all systems	VFD on all systems
Energy Recovery	None	90% energy recovery effectiveness
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	Dual Temperature	capable of 100% OA mode; dual enthalpy w/ ERV bypass
HEATING PLANT		
Central Heating Efficiency	1 modulating boilers (down to 25% capacity): 83.3% rated efficiency	Central ground source heat pumps providing heating Heating COP: 3.2 Supplemented by a biomass boiler
Hot Water Temperature	82°C - Δ 17°C (180°F - Δ 30°F)	54°C - Δ 17°C (130°F - Δ 30°F)
Hot Water Flow	Single speed primary-only pumping	variable speed pumping
COOLING PLANT		
Central Cooling Efficiency	2 water-cooled centrifugal chiller: 5.67 COP	Central ground source heat pumps providing cooling Cooling COP: 5.8
Chilled Water Temperature	7°C - Δ 6°C (44°F - Δ 11°F)	7°C - Δ 6°C (44°F - Δ 11°F)
Chilled Water Flow	Single speed primary-only pumping	variable speed pumping
Cooling Tower	1 cooling tower (1 cell, single speed fan):	1 fluid cooler to supplement geo-exchange field during peak
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 80%	Heat Pump COP: 3.0
Avg. Load (GPM)	13.6	34% reduction (ultra low-flow fixtures)
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	80% of available roof area

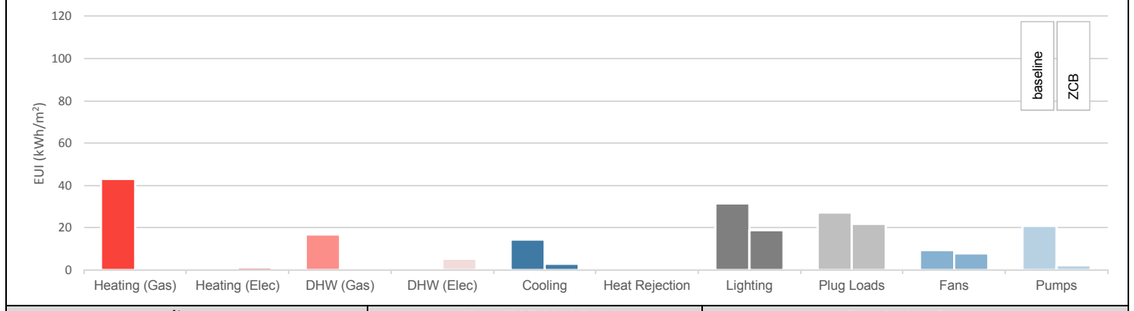
Low-Rise Office Archetype

Key Building Characteristics

The low-rise office archetype represents a 53,620 ft² (4,982 m²), 3-storey core & shell building with a wall-to-roof area ratio of 1.2. The window-to-wall area ratio is 33%. The exterior façade is comprised of curtain wall, with continuous interior insulation on the inboard side of metal spandrel panel assemblies. Each floor is divided into 5 zones, and 2 space types, including office and core & support spaces. A set of 2 elevators and 2 exit stairwells serve the building access and egress requirements.

BASELINE HVAC: The HVAC system includes 3 rooftop built-up variable air volume (VAV) units with hydronic heating and cooling, serving each floor. One natural gas boiler provides heating. One water-cooled scroll chiller provide cooling. One open cooling tower cools the chiller condensers.

ZERO CARBON DESIGN: This package involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for PV (both roof-mounted and site). Mechanically, it introduces the use of a dedicated outdoor air system (DOAS), ventilation delivered through an underfloor system (with occupancy sensor control), and variable refrigerant flow (VRF) heating/cooling connected to a central geo-exchange field. This package also further improves exhaust heat recovery. Lighting will incorporate directly addressable LED fixtures tied to occupancy sensors that provide advanced, fine-tuned control over light levels in areas where occupant activity is occurring.



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	100%	0%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	33.0%					Same as Baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.6					0.270
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule A					Same as Baseline
Lighting	Office: 1.022 W/ft² Other: 1.25 W/ft²					40% reduction (fully addressable LED, with advanced controls)
Equipment density	Office: 0.697 W/ft² Mech: 0.093 W/ft²; Server: 1.506 W/ft²					22% reduction (outlet controls, process savings, etc.)
Infiltration	0.05 cfm/ft2 of total wall and roof areas					50% whole-enclosure reduction interface detailing

Low-Rise Office Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	3 built-up VAV systems with reheat	Central DOAS
Principle Heating Fuel Type	Natural Gas Boiler	Electricity
Cooling Source	Water-cooled chiller and cooling tower	Water-cooled VRF connected to ground loop
Supply Air Temperature Control	Cooling: 13°C (55°F) Heating: 43°C (109°F) Reset: 18°C at OAT 16°C; 13°C at OAT 27°C (65°F at OAT 60°F; 55°F at OAT 80°F)	Cooling: 16°C (60°F) Heating: 38°C (100°F)
Fan Power	Supply/Return fan: Total static (inches water gauge):4/1 Total efficiency: 0.55/0.3	DOAS Supply/Return fan: Total static (inches water gauge):3/1 Total efficiency: equal to baseline Multiple fan configuration (min flow: 10%) Fans/ductwork oversized by 30% VRF terminals: 0.000193 kW/cfm
Outside Air	Variable supply of OA Ev/Ez: 0.8/1.0	Underfloor ventilation with DCV Ev/Ez: 1.0/1.2
Fan Curve (VAV only)	VFD	VFD
Energy Recovery	None	75% energy recovery effectiveness
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	OA Temp, drybulb high limit: 18°C (65°F)	Dual enthalpy bypass of ERV
HEATING PLANT		
Central Heating Efficiency	1 modulating boiler (down to 25% capacity): 83% rated efficiency	Water-source VRF connected to ground loop COP 5.9 in heating
Hot Water Temperature	82°C - Δ 17°C (180°F - Δ 30°F)	ground loop varies seasonally
Hot Water Flow	Single speed primary-only pumping	variable speed pumping
COOLING PLANT		
Central Cooling Efficiency	1 water-cooled reciprocating chiller: 3.54 COP	Water-source VRF connected to ground loop COP 5.0 in cooling
Chilled Water Temperature	7°C - Δ 6°C (44°F - Δ 11°F)	ground loop varies seasonally
Chilled Water Flow	Single speed primary-only pumping	variable speed pumping
Cooling Tower	1 cooling tower (1 cell, single speed fan):	not installed
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 81%	Heat pump: COP 3.0
Avg. Load (GPM)	1.9	34% reduction (ultra low-flow fixtures)
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	80% of roof area and a portion of site area (200 m²)

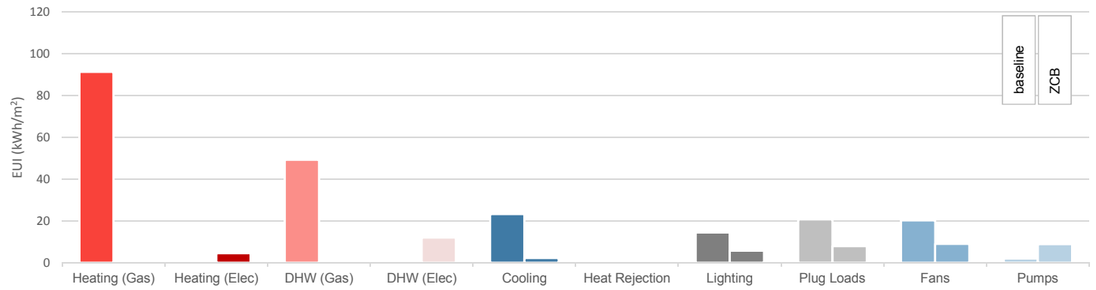
Mid-Rise MURB Archetype

Key Building Characteristics

The mid-rise MURB archetype represents an 84,350 ft² (7,830 m²), 10-storey building with a wall-to-roof area ratio of 4.9. The window-to-wall area ratio is 40%. The exterior façade is comprised of window wall, with continuous interior insulation on the inboard side of metal spandrel panel assemblies. The zoning includes 8 apartments and 1 core zone per floor. There are 2 levels of unconditioned below-grade parking. A set of 4 elevators and 2 exit stairwells serve the building access and egress requirements.

BASELINE HVAC: The suites are served by fan coil units (FCUs) with hydronic heating coils and direct expansion (DX) cooling (through the wall). A central make-up air unit (MAU) unit provides 100% outdoor air (OA) to the core zones, and into the suites via door undercuts. The central make-up air unit (MAU) will be located on the roof and will include hydronic heating coil and DX cooling coil. Envelope losses in corridors will be handled by hydronic perimeter baseboards. Two natural gas boilers serve the hydronic heating loop.

ZERO CARBON DESIGN: Involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for roof-mounted PV. Mechanically, this package involves a centralized air distribution system with zone-level ventilation control, as well as incorporating variable refrigerant flow (VRF) for heating/cooling delivery. This package also further incorporates central exhaust heat recovery, and introduces a central ground source heat pump (GSHP) system (supplemented by a biomass boiler).



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	100%	0%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	40.0%					Same as Baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.6					0.270
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule G					Same as Baseline
Lighting	0.495 W/ft² (avg)					40% reduction (LED & controls)
Equipment density	0.465 W/ft² (avg)					25% reduction (EnergyStar appliances and process equipment savings)
Infiltration	0.05 cfm/ft2 of total wall and roof areas					15% reduction for wall/roof interface detailing 35% reduction for window frame interface detailing

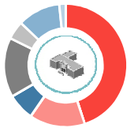
Mid-Rise MURB Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	Central MAU serving corridors FCUs for suite space conditioning	Central DOAS
Principle Heating Fuel Type	Natural gas boiler serving hydronic coils in FCU and MAU, and baseboards (non-suite perimeter)	Electricity - water-cooled VRF connected to geo-exchange
Cooling Source	DX cooling for MAU, and DX coils in the FCUs (split condenser for each unit)	Electricity - water-cooled VRF connected to geo-exchange
Supply Air Temperature Control	MAU Cooling/Heating: 21°C/24°C (70°F/75°F) FCUs Cooling/Heating: 16°C/38°C (60°F/100°F)	Cooling: 16°C (60°F) Heating: 38°C (100°F)
Fan Power	MAU Supply/Return fan: Total Static (inches Water Gauge): 3/1 Total Efficiency: 0.55 Suite unit fan: 0.0003 kW/cfm	MAU Supply/Return fan: Total Static (inches Water Gauge): 3/1 Total Efficiency: 0.55 VRF terminal unit: 0.000193 kW/cfm
Outside Air	OA supply through corridor pressurization 0.5 ventilation effectiveness	Direct-ducted OA supply 1.0 ventilation effectivenss
Fan Curve (VAV only)	MAU constant volume FCUs cycling	VFD for DOAS terminal units have ECM fans with low-speed during heating and float hours
Energy Recovery	None	90% energy recovery effectiveness
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	Dual Temperature	Dual Enthalpy
HEATING PLANT		
Central Heating Efficiency	1 modulating boilers (down to 25% capacity): 83% rated efficiency	water-source VRF connected to central ground loop COP 5.9 in heating supplemented by a biomass boiler
Hot Water Temperature	82°C - Δ 16°C (180°F - Δ 28.8°F) OAT reset	ground loop varies seasonally
Hot Water Flow	Single speed primary-only pumping, VSD	High efficiency VSD pump
COOLING PLANT		
Central Cooling Efficiency	cooling provided by in-suite AC units Cooling electric COP 2.93	water-source VRF connected to central ground loop COP 5.0 in cooling
Chilled Water Temperature		ground loop varies seasonally
Chilled Water Flow		High efficiency VSD pump
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 80%	Heat pump COP 3
Avg. Load (GPM)	4.4	53% reduction (ultra low-flow and misting fixtures, drain heat recovery)
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	80% of roof area

Public School Archetype

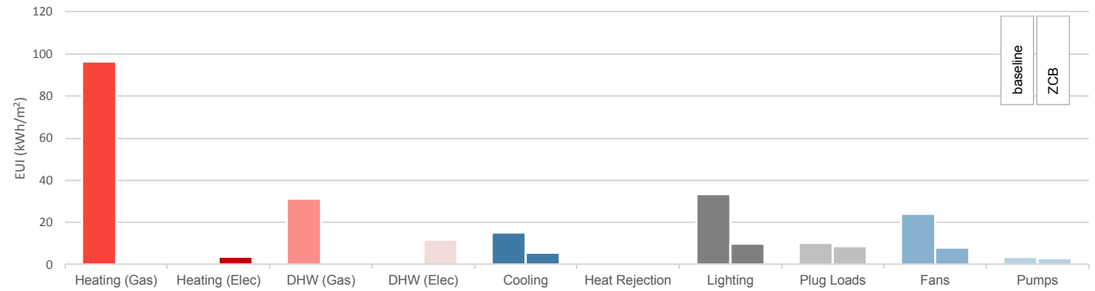
Key Building Characteristics



The school archetype represents a 73,932 ft² (6,871 m²) one-storey building. The building contains a kitchen (2.4% of total building area), cafeteria (4.6%), bathrooms (2.8%), computer room (2.4%), gym (5.2%), library (5.8%), mechanical and electrical room (3.7%), offices (6.4%), and classrooms (48%). The building has a wall-to-roof area ratio of 37%. The window-to-wall area ratio is approximately 35%. Walls are concrete mass walls.

BASELINE HVAC: 2 packaged VAV systems serve all classroom and office areas. The gym and kitchen areas each have dedicated constant volume rooftop units (RTUs). Units will include a direct expansion (DX) cooling coil and an indirect gas heating section. All perimeter areas also have hydronic baseboards connected to a two single-stage boiler plant.

ZERO CARBON DESIGN: This package involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for PV (both roof-mounted and site). Mechanically, this package involves a centralized dedicated outdoor air distribution system (DOAS) with zone-level ventilation control. This package also further incorporates central exhaust heat recovery (90% effectiveness), and introduces a central ground source heat pump (GSHP) system serving in-floor radiant heating/cooling for classrooms, while incorporating water-cooled variable refrigerant flow (VRF) for heating/cooling delivery for office areas. It includes a supplementary biomass boiler to inject heat into the ground loop as required to maintain balanced operation. Lighting will incorporate directly addressable LED fixtures tied to occupancy sensors that provide advance, fine-tuned control over light levels in areas where occupant activity is occurring.



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	100%	0%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	35.0%					Same as Baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.6					0.270
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule D					Same as Baseline
Lighting	Classroom 1.24 W/ft² ; Other: 0.88 W/ft² (avg)					42% reduction (LED and controls)
Equipment density	Classroom 0.465 W/ft² Kitchen: 0.929 W/ft² ; Other: 0.148 W/ft² (avg)					15% reduction (EnergyStar appliances, energy saving classroom equipment and controls)
Infiltration	0.05 cfm/ft2 of total wall and roof areas					75% reduction

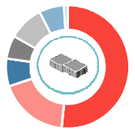
Public School Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	25 RTUs with DX cooling and gas furnace, with hydronic baseboards for perimeter heating.	Central DOAS
Principle Heating Fuel Type	Natural Gas Furnace	VRF connected to ground loop - non-classrooms Radiant in-floor heating from central GSHP - classrooms Supplemented by peaking biomass boiler
Cooling Source	Air-cooled condenser and DX Cooling	VRF connected to ground loop - non-classrooms Radiant in-floor cooling from central GSHP - classrooms
Supply Air Temperature Control	Cooling: 13°C (55°F) Heating: 33°C (92°F) Reset: 18°C at OAT 16°C; 13°C at OAT 27°C (65°F at OAT 60°F; 55°F at OAT 80°F)	DOAS: Cooling: 21°C (70°F) Heating: 24°C (75°F) Terminal VRF units: Cooling: 13°C (55°F) Heating: 38°C (100°F)
Fan Power	Supply fans: Total Static (inches water gauge): 2.6 Total Efficiency: 0.4	DOAS Supply/Return fan: Total Static (inches water gauge): 3/2 Total Efficiency: 0.55/0.50 VRF Terminal Units: Design kW/cfm: 0.00078
Outside Air	Sum of Zone OA	DCV (36% reduction)
Fan Curve (VAV only)	Constant Volume	VFD on all systems
Energy Recovery	None	90% energy recovery effectivness (reverse-flow)
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	Dual Enthalpy	Dual Enthalpy
HEATING PLANT		
Central Heating Efficiency	1 modulating boiler (down to 25% capacity): 83% rated efficiency	Central ground source heat pumps Heating COP: 3.2 VRF providing heating for non-classroom zones Heating COP: 5.9 Supplemented by peaking biomass boiler
Hot Water Temperature	82°C - Δ 16°C (180°F - Δ 28.8°F)	54°C - Δ 16°C (130°F - Δ 28.8°F) ground loop: varies
Hot Water Flow	Single speed primary-only pumping	Premium variable speed pumping
COOLING PLANT		
Central Cooling Efficiency	DX COP 2.84 to 3.45	Central ground source heat pumps Cooling COP: 5.8 Water-cooled VRF connected to ground loop Cooling COP: 5.0
Chilled Water Temperature		7°C - Δ 6°C (44°F - Δ 11°F) ground loop: varies
Chilled Water Flow		Premium variable speed pump
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 83% efficiency	Heat pump COP: 3
Avg. Load (GPM)	3.4	34% reduction (ultra low-flow fixtures)
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	80% of roof area and a portion of site area (825 m²)

Low-Rise MURB Archetype

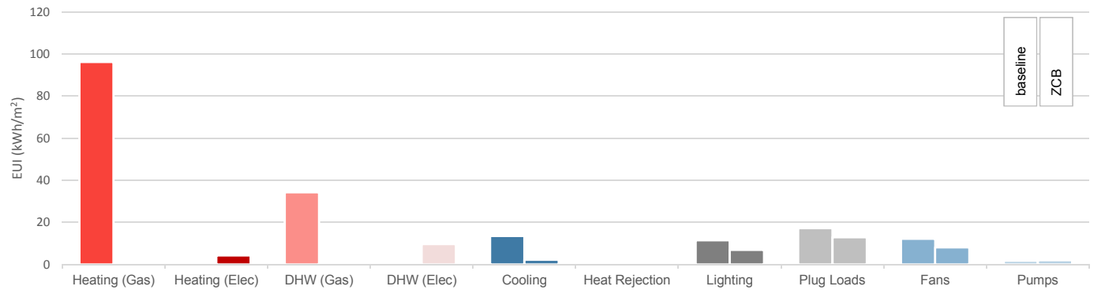
Key Building Characteristics



The low-rise MURB archetype represents a 33,750 ft² (3,135 m²), 4-storey building with a wall-to-roof area ratio of 2. The window-to-wall area ratio is 20%. The exterior façade is comprised of window wall, with continuous interior insulation on the inboard side of metal spandrel panel assemblies. The zoning includes 8 apartments and 1 core zone per floor. A set of 2 elevators and 2 exit stairwells serve the building access and egress requirements.

BASELINE HVAC: The suites are served by fan coil units (FCUs) with hydronic heating coils and direct expansion (DX) cooling (through the wall). A central make-up air unit (MAU) unit provides 100% outdoor air (OA) to the core zones, and into the suites via door undercuts. The central MAU will be located on the roof and will include hydronic heating coil, DX cooling coil. Envelope losses in corridors will be handled by hydronic perimeter baseboards. Hydronic heating is connected to one single-stage boiler with a single speed pump to be fitted with a variable frequency drive (VFD). All heating terminals will use two-way valves.

ZERO CARBON DESIGN: This package involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for PV (both roof-mounted and site). Mechanically, this package involves a centralized air distribution system with zone-level ventilation control, as well as incorporating variable refrigerant flow (VRF) for heating/cooling delivery. This package also further incorporates central exhaust heat recovery, and introduces a central geoexchange system. Lighting will incorporate directly addressable LED fixtures tied to occupancy sensors that provide advance, fine-tuned control over light levels in areas where occupant activity is occurring.



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	100%	0%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	20.0%					Same as Baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.6					0.270
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule G					Same as Baseline
Lighting	0.495 W/ft² (avg)					40% reduction (LED & controls)
Equipment density	0.419 W/ft² (avg)					25% reduction (EnergyStar appliances and process equipment savings)
Infiltration	0.05 cfm/ft2 of total wall and roof areas					50% whole-enclosure reduction interface detailing

Low-Rise MURB Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	Central MAU serving corridors FCUs for suite space conditioning	Central DOAS
Principle Heating Fuel Type	Natural gas boiler serving hydronic coils in FCU and MAU, and baseboards (non-suite perimeter)	Electricity - water-source VRF fed by ground loop
Cooling Source	DX cooling for MAU, and DX coils in the FCUs (split condenser for each unit)	Electricity - water-source VRF fed by ground loop
Supply Air Temperature Control	MAU Cooling/Heating: 21°C/24°C (70°F/75°F) FCUs Cooling/Heating: 13°C/38°C (60°F/100°F)	Cooling: 16°C (60°F) Heating: 38°C (100°F)
Fan Power	MAU, Supply/Return: Total Static (inches water gauge): 3/1 Total Efficiency: 0.55 Suite unit:: 0.0003 kW/cfm	MAU, Supply/Return: Total Static (inches water gauge): 3/1 Total Efficiency: 0.53 VRF terminal unit: 0.000193 kW/cfm
Outside Air	OA supply through corridor pressurization 0.5 ventilation effectiveness	Direct-ducted OA supply 1.0 ventilation effectivenss
Fan Curve	MAU constant volume FCU two-speed	VFD for DOAS w/ fans/ductwork oversized by 30%
Energy Recovery	None	75% energy recovery effectiveness
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	Dual Temperature	Dual Enthalpy
HEATING PLANT		
Central Heating Efficiency	2 modulating boilers (down to 25% capacity): 83% rated efficiency	Water-cooled VRF connected to ground loop COP 5.9 in heating
Hot Water Temperature	82°C - Δ 16°C (180°F - Δ 28.8°F)	ground loop varies seasonally
Hot Water Flow	Single speed primary-only pumping. Pump motor to be fitted with VFD, all heating terminals will use two-way valves	High efficiency VSD pump
COOLING PLANT		
Central Cooling Efficiency	cooling provided by in-suite AC units Cooling electric COP 2.93	Water-cooled VRF connected to ground loop COP 5.0 in cooling
Chilled Water Temperature		ground loop varies seasonally
Chilled Water Flow		High efficiency VSD pump
Cooling Tower		not installed
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 80%	Heat pump COP 3
Avg. Load (GPM)	1.75	50% reduction (ultra low-flow and misting fixtures, drain heat recovery)
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	80% of roof area and a portion of site area (95 m²)

Warehouse Archetype

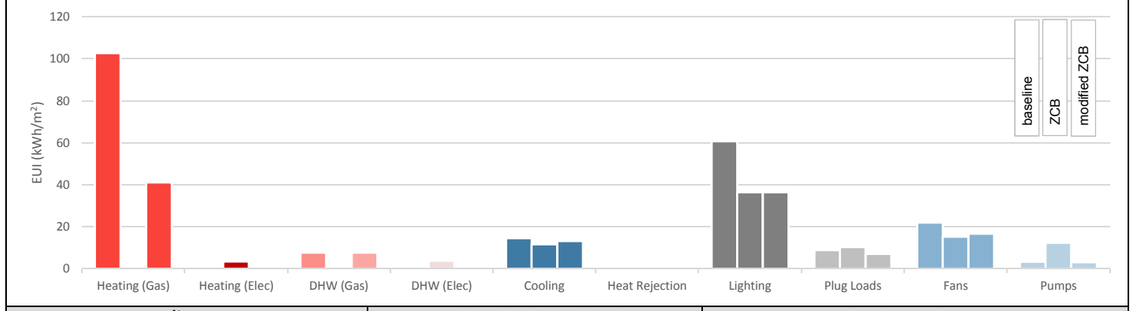
Key Building Characteristics

The warehouse archetype represents a 49,500 ft² (4,600 m²) one-storey building. The building contains an office area that is 5% of the total area of the building. The building has a wall-to-roof area ratio of 0.5. The window-to-wall area ratio is less than 1%. Skylights are installed in the warehouse areas, with total coverage of 68 m2. Walls are 50% concrete mass and 50% insulated metal panel.

BASELINE HVAC: The HVAC system includes 5 rooftop units (RTUs) equipped with air-side economizers, hydronic heating and direct expansion (DX) cooling. Two natural gas boilers provide heating. DX cooling in RTUs will provide cooling to the warehouse and office areas, with supplemental heating provided by baseboards (office areas) and unit heaters (warehouse areas).

ZERO CARBON DESIGN: This package involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for PV (both roof-mounted and site). Mechanically, this package involves the use of a dedicated outdoor air system (DOAS) with displacement ventilation (DV) and includes in-floor radiant heating/cooling for the warehouses and variable refrigerant flow (VRF) for the office area. This package also further incorporates central exhaust heat recovery (90% efficiency), over-sized fans, and introduces a central ground source heat pump (GSHP) system (supplemented by a biomass boiler). Lighting will incorporate directly addressable LED fixtures tied to occupancy sensors that provide advanced, fine-tuned control over light levels in areas where occupant activity is occurring.

MODIFIED ZERO CARBON DESIGN: Equivalent to above, except GSHP has been removed, and the DOAS serves the RTUs directly (instead of zonal DV), which provide heating using indirect fire burners and cooling using DX coils. Supplemental heating is provided by hydronic baseboards and unit heaters. Windows are also reset to baseline performance. The size of the PV array has been increased to offset the carbon impact.



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	50%	50%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	1.0%					equivalent to baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216 [modified: equivalent to baseline]
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.6					0.600
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule A					equivalent to baseline
Lighting	Bulk:0.59 W/ft² Fine:0.95 W/ft² Office:1.11 W/ft²					53% reduction (LED and zonal control)
Equipment density	Bulk & Fine: 0.093 W/ft² Office:0.697 W/ft²					22% reduction
Infiltration	0.05 cfm/ft2 of total wall and roof areas					50% reduction (prefab panel and interface detailing)

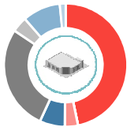
Warehouse Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	5 RTUs with unit heaters, hydronic baseboards for office perimeter heating	Central DOAS [modified: DOAS serving 5 RTUs]
Principle Heating Fuel Type	Natural gas furnace	Electricity - GSHP [modified: equivalent to baseline]
Cooling Source	Air-cooled condenser and DX Cooling	Water-cooled VRF connected to geo-exchange [modified: equivalent to baseline]
Supply Air Temperature Control	Cooling: 13°C (55°F) Heating: 43°C (109.8°F)	Cooling: 16°C (60°F) Heating: 32°C (90°F) [modified: equivalent to baseline]
Fan Power	Supply fan: Total Static (inches water gauge): 2.6 Total Efficiency: 0.4	Supply/Return: Total Static (inches water gauge): 3/1 Total Efficiency: 0.5 Packaged Unit: 0.000193 kW/cfm
Outside Air	Sum of Zone OA	demand control (DCV)
Fan Curve (VAV only)	Constant Volume	VSD on all systems
Energy Recovery	None	90% energy recovery effectiveness
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	Dual temperature	Dual enthalpy
HEATING PLANT		
Central Heating Efficiency	2 modulating boilers (down to 25% capacity): 83% rated efficiency	Central ground source heat pumps Heating COP: 3.2 water-source VRF for office areas [modified: equivalent to baseline]
Hot Water Temperature	82°C - Δ 16°C (180°F - Δ 28.8°F)	54°C - Δ 17°C (130°F - Δ 30°F) [modified: equivalent to baseline]
Hot Water Flow	Single speed primary-only pumping	variable speed pumping
COOLING PLANT		
Central Cooling Efficiency	Air-cooled condenser: COP 3.45	Central ground source heat pumps Cooling COP: 5.8 water-source VRF for office areas [modified: equivalent to baseline]
Chilled Water Temperature		7°C - Δ 6°C (46°F - Δ 10°F) [modified: n/a]
Chilled Water Flow		variable speed pumping
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 80%	Heat pump COP 3 [modified: equivalent to baseline]
Avg. Load (GPM)	0.35	25.5% reduction (ultra low-flow fixtures)
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	50% of roof area and a portion of site area (552 m²)

Big Box Retail Archetype

Key Building Characteristics

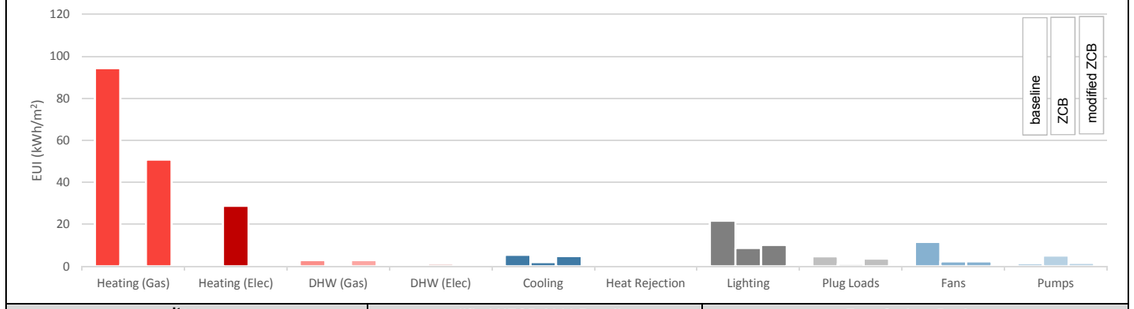


The retail archetype represents a 24,689 ft² (2,294 m²) one-storey building. The building contains a back storage space that is 17% of the total area of the building. The building has a wall-to-roof area ratio of 0.5. The window-to-wall area ratio is approximately 7.2%. Skylights are installed in the core retail areas, with total coverage of 24 m². Walls are 50% concrete mass and 50% insulated metal panel.

BASELINE HVAC: The retail and storage areas are served by packaged constant volume rooftop units (RTUs) with indirect gas-fired heating and a direct expansion (DX) cooling section, along with and hydronic radiant panels for perimeter heating, connected to a central, single-stage boilder. Cooling is provide to the retail spaces and storage area by DX cooling in RTUs and the make-up air unit (MAU).

ZERO CARBON DESIGN: This package involves a higher performance envelope than the baseline design, reduced internal loads and design considerations for PV (both roof-mounted and site). Vestibule zones are added for all storage bay entries, including high-speed roll-up doors with exceptional air-sealing, creating a partially conditioned buffer zone where loading/unloading activities can take place. Mechanically, this package involves the use of a dedicated outdoor air system (DOAS) and includes in-floor radiant heating for all areas, along with fan-coil units for cooling. This package also further incorporates central exhaust heat recovery (75% efficiency), over-sized fans, and introduces a central ground source heat pump (GSHP) system. Lighting will incorporate directly addressable LED fixtures tied to occupancy sensors that provide advanced, fine-tuned control over light levels in areas where occupant activity is occurring.

MODIFIED ZERO CARBON DESIGN: Equivalent to above, except GSHP has been removed, and the DOAS serves the RTUs directly (instead of zonal DV), which provide heating using indirect fire burners and cooling using DX coils. Supplemental heating is provided by hydronic baseboards and unit heaters. Windows are also reset to baseline performance. The size of the PV array has been increased to offset the carbon impact.



Item	modified NECB 2011 Baseline					Zero Carbon Design
EXTERIOR SURFACES						
Wall Overall R-Value	Mass	Metal	Steel	Other	R_{net}	30 (net)
	50%	50%	0%	0%	20.4	
	20.4	20.4	20.4	20.4		
Roof Overall R-Value	Insulation Entirely above Deck					40 (net)
	31.0					
GLAZING						
Glazing Percent	7.2%					equivalent to baseline
Window U-value	Nonmetal framing, all	Metal Framing, fixed	Metal Framing, operable	Metal Framing, entrance door	U_o	0.216 [modified: equivalent to baseline]
	0%	100%	0%	0%	0.39	
	0.39	0.39	0.39	0.39		
Window Solar Heat Gain Coefficient	0.600					0.600
SPACE CONDITIONS						
Schedules	NECB 2011 Schedule C					equivalent to baseline
Lighting	Retail: 1.68 W/ft², Storage: 0.63 W/ft²					40% reduction (LED and controls)
Equipment density	Retail: 0.232 W/ft², Storage: 0.093 W/ft²					25% reduction
Infiltration	0.05 cfm/ft2 of total wall and roof areas					50% reduction (prefab panel and interface detailing)

Big Box Retail Archetype

Key Building Characteristics

HVAC SYSTEM TYPE		
Air Handling	5 RTUs with indirect gas-fired heating and a DX cooling section	Central DOAS [modified: DOAS serving 5 RTUs]
Principle Heating Fuel Type	Natural Gas Boilers serving BBs Indirect NG heating in AHUs	Electricity - GSHP serving radiant floor perimeter heating [modified: equivalent to baseline]
Cooling Source	Air-cooled condenser and DX Cooling	Electricity - Central GSHP serving fan-coils [modified: equivalent to baseline]
Supply Air Temperature Control	Cooling: 13°C (55°F) Heating (stg/retail): 43°C/18°C (110°F/65°F)	Cooling: 18°C (65°F) Heating: 29°C (85°F) [modified: equivalent to baseline]
Fan Power	Supply fans: Total Static (inches water gauge): 2.6 Total Efficiency: 0.40	Central DOAS Supply/Return Total Static (inches water gauge): 3/1 Total Efficiency: 0.5/0.5 FCUs: Total Static in WG: 2 Total Efficiency: 0.55
Outside Air	Sum of Zone OA	DCV
Fan Curve (VAV only)	Constant Volume	VSD on all systems
Energy Recovery	None	75% energy recovery effectiveness
HVAC CONTROL		
Heating and Cooling Setpoints	Heating: 22°C (72°F) Cooling: 24°C (75°F)	Heating: 22°C (72°F) Cooling: 24°C (75°F)
Economizer	OA Temp, Drybulb High Limit: 18°C (65°F)	Dual Temperature
HEATING PLANT		
Central Heating Efficiency	2 modulating boilers (down to 25% capacity): 83% rated efficiency	Central ground source heat pumps providing heating Heating COP: 3.2 [modified: equivalent to baseline]
Hot Water Temperature	82°C - Δ 17°C (180°F - Δ 30°F)	54°C - Δ 17°C (130°F - Δ 30°F) [modified: equivalent to baseline]
Hot Water Flow	High efficiency VSD pump	High efficiency VSD pump
COOLING PLANT		
Central Cooling Efficiency	DX COP 2.8	Central ground source heat pumps providing cooling Cooling COP: 5.8 [modified: equivalent to baseline]
Chilled Water Temperature		8°C - Δ 6°C (46°F - Δ 10°F) [modified: n/a]
Chilled Water Flow		High efficiency VSD pump
DOMESTIC HOT WATER (DHW)		
Heating Efficiency	1 natural gas DHW tank heater: 80%	Heat pump heater: COP 3 [modified: equivalent to baseline]
Avg. Load (GPM)	0.5	0% reduction
ONSITE RENEWABLE ENERGY		
Photovoltaic panels (available area)	-	50% of roof area and a portion of site area (460 m²)

A-2 ENERGY MODELING NOTES

ENERGY MODELING PROCESS

The primary simulation platform used for this study was eQuest v3.65, with OpenStudio baseline models developed by the NRC used for validation of some archetypes.

The primary goal of the energy modeling was to generate consistent representations of the archetype buildings and implementation of the bundles of energy conservation measures. Accurate representation of local markets and construction standards was also important. Meaningful comparisons (i.e. deltas) between different archetypes and locations relied on this consistency, which minimizes the impact of other confounding variables.

The sub-sets of energy conservation measures included in this study were selected and applied to the models based on experience drawn from work on actual building projects, targeting the most effective means of achieving significant carbon reductions. These measures were packaged together in “bundles” representing key strategies that apply across building types.

Therefore, for the purposes of this national study, overarching design approaches were fixed across all locations, while specific implementation, operational assumptions, and costs were modified to suit typical construction as closely as reasonable. In real world application, some measures may not be optimal for all locations or archetypes. Case-by-case design optimization was considered beyond the scope of this study and would have made the comparative analysis of bundles impossible.

CASCADING BUNDLES

The individual bundle modeling process was straight-forward: the appropriate modeling changes for each individual bundle were applied to the baseline models, respecting the fact that equipment sizes may need to be larger than when included in the combined package.

The cascading bundle process was somewhat more complex. During the process of modeling the cascading bundles of improvements, independent bundles sometimes required HVAC system changes for the interim (i.e. partial) model to function properly, resulting in intermediate configurations not carried through to the final package. For example, where heating/cooling delivery involved VRF or heat pump terminals, but no GSHP was included, either air-source VRF systems or a conventional water loop heat pump was assumed. Other, less minor, but similar variations were included for other bundles.

MEASURES CONSIDERED, BUT NOT MODELED

A variety of other energy conservation and carbon reduction measures were considered but not included in the scope of this study.

- Thermochromic or electrochromic glass: impact on peak demand, where it might demonstrate greatest benefit, was not a focus of the study.
- Phase change enclosure materials/layers: similar impact/benefit as controlled glazings (shifts/smooths peak demand).
- Variations in the window-to-wall ratio: NECB baseline designs were considered to already have reasonable WWR.
- Alternative sources for thermal energy for heat pumps (air, sewage, industrial processes, etc.).

- Alternative renewable energy technologies such as small-scale wind or hydro electric: these are considered very site-specific and not appropriate for broad, national conclusions.
- Battery (or other) storage of electricity to smooth out demand, though this technology is considered important to the future of low-carbon and dynamic grids.

PV ANALYSIS

For the ZCB designs, the target for installed capacity of onsite PV generation was set based on the installed capacity that would be required to offset remaining GHG emissions, after all other energy conservation bundles were applied. The actual installed PV capacity was constrained by available space.

Total available space for PV installation was assumed to be 50-80% of roof area (with the variation due to the presence of skylights or other major obstructions), and 12-20% of adjacent site area (over parking, not applicable for the mid-rise archetypes).

Average performance from three best-in-class fixed Mono-Si solar panels and inverters were assumed (readily available on the market), with a racking system grid that is consistent with the grid-pattern of the roof. Additional rack-mounted PV was included over exposed portions of site area adjacent to building. Specific performance specs for the PV arrays are as follows:

- 6” mono-crystalline solar cells
- 1.62 m^2 panel area
- 162 W/m^2 nominal capacity (15-19% efficiency)
- 96% inverter efficiency at a DC to AC size ratio of 1.2
- Overall system losses of 14%

Hourly solar radiation for each location was based on TMY data for each location, with panels positioned facing due South (azimuth 180°):

Solar PV Location Information

City	Weather Station	Latitude : Longitude	Tilt (degrees)	Solar Radiation ($kWh/m^2/day$)
Toronto	Toronto Pearson Intl AP	43.677 ; -79.631	35	4.60
Ottawa	Macdonald-Cartier Intl AP	45.317 ; -75.667	40	4.57
Calgary	Calgary Intl AP	51.114 ; -114.020	45	4.55
Halifax	Halifax Stanfield Intl AP	44.881 ; -63.509	40	4.36
Vancouver	Vancouver Intl AP	49.195 ; -123.184	40	3.95
Montreal	Montreal-Trudeau Intl AP	45.471 ; -73.741	40	4.56

The contribution towards GHG emissions reduction by PV is calculated based on the Zero Carbon Buildings guidelines, which credits hourly PV generation based on either the local average grid emissions factor (where offsetting onsite electricity demand) or the marginal emissions factor (where generation surpasses onsite electricity requirements).

Hourly PV generation potential was determined using the PVWatts application for each location. This data was compared against the hourly building electricity demand for each archetype and location, under two scenarios: targeting onsite net zero GHG emissions for the full ZCB design package (if possible) and installation of a PV array covering all available area. The latter was used for assessing the life-cycle cost benefit of PV as an independent measure.

The ratio of electricity used onsite versus the portion exported over the course of a year, together with the grid emissions factors, determined how effective PV generation was for offsetting building GHG emissions. The effectiveness was further constrained by available area, with buildings having smaller roof area relative to floor area (e.g. the mid-rise archetypes) being less capable of achieving ZCB onsite (i.e. without RECs).

The range in contribution is highlighted in the summary of selected hourly results for different locations and archetypes included in Appendix B-5. Results are provided for Toronto, Calgary and Montreal for all archetypes to summarize the full range of variation.

A-3 CARBON ACCOUNTING

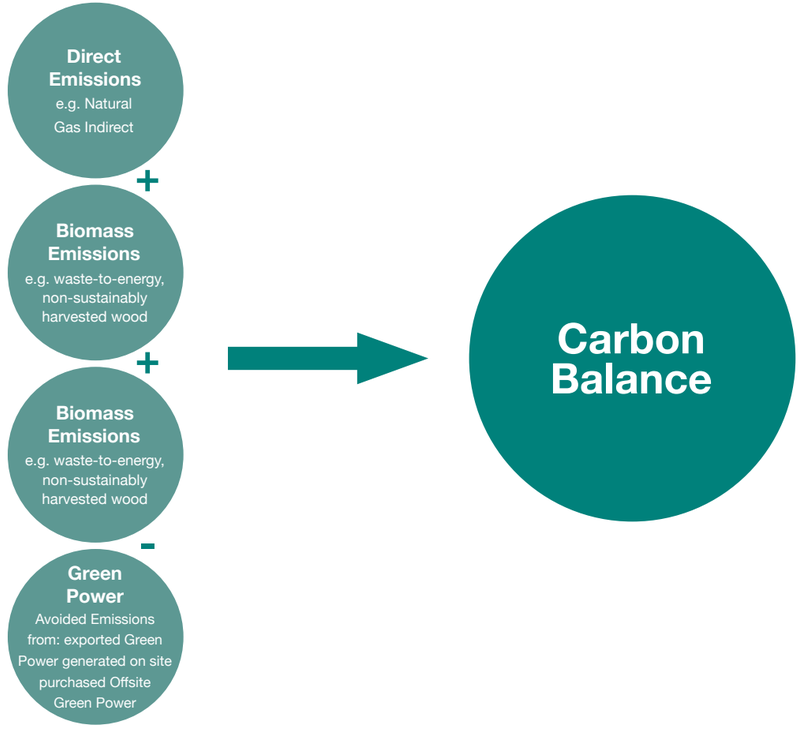
ZERO CARBON DEFINITION

This report applies the definition of “zero carbon balance” as outlined in the Canadian Green Building Council’s (CaGBC’s) Zero Carbon Buildings Standard (May 2017)[1]:

Projects must annually generate or procure enough zero-emissions, renewable energy to offset 100% of the GHG emissions associated with the building’s total annual site energy consumption.

While the general approach in the study is to reduce carbon emissions at the site as much as possible, procurement of offsite green power (in the form of RECs) is assumed to be necessary for two reasons. First, tall buildings are unlikely to achieve a zero carbon balance onsite with current technologies. Second, market rate development is capital-cost focused. Even if a Zero Carbon bundle of onsite measures yields a small life-cycle cost premium, procurement provides a more straight-forward way to amortize costs in a capital-constrained industry.

The approach taken in the study is therefore to target a zero carbon balance onsite; first through conservation, then fuel switching followed by generation of green power within the site boundary, and finally procurement.



[1] https://www.cagbc.org/cagbcdocs/zerocarbon/CaGBC_Zero_Carbon_Building_Standard_EN.pdf

PRIMARY FUEL

Natural gas was used as the primary fuel for the baseline buildings and for the ZCB big box retail and warehouse buildings. The emission factor for natural gas varies slightly across the country, but is typically around 180 gCO_2e/kWh.

Wood pellets were used as the peaking/top-up fuel for the mid-rise office and mid-rise MURB ZCBs. Pricing for pellets was confirmed by pellet manufacturers to account for sourcing from sustainability managed forests and for low or zero-carbon emission during the manufacturing, so the assumption is that emissions are 0 gCO2e/kWh per the allowance within the ZCB standard.

GHG EMISSION FACTORS

Emissions factors are used to quantify the greenhouse gas emissions produced by an activity, such as the consumption of energy for electricity generation or for the fueling of vehicles. Consumption data is multiplied by an emissions factor to quantify the associated emissions.

To enable comparisons between emissions of carbon dioxide, methane, nitrous oxide, and other greenhouse gases, a global warming potential (GWP) value is used to convert the emissions associated with each greenhouse gas into a carbon dioxide equivalent (CO_2e). GWP is an indicator of the amount of radiative forcing, the difference between insolation (sunlight) absorbed by the earth and energy radiated back to space, caused by a given greenhouse gas over a specified period. Environment and Climate Change Canada's National Inventory Report (2018) uses the one-hundred-year GWP values from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report.

An updated version of the IPCC Guidelines for National Greenhouse Gas Inventories will be released in May 2019. The update will incorporate updated scientific research associated with methane emissions related to the extraction and processing of fossil fuels including natural gas.

With a lifetime of only 12 years in the atmosphere, methane is considered a near term climate forcer (see table of Global Warming Potentials below). Most methane emissions occur during the production of natural gas, light/medium oil, and conventional heavy oil and not at the point of consumption as it relates to the heating, cooling or powering of buildings. A variety of regulatory and carbon pollution pricing mechanisms are now in use to reduce methane, especially from direct venting. Ensuring that an incremental price on carbon pollution is applied across all production and consumption processes, and takes methane emissions into account, will support the IPCC recommended target of carbon neutrality by 2050 while also enhancing the cost-effectiveness of ZCBs.

Global Warming Potentials

	20-Year GWP	100-Year GWP	500-Year GWP
Carbon Dioxide	1	1	1
Methane	72	25	7.6
Nitrous Oxide	289	298	153

Source: IPCC's Fourth Assessment Report (IPCC 2012).

GRID ELECTRICITY

For the study, the average and marginal emissions factors used are taken from the requirements of the ZCB Standard, which uses the current ENERGY STAR factors[2]. For easy reference, the factors used are included in the table below.

GHG Emissions Factors by Province

Province/Territory	Natural Gas Emissions (gCO_2e/kWh)	Average Electricity Emissions (gCO_2e/kWh)	Marginal Electricity Emissions (gCO_2e/kWh)
Saskatchewan	172	900	521
Alberta	182	880	469
Nunavut	232	750	881
Nova Scotia	179	730	711
NW Territories	232	300	881
PEI	179	287	781
New Brunswick	179	287	632
Yukon	179	41	881
Ontario	178	40	394
Newfoundland and Labrador	179	31	373
British Columbia	181	17	517
Quebec	178	2	331
Manitoba	178	4	1247

These regions can be approximately grouped into three categories:

1. High-carbon intensity grids (AB, NU, SK, NS/PEI, NT, NB)
2. Medium-carbon intensity grids (YT, ON, NL, PE)
3. Low-carbon intensity grids (BC, MB, QC)

As discussed below in the National Statistics section (A-5), these groupings were used to relate the studied locations to the entire building stock.

[2] ENERGY STAR Portfolio Manager Technical Reference (August 2017). Converted from KG/Mbtu to g/kWh. https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf

A-4 FINANCIAL ANALYSIS

FINANCIAL METRICS

The primary financial metrics used to analyze the cost-benefit of different overall packages and individual measures include:

1. Incremental Capital Cost (ICC)
2. Incremental Life-Cycle Cost (ILCC)

Both metrics were analyzed on a per m^2 and per tonne CO2-equivalent saved ($/$m^2$ and $/$tCO_2e$).

These two metrics are often best used in conjunction and with a summary of total GHG reductions to better understand the combined cost-benefit of any given measure.

Incremental life-cycle cost (ILCC) is emphasized as the most important financial metric in this analysis because it captures the full financial picture, reflecting both initial investment and ongoing costs.

ILCC PARAMETERS

Study length. A 25-year period is used.

Construction is assumed to begin in 2019, with capital expense spread evenly across a 3-year construction period. Buildings are assumed to be operating by 2022, at which point the 25-year life-cycle analysis period begins, with all operating costs escalated accordingly.

Capital cost. First/capital costs of packages were prepared based on:

- Detailed Class D estimates from A.W. Hooker & Associates for Toronto
- City variation factors for Vancouver, Calgary, Ottawa, Montreal and Halifax
- Additional estimates and factors of safety applied by WSP based on previous project experience

In general, contingency for design and construction was kept constant across all packages (i.e. the contingency amount carried was the same, not the contingency factor) since the technologies recommended in the ZCB scenarios were not riskier to construct than the baseline technologies. Sensitivity analysis was done, however, to show the impact of variation in energy and capital cost on the robustness of the package performance, as discussed below.

Utility costs. Costs relevant to each studied city are provided below. Annual escalation was 2%.

Costs for biomass were kept the same in each market at ~$0.09/kWh, despite the expectation that pricing will vary significantly, especially as the sustainably-harvested wood biomass market begins to grow in Canada, affecting a currently export-dominated market.

City	Provinces	Electricity Cost ($/kWh)			Natural Gas ($/kWh)	Elec/Gas
		Warehouse, LR MURB, Retail	School, LR Office, MR MRB	MR Office	All buildings	
Toronto	ON	0.155	0.141	0.146	0.034	4.3
Calgary	AB	0.074	0.065	0.061	0.017	3.9
Vancouver	BC	0.087	0.081	0.075	0.033	2.5
Montreal	QC	0.080	0.068	0.052	0.039	1.7
Winnipeg	MB	0.066	0.056	0.050	0.027	2.1
Moncton	NB	0.0119	0.115	0.079	0.056	1.9
St. John's	NL	0.079	0.074	0.070	0.056	1.3
Ottawa	ON	0.131	0.129	0.125	0.034	3.7
Halifax	NS	0.128	0.117	0.101	0.056	2.1
Regina	SK	0.116	0.097	0.087	0.028	3.6

Utility rate projections are outside the scope of this study; therefore, virtual rates for "typical" building demand profiles were used[1] to maintain consistency in long-term comparisons across locations.

Demand charges may have a significant impact on financial viability for certain technologies in some locations, and sensitivity to this variable has not been accounted for. This is a subject of potential further work, particularly to expand on the benefit of demand reduction technologies to lowering GHGs and energy costs.

Operations & maintenance. General operations and maintenance costs were assumed to be equal in the baselines and ZCBs, calculated as approximately 1.5% of total baseline capital cost (escalated at inflation).

Savings associated with O&M for some energy conservation measures may be significant; however, the factors that influence O&M are complex, and beyond the scope of this study. It has generally been WSP's experience that O&M costs are slightly lower for ZCB designs consistent with the assumptions in this study; however, we have ignored this difference to simplify comparison in this study.

[1] Hydro Quebec North American Utility Rate Study. 2017 data used for study, since 2018 report was not yet complete when study began. http://www.hydroquebec.com/data/documents-donnees/pdf/comparison-electricity-prices.pdf

Service life replacement and residual value. Building component service life estimates were per the table below.

Building Component	Average Service Life (years)
Windows	30
Roof	25
Other Enclosure	40
All Structure	60
Lighting, LED, typical control	20
Other Electrical	25
General HVAC Delivery	20
Ductwork & Piping	50
General HVAC Plant	25
Biomass Boilers, typical usage	30
Geoexchange system	60
PV Panels & Structure	25
PV System Inverters	10
All Other	25

Replacement and residual costs of equipment were calculated based on service life (i.e. equipment is linearly-depreciated to service life, with replacement costs accounted for, along with residual value at the end of the study period).

Inflation and discount rate. Standard inflation rates (1.9%) and discount rates (2.5%) were used, as per federal government guidelines for similar studies.

All life-cycle costs were calculated relative to the baseline resulting in an incremental LCC estimate for each of the ZCBs. Life-cycle costs were calculated using a standard net present value (NPV) approach to account for the time-value of money.

Note that government discount rates are used, since they reflect the cost required to use federal or provincial bonds to fund the work. This assumption allows the results to be consistent with the costs required to support incentive programs and for most government projects.

A higher discount rate may be warranted for projects that cannot access capital at a similar cost, or when comparing to other GHG reduction projects with high return.

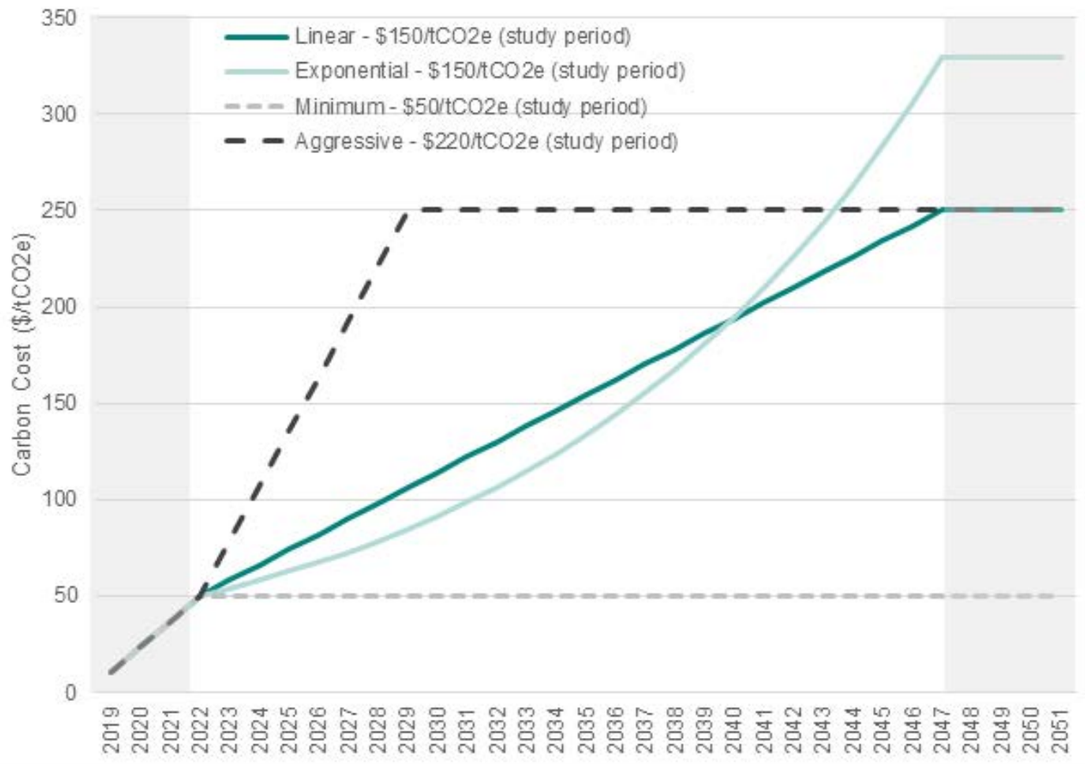
Escalating cost of carbon (e.g. carbon tax). This study uses a cost of carbon of $50/tCO$_2$e in 2022 and escalating by $8/year for 25 years until 2046. This results in an average cost of carbon of $150/tonne over the project life (including year 0).

This escalation rate is derived from a combination of two sources:

> " A roadmap for rapid Decarbonization" – Science - May, 2017 and
>
> " Carbon Pricing Policy Advisory Note", National Roundtable on the Environment and the Economy, 2009

The following graphic depicts a variety of scenarios that were discussed for use in the study. In the end, the linear trend was used.

Figure 1 – Projected Cost of Carbon under different escalation scenarios



RENEWABLE ENERGY CERTIFICATES (RECS)

Emissions reductions can also be achieved with the purchase of Renewable Energy Certificates (RECs), which are generated from offsite low-carbon electricity. In the CaGBC ZCB Standard, RECs offset onsite emissions based on the local marginal grid intensity.

This study assumes an average cost of RECs of $25/MWh which reflects the average price for EcoLogo-certified RECs across the country (the ZCB standard requires that RECs be EcoLogo-certified).

The table below summarizes the cost of RECs per tonne of CO_2e based on the local marginal grid intensity.

Renewable Energy Certificate (REC) Average Cost

City	REC Cost($/tCO$_2$e)
Calgary	$53
Halifax	$35
Montreal	$76
Ottawa	$63
Toronto	$63
Vancouver	$48

These values can be used as an estimate to compare to the ILCC/ tCO_2e of the packages and measures used in this study, to help gauge their cost-effectiveness.

Where RECs were needed in the study, costs were escalated at the same rate as energy prices.

SENSITIVITY ANALYSIS

Sensitivity analysis was completed on two archetypes (mid-rise office and low-rise MURB) for all study locations using RETScreen Expert. These analyses are meant to provide insight into the robustness of the life-cycle cost performance of the ZCB options and to show the relative impact of different components of the life-cycle on the overall results.

Sensitivity results are included in Appendix B-3 as raw outputs from RETScreen. Note that the results for life-cycle cost in RETScreen show negative as a life-cycle cost increase (i.e. negative is bad, positive is good). This interpretation is opposite to the way it is discussed in the report.

A-5 NATIONAL STATISTICS

NATIONAL BUILDING STOCK

Natural Resources Canada has summarized the available data from a variety of studies into a useful on-line resource called the Comprehensive Energy Use Database (CEUD)[1]: Data up to 2015 from this database were used to establish a frame of reference for the building area, energy and GHG data developed in the study, and to extrapolate to a national context

The precedent residential and commercial energy use surveys used in this study are:

- Natural Resources Canada, 2011 Survey of Household Energy Use - Detailed Statistical Report, Ottawa, 2013
- Natural Resources Canada, 2014 Survey of Commercial and Institutional Buildings, Ottawa, 2016

Statistics Canada's on-line future population estimation database was also used[2], officially cited as:

- Statistics Canada. Table 17-10-0057-01 Projected population, by projection scenario, age and sex, as of December, 2018.

Based on the CEUD and the sources above, the table below was developed, which provides an estimated breakdown of the existing non-industrial buildings.

[1] http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive_tables/list.cfm
[2] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710005701

Category	Occupancy Type	1,000,000 m² (2018 est.)	%-category	%-total	Study Facility Mapping	Studied Area 1,000,000 m²
Residential	Single Detached	1351	65%	46.3%	N/A	0
	Single Attached	238	11%	8.2%	N/A	0
	Mobile Home	28	1%	0.9%	N/A	0
	Low-rise Apartment	305	15%	10.5%	Low-rise MURB	305
	High-rise Apartment	164	8%	5.6%	Mid-rise MURB	164
Res Total		2087				469
Commercial	Assisted daily/ residential care facilities	21	2%	0.7%	Low-rise MURB	21
	Hotels, motels or lodges	19	2%	0.7%	Low-rise MURB	19
	Office buildings (non-medical)	292	35%	10%	50%/50% - Low/Mid Office	292
	Medical office buildings	16	2%	0.6%	Low-rise Office	16
	Elementary and/or secondary schools	74	9%	2.5%	Primary School	74
	Warehouses	97	12%	3.3%	Warehouse	97
	Non-food retail stores	89	11%	3.1%	Big Box Retail	89
	Other activity or function	188	22%	6.4%	80% are Average of All Non-MURB (20% high-intensity)	150
	Hospitals	16	2%	0.5%	N/A	0
	Food and beverage stores	23	3%	0.8%	N/A	0
Comm. Total		820				758
Grand Total (m²)		2846				1227

Assumptions were made about what fraction of each category of residential and commercial buildings could be reliably mapped to the studied archetypes (see the column labeled “Study Facility Mapping”). Only apartments were mapped to the MURB archetypes; other residential usage was excluded. For the office buildings, a split of 50/50 between low-rise and mid-rise was assumed. High-intensity institutional and commercial uses were excluded (i.e. hospitals and food/beverage stores), including 20% of the “other activity or function” category, which was assumed to be laboratory facilities and other high-intensity facilities. The remaining 80% was assigned evenly to all the non-MURB archetypes. The final floor area assigned to each archetype is summarized in the following table.

National Stats Table A – Archetype Breakdown of National Building Stock

Archetype	Area Assigned (1,000,000 m²)
Low-Rise MURB	345
Mid-Rise MURB	164
Mid-Rise Office	176
Low-Rise Office	193
Primary School	104
Warehouse	127
Retail	119

BUILDING LOCATION - POPULATION AND GRID VARIATIONS

To accurately reflect the potential for GHG emission reductions across the country, two key parameters need to be considered: expected population growth and emissions factors from electricity generation.

The table below summarizes the expected population growth for each province, as per the Statistics Canada database referenced above, using medium growth scenario M5 (based on 2009/2010 to 2010/2011 trends). Population estimates by province are only available until 2038, so the assumption about where people will live beyond that date is based on an extrapolation of the 2038 results included below and applied to the 2049 total from the database.

Overall growth is 26% and is assumed to vary between 9% to 41% across the country.

National Population Growth 2018 to 2049

Province/Territory	Population (2018) (thousands)	Population (2038) (thousands)	Population (2049) (thousands)	Growth from 2018 (%)
Canada	**36,940**	**43,474**	**46,583**	**26%**
BC	4,830	5,734	6,144	27%
ON	14,189	16,583	17,769	25%
QC	8,494	9,582	10,268	21%
NL	534	536	575	8%
NB	768	779	834	9%
NS	954	966	1,035	8%
PE	152	177	189	25%
MB	1,345	1,704	1,826	36%
SK	1,186	1,527	1,636	38%
AB	4,362	5,723	6,132	41%

Six key locations were selected for this study: Vancouver, Calgary, Toronto, Ottawa, Montreal and Halifax. For the purposes of this study, provinces and territories without one of the representative six city were assigned a city based on similar climate and electricity grid carbon intensity. This compression of the provincial data into the seven locations is crude, but allows for a simpler estimate of total national impact without requiring study results across the country.

Representative Study Locations

Province/Territory	Study Location
BC YT PE	Vancouver
AB SK NU	Calgary
ON	Toronto (80%) / Ottawa (20%)
NL	Ottawa
QC MB	Montreal
NB NS NTa	Halifax

One weakness of this approach is that several provinces and territories have colder climates or regions with colder climates than the locations studied. Based on previous studies, however, the financial results of energy conservation are typically much better in regions with colder climates because energy costs are typically higher due to increased demand for heating and reduced access to natural gas.

Combining the previous two tables allows for a picture of the split of national population as it would be assigned to the seven studied locations and a summary of the expected growth between 2018 and 2049. This combined result is shown in the table below.

National Stats Table B – Location Breakdown of Population And Growth

Location	Share of Population (2018)	Population Growth (2018 to 2049)
Vancouver	13%	27%
Calgary	15%	40%
Toronto	31%	25%
Ottawa	9%	22%
Montreal	27%	23%
Halifax	5%	9%

NATIONAL RESULTS AVERAGING PROCESS

To provide a simple, but useful estimate of the impact of the studied ZCB results on the entire Canadian commercial and multi-unit residential market, Table A and Table B have been combined as follows:

For each archetype, location combination:

Assigned Area	=	Table A 2018 Area (Archetype) (m^2) x Table B 2018 Share (Location) (%) x (1 + Table B 2018-2049 Growth (location) (% > 100))

This calculation provides an estimate of the total facility area for a given archetype in a given location up to 2049. The calculation assumes that the building area in 2018 was distributed according to the population in 2018 and that growth in each sector will be a function of population growth assigned to each location. This is a simplification, but it provides a useful indication of the potential of GHGs throughout the commercial and MURB sector.

To estimate the number of facilities that will be new construction (NC) by 2049 (i.e. the scope of the study) it was assumed that NC will match the average growth rate between 2018 and 2049 – approximately 26%. This factor is applied to the facility area to determine a total square footage of studied area for potential ZCBs.

NC Assigned Area	=	Assigned Area * 0.26

To calculate the potential location/archetype GHG reduction, capital cost and life-cycle costs, the NC Assigned Area was multiplied by the difference in baseline and ZCB intensity (i.e. per m^2) results (per Appendix B1) for each archetype/location combination.

NC Assigned GHG	=	NC Facility Area * Appendix B1 GHGI for Location/Archetype
NC Assigned ICC	=	NC Facility Area * Appendix B1 ICC$/$m^2$ for Location/Archetype
NC Assigned ILCC	=	NC Facility Area * Appendix B1 ILCC$/$m^2$ for Location/Archetype

To summarize the calculation procedure, here is an example of the above calculations for Toronto, Mid-rise Office:

Assigned Area	=	Area(176 Mm^2) * Share(31%) * Growth(125%) = 68.2 Mm^2
NC Assigned Area	=	68.2 Mm^2 * 0.26 = 17.7 Mm^2
NC Assigned GHG	=	17.7 Mm^2 * (15 – 0) kgCO_2e/m^2 = 265.5 million kgCO_2e saved or 265,500 tCO_2e
NC Assigned ICC	=	17.7 Mm^2 * $100 / m^2 = $1,770,000,000 capital required
NC Assigned ILCC	=	17.7 Mm^2 * -$156 / m^2 = $2,761,200,000 life-cycle cost savings over 25 years.

All of the individual NC Assigned results are summed and then divided by total area to calculate weighted averages of all the important metrics (e.g. GHG reduction, ICC and ILCC) across archetypes and locations and to produce a single national average number for each key metric as summarized in the main report and in Appendix B-4.

ROLL-OUT OF COSTS AND SAVINGS

The process outlined above can be assumed to provide a reasonable estimate of the potential savings and costs for all NC buildings built between now and 2049 and to provide an indication of averages across different sectors and locations. However, providing overall benefits and averages is not the same as predicting the actual savings and costs in a changing national market, which would be useful for policy-makers to understand the costs likely to be paid by developers in order to design appropriate market incentives and other regulations.

Even if all ZCBs achieved the studied performance and had the same costs per m^2, the following key factors would still need to be considered in an estimate of roll-out costs:

1. Disparate baseline/code conditions and relative costs and savings associated (i.e. disparity in base case)
2. Disparity in the market transition towards ZCBs and available incentives/disincentives that motivate action in the studied NC markets (i.e. disparity in ZCB uptake)

These factors would need to be explored in order to provide an accurate estimate of how much of the expected NC stock could be ZCB by 2050 and how much it will cost developers to implement ZCBs in their respective markets. Taking into account market specifics in each jurisdiction and estimating the actual roll-out cost as described above is a source of potential future work.

APPENDIX B

DETAILED RESULTS

B-1 OVERALL ARCHETYPE RESULTS

In addition to the two-page summaries of TEDI, EUI, GHGI, ICC and ILCC results that follow, the following summary tables of overall financial performance have been prepared for quick reference.

ICC % increase	Mid Rise Office	Low Rise Office	Mid Rise MURB	Primary School	Low Rise MURB	Warehouse	Retail Stand Alone
Halifax	4.0%	6.4%	6.7%	15.5%	11.8%	9.1%	15.2%
Calgary	3.9%	6.3%	6.5%	16.3%	11.6%	9.4%	16.4%
Ottawa	4.0%	3.8%	6.6%	12.8%	9.8%	10.9%	14.9%
Toronto	3.9%	3.6%	6.6%	12.7%	9.7%	9.8%	12.8%
Montreal	3.5%	2.7%	6.2%	11.7%	9.1%	11.4%	14.9%
Vancouver	4.1%	3.2%	6.4%	12.0%	9.2%	9.9%	14.9%

ILCC % increase	Mid Rise Office	Low Rise Office	Mid Rise MURB	Primary School	Low Rise MURB	Warehouse	Retail Stand Alone
Halifax	-5.2%	-7.3%	-2.3%	-4.4%	-2.7%	-5.7%	-6.4%
Calgary	-3.2%	-3.7%	0.2%	0.9%	1.6%	-2.5%	-1.2%
Ottawa	-3.4%	-3.2%	-0.9%	0.1%	0.7%	-1.7%	-1.9%
Toronto	-3.9%	-3.1%	-0.9%	0.9%	1.0%	-3.0%	-3.7%
Montreal	-1.5%	-1.3%	-0.4%	1.4%	0.9%	0.4%	1.6%
Vancouver	-0.8%	-0.7%	1.0%	2.9%	2.8%	0.7%	3.3%

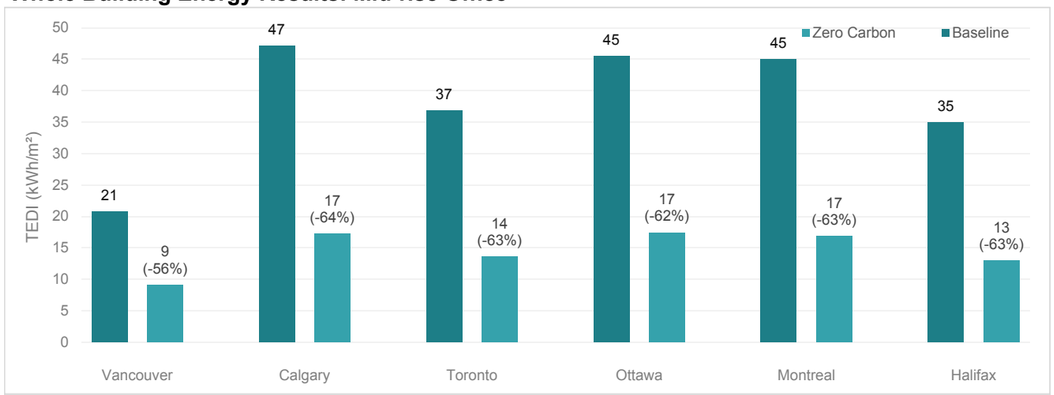
(negative values indicate net cost savings over 25-years)

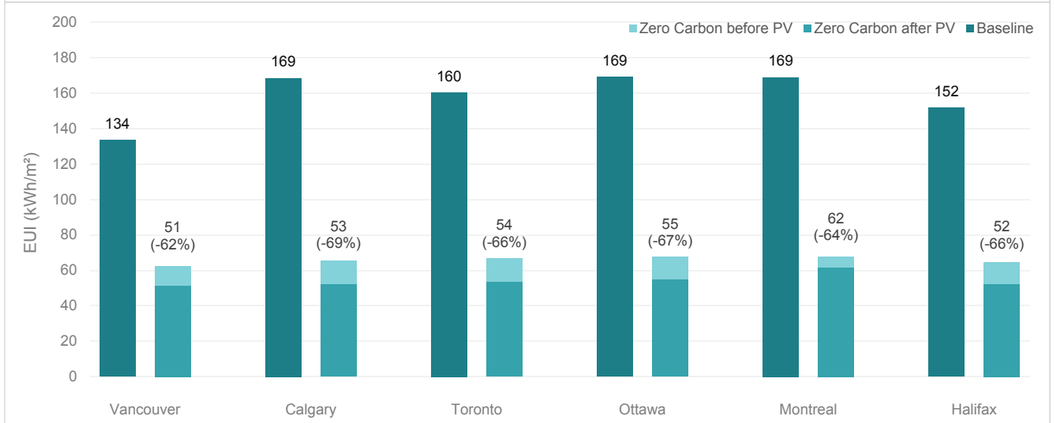
ICC/GHG-saved ($/tCO2e)	Mid Rise Office	Low Rise Office	Mid Rise MURB	Primary School	Low Rise MURB	Warehouse	Retail Stand Alone
Halifax	97	106	240	236	256	147	151
Calgary	82	99	207	222	257	137	145
Ottawa	295	289	367	509	435	362	441
Toronto	329	321	439	655	520	418	544
Montreal	298	264	375	514	439	405	507
Vancouver	504	396	529	696	633	476	680

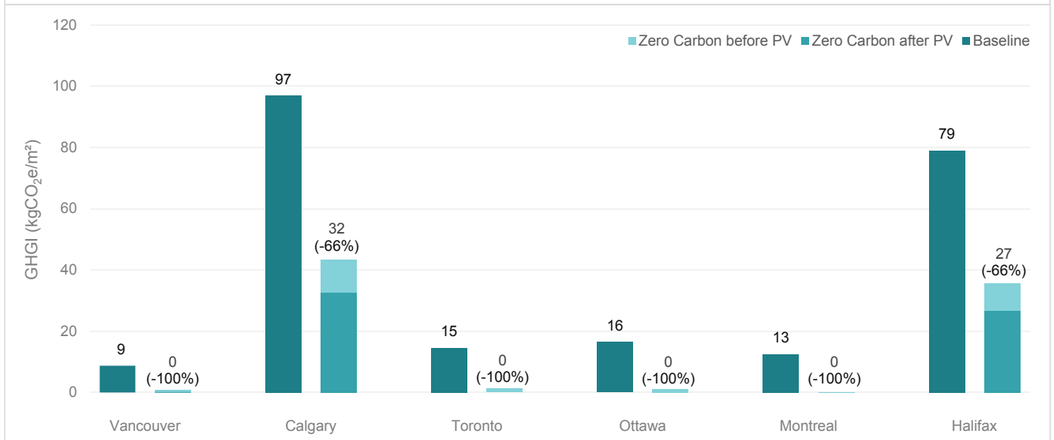
% of EUI before PV matched by PV generation*	Mid Rise Office	Low Rise Office	Mid Rise MURB	Primary School	Low Rise MURB	Warehouse	Retail Stand Alone
Halifax	19%	101%	25%	101%	102%	43%	61%
Calgary	20%	111%	26%	142%	113%	48%	75%
Ottawa	19%	34%	25%	32%	33%	62%	57%
Toronto	20%	34%	26%	31%	33%	64%	57%
Montreal	9%	9%	16%	6%	16%	69%	60%
Vancouver	18%	19%	20%	15%	22%	57%	50%

** This metric shows the percent of total energy consumption met by onsite generation of electricity over the course of a year. That generation is then used to reduce the "after PV" EUIs in the tables below.*

Whole Building Energy Results: Mid-rise Office

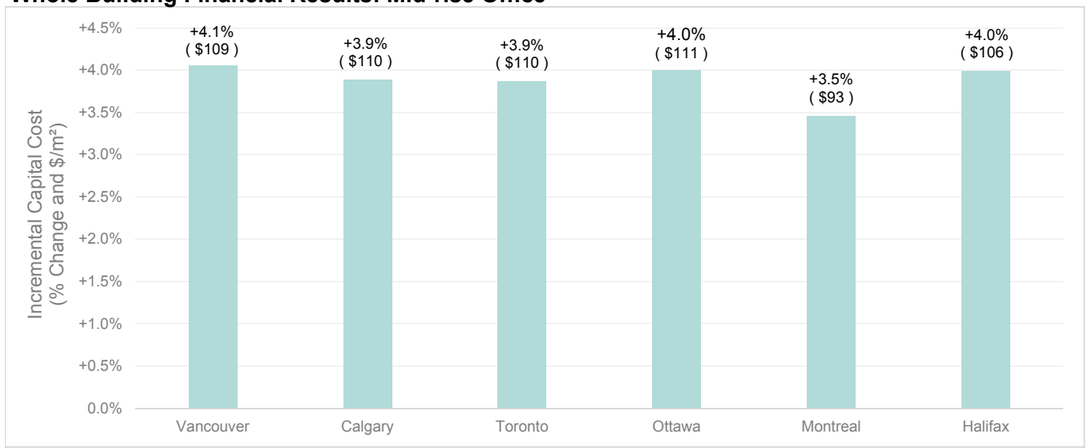


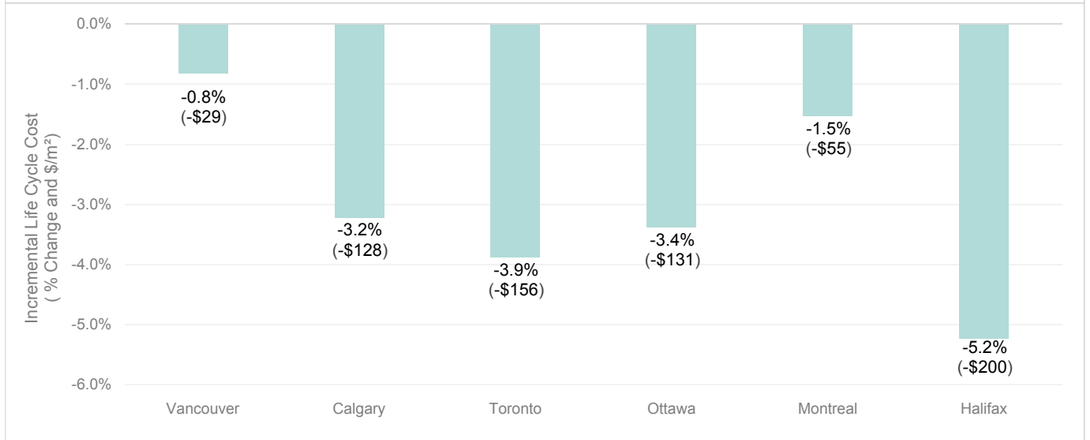


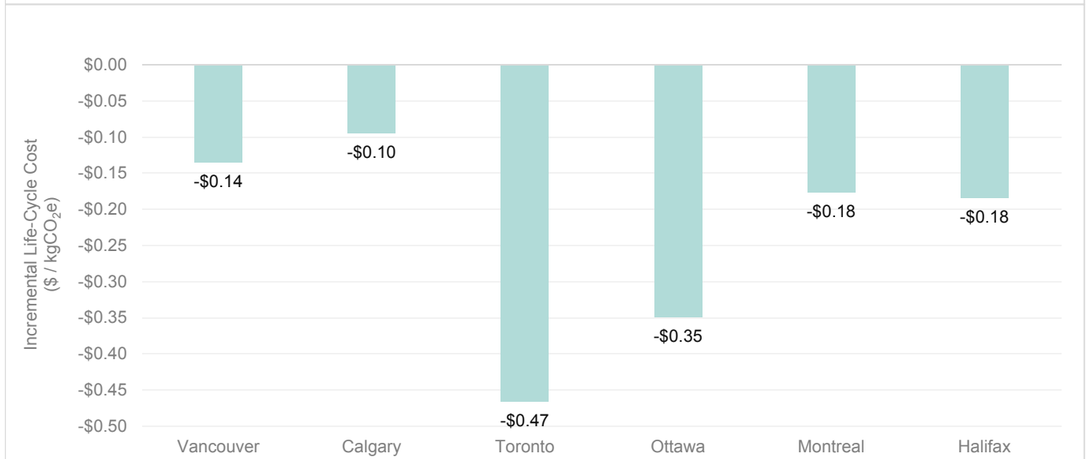


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Financial Results: Mid-rise Office

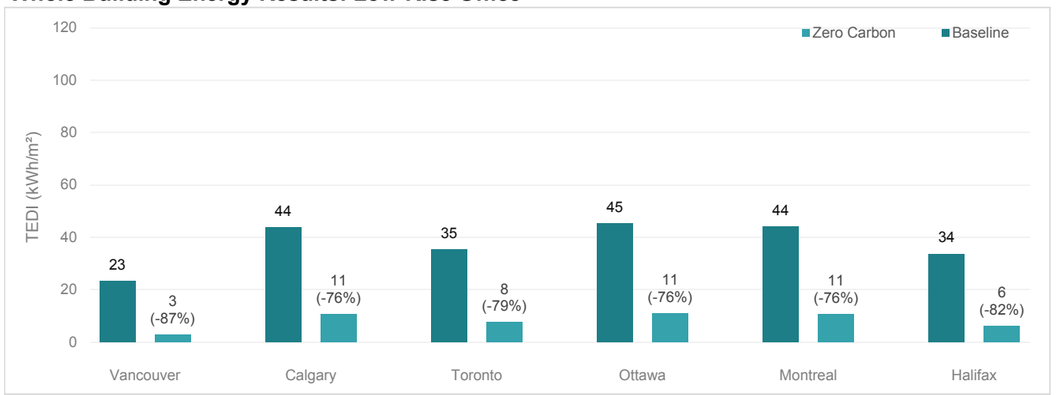


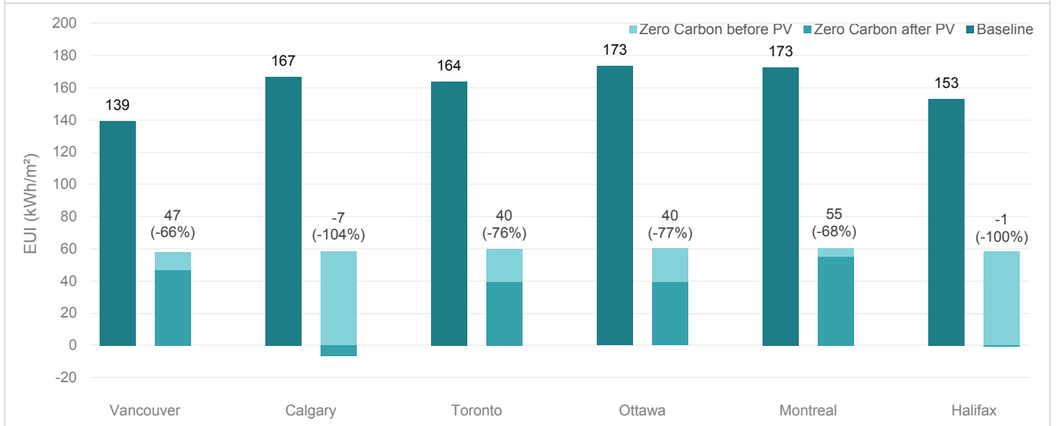


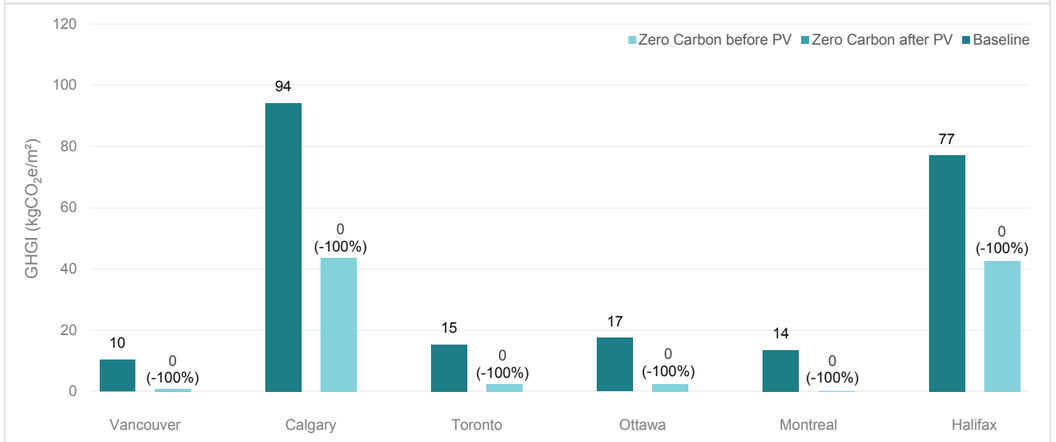


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Low-Rise Office

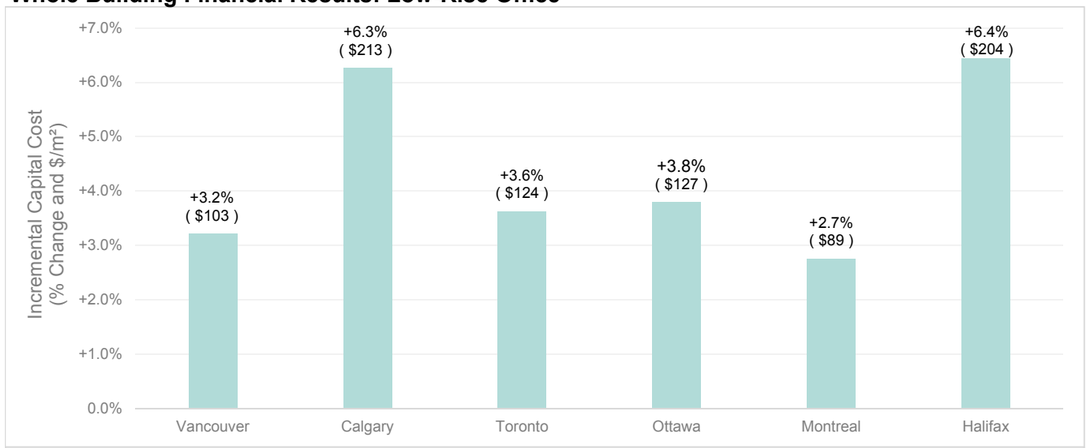


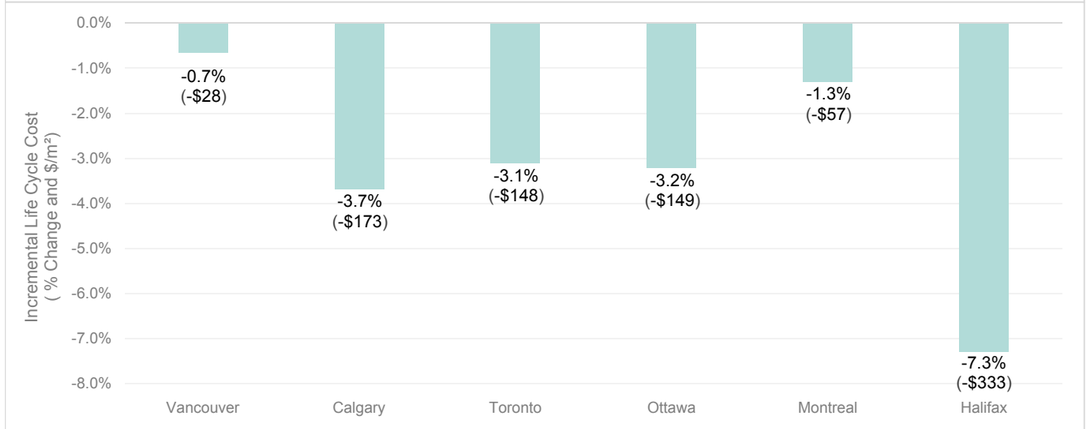




Note: All Zero Carbon labels are after accounting for PV reductions

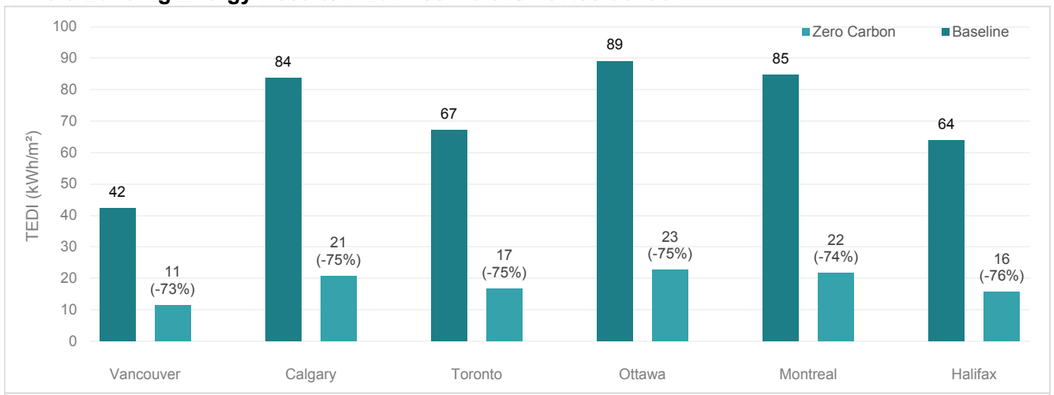
Whole Building Financial Results: Low-Rise Office

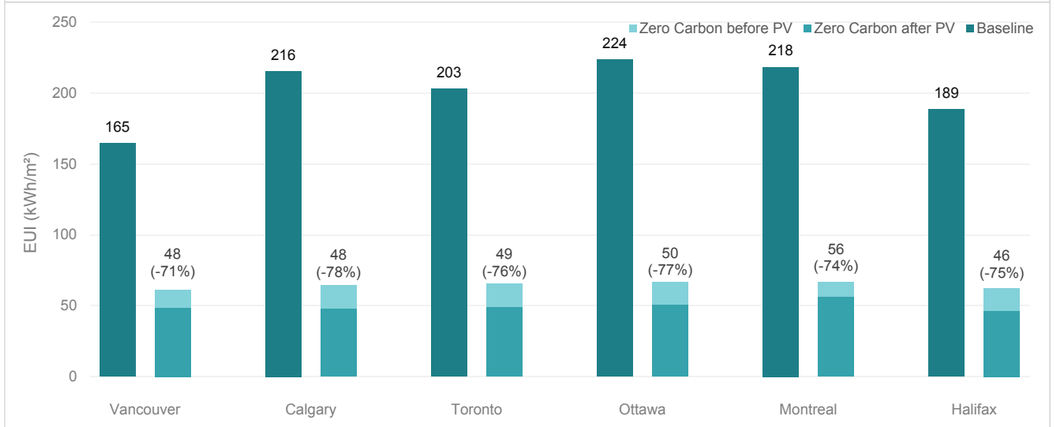


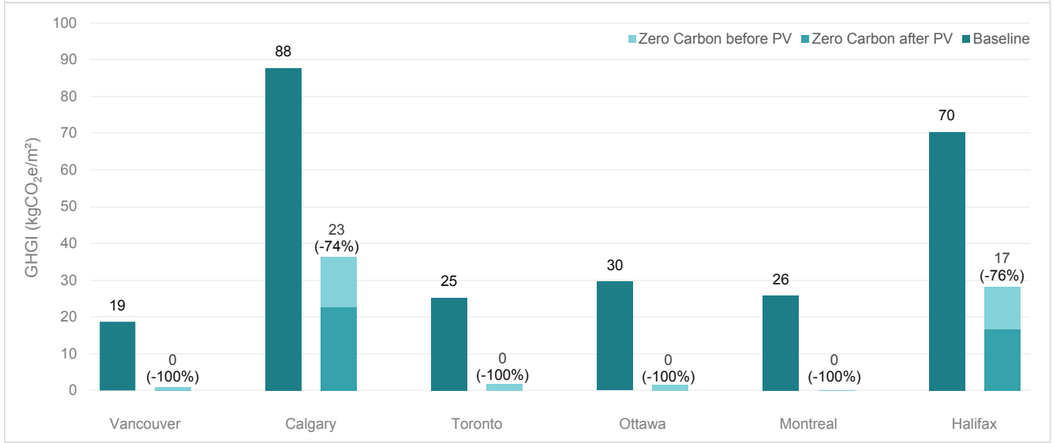


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Mid-Rise Multi-Unit Residential

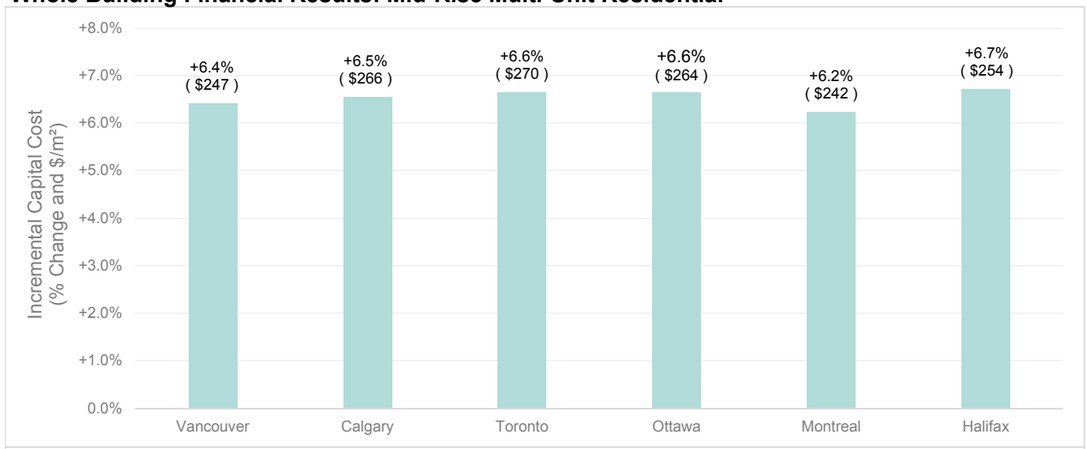


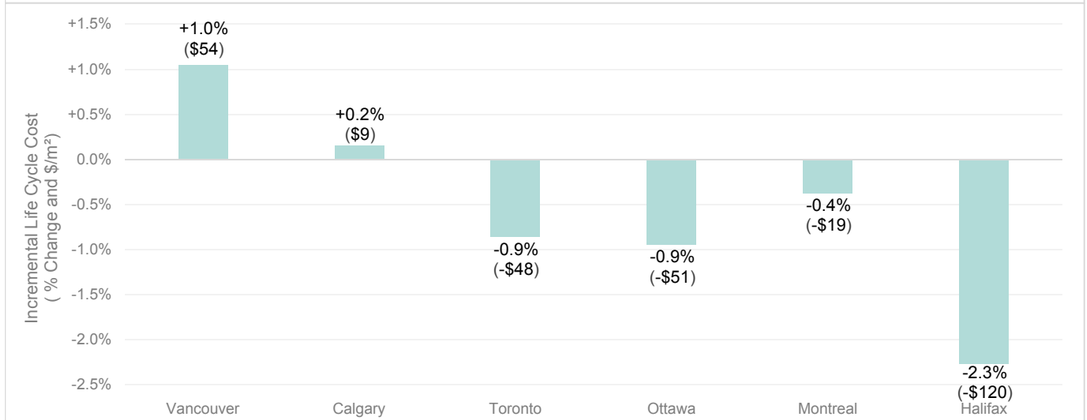




Note: All Zero Carbon labels are after accounting for PV reductions

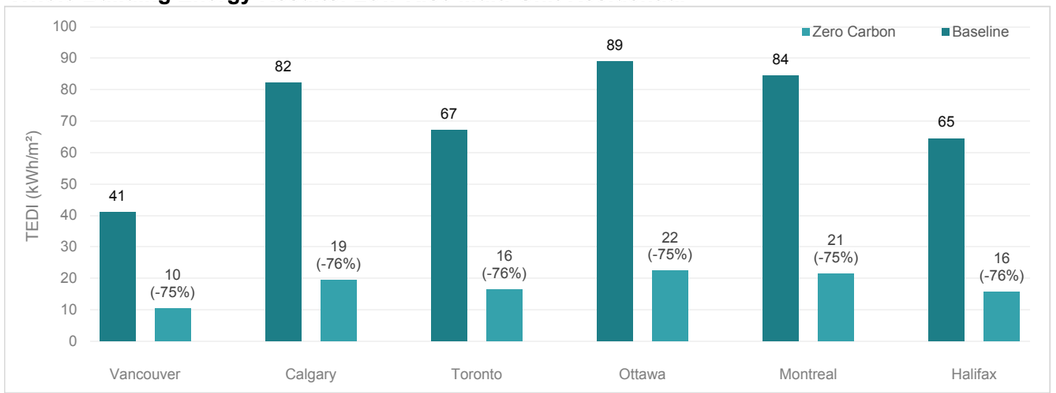
Whole Building Financial Results: Mid-Rise Multi-Unit Residential

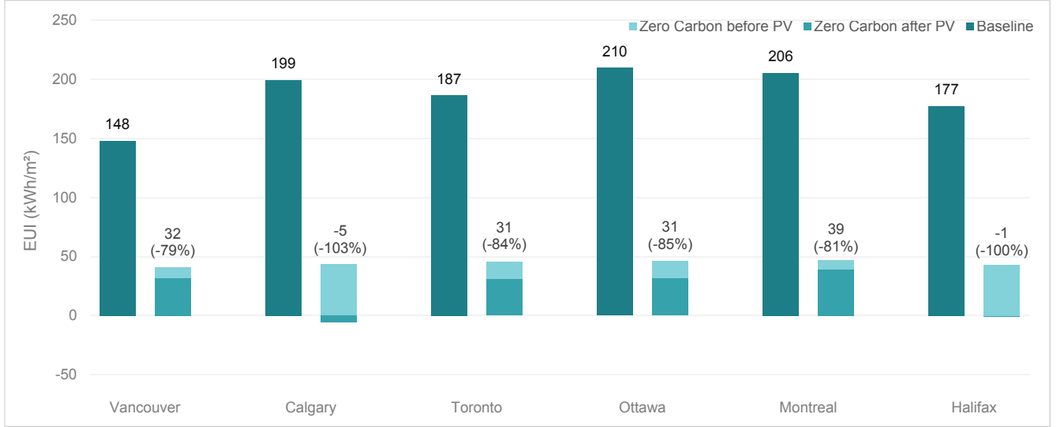


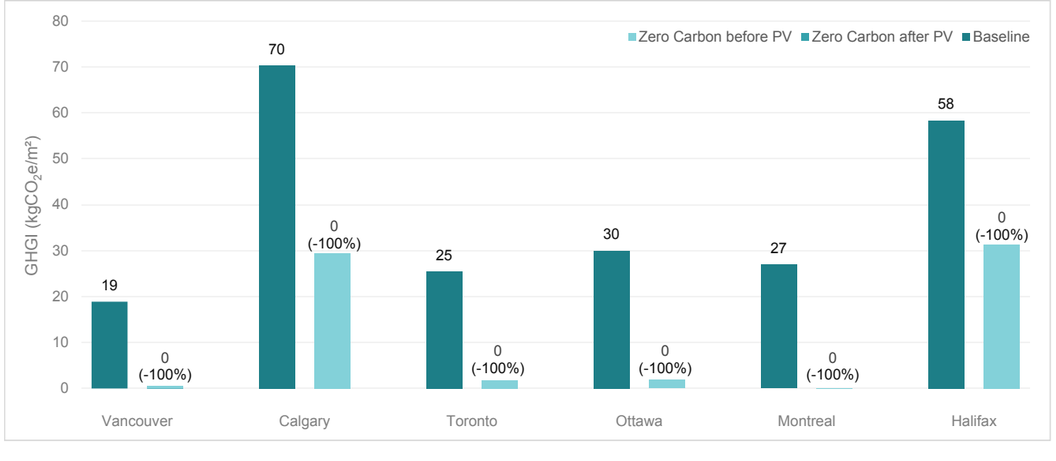


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Low-Rise Multi-Unit Residential

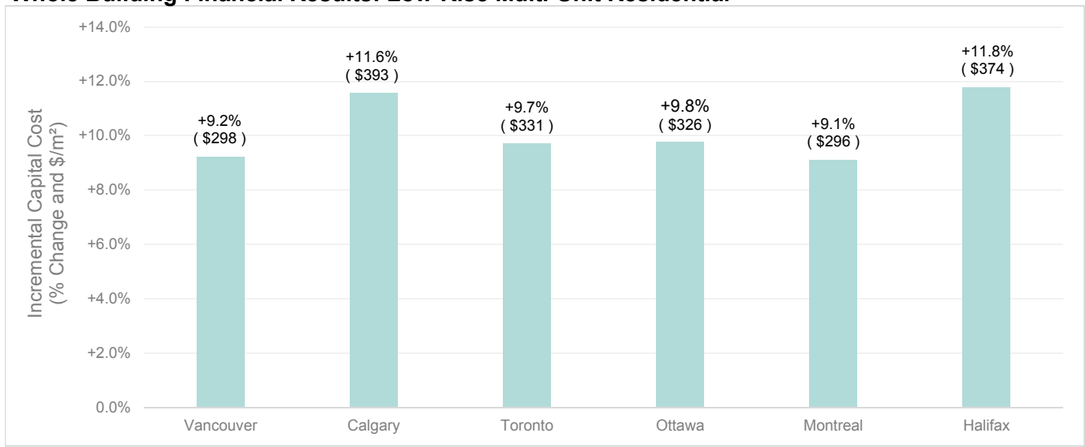


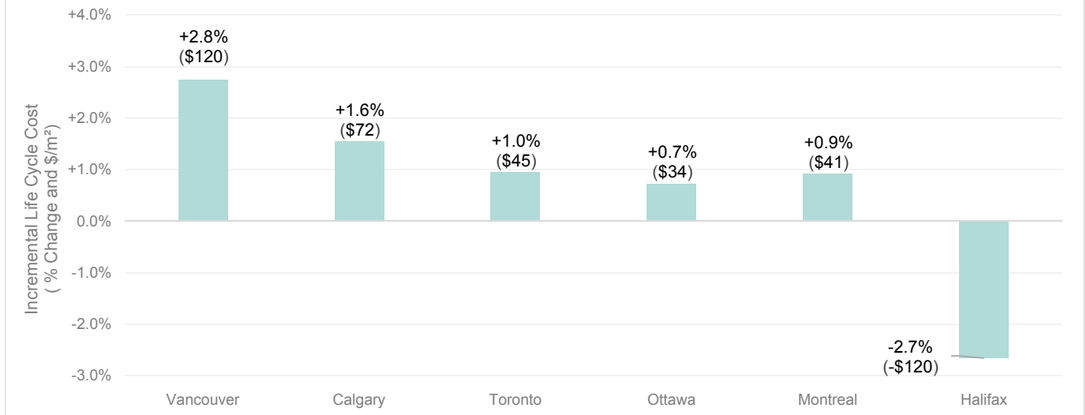




Note: All Zero Carbon labels are after accounting for PV reductions

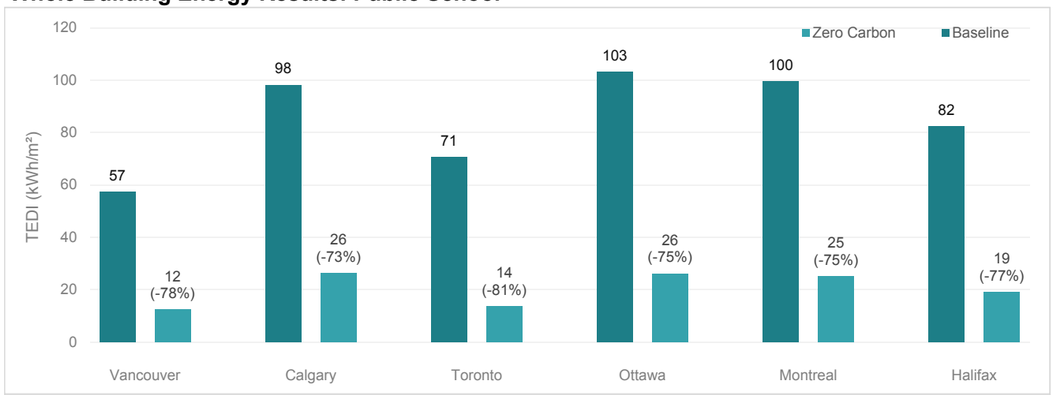
Whole Building Financial Results: Low-Rise Multi-Unit Residential

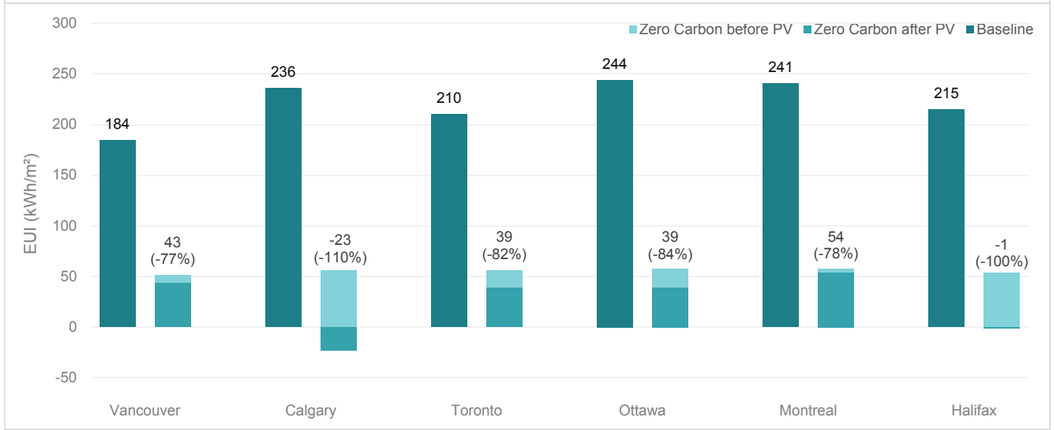


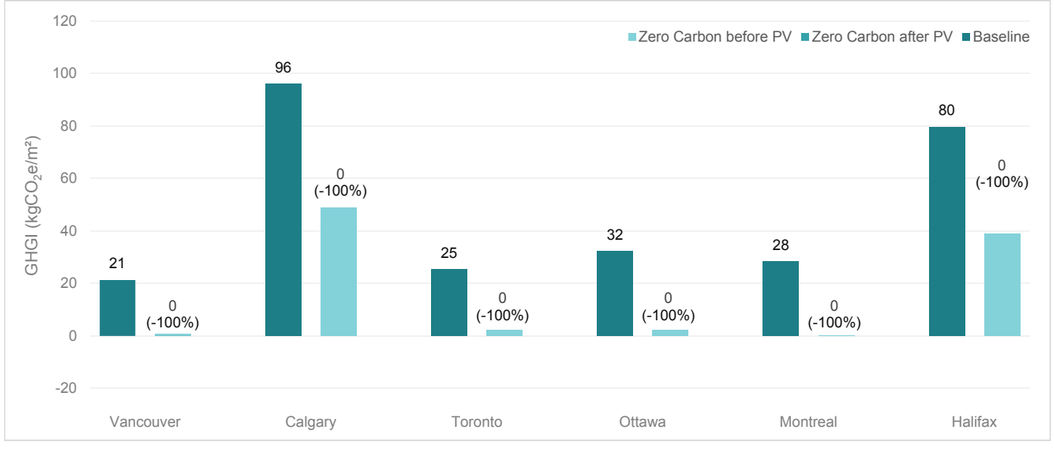


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Public School

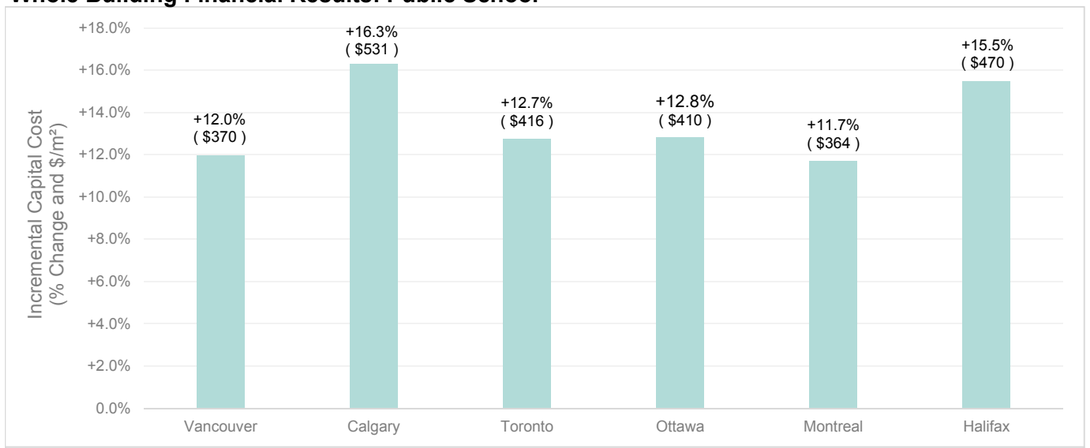


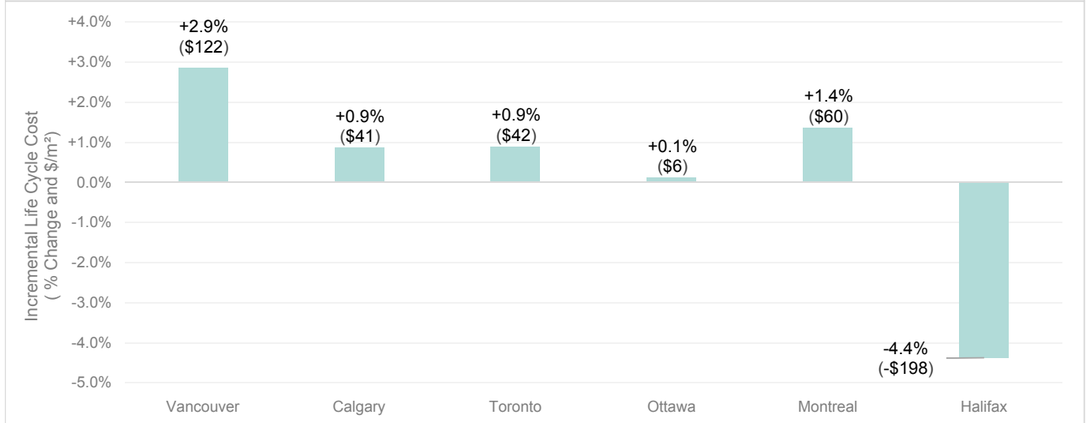




Note: All Zero Carbon labels are after accounting for PV reductions

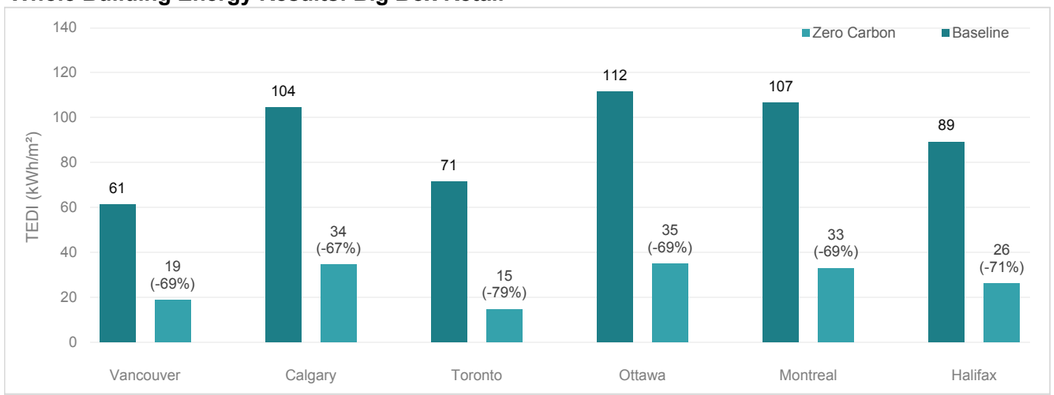
Whole Building Financial Results: Public School

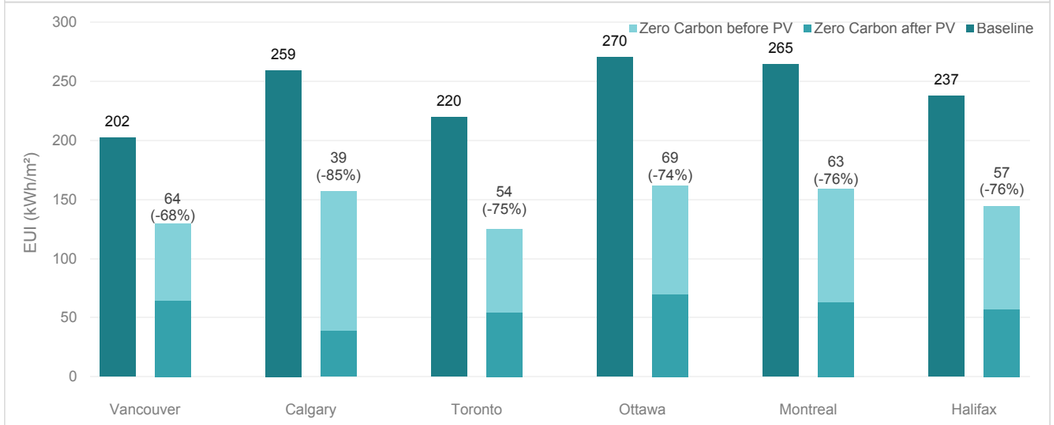


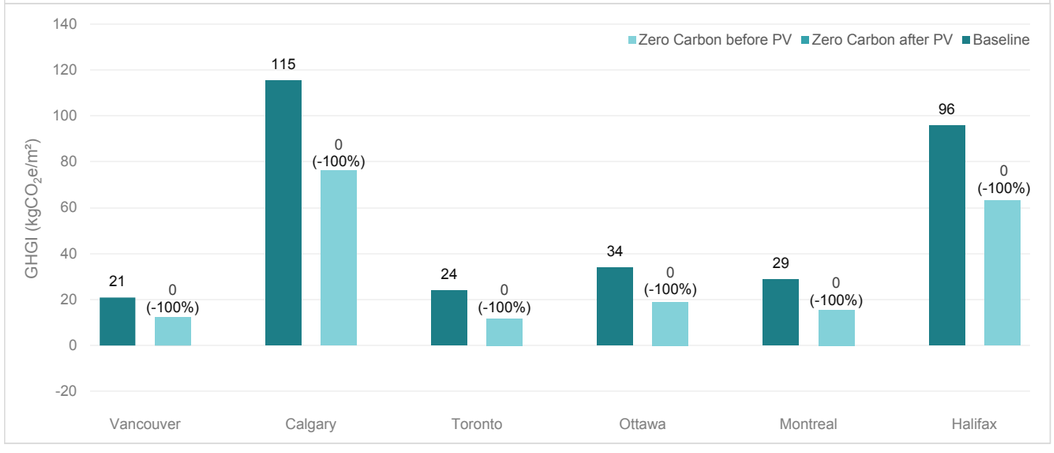


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Big Box Retail

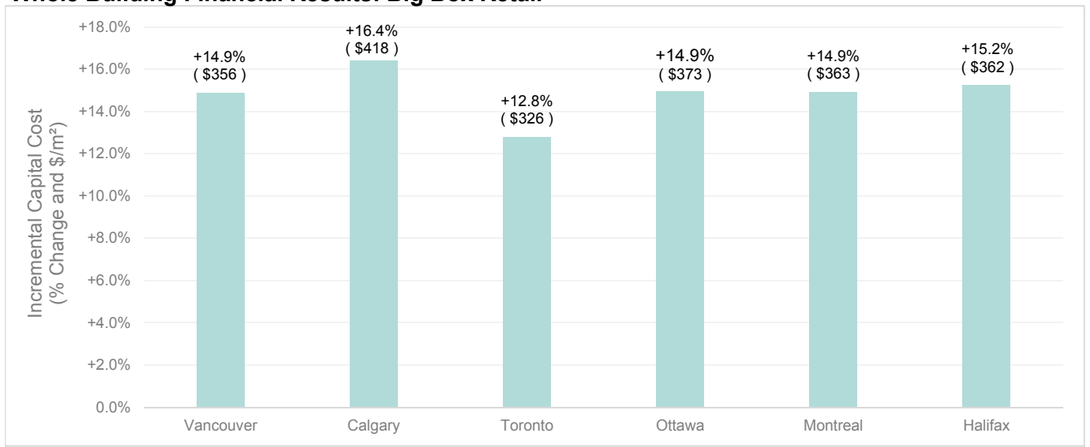


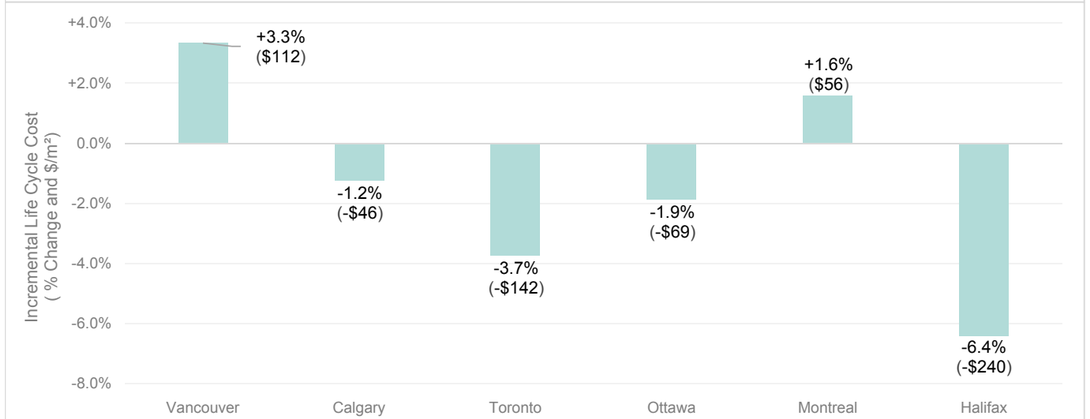


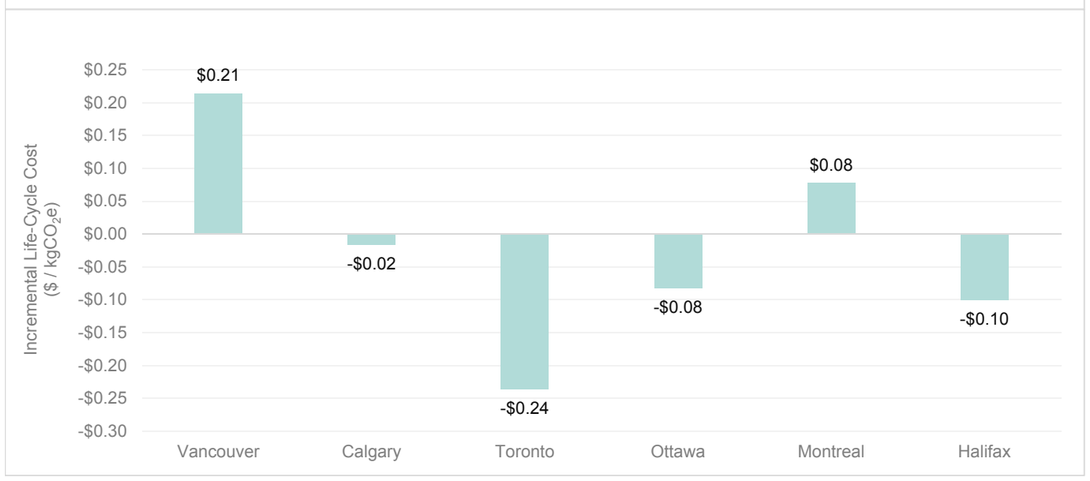


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Financial Results: Big Box Retail

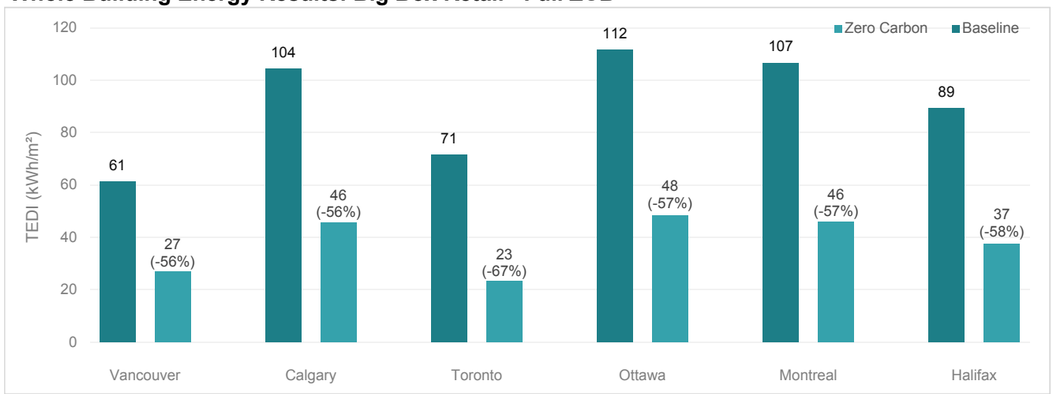


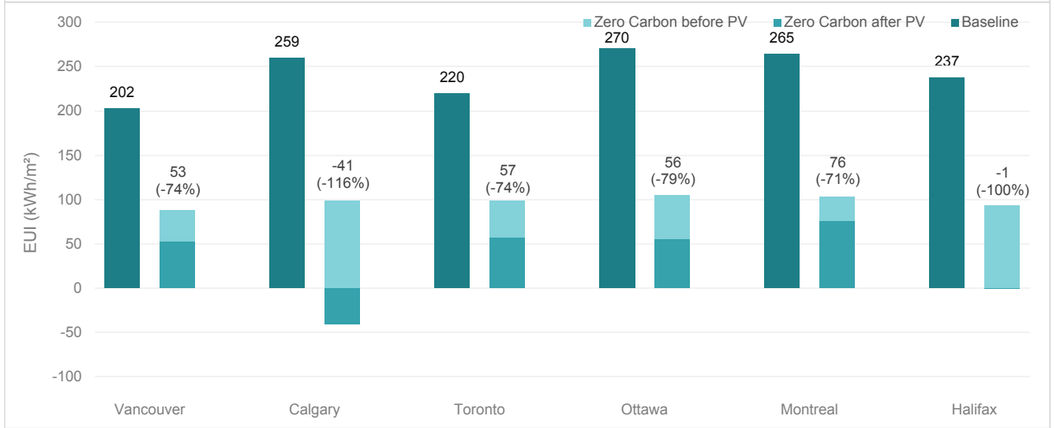


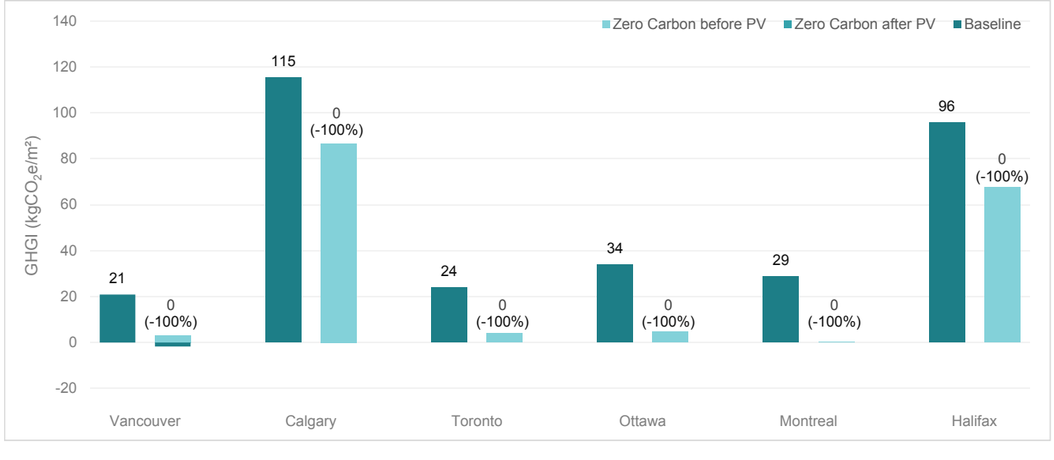


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Big Box Retail - Full ZCB

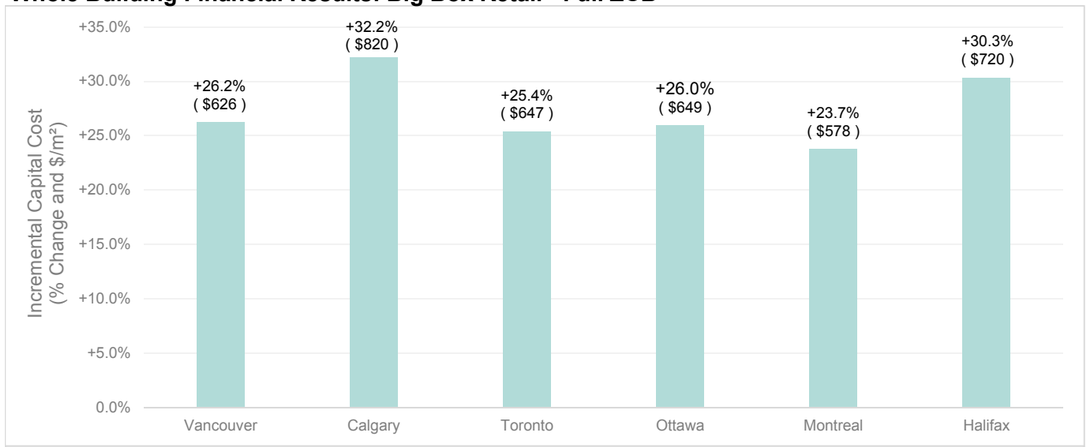


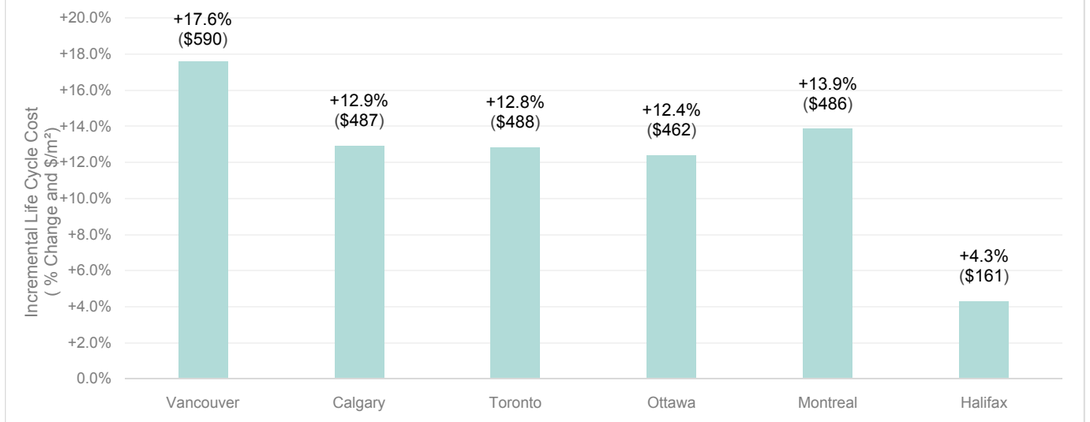


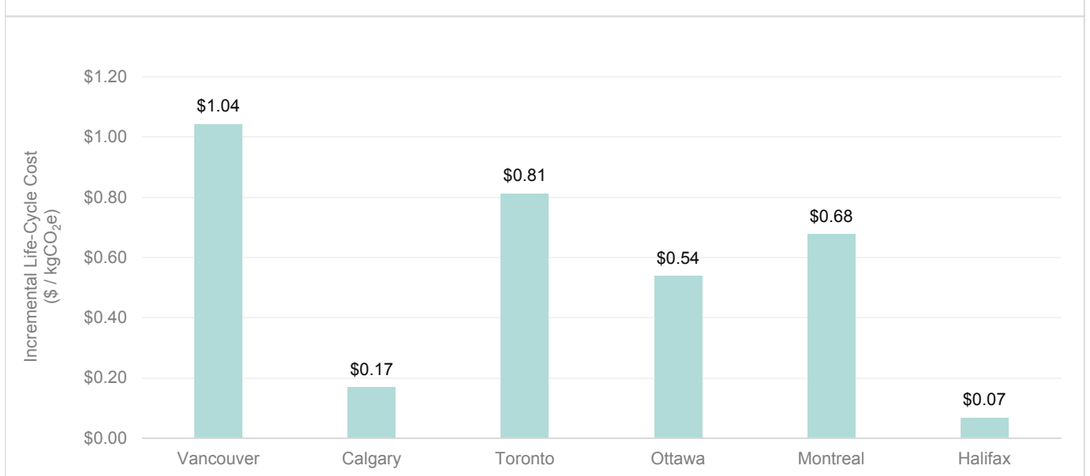


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Financial Results: Big Box Retail - Full ZCB

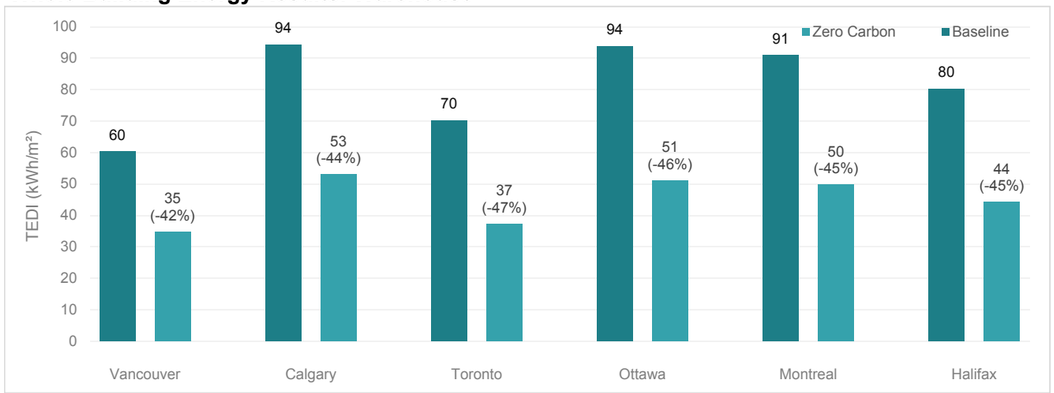


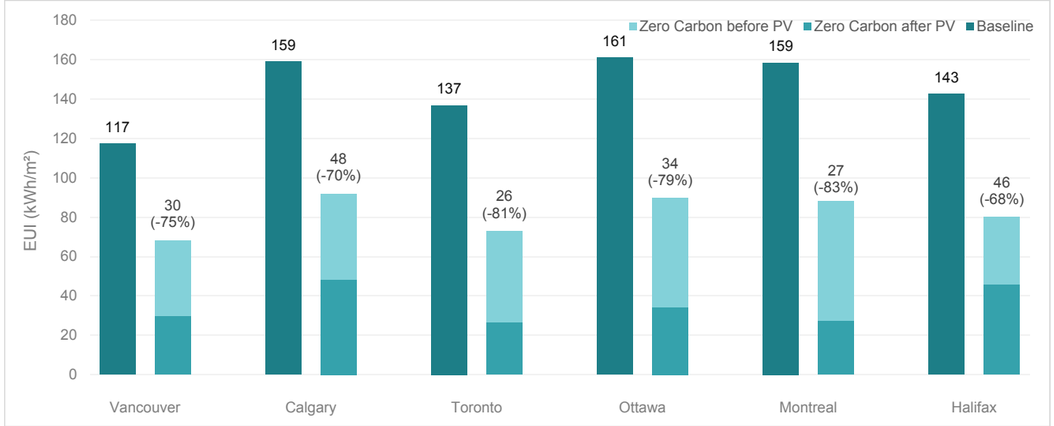


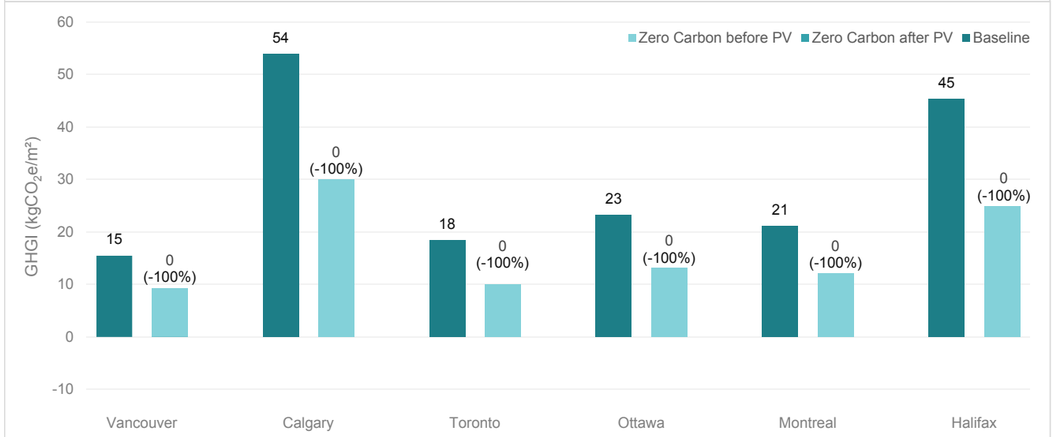


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Warehouse

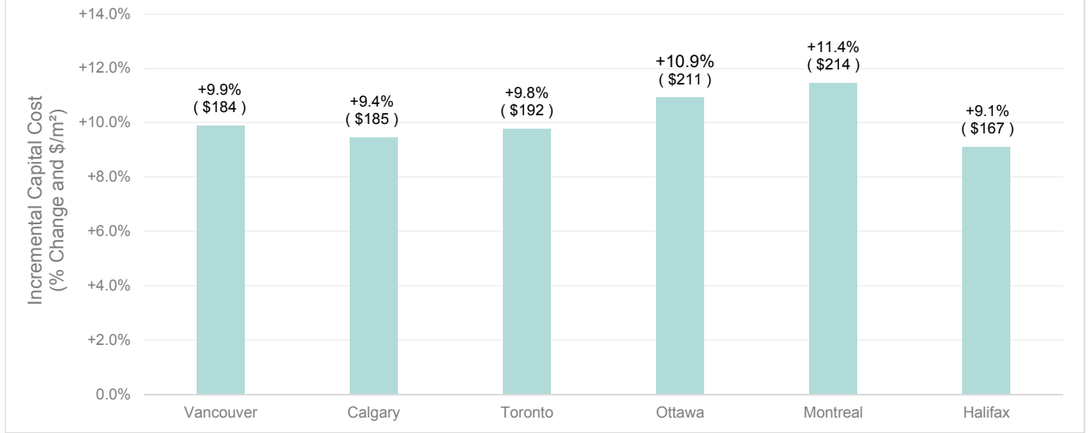


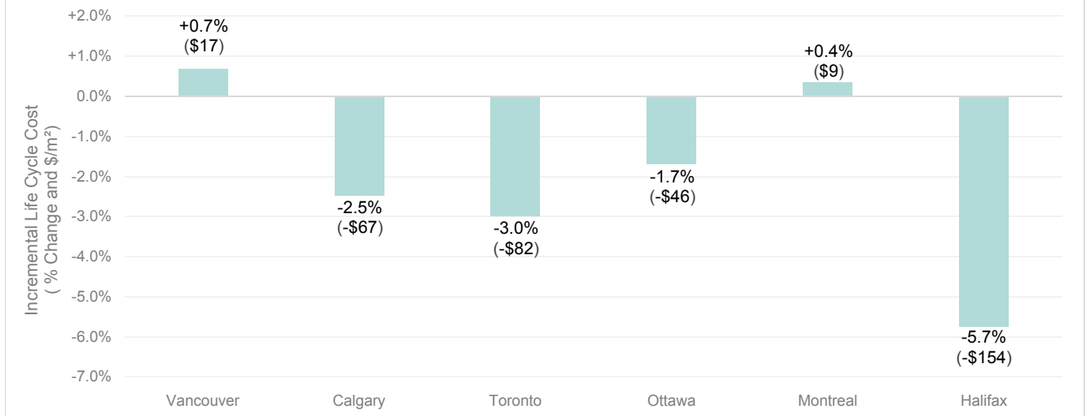




Note: All Zero Carbon labels are after accounting for PV reductions

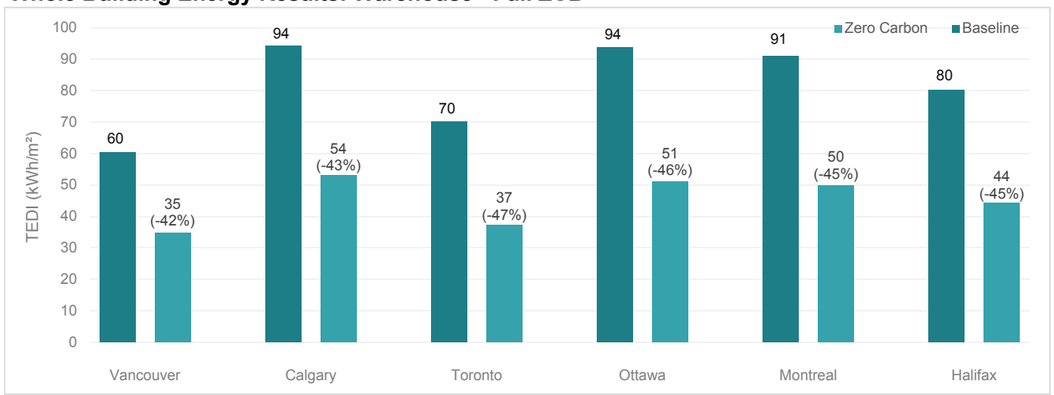
Whole Building Financial Results: Warehouse

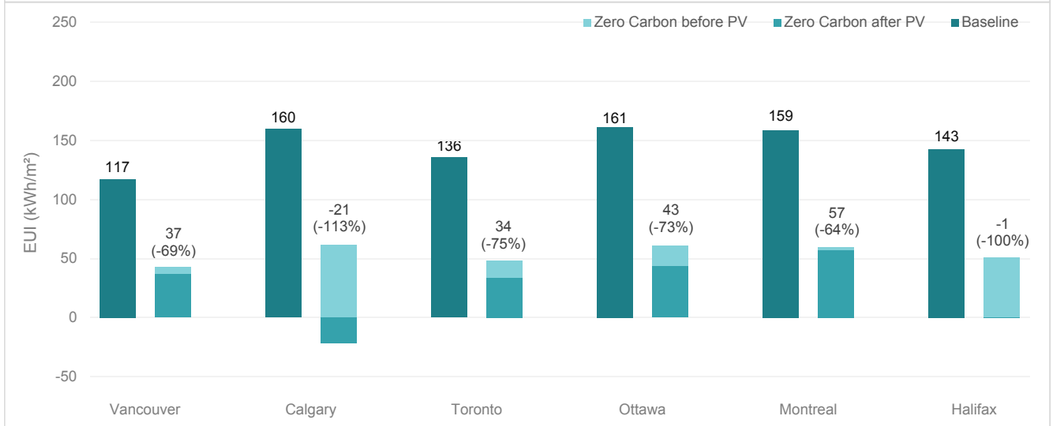


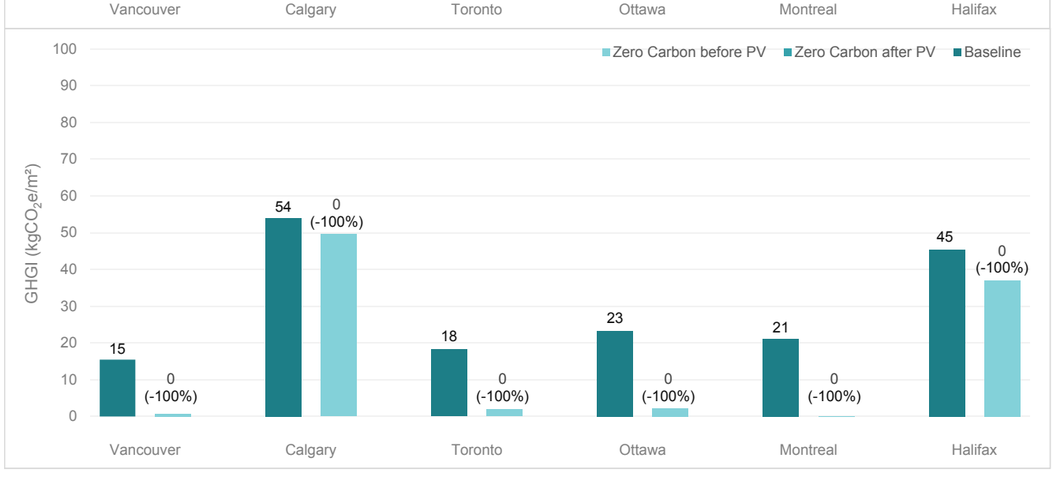


Note: All Zero Carbon labels are after accounting for PV reductions

Whole Building Energy Results: Warehouse - Full ZCB



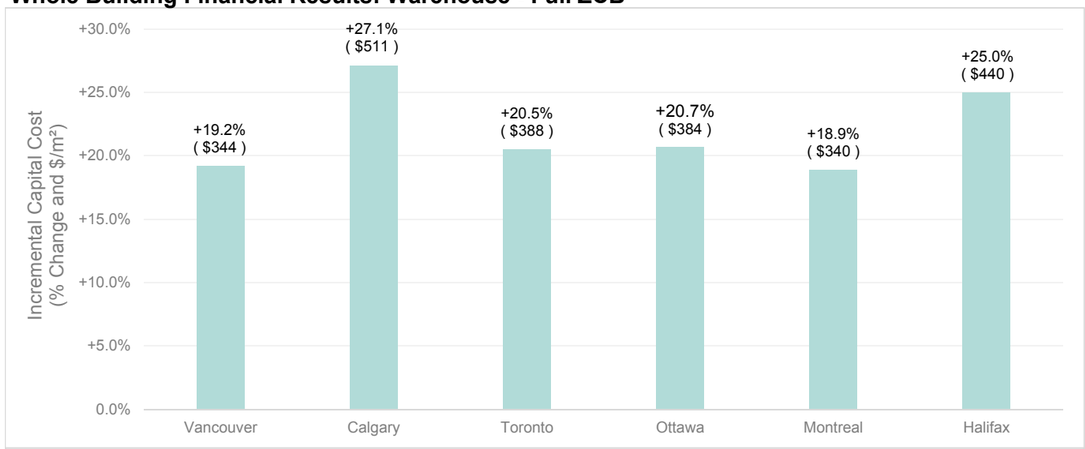


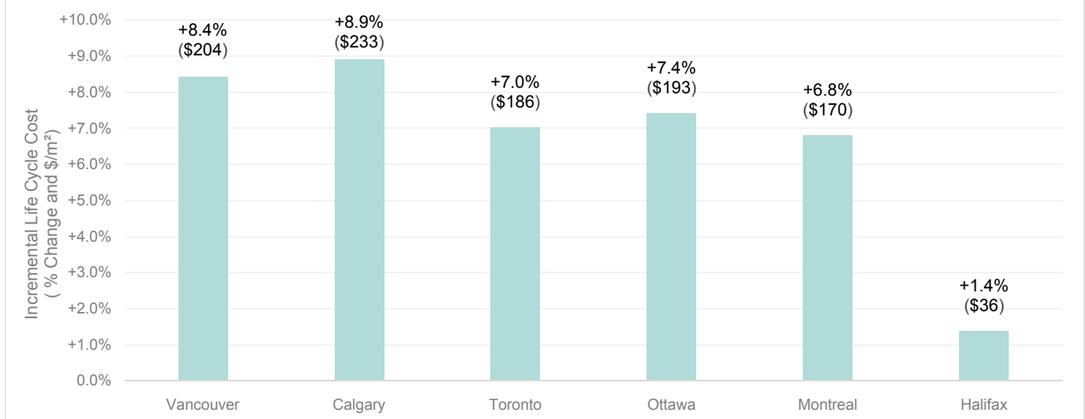


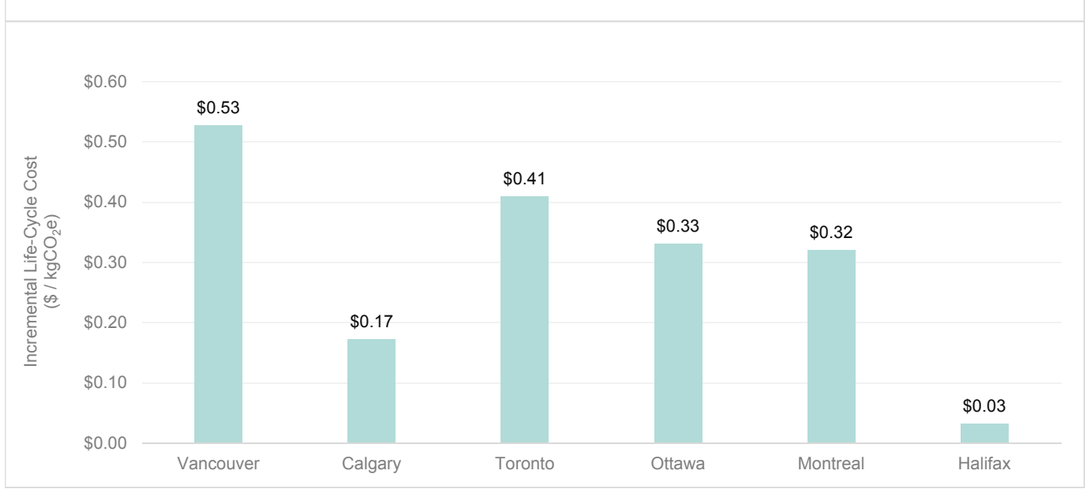
Note: All Zero Carbon labels are after accounting for PV reductions

B-2 CASCADING BUNDLE RESULTS

Whole Building Financial Results: Warehouse - Full ZCB

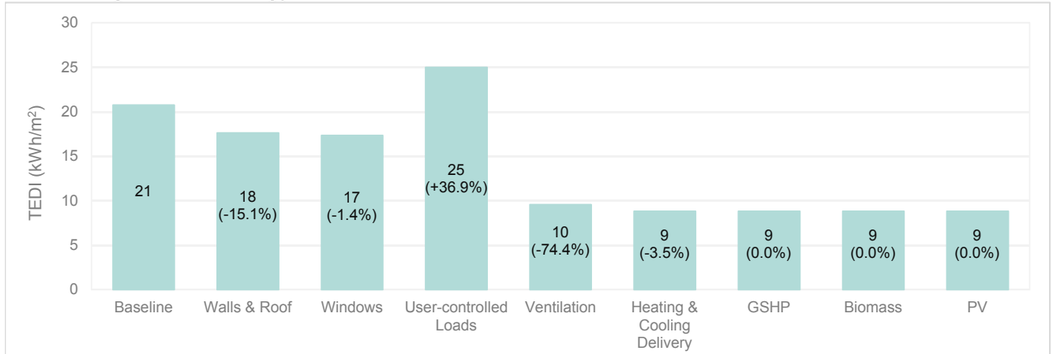


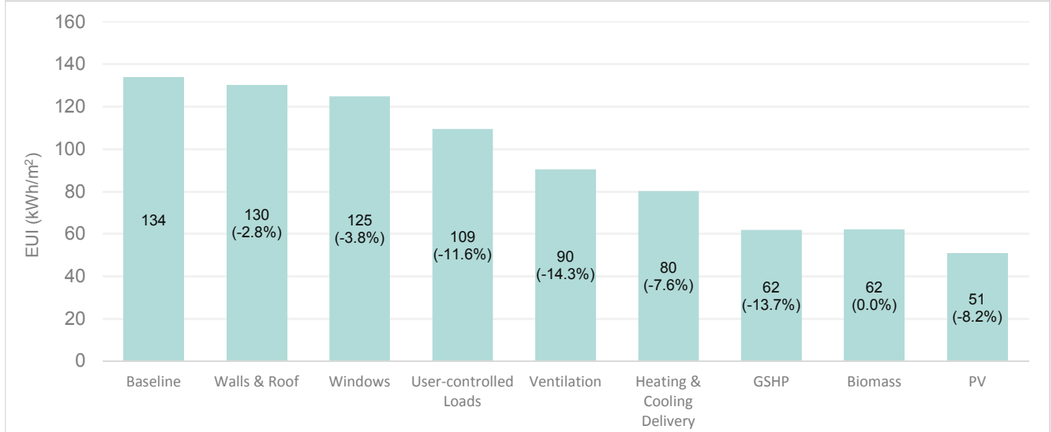


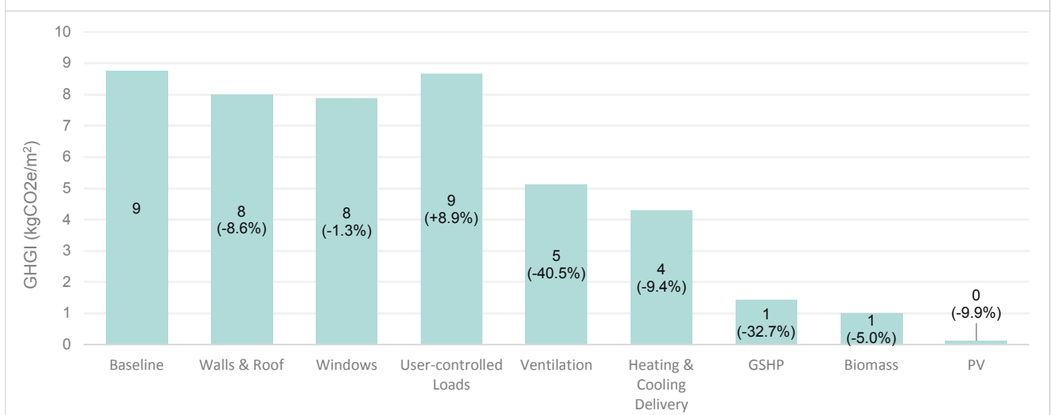


Note: All Zero Carbon labels are after accounting for PV reductions

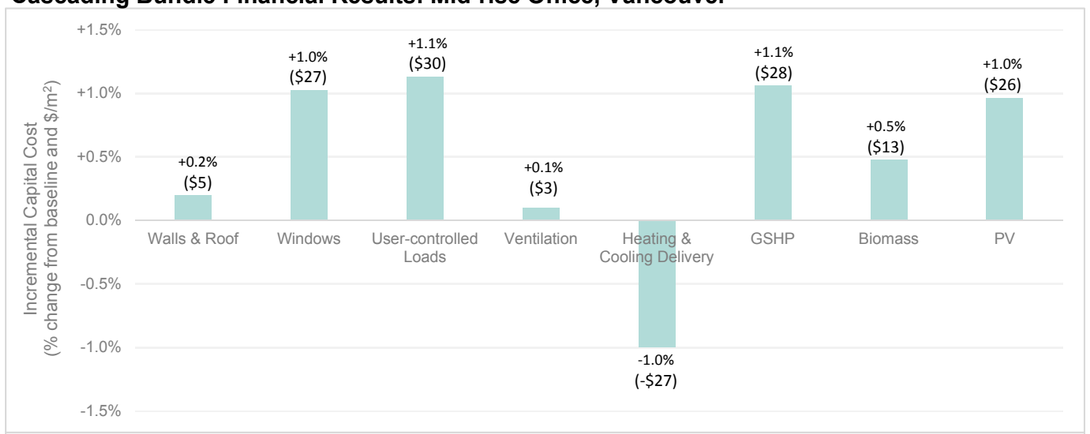
Cascading Bundle Energy Results: Mid-rise Office, Vancouver

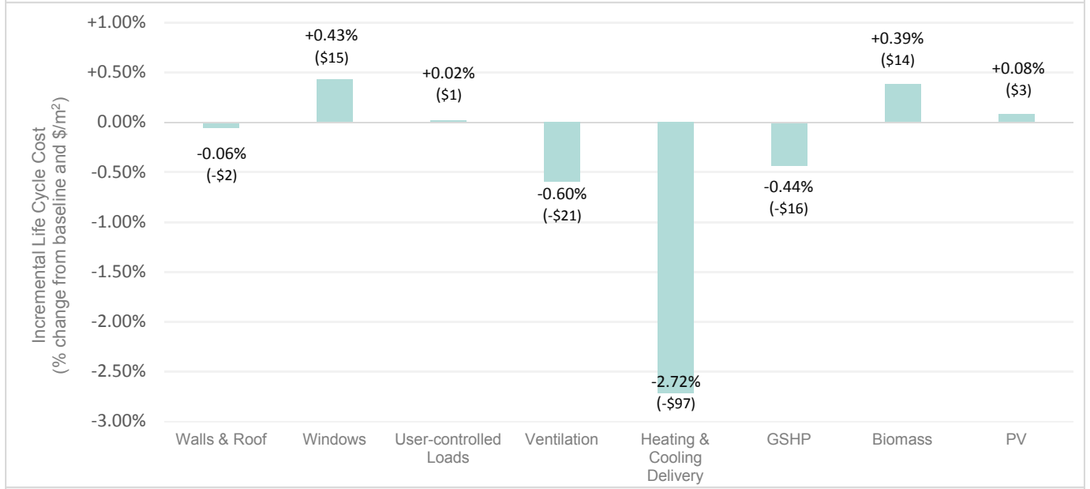


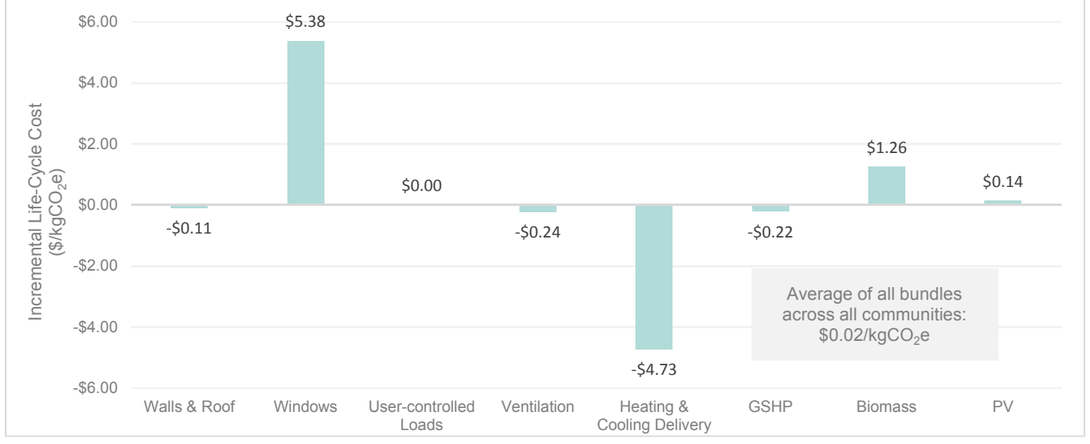




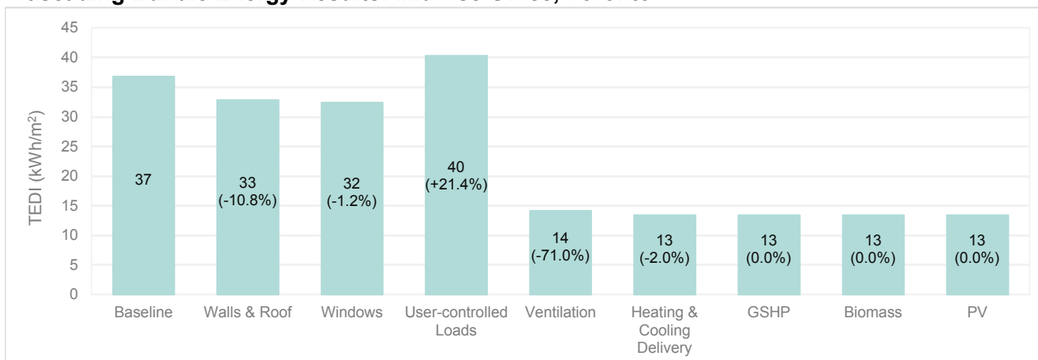
Cascading Bundle Financial Results: Mid-rise Office, Vancouver

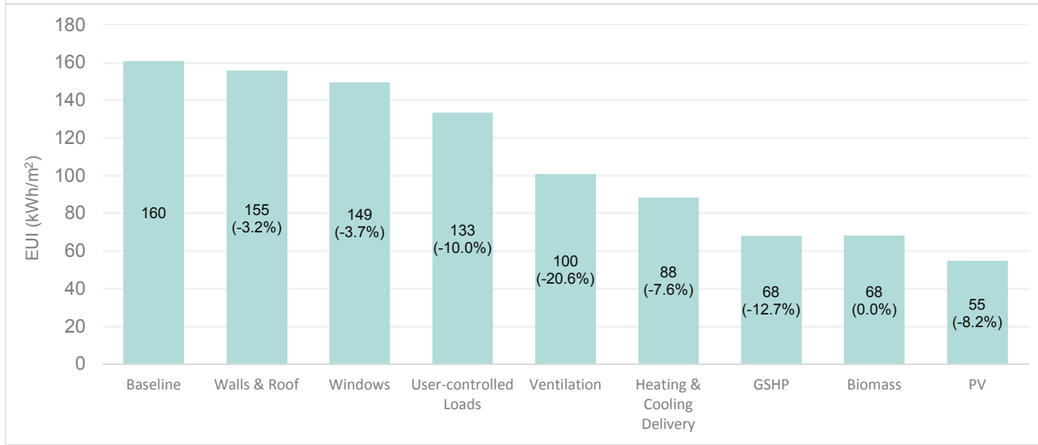


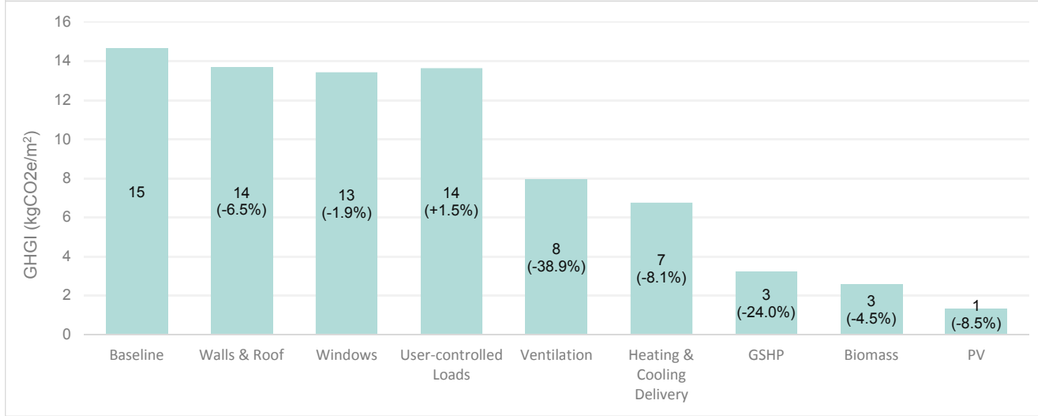




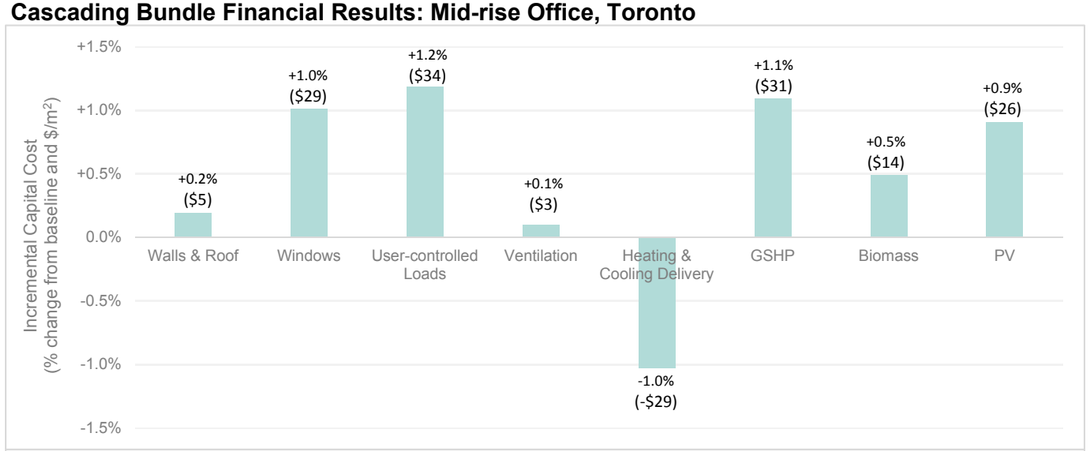
Cascading Bundle Energy Results: Mid-rise Office, Toronto

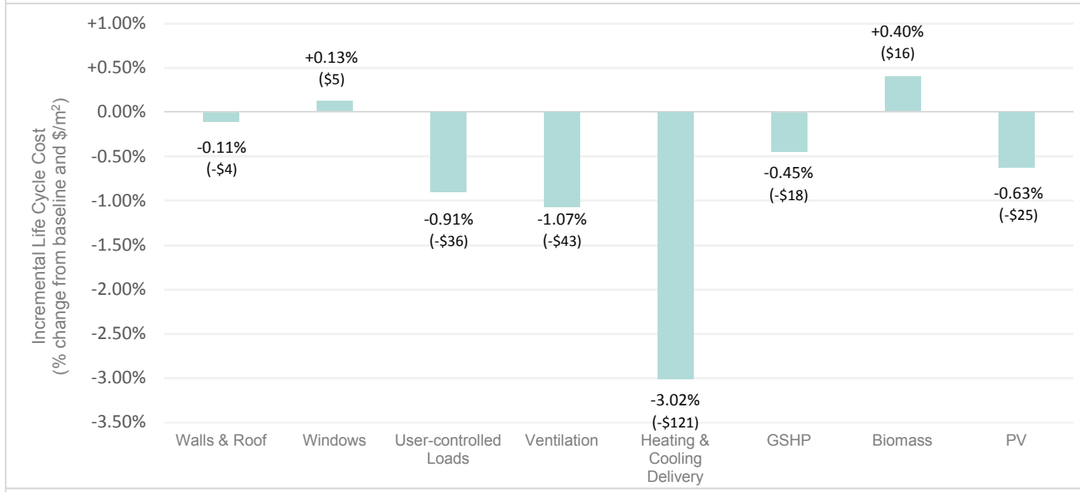




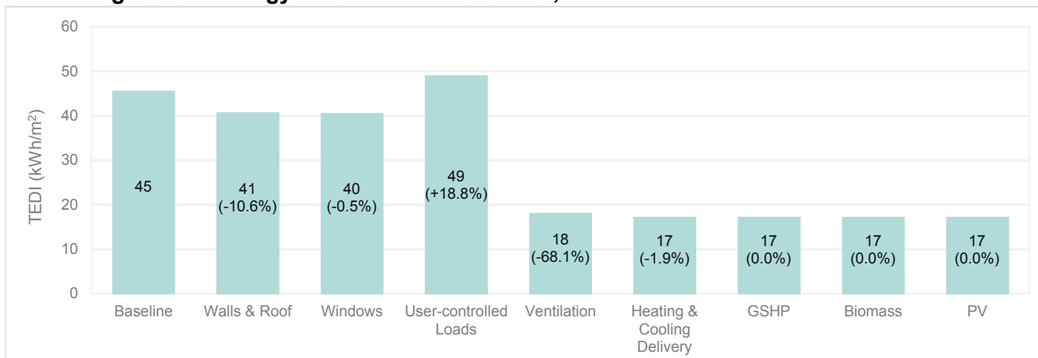


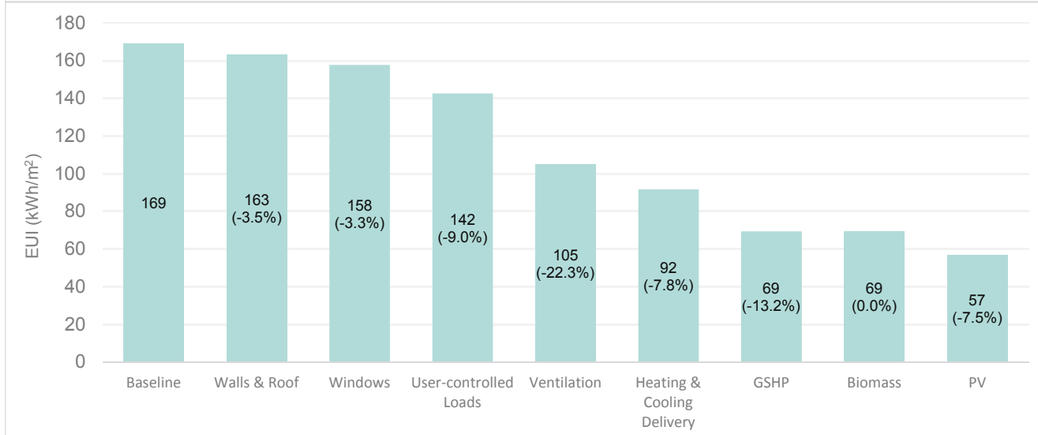
Cascading Bundle Financial Results: Mid-rise Office, Toronto

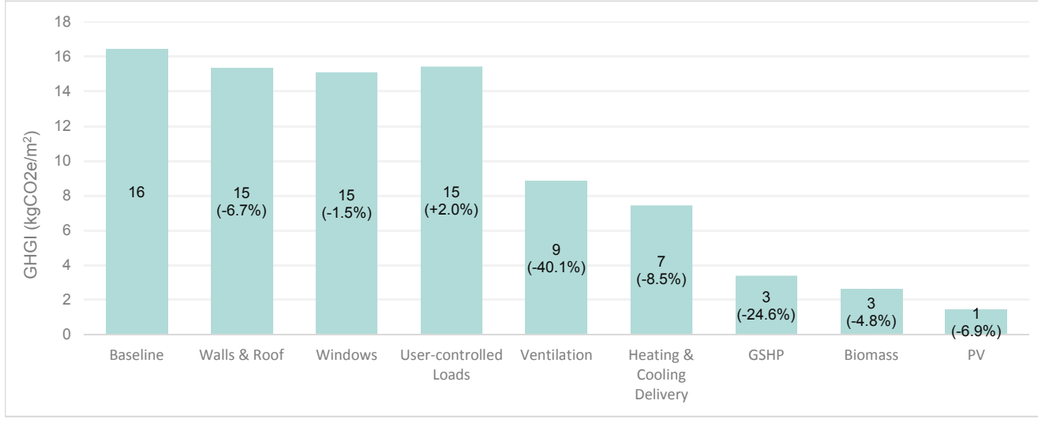




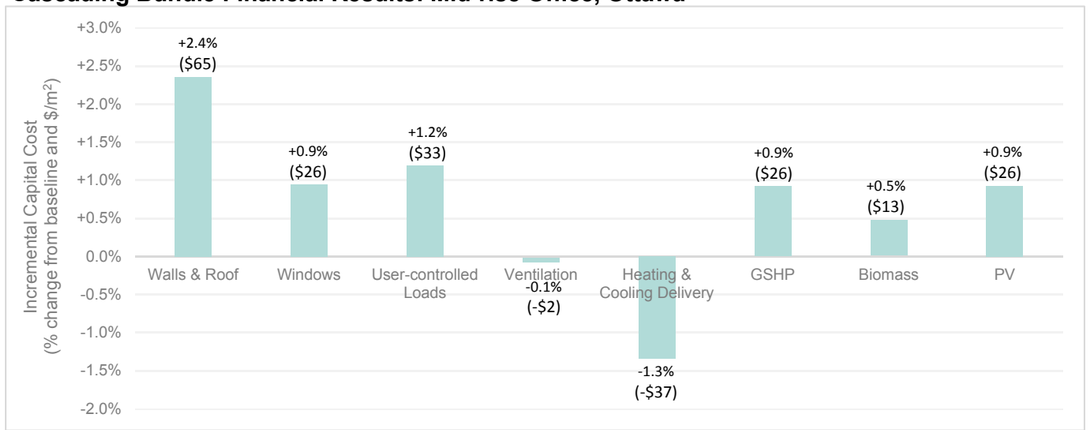
Cascading Bundle Energy Results: Mid-rise Office, Ottawa

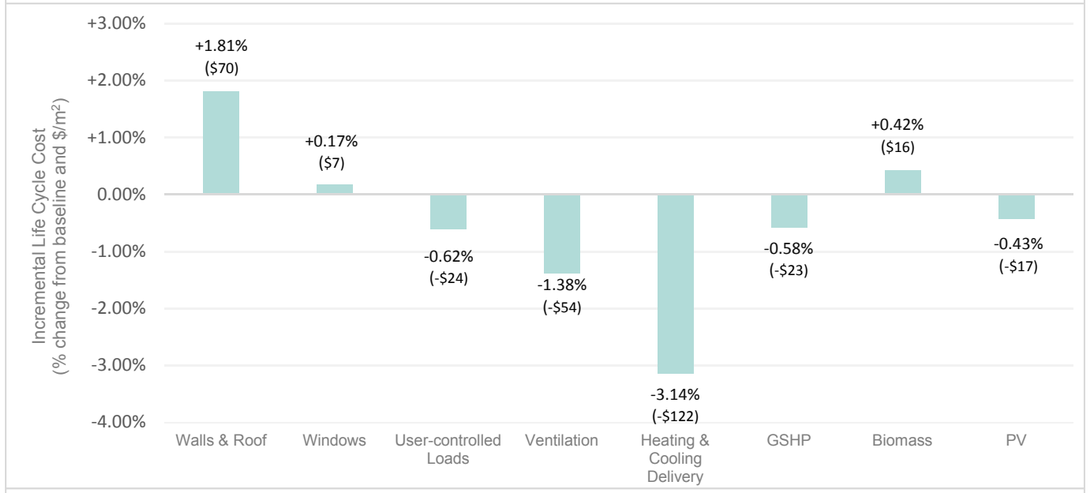


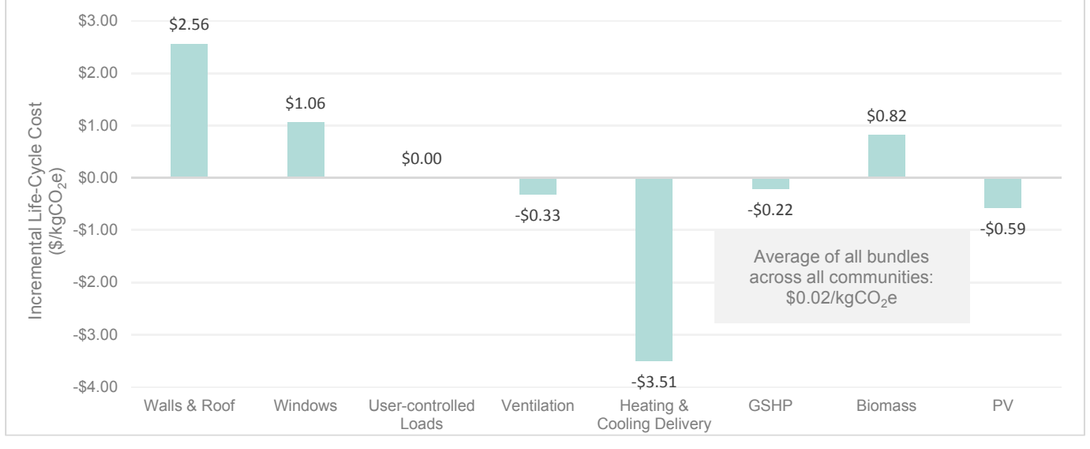




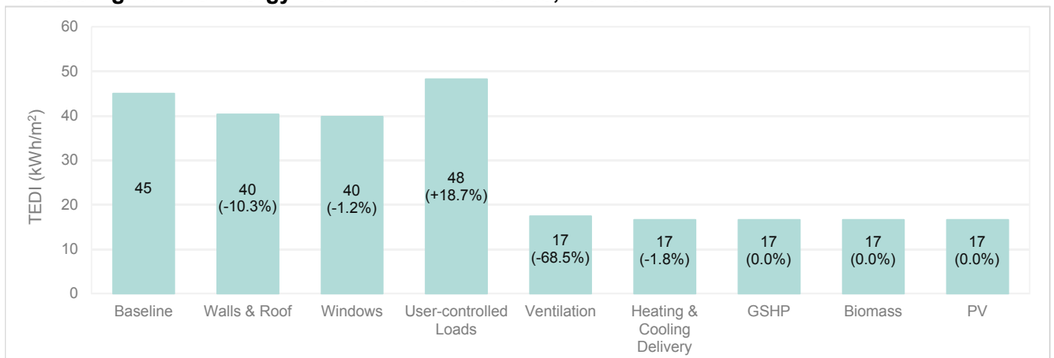
Cascading Bundle Financial Results: Mid-rise Office, Ottawa

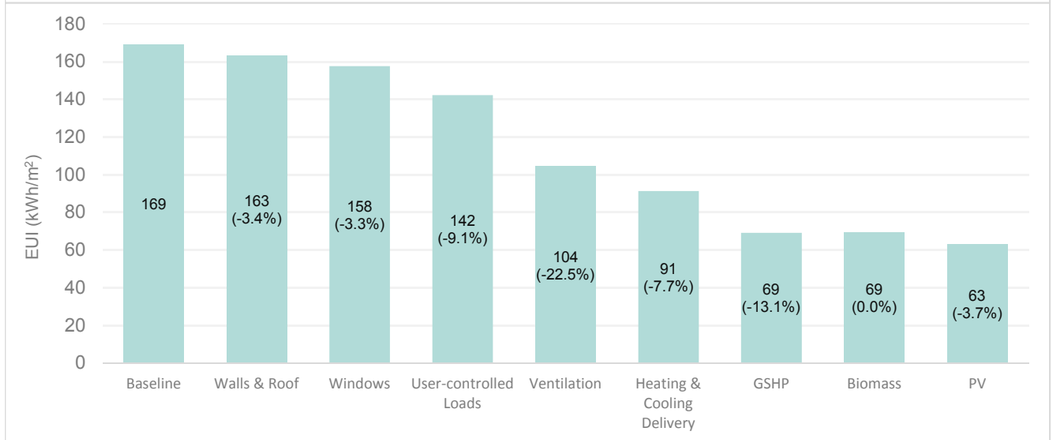


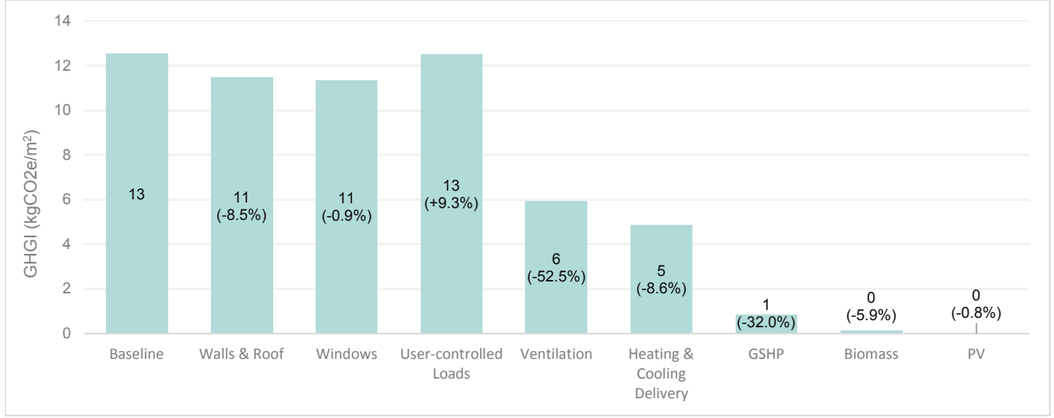




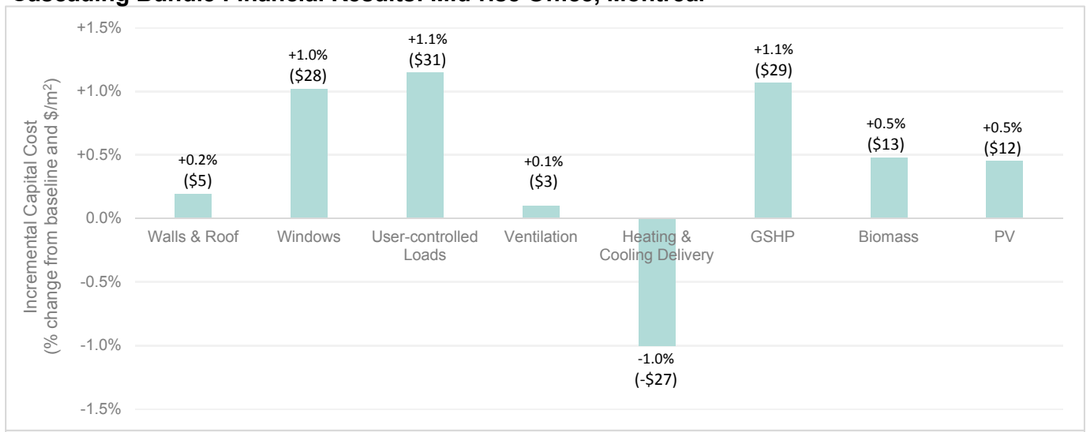
Cascading Bundle Energy Results: Mid-rise Office, Montreal

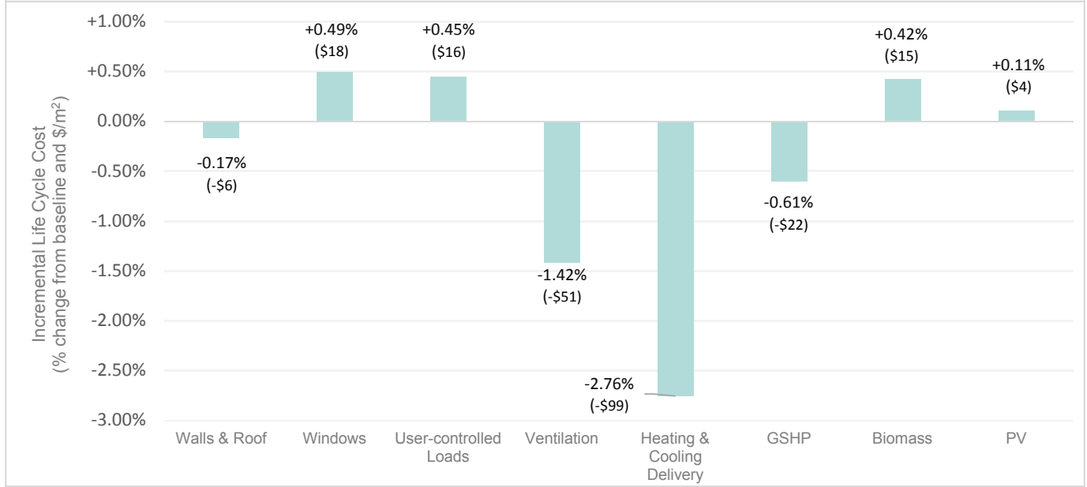


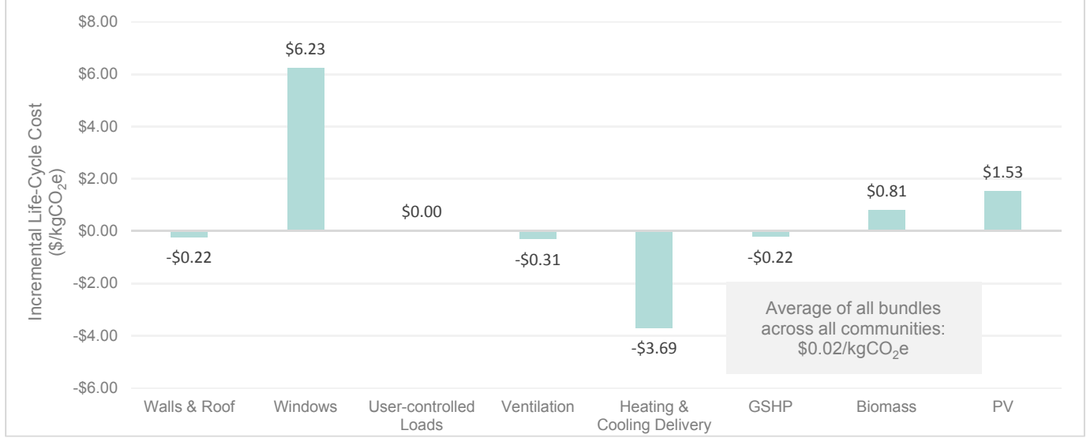




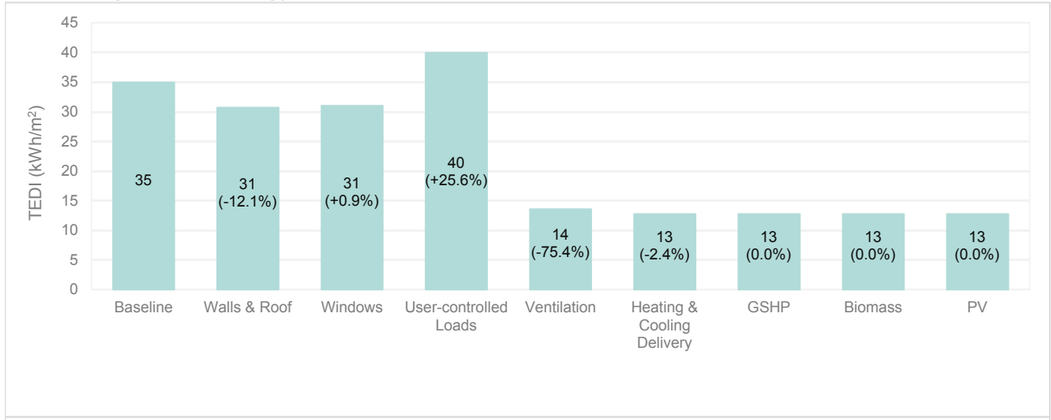
Cascading Bundle Financial Results: Mid-rise Office, Montreal

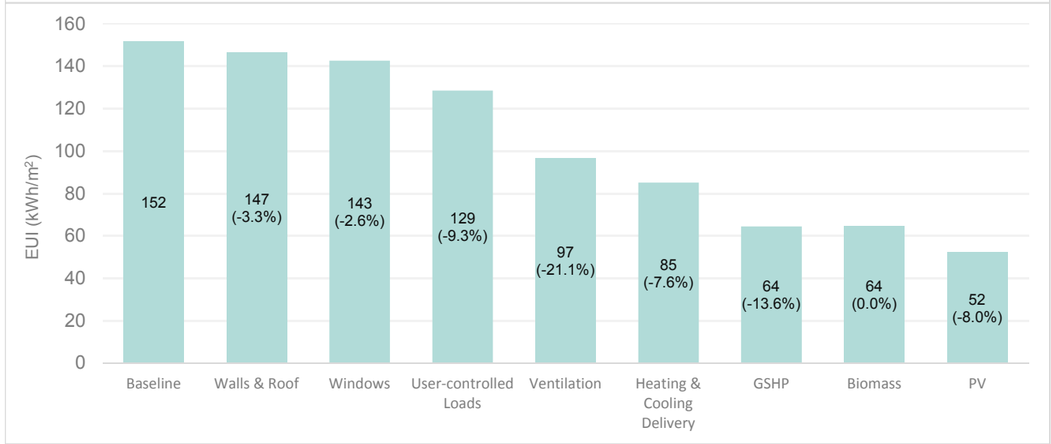


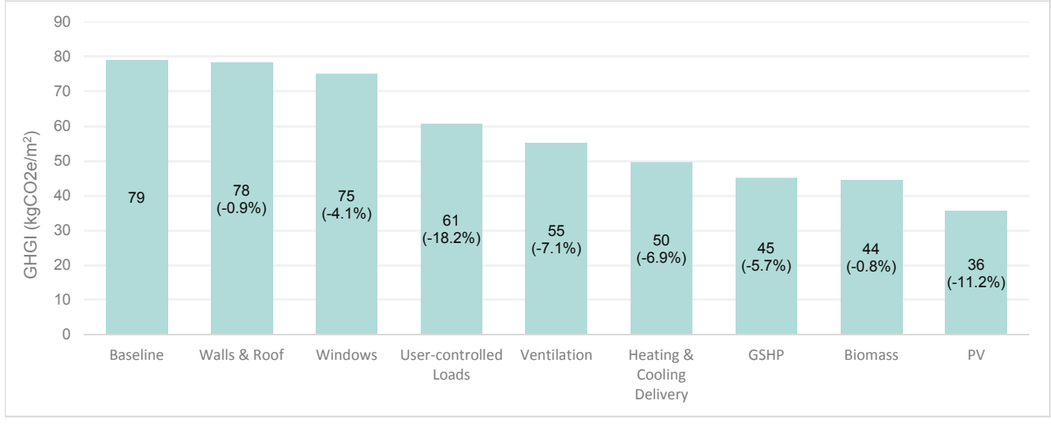




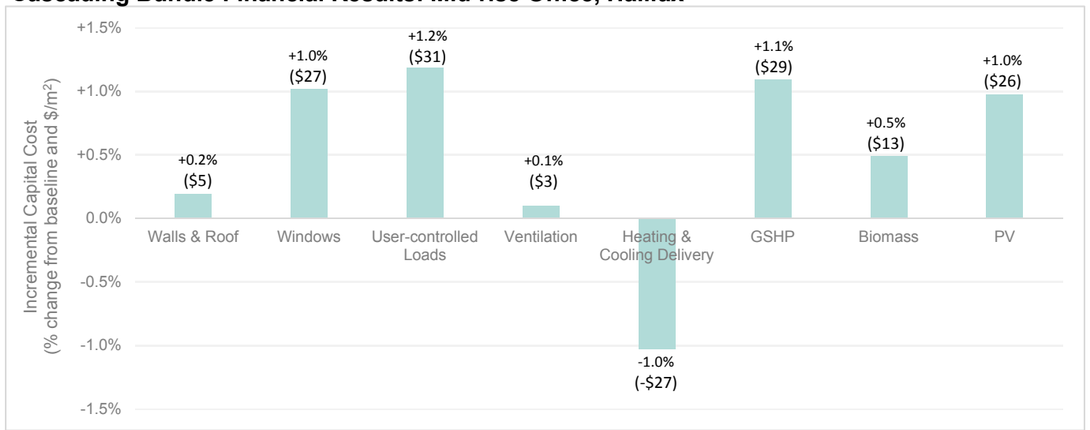
Cascading Bundle Energy Results: Mid-rise Office, Halifax

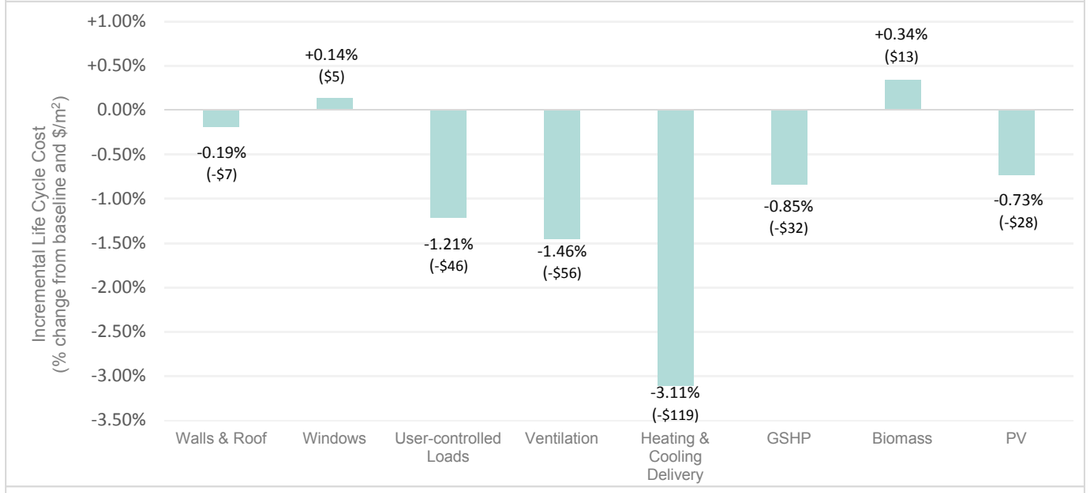


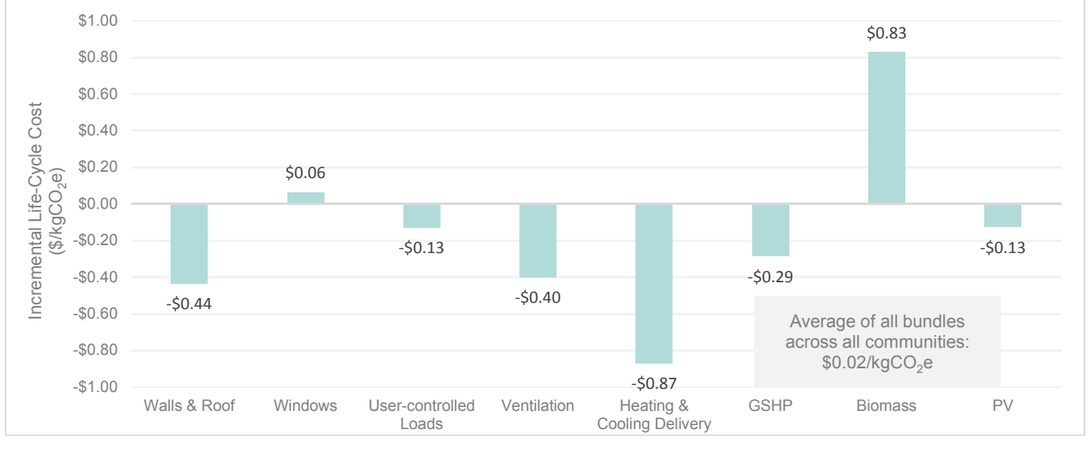




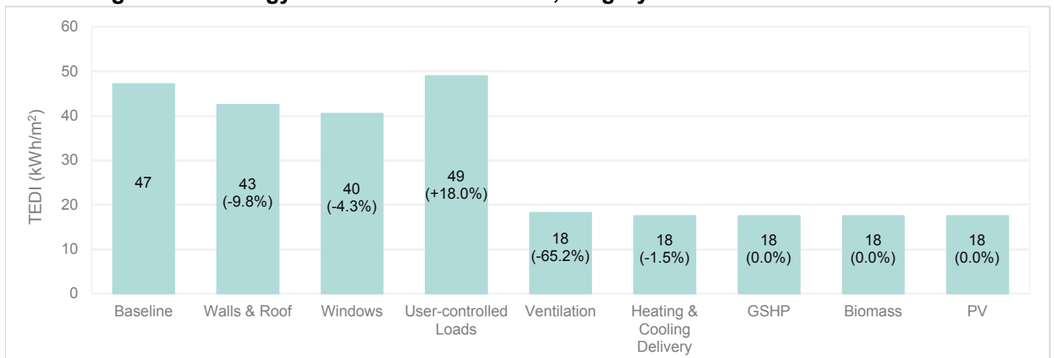
Cascading Bundle Financial Results: Mid-rise Office, Halifax

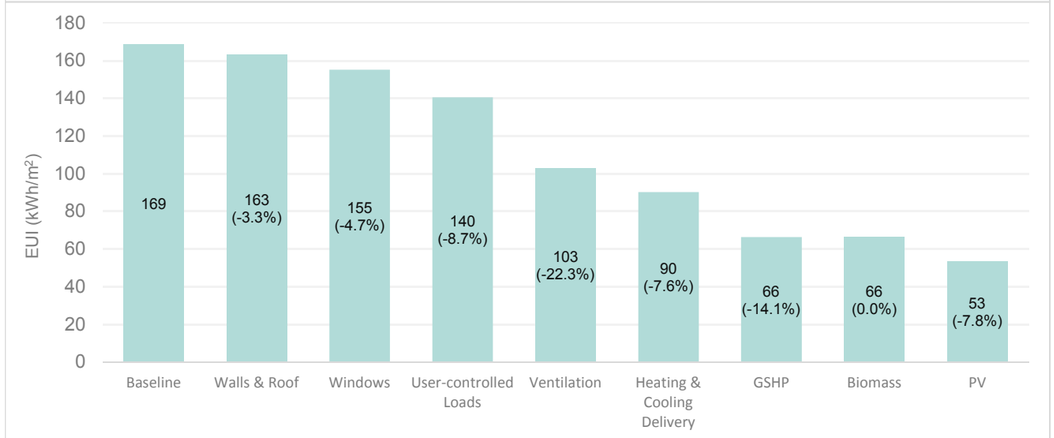


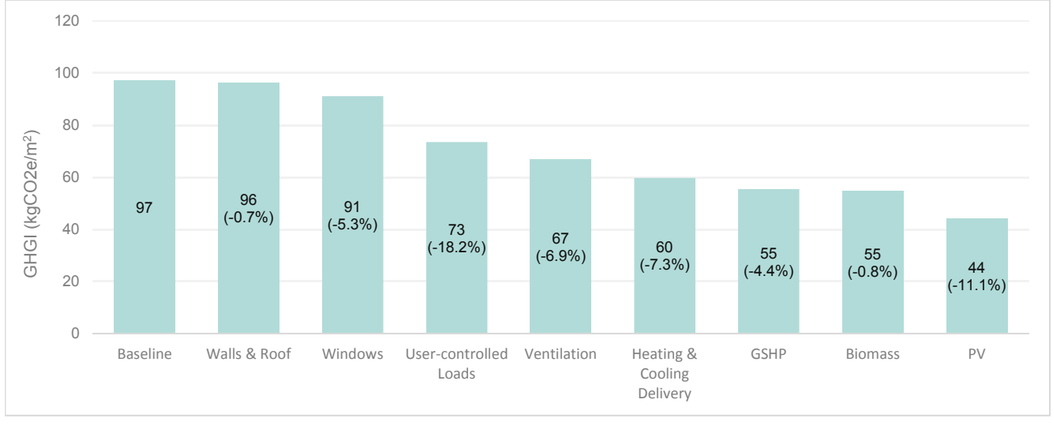




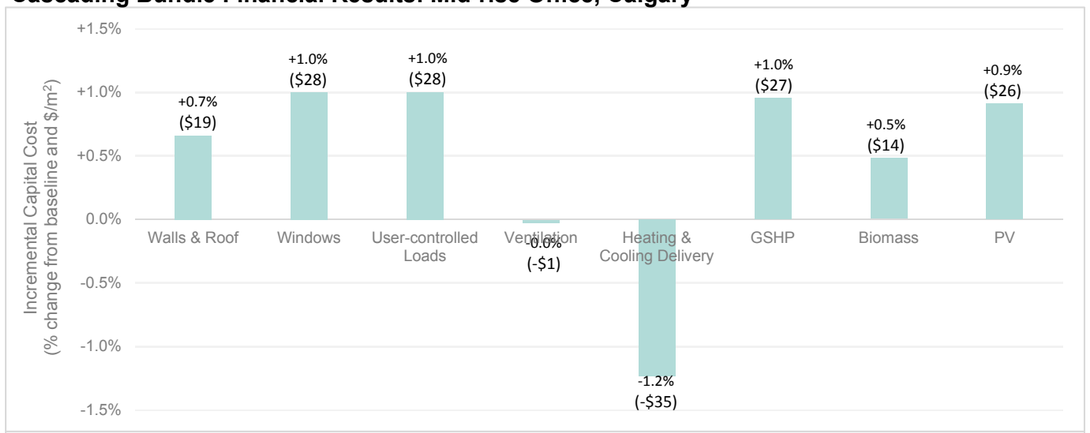
Cascading Bundle Energy Results: Mid-rise Office, Calgary

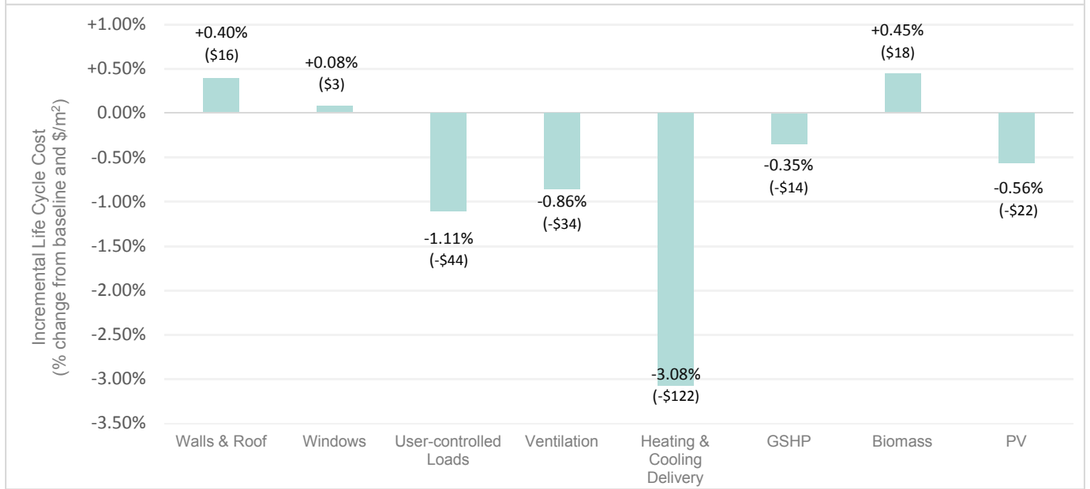


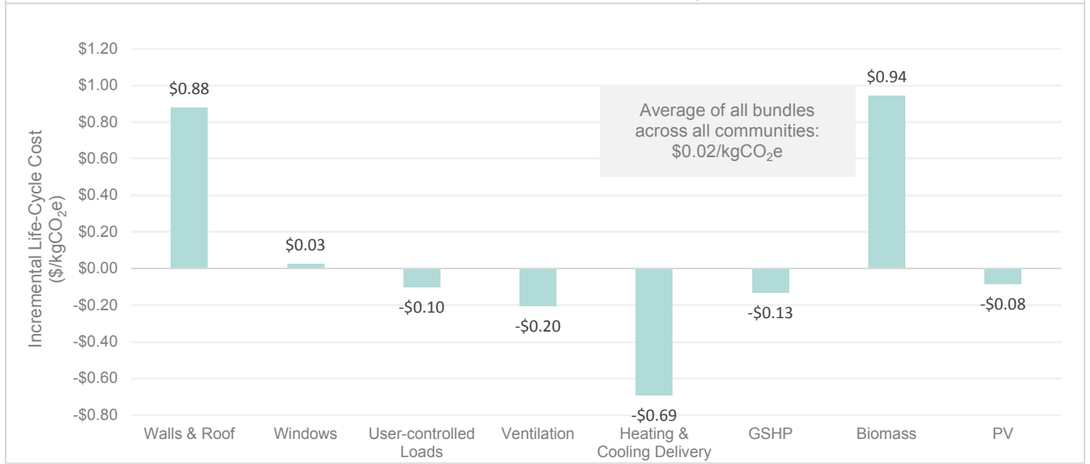




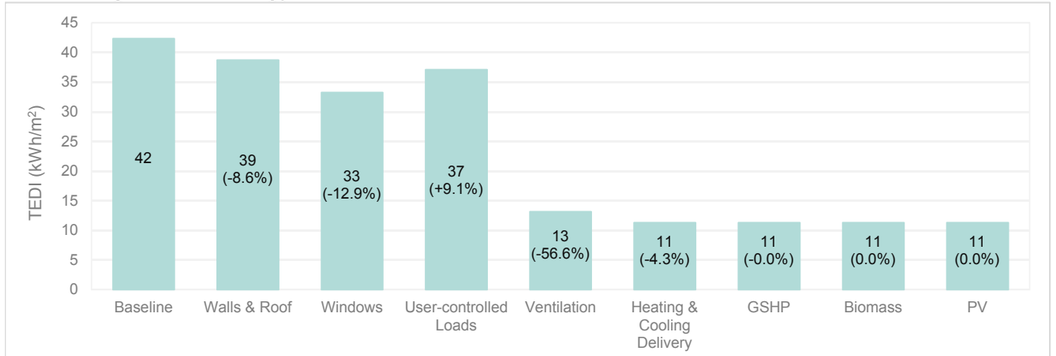
Cascading Bundle Financial Results: Mid-rise Office, Calgary

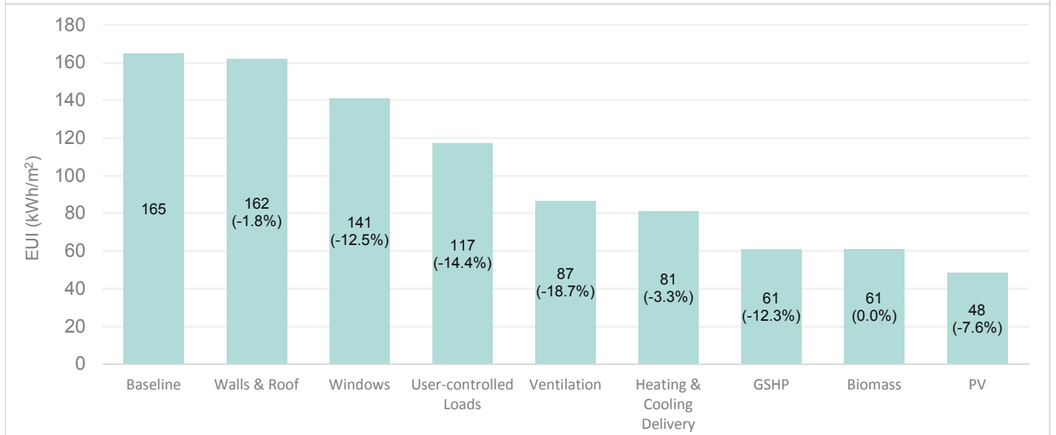


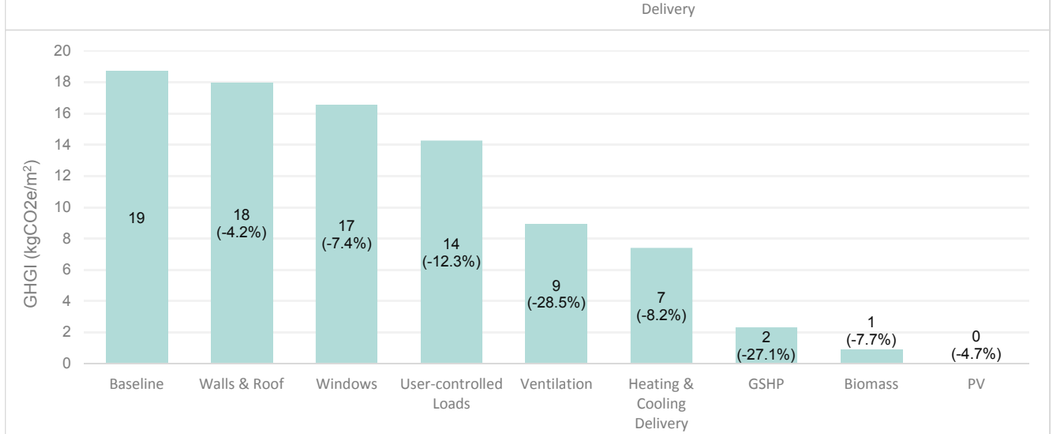




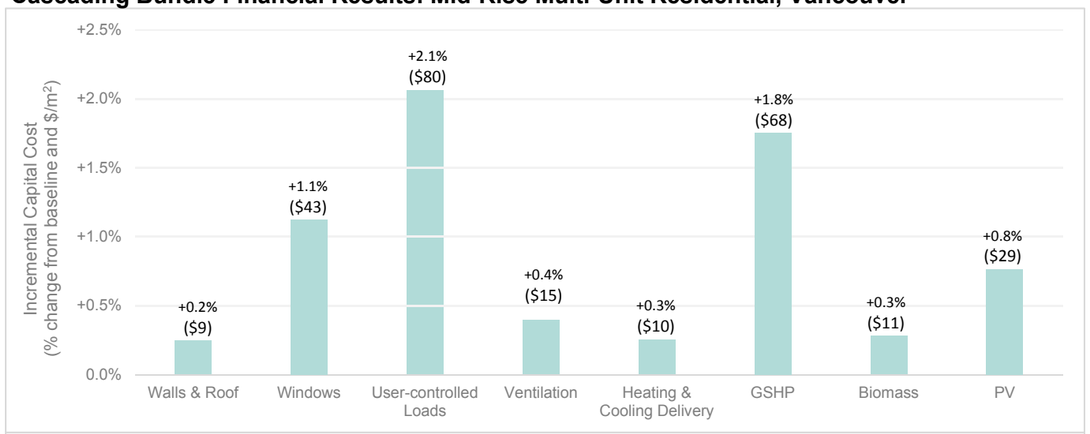
Cascading Bundle Energy Results: Mid-Rise Multi-Unit Residential, Vancouver

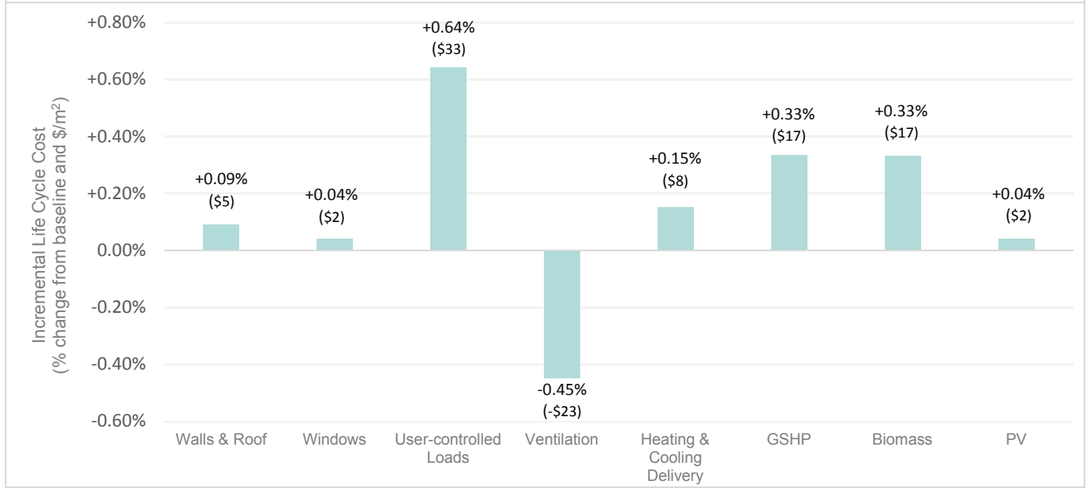


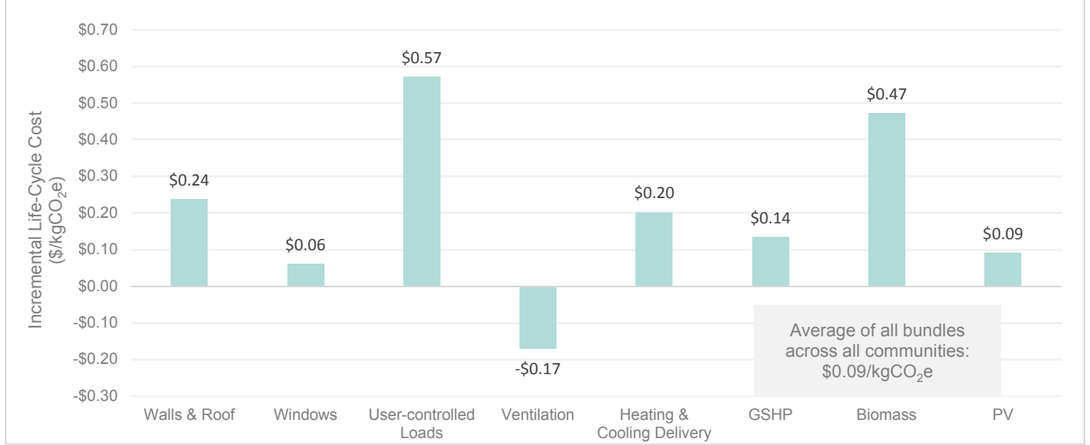




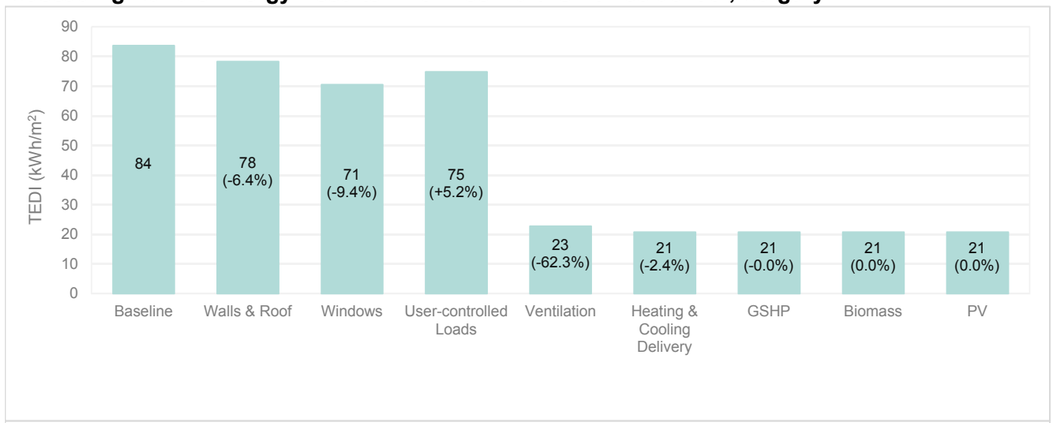
Cascading Bundle Financial Results: Mid-Rise Multi-Unit Residential, Vancouver

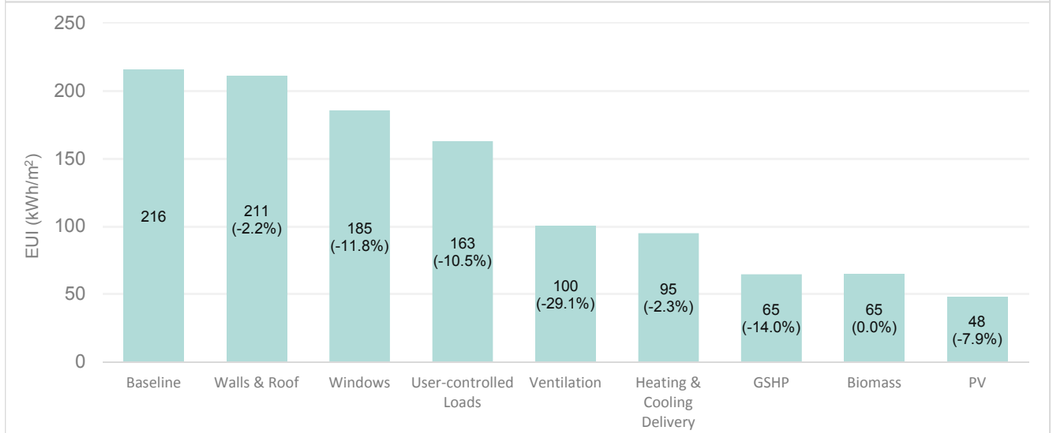


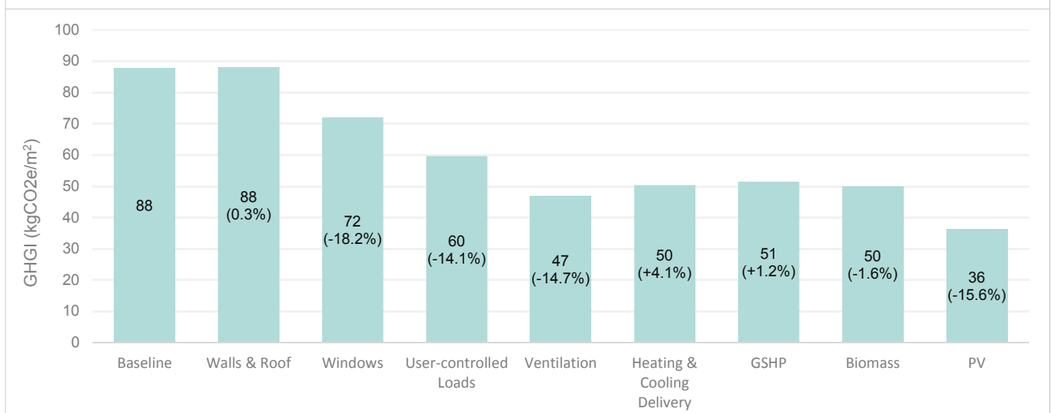




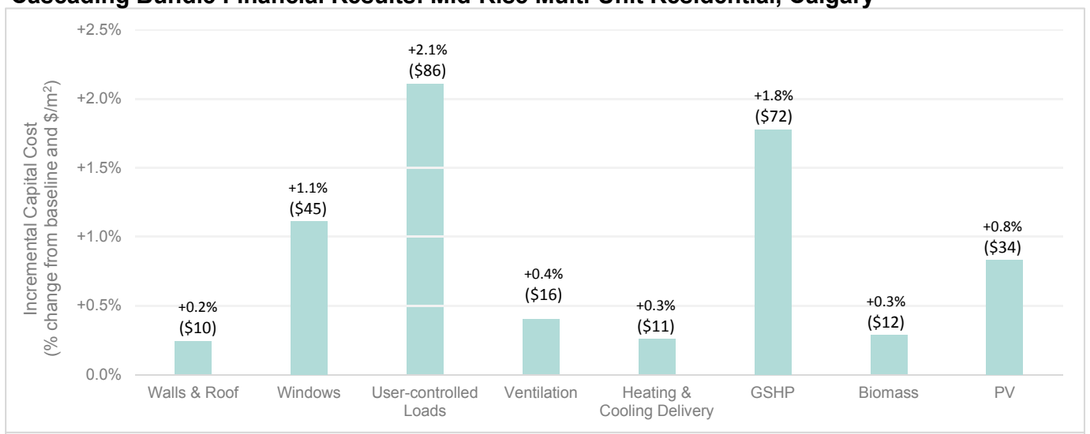
Cascading Bundle Energy Results: Mid-Rise Multi-Unit Residential, Calgary

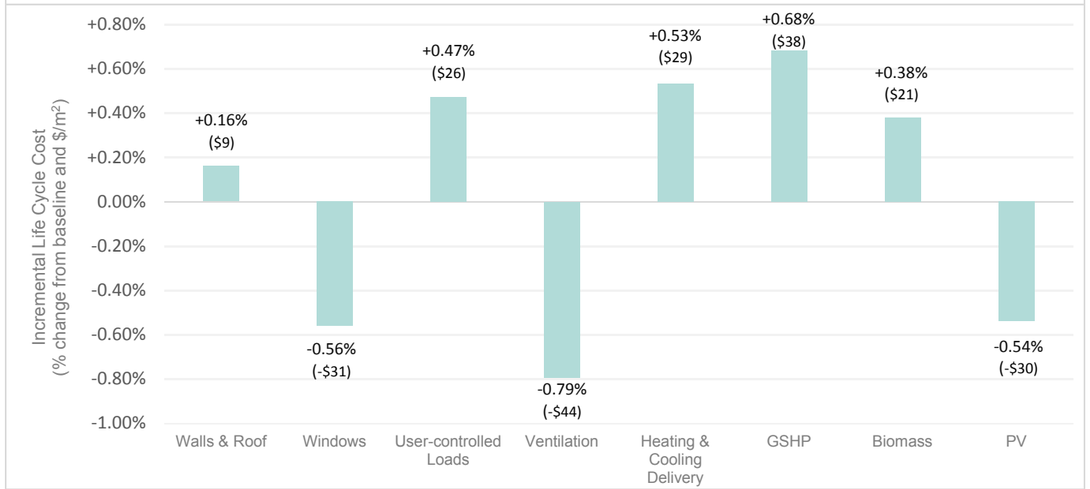


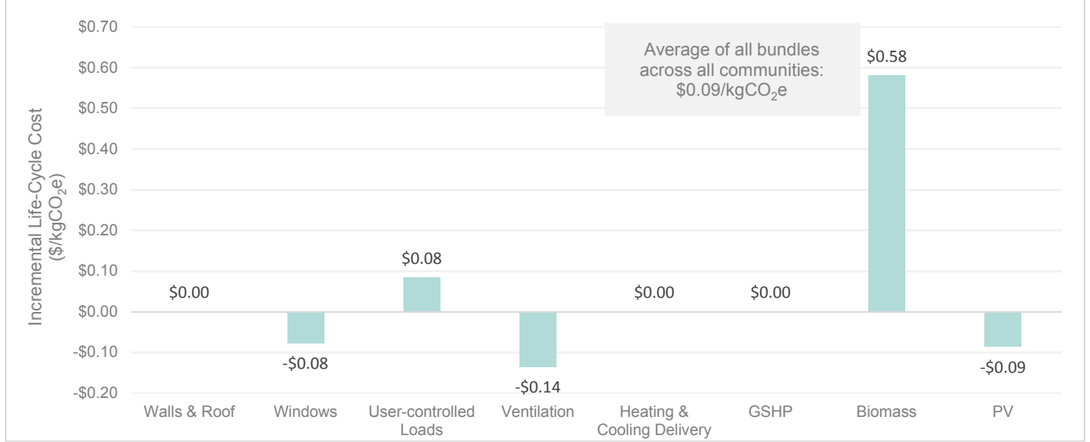




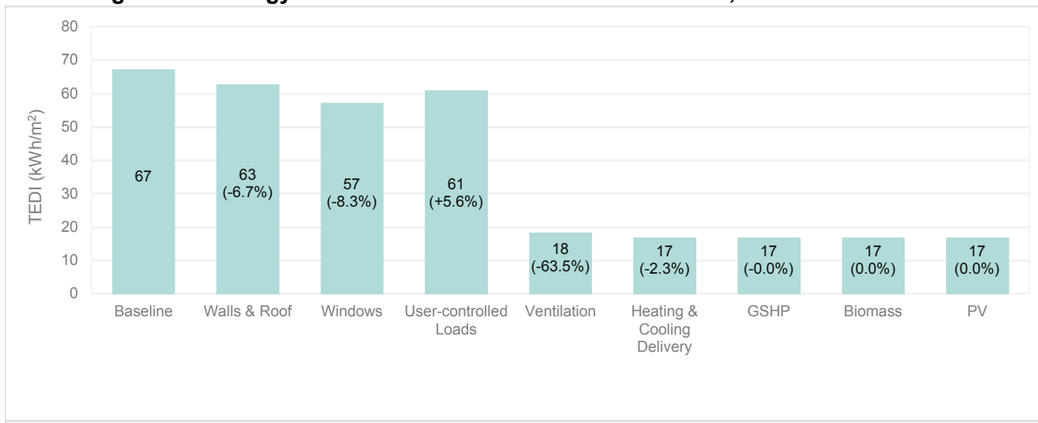
Cascading Bundle Financial Results: Mid-Rise Multi-Unit Residential, Calgary

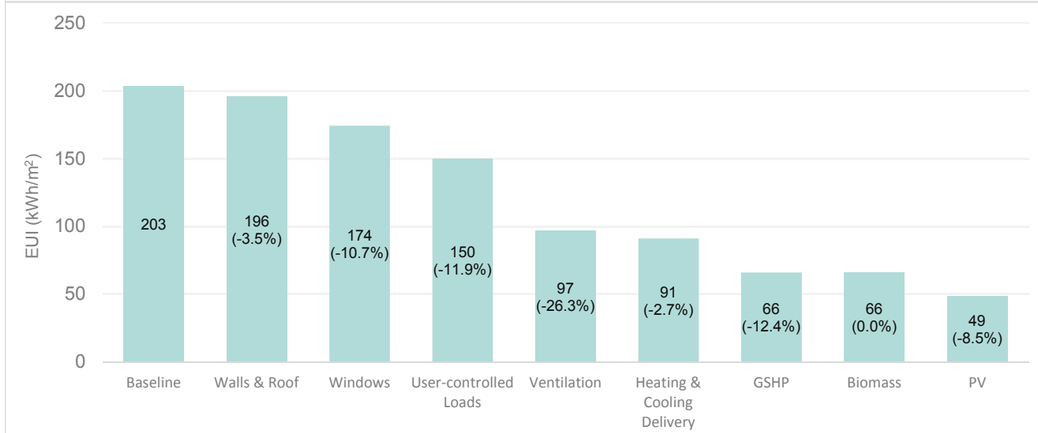


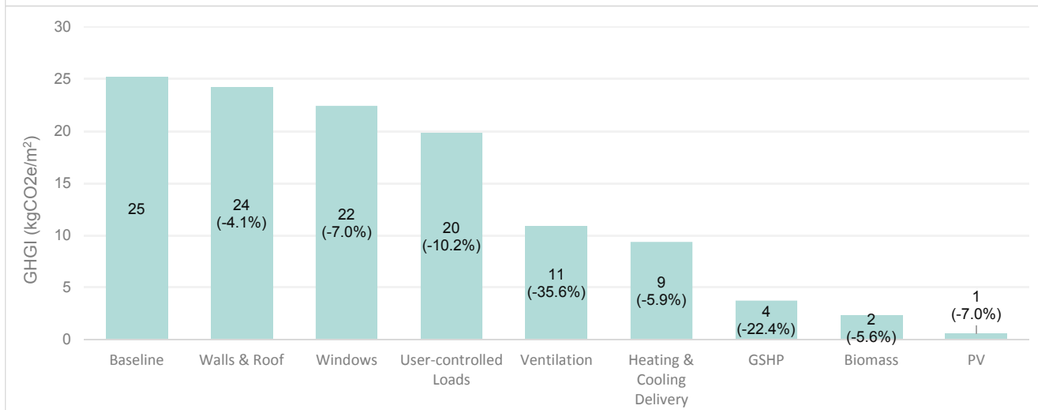




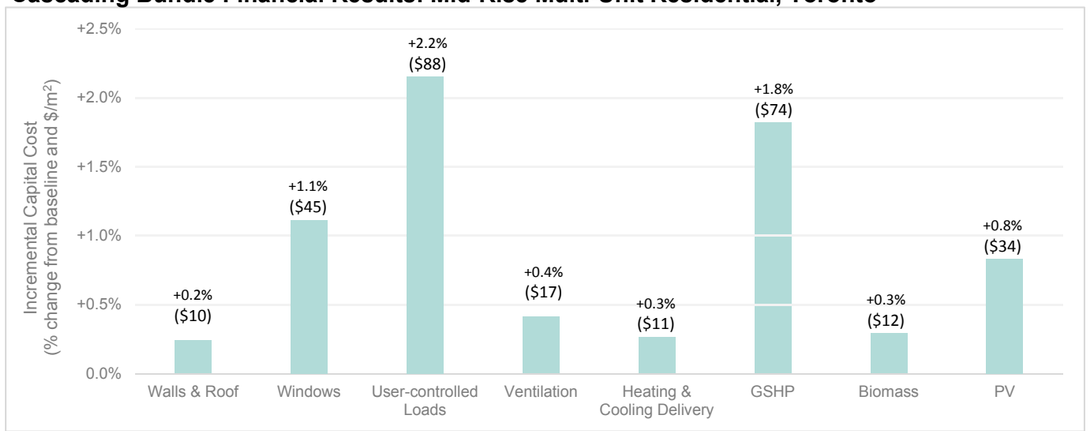
Cascading Bundle Energy Results: Mid-Rise Multi-Unit Residential, Toronto

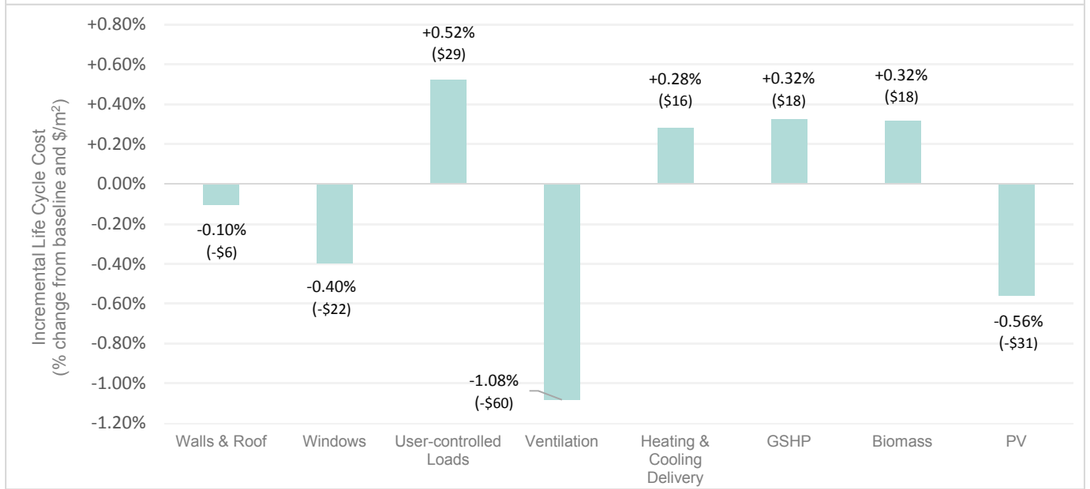


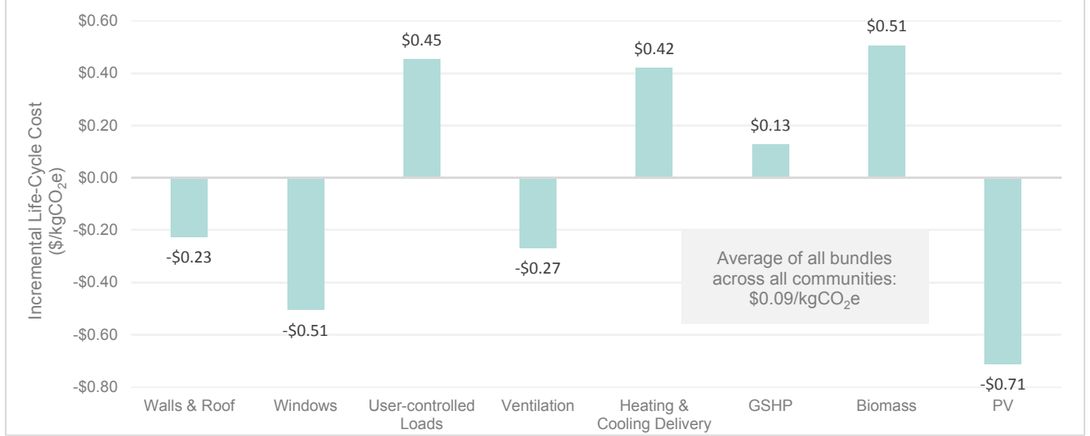




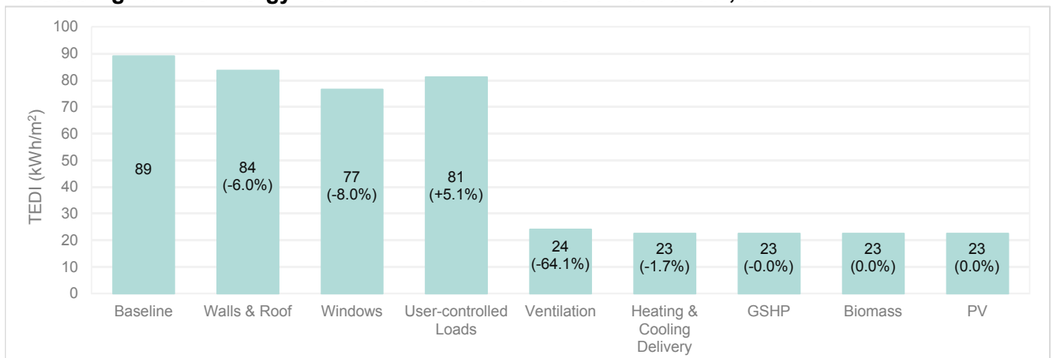
Cascading Bundle Financial Results: Mid-Rise Multi-Unit Residential, Toronto

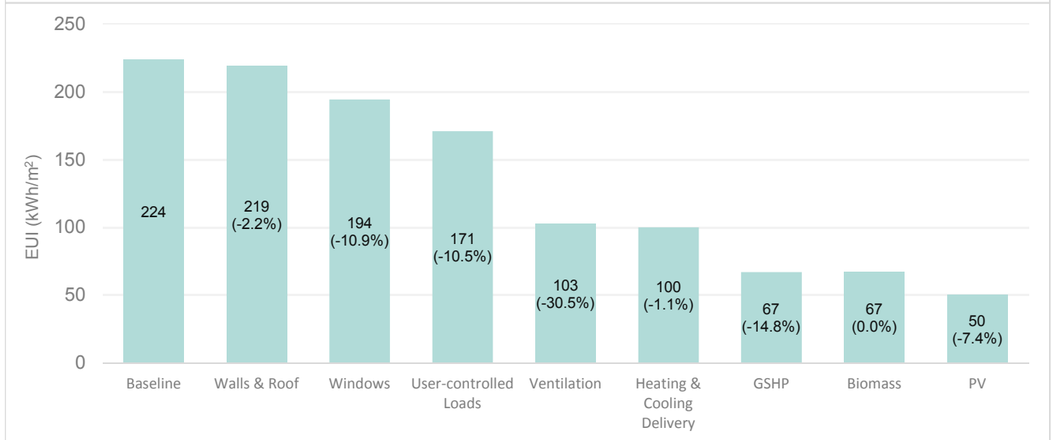


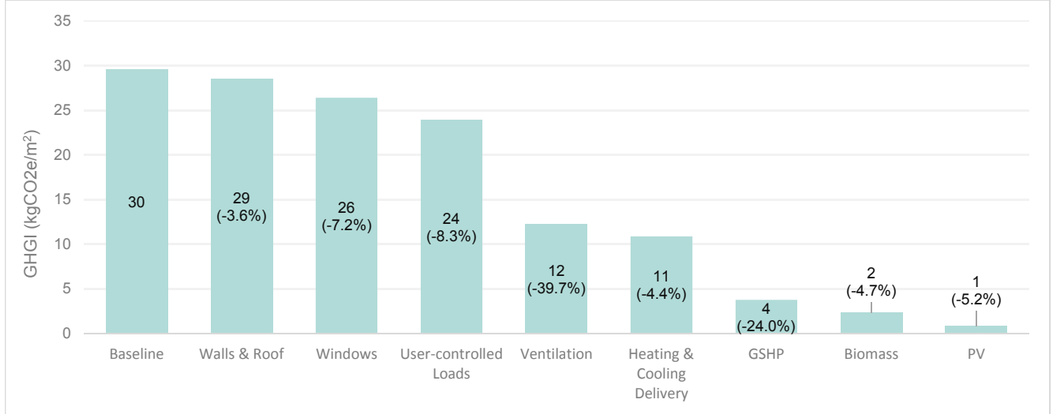




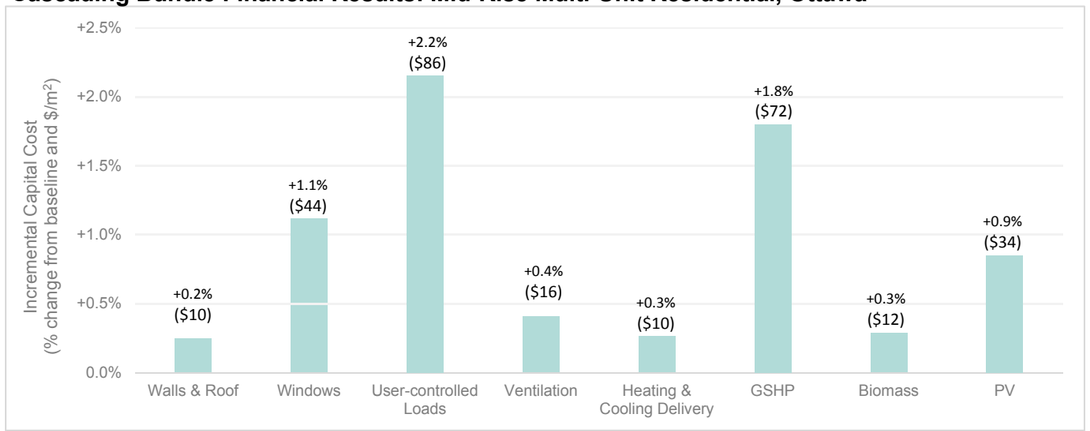
Cascading Bundle Energy Results: Mid-Rise Multi-Unit Residential, Ottawa

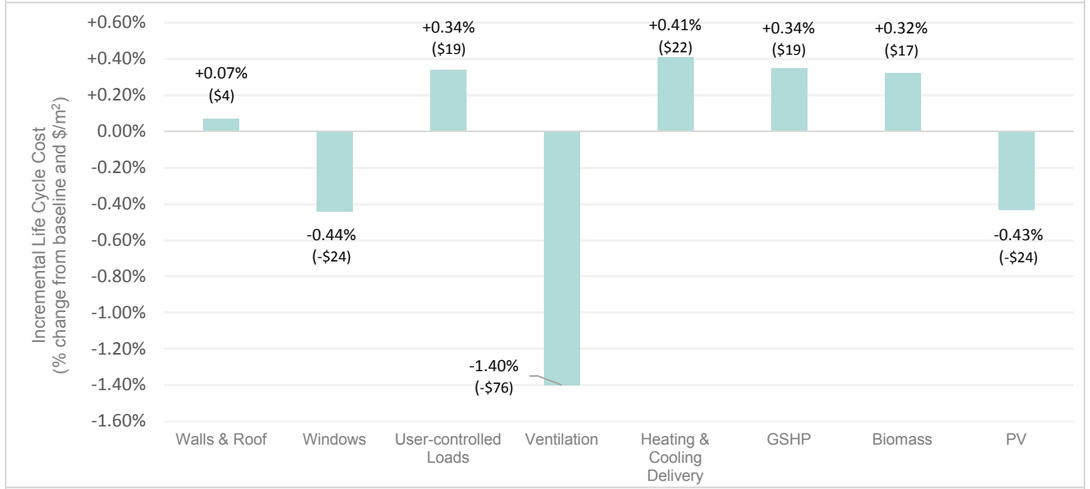


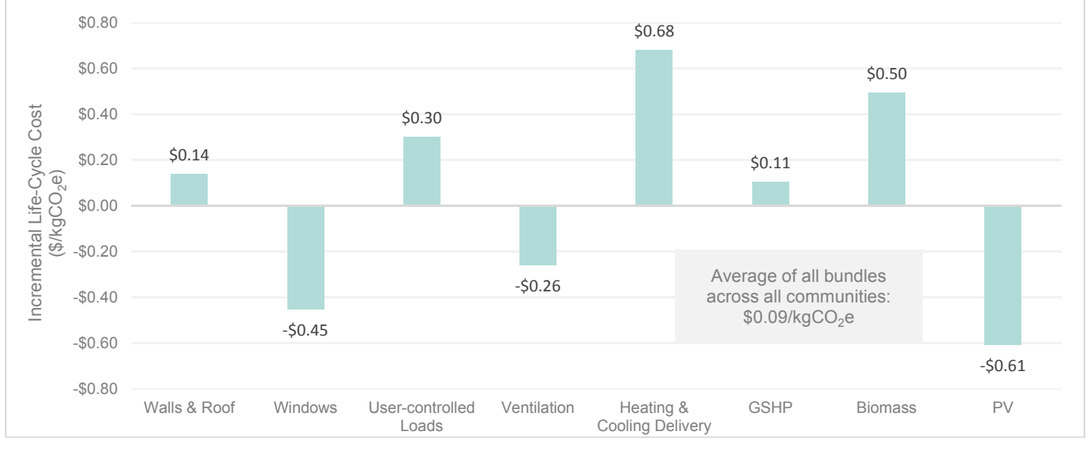




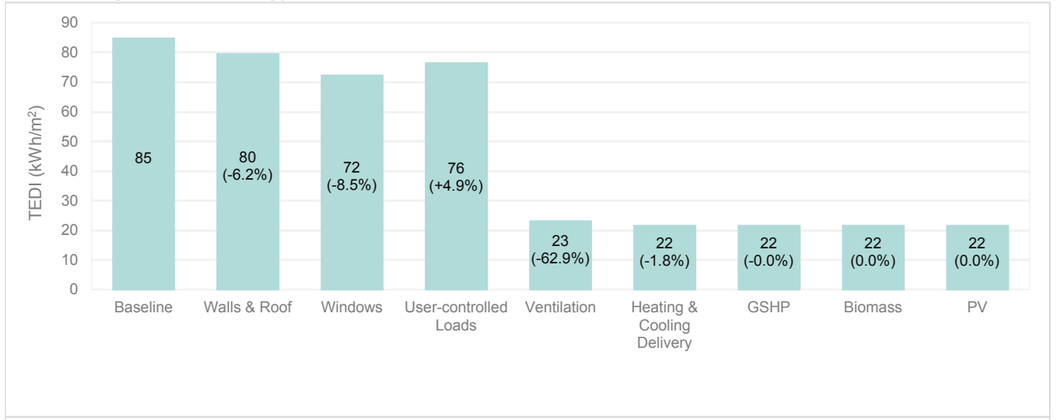
Cascading Bundle Financial Results: Mid-Rise Multi-Unit Residential, Ottawa

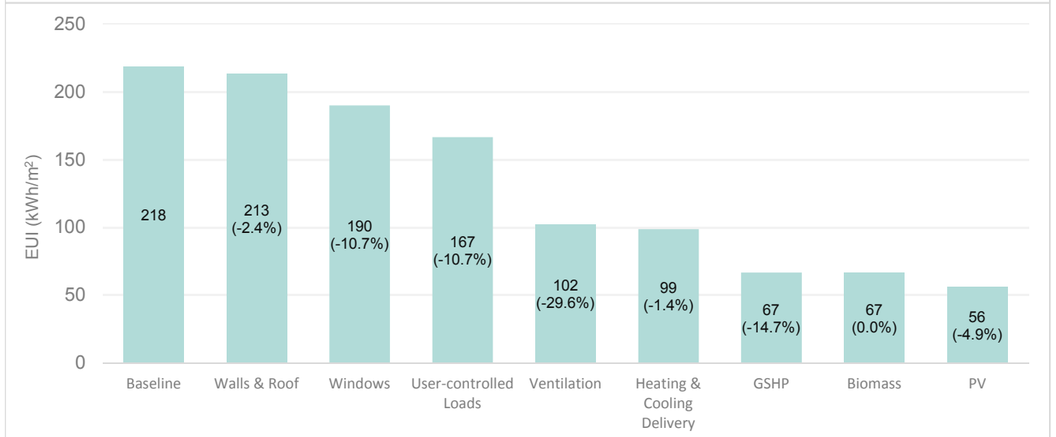


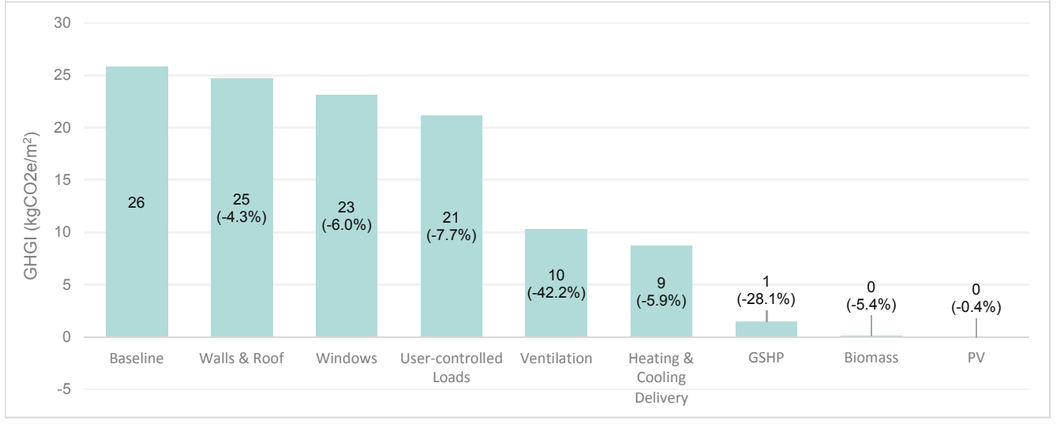




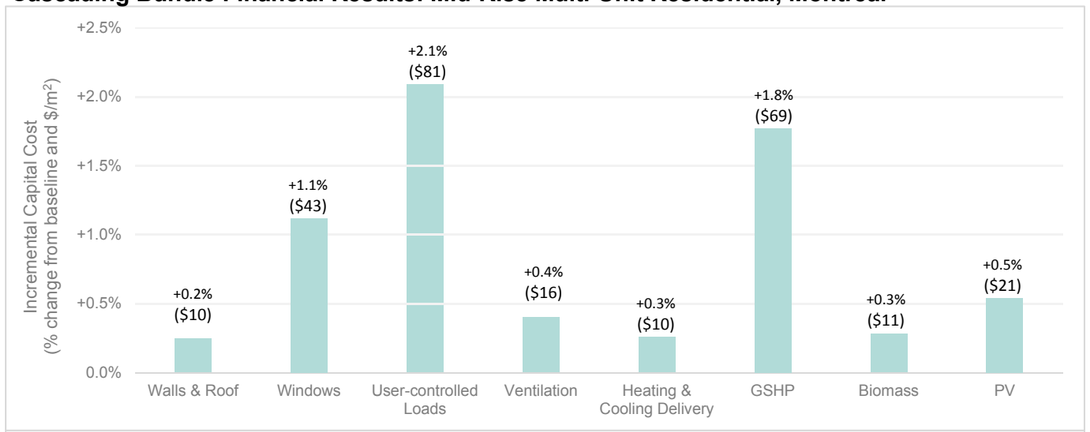
Cascading Bundle Energy Results: Mid-Rise Multi-Unit Residential, Montreal

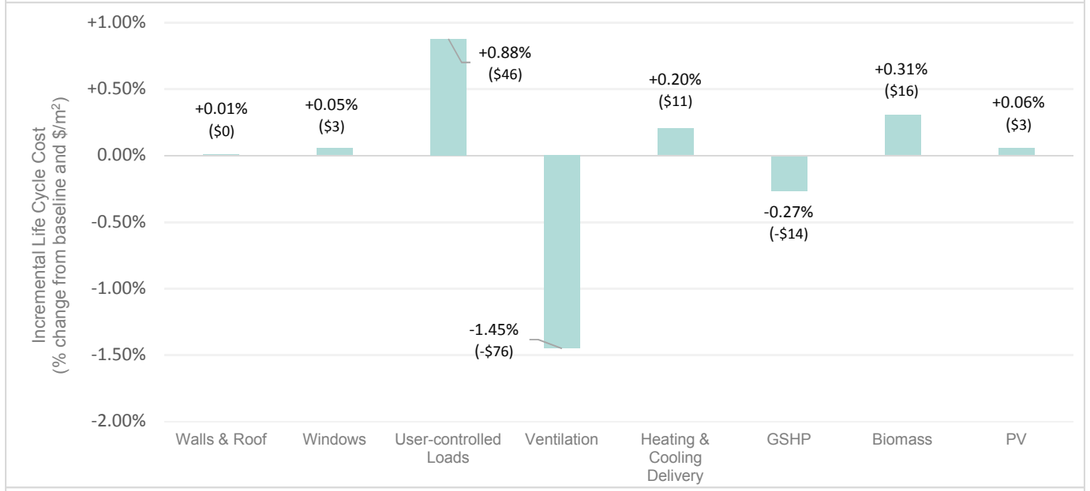


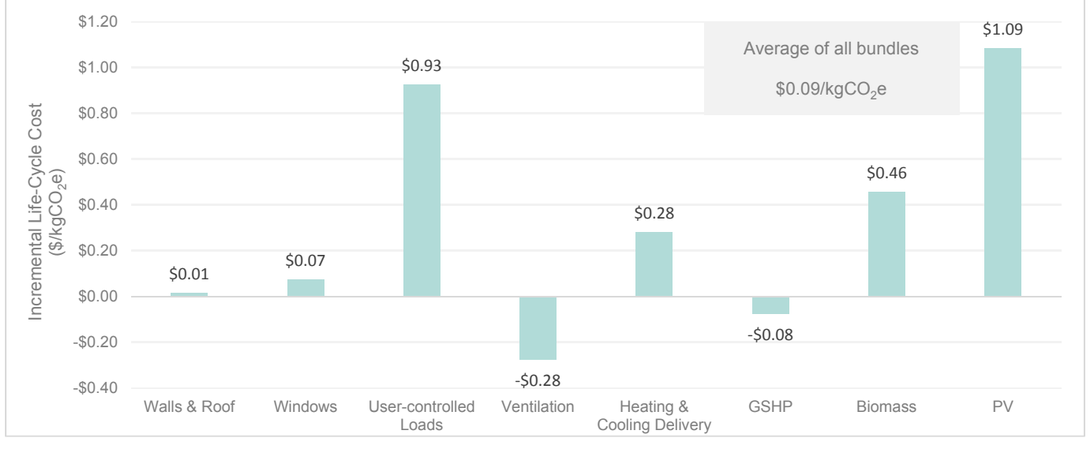




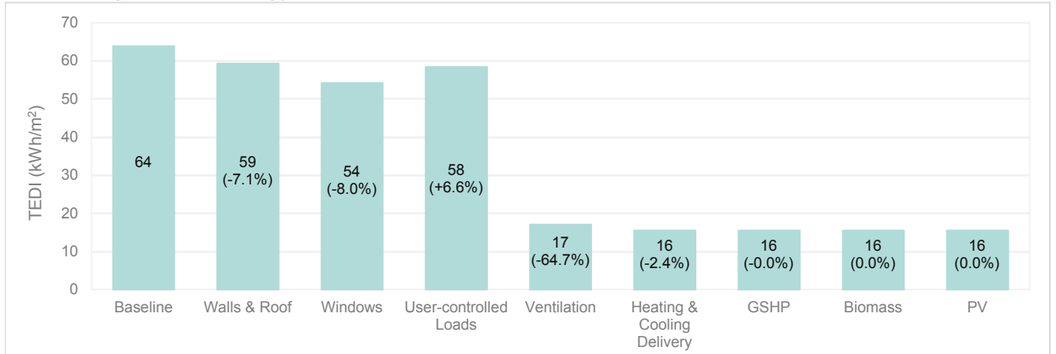
Cascading Bundle Financial Results: Mid-Rise Multi-Unit Residential, Montreal

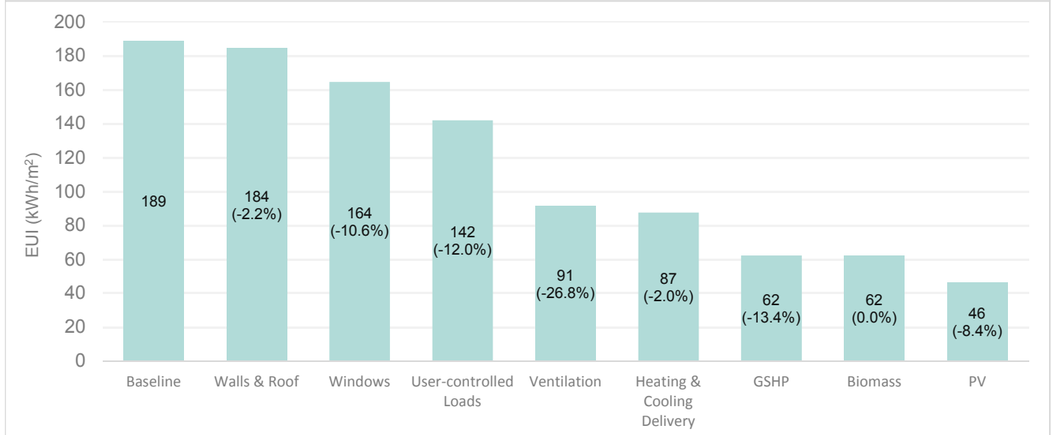


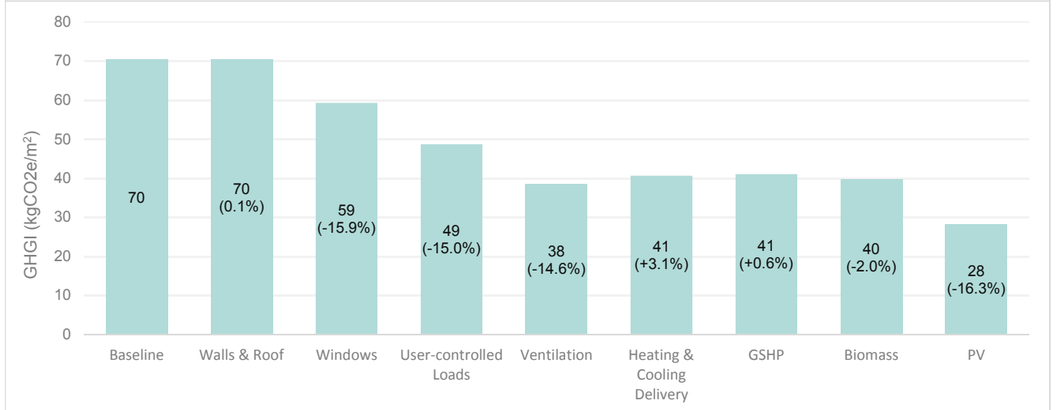




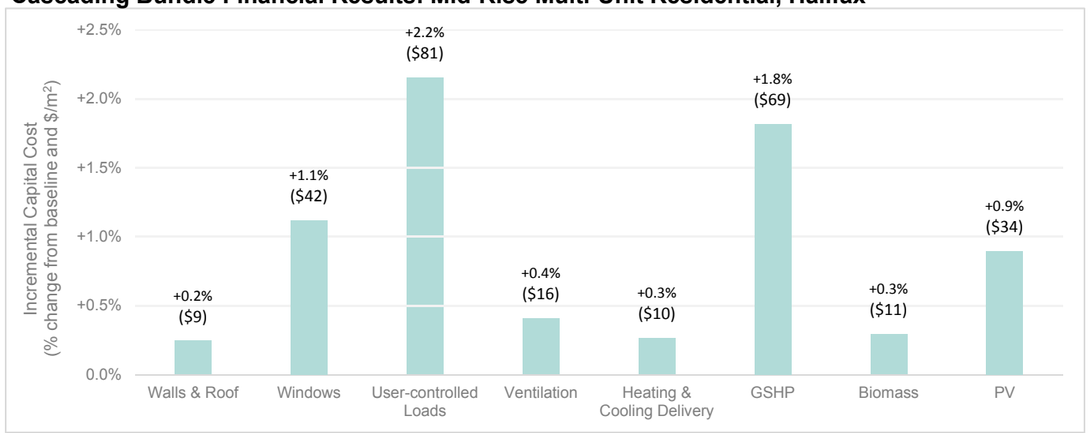
Cascading Bundle Energy Results: Mid-Rise Multi-Unit Residential, Halifax

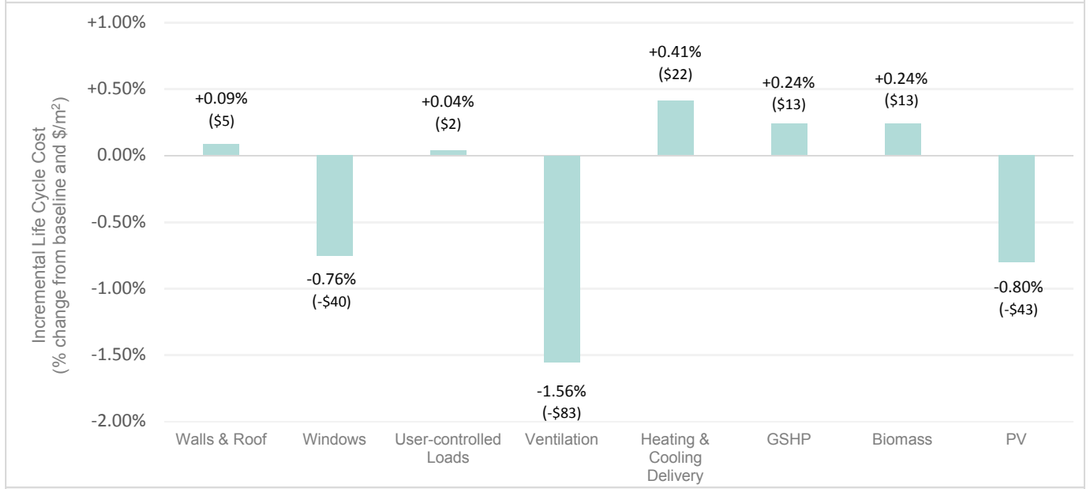


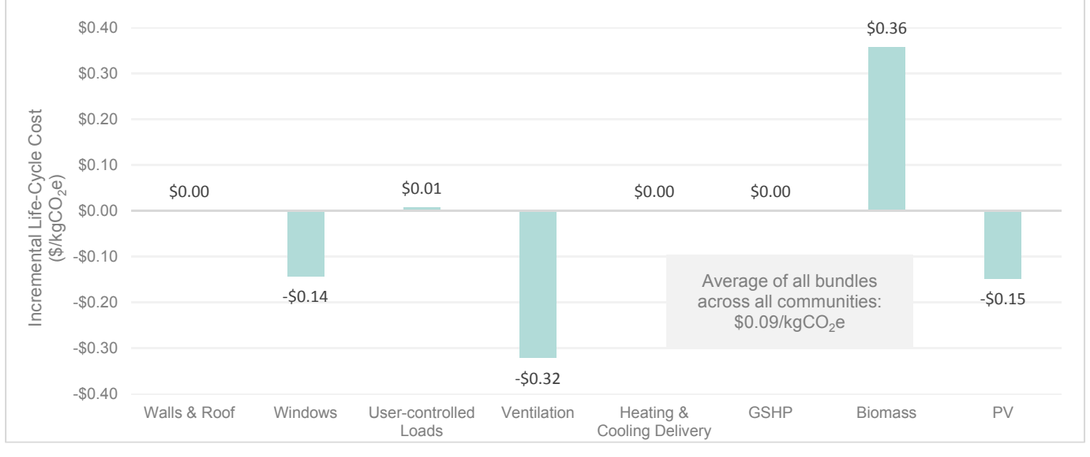




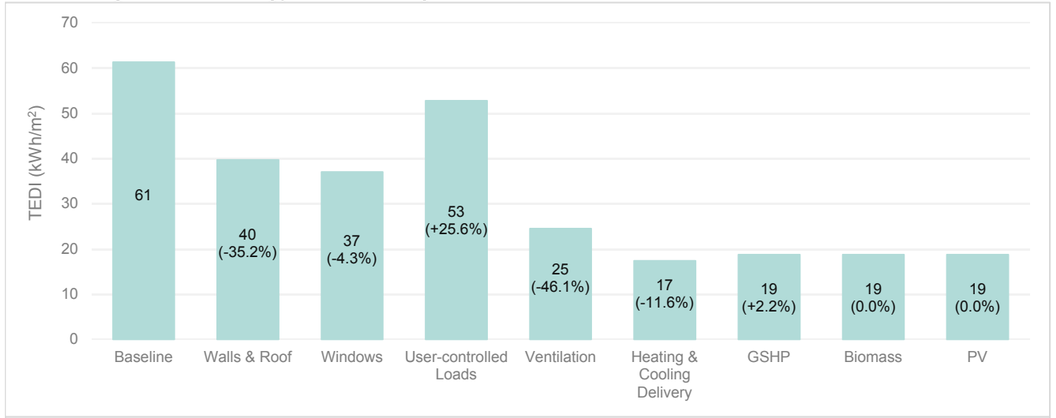
Cascading Bundle Financial Results: Mid-Rise Multi-Unit Residential, Halifax

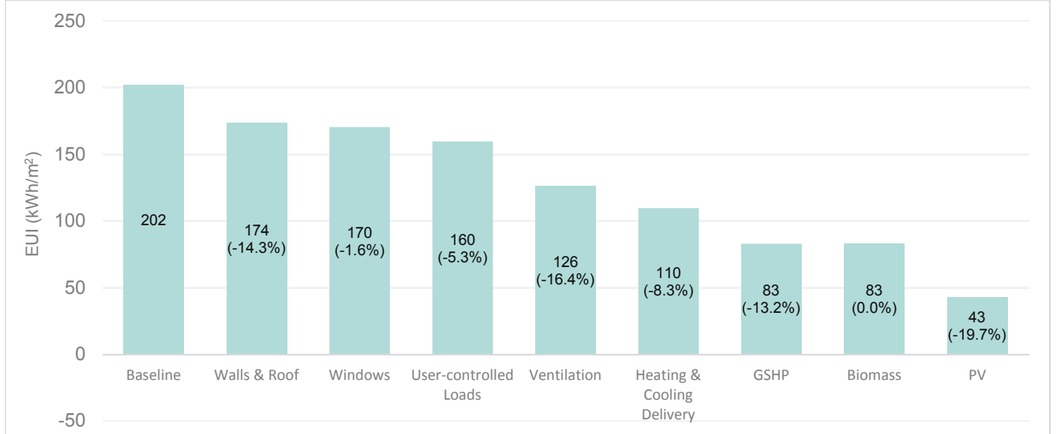


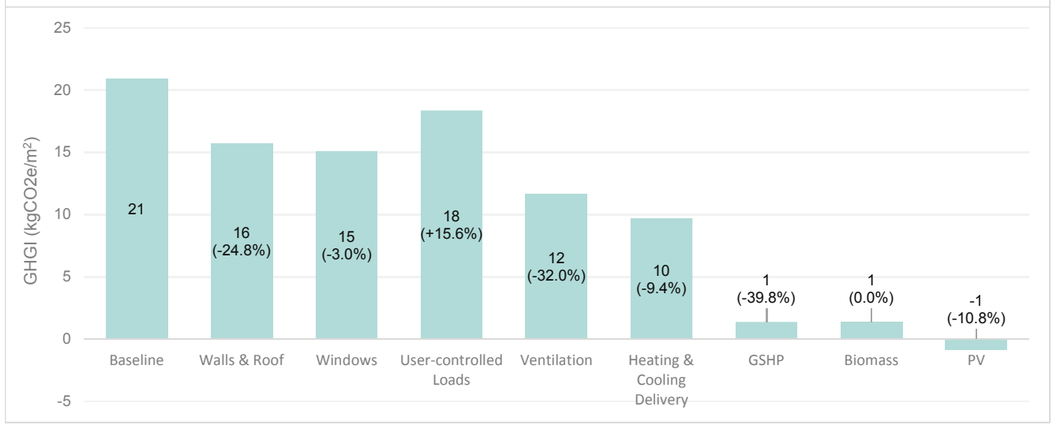




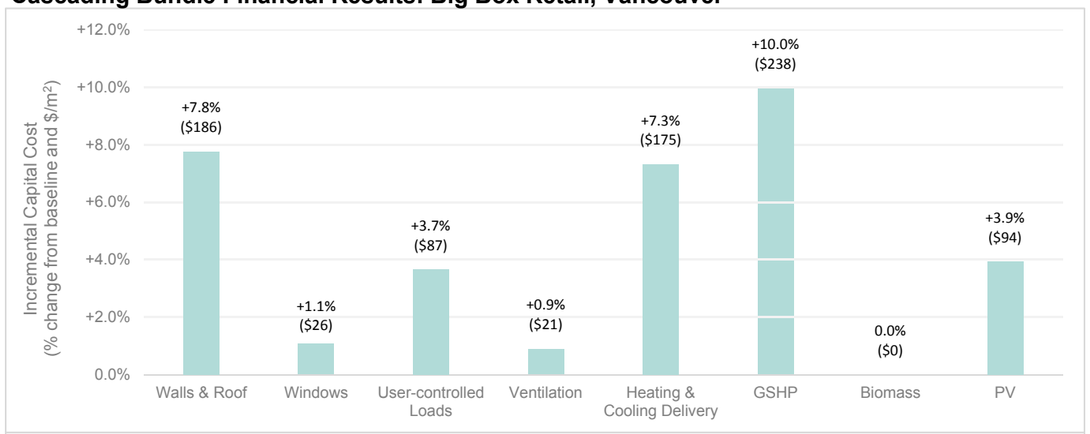
Cascading Bundle Energy Results: Big Box Retail, Vancouver

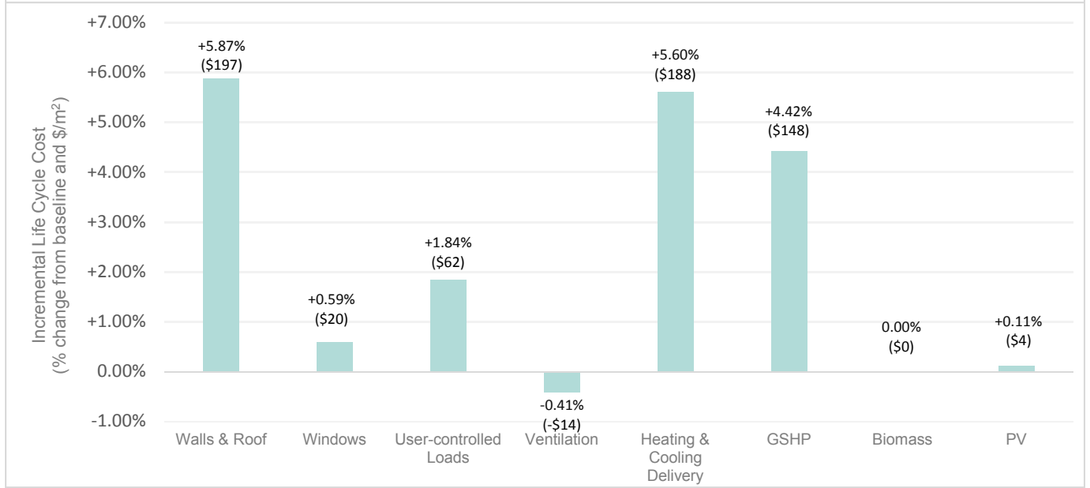


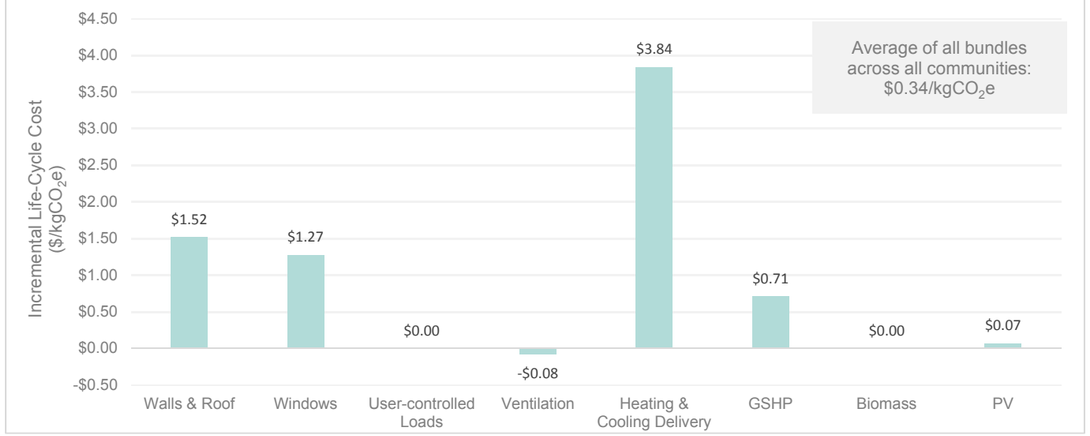




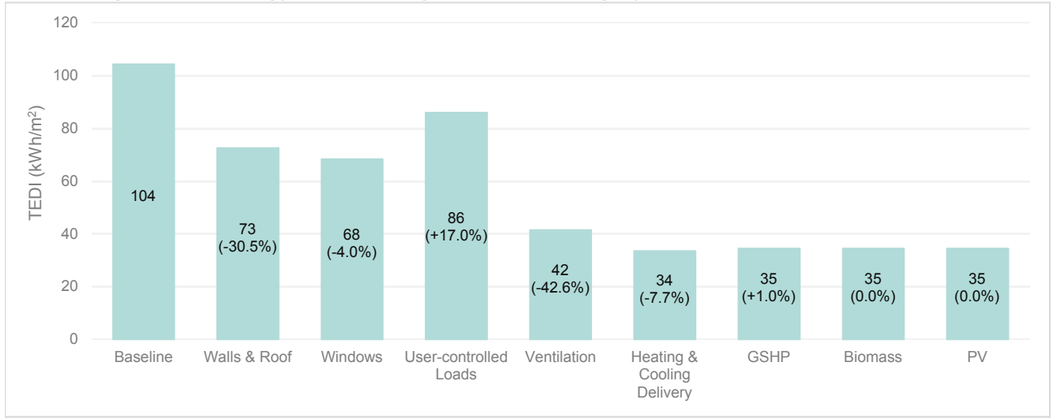
Cascading Bundle Financial Results: Big Box Retail, Vancouver

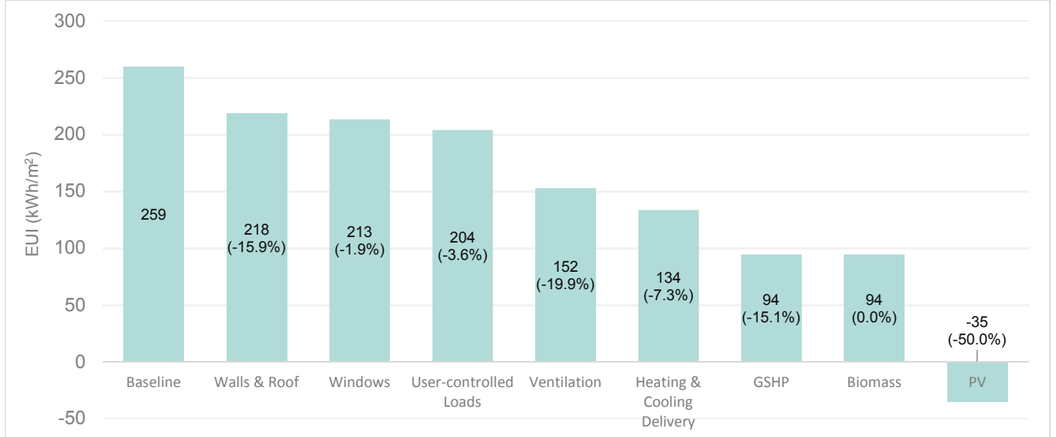


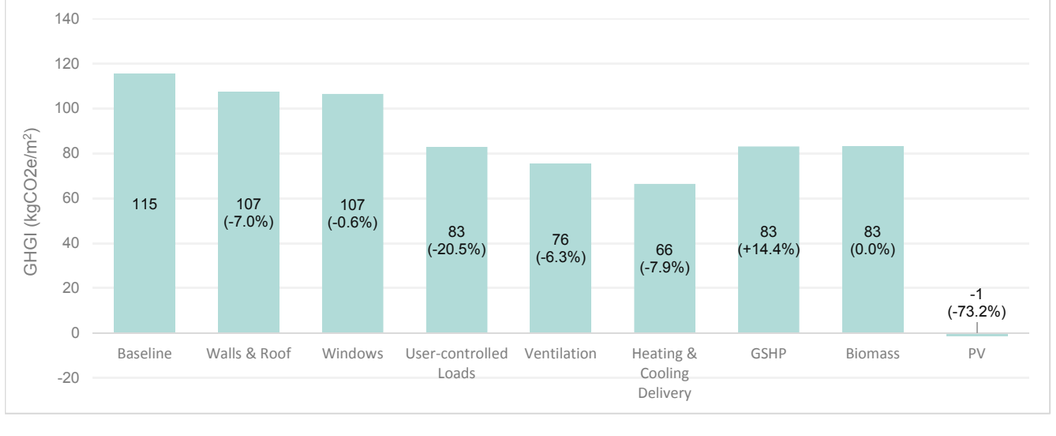




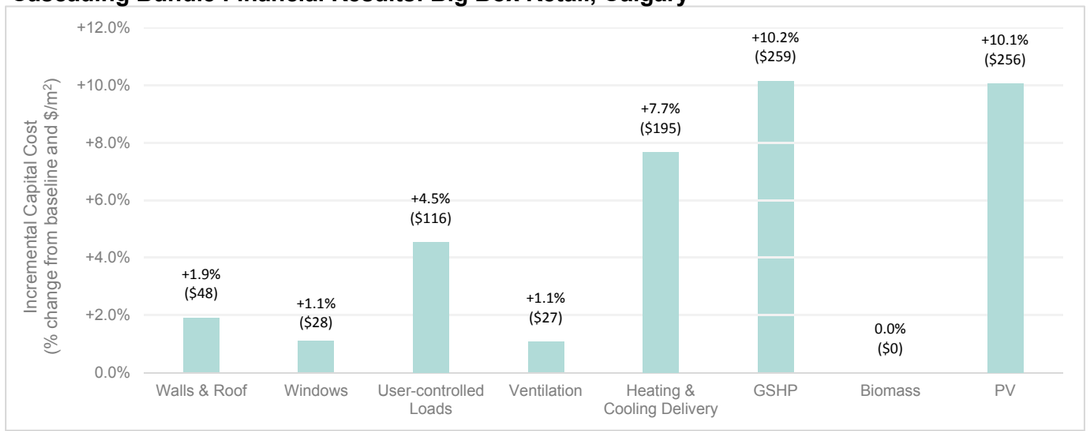
Cascading Bundle Energy Results: Big Box Retail, Calgary

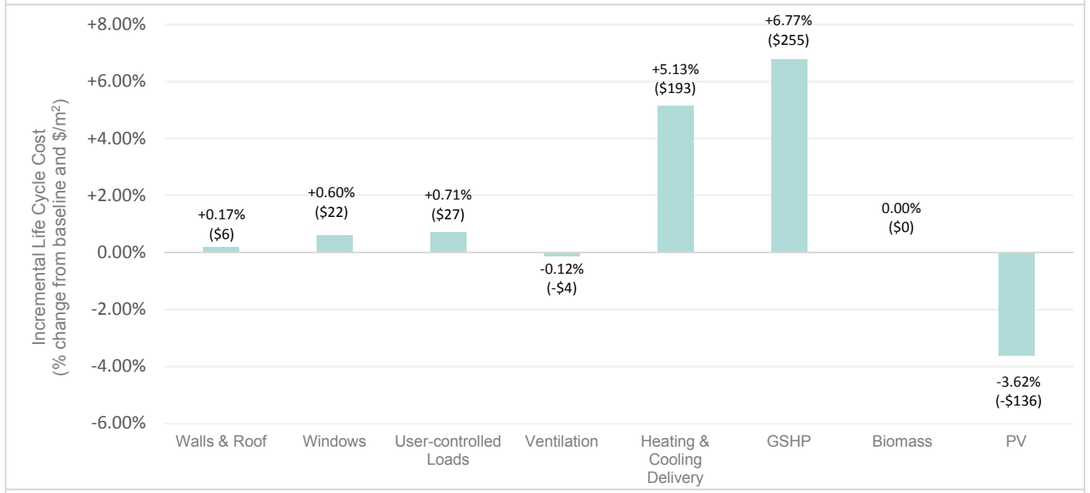


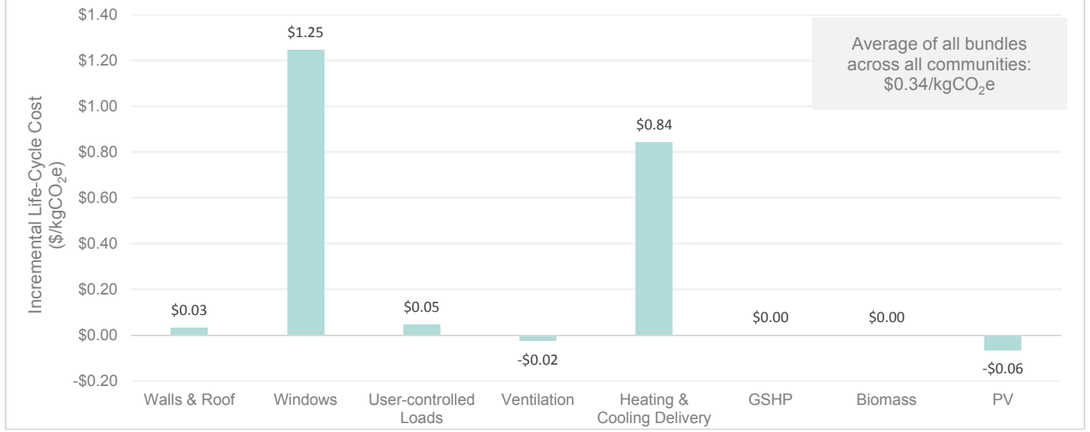




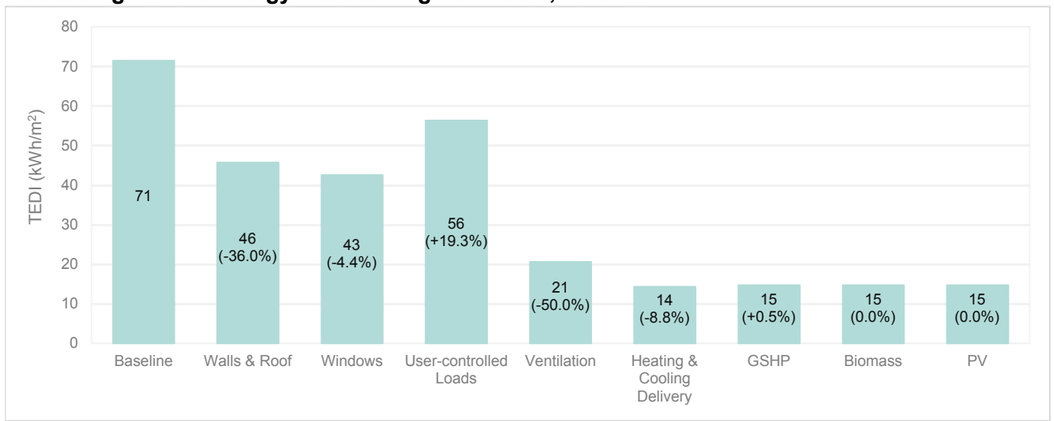
Cascading Bundle Financial Results: Big Box Retail, Calgary

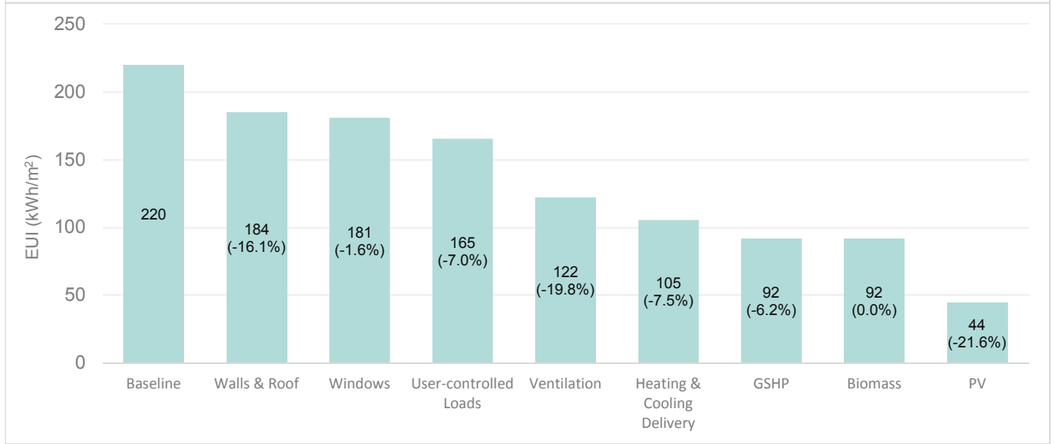


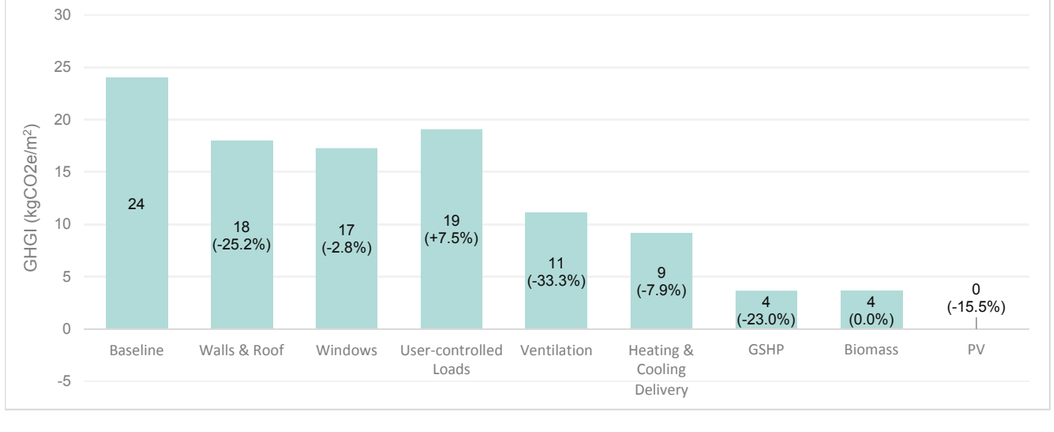




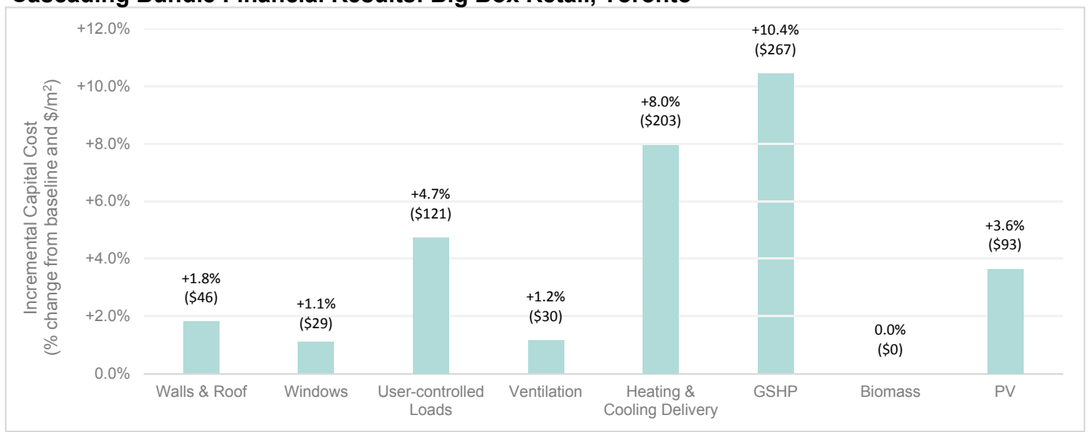
Cascading Bundle Energy Results: Big Box Retail, Toronto

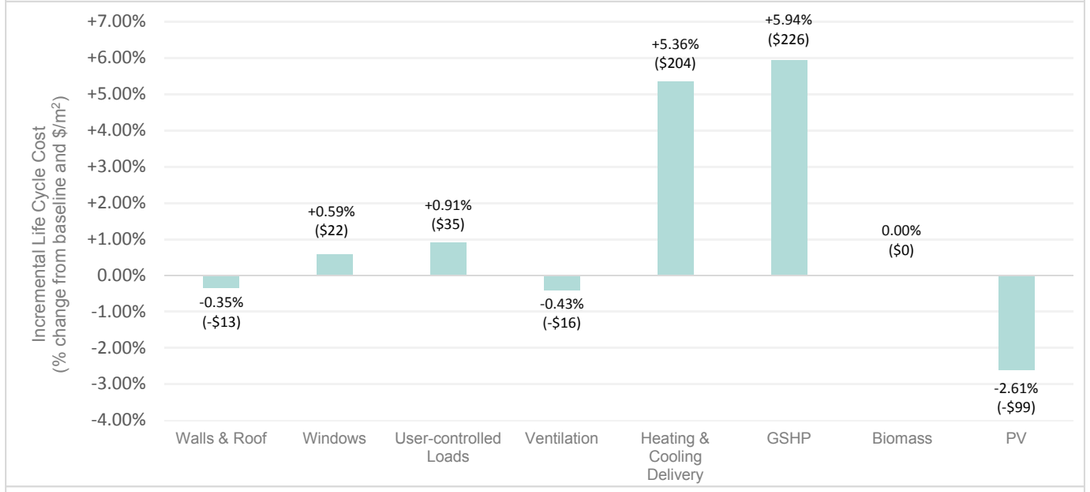




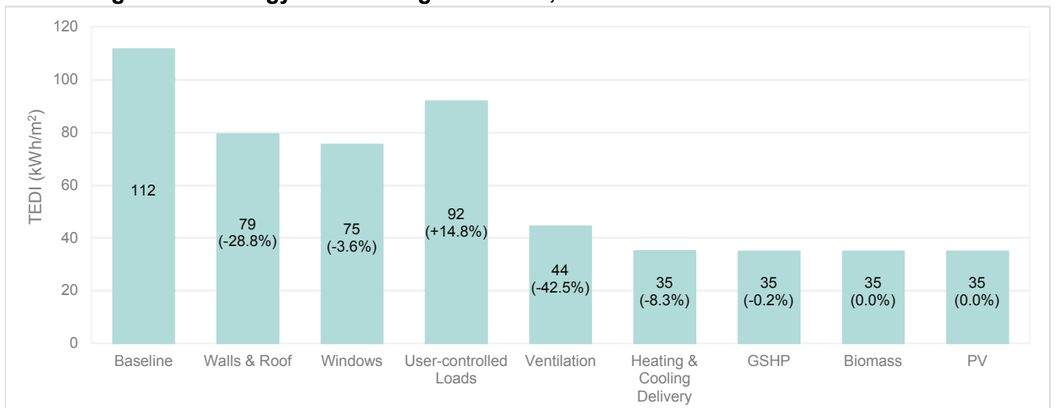


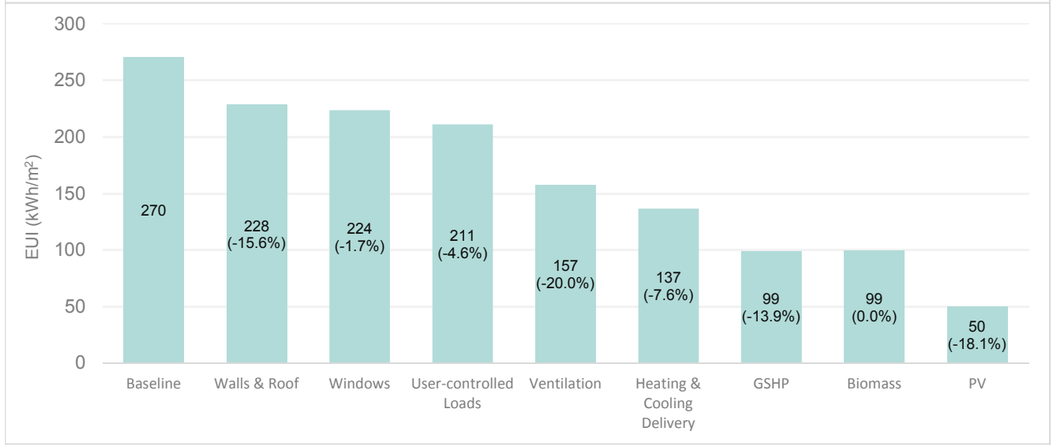
Cascading Bundle Financial Results: Big Box Retail, Toronto

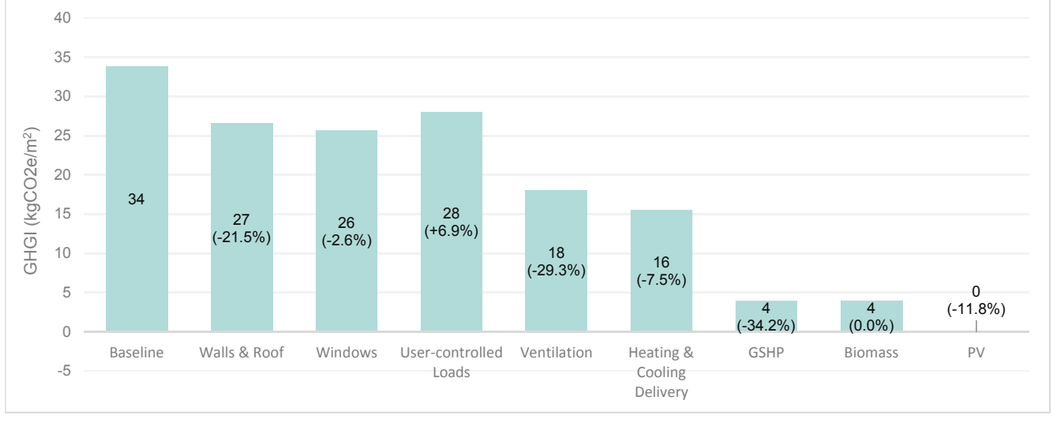




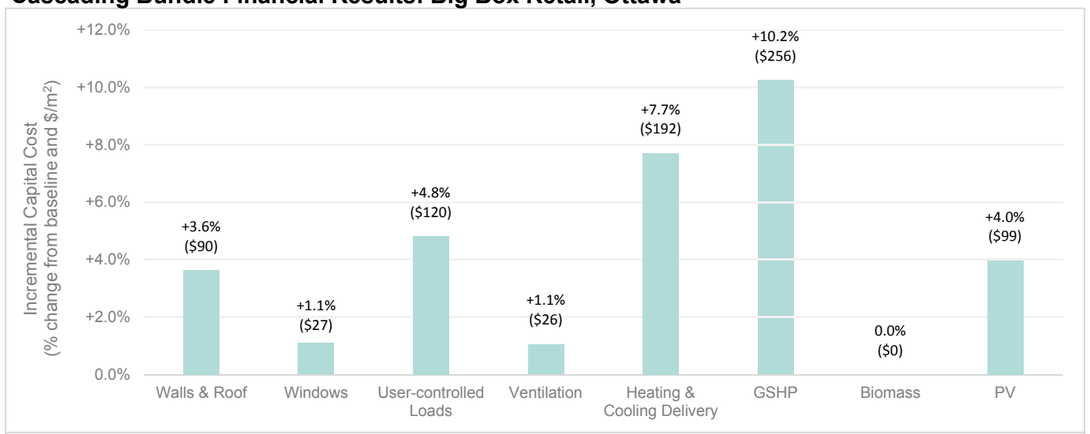
Cascading Bundle Energy Results: Big Box Retail, Ottawa

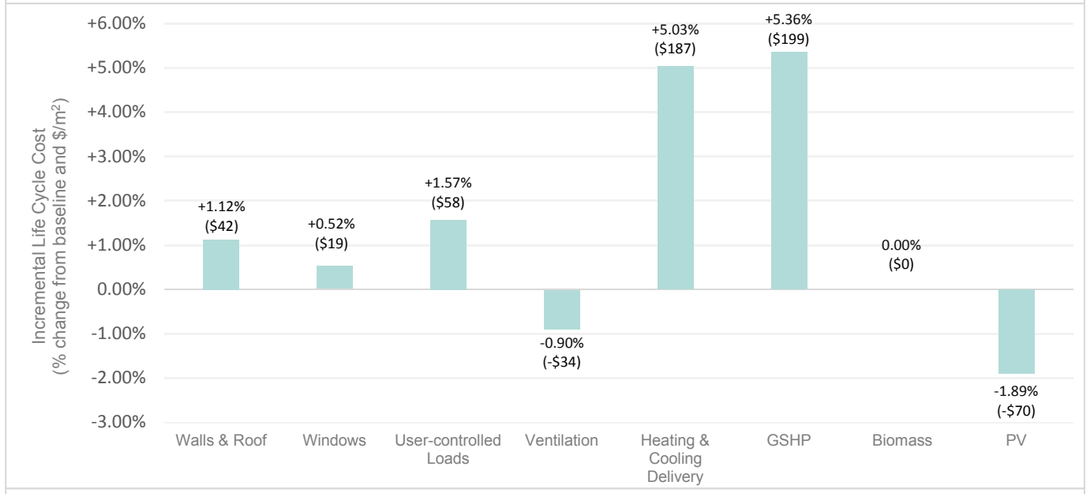


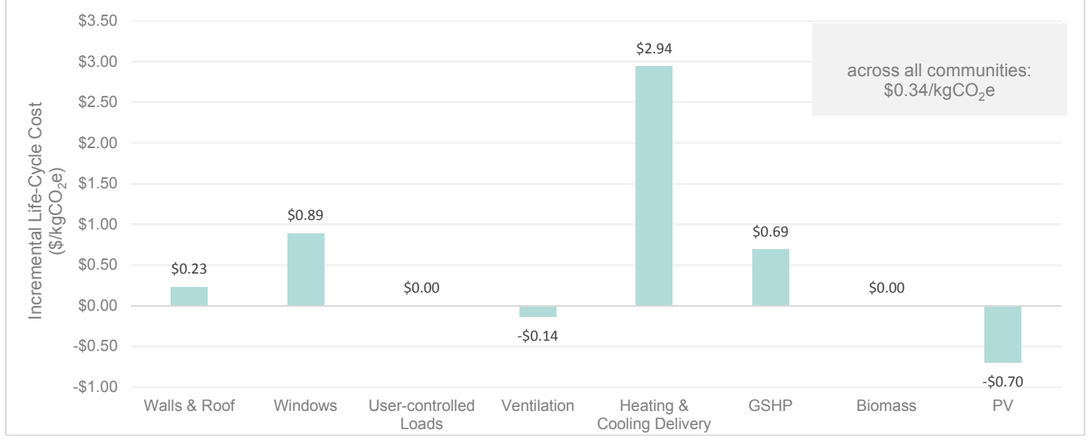




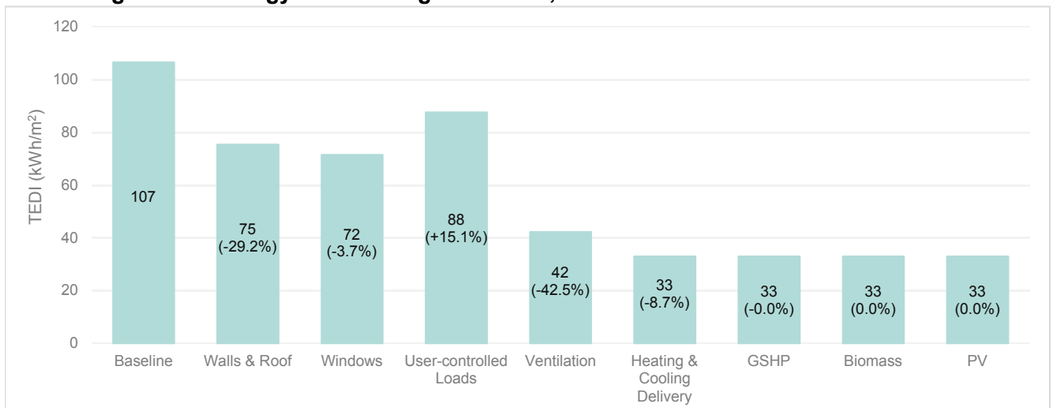
Cascading Bundle Financial Results: Big Box Retail, Ottawa

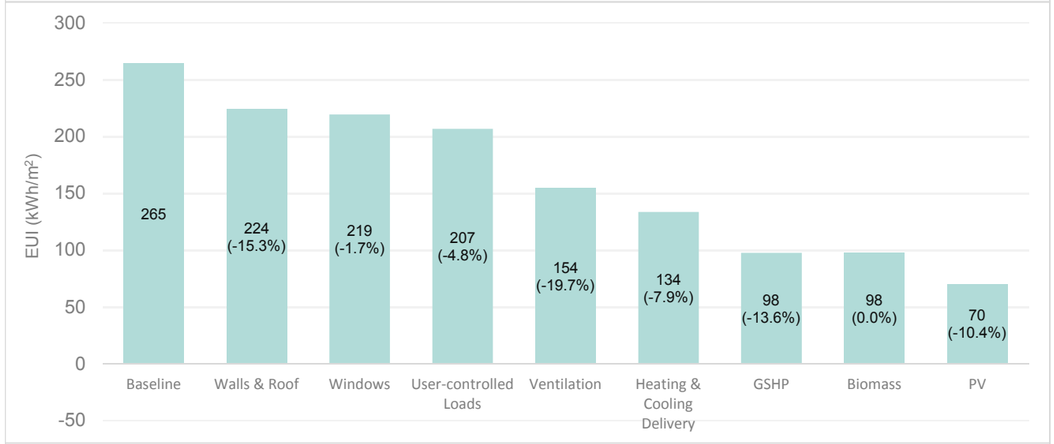


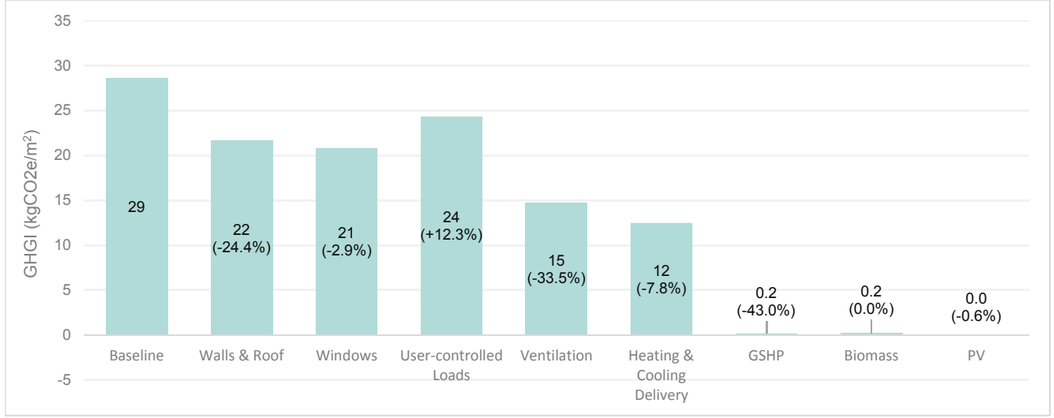




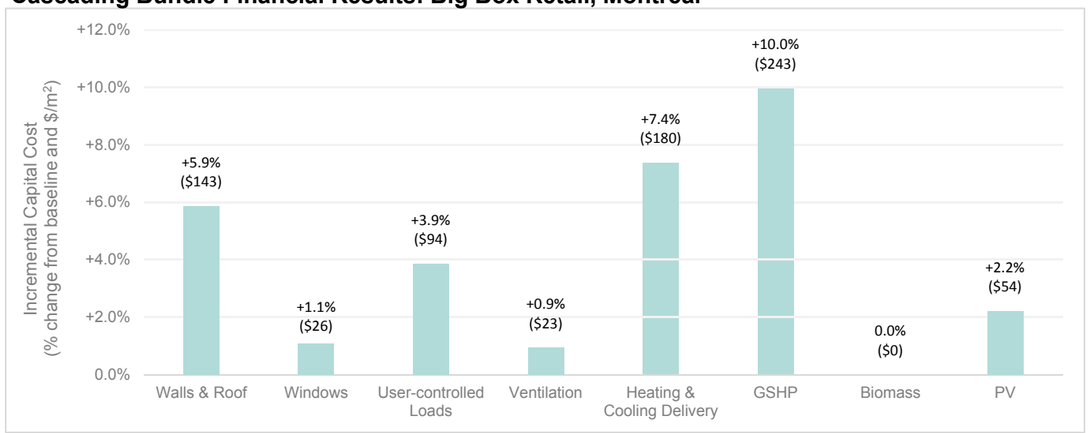
Cascading Bundle Energy Results: Big Box Retail, Montreal

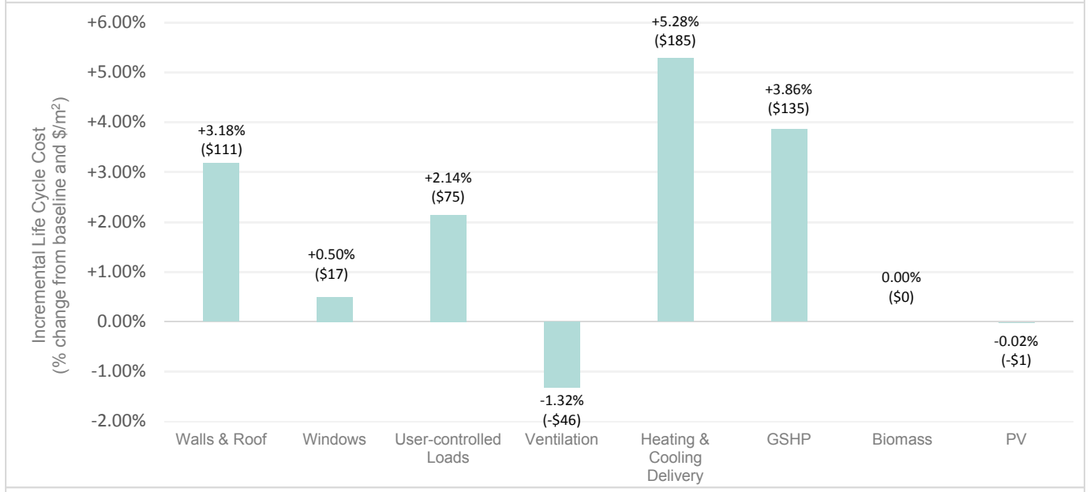


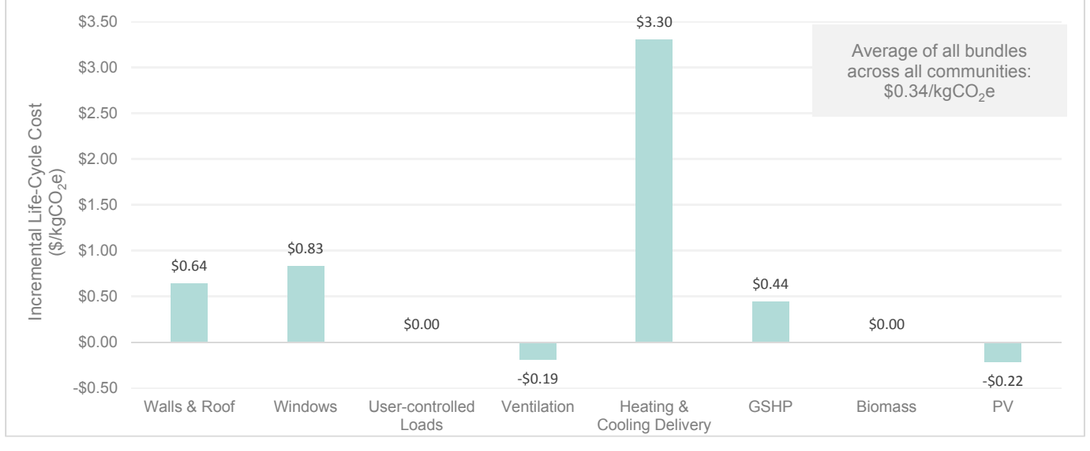




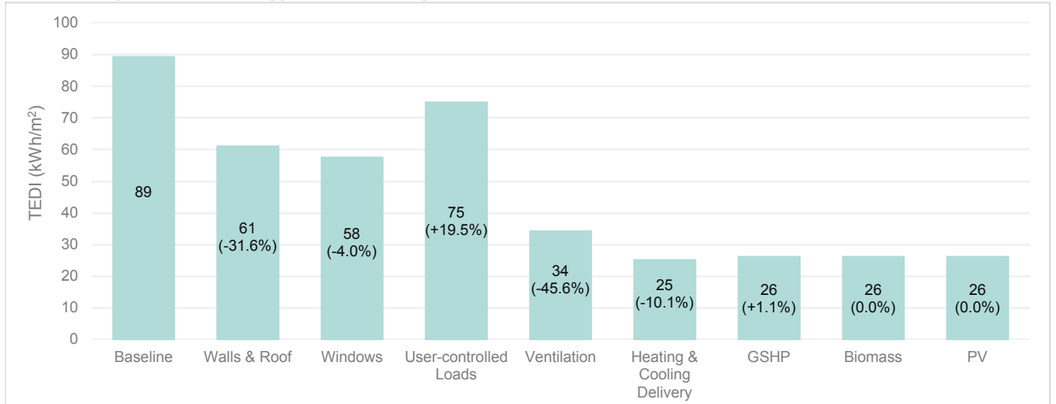
Cascading Bundle Financial Results: Big Box Retail, Montreal

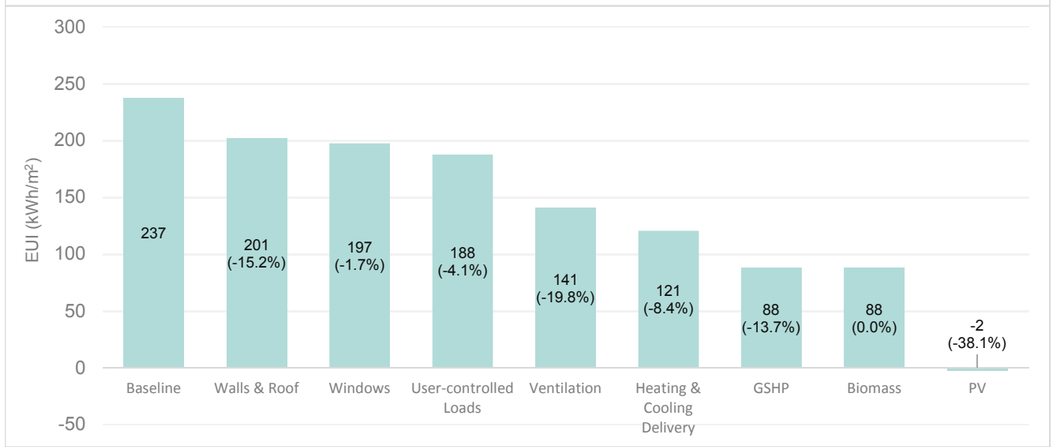


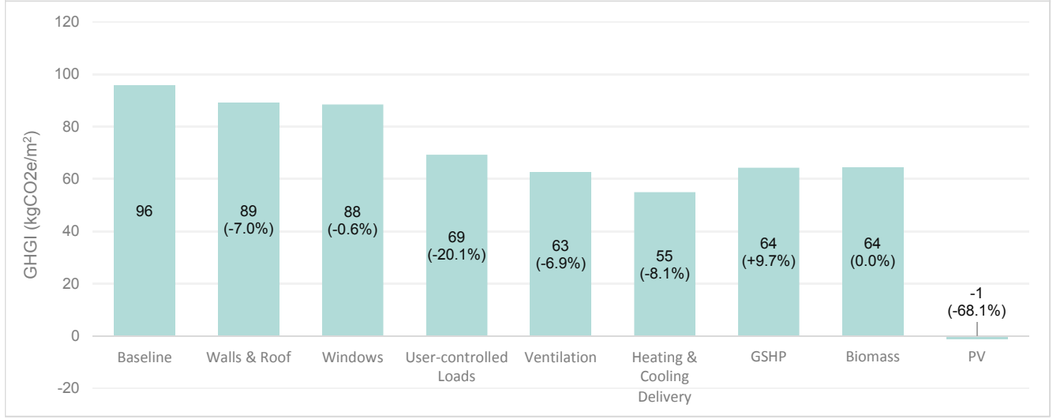




Cascading Bundle Energy Results: Big Box Retail, Halifax







B-3 SENSITIVITY ANALYSIS

MID-RISE OFFICE - VANCOUVER

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis

Fuel cost - proposed case		Initial costs: 2,517,675	3,776,513	5,035,350	6,294,188	7,553,025 $
$		-50.0%	-25.0%	0.0%	25.0%	50.0%
95,880	-50.0%	5,716,474	4,457,636	3,198,799	1,939,961	681,124
143,819	-25.0%	4,595,283	3,336,445	2,077,608	818,770	-440,067
191,759	0.0%	3,474,092	2,215,254	**956,417**	-302,421	-1,561,258
239,699	25.0%	2,352,901	1,094,063	-164,774	-1,423,612	-2,682,449
287,639	50.0%	1,231,710	-27,127	-1,285,965	-2,544,802	-3,803,640

- Remove analysis

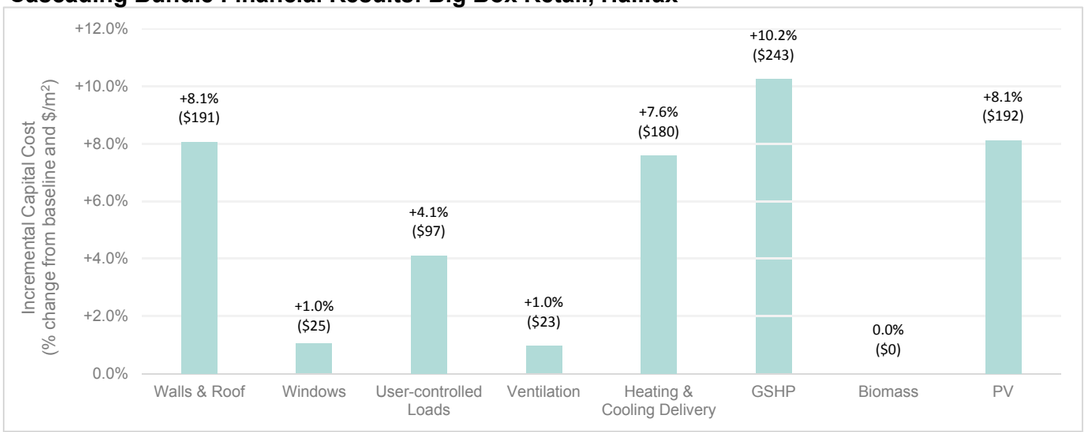
Fuel cost - base case		Fuel cost - proposed case: 95,880	143,819	191,759	239,699	287,639 $
$		-50.0%	-25.0%	0.0%	25.0%	50.0%
206,516	-50.0%	-1,631,079	-2,752,270	-3,873,460	-4,994,651	-6,115,842
309,774	-25.0%	783,860	-337,331	-1,458,522	-2,579,713	-3,700,904
413,031	0.0%	3,198,799	2,077,608	**956,417**	-164,774	-1,285,965
516,289	25.0%	5,613,737	4,492,546	3,371,355	2,250,165	1,128,974
619,547	50.0%	8,028,676	6,907,485	5,786,294	4,665,103	3,543,912

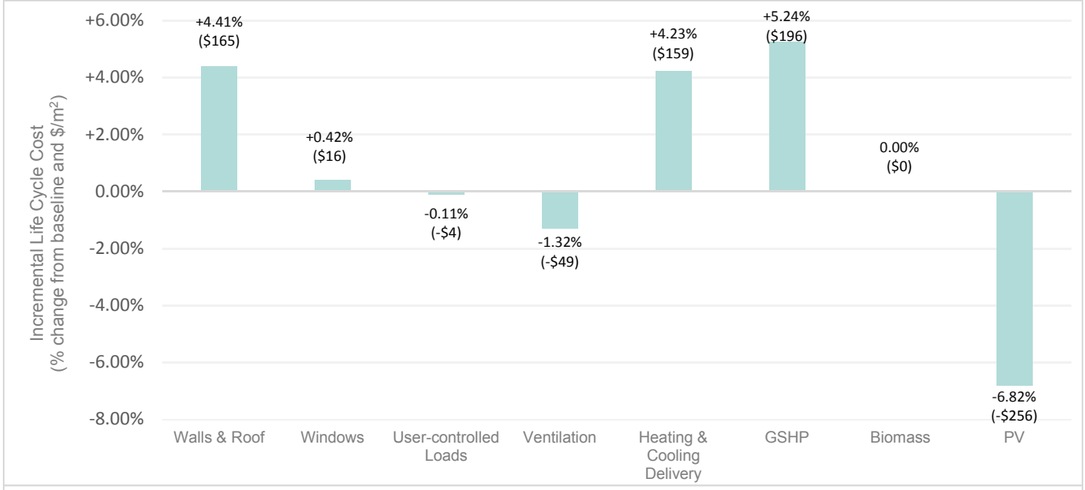
- Remove analysis

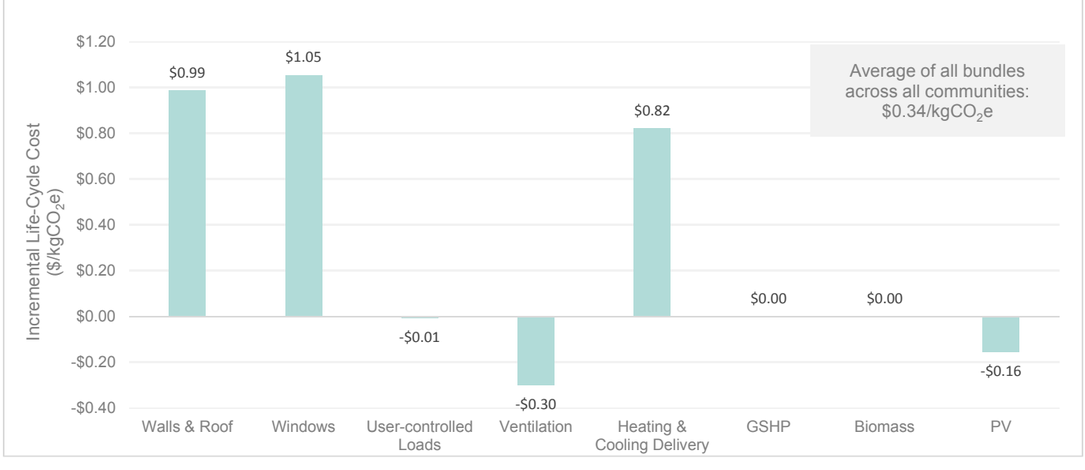
None		GHG reduction credit rate: 26.10	39.14	52.19	65.24	78.29 $/tCO₂
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	426,512	691,464	**956,417**	1,221,369	1,486,322

+ Add analysis

Cascading Bundle Financial Results: Big Box Retail, Halifax





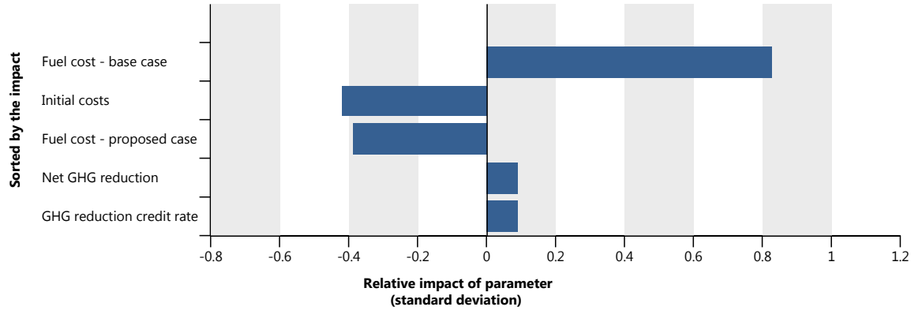


Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

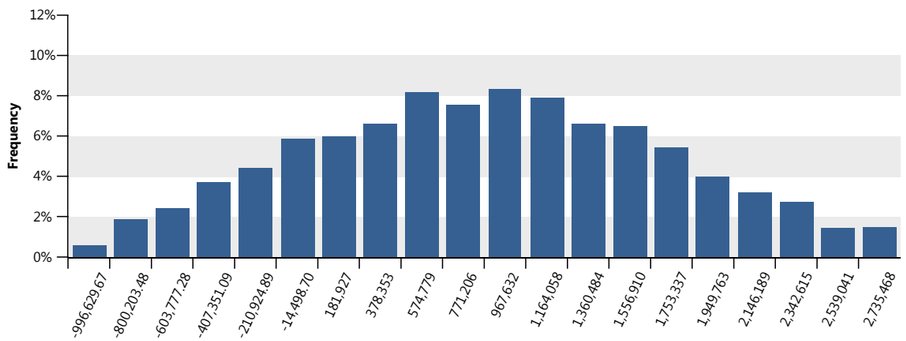
Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	5,035,350	25%	3,776,513	6,294,188
Fuel cost - proposed case	$	191,759	25%	143,819	239,699
Fuel cost - base case	$	413,031	25%	309,774	516,289
Net GHG reduction - credit duration	tCO_2	9,866	25%	7,400	12,333
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24

Impact - Net Present Value (NPV)



Median	$	971,204
Level of risk	%	5%
Minimum within level of confidence	$	-996,831
Maximum within level of confidence	$	2,931,988

Distribution - Net Present Value (NPV)



MID-RISE OFFICE - CALGARY

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis

Fuel cost - proposed case	Initial costs					$
$		2,548,328	3,822,492	5,096,656	6,370,820	7,644,984
		-50.0%	-25.0%	0.0%	25.0%	50.0%
81,770	-50.0%	10,079,382	8,805,218	7,531,054	6,256,890	4,982,726
122,655	-25.0%	9,123,189	7,849,025	6,574,861	5,300,697	4,026,533
163,539	0.0%	8,166,996	6,892,832	**5,618,668**	4,344,504	3,070,340
204,424	25.0%	7,210,802	5,936,638	4,662,474	3,388,310	2,114,146
245,309	50.0%	6,254,609	4,980,445	3,706,281	2,432,117	1,157,953

- Remove analysis

Fuel cost - base case	Fuel cost - proposed case					$
$		81,770	122,655	163,539	204,424	245,309
		-50.0%	-25.0%	0.0%	25.0%	50.0%
173,635	-50.0%	3,470,171	2,513,978	1,557,785	601,592	-354,601
260,453	-25.0%	5,500,612	4,544,419	3,588,226	2,632,033	1,675,840
347,270	0.0%	7,531,054	6,574,861	**5,618,668**	4,662,474	3,706,281
434,088	25.0%	9,561,495	8,605,302	7,649,109	6,692,916	5,736,723
520,905	50.0%	11,591,936	10,635,743	9,679,550	8,723,357	7,767,164

- Remove analysis

None	GHG reduction credit rate					$/tCO2
		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	2,289,794	3,954,231	**5,618,668**	7,283,104	8,947,541

+ Add analysis

MID-RISE OFFICE - TORONTO

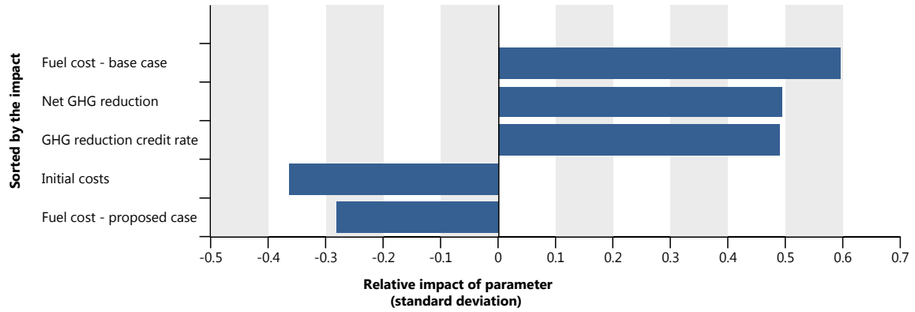
RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

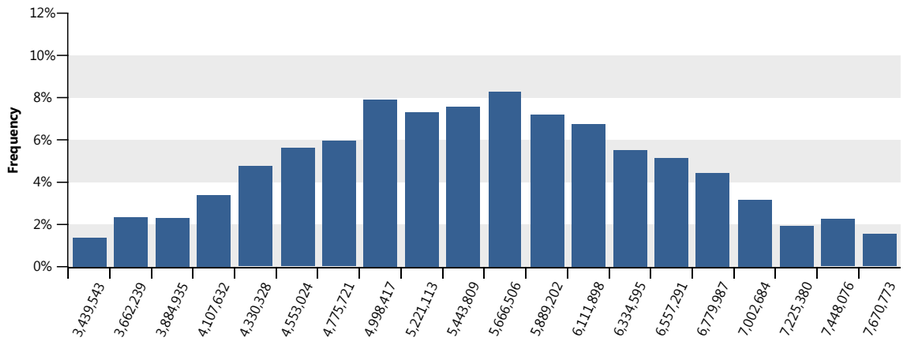
Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	5,096,656	25%	3,822,492	6,370,820
Fuel cost - proposed case	$	163,539	25%	122,655	204,424
Fuel cost - base case	$	347,270	25%	260,453	434,088
Net GHG reduction - credit duration	tCO_2	61,980	25%	46,485	77,474
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24

Impact - Net Present Value (NPV)



Median	$	5,624,895
Level of risk	%	5%
Minimum within level of confidence	$	3,439,243
Maximum within level of confidence	$	7,893,559

Distribution - Net Present Value (NPV)



Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis

Fuel cost - proposed case		Initial costs				$
$		2,546,339	3,819,509	5,092,678	6,365,848	7,639,017
		-50.0%	-25.0%	0.0%	25.0%	50.0%
186,387	-50.0%	13,662,898	12,389,729	11,116,559	9,843,390	8,570,220
279,581	-25.0%	11,483,334	10,210,165	8,936,995	7,663,826	6,390,656
372,775	0.0%	9,303,770	8,030,601	**6,757,431**	5,484,262	4,211,092
465,969	25.0%	7,124,206	5,851,037	4,577,867	3,304,698	2,031,528
559,162	50.0%	4,944,642	3,671,473	2,398,303	1,125,134	-148,036

- Remove analysis

Fuel cost - base case		Fuel cost - proposed case				$
$		186,387	279,581	372,775	465,969	559,162
		-50.0%	-25.0%	0.0%	25.0%	50.0%
410,026	-50.0%	1,527,081	-652,483	-2,832,047	-5,011,611	-7,191,175
615,040	-25.0%	6,321,820	4,142,256	1,962,692	-216,872	-2,396,436
820,053	0.0%	11,116,559	8,936,995	**6,757,431**	4,577,867	2,398,303
1,025,066	25.0%	15,911,298	13,731,734	11,552,170	9,372,606	7,193,042
1,230,079	50.0%	20,706,037	18,526,473	16,346,909	14,167,345	11,987,781

- Remove analysis

None		GHG reduction credit rate				$/tCO$_2$
		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	5,923,855	6,340,643	**6,757,431**	7,174,219	7,591,008

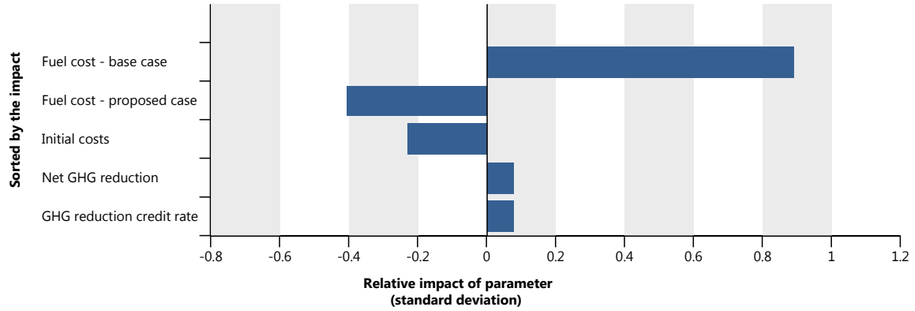
+ Add analysis

Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

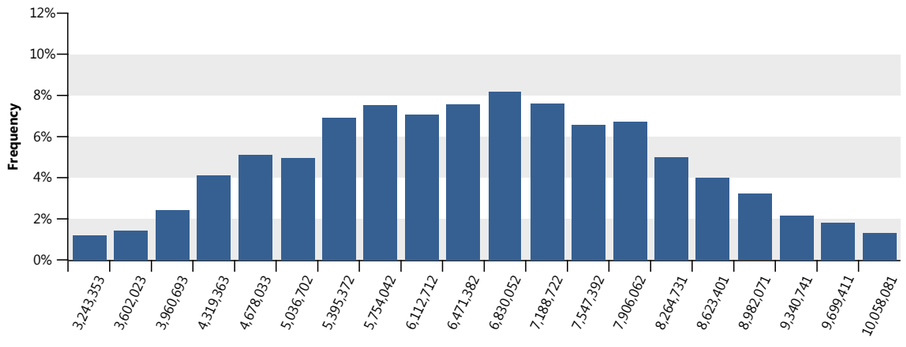
Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	5,092,678	25%	3,819,509	6,365,848
Fuel cost - proposed case	$	372,775	25%	279,581	465,969
Fuel cost - base case	$	820,053	25%	615,040	1,025,066
Net GHG reduction - credit duration	tCO_2	15,520	25%	11,640	19,400
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24

Impact - Net Present Value (NPV)



Median	$	6,783,272
Level of risk	%	5%
Minimum within level of confidence	$	3,243,206
Maximum within level of confidence	$	10,417,307

Distribution - Net Present Value (NPV)



LOW-RISE MURB - VANCOUVER

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis — Initial costs ($)

Fuel cost - proposed case ($)		467,305	700,958	934,610	1,168,263	1,401,915
		-50.0%	-25.0%	0.0%	25.0%	50.0%
4,614	-50.0%	190,041	-43,611	-277,264	-510,916	-744,569
6,922	-25.0%	136,081	-97,572	-331,224	-564,877	-798,529
9,229	0.0%	82,120	-151,532	**-385,185**	-618,837	-852,490
11,536	25.0%	28,160	-205,493	-439,145	-672,798	-906,450
13,843	50.0%	-25,800	-259,453	-493,105	-726,758	-960,410

- Remove analysis — Fuel cost - proposed case ($)

Fuel cost - base case ($)		4,614	6,922	9,229	11,536	13,843
		-50.0%	-25.0%	0.0%	25.0%	50.0%
12,532	-50.0%	-570,354	-624,315	-678,275	-732,235	-786,196
18,798	-25.0%	-423,809	-477,769	-531,730	-585,690	-639,651
25,064	0.0%	-277,264	-331,224	**-385,185**	-439,145	-493,105
31,330	25.0%	-130,719	-184,679	-238,639	-292,600	-346,560
37,596	50.0%	15,827	-38,134	-92,094	-146,055	-200,015

- Remove analysis — GHG reduction credit rate ($/$tCO_2$)

None		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	-463,463	-424,324	**-385,185**	-346,045	-306,906

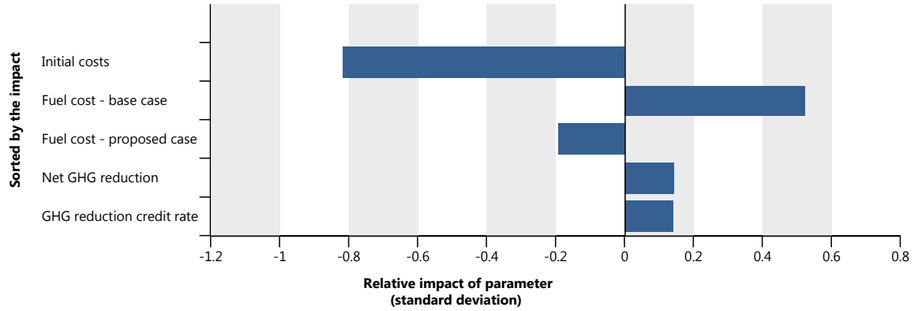
+ Add analysis

Risk analysis

Perform analysis on		Net Present Value (NPV)
Number of combinations		3000
Random seed		No

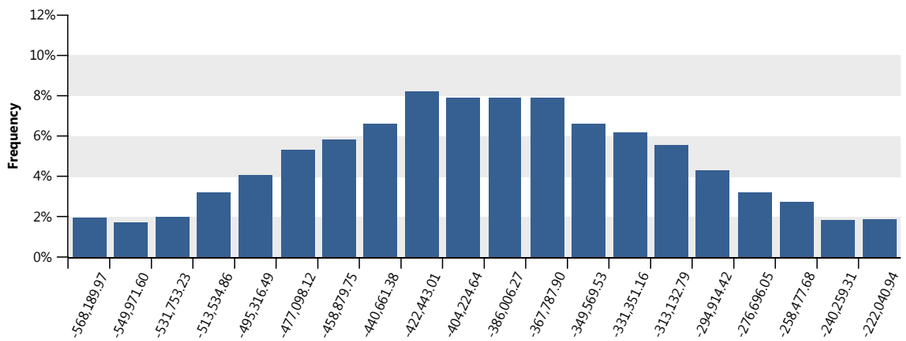
Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	934,610	25%	700,958	1,168,263
Fuel cost - proposed case	$	9,229	25%	6,922	11,536
Fuel cost - base case	$	25,064	25%	18,798	31,330
Net GHG reduction - credit duration	tCO_2	1,457	25%	1,093	1,822
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24

Impact - Net Present Value (NPV)



Median	$	-384,784
Level of risk	%	5%
Minimum within level of confidence	$	-568,201
Maximum within level of confidence	$	-203,823

Distribution - Net Present Value (NPV)



LOW-RISE MURB - CALGARY

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on		Net Present Value (NPV)
Sensitivity range		50%
Threshold	0	$

- Remove analysis — Initial costs ($)

Fuel cost - base case ($)		616,506	924,758	1,233,011	1,541,264	1,849,517
		-50.0%	-25.0%	0.0%	25.0%	50.0%
10,194	-50.0%	116,787	-191,466	-499,718	-807,971	-1,116,224
15,291	-25.0%	235,995	-72,258	-380,511	-688,763	-997,016
20,388	0.0%	355,203	46,950	**-261,303**	-569,556	-877,808
25,485	25.0%	474,411	166,158	-142,095	-450,348	-758,600
30,583	50.0%	593,618	285,366	-22,887	-331,140	-639,393

- Remove analysis — None

Fuel cost - base case ($)		0.0%
10,194	-50.0%	-499,718
15,291	-25.0%	-380,511
20,388	0.0%	**-261,303**
25,485	25.0%	-142,095
30,583	50.0%	-22,887

- Remove analysis — GHG reduction credit rate ($/tCO$_2$)

None		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	-503,265	-382,284	**-261,303**	-140,322	-19,341

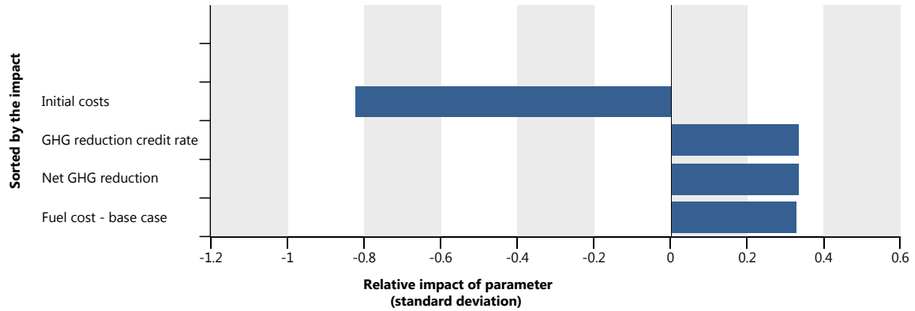
+ Add analysis

Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

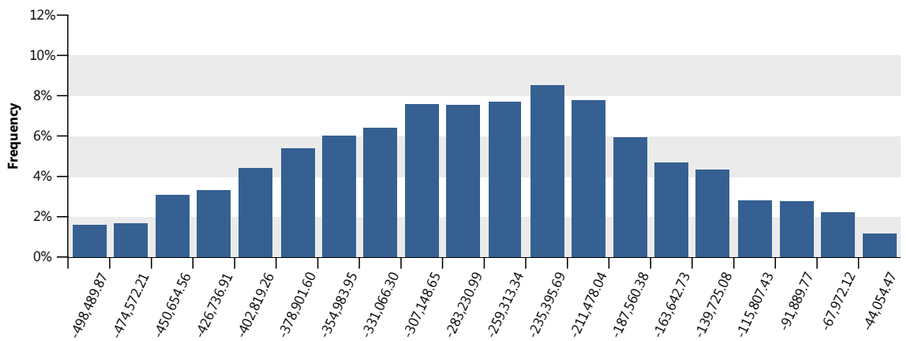
Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	1,233,011	25%	924,758	1,541,264
Fuel cost - base case	$	20,388	25%	15,291	25,485
Net GHG reduction - credit duration	tCO_2	4,505	25%	3,379	5,631
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24

Impact - Net Present Value (NPV)



Median	$	-257,842
Level of risk	%	5%
Minimum within level of confidence	$	-498,510
Maximum within level of confidence	$	-20,038

Distribution - Net Present Value (NPV)



LOW-RISE MURB - TORONTO

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis

Fuel cost - proposed case		Initial costs				
$		519,239	778,858	1,038,477	1,298,096	1,557,716
		-50.0%	-25.0%	0.0%	25.0%	50.0%
7,857	-50.0%	554,909	295,290	35,670	-223,949	-483,568
11,785	-25.0%	463,034	203,415	-56,204	-315,824	-575,443
15,713	0.0%	371,159	111,540	**-148,079**	-407,698	-667,318
19,642	25.0%	279,285	19,666	-239,954	-499,573	-759,192
23,570	50.0%	187,410	-72,209	-331,828	-591,448	-851,067

- Remove analysis

Fuel cost - base case		Fuel cost - proposed case				
$		7,857	11,785	15,713	19,642	23,570
		-50.0%	-25.0%	0.0%	25.0%	50.0%
21,855	-50.0%	-475,464	-567,339	-659,214	-751,088	-842,963
32,783	-25.0%	-219,897	-311,772	-403,646	-495,521	-587,396
43,710	0.0%	35,670	-56,204	**-148,079**	-239,954	-331,828
54,638	25.0%	291,238	199,363	107,488	15,614	-76,261
65,565	50.0%	546,805	454,930	363,055	271,181	179,306

- Remove analysis

None		GHG reduction credit rate				$/tCO$_2$
		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
0.0%		-255,907	-201,993	**-148,079**	-94,165	-40,251

+ Add analysis

LOW-RISE MURB - VANCOUVER

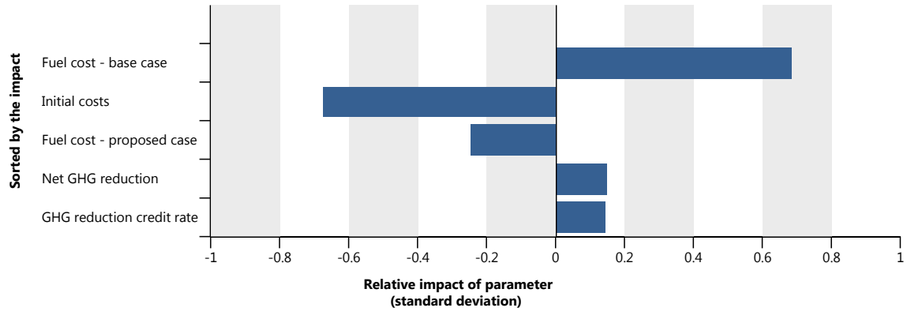
RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

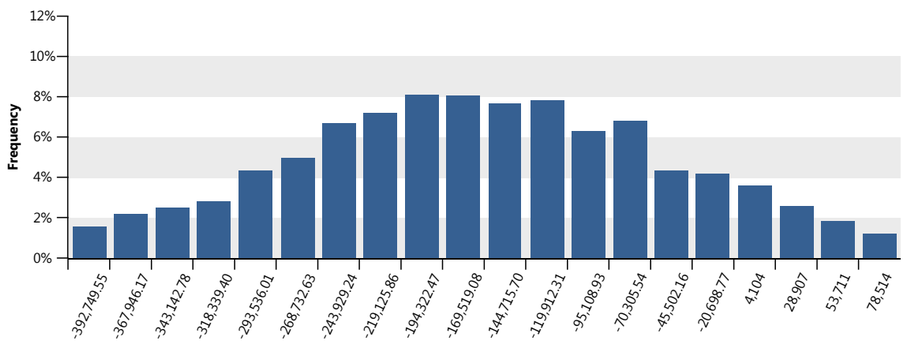
Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	1,038,477	25%	778,858	1,298,096
Fuel cost - proposed case	$	15,713	25%	11,785	19,642
Fuel cost - base case	$	43,710	25%	32,783	54,638
Net GHG reduction - credit duration	tCO_2	2,008	25%	1,506	2,510
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24

Impact - Net Present Value (NPV)



Median	$	-148,114
Level of risk	%	5%
Minimum within level of confidence	$	-392,780
Maximum within level of confidence	$	103,325

Distribution - Net Present Value (NPV)



Sensitivity analysis

Perform analysis on	Net Present Value (NPV)
Sensitivity range	50%
Threshold	0 $

- Remove analysis — Initial costs ($)

Fuel cost - proposed case ($)		467,305	700,958	934,610	1,168,263	1,401,915
		-50.0%	-25.0%	0.0%	25.0%	50.0%
4,614	-50.0%	190,041	-43,611	-277,264	-510,916	-744,569
6,922	-25.0%	136,081	-97,572	-331,224	-564,877	-798,529
9,229	0.0%	82,120	-151,532	**-385,185**	-618,837	-852,490
11,536	25.0%	28,160	-205,493	-439,145	-672,798	-906,450
13,843	50.0%	-25,800	-259,453	-493,105	-726,758	-960,410

- Remove analysis — Fuel cost - proposed case ($)

Fuel cost - base case ($)		4,614	6,922	9,229	11,536	13,843
		-50.0%	-25.0%	0.0%	25.0%	50.0%
12,532	-50.0%	-570,354	-624,315	-678,275	-732,235	-786,196
18,798	-25.0%	-423,809	-477,769	-531,730	-585,690	-639,651
25,064	0.0%	-277,264	-331,224	**-385,185**	-439,145	-493,105
31,330	25.0%	-130,719	-184,679	-238,639	-292,600	-346,560
37,596	50.0%	15,827	-38,134	-92,094	-146,055	-200,015

- Remove analysis — GHG reduction credit rate ($/$tCO_2$)

None		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	-463,463	-424,324	**-385,185**	-346,045	-306,906

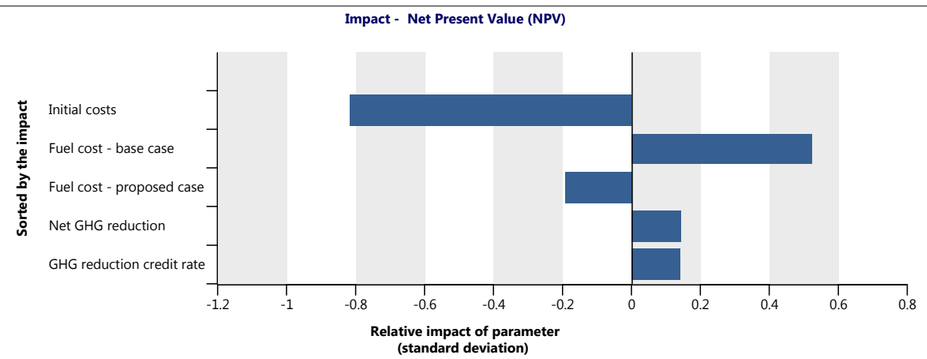
+ Add analysis

LOW-RISE MURB - VANCOUVER

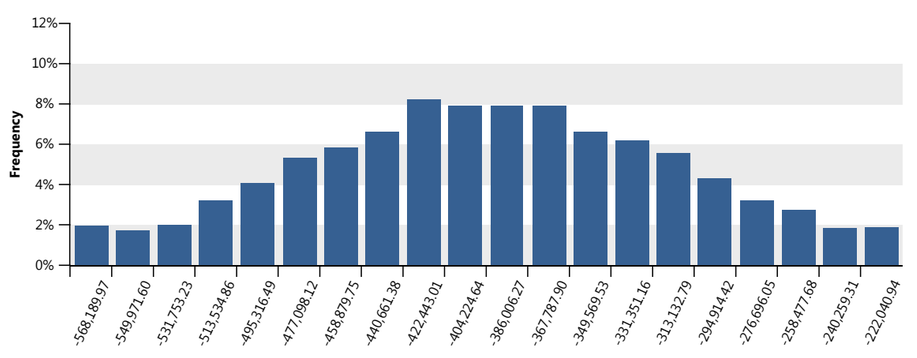
Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	934,610	25%	700,958	1,168,263
Fuel cost - proposed case	$	9,229	25%	6,922	11,536
Fuel cost - base case	$	25,064	25%	18,798	31,330
Net GHG reduction - credit duration	tCO_2	1,457	25%	1,093	1,822
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24



Median	$	-384,784
Level of risk	%	5%
Minimum within level of confidence	$	-568,201
Maximum within level of confidence	$	-203,823



LOW-RISE MURB - CALGARY

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis — Initial costs ($)

Fuel cost - base case ($)		-50.0%	-25.0%	0.0%	25.0%	50.0%
		616,506	924,758	1,233,011	1,541,264	1,849,517
10,194	-50.0%	116,787	-191,466	-499,718	-807,971	-1,116,224
15,291	-25.0%	235,995	-72,258	-380,511	-688,763	-997,016
20,388	0.0%	355,203	46,950	**-261,303**	-569,556	-877,808
25,485	25.0%	474,411	166,158	-142,095	-450,348	-758,600
30,583	50.0%	593,618	285,366	-22,887	-331,140	-639,393

- Remove analysis — None

Fuel cost - base case ($)		0.0%
10,194	-50.0%	-499,718
15,291	-25.0%	-380,511
20,388	0.0%	**-261,303**
25,485	25.0%	-142,095
30,583	50.0%	-22,887

- Remove analysis — GHG reduction credit rate ($/tCO2)

None		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	-503,265	-382,284	**-261,303**	-140,322	-19,341

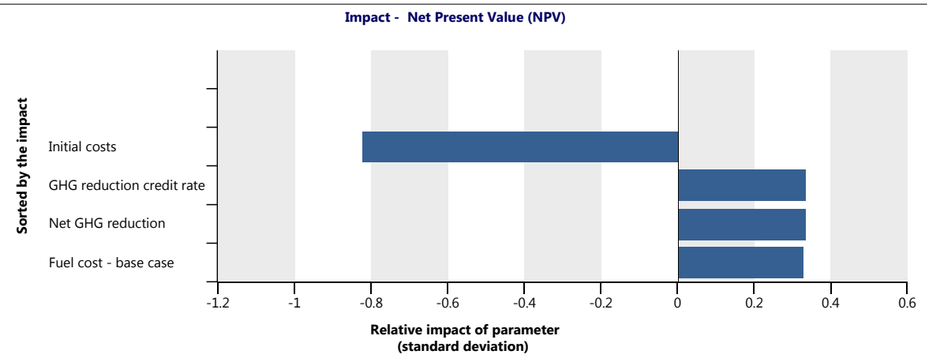
+ Add analysis

LOW-RISE MURB - CALGARY

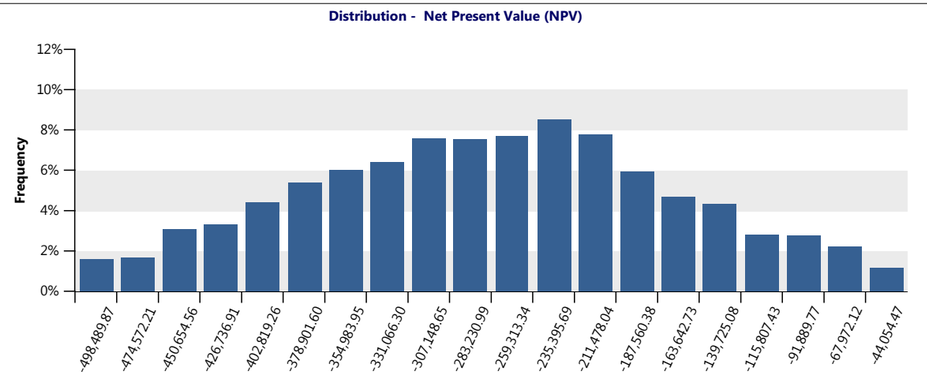
Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	1,233,011	25%	924,758	1,541,264
Fuel cost - base case	$	20,388	25%	15,291	25,485
Net GHG reduction - credit duration	tCO_2	4,505	25%	3,379	5,631
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24



Median	$	-257,842
Level of risk	%	5%
Minimum within level of confidence	$	-498,510
Maximum within level of confidence	$	-20,038



LOW-RISE MURB - TORONTO

RETScreen - Sensitivity & Risk Analysis **Subscriber: WSP Canada Group Limited - Professional**

Sensitivity analysis

Perform analysis on	Net Present Value (NPV)	
Sensitivity range	50%	
Threshold	0	$

- Remove analysis — Initial costs — $

Fuel cost - proposed case		519,239	778,858	1,038,477	1,298,096	1,557,716
$		-50.0%	-25.0%	0.0%	25.0%	50.0%
7,857	-50.0%	554,909	295,290	35,670	-223,949	-483,568
11,785	-25.0%	463,034	203,415	-56,204	-315,824	-575,443
15,713	0.0%	371,159	111,540	**-148,079**	-407,698	-667,318
19,642	25.0%	279,285	19,666	-239,954	-499,573	-759,192
23,570	50.0%	187,410	-72,209	-331,828	-591,448	-851,067

- Remove analysis — Fuel cost - proposed case — $

Fuel cost - base case		7,857	11,785	15,713	19,642	23,570
$		-50.0%	-25.0%	0.0%	25.0%	50.0%
21,855	-50.0%	-475,464	-567,339	-659,214	-751,088	-842,963
32,783	-25.0%	-219,897	-311,772	-403,646	-495,521	-587,396
43,710	0.0%	35,670	-56,204	**-148,079**	-239,954	-331,828
54,638	25.0%	291,238	199,363	107,488	15,614	-76,261
65,565	50.0%	546,805	454,930	363,055	271,181	179,306

- Remove analysis — GHG reduction credit rate — $/$tCO_2$

None		26.10	39.14	52.19	65.24	78.29
		-50.0%	-25.0%	0.0%	25.0%	50.0%
	0.0%	-255,907	-201,993	**-148,079**	-94,165	-40,251

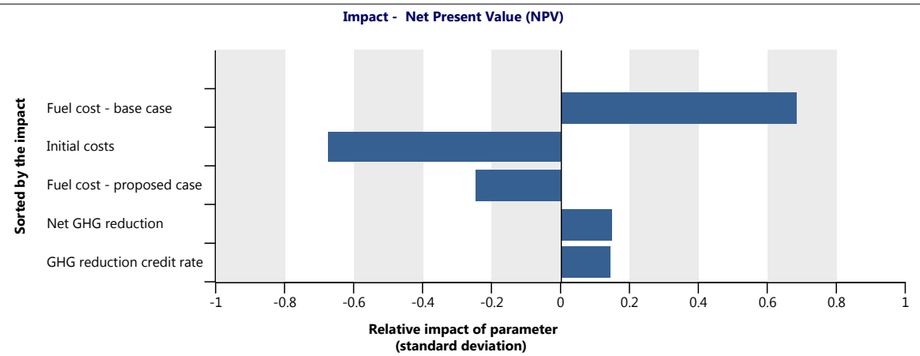
+ Add analysis

LOW-RISE MURB - TORONTO

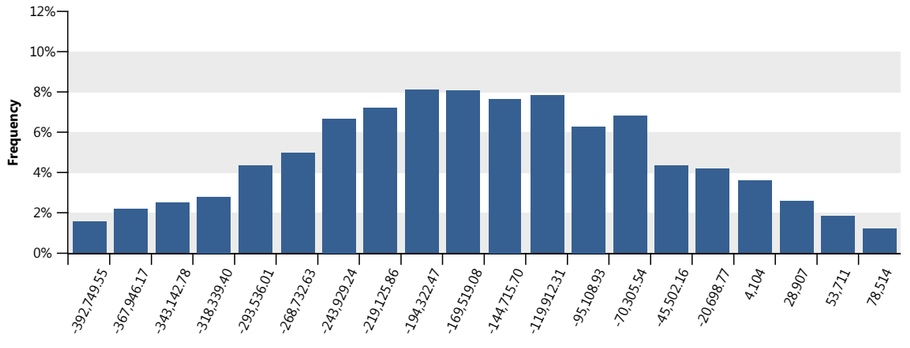
Risk analysis

Perform analysis on	Net Present Value (NPV)
Number of combinations	3000
Random seed	No

Parameter	Unit	Value	Range (+/-)	Minimum	Maximum
Initial costs	$	1,038,477	25%	778,858	1,298,096
Fuel cost - proposed case	$	15,713	25%	11,785	19,642
Fuel cost - base case	$	43,710	25%	32,783	54,638
Net GHG reduction - credit duration	tCO_2	2,008	25%	1,506	2,510
GHG reduction credit rate	$/tCO_2$	52.19	25%	39.14	65.24



Median	$	-148,114
Level of risk	%	5%
Minimum within level of confidence	$	-392,780
Maximum within level of confidence	$	103,325

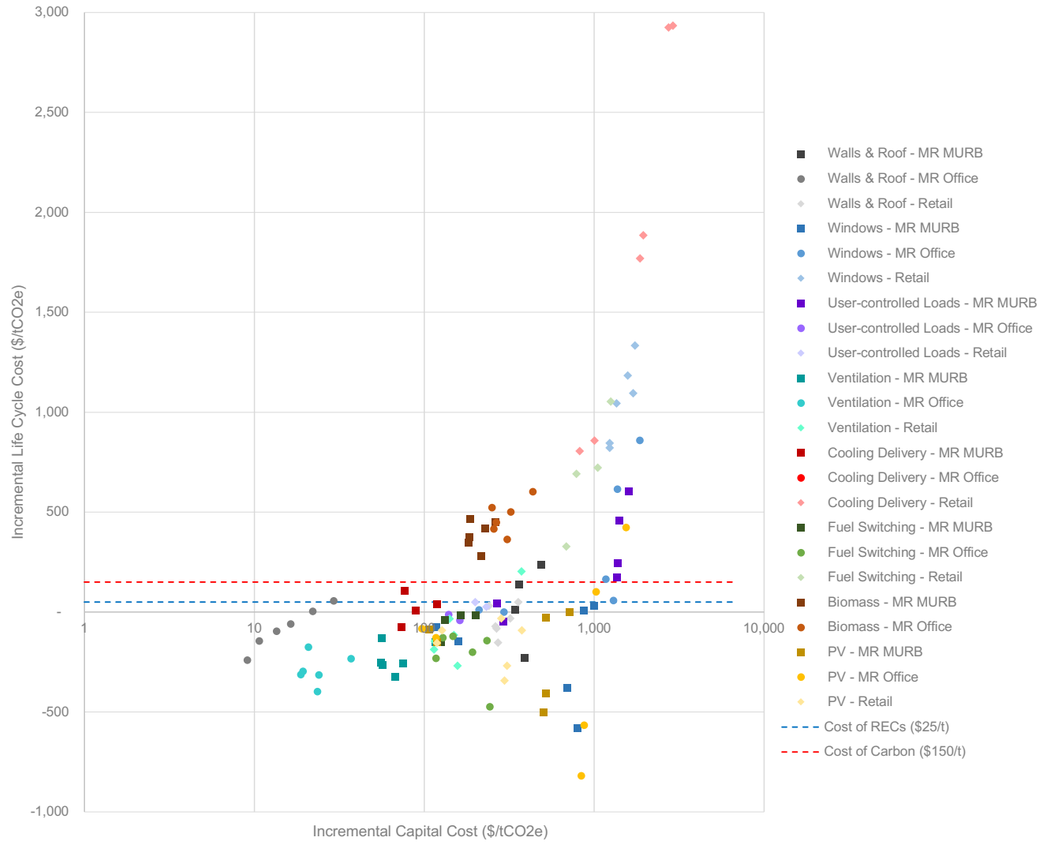


B-4 INDIVIDUAL BUNDLE SUMMARY RESULTS

The GHG abatement curve shown in the following Figure provides an overall summary of the life-cycle and capital costs per tonne of GHG emissions saved for each bundle of carbon abatement measures (based on independent contribution), across the mid-rise MURB, mid-rise office, and retail archetypes. The six results for each archetype/bundle combination reflect the six communities studied.

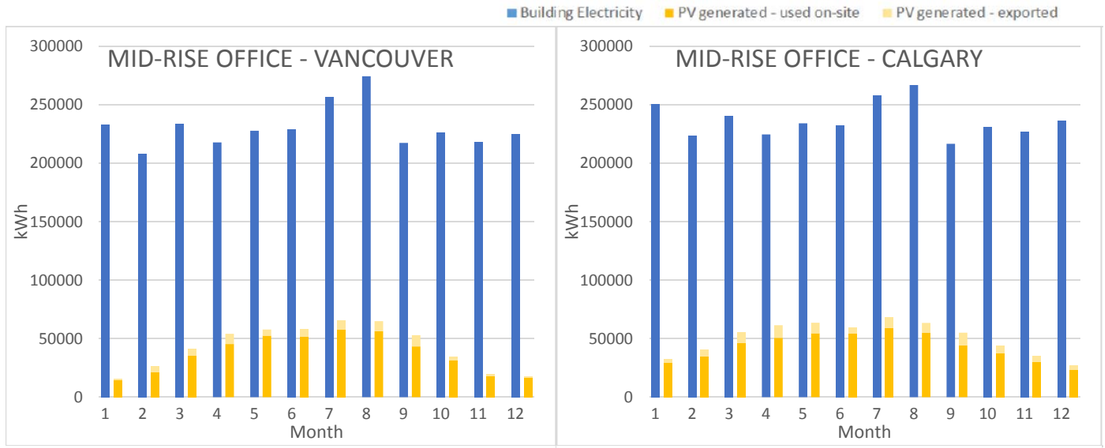
This graph highlights the relationship between incremental capital cost and life-cycle cost (on a logarithmic scale), as well as the overall trends across the scenarios investigated for this study. For example, improvements to walls and roofs in the mid-rise office archetype have the lowest incremental capital cost and almost always offer a positive life-cycle return (with the exception of one community), Improvements to cooling delivery in retail archetypes is both capital intensive and does not offer a life-cycle return, which is one of the key reasons that an alternate ZCB design was developed for this study. This design incorporated different carbon reduction measures and was used to assess whole-building life-cycle costs.

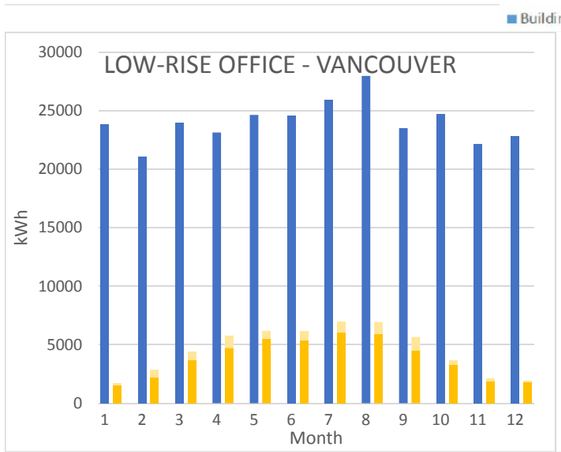
Some archetype and location combinations did not demonstrate emissions reduction with User-controlled Load measures alone, and are therefore not represented.

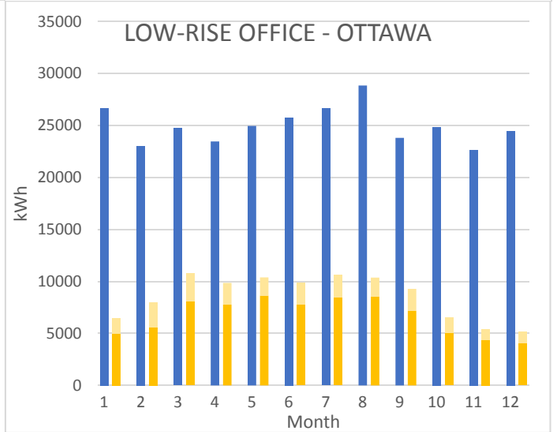


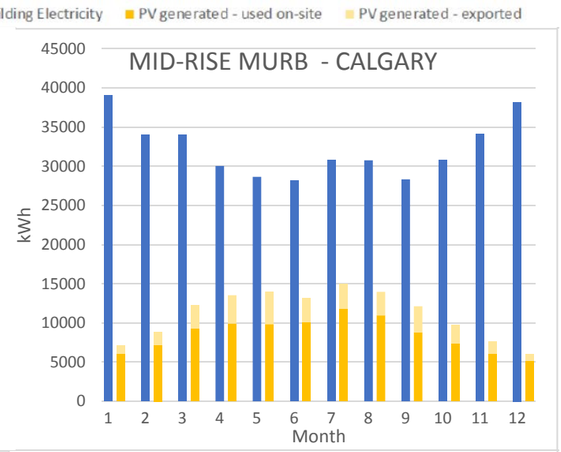
B-5 SELECTED HOURLY PV ANALYSIS RESULTS

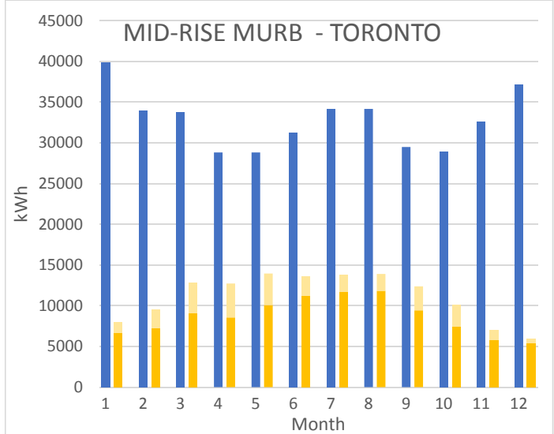
Beginning on **page 119**.

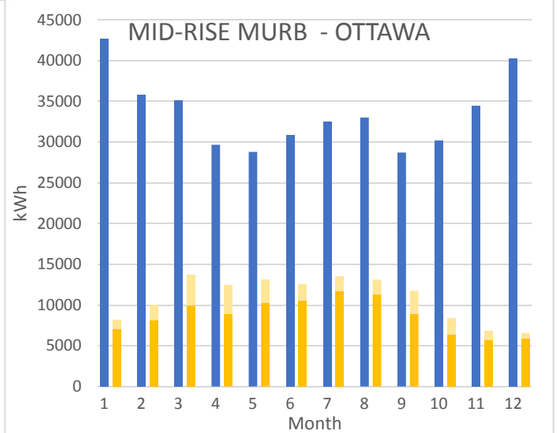


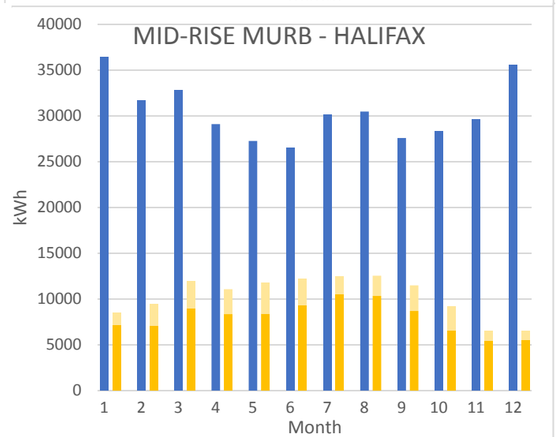

LOW-RISE OFFICE - VANCOUVER
Building Electricity
PV generated - used on-site
PV generated - exported
kWh
Month

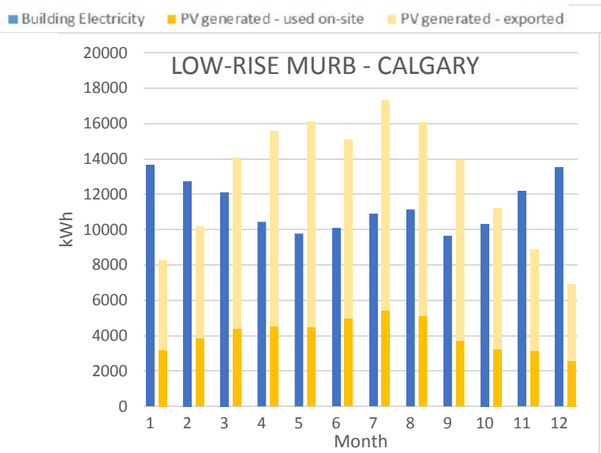

LOW-RISE OFFICE - OTTAWA
kWh
Month

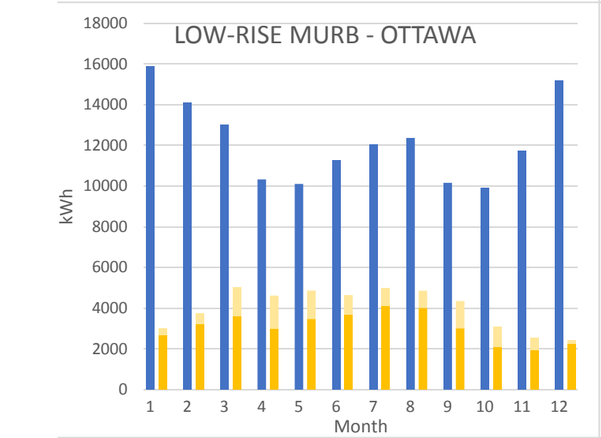

MID-RISE MURB - CALGARY
Building Electricity
PV generated - used on-site
PV generated - exported
kWh
Month

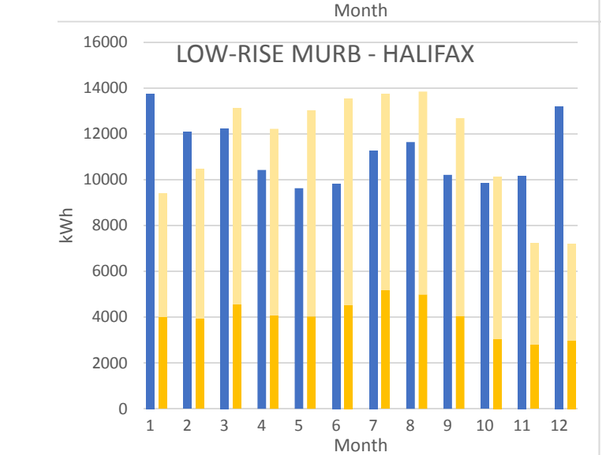

MID-RISE MURB - TORONTO
kWh
Month

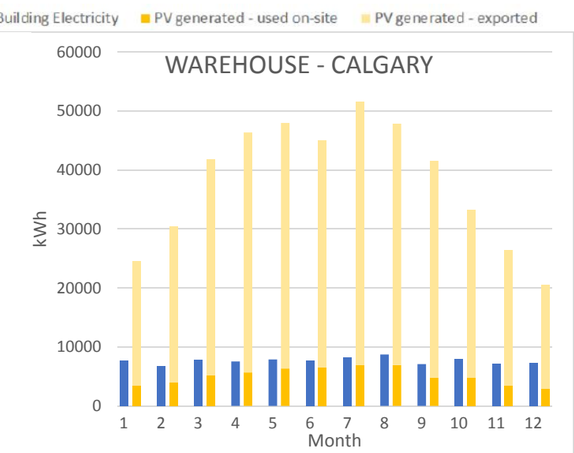

MID-RISE MURB - OTTAWA
kWh
Month

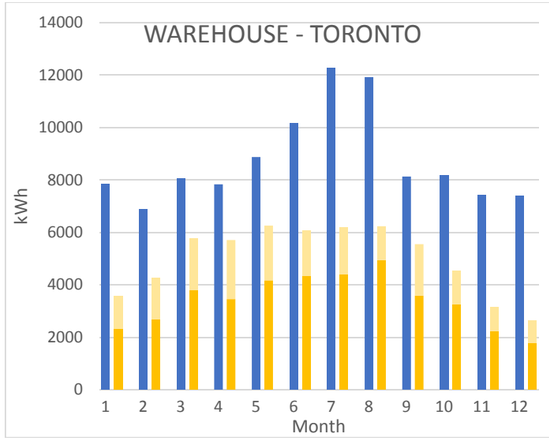

MID-RISE MURB - HALIFAX
kWh
Month

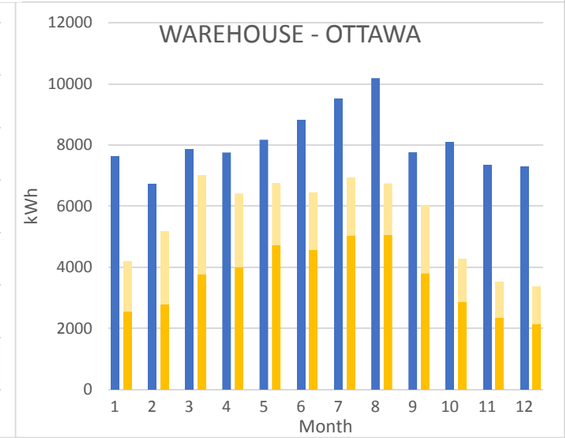

Building Electricity
PV generated - used on-site
PV generated - exported
LOW-RISE MURB - CALGARY
kWh
Month

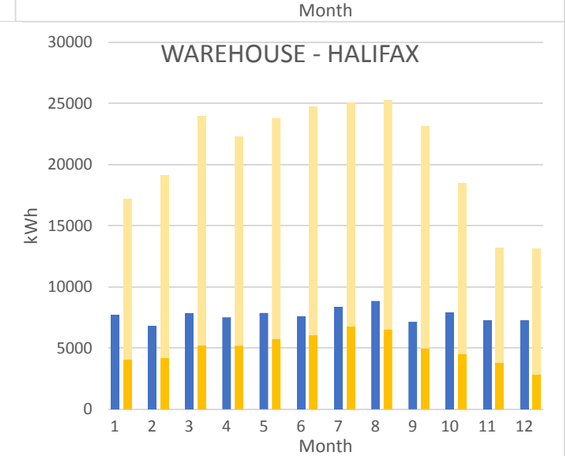

LOW-RISE MURB - OTTAWA
kWh
Month

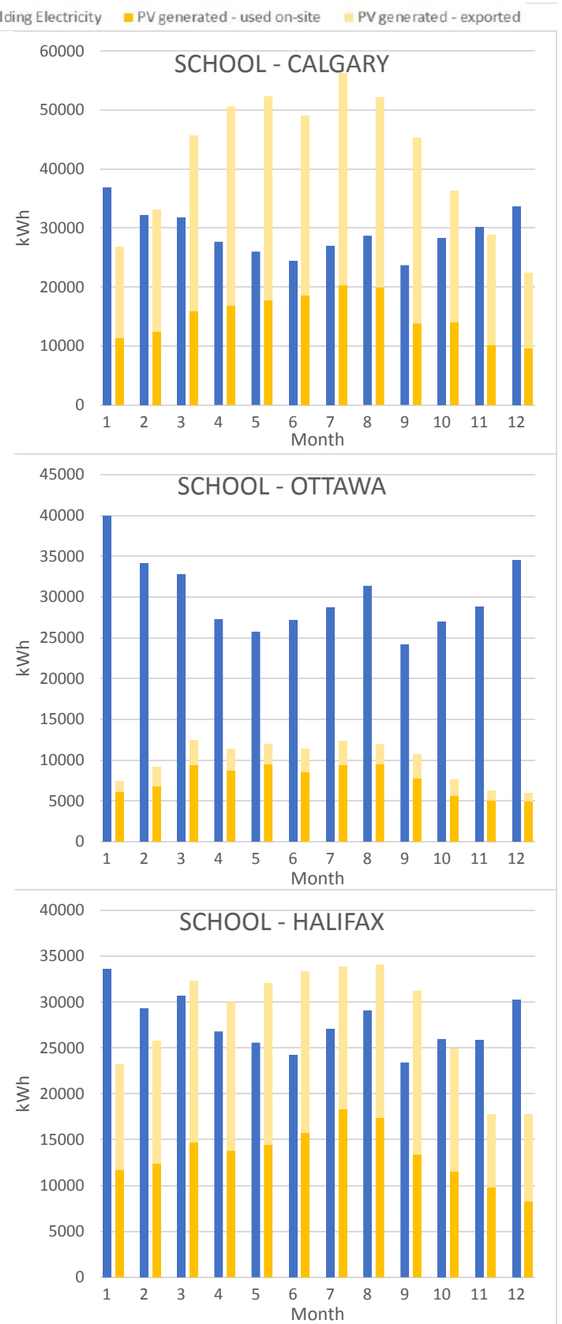

LOW-RISE MURB - HALIFAX
kWh
Month


Building Electricity
PV generated - used on-site
PV generated - exported
WAREHOUSE - CALGARY
kWh
Month


WAREHOUSE - TORONTO
kWh
Month


WAREHOUSE - OTTAWA
kWh
Month

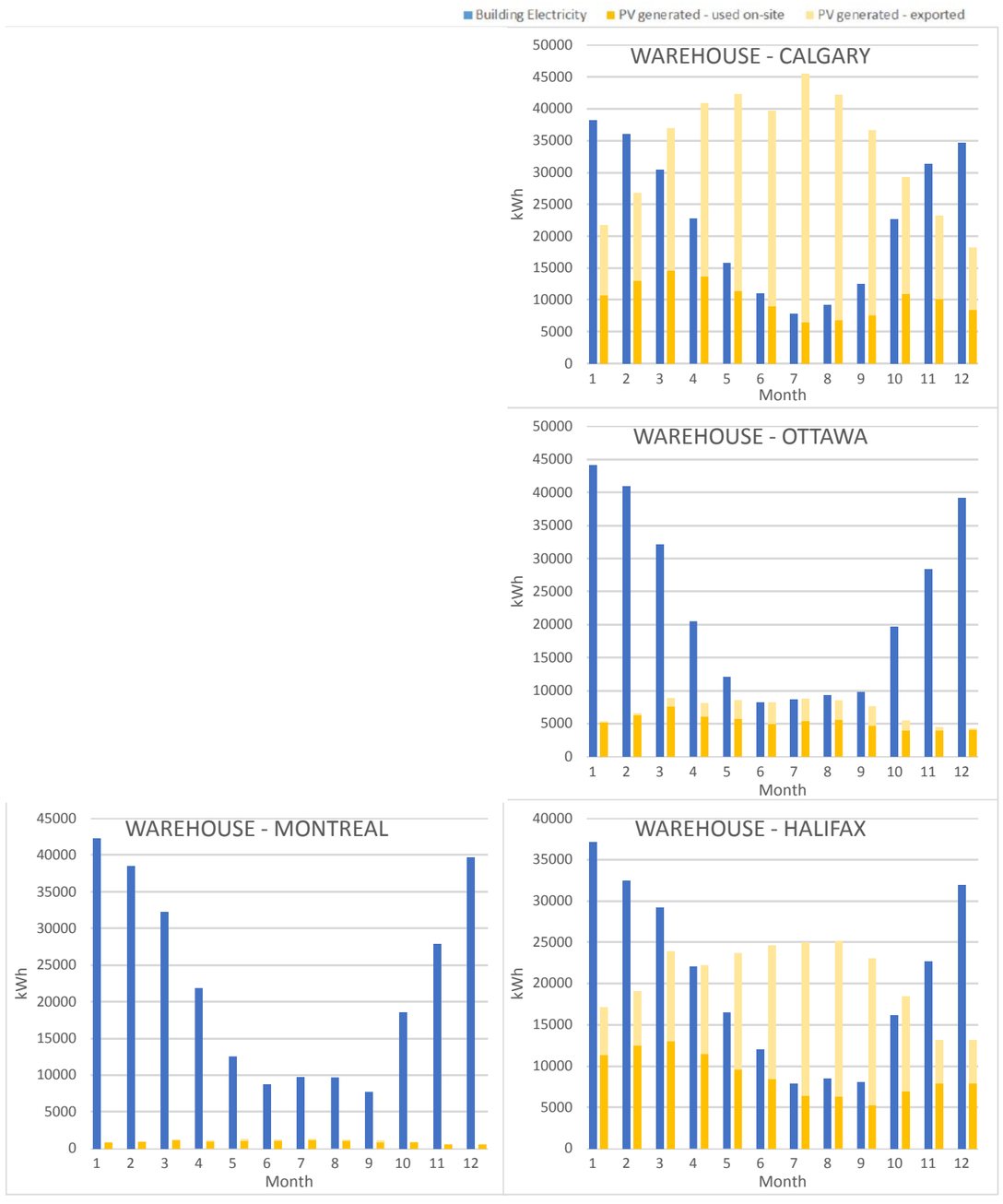

WAREHOUSE - HALIFAX
kWh
Month


Building Electricity
PV generated - used on-site
PV generated - exported
SCHOOL - CALGARY
kWh
Month
SCHOOL - OTTAWA
kWh
Month
SCHOOL - HALIFAX
kWh
Month


Building Electricity
PV generated - used on-site
PV generated - exported
RETAIL - VANCOUVER
kWh
Month
RETAIL - CALGARY
kWh
Month
RETAIL - OTTAWA
kWh
Month
RETAIL - HALIFAX
kWh
Month

RETAIL - ALL BUNDLES

WAREHOUSE- ALL BUNDLES



APPENDIX C

ELEMENTAL COST BREAKDOWNS

C ELEMENTAL COST BREAKDOWNS

Terms used to refer to archetypes changed slightly throughout the study development process, leading to some inconsistency in the naming conversion used for the capital cost analysis and that used in the final report. The following table highlights the equivalency between terms used in the costing report to those of the final study report.

Costing Report	Final Study Report
Base	NECB-2011 Baseline
100% ECM Reduction	Zero Carbon Building (ZCB)
High-Rise (e.g. High-Rise MURB or High-Rise Office)	Mid-Rise
Stand Alone Retail	Big Box Retail

MULTIPLE ESTIMATE SUMMARY

CONSTRUCTION COSTS FOR GENERIC BUILDING TYPES

ORDER OF MAGNITUDE ESTIMATE

DECEMBER 06, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Hard Construction Costs	GFA (m2)	Unit (Cost/SF)	Unit (Cost/m2)	Estimated Total
Construction Costs Based on Toronto, ON				
1a Low Rise Office Building - Base	4,983	305	$3,285.97	$16,374,000
1b Low Rise Office Building - 100% ECM Reduction	4,983	316	$3,398.35	$16,934,000
2a Low Rise Multi Use Residential Building	3,135	305	$3,287.08	$10,305,000
2b Low Rise Multi Use Residential Building - 100% ECM Reduction	3,135	345	$3,709.41	$11,629,000
3a Stand Alone Retail Building - Base	2,294	228	$2,456.84	$5,636,000
3b Stand Alone Retail Building - 100% ECM Reduction	2,294	318	$3,418.05	$7,841,000
4a Primary School Building - Base	6,871	292	$3,148.30	$21,632,000
4b Primary School Building - 100% ECM Reduction	6,871	342	$3,682.87	$25,305,000
5a Warehouse Building - Base	4,835	176	$1,892.66	$9,151,000
5b Warehouse Building - 100% ECM Reduction	4,835	224	$2,411.58	$11,660,000
6a High Rise Multi Use Residential Building	9,396	303	$3,264.47	$30,673,000
6b High Rise Multi Use Residential Building - 100% ECM Reduction	9,396	329	$3,540.02	$33,262,000
7a High Rise Office Building - Base	49,896	236	$2,541.37	$126,804,000
7b High Rise Office Building - 100% ECM Reduction	49,896	242	$2,605.32	$129,995,000

Cost Comparison Per Location	Vancouver	Calgary	Toronto	Ottawa	Montreal	Halifax
1a Low Rise Office Building - Base	$15,463,000	$16,307,000	$16,374,000	$16,005,000	$15,570,000	$15,231,000
Cost per m2	$3,103	$3,273	$3,286	$3,212	$3,125	$3,057
1b Low Rise Office Building - 100% ECM Reduction	$15,985,000	$16,865,000	$16,934,000	$16,565,000	$16,099,000	$15,754,000
Cost per m2	$3,208	$3,385	$3,398	$3,324	$3,231	$3,162
2a Low Rise Multi Use Residential Building - Base	$9,771,000	$10,273,000	$10,305,000	$10,076,000	$9,820,000	$9,593,000
Cost per m2	$3,117	$3,277	$3,287	$3,214	$3,132	$3,060
2b Low Rise Multi Use Residential Building - 100% ECM Reduction	$11,000,000	$11,577,000	$11,629,000	$11,369,000	$11,062,000	$10,826,000
Cost per m2	$3,509	$3,693	$3,709	$3,626	$3,529	$3,453
3a Stand Alone Retail Building - Base	$5,345,000	$5,626,000	$5,636,000	$5,516,000	$5,375,000	$5,242,000
Cost per m2	$2,330	$2,452	$2,457	$2,405	$2,343	$2,285
3b Stand Alone Retail Building - 100% ECM Reduction	$7,390,000	$7,798,000	$7,841,000	$7,668,000	$7,443,000	$7,294,000
Cost per m2	$3,221	$3,399	$3,418	$3,343	$3,245	$3,180
4a Primary School Building - Base	$20,461,000	$21,589,000	$21,632,000	$21,155,000	$20,593,000	$20,102,000
Cost per m2	$2,978	$3,142	$3,148	$3,079	$2,997	$2,926
4b Primary School Building - 100% ECM Reduction	$23,879,000	$25,209,000	$25,305,000	$24,737,000	$24,045,000	$23,522,000
Cost per m2	$3,475	$3,669	$3,683	$3,600	$3,499	$3,423
5a Warehouse Building - Base	$8,661,000	$9,117,000	$9,151,000	$8,964,000	$8,710,000	$8,517,000
Cost per m2	$1,791	$1,886	$1,893	$1,854	$1,801	$1,762
5b Warehouse Building - 100% ECM Reduction	$10,988,000	$11,583,000	$11,660,000	$11,403,000	$11,061,000	$10,850,000
Cost per m2	$2,273	$2,396	$2,412	$2,358	$2,288	$2,244
6a High Rise Multi Use Residential Building - Base	$29,092,000	$30,644,000	$30,673,000	$29,988,000	$29,252,000	$28,502,000
Cost per m2	$3,096	$3,261	$3,264	$3,192	$3,113	$3,033
6b High Rise Multi Use Residential Building - 100% ECM Reduction	$31,505,000	$33,197,000	$33,262,000	$32,514,000	$31,687,000	$30,912,000
Cost per m2	$3,353	$3,533	$3,540	$3,460	$3,372	$3,290
7a High Rise Office Building - Base	$119,531,000	$126,190,000	$126,804,000	$124,001,000	$120,407,000	$117,990,000
Cost per m2	$2,396	$2,529	$2,541	$2,485	$2,413	$2,365
7b High Rise Office Building - 100% ECM Reduction	$122,753,000	$129,416,000	$129,995,000	$127,276,000	$123,540,000	$121,034,000
Cost per m2	$2,460	$2,594	$2,605	$2,551	$2,476	$2,426

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE

CLASS D ESTIMATE (Rev.3)

NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	4,983
Cost Per m2	3,103

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$519,277**
A1.1 Foundations	0.33	1,661	m2	$312.63	$519,277	
A2. Structure						**$2,767,409**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$86.25	$143,265	
A2.2 Upper Floor Construction	0.67	3,322	m2	$614.20	$2,040,386	
A2.3 Roof Construction	0.33	1,661	m2	$351.45	$583,758	
A3. Exterior Enclosure						**$1,926,631**
A3.2 Walls Above Grade	0.40	1,978	m2	$781.11	$1,545,042	
A3.3 Windows & Entrances	0.00	18	m2	$3,087.83	$55,581	
A3.4 Roof Finish	0.33	1,661	m2	$175.55	$291,581	
A3.5 Projections	1.00	4,983	m2	$6.91	$34,428	
B. INTERIORS						
B1 Partitions & Doors						**$109,443**
B1.1 Partitions	0.01	60	m2	$382.00	$22,920	
B1.2 Doors	0.02	76	m2	$1,138.46	$86,523	
B2 Finishes						**$763,412**
B2.1 Floor Finishes	0.95	4,734	m2	$65.70	$311,005	
B2.2 Ceiling Finishes	0.95	4,734	m2	$76.11	$360,319	
B2.3 Wall Finishes	1.80	8,969	m2	$10.27	$92,088	
B3 Fittings & Equipment						**$848,233**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$36.07	$179,733	
B3.3 Conveying Systems	1.00	4,983	m2	$134.16	$668,500	
C. SERVICES						
C1 Mechanical						**$2,707,012**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$80.12	$399,233	
C1.2 Fire Protection	1.00	4,983	m2	$27.94	$139,223	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$384.06	$1,913,772	
C1.4 Controls	1.00	4,983	m2	$51.13	$254,784	
C2 Electrical						**$1,251,286**
C2.1 Service & Distribution	1.00	4,983	m2	$79.28	$395,049	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$124.41	$619,924	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$47.42	$236,313	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$270,367**
D1.3 Electrical Site Services	1.00	4,983	m2	$54.26	$270,367	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,122,698**
Z1.1 General Requirements	1.00	4,983	m2	$152.48	$759,798	
Z1.2 Fees	1.00	4,983	m2	$72.83	$362,900	
Z2 Allowances						**$3,177,190**
Z2.1 Design Allowance	1.00	4,983	m2	$488.17	$2,432,576	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$149.43	$744,614	
Total				**$288 per sf**		**$15,463,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2) 4,983
Cost Per m2 3,273

Location : Calgary

Description Element\Sub-Element	Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$569,739**
A1.1 Foundations	0.33	1,661	m2	$343.01	$569,739	
A2. Structure						**$2,886,219**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$89.96	$149,415	
A2.2 Upper Floor Construction	0.67	3,322	m2	$640.57	$2,127,984	
A2.3 Roof Construction	0.33	1,661	m2	$366.54	$608,820	
A3. Exterior Enclosure						**$2,009,345**
A3.2 Walls Above Grade	0.40	1,978	m2	$814.65	$1,611,374	
A3.3 Windows & Entrances	0.00	18	m2	$3,220.40	$57,967	
A3.4 Roof Finish	0.33	1,661	m2	$183.08	$304,099	
A3.5 Projections	1.00	4,983	m2	$7.21	$35,906	
B. INTERIORS						
B1 Partitions & Doors						**$114,142**
B1.1 Partitions	0.01	60	m2	$398.40	$23,904	
B1.2 Doors	0.02	76	m2	$1,187.34	$90,238	
B2 Finishes						**$813,241**
B2.1 Floor Finishes	0.95	4,734	m2	$64.35	$304,652	
B2.2 Ceiling Finishes	0.95	4,734	m2	$84.71	$401,037	
B2.3 Wall Finishes	1.80	8,969	m2	$11.99	$107,552	
B3 Fittings & Equipment						**$884,649**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$37.62	$187,449	
B3.3 Conveying Systems	1.00	4,983	m2	$139.92	$697,200	
C. SERVICES						
C1 Mechanical						**$2,893,804**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$85.65	$426,781	
C1.2 Fire Protection	1.00	4,983	m2	$29.87	$148,830	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$410.56	$2,045,828	
C1.4 Controls	1.00	4,983	m2	$54.66	$272,365	
C2 Electrical						**$1,369,463**
C2.1 Service & Distribution	1.00	4,983	m2	$86.77	$432,359	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$136.16	$678,472	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$51.90	$258,632	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$281,975**
D1.3 Electrical Site Services	1.00	4,983	m2	$56.59	$281,975	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,170,898**
Z1.1 General Requirements	1.00	4,983	m2	$159.02	$792,418	
Z1.2 Fees	1.00	4,983	m2	$75.95	$378,480	
Z2 Allowances						**$3,313,592**
Z2.1 Design Allowance	1.00	4,983	m2	$509.13	$2,537,011	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$155.85	$776,581	
Total				**$304 per sf**		**$16,307,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2) 4,983
Cost Per m2 3,286

Location : Toronto

Description Element\Sub-Element	Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$542,609**
A1.1 Foundations	0.33	1,661	m2	$326.68	$542,609	
A2. Structure						**$2,897,811**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$90.32	$150,016	
A2.2 Upper Floor Construction	0.67	3,322	m2	$643.15	$2,136,530	
A2.3 Roof Construction	0.33	1,661	m2	$368.01	$611,265	
A3. Exterior Enclosure						**$2,017,415**
A3.2 Walls Above Grade	0.40	1,978	m2	$817.92	$1,617,845	
A3.3 Windows & Entrances	0.00	18	m2	$3,233.33	$58,200	
A3.4 Roof Finish	0.33	1,661	m2	$183.82	$305,320	
A3.5 Projections	1.00	4,983	m2	$7.23	$36,050	
B. INTERIORS						
B1 Partitions & Doors						**$114,600**
B1.1 Partitions	0.01	60	m2	$400.00	$24,000	
B1.2 Doors	0.02	76	m2	$1,192.11	$90,600	
B2 Finishes						**$772,675**
B2.1 Floor Finishes	0.95	4,734	m2	$61.00	$288,770	
B2.2 Ceiling Finishes	0.95	4,734	m2	$81.14	$384,135	
B2.3 Wall Finishes	1.80	8,969	m2	$11.12	$99,770	
B3 Fittings & Equipment						**$888,202**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$37.77	$188,202	
B3.3 Conveying Systems	1.00	4,983	m2	$140.48	$700,000	
C. SERVICES						
C1 Mechanical						**$2,964,963**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$87.75	$437,276	
C1.2 Fire Protection	1.00	4,983	m2	$30.60	$152,490	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$420.66	$2,096,135	
C1.4 Controls	1.00	4,983	m2	$56.00	$279,063	
C2 Electrical						**$1,390,318**
C2.1 Service & Distribution	1.00	4,983	m2	$88.09	$438,943	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$138.23	$688,804	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$52.69	$262,570	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$283,107**
D1.3 Electrical Site Services	1.00	4,983	m2	$56.81	$283,107	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,175,600**
Z1.1 General Requirements	1.00	4,983	m2	$159.66	$795,600	
Z1.2 Fees	1.00	4,983	m2	$76.26	$380,000	
Z2 Allowances						**$3,326,900**
Z2.1 Design Allowance	1.00	4,983	m2	$511.18	$2,547,200	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$156.47	$779,700	
Total				**$305 per sf**		**$16,374,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,212**

	Location :			**Ottawa**		
	Elemental Cost					
Description Element\Sub-Element	**Ratio**	**Quantity**	**Unit**	**Unit Rate**	**Sub Element**	**Element Total**
A. SHELL						
A1. Sub-Structure						**$527,959**
A1.1 Foundations	0.33	1,661	m2	$317.86	$527,959	
A2. Structure						**$2,839,854**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$88.51	$147,015	
A2.2 Upper Floor Construction	0.67	3,322	m2	$630.28	$2,093,799	
A2.3 Roof Construction	0.33	1,661	m2	$360.65	$599,040	
A3. Exterior Enclosure						**$1,977,067**
A3.2 Walls Above Grade	0.40	1,978	m2	$801.56	$1,585,488	
A3.3 Windows & Entrances	0.00	18	m2	$3,168.67	$57,036	
A3.4 Roof Finish	0.33	1,661	m2	$180.14	$299,214	
A3.5 Projections	1.00	4,983	m2	$7.09	$35,329	
B. INTERIORS						
B1 Partitions & Doors						**$112,308**
B1.1 Partitions	0.01	60	m2	$392.00	$23,520	
B1.2 Doors	0.02	76	m2	$1,168.26	$88,788	
B2 Finishes						**$731,404**
B2.1 Floor Finishes	0.95	4,734	m2	$58.25	$275,775	
B2.2 Ceiling Finishes	0.95	4,734	m2	$75.95	$359,550	
B2.3 Wall Finishes	1.80	8,969	m2	$10.71	$96,079	
B3 Fittings & Equipment						**$870,438**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$37.01	$184,438	
B3.3 Conveying Systems	1.00	4,983	m2	$137.67	$686,000	
C. SERVICES						
C1 Mechanical						**$2,867,120**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$84.86	$422,845	
C1.2 Fire Protection	1.00	4,983	m2	$29.59	$147,458	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$406.78	$2,026,963	
C1.4 Controls	1.00	4,983	m2	$54.15	$269,853	
C2 Electrical						**$1,388,927**
C2.1 Service & Distribution	1.00	4,983	m2	$88.00	$438,504	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$138.09	$688,115	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$52.64	$262,308	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$277,445**
D1.3 Electrical Site Services	1.00	4,983	m2	$55.68	$277,445	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,152,088**
Z1.1 General Requirements	1.00	4,983	m2	$156.47	$779,688	
Z1.2 Fees	1.00	4,983	m2	$74.73	$372,400	
Z2 Allowances						**$3,260,362**
Z2.1 Design Allowance	1.00	4,983	m2	$500.95	$2,496,256	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$153.34	$764,106	
Total				**$298 per sf**		**$16,005,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,125**

	Location :			**Montreal**		
	Elemental Cost					
Description Element\Sub-Element	**Ratio**	**Quantity**	**Unit**	**Unit Rate**	**Sub Element**	**Element Total**
A. SHELL						
A1. Sub-Structure						**$527,959**
A1.1 Foundations	0.33	1,661	m2	$317.86	$527,959	
A2. Structure						**$2,773,205**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$86.43	$143,565	
A2.2 Upper Floor Construction	0.67	3,322	m2	$615.49	$2,044,659	
A2.3 Roof Construction	0.33	1,661	m2	$352.19	$584,981	
A3. Exterior Enclosure						**$1,930,666**
A3.2 Walls Above Grade	0.40	1,978	m2	$782.75	$1,548,278	
A3.3 Windows & Entrances	0.00	18	m2	$3,094.30	$55,697	
A3.4 Roof Finish	0.33	1,661	m2	$175.91	$292,191	
A3.5 Projections	1.00	4,983	m2	$6.92	$34,500	
B. INTERIORS						
B1 Partitions & Doors						**$109,672**
B1.1 Partitions	0.01	60	m2	$382.80	$22,968	
B1.2 Doors	0.02	76	m2	$1,140.84	$86,704	
B2 Finishes						**$771,492**
B2.1 Floor Finishes	0.95	4,734	m2	$61.61	$291,658	
B2.2 Ceiling Finishes	0.95	4,734	m2	$80.49	$381,062	
B2.3 Wall Finishes	1.80	8,969	m2	$11.01	$98,772	
B3 Fittings & Equipment						**$850,009**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$36.14	$180,109	
B3.3 Conveying Systems	1.00	4,983	m2	$134.44	$669,900	
C. SERVICES						
C1 Mechanical						**$2,748,521**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$81.35	$405,354	
C1.2 Fire Protection	1.00	4,983	m2	$28.37	$141,358	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$389.95	$1,943,118	
C1.4 Controls	1.00	4,983	m2	$51.91	$258,691	
C2 Electrical						**$1,279,092**
C2.1 Service & Distribution	1.00	4,983	m2	$81.04	$403,828	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$127.17	$633,700	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$48.48	$241,565	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$270,933**
D1.3 Electrical Site Services	1.00	4,983	m2	$54.37	$270,933	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,125,049**
Z1.1 General Requirements	1.00	4,983	m2	$152.80	$761,389	
Z1.2 Fees	1.00	4,983	m2	$72.98	$363,660	
Z2 Allowances						**$3,183,843**
Z2.1 Design Allowance	1.00	4,983	m2	$489.20	$2,437,670	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$149.74	$746,173	
Total				**$290 per sf**		**$15,570,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE

A.W. HOOKER ®
QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,057**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$484,550**
A1.1 Foundations	0.33	1,661	m2	$291.72	$484,550	
A2. Structure						**$2,706,555**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$84.36	$140,114	
A2.2 Upper Floor Construction	0.67	3,322	m2	$600.70	$1,995,519	
A2.3 Roof Construction	0.33	1,661	m2	$343.72	$570,922	
A3. Exterior Enclosure						**$1,884,266**
A3.2 Walls Above Grade	0.40	1,978	m2	$763.94	$1,511,067	
A3.3 Windows & Entrances	0.00	18	m2	$3,019.93	$54,359	
A3.4 Roof Finish	0.33	1,661	m2	$171.69	$285,169	
A3.5 Projections	1.00	4,983	m2	$6.76	$33,671	
B. INTERIORS						
B1 Partitions & Doors						**$107,036**
B1.1 Partitions	0.01	60	m2	$373.60	$22,416	
B1.2 Doors	0.02	76	m2	$1,113.43	$84,620	
B2 Finishes						**$702,980**
B2.1 Floor Finishes	0.95	4,734	m2	$55.45	$262,492	
B2.2 Ceiling Finishes	0.95	4,734	m2	$73.11	$346,106	
B2.3 Wall Finishes	1.80	8,969	m2	$10.52	$94,382	
B3 Fittings & Equipment						**$829,581**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$35.28	$175,781	
B3.3 Conveying Systems	1.00	4,983	m2	$131.21	$653,800	
C. SERVICES						
C1 Mechanical						**$2,751,486**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$81.44	$405,792	
C1.2 Fire Protection	1.00	4,983	m2	$28.40	$141,511	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$390.37	$1,945,214	
C1.4 Controls	1.00	4,983	m2	$51.97	$258,970	
C2 Electrical						**$1,294,386**
C2.1 Service & Distribution	1.00	4,983	m2	$82.01	$408,656	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$128.69	$641,277	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$49.06	$244,453	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$264,422**
D1.3 Electrical Site Services	1.00	4,983	m2	$53.06	$264,422	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,098,010**
Z1.1 General Requirements	1.00	4,983	m2	$149.13	$743,090	
Z1.2 Fees	1.00	4,983	m2	$71.23	$354,920	
Z2 Allowances						**$3,107,325**
Z2.1 Design Allowance	1.00	4,983	m2	$477.44	$2,379,085	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$146.14	$728,240	
Total				**$284 per sf**		**$15,231,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ®
QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,208**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$519,277**
A1.1 Foundations	0.33	1,661	m2	$312.63	$519,277	
A2. Structure						**$2,767,409**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$86.25	$143,265	
A2.2 Upper Floor Construction	0.67	3,322	m2	$614.20	$2,040,386	
A2.3 Roof Construction	0.33	1,661	m2	$351.45	$583,758	
A3. Exterior Enclosure						**$2,162,732**
A3.2 Walls Above Grade	0.40	1,978	m2	$884.44	$1,749,418	
A3.3 Windows & Entrances	0.00	18	m2	$3,087.83	$55,581	
A3.4 Roof Finish	0.33	1,661	m2	$194.65	$323,306	
A3.5 Projections	1.00	4,983	m2	$6.91	$34,428	
B. INTERIORS						
B1 Partitions & Doors						**$109,443**
B1.1 Partitions	0.01	60	m2	$382.00	$22,920	
B1.2 Doors	0.02	76	m2	$1,138.46	$86,523	
B2 Finishes						**$763,412**
B2.1 Floor Finishes	0.95	4,734	m2	$65.70	$311,005	
B2.2 Ceiling Finishes	0.95	4,734	m2	$76.11	$360,319	
B2.3 Wall Finishes	1.80	8,969	m2	$10.27	$92,088	
B3 Fittings & Equipment						**$848,233**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$36.07	$179,733	
B3.3 Conveying Systems	1.00	4,983	m2	$134.16	$668,500	
C. SERVICES						
C1 Mechanical						**$2,457,297**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$82.56	$411,414	
C1.2 Fire Protection	1.00	4,983	m2	$27.94	$139,223	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$339.43	$1,691,374	
C1.4 Controls	1.00	4,983	m2	$43.20	$215,285	
C2 Electrical						**$1,638,644**
C2.1 Service & Distribution	1.00	4,983	m2	$88.67	$441,833	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$192.75	$960,497	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$47.42	$236,313	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$270,367**
D1.3 Electrical Site Services	0.04	200	m2	$1,351.84	$270,367	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,161,089**
Z1.1 General Requirements	1.00	4,983	m2	$157.69	$785,774	
Z1.2 Fees	1.00	4,983	m2	$75.32	$375,315	
Z2 Allowances						**$3,287,588**
Z2.1 Design Allowance	1.00	4,983	m2	$505.21	$2,517,476	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$154.55	$770,112	
Total				**$298 per sf**		**$15,985,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE BUILDING 100% CARBON REDUCTION

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,385**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$569,739**
A1.1 Foundations	0.33	1,661	m2	$343.01	$569,739	
A2. Structure						**$2,886,219**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$89.96	$149,415	
A2.2 Upper Floor Construction	0.67	3,322	m2	$640.57	$2,127,984	
A2.3 Roof Construction	0.33	1,661	m2	$366.54	$608,820	
A3. Exterior Enclosure						**$2,255,582**
A3.2 Walls Above Grade	0.40	1,978	m2	$922.41	$1,824,524	
A3.3 Windows & Entrances	0.00	18	m2	$3,220.40	$57,967	
A3.4 Roof Finish	0.33	1,661	m2	$203.00	$337,186	
A3.5 Projections	1.00	4,983	m2	$7.21	$35,906	
B. INTERIORS						
B1 Partitions & Doors						**$114,142**
B1.1 Partitions	0.01	60	m2	$398.40	$23,904	
B1.2 Doors	0.02	76	m2	$1,187.34	$90,238	
B2 Finishes						**$813,241**
B2.1 Floor Finishes	0.95	4,734	m2	$64.35	$304,652	
B2.2 Ceiling Finishes	0.95	4,734	m2	$84.71	$401,037	
B2.3 Wall Finishes	1.80	8,969	m2	$11.99	$107,552	
B3 Fittings & Equipment						**$884,649**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$37.62	$187,449	
B3.3 Conveying Systems	1.00	4,983	m2	$139.92	$697,200	
C. SERVICES						
C1 Mechanical						**$2,626,859**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$88.26	$439,803	
C1.2 Fire Protection	1.00	4,983	m2	$29.87	$148,830	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$362.85	$1,808,084	
C1.4 Controls	1.00	4,983	m2	$46.19	$230,141	
C2 Electrical						**$1,793,405**
C2.1 Service & Distribution	1.00	4,983	m2	$97.04	$483,562	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$210.96	$1,051,211	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$51.90	$258,632	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$281,975**
D1.3 Electrical Site Services	0.04	200	m2	$1,409.87	$281,975	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,210,937**
Z1.1 General Requirements	1.00	4,983	m2	$164.46	$819,509	
Z1.2 Fees	1.00	4,983	m2	$78.55	$391,428	
Z2 Allowances						**$3,428,730**
Z2.1 Design Allowance	1.00	4,983	m2	$526.90	$2,625,556	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$161.18	$803,174	
Total				**$314 per sf**		**$16,865,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE BUILDING 100% CARBON REDUCTION

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,398**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$542,609**
A1.1 Foundations	0.33	1,661	m2	$326.68	$542,609	
A2. Structure						**$2,897,811**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$90.32	$150,016	
A2.2 Upper Floor Construction	0.67	3,322	m2	$643.15	$2,136,530	
A2.3 Roof Construction	0.33	1,661	m2	$368.01	$611,265	
A3. Exterior Enclosure						**$2,264,641**
A3.2 Walls Above Grade	0.40	1,978	m2	$926.11	$1,831,851	
A3.3 Windows & Entrances	0.00	18	m2	$3,233.33	$58,200	
A3.4 Roof Finish	0.33	1,661	m2	$203.82	$338,540	
A3.5 Projections	1.00	4,983	m2	$7.23	$36,050	
B. INTERIORS						
B1 Partitions & Doors						**$114,600**
B1.1 Partitions	0.01	60	m2	$400.00	$24,000	
B1.2 Doors	0.02	76	m2	$1,192.11	$90,600	
B2 Finishes						**$772,675**
B2.1 Floor Finishes	0.95	4,734	m2	$61.00	$288,770	
B2.2 Ceiling Finishes	0.95	4,734	m2	$81.14	$384,135	
B2.3 Wall Finishes	1.80	8,969	m2	$11.12	$99,770	
B3 Fittings & Equipment						**$888,202**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$37.77	$188,202	
B3.3 Conveying Systems	1.00	4,983	m2	$140.48	$700,000	
C. SERVICES						
C1 Mechanical						**$2,691,454**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$90.43	$450,618	
C1.2 Fire Protection	1.00	4,983	m2	$30.60	$152,490	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$371.77	$1,852,546	
C1.4 Controls	1.00	4,983	m2	$47.32	$235,800	
C2 Electrical						**$1,820,716**
C2.1 Service & Distribution	1.00	4,983	m2	$98.52	$490,926	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$214.17	$1,067,219	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$52.69	$262,570	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$283,107**
D1.3 Electrical Site Services	0.04	200	m2	$1,415.54	$283,107	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,215,800**
Z1.1 General Requirements	1.00	4,983	m2	$165.12	$822,800	
Z1.2 Fees	1.00	4,983	m2	$78.87	$393,000	
Z2 Allowances						**$3,442,500**
Z2.1 Design Allowance	1.00	4,983	m2	$529.02	$2,636,100	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$161.83	$806,400	
Total				**$316 per sf**		**$16,934,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE BUILDING 100% CARBON REDUCTION

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,324**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$527,959**
A1.1 Foundations	0.33	1,661	m2	$317.86	$527,959	
A2. Structure						**$2,839,854**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$88.51	$147,015	
A2.2 Upper Floor Construction	0.67	3,322	m2	$630.28	$2,093,799	
A2.3 Roof Construction	0.33	1,661	m2	$360.65	$599,040	
A3. Exterior Enclosure						**$2,219,348**
A3.2 Walls Above Grade	0.40	1,978	m2	$907.59	$1,795,214	
A3.3 Windows & Entrances	0.00	18	m2	$3,168.67	$57,036	
A3.4 Roof Finish	0.33	1,661	m2	$199.74	$331,769	
A3.5 Projections	1.00	4,983	m2	$7.09	$35,329	
B. INTERIORS						
B1 Partitions & Doors						**$112,308**
B1.1 Partitions	0.01	60	m2	$392.00	$23,520	
B1.2 Doors	0.02	76	m2	$1,168.26	$88,788	
B2 Finishes						**$731,404**
B2.1 Floor Finishes	0.95	4,734	m2	$58.25	$275,775	
B2.2 Ceiling Finishes	0.95	4,734	m2	$75.95	$359,550	
B2.3 Wall Finishes	1.80	8,969	m2	$10.71	$96,079	
B3 Fittings & Equipment						**$870,438**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$37.01	$184,438	
B3.3 Conveying Systems	1.00	4,983	m2	$137.67	$686,000	
C. SERVICES						
C1 Mechanical						**$2,602,636**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$87.45	$435,748	
C1.2 Fire Protection	1.00	4,983	m2	$29.59	$147,458	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$359.50	$1,791,412	
C1.4 Controls	1.00	4,983	m2	$45.76	$228,019	
C2 Electrical						**$1,818,895**
C2.1 Service & Distribution	1.00	4,983	m2	$98.42	$490,435	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$213.96	$1,066,152	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$52.64	$262,308	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$277,445**
D1.3 Electrical Site Services	0.04	200	m2	$1,387.22	$277,445	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,191,484**
Z1.1 General Requirements	1.00	4,983	m2	$161.82	$806,344	
Z1.2 Fees	1.00	4,983	m2	$77.29	$385,140	
Z2 Allowances						**$3,373,650**
Z2.1 Design Allowance	1.00	4,983	m2	$518.44	$2,583,378	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$158.59	$790,272	
Total				**$309 per sf**		**$16,565,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE BUILDING 100% CARBON REDUCTION

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	**4,983**
Cost Per m2	**3,231**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$527,959**
A1.1 Foundations	0.33	1,661	m2	$317.86	$527,959	
A2. Structure						**$2,773,205**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$86.43	$143,565	
A2.2 Upper Floor Construction	0.67	3,322	m2	$615.49	$2,044,659	
A2.3 Roof Construction	0.33	1,661	m2	$352.19	$584,981	
A3. Exterior Enclosure						**$2,167,261**
A3.2 Walls Above Grade	0.40	1,978	m2	$886.29	$1,753,081	
A3.3 Windows & Entrances	0.00	18	m2	$3,094.30	$55,697	
A3.4 Roof Finish	0.33	1,661	m2	$195.05	$323,983	
A3.5 Projections	1.00	4,983	m2	$6.92	$34,500	
B. INTERIORS						
B1 Partitions & Doors						**$109,672**
B1.1 Partitions	0.01	60	m2	$382.80	$22,968	
B1.2 Doors	0.02	76	m2	$1,140.84	$86,704	
B2 Finishes						**$771,492**
B2.1 Floor Finishes	0.95	4,734	m2	$61.61	$291,658	
B2.2 Ceiling Finishes	0.95	4,734	m2	$80.49	$381,062	
B2.3 Wall Finishes	1.80	8,969	m2	$11.01	$98,772	
B3 Fittings & Equipment						**$850,009**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$36.14	$180,109	
B3.3 Conveying Systems	1.00	4,983	m2	$134.44	$669,900	
C. SERVICES						
C1 Mechanical						**$2,494,977**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$83.83	$417,723	
C1.2 Fire Protection	1.00	4,983	m2	$28.37	$141,358	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$344.63	$1,717,310	
C1.4 Controls	1.00	4,983	m2	$43.87	$218,587	
C2 Electrical						**$1,675,058**
C2.1 Service & Distribution	1.00	4,983	m2	$90.64	$451,652	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$197.04	$981,842	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$48.48	$241,565	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$270,933**
D1.3 Electrical Site Services	0.04	200	m2	$1,354.67	$270,933	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,163,521**
Z1.1 General Requirements	1.00	4,983	m2	$158.02	$787,420	
Z1.2 Fees	1.00	4,983	m2	$75.48	$376,101	
Z2 Allowances						**$3,294,473**
Z2.1 Design Allowance	1.00	4,983	m2	$506.27	$2,522,748	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$154.87	$771,725	
Total				**$300 per sf**		**$16,099,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE OFFICE BASE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	4,983
Cost Per m2	3,162

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$484,550**
A1.1 Foundations	0.33	1,661	m2	$291.72	$484,550	
A2. Structure						**$2,706,555**
A2.1 Lowest Floor Construction	0.33	1,661	m2	$84.36	$140,114	
A2.2 Upper Floor Construction	0.67	3,322	m2	$600.70	$1,995,519	
A2.3 Roof Construction	0.33	1,661	m2	$343.72	$570,922	
A3. Exterior Enclosure						**$2,115,175**
A3.2 Walls Above Grade	0.40	1,978	m2	$864.99	$1,710,949	
A3.3 Windows & Entrances	0.00	18	m2	$3,019.93	$54,359	
A3.4 Roof Finish	0.33	1,661	m2	$190.37	$316,196	
A3.5 Projections	1.00	4,983	m2	$6.76	$33,671	
B. INTERIORS						
B1 Partitions & Doors						**$107,036**
B1.1 Partitions	0.01	60	m2	$373.60	$22,416	
B1.2 Doors	0.02	76	m2	$1,113.43	$84,620	
B2 Finishes						**$702,980**
B2.1 Floor Finishes	0.95	4,734	m2	$55.45	$262,492	
B2.2 Ceiling Finishes	0.95	4,734	m2	$73.11	$346,106	
B2.3 Wall Finishes	1.80	8,969	m2	$10.52	$94,382	
B3 Fittings & Equipment						**$829,581**
B3.1 Fittings & Fixtures	1.00	4,983	m2	$35.28	$175,781	
B3.3 Conveying Systems	1.00	4,983	m2	$131.21	$653,800	
C. SERVICES						
C1 Mechanical						**$2,497,669**
C1.1 Plumbing & Drainage	1.00	4,983	m2	$83.92	$418,174	
C1.2 Fire Protection	1.00	4,983	m2	$28.40	$141,511	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,983	m2	$345.01	$1,719,162	
C1.4 Controls	1.00	4,983	m2	$43.91	$218,822	
C2 Electrical						**$1,695,086**
C2.1 Service & Distribution	1.00	4,983	m2	$91.72	$457,052	
C2.2 Lighting, Devices & Heating	1.00	4,983	m2	$199.39	$993,581	
C2.3 Systems & Ancillaries	1.00	4,983	m2	$49.06	$244,453	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$264,422**
D1.3 Electrical Site Services	0.04	200	m2	$1,322.11	$264,422	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,135,557**
Z1.1 General Requirements	1.00	4,983	m2	$154.22	$768,495	
Z1.2 Fees	1.00	4,983	m2	$73.66	$367,062	
Z2 Allowances						**$3,215,295**
Z2.1 Design Allowance	1.00	4,983	m2	$494.10	$2,462,117	
Z2.2 Escalation Allowance	1.00	4,983	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,983	m2	$151.15	$753,178	
Total				**$294 per sf**		**$15,754,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	3,135
Cost Per m2	3,117

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$242,301**
A1.1 Foundations	0.25	784	m2	$309.06	$242,301	
A2. Structure						**$1,289,250**
A2.1 Lowest Floor Construction	0.25	784	m2	$90.73	$71,131	
A2.2 Upper Floor Construction	0.75	2,351	m2	$406.72	$956,196	
A2.3 Roof Construction	0.25	784	m2	$334.08	$261,922	
A3. Exterior Enclosure						**$1,041,938**
A3.2 Walls Above Grade	0.46	1,449	m2	$529.56	$767,327	
A3.3 Windows & Entrances	0.04	131	m2	$832.55	$108,822	
A3.4 Roof Finish	0.25	784	m2	$177.84	$139,430	
A3.5 Projections	1.00	3,135	m2	$8.41	$26,358	
B. INTERIORS						
B1 Partitions & Doors						**$933,231**
B1.1 Partitions	1.40	4,396	m2	$166.79	$733,254	
B1.2 Doors	0.18	551	m2	$363.05	$199,977	
B2 Finishes						**$537,570**
B2.1 Floor Finishes	1.00	3,135	m2	$97.68	$306,216	
B2.2 Ceiling Finishes	1.00	3,135	m2	$43.93	$137,736	
B2.3 Wall Finishes	2.13	6,669	m2	$14.04	$93,618	
B3 Fittings & Equipment						**$635,342**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$114.93	$360,302	
B3.3 Conveying Systems	1.00	3,135	m2	$87.73	$275,040	
C. SERVICES						
C1 Mechanical						**$1,354,652**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$205.98	$645,732	
C1.2 Fire Protection	1.00	3,135	m2	$28.43	$89,125	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$192.78	$604,360	
C1.4 Controls	1.00	3,135	m2	$4.92	$15,435	
C2 Electrical						**$617,161**
C2.1 Service & Distribution	1.00	3,135	m2	$45.85	$143,748	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$61.01	$191,270	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$90.00	$282,143	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$71,008**
D1.3 Electrical Site Services	1.00	3,135	m2	$22.65	$71,008	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,031,400**
Z1.1 General Requirements	1.00	3,135	m2	$210.19	$658,950	
Z1.2 Fees	1.00	3,135	m2	$118.80	$372,450	
Z2 Allowances						**$2,017,151**
Z2.1 Design Allowance	1.00	3,135	m2	$493.95	$1,548,533	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$149.48	$468,619	
Total				**$290 per sf**		**$9,771,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,277**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$265,847**
A1.1 Foundations	0.25	784	m2	$339.09	$265,847	
A2. Structure						**$1,344,600**
A2.1 Lowest Floor Construction	0.25	784	m2	$94.62	$74,185	
A2.2 Upper Floor Construction	0.75	2,351	m2	$424.18	$997,248	
A2.3 Roof Construction	0.25	784	m2	$348.43	$273,167	
A3. Exterior Enclosure						**$1,086,670**
A3.2 Walls Above Grade	0.46	1,449	m2	$552.29	$800,270	
A3.3 Windows & Entrances	0.04	131	m2	$868.29	$113,494	
A3.4 Roof Finish	0.25	784	m2	$185.48	$145,416	
A3.5 Projections	1.00	3,135	m2	$8.77	$27,490	
B. INTERIORS						
B1 Partitions & Doors						**$973,296**
B1.1 Partitions	1.40	4,396	m2	$173.95	$764,734	
B1.2 Doors	0.18	551	m2	$378.63	$208,562	
B2 Finishes						**$562,602**
B2.1 Floor Finishes	1.00	3,135	m2	$95.68	$299,961	
B2.2 Ceiling Finishes	1.00	3,135	m2	$48.90	$153,301	
B2.3 Wall Finishes	2.13	6,669	m2	$16.40	$109,339	
B3 Fittings & Equipment						**$662,619**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$119.86	$375,771	
B3.3 Conveying Systems	1.00	3,135	m2	$91.50	$286,848	
C. SERVICES						
C1 Mechanical						**$1,448,128**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$220.19	$690,289	
C1.2 Fire Protection	1.00	3,135	m2	$30.39	$95,275	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$206.08	$646,063	
C1.4 Controls	1.00	3,135	m2	$5.26	$16,501	
C2 Electrical						**$675,448**
C2.1 Service & Distribution	1.00	3,135	m2	$50.18	$157,324	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$66.77	$209,334	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$98.50	$308,790	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$74,057**
D1.3 Electrical Site Services	1.00	3,135	m2	$23.62	$74,057	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,075,680**
Z1.1 General Requirements	1.00	3,135	m2	$219.22	$687,240	
Z1.2 Fees	1.00	3,135	m2	$123.90	$388,440	
Z2 Allowances						**$2,103,751**
Z2.1 Design Allowance	1.00	3,135	m2	$515.16	$1,615,014	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$155.90	$488,737	
Total				**$304 per sf**		**$10,273,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,287**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$253,188**
A1.1 Foundations	0.25	784	m2	$322.94	$253,188	
A2. Structure						**$1,350,000**
A2.1 Lowest Floor Construction	0.25	784	m2	$95.00	$74,483	
A2.2 Upper Floor Construction	0.75	2,351	m2	$425.88	$1,001,253	
A2.3 Roof Construction	0.25	784	m2	$349.83	$274,264	
A3. Exterior Enclosure						**$1,091,034**
A3.2 Walls Above Grade	0.46	1,449	m2	$554.51	$803,484	
A3.3 Windows & Entrances	0.04	131	m2	$871.78	$113,950	
A3.4 Roof Finish	0.25	784	m2	$186.22	$146,000	
A3.5 Projections	1.00	3,135	m2	$8.80	$27,600	
B. INTERIORS						
B1 Partitions & Doors						**$977,205**
B1.1 Partitions	1.40	4,396	m2	$174.65	$767,805	
B1.2 Doors	0.18	551	m2	$380.15	$209,400	
B2 Finishes						**$532,592**
B2.1 Floor Finishes	1.00	3,135	m2	$90.69	$284,324	
B2.2 Ceiling Finishes	1.00	3,135	m2	$46.84	$146,840	
B2.3 Wall Finishes	2.13	6,669	m2	$15.21	$101,428	
B3 Fittings & Equipment						**$665,280**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$120.34	$377,280	
B3.3 Conveying Systems	1.00	3,135	m2	$91.87	$288,000	
C. SERVICES						
C1 Mechanical						**$1,483,737**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$225.60	$707,264	
C1.2 Fire Protection	1.00	3,135	m2	$31.14	$97,618	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$211.15	$661,950	
C1.4 Controls	1.00	3,135	m2	$5.39	$16,906	
C2 Electrical						**$685,734**
C2.1 Service & Distribution	1.00	3,135	m2	$50.95	$159,720	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$67.79	$212,522	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$100.00	$313,492	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$74,354**
D1.3 Electrical Site Services	1.00	3,135	m2	$23.72	$74,354	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,080,000**
Z1.1 General Requirements	1.00	3,135	m2	$220.10	$690,000	
Z1.2 Fees	1.00	3,135	m2	$124.40	$390,000	
Z2 Allowances						**$2,112,200**
Z2.1 Design Allowance	1.00	3,135	m2	$517.22	$1,621,500	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$156.52	$490,700	
Total				**$305 per sf**		**$10,305,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,214**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$246,352**
A1.1 Foundations	0.25	784	m2	$314.22	$246,352	
A2. Structure						**$1,323,000**
A2.1 Lowest Floor Construction	0.25	784	m2	$93.10	$72,994	
A2.2 Upper Floor Construction	0.75	2,351	m2	$417.37	$981,228	
A2.3 Roof Construction	0.25	784	m2	$342.83	$268,779	
A3. Exterior Enclosure						**$1,069,214**
A3.2 Walls Above Grade	0.46	1,449	m2	$543.42	$787,415	
A3.3 Windows & Entrances	0.04	131	m2	$854.34	$111,671	
A3.4 Roof Finish	0.25	784	m2	$182.50	$143,080	
A3.5 Projections	1.00	3,135	m2	$8.63	$27,048	
B. INTERIORS						
B1 Partitions & Doors						**$957,661**
B1.1 Partitions	1.40	4,396	m2	$171.15	$752,449	
B1.2 Doors	0.18	551	m2	$372.55	$205,212	
B2 Finishes						**$506,646**
B2.1 Floor Finishes	1.00	3,135	m2	$86.61	$271,529	
B2.2 Ceiling Finishes	1.00	3,135	m2	$43.84	$137,442	
B2.3 Wall Finishes	2.13	6,669	m2	$14.65	$97,675	
B3 Fittings & Equipment						**$651,974**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$117.94	$369,734	
B3.3 Conveying Systems	1.00	3,135	m2	$90.03	$282,240	
C. SERVICES						
C1 Mechanical						**$1,434,774**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$218.16	$683,924	
C1.2 Fire Protection	1.00	3,135	m2	$30.11	$94,396	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$204.18	$640,105	
C1.4 Controls	1.00	3,135	m2	$5.21	$16,348	
C2 Electrical						**$685,048**
C2.1 Service & Distribution	1.00	3,135	m2	$50.90	$159,560	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$67.72	$212,310	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$99.90	$313,179	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$72,867**
D1.3 Electrical Site Services	1.00	3,135	m2	$23.24	$72,867	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,058,400**
Z1.1 General Requirements	1.00	3,135	m2	$215.69	$676,200	
Z1.2 Fees	1.00	3,135	m2	$121.91	$382,200	
Z2 Allowances						**$2,069,956**
Z2.1 Design Allowance	1.00	3,135	m2	$506.88	$1,589,070	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$153.39	$480,886	
Total				**$299 per sf**		**$10,076,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,132**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$246,352**
A1.1 Foundations	0.25	784	m2	$314.22	$246,352	
A2. Structure						**$1,291,950**
A2.1 Lowest Floor Construction	0.25	784	m2	$90.92	$71,280	
A2.2 Upper Floor Construction	0.75	2,351	m2	$407.57	$958,199	
A2.3 Roof Construction	0.25	784	m2	$334.78	$262,471	
A3. Exterior Enclosure						**$1,044,120**
A3.2 Walls Above Grade	0.46	1,449	m2	$530.67	$768,934	
A3.3 Windows & Entrances	0.04	131	m2	$834.29	$109,050	
A3.4 Roof Finish	0.25	784	m2	$178.22	$139,722	
A3.5 Projections	1.00	3,135	m2	$8.43	$26,413	
B. INTERIORS						
B1 Partitions & Doors						**$935,185**
B1.1 Partitions	1.40	4,396	m2	$167.14	$734,790	
B1.2 Doors	0.18	551	m2	$363.81	$200,396	
B2 Finishes						**$533,246**
B2.1 Floor Finishes	1.00	3,135	m2	$91.60	$287,167	
B2.2 Ceiling Finishes	1.00	3,135	m2	$46.46	$145,665	
B2.3 Wall Finishes	2.13	6,669	m2	$15.06	$100,414	
B3 Fittings & Equipment						**$636,673**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$115.17	$361,057	
B3.3 Conveying Systems	1.00	3,135	m2	$87.92	$275,616	
C. SERVICES						
C1 Mechanical						**$1,375,424**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$209.13	$655,633	
C1.2 Fire Protection	1.00	3,135	m2	$28.86	$90,491	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$195.73	$613,627	
C1.4 Controls	1.00	3,135	m2	$5.00	$15,672	
C2 Electrical						**$630,875**
C2.1 Service & Distribution	1.00	3,135	m2	$46.87	$146,942	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$62.37	$195,520	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$92.00	$288,413	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$71,157**
D1.3 Electrical Site Services	1.00	3,135	m2	$22.70	$71,157	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,033,560**
Z1.1 General Requirements	1.00	3,135	m2	$210.63	$660,330	
Z1.2 Fees	1.00	3,135	m2	$119.05	$373,230	
Z2 Allowances						**$2,021,375**
Z2.1 Design Allowance	1.00	3,135	m2	$494.98	$1,551,776	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$149.79	$469,600	
Total				**$291 per sf**		**$9,820,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB BASE

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,060**

Description Element\Sub-Element	Location : Halifax — Elemental Cost — Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$226,097**
A1.1 Foundations	0.25	784	m2	$288.39	$226,097	
A2. Structure						**$1,260,900**
A2.1 Lowest Floor Construction	0.25	784	m2	$88.73	$69,567	
A2.2 Upper Floor Construction	0.75	2,351	m2	$397.78	$935,170	
A2.3 Roof Construction	0.25	784	m2	$326.74	$256,163	
A3. Exterior Enclosure						**$1,019,026**
A3.2 Walls Above Grade	0.46	1,449	m2	$517.91	$750,454	
A3.3 Windows & Entrances	0.04	131	m2	$814.24	$106,429	
A3.4 Roof Finish	0.25	784	m2	$173.93	$136,364	
A3.5 Projections	1.00	3,135	m2	$8.22	$25,778	
B. INTERIORS						
B1 Partitions & Doors						**$912,710**
B1.1 Partitions	1.40	4,396	m2	$163.12	$717,130	
B1.2 Doors	0.18	551	m2	$355.06	$195,580	
B2 Finishes						**$486,704**
B2.1 Floor Finishes	1.00	3,135	m2	$82.44	$258,450	
B2.2 Ceiling Finishes	1.00	3,135	m2	$42.20	$132,303	
B2.3 Wall Finishes	2.13	6,669	m2	$14.39	$95,951	
B3 Fittings & Equipment						**$621,372**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$112.40	$352,380	
B3.3 Conveying Systems	1.00	3,135	m2	$85.80	$268,992	
C. SERVICES						
C1 Mechanical						**$1,376,908**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$209.36	$656,341	
C1.2 Fire Protection	1.00	3,135	m2	$28.90	$90,589	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$195.95	$614,289	
C1.4 Controls	1.00	3,135	m2	$5.00	$15,689	
C2 Electrical						**$638,419**
C2.1 Service & Distribution	1.00	3,135	m2	$47.43	$148,699	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$63.11	$197,858	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$93.10	$291,861	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$69,447**
D1.3 Electrical Site Services	1.00	3,135	m2	$22.15	$69,447	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,008,720**
Z1.1 General Requirements	1.00	3,135	m2	$205.57	$644,460	
Z1.2 Fees	1.00	3,135	m2	$116.19	$364,260	
Z2 Allowances						**$1,972,795**
Z2.1 Design Allowance	1.00	3,135	m2	$483.09	$1,514,481	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$146.19	$458,314	
Total				**$284 per sf**		**$9,593,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,509**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost — Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$242,301**
A1.1 Foundations	0.25	784	m2	$309.06	$242,301	
A2. Structure						**$1,289,250**
A2.1 Lowest Floor Construction	0.25	784	m2	$90.73	$71,131	
A2.2 Upper Floor Construction	0.75	2,351	m2	$406.72	$956,196	
A2.3 Roof Construction	0.25	784	m2	$334.08	$261,922	
A3. Exterior Enclosure						**$1,165,390**
A3.2 Walls Above Grade	0.46	1,449	m2	$604.42	$875,805	
A3.3 Windows & Entrances	0.04	131	m2	$832.55	$108,822	
A3.4 Roof Finish	0.25	784	m2	$196.94	$154,404	
A3.5 Projections	1.00	3,135	m2	$8.41	$26,358	
B. INTERIORS						
B1 Partitions & Doors						**$933,231**
B1.1 Partitions	1.40	4,396	m2	$166.79	$733,254	
B1.2 Doors	0.18	551	m2	$363.05	$199,977	
B2 Finishes						**$537,570**
B2.1 Floor Finishes	1.00	3,135	m2	$97.68	$306,216	
B2.2 Ceiling Finishes	1.00	3,135	m2	$43.93	$137,736	
B2.3 Wall Finishes	2.13	6,669	m2	$14.04	$93,618	
B3 Fittings & Equipment						**$635,342**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$114.93	$360,302	
B3.3 Conveying Systems	1.00	3,135	m2	$87.73	$275,040	
C. SERVICES						
C1 Mechanical						**$1,915,490**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$245.80	$770,577	
C1.2 Fire Protection	1.00	3,135	m2	$28.43	$89,125	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$298.33	$935,273	
C1.4 Controls	1.00	3,135	m2	$38.44	$120,516	
C2 Electrical						**$769,447**
C2.1 Service & Distribution	1.00	3,135	m2	$62.43	$195,733	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$93.01	$291,572	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$90.00	$282,143	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$71,008**
D1.3 Electrical Site Services	0.20	627	m2	$113.25	$71,008	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,163,286**
Z1.1 General Requirements	1.00	3,135	m2	$237.03	$743,086	
Z1.2 Fees	1.00	3,135	m2	$134.04	$420,200	
Z2 Allowances						**$2,278,057**
Z2.1 Design Allowance	1.00	3,135	m2	$557.95	$1,749,178	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$168.70	$528,879	
Total				**$326 per sf**		**$11,000,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,693**

Location : Calgary

Description Element\Sub-Element	Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$265,847**
A1.1 Foundations	0.25	784	m2	$339.09	$265,847	
A2. Structure						**$1,344,600**
A2.1 Lowest Floor Construction	0.25	784	m2	$94.62	$74,185	
A2.2 Upper Floor Construction	0.75	2,351	m2	$424.18	$997,248	
A2.3 Roof Construction	0.25	784	m2	$348.43	$273,167	
A3. Exterior Enclosure						**$1,215,422**
A3.2 Walls Above Grade	0.46	1,449	m2	$630.37	$913,405	
A3.3 Windows & Entrances	0.04	131	m2	$868.29	$113,494	
A3.4 Roof Finish	0.25	784	m2	$205.40	$161,033	
A3.5 Projections	1.00	3,135	m2	$8.77	$27,490	
B. INTERIORS						
B1 Partitions & Doors						**$973,296**
B1.1 Partitions	1.40	4,396	m2	$173.95	$764,734	
B1.2 Doors	0.18	551	m2	$378.63	$208,562	
B2 Finishes						**$562,602**
B2.1 Floor Finishes	1.00	3,135	m2	$95.68	$299,961	
B2.2 Ceiling Finishes	1.00	3,135	m2	$48.90	$153,301	
B2.3 Wall Finishes	2.13	6,669	m2	$16.40	$109,339	
B3 Fittings & Equipment						**$662,619**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$119.86	$375,771	
B3.3 Conveying Systems	1.00	3,135	m2	$91.50	$286,848	
C. SERVICES						
C1 Mechanical						**$2,047,665**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$262.76	$823,749	
C1.2 Fire Protection	1.00	3,135	m2	$30.39	$95,275	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$318.92	$999,810	
C1.4 Controls	1.00	3,135	m2	$41.09	$128,832	
C2 Electrical						**$842,117**
C2.1 Service & Distribution	1.00	3,135	m2	$68.33	$214,219	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$101.79	$319,109	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$98.50	$308,790	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$74,057**
D1.3 Electrical Site Services	0.20	627	m2	$118.11	$74,057	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,213,228**
Z1.1 General Requirements	1.00	3,135	m2	$247.20	$774,988	
Z1.2 Fees	1.00	3,135	m2	$139.79	$438,240	
Z2 Allowances						**$2,375,858**
Z2.1 Design Allowance	1.00	3,135	m2	$581.91	$1,824,274	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$175.94	$551,585	
Total				**$343 per sf**		**$11,577,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,709**

Location : Toronto

Description Element\Sub-Element	Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$253,188**
A1.1 Foundations	0.25	784	m2	$322.94	$253,188	
A2. Structure						**$1,350,000**
A2.1 Lowest Floor Construction	0.25	784	m2	$95.00	$74,483	
A2.2 Upper Floor Construction	0.75	2,351	m2	$425.88	$1,001,253	
A2.3 Roof Construction	0.25	784	m2	$349.83	$274,264	
A3. Exterior Enclosure						**$1,220,303**
A3.2 Walls Above Grade	0.46	1,449	m2	$632.90	$917,073	
A3.3 Windows & Entrances	0.04	131	m2	$871.78	$113,950	
A3.4 Roof Finish	0.25	784	m2	$206.22	$161,680	
A3.5 Projections	1.00	3,135	m2	$8.80	$27,600	
B. INTERIORS						
B1 Partitions & Doors						**$977,205**
B1.1 Partitions	1.40	4,396	m2	$174.65	$767,805	
B1.2 Doors	0.18	551	m2	$380.15	$209,400	
B2 Finishes						**$532,592**
B2.1 Floor Finishes	1.00	3,135	m2	$90.69	$284,324	
B2.2 Ceiling Finishes	1.00	3,135	m2	$46.84	$146,840	
B2.3 Wall Finishes	2.13	6,669	m2	$15.21	$101,428	
B3 Fittings & Equipment						**$665,280**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$120.34	$377,280	
B3.3 Conveying Systems	1.00	3,135	m2	$91.87	$288,000	
C. SERVICES						
C1 Mechanical						**$2,098,018**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$269.22	$844,005	
C1.2 Fire Protection	1.00	3,135	m2	$31.14	$97,618	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$326.76	$1,024,395	
C1.4 Controls	1.00	3,135	m2	$42.11	$132,000	
C2 Electrical						**$854,942**
C2.1 Service & Distribution	1.00	3,135	m2	$69.37	$217,481	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$103.34	$323,969	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$100.00	$313,492	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$74,354**
D1.3 Electrical Site Services	0.20	627	m2	$118.59	$74,354	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,218,100**
Z1.1 General Requirements	1.00	3,135	m2	$248.20	$778,100	
Z1.2 Fees	1.00	3,135	m2	$140.35	$440,000	
Z2 Allowances						**$2,385,400**
Z2.1 Design Allowance	1.00	3,135	m2	$584.24	$1,831,600	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$176.65	$553,800	
Total				**$345 per sf**		**$11,629,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,626**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$246,352**
A1.1 Foundations	0.25	784	m2	$314.22	$246,352	
A2. Structure						**$1,323,000**
A2.1 Lowest Floor Construction	0.25	784	m2	$93.10	$72,994	
A2.2 Upper Floor Construction	0.75	2,351	m2	$417.37	$981,228	
A2.3 Roof Construction	0.25	784	m2	$342.83	$268,779	
A3. Exterior Enclosure						**$1,195,897**
A3.2 Walls Above Grade	0.46	1,449	m2	$620.24	$898,732	
A3.3 Windows & Entrances	0.04	131	m2	$854.34	$111,671	
A3.4 Roof Finish	0.25	784	m2	$202.10	$158,446	
A3.5 Projections	1.00	3,135	m2	$8.63	$27,048	
B. INTERIORS						
B1 Partitions & Doors						**$957,661**
B1.1 Partitions	1.40	4,396	m2	$171.15	$752,449	
B1.2 Doors	0.18	551	m2	$372.55	$205,212	
B2 Finishes						**$506,646**
B2.1 Floor Finishes	1.00	3,135	m2	$86.61	$271,529	
B2.2 Ceiling Finishes	1.00	3,135	m2	$43.84	$137,442	
B2.3 Wall Finishes	2.13	6,669	m2	$14.65	$97,675	
B3 Fittings & Equipment						**$651,974**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$117.94	$369,734	
B3.3 Conveying Systems	1.00	3,135	m2	$90.03	$282,240	
C. SERVICES						
C1 Mechanical						**$2,028,783**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$260.34	$816,153	
C1.2 Fire Protection	1.00	3,135	m2	$30.11	$94,396	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$315.98	$990,590	
C1.4 Controls	1.00	3,135	m2	$40.72	$127,644	
C2 Electrical						**$854,087**
C2.1 Service & Distribution	1.00	3,135	m2	$69.30	$217,263	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$103.24	$323,645	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$99.90	$313,179	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$72,867**
D1.3 Electrical Site Services	0.20	627	m2	$116.22	$72,867	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,193,738**
Z1.1 General Requirements	1.00	3,135	m2	$243.23	$762,538	
Z1.2 Fees	1.00	3,135	m2	$137.54	$431,200	
Z2 Allowances						**$2,337,692**
Z2.1 Design Allowance	1.00	3,135	m2	$572.56	$1,794,968	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$173.12	$542,724	
Total				**$337 per sf**		**$11,369,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,529**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$246,352**
A1.1 Foundations	0.25	784	m2	$314.22	$246,352	
A2. Structure						**$1,291,950**
A2.1 Lowest Floor Construction	0.25	784	m2	$90.92	$71,280	
A2.2 Upper Floor Construction	0.75	2,351	m2	$407.57	$958,199	
A2.3 Roof Construction	0.25	784	m2	$334.78	$262,471	
A3. Exterior Enclosure						**$1,167,830**
A3.2 Walls Above Grade	0.46	1,449	m2	$605.69	$877,639	
A3.3 Windows & Entrances	0.04	131	m2	$834.29	$109,050	
A3.4 Roof Finish	0.25	784	m2	$197.36	$154,728	
A3.5 Projections	1.00	3,135	m2	$8.43	$26,413	
B. INTERIORS						
B1 Partitions & Doors						**$935,185**
B1.1 Partitions	1.40	4,396	m2	$167.14	$734,790	
B1.2 Doors	0.18	551	m2	$363.81	$200,396	
B2 Finishes						**$533,246**
B2.1 Floor Finishes	1.00	3,135	m2	$91.60	$287,167	
B2.2 Ceiling Finishes	1.00	3,135	m2	$46.46	$145,665	
B2.3 Wall Finishes	2.13	6,669	m2	$15.06	$100,414	
B3 Fittings & Equipment						**$636,673**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$115.17	$361,057	
B3.3 Conveying Systems	1.00	3,135	m2	$87.92	$275,616	
C. SERVICES						
C1 Mechanical						**$1,944,862**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$249.57	$782,393	
C1.2 Fire Protection	1.00	3,135	m2	$28.86	$90,491	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$302.91	$949,614	
C1.4 Controls	1.00	3,135	m2	$39.03	$122,364	
C2 Electrical						**$786,546**
C2.1 Service & Distribution	1.00	3,135	m2	$63.82	$200,082	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$95.07	$298,051	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$92.00	$288,413	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$71,157**
D1.3 Electrical Site Services	0.20	627	m2	$113.49	$71,157	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,165,722**
Z1.1 General Requirements	1.00	3,135	m2	$237.53	$744,642	
Z1.2 Fees	1.00	3,135	m2	$134.32	$421,080	
Z2 Allowances						**$2,282,828**
Z2.1 Design Allowance	1.00	3,135	m2	$559.12	$1,752,841	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$169.05	$529,987	
Total				**$328 per sf**		**$11,062,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - LOW RISE MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**3,135**
Cost Per m2	**3,453**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$226,097**
A1.1 Foundations	0.25	784	m2	$288.39	$226,097	
A2. Structure						**$1,260,900**
A2.1 Lowest Floor Construction	0.25	784	m2	$88.73	$69,567	
A2.2 Upper Floor Construction	0.75	2,351	m2	$397.78	$935,170	
A2.3 Roof Construction	0.25	784	m2	$326.74	$256,163	
A3. Exterior Enclosure						**$1,139,763**
A3.2 Walls Above Grade	0.46	1,449	m2	$591.13	$856,546	
A3.3 Windows & Entrances	0.04	131	m2	$814.24	$106,429	
A3.4 Roof Finish	0.25	784	m2	$192.61	$151,009	
A3.5 Projections	1.00	3,135	m2	$8.22	$25,778	
B. INTERIORS						
B1 Partitions & Doors						**$912,710**
B1.1 Partitions	1.40	4,396	m2	$163.12	$717,130	
B1.2 Doors	0.18	551	m2	$355.06	$195,580	
B2 Finishes						**$486,704**
B2.1 Floor Finishes	1.00	3,135	m2	$82.44	$258,450	
B2.2 Ceiling Finishes	1.00	3,135	m2	$42.20	$132,303	
B2.3 Wall Finishes	2.13	6,669	m2	$14.39	$95,951	
B3 Fittings & Equipment						**$621,372**
B3.1 Fittings & Fixtures	1.00	3,135	m2	$112.40	$352,380	
B3.3 Conveying Systems	1.00	3,135	m2	$85.80	$268,992	
C. SERVICES						
C1 Mechanical						**$1,946,960**
C1.1 Plumbing & Drainage	1.00	3,135	m2	$249.84	$783,237	
C1.2 Fire Protection	1.00	3,135	m2	$28.90	$90,589	
C1.3 Heating, Ventilation, Air Cond.	1.00	3,135	m2	$303.23	$950,639	
C1.4 Controls	1.00	3,135	m2	$39.07	$122,496	
C2 Electrical						**$795,951**
C2.1 Service & Distribution	1.00	3,135	m2	$64.59	$202,475	
C2.2 Lighting, Devices & Heating	1.00	3,135	m2	$96.21	$301,615	
C2.3 Systems & Ancillaries	1.00	3,135	m2	$93.10	$291,861	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$69,447**
D1.3 Electrical Site Services	0.20	627	m2	$110.76	$69,447	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,137,705**
Z1.1 General Requirements	1.00	3,135	m2	$231.82	$726,745	
Z1.2 Fees	1.00	3,135	m2	$131.09	$410,960	
Z2 Allowances						**$2,227,964**
Z2.1 Design Allowance	1.00	3,135	m2	$545.68	$1,710,714	
Z2.2 Escalation Allowance	1.00	3,135	m2	Excluded		
Z2.3 Construction Allowance	1.00	3,135	m2	$164.99	$517,249	
Total					**$321 per sf**	**$10,826,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**2,330**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$286,537**
A1.1 Foundations	1.00	2,294	m2	$124.91	$286,537	
A2. Structure						**$834,512**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$136.69	$313,573	
A2.3 Roof Construction	1.00	2,294	m2	$227.09	$520,939	
A3. Exterior Enclosure						**$1,029,314**
A3.2 Walls Above Grade	0.51	1,177	m2	$434.51	$511,303	
A3.3 Windows & Entrances	0.05	114	m2	$247.96	$28,268	
A3.4 Roof Finish	1.00	2,294	m2	$186.87	$428,680	
A3.5 Projections	1.00	2,294	m2	$26.62	$61,063	
B. INTERIORS						
B1 Partitions & Doors						**$225,692**
B1.1 Partitions	0.56	1,275	m2	$135.44	$172,690	
B1.2 Doors	0.02	54	m2	$981.53	$53,003	
B2 Finishes						**$222,573**
B2.1 Floor Finishes	1.00	2,294	m2	$47.54	$109,068	
B2.2 Ceiling Finishes	1.00	2,294	m2	$39.11	$89,720	
B2.3 Wall Finishes	0.51	1,177	m2	$20.21	$23,786	
B3 Fittings & Equipment						**$132,928**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$51.70	$118,603	
B3.2 Equipment	1.00	2,294	m2	$6.24	$14,325	
C. SERVICES						
C1 Mechanical						**$499,407**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$58.22	$133,559	
C1.2 Fire Protection	1.00	2,294	m2	$18.86	$43,258	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$137.24	$314,829	
C1.4 Controls	1.00	2,294	m2	$3.38	$7,761	
C2 Electrical						**$416,213**
C2.1 Service & Distribution	1.00	2,294	m2	$39.05	$89,588	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$102.76	$235,737	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$39.62	$90,888	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$23,639**
D1.3 Electrical Site Services	1.00	2,294	m2	$10.30	$23,639	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$563,164**
Z1.1 General Requirements	1.00	2,294	m2	$156.82	$359,749	
Z1.2 Fees	1.00	2,294	m2	$88.67	$203,415	
Z2 Allowances						**$1,110,665**
Z2.1 Design Allowance	1.00	2,294	m2	$372.43	$854,343	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$111.74	$256,322	
Total					**$216 per sf**	**$5,345,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC
STAND ALONE RETAIL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**2,452**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$314,383**
A1.1 Foundations	1.00	2,294	m2	$137.05	$314,383	
A2. Structure						**$870,339**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$142.56	$327,036	
A2.3 Roof Construction	1.00	2,294	m2	$236.84	$543,304	
A3. Exterior Enclosure						**$1,073,505**
A3.2 Walls Above Grade	0.51	1,177	m2	$453.16	$533,254	
A3.3 Windows & Entrances	0.05	114	m2	$258.61	$29,482	
A3.4 Roof Finish	1.00	2,294	m2	$194.89	$447,084	
A3.5 Projections	1.00	2,294	m2	$27.76	$63,684	
B. INTERIORS						
B1 Partitions & Doors						**$235,382**
B1.1 Partitions	0.56	1,275	m2	$141.26	$180,104	
B1.2 Doors	0.02	54	m2	$1,023.67	$55,278	
B2 Finishes						**$234,479**
B2.1 Floor Finishes	1.00	2,294	m2	$46.57	$106,840	
B2.2 Ceiling Finishes	1.00	2,294	m2	$43.53	$99,859	
B2.3 Wall Finishes	0.51	1,177	m2	$23.60	$27,780	
B3 Fittings & Equipment						**$138,635**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$53.92	$123,695	
B3.2 Equipment	1.00	2,294	m2	$6.51	$14,940	
C. SERVICES						
C1 Mechanical						**$533,868**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$62.24	$142,775	
C1.2 Fire Protection	1.00	2,294	m2	$20.16	$46,243	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$146.71	$336,554	
C1.4 Controls	1.00	2,294	m2	$3.62	$8,296	
C2 Electrical						**$455,522**
C2.1 Service & Distribution	1.00	2,294	m2	$42.74	$98,049	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$112.47	$258,001	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$43.36	$99,472	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$24,654**
D1.3 Electrical Site Services	1.00	2,294	m2	$10.75	$24,654	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$587,341**
Z1.1 General Requirements	1.00	2,294	m2	$163.55	$375,193	
Z1.2 Fees	1.00	2,294	m2	$92.48	$212,148	
Z2 Allowances						**$1,158,348**
Z2.1 Design Allowance	1.00	2,294	m2	$388.41	$891,022	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$116.53	$267,326	
Total				**$228 per sf**		**$5,626,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC
STAND ALONE RETAIL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**2,457**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$299,412**
A1.1 Foundations	1.00	2,294	m2	$130.52	$299,412	
A2. Structure						**$873,835**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$143.13	$328,349	
A2.3 Roof Construction	1.00	2,294	m2	$237.79	$545,486	
A3. Exterior Enclosure						**$1,077,816**
A3.2 Walls Above Grade	0.51	1,177	m2	$454.98	$535,396	
A3.3 Windows & Entrances	0.05	114	m2	$259.65	$29,600	
A3.4 Roof Finish	1.00	2,294	m2	$195.68	$448,880	
A3.5 Projections	1.00	2,294	m2	$27.87	$63,940	
B. INTERIORS						
B1 Partitions & Doors						**$236,327**
B1.1 Partitions	0.56	1,275	m2	$141.83	$180,827	
B1.2 Doors	0.02	54	m2	$1,027.78	$55,500	
B2 Finishes						**$222,690**
B2.1 Floor Finishes	1.00	2,294	m2	$44.15	$101,270	
B2.2 Ceiling Finishes	1.00	2,294	m2	$41.70	$95,650	
B2.3 Wall Finishes	0.51	1,177	m2	$21.89	$25,770	
B3 Fittings & Equipment						**$139,192**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$54.14	$124,192	
B3.2 Equipment	1.00	2,294	m2	$6.54	$15,000	
C. SERVICES						
C1 Mechanical						**$546,996**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$63.77	$146,286	
C1.2 Fire Protection	1.00	2,294	m2	$20.65	$47,380	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$150.32	$344,830	
C1.4 Controls	1.00	2,294	m2	$3.71	$8,500	
C2 Electrical						**$462,459**
C2.1 Service & Distribution	1.00	2,294	m2	$43.39	$99,542	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$114.18	$261,930	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$44.02	$100,986	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$24,753**
D1.3 Electrical Site Services	1.00	2,294	m2	$10.79	$24,753	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$589,700**
Z1.1 General Requirements	1.00	2,294	m2	$164.21	$376,700	
Z1.2 Fees	1.00	2,294	m2	$92.85	$213,000	
Z2 Allowances						**$1,163,000**
Z2.1 Design Allowance	1.00	2,294	m2	$389.97	$894,600	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$117.00	$268,400	
Total				**$228 per sf**		**$5,636,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**2,405**

Location : Ottawa

Description Element\Sub-Element	Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$291,328**
A1.1 Foundations	1.00	2,294	m2	$127.00	$291,328	
A2. Structure						**$856,358**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$140.27	$321,782	
A2.3 Roof Construction	1.00	2,294	m2	$233.03	$534,576	
A3. Exterior Enclosure						**$1,056,259**
A3.2 Walls Above Grade	0.51	1,177	m2	$445.88	$524,688	
A3.3 Windows & Entrances	0.05	114	m2	$254.46	$29,008	
A3.4 Roof Finish	1.00	2,294	m2	$191.76	$439,902	
A3.5 Projections	1.00	2,294	m2	$27.32	$62,661	
B. INTERIORS						
B1 Partitions & Doors						**$231,600**
B1.1 Partitions	0.56	1,275	m2	$138.99	$177,210	
B1.2 Doors	0.02	54	m2	$1,007.22	$54,390	
B2 Finishes						**$211,058**
B2.1 Floor Finishes	1.00	2,294	m2	$42.16	$96,713	
B2.2 Ceiling Finishes	1.00	2,294	m2	$39.03	$89,528	
B2.3 Wall Finishes	0.51	1,177	m2	$21.08	$24,817	
B3 Fittings & Equipment						**$136,408**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$53.05	$121,708	
B3.2 Equipment	1.00	2,294	m2	$6.41	$14,700	
C. SERVICES						
C1 Mechanical						**$528,945**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$61.66	$141,459	
C1.2 Fire Protection	1.00	2,294	m2	$19.97	$45,816	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$145.36	$333,450	
C1.4 Controls	1.00	2,294	m2	$3.58	$8,220	
C2 Electrical						**$461,996**
C2.1 Service & Distribution	1.00	2,294	m2	$43.35	$99,443	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$114.07	$261,668	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$43.98	$100,885	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$24,258**
D1.3 Electrical Site Services	1.00	2,294	m2	$10.57	$24,258	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$577,906**
Z1.1 General Requirements	1.00	2,294	m2	$160.93	$369,166	
Z1.2 Fees	1.00	2,294	m2	$90.99	$208,740	
Z2 Allowances						**$1,139,740**
Z2.1 Design Allowance	1.00	2,294	m2	$382.17	$876,708	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$114.66	$263,032	
Total				**$223 per sf**		**$5,516,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**2,343**

Location : Montreal

Description Element\Sub-Element	Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$291,328**
A1.1 Foundations	1.00	2,294	m2	$127.00	$291,328	
A2. Structure						**$836,260**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$136.98	$314,230	
A2.3 Roof Construction	1.00	2,294	m2	$227.56	$522,030	
A3. Exterior Enclosure						**$1,031,470**
A3.2 Walls Above Grade	0.51	1,177	m2	$435.42	$512,374	
A3.3 Windows & Entrances	0.05	114	m2	$248.48	$28,327	
A3.4 Roof Finish	1.00	2,294	m2	$187.26	$429,578	
A3.5 Projections	1.00	2,294	m2	$26.67	$61,191	
B. INTERIORS						
B1 Partitions & Doors						**$226,165**
B1.1 Partitions	0.56	1,275	m2	$135.73	$173,051	
B1.2 Doors	0.02	54	m2	$983.58	$53,114	
B2 Finishes						**$222,680**
B2.1 Floor Finishes	1.00	2,294	m2	$44.59	$102,283	
B2.2 Ceiling Finishes	1.00	2,294	m2	$41.36	$94,885	
B2.3 Wall Finishes	0.51	1,177	m2	$21.68	$25,512	
B3 Fittings & Equipment						**$133,207**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$51.81	$118,852	
B3.2 Equipment	1.00	2,294	m2	$6.26	$14,355	
C. SERVICES						
C1 Mechanical						**$507,065**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$59.11	$135,607	
C1.2 Fire Protection	1.00	2,294	m2	$19.15	$43,921	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$139.34	$319,657	
C1.4 Controls	1.00	2,294	m2	$3.43	$7,880	
C2 Electrical						**$425,462**
C2.1 Service & Distribution	1.00	2,294	m2	$39.92	$91,579	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$105.05	$240,975	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$40.50	$92,908	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$23,689**
D1.3 Electrical Site Services	1.00	2,294	m2	$10.33	$23,689	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$564,343**
Z1.1 General Requirements	1.00	2,294	m2	$157.15	$360,502	
Z1.2 Fees	1.00	2,294	m2	$88.86	$203,841	
Z2 Allowances						**$1,112,991**
Z2.1 Design Allowance	1.00	2,294	m2	$373.20	$856,132	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$111.97	$256,859	
Total				**$218 per sf**		**$5,375,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**2,285**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$267,375**
A1.1 Foundations	1.00	2,294	m2	$116.55	$267,375	
A2. Structure						**$816,162**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$133.69	$306,678	
A2.3 Roof Construction	1.00	2,294	m2	$222.09	$509,484	
A3. Exterior Enclosure						**$1,006,680**
A3.2 Walls Above Grade	0.51	1,177	m2	$424.95	$500,060	
A3.3 Windows & Entrances	0.05	114	m2	$242.51	$27,646	
A3.4 Roof Finish	1.00	2,294	m2	$182.76	$419,254	
A3.5 Projections	1.00	2,294	m2	$26.03	$59,720	
B. INTERIORS						
B1 Partitions & Doors						**$220,729**
B1.1 Partitions	0.56	1,275	m2	$132.46	$168,892	
B1.2 Doors	0.02	54	m2	$959.94	$51,837	
B2 Finishes						**$202,614**
B2.1 Floor Finishes	1.00	2,294	m2	$40.13	$92,054	
B2.2 Ceiling Finishes	1.00	2,294	m2	$37.57	$86,181	
B2.3 Wall Finishes	0.51	1,177	m2	$20.71	$24,378	
B3 Fittings & Equipment						**$130,005**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$50.56	$115,995	
B3.2 Equipment	1.00	2,294	m2	$6.11	$14,010	
C. SERVICES						
C1 Mechanical						**$507,612**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$59.18	$135,753	
C1.2 Fire Protection	1.00	2,294	m2	$19.17	$43,969	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$139.50	$320,002	
C1.4 Controls	1.00	2,294	m2	$3.44	$7,888	
C2 Electrical						**$430,549**
C2.1 Service & Distribution	1.00	2,294	m2	$40.40	$92,674	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$106.30	$243,857	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$40.98	$94,018	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$23,119**
D1.3 Electrical Site Services	1.00	2,294	m2	$10.08	$23,119	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$550,780**
Z1.1 General Requirements	1.00	2,294	m2	$153.37	$351,838	
Z1.2 Fees	1.00	2,294	m2	$86.72	$198,942	
Z2 Allowances						**$1,086,242**
Z2.1 Design Allowance	1.00	2,294	m2	$364.24	$835,556	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$109.28	$250,686	
Total				**$212 per sf**		**$5,242,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**3,221**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$286,537**
A1.1 Foundations	1.00	2,294	m2	$124.91	$286,537	
A2. Structure						**$834,512**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$136.69	$313,573	
A2.3 Roof Construction	1.00	2,294	m2	$227.09	$520,939	
A3. Exterior Enclosure						**$1,192,223**
A3.2 Walls Above Grade	0.51	1,177	m2	$507.83	$597,716	
A3.3 Windows & Entrances	0.01	29	m2	$974.76	$28,268	
A3.4 Roof Finish	1.00	2,294	m2	$220.22	$505,176	
A3.5 Projections	1.00	2,294	m2	$26.62	$61,063	
B. INTERIORS						
B1 Partitions & Doors						**$225,692**
B1.1 Partitions	0.56	1,275	m2	$135.44	$172,690	
B1.2 Doors	0.02	54	m2	$981.53	$53,003	
B2 Finishes						**$222,573**
B2.1 Floor Finishes	1.00	2,294	m2	$47.54	$109,068	
B2.2 Ceiling Finishes	1.00	2,294	m2	$39.11	$89,720	
B2.3 Wall Finishes	0.51	1,177	m2	$20.21	$23,786	
B3 Fittings & Equipment						**$132,928**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$51.70	$118,603	
B3.2 Equipment	1.00	2,294	m2	$6.24	$14,325	
C. SERVICES						
C1 Mechanical						**$1,494,164**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$58.19	$133,479	
C1.2 Fire Protection	1.00	2,294	m2	$18.86	$43,258	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$512.13	$1,174,816	
C1.4 Controls	1.00	2,294	m2	$62.17	$142,611	
C2 Electrical						**$649,647**
C2.1 Service & Distribution	1.00	2,294	m2	$48.46	$111,166	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$195.11	$447,593	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$39.62	$90,888	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$23,639**
D1.3 Electrical Site Services	0.20	460	m2	$51.39	$23,639	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$783,291**
Z1.1 General Requirements	1.00	2,294	m2	$218.23	$500,611	
Z1.2 Fees	1.00	2,294	m2	$123.23	$282,680	
Z2 Allowances						**$1,545,286**
Z2.1 Design Allowance	1.00	2,294	m2	$518.17	$1,188,689	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$155.45	$356,597	
Total				**$299 per sf**		**$7,390,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**3,399**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$314,383**
A1.1 Foundations	1.00	2,294	m2	$137.05	$314,383	
A2. Structure						**$870,339**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$142.56	$327,036	
A2.3 Roof Construction	1.00	2,294	m2	$236.84	$543,304	
A3. Exterior Enclosure						**$1,243,407**
A3.2 Walls Above Grade	0.51	1,177	m2	$529.63	$623,377	
A3.3 Windows & Entrances	0.01	29	m2	$1,016.61	$29,482	
A3.4 Roof Finish	1.00	2,294	m2	$229.67	$526,864	
A3.5 Projections	1.00	2,294	m2	$27.76	$63,684	
B. INTERIORS						
B1 Partitions & Doors						**$235,382**
B1.1 Partitions	0.56	1,275	m2	$141.26	$180,104	
B1.2 Doors	0.02	54	m2	$1,023.67	$55,278	
B2 Finishes						**$234,479**
B2.1 Floor Finishes	1.00	2,294	m2	$46.57	$106,840	
B2.2 Ceiling Finishes	1.00	2,294	m2	$43.53	$99,859	
B2.3 Wall Finishes	0.51	1,177	m2	$23.60	$27,780	
B3 Fittings & Equipment						**$138,635**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$53.92	$123,695	
B3.2 Equipment	1.00	2,294	m2	$6.51	$14,940	
C. SERVICES						
C1 Mechanical						**$1,597,266**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$62.20	$142,689	
C1.2 Fire Protection	1.00	2,294	m2	$20.16	$46,243	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$547.46	$1,255,883	
C1.4 Controls	1.00	2,294	m2	$66.46	$152,451	
C2 Electrical						**$711,002**
C2.1 Service & Distribution	1.00	2,294	m2	$53.04	$121,664	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$213.54	$489,866	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$43.36	$99,472	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$24,654**
D1.3 Electrical Site Services	0.20	460	m2	$53.60	$24,654	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$816,919**
Z1.1 General Requirements	1.00	2,294	m2	$227.60	$522,103	
Z1.2 Fees	1.00	2,294	m2	$128.52	$294,816	
Z2 Allowances						**$1,611,628**
Z2.1 Design Allowance	1.00	2,294	m2	$540.42	$1,239,721	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$162.12	$371,906	
Total				**$316 per sf**		**$7,798,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**3,418**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$299,412**
A1.1 Foundations	1.00	2,294	m2	$130.52	$299,412	
A2. Structure						**$873,835**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$143.13	$328,349	
A2.3 Roof Construction	1.00	2,294	m2	$237.79	$545,486	
A3. Exterior Enclosure						**$1,248,401**
A3.2 Walls Above Grade	0.51	1,177	m2	$531.76	$625,881	
A3.3 Windows & Entrances	0.01	29	m2	$1,020.69	$29,600	
A3.4 Roof Finish	1.00	2,294	m2	$230.59	$528,980	
A3.5 Projections	1.00	2,294	m2	$27.87	$63,940	
B. INTERIORS						
B1 Partitions & Doors						**$236,327**
B1.1 Partitions	0.56	1,275	m2	$141.83	$180,827	
B1.2 Doors	0.02	54	m2	$1,027.78	$55,500	
B2 Finishes						**$222,690**
B2.1 Floor Finishes	1.00	2,294	m2	$44.15	$101,270	
B2.2 Ceiling Finishes	1.00	2,294	m2	$41.70	$95,650	
B2.3 Wall Finishes	0.51	1,177	m2	$21.89	$25,770	
B3 Fittings & Equipment						**$139,192**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$54.14	$124,192	
B3.2 Equipment	1.00	2,294	m2	$6.54	$15,000	
C. SERVICES						
C1 Mechanical						**$1,636,543**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$63.73	$146,198	
C1.2 Fire Protection	1.00	2,294	m2	$20.65	$47,380	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$560.93	$1,286,765	
C1.4 Controls	1.00	2,294	m2	$68.09	$156,200	
C2 Electrical						**$721,830**
C2.1 Service & Distribution	1.00	2,294	m2	$53.84	$123,517	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$216.79	$497,326	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$44.02	$100,986	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$24,753**
D1.3 Electrical Site Services	0.20	460	m2	$53.81	$24,753	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$820,200**
Z1.1 General Requirements	1.00	2,294	m2	$228.51	$524,200	
Z1.2 Fees	1.00	2,294	m2	$129.03	$296,000	
Z2 Allowances						**$1,618,100**
Z2.1 Design Allowance	1.00	2,294	m2	$542.59	$1,244,700	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$162.77	$373,400	
Total				**$318 per sf**		**$7,841,000**

ELEMENTAL SUMMARY
CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**3,343**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$291,328**
A1.1 Foundations	1.00	2,294	m2	$127.00	$291,328	
A2. Structure						**$856,358**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$140.27	$321,782	
A2.3 Roof Construction	1.00	2,294	m2	$233.03	$534,576	
A3. Exterior Enclosure						**$1,223,433**
A3.2 Walls Above Grade	0.51	1,177	m2	$521.12	$613,363	
A3.3 Windows & Entrances	0.01	29	m2	$1,000.28	$29,008	
A3.4 Roof Finish	1.00	2,294	m2	$225.98	$518,400	
A3.5 Projections	1.00	2,294	m2	$27.32	$62,661	
B. INTERIORS						
B1 Partitions & Doors						**$231,600**
B1.1 Partitions	0.56	1,275	m2	$138.99	$177,210	
B1.2 Doors	0.02	54	m2	$1,007.22	$54,390	
B2 Finishes						**$211,058**
B2.1 Floor Finishes	1.00	2,294	m2	$42.16	$96,713	
B2.2 Ceiling Finishes	1.00	2,294	m2	$39.03	$89,528	
B2.3 Wall Finishes	0.51	1,177	m2	$21.08	$24,817	
B3 Fittings & Equipment						**$136,408**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$53.05	$121,708	
B3.2 Equipment	1.00	2,294	m2	$6.41	$14,700	
C. SERVICES						
C1 Mechanical						**$1,582,537**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$61.63	$141,373	
C1.2 Fire Protection	1.00	2,294	m2	$19.97	$45,816	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$542.42	$1,244,302	
C1.4 Controls	1.00	2,294	m2	$65.84	$151,045	
C2 Electrical						**$721,108**
C2.1 Service & Distribution	1.00	2,294	m2	$53.79	$123,394	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$216.58	$496,829	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$43.98	$100,885	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$24,258**
D1.3 Electrical Site Services	0.20	460	m2	$52.73	$24,258	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$803,796**
Z1.1 General Requirements	1.00	2,294	m2	$223.94	$513,716	
Z1.2 Fees	1.00	2,294	m2	$126.45	$290,080	
Z2 Allowances						**$1,585,738**
Z2.1 Design Allowance	1.00	2,294	m2	$531.74	$1,219,806	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$159.52	$365,932	
Total				**$311 per sf**		**$7,668,000**

ELEMENTAL SUMMARY
CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**2,294**
Cost Per m2	**3,245**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$291,328**
A1.1 Foundations	1.00	2,294	m2	$127.00	$291,328	
A2. Structure						**$836,260**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$136.98	$314,230	
A2.3 Roof Construction	1.00	2,294	m2	$227.56	$522,030	
A3. Exterior Enclosure						**$1,194,720**
A3.2 Walls Above Grade	0.51	1,177	m2	$508.89	$598,968	
A3.3 Windows & Entrances	0.01	29	m2	$976.80	$28,327	
A3.4 Roof Finish	1.00	2,294	m2	$220.68	$506,234	
A3.5 Projections	1.00	2,294	m2	$26.67	$61,191	
B. INTERIORS						
B1 Partitions & Doors						**$226,165**
B1.1 Partitions	0.56	1,275	m2	$135.73	$173,051	
B1.2 Doors	0.02	54	m2	$983.58	$53,114	
B2 Finishes						**$222,680**
B2.1 Floor Finishes	1.00	2,294	m2	$44.59	$102,283	
B2.2 Ceiling Finishes	1.00	2,294	m2	$41.36	$94,885	
B2.3 Wall Finishes	0.51	1,177	m2	$21.68	$25,512	
B3 Fittings & Equipment						**$133,207**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$51.81	$118,852	
B3.2 Equipment	1.00	2,294	m2	$6.26	$14,355	
C. SERVICES						
C1 Mechanical						**$1,517,075**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$59.08	$135,526	
C1.2 Fire Protection	1.00	2,294	m2	$19.15	$43,921	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$519.98	$1,192,831	
C1.4 Controls	1.00	2,294	m2	$63.12	$144,797	
C2 Electrical						**$664,083**
C2.1 Service & Distribution	1.00	2,294	m2	$49.54	$113,636	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$199.45	$457,540	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$40.50	$92,908	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$23,689**
D1.3 Electrical Site Services	0.20	460	m2	$51.50	$23,689	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$784,931**
Z1.1 General Requirements	1.00	2,294	m2	$218.68	$501,659	
Z1.2 Fees	1.00	2,294	m2	$123.48	$283,272	
Z2 Allowances						**$1,548,522**
Z2.1 Design Allowance	1.00	2,294	m2	$519.26	$1,191,178	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$155.77	$357,344	
Total				**$301 per sf**		**$7,443,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC STAND ALONE RETAIL 100% CARBON REDUCTION

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	2,294
Cost Per m2	3,180

Description Element\Sub-Element	Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
			Location :	Halifax	Elemental Cost	
A. SHELL						
A1. Sub-Structure						**$267,375**
A1.1 Foundations	1.00	2,294	m2	$116.55	$267,375	
A2. Structure						**$816,162**
A2.1 Lowest Floor Construction	1.00	2,294	m2	$133.69	$306,678	
A2.3 Roof Construction	1.00	2,294	m2	$222.09	$509,484	
A3. Exterior Enclosure						**$1,166,007**
A3.2 Walls Above Grade	0.51	1,177	m2	$496.66	$584,573	
A3.3 Windows & Entrances	0.01	29	m2	$953.32	$27,646	
A3.4 Roof Finish	1.00	2,294	m2	$215.37	$494,067	
A3.5 Projections	1.00	2,294	m2	$26.03	$59,720	
B. INTERIORS						
B1 Partitions & Doors						**$220,729**
B1.1 Partitions	0.56	1,275	m2	$132.46	$168,892	
B1.2 Doors	0.02	54	m2	$959.94	$51,837	
B2 Finishes						**$202,614**
B2.1 Floor Finishes	1.00	2,294	m2	$40.13	$92,054	
B2.2 Ceiling Finishes	1.00	2,294	m2	$37.57	$86,181	
B2.3 Wall Finishes	0.51	1,177	m2	$20.71	$24,378	
B3 Fittings & Equipment						**$130,005**
B3.1 Fittings & Fixtures	1.00	2,294	m2	$50.56	$115,995	
B3.2 Equipment	1.00	2,294	m2	$6.11	$14,010	
C. SERVICES						
C1 Mechanical						**$1,518,712**
C1.1 Plumbing & Drainage	1.00	2,294	m2	$59.14	$135,672	
C1.2 Fire Protection	1.00	2,294	m2	$19.17	$43,969	
C1.3 Heating, Ventilation, Air Cond.	1.00	2,294	m2	$520.54	$1,194,118	
C1.4 Controls	1.00	2,294	m2	$63.19	$144,954	
C2 Electrical						**$672,023**
C2.1 Service & Distribution	1.00	2,294	m2	$50.13	$114,995	
C2.2 Lighting, Devices & Heating	1.00	2,294	m2	$201.84	$463,011	
C2.3 Systems & Ancillaries	1.00	2,294	m2	$40.98	$94,018	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$23,119**
D1.3 Electrical Site Services	0.20	460	m2	$50.26	$23,119	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$766,067**
Z1.1 General Requirements	1.00	2,294	m2	$213.43	$489,603	
Z1.2 Fees	1.00	2,294	m2	$120.52	$276,464	
Z2 Allowances						**$1,511,305**
Z2.1 Design Allowance	1.00	2,294	m2	$506.78	$1,162,550	
Z2.2 Escalation Allowance	1.00	2,294	m2	Excluded		
Z2.3 Construction Allowance	1.00	2,294	m2	$152.03	$348,756	
Total				**$295 per sf**		**$7,294,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL BASE BUILDING

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	6,871
Cost Per m2	2,978

Description Element\Sub-Element	Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
			Location :	Vancouver	Elemental Cost	
A. SHELL						
A1. Sub-Structure						**$1,220,779**
A1.1 Foundations	1.00	6,871	m2	$177.67	$1,220,779	
A2. Structure						**$1,925,304**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$87.82	$603,393	
A2.3 Roof Construction	1.00	6,871	m2	$192.39	$1,321,911	
A3. Exterior Enclosure						**$2,408,978**
A3.2 Walls Above Grade	0.24	1,633	m2	$424.98	$693,984	
A3.3 Windows & Entrances	0.13	917	m2	$541.45	$496,600	
A3.4 Roof Finish	1.00	6,871	m2	$154.83	$1,063,851	
A3.5 Projections	1.00	6,871	m2	$22.49	$154,543	
B. INTERIORS						
B1 Partitions & Doors						**$1,744,502**
B1.1 Partitions	0.98	6,734	m2	$215.83	$1,453,418	
B1.2 Doors	0.04	269	m2	$1,082.10	$291,084	
B2 Finishes						**$1,083,858**
B2.1 Floor Finishes	0.95	6,527	m2	$88.51	$577,749	
B2.2 Ceiling Finishes	0.95	6,527	m2	$52.58	$343,205	
B2.3 Wall Finishes	1.70	11,668	m2	$13.96	$162,904	
B3 Fittings & Equipment						**$682,968**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$89.67	$616,118	
B3.2 Equipment	1.00	6,871	m2	$9.73	$66,850	
C. SERVICES						
C1 Mechanical						**$2,970,911**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$110.87	$761,802	
C1.2 Fire Protection	1.00	6,871	m2	$29.65	$203,718	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$257.02	$1,766,003	
C1.4 Controls	1.00	6,871	m2	$34.84	$239,389	
C2 Electrical						**$1,908,451**
C2.1 Service & Distribution	1.00	6,871	m2	$45.82	$314,815	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$118.60	$814,928	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$113.33	$778,709	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$91,318**
D1.3 Electrical Site Services	1.00	6,871	m2	$13.29	$91,318	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,161,070**
Z1.1 General Requirements	1.00	6,871	m2	$200.90	$1,380,357	
Z1.2 Fees	1.00	6,871	m2	$113.62	$780,713	
Z2 Allowances						**$4,262,834**
Z2.1 Design Allowance	1.00	6,871	m2	$477.24	$3,279,088	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$143.17	$983,746	
Total				**$277 per sf**		**$20,461,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,142**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,339,413**
A1.1 Foundations	1.00	6,871	m2	$194.94	$1,339,413	
A2. Structure						**$2,007,961**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$91.59	$629,298	
A2.3 Roof Construction	1.00	6,871	m2	$200.65	$1,378,663	
A3. Exterior Enclosure						**$2,512,400**
A3.2 Walls Above Grade	0.24	1,633	m2	$443.22	$723,778	
A3.3 Windows & Entrances	0.13	917	m2	$564.69	$517,920	
A3.4 Roof Finish	1.00	6,871	m2	$161.48	$1,109,524	
A3.5 Projections	1.00	6,871	m2	$23.46	$161,178	
B. INTERIORS						
B1 Partitions & Doors						**$1,819,397**
B1.1 Partitions	0.98	6,734	m2	$225.10	$1,515,816	
B1.2 Doors	0.04	269	m2	$1,128.55	$303,581	
B2 Finishes						**$1,138,197**
B2.1 Floor Finishes	0.95	6,527	m2	$86.70	$565,947	
B2.2 Ceiling Finishes	0.95	6,527	m2	$58.52	$381,989	
B2.3 Wall Finishes	1.70	11,668	m2	$16.31	$190,261	
B3 Fittings & Equipment						**$712,289**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$93.52	$642,569	
B3.2 Equipment	1.00	6,871	m2	$10.15	$69,720	
C. SERVICES						
C1 Mechanical						**$3,175,914**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$118.52	$814,369	
C1.2 Fire Protection	1.00	6,871	m2	$31.69	$217,775	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$274.76	$1,887,863	
C1.4 Controls	1.00	6,871	m2	$37.24	$255,907	
C2 Electrical						**$2,088,694**
C2.1 Service & Distribution	1.00	6,871	m2	$50.15	$344,547	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$129.81	$891,893	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$124.04	$852,253	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$95,238**
D1.3 Electrical Site Services	1.00	6,871	m2	$13.86	$95,238	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,253,848**
Z1.1 General Requirements	1.00	6,871	m2	$209.52	$1,439,618	
Z1.2 Fees	1.00	6,871	m2	$118.50	$814,230	
Z2 Allowances						**$4,445,845**
Z2.1 Design Allowance	1.00	6,871	m2	$497.72	$3,419,866	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$149.32	$1,025,980	
Total				**$292 per sf**		**$21,589,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,148**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,275,631**
A1.1 Foundations	1.00	6,871	m2	$185.65	$1,275,631	
A2. Structure						**$2,016,026**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$91.96	$631,826	
A2.3 Roof Construction	1.00	6,871	m2	$201.46	$1,384,200	
A3. Exterior Enclosure						**$2,522,490**
A3.2 Walls Above Grade	0.24	1,633	m2	$445.00	$726,685	
A3.3 Windows & Entrances	0.13	917	m2	$566.96	$520,000	
A3.4 Roof Finish	1.00	6,871	m2	$162.13	$1,113,980	
A3.5 Projections	1.00	6,871	m2	$23.55	$161,825	
B. INTERIORS						
B1 Partitions & Doors						**$1,826,704**
B1.1 Partitions	0.98	6,734	m2	$226.00	$1,521,904	
B1.2 Doors	0.04	269	m2	$1,133.09	$304,800	
B2 Finishes						**$1,078,827**
B2.1 Floor Finishes	0.95	6,527	m2	$82.18	$536,443	
B2.2 Ceiling Finishes	0.95	6,527	m2	$56.06	$365,890	
B2.3 Wall Finishes	1.70	11,668	m2	$15.13	$176,494	
B3 Fittings & Equipment						**$715,150**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$93.89	$645,150	
B3.2 Equipment	1.00	6,871	m2	$10.19	$70,000	
C. SERVICES						
C1 Mechanical						**$3,254,010**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$121.44	$834,394	
C1.2 Fire Protection	1.00	6,871	m2	$32.47	$223,130	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$281.51	$1,934,286	
C1.4 Controls	1.00	6,871	m2	$38.16	$262,200	
C2 Electrical						**$2,120,502**
C2.1 Service & Distribution	1.00	6,871	m2	$50.91	$349,794	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$131.78	$905,475	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$125.93	$865,232	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$95,621**
D1.3 Electrical Site Services	1.00	6,871	m2	$13.92	$95,621	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,262,900**
Z1.1 General Requirements	1.00	6,871	m2	$210.36	$1,445,400	
Z1.2 Fees	1.00	6,871	m2	$118.98	$817,500	
Z2 Allowances						**$4,463,700**
Z2.1 Design Allowance	1.00	6,871	m2	$499.72	$3,433,600	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$149.92	$1,030,100	
Total				**$292 per sf**		**$21,632,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,079**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,241,189**
A1.1 Foundations	1.00	6,871	m2	$180.64	$1,241,189	
A2. Structure						**$1,975,705**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$90.12	$619,189	
A2.3 Roof Construction	1.00	6,871	m2	$197.43	$1,356,516	
A3. Exterior Enclosure						**$2,472,040**
A3.2 Walls Above Grade	0.24	1,633	m2	$436.10	$712,151	
A3.3 Windows & Entrances	0.13	917	m2	$555.62	$509,600	
A3.4 Roof Finish	1.00	6,871	m2	$158.89	$1,091,700	
A3.5 Projections	1.00	6,871	m2	$23.08	$158,589	
B. INTERIORS						
B1 Partitions & Doors						**$1,790,169**
B1.1 Partitions	0.98	6,734	m2	$221.48	$1,491,465	
B1.2 Doors	0.04	269	m2	$1,110.42	$298,704	
B2 Finishes						**$1,024,740**
B2.1 Floor Finishes	0.95	6,527	m2	$78.48	$512,303	
B2.2 Ceiling Finishes	0.95	6,527	m2	$52.47	$342,473	
B2.3 Wall Finishes	1.70	11,668	m2	$14.57	$169,964	
B3 Fittings & Equipment						**$700,847**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$92.02	$632,247	
B3.2 Equipment	1.00	6,871	m2	$9.98	$68,600	
C. SERVICES						
C1 Mechanical						**$3,146,628**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$117.43	$806,859	
C1.2 Fire Protection	1.00	6,871	m2	$31.40	$215,767	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$272.22	$1,870,455	
C1.4 Controls	1.00	6,871	m2	$36.90	$253,547	
C2 Electrical						**$2,118,381**
C2.1 Service & Distribution	1.00	6,871	m2	$50.86	$349,445	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$131.65	$904,570	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$125.80	$864,367	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$93,708**
D1.3 Electrical Site Services	1.00	6,871	m2	$13.64	$93,708	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,217,642**
Z1.1 General Requirements	1.00	6,871	m2	$206.16	$1,416,492	
Z1.2 Fees	1.00	6,871	m2	$116.60	$801,150	
Z2 Allowances						**$4,374,426**
Z2.1 Design Allowance	1.00	6,871	m2	$489.73	$3,364,928	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$146.92	$1,009,498	
Total				**$286 per sf**		**$21,155,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**2,997**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,241,189**
A1.1 Foundations	1.00	6,871	m2	$180.64	$1,241,189	
A2. Structure						**$1,929,336**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$88.00	$604,657	
A2.3 Roof Construction	1.00	6,871	m2	$192.79	$1,324,679	
A3. Exterior Enclosure						**$2,414,023**
A3.2 Walls Above Grade	0.24	1,633	m2	$425.87	$695,438	
A3.3 Windows & Entrances	0.13	917	m2	$542.58	$497,640	
A3.4 Roof Finish	1.00	6,871	m2	$155.16	$1,066,079	
A3.5 Projections	1.00	6,871	m2	$22.54	$154,867	
B. INTERIORS						
B1 Partitions & Doors						**$1,748,155**
B1.1 Partitions	0.98	6,734	m2	$216.28	$1,456,462	
B1.2 Doors	0.04	269	m2	$1,084.36	$291,694	
B2 Finishes						**$1,079,500**
B2.1 Floor Finishes	0.95	6,527	m2	$83.00	$541,807	
B2.2 Ceiling Finishes	0.95	6,527	m2	$55.61	$362,963	
B2.3 Wall Finishes	1.70	11,668	m2	$14.97	$174,729	
B3 Fittings & Equipment						**$684,399**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$89.86	$617,409	
B3.2 Equipment	1.00	6,871	m2	$9.75	$66,990	
C. SERVICES						
C1 Mechanical						**$3,016,467**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$112.57	$773,483	
C1.2 Fire Protection	1.00	6,871	m2	$30.10	$206,842	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$260.96	$1,793,083	
C1.4 Controls	1.00	6,871	m2	$35.37	$243,059	
C2 Electrical						**$1,950,861**
C2.1 Service & Distribution	1.00	6,871	m2	$46.84	$321,811	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$121.24	$833,037	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$115.85	$796,013	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$91,509**
D1.3 Electrical Site Services	1.00	6,871	m2	$13.32	$91,509	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,165,595**
Z1.1 General Requirements	1.00	6,871	m2	$201.32	$1,383,248	
Z1.2 Fees	1.00	6,871	m2	$113.86	$782,348	
Z2 Allowances						**$4,271,761**
Z2.1 Design Allowance	1.00	6,871	m2	$478.24	$3,285,955	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$143.47	$985,806	
Total				**$278 per sf**		**$20,593,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**2,926**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,139,138**
A1.1 Foundations	1.00	6,871	m2	$165.79	$1,139,138	
A2. Structure						**$1,882,968**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$85.89	$590,125	
A2.3 Roof Construction	1.00	6,871	m2	$188.16	$1,292,843	
A3. Exterior Enclosure						**$2,356,006**
A3.2 Walls Above Grade	0.24	1,633	m2	$415.63	$678,724	
A3.3 Windows & Entrances	0.13	917	m2	$529.54	$485,680	
A3.4 Roof Finish	1.00	6,871	m2	$151.43	$1,040,457	
A3.5 Projections	1.00	6,871	m2	$22.00	$151,145	
B. INTERIORS						
B1 Partitions & Doors						**$1,706,141**
B1.1 Partitions	0.98	6,734	m2	$211.09	$1,421,458	
B1.2 Doors	0.04	269	m2	$1,058.30	$284,683	
B2 Finishes						**$984,257**
B2.1 Floor Finishes	0.95	6,527	m2	$74.70	$487,627	
B2.2 Ceiling Finishes	0.95	6,527	m2	$50.51	$329,667	
B2.3 Wall Finishes	1.70	11,668	m2	$14.31	$166,964	
B3 Fittings & Equipment						**$667,950**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$87.70	$602,570	
B3.2 Equipment	1.00	6,871	m2	$9.52	$65,380	
C. SERVICES						
C1 Mechanical						**$3,019,721**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$112.69	$774,318	
C1.2 Fire Protection	1.00	6,871	m2	$30.14	$207,065	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$261.25	$1,795,017	
C1.4 Controls	1.00	6,871	m2	$35.41	$243,322	
C2 Electrical						**$1,974,187**
C2.1 Service & Distribution	1.00	6,871	m2	$47.40	$325,659	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$122.69	$842,998	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$117.24	$805,531	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$89,310**
D1.3 Electrical Site Services	1.00	6,871	m2	$13.00	$89,310	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,113,549**
Z1.1 General Requirements	1.00	6,871	m2	$196.48	$1,350,004	
Z1.2 Fees	1.00	6,871	m2	$111.13	$763,545	
Z2 Allowances						**$4,169,096**
Z2.1 Design Allowance	1.00	6,871	m2	$466.74	$3,206,982	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$140.03	$962,113	
Total				**$272 per sf**		**$20,102,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,475**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,220,779**
A1.1 Foundations	1.00	6,871	m2	$177.67	$1,220,779	
A2. Structure						**$1,925,304**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$87.82	$603,393	
A2.3 Roof Construction	1.00	6,871	m2	$192.39	$1,321,911	
A3. Exterior Enclosure						**$2,864,269**
A3.2 Walls Above Grade	0.24	1,633	m2	$439.30	$717,377	
A3.3 Windows & Entrances	0.13	917	m2	$797.72	$731,645	
A3.4 Roof Finish	1.00	6,871	m2	$183.48	$1,260,705	
A3.5 Projections	1.00	6,871	m2	$22.49	$154,543	
B. INTERIORS						
B1 Partitions & Doors						**$1,744,502**
B1.1 Partitions	0.98	6,734	m2	$215.83	$1,453,418	
B1.2 Doors	0.04	269	m2	$1,082.10	$291,084	
B2 Finishes						**$1,083,858**
B2.1 Floor Finishes	0.95	6,527	m2	$88.51	$577,749	
B2.2 Ceiling Finishes	0.95	6,527	m2	$52.58	$343,205	
B2.3 Wall Finishes	1.70	11,668	m2	$13.96	$162,904	
B3 Fittings & Equipment						**$682,968**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$89.67	$616,118	
B3.2 Equipment	1.00	6,871	m2	$9.73	$66,850	
C. SERVICES						
C1 Mechanical						**$4,610,989**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$114.93	$789,676	
C1.2 Fire Protection	1.00	6,871	m2	$29.65	$203,718	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$475.65	$3,268,190	
C1.4 Controls	1.00	6,871	m2	$50.85	$349,405	
C2 Electrical						**$2,140,633**
C2.1 Service & Distribution	1.00	6,871	m2	$55.21	$379,314	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$143.01	$982,611	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$113.33	$778,709	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$91,318**
D1.3 Electrical Site Services	0.12	825	m2	$110.69	$91,318	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,528,076**
Z1.1 General Requirements	1.00	6,871	m2	$235.02	$1,614,810	
Z1.2 Fees	1.00	6,871	m2	$132.92	$913,267	
Z2 Allowances						**$4,986,628**
Z2.1 Design Allowance	1.00	6,871	m2	$558.27	$3,835,853	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$167.48	$1,150,775	
Total				**$323 per sf**		**$23,879,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,669**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,339,413**
A1.1 Foundations	1.00	6,871	m2	$194.94	$1,339,413	
A2. Structure						**$2,007,961**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$91.59	$629,298	
A2.3 Roof Construction	1.00	6,871	m2	$200.65	$1,378,663	
A3. Exterior Enclosure						**$2,987,238**
A3.2 Walls Above Grade	0.24	1,633	m2	$458.16	$748,175	
A3.3 Windows & Entrances	0.13	917	m2	$831.97	$763,056	
A3.4 Roof Finish	1.00	6,871	m2	$191.36	$1,314,830	
A3.5 Projections	1.00	6,871	m2	$23.46	$161,178	
B. INTERIORS						
B1 Partitions & Doors						**$1,819,397**
B1.1 Partitions	0.98	6,734	m2	$225.10	$1,515,816	
B1.2 Doors	0.04	269	m2	$1,128.55	$303,581	
B2 Finishes						**$1,138,197**
B2.1 Floor Finishes	0.95	6,527	m2	$86.70	$565,947	
B2.2 Ceiling Finishes	0.95	6,527	m2	$58.52	$381,989	
B2.3 Wall Finishes	1.70	11,668	m2	$16.31	$190,261	
B3 Fittings & Equipment						**$712,289**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$93.52	$642,569	
B3.2 Equipment	1.00	6,871	m2	$10.15	$69,720	
C. SERVICES						
C1 Mechanical						**$4,929,163**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$122.86	$844,166	
C1.2 Fire Protection	1.00	6,871	m2	$31.69	$217,775	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$508.47	$3,493,706	
C1.4 Controls	1.00	6,871	m2	$54.36	$373,515	
C2 Electrical						**$2,342,804**
C2.1 Service & Distribution	1.00	6,871	m2	$60.42	$415,138	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$156.51	$1,075,413	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$124.04	$852,253	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$95,238**
D1.3 Electrical Site Services	0.12	825	m2	$115.44	$95,238	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,636,611**
Z1.1 General Requirements	1.00	6,871	m2	$245.11	$1,684,136	
Z1.2 Fees	1.00	6,871	m2	$138.62	$952,475	
Z2 Allowances						**$5,200,714**
Z2.1 Design Allowance	1.00	6,871	m2	$582.23	$4,000,534	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$174.67	$1,200,180	
Total				**$341 per sf**		**$25,209,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,683**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,275,631**
A1.1 Foundations	1.00	6,871	m2	$185.65	$1,275,631	
A2. Structure						**$2,016,026**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$91.96	$631,826	
A2.3 Roof Construction	1.00	6,871	m2	$201.46	$1,384,200	
A3. Exterior Enclosure						**$2,999,235**
A3.2 Walls Above Grade	0.24	1,633	m2	$460.00	$751,180	
A3.3 Windows & Entrances	0.13	917	m2	$835.31	$766,120	
A3.4 Roof Finish	1.00	6,871	m2	$192.13	$1,320,110	
A3.5 Projections	1.00	6,871	m2	$23.55	$161,825	
B. INTERIORS						
B1 Partitions & Doors						**$1,826,704**
B1.1 Partitions	0.98	6,734	m2	$226.00	$1,521,904	
B1.2 Doors	0.04	269	m2	$1,133.09	$304,800	
B2 Finishes						**$1,078,827**
B2.1 Floor Finishes	0.95	6,527	m2	$82.18	$536,443	
B2.2 Ceiling Finishes	0.95	6,527	m2	$56.06	$365,890	
B2.3 Wall Finishes	1.70	11,668	m2	$15.13	$176,494	
B3 Fittings & Equipment						**$715,150**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$93.89	$645,150	
B3.2 Equipment	1.00	6,871	m2	$10.19	$70,000	
C. SERVICES						
C1 Mechanical						**$5,050,372**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$125.88	$864,925	
C1.2 Fire Protection	1.00	6,871	m2	$32.47	$223,130	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$520.97	$3,579,617	
C1.4 Controls	1.00	6,871	m2	$55.70	$382,700	
C2 Electrical						**$2,378,481**
C2.1 Service & Distribution	1.00	6,871	m2	$61.34	$421,460	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$158.90	$1,091,790	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$125.93	$865,232	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$95,621**
D1.3 Electrical Site Services	0.12	825	m2	$115.90	$95,621	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,647,200**
Z1.1 General Requirements	1.00	6,871	m2	$246.09	$1,690,900	
Z1.2 Fees	1.00	6,871	m2	$139.18	$956,300	
Z2 Allowances						**$5,221,600**
Z2.1 Design Allowance	1.00	6,871	m2	$584.57	$4,016,600	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$175.37	$1,205,000	
Total				**$342 per sf**		**$25,305,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,600**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,241,189**
A1.1 Foundations	1.00	6,871	m2	$180.64	$1,241,189	
A2. Structure						**$1,975,705**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$90.12	$619,189	
A2.3 Roof Construction	1.00	6,871	m2	$197.43	$1,356,516	
A3. Exterior Enclosure						**$2,939,250**
A3.2 Walls Above Grade	0.24	1,633	m2	$450.80	$736,156	
A3.3 Windows & Entrances	0.13	917	m2	$818.60	$750,798	
A3.4 Roof Finish	1.00	6,871	m2	$188.29	$1,293,708	
A3.5 Projections	1.00	6,871	m2	$23.08	$158,589	
B. INTERIORS						
B1 Partitions & Doors						**$1,790,169**
B1.1 Partitions	0.98	6,734	m2	$221.48	$1,491,465	
B1.2 Doors	0.04	269	m2	$1,110.42	$298,704	
B2 Finishes						**$1,024,740**
B2.1 Floor Finishes	0.95	6,527	m2	$78.48	$512,303	
B2.2 Ceiling Finishes	0.95	6,527	m2	$52.47	$342,473	
B2.3 Wall Finishes	1.70	11,668	m2	$14.57	$169,964	
B3 Fittings & Equipment						**$700,847**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$92.02	$632,247	
B3.2 Equipment	1.00	6,871	m2	$9.98	$68,600	
C. SERVICES						
C1 Mechanical						**$4,883,709**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$121.73	$836,382	
C1.2 Fire Protection	1.00	6,871	m2	$31.40	$215,767	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$503.78	$3,461,490	
C1.4 Controls	1.00	6,871	m2	$53.86	$370,071	
C2 Electrical						**$2,376,103**
C2.1 Service & Distribution	1.00	6,871	m2	$61.28	$421,038	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$158.74	$1,090,698	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$125.80	$864,367	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$93,708**
D1.3 Electrical Site Services	0.12	825	m2	$113.59	$93,708	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,594,256**
Z1.1 General Requirements	1.00	6,871	m2	$241.17	$1,657,082	
Z1.2 Fees	1.00	6,871	m2	$136.40	$937,174	
Z2 Allowances						**$5,117,168**
Z2.1 Design Allowance	1.00	6,871	m2	$572.88	$3,936,268	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$171.87	$1,180,900	
Total				**$334 per sf**		**$24,737,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,499**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,241,189**
A1.1 Foundations	1.00	6,871	m2	$180.64	$1,241,189	
A2. Structure						**$1,929,336**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$88.00	$604,657	
A2.3 Roof Construction	1.00	6,871	m2	$192.79	$1,324,679	
A3. Exterior Enclosure						**$2,870,268**
A3.2 Walls Above Grade	0.24	1,633	m2	$440.22	$718,879	
A3.3 Windows & Entrances	0.13	917	m2	$799.39	$733,177	
A3.4 Roof Finish	1.00	6,871	m2	$183.87	$1,263,345	
A3.5 Projections	1.00	6,871	m2	$22.54	$154,867	
B. INTERIORS						
B1 Partitions & Doors						**$1,748,155**
B1.1 Partitions	0.98	6,734	m2	$216.28	$1,456,462	
B1.2 Doors	0.04	269	m2	$1,084.36	$291,694	
B2 Finishes						**$1,079,500**
B2.1 Floor Finishes	0.95	6,527	m2	$83.00	$541,807	
B2.2 Ceiling Finishes	0.95	6,527	m2	$55.61	$362,963	
B2.3 Wall Finishes	1.70	11,668	m2	$14.97	$174,729	
B3 Fittings & Equipment						**$684,399**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$89.86	$617,409	
B3.2 Equipment	1.00	6,871	m2	$9.75	$66,990	
C. SERVICES						
C1 Mechanical						**$4,681,694**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$116.69	$801,785	
C1.2 Fire Protection	1.00	6,871	m2	$30.10	$206,842	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$482.94	$3,318,305	
C1.4 Controls	1.00	6,871	m2	$51.63	$354,763	
C2 Electrical						**$2,188,203**
C2.1 Service & Distribution	1.00	6,871	m2	$56.43	$387,743	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$146.19	$1,004,446	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$115.85	$796,013	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$91,509**
D1.3 Electrical Site Services	0.12	825	m2	$110.92	$91,509	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,533,370**
Z1.1 General Requirements	1.00	6,871	m2	$235.51	$1,618,191	
Z1.2 Fees	1.00	6,871	m2	$133.19	$915,179	
Z2 Allowances						**$4,997,071**
Z2.1 Design Allowance	1.00	6,871	m2	$559.44	$3,843,886	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$167.83	$1,153,185	
Total				**$325 per sf**		**$24,045,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - PRIMARY SCHOOL 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**6,871**
Cost Per m2	**3,423**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$1,139,138**
A1.1 Foundations	1.00	6,871	m2	$165.79	$1,139,138	
A2. Structure						**$1,882,968**
A2.1 Lowest Floor Construction	1.00	6,871	m2	$85.89	$590,125	
A2.3 Roof Construction	1.00	6,871	m2	$188.16	$1,292,843	
A3. Exterior Enclosure						**$2,801,285**
A3.2 Walls Above Grade	0.24	1,633	m2	$429.64	$701,602	
A3.3 Windows & Entrances	0.13	917	m2	$780.18	$715,556	
A3.4 Roof Finish	1.00	6,871	m2	$179.45	$1,232,983	
A3.5 Projections	1.00	6,871	m2	$22.00	$151,145	
B. INTERIORS						
B1 Partitions & Doors						**$1,706,141**
B1.1 Partitions	0.98	6,734	m2	$211.09	$1,421,458	
B1.2 Doors	0.04	269	m2	$1,058.30	$284,683	
B2 Finishes						**$984,257**
B2.1 Floor Finishes	0.95	6,527	m2	$74.70	$487,627	
B2.2 Ceiling Finishes	0.95	6,527	m2	$50.51	$329,667	
B2.3 Wall Finishes	1.70	11,668	m2	$14.31	$166,964	
B3 Fittings & Equipment						**$667,950**
B3.1 Fittings & Fixtures	1.00	6,871	m2	$87.70	$602,570	
B3.2 Equipment	1.00	6,871	m2	$9.52	$65,380	
C. SERVICES						
C1 Mechanical						**$4,686,745**
C1.1 Plumbing & Drainage	1.00	6,871	m2	$116.82	$802,650	
C1.2 Fire Protection	1.00	6,871	m2	$30.14	$207,065	
C1.3 Heating, Ventilation, Air Cond.	1.00	6,871	m2	$483.46	$3,321,885	
C1.4 Controls	1.00	6,871	m2	$51.69	$355,146	
C2 Electrical						**$2,214,366**
C2.1 Service & Distribution	1.00	6,871	m2	$57.11	$392,379	
C2.2 Lighting, Devices & Heating	1.00	6,871	m2	$147.93	$1,016,456	
C2.3 Systems & Ancillaries	1.00	6,871	m2	$117.24	$805,531	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$89,310**
D1.3 Electrical Site Services	0.12	825	m2	$108.25	$89,310	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,472,485**
Z1.1 General Requirements	1.00	6,871	m2	$229.85	$1,579,301	
Z1.2 Fees	1.00	6,871	m2	$129.99	$893,184	
Z2 Allowances						**$4,876,974**
Z2.1 Design Allowance	1.00	6,871	m2	$545.99	$3,751,504	
Z2.2 Escalation Allowance	1.00	6,871	m2	Excluded		
Z2.3 Construction Allowance	1.00	6,871	m2	$163.80	$1,125,470	
Total				**$318 per sf**		**$23,522,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**1,791**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$465,543**
A1.1 Foundations	1.00	4,835	m2	$96.29	$465,543	
A2. Structure						**$1,647,319**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$147.00	$710,731	
A2.3 Roof Construction	1.00	4,835	m2	$193.71	$936,588	
A3. Exterior Enclosure						**$1,576,643**
A3.2 Walls Above Grade	0.25	1,230	m2	$409.40	$503,562	
A3.3 Windows & Entrances	0.02	119	m2	$1,109.08	$131,981	
A3.4 Roof Finish	1.00	4,835	m2	$182.13	$880,601	
A3.5 Projections	1.00	4,835	m2	$12.51	$60,499	
B. INTERIORS						
B1 Partitions & Doors						**$121,930**
B1.1 Partitions	1.00	4,835	m2	$19.55	$94,521	
B1.2 Doors	0.01	32	m2	$856.52	$27,409	
B2 Finishes						**$90,337**
B2.1 Floor Finishes	1.00	4,835	m2	$14.00	$67,668	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.53	$17,090	
B2.3 Wall Finishes	1.00	4,835	m2	$1.15	$5,578	
B3 Fittings & Equipment						**$158,702**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$12.68	$61,292	
B3.2 Equipment	1.00	4,835	m2	$20.15	$97,410	
C. SERVICES						
C1 Mechanical						**$937,291**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$37.33	$180,488	
C1.2 Fire Protection	1.00	4,835	m2	$35.26	$170,484	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$99.73	$482,214	
C1.4 Controls	1.00	4,835	m2	$21.53	$104,105	
C2 Electrical						**$705,291**
C2.1 Service & Distribution	1.00	4,835	m2	$43.72	$211,401	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$51.33	$248,160	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$50.82	$245,729	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$298,024**
D1.1 Site Development	1.00	4,835	m2	$50.77	$245,461	
D1.3 Electrical Site Services	1.00	4,835	m2	$10.87	$52,564	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$856,826**
Z1.1 General Requirements	1.00	4,835	m2	$122.11	$590,381	
Z1.2 Fees	1.00	4,835	m2	$55.11	$266,445	
Z2 Allowances						**$1,803,422**
Z2.1 Design Allowance	1.00	4,835	m2	$286.91	$1,387,233	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$86.08	$416,189	
Total				**$166 per sf**		**$8,661,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**1,886**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$510,784**
A1.1 Foundations	1.00	4,835	m2	$105.64	$510,784	
A2. Structure						**$1,718,041**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$153.31	$741,244	
A2.3 Roof Construction	1.00	4,835	m2	$202.03	$976,797	
A3. Exterior Enclosure						**$1,644,331**
A3.2 Walls Above Grade	0.25	1,230	m2	$426.98	$525,181	
A3.3 Windows & Entrances	0.02	119	m2	$1,156.70	$137,647	
A3.4 Roof Finish	1.00	4,835	m2	$189.95	$918,407	
A3.5 Projections	1.00	4,835	m2	$13.05	$63,097	
B. INTERIORS						
B1 Partitions & Doors						**$127,164**
B1.1 Partitions	1.00	4,835	m2	$20.39	$98,579	
B1.2 Doors	0.01	32	m2	$893.29	$28,585	
B2 Finishes						**$91,822**
B2.1 Floor Finishes	1.00	4,835	m2	$13.71	$66,286	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.93	$19,022	
B2.3 Wall Finishes	1.00	4,835	m2	$1.35	$6,515	
B3 Fittings & Equipment						**$165,515**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$13.22	$63,923	
B3.2 Equipment	1.00	4,835	m2	$21.01	$101,592	
C. SERVICES						
C1 Mechanical						**$1,001,967**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$39.91	$192,943	
C1.2 Fire Protection	1.00	4,835	m2	$37.69	$182,248	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$106.62	$515,488	
C1.4 Controls	1.00	4,835	m2	$23.02	$111,288	
C2 Electrical						**$771,902**
C2.1 Service & Distribution	1.00	4,835	m2	$47.85	$231,367	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$56.17	$271,598	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$55.62	$268,937	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$310,819**
D1.1 Site Development	1.00	4,835	m2	$52.95	$255,999	
D1.3 Electrical Site Services	1.00	4,835	m2	$11.34	$54,820	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$893,611**
Z1.1 General Requirements	1.00	4,835	m2	$127.35	$615,727	
Z1.2 Fees	1.00	4,835	m2	$57.47	$277,884	
Z2 Allowances						**$1,880,846**
Z2.1 Design Allowance	1.00	4,835	m2	$299.23	$1,446,790	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$89.77	$434,057	
Total				**$175 per sf**		**$9,117,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**1,893**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$486,461**
A1.1 Foundations	1.00	4,835	m2	$100.61	$486,461	
A2. Structure						**$1,724,941**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$153.92	$744,221	
A2.3 Roof Construction	1.00	4,835	m2	$202.84	$980,720	
A3. Exterior Enclosure						**$1,650,935**
A3.2 Walls Above Grade	0.25	1,230	m2	$428.69	$527,290	
A3.3 Windows & Entrances	0.02	119	m2	$1,161.34	$138,200	
A3.4 Roof Finish	1.00	4,835	m2	$190.71	$922,095	
A3.5 Projections	1.00	4,835	m2	$13.10	$63,350	
B. INTERIORS						
B1 Partitions & Doors						**$127,675**
B1.1 Partitions	1.00	4,835	m2	$20.47	$98,975	
B1.2 Doors	0.01	32	m2	$896.88	$28,700	
B2 Finishes						**$87,094**
B2.1 Floor Finishes	1.00	4,835	m2	$12.99	$62,830	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.77	$18,220	
B2.3 Wall Finishes	1.00	4,835	m2	$1.25	$6,044	
B3 Fittings & Equipment						**$166,180**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$13.27	$64,180	
B3.2 Equipment	1.00	4,835	m2	$21.10	$102,000	
C. SERVICES						
C1 Mechanical						**$1,026,606**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$40.89	$197,687	
C1.2 Fire Protection	1.00	4,835	m2	$38.62	$186,730	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$109.24	$528,164	
C1.4 Controls	1.00	4,835	m2	$23.58	$114,025	
C2 Electrical						**$783,656**
C2.1 Service & Distribution	1.00	4,835	m2	$48.58	$234,890	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$57.03	$275,734	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$56.47	$273,033	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$312,067**
D1.1 Site Development	1.00	4,835	m2	$53.16	$257,027	
D1.3 Electrical Site Services	1.00	4,835	m2	$11.38	$55,040	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$897,200**
Z1.1 General Requirements	1.00	4,835	m2	$127.86	$618,200	
Z1.2 Fees	1.00	4,835	m2	$57.70	$279,000	
Z2 Allowances						**$1,888,400**
Z2.1 Design Allowance	1.00	4,835	m2	$300.43	$1,452,600	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$90.13	$435,800	
Total				**$176 per sf**		**$9,151,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**1,854**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$473,327**
A1.1 Foundations	1.00	4,835	m2	$97.90	$473,327	
A2. Structure						**$1,690,442**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$150.85	$729,337	
A2.3 Roof Construction	1.00	4,835	m2	$198.78	$961,106	
A3. Exterior Enclosure						**$1,617,916**
A3.2 Walls Above Grade	0.25	1,230	m2	$420.12	$516,744	
A3.3 Windows & Entrances	0.02	119	m2	$1,138.12	$135,436	
A3.4 Roof Finish	1.00	4,835	m2	$186.90	$903,653	
A3.5 Projections	1.00	4,835	m2	$12.84	$62,083	
B. INTERIORS						
B1 Partitions & Doors						**$125,122**
B1.1 Partitions	1.00	4,835	m2	$20.06	$96,996	
B1.2 Doors	0.01	32	m2	$878.94	$28,126	
B2 Finishes						**$82,877**
B2.1 Floor Finishes	1.00	4,835	m2	$12.41	$60,003	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.53	$17,054	
B2.3 Wall Finishes	1.00	4,835	m2	$1.20	$5,820	
B3 Fittings & Equipment						**$162,856**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$13.01	$62,896	
B3.2 Equipment	1.00	4,835	m2	$20.67	$99,960	
C. SERVICES						
C1 Mechanical						**$992,728**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$39.54	$191,163	
C1.2 Fire Protection	1.00	4,835	m2	$37.35	$180,568	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$105.63	$510,735	
C1.4 Controls	1.00	4,835	m2	$22.81	$110,262	
C2 Electrical						**$782,873**
C2.1 Service & Distribution	1.00	4,835	m2	$48.53	$234,655	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$56.97	$275,458	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$56.41	$272,760	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$305,826**
D1.1 Site Development	1.00	4,835	m2	$52.10	$251,886	
D1.3 Electrical Site Services	1.00	4,835	m2	$11.16	$53,940	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$879,256**
Z1.1 General Requirements	1.00	4,835	m2	$125.30	$605,836	
Z1.2 Fees	1.00	4,835	m2	$56.55	$273,420	
Z2 Allowances						**$1,850,632**
Z2.1 Design Allowance	1.00	4,835	m2	$294.43	$1,423,548	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$88.33	$427,084	
Total				**$172 per sf**		**$8,964,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**1,801**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$473,327**
A1.1 Foundations	1.00	4,835	m2	$97.90	$473,327	
A2. Structure						**$1,650,769**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$147.31	$712,220	
A2.3 Roof Construction	1.00	4,835	m2	$194.12	$938,549	
A3. Exterior Enclosure						**$1,579,945**
A3.2 Walls Above Grade	0.25	1,230	m2	$410.26	$504,617	
A3.3 Windows & Entrances	0.02	119	m2	$1,111.41	$132,257	
A3.4 Roof Finish	1.00	4,835	m2	$182.51	$882,445	
A3.5 Projections	1.00	4,835	m2	$12.54	$60,626	
B. INTERIORS						
B1 Partitions & Doors						**$122,185**
B1.1 Partitions	1.00	4,835	m2	$19.59	$94,719	
B1.2 Doors	0.01	32	m2	$858.31	$27,466	
B2 Finishes						**$87,516**
B2.1 Floor Finishes	1.00	4,835	m2	$13.12	$63,458	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.74	$18,074	
B2.3 Wall Finishes	1.00	4,835	m2	$1.24	$5,983	
B3 Fittings & Equipment						**$159,034**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$12.70	$61,420	
B3.2 Equipment	1.00	4,835	m2	$20.19	$97,614	
C. SERVICES						
C1 Mechanical						**$951,664**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$37.90	$183,256	
C1.2 Fire Protection	1.00	4,835	m2	$35.80	$173,099	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$101.26	$489,608	
C1.4 Controls	1.00	4,835	m2	$21.86	$105,701	
C2 Electrical						**$720,964**
C2.1 Service & Distribution	1.00	4,835	m2	$44.69	$216,099	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$52.47	$253,675	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$51.95	$251,190	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$298,648**
D1.1 Site Development	1.00	4,835	m2	$50.87	$245,975	
D1.3 Electrical Site Services	1.00	4,835	m2	$10.89	$52,674	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$858,620**
Z1.1 General Requirements	1.00	4,835	m2	$122.36	$591,617	
Z1.2 Fees	1.00	4,835	m2	$55.22	$267,003	
Z2 Allowances						**$1,807,199**
Z2.1 Design Allowance	1.00	4,835	m2	$287.52	$1,390,138	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$86.26	$417,061	
Total				**$167 per sf**		**$8,710,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**1,762**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$434,410**
A1.1 Foundations	1.00	4,835	m2	$89.85	$434,410	
A2. Structure						**$1,611,095**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$143.76	$695,103	
A2.3 Roof Construction	1.00	4,835	m2	$189.45	$915,992	
A3. Exterior Enclosure						**$1,541,973**
A3.2 Walls Above Grade	0.25	1,230	m2	$400.40	$492,489	
A3.3 Windows & Entrances	0.02	119	m2	$1,084.70	$129,079	
A3.4 Roof Finish	1.00	4,835	m2	$178.13	$861,237	
A3.5 Projections	1.00	4,835	m2	$12.24	$59,169	
B. INTERIORS						
B1 Partitions & Doors						**$119,248**
B1.1 Partitions	1.00	4,835	m2	$19.12	$92,443	
B1.2 Doors	0.01	32	m2	$837.68	$26,806	
B2 Finishes						**$79,246**
B2.1 Floor Finishes	1.00	4,835	m2	$11.81	$57,112	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.40	$16,416	
B2.3 Wall Finishes	1.00	4,835	m2	$1.18	$5,717	
B3 Fittings & Equipment						**$155,212**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$12.40	$59,944	
B3.2 Equipment	1.00	4,835	m2	$19.70	$95,268	
C. SERVICES						
C1 Mechanical						**$952,690**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$37.94	$183,454	
C1.2 Fire Protection	1.00	4,835	m2	$35.84	$173,285	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$101.37	$490,136	
C1.4 Controls	1.00	4,835	m2	$21.89	$105,815	
C2 Electrical						**$729,584**
C2.1 Service & Distribution	1.00	4,835	m2	$45.23	$218,683	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$53.09	$256,708	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$52.57	$254,193	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$291,471**
D1.1 Site Development	1.00	4,835	m2	$49.65	$240,063	
D1.3 Electrical Site Services	1.00	4,835	m2	$10.63	$51,408	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$837,985**
Z1.1 General Requirements	1.00	4,835	m2	$119.42	$577,399	
Z1.2 Fees	1.00	4,835	m2	$53.90	$260,586	
Z2 Allowances						**$1,763,766**
Z2.1 Design Allowance	1.00	4,835	m2	$280.61	$1,356,728	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$84.19	$407,037	
Total				**$164 per sf**		**$8,517,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**2,273**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$465,543**
A1.1 Foundations	1.00	4,835	m2	$96.29	$465,543	
A2. Structure						**$1,647,319**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$147.00	$710,731	
A2.3 Roof Construction	1.00	4,835	m2	$193.71	$936,588	
A3. Exterior Enclosure						**$1,690,455**
A3.2 Walls Above Grade	0.25	1,230	m2	$409.40	$503,562	
A3.3 Windows & Entrances	0.02	119	m2	$1,109.08	$131,981	
A3.4 Roof Finish	1.00	4,835	m2	$205.67	$994,413	
A3.5 Projections	1.00	4,835	m2	$12.51	$60,499	
B. INTERIORS						
B1 Partitions & Doors						**$121,930**
B1.1 Partitions	1.00	4,835	m2	$19.55	$94,521	
B1.2 Doors	0.01	32	m2	$856.52	$27,409	
B2 Finishes						**$90,337**
B2.1 Floor Finishes	1.00	4,835	m2	$14.00	$67,668	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.53	$17,090	
B2.3 Wall Finishes	1.00	4,835	m2	$1.15	$5,578	
B3 Fittings & Equipment						**$158,702**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$12.68	$61,292	
B3.2 Equipment	1.00	4,835	m2	$20.15	$97,410	
C. SERVICES						
C1 Mechanical						**$2,367,604**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$40.72	$196,872	
C1.2 Fire Protection	1.00	4,835	m2	$35.26	$170,484	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$366.23	$1,770,719	
C1.4 Controls	1.00	4,835	m2	$47.47	$229,528	
C2 Electrical						**$758,795**
C2.1 Service & Distribution	1.00	4,835	m2	$53.11	$256,809	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$53.00	$256,256	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$50.82	$245,729	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$298,024**
D1.1 Site Development	1.00	4,835	m2	$50.77	$245,461	
D1.3 Electrical Site Services	1.00	4,835	m2	$10.87	$52,564	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,091,470**
Z1.1 General Requirements	1.00	4,835	m2	$155.43	$751,490	
Z1.2 Fees	1.00	4,835	m2	$70.32	$339,980	
Z2 Allowances						**$2,297,635**
Z2.1 Design Allowance	1.00	4,835	m2	$365.55	$1,767,419	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$109.66	$530,216	
Total				**$211 per sf**		**$10,988,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**2,396**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$510,784**
A1.1 Foundations	1.00	4,835	m2	$105.64	$510,784	
A2. Structure						**$1,718,041**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$153.31	$741,244	
A2.3 Roof Construction	1.00	4,835	m2	$202.03	$976,797	
A3. Exterior Enclosure						**$1,763,030**
A3.2 Walls Above Grade	0.25	1,230	m2	$426.98	$525,181	
A3.3 Windows & Entrances	0.02	119	m2	$1,156.70	$137,647	
A3.4 Roof Finish	1.00	4,835	m2	$214.50	$1,037,105	
A3.5 Projections	1.00	4,835	m2	$13.05	$63,097	
B. INTERIORS						
B1 Partitions & Doors						**$127,164**
B1.1 Partitions	1.00	4,835	m2	$20.39	$98,579	
B1.2 Doors	0.01	32	m2	$893.29	$28,585	
B2 Finishes						**$91,822**
B2.1 Floor Finishes	1.00	4,835	m2	$13.71	$66,286	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.93	$19,022	
B2.3 Wall Finishes	1.00	4,835	m2	$1.35	$6,515	
B3 Fittings & Equipment						**$165,515**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$13.22	$63,923	
B3.2 Equipment	1.00	4,835	m2	$21.01	$101,592	
C. SERVICES						
C1 Mechanical						**$2,530,977**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$43.53	$210,457	
C1.2 Fire Protection	1.00	4,835	m2	$37.69	$182,248	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$391.50	$1,892,904	
C1.4 Controls	1.00	4,835	m2	$50.75	$245,366	
C2 Electrical						**$830,459**
C2.1 Service & Distribution	1.00	4,835	m2	$58.13	$281,064	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$58.01	$280,458	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$55.62	$268,937	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$310,819**
D1.1 Site Development	1.00	4,835	m2	$52.95	$255,999	
D1.3 Electrical Site Services	1.00	4,835	m2	$11.34	$54,820	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,138,328**
Z1.1 General Requirements	1.00	4,835	m2	$162.10	$783,752	
Z1.2 Fees	1.00	4,835	m2	$73.34	$354,576	
Z2 Allowances						**$2,396,276**
Z2.1 Design Allowance	1.00	4,835	m2	$381.24	$1,843,297	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$114.37	$552,979	
Total				**$223 per sf**		**$11,583,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**2,412**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$486,461**
A1.1 Foundations	1.00	4,835	m2	$100.61	$486,461	
A2. Structure						**$1,724,941**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$153.92	$744,221	
A2.3 Roof Construction	1.00	4,835	m2	$202.84	$980,720	
A3. Exterior Enclosure						**$1,770,110**
A3.2 Walls Above Grade	0.25	1,230	m2	$428.69	$527,290	
A3.3 Windows & Entrances	0.02	119	m2	$1,161.34	$138,200	
A3.4 Roof Finish	1.00	4,835	m2	$215.36	$1,041,270	
A3.5 Projections	1.00	4,835	m2	$13.10	$63,350	
B. INTERIORS						
B1 Partitions & Doors						**$127,675**
B1.1 Partitions	1.00	4,835	m2	$20.47	$98,975	
B1.2 Doors	0.01	32	m2	$896.88	$28,700	
B2 Finishes						**$87,094**
B2.1 Floor Finishes	1.00	4,835	m2	$12.99	$62,830	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.77	$18,220	
B2.3 Wall Finishes	1.00	4,835	m2	$1.25	$6,044	
B3 Fittings & Equipment						**$166,180**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$13.27	$64,180	
B3.2 Equipment	1.00	4,835	m2	$21.10	$102,000	
C. SERVICES						
C1 Mechanical						**$2,593,214**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$44.60	$215,633	
C1.2 Fire Protection	1.00	4,835	m2	$38.62	$186,730	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$401.13	$1,939,451	
C1.4 Controls	1.00	4,835	m2	$52.00	$251,400	
C2 Electrical						**$843,106**
C2.1 Service & Distribution	1.00	4,835	m2	$59.02	$285,344	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$58.89	$284,729	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$56.47	$273,033	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$312,067**
D1.1 Site Development	1.00	4,835	m2	$53.16	$257,027	
D1.3 Electrical Site Services	1.00	4,835	m2	$11.38	$55,040	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,142,900**
Z1.1 General Requirements	1.00	4,835	m2	$162.75	$786,900	
Z1.2 Fees	1.00	4,835	m2	$73.63	$356,000	
Z2 Allowances						**$2,405,900**
Z2.1 Design Allowance	1.00	4,835	m2	$382.77	$1,850,700	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$114.83	$555,200	
Total				**$224 per sf**		**$11,660,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**2,358**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$473,327**
A1.1 Foundations	1.00	4,835	m2	$97.90	$473,327	
A2. Structure						**$1,690,442**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$150.85	$729,337	
A2.3 Roof Construction	1.00	4,835	m2	$198.78	$961,106	
A3. Exterior Enclosure						**$1,734,708**
A3.2 Walls Above Grade	0.25	1,230	m2	$420.12	$516,744	
A3.3 Windows & Entrances	0.02	119	m2	$1,138.12	$135,436	
A3.4 Roof Finish	1.00	4,835	m2	$211.05	$1,020,445	
A3.5 Projections	1.00	4,835	m2	$12.84	$62,083	
B. INTERIORS						
B1 Partitions & Doors						**$125,122**
B1.1 Partitions	1.00	4,835	m2	$20.06	$96,996	
B1.2 Doors	0.01	32	m2	$878.94	$28,126	
B2 Finishes						**$82,877**
B2.1 Floor Finishes	1.00	4,835	m2	$12.41	$60,003	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.53	$17,054	
B2.3 Wall Finishes	1.00	4,835	m2	$1.20	$5,820	
B3 Fittings & Equipment						**$162,856**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$13.01	$62,896	
B3.2 Equipment	1.00	4,835	m2	$20.67	$99,960	
C. SERVICES						
C1 Mechanical						**$2,507,638**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$43.13	$208,517	
C1.2 Fire Protection	1.00	4,835	m2	$37.35	$180,568	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$387.89	$1,875,449	
C1.4 Controls	1.00	4,835	m2	$50.28	$243,104	
C2 Electrical						**$842,263**
C2.1 Service & Distribution	1.00	4,835	m2	$58.96	$285,058	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$58.83	$284,445	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$56.41	$272,760	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$305,826**
D1.1 Site Development	1.00	4,835	m2	$52.10	$251,886	
D1.3 Electrical Site Services	1.00	4,835	m2	$11.16	$53,940	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,120,042**
Z1.1 General Requirements	1.00	4,835	m2	$159.50	$771,162	
Z1.2 Fees	1.00	4,835	m2	$72.16	$348,880	
Z2 Allowances						**$2,357,782**
Z2.1 Design Allowance	1.00	4,835	m2	$375.12	$1,813,686	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$112.53	$544,096	
Total				**$219 per sf**		**$11,403,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BUILDING 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**4,835**
Cost Per m2	**2,288**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$473,327**
A1.1 Foundations	1.00	4,835	m2	$97.90	$473,327	
A2. Structure						**$1,650,769**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$147.31	$712,220	
A2.3 Roof Construction	1.00	4,835	m2	$194.12	$938,549	
A3. Exterior Enclosure						**$1,693,995**
A3.2 Walls Above Grade	0.25	1,230	m2	$410.26	$504,617	
A3.3 Windows & Entrances	0.02	119	m2	$1,111.41	$132,257	
A3.4 Roof Finish	1.00	4,835	m2	$206.10	$996,495	
A3.5 Projections	1.00	4,835	m2	$12.54	$60,626	
B. INTERIORS						
B1 Partitions & Doors						**$122,185**
B1.1 Partitions	1.00	4,835	m2	$19.59	$94,719	
B1.2 Doors	0.01	32	m2	$858.31	$27,466	
B2 Finishes						**$87,516**
B2.1 Floor Finishes	1.00	4,835	m2	$13.12	$63,458	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.74	$18,074	
B2.3 Wall Finishes	1.00	4,835	m2	$1.24	$5,983	
B3 Fittings & Equipment						**$159,034**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$12.70	$61,420	
B3.2 Equipment	1.00	4,835	m2	$20.19	$97,614	
C. SERVICES						
C1 Mechanical						**$2,403,909**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$41.34	$199,891	
C1.2 Fire Protection	1.00	4,835	m2	$35.80	$173,099	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$371.85	$1,797,871	
C1.4 Controls	1.00	4,835	m2	$48.20	$233,048	
C2 Electrical						**$775,657**
C2.1 Service & Distribution	1.00	4,835	m2	$54.29	$262,516	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$54.18	$261,951	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$51.95	$251,190	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$298,648**
D1.1 Site Development	1.00	4,835	m2	$50.87	$245,975	
D1.3 Electrical Site Services	1.00	4,835	m2	$10.89	$52,674	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,093,755**
Z1.1 General Requirements	1.00	4,835	m2	$155.75	$753,063	
Z1.2 Fees	1.00	4,835	m2	$70.46	$340,692	
Z2 Allowances						**$2,302,446**
Z2.1 Design Allowance	1.00	4,835	m2	$366.31	$1,771,120	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$109.89	$531,326	
Total				**$213 per sf**		**$11,061,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - GENERIC WAREHOUSE BUILDING 100% CARBON REDUCTION

CLASS D ESTIMATE (Rev.1)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	**4,835**
Cost Per m2	**2,244**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$434,410**
A1.1 Foundations	1.00	4,835	m2	$89.85	$434,410	
A2. Structure						**$1,611,095**
A2.1 Lowest Floor Construction	1.00	4,835	m2	$143.76	$695,103	
A2.3 Roof Construction	1.00	4,835	m2	$189.45	$915,992	
A3. Exterior Enclosure						**$1,653,283**
A3.2 Walls Above Grade	0.25	1,230	m2	$400.40	$492,489	
A3.3 Windows & Entrances	0.02	119	m2	$1,084.70	$129,079	
A3.4 Roof Finish	1.00	4,835	m2	$201.15	$972,546	
A3.5 Projections	1.00	4,835	m2	$12.24	$59,169	
B. INTERIORS						
B1 Partitions & Doors						**$119,248**
B1.1 Partitions	1.00	4,835	m2	$19.12	$92,443	
B1.2 Doors	0.01	32	m2	$837.68	$26,806	
B2 Finishes						**$79,246**
B2.1 Floor Finishes	1.00	4,835	m2	$11.81	$57,112	
B2.2 Ceiling Finishes	1.00	4,835	m2	$3.40	$16,416	
B2.3 Wall Finishes	1.00	4,835	m2	$1.18	$5,717	
B3 Fittings & Equipment						**$155,212**
B3.1 Fittings & Fixtures	1.00	4,835	m2	$12.40	$59,944	
B3.2 Equipment	1.00	4,835	m2	$19.70	$95,268	
C. SERVICES						
C1 Mechanical						**$2,406,502**
C1.1 Plumbing & Drainage	1.00	4,835	m2	$41.39	$200,107	
C1.2 Fire Protection	1.00	4,835	m2	$35.84	$173,285	
C1.3 Heating, Ventilation, Air Cond.	1.00	4,835	m2	$372.25	$1,799,811	
C1.4 Controls	1.00	4,835	m2	$48.25	$233,299	
C2 Electrical						**$784,931**
C2.1 Service & Distribution	1.00	4,835	m2	$54.94	$265,655	
C2.2 Lighting, Devices & Heating	1.00	4,835	m2	$54.83	$265,083	
C2.3 Systems & Ancillaries	1.00	4,835	m2	$52.57	$254,193	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$291,471**
D1.1 Site Development	1.00	4,835	m2	$49.65	$240,063	
D1.3 Electrical Site Services	1.00	4,835	m2	$10.63	$51,408	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$1,067,469**
Z1.1 General Requirements	1.00	4,835	m2	$152.01	$734,965	
Z1.2 Fees	1.00	4,835	m2	$68.77	$332,504	
Z2 Allowances						**$2,247,111**
Z2.1 Design Allowance	1.00	4,835	m2	$357.51	$1,728,554	
Z2.2 Escalation Allowance	1.00	4,835	m2	Excluded		
Z2.3 Construction Allowance	1.00	4,835	m2	$107.25	$518,557	
Total				**$208 per sf**		**$10,850,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE MURB BASE BUILDING

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

A.W. HOOKER ® QUANTITY SURVEYORS

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,096**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,173,512**
A1.1 Foundations	0.08	784	m2	$2,591.84	$2,032,004	
A1.2 Basement Excavation	0.08	784	m2	$180.50	$141,508	
A2. Structure						**$3,738,167**
A2.1 Lowest Floor Construction	0.08	784	m2	$105.35	$82,591	
A2.2 Upper Floor Construction	0.92	8,613	m2	$394.02	$3,393,653	
A2.3 Roof Construction	0.08	784	m2	$334.08	$261,922	
A3. Exterior Enclosure						**$2,492,795**
A3.2 Walls Above Grade	0.38	3,547	m2	$588.94	$2,088,750	
A3.3 Windows & Entrances	0.04	346	m2	$685.53	$237,270	
A3.4 Roof Finish	0.08	784	m2	$177.82	$139,415	
A3.5 Projections	1.00	9,396	m2	$2.91	$27,361	
B. INTERIORS						
B1 Partitions & Doors						**$2,483,161**
B1.1 Partitions	1.21	11,361	m2	$175.45	$1,993,246	
B1.2 Doors	0.15	1,377	m2	$355.76	$489,915	
B2 Finishes						**$1,413,948**
B2.1 Floor Finishes	0.98	9,241	m2	$88.99	$822,334	
B2.2 Ceiling Finishes	0.98	9,241	m2	$39.25	$362,673	
B2.3 Wall Finishes	1.72	16,129	m2	$14.19	$228,941	
B3 Fittings & Equipment						**$2,043,853**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$92.28	$867,102	
B3.3 Conveying Systems	1.00	9,396	m2	$125.24	$1,176,751	
C. SERVICES						
C1 Mechanical						**$3,780,434**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$182.53	$1,715,051	
C1.2 Fire Protection	1.00	9,396	m2	$36.21	$340,211	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$172.86	$1,624,161	
C1.4 Controls	1.00	9,396	m2	$10.75	$101,010	
C2 Electrical						**$1,791,407**
C2.1 Service & Distribution	1.00	9,396	m2	$50.89	$478,189	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$49.33	$463,487	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$90.44	$849,731	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$79,376**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.45	$79,376	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,066,410**
Z1.1 General Requirements	1.00	9,396	m2	$208.45	$1,958,610	
Z1.2 Fees	1.00	9,396	m2	$117.90	$1,107,800	
Z2 Allowances						**$6,029,297**
Z2.1 Design Allowance	1.00	9,396	m2	$493.23	$4,634,424	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$148.45	$1,394,873	
Total				**$288 per sf**		**$29,092,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,261**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,377,055**
A1.1 Foundations	0.08	784	m2	$2,843.71	$2,229,471	
A1.2 Basement Excavation	0.08	784	m2	$188.24	$147,583	
A2. Structure						**$3,898,654**
A2.1 Lowest Floor Construction	0.08	784	m2	$109.87	$86,137	
A2.2 Upper Floor Construction	0.92	8,613	m2	$410.93	$3,539,350	
A2.3 Roof Construction	0.08	784	m2	$348.43	$273,167	
A3. Exterior Enclosure						**$2,599,816**
A3.2 Walls Above Grade	0.38	3,547	m2	$614.23	$2,178,424	
A3.3 Windows & Entrances	0.04	346	m2	$714.96	$247,456	
A3.4 Roof Finish	0.08	784	m2	$185.46	$145,400	
A3.5 Projections	1.00	9,396	m2	$3.04	$28,535	
B. INTERIORS						
B1 Partitions & Doors						**$2,589,767**
B1.1 Partitions	1.21	11,361	m2	$182.98	$2,078,819	
B1.2 Doors	0.15	1,377	m2	$371.04	$510,948	
B2 Finishes						**$1,476,581**
B2.1 Floor Finishes	0.98	9,241	m2	$87.17	$805,536	
B2.2 Ceiling Finishes	0.98	9,241	m2	$43.68	$403,657	
B2.3 Wall Finishes	1.72	16,129	m2	$16.58	$267,387	
B3 Fittings & Equipment						**$2,131,599**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$96.25	$904,328	
B3.3 Conveying Systems	1.00	9,396	m2	$130.62	$1,227,271	
C. SERVICES						
C1 Mechanical						**$4,041,296**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$195.13	$1,833,396	
C1.2 Fire Protection	1.00	9,396	m2	$38.71	$363,687	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$184.78	$1,736,234	
C1.4 Controls	1.00	9,396	m2	$11.49	$107,980	
C2 Electrical						**$1,960,596**
C2.1 Service & Distribution	1.00	9,396	m2	$55.70	$523,352	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$53.99	$507,261	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$98.98	$929,983	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$82,784**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.81	$82,784	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,198,056**
Z1.1 General Requirements	1.00	9,396	m2	$217.40	$2,042,696	
Z1.2 Fees	1.00	9,396	m2	$122.96	$1,155,360	
Z2 Allowances						**$6,288,146**
Z2.1 Design Allowance	1.00	9,396	m2	$514.41	$4,833,389	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$154.83	$1,454,758	
Total				**$303 per sf**		**$30,644,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,264**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,271,482**
A1.1 Foundations	0.08	784	m2	$2,708.30	$2,123,306	
A1.2 Basement Excavation	0.08	784	m2	$189.00	$148,176	
A2. Structure						**$3,914,311**
A2.1 Lowest Floor Construction	0.08	784	m2	$110.31	$86,483	
A2.2 Upper Floor Construction	0.92	8,613	m2	$412.58	$3,553,564	
A2.3 Roof Construction	0.08	784	m2	$349.83	$274,264	
A3. Exterior Enclosure						**$2,610,257**
A3.2 Walls Above Grade	0.38	3,547	m2	$616.70	$2,187,173	
A3.3 Windows & Entrances	0.04	346	m2	$717.84	$248,450	
A3.4 Roof Finish	0.08	784	m2	$186.20	$145,984	
A3.5 Projections	1.00	9,396	m2	$3.05	$28,650	
B. INTERIORS						
B1 Partitions & Doors						**$2,600,168**
B1.1 Partitions	1.21	11,361	m2	$183.72	$2,087,168	
B1.2 Doors	0.15	1,377	m2	$372.53	$513,000	
B2 Finishes						**$1,398,227**
B2.1 Floor Finishes	0.98	9,241	m2	$82.62	$763,542	
B2.2 Ceiling Finishes	0.98	9,241	m2	$41.84	$386,645	
B2.3 Wall Finishes	1.72	16,129	m2	$15.38	$248,040	
B3 Fittings & Equipment						**$2,140,160**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$96.63	$907,960	
B3.3 Conveying Systems	1.00	9,396	m2	$131.14	$1,232,200	
C. SERVICES						
C1 Mechanical						**$4,140,672**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$199.92	$1,878,479	
C1.2 Fire Protection	1.00	9,396	m2	$39.66	$372,630	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$189.33	$1,778,928	
C1.4 Controls	1.00	9,396	m2	$11.77	$110,635	
C2 Electrical						**$1,990,453**
C2.1 Service & Distribution	1.00	9,396	m2	$56.55	$531,321	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$54.81	$514,986	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$100.48	$944,145	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$83,116**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.85	$83,116	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,210,900**
Z1.1 General Requirements	1.00	9,396	m2	$218.27	$2,050,900	
Z1.2 Fees	1.00	9,396	m2	$123.46	$1,160,000	
Z2 Allowances						**$6,313,400**
Z2.1 Design Allowance	1.00	9,396	m2	$516.48	$4,852,800	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$155.45	$1,460,600	
Total				**$303 per sf**		**$30,673,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE MURB BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,192**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,211,189**
A1.1 Foundations	0.08	784	m2	$2,635.17	$2,065,977	
A1.2 Basement Excavation	0.08	784	m2	$185.22	$145,212	
A2. Structure						**$3,836,025**
A2.1 Lowest Floor Construction	0.08	784	m2	$108.10	$84,754	
A2.2 Upper Floor Construction	0.92	8,613	m2	$404.33	$3,482,493	
A2.3 Roof Construction	0.08	784	m2	$342.83	$268,779	
A3. Exterior Enclosure						**$2,558,052**
A3.2 Walls Above Grade	0.38	3,547	m2	$604.36	$2,143,429	
A3.3 Windows & Entrances	0.04	346	m2	$703.48	$243,481	
A3.4 Roof Finish	0.08	784	m2	$182.48	$143,064	
A3.5 Projections	1.00	9,396	m2	$2.99	$28,077	
B. INTERIORS						
B1 Partitions & Doors						**$2,548,165**
B1.1 Partitions	1.21	11,361	m2	$180.04	$2,045,425	
B1.2 Doors	0.15	1,377	m2	$365.08	$502,740	
B2 Finishes						**$1,329,944**
B2.1 Floor Finishes	0.98	9,241	m2	$78.91	$729,182	
B2.2 Ceiling Finishes	0.98	9,241	m2	$39.16	$361,900	
B2.3 Wall Finishes	1.72	16,129	m2	$14.81	$238,863	
B3 Fittings & Equipment						**$2,097,357**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$94.70	$889,801	
B3.3 Conveying Systems	1.00	9,396	m2	$128.52	$1,207,556	
C. SERVICES						
C1 Mechanical						**$4,004,030**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$193.33	$1,816,489	
C1.2 Fire Protection	1.00	9,396	m2	$38.35	$360,333	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$183.08	$1,720,224	
C1.4 Controls	1.00	9,396	m2	$11.39	$106,984	
C2 Electrical						**$1,988,462**
C2.1 Service & Distribution	1.00	9,396	m2	$56.49	$530,790	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$54.75	$514,471	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$100.38	$943,201	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$81,454**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.67	$81,454	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,146,682**
Z1.1 General Requirements	1.00	9,396	m2	$213.91	$2,009,882	
Z1.2 Fees	1.00	9,396	m2	$120.99	$1,136,800	
Z2 Allowances						**$6,187,132**
Z2.1 Design Allowance	1.00	9,396	m2	$506.15	$4,755,744	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$152.34	$1,431,388	
Total				**$297 per sf**		**$29,988,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE MURB BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,113**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,207,781**
A1.1 Foundations	0.08	784	m2	$2,635.17	$2,065,977	
A1.2 Basement Excavation	0.08	784	m2	$180.87	$141,804	
A2. Structure						**$3,745,996**
A2.1 Lowest Floor Construction	0.08	784	m2	$105.57	$82,764	
A2.2 Upper Floor Construction	0.92	8,613	m2	$394.84	$3,400,761	
A2.3 Roof Construction	0.08	784	m2	$334.78	$262,471	
A3. Exterior Enclosure						**$2,498,016**
A3.2 Walls Above Grade	0.38	3,547	m2	$590.18	$2,093,124	
A3.3 Windows & Entrances	0.04	346	m2	$686.97	$237,767	
A3.4 Roof Finish	0.08	784	m2	$178.20	$139,707	
A3.5 Projections	1.00	9,396	m2	$2.92	$27,418	
B. INTERIORS						
B1 Partitions & Doors						**$2,488,361**
B1.1 Partitions	1.21	11,361	m2	$175.82	$1,997,420	
B1.2 Doors	0.15	1,377	m2	$356.51	$490,941	
B2 Finishes						**$1,400,288**
B2.1 Floor Finishes	0.98	9,241	m2	$83.45	$771,177	
B2.2 Ceiling Finishes	0.98	9,241	m2	$41.51	$383,552	
B2.3 Wall Finishes	1.72	16,129	m2	$15.22	$245,560	
B3 Fittings & Equipment						**$2,048,133**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$92.48	$868,918	
B3.3 Conveying Systems	1.00	9,396	m2	$125.50	$1,179,215	
C. SERVICES						
C1 Mechanical						**$3,838,403**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$185.33	$1,741,350	
C1.2 Fire Protection	1.00	9,396	m2	$36.76	$345,428	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$175.51	$1,649,066	
C1.4 Controls	1.00	9,396	m2	$10.92	$102,559	
C2 Electrical						**$1,831,216**
C2.1 Service & Distribution	1.00	9,396	m2	$52.02	$488,816	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$50.42	$473,787	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$92.45	$868,614	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$79,542**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.47	$79,542	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,072,831**
Z1.1 General Requirements	1.00	9,396	m2	$208.89	$1,962,711	
Z1.2 Fees	1.00	9,396	m2	$118.15	$1,110,120	
Z2 Allowances						**$6,041,924**
Z2.1 Design Allowance	1.00	9,396	m2	$494.27	$4,644,130	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$148.76	$1,397,794	
Total				**$289 per sf**		**$29,252,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE MURB BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.3)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,033**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,034,509**
A1.1 Foundations	0.08	784	m2	$2,418.51	$1,896,112	
A1.2 Basement Excavation	0.08	784	m2	$176.53	$138,396	
A2. Structure						**$3,655,966**
A2.1 Lowest Floor Construction	0.08	784	m2	$103.03	$80,775	
A2.2 Upper Floor Construction	0.92	8,613	m2	$385.35	$3,319,029	
A2.3 Roof Construction	0.08	784	m2	$326.74	$256,163	
A3. Exterior Enclosure						**$2,437,980**
A3.2 Walls Above Grade	0.38	3,547	m2	$575.99	$2,042,819	
A3.3 Windows & Entrances	0.04	346	m2	$670.46	$232,052	
A3.4 Roof Finish	0.08	784	m2	$173.91	$136,349	
A3.5 Projections	1.00	9,396	m2	$2.85	$26,759	
B. INTERIORS						
B1 Partitions & Doors						**$2,428,557**
B1.1 Partitions	1.21	11,361	m2	$171.59	$1,949,415	
B1.2 Doors	0.15	1,377	m2	$347.94	$479,142	
B2 Finishes						**$1,277,072**
B2.1 Floor Finishes	0.98	9,241	m2	$75.10	$694,059	
B2.2 Ceiling Finishes	0.98	9,241	m2	$37.70	$348,367	
B2.3 Wall Finishes	1.72	16,129	m2	$14.55	$234,646	
B3 Fittings & Equipment						**$1,998,909**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$90.25	$848,035	
B3.3 Conveying Systems	1.00	9,396	m2	$122.49	$1,150,875	
C. SERVICES						
C1 Mechanical						**$3,842,544**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$185.53	$1,743,229	
C1.2 Fire Protection	1.00	9,396	m2	$36.80	$345,801	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$175.70	$1,650,845	
C1.4 Controls	1.00	9,396	m2	$10.93	$102,669	
C2 Electrical						**$1,853,111**
C2.1 Service & Distribution	1.00	9,396	m2	$52.65	$494,660	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$51.03	$479,452	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$93.55	$878,999	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$77,631**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.26	$77,631	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$2,998,981**
Z1.1 General Requirements	1.00	9,396	m2	$203.87	$1,915,541	
Z1.2 Fees	1.00	9,396	m2	$115.31	$1,083,440	
Z2 Allowances						**$5,896,716**
Z2.1 Design Allowance	1.00	9,396	m2	$482.39	$4,532,515	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$145.19	$1,364,200	
Total				**$282 per sf**		**$28,502,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.2)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,353**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,173,512**
A1.1 Foundations	0.08	784	m2	$2,591.84	$2,032,004	
A1.2 Basement Excavation	0.08	784	m2	$180.50	$141,508	
A2. Structure						**$3,738,167**
A2.1 Lowest Floor Construction	0.08	784	m2	$105.35	$82,591	
A2.2 Upper Floor Construction	0.92	8,613	m2	$394.02	$3,393,653	
A2.3 Roof Construction	0.08	784	m2	$334.08	$261,922	
A3. Exterior Enclosure						**$2,890,862**
A3.2 Walls Above Grade	0.38	3,547	m2	$696.88	$2,471,842	
A3.3 Windows & Entrances	0.04	346	m2	$685.53	$237,270	
A3.4 Roof Finish	0.08	784	m2	$196.92	$154,389	
A3.5 Projections	1.00	9,396	m2	$2.91	$27,361	
B. INTERIORS						
B1 Partitions & Doors						**$2,483,161**
B1.1 Partitions	1.21	11,361	m2	$175.45	$1,993,246	
B1.2 Doors	0.15	1,377	m2	$355.76	$489,915	
B2 Finishes						**$1,413,952**
B2.1 Floor Finishes	0.98	9,241	m2	$88.99	$822,334	
B2.2 Ceiling Finishes	0.98	9,241	m2	$39.25	$362,673	
B2.3 Wall Finishes	1.72	16,129	m2	$14.19	$228,945	
B3 Fittings & Equipment						**$2,043,853**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$92.28	$867,102	
B3.3 Conveying Systems	1.00	9,396	m2	$125.24	$1,176,751	
C. SERVICES						
C1 Mechanical						**$4,844,395**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$219.27	$2,060,289	
C1.2 Fire Protection	1.00	9,396	m2	$36.21	$340,211	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$231.92	$2,179,153	
C1.4 Controls	1.00	9,396	m2	$28.18	$264,742	
C2 Electrical						**$1,971,984**
C2.1 Service & Distribution	1.00	9,396	m2	$62.25	$584,934	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$57.19	$537,320	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$90.44	$849,731	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$79,376**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.45	$79,376	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,325,788**
Z1.1 General Requirements	1.00	9,396	m2	$226.10	$2,124,398	
Z1.2 Fees	1.00	9,396	m2	$127.86	$1,201,390	
Z2 Allowances						**$6,539,458**
Z2.1 Design Allowance	1.00	9,396	m2	$535.00	$5,026,834	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$160.99	$1,512,625	
Total				**$312 per sf**		**$31,505,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.2)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,533**

Description Element\Sub-Element	Location : Calgary — Elemental Cost — Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,377,055**
A1.1 Foundations	0.08	784	m2	$2,843.71	$2,229,471	
A1.2 Basement Excavation	0.08	784	m2	$188.24	$147,583	
A2. Structure						**$3,898,654**
A2.1 Lowest Floor Construction	0.08	784	m2	$109.87	$86,137	
A2.2 Upper Floor Construction	0.92	8,613	m2	$410.93	$3,539,350	
A2.3 Roof Construction	0.08	784	m2	$348.43	$273,167	
A3. Exterior Enclosure						**$3,014,972**
A3.2 Walls Above Grade	0.38	3,547	m2	$726.80	$2,577,963	
A3.3 Windows & Entrances	0.04	346	m2	$714.96	$247,456	
A3.4 Roof Finish	0.08	784	m2	$205.38	$161,017	
A3.5 Projections	1.00	9,396	m2	$3.04	$28,535	
B. INTERIORS						
B1 Partitions & Doors						**$2,589,767**
B1.1 Partitions	1.21	11,361	m2	$182.98	$2,078,819	
B1.2 Doors	0.15	1,377	m2	$371.04	$510,948	
B2 Finishes						**$1,476,585**
B2.1 Floor Finishes	0.98	9,241	m2	$87.17	$805,536	
B2.2 Ceiling Finishes	0.98	9,241	m2	$43.68	$403,657	
B2.3 Wall Finishes	1.72	16,129	m2	$16.58	$267,391	
B3 Fittings & Equipment						**$2,131,599**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$96.25	$904,328	
B3.3 Conveying Systems	1.00	9,396	m2	$130.62	$1,227,271	
C. SERVICES						
C1 Mechanical						**$5,178,674**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$234.40	$2,202,456	
C1.2 Fire Protection	1.00	9,396	m2	$38.71	$363,687	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$247.93	$2,329,522	
C1.4 Controls	1.00	9,396	m2	$30.12	$283,010	
C2 Electrical						**$2,158,227**
C2.1 Service & Distribution	1.00	9,396	m2	$68.13	$640,177	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$62.59	$588,067	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$98.98	$929,983	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$82,784**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.81	$82,784	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,468,570**
Z1.1 General Requirements	1.00	9,396	m2	$235.80	$2,215,602	
Z1.2 Fees	1.00	9,396	m2	$133.35	$1,252,968	
Z2 Allowances						**$6,820,210**
Z2.1 Design Allowance	1.00	9,396	m2	$557.97	$5,242,645	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$167.90	$1,577,564	
Total				**$328 per sf**		**$33,197,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.2)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,540**

Description Element\Sub-Element	Location : Toronto — Elemental Cost — Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,271,482**
A1.1 Foundations	0.08	784	m2	$2,708.30	$2,123,306	
A1.2 Basement Excavation	0.08	784	m2	$189.00	$148,176	
A2. Structure						**$3,914,311**
A2.1 Lowest Floor Construction	0.08	784	m2	$110.31	$86,483	
A2.2 Upper Floor Construction	0.92	8,613	m2	$412.58	$3,553,564	
A2.3 Roof Construction	0.08	784	m2	$349.83	$274,264	
A3. Exterior Enclosure						**$3,027,080**
A3.2 Walls Above Grade	0.38	3,547	m2	$729.72	$2,588,316	
A3.3 Windows & Entrances	0.04	346	m2	$717.84	$248,450	
A3.4 Roof Finish	0.08	784	m2	$206.20	$161,664	
A3.5 Projections	1.00	9,396	m2	$3.05	$28,650	
B. INTERIORS						
B1 Partitions & Doors						**$2,600,168**
B1.1 Partitions	1.21	11,361	m2	$183.72	$2,087,168	
B1.2 Doors	0.15	1,377	m2	$372.53	$513,000	
B2 Finishes						**$1,398,231**
B2.1 Floor Finishes	0.98	9,241	m2	$82.62	$763,542	
B2.2 Ceiling Finishes	0.98	9,241	m2	$41.84	$386,645	
B2.3 Wall Finishes	1.72	16,129	m2	$15.38	$248,044	
B3 Fittings & Equipment						**$2,140,160**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$96.63	$907,960	
B3.3 Conveying Systems	1.00	9,396	m2	$131.14	$1,232,200	
C. SERVICES						
C1 Mechanical						**$5,306,019**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$240.17	$2,256,615	
C1.2 Fire Protection	1.00	9,396	m2	$39.66	$372,630	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$254.02	$2,386,805	
C1.4 Controls	1.00	9,396	m2	$30.86	$289,969	
C2 Electrical						**$2,191,094**
C2.1 Service & Distribution	1.00	9,396	m2	$69.17	$649,926	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$63.54	$597,022	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$100.48	$944,145	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$83,116**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.85	$83,116	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,482,500**
Z1.1 General Requirements	1.00	9,396	m2	$236.75	$2,224,500	
Z1.2 Fees	1.00	9,396	m2	$133.89	$1,258,000	
Z2 Allowances						**$6,847,600**
Z2.1 Design Allowance	1.00	9,396	m2	$560.21	$5,263,700	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$168.57	$1,583,900	
Total				**$329 per sf**		**$33,262,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.2)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,460**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,211,189**
A1.1 Foundations	0.08	784	m2	$2,635.17	$2,065,977	
A1.2 Basement Excavation	0.08	784	m2	$185.22	$145,212	
A2. Structure						**$3,836,025**
A2.1 Lowest Floor Construction	0.08	784	m2	$108.10	$84,754	
A2.2 Upper Floor Construction	0.92	8,613	m2	$404.33	$3,482,493	
A2.3 Roof Construction	0.08	784	m2	$342.83	$268,779	
A3. Exterior Enclosure						**$2,966,539**
A3.2 Walls Above Grade	0.38	3,547	m2	$715.13	$2,536,550	
A3.3 Windows & Entrances	0.04	346	m2	$703.48	$243,481	
A3.4 Roof Finish	0.08	784	m2	$202.08	$158,431	
A3.5 Projections	1.00	9,396	m2	$2.99	$28,077	
B. INTERIORS						
B1 Partitions & Doors						**$2,548,165**
B1.1 Partitions	1.21	11,361	m2	$180.04	$2,045,425	
B1.2 Doors	0.15	1,377	m2	$365.08	$502,740	
B2 Finishes						**$1,329,948**
B2.1 Floor Finishes	0.98	9,241	m2	$78.91	$729,182	
B2.2 Ceiling Finishes	0.98	9,241	m2	$39.16	$361,900	
B2.3 Wall Finishes	1.72	16,129	m2	$14.81	$238,866	
B3 Fittings & Equipment						**$2,097,357**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$94.70	$889,801	
B3.3 Conveying Systems	1.00	9,396	m2	$128.52	$1,207,556	
C. SERVICES						
C1 Mechanical						**$5,130,920**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$232.24	$2,182,147	
C1.2 Fire Protection	1.00	9,396	m2	$38.35	$360,333	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$245.64	$2,308,040	
C1.4 Controls	1.00	9,396	m2	$29.84	$280,400	
C2 Electrical						**$2,188,902**
C2.1 Service & Distribution	1.00	9,396	m2	$69.10	$649,276	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$63.48	$596,425	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$100.38	$943,201	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$81,454**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.67	$81,454	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,412,850**
Z1.1 General Requirements	1.00	9,396	m2	$232.01	$2,180,010	
Z1.2 Fees	1.00	9,396	m2	$131.21	$1,232,840	
Z2 Allowances						**$6,710,648**
Z2.1 Design Allowance	1.00	9,396	m2	$549.00	$5,158,426	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$165.20	$1,552,222	
Total				**$321 per sf**		**$32,514,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.2)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,372**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,207,781**
A1.1 Foundations	0.08	784	m2	$2,635.17	$2,065,977	
A1.2 Basement Excavation	0.08	784	m2	$180.87	$141,804	
A2. Structure						**$3,745,996**
A2.1 Lowest Floor Construction	0.08	784	m2	$105.57	$82,764	
A2.2 Upper Floor Construction	0.92	8,613	m2	$394.84	$3,400,761	
A2.3 Roof Construction	0.08	784	m2	$334.78	$262,471	
A3. Exterior Enclosure						**$2,896,916**
A3.2 Walls Above Grade	0.38	3,547	m2	$698.34	$2,477,019	
A3.3 Windows & Entrances	0.04	346	m2	$686.97	$237,767	
A3.4 Roof Finish	0.08	784	m2	$197.34	$154,712	
A3.5 Projections	1.00	9,396	m2	$2.92	$27,418	
B. INTERIORS						
B1 Partitions & Doors						**$2,488,361**
B1.1 Partitions	1.21	11,361	m2	$175.82	$1,997,420	
B1.2 Doors	0.15	1,377	m2	$356.51	$490,941	
B2 Finishes						**$1,400,292**
B2.1 Floor Finishes	0.98	9,241	m2	$83.45	$771,177	
B2.2 Ceiling Finishes	0.98	9,241	m2	$41.51	$383,552	
B2.3 Wall Finishes	1.72	16,129	m2	$15.22	$245,564	
B3 Fittings & Equipment						**$2,048,133**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$92.48	$868,918	
B3.3 Conveying Systems	1.00	9,396	m2	$125.50	$1,179,215	
C. SERVICES						
C1 Mechanical						**$4,918,679**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$222.64	$2,091,882	
C1.2 Fire Protection	1.00	9,396	m2	$36.76	$345,428	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$235.48	$2,212,568	
C1.4 Controls	1.00	9,396	m2	$28.61	$268,801	
C2 Electrical						**$2,015,806**
C2.1 Service & Distribution	1.00	9,396	m2	$63.64	$597,932	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$58.46	$549,260	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$92.45	$868,614	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$79,542**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.47	$79,542	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,332,753**
Z1.1 General Requirements	1.00	9,396	m2	$226.57	$2,128,847	
Z1.2 Fees	1.00	9,396	m2	$128.13	$1,203,906	
Z2 Allowances						**$6,553,153**
Z2.1 Design Allowance	1.00	9,396	m2	$536.12	$5,037,361	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$161.32	$1,515,792	
Total				**$313 per sf**		**$31,687,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
MURB 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.2)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**9,396**
Cost Per m2	**3,290**

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$2,034,509**
A1.1 Foundations	0.08	784	m2	$2,418.51	$1,896,112	
A1.2 Basement Excavation	0.08	784	m2	$176.53	$138,396	
A2. Structure						**$3,655,966**
A2.1 Lowest Floor Construction	0.08	784	m2	$103.03	$80,775	
A2.2 Upper Floor Construction	0.92	8,613	m2	$385.35	$3,319,029	
A2.3 Roof Construction	0.08	784	m2	$326.74	$256,163	
A3. Exterior Enclosure						**$2,827,293**
A3.2 Walls Above Grade	0.38	3,547	m2	$681.56	$2,417,487	
A3.3 Windows & Entrances	0.04	346	m2	$670.46	$232,052	
A3.4 Roof Finish	0.08	784	m2	$192.59	$150,994	
A3.5 Projections	1.00	9,396	m2	$2.85	$26,759	
B. INTERIORS						
B1 Partitions & Doors						**$2,428,557**
B1.1 Partitions	1.21	11,361	m2	$171.59	$1,949,415	
B1.2 Doors	0.15	1,377	m2	$347.94	$479,142	
B2 Finishes						**$1,277,076**
B2.1 Floor Finishes	0.98	9,241	m2	$75.10	$694,059	
B2.2 Ceiling Finishes	0.98	9,241	m2	$37.70	$348,367	
B2.3 Wall Finishes	1.72	16,129	m2	$14.55	$234,650	
B3 Fittings & Equipment						**$1,998,909**
B3.1 Fittings & Fixtures	1.00	9,396	m2	$90.25	$848,035	
B3.3 Conveying Systems	1.00	9,396	m2	$122.49	$1,150,875	
C. SERVICES						
C1 Mechanical						**$4,923,985**
C1.1 Plumbing & Drainage	1.00	9,396	m2	$222.88	$2,094,139	
C1.2 Fire Protection	1.00	9,396	m2	$36.80	$345,801	
C1.3 Heating, Ventilation, Air Cond.	1.00	9,396	m2	$235.73	$2,214,955	
C1.4 Controls	1.00	9,396	m2	$28.64	$269,091	
C2 Electrical						**$2,039,908**
C2.1 Service & Distribution	1.00	9,396	m2	$64.40	$605,081	
C2.2 Lighting, Devices & Heating	1.00	9,396	m2	$59.16	$555,828	
C2.3 Systems & Ancillaries	1.00	9,396	m2	$93.55	$878,999	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$77,631**
D1.3 Electrical Site Services	1.00	9,396	m2	$8.26	$77,631	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$3,252,655**
Z1.1 General Requirements	1.00	9,396	m2	$221.12	$2,077,683	
Z1.2 Fees	1.00	9,396	m2	$125.05	$1,174,972	
Z2 Allowances						**$6,395,658**
Z2.1 Design Allowance	1.00	9,396	m2	$523.23	$4,916,296	
Z2.2 Escalation Allowance	1.00	9,396	m2	Excluded		
Z2.3 Construction Allowance	1.00	9,396	m2	$157.45	$1,479,363	
Total				**$306 per sf**		**$30,912,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE
OFFICE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,396**

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,550,094**
A1.1 Foundations	0.07	3,577	m2	$798.72	$2,857,019	
A1.2 Basement Excavation	0.07	3,577	m2	$193.76	$693,075	
A2. Structure						**$27,575,122**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$89.66	$320,721	
A2.2 Upper Floor Construction	0.93	46,319	m2	$561.39	$26,002,878	
A2.3 Roof Construction	0.07	3,563	m2	$351.26	$1,251,523	
A3. Exterior Enclosure						**$9,877,384**
A3.2 Walls Above Grade	0.23	11,590	m2	$790.24	$9,158,870	
A3.3 Windows & Entrances	0.00	18	m2	$3,087.83	$55,581	
A3.4 Roof Finish	0.07	3,563	m2	$171.57	$611,315	
A3.5 Projections	1.00	49,896	m2	$1.03	$51,618	
B. INTERIORS						
B1 Partitions & Doors						**$638,704**
B1.1 Partitions	0.01	700	m2	$382.00	$267,400	
B1.2 Doors	0.01	337	m2	$1,101.79	$371,304	
B2 Finishes						**$6,345,970**
B2.1 Floor Finishes	0.95	47,401	m2	$59.72	$2,830,804	
B2.2 Ceiling Finishes	0.95	47,401	m2	$49.67	$2,354,577	
B2.3 Wall Finishes	1.80	89,813	m2	$12.92	$1,160,589	
B3 Fittings & Equipment						**$2,431,972**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$21.95	$1,094,972	
B3.3 Conveying Systems	1.00	49,896	m2	$26.80	$1,337,000	
C. SERVICES						
C1 Mechanical						**$22,385,481**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$57.34	$2,861,259	
C1.2 Fire Protection	1.00	49,896	m2	$29.06	$1,450,010	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$324.86	$16,209,248	
C1.4 Controls	1.00	49,896	m2	$37.38	$1,864,963	
C2 Electrical						**$12,787,143**
C2.1 Service & Distribution	1.00	49,896	m2	$64.11	$3,198,807	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$101.03	$5,040,766	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$91.14	$4,547,570	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$351,257**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.04	$351,257	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$8,663,474**
Z1.1 General Requirements	1.00	49,896	m2	$117.49	$5,862,459	
Z1.2 Fees	1.00	49,896	m2	$56.14	$2,801,015	
Z2 Allowances						**$24,924,163**
Z2.1 Design Allowance	1.00	49,896	m2	$383.95	$19,157,587	
Z2.2 Escalation Allowance	1.00	49,896	m2	Excluded		
Z2.3 Construction Allowance	1.00	49,896	m2	$115.57	$5,766,577	
Total				**$223 per sf**		**$119,531,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,529**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,857,491**
A1.1 Foundations	0.07	3,577	m2	$876.34	$3,134,661	
A1.2 Basement Excavation	0.07	3,577	m2	$202.08	$722,830	
A2. Structure						**$28,758,976**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$93.51	$334,490	
A2.2 Upper Floor Construction	0.93	46,319	m2	$585.49	$27,119,232	
A2.3 Roof Construction	0.07	3,563	m2	$366.34	$1,305,253	
A3. Exterior Enclosure						**$10,301,439**
A3.2 Walls Above Grade	0.23	11,590	m2	$824.17	$9,552,078	
A3.3 Windows & Entrances	0.00	18	m2	$3,220.40	$57,967	
A3.4 Roof Finish	0.07	3,563	m2	$178.94	$637,560	
A3.5 Projections	1.00	49,896	m2	$1.08	$53,834	
B. INTERIORS						
B1 Partitions & Doors						**$666,125**
B1.1 Partitions	0.01	700	m2	$398.40	$278,880	
B1.2 Doors	0.01	337	m2	$1,149.09	$387,245	
B2 Finishes						**$6,749,126**
B2.1 Floor Finishes	0.95	47,401	m2	$58.50	$2,772,979	
B2.2 Ceiling Finishes	0.95	47,401	m2	$55.29	$2,620,659	
B2.3 Wall Finishes	1.80	89,813	m2	$15.09	$1,355,488	
B3 Fittings & Equipment						**$2,536,382**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$22.89	$1,141,982	
B3.3 Conveying Systems	1.00	49,896	m2	$27.95	$1,394,400	
C. SERVICES						
C1 Mechanical						**$23,930,153**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$61.30	$3,058,696	
C1.2 Fire Protection	1.00	49,896	m2	$31.07	$1,550,066	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$347.28	$17,327,740	
C1.4 Controls	1.00	49,896	m2	$39.96	$1,993,652	
C2 Electrical						**$13,994,818**
C2.1 Service & Distribution	1.00	49,896	m2	$70.16	$3,500,917	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$110.57	$5,516,839	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$99.75	$4,977,062	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$366,337**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.34	$366,337	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$9,035,413**
Z1.1 General Requirements	1.00	49,896	m2	$122.54	$6,114,145	
Z1.2 Fees	1.00	49,896	m2	$58.55	$2,921,268	
Z2 Allowances						**$25,994,206**
Z2.1 Design Allowance	1.00	49,896	m2	$400.43	$19,980,059	
Z2.2 Escalation Allowance	1.00	49,896	m2	Excluded		
Z2.3 Construction Allowance	1.00	49,896	m2	$120.53	$6,014,147	
Total				**$235 per sf**		**$126,190,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,541**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,711,124**
A1.1 Foundations	0.07	3,577	m2	$834.61	$2,985,391	
A1.2 Basement Excavation	0.07	3,577	m2	$202.89	$725,733	
A2. Structure						**$28,874,474**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$93.89	$335,834	
A2.2 Upper Floor Construction	0.93	46,319	m2	$587.84	$27,228,145	
A2.3 Roof Construction	0.07	3,563	m2	$367.81	$1,310,495	
A3. Exterior Enclosure						**$10,342,810**
A3.2 Walls Above Grade	0.23	11,590	m2	$827.48	$9,590,440	
A3.3 Windows & Entrances	0.00	18	m2	$3,233.33	$58,200	
A3.4 Roof Finish	0.07	3,563	m2	$179.66	$640,120	
A3.5 Projections	1.00	49,896	m2	$1.08	$54,050	
B. INTERIORS						
B1 Partitions & Doors						**$668,800**
B1.1 Partitions	0.01	700	m2	$400.00	$280,000	
B1.2 Doors	0.01	337	m2	$1,153.71	$388,800	
B2 Finishes						**$6,396,036**
B2.1 Floor Finishes	0.95	47,401	m2	$55.45	$2,628,416	
B2.2 Ceiling Finishes	0.95	47,401	m2	$52.96	$2,510,210	
B2.3 Wall Finishes	1.80	89,813	m2	$14.00	$1,257,410	
B3 Fittings & Equipment						**$2,546,568**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$22.98	$1,146,568	
B3.3 Conveying Systems	1.00	49,896	m2	$28.06	$1,400,000	
C. SERVICES						
C1 Mechanical						**$24,518,600**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$62.81	$3,133,910	
C1.2 Fire Protection	1.00	49,896	m2	$31.83	$1,588,182	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$355.82	$17,753,832	
C1.4 Controls	1.00	49,896	m2	$40.94	$2,042,676	
C2 Electrical						**$14,207,937**
C2.1 Service & Distribution	1.00	49,896	m2	$71.23	$3,554,230	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$112.25	$5,600,852	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$101.27	$5,052,855	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$367,809**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.37	$367,809	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$9,071,700**
Z1.1 General Requirements	1.00	49,896	m2	$123.03	$6,138,700	
Z1.2 Fees	1.00	49,896	m2	$58.78	$2,933,000	
Z2 Allowances						**$26,098,600**
Z2.1 Design Allowance	1.00	49,896	m2	$402.04	$20,060,300	
Z2.2 Escalation Allowance	1.00	49,896	m2	Excluded		
Z2.3 Construction Allowance	1.00	49,896	m2	$121.02	$6,038,300	
Total				**$236 per sf**		**$126,804,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,485**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,616,004**
A1.1 Foundations	0.07	3,577	m2	$812.07	$2,904,785	
A1.2 Basement Excavation	0.07	3,577	m2	$198.83	$711,218	
A2. Structure						**$28,296,984**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$92.01	$329,117	
A2.2 Upper Floor Construction	0.93	46,319	m2	$576.08	$26,683,582	
A2.3 Roof Construction	0.07	3,563	m2	$360.45	$1,284,285	
A3. Exterior Enclosure						**$10,135,954**
A3.2 Walls Above Grade	0.23	11,590	m2	$810.93	$9,398,631	
A3.3 Windows & Entrances	0.00	18	m2	$3,168.67	$57,036	
A3.4 Roof Finish	0.07	3,563	m2	$176.06	$627,318	
A3.5 Projections	1.00	49,896	m2	$1.06	$52,969	
B. INTERIORS						
B1 Partitions & Doors						**$655,424**
B1.1 Partitions	0.01	700	m2	$392.00	$274,400	
B1.2 Doors	0.01	337	m2	$1,130.64	$381,024	
B2 Finishes						**$6,070,580**
B2.1 Floor Finishes	0.95	47,401	m2	$52.96	$2,510,137	
B2.2 Ceiling Finishes	0.95	47,401	m2	$49.57	$2,349,557	
B2.3 Wall Finishes	1.80	89,813	m2	$13.48	$1,210,886	
B3 Fittings & Equipment						**$2,495,637**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$22.52	$1,123,637	
B3.3 Conveying Systems	1.00	49,896	m2	$27.50	$1,372,000	
C. SERVICES						
C1 Mechanical						**$23,709,486**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$60.74	$3,030,491	
C1.2 Fire Protection	1.00	49,896	m2	$30.78	$1,535,772	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$344.07	$17,167,955	
C1.4 Controls	1.00	49,896	m2	$39.59	$1,975,268	
C2 Electrical						**$14,193,729**
C2.1 Service & Distribution	1.00	49,896	m2	$71.16	$3,550,676	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$112.14	$5,595,251	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$101.17	$5,047,802	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$360,452**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.22	$360,452	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$8,890,266**
Z1.1 General Requirements	1.00	49,896	m2	$120.57	$6,015,926	
Z1.2 Fees	1.00	49,896	m2	$57.61	$2,874,340	
Z2 Allowances						**$25,576,628**
Z2.1 Design Allowance	1.00	49,896	m2	$394.00	$19,659,094	
Z2.2 Escalation Allowance	1.00	49,896	m2	Excluded		
Z2.3 Construction Allowance	1.00	49,896	m2	$118.60	$5,917,534	
Total				**$231 per sf**		**$124,001,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
NOVEMBER 22, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,413**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,599,312**
A1.1 Foundations	0.07	3,577	m2	$812.07	$2,904,785	
A1.2 Basement Excavation	0.07	3,577	m2	$194.16	$694,526	
A2. Structure						**$27,632,871**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$89.85	$321,393	
A2.2 Upper Floor Construction	0.93	46,319	m2	$562.56	$26,057,335	
A2.3 Roof Construction	0.07	3,563	m2	$351.99	$1,254,144	
A3. Exterior Enclosure						**$9,898,069**
A3.2 Walls Above Grade	0.23	11,590	m2	$791.89	$9,178,051	
A3.3 Windows & Entrances	0.00	18	m2	$3,094.30	$55,697	
A3.4 Roof Finish	0.07	3,563	m2	$171.93	$612,595	
A3.5 Projections	1.00	49,896	m2	$1.04	$51,726	
B. INTERIORS						
B1 Partitions & Doors						**$640,042**
B1.1 Partitions	0.01	700	m2	$382.80	$267,960	
B1.2 Doors	0.01	337	m2	$1,104.10	$372,082	
B2 Finishes						**$6,389,664**
B2.1 Floor Finishes	0.95	47,401	m2	$56.01	$2,654,700	
B2.2 Ceiling Finishes	0.95	47,401	m2	$52.53	$2,490,128	
B2.3 Wall Finishes	1.80	89,813	m2	$13.86	$1,244,836	
B3 Fittings & Equipment						**$2,437,066**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$21.99	$1,097,266	
B3.3 Conveying Systems	1.00	49,896	m2	$26.85	$1,339,800	
C. SERVICES						
C1 Mechanical						**$22,728,742**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$58.22	$2,905,134	
C1.2 Fire Protection	1.00	49,896	m2	$29.51	$1,472,245	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$329.84	$16,457,802	
C1.4 Controls	1.00	49,896	m2	$37.95	$1,893,561	
C2 Electrical						**$13,071,302**
C2.1 Service & Distribution	1.00	49,896	m2	$65.53	$3,269,892	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$103.27	$5,152,783	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$93.17	$4,648,627	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$351,993**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.05	$351,993	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$8,681,617**
Z1.1 General Requirements	1.00	49,896	m2	$117.74	$5,874,736	
Z1.2 Fees	1.00	49,896	m2	$56.25	$2,806,881	
Z2 Allowances						**$24,976,360**
Z2.1 Design Allowance	1.00	49,896	m2	$384.75	$19,197,707	
Z2.2 Escalation Allowance	1.00	49,896	m2	Excluded		
Z2.3 Construction Allowance	1.00	49,896	m2	$115.81	$5,778,653	
Total				**$224 per sf**		**$120,407,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE BASE BUILDING

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
NOVEMBER 22, 2018

Gross Floor Area (m2)	49,896
Cost Per m2	2,365

Description Element\Sub-Element	Location : Halifax — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						$3,343,789
A1.1 Foundations	0.07	3,577	m2	$745.30	$2,665,954	
A1.2 Basement Excavation	0.07	3,577	m2	$189.50	$677,835	
A2. Structure						$26,968,758
A2.1 Lowest Floor Construction	0.07	3,577	m2	$87.69	$313,668	
A2.2 Upper Floor Construction	0.93	46,319	m2	$549.04	$25,431,087	
A2.3 Roof Construction	0.07	3,563	m2	$343.53	$1,224,002	
A3. Exterior Enclosure						$9,660,185
A3.2 Walls Above Grade	0.23	11,590	m2	$772.86	$8,957,471	
A3.3 Windows & Entrances	0.00	18	m2	$3,019.93	$54,359	
A3.4 Roof Finish	0.07	3,563	m2	$167.80	$597,872	
A3.5 Projections	1.00	49,896	m2	$1.01	$50,483	
B. INTERIORS						
B1 Partitions & Doors						$624,659
B1.1 Partitions	0.01	700	m2	$373.60	$261,520	
B1.2 Doors	0.01	337	m2	$1,077.56	$363,139	
B2 Finishes						$5,840,439
B2.1 Floor Finishes	0.95	47,401	m2	$50.40	$2,389,230	
B2.2 Ceiling Finishes	0.95	47,401	m2	$47.71	$2,261,699	
B2.3 Wall Finishes	1.80	89,813	m2	$13.24	$1,189,510	
B3 Fittings & Equipment						$2,378,495
B3.1 Fittings & Fixtures	1.00	49,896	m2	$21.46	$1,070,895	
B3.3 Conveying Systems	1.00	49,896	m2	$26.21	$1,307,600	
C. SERVICES						
C1 Mechanical						$22,753,260
C1.1 Plumbing & Drainage	1.00	49,896	m2	$58.29	$2,908,268	
C1.2 Fire Protection	1.00	49,896	m2	$29.54	$1,473,833	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$330.20	$16,475,556	
C1.4 Controls	1.00	49,896	m2	$37.99	$1,895,604	
C2 Electrical						$13,227,589
C2.1 Service & Distribution	1.00	49,896	m2	$66.32	$3,308,988	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$104.51	$5,214,393	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$94.28	$4,704,208	
D. SITE & ANCILLARY WORK						
D1 Site Work						$343,533
D1.3 Electrical Site Services	1.00	49,896	m2	$6.88	$343,533	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						$8,472,968
Z1.1 General Requirements	1.00	49,896	m2	$114.91	$5,733,546	
Z1.2 Fees	1.00	49,896	m2	$54.90	$2,739,422	
Z2 Allowances						$24,376,092
Z2.1 Design Allowance	1.00	49,896	m2	$375.51	$18,736,320	
Z2.2 Escalation Allowance	1.00	49,896	m2	Excluded		
Z2.3 Construction Allowance	1.00	49,896	m2	$113.03	$5,639,772	
Total					$220 per sf	$117,990,000

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
DECEMBER 06, 2018

Gross Floor Area (m2)	49,896
Cost Per m2	2,460

Description Element\Sub-Element	Location : Vancouver — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						$3,550,094
A1.1 Foundations	0.07	3,577	m2	$798.72	$2,857,019	
A1.2 Basement Excavation	0.07	3,577	m2	$193.76	$693,075	
A2. Structure						$27,575,122
A2.1 Lowest Floor Construction	0.07	3,577	m2	$89.66	$320,721	
A2.2 Upper Floor Construction	0.93	46,319	m2	$561.39	$26,002,878	
A2.3 Roof Construction	0.07	3,563	m2	$351.26	$1,251,523	
A3. Exterior Enclosure						$11,337,848
A3.2 Walls Above Grade	0.23	11,590	m2	$910.38	$10,551,281	
A3.3 Windows & Entrances	0.00	18	m2	$3,087.83	$55,581	
A3.4 Roof Finish	0.07	3,563	m2	$190.67	$679,368	
A3.5 Projections	1.00	49,896	m2	$1.03	$51,618	
B. INTERIORS						
B1 Partitions & Doors						$638,704
B1.1 Partitions	0.01	700	m2	$382.00	$267,400	
B1.2 Doors	0.01	337	m2	$1,101.79	$371,304	
B2 Finishes						$5,374,746
B2.1 Floor Finishes	0.95	47,401	m2	$59.72	$2,830,804	
B2.2 Ceiling Finishes	0.95	47,401	m2	$29.18	$1,383,353	
B2.3 Wall Finishes	1.80	89,813	m2	$12.92	$1,160,589	
B3 Fittings & Equipment						$8,170,953
B3.1 Fittings & Fixtures	1.00	49,896	m2	$21.95	$1,094,972	
B3.2 Equipment	1.00	49,896	m2	$115.02	$5,738,981	
B3.3 Conveying Systems	1.00	49,896	m2	$26.80	$1,337,000	
C. SERVICES						
C1 Mechanical						$17,179,540
C1.1 Plumbing & Drainage	1.00	49,896	m2	$55.39	$2,763,720	
C1.2 Fire Protection	1.00	49,896	m2	$29.06	$1,450,010	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$221.40	$11,046,928	
C1.4 Controls	1.00	49,896	m2	$38.46	$1,918,881	
C2 Electrical						$14,138,805
C2.1 Service & Distribution	1.00	49,896	m2	$74.10	$3,697,322	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$118.12	$5,893,913	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$91.14	$4,547,570	
D. SITE & ANCILLARY WORK						
D1 Site Work						$351,257
D1.3 Electrical Site Services	1.00	49,896	m2	$7.04	$351,257	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						$8,882,455
Z1.1 General Requirements	1.00	49,896	m2	$120.47	$6,010,770	
Z1.2 Fees	1.00	49,896	m2	$57.55	$2,871,685	
Z2 Allowances						$25,553,031
Z2.1 Design Allowance	1.00	49,896	m2	$393.64	$19,641,294	
Z2.3 Construction Allowance	1.00	49,896	m2	$118.48	$5,911,737	
Total					$229 per sf	$122,753,000

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
DECEMBER 06, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,594**

Description Element\Sub-Element	Location : Calgary — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,857,491**
A1.1 Foundations	0.07	3,577	m2	$876.34	$3,134,661	
A1.2 Basement Excavation	0.07	3,577	m2	$202.08	$722,830	
A2. Structure						**$28,758,976**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$93.51	$334,490	
A2.2 Upper Floor Construction	0.93	46,319	m2	$585.49	$27,119,232	
A2.3 Roof Construction	0.07	3,563	m2	$366.34	$1,305,253	
A3. Exterior Enclosure						**$11,824,604**
A3.2 Walls Above Grade	0.23	11,590	m2	$949.46	$11,004,268	
A3.3 Windows & Entrances	0.00	18	m2	$3,220.40	$57,967	
A3.4 Roof Finish	0.07	3,563	m2	$198.86	$708,534	
A3.5 Projections	1.00	49,896	m2	$1.08	$53,834	
B. INTERIORS						
B1 Partitions & Doors						**$666,125**
B1.1 Partitions	0.01	700	m2	$398.40	$278,880	
B1.2 Doors	0.01	337	m2	$1,149.09	$387,245	
B2 Finishes						**$5,668,148**
B2.1 Floor Finishes	0.95	47,401	m2	$58.50	$2,772,979	
B2.2 Ceiling Finishes	0.95	47,401	m2	$32.48	$1,539,681	
B2.3 Wall Finishes	1.80	89,813	m2	$15.09	$1,355,488	
B3 Fittings & Equipment						**$8,521,748**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$22.89	$1,141,982	
B3.2 Equipment	1.00	49,896	m2	$119.96	$5,985,366	
B3.3 Conveying Systems	1.00	49,896	m2	$27.95	$1,394,400	
C. SERVICES						
C1 Mechanical						**$18,364,984**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$59.21	$2,954,426	
C1.2 Fire Protection	1.00	49,896	m2	$31.07	$1,550,066	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$236.68	$11,809,202	
C1.4 Controls	1.00	49,896	m2	$41.11	$2,051,290	
C2 Electrical						**$15,474,136**
C2.1 Service & Distribution	1.00	49,896	m2	$81.10	$4,046,514	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$129.28	$6,450,560	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$99.75	$4,977,062	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$366,337**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.34	$366,337	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$9,263,796**
Z1.1 General Requirements	1.00	49,896	m2	$125.64	$6,268,824	
Z1.2 Fees	1.00	49,896	m2	$60.02	$2,994,972	
Z2 Allowances						**$26,650,072**
Z2.1 Design Allowance	1.00	49,896	m2	$410.54	$20,484,533	
Z2.3 Construction Allowance	1.00	49,896	m2	$123.57	$6,165,539	
Total				**$241 per sf**		**$129,416,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
DECEMBER 06, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,605**

Description Element\Sub-Element	Location : Toronto — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,711,124**
A1.1 Foundations	0.07	3,577	m2	$834.61	$2,985,391	
A1.2 Basement Excavation	0.07	3,577	m2	$202.89	$725,733	
A2. Structure						**$28,874,474**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$93.89	$335,834	
A2.2 Upper Floor Construction	0.93	46,319	m2	$587.84	$27,228,145	
A2.3 Roof Construction	0.07	3,563	m2	$367.81	$1,310,495	
A3. Exterior Enclosure						**$11,872,092**
A3.2 Walls Above Grade	0.23	11,590	m2	$953.28	$11,048,462	
A3.3 Windows & Entrances	0.00	18	m2	$3,233.33	$58,200	
A3.4 Roof Finish	0.07	3,563	m2	$199.66	$711,380	
A3.5 Projections	1.00	49,896	m2	$1.08	$54,050	
B. INTERIORS						
B1 Partitions & Doors						**$668,800**
B1.1 Partitions	0.01	700	m2	$400.00	$280,000	
B1.2 Doors	0.01	337	m2	$1,153.71	$388,800	
B2 Finishes						**$5,360,616**
B2.1 Floor Finishes	0.95	47,401	m2	$55.45	$2,628,416	
B2.2 Ceiling Finishes	0.95	47,401	m2	$31.11	$1,474,790	
B2.3 Wall Finishes	1.80	89,813	m2	$14.00	$1,257,410	
B3 Fittings & Equipment						**$8,555,972**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$22.98	$1,146,568	
B3.2 Equipment	1.00	49,896	m2	$120.44	$6,009,404	
B3.3 Conveying Systems	1.00	49,896	m2	$28.06	$1,400,000	
C. SERVICES						
C1 Mechanical						**$18,816,582**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$60.67	$3,027,076	
C1.2 Fire Protection	1.00	49,896	m2	$31.83	$1,588,182	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$242.50	$12,099,592	
C1.4 Controls	1.00	49,896	m2	$42.12	$2,101,732	
C2 Electrical						**$15,709,783**
C2.1 Service & Distribution	1.00	49,896	m2	$82.33	$4,108,136	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$131.25	$6,548,792	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$101.27	$5,052,855	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$367,809**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.37	$367,809	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$9,301,000**
Z1.1 General Requirements	1.00	49,896	m2	$126.14	$6,294,000	
Z1.2 Fees	1.00	49,896	m2	$60.27	$3,007,000	
Z2 Allowances						**$26,757,100**
Z2.1 Design Allowance	1.00	49,896	m2	$412.19	$20,566,800	
Z2.3 Construction Allowance	1.00	49,896	m2	$124.06	$6,190,300	
Total				**$242 per sf**		**$129,995,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
DECEMBER 06, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,551**

Description Element\Sub-Element	Location : Ottawa — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,616,004**
A1.1 Foundations	0.07	3,577	m2	$812.07	$2,904,785	
A1.2 Basement Excavation	0.07	3,577	m2	$198.83	$711,218	
A2. Structure						**$28,296,984**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$92.01	$329,117	
A2.2 Upper Floor Construction	0.93	46,319	m2	$576.08	$26,683,582	
A2.3 Roof Construction	0.07	3,563	m2	$360.45	$1,284,285	
A3. Exterior Enclosure						**$11,634,650**
A3.2 Walls Above Grade	0.23	11,590	m2	$934.21	$10,827,493	
A3.3 Windows & Entrances	0.00	18	m2	$3,168.67	$57,036	
A3.4 Roof Finish	0.07	3,563	m2	$195.66	$697,152	
A3.5 Projections	1.00	49,896	m2	$1.06	$52,969	
B. INTERIORS						
B1 Partitions & Doors						**$655,424**
B1.1 Partitions	0.01	700	m2	$392.00	$274,400	
B1.2 Doors	0.01	337	m2	$1,130.64	$381,024	
B2 Finishes						**$5,101,427**
B2.1 Floor Finishes	0.95	47,401	m2	$52.96	$2,510,137	
B2.2 Ceiling Finishes	0.95	47,401	m2	$29.12	$1,380,403	
B2.3 Wall Finishes	1.80	89,813	m2	$13.48	$1,210,886	
B3 Fittings & Equipment						**$8,384,853**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$22.52	$1,123,637	
B3.2 Equipment	1.00	49,896	m2	$118.03	$5,889,216	
B3.3 Conveying Systems	1.00	49,896	m2	$27.50	$1,372,000	
C. SERVICES						
C1 Mechanical						**$18,195,635**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$58.67	$2,927,182	
C1.2 Fire Protection	1.00	49,896	m2	$30.78	$1,535,772	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$234.49	$11,700,306	
C1.4 Controls	1.00	49,896	m2	$40.73	$2,032,375	
C2 Electrical						**$15,694,073**
C2.1 Service & Distribution	1.00	49,896	m2	$82.25	$4,104,028	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$131.12	$6,542,243	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$101.17	$5,047,802	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$360,452**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.22	$360,452	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$9,114,980**
Z1.1 General Requirements	1.00	49,896	m2	$123.62	$6,168,120	
Z1.2 Fees	1.00	49,896	m2	$59.06	$2,946,860	
Z2 Allowances						**$26,221,958**
Z2.1 Design Allowance	1.00	49,896	m2	$403.95	$20,155,464	
Z2.3 Construction Allowance	1.00	49,896	m2	$121.58	$6,066,494	
Total				**$237 per sf**		**$127,276,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE 100% CARBON REDUCTION

A.W. HOOKER ® QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
DECEMBER 06, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,476**

Description Element\Sub-Element	Location : Montreal — Elemental Cost: Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,599,312**
A1.1 Foundations	0.07	3,577	m2	$812.07	$2,904,785	
A1.2 Basement Excavation	0.07	3,577	m2	$194.16	$694,526	
A2. Structure						**$27,632,871**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$89.85	$321,393	
A2.2 Upper Floor Construction	0.93	46,319	m2	$562.56	$26,057,335	
A2.3 Roof Construction	0.07	3,563	m2	$351.99	$1,254,144	
A3. Exterior Enclosure						**$11,361,592**
A3.2 Walls Above Grade	0.23	11,590	m2	$912.28	$10,573,378	
A3.3 Windows & Entrances	0.00	18	m2	$3,094.30	$55,697	
A3.4 Roof Finish	0.07	3,563	m2	$191.07	$680,791	
A3.5 Projections	1.00	49,896	m2	$1.04	$51,726	
B. INTERIORS						
B1 Partitions & Doors						**$640,042**
B1.1 Partitions	0.01	700	m2	$382.80	$267,960	
B1.2 Doors	0.01	337	m2	$1,104.10	$372,082	
B2 Finishes						**$5,362,528**
B2.1 Floor Finishes	0.95	47,401	m2	$56.01	$2,654,700	
B2.2 Ceiling Finishes	0.95	47,401	m2	$30.86	$1,462,992	
B2.3 Wall Finishes	1.80	89,813	m2	$13.86	$1,244,836	
B3 Fittings & Equipment						**$8,188,065**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$21.99	$1,097,266	
B3.2 Equipment	1.00	49,896	m2	$115.26	$5,751,000	
B3.3 Conveying Systems	1.00	49,896	m2	$26.85	$1,339,800	
C. SERVICES						
C1 Mechanical						**$17,442,972**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$56.24	$2,806,099	
C1.2 Fire Protection	1.00	49,896	m2	$29.51	$1,472,245	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$224.79	$11,216,322	
C1.4 Controls	1.00	49,896	m2	$39.05	$1,948,305	
C2 Electrical						**$14,453,000**
C2.1 Service & Distribution	1.00	49,896	m2	$75.75	$3,779,485	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$120.75	$6,024,888	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$93.17	$4,648,627	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$351,993**
D1.3 Electrical Site Services	1.00	49,896	m2	$7.05	$351,993	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$8,901,057**
Z1.1 General Requirements	1.00	49,896	m2	$120.72	$6,023,358	
Z1.2 Fees	1.00	49,896	m2	$57.67	$2,877,699	
Z2 Allowances						**$25,606,545**
Z2.1 Design Allowance	1.00	49,896	m2	$394.47	$19,682,428	
Z2.3 Construction Allowance	1.00	49,896	m2	$118.73	$5,924,117	
Total				**$230 per sf**		**$123,540,000**

ELEMENTAL SUMMARY

CARBON COSTING STUDY - HIGH RISE OFFICE 100% CARBON REDUCTION

A.W. HOOKER ®
QUANTITY SURVEYORS

CLASS D ESTIMATE (Rev.4)
DECEMBER 06, 2018

Gross Floor Area (m2)	**49,896**
Cost Per m2	**2,426**

Description Element\Sub-Element	Location : Halifax Elemental Cost Ratio	Quantity	Unit	Unit Rate	Sub Element	Element Total
A. SHELL						
A1. Sub-Structure						**$3,343,789**
A1.1 Foundations	0.07	3,577	m2	$745.30	$2,665,954	
A1.2 Basement Excavation	0.07	3,577	m2	$189.50	$677,835	
A2. Structure						**$26,968,758**
A2.1 Lowest Floor Construction	0.07	3,577	m2	$87.69	$313,668	
A2.2 Upper Floor Construction	0.93	46,319	m2	$549.04	$25,431,087	
A2.3 Roof Construction	0.07	3,563	m2	$343.53	$1,224,002	
A3. Exterior Enclosure						**$11,088,534**
A3.2 Walls Above Grade	0.23	11,590	m2	$890.36	$10,319,264	
A3.3 Windows & Entrances	0.00	18	m2	$3,019.93	$54,359	
A3.4 Roof Finish	0.07	3,563	m2	$186.48	$664,429	
A3.5 Projections	1.00	49,896	m2	$1.01	$50,483	
B. INTERIORS						
B1 Partitions & Doors						**$624,659**
B1.1 Partitions	0.01	700	m2	$373.60	$261,520	
B1.2 Doors	0.01	337	m2	$1,077.56	$363,139	
B2 Finishes						**$4,907,526**
B2.1 Floor Finishes	0.95	47,401	m2	$50.40	$2,389,230	
B2.2 Ceiling Finishes	0.95	47,401	m2	$28.03	$1,328,786	
B2.3 Wall Finishes	1.80	89,813	m2	$13.24	$1,189,510	
B3 Fittings & Equipment						**$7,991,278**
B3.1 Fittings & Fixtures	1.00	49,896	m2	$21.46	$1,070,895	
B3.2 Equipment	1.00	49,896	m2	$112.49	$5,612,783	
B3.3 Conveying Systems	1.00	49,896	m2	$26.21	$1,307,600	
C. SERVICES						
C1 Mechanical						**$17,461,788**
C1.1 Plumbing & Drainage	1.00	49,896	m2	$56.30	$2,809,127	
C1.2 Fire Protection	1.00	49,896	m2	$29.54	$1,473,833	
C1.3 Heating, Ventilation, Air Cond.	1.00	49,896	m2	$225.04	$11,228,422	
C1.4 Controls	1.00	49,896	m2	$39.09	$1,950,407	
C2 Electrical						**$14,625,808**
C2.1 Service & Distribution	1.00	49,896	m2	$76.65	$3,824,675	
C2.2 Lighting, Devices & Heating	1.00	49,896	m2	$122.19	$6,096,925	
C2.3 Systems & Ancillaries	1.00	49,896	m2	$94.28	$4,704,208	
D. SITE & ANCILLARY WORK						
D1 Site Work						**$343,533**
D1.3 Electrical Site Services	1.00	49,896	m2	$6.88	$343,533	
Z. GENERAL REQUIREMENTS & ALLOWANCES						
Z1 General Requirements & Fees						**$8,687,134**
Z1.1 General Requirements	1.00	49,896	m2	$117.82	$5,878,596	
Z1.2 Fees	1.00	49,896	m2	$56.29	$2,808,538	
Z2 Allowances						**$24,991,131**
Z2.1 Design Allowance	1.00	49,896	m2	$384.99	$19,209,391	
Z2.3 Construction Allowance	1.00	49,896	m2	$115.88	$5,781,740	
Total				**$225 per sf**		**$121,034,000**

Canada Green Building Council
Every Building Greener

Conseil du bâtiment durable du Canada
Verdir tous les bâtiments

Canada Green Building Council

100 Murray Street, Suite 400
Ottawa, ON K1N 0A1
Telephone: +1 (613) 241-1184
Fax: +1 (613) 241-4782
Toll-free: +1 (866) 941-1184
zerocarbon@cagbc.org

cagbc.org/zerocarbon

Global Headquarters

1600, boul. René-Lévesque Ouest, 16e étage
Montréal , Québec H3H 1P9
Tel: +1 514-340-0046
Fax: +1 514-340-1337

wsp.com