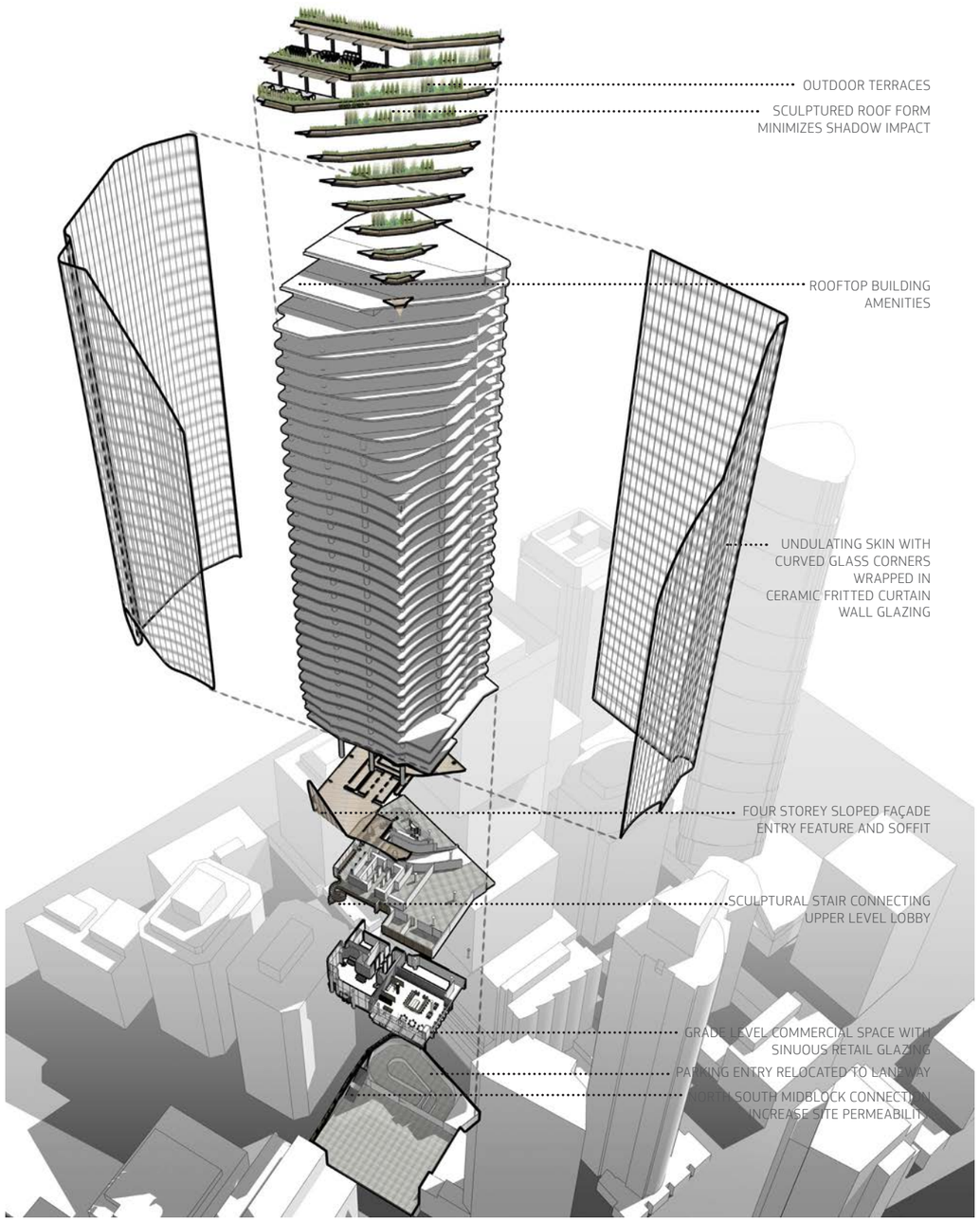
3.0 Architectural Design Principles

3.1 Building Character

1166 West Pender will house 31 floors of office space, blending high design, ecological responsibility, and civic enhancement. The building brings strategic densification to the area, adding 354,978 sf of office space and commercial amenities to a constrained site in the downtown Coal Harbour neighbourhood. Replacing an existing 15-storey office tower, the sinuous 31-storey tower will introduce a strong architectural presence and enhance the public realm. The shape and form of the tower are directly informed by the surrounding buildings and the limitations of the site. Convex and concave exterior walls respond to the contours of the adjacent buildings to form an undulating body wrapped in ceramic-fritted curtain wall glazing. A curved white glass curtain wall affords unobstructed views and establishes a distinct character and impressive presence. The ceramic frit also reduces thermal transmission, lowering heating and cooling costs and improving the building's sustainability.

Situated at the border between a district of office towers and a neighbourhood of slender residential high-rises, the proposed design for 1166 West Pender responds to its unique location with varied floorplates and a distinct shape. The tower deviates from a typical rectangular form by dropping downwards in a deep wedge shape along the West Pender Street façade. Reducing shadow impact to the surrounding public realm while maintaining height, the floorplates at the top of the building are scaled down. The sloping façade features rooftop garden terraces that step down along the north-east corner of the tower. The architectural language of the descending wedge meets at a point and runs down the entire height of the building, tying the top of the tower to the base. Amenities on the penthouse floor and green rooftop gardens add to the character of the building.

Located on a site with a significant grade variation between the laneway to the south and West Pender Street to the north, the building's lobby spans the width of the block and is accessible from both directions. A sculptural staircase that reflects the sinuous forms of the exterior walls connects the upper and lower lobby space. Parking access from the upper level and a mid-block connection to the rear laneway activates the block and allows for enhanced permeability though the site. Leading out to the laneway on the south side of the site, a spacious upper level lobby provides an opportunity for future gathering spaces that will activate the mid-block connection and thoroughfare. 1166 West Pender will be a welcomed addition to this bustling Vancouver neighbourhood, providing a sustainable, visually compelling design while offering first-rate commercial spaces and enlivening the neighbourhood.



3.2 Sustainability

OVERVIEW

As a part of the Rezoning Application package, the following Sustainable Design Strategy has been developed to provide confirmation the project design submitted is on target to meet the requirements as dictated by the Green Buildings Policy for Rezonings 2016, option B. Low Emissions Green Building, effective May 1, 2017.

The following narrative includes preliminary strategies explored by the design team, with the aim to achieve the various requirements of the Low Emissions Green Building pathway, along with all required supporting evidence at this stage, as listed:

- Item B.2: Brief summary of strategies and measures to achieve performance limits for energy use, heat loss, and greenhouse gas emissions, including;
  - Preliminary Zero Emissions Building Plan (ZEBP) Energy Checklist, completed by the project energy modeller, showing that the project meets the performance limits for energy use (TEUI), heat loss (TEDI), and greenhouse gas emissions (GHGI), together with key inputs;
  - 2-4 page summary of detailed energy model inputs for detailed and/or 3rd party review.
- Item B.6.2: Preliminary embodied emissions calculations, and a description of specific measures that will be explored during design to reduce embodied emissions;
- Item B.10: The site IRMP, describing the chosen strategies and green and grey infrastructure measures included in the landscape and building design. The IRMP describes;
  - How these measures contribute to the city-wide IRMP targets for water volume reduction and quality treatment, and
  - Include preliminary site and volume calculations to compare site performance to the City-wide targets;
  - Landscape/Architectural Site Plans highlighting the green and grey infrastructure measures described in the site IRMP as also provided.
- A commitment by the owner to meet the requirements of the Green Buildings Policy for Rezonings with documentation to be submitted at a later project phase, including:
  - B.3: design, build, and test to meet an airtightness target of 2.0 L/s/m² @ 75 Pa;
  - B.4: complete an enhanced commissioning process;
  - B.5: design and build to include building metering and sub-metering of energy, and to enter into agreement on energy reporting, including assistance for building future owners;
  - B.6.1: complete refrigerant emissions calculations;
  - B.7: design and build a direct ventilation system;
  - B.8: design and build with low-emitting materials;
  - B.9: test indoor air quality prior to occupancy;
  - B.11: design and build a resilient potable water access point.

LEED GOLD - BUILDING DESIGN + CONSTRUCTION

As the project is over 50% commercial, LEED Gold registration is required. 63 points are currently targeted under core and shell. The preliminary scorecard is attached to this report – please see *Sustainability Appendix 1.1 - Preliminary LEED v4 BD+C: Core and Shell Narrative and Scorecard*

PERFORMANCE LIMITS

At this stage, the project is still in concept design where the building shape/massing and suite layout are subject to City approval and other changes. Additionally, the mechanical, electrical and envelope design are not fully defined, but instead, under exploration.

A preliminary energy model has been conducted to identify building design parameters required to be in compliance with the performance limits for Commercial High-Rise buildings with Restaurant (connected to a City-recognized low carbon energy system). Whole-Building Performance Limits modeled for 1166 West Pender Street include: TEUI 140.4 kWh/m^2; TEDI 50.8 kWh/m^2; GHGI 7.6 kgCO_2/m^2. As currently modeled, the project is expected to satisfy these requirements by meeting the following energy performance criteria: TEUI 140.1 kWh/m^2; TEDI 25.8 kWh/m^2; GHGI 5.1 kgCO_2/m^2. The design team and project owner confirm the project design will be maintained to meet these criteria.

The Zero Emissions Building Plan Energy Checklist, along with a summary of the detailed model inputs have been included to confirm compliance – please see *Sustainability Appendix 1.2 - Zero Emissions Building Plan Energy Checklist & detailed model inputs.*

AIRTIGHTNESS TESTING

Whole-building airtightness testing and reporting is required for this commercial office building. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

ENHANCED COMMISSIONING

An enhanced commissioning process is required for all building energy systems. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

ENERGY SYSTEM SUB-METERING + REPORTING

Separate master metering for each energy utility, along with sub-metering of all major energy end-uses and major space uses is required. The building owner must enter an agreement with the City of Vancouver to share utility data for minimum three (3) years and provide assistance for building future owners. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

REFRIGERANT EMISSIONS + EMBODIED EMISSIONS

Preliminary embodied emissions calculations for all major building materials have been conducted based on the building's rezoning concept design. Various floor, wall and roof areas have been confirmed through the preliminary energy model. As current designs do not include detailed structural information, various comparable mixed-use developments in Vancouver were referenced. From these reference buildings, applicable details related to column quantity, span, load and typical wall assemblies have been applied to the various floor, wall, and roof lengths and areas for this building. As more detailed information is available specific to this project, the life cycle assessment model will be refined and updated.

The total building height is 135.3 m and the building includes six levels of parkade. Other major concept design assumptions include:

Concept Design Assumptions	Parkade	Above Grade
Floor Area	9,213 m2	35,766 m2
Building Footprint	1,624 m2	1,441 m2
Columns & Beams	Type: Concrete Height: 2.9 m	Type: Concrete Height: 3.55 m
Foundations	Concrete Footings Concrete Slab on Grade	n/a
Interior Walls	Elevator Cores: Cast in place 55 MPa concrete	Elevator Cores: Cast in place 55 MPa concrete Interior Hallways: Concrete Block
Exterior Walls	1100.8 m total wall length Cast in Place 35 MPa Concrete	4,227 m total wall length Curtain Wall, Fibre Glass Insulation, Metal Spandrel Panel
Floors	9,213 m2 floor area Concrete 35 MPa	33,622 m2 floor area Concrete 35 MPa 683 m2 floor area above unconditioned space Concrete 35 MPa, XPS insulation
Roof	n/a	1,007.4 m2 total roof/balcony area Concrete 35 MPa, XPS Insulation, Concrete Tile
Glazing	n/a	70% WWR

The Athena Impact Estimator for Buildings software was utilized, which is in compliance with EN 15978. A 60 year building life expectancy was modeled. The following outputs represent the overall embodied emissions associated with these assumed structural and enclosure components:

Embodied Emissions at Concept Design	**Unit**	**Total**
Global Warming Potential	kg CO2 eq	1.7E+07
Global Warming Potential Intensity	kgCO2eq/m²	377.9
Global Warning Potential Annualized Intensity (60 year building life expectancy)	kgCO2eq/m²/year	6.3

It has been determined based on the Concept Design of 1166 West Pender Street, the total lifecycle embodied emissions Global Warming Potential *intensity* is 377.9 kgCO2eq/m² and *annualized intensity* is 6.3 kgCO2eq/m²/year, considering a 60 year building life.

During design development, the same exercise will be conducted should the building heating and cooling system selections have a capacity of equipment containing refrigerants 35 kW or greater. Once mechanical systems have been selected, emissions from refrigerants will been calculated using the following formula: kgCO2e/m2 = [GWPr*Rc*(0.02*L+0.1+)] / (L*A). Outputs representing the overall refrigerant emissions associated with the building's mechanical components will be provided to the City of Vancouver.

Upon Building Permit Application, the project team will provide embodied emissions calculations representing the building permit stage design and a description of what measures, if any, were taken to reduce embodied emissions.

VERIFIED DIRECT VENTILATION

A preliminary energy model has been conducted to identify building design parameters required to be in compliance with the performance limits for Commercial High-Rise buildings with Restaurant (connected to a City-recognized low carbon energy system). Whole-Building Performance Limits modeled for 1166 West Pender Street include: TEUI 140.4 kWh/m^2; TEDI 50.8 kWh/m^2; GHGI 7.6 kgCO_2/m^2. As currently modeled, the project is expected to satisfy these requirements by meeting the following energy performance criteria: TEUI 140.1 kWh/m^2; TEDI 25.8 kWh/m^2; GHGI 5.1 kgCO_2/m^2. The design team and project owner confirm the project design will be maintained to meet these criteria.

The Zero Emissions Building Plan Energy Checklist, along with a summary of the detailed model inputs have been included to confirm compliance – please see *Sustainability Appendix 1.2 - Zero Emissions Building Plan Energy Checklist & detailed model inputs.*

AIRTIGHTNESS TESTING

Whole-building airtightness testing and reporting is required for this commercial office building. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

ENHANCED COMMISSIONING

An enhanced commissioning process is required for all building energy systems. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

ENERGY SYSTEM SUB-METERING + REPORTING

Separate master metering for each energy utility, along with sub-metering of all major energy end-uses and major space uses is required. The building owner must enter an agreement with the City of Vancouver to share utility data for minimum three (3) years and provide assistance for building future owners. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

REFRIGERANT EMISSIONS + EMBODIED EMISSIONS

Preliminary embodied emissions calculations for all major building materials have been conducted based on the building's rezoning concept design. Various floor, wall and roof areas have been confirmed through the preliminary energy model. As current designs do not include detailed structural information, various comparable mixed-use developments in Vancouver were referenced. From these reference buildings, applicable details related to column quantity, span, load and typical wall assemblies have been applied to the various floor, wall, and roof lengths and areas for this building. As more detailed information is available specific to this project, the life cycle assessment model will be refined and updated.

The total building height is 135.3 m and the building includes six levels of parkade. Other major concept design assumptions include:

B.9: INDOOR AIR QUALITY TESTING

Prior to occupancy, testing for formaldehyde, particulates, ozone, total volatile organic compounds and carbon monoxide will be conducted. The results will be compared to City targets and will be reported for occupancy permit. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

B.10: INTEGRATED RAINWATER MANAGEMENT + GREEN INFRASTRUCTURE

In consultation with the City of Vancouver's Best Management Practice Toolkit, the project site Integrated Rainwater Management Plan (IRMP) includes green and grey infrastructure measures considered appropriate for the building type, design, project location and surrounding area. A certified IRMP was developed by a civil consultant; R.F. Binnie & Associates. The full report has highlighting the green and grey infrastructure measures used to meet the Green Buildings Policy for Rezoning has been included with this Rezoning Application Package – please see *Sustainability Appendix 1.4 - Integrated Rainwater Management Plan & Site Plan*.

B.11: RESILIENT DRINKING WATER ACCESS

The building's design will provide access to potable water which utilizes City operated system pressure (not electrically aided). Providing a resilient water access point for every 75 occupants is mainly intended for Residential buildings. 1166 West Pender is a Commercial High-Rise with Restaurant Retail, and to meet the intent of the policy, one (1) resilient water access point will be provided on level 1 to operate on City pressure. The project owner has committed to meet this requirement – please see *Sustainability Appendix 1.3 - Letter of Commitment*.

SUMMARY

The above noted strategies support a holistic approach to addressing the requirements of the City of Vancouver's Green Buildings Policy for Rezonings. Implementing these strategies through design and construction will produce a sustainable and resilient building capable of delivering optimum building performance, while also improving indoor environmental quality for occupants.

The applicant and design team are committed to incorporating green building principles into the design and long-term operations of the proposed development at 1166 Pender. The project will be registered with the Canada Green Building Council's LEED v4 for Core and Shell rating system and will target a designation of Gold with 63 points. Beyond these targets, several other strategies are potentially available and will be confirmed as the design is refined. These sustainability strategies are consistent with the City of Vancouver's Green Building Policy for Low Emissions Green Buildings May 2017.

This development will become a showcase project for energy performance and environmentally responsible building construction through:

Location and Transportation

The project is located on a previously developed infill site, avoiding sensitive habitats and taking advantage of existing infrastructure and surrounding amenities which promote a walkable community. The development's design densifies the existing site to maximize land usage. The site is located within a short walking distance to Expo line at Burrard and also to multiple bus routes in the vicinity. This location provides optimum connectivity to pedestrian and public transit options and encourages building occupants to utilize alternative transportation opportunities, reducing dependence on single occupancy vehicles. The location along these transit corridors combined with secured storage for bicycles and bicycle networks accessible affords a distinct advantage for carless commuters.

Sustainable Sites

The project's management of rainwater runoff will be done in such a fashion as to maximize the availability rainwater to be utilized as a source of non-potable water. The development's hardscapes and green spaces will be considerate of urban heat island effect and support the project's larger irrigation and water use reduction targets.

An erosion and sedimentation control plan will be implemented to minimize erosion and sedimentation during demolition, site preparation and throughout construction. Best practices will be implemented during construction to optimize air quality for site workers and the surrounding area, and provide a clean and healthy building for future residents.

Water Use Efficiency

The project will address water management through two design approaches. Firstly, water conservation through low flow plumbing fixtures, the project will be targeting a 35% reduction in the use of potable water through selection of plumbing fixtures. Secondly, to support the projects target of reducing 50% of the outdoor water use reduction, an efficient irrigation design will be implemented. In addition to that, a rainwater capture and reuse system considered to further reduce the overall consumption.

Finally, the project will target increased cooling tower water efficiency as a means of reducing the potable water consumed in the cooling of the building. This will be done by selecting systems, which maximize the number of cooling cycles achieved per water cycle while also providing a source of non-potable water where feasible. The combined indoor and outdoor water use strategies support an integrated approach to reduce demand on the City of Vancouver's water services, while limiting the waste of potable treated water supplies.

Energy Performance

ASHRAE 90.1-2010 will drive mechanical, electrical and architectural systems selection. High performance systems in line to the Low Emissions Green Buildings have been selected targeting a reduction of TEUI –140.1, TEDI – 25.8 and GHGI of 5.1. This will support the project's goal of LEED Gold certification with a reduction of 15% resulting in 7 Optimized Energy points.

To maximize the envelope efficiency of the building, carefully designed window to wall ratios will be utilized to manage solar heat gains through the exterior glazing, while retaining energy to maintain thermal comfort. The wall systems for the building will be specified to support the window assemblies in their performance and be well insulated to eliminate energy transfer between the interior and exterior spaces. Adding to a high efficiency envelope, the development will further reduce energy, and carbon emissions through a high efficiency HVAC design.

In addition to high performance system design, the project's mechanical, electrical, and envelope systems will be commissioned, ensuring the ongoing performance and energy management of the entire development through to building operations. Building level energy and water enduse information will be provided to building operators through the use of advanced enduse metering. This will ultimately result in continued energy savings and environmental benefit beyond the initial design of the project.

Building Materials

Using a building lifecycle impact analysis, the project will aim to demonstrate building lifecycle impact reductions in overall CO_2 emissions, depletion of non-renewable energy resources, eutrophication and other global impact categories.

Construction waste management will be an integral part of the building process, firstly through source minimization, smart product selection, packaging and transport. Recycled content and regionally sourced materials will be preferred through the selection process, focusing on steel, concrete and glass components, reducing the impact of extracting of virgin resources. These materials retain their high value in the recycling chain and so once the service life of the proposed building comes to an end, re-use and integration into new building materials is a viable option. Furthermore, waste generated on site during construction will be addressed through a comprehensive waste management plan, detailing recycling facilities and documenting the diversion of standard debris from landfill.

Indoor Environment

Outdoor air ventilation will be implemented and adhere to ASHRAE 62.1-2010 to reduce occupant exposure to indoor pollutants by ventilating with outdoor air. Indoor pollutants will be further managed by utilizing building entryway systems and MERV 13 filtration where feasible to minimize the introduction of exterior contaminates into the indoors space coupled with CO_2 monitoring requirements keeping the levels in check.

To further improve the indoor air quality of the building, interior finishes and coatings will be specially selected to limit the quantities of harmful volatile organic compounds (VOCs) which would be off-gassed after installation. The selection of low emitting materials will also include the project's insulation in addition of the traditional scope of paints, sealants, flooring and formaldehyde free woods.

Given the unique shape of the floorplate, the opportunities for views access will be maximized. The project will also aim to demonstrate reasonable visual access to the outdoors from over 75% of the regularly occupied floor space.

Conclusion

The above noted strategies support a holistic approach to addressing the requirements of the City of Vancouver's Green Building Policy for Rezoning and LEED Gold-level certification goal. Implementing these strategies through design and construction will produce an intelligently designed project capable of delivering enhanced building performance while also improving indoor environmental quality for tenants. A Rezoning LEED checklist is included with the application for review.

1166 Pender: Gold-level Checklist
LEED v4 BD+C: CORE + SHELL

Date Issued:
USGBC Project No.:

Achieved ++	Targeted +	Maybe ?	Not Likely -	NO --
	63	16	8	21

Project Total

Certified 40 to 49 points | Silver 50 to 59 points | Gold 60 to 79 points | Platinum 80 to 110 points

	1			

Integrative Process — Possible Points: 1

	1			

IPc1 Integrative Process

	15	1		4

Location + Transportation — Possible Points: 20

				-
	2			
				3
	6			
	6			
	1			
				1
		1		

LTc1 LEED for Neighborhood Development Location
LTc2 Sensitive Land Protection
LTc3 High Priority Site
LTc4 Surrounding Density and Diverse Uses
LTc5 Access to Quality Transit
LTc6 Bicycle Facilities
LTc7 Reduced Parking Footprint
LTc8 Green Vehicles

	6	2	2	1

Sustainable Sites — Possible Points: 11

	Y			
	1			
		1		1
			1	
	3			
	1	1		
			1	
	1			

SSp1 Construction Activity Pollution Prevention
SSc1 Site Assessment
SSc2 Site Development: Protect or Restore Habitat
SSc3 Open Space
SSc4 Rainwater Management
SSc5 Heat Island Reduction
SSc6 Light Pollution Reduction
SSc7 Tenant Design and Construction Guidelines

	6	5		

Water Efficiency — Possible Points: 11

	Y			
	Y			
	Y			
	1	1		
	3	3		
	1	1		
	1			

WEp1 Outdoor Water Use Reduction: 30%
WEp2 Indoor Water Use Reduction: 20%
WEp3 Building-Level Water Metering
WEc1 Outdoor Water Use Reduction
WEc2 Indoor Water Use Reduction
WEc3 Cooling Tower Water Use
WEc4 Water Metering

	14	1	6	10

Energy + Atmosphere — Possible Points: 33

	Y			
	Y			
	Y			
	Y			
	6			
	7			9
	1			
		1		1
			3	
			1	
			2	

EAp1 Fundamental Commissioning and Verification
EAp2 Minimum Energy Performance
EAp3 Building-Level Energy Metering
EAp4 Fundamental Refrigerant Management
EAc1 Enhanced Commissioning
EAc2 Optimize Energy Performance:
EAc3 Advanced Energy Metering
EAc4 Demand Response
EAc5 Renewable Energy Production
EAc6 Enhanced Refrigerant Management
EAc7 Green Power and Carbon Offsets

	5	3		6

Materials + Resources — Possible Points: 14

	Y			
	Y			
	3			3
		1		1
		1		1
		1		1
	2			

MRp1 Storage & Collection of Recyclables
MRp2 Construction and Demolition Waste Management Planning
MRc1 Building Life-Cycle Impact Reduction
MRc2 Building Product Disclosure & Optimization: Environmental Product Declarations
MRc3 Building Product Disclosure & Optimization: Sourcing of Raw Materials
MRc4 Building Product Disclosure & Optimization: Material Ingredients
MRc5 Construction & Demolition Waste Management

	7	3		

Indoor Environmental Quality — Possible Points: 10

	Y			
	Y			
	2			
	3			
	1			
		3		
	1			

IEQp1 Minimum IAQ Performance
IEQp2 Environmental Tobacco Smoke (ETS) Control
IEQc1 Enhanced Air Quality Strategies
IEQc2 Low-Emitting Materials
IEQc3 Construction IAQ Management Plan
IEQc7 Daylight
IEQc8 Quality Views

	6			

Innovation + Design Process — Possible Points: 6

	1			
	1			
	1			
	1			
	1			
	1			

IDc1.1 Innovation: Occupant Comfort Survey
IDc1.2 Innovationt: Purchasing Plan - Lamps
IDc1.3 Innovation: LEED O+M Starter Kit
IDc1.4 Exemplary Performance: Access to Quality Transit
IDc1.5 Exemplary Performance: Construction Waste Management
IDc2 LEED™ Accredited Professional

	3	1		

Regional Priority Credits — Possible Points: 4

		1		
	1			
	1			
	1			

RPc1.1 Regional Priority: Indoor Water Use Reduction (4 pts)
RPc1.2 Regional Priority: Enhanced Commissioning (5 pts)
RPc1.3 Regional Priority: Building Life-Cycle Impact Reduction (3 pts)
RPc1.4 Regional Priority: Outdoor Water Use Reduction (2 pts)

City of Vancouver Rezoning Energy Modeling Input Summary Table

	NECB 2011 Baseline Model Characteristics for Restaurant	Proposed Design Model Characteristics
General		
Location	Vancouver, BC	
Simulation Weather File	Vancouver2016 CWEC	
Climate Zone	NECB Climate Zone 4	
Modeling Software	eQUEST 3.64	
Building Area	Total: 344,018 ft² (31960 m²)	
Hours of Operation/Variation Profiles	Based on *ENERGY MODELLING GUIDELINES section 2.1 Schedules* Office: Monday – Friday: 6am to 8pm As per NECB 2011 Schedule A Restaurant: Monday – Saturday: 8am to 1am Sunday: 9am to 10pm As per NECB 2011 Schedule B	
Envelope Performance[1]		
Overall Roof U-value	U-0.040 (R-25)	U-0.05 (R-20)
Overall Wall U-value	U-0.111 (R-9)	U-0.10 (R-10)
Overall Exposed Floor U-value	U-0.040 (R-25)	U-0.05 (R-20)
Percentage Glazing	40%	70%
Overall Glass U-value including frame, and Solar Heat Gain Coefficient (SHGC)	U-0.423 SHGC-0.313	U-0.216 (Curtain wall) SHGC-0.313
Infiltration	As per City of Vancouver Energy Modelling Guidelines Version 2.0	
Restaurant Assumptions[2]		
Energy Efficient Designs	As per NECB 2011 Process load such as cooking appliances as per standard practice	Lighting • Interior Lighting ○ Efficient lamps and ballasts to reduce LPD to 0.83 W/ft² ○ Occupancy sensors in office, active storage and restroom

[1] Baseline envelope performance as per NECB 2011 Table 3.2.2.2 & 3 and wall performance as per "Accounting for thermal bridging at interface details – a methodology for de-rating prescriptive opaque envelope requirements in energy codes"

	NECB 2011 Baseline Model Characteristics for Restaurant	Proposed Design Model Characteristics
		• Exterior Lighting ○ Reduced lighting power allowance ○ Bi-level switching and photocell-controlled exterior lights • Daylighting ○ Daylight dimming controls in dining area Kitchen Appliances • Commercial kitchen appliances ○ Ultra-efficient cooling appliances • Refrigeration ○ ECM motor in walk-in cooler/freezer, additional insulation, waste heat recovery from refrigerant to preheat hot water etc. HVAC Systems • System efficiency ○ Air conditioners with premium cooling efficiency • Kitchen exhaust hoods ○ Reduced exhaust flow rate for ultra-efficient cooking appliances and efficient exhaust hoods ○ Demand-controlled exhaust based on cooking appliance schedule • Service water heater ○ Gas-fired condensing water heater with 95% thermal efficiency Kitchen has not been designed at this point in time. To demonstrate 35% energy savings as compared to the baseline, proposed kitchen design assumed to follow "Technical Support Document: 50% Energy Savings for Quick-Service Restaurants" prepared for the U.S. Department of Energy by Pacific Northwest National Laboratory. Actual design may differ from current assumptions.
Internal Loads		
Occupancy	Office: 25 m²/person Restaurant: 10 m²/person As per NECB 2011 occupancy density	

	NECB 2011 Baseline Model Characteristics for Restaurant	Proposed Design Model Characteristics
Interior Lighting Power Density (LPD) (W/ft²) & Control	Space by Space Method / NECB 2011 Lighting Power Density [W/ft²]: Corridor/Transition 0.78 Electrical/Mechanical 1.24 Lobby 0.90 Lobby for Elevators 0.64 Locker Room 0.91* Office 1.02 Parking Garage 0.19 Restaurant 1.31 Stairway 0.69 Storage 0.63* Washroom 0.98* Workshop 1.59 As per NECB 2011 Table 4.2.1.6 *Occupancy Sensors: 10% LPD Reduction as per NECB 2011 4.2.2.2	Space by Space Method / Proposed Lighting Power Density [W/ft2]: Corridor/Transition 0.46 Electrical/Mechanical 0.67 Lobby 0.63 Lobby for Elevators 0.45 Locker Room 0.53* Office 0.50* Parking Garage 0.13 Restaurant 0.83 Stairway 0.48 Storage 0.44* Washroom 0.69* Workshop 1.11 30% LPD reduction from ASHRAE 90.1-2010 as per lighting designer Interior Lighting EEM at Restaurant[2] *Tenant lease agreement *Occupancy Sensors: 10% LPD Reduction Daylighting sensors as per ASHRAE 90.1-2010
Restaurant Exterior Lighting[2]	8.42 kW	4.34 kW as per Lighting EEM Only applied to L1 restaurant
Receptacle Loads (W/ft²)	As per NECB 2011 receptacle density, Table A-8.4.3.2.(2)-B	
Process Loads	Elevator: 3 kW x 6 IT load allowance: 5 kW/floor Total Restaurant kitchen load: • Electricity: 20,114 kWh • Gas: 152,433 kBTU Estimated as per Energy Information Administration Commercial Kitchen Appliances EEM[2]: 35% reduction in proposed kitchen load assumed	
Domestic Hot Water (DHW) Demand	Restaurant: same as proposed	Office: 246,313 Btu/h with 30% reduction from low flow fixtures As per NECB 2011 Table A-8.4.3.3.(1)B. Restaurant: 154,439 Btu/h Estimated as per U.S. Energy Information Administration (EIA)

	NECB 2011 Baseline Model Characteristics for Restaurant	Proposed Design Model Characteristics
Mechanical Systems		
Indoor Design Temperature for Conditioned Areas	Office & Restaurant: 72°F heating, 75°F cooling Kitchen: 60°F heating Mechanical/ electrical room: 82°F cooling	
System Description	Kitchen: Single-zone make-up air unit with baseboard heating (System 4) Kitchen fan: • Canopy type • 8,000 cfm Restaurant: packaged unitary rooftop heat pump As per NECB 2011 Table 8.4.4.14	Office: • Conditioned by fan coil units and ventilated by HRV Restaurant: Conditioned by fan coil units and ventilated by HRV Kitchen: • Conditioned and ventilated by direct gas fired make up air unit • L1 kitchen equip with proximity type kitchen ecology unit • L31 kitchen equip with proximity type exhaust fan Kitchen fan: • Proximity type (Preliminary assumption) • 5,200 cfm (35% reduction from baseline assumed through HVAC EEM[2]) • Direct Gas fired with 92% thermal efficiency Mechanical/ electrical room: • Conditioned by fan coil units
Fan Power & Control	Fans run continuously during occupied hours and cycle on/off to meet the heating/cooling loads during unoccupied hours (outdoor air off) Fan power: • Static Pressure of 640 Pa • Combined fan-motor efficiency of 40% As per NECB 2011 8.4.4.19	Fans run continuously during occupied hours and cycle on/off to meet the heating/cooling loads during unoccupied hours (outdoor air off) Fan power: Office HRV: • 1.584 W/cfm Kitchen MUA: • 0.466 W/cfm Kitchen Ecology Unit: • 1.115 W/cfm Kitchen Exhaust Fan: • 0.348 W/cfm FCU • 0.217 W/cfm

	NECB 2011 Baseline Model Characteristics for Restaurant	Proposed Design Model Characteristics
Total Ventilation Rates	Kitchen: 16,000 cfm Restaurant total: 12.120 cfm	Kitchen: 10,400 cfm As per HVAC EEM[2] Restaurant total: 12,120 cfm Office Total: 42,731 cfm
Ventilation Control	Air side economizers high limit shutoff at 75°F As per NECB 2011 5.2.2.8	CO_2 sensors in lobby, office and restaurant
Heat Recovery	None	Heat recovery ventilators: • HRV: ○ Heat pipe: 60% sensible
Central Plant		
Heating Type & Efficiency	Fuel fired furnace • Efficiency: 81% Heat pump • Average 3.7 COP As per NECB 2011 Table 5.2.12.1	Air-source Heat Pump • Heating COP: 2.35 at 25°F ambient • Design supply: 110°F • Design loop: 10°F Condensing Boilers • Efficiency: 96%
Cooling Type & Efficiency	Heat Pump, efficiency as per NECB 2011 Table 5.2.12.1 Kitchen Refrigerator/Cooler[2] • 6.3 EER	Heat Recovery Chiller • Cooling COP: 3.760 Air-source Heat Pump • Cooling COP: 3.63 at 82.4°F ambient • Design supply: 44°F • Design loop DT: 10°F Kitchen Refrigerator/Cooler[2] • 9.2 EER

Domestic Water Heater and Efficiency	• Gas water heater
	  ○ Efficiency 83%
	As per NECB 2011 Table 5.2.12.1.
		• Gas water heater
		  ○ Thermal efficiency: 96%

Pumps	None	Hot Water Pumps:
		• 19 W/gpm
		• Primary and Secondary Pump
		  ○ Variable speed
		
		Chilled Water Pumps:
		• 22 W/gpm
		• Primary and Secondary Pump
		  ○ Variable speed
		
		Condenser Water Pumps:
		• 19 W/gpm
		• Primary and Secondary Pump
		  ○ Variable speed

[2] As per "Technical Support Document: 50% Energy Savings for Quick-Service Restaurants" prepared for the U.S. Department of Energy by Pacific Northwest National Laboratory

CITY OF VANCOUVER

Zero Emissions Building Plan Energy Checklist

Please complete all fields that apply to the project, using information that represents the current stage of design. For fields that do not apply or for which there is no information yet, please enter "N/A".

Project Information (enter all that apply)

Project Address	1166 West Pender St
Secondary Address	
Project Working Title	1166 West Pender
POSSE File Name (City use only)	
Gross Floor Area indicated on Arch. Drawings (m²)	31,960
Parkade Area (m²)	8,834

Building Information and Performance Limits

For building types with Performance Limits, enter this information in this section

Building Type(s)	Modelled Floor Area (m²)	Rezoning?	City-Recognized Low Carbon Energy System?	Limits TEUI	Limits TEDI	Limits GHGI
Office	30,811	Yes	Yes	110	27	3
				0	0	0
				0	0	0
Total	30,811	**TEDI limit for this portion of building**			**27.0**	

For other building types, create a baseline energy model to establish limits, and enter this information in this section

Building Type	Modelled Floor Area (m²)	Rezoning?
Restaurant	1,149	Yes

Enter Other Building Type Baseline Model Performance	Energy (kWh)	Em. Factor	Emissions (kgCO2e)		TEUI	TEDI	GHGI
Total Annual Electricity Use	919,833	0.011	10,118	Baseline:	1468.136	690.2092	132.3092
Total Annual Natural Gas Use	767,055	0.185	141,905	Target:	954.2881	690.2092	132.3092
Total Annual District Energy Use	-	0.070	-				
Total	1,686,888		152,023				
Total Annual Heat Demand - for TEDI	793,050						

			TEUI	TEDI	GHGI
Total Modelled Floor Area (m²)	31,960	**Whole-Building Performance Limits**	**140.4**	**50.8**	**7.6**
Modelled Floor Area within 5% of Gross Floor Area?	Yes				

Modelled Building Performance

	Energy (kWh)	Fuel Type	Em. Factor	Emissions (kgCO2e)	TEUI	GHGI
Interior Lighting	543,530	Electricity	0.011	5978.826	17.0	0.2
Exterior Lighting	16,148	Electricity	0.011	177.6304	0.5	0.0
Heating	113,506	Electricity	0.011	1248.57	3.6	0.0
Cooling	537,023	Electricity	0.011	5907.257	16.8	0.2
Pumps	316,312	Electricity	0.011	3479.428	9.9	0.1
Fans	728,047	Electricity	0.011	8008.519	22.8	0.3
Domestic Hot Water	221,005	Natural Gas	0.185	40885.91	6.9	1.3
Plug Loads	28,955	Natural Gas	0.185	5356.753	0.9	0.2
Plug Loads and Refrigeration	1,573,821	Electricity	0.011	17312.03	49.2	0.5
Heating	395,236	Natural Gas	0.185	73118.59	12.4	2.3
Heat Rejection	2,550	Electricity	0.011	28.0469	0.1	0.0

Total Annual Electricity Use	3,830,937	0.011	42,140
Total Annual Natural Gas Use	645,196	0.185	119,361
Total Annual District Energy Use	-	0.070	-
Total	4,476,133		161,502
Total Electricity Generated On-Site (kWh)		% of Use	0.0%
Total Purchased Renewable Electricity (kWh)		% of Use	0.0%
Total Purchased Renewable Natural Gas (kWh)		% of Use	0.0%

Note: purchaes renewables used to demonstrate compliance must be secured to satisfaction of AHJ

Adjusted Electricity Emissions Factor (kgCO2e/kWh)	0.011
Adjusted Natural Gas Emissions Factor (kgCO2e/kWh)	0.185

Annual Heat Demand of portions with Perf. Limits (kWh)	394,580			**12.8**
Total Annual Heat Demand - for TEDI (kWh)	823,033			
Total Annual Cooling Demand - *for info only* (kWh)	1,940,482	60.7 kWh/m²		

	TEUI	TEDI	GHGI
Modelled Whole-Building Performance	**140.1**	**25.8**	**5.1**

Corridor Pressurization Adjustment

			TEUI	TEDI	GHGI
Heating Degree Days					
Number of Suite Doors Pressurized					
Airflow for Pressurization per Door (L/s/door)					
Area of Corridors Pressurized (m²)					
Make-Up Air Fuel Type					
Make-Up Air Emissions Factor		Adjustments for Corridor Pressurization	-	-	-
Suite-level Metering for Space Heating	Yes	Adjustments for Suite Submetering of Heating	-		

Note: select yes if the energy used for heating is metered at the suite level

Adjusted TEDI Performance of Portions with Limits		**12.8**
Adjusted Whole-Building Performance for Compliance	**140.1**	**25.8**	**5.1**

Modelled Inputs

Modelled Above-Ground Wall Area (m²)	15,031		Vertical facade-to-Floor Area Ratio (VFAR)	0.47
Window-to-Wall Area Ratio (WWR)	70%		Window-to-Floor Area Ratio	0.33
Infiltration Rate (L/s/m²$_{sfc}$)	0.1			
Wall Effective R-Value - incl. thermal bridging (m²K/W)	1.8	10.00 (ft²hr°F/Btu)	Average Floor Edge Psi-Value (W/m°K)	
Roof Effective R-Value - incl. thermal bridging (m²K/W)	3.5	20.00 (ft²hr°F/Btu)	Avg. Window Transition Psi-Value (W/m°K)	
Average Window Effective U-Value (W/m²°K)	1.23	0.22 (Btu/ft²hr°F)	Window Solar Heat Gain Coefficient	
Average Suite Occupant Density (m²/pers)	22.35		Average Lighting W/m²	5.705
Average Suite Ventilation Rate (L/s/m²)	0.88378		DHW Low-Flow Savings (%)	30
Average HRV Effectiveness	60%		DHW Drain Heat Recovery Effectiveness	
Heating System Type (fuel, plant, distribution, etc.)	Air source heat pump with condensing boiler backup			
Cooling System Type (fuel, plant, distribution, etc.)	Heat recovery chiller and air source heat pump			
DHW System Type (fuel, plant, distribution, etc.)	Condensing boiler			

Modeller Information

Modeller Name	Kevin Leung
☑	*These results have been created using the COV Energy Modelling Guidelines version:* 2
Company	Integral Group
Phone Number	604-687-1800 x 2098
Email	kleung@integralgroup.com

ZEBP Energy Checklist v1.5 - 2018-07-27