

CITY OF VANCOUVER ENERGY TARGETS FOR PART 3 BUILDINGS

TECHNICAL PRIMER

The City of Vancouver Council approved the Zero Emissions Building Plan in 2016, which sets a roadmap for new buildings to emit zero operational GHG emissions by 2030. The City is implementing the Plan by incrementally reducing the limits for GHG emissions in policies and regulations. This primer describes the requirements for large and complex buildings, classified under Part 3 of the British Columbia Building Code.

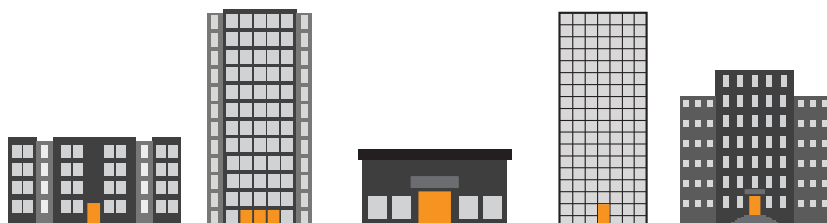
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PREPARED BY



THE UNIVERSITY
OF BRITISH COLUMBIA

QUICK SUMMARY



POLICY OR REGULATION ¹	OPTIONS	METRICS ²	RESIDENTIAL 6-storeys or less ³	RESIDENTIAL above 6-storeys	RETAIL	OFFICE	HOTEL & MOTEL
VANCOUVER BUILDING BY-LAW (2019) ⁴	OPTION A ⁵	TEUI	110	130	170	130	170
		TEDI	2.5	45	30	30	30
		GHGI	5.5	14	5	7	14
		Airtightness	Residential per suite ⁶ : 1.23 Total: 2.03				
	OPTION B ⁶	TEUI	N/A	120	120	100	140
		TEDI	N/A	30	20	20	20
		Airtightness	Residential per suite ⁶ : 1.23 Total: 2.03				
	PASSIVE HOUSE ⁷	PE or PER	120 OR 60				
		Space Heating Demand	Annual Demand: 15 OR Peak Load: 10				
		Airtightness	0.6				
GREENBUILDING POLICY FOR REZONING (2017) ⁹	OPTION A	TEUI	100	120	170	100	170
		TEDI	15	32	21	27	25
		GHGI	5	6	3	3	8
		Airtightness	Residential per suite ⁶ : 1.2 Total: 2				
	OPTION B (connected to an LCES ¹⁰)	TEUI	110	130	170	110	210
		TEDI	25	40	21	27	25
		GHGI	5	6	3	3	8
		Airtightness	Residential per suite ⁶ : 1.2 Total: 2				
	NEAR ZERO EMISSIONS BUILDINGS (Passive House ^{7, 11})	PE or PER	120 OR 60				
		Space Heating Demand	Annual Demand: 15 OR Peak Load: 10				
		Airtightness	0.6				
HIGHER BUILDINGS POLICY (2018) ¹²	OPTION A (must connect to an LCES ¹⁰)	TEUI	N/A	100	100	100	120
		TEDI	N/A	15	15	15	15
		GHGI	N/A	3	1.5	1.5	4
	OPTION B (Passive House ⁷)	PE or PER	120 OR 60				
		Space Heating Demand	Annual Demand: 15 OR Peak Load: 10				
		Airtightness	0.6				

Total Energy Use Intensity (TEUI) kWh/m²/yr
 Thermal Energy Demand Intensity (TEDI) kWh/m²/yr
 Green House Gas Intensity (GHGI) kgCO₂e/m²/yr
 Airtightness L/s/m² @ 75 Pa | Passive House: ACH @ 50 Pa
 Primary Energy Demand-Non-Renewable (PE) kWh/m²/yr
 Primary Energy Demand-Renewable (PER) kWh/m²/yr
 Space Heating Demand kWh/m² per year or W/m² peak load

¹ The policies and regulations are further described on page 6.

² Metrics are further explained on page 5.

³ 4 to 6-storey residential buildings and 1 to 6-Storey mixed-use residential buildings. The policies for 1-3-storey residential buildings are outlined on page 7.

⁴ For the full requirements, refer to [Vancouver Building By-law 2019](#). The updates to the Bylaw, which will come to effect in 2021 and 2022, are explained on pages 6 and 7.

⁵ Equivalent to Step 2 of the B.C. Energy Step Code.

⁶ This alternative option requires achieving better energy performance than Option A, equivalent to Step 3 of the Step Code, with no restriction on GHGI emissions.

⁷ All the metrics in the Zero Emissions Building Plan use the gross floor area of the building for calculating the values per square meter. Whereas Passive House uses the treated floor area. Refer to page 5 for further details.

⁸ In residential buildings, airtightness testing should be conducted on 10% of the first 100 units, and 5% of all units above that.

⁹ For the full requirements, refer to [Green Building Policy for Rezoning](#).

¹⁰ For buildings that are connected to a city-recognized [Low Carbon Energy System](#) (LCES), which is a district system that supplies energy primarily from highly-efficient and renewable sources.

¹¹ Or alternate near-zero-emissions building standards as deemed suitable by the Director of Sustainability. Refer to page 5 for further details.

¹² For the full requirements, refer to [Higher Buildings Policy](#).

ZERO EMISSIONS BUILDING PLAN

The Zero Emissions Building Plan was developed by the City of Vancouver as a phased approach to eliminate operational GHG emissions from new buildings by 2030 through setting specific targets that get stricter over time as the industry's capacity increases.

The [Zero Emissions Building Plan](#) (ZEBP) establishes targets that require all new buildings within the City of Vancouver to have no operational GHG emissions by 2030. That means the buildings will be highly energy-efficient and only use renewable energy. These targets are planned to be achieved through four action strategies:

Limiting Emissions: establishing GHG emission limits for different building types and, over time, reducing the limits to zero.

Providing Public Leadership: requiring City-owned building projects to demonstrate zero-emissions design and construction approaches where viable. See ZEBx case studies on Fire Hall No. 17 and the Gastown Childcare Centre for examples of these demonstration projects.

Catalyzing Private Sector Leadership: developing tools to incentivize and support leading private stakeholders to incorporate effective approaches to zero-emission in their new building projects.

Building Capacity: educating and training the local building industry, through the [Zero Emissions Building Exchange](#) (ZEBx) and other information-sharing tools, to develop the knowledge, skills and experience required to successfully achieve this goal.

ZERO EMISSIONS BUILDING PLAN'S GOAL

The ZEBP focuses on transitioning the local building industry away from fossil-fuel use to the use of renewable energy sources with low or no GHG emissions, such as hydroelectricity, biogas, and [Low Carbon Energy Systems](#). It focuses solely on new building projects and includes energy used during a building's operation for space heating, cooling, and domestic hot water.

The ZEBP followed zero-emissions goals set in earlier City plans. The [Greenest City 2020 Action Plan](#), developed in 2011, aimed to make all buildings constructed from 2020 onward to be carbon neutral in operations. This was not achieved but the GHG emissions from new buildings were reduced by about 50%. The [Renewable City Strategy](#), developed in 2015, set the target of deriving 100% of the energy used in the City of Vancouver from renewable sources and reducing GHG emissions by at least 80% below 2007 levels by 2050.

The City estimates that of the existing buildings in 2050, 30% would have been built before 2010, 30% would have been built between 2010 and 2020, and 40% after 2020. Hence, for buildings to use renewable energy with no GHG emissions by 2050, as many buildings as possible must be built to zero-emissions standards today. Buildings that are retrofitted also need to meet this goal but they are not addressed in the ZEBP.



ENERGY & EMISSIONS PERFORMANCE METRICS

To quantify a building's energy and emissions performance, the ZEBP uses different metrics to quantify annual thermal energy demand, total energy use, and greenhouse gas emissions. It also allows meeting Passive House standard requirements as an alternative.

ZERO EMISSIONS BUILDING PLAN METRICS



TOTAL ENERGY-USE INTENSITY (TEUI)

Unit: kWh/m² per year

The total annual energy used in a building or on the building site for the operation of the building. This is both thermal energy and electricity used on a building site associated with the building operation such as space heating, ventilation, air conditioning, hot water, interior and exterior lighting, fans, pumps, appliances, auxiliary systems such as elevators, plug loads. TEUI is calculated per square meter per year, by dividing the total energy use in a year by the building's gross floor area.



THERMAL ENERGY DEMAND INTENSITY (TEDI)

Unit: kWh/m² per year

The total annual thermal energy use to maintain the indoor temperature and moisture level within a building, through space heating, ventilation, and air conditioning (i.e. HVAC). HVAC systems are used to maintain the interior thermal comfort within a range defined in ASHRAE 55. TEDI is calculated per square meter per year, by dividing the building's total amount of thermal energy use in a year by its gross floor area.



GREENHOUSE GAS INTENSITY (GHGI)

Unit: kgCO₂ eq./m² per year

The total annual GHG emissions from all the energy use for the operation of a building. GHGI is calculated per square meter per year, by multiplying the total amount of a building's energy use in one year by the carbon intensity of each energy source, specified in the City's [Energy Modelling Guidelines](#) in equivalent kilograms of CO₂, and dividing it by the building's gross floor area.



AIRTIGHTNESS

Unit: L/s per m² @ 75 Pa

The resistance of the building envelope to infiltration when ventilators are closed. The better the airtightness at a given pressure difference across the envelope, the lower the infiltration. For the Vancouver Building By-law and Green Building Policy for Rezoning, the airtightness is required to be reported by litres of air leakage per second per square meter of envelope area at 75 Pascal pressure.

PASSIVE HOUSE STANDARD METRICS



TOTAL PRIMARY ENERGY NON-RENEWABLE (PE)

Unit: kWh/m² per year

The total energy demand for the operation of a building for one year. PE takes into account energy losses along the generation and supply chain. To do this the total energy demand is multiplied by a PE-factor, Passive House Institute (PHI) assigns to each type of energy source in each region based on their supply efficiency.

OR



TOTAL RENEWABLE PRIMARY ENERGY (PER)

Unit: kWh/m² per year

PER is an updated metric that was introduced in 2015 to eventually replace PE. PER takes into account both energy supply chain efficiency and renewability of energy sources. To do this, the total energy demand is multiplied by PER-factors that PHI assigns to each type of energy source in a region. Renewable energy sources have a lower factor than those allocated to non-renewable sources.



SPACE HEATING DEMAND

Unit: kWh/m² per year or W/m² peak load

The total amount of active heating required to heat a building. Similar to TEDI, this metric is calculated per square meter per year, except for it uses the treated floor area rather than the gross floor area.

Peak heating demand is an alternative metric for the space heating demand. However, achieving its limit is more challenging in the Lower Mainland climate.



AIRTIGHTNESS

Unit: Passive House: ACH @ 75 Pa

In Passive House standard airtightness is defined as air leakage rate per hour per square meter of envelope area at a test reference pressure differential across the building envelope of 50 Pascal.

Note: All the Zero Emissions Building Plan metrics use the gross floor area, measured from the inside of the exterior envelope and excludes parkade space, for calculating values per square meter. Whereas Passive House uses the treated floor area, which is the space inside the thermal envelope. This makes achieving the Passive House requirements more challenging because the same amount of energy is divided by a smaller floor area.

POLICIES AND REGULATIONS

The City of Vancouver uses different energy use and emissions reduction metrics for different building types. These are outlined in policies and bylaws such as the Vancouver Building By-law, Green Building Policy for Rezoning, and Higher Building Policy.

The City of Vancouver policies and bylaws incentivize or enforce the energy use and emissions reduction targets set in the ZEBP, which vary based on building type, function and size. The most commonly used are the Vancouver Building By-law (2019), Green Building Policy for Rezoning (2017), and Higher Building Policy (2018). The ZEBP also references compliance with Passive House as a high-performance building standard. Other standards may be used as alternative compliance pathways for some of these policies.

VANCOUVER BUILDING BY-LAW

The Vancouver Building By-law (VBBL) is the City of Vancouver's local building code, which is based on the British Columbia Building code and regulates the design and construction of buildings within the City's jurisdiction. It prescribes the minimum performance and safety standards for buildings in Vancouver and includes additional objectives such as energy conservation and GHG emissions reductions.

GREEN BUILDING POLICY FOR REZONING

The Green Building Policy for Rezoning outlines performance requirements for new building projects which must be addressed at the rezoning application stage. The policy offers two compliance pathways: Near-Zero Emissions Buildings, which allows the Passive House standard and other standards accepted by the City; and Low Emissions Green Buildings, which establishes performance limits for heat loss, energy use, and GHG emissions, with more stringent limits on heat loss and energy use for projects not connected to a Low Carbon Energy System.

HIGHER BUILDINGS POLICY

The Higher Buildings Policy was formulated to mark the prominence of the Central Business District in Vancouver's downtown skyline with the highest buildings. It applies exclusively to new buildings that seek significant additional height above their current zoning allowance and high building developments in the Vancouver view corridors in Downtown, False Creek, or Queen Elizabeth Park areas. The buildings must achieve Passive House certification or achieve specified energy targets and connect to an approved Low Carbon Energy System. This policy must be used in conjunction with other applicable policies, such as the Green Buildings Policy for Rezoning that applies to all developments subject to the Higher Building Policy.

PASSIVE HOUSE STANDARD

Passive House is an internationally recognized certification program, developed by the Passive House Institute, an independent research institute based in Germany. Complying with the Passive House standard confirms that the building has been designed to achieve high levels of occupant comfort and energy performance.

ALTERNATE NEAR ZERO-EMISSIONS BUILDING STANDARDS

The Green Building Policy for Rezoning allows the use of alternate near zero-emissions standards. These standards include the Net Zero Homes Standard of the Canadian Home Builders' Association, the Canada Green Building Council's Zero Carbon Building Standard, and the International Living Future Institute's Living Building, Core Green Building, Zero Energy or Zero Carbon certifications. Projects using the Net Zero Homes Standard must restrict the use of fossil fuels based energy only to space heating and domestic hot water. Projects using Zero Carbon Building Standard must demonstrate a zero-emissions balance, without using offsite renewable energy. Other zero-emissions standards that are not named above may be used at the discretion of the City of Vancouver's Director of Sustainability and require detailed submissions.



VBBL ENERGY USE AND EMISSIONS UPDATES

The updates to the VBBL, approved by the City Council in April 2020, align the energy performance requirements of the VBBL with the B.C. Energy Step Code and bring the emissions targets limits up to the level of the Green Building Policy for Rezoning.

The updates to the VBBL that will take effect in January 2021 will align the Part 3 residential buildings performance requirements with the highest level of the B.C. Energy Step Code (Step 4) and add an option for connecting to an approved Low Carbon Energy System (LCES).

Updates to energy use and emissions targets for part 3 buildings in 2021 VBBL updates.

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	OPTION B	TEUI	100		N/A	N/A	N/A
		TEDI	15		N/A	N/A	N/A
		GHGI	N/A		N/A	N/A	N/A
		Airtightness	Residential per suite: 1.23 Total: 2.03				
	OPTION C (connected to an LCES)	TEUI	N/A	130	170	170	170
		TEDI	N/A	40	30	30	30
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The Heights, Cornerstone Architecture

PART 9 BUILDING EMISSIONS REQUIREMENTS

The current VBBL mandates prescriptive requirements for Part 9 buildings, that specify thermal resistance and conductance values for major building assemblies and exterior enclosures. With the VBBL update, from January 2022, performance-based requirements for Part 9 buildings will be going into effect.

CURRENT REQUIREMENTS

The information on the preceding pages provides an overview of the City of Vancouver's energy use and GHG emissions requirements for Part 3 buildings, which are mainly mid to high-rise or larger buildings.

Small buildings, single-family houses, and one to three storey buildings with a footprint of up to 600 square metres fall under Part 9 of the B.C. Building Code and VBBL. These small building projects tend to have project teams commensurate with the size of the building with fewer resources or energy modelling expertise. Because of this, the City of Vancouver has not yet set energy use and GHG emissions performance targets for these types of projects.

The exception is the one or two-family dwellings, which are larger than 325 m². These houses are required to limit the annual GHG emissions of their property to three tonnes CO₂ eq. This includes emissions from the energy used for space heating, domestic hot water, heated pools, plumbed patio heaters, and snowmelt equipment.

For all other Part 9 buildings, the VBBL has prescriptive requirements for each major building assembly (e.g. foundation, walls, floors, and roof) and each type of enclosure, including doors and windows. For each building assembly category, the minimum effective thermal resistance or R-Values (m²K/W) are specified. Similarly, for each exterior enclosure category, the maximum thermal transmittance or U-values (W/m²K) are specified. Further details can be found in the Energy and Water-Efficiency chapter (Part 10) of the [2019 VBBL](#), in the Design Measures for Energy Efficiency section (see Table 10.2.2.6 and Table 10.2.2.7).



Futrhaus, b Squared Architecture Inc. (Credit: EIC Media)

2022 VBBL UPDATES

Recent updates to the VBBL include adding performance-based requirements for Part 9 buildings. These requirements will come into effect in 2022 as an alternative to the prescriptive requirements for exterior closures and fenestration, which have also become more stringent.

The performance path metrics for Part 9 buildings, which are derived from Step 4 of the B.C. Energy Step Code, include a TEDI limit of 20 kWh/m² per year, Mechanical Energy Use Intensity (MEUI) as specified in the table below, and airtightness of 2.5 ACH @ 50 Pa. MEUI is an energy use metric that includes the energy consumption from heating, ventilation, and air conditioning systems. This includes domestic hot water supply, pumps, and fans, but omits base loads such as plug loads and lighting.

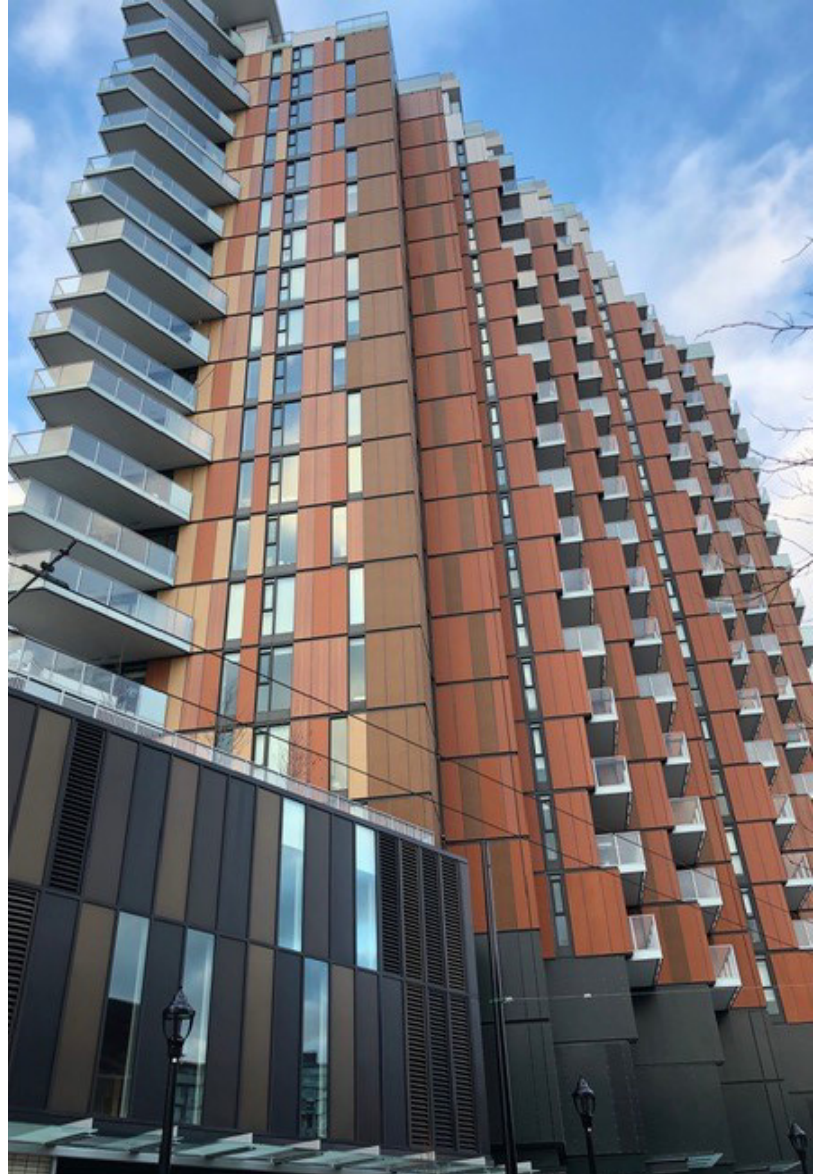
In addition, starting in 2022 all Part 9 residential buildings are required to meet an annual GHG limit of 3 kgCO₂ eq./m². In most cases, this limit will result in zero-emissions space and water heating. An alternative compliance path is meeting the Passive House standard requirements.

The updated VBBL maintains the annual GHG cap requirement for large houses but reduces it to two tonnes CO₂ eq. This applies to houses with more than 325 m² of conditioned space with one principal dwelling unit.

These updated requirements are estimated to reduce GHG emissions of a typical house by 63% when compared to an alternative built to the 2019 by-law and 86% when compared to a similar house built to Vancouver's 2007 requirements. The City estimates the cost implications of these added requirements to Part 9 houses to be less than 0.5% of the sale prices for new houses. Additionally, more than 60% of new houses are expected to reduce their monthly operating costs.

Mechanical energy use intensity requirement for Part 9 buildings in VBBL 2022 update

Conditioned Floor Area (m ²)	≤ 50	≤ 75	≤ 120	≤ 165	≤ 210	> 210	> 325
MEUI (kWh/m ² yr)	125	108	78	58	48	45	46



CITY OF VANCOUVER

ENERGY TARGETS FOR PART 3 BUILDINGS

Learn more at

<https://zebx.org/resources/#case-studies>



<https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx>

