CITY OF VANCOUVER

POLICY REPORT
DEVELOPMENT AND BUILDING

Report Date: November 1, 2016
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Meeting Date: November 16, 2016

TO: Standing Committee on City Finance and Services

FROM: General Manager of Planning, Urban Design and Sustainability

SUBJECT: Updates to the Green Buildings Policy for Rezonings

RECOMMENDATION

A. THAT Council approve updates (set out in Appendix A) to the Green Buildings Policy for Rezonings (the "Policy"), which updates include adopting limits on greenhouse gas emissions, thermal energy and total energy use, and establishing administrative requirements as intended in the Zero Emissions Building Plan.

B. THAT Council direct staff to report back by Q3 2017 with updates to the sustainability requirements in the Rezoning Policy for Large Sustainable Sites and the General Policy for Higher Buildings.

REPORT SUMMARY

This recommended Policy update includes many of the priority actions recommended in the Zero Emissions Building Plan (ZEBP), including establishing the first limits on greenhouse gas (GHG) emissions, heat loss and total energy use in new buildings. Taking the first step of the ZEBP, the recommended Policy updates will:

- Reduce GHG emissions in new rezoned buildings by 50% or more (depending on building type);
- Provide flexibility to achieve these GHG reductions using simple, locally proven approaches and technologies;
- Not require incremental construction or operating costs in residential buildings;
- Improve the health of residents in new rezoned building(s) due to higher indoor air quality.

In addition, the proposed Policy updates introduce requirements to report embodied emissions associated with the construction of building(s) and to ensure GHG reductions are long-lasting through airtightness testing, building system commissioning, and energy sub-metering.

Water efficiency measures achieved in the current policy have informed proposed updates to the Building By-law, expanding water efficiency from rezoned buildings to all new buildings.

COUNCIL AUTHORITY/PREVIOUS DECISIONS

In June 2008, Council adopted a Building By-Law amendment to require the use of ASHRAE 90.1-2007, to improve the energy efficiency performance of all new Part 3 (large residential, commercial, industrial) buildings.

In July 2010, Council approved the current version of the Policy, which required all applicable developments applying for rezoning to achieve the LEED standard. In its current form, the Policy requires meeting LEED Gold with additional energy and water reductions. This Policy was developed to use a well-established City process (rezoning) to help transition industry toward more sustainable building practices.

In January 2011, Council adopted the revised *Greenest City Action Plan 2020* targets, which included the target to have all buildings constructed from 2020 onward will be carbon neutral in operations.

In October 2012, Council approved the *Vancouver Neighbourhood Energy Strategy and Energy Centre Guidelines*, to address the *Greenest City 2020 Action Plan* objective of reducing 120,000 tonnes carbon dioxide per year through the conversion of existing steam heat systems to low carbon energy sources and the deployment of sustainable energy systems for high-density neighbourhoods.

In April 2014, Council adopted a set of progressive Building By-law amendments as part of Vancouver's revised 2014 Building By-law that made great strides forward in energy efficiency for one- and two-family dwellings and laneway houses, which included mandatory airtightness testing for the first time in Vancouver.

In November 2015, Council approved the Renewable City Strategy (RCS), detailing how Vancouver will achieve the target of 100% renewable energy use by 2050 and directed staff to bring forward recommendations for achieving zero emission new buildings by 2030 and where possible, sooner.

In July 2016, Council approved the Zero Emissions Building Plan (ZEBP), which established a framework to reach zero emissions in all newly permitted buildings by 2030. The plan directed staff, amongst a number of other actions, to recommend stepped changes to energy efficiency policy and regulations to specifically limit GHG emissions.

CITY MANAGER'S COMMENTS

The City Manager supports these recommendations as an effective first step to reducing GHG emissions in new buildings while supporting other priority outcomes, including housing affordability, public health, economic development, and resilience.

REPORT

Background/Context

Vancouver's Renewable City Strategy (RCS) aims to have all energy used in Vancouver come from only renewable sources by 2050. Given the challenges associated with deep energy retrofits for existing buildings, especially large buildings with multiple tenants or families, one of the highest priorities identified in the Strategy was to develop a plan to have all *new* buildings achieve zero emissions by 2030 or sooner.

The Zero Emissions Building Plan (ZEBP) approved by Council in July 2016 establishes four actions to enable all newly permitted buildings to have no operational GHG emissions by 2030 including: 1) establish GHG and heat loss limits for new buildings and step them down over time to zero; 2) demonstrate leadership in new City-owned buildings by developing these to be zero or near zero emissions; 3) provide catalyst tools for industry to develop and demonstrate cost effective ways of developing zero emission buildings; 4) invest in building industry capacity and removing barriers.

A minimum of 93% of electricity in BC comes from renewable sources and therefore electricity use has very limited impact on GHG emissions. Approximately 82% of new development in Vancouver is residential. In these buildings, over 90% of operational GHG emissions are related to providing heat and hot water for residents. In the development of the ZEBP, residential building owners and operators indicated that they typically lacked the specialized skills required to properly manage the operation of complex buildings systems and technologies and as a result, these systems were not operating as efficiently as intended.

As a result of these factors, the ZEBP established two options to achieve real and durable GHG reductions from new buildings:

1) Option 1 - Reduce Energy Use First: invest in energy efficient windows and well-insulated, air tight buildings that provide fresh air directly to occupied spaces and that is pre-heated by recovering the energy in the exhaust air to greatly reduce energy use and GHG emissions.

2) Option 2 - Reduce and use Renewable or Low-Carbon Energy: balance investments in energy reductions with the use of professionally operated and maintained City-recognized low-carbon energy systems (such as connecting to a City-recognized low carbon Neighbourhood Energy Utility ("NEU")).

The Vancouver Building By-law establishes minimum levels of energy performance in new buildings. The voluntary rezoning process creates an opportunity for applicants to commit to exceed the minimum allowed requirements of the Building By-law. The current Green Building Policy for Rezonings (the Policy) impacts approximately 55% of floor area of new commercial and multi-family buildings developed in the city each year. This Policy, originally adopted in 2010, is intended to encourage green building best practices so as to help in transforming the industry towards more sustainable buildings. The Policy also requires buildings be designed to achieve LEED Gold certification and reduce operational energy cost by 22% below the Building By-law requirements.

Leadership in Environment and Energy Design (LEED) is a voluntary, points-based standard for achieving holistic sustainability in buildings. As uptake quickly grew throughout North America and beyond, it created and continues to mainstream the green building movement we benefit from today. LEED created a shared language that is both technical and relatable, enabling a continent-wide network of professionals to learn and gain inspiration from one another. By continually identifying and incorporating best practices from across North America, it drives innovation in design and green building policy.

Since the current version of the Policy was adopted, sixty seven large condominium, apartment, and commercial buildings representing over 8.5 million square feet of new development are under construction or have been built to meet the Policy and achieve

LEED Gold certification. These buildings, combined with broader industry shifts in North America, have changed standard design and construction approaches in Vancouver towards more efficient lighting, heating, and water systems along with improved ventilation and the use of healthier materials for higher indoor air quality. In addition to this transformation of industry practices, LEED has set the industry standard in green building compliance, through the use of regular, detailed audits of submissions, as well as independent third-party reviews of energy models.

As the best practices pioneered by LEED have spread throughout the industry and in particular in Vancouver, they have increasingly been incorporated into local regulations. The City has included provisions such as mandatory bike parking and a requirement that new buildings are 22% more energy cost efficient than the base requirements.

Since the current version of the Policy was originally approved and the local development industry has evolved towards more sustainable practices, the City developed greater clarity on the local priorities that the Policy is aiming to achieve such as GHG reductions, water and waste reduction, healthier and more affordable homes, and green job opportunities. The Zero Emissions Building Plan provided staff with direction to recommend changes to the Policy so as to establish GHG limits for new buildings and to focus on priority policy outcomes.

Consultations

Building on the extensive consultations conducted during the development of the Zero Emissions Building Plan and the provincial Step Code, the development of the recommended Policy updates described in this Report followed a concerted effort to reach an even wider group of stakeholders.

This consultation process started with gaining input from industry experts on the content and specifications of the policy itself. It then expanded to include many diverse stakeholders, including focused workshops with:

- Green Building Professionals
- Airtightness Professionals and Contractors
- Green Building External Advisory Committee, including homeowner and landlord associations as well as BC Hydro and FortisBC
- UDI Codes & Standards Committee
- UDI General membership (Breakfast Seminar)
- Canada Green Building Council
- Non-Residential Building Stakeholders
- Purpose-Built Rental and Non-Profit Housing Stakeholders
- Restaurant and Tourism Business Associations
- Open House for Industry and the Public

As part of these consultations, city staff provided detailed costing information and received feedback from stakeholders. Other consultation formats included an Annual General Meeting with energy modellers, a luncheon with industry managers, and an evening question and answer session with local green builders, as well as many one-on-one discussions and follow-ups between staff and interested stakeholders.

In addition, discussions between staff and the National Research Council have been initiated on how to best collaborate in implementing the Zero Emissions Building Plan and establishing a Centre of Excellence. An in-person workshop is planned for early January 2017.

A full list of organizations consulted in the development of this policy update is provided in Appendix B.

Strategic Analysis

The first action in the Zero Emissions Building Plan is to restructure the current version of the Policy to make establishment of GHG and heat loss limits for new buildings a key focus, while achieving other City priority outcomes. The updated Policy includes requirements for:

a) GHG, heat loss, and total energy use limits
b) Building airtightness testing
c) Enhanced commissioning
d) Energy system sub-metering
e) Embodied and refrigerant emissions reporting
f) Direct ventilation
g) Low emitting materials
h) Indoor air quality testing
i) Integrated rainwater management and green infrastructure
j) Resilient drinking water access

Each of these requirements is described in greater detail below as well as in the updated Policy (Appendix A).

a) GHG, Heat Loss and Total Energy Use Limits

In the development of the Zero Emissions Building Plan, establishing limits on GHG emissions, heat loss, and energy use began with a consultant team creating models of typical buildings that would meet today's LEED Gold and 22% reduced energy cost rezoning requirements.

Envelope and mechanical system improvements were then identified that use locally proven approaches and technologies. Working in partnership with the Urban Development Institute, city staff consulted on these approaches with local builders, suppliers, and design professionals, and the most cost-effective and buildable approaches were highlighted. At the same time Energy Modelling Guidelines were developed for the City that standardize inputs and assumptions for energy models, creating a standard for comparison between different models and buildings. The consultant team then modelled and costed multiple combinations of improvements.

Using these results, staff established the limits based on cost-effective changes that maximized the GHG and heat loss reductions. The limits established a required performance outcome while providing flexibility in how that outcome is achieved.

Following the adoption of the Zero Emissions Building Plan, a study of over 120,000 residential building simulations was conducted to test the achievability of the residential limits even with a wide variety in building forms, composition, and amenities. This study found that while challenges can exist for some buildings, such as

those on constrained sites or with energy-intensive amenities like indoor pools, these challenges can be readily overcome with other improvements such as more efficient windows, ventilation, or other mechanical equipment. As the limits become more restrictive in future Policy update steps, means for mitigating unfair challenges will be explored.

To illustrate the nature of the changes the recommended Policy updates could bring, a typical design response for a high-rise multi-family residential building could include:

- Walls designed to insulate concrete slab ends, increase continuous insulation;
- Improved transition details around window frames;
- Ten-percent less glass (down to 50% from 60%);
- Improved efficiency of heat-recovery ventilators (HRVs);
- Allowing electric resistance space heating as demand for space heating will be greatly reduced by the previous measures;
- High-efficiency lighting;
- High-efficiency gas heating for corridor make-up air and domestic hot water.

Appropriate limits for office, retail and hotel buildings were also developed (the latter was conducted in partnership with the City of Richmond) using a similar process as above. As noted in the ZEBP, further research and analysis will be required before recommending specific GHG limits and the implementation for achieving zero emissions in the dozens of other buildings types that make up the remaining new development in Vancouver, as each of these buildings types has very unique energy usage and emissions profiles.

The proposed limits in the Policy were developed using current carbon accounting protocols and emissions factors at the province and BC Hydro. It is anticipated that these protocols will be updated next year, and that the emissions factors in the City's Energy Modelling Guidelines and the limits may be updated accordingly once the updated protocols are in place.

The current version of the Policy requires new buildings to be 22% more energy cost efficient than required in the Building By-law. Energy cost savings is the efficiency metric utilized by ASHRAE 90.1, the standard referenced in the Building By-law. Regulating energy cost prioritizes conservation of the most expensive fuels. In British Columbia this can place a lower priority on reducing lower-cost, higher-carbon fuels. Regulating energy use treats energy savings from all fuels equally. While it varies with building type, a 22% energy cost reduction typically corresponds to 25-40% energy use reduction. After input from industry experts, staff concluded that a 35% reduction in energy use represents a challenging yet attainable target for all other building types.

The Zero Emissions Building Plan describes two pathways to reliably meeting GHG limits in new buildings: 1) focus primarily on reducing energy use, or; 2) balance energy use reduction investments with the use of reliable, City-recognized low-carbon energy systems (such as connecting to a City-recognized low-carbon NEU). Under the first option, allowable heat loss limits are more stringent than under the second pathway but both achieve comparable GHG outcomes. The proposed Policy updates establish the limits to be used by a building pursuing either pathway, and staff are scheduled to report back to council in Q1 2017 with updated neighbourhood energy connection areas.

Given the importance of low-carbon NEUs in achieving the City's GHG reduction objectives, it is essential to continue collaborating with NEU providers to ensure that the conditions required for their success can be fostered in the high density neighbourhoods that they serve.

b) Whole-Building Airtightness Testing

Unplanned and uncontrolled air leakage from a building results in significant heat loss in the winter, undesired heating in the summer, and increases the introduction of external air and noise pollution into the building. Designing, building, and testing new buildings to an airtightness target can increase the overall quality of construction, enable improved indoor air quality and reduce energy use over the lifetime of the building. The target recommended in the Policy is consistent with the current Seattle policy.

c) Enhanced Commissioning

Commissioning of building systems and equipment provides increased quality assurance to the owner that these systems will perform as intended. An individual is designated as the Commissioning Authority before the design phase of a new building to document the owner's requirements. This Commissioning Authority is responsible for verifying that the design and construction of building systems meets those requirements, and reviews the project during all phases of design, construction, and handover. They focus particularly on active building systems such as the Heating, Ventilation, and Air-Conditioning (HVAC), plumbing, and lighting systems and their controls, to ensure that they operate as intended under a variety of conditions. This process will often include a follow-up review after the building is occupied in different seasons to ensure both heating and cooling system function correctly. This process is currently carried out already on most LEED projects as well being required under energy codes in California and Seattle.

d) Energy System Sub-Metering

The recommended Policy update requires that new buildings include a master energy meter for each building along with sub-meters for major energy uses and space types. This will better equip building owners and operators with tools to manage the long-term energy efficiency of the building, as well as identify and correct deficiencies from specific systems.

In addition, staff will explore and bring back recommendations regarding a mechanism to require building owners to annually benchmark and report new building energy use to provide feedback on the effectiveness of this Policy.

e) Embodied and Refrigerant Emission Reporting

The GHG limits proposed in the recommended Policy updates will significantly reduce the operational emissions of new buildings. Initial research has indicated that as operational emissions are reduced, understanding and eventually limiting embodied emissions and fugitive refrigerant emissions will become increasingly important. The proposed Policy updates will require projects to calculate the embodied and refrigerant emissions over the life of the building, and to report the equivalent annual values alongside the operational emissions. This will allow the City to begin gathering data on the scale of embodied emissions and the factors that affect it most. In

addition, this requirement introduces a Life-Cycle Assessment process that is consistent with new LEED credits. This assessment can be carried out using simple free tools that are publicly available and that allow a project to quantify its environmental impact across a wide range of categories.

f) Direct Ventilation

This recommended requirement helps to provide good indoor air quality through best practices in ventilation system design. The current policy, by referencing LEED, has helped the market transform to better ventilation practices, where outdoor air is delivered directly to spaces where it is needed, and in ways that can be tested and verified. The current Building By-law sets the amount of outdoor air to be provided to a space, but is less explicit in defining how it is delivered and measured. This recommended update makes these practices explicit in the Policy for all rezoned buildings. These best practices will be used to inform future updates to the Building By-law, in coordination with updates to provincial building codes.

g) Low-Emitting Materials

This recommended requirement helps to maintain good indoor air quality by reducing pollutant sources. It minimizes the installation of materials with high content of Volatile Organic Compounds (VOCs) and other pollutants, which can strongly impact indoor air quality. Nearly all buildings meet this voluntarily under the current version of the Policy, however the recommended updates make this requirement explicit in the Policy for all buildings.

h) Indoor Air Quality Testing

This recommended requirement provides a measure of quality assurance for indoor air quality, with numerical data being collected and reported for the most common indoor air pollutants. Nearly all buildings test a sample of suites voluntarily under the current version of the Policy, however the recommended updates make this requirement explicit in the Policy for all buildings.

i) Integrated Rainwater Management and Green Infrastructure

Green infrastructure manages rainwater at a site or district level by retaining, filtering, and infiltrating some or all of the rainwater that falls on site through permeable materials, rainwater reuse technologies and planted areas. These types of infrastructure give design teams the flexibility to explore where it is best suited on the project site, while enabling city staff to encourage these opportunities where they arise. More information on rainwater management targets and green infrastructure practices may be found in the Citywide Integrated Rainwater Management Plan Volume I and II, available on the City of Vancouver website.

j) Resilient Drinking Water Access

The simple requirement of having drinking water access provided at a ground floor common area of the building helps to ensure that all building occupants have access to clean drinking water, even in the event of an extended power outage. It is adapted from a LEED pilot credit on design for enhanced resilience, and is a simple measure to enhance the resilience of the built environment.

Passive House

The recommended proposed Policy updates include an option for projects to comply by meeting Passive House, or an alternate near zero emissions building standard. Passive House is the most rigorous and widely applied global standard that has been developed and refined specifically for ensuring highly energy efficient building envelope and ventilation system design and construction. In addition to reducing GHG emissions to near zero, Passive House buildings are also recognized to be extremely quiet, comfortable, and to have excellent indoor air quality.

In addition to the requirements described above, additional analysis to inform and support the recommended changes was undertaken:

Streamlining Residential Requirements

Since the Policy was originally approved the local development industry has evolved towards more sustainable practices, a number of the green building outcomes have been required through regulation, and the City developed greater clarity on the local priorities that the Policy is aiming to achieve with the adoption of the Greenest City Action Plan and the Heathy City Strategy.

In order to achieve significant GHG emission and water use reductions while providing healthier new homes without negatively impacting housing affordability, it was important to identify opportunities to streamline the current Policy requirements.

In order to do this, the typical design and construction features incorporated into new multi-family residential buildings to demonstrate compliance with the current Policy were compared to those now required by regulation, those achieved due to Vancouver's urban context, and those typically incorporated into new residential buildings in the region even where there is no policy requirement to do so. The key Greenest City and Healthy City outcomes that the current policy delivers that were not being addressed by other means included improved indoor air quality and increased water efficiency.

The proposed Policy update focuses on priority City policy objectives and includes multiple measures to ensure good indoor air quality. The water efficiency outcomes achieved in the current Policy were determined to be very cost effective and have informed proposed updates to the Building By-law.

Rezoning Policy for Large Developments and Rezoning Policy for Tall Buildings

In addition to the Policy, the City has two additional policies intended to foster even greater leadership and market transformation towards energy efficient and green buildings. If the proposed changes to Green Buildings Policy for Rezonings are approved, these additional policies need to be updated to reflect the Zero Emissions Building Plan outcomes and approach.

Cost Effectiveness

Detailed construction costs of the residential and office cases were provided by a quantity surveyor and the consultant team that modelled each case. These were compiled together with the costs of new requirements such as airtightness testing, and with the operational costs, and distributed to stakeholders for feedback during consultations.

In a typical multifamily residential building, the costs of envelope improvements were offset by simplified mechanical systems, and the additional cost of measures such as airtightness testing were offset by the streamlining of the current Policy requirements. From an operational perspective, the slight increase in energy costs resulting from the proposed Policy changes was offset by modest decreases in maintenance and capital replacement costs, again due to simplified mechanical systems. In a typical multifamily residential building the proposed Policy updates will not result in incremental construction or operating costs in residential buildings but will reduce GHG emissions by over 50%.

In a typical office building, reduced glazing in the envelope was found to present a cost savings, while mechanical costs increased modestly due to the inclusion of a heat pump for heating. When combined with consultants' estimates of the costs of airtightness testing and other new requirements, the City has found an overall increase in Office construction cost of $\$2.5/ft^2$, or less than 1% of new construction costs, while achieving a 10% savings in energy costs and greater than 50% GHG emissions reductions.

For a detailed summary of construction and operational costs, please refer to Appendix C.

Implementation Plan

If the proposed Policy updates are approved, they will become mandatory as of May 1, 2017. Prior to this date, for applications that have not yet been approved by Council, applicants will have the option of complying with either the current or revised Policy requirements. A modest delay prior to the new Policy becoming mandatory provides an adjustment period to those projects that are currently working on applications. In addition, it provides time for the City to update its mandatory NEU connection areas as described above.

An Administrative Bulletin detailing the compliance requirements has been developed to complement the Policy. The Bulletin includes detailed technical requirements and describes the compliance process and submissions expectations. It has been developed to provide clarity and certainty for applicants as well as staff.

The Bulletin will include City of Vancouver Energy Modelling Guidelines to be used to demonstrate compliance with the Limits required under the Policy. The Modelling Guidelines also clarify all factors to be accounted for, such as accounting for all heat loss including through thermal bridges, and consideration for summertime thermal comfort.

Capacity Building

To help local industry prepare to comply with the Policy updates before they become mandatory, and before buildings are built in the following years, several initiatives are currently underway to build capacity.

First, the City, together with the HPO and BC Hydro, is championing a guide to designing, building, and testing whole-building airtightness, which will include training sessions for industry scheduled to take place in early 2017.

Second, the City has supported the development of an energy visualization tool that will be available without charge to allow developers and designers to quickly assess different ways of meeting the GHG emission, heating demand, and energy use limits.

Third, the city has funded research into cost-effective ways that residential buildings can be designed to avoid overheating in summer without the need for air-conditioning. This research includes exploring the effectiveness of these measures in the hotter summers expected in 2050, so as to better understand the climate resilience and adaptation options of residential buildings.

Implications/Related Issues/Risk

Financial

There are no financial implications for the City.

Environmental

The recommended Policy updates will reduce GHG emissions in rezoned new buildings by greater than 50%.

Legal

There are no legal implications for the City.

CONCLUSION

Meeting the City's 2050 target to use only renewable energy will require the majority of new buildings be designed and built to achieve zero emissions by 2030. This is a first and significant step for new buildings that will lower greenhouse gas emissions by over 50%. Should Council adopt these recommendations it will put Vancouver at the forefront of sustainable development practices in North America, by reducing greenhouses gases in a cost effective and reliable manner.

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GREEN BUILDINGS POLICY FOR REZONINGS

Adopted by City Council on July 22, 2010
Amended June 25, 2014
Amended _____, 2016

All rezonings must meet the following requirements of either:

A) Near Zero Emissions Buildings, or
B) Low Emissions Green Buildings.

This policy is effective immediately, and shall be mandatory for all Rezoning Applications received on or after May 1, 2017, with exceptions permitted at the discretion of the Director of Planning. For rezoning Applications received prior to May 1, 2017 that have not yet been approved by Council, applicants may choose to meet this updated version of the Policy or the preceding version.

REQUIREMENTS

A) Near Zero Emissions Buildings

Projects shall be designed to meet Passive House requirements and apply for certification, or to an alternate near zero emissions building standard, such as the International Living Building Institute's Net Zero Energy Building Certification, as deemed suitable by the Director of Sustainability.

OR

B) Low Emissions Green Buildings

1) LEED Gold - Building Design and Construction

All projects – with the exception of residential buildings - shall register with the Canadian Green Building Council (CaGBC) and be designed to achieve LEED Gold certification for Building Design + Construction (BD+C), or an alternate holistic green building rating system. A residential building is defined as a building in which at least 50% of the gross floor area is residential space. Where a project has multiple buildings, each building shall be evaluated separately.

The BD+C project type applies to buildings that are being newly constructed or going through a major renovation, and includes many rating systems designed for various building types. The applicant is responsible for choosing the rating system (within BD+C) that is most applicable to the project.

AND

2) Performance Limits

All buildings shall meet or exceed performance limits according to their building type summarized in the tables below, as modelled according to the City of Vancouver Energy Modelling Guidelines. The Energy Modelling Guidelines set standard assumptions and requirements for energy models when assessing compliance with the limits, including accounting for thermal bridging, consideration of summertime thermal comfort, and the treatment of mixed-use buildings.

Performance Limits - Buildings Not Connected to a City-recognized Low Carbon Energy System			
Building Type	TEUI (kWh/m^2)	TEDI (kWh/m^2)	GHGI ($kgCO_2/m^2$)
Residential Low-Rise (< 7 storeys)	100	15	5
Residential High-Rise (7+ storeys)	120	32	6
Office	100	27	3
Retail	170	21	3
Hotel	170	25	8
All Other Buildings	EUI 35% below 90.1-2010		

Performance Limits - Buildings Connected to a City-recognized Low Carbon Energy System			
Building Type	TEUI (kWh/m^2)	TEDI (kWh/m^2)	GHGI ($kgCO_2/m^2$)
Residential Low-Rise (< 7 storeys)	110	25	5
Residential High-Rise (7+ storeys)	130	40	6
Office	110	27	3
Retail	170	21	3
Hotel	210	25	8
All Other Buildings	EUI 35% below 90.1-2010		

TEUI: Total Energy Use Intensity
TEDI: Thermal Energy Demand Intensity
GHGI: Greenhouse Gas Intensity

AND

3) Airtightness Testing

Whole-building airtightness for each building is to be tested and reported, and all buildings are to be designed and constructed with the intention of meeting an air-leakage target of 2.0 $L/s*m^2$ @75 Pa (0.40 cfm/ft^2 @ 0.3”w.c.), or sealed according to good engineering practice.

Airtightness of suites is to be tested and reported for residential buildings and must demonstrate compliance with a suite-level air-leakage target of 1.2 $L/s*m^2$ @50 Pa (0.23 cfm/ft^2 @ 0.2”w.c.), as tested to ASTM E779 or an equivalent standard.

AND

4) Enhanced Commissioning

An enhanced commissioning process for all building energy systems is to be completed in accordance with ASHRAE Guideline 0-2005 and 1.1-2007, or an alternate commissioning standard.

AND

5) Energy System Sub-Metering

Separate master metering for each energy utility (eg: Electricity, Gas, etc.) and each building is to be provided as well as sub-metering of all major energy end-uses and major space uses within each building.

An Energy Star Portfolio Manager account is to be setup for each building and must include all basic property information for each building as designed, including setup of meters for all energy utilities servicing the building.

AND

6) Refrigerant Emissions and Embodied Emissions

All projects shall calculate and report the life-cycle equivalent annual carbon dioxide emissions of each building, in $kgCO_2e/m^2$, from the emission of refrigerants. This requirement does not apply to projects where the total installed heating and cooling capacity of equipment containing refrigerants is less than 35kW.

All projects shall report the life-cycle equivalent carbon dioxide emissions (ie: global warming potential impact, or 'embodied carbon') of each building, in $kgCO_2e/m^2$, as calculated by a whole-building life-cycle assessment (LCA).

AND

7) Verified Direct Ventilation

All buildings shall be designed and constructed with a ventilation system that provides outdoor air directly to all occupiable spaces, in the quantities defined by code. This includes bedrooms, living rooms, and dens in residential units. The ventilation system shall allow for the designed flow rates to be tested and verified at the occupiable space level as part of the enhanced commissioning process.

AND

8) Low-Emitting Materials

Emissions from interior materials containing volatile organic compounds (VOCs) or added urea formaldehyde are to be minimized by meeting the content requirements of Green Seal, Green Label, Green Label Plus, FloorScore, South Coast Air Quality Management District (SCAQMD) Rules, or alternate low VOC criteria as applicable to each material or product, and shall contain no added urea formaldehyde resins.

AND

9) Indoor Air Quality Testing

Indoor air quality testing is to be conducted for formaldehyde, particulates, ozone, total volatile organic compounds, and carbon monoxide prior to occupancy, and report results to the City as compared to acceptable target concentration levels and standards.

AND

10) Integrated Rainwater Management and Green Infrastructure

Explore and describe measures for the management of the site's rainfall through integrated rainwater management and Green Infrastructure (GI) as described in the City-Wide Integrated Rainwater Management Plan. Project teams can refer to the Citywide Integrated Rainwater Management Plan Volume I: Vision, Principles and Actions and Volume II: Best Management Practice Toolkit, for specific targets and examples of green infrastructure for rainwater management.

AND

11) Resilient Drinking Water Access

A water fountain, bottle-filling station, or other fixture capable of operating on city water pressure alone and without electricity is to be provided in a location easily accessible to all building occupants.

REQUIREMENT ADMINSTRATION

Projects demonstrating that the building is extremely ill-suited to achieving a specific requirement may request that the requirement be modified, or deemed not applicable, at the discretion of the Director of Sustainability.

HERITAGE BUILDINGS

Where a project includes heritage retention, heritage components can be exempted from one or all of the requirements of this policy at the discretion of the Director of Planning.

Organizations Involved in the Development of the Proposed Updates to the Green Buildings Policy for Rezonings

Energy Utilities

- BC Hydro
- FortisBC

Homeowner and Housing Associations

- Landlord BC
- Condominium Home Owners Association of BC
- BC Non-Profit Housing Association
- Vancouver Affordable Housing Association

Industry and Professional Associations

- Urban Development Institute BC
- Architectural Institute of BC
- Association of Professional Engineers and Geoscientists of BC
- International Building Performance Simulation Association – BC Chapter
- Professional Services Management Association
- Building Owners and Managers Association
- BC Restaurant and Food Services Association
- Tourism Vancouver

Public Sector

- Government of Canada, Public Services and Procurement Canada
- BC Ministry Responsible for Housing, Building and Safety Standards Branch
- Cities of Richmond, North Vancouver, Surrey, Port Moody, and Township of Langley
- Metro Vancouver
- BC Housing and the Homeowners Protection Office
- Vancouver School Board

Non-Governmental Associations

- Pembina Institute
- Canadian Passive House Institute
- Canadian Green Building Council
- Lighthouse Sustainable Building Institute
- WoodWORKS! BC and Canadian Wood Council

Academic Institutions

- UBC
- SFU Community Trust
- BCIT

Consultant Team

- RDH Engineering
- Integral
- BTY
- EnerSys
- Morrison Hershfield
- New Buildings Institute

Companies

- Recollective
- Perkins and Will Architecture
- Cornerstone Architecture
- Bentall Kennedy
- Smartforme
- Concert Properties
- Bosa Properties
- Kane Consulting
- Stantec Architecture
- Onni Group
- Polygon Homes
- E3 Eco Group
- AES Engineering
- Numerous additional builders, architects, engineers, and industry members

Detailed Summary of Costs for Residential and Office Buildings

Residential Cost Comparison - Outside NEU Areas: Current Rezoning vs Proposed Rezoning Policy

Based on a 100,000ft² residential archetype, 102 units, 850ft²/unit avg.

This document is intended to be reviewed by stakeholders interested in greater detail on costs after attending consultations on the proposed update to the Green Building Policy for Rezonings. If you have questions about this document please follow up with Green.Buildings@vancouver.ca. The data compiled below represents one example of a building that meets the proposed performance limits (GHGI, TEDI, EUI), and the performance approach allows for many other solutions. The construction cost data compiled by the city was provided by BTY Group, based on archetypes prepared by Integral Group, Morrison Hershfield, and Enersys Analytics. The operating costs were compiled by the city using published utility rates and maintenance cost data provided by local service contractors and asset managers.

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Construction Costs

Envelope

Case	Type	Description	Area (ft²)	Cost ($/ft²)	Cost ($)
Current Rezoning	Glazing	Glazing 60% U-0.36	34,020	62.00	2,109,240
	Wall	Steel stud opaque wall, overall R7.2 nominal, R4 effective	21,728	59.60	1,295,051
	Balcony	Balcony area (slab edge)	952	71.37	67,947
				Total:	**3,472,238**
Proposed Rezoning	Glazing	Glazing 50% U-0.36	28,350	62.00	1,757,700
	Wall	Steel stud opaque wall, overall R9 effective	27,398	61.09	1,673,871
	Balcony	Balcony area (slab edge with outboard insulation)	952	88.44	84,198
				Total:	**3,515,769**
				Envelope Cost Difference ($):	**43,532**
				Envelope Cost Difference ($/ft²):	**0.44**

Lighting

Case	Type	Description	Area (ft²)	Cost ($/ft²)	Cost ($)
Current Rezoning	Interior	Lighting - Interior 0.6W/ft2 common/0.84W/ft2 suites	100,000	3.48	348,386
	Parking	Lighting - Parking 0.25W/ft2	40,000	1.15	46,000
				Total:	**394,386**
Proposed Rezoning	Interior	Lighting - Interior + 22% savings	100,000	4.01	400,644
	Parking	Lighting - Parking + 22% savings	40,000	1.32	52,900
				Total:	**453,544**
				Lighting Cost Difference ($):	**59,158**
				Lighting Cost Difference ($/ft²):	**0.59**

HVAC

Case	Type	Description	Area (ft²)	Cost ($/ft²)	Cost ($)
Current Rezoning	Heating	Hydronic heating	100,000	3.72	371,612
	Heating	Boiler (4 unit 300 MBH each) 80%-85% efficiency	100,000	1.00	100,000
	MUA	85% efficient MUA + distribution	100,000	2.70	270,000
	HRV	Heat recovery ventilator 52% efficiency	100,000	4.50	450,000
	DHW	DHW (2 unit 300 MBH each) 80-84% efficiency	100,000	0.50	50,000
	Mech Rm	Larger Mechanical Room (avg. across building)	100,000	0.40	40,000
				Total:	**1,281,612**
Proposed Rezoning	Heating	Electric baseboard	100,000	0.80	79,897
	MUA	94% efficient MUA + distribution	100,000	3.24	324,046
	HRV	Heat recovery ventilator 78% efficiency	100,000	6.00	600,000
	DHW	DHW (2 unit 300 MBH each) 94% efficiency	100,000	0.65	65,000
				Total:	**1,068,942**
				HVAC Cost Difference ($):	**(212,670)**
				HVAC Cost Difference ($/ft²):	**(2.13)**

TOTAL

Envelope Cost Difference ($/ft²):	0.44
Lighting Cost Difference ($/ft²):	0.59
HVAC Cost Difference ($/ft²):	(2.13)
TOTAL Construction Cost Difference ($/ft²):	**(1.10)**

Operating Costs					
Energy					
Case	kWh/m²	Description	kWh	$/kWh	Cost ($)
Current Rezoning	86	Annual Natural Gas (2016)	797,569	0.031	24,725
	55	Annual Electricity (2016)	514,222	0.103	52,965
	-	Annual NEU Heat (2016)	-	0.103	-
				Total:	**77,690**
Proposed Rezoning	27	Annual Natural Gas (2016)	250,253	0.031	7,758
	83	Annual Electricity (2016)	767,035	0.103	79,005
	-	Annual NEU Heat (2016)	-	0.103	-
				Total:	**86,762**
				Annual Energy Cost Difference ($):	**9,073**
				Annual Energy Cost Difference ($/ft²):	**0.09**
				Monthly Energy Cost Difference in 850ft² Unit ($):	**6**
				Monthly Emissions Reduction in 850ft² Unit ($kgCO_{2e}$):	**70**
Maintenance and Replacement					
Case		Description			Cost ($)
Current Rezoning		Annual Basic Maintenance (filters, fan belts, backflows, etc.)			6,000
		Annual Boiler Maintenance (cleaning, performance checks, etc.)			6,000
		Annual Hydronic Maintenance (pumps, chemical treatment, etc.)			2,000
		Annual Capital Reserve Contribution for Boiler Replacement ($100k /25yrs)			4,000
		Avg. Annual Replacement of Heating Valves ($500 /unit /25yrs)			2,040
				Total:	**20,040**
Proposed Rezoning		Annual Basic Maintenance (filters, fan belts, etc.)			6,000
		Annual Electric Baseboard Maintenance			-
		Annual Capital Reserve Contribution for Baseboard Replacement ($80k /25yrs)			3,200
				Total:	**9,200**
				Annual Maintenance and Replacement Cost Difference ($):	**(10,840)**
				Annual Maintenance and Replacement Cost Difference ($/ft²):	**(0.11)**
				Monthly Maintenance and Replacement Cost Difference in 850ft² Unit ($):	**(8)**
TOTAL					
				Annual Energy Cost Difference ($/ft²):	0.09
				Annual Maintenance Cost Difference ($/ft²):	(0.11)
				TOTAL Operating Cost Difference ($/ft²):	**(0.02)**

Office Cost Comparison - Outside NEU Areas: Current Rezoning vs Proposed Rezoning Policy

Based on a 260,000ft² commercial office archetype

This document is intended to be reviewed by stakeholders interested in greater detail on costs after attending consultations on the proposed update to the Green Building Policy for Rezonings. If you have questions about this document please follow up with Green.Buildings@vancouver.ca. The data compiled below represents one example of a building that meets the proposed performance limits (GHGI, TEDI, EUI), and the performance approach allows for many other solutions. The construction cost data compiled by the city was provided by BTY Group, based on archetypes prepared by Integral Group, Morrison Hershfield, and Enersys Analytics. The operating costs were compiled by the city using published utility rates, while maintenance costs are not expected to change from current practices.

Construction Costs

Envelope

Case	Type	Description	Area (ft²)	Cost ($/ft²)	Cost ($)
Current Rezoning	Glazing	Glazing 70% U-0.23 triple glazing - Curtain wall	72,600	95.00	6,897,000
	Wall	Wall with R9.3 (Precast Panel)	31,110	65.90	2,050,149
				Total:	**8,947,149**
Proposed Rezoning	Glazing	Glazing 60% U-0.23 triple glazing - Curtain wall	62,220	95.00	5,910,900
	Wall	Wall with R12.3 (precast panel)	41,480	66.20	2,745,976
				Total:	**8,656,876**
				Envelope Cost Difference ($):	**(290,273)**
				Envelope Cost Difference ($/ft²):	**(1.12)**

Lighting - No change in costs anticipated

Lighting Cost Difference ($/ft²):	**-**

HVAC

Case	Type	Description	Area (ft²)	Cost ($/ft²)	Cost ($)
Current Rezoning	Htg/Clg	Fan coil unit	260,000	16.67	4,333,333
	MUA	85% efficient MUA + distribution	260,000	2.08	540,000
	HRV	Heat recovery ventilator 65% efficiency	260,000	5.00	1,300,000
	Heating	Boiler (4 unit 300 MBH each) 92% efficiency	260,000	1.30	338,000
	Cooling	Chiller Plant (2 centrifugal chiller units, 250 tons each)	260,000	2.80	728,000
				Total:	**7,239,333**
Proposed Rezoning	Htg/Clg	Fan coil unit	260,000	16.67	4,333,333
	MUA	85% efficient MUA + distribution	260,000	2.08	540,000
	HRV	Heat recovery ventilator 65% efficiency	260,000	5.00	1,300,000
	Htg/Clg	ASHP/Boiler (2 unit 300 MBH each) 94% efficiency	260,000	6.85	1,781,000
				Total:	**7,954,333**
				HVAC Cost Difference ($):	**715,000**
				HVAC Cost Difference ($/ft²):	**2.75**

TOTAL

Envelope Cost Difference ($/ft²):	(1.12)
Lighting Cost Difference ($/ft²):	-
HVAC Cost Difference ($/ft²):	2.75
TOTAL Construction Cost Difference ($/ft²):	**1.63**

Operating Costs

Energy

Case	kWh/m²	Description	kWh	$/kWh	Cost ($)
Current Rezoning	35	Annual Natural Gas (2016)	840,900	0.031	26,068
	77	Annual Electricity (2016)	1,854,699	0.063	116,846
	-	Annual NEU Heat (2016)	-	0.103	-
				Total:	**142,914**
Proposed Rezoning	4	Annual Natural Gas (2016)	92,704	0.031	2,874
	84	Annual Electricity (2016)	2,025,077	0.063	127,580
	-	Annual NEU Heat (2016)	-	0.103	-
				Total:	**130,454**
				Annual Energy Cost Difference ($):	**(12,460)**
				Annual Energy Cost Difference (%):	**-9%**
				Annual Energy Cost Difference ($/ft²):	**(0.05)**
				Annual Emissions Reduction in ($kgCO_{2e}$):	**103,478**

Maintenance and Replacement - No change in costs anticipated