



REPORT

Report Date: May 5, 2022
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Meeting Date: May 17, 2022
[Submit comments to Council](#)

TO: Vancouver City Council

FROM: General Manager of Planning, Urban Design and Sustainability

SUBJECT: Climate Emergency – Bylaw and Policy Updates Applicable to New Buildings

RECOMMENDATION

- A. THAT Council approve, in principle, amendments to the Building By-law generally in the form attached as Appendix A, including reductions in the carbon emissions limit for new 4-6 storey residential buildings; requirement for air filtration, and reporting and initial limit of embodied carbon in new Part 3 buildings, all to come into force and effect on July 1, 2023;

FURTHER THAT Council instruct the Director of Legal Services to prepare and bring forward for enactment the by-law necessary to implement these amendments, generally as outlined in Appendix A.

- B. THAT Council approve, in principle, proposed changes to the Building By-law generally in the form attached as Appendix B, including reductions in energy and carbon emissions limits for new residential and commercial buildings, embodied carbon reduction requirements, and a cooling requirement for all dwelling units in new Part 3 buildings, beginning in January 2025;

FURTHER THAT Council directs staff to further review the proposed changes attached as Appendix B, and bring forward final recommendations to Council, including a proposed by-law for consideration by Council in order to implement the proposed changes, by Q1 2024.

- C. THAT Council approve a revised Green Buildings Policy for Rezonings effective immediately, as set out in Appendix C.

- D. THAT Council direct staff to explore further Building By-law changes for energy efficiency, emissions reductions, climate resilience, and for requirements previously included in the Green Buildings Policy for Rezoning (i.e. low-VOC materials, commissioning, etc.), and report back to Council with recommendations as early as possible in 2023.
- E. THAT Council direct staff to bring recommendations to Council as early as possible in 2023 to remove green building requirements from City policies and by-laws made redundant or unnecessary by the changes in Recommendations A and B, including the Secured Rental Policy and the C-2, C-2B, C-2C, and C-2C1 district schedules.

REPORT SUMMARY

This report recommends changes to the Building By-law and the Green Buildings Policy for Rezoning that advance three Council priorities for new construction under the Climate Emergency Action Plan (CEAP) and the Climate Change Adaptation Strategy: Energy Use and Carbon Emissions (CEAP Big Move 4); Resilient Buildings; and, Embodied Carbon (CEAP Big Move 5). These changes also consolidate green building requirements in the by-law, reducing complexity and process for applicants and staff. By approving in principle the by-law changes for 2025 Council sends a clear signal to industry on what the future Building By-law will require, while allowing time for designers and suppliers to adapt, and for staff to make final adjustments if necessary.

These changes for new multifamily and commercial buildings:

- Achieve Council's climate emergency goal of zero emissions heating and hot water in new buildings by 2025
- Require filtered outdoor air in new buildings beginning in 2023, helping to protect residents from the health impacts traffic- and wildfire-related air pollution
- Require cooling for new multifamily homes beginning in 2025, helping to protect residents from the health impacts of heat, air pollution, and noise
- Introduce the first whole-building embodied carbon building by-law requirements in North America to begin reducing carbon emissions from materials and construction by 2025, on the path to Council's climate emergency goal of a 40% reduction by 2030
- Encourage sustainable, healthy, and 'circular' materials and construction
- Streamline green buildings policy and process for both applicants and staff.

A summary of the proposed changes can be found in the Strategic Analysis section of this report, and the full proposed changes are provided in Appendices A, B, C, D, and G (where Appendix D and G are redline versions).

COUNCIL AUTHORITY/PREVIOUS DECISIONS

In July 2010, Council approved the Green Buildings Policy for Rezoning, which required all applicable developments applying for rezoning to achieve the LEED standard. This policy was developed to use a well-established City process (rezoning) to help transition industry toward more sustainable building practices.

In July 2016, Council approved the Zero Emissions Building Plan which included time-stepped GHG emission and energy efficiency limits for each building type for inclusion in policies and the Building By-law, and set a goal of zero emissions new buildings in by-law by 2030 or earlier.

In May 2018, Council approved amendments to the Vancouver Building By-law to introduce GHG emissions and energy use limits for multifamily and commercial buildings, beginning in July 2019, and for further reductions in those limits beginning in July 2021.

In December 2018, Council approved the updated Climate Change Adaptation Strategy to ensure a vibrant, liveable, and resilient city in the face of climate change. This update identified new focus areas such as climate resilient buildings and included a core action to future-proof the building stock to improve resilience in the face of hotter summers and poor air quality.

In October 2020, Council approved the Climate Emergency Action Plan, Which included direction to require zero emissions new heating and hot water equipment by 2025. Council also directed staff to bring forward recommendations on updates to the Green Building Policy for Rezoning to set initial limits for embodied carbon in new developments in accordance with the Embodied Carbon Strategy.

CITY MANAGER'S/GENERAL MANAGER'S COMMENTS

The City Manager recommends approval of the foregoing.

REPORT

Background/Context

Energy Use and Carbon Emissions

In Vancouver, 57% of carbon pollution in 2020 was from burning natural gas in buildings, and over three-quarters of these emissions are from burning natural gas for two uses: space heating, and hot water heating. One key factor enabling Vancouver to reduce carbon pollution in buildings is that currently 98% of electricity in BC is from clean or renewable sources.

Meeting the CEAP targets depends on action at all levels of government. The City cannot act alone. The City's policies and regulations align with those of the Province, including the Greenhouse Gas Reduction Regulation. This regulation is essential in ensuring the delivery of reliable low carbon energy supply to meet our day to day needs in our homes, places of work, and society at large.

As part of the Zero Emissions Building Plan adopted by Council in 2016, the City began to implement energy use and carbon emissions limits in the Green Building Policy for Rezoning (the 'Rezoning Policy') and the Building By-law. These changes have significantly reduced heating demand and improved energy efficiency, while dramatically reducing carbon emissions from space heating, largely through the use of heat pumps and electric heating. This report includes the last major step of the Zero Emissions Building Plan for new buildings by updating carbon emission limits so as to drive hot water equipment to zero emissions.

Climate Resilient Buildings

Since 2015, Vancouver has experienced 60 days with air quality advisories largely due to high PM_{2.5} concentrations (particulates of 2.5 microns in size that are associated with wildfire smoke). Currently there are no filtration requirements for ventilation air in new buildings in Vancouver, and residents have had to find their own ways to reduce exposure to poor air quality during wildfire events, from using home-made air filters to going to City-designated clean air spaces. Residents near arterial roads also face year-round exposure to traffic-related air pollution, which contributes to adverse health effects such as premature death, asthma symptoms, and acute respiratory symptoms.¹

Vancouver's summers continue to become hotter and drier, due to the ongoing impacts climate change. The changes proposed herein will address both heat and air quality in new Part 3 residential buildings. For more background on heat and air quality in Vancouver, see Appendix H.

Embodied Carbon

Globally, the construction sector accounts for 11% of total carbon emissions annually. In Vancouver, embodied carbon from new building accounts for approximately 179,500 tonnes of carbon emissions every year. While these emissions are considered 'Scope 3 emissions', meaning they largely take place outside Vancouver, we can have significant influence in reducing these emissions, and join cities around the world in taking responsibility for the consumption of construction materials. In 2017, Vancouver introduced embodied carbon reporting requirements for all rezonings, to build industry capacity to understand and reduce embodied carbon. In 2019, Vancouver City Council set a goal of reducing embodied carbon from construction by 40% by 2030, compared to 2018, and in 2020 Council approved the Embodied Carbon Strategy in the Climate Emergency Action Plan and directed staff to report back with reduction requirements for new developments.

Green Buildings Policy for Rezonings

Since 2010, Vancouver has used the Rezoning Policy to set higher green building expectations for buildings and to provide a clear signal to local industry how the Building By-law may be expected to change within 3-5 years. Beginning with the Zero Emissions Building Plan in 2016, this policy has included energy and carbon emissions limits, and these limits have now been fully incorporated into the Building By-law for all buildings. The City has also been making a multi-year concerted effort to streamline and simplify the rules and approvals process for new developments, and has made efforts to reduce the number and complexity of policies as well as overall use of rezoning to achieve City goals.

Strategic Analysis

The proposed Building By-law changes in Recommendations A and B, and the rationale for the changes, are summarized in Table 1.

All proposed changes are for 'Part 3' buildings unless otherwise specified, where registered professionals are required to oversee the design, and typically excludes 1-3 storey residential

¹ <https://www.canada.ca/en/health-canada/services/air-quality/outdoor-pollution-health.html#a3>

and small commercial buildings ('Part 9' buildings)². The design and construction teams of Part 3 buildings typically have more capacity to adapt to new requirements and technologies, while the Certified Professionals (CP) process used by most Part 3 buildings significantly streamlines the permitting process, minimizing the process impacts of new requirements on staff and applicants.

Table 1: Summary of Proposed Building By-law Changes

Category	Proposed Change	Description	Rationale
Changes to be effective July 1, 2023			
Energy and Emissions	Reduce carbon emissions limits	Reduce the carbon emissions limit for new 4-6 storey residential buildings (except hotels/motels) from 5.5 to 3 kgCO ₂ e/m ²	These limits effectively decarbonize hot water heating - the last major step in reducing carbon emissions in new buildings
	Reduce carbon emissions for other building types	Introduce a 50% carbon emissions reduction requirement for all new building types without a GHGI limit (i.e. assembly, care, and industrial)	These building types currently have no requirement to reduce carbon emissions. These reductions are generally consistent with decarbonizing space heating
Resilient Buildings	Filtered ventilation air	Introduce a requirement for minimum MERV 13 filters in new building ventilation systems	MERV 13 filters are industry best-practice, and catch most particulates from traffic- and wildfire-related air pollution
	Overheating limits	An administrative change to copy the existing overheating limits in the referenced CoV guidelines to the By-law	This change improves the visibility and enforceability of the existing overheating limits
Embodied Carbon	Embodied carbon reporting and limit	Introduce an embodied carbon reporting requirement for all new Part 3 buildings, and a limit of maximum 2x the standardized baseline (to be included in new, referenced CoV guidelines)	Foster industry-wide capacity and knowledge of embodied carbon, and introduce the first, very easy, limit on embodied carbon emissions
Changes to be proposed for January 1, 2025			
Energy and Emissions	Reduce carbon emissions limits	Reduce the carbon emissions limit for new 7+ storey residential buildings from 6 to 3 kgCO ₂ e/m ² . Reduce the limit for new hotel buildings from 8 to 4 kgCO ₂ e/m ²	These limits effectively decarbonize hot water heating - the last major step (after heating) in reducing carbon emissions in new buildings
	Further reduce carbon emissions for other building types	Increase from 50% to an 85% reduction in carbon emissions for all new building types without a GHGI limit (i.e. assembly, care, and industrial)	These reductions are generally consistent with decarbonizing space heating and hot water heating, and align these buildings with reductions requirements in residential and commercial buildings
	Include refrigerant gas emissions in carbon emissions limits	Include estimated refrigerant gas emissions in definition and calculations of carbon emissions limits (change to be made in referenced CoV guidelines)	To reduce the risk of leaks of high global warming potential gases through design

² For the full definition of 'Part 3' buildings, refer to Sentence 1.3.3.2.(1) of Division A of the Building By-law, available at: <https://free.bcpublishings.ca/civix/document/id/public/vbbl2019/1324539232>

Resilient Buildings	Require mechanical cooling for dwelling units in 'Part 3' buildings	Require all dwelling units in new Part 3 buildings be served by active mechanical cooling capable of maintaining 26°C or less, with windows closed	To avoid health impacts to residents from overheating in new Part 3 multifamily buildings
Embodied Carbon	Embodied carbon reductions	Require embodied carbon reductions of 10% for all new Part 3 buildings, and 20% for new low-rise buildings that can build with wood or mass timber (compared to concrete baseline)	To introduce the first reduction requirements for embodied carbon in Building By-Law.
	Responsible materials	Require one of three options: sustainable sourcing of wood, concrete, or steel; disclosure of chemical ingredients of building products; or, 75% construction waste diversion and design for disassembly	To reduce upstream and downstream emissions from building materials, and encourage sustainable, healthy, and 'circular' materials and construction

Energy Use and Carbon Emissions

The Building By-law changes in Recommendation A, and the proposed future Building By-law changes in Recommendation B, achieve the Climate Emergency Action Plan goal of zero emissions heating and hot water in new buildings by 2025. The proposed changes for 2023 in VBBL include a reduction in carbon emissions limits (known as the Greenhouse Gas Intensity or GHGI) for 4-6 storey residential buildings, with the same reduction to be proposed to Council for all commercial and 7+ storey residential buildings for 2025 in VBBL. This difference in timeline recognizes that taller buildings have longer design and construction lead times – a Building By-law change in 2023 for 7+ storey buildings could cause significant redesign and scheduling issues for buildings that are already well into their design and development processes.

For buildings that are not commercial or residential in occupancy, there are no current carbon limits in the By-law. The proposal is to introduce a carbon limit equivalent of 50% of the emissions of a building using fossil fuel energy for 2023. Then, in 2025, this reduction target is proposed to increase to an 85% reduction. Staff anticipate this strategy would have the effect of decarbonizing the building's space heating and hot water heating systems.

In recent years, heat pump technologies that can provide highly efficient domestic hot water heating have become market-ready, with multiple products locally-available for different system designs. Meanwhile, 100% efficient electric resistance hot water heaters have been reliably used for decades in BC for hot water heating, due to their simplicity and low capital costs. Both types of technology can be used to achieve the proposed building carbon emissions limits.

A consultant design and cost estimation study was undertaken to better understand the capital costs of the proposed changes, with the detailed results included in Appendix E. In general, these changes can be expected to increase construction costs by 0.1% to 1.6%. Staff estimate impacts on the overall economics of new development will be negligible, as the economics of development in Vancouver are based on multiple factors, with construction costs being just one of many. The proposed changes to simplify permitting will speed up building applications which will help reduce overall project costs.

Climate Resilient Buildings

Recommendations A and B include air filtration and cooling requirements, which act together to strategically reduce residents' exposure to increased frequency of extreme heat events (such as

the heat dome of 2021) as well as poor air quality from wildfires. An air filtration requirement can help provide year-round health protection for residents of new multi-family buildings along Vancouver's arterial roads. The proposed filtration requirement would be effective in removing 50-85% of the particulates stemming from traffic pollution and wildfire smoke.

Climate change shocks and stresses such as exposure to high temperatures and wildfire smoke do not affect all groups in the community equally. Vancouver is striving to respond to the climate crisis with ambitious carbon reduction policies and is committed to the equitable implementation of those policies.

Cost estimates of mechanical cooling are detailed in Appendix E. In general, these changes will increase construction costs by 0-3.5%, depending on the baseline for comparison for projects not already adding cooling. Data from rezonings show all condo, and the majority of rental and non-market development, are already incorporating mechanical cooling.

Embodied Carbon

The recommended 2023 by-law changes set an initial limit on embodied carbon impacts of not more than 2-times the baseline. This limit enables reporting of embodied carbon impacts by setting a requirement in the by-law, and also sets the first, very easy limit on embodied carbon in Building By-Law. This will help prepare designers for future reduction requirements in 2025.

The By-law changes to be proposed for 2025 in Recommendation B will build on the 2023 changes in Recommendation A, moving from reporting and the initial limit to requiring 10% or 20% reductions. The proposed 2025 changes also include a new requirement for responsible materials. These changes further address upstream and downstream carbon emissions from materials, while also encouraging sustainable, healthy, and 'circular' materials and construction. For more details on the specific changes refer to Appendix B. These changes build on decades of industry experience with materials credits in third-party green building standards such as LEED, and begin to introduce them into By-law.

Staff are also developing new Embodied Carbon Guidelines, which will standardize the baseline for calculating embodied carbon impacts. By comparing against materials and mixes that are representative of typical good practice today, the baseline itself will further eliminate up to 40% of the worst embodied carbon outcomes. These guidelines are currently in draft and under review with industry experts, and are expected to be published by the end of 2022.

These changes are achievable without impact to construction costs, and consultations with industry experts and material suppliers confirm this is likely the case and staff also initiated a consultant study of design options and costs, with a sample of results available in Appendix E.

Green Buildings Policy for Rezoning

Many of the changes proposed to Building By-law in Recommendations A and B originated in the current version of the Rezoning Policy as part of the implementation of the Zero Emissions Building Plan approved by Council in 2016. The industry has had 7+ years of experience with the green building metrics and requirements set through the Rezoning Policy, with more than 50% of all large new construction projects having worked with these requirements since 2017. There is now sufficient industry capacity to remove the majority of the building requirements (including the requirement for LEED in non-residential buildings, affecting 3-4 buildings per

year) from the Policy – this will reduce the complexity and processing time for rezoning projects for both applicants and staff.

The proposed new Rezoning Policy (Recommendation C) has only two requirements: preliminary design reports, and the current rainwater management requirement. The reporting requirement helps to ensure projects are on track to meet the proposed Building By-law changes, and will also provide staff early insight into any design, construction or procurement challenges that may arise with the proposed Building By-law changes.

Maintaining the rainwater management requirement in its current form maintains continuity for developers, while staff continue to work with consultants, industry and various City departments to implement the Rain City Strategy.

Implementation

If Council approves the proposed changes, staff will focus on updating the relevant guidelines, technical bulletins and standardized submittal documents that support the changes, as well as review and support any internal processes needed to successfully facilitate compliance in advance of the changes coming into force and effect. Staff will also conduct industry outreach to in-stream projects that will be affected by the 2023 by-law changes, and continue to build capacity and support training for industry.

As part of Recommendation B, Council is recommended to approve in principle the By-law changes for 2025, to provide industry with a clear and consistent signal needed to plan new low carbon and resilient buildings. Staff will continue to engage with industry to uncover potential challenges or identify opportunities relating to the 2025 By-law changes, particularly opportunities to minimize costs for residents and owners, and provide a report to council by Q1 2024, well in advance of the 2025 changes coming into effect.

Industry Consultation Feedback

In developing the set of proposed changes over the past two years, staff engaged with more than 25 industry stakeholder organizations ranging from building designers and engineers, development managers, low-carbon equipment suppliers and local thermal energy providers, and others. As part of seven open industry webinars hosted in 2022 on this set of proposed changes, more than 200 individuals were engaged. Details of consultation process can be found in Appendix F. The public webinars revealed generally strong support for each of the proposed changes to the Building By-law and Rezoning Policy, across all consultations and stakeholder groups.

Vancouver Coastal Health has communicated they believe the proposed changes will materially benefit long-term public health in Vancouver. While the changes received strong support, staff heard concerns around escalating construction costs and the challenge of delivering affordable rental, a need for more experience and capacity building for embodied carbon, and concern over a potential gap in some existing requirements in the Rezoning policy (e.g. commissioning, etc.) before staff can bring them in to the Building By-law.

In response to these concerns, staff have made several adjustments to the proposed changes. To address concerns about increasing construction costs, staff have removed a proposal to reduce the heat loss limit for 4-6 storey residential buildings, which can have costs associated with the highest-performing building envelopes. Staff will also work with partners to support

research and knowledge-sharing of the most cost-effective solutions for low-carbon and resilient multifamily buildings. In response to the need for experience with embodied carbon, staff are commissioning multiple case studies from diverse project types, and the City is supporting – together with the Province – a new Embodied Carbon Centre of Excellence, beginning in 2022. And to address concerns about removing some existing requirements in the rezoning policy, Recommendation D proposes staff report back to Council as soon as possible in 2023. Recommendation B also contains a further review and report back to Council on the proposed 2025 changes by 2024, presenting a further opportunity to address any remaining stakeholder concerns.

Implications/Related Issues/Risk (

Financial

Please refer to Appendix E: Cost Estimation Studies for the incremental capital costs (including architectural, mechanical, and electrical incremental costs) and energy costs (savings) associated with various zero emissions building options, air filtration, and embodied carbon.

Human Resources/Labour Relations

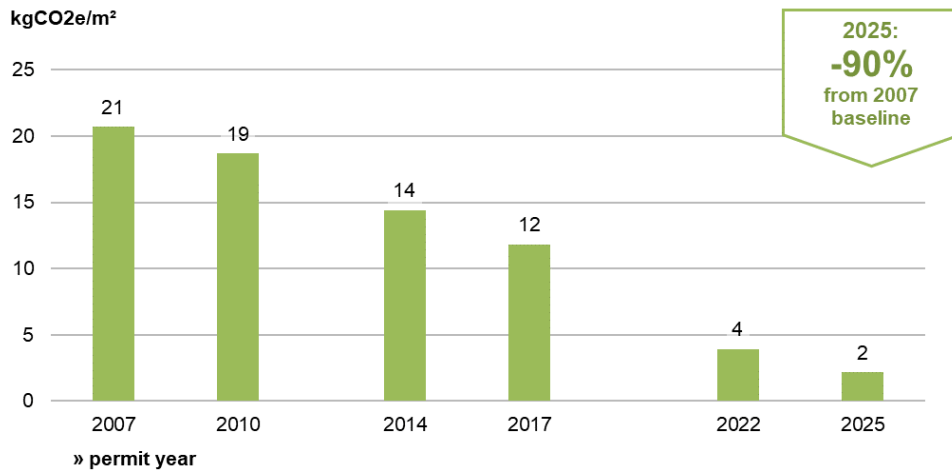
There are no human resources / labour relations implications.

Environmental

The recommended by-law updates will avoid operational carbon emissions from new buildings by an estimated 4,600 tonnesCO₂e/yr by 2030, and embodied carbon emissions from new construction by an estimated 18,900 tonnesCO₂e/yr by 2030. These measures, when combined, would be equivalent to removing 5,900 cars from the road.

The chart below shows the estimated greenhouse gas emissions intensity of all new buildings over time. It reflects the requirements for zero emission heating and hot water from new single family and duplex homes that came into effect at the beginning of 2022 and the projected impact of the changes for multifamily and commercial recommended in this report. Average emissions from new buildings will be reduced by 90% from 2007 levels when these new regulations are enacted and take effect.

Weighted Average GHG Intensity of All New Buildings



Legal

There are no legal implications.

CONCLUSION

Staff recommend the changes to City policies and by-laws in this report to create more stringent energy use and carbon emission limits, introduce embodied carbon reporting and reduction requirements, as well as measures to improve resilience in buildings. If approved, these proposed changes will simplify policy and process for industry and staff, reduce greenhouse gas emissions, and further enable the adoption of zero emissions and net zero energy ready buildings in Vancouver and across BC.

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Appendix A: Draft By-law to Amend the Building By-law

BY-LAW NO. _____

**DRAFT By-law to amend Building By-law No. 12511
regarding carbon emissions, air filtration, and embodied carbon limits**

Note: A By-law will be prepared generally in accordance with the provisions listed below, subject to change and refinement prior to posting.

1. This By-law amends the indicated provisions of Building By-law No. 12511.
2. In Table 1.3.1.2. of Book I, Division B, Council adds the following new entries in the correct alphanumerical order:

(a)

ASHRAE	ANSI/ASHRAE 52.2-2017	Method of Testing General Ventilation Air-Cleaning Devices	6.3.2.14.(1)
ASHRAE	ANSI/ASHRAE 55-2010	Thermal Environmental Conditions for Human Occupancy	6.6.2.1.(1)

”; and

(b)

CoV	v1.0	City of Vancouver Embodied Carbon Guidelines	10.4.1.2.(1)
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3. Council strikes out Sentence 6.3.2.14. of Book I, Division B, and substitutes the following:

“6.3.2.14. Cleaning Devices

1) Ventilation required by Sentence 6.3.1.1.(1) shall be provided by a ventilation system designed to include filtration devices with a Minimum Efficiency Reporting Value (MERV) of 13, as defined by ANSI/ASHRAE 52.2, prior to introduction of outdoor air into indoor occupied spaces.”.

4. In Section 6.6. of Book I, Division B, Council adds the following new Subsection:

“6.6.2 Passively Cooled Buildings

6.6.2.1 Passively Cooled Buildings

1) For a *building* described in Sentence 1.3.3.2.(1) of Division A containing Group C, D, or E *Major Occupancies, conditioned space* that does not incorporate mechanical cooling systems shall be designed such that interior dry bulb temperatures do not exceed the 80% acceptability limits for naturally

conditioned spaces, as defined in ANSI/ASHRAE 55 Section 5.3, for the following number of hours annually

- a) for *conditioned space* containing seniors housing, shelter or supportive housing, daycares, schools, or healthcare facilities, no more than 20 hours per year, or
- b) for any other *conditioned space*, no more than 200 hours per year.”.

5. In Clause 10.2.1.2.(1)(b) of Book I, Division B, Council strikes out “[UTV Deleted],” and substitutes “except where space heating and service water heating systems are powered only by electricity, shall be designed with a *greenhouse gas* intensity (GHGI) reduction in compliance with Table 10.2.2.5.A1, or a reduction as *acceptable* to the *Chief Building Official*,”.

6. Council strikes out Table 10.2.2.5.A1 of Book 1, Division B, and the Notes associated with the Table, and substitutes the following:

“

Table 10.2.2.5.A1 Maximum Energy Use and Emissions Intensities Forming part of Sentence 10.2.2.5.(2)			
Occupancy Classification ⁽¹⁾	Total Energy Use Intensity (kWh/m²a)	Thermal Energy Demand Intensity (kWh/m²a)	Greenhouse Gas Intensity (kgCO₂e/m²a)
Group C occupancies complying with 10.2.1.5.(2)(a)(i)	See Table 10.2.2.5.A2	20	3
Group C occupancies in buildings up to 6 Storeys, except Hotel and Motel	110	25	3
Group C occupancies in buildings over 6 Storeys, except Hotel and Motel	120	30	6
Hotel and Motel occupancies	140	20	8
Group D and E occupancies, except Office	120	20	3
Office occupancies	100	20	3
All other occupancies	⁽¹⁾		50% lower than GHGI of the reference building modelled using only fossil-fuel systems

Notes to Table 10.2.2.5.A1:

- (1) For *buildings* containing multiple *occupancies*, refer to the procedures in Section 5 of the City of Vancouver Energy Modelling Guidelines.

”.

7. Council strikes out Table 10.2.2.5.C of Book I, Division B, and substitutes the following:

“

Table 10.2.2.5.C Maximum Energy Use and Emissions Intensities Forming part of Sentence 10.2.2.5.(5)			
Occupancy Classification	Total Energy Use Intensity (kWh/m²a)	Thermal Energy Demand Intensity (kWh/m²a)	Greenhouse Gas Intensity (kgCO₂e/m²a)
Group C <i>occupancies</i> in <i>buildings</i> up to 6 <i>Storeys</i> , except Hotel and Motel	110	25	3
Group C <i>occupancies</i> in <i>buildings</i> over 6 <i>Storeys</i> , except Hotel and Motel	130	40	6
Hotel and Motel <i>occupancies</i>	170	30	8
Business and Personal Services or Mercantile <i>occupancies</i> , except Office	170	30	3
Office <i>occupancies</i>	130	30	3

”

8. Council renumbers Section 10.4., Subsection 10.4.1., Article 10.4.1.1., and Table 10.4.1.1. of Book I, Division B, as Section 10.5., Subsection 10.5.1., Article 10.5.1.1., and Table 10.5.1.1., respectively.

9. In Sentence 10.5.1.1.(1) of Book I, Division B, Council strikes out “Table 10.4.1.1.” and substitutes “Table 10.5.1.1.”.

10. In Table 10.5.1.1. of Book I, Division B, Council strikes out “Forming part of Sentence 10.4.1.1.(1)” and substitutes “Forming part of Sentence 10.5.1.1.(1)”.

11. In Part 10 of Book I, Division B, Council adds a new Section as follows:

“Section 10.4. Low Carbon Materials and Construction

10.4.1. Low Carbon Materials and Construction

10.4.1.1 Application

1) This Section applies to *buildings* described in Sentence 1.3.3.2.(1) of Division A.

10.4.1.2 Low Carbon Materials and Construction

1) A *building* shall be designed and constructed to achieve whole-building embodied carbon impacts of not more than double that of a functionally

Appendix B: Changes to 2025 Vancouver Building By-law to be proposed

Item	Description	Proposal
Update to the <i>Building By-law (VBBL)</i> To be proposed for an Effective date of January 1 st , 2025		
1)	Update Energy & Emissions Performance Requirements	<ul style="list-style-type: none"> Reduce the GHGI limits by half for the following occupancy classifications in <i>Tables 10.2.2.5.A1</i> and <i>10.2.2.5.C</i> (excerpts below): <ul style="list-style-type: none"> Group C occupancies in buildings over 6 Storeys, except Hotel and Motel Hotel and Motel occupancies For Groups A, B and F occupancy types, increase the GHGI reduction target to 85% compared to the minimum performance baseline with fossil fuel systems, as shown in <i>Table 10.2.2.5.A1</i> (except below); or design as per the applicable prescriptive requirements of <i>Division B Articles 10.2.2.2. or 10.2.2.3</i> and incorporate space heating and electric service water heating fueled only by electricity. GHGI limits referenced in <i>Tables 10.2.2.5.A1</i> and <i>10.2.2.5.C</i> will include the greenhouse gas intensity impact of refrigerants (GHGI-R) used for the building's heating, cooling and domestic hot water heating systems. <ul style="list-style-type: none"> Note: this change is to be reflected in the <i>City of Vancouver Energy Modelling Guidelines</i>, and is to become effective for <i>Vancouver Building By-law</i> at the same time the 2025 by-law changes.

Table 10.2.2.5.A1 Maximum Energy Use and Emissions Intensities Forming part of Sentence 10.2.2.5.(2)			
Occupancy Classification ⁽¹⁾	Total Energy Use Intensity (kWh/m ² a)	Thermal Energy Demand Intensity (kWh/m ² a)	Greenhouse Gas Intensity (kgCO ₂ e/m ² a)
Group C occupancies in buildings over 6 Storeys, except Hotel and Motel	120	30	6 3
Hotel and Motel occupancies	140	20	8 4
All other occupancies	GHGI: 50% 85% reduction compared to the minimum building performance modelled based on fossil-fuel systems as per Subsections 10.2.2.2 and 10.2.2.3; or designed as per the prescriptive requirements of 10.2.2.2 or 10.2.2.3 and incorporate electric space heating and electric service water heating.		

Item	Description	Proposal
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Occupancy Classification	Total Energy Use Intensity (kWh/m ² a)	Thermal Energy Demand Intensity (kWh/m ² a)	Greenhouse Gas Intensity (kgCO ₂ e/m ² a)
Group C <i>occupancies</i> in buildings over 6 <i>Storeys</i> , except Hotel and Motel	130	40	6 <u>3</u>
Hotel and Motel occupancies	170	30	8 <u>4</u>

NOTE: The tables above only show the rows with changes, not the entire table in its final state. Other rows in the existing tables will remain unchanged.

2)

Embodied Carbon Reductions

- All new Part 3, 1-6 storey buildings that can be built of wood or mass timber construction must achieve whole-building embodied carbon reductions of at least 20%, as compared to a functionally equivalent baseline, using the guidance in the new *City of Vancouver Embodied Carbon Guidelines*
 - Note: these guidelines set the baseline for comparison as a concrete building
- All new Part 3, 7+ storey buildings, and 1-6 storey buildings that can only be built of non-combustible construction, must achieve whole-building embodied carbon reductions of at least 10%, as compared to a functionally equivalent baseline, using the guidance in the new *City of Vancouver Embodied Carbon Guidelines*.
- All new Part 3 buildings must achieve the criteria of one responsible materials category, as shown in the table below,
OR,
achieve double the applicable minimum embodied carbon reductions in the bullets above.

Responsible Materials Category	Criteria
<p>Sustainable and Ethical Materials</p>	<p>At least 50%, (by weight or volume) of the primary structural material of the <i>building</i> is sourced according to one of the following standards and practices:</p> <ul style="list-style-type: none"> - Wood certified by the Forest Stewardship Council (FSC); - Wood certified by the Sustainable Forestry Initiative (SFI); - Wood certified by the Canadian Standards Association (CSA); - Wood from Indigenous-managed or community-based forestry; - Concrete certified by the Concrete Sustainability Council's Responsible Sourcing Certification (v2 or newer); - Steel certified by the Responsible Steel Standard (v3 or newer); <p>or,</p> <p>alternate standards provided and documented to the satisfaction of the <i>Chief Building Official</i>.</p>
<p>Healthy and Transparent Materials</p>	<p>At least 50% by count or 20 distinct, permanently installed products (including at least 25% by count or 3 products from flooring, insulation, wet-applied products, ceiling and wall assemblies and systems) of the <i>building</i> transparently disclose their ingredients according to one of the following standards and practices:</p> <ul style="list-style-type: none"> - A Declare label, operated by the International Living Future Institute; - A Health Product Declaration (HPD) published in the HPD Public Repository, operated by the Health Product Declaration Collaborative; - A Cradle-to-Cradle Certified product, or a product with a Material Health Certificate from the Cradle to Cradle Products Innovation Institute; - A Product Lens Certification, Operated by UL; - A Product Health Declaration, operated by Global Green Tag; - A manufacturer's inventory containing CAS numbers of all individual compounds down to 1,000 ppm (0.1%). If the product contains a trade secret compound, GHS hazards of category 1 or 2 are listed and a concentration range is provided for each undisclosed component; - products created by Indigenous peoples using traditional ecological knowledge; or, <p>alternates provided and documented to the satisfaction of the <i>Chief Building Official</i>.</p>
<p>Circular Materials</p>	<p>The <i>building</i> is designed and constructed to create and achieve the following plans:</p> <ul style="list-style-type: none"> - a construction and demolition Waste Management Plan, achieving at least 75% diversion of construction and demolition waste from landfills; - a Material Re-use Plan, identifying where and how re-used or recycled systems, elements, assemblies, sub-components, or materials are included in the <i>building</i>, if any; and,

Item	Description	Proposal
		<ul style="list-style-type: none"> - a Deconstruction Plan, identifying where and how <i>building</i> systems, elements, assemblies, sub-components, or materials are designed for adaptability and disassembly, generally in accordance with ISO 20887:2020; or, <p>alternate waste management and circular design performance provided and documented to the satisfaction of the <i>Chief Building Official</i>.</p>

3)	Require mechanical cooling for all new homes in Part 3 buildings	<ul style="list-style-type: none"> • All dwelling units within new Part 3 buildings must be served by active mechanical cooling capable of maintaining an indoor air temperature of 26°C, with windows closed.
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Appendix C Proposed New Green Building Policy for Rezonings

Note: Amendments to Council-adopted policies will be prepared generally in accordance with the provisions listed below, subject to change and refinement prior to posting.

*This version shows the proposed new version of the Policy. A redline version with the proposed amendments is shown in Appendix D to follow.

Policy

Green Building Policy for Rezonings

Approved by Council [July 22, 2010](#)

Amended [June 25, 2014](#), [February 7, 2017](#), [May 2, 2018](#) and [xx xx, 2022](#)

Table of Contents

Background and Context	3
Intent	3
Policies	3
1 Integrated Rainwater Management and Green Infrastructure	3
2 Reporting of Green and Resilient Building Measures	3
2.1 Energy & Emissions Performance Limits	3
2.2 Embodied Carbon Limits	3
2.3 Resilient Buildings Planning Worksheet	4
Requirement Administration	4
Heritage Buildings	4

Background and Context

In [July 2010](#), Council approved the Green Building Policy for Rezoning setting out requirements for all applicable developments applying for rezoning to help transition industry toward more sustainable building practices. Subsequent amendments of this Policy in [2014](#), [2017](#) and [2018](#) updated requirements as the local development industry gained capacity in green building design and construction practices and new priority topics emerged. This current version of the Green Building Policy for Rezoning reflects Council's direction and targets stated in the Zero Emissions Building Plan, the Climate Change Adaptation Strategy, the Embodied Carbon Strategy and the Climate Emergency Action Plan.

Intent

This policy is effective immediately, and shall be mandatory for all Rezoning Applications received on or after May 18, 2022, with exceptions permitted at the discretion of the Director of Planning. For Rezoning Applications received prior to May 18, 2022 that have not yet been referred for approval by Council to Public Hearing by August 1, 2022, applicants may choose to meet this updated version of the Policy or the preceding version.

Policies

1. Integrated Rainwater Management and Green Infrastructure

All rezoning projects shall 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.

2. Reporting of Green and Resilient Building Measures

For all Part 3 building projects as defined by the *Vancouver Building By-law*, provide the following design reports and worksheet at the time of the rezoning application:

2.1 Energy & Emissions Performance Limits

Complete the *Energy & Emissions Design Report* for each building to demonstrate that the project is on track to meet the *Vancouver Building By-law* energy and emissions performance limits expected to be in force at the time of the project's first Building Permit application. Performance limits are modelled according to the *City of Vancouver Energy Modelling Guidelines*, which set standard assumptions and requirements for energy models when assessing compliance with the limits.

2.2 Embodied Carbon Limits

Complete the *Embodied Carbon Design Report* for each building to demonstrate that the project is on track to meet the *Vancouver Building By-law* life-cycle equivalent carbon dioxide emissions (i.e. global potential impact, or 'embodied carbon') limits expected to be in force at the time of the project's first Building Permit application.

Embodied carbon is calculated for each building, in kgCO₂e/m², as calculated by a whole-building life-cycle assessment using standard assumptions according to the *City of Vancouver Embodied Carbon Guidelines*.

2.3 Resilient Buildings Planning Worksheet

Complete the *Resilient Buildings Planning Worksheet* to summarize the level of resilience planning undertaken by the project and to identify proposed resilience strategies.

Requirement Administration

Refer to the bulletin [Green Building Policy for Rezoning - Process and Requirements](#) for more guidance on meeting the requirements of this Policy.

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.

Appendix D Redline version of the Green Building Policy for Rezonings

Note: Amendments to Council-adopted policies will be prepared generally in accordance with the provisions listed below, subject to change and refinement prior to posting.

*A clean version of the proposed amendments is shown in Appendix C previous.

GREEN BUILDINGS POLICY FOR REZONINGS

~~Adopted~~ ~~Approved~~ by ~~City~~ Council ~~on~~ July 22, 2010
Amended June 25, 2014, February 7, 2017 and May 2, 2018 and ~~XX XX, 2022~~

~~(Applies to rezoning applications after May 1, 2018)~~

~~All rezonings must meet the following requirements of either:~~

- ~~A. — Near Zero Emissions Buildings, or~~
- ~~B. — Low Emissions Green Buildings.~~

~~Background and Context~~

~~In July 2010, Council approved the Green Building Policy for Rezonings setting out requirements for all applicable developments applying for rezoning to help transition industry toward more sustainable building practices. Subsequent amendments of this Policy in 2014, 2017 and 2018 updated requirements as the local development industry gained capacity in green building design and construction practices and new priority topics emerged. This current version of the Green Building Policy for Rezonings reflects Council's direction and targets stated in the Zero Emissions Building Plan, the Climate Change Adaptation Strategy, the Embodied Carbon Strategy and the Climate Emergency Action Plan.~~

~~Intent~~

~~This policy is effective immediately, and shall be mandatory for all Rezoning Applications received on or after ~~May 2, 2018~~ May 18 2022, with exceptions permitted at the discretion of the Director of Planning. For Rezoning Applications received prior to ~~May 2, 2018~~ May 18, 2022 that have not yet been referred for approval ~~approved~~ by Council to Public Hearing by August 1, 2022, applicants may choose to meet this updated version of the Policy or the preceding version.~~

~~Policies~~

~~REQUIREMENTS~~

~~A. — Near Zero Emissions Buildings~~

~~(1) — Near Zero Emissions Building Standard~~

~~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 Future Institute's Zero Energy Building Certification, as deemed suitable by the Director of Sustainability.~~

AND

~~(2) Energy System Sub-Metering and Reporting~~

~~Projects shall meet the requirements for Energy System Sub-Metering and Reporting, as described in B.5 of this policy.~~

AND

~~(3) Low-Emitting Materials~~

~~Projects shall be designed to minimize emissions from interior materials containing volatile organic compounds (VOCs) or added urea formaldehyde, as described in B.8 of this policy.~~

~~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	30	6
Office	100	27	3
Retail	170	21	3
Hotel	170	25	8
All Other Buildings	EUI 35% better than Building By-law energy efficiency requirements, Section 10.2, in effect at the time of rezoning application		

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	170	25	8
All Other Buildings	EUI 35% better than Building By law energy efficiency requirements, Section 10.2, in effect at the time of rezoning application		

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

~~Alternate Compliance Pathway for Energy and GHG Reductions: In lieu of compliance with the GHGI limits required by the table above, Residential High Rises (7+ storeys) and Hotels may achieve a TEUI of 100 and 120 respectively, and a TEDI of 15. In addition, any building type seeking an alternative compliance path may use A.1, Near Zero Emissions Building Standard.~~

~~Small Buildings: for Part 9 buildings, in lieu of the TEUI and TEDI limits required by this policy, projects may meet an alternate set of performance or prescriptive requirements, such as an equivalent step of the Part 9 BC Energy Step Code, as deemed acceptable by the Director of Sustainability.~~

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*m² @75 Pa (0.40 cfm/ft² @ 0.3" w.e.), 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*m² @50 Pa (0.23 cfm/ft² @ 0.2" w.e.), 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, CSA Z5000-18, or ASHRAE Guideline 0-2005 and 1.1-2007, or an alternate commissioning standard acceptable by the Director of Sustainability.~~

AND

~~(5) Energy System Sub-Metering and Reporting~~

~~Separate master metering for each energy utility (e.g. 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.~~

~~A rezoning applicant will enter into an agreement with the City, on terms and conditions acceptable to the City, that requires the future owner of the building to report energy use data, on an aggregated basis, for the building as a whole and certain common areas and building systems. Such an agreement will further provide for the hiring of an approved professional service provider to assist the building owner for a minimum of three years in collecting and submitting energy use data to the City.~~

~~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 kgCO₂e/m², 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 (i.e. global warming potential impact, or ‘embodied carbon’) of each building, in kgCO₂e/m², 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**

All rezoning projects shall explore ~~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 Cityde 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.~~

2 Reporting of Green and Resilient Building Measures

For all Part 3 building projects as defined by the *Vancouver Building By-law*, provide the following design reports and worksheet at the time of the rezoning application:

2.1 Energy & Emissions Performance Limits

Complete the *Energy & Emissions Design Report* for each building to demonstrate that the project is on track to meet the *Vancouver Building By-law* energy and emissions performance limits expected to be in force at the time of the project's first Building Permit application. Performance limits are modelled according to the *City of Vancouver Energy Modelling Guidelines*, which set standard assumptions and requirements for energy models when assessing compliance with the limits.

2.2 Embodied Carbon Limits

Complete the *Embodied Carbon Design Report* for each building to demonstrate that the project is on track to meet the *Vancouver Building By-law* life-cycle equivalent carbon dioxide emissions (i.e. global potential impact, or 'embodied carbon') limits expected to be in force at the time of the project's first Building Permit application. Embodied carbon is calculated for each building, in kgCO₂/m², as calculated by a whole-building life-cycle assessment using standard assumptions according to the *City of Vancouver Embodied Carbon Guidelines*.

2.3 Resilient Buildings Planning Worksheet

Complete the *Resilient Buildings Planning Worksheet* to summarize the level of resilience planning undertaken by the project and to identify proposed resilience strategies.

REQUIREMENT ADMINISTRATION

Refer to the bulletin [Green Building Policy for Rezonings – Process and Requirements](#) for more guidance on meeting the requirements of this Policy.

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.

Appendix E: Cost Estimation Studies

Energy Use and Carbon Emissions:

The following tables are excerpts from a consultant cost estimation study, showing incremental capital costs (including architectural, mechanical, and electrical incremental costs) and energy costs. For more information on these costs, visit the full study at:

<https://vancouver.ca/files/cov/zero-emissions-building-options-costing-study.pdf>

High-Rise Residential Archetype	Capital Costs			Energy Costs		
	Option #	Total Cost (\$/sq.ft.)	Incremental Cost Over Total Construction* (\$/sq.ft.)	Incremental Cost Over Total Construction Cost** (%)	Energy Cost (\$/yr/suite)	Incremental Energy Costs (\$/yr/suite)
Baseline 1: Baseboard + Gas DHW and Corridor Vent	\$325.00	-	-	\$739.39	-	-
Zero Emission Option 1: Baseboard + Electric DHW	\$325.30	\$0.30	0.1%	\$892.46	\$153.07	20.7%
Zero Emission Option 2: Baseboard + ASHP DHW	\$326.25	\$1.25	0.4%	\$778.03	\$38.64	5.2%
Baseline 2: ASHP + Gas DHW and Corridor Vent	\$343.00	-	-	\$723.07	-	-
Zero Emission Option 3: ASHP + ASHP DHW	\$343.78	\$0.78	0.2%	\$732.23	\$9.16	1.3%
Zero Emission Option 4: ASHP + ASHP w/ Electric Top Up DHW	\$343.71	\$0.71	0.2%	\$757.40	\$34.33	4.7%
Zero Emission Option 5: Water-Cooled VRF + Electric DHW	\$339.74	-\$3.26	-1.0%	\$940.11	\$217.04	30.0%
Zero Emission Option 6: 2-Pipe Loop w/ ASHP + WWHP DHW	\$339.76	-\$3.24	-0.9%	\$797.54	\$74.47	10.3%
Zero Emission Option 7: ASHP + Heat Exchanger DHW	\$343.32	\$0.32	0.1%	\$722.48	-\$0.59	-0.1%
Zero Emission Option 8: PTHP + Electric DHW	\$335.42	-\$7.58	-2.2%	\$845.49	\$122.42	16.9%

* Includes mechanical system and any associated incremental costs to architectural, electrical, or other systems/disciplines, but excludes soft costs, etc...

** This is an estimate of the total cost of construction, including all structure, envelope, foundation, services, etc.

Low-Rise Residential Archetype	Capital Costs			Energy Costs		
	Option #	Total Cost (\$/sq.ft.)	Incremental Cost Over Total Construction* (\$/sq.ft.)	Incremental Cost Over Total Construction Cost** (%)	Energy Cost (\$/yr/suite)	Incremental Energy Costs (\$/yr/suite)
Baseline 1: Baseboard + Gas DHW and Corridor Vent	\$302.00	-	-	\$714.53	-	-
Zero Emission Option 1: Baseboard + Electric DHW	\$302.55	\$0.55	0.2%	\$859.42	\$144.89	20.3%
Zero Emission Option 2: Baseboard + ASHP DHW	\$306.78	\$4.78	1.6%	\$744.92	\$30.39	4.3%
Zero Emission Option 9: Baseboard + Electric In-Suite DHW	\$303.33	\$1.33	0.4%	\$859.42	\$144.89	20.3%
Baseline 2: ASHP + Gas DHW and Corridor Vent	\$317.00	-	-	\$699.86	-	-
Zero Emission Option 3: ASHP + ASHP DHW	\$322.14	\$5.14	1.6%	\$706.55	\$6.69	1.0%
Zero Emission Option 4: ASHP + ASHP w/ Electric Top Up DHW	\$317.88	\$0.88	0.3%	\$708.80	\$8.94	1.3%
Zero Emission Option 5: Air-Cooled VRF + Electric DHW	\$317.36	\$0.36	0.1%	\$861.82	\$161.96	23.1%
Zero Emission Option 6: 2-Pipe Loop w/ ASHP + WWHP DHW	\$313.99	-\$3.01	-0.9%	\$814.17	\$114.31	16.3%
Zero Emission Option 7: ASHP + Heat Exchanger DHW	\$317.15	\$0.15	0.0%	\$678.91	-\$20.95	-3.0%
Zero Emission Option 8: PTHP + Electric DHW	\$310.21	-\$6.79	-2.1%	\$869.36	\$169.50	24.2%

* Includes mechanical system and any associated incremental costs to architectural, electrical, or other systems/disciplines, but excludes soft costs, etc...

** This is an estimate of the total cost of construction, including all structure, envelope, foundation, services, etc.

In the tables above, **red numbers** are savings.

The study estimated lowest capital cost options at \$0.3/ft² - \$0.55/ft² for electric resistance hot water systems in high-rise and low-rise multifamily respectively (0.1% and 0.2% of total construction costs, respectively). For heat pumps, the estimated capital cost is \$1.33/ft² and \$4.44/ft² in high-rise and low-rise multifamily respectively (0.4% and 1.4% of total construction costs, respectively). Some medium-sized low-rise multifamily buildings may be on the cusp of increased electrical servicing requirements, which could result in additional costs of \$1-3/ft² (0.3%-1% of total construction costs). City staff understand BC Hydro is actively working to reduce electrical connection and servicing costs, and will explore opportunities to avoid or minimize electrical servicing costs with BC Hydro.

Even though electricity is more expensive than natural gas, electric heat pumps can have efficiencies of 300% or more and can now compete on an operating cost basis with natural gas systems, which are only 85-95% efficient. Low-emissions buildings can help insulate residents from the global price volatility of fossil fuels, as well as the upcoming significant increases to the carbon tax³. At the same time, BC Hydro predicts the implementation of their 2021 Electrification Plan will result in electricity rates being lower than they would have otherwise been. As a result of these trends, residents in low-emissions buildings may expect to see lower and more stable long-term energy costs compared to high-emissions buildings.

Low-rise buildings and electrical upgrade costs (Appendix G, p.176 of the linked study):

For capital costs of low-rise buildings, and especially to examine the cost impacts of site electrical upgrades, an additional low-rise scenario was run with a much smaller building (41 units, compared to 110 units in the original low-rise scenario). This smaller building did not require a unit substation and/or Vista switch, and could instead use a pad-mounted transformer (PMT), resulting in a significant savings in electrical costs compared to the larger low-rise. For this smaller building, even fully-electrifying and using electric resistance for heating and hot water did not force it to upgrade to a substation and/or Vista switch. However, by comparing the large and small low-rise buildings it is possible to conclude that some buildings with electrical loads falling in between the two may find themselves on the edge between a PMT and/or a Vista switch. By comparing the electrical service and distribution costs of the two buildings, the study estimates such a building could face electrical upgrade costs on the order of \$87,000, or roughly on the order of \$1-3/sq.ft. depending on the building size.

Operating costs compared to buildings from 2014 (Appendix F, p173 of the linked study):

For operational costs, an additional scenario was run to compare the study scenarios against the operating costs of a typical 2014 By-law-minimum baseline using fossil fuels:

³ BC's carbon tax is currently \$40-45 per tCO₂e and is planned to increase in line with the federal benchmark of \$170/tCO₂e by 2030

Performance Metrics	TEUI (kWh/m ² /yr)	TEDI (kWh/m ² /yr)	GHGI (kgCO ₂ e/m ² /yr)	Energy Cost (\$/yr)	Energy Cost (\$/yr/suite)	Energy Savings	Energy Cost Savings
2014 Code Baseline	162.5	69.9	19.6	\$229,838.00	\$801	-	-
2017 Rezoning Baseline 1	108.4	28.9	5.9	\$212,205.00	\$739	33%	8%
Zero Emission Option 1	106.9	28.9	1.2	\$256,137.00	\$892	34%	-11%
Zero Emission Option 1b	107.3	28.9	1.3	\$247,534.00	\$862	34%	-8%
Zero Emissions Option 2	92.4	28.9	1.0	\$223,294.00	\$778	43%	3%

Performance Metrics	TEUI (kWh/m ² /yr)	TEDI (kWh/m ² /yr)	GHGI (kgCO ₂ e/m ² /yr)	Energy Cost (\$/yr)	Energy Cost (\$/yr/suite)	Energy Savings	Energy Cost Savings
2014 Code Baseline	152.4	54.2	17.7	\$105,061.00	\$947	-	-
2017 Rezoning Baseline 1	84.2	12.9	5.0	\$76,910.00	\$693	45%	27%
Zero Emission Option 1	82.4	12.9	0.9	\$93,903.00	\$846	46%	11%
Zero Emission Option 1b	82.7	12.9	1.2	\$90,233.00	\$831	46%	14%
Zero Emissions Option 2	70.6	12.9	0.8	\$81,194.00	\$731	54%	23%

In the tables above, **red numbers** are increased costs. In the tables above, Option 1 uses electric make-up air while Option 1b uses gas-fired make-up air, and comparing the two shows the relatively minimal impact on operating costs of this difference when compared to overall efficiency improvements since 2014.

Resilient Buildings

Air filter cost estimates:

The cost of requiring air filters was determined to be negligible, based on a consultant feasibility study accessible here: <https://vancouver.ca/files/cov/filtration-best-practices-study.pdf>

MERV 13 was selected as a By-law requirement because it is readily available and compatible with most ventilation designs and equipment used today, and represents a good balance between filter replacement costs and effectiveness, as the table on p.13 of the linked report shows. Costs per square foot noted are for filter face area, not building floor area.

MERV Rating	Nominal Depth [mm]	Pressure Drop at 2.54 m/s [Pa]	Minimum % Efficiency at 0.3 µm - 1 µm	Minimum % Efficiency at 1 µm - 3 µm	Minimum % Efficiency at 3 µm - 10 µm	Approx. Cost [CAD / ft ²]
8	100	34.8	N/A	20	70	\$4 - \$5
11	100	49.8	20	65	85	\$5 - \$7
13	100	84.6	50	85	90	\$10 - \$12
14	100	92.1	75	90	95	\$40 - \$45
15	100	107.0	85	90	95	\$40 - \$45
16	300	184.1	95	95	95	>\$70

Mechanical cooling cost estimates:

Cost estimates of mechanical cooling was determined using the same study linked on Page 1 of this Appendix, by comparing the costs of cooling scenarios against the costs of the heating-only baseline scenario. The lowest-cost option with full mechanical cooling was the packaged terminal heat pump (PTHP) scenario, with incremental costs over the heating-only scenario of \$8-10/sq.ft., depending on the archetype. Other cooling system designs cost more, and some developers have communicated that their own studies of the cost of adding cooling showed significantly higher incremental costs than the \$8-10/sq.ft range.

To achieve more affordable designs with cooling, some developers have explored minimizing cooling loads through passive design, and then using the ventilation air to distribute cooling. This approach was studied in Part 2 of the study linked on Page 1 of this Appendix. While the criteria studied were less stringent than those proposed for the 2025 By-law in Appendix B, they showed significant economies may be possible. The designs presented in Part 2 of the study as '1b' scenarios achieved adaptive thermal comfort limits under 2050's scenarios with incremental capital costs of only \$1.5-1.8/sq.ft. Based on this and examples from projects in design, such as the use of heat pumps that are integrated into in-suite heat-recovery ventilators, staff believe further industry capacity building and knowledge sharing in advance of 2025 could deliver significant breakthroughs in the costs of providing affordable mechanical cooling in multifamily buildings.

Embodied Carbon

High-Rise cost estimates:

High Rise: Individual Design Options (sorted by largest savings)	GWP	% GWP Savings	% Cost Savings (Structure + Envelope)
Sandwich Panel with XPS (2021)	304	3.4%	19.24%
Sandwich Panel with Min Wool	269	14.0%	19.22%
60% WWR	301	4.3%	6.96%
Steel Stud	277	11.6%	5.20%
2 Level Parking, 40% SCM	278	11.3%	1.93%
2 Level Parking, 0% SCM	317	-0.8%	1.90%
4 Level Parking, 30% SCM	300	4.6%	0.03%
4 Level Parking, 40% SCM	284	9.3%	0.03%
Baseline: Window Wall, Concrete Structure, 40% WWR, 4 Lvl Parking, 20% SCM	314	0%	0%
6 Level Parking, 40% SCM	291	7.2%	-2.35%
6 Level Parking, 0% SCM	330	-4.8%	-2.44%
Note: negative numbers are cost and carbon increases over the baseline			

The above sample of results from the design and cost study commissioned by staff show a number options to reduce embodied carbon without increasing construction costs. This result is consistent with consultations with material suppliers, as well as other studies by third parties such as the Rocky Mountain Institute.⁴

⁴ <https://rmi.org/insight/reducing-embodied-carbon-in-buildings/>

Appendix F: Consultation Summary

The engagement process for the changes proposed in this report began in April 2021 with targeted industry stakeholder organizations and internal staff across City departments. In January 2022, broader public engagement began with one public webinar session with energy modelling professionals. In March 2022, six open-invitation webinars were held with over 200 individuals participating in these sessions. At these public webinars, participants were invited to provide feedback verbally or through an online whiteboard platform – more than 100 comments were received this way. An industry consultation letter was sent in March 2022 to more than 300 individuals detailing the proposed changes and inviting written feedback - 16 written responses were received. Staff also invited feedback from groups such as the Council’s Renters Advisory Committee and the Climate & Equity Working Group. Invitations to the Host Nations to engage were provided through the February 2022 quarterly staff update package managed by the City’s Intergovernmental Relations department.

Table F.1 lists in alphabetical order the organizations represented by the participants who took part in the engagement process since 2021. These organizations include the local building designers (architects, engineers, energy modellers, code consultants, and sustainability consultants), developers, building owners and operators, professional organizations, local governments and provincial ministries.

Table F.1 List of Participants’ Organizations

Aboriginal Housing Management Association	Corix Energy	Keltic Development
AECOM	Creative Energy	Landlord BC
AES Engineering	Cressey Development Group	Lanefab Design/Build
Allied Air Enterprises	Darwin Construction	Lantern Properties
Alphatec Energy Inc.	Dialog Design	Ledcor Group
AME Group	District of North Vancouver	Lehigh Hanson Inc.
Ankush Rastogi Consulting Inc.	Edge Consultants	LMDG Building Code Consultants
Anthem Properties	EllisDon	Manifest Climate
Aqua-Coast Engineering	Enerficiency Consulting	Mantle Developments
Architectural Institute of British Columbia	EnerSys Analytics Inc.	Marcon Construction
ASHRAE BC	EnEta Energy Engineering Inc.	MCW Consultants
BC Building Sciences	Engineers & Geoscientists BC	Metro Vancouver
BC Housing	Evoked Buildings	Mitsubishi Electric Sales Canada Inc.
BC Hydro	Fast + Epp	Morrison Hershfield
BC Non-Profit Housing Association	FaulknerBrowns Architecture	Mott MacDonald
BGIS	Focal Engineering	National Research Council
Cambie Thermal	Footprint	Oakridge Energy
Canada Green Building Council	Fortis Alternative Energy Systems	Olympic International
Carbon Leadership Forum - Vancouver	Fortis BC	Onni Group of Companies
Chard Development	GHL Consultants Ltd.	Perkins+Will
Chemours Canada	GMC Projects	Pilot Projects Design Collective
Christopher Collett and Associates Ltd.	GWL Realty Advisors	PK Engineering
City of Burnaby	Harmony Engineering	Polygon Homes
City of Coquitlam	HAVAN	Priopta
City of Delta	HCMA Architecture + Design	Province of BC - Building and Safety Standards Branch
City of Nelson	Heating, Refrigeration and Air Conditioning Institute of Canada	Province of BC - Climate Action Secretariat
City of New Westminster	Henriquez Partners Architects	Province of BC - Ministry of Energy, Mines and Low Carbon Innovation
City of North Vancouver	IESVE	Province of BC - Ministry of Jobs, Economic Recovery and Innovation
City of Port Moody	Impact Engineering	Purpose Building
City of Richmond	Integral Group	QuadReal Property Group
City of Surrey	Intracorp Homes	RDH
Community Energy Association	IoAirFlow	Recollective Consulting
Concert Properties	J.M. Hasick & Associates Ltd.	Reinbold Engineering Group
Condominium Homeowners Association	Johnson Barrow	
	Johnson Controls	
	JRS Engineering	

ReLoad Sustainable Design
Riada Sales Inc.
River District Energy
RJC Engineers
Rob Sianchuk Consulting
Rocky Point Engineering
Scius Advisory
Small Planet Supply
Soprema
Stantec

Starlight Investments
Straiton Engineering
Strand Developments
StreetSide Developments
Third Space Properties
TL Housing Solutions
Township of Langley
Trane
Tri-Can Consulting Ltd.
Unbuilders

University of British Columbia
Urban Development Institute – Pacific
Vancouver Coastal Health
Wesbild
Wesgroup Properties
Williams Engineering
WoodWorks BC
WSP
Yoneda & Associates
ZGF

Appendix G: Redline of Vancouver Building By-law Amendments

This document is being provided for information only as a reference tool to highlight the proposed amendments. The draft amending by-laws attached to the Council report RTS No. 14981 entitled **Climate Emergency New Buildings Updates** represent the amendments being proposed to Council for approval. Should there be any discrepancy between this redline version and the draft amending by-laws, the draft amending by-laws prevail.

RED TEXT: proposed VBBL changes to be effective July 1, 2023

Div B Part 1 – General

Section 1.3. Referenced Documents and Organizations

1.3.1. Referenced Documents

1.3.1.2. Applicable Editions

Table 1.3.1.2 Documents Referenced in Book I (General) of the Building By-law

Issuing Agency	Document Number	Title of Document	By-law Reference
ASHRAE	ANSI/ASHRAE 52.2-2017	Method of Testing General Ventilation Air-Cleaning Devices	6.3.2.14.(1)
ASHRAE	ANSI/ASHRAE 55-2010	Thermal Environmental Conditions for Human Occupancy	6.6.2.1.(1)
CoV	v1.0	City of Vancouver Embodied Carbon Guidelines	10.4.1.2.(1)

Div B Part 6 – Heating, Ventilation and Air-conditioning

6.3.1. Ventilation

6.3.1.1. Required Ventilation

- 1) Except as provided in Sentence (3), all buildings shall be ventilated in accordance with this Part.
- 2) Except in storage garages covered by Article 6.3.1.4., the rates at which outdoor air is supplied in buildings by ventilation systems shall be not less than the rates required by ANSI/ASHRAE 62, "Ventilation for Acceptable Indoor Air Quality" (except Addendum n).
- 3) Self-contained heating-season mechanical ventilation systems serving only one dwelling unit shall comply with a) this Part, or b) Subsection 9.32.3.
- 4) For suites in buildings conforming to Subsection 10.2.2.5., the outdoor air required by Sentence (2) shall be supplied directly to each suite by mechanical ventilation through ducting. (See Note A-6.3.1.1.(4).)

6.3.2. Air Duct Systems

6.3.2.13. Filters

- 1) Air filters for air duct systems shall conform to the requirements for Class 2 air filter units as described in CAN/ULC-S111, "Fire Tests for Air Filter Units."
- 2) When electrostatic-type filters are used, they shall be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or, in dwelling units, when the furnace circulation fan is not operating.

6.3.2.14. ~~Reserved~~ Cleaning Devices

- 1) ~~Ventilation required by Sentence 6.3.1.1.(1) shall be provided by a ventilation system designed to include filtration devices with a Minimum Efficiency Reporting Value (MERV) of 13, as defined by ANSI/ASHRAE 52.2, prior to introduction of outdoor air into indoor occupied spaces.~~

6.6. Refrigeration and Cooling Systems

6.6.1. Refrigerating Systems and Equipment for Air-conditioning

6.6.1.1. Cooling Units

- 1) Where a cooling unit is combined with a fuel-fired furnace in the same duct system, the cooling unit shall be installed
 - a) in parallel with the heating furnace,
 - b) upstream of the furnace provided the furnace is designed for such application, or
 - c) downstream of the furnace provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

Section 6.6.2 Passively Cooled Buildings

6.6.2.1 Passively Cooled Buildings

1) For a *building* described in Sentence 1.3.3.2.(1) of Division A containing Group C, D, or E *Major Occupancies*, *conditioned space* that does not incorporate mechanical cooling systems shall be designed such that interior dry bulb temperatures do not exceed the 80% acceptability limits for naturally conditioned spaces, as defined in ANSI/ASHRAE 55 Section 5.3, for the following number of hours annually

- a) for *conditioned space* containing seniors housing, shelter or supportive housing, daycares, schools, or healthcare facilities, no more than 20 hours per year, or
- b) for any other *conditioned space*, no more than 200 hours per year.

Div B Part 10 - Energy and Water Efficiency

Section 10.2. Energy Efficiency

10.2.1.2. Buildings Without Residential or Commercial Components

- 1) All *buildings* except those included in 10.2.1.3 through 10.2.1.5.,
- a) shall be designed in compliance with (See Note A-10.2.1.2.(1)(a.)
 - i) 10.2.2.2. or 10.2.2.3., or
 - ii) 10.2.2.2. in a *building* required to be designed to Part 9 by Division A, 1.3.3.3.,
 - b) ~~[UTV Deleted]~~, except where space heating and service water heating systems are powered only by electricity, shall be designed with a *greenhouse gas intensity (GHGI) reduction in compliance with Table 10.2.2.5.A1, or a reduction as acceptable to the Chief Building Official,*
 - c) [UTV Deleted],
 - d) [UTV Deleted],
 - e) shall be provided with vestibules in compliance with Article 10.2.2.8.,
 - f) shall be provided with metering equipment in compliance with Article 10.2.2.9,
 - g) shall be provided with lighting in conformance with Article 10.2.2.10.,
 - h) [UTV Deleted],
 - i) shall comply with Article 10.2.2.15. where gas-fired fireplaces are provided, and
 - j) may provide exterior heated spaces in compliance with Article 10.2.2.22.

10.2.2. Design Measures for Energy Efficiency

10.2.2.5. Building Energy and Emissions Performance

Table 10.2.2.5.A1 Maximum Energy Use and Emissions Intensities Forming part of Sentence 10.2.2.5.(2)			
Occupancy Classification ⁽¹⁾	Total Energy Use Intensity (kWh/m ² a)	Thermal Energy Demand Intensity (kWh/m ² a)	Greenhouse Gas Intensity (kgCO ₂ e/m ² a)
Group C occupancies complying with 10.2.1.5.(2)(a)(i)	See Table 10.2.2.5.A2	20	3
Group C occupancies in <i>buildings</i> up to 6 Storeys, except Hotel and Motel	110	25	5.5 3
Group C occupancies in <i>buildings</i> over 6 Storeys, except Hotel and Motel	120	30	6
Hotel and Motel occupancies	140	20	8

Group D and E <i>occupancies</i> , except Office	120	20	3
Office <i>occupancies</i>	100	20	3
All other <i>occupancies</i>	(1)		50% lower than GHGI of the reference building modelled using only fossil-fuel systems

Notes to Table 10.2.2.5.A1:

(1) For *buildings* containing multiple *occupancies*, refer to the procedures in Section 5 of the City of Vancouver Energy Modelling Guidelines.

Table 10.2.2.5.C Maximum Energy Use and Emissions Intensities Forming part of Sentence 10.2.2.5.(5)			
Occupancy Classification	Total Energy Use Intensity (kWh/m²a)	Thermal Energy Demand Intensity (kWh/m²a)	Greenhouse Gas Intensity (kgCO₂e/m²a)
Group C <i>occupancies</i> in <i>buildings</i> up to 6 Storeys, except Hotel and Motel	110	25	5.5 3
Group C <i>occupancies</i> in <i>buildings</i> over 6 Storeys, except Hotel and Motel	130	40	6
Hotel and Motel <i>occupancies</i>	170	30	8
Business and Personal Services or Mercantile <i>occupancies</i> , except Office	170	30	3
Office <i>occupancies</i>	130	30	3

[note: The following is a new section, which bumps all of existing 10.4. Objective Statements to a new 10.5]

Section 10.4. Low Carbon Materials and Construction

10.4.1 Low Carbon Materials and Construction

10.4.1.1 Application

- 1) This Section applies to *buildings* described in Sentence 1.3.3.2.(1) of Division A.

10.4.1.2 Low Carbon Materials and Construction

- 2) A *building* shall be designed and constructed to achieve whole-building embodied carbon impacts of not more than double that of a functionally equivalent baseline, as determined in compliance with the City of Vancouver Embodied Carbon Guidelines, or as *acceptable* to the *Chief Building Official*.

Appendix H: Further Background on Heat and Air Quality in Vancouver

It is anticipated there will be more than a doubling in the number of summer days above 25°C, and days above 30°C that happened once a year in 2018 will happen 12 times per year, with 2021 already seeing six such days during a summer of unprecedented extreme heat.¹ Self-reported data from a City-led survey of residents show some neighbourhood temperatures reached well above 30°C, and some indoor temperatures reached over 40°C.² On August 13th, 2021, Vancouver experienced both a Level 2 heat warning – issued when temperatures reach 31°C in Vancouver³ – and a special air quality statement, with the Air Quality Index reaching the maximum of 11 or ‘very high risk’, due to wildfire smoke.⁴ According to the provincial coroner’s service, nearly 600 people died due to extreme temperatures during the summer, with 99 heat-related deaths in Vancouver⁵.

Beginning in 2017, Vancouver introduced the first limits on the number of hours a new building can overheat, with more stringent limits for buildings with vulnerable populations. These limits were an important first step in creating climate resilient buildings but they also have limitations: the limits rely on average historical weather at YVR Airport; on modelling assumptions such as typical occupancy, operable windows and natural ventilation; and do not set a maximum allowable indoor design temperature.

¹ <https://www.theweathernetwork.com/ca/monthly/british-columbia/vancouver?year=2021&month=5&dispt=calendar-container-monthly>

² Vancouver Coastal Health/City of Vancouver/BCCDC Indoor Air Temperature Survey (preliminary findings), 2022.

³ <https://vancouver.sun.com/news/local-news/vancouver-adds-overnight-cooling-centre-as-health-officials-raise-heat-level-warning-to-extreme-in-metro-vancouver-and-fraser-valley>

⁴ <https://vancouver.weatherstats.ca/>

⁵ <https://www2.gov.bc.ca/gov/content/life-events/death/coroners-service/news-and-updates/heat-related>