City of Port Moody Zero Emissions Municipal Buildings Policy Research Report

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Disclaimer

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This project was conducted under the mentorship of City of Port Moody staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of City of Port Moody or the University of British Columbia.

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We carry out our business on the ancestral and unceded homelands of the kʷikʷəƛ̓əm (Kwikwetlem), səlilwətaɬ (Tsleil-Waututh), xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), q̓i̓c̓əy̓ (Katzie), q’ʷa:ṅ ƛ’əṅ (Kwantlen), qiqéyt (Qayqayt), and Stó:lō (Sto:lo) Peoples, and extend appreciation for the opportunity to work on this territory.

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Glossary

Avoided emissions: Emissions avoided through exporting green power and purchase of carbon offsets;

Exported green power: Excess green power produced within the project building and exported to grid;

Carbon offset: Credits available for purchase to compensate greenhouse gas emissions of a project or a company, the money is then invested in greenhouse gas reduction projects, such as renewable energy and forestry;

Construction carbon: Carbon emissions from construction activities

Direct emissions: Carbon emissions from onsite combustion and from leakage of refrigerants

Embodied carbon: Carbon emissions arise from manufacturing, transportation, installation, use and end-of-life of building materials;

Emission factor: Conversion factor to estimate carbon emission from indirect sources;

End of lift carbon: Embodied carbon emissions from building demolition, including demolition, transportation, processing and disposal of construction waste;

Global warming potential (GWP): Measure of each greenhouse gas's ability to trap heat in atmosphere compared to carbon dioxide over a specific time frame;

Green power: Electricity generated from renewable source, such as solar, wind, geothermal, hydro and biofuels;

Indirect emissions: Emission from purchased energy, water use, waste and transportation;

Life cycle assessment (LCA): Assessment to evaluate environmental impacts throughout the life cycle of a building, infrastructure, product or material;

Net zero emissions: Sum of operational, embodied, construction emissions minus avoided emissions equals to or lower than zero;

Onsite renewable energy: Energy produced by renewable energy systems within the project building;

Operational Carbon: Emissions from building operation

Pollution, erosion and sedimentation control plan: Plan to be developed and implemented during construction to mitigate environmental impact of construction activities;

Upfront carbon: Embodied carbon emissions from material production and construction stages

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Use stage carbon: Embodied carbon emissions from daily usage, maintenance, repair, refurbishment and replacement of building materials;

Waste management plan: Plan to record and treat waste during construction.

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Executive Summary

City of Port Moody's municipal buildings energy use accounts for 54% of the City's corporate greenhouse gas emissions. (City of Port Moody, Port Moody Climate Action Plan July 2020, 2020`) The City targets to develop a Zero Emissions Municipal Buildings Policy to address emission from the City owned properties.

Similar policies from other municipalities, namely City of Abbotsford's Green Buildings Policy, BC housing's Desing Guidelines and Construction Standards, CAGBC's Zero Carbon Building Performance Standard and City of Vancouver's Zero Emissions Building Plan, are studied for developing City of Port Moody's Zero Emissions Municipal Buildings Policy. And an interview was conducted with City of Abbotsford to share their experience in developing and implementing of the Green Building Policy.

Carbon balance calculation as reference to CAGBC's Zero Carbon Building Performance Standard (Canada Green Building Council, 2022) is recommended to be the main framework of the Zero Emissions Municipal Buildings Policy, which covers operational, embodied, construction and avoided carbon emissions, to record emissions from the whole building life cycle of the municipal buildings.

Building energy modeling, airtightness and commissioning are also recommended to be included in the policy with reference to other studies policies, to optimize building envelop, minimize building energy use and to ensure the municipal buildings are operating according to the design intent.

Waste management plan and pollution, erosion and sedimentation control plan are recommended to be implemented during construction to monitor site condition and mitigate pollution from construction activities.

City of Port Moody will be facing a hotter climate with increased frequency and intensity of rainfall in fall, winter and spring and longer dry spells in summer in the future. Resilience measures are recommended to be included in the policy to prepare the City's municipal buildings for the future climate and extreme climate events. (City of Port Moody, Extreme Weather Resilience Plan, 2022)

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Introduction

City of Port Moody joined other local governments in declaring a climate emergency in June 2019, to highlight the need to take immediate action on climate change. The City shall ramp up its climate actions to limit global warming to 1.5°C. The City's Climate Action Plan targets to achieve more than 40% reductions from the 2007 emission level by 2030 and to become carbon neutral by 2050. (City of Port Moody, Port Moody Climate Action Plan July 2020, 2020`)

One of the focus areas outlined in the Climate Action Plan is buildings. 54% of the City's corporate greenhouse gas emissions are from energy used in buildings owned and operated by the City. (City of Port Moody, Port Moody Climate Action Plan July 2020, 2020`)The City targets to develop a Zero Emissions Municipal Buildings Policy to address emission from the City owned properties.

City of Port Moody's Zero Emissions Municipal Buildings Policy is developed with reference to similar policies, including the City of Abbotsford's Green Buildings Policy, BC housing's Desing Guidelines and Construction Standards, Canada Green Building Council (CAGBC)'s Zero Carbon Building Performance Standard and City of Vancouver's Zero Emissions Building Plan. Interview was conducted with City of Abbotsford to share their experience on developing and implementing their Green Building Policy.

From the policies listed above, it is recommended that the policy adopts the carbon balance calculation similar to the CAGBC's Zero Carbon Building Performance Standard which covers the whole building life cycle, including embodied, operational, construction and avoided carbon emissions, to record and control carbon emissions of the City's facilities. (Canada Green Building Council, 2022)

Furthermore, resilience is recommended to be included in the Policy to address how buildings shall adapt to the future climate. In 2080, City of Port Moody will be experiencing a hotter climate, increase in precipitation during fall, winter and spring and longer dry spells in summer, measures are recommended to be included to address the issues. (City of Port Moody, Extreme Weather Resilience Plan, 2022)

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Background

The City of Port Moody published a Climate Action Plan in 2020. The City targets to achieve carbon neutrality by shifting away the dependence on fossil fuels and reduction in emissions though initiatives and targets. According to the Climate Action Plan, the City's building operations account for more than half of the City's operations greenhouse gas emissions in 2016. As stated in the Climate Action Plan, one of the key actions is to develop and implement a green buildings policy for the construction and renovation of City-owned facilities. (City of Port Moody, Port Moody Climate Action Plan July 2020, 2020`)

Policies from other municipalities and organizations have been studied, namely City of Abbotsford's Green Buildings Policy, BC housing's Desing Guidelines and Construction Standards, CAGBC's Zero Carbon Building Performance Standard and City of Vancouver's Zero Emissions Building Plan. We also have the privilege to interview City of Abbotsford to learn more about their experience in developing and implementing their Green Buildings Policy.

City of Abbotsford's Green Buildings Policy applies to new construction, addition and major renovations of the City-owned buildings. The policy includes energy efficient measures such as energy modelling, net zero-emissions balance, energy load reduction, low-emission system installation, renewable energy and carbon offset allocation and metering. The energy efficient measures shall be applied in the design stage. The policy does not cover the construction stage; however, commissioning and training requirements are included, and an as-built energy model is also required prior occupancy. (City of Abbotsford, 2022)

BC Housing Design Guidelines and Construction Standards is a detailed which applies to both design and construction stages and covers a wide range of aspects. The design guidelines cover both building and system design requirements, with suggestions on passive design strategies. The guidelines require to conduct energy modelling, thermal comfort evaluation for passively cooled buildings and whole building airtightness test in accordance with the BC Step Code. The construction standards cover construction management, materials selection and installation and commissioning. The BC Housing Design Guidelines and Construction Standards is an all-rounded policy which provides detailed requirements of the design and construction of the buildings. (BC Housing, 2019)

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CAGBC's Zero Carbon Building Performance Standard focuses on carbon emissions of buildings, buildings are required to achieve a carbon balance of zero or better. Carbon balance is the net emission of the building, derived from the equation Net Emissions = Embodied Carbon + Operational Carbon - Avoided Emissions. Embodied carbon are emissions from producing, transporting, and use of building materials until its end-of life. Life cycle assessment covering upfront, use stage and end of life of building materials shall be conducted to determine the embodied carbon. Operational carbon refers to all emissions related to energy use and release of refrigerants during building operation. The Standard divides operational carbon emissions into direct emissions like emissions from refrigerants, combustion, biogas and biomass, and indirect emissions, like district heating and cooling, green heat, grid or district electricity, owned renewable energy systems and green power products. Avoided emissions are reduction outside of the building's life cycle, from exported green power and carbon offsets. The Standard also includes energy requirements, such as energy use intensity, peak demand and airtightness. The Standard provides a straightforward and simple calculation method to evaluate a building's carbon emission from cradle to grave. (Canada Green Building Council, 2022)

City of Vancouver's Zero Emissions Building Plan divides into 2 reduction pathways for new buildings, Path1: high performance building envelope and ventilation systems and Path 2: neighborhood renewable energy systems. Path 1 focuses on highly efficient building envelopes and ventilation systems, which require minimal maintenance since most of the new developments in City of Vancouver are residential projects. Path 2 requires new buildings to connect to neighborhood renewable energy systems for space heating, ventilation air and domestic hot water. Buildings are also required to provide improved envelopes and ventilation systems. The Plan also includes requirements on embodied carbon, building energy performance modelling, air barrier testing and commissioning. (City of Vancouver, 2016)

The City of Port Moody's Zero Emissions Municipal Buildings Policy is developed with reference to the policies listed above. The Policy is only applicable to the City's municipal buildings and recommended to cover both new buildings and retrofitting of existing buildings, including both the design and construction process. The policy adopts a simple calculation method with reference to the CAGBC Zero Carbon Building Performance Standard to include the carbon emissions of the whole building life cycle. The draft policy is provided in the sections below.

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Carbon Balance

Carbon balance with reference to the CAGBC's Zero Carbon Building Performance Standard is recommended as the key framework of City of Port Moody's Zero Emissions Municipal Buildings Policy. Buildings are recommended to achieve net zero carbon emission based on this equation:

Net Emissions = Operational Carbon + Embodied Carbon + Construction Carbon - Avoided Emissions (Canada Green Building Council, 2022)

Details of each parameter are discussed in the sections below.

Operational Carbon

Based on CAGBC's Zero Carbon Building Performance Standard, operational carbon emissions are emissions from energy use and release of refrigerants during building operations, which are classified as direct and indirect emissions. (Canada Green Building Council, 2022)

Direct Emissions

Direct emissions are emissions resulting from the combustion of fossil fuels, or the release of refrigerants occurring at the project site. There are 4 types of direct emissions, emissions from release of refrigerants, combustion, biogas and biomass. (Canada Green Building Council, 2022)

HVAC systems adopt refrigerants for heating and cooling, the refrigerant might leak to the atmosphere and contributes to climate change. Projects are recommended to record the total quantity, type and Global Warming Potential (GWP) of refrigerants in the buildings, and to record any change in the volume of refrigerant. The quantity is then converted with the emissions factors of refrigerants and included in the carbon balance calculation. (Canada Green Building Council, 2022)

Emissions from onsite combustions are recommended to be included in the carbon balance calculation, emission factors from FortisBC are recommended to be adopted for the calculation of natural gas emissions. For other onsite combustions, emission factors shall refer to Canada's National Inventory Report. Fuel used in powering emergency back-up generators are also recommended to be included in the calculation. (Canada Green Building Council, 2022)

Indirect Emissions

Indirect Emissions are emissions not directly occur within the project site, emissions from purchased energy, water use, waste and transportation. (Canada Green Building Council, 2022)

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Purchased energy from electricity grid and district systems are recommended to be included in the carbon balance calculation by adopting emission factors from energy providers such as BC Hydro, to represent emissions that arise from production of the energy. (Canada Green Building Council, 2022)

Other indirect emissions such as water use, waste and transportation emission from commuting are also recommended to be included in the carbon balance calculation to consider all emissions from building operations. (Canada Green Building Council, 2022)

Energy Efficiency

Referred to City of Abbotsford's Green Buildings Policy, energy modeling is recommended to be conducted during both design and occupancy permit stages in accordance with the BC Building Code. The energy model is recommended to optimize the building envelope and include high efficiency building services system to minimize building energy use. The design stage energy model demonstrates fulfilment of BC Energy Step Code and Zero Carbon Step Code to minimize both energy use and greenhouse gas emissions. The occupancy permit stage model reflects all changes during construction and identical to the as built condition. (City of Abbotsford, 2022)

Meters are also recommended to be provided to monitor building energy use, a master meter for each fuel type and submetering for all major systems, such as heating, lighting, renewable energy etc. (City of Abbotsford, 2022)

Airtightness

With reference to City of Abbotsford's Green Buildings Policy, airtightness of buildings is recommended to be tested to ensure the effectiveness of the building envelop insulation. The testing is recommended follow ASTM E3158-18 – Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building. (City of Abbotsford, 2022)

Commissioning

From City of Abbotsford's Green Buildings Policy, during occupancy permit stage, commissioning is recommended to be conducted to all building services systems to confirm the systems operates as designed. A Commissioning agent are recommended to be engaged to ensure systems are installed, tested and operating as designed. Training and documentation are also recommended to be provided to the facility's operation team to provide a guide for future operation and maintenance. (City of Abbotsford, 2022)

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Embodied Carbon

From CAGBC Zero Carbon Building Performance Standard, building embodied carbon emissions arise from manufacturing, transportation, installation, use and end-of-life of buildings materials. Life cycle assessment (LCA) shall be conducted to cover upfront, use stage and end of life embodied carbon. (Canada Green Building Council, 2022)

Emissions from materials production and construction stages are defined as upfront carbon. Upfront carbon can be reduced by choosing low emission materials and storing carbon in the materials. Carbon stored in buildings can be locked in for the whole lifetime of buildings and may also store more carbon than emissions from its manufacturing process, which results in negative upfront carbon. (Canada Green Building Council, 2022)

Use stage embodied carbon includes embodied carbon from daily usage, maintenance, repair, refurbishment and replacement of building materials. Embodied carbon at this stage can be reduced by selecting materials with longer life span, to reduce the need for maintenance and repair. (Canada Green Building Council, 2022)

End of life embodied carbon refers to emission from building demolition, which includes demolition, transportation, processing and disposal of construction waste. End of life carbon can be reduced by choosing durable materials which can be reused, recovered and recycled when the building's service life ends. (Canada Green Building Council, 2022)

The LCA are recommended to include structural and building envelope materials, from foundation to roof components. Excavation, interior finishes and building services systems are recommended to be excluded from the LCA. (Canada Green Building Council, 2022)

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Construction Carbon

This section targets to provide recommendations to monitor site condition and mitigate pollution during construction for both new buildings and retrofitting. Waste and pollution during construction are recommended to be monitored and recorded.

Construction Waste

From BC Housing Design Guidelines and Construction Standards, Waste management plan are recommended to be developed by the contractor before construction commencement, to plan on how to record and treat waste produced during construction. The waste management plan can include an estimated amount of waste to be produced, recycled and disposed. Construction waste can be reused and recycled as much as possible, 80% of total waste generated during construction are recommended to be diverted. (BC Housing, 2019)

Construction Pollution

Pollution, erosion and sedimentation control plan is recommended by BC Housing Design Guidelines and Construction Standards to be developed and implemented during construction. The Plan targets to reduce pollution from construction activities by implementing mitigation strategies to control soil erosion, sedimentation in water discharge and airborne dust. (BC Housing, 2019)

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Avoided Emissions

Both CAGBC Zero Carbon Building Performance Standard and City of Abbotsford's Green Buildings Policy recommended to achieve emissions reduction through avoided emissions such as export of green power and purchase of carbon offset.

Exported Green Power

Renewable energy generated from onsite renewable energy system can be used within the site first, then excess energy generated can be exported to the electricity grid. The exported green power reduces indirect emissions and the emission factor for the reduction can be referred to energy providers such as BC Hydro. (Canada Green Building Council, 2022)

Carbon Offset

Another way of avoiding emissions is to purchase carbon offsets to reduce direct or indirect emissions. As recommended by City of Abbotsford's Green Building Policy, to balance out the remaining emissions from the carbon balance calculation, City of Port Moody can allocate the estimated cost of carbon offsets to invest in the City's municipal buildings for future greenhouse gas emission reduction initiatives. (City of Abbotsford, 2022)

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Resilience

City of Port Moody's City Council endorsed the Extreme Weather Resilience Plan in September 2022. The Plan considers current and future climate projections and identifies solutions to mitigate future impact from extreme weather events.

Future Climate

According to the future-shifted weather files for Abbotsford International Airport obtained from Pacific Climate Impacts Consortium, by 2080 there will be a slight decrease in the number of heating degree days (HDD), 2859 in 2016 and 1748 in 2080, and a huge increase in the number of cooling degree days (CDD), 75 in 2016 and 533 in 2080, which shows the City will be experiencing a hotter climate. (Pacific Climate Impacts Consortium, 2023)

From the Extreme Weather Resilience Plan, it is projected that by 2080, there will be increased frequency and intensity of precipitation in fall, winter and spring, which increases the risk of flooding due to high rain intensity and melting of snow. (City of Port Moody, Extreme Weather Resilience Plan, 2022)

Furthermore, there are longer dry spells in the summer, which increase the number of wildfire events, decreases frequency of precipitation in summer. These events result in poor air quality and haze. (City of Port Moody, Extreme Weather Resilience Plan, 2022)

Measures

To withstand the increasing heat in the future, City of Port Moody's municipal buildings are recommended to be equipped with air conditioning devices, such as split system or heat pump, to provide cooling in the municipal buildings. The buildings can further be adopted as cooling shelters during extreme heat events to serve residents in need.

For the increase of precipitation, the municipal buildings are recommended to consider rainwater harvesting, to store rainwater during extreme weather events, reduce the demand of the City's drainage system. Treated rainwater can then be used for irrigation and flushing water purpose.

To avoid poor air quality to enter the municipal buildings, filters at least MERV 13 are recommended at fresh air intakes, to filter pollutants and maintain a healthy indoor environment for the residents.

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Summary

City of Port Moody's Zero Emission Municipal Buildings Policy is recommended to adopt a carbon balance calculation method to cover buildings' emissions from cradle to grave. Net emissions of municipal buildings are calculated by the sum of operational carbon, embodied carbon, construction carbon minus avoided emissions.

Operational carbon includes both direct and indirect emission arise from normal operation of the municipal buildings. Measures such as energy modelling, airtightness testing and commissioning are also recommended to ensure the energy efficiency of the municipal buildings.

Embodied carbon mainly focuses on the material use, emissions from manufacturing and transportation to demolition and disposal, covers the whole life cycle of the building materials.

Construction carbon focuses on emissions and pollution during construction. Waste generated are recommended to be recorded and 80% diverted from landfill, to utilize materials use during construction. Projects are also recommended to implement pollution, erosion and sedimentation control plan to mitigate pollution from construction activities.

Avoided emissions can be achieved in 2 ways, exported green power and carbon offset. Municipal buildings which equipped with onsite renewable energy generation systems are able to reduce the emissions by exporting excess energy generated to the electricity grid. And carbon offset requires investment in high quality carbon offset projects.

Resilience is another key area recommended to be included in the Policy, City of Port Moody will be facing a hotter climate, increase in precipitation in fall, winter and spring and longer dry spells during summer. Measures targeting each type of events are recommended to be equipped in municipal buildings to provide a safe environment for the City's residents.

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References

Pacific Climate Impacts Consortium. (2023). *Weather Files Pacific Climate Impacts Consortium.* Retrieved from Pacific Climate Impacts Consortium: https://www.pacificclimate.org/data/weather-files

BC Housing. (2019). *Design Guidelines & Construction Standards.* Retrieved from BC Housing: https://www.bchousing.org/publications/BCH-Design-Guidelines-Construction-Standards.pdf

Canada Green Building Council. (2022, June). *Zero Carbon Building Performance Standard Version 2.* Retrieved from Canada Green Building Council: https://www.cagbc.org/wp-content/uploads/2022/06/CaGBC_Zero_Carbon_Building_Standard_v2_Performance.pdf

City of Abbotsford. (2022, June 7). *Attachment C - Green Buildings Policy (Final Draft).* Retrieved from Abbotsford - Document Center: https://abbotsford.civicweb.net/document/56969/

City of Port Moody. (2020`, July). *Port Moody Climate Action Plan July 2020.* Retrieved from City of Port Moody: https://www.portmoody.ca/common/Services/eDocs.ashx?docnumber=511721

City of Port Moody. (2022, August). *Extreme Weather Resilience Plan.* Retrieved from City of Port Moody: https://www.portmoody.ca/common/Services/eDocs.ashx?docnumber=590884

City of Vancouver. (2016, July 12). *Report - Zero Emissions Building Plan: 2016 Jul 12.* Retrieved from City of Vancouver: https://vancouver.ca/files/cov/zero-emissions-building-plan.pdf