



ASHRAE BC Chapter

November 2022 Meeting:
ASHRAE BC Building Sustainability &
Resilience Guide – The Three Pillars

Warrick Brown

Nathaniel Masters &

Charling Li

Agenda



- ▶ Introductions
- ▶ About the Guide
- ▶ Mitigation – Nathaniel Masters
- ▶ Adaptation– Warrick Brown
- ▶ Resilience – Charling Li
- ▶ Thank You / Q&A

Introductions



Warrick Brown

Vancouver Office Manager

ASHRAE BC Sustainability Chair



Nathaniel Masters

Sustainability & Energy Team Lead

Norman Disney & Young



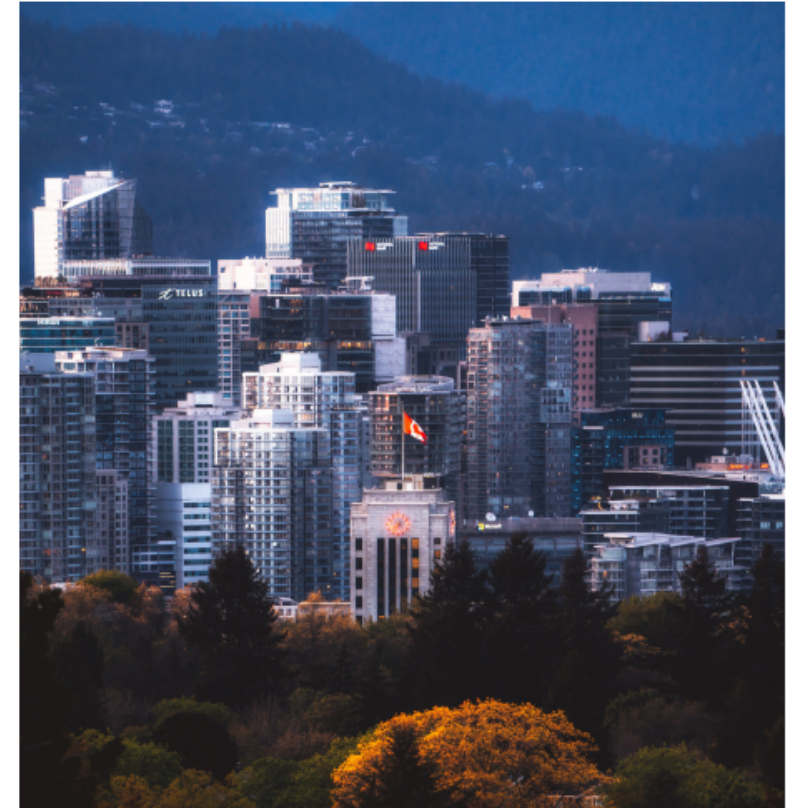
Charling Li

Green Building Engineer

City of Vancouver



Max Lauretta
ASHRAE BC Sustainability Chair
March 2020 – Dec 2021



BUILDING SUSTAINABILITY &
RESILIENCE GUIDE

A GUIDE OF MITIGATION, ADAPATION & RESILIENCE
STRATEGIES FOR BUILDING MECHANICAL SYSTEMS.
APPLICABLE TO BOTH NEW & EXISTING BUILDINGS.

Mitigation

Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behavior

United Nations Environment Program (UNEP)

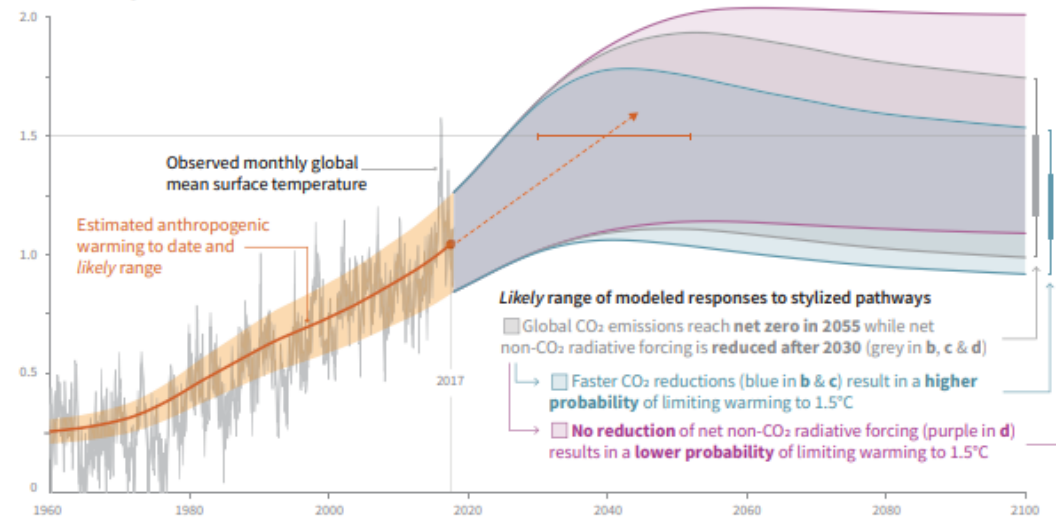


Nathaniel Masters
Sustainability & Energy Team Lead
Norman Disney Young

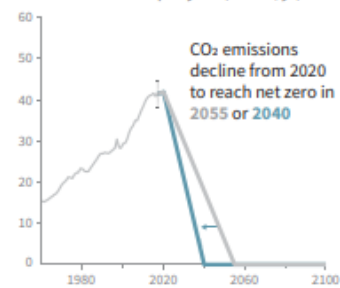
Mitigation

Setting the Stage

Global warming relative to 1850-1900 (°C)

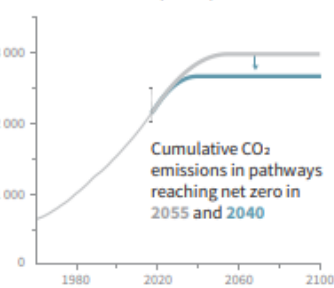


b) Stylized net global CO₂ emission pathways
Billion tonnes CO₂ per year (GtCO₂/yr)



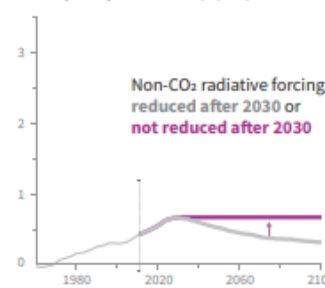
Faster immediate CO₂ emission reductions limit cumulative CO₂ emissions shown in panel (c).

c) Cumulative net CO₂ emissions
Billion tonnes CO₂ (GtCO₂)



Maximum temperature rise is determined by cumulative net CO₂ emissions and net non-CO₂ radiative forcing due to methane, nitrous oxide, aerosols and other anthropogenic forcing agents.

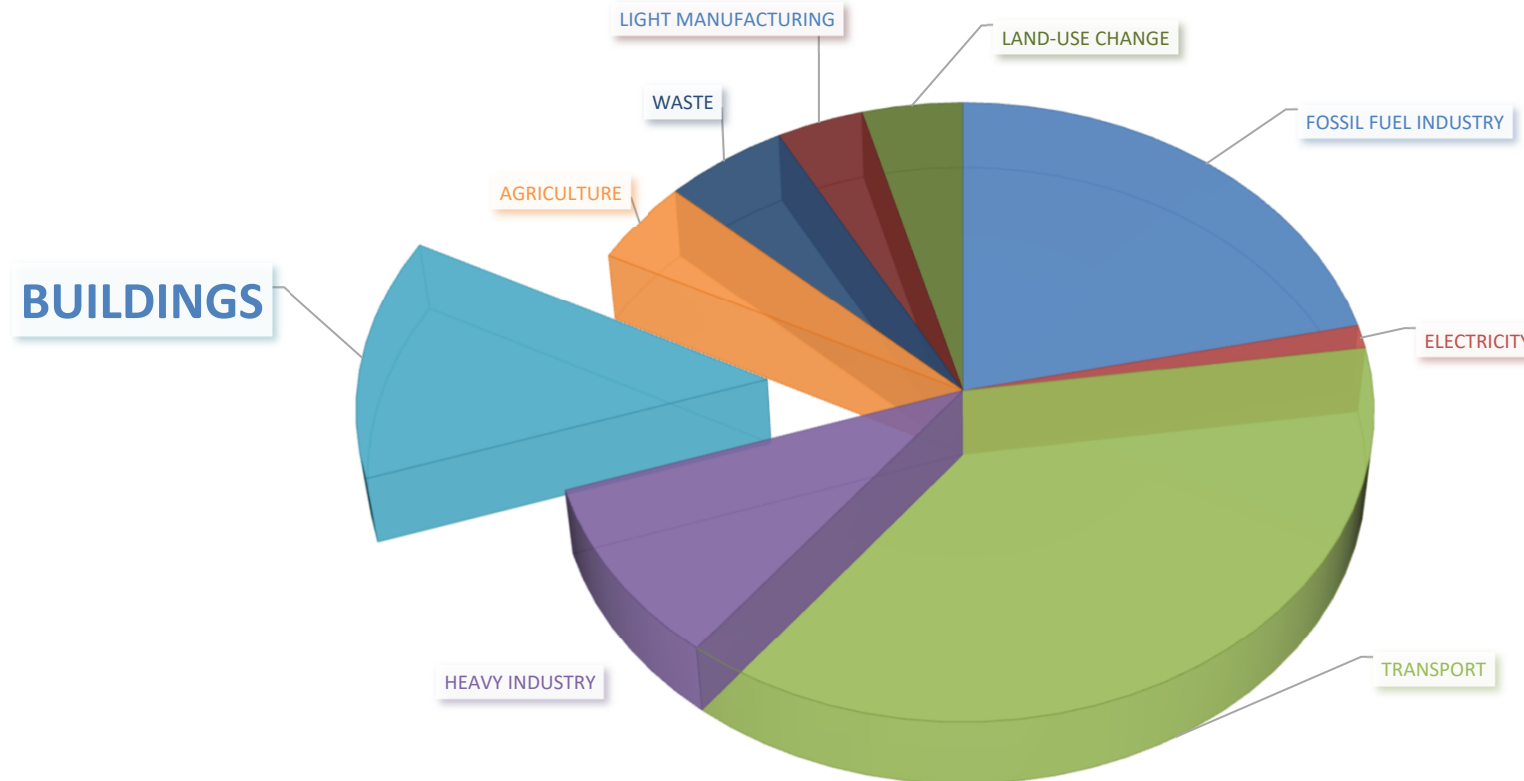
d) Non-CO₂ radiative forcing pathways
Watts per square metre (W/m²)



- ▶ Modelling sees us reaching beyond 1.5 °C as an average temperature increase
- ▶ Emissions targets and net zero future ready requirements are becoming mandated throughout the world
- ▶ Corporate ESG reporting policies require low / zero carbon operations / facilities.

Mitigation

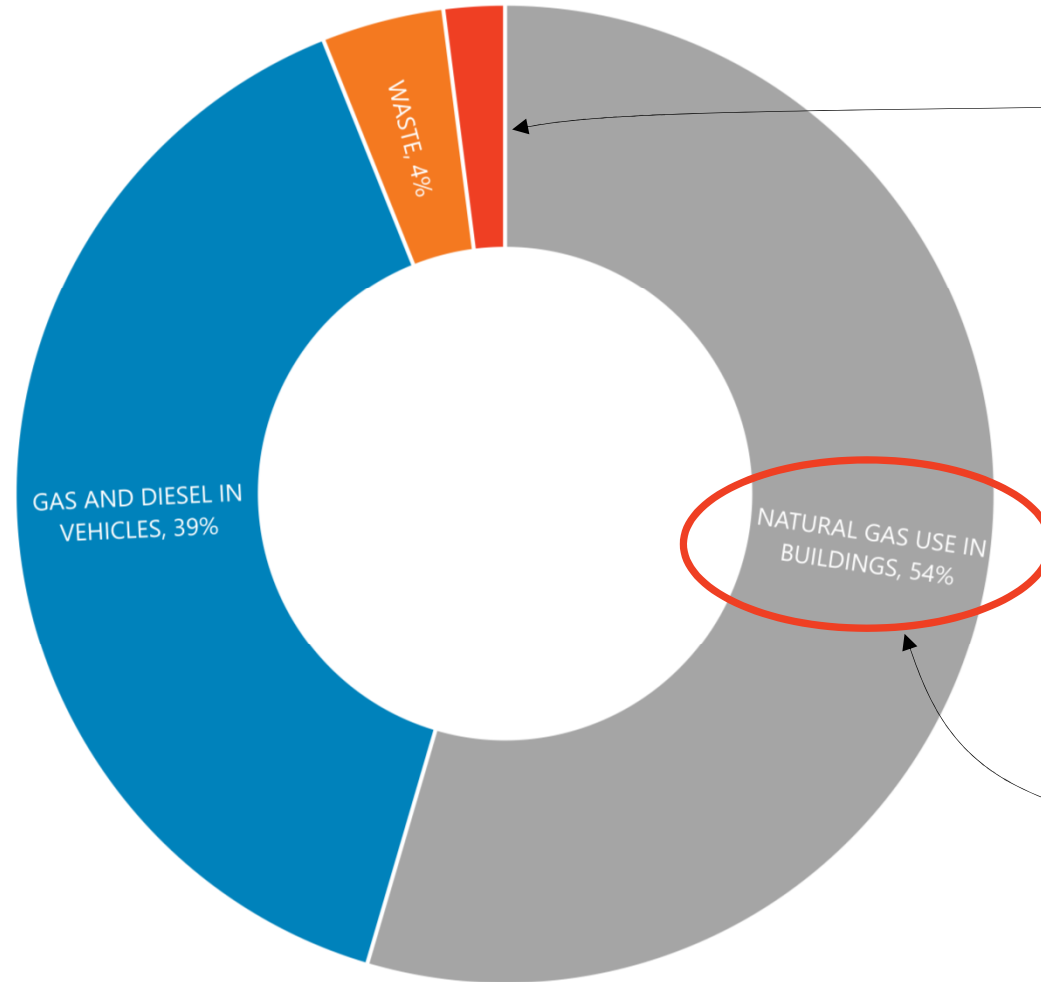
Local Context – Our Piece of the Pie





Mitigation

Local Context

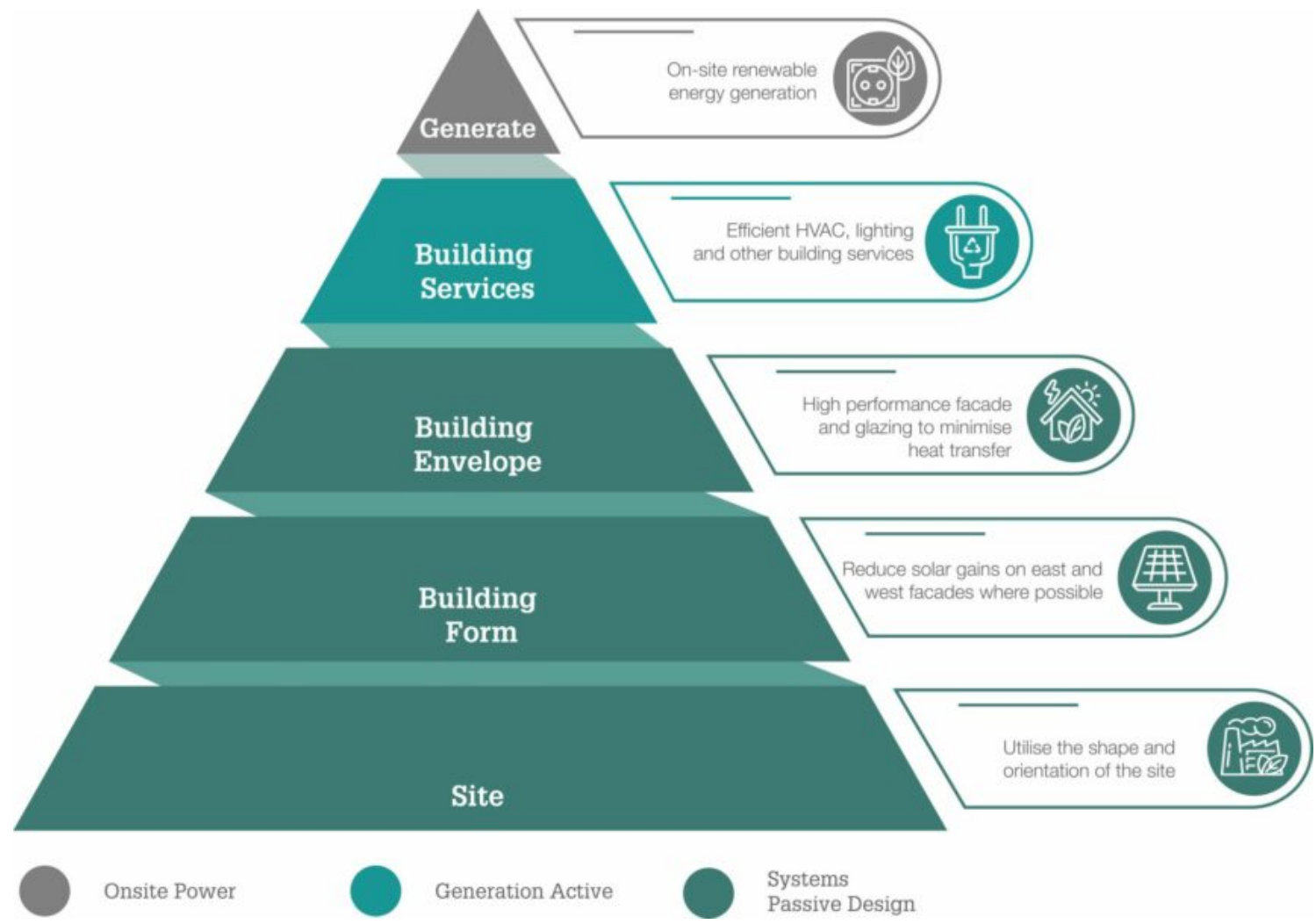


Electricity only accounts for 2% of Vancouver's GHG Emissions. BC's Electricity Grid is so Green!

Natural Gas in Buildings accounts for over 50% of the GHG Emissions in City of Vancouver!



Mitigation Design Hierarchy



Mitigation

BC Step Code



Figure 1: Definition of Lower and Upper Steps by building type (Part 9 and Part 3)

TEDI
(kWh/m²
per year)

Thermal Energy Demand Intensity

- ▶ Total heat required by a building
- ▶ Independent of building services systems efficiencies (except HRV or ERV)

TEUI
(kWh/m²
per year)

Total Energy Use Intensity

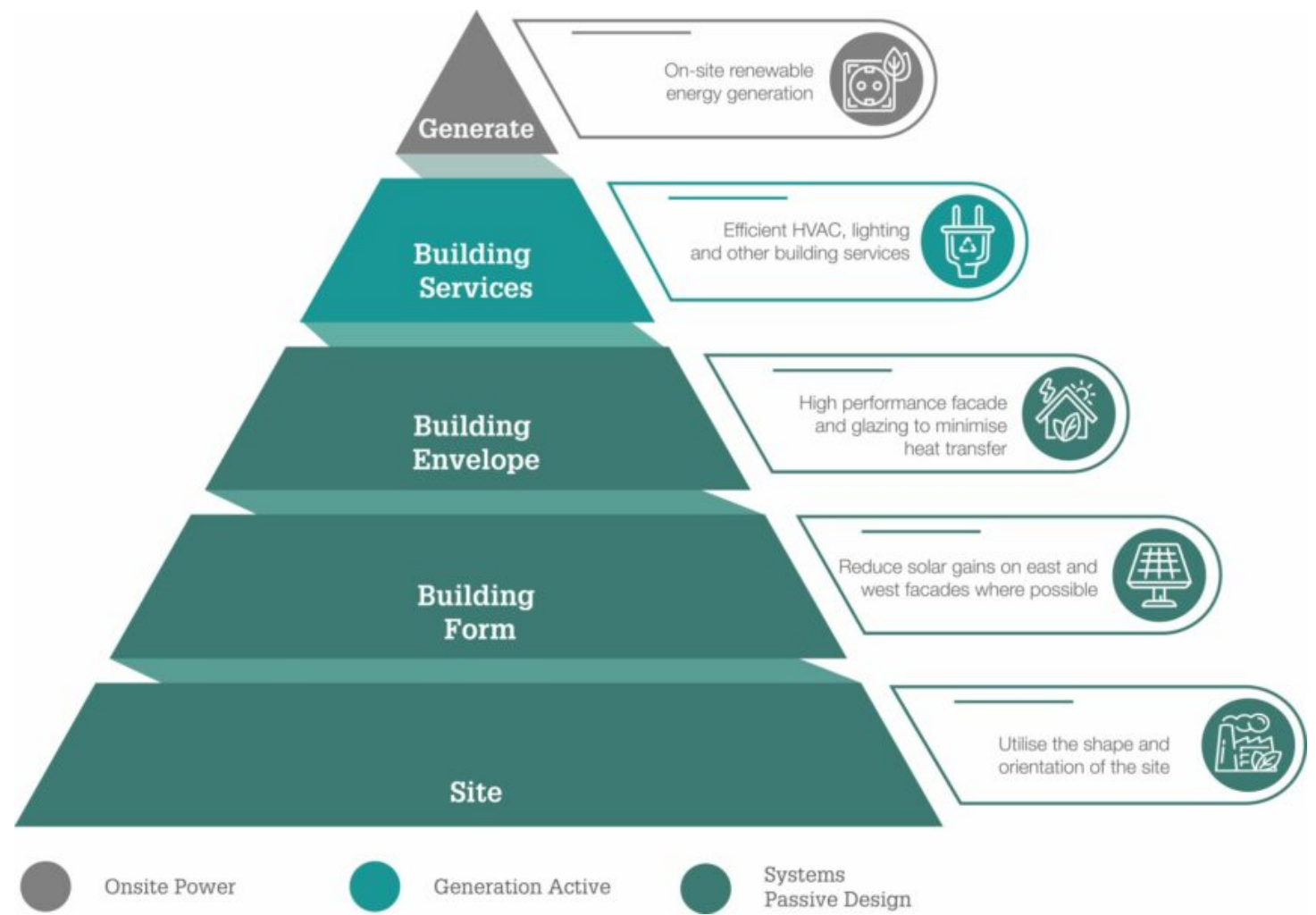
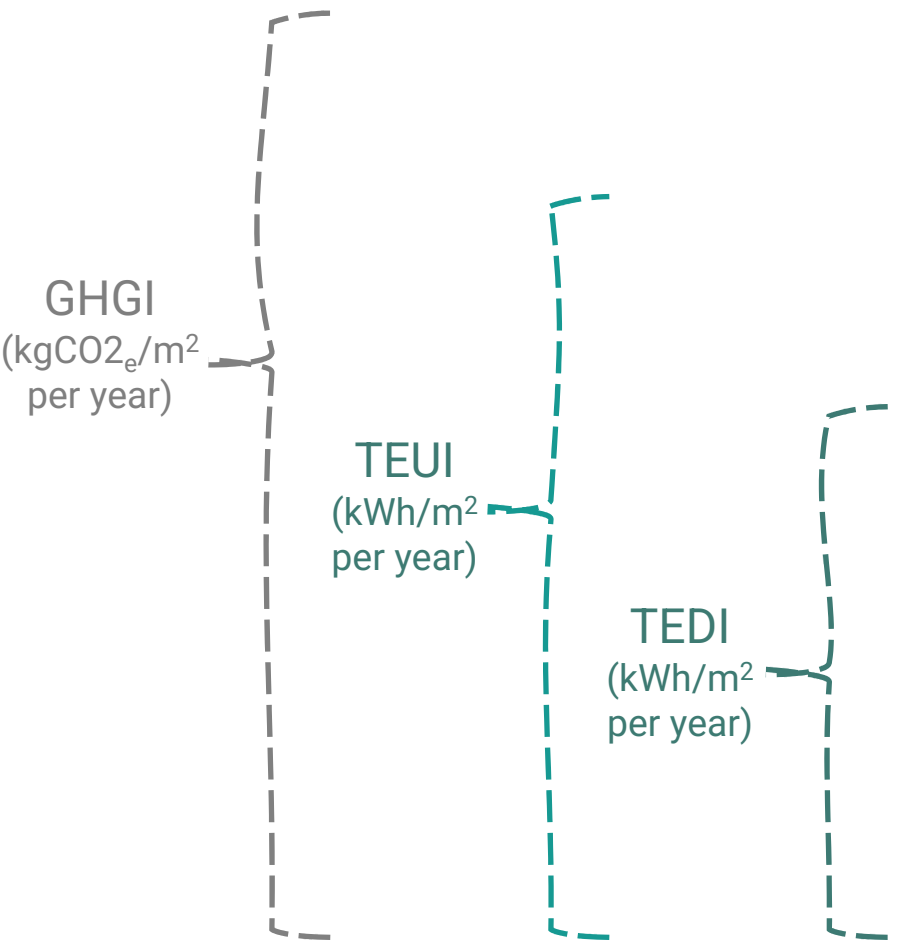
- ▶ Total energy required to operate a building
- ▶ Assisted by efficient systems (HVAC, lighting etc.)

GHGI
(kgCO_{2e}/m²
per year)

Greenhouse Gas Emissions Intensity

- ▶ Total GHG Emissions associated with operation of a building.
- ▶ Impacted by greenness of grid and renewable energy sources.

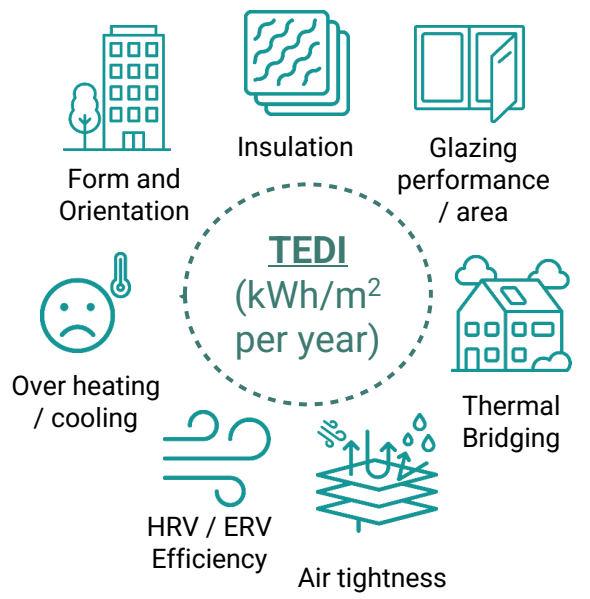
Mitigation Design Hierarchy



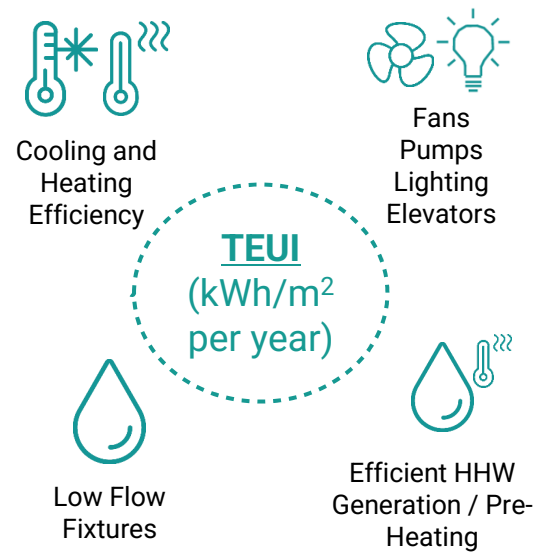


Mitigation BC Step Code

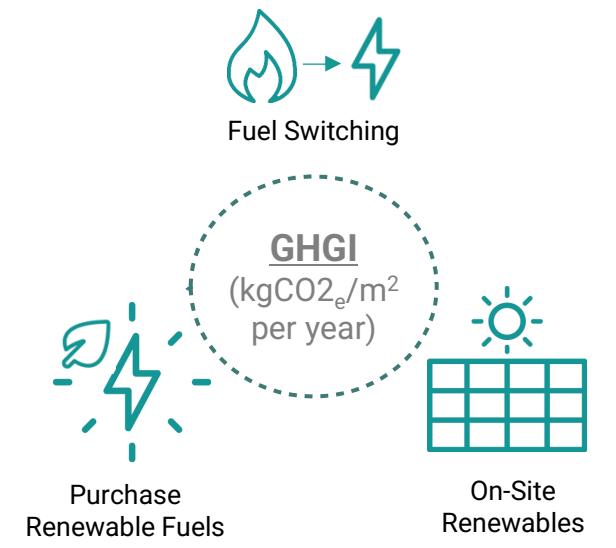
Passive Systems



Active Systems



Generation



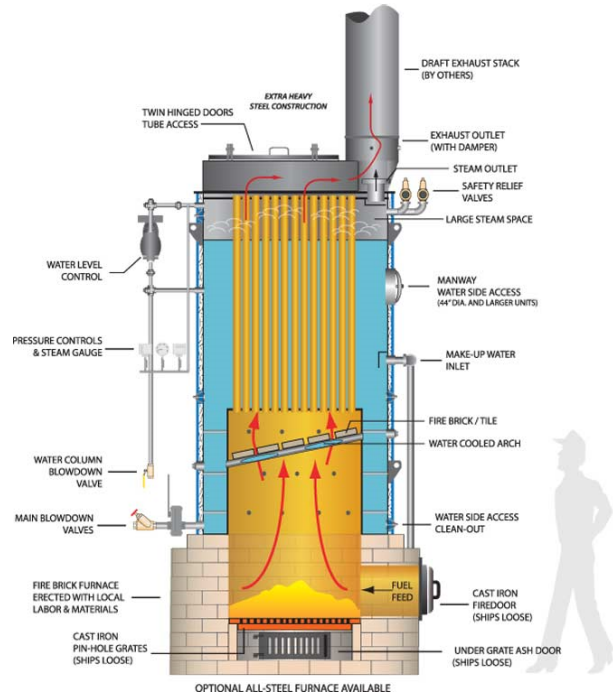
Mitigation

BC Step Code – Part 3 Residential – Wood Frame

Component	Step 2	Step 3	Step 4
<ul style="list-style-type: none"> Walls 	<ul style="list-style-type: none"> R-24 batt insulation 	<ul style="list-style-type: none"> R-24 batt insulation + 2" rigid continuous insulation 	<ul style="list-style-type: none"> R-30+ batt insulation + 2" rigid continuous insulation. Effective R-15 for envelope.
<ul style="list-style-type: none"> Roof 	<ul style="list-style-type: none"> R-30 continuous insulation or insulated roof joists. 	<ul style="list-style-type: none"> R-30 continuous insulation or R-20+ insulation between joists. 	<ul style="list-style-type: none"> R-40 continuous insulation or R-30+ insulation between joists.
<ul style="list-style-type: none"> Glazing 	<ul style="list-style-type: none"> U-0.32 50% WWR 	<ul style="list-style-type: none"> U-0.32 or better 40% WWR 	<ul style="list-style-type: none"> U-0.25 25% WWR
<ul style="list-style-type: none"> ERV / HRV 	<ul style="list-style-type: none"> Residential – ERVs with 65+% eff Offices may be exempted from HRV (case dependent) 	<ul style="list-style-type: none"> Residential – ERVs with 65+% efficiency Offices 75+% eff HRV or DOAS system 	<ul style="list-style-type: none"> Residential – ERVs with 65+% eff and 70+% apparent sensible eff.



Mitigation Electrification



Hurst Boilers

PM Engineer - Heat pump water heaters poised for growth in commercial markets

Mitigation

Key Takeaways

- ▶ Biggest impact can be made early in the design process when considering building form.
- ▶ TEDI – Thermal Energy Demand Intensity – How efficient is the building's form?
- ▶ TEUI – Total Energy Use Intensity – How efficient are the buildings systems?
- ▶ GHGI – Greenhouse Gas Intensity – The end goal. What are the building's emissions?
- ▶ BC's electricity grid is so green. Electrification is the key!

Adaptation

human-driven adjustments in ecological, social or economic systems or policy processes, in response to actual or expected climate stimuli and their effects or impacts



Warrick Brown

Vancouver Office Manager

ASHRAE BC Sustainability Chair



Adaptation

Change in Design Conditions

Winter	Summer
-7 ⁰ C	28 ⁰ C

Current 2.5% HVAC Design Conditions
Source – BC Building Code 2019 – Vancouver Location



Adaptation

Change in Design Conditions

Winter	Summer
-7 ⁰ C	28 ⁰ C

2021 – Metro Vancouver

Heat Dome – 4 Days in a Row Above 32⁰ C, Peak 34⁰ C

Coldest Day - 5 Days in a Row Below -8⁰ C, Peak -16⁰ C



Adaptation

2050 Projections - Summer

	Typical Now	2050
No. Days Above 25 ⁰ C	22	55
No. Days Above 30 ⁰ C	2	14
Hottest Day	31 ⁰ C	35 ⁰ C
1 in 20 Hottest Day	34 ⁰ C	39 ⁰ C

Source – Climate Projections for Metro Vancouver Report - 2016

Adaptation

Rainfall

- More Intense Rainfall
- Longer Droughts

Months-long drought on B.C.'s Sunshine Coast prompts water ban, climate anxiety

NANCY MACDONALD >

SUNSHINE COAST

PUBLISHED OCTOBER 18, 2022

UPDATED OCTOBER 19, 2022



Adaptation

Bushfires

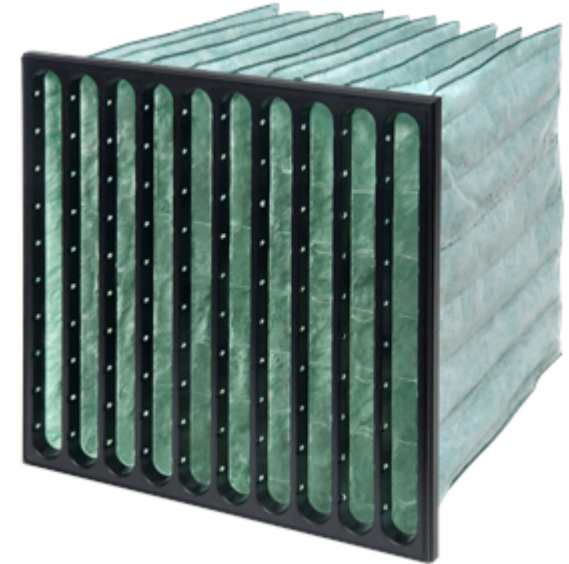
News

Is B.C.'s 2021 wildfire season the worst on record?

- No – 2017 and 2018 were worse
- The three worst years on record happened in the last 6 years

Adaptation

Airborne Pathogens



- Latest ASHRAE advice – MERV 13 Filtration Minimum
- MERV 9 Typical
- Increased Airflows Above ASHRAE Minimum – Encouraged by WELL and LEED Building rating systems

Adaptation

Major Weather Events

- Hurricanes, Floods, Earthquakes
- Loss of Grid Power



At its peak, about 90 per cent of the utility's electrical system -- or about 82,000 customers -- lost power due to Fiona.

Adaptation

REV 1

AUGUST 2022



BUILDING SUSTAINABILITY & RESILIENCE GUIDE

A GUIDE OF MITIGATION, ADAPATION & RESILIENCE STRATEGIES FOR BUILDING MECHANICAL SYSTEMS. APPLICABLE TO BOTH NEW & EXISTING BUILDINGS.

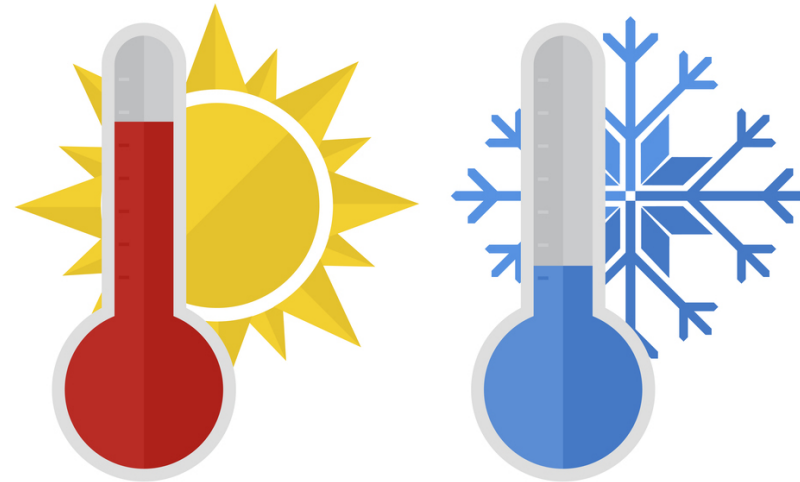
Adaptation

- Consider going above and beyond minimum requirements for design of
 - Heating and Cooling
 - Outside Air
 - Stormwater systems
 - Insulation and glazing performance



Adaptation

- Ensure equipment can operate in more extreme conditions
 - -20⁰ C for Heating
 - 45⁰ C for Cooling



Equipment will derate at these conditions but still provide some relief



Adaptation

- Whilst you may not design for 2050 conditions today consider upsizing the following
 - Plant spare space (transformers/heat pumps/chillers)
 - Piping and pump infrastructure
 - Heat exchangers and make up air units
 - Cable infrastructure or space for additional cables
 - Space for retention tanks

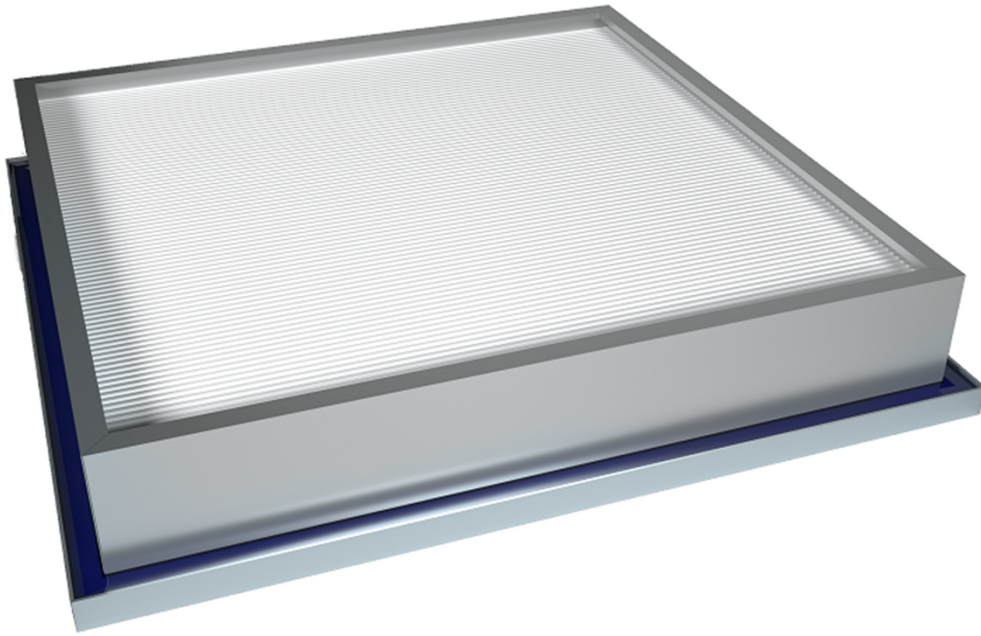
Adaptation

- In areas of high risk, consider systems that;
 - Don't use water
 - Have generator backup



Adaptation

- Use Merv 13 filters as minimum, and include fan allowances and space for additional filters (carbon or HEPA) to use temporarily



Resilience

Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events



Charling Li

Green Building Engineer

City of Vancouver

Agenda



1. Approved Green Building Changes to Policy and VBBL for Part 3 New Construction
2. Regulations for Existing Commercial & Multi-family Buildings

Context

4

ZERO EMISSIONS SPACE
AND WATER HEATING

By 2030, the carbon pollution from buildings will be cut in half from 2007 levels.

5

LOW CARBON MATERIALS
AND CONSTRUCTION
PRACTICES

By 2030, the embodied carbon from new buildings will be 40% less than 2018 levels.

New Construction:

- Green Building Policy for Rezonings (effective May 18 2022)
- Vancouver Building By-law (effective July 2023 and January 2025).

Existing Buildings:

- New GHG Limits By-law approved July 2022
- Existing energy upgrade triggers repealed Nov 2022



1) Approved Green Building Changes for Part 3 New Construction

Approved Changes



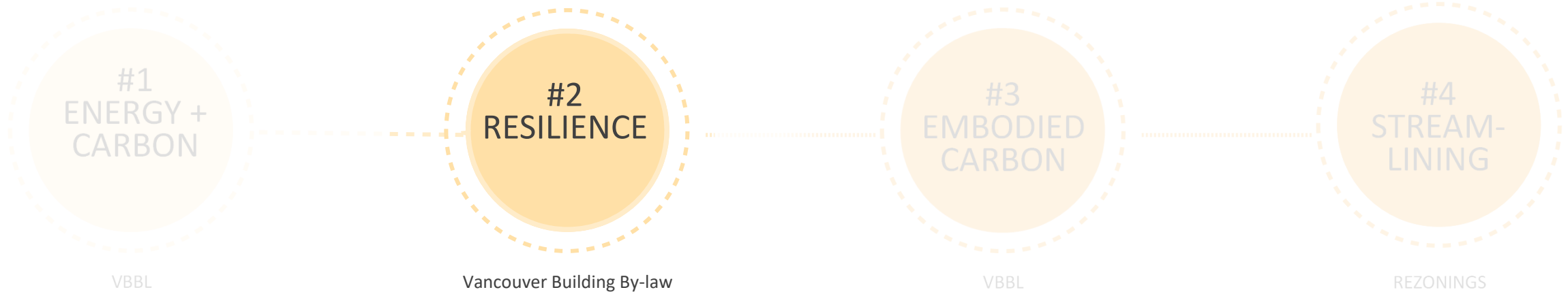
Effective July 2023

- 4-6 story residential occupancies: GHGI = 3
- For industrial/care/assembly (Group A, B, F major occupancies): 50% lower than the GHGI of the reference building modelled using only fossil-fuel systems

Effective Jan 2025

- 7+ storey residential occupancies: GHGI = 3
- Hotel & motel occupancies: GHGI = 4
- Include refrigerant impact (GHGI-R) in calculation of whole building GHGI limit
- For industrial/care/assembly (Group A, B, F major occupancies): 85% lower than the GHGI of the reference building modelled using only fossil-fuel systems

Approved Changes



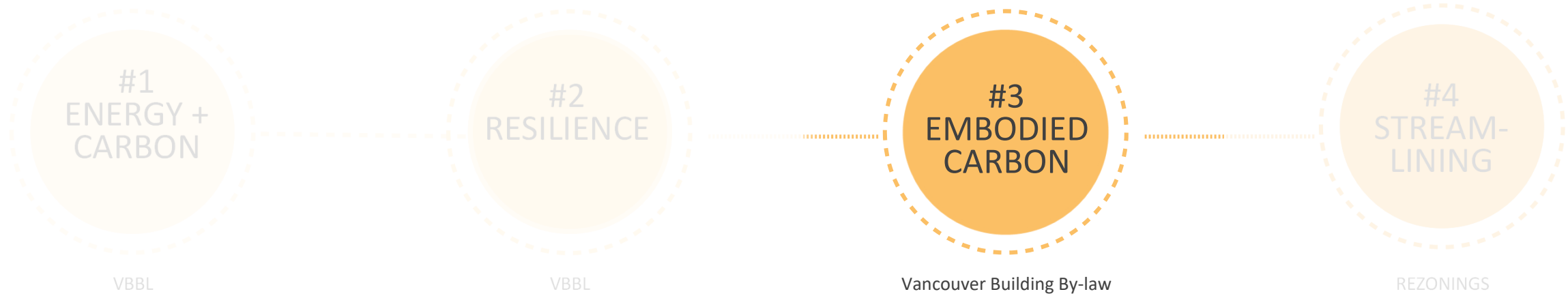
Effective July 2023

- MERV 13 filtration is required prior to introduction of outdoor air into indoor occupied spaces

Effective Jan 2025

- 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.

Approved Changes



Effective July 2023

- Report whole-building embodied carbon impacts that must not be more than double that of a functionally equivalent baseline (created based on new COV Embodied Carbon Guidelines)

Effective Jan 2025

- 1-6 storey buildings that can be built with wood or mass timber: 20% embodied carbon reductions compared to baseline
- All other buildings: 10% embodied carbon reductions
- All new Part 3 buildings: meet one responsible source materials category, **OR** double the minimum embodied carbon reductions noted above

Approved Changes



Effective May 18, 2022

Streamlined Process: submissions at rezoning application stage only*

*refer to [Green Buildings Policy for Rezoning – Process and Requirements](#)

Implementation supports in progress



VBBL

VBBL

VBBL

REZONINGS

NEW Energy & Emissions Design Report

NEW Resilient Buildings Planning Worksheet

NEW Embodied Carbon Guidelines

NEW Standardized submittals

UPDATE Energy Modelling Guidelines

NEW Embodied Carbon Design Report

NEW Embodied Carbon Centre of Excellence

NEW Create case studies

2) Regulations for existing commercial + multi-family buildings

large commercial + multi-family



Detached homes + duplexes

78,800 homes

28% of total GHG's



Multi-Family Residential*

6,115 buildings

24% of total GHG's

*incl. rental, non-market, condos



Commercial

3,420 buildings

26% of total GHG's



Industrial

1,081 buildings

20% total GHG's

Approved policies



Approved policies



2024
COMMERCIAL
>100K ft²
250 buildings

2025
COMMERCIAL
>50K ft²
MULTI-FAMILY
>100K ft²
800 buildings

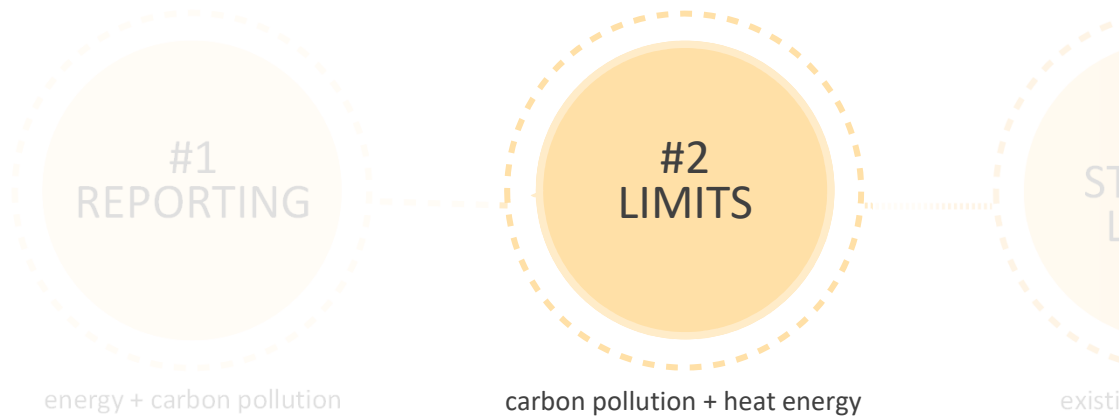
2026
MULTI-FAMILY
>50K ft²
450 buildings

BIG MOVE

4

COMMERCIAL + MULTI-FAMILY

Approved policies



OFFICE + RETAIL
>100K ft²
2026 limits
~45 buildings
Office: 25 kg CO₂e/m²/yr
Retail: 14 kg CO₂e/m²/yr

2040 limits
~175 buildings
GHGI: 0 kg CO₂e/m²/yr
HEL: 0.09 GJ/m²/yr

CITY OF VANCOUVER BRITISH COLUMBIA



ANNUAL GREENHOUSE GAS AND ENERGY LIMITS BY-LAW NO. 13472

This By-law is printed under and
by authority of the Council of
the City of Vancouver

July 20, 2022



Approved policies



ALL BUILDINGS
except 1+2 family
homes

Nov 2022
repealed existing building energy
upgrade requirements
VBBL part 11

BIG MOVE

4

COMMERCIAL + MULTI-FAMILY

Approved policies



2024
recommendations
to Council to achieve 2030 target

COMMERCIAL REGs
limits for smaller + more commercial types
prescriptive requirements

MULTI-FAMILY REGs
2030 limits + prescriptive requirements



Approved policies



MULTI-FAMILY
-early reporting incentive
-pilot cooling/heat pump program

COMMERCIAL
- tune-up program
- 2040 retrofit planning + concierge service

Thank you!

Website:

<http://www.ashraebc.com/resources>

<http://vancouver.ca/zeroemissions>

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Contacts

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