2022

# Technical Review: Step Code and Carbon Pollution Standard

Charting a Path to Net Zero Emissions Buildings in the Victoria Region


July 5, 2022

CITY OF VICTORIA

Saanich

Central Saanich

CRD

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# 1.0 Introduction

This technical review summarizes the qualitative and quantitative data that was compiled and analyzed to inform the proposed Step Code and Carbon Pollution Standard adoption pathway. This is a supplement to the engagement process that was undertaken. This technical review includes background information on the BC Energy Step Code and carbon pollution standards, a discussion of Step Code policy adopted by other BC local governments, a discussion of related Provincial policy that will have impacts on new construction, an overview of local Council Direction and the impact of such legislation on local greenhouse gas (GHG) emissions models and targets, an analysis of building permits data, and a summary of a Provincial modelling and costing study. Each section contributes to the body of knowledge that informs the Step Code and carbon pollutions standards adoption approaches being taken by local governments in the Capital Regional District. This is a companion document to the *Final Engagement Report: Step Code and Carbon Pollution Standards, July 2022,* which summarizes the industry engagement conducted.

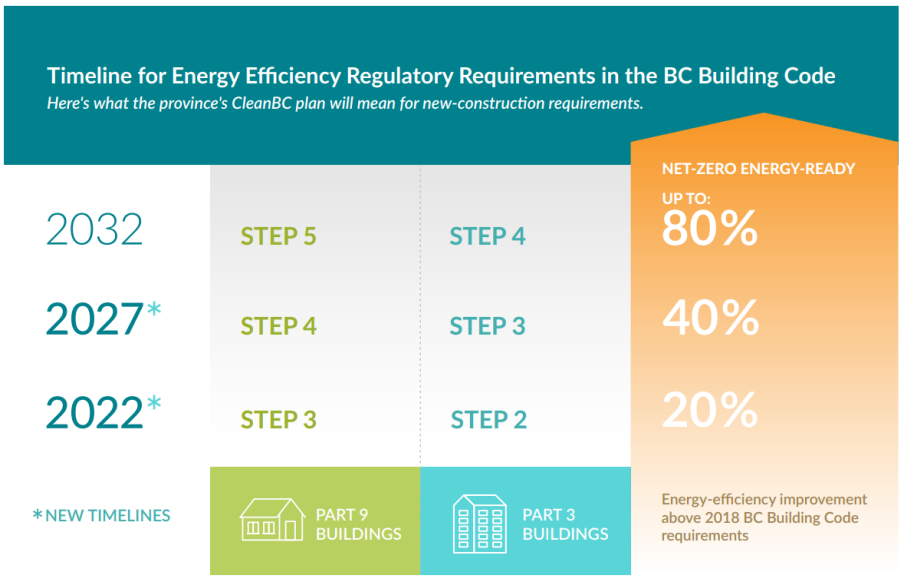
# 2.0 BC Energy Step Code and Provincial Policy

The BC Energy Step Code is an optional compliance path in the BC Building Code that local governments may use to require a level of energy efficiency in new construction that goes above and beyond the requirements of the BC Building Code[1]. The Step Code is divided into two main segments, Steps that apply to Part 9 Residential buildings (single family dwellings, duplexes, triplexes, townhouses, and laneway homes), and Steps that apply to Part 3 buildings (multi-unit, commercial, mixed use, office, and hotels).

For Part 9 residential buildings, there are five 'Steps' with each Step increasing energy efficiency beyond the standard code requirements. Buildings will be 10% more efficient at Step 2, 20% more efficient at Step 3, 40% more efficient at Step 4, and 80% more efficient at Step 5. For most Part 3 buildings there are four Steps. Buildings will be 20% more efficient at Step 2, 40% more efficient at Step 3, and 80% more efficient at Step 4. For all building types, Step 1 requires the measurement of energy efficiency, but no increased efficiency requirements. The steps for Part 9 and Part 3 buildings are outlined in Figure 1.

[1] energystepcode.ca

**Figure 1: Provincial Step Code Adoption Schedule**




## 2.1 Step Code Adoption in the Victoria Region

Several local governments in the Capital Region have adopted the Step Code. The current Step Code compliance requirements for the City of Victoria, District of Saanich and District of Central Saanich are outlined in Table 1 below.

**Table 1: Step Code Adoption in Victoria, Saanich and Central Saanich**

| Building Type | Compliance Requirement |
|---|---|
| Part 9 Buildings | Step 3 |
| Part 9 – 111.5 m2 or less* | Step 2 |
| Part 3 – residential wood frame building six stories or less | Step 3 |
| All other Part 3 Buildings | Step 2 |

*Central Saanich does not have this relaxation for small buildings

Based on considerable engagement and GHG modelling completed in the development of their respective climate plans, the Councils in the City of Victoria, District of Saanich and District of Central Saanich have set direction to staff to meet the following targets:

- Highest steps of the BC Energy Step Code by 2025
- 100% renewable energy and/or net-zero carbon in new construction by 2030
- 50% community-wide GHG emission reductions by 2030

The City of Victoria and District of Saanich have also directed staff to:

- Accelerate adoption of net-zero carbon new construction/quickly decarbonize new construction
- Integrate a carbon/GHG emissions cap into Step Code adoption
- Adopt the highest Steps of the Step Code by 2025 (in the City of Victoria this is for most buildings and then 2027 for some part 3 buildings)

## 2.2 Step Code Policy and Adoption in BC

There are a wide variety of approaches that have been taken by local governments to adopt the Step Code in BC. Several jurisdictions have adoption schedules that reach the highest steps for the most common building types. It is common for building bylaws to include schedules that indicate future adoption dates for the highest steps for all part 9 residential buildings, and all part 3 residential buildings (below 6 stories). While some jurisdictions have adoption dates in bylaw for all building types, most jurisdictions do not have specific dates for the highest steps for buildings such as garden suites, residential buildings over 6 stories, and buildings with business, personal service and mercantile occupancies.

Several jurisdictions have adopted an approach that requires higher or highest steps of the Step Code but allows for an optional lower steps to be met for buildings built with a low carbon energy system (LCES). The definition of a LCES varies, most common is a specific greenhouse gas emissions intensity (GHGi) score, 3 or 6 kg/$m^2$/year are both currently in use. Surrey allows connections to their district energy system as a LCES, Richmond includes an absolute $tCO_2e$/year as a secondary definition.

Details related to Step Code and LCES adoption schedules for various BC jurisdictions are outlined in Tables 2 – 9 below.

**Table 2: City of Surrey Step Code Adoption[2]**

| *Buildings Type* | Building Bylaw | | Future Anticipated | |
|---|---|---|---|---|
| | Apr. 1, 2019 | Jan. 1, 2021 | 2023 | 2025 |
| *Part 9 Residential* | Step 1 | Step 3 | Step 4 | Step 5 |
| *Part 3 Residential* | Step 3 or Step 2 with LCES* | | Step 4 or step 3 with LCES* | |
| *Part 3 Group D&E* | Step 2 | | Step 3 | |

**LCES defined as GHGi @max. 6 kg/m2/yr.*

**Table 3: City of North Vancouver Step Code Adoption**

| *Buildings Type* | Building Bylaw | |
|---|---|---|
| | July 1 2018 | July 1 2021 |
| *Part 9 Residential* | Step 3 | Step 5 or Step 3 with a LCES* |
| *Part 3 Residential* | Step 3 or Step 2 with LCES* | |
| *Part 3 Groups A & B* | Step 1 | |
| *Part 3 Group C* | Step 3 | |
| *Part 3 Groups D&E* | Step 2 | |

**LCES defined as GHGI @ max of 3 kg/m2/yr*

**Table 4: City of Burnaby Step Code Adoption[3]**

| *Buildings Type* | Current Requirements |
|---|---|
| *All Part 9 Buildings* | Step 1 |
| *All Part 3 Buildings* | Step 1 |
| *Part 3 projects that require a rezoning* | Step 3 OR Step 2 with a low-carbon energy system and greenhouse gas emission limits |

[2] City of Surrey Builder session presentation, December 8, available at: https://www.surrey.ca/sites/default/files/media/documents/BuildersessionDec8withspeakernotes.pdf, and BC Energy Step Code for New Buildings, City of Surrey, available at https://www.surrey.ca/renovating-building-development/green-buildings/bc-energy-step-code-for-new-buildings

[3] City of Burnaby Green Building & Land Development webpage, available at https://www.burnaby.ca/services-and-payments/construction-and-renovation/green-building-and-land-development

**Table 5: City of New Westminster Part 9 Step Code Adoption[4]**

| ***Part 9 Residential*** | **January 1, 2020** |
|---|---|
| *Single- or Two-*Family *Dwellings* | Step 3 |
| *Laneway and Carriage Dwellings* | Step 2 |
| *Townhomes and Apartment Buildings up to three floors* | Step 3 |

**Table 6: City of New Westminster Part 3 Step Code Adoption**

| ***Part 3 Multi-Family Residential*** | **January 1, 2020** |
|---|---|
| *Group C – Residential Occupancies 6 stories or less and combustible construction*<br><br>*Group C – Residential Occupancies over 6 stories or non-combustible construction*<br><br>*Hotels / Motels* | Step 3 OR Step 2 with approved Low Carbon Energy System* |
| *Offices (Personal and Personal Services)*<br><br>*Other Group D and E Occupancies (Mercantile)* | Step 2 |

**"Low Carbon Energy System" means the space heating, cooling and domestic hot water heating mechanical systems in a building that is supplied energy through a connection to a district energy utility, or a building-scale or site-scale thermal energy system, that is designed to meet a minimum of 70% of the building's annual heating, cooling and domestic hot water from a renewable energy source, as approved by the City.*

[4] City of New Westminster Building Bylaw No. 8125, 2019, available at: https://www.newwestcity.ca/database/files/library/Consolidated_Bylaw_8125__2019_Building.pdf

**Table 7: City of Richmond Part 9 Step Code Adoption[5]**

| | Current Bylaw | Proposed Bylaw | Future Amendments | | |
|---|---|---|---|---|---|
| | Dec. 2020 | July 2022 | July 2023 | Jan. 2025 | Jan 2027 |
| *Single Family Dwellings, Duplexes and Multiplexes including townhomes and Apartments* | Step **3** *-or-* Step **2** + LCES <6kg/m$^2$ | Step **5** *-or-* Step **4** *-or-* Step **3**+ LCES <2.5kg/m$^2$ | Step **5** + BC GHGI: Mid Carbon *-or-* Step **4** + BC GHGI: Low Carbon *-or-* Step **3** + BC GHGI: Zero Carbon Ready | Step **5** + BC GHGI: Low Carbon *-or-* Step **4** + BC GHGI: Zero Carbon Ready | Step **5** + BC GHGI: Zero Carbon Ready |

***Table 8*: City of Richmond Part 3 Step Code Adoption**

| | Current | Proposed | Future Amendments | | |
|---|---|---|---|---|---|
| | **Dec. 2020** | **July 2022** | **July 2023** | **Jan. 2025** | **Jan 2027** |
| *Office and Retail* | Step **2** | Step **3** *-or-* Step **2** + LCES | Step **3** + BC GHGI: *-or-* Step **2** + BC GHGI | Step **3** + BC GHGI: | Step **3** + BC GHGI: |
| *Residential: Wood Frame (mid-rise)* | Step **3** | Step **4** *-or-* Step **3** + LCES | Step **4** + BC GHGI: *-or-* Step **3** + BC GHGI | Step **4** + BC GHGI: | Step **4** + BC GHGI: |
| *Residential: concrete Frame* | Step **3** -or- Step **2** + LCES | Step **3** *-or-* Step **2** + LCES | Step **3** + BC GHGI: *-or-* Step **2** + BC GHGI | Step **4** + BC GHGI: *-or-* Step **3** + BC GHGI | Step **4** + BC GHGI: |
| *Hotels and Motels* | Step **3** -or- Step **2** + LCES | Step **3** *-or-* Step **2** + LCES | Step **4** + BC GHGI: *-or-* Step **3** + BC GHGI | Step **4** + BC GHGI: *-or-* Step **3** + BC GHGI | Step **4** + BC GHGI: |

[5] Source: May 9, 2022, General Purposes Committee Report: 2022 BC energy Step Code and GHG Requirements for New Buildings

**Table 9: District of West Vancouver Step Code Adoption[6]**

| *Building Type* | Current Standard |
|---|---|
| *Part 9 Buildings* | Step 5 or Step 3 with a LCES* |
| *Detached secondary suite (garden suite?)* | Step 5 or Step 2 with a LCES* |
| *Part 3 residential (multi-family and apartment buildings)* | Step 4 or Step 2 with a LCES* |
| *Part 3 for business and personal services or mercantile occupancies* | Step 2 |

*"Low Carbon Energy System" means a mechanical system providing all thermal conditioning and all domestic hot water heating for a building primarily from low-carbon energy sources with the following characteristics: (a) system seasonal average co-efficient of performance greater than two; (b) modelled Greenhouse Gas Intensity of no more than 3 kg CO2e/m2 /yr; and (c) any natural gas fired peak demand heating equipment is appropriately sized to augment the primary low carbon system under peak demand conditions;*

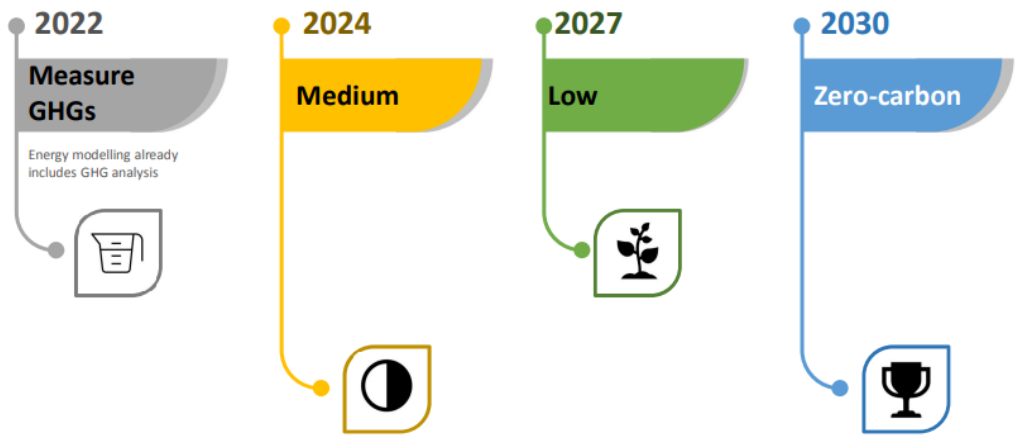
## 2.2 Related Provincial Targets from CleanBC

The 2018 CleanBC plan[7] and subsequent 2021 CleanBC: Roadmap to 2030[8] set the Provincial adoption schedule for the Step Code. The Roadmap to 2030 has accelerated the Provincial adoption of net zero ready regulation for all building types by 2 years, moving it to 2030. There is no indication if the intermediate steps will also be changed, so for the time being the original 2027 for Step 4 (part 9) Step 3 (part 3 residential) will be assumed to be the Provincial schedule.

There are several other policies in the Roadmap that will have a large impact on new construction and how the Step Code is implemented. First and foremost is the introduction of greenhouse gas emissions intensity (GHGi) targets. This GHGi is meant to cap emissions from new buildings and will be introduced via carbon pollution standards in the BC Building Code in 2022 (measure only), with mandatory requirements in 2024 that then phase to zero carbon by 2030 as outlined in Figure 2.

[6] District of West Vancouver BC Energy Step Code webpage, available at; BC Energy Step Code | District of West Vancouver
[7] CleanBC: our nature. our power. our future. (gov.bc.ca)
[8] CleanBC Roadmap to 2030 (gov.bc.ca)

**Figure 2: Anticipated Provincial GHGi for New Buildings Implementation Timeline**




Complimenting the GHGi is regulation that will require all new and replacement domestic hot water (DHW) and space heating equipment systems to be 100% efficient or better by 2030. While this will certainly encourage the installation of equipment like heat pumps, electric baseboards, and electric DHW heaters, it will allow natural gas/electric combination systems. When asked what this might look like, the Province provided the following clarification:

> *The most direct examples are residential dual fuel heat pumps and commercial hybrid rooftop units. Residential dual fuel systems consist of a central heat pump integrated with a gas furnace. Commercial hybrid rooftop units are package systems that include both a heat pump (instead of the DX Cooling component) and a gas furnace. In both cases the heat pump covers the majority of the heating load while the gas furnace provides the backup/peaking service.*
>
> *Beyond the above examples there is a variety of systems that could be considered "hybrids." We are working to define what will and won't be compliant. The metric is a system efficiency >= 100% and a significant reduction of emissions compared to current combustion technology (i.e., compared to a condensing furnace).*

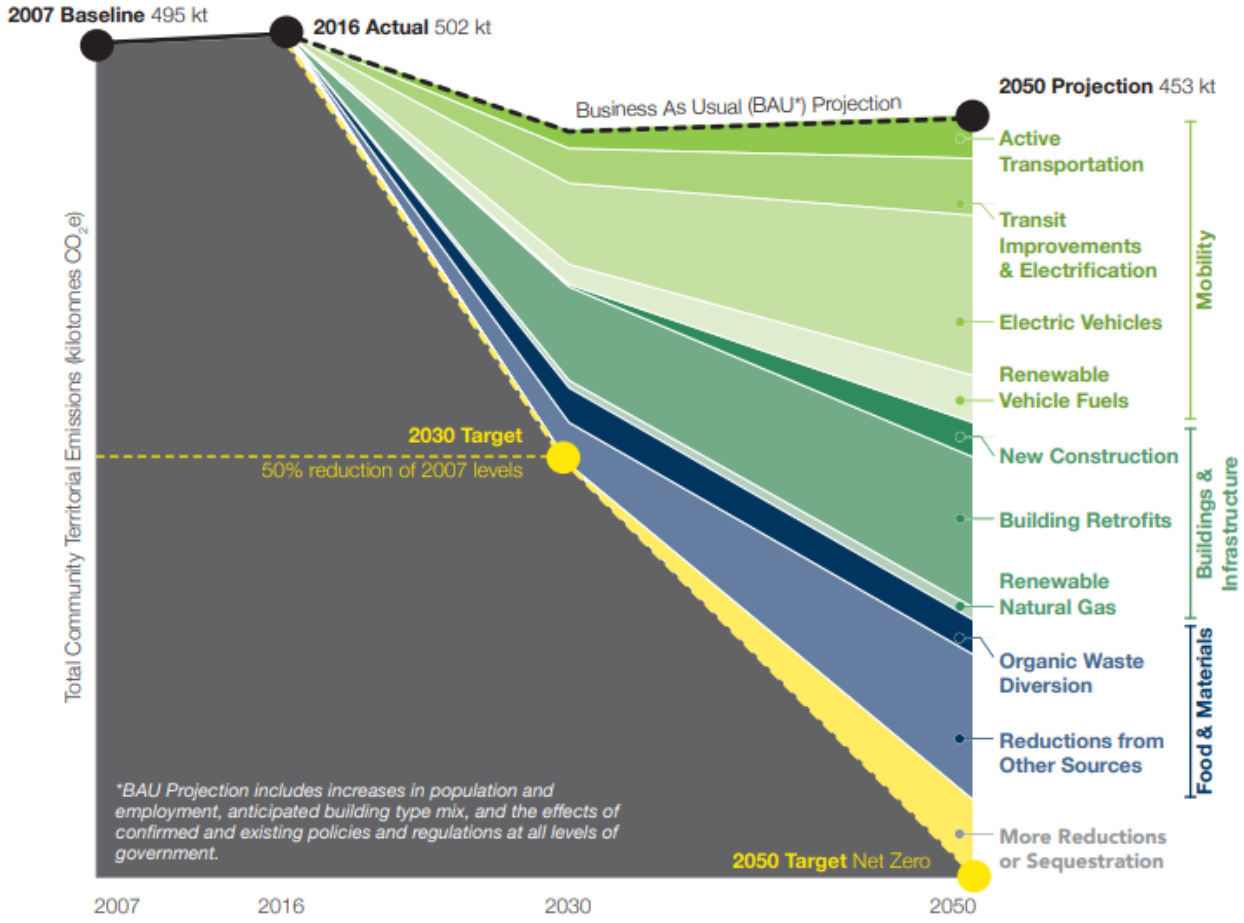
The following CleanBC Roadmap policy directions will also have an impact on new construction and the emissions from buildings generally, although they are unlikely to influence the course of Step Code adoption in the Victoria region:

- 15% of all gas used in BC to be RNG by 2030;
- 30% reduction in carbon from natural gas by 2030;
- Enhancing energy efficiency program;
- Introducing home energy labelling (believed to be focused on Part 9 buildings); and
- More low carbon building materials.

# 3.0 Community Emissions Modelling

Both the City of Victoria and District of Saanich conducted community energy and GHG emissions modelling as part of their Climate Plan development. This was necessary to understand and evaluate the types and magnitude of changes required to meet our territorial GHG emission reduction targets. The models (the model for the District of Saanich is shown in Figure 3) show that reaching our targets will require multiple strategies and transformative change, primarily in the areas of mobility and buildings. The Business as Usual (BAU) projection for Saanich indicates that only a 9% reduction in GHG emissions from 2007 levels would be achieved by 2050 if we were to adhere to existing and confirmed policies and regulations at time of adoption (2020). However, the target for 2050 is net-zero emissions.

**Figure 3: Modelled Pathway for Territorial GHG Emission reductions in Saanich**



The models are clear that every strategy must be implemented in order to come close to the 2050 emissions targets and, even then, more reductions and carbon sequestration is required. Over 23% of the emissions reductions in the Saanich model relate to building strategies and while much of this is associated with building retrofits, it is critical that all new construction converts to renewable energy and meets zero carbon standards by 2025 if our targets are to be achieved. Ensuring all new buildings use 100% renewable energy by 2025 represents 7% of total emissions reductions in 2050 for the City of Victoria and 4% in the District of Saanich. It is important to note that all new construction that uses fossil fuels adds to the overall emissions inventory and to the building stock that needs to be retrofitted in the near future to meet our targets. This can be much more costly to do via retrofitting rather than electrifying the development when it is initially built and owners/renters can face multiple barriers to retrofitting, particularly in multi-family buildings with strata boards. This also does not account for the additional waste and embodied carbon emissions involved with retrofitting and from the stranded assets associated with fossil fuel infrastructure such as natural gas connections.

While these models apply specifically to the District of Saanich and City of Victoria, the emissions modelling for other jurisdictions in the CRD would be similar.

# 4.0 Implications of the BC Step Code on GHG Emissions

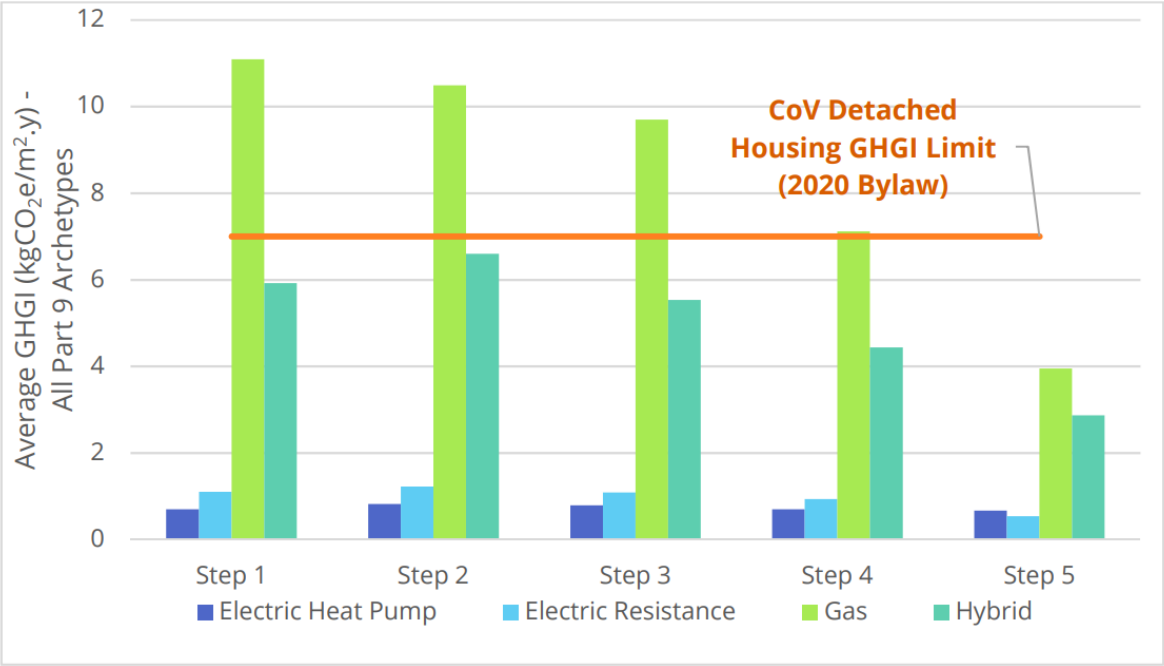
In June 2019, the BC Energy Step Code Council published a report entitled *"Implications of the BC Energy Step Code on GHG Emissions."*[9] This report sought to understand the relationship between the BC Energy Step Code efficiency standards and GHG emissions reductions.

Overall, the results of the study show that that while the Step Code is an effective tool for driving significant emissions reductions in select building types and configurations, it can nevertheless result in buildings that continue to emit significant emissions over their lifetime. In short, the Step Code's focus on energy efficiency does not guarantee the level of emissions reductions necessary to drive emissions to zero or near-zero levels. Building designers can pursue mechanical system options that result in significantly higher GHGis, potentially hampering the Province's ability to realize CleanBC's future vision of zero emissions buildings and local government climate targets. This is summarized in sections taken from the report and detailed below and in Figure 4:

- *While the energy efficiency of buildings is greatly improved, the implementation of the Step Code can nevertheless result in significant variations in the total GHGI of different building, even at higher steps. Depending on mechanical heating systems selected, GHGI varied by:*
    - *An average of 91% for Part 9 buildings, and*
    - *An average of 92% for Part 3 buildings.*
- *Even at the highest Steps, the Step Code does not require designers to select a low-carbon mechanical system – in other words, the energy efficiency targets set by the Step Code can be met using a range of mechanical systems.*
- *The Step Code drives emissions intensity reductions in gas-based systems, but electric-based systems offer very low GHGIs (around or below 1 kgCO2e/m2/year) independent of the Step achieved. To provide more detail on the findings above, GHGIs for Part 9 and Part 3 buildings by mechanical heating system are shown in the figures below (averaged across all archetypes). The City of Vancouver's GHGI targets are shown alongside each step to provide a context for a low-emissions building.*

[9] Implications of the BC Energy Step Code on GHG Emissions, Integral Group, June 2019, available at: https://energystepcode.ca/app/uploads/sites/257/2019/11/BC-Step-Code-GHGI-Report_Nov-2019.pdf

**Figure 4: Part 9 GHG Intensity by Mechanical Systems (average across all archetypes)**




# 5.0 BC Proposed carbon pollution standards

The Province of British Columbia is introducing greenhouse gas (GHG) reduction targets for new buildings into the BC Building Code, which local governments may reference in their building or zoning bylaws. These targets will enable local governments to regulate the emissions of new construction in their communities. The province released a bulletin outlining a draft of the regulation.

The Provincial bulletin provides an overview of the greenhouse gas reduction (GHG) targets, the Province's intentions and policies regarding the targets, and guidance for Authorities Having Jurisdiction who wish to implement the GHG targets.

The BC carbon pollution standards are new regulations that are expected to be added to the BC Building Code in December 2022[10]. It is expected to provide local governments with the ability to

[10] Provincial policy bulletin for reducing greenhouse gasses from new construction
A best practices bulletin for local governments and other Authorities Having Jurisdiction.
February 2022

limit GHG emissions from new construction. The BC carbon pollution standards will be available for municipalities to opt into, and are expected to have four levels:

1. Measure-only - requires measurement of a building's emissions without reductions, and is intended to build knowledge and capacity;
2. Medium carbon - in most cases, will require electrification of either space heating or domestic hot water systems;
3. Low carbon - in most cases, will require electrification of both space heating and domestic hot water systems; and
4. Zero-carbon - in most cases will require the full electrification of a building.

In practice the BC carbon pollution standard use a GHG intensity (GHGi) and total GHG emission maximums to achieve the stated intent of each threshold as outlined in Tables 10 -13 below.

## 5.1 Proposed Part 3 Carbon Pollution Standard Metrics

**Table 10: Proposed Part 3 Carbon Pollution Standards**

| (All GHGI targets in $kgCO_2e/m^2/year$) | Medium | Low | Zero Carbon Ready |
|---|---|---|---|
| **MURB** | 7 | 3 | 1.8 |
| **Office** | 5 | 3 | 1.5 |
| **Retail** | 6 | 3 | 2 |
| **Hotel** | 9 | 4 | 2 |

## 5.2 Proposed Part 9 Carbon Pollution Standards

**Table 11: Proposed Part 9 Carbon Pollutions Standards, GHG Base Allowance**

| | **GHG Base Allowance** *(ideal for small houses)* |
|---|---|
| | kg CO2e per unit |
| **Medium** | 1050 |
| **Low** | 440 |
| **Zero Carbon Ready** | 265 |

**Table 12: Proposed Part 9 Carbon Pollution Standards, GHG Intensity and GHG Maximum**

| | **Whichever emits less total GHG** | | |
|---|---|---|---|
| | **Building GHG Intensity** *(ideal for medium-sized houses)* | **OR** | **GHG Maximum Cap** *(limits emissions of the largest houses)* |
| | $kgCO_2e/m^2/year$ | | kg CO2e per unit |
| **Medium** | 6 | | 2400 |
| **Low** | 2.5 | | 800 |
| **Zero Carbon Ready** | 1.5 | | 500 |

## 5.3 Proposed Part 9 Carbon Pollution Prescriptive Standards

**Table 13: Proposed Part 9 Carbon Pollution Standards, Prescriptive Pathway**

| | Action |
|---|---|
| **Medium** | Decarbonize heat |
| **Low** | Decarbonize both heat and hot water |
| **Zero Carbon Ready** | Fully decarbonized building |

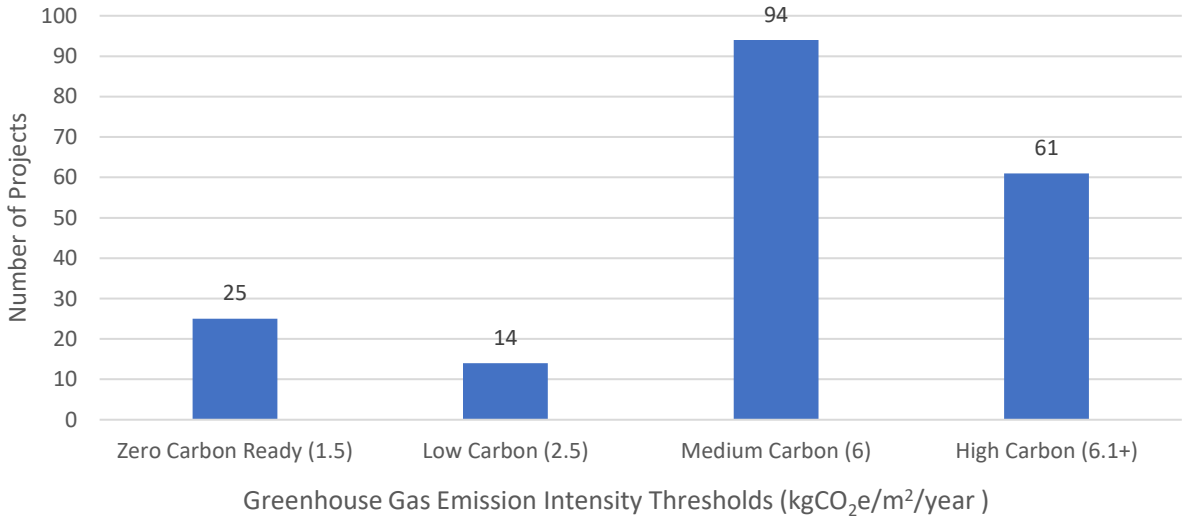
# 6.0 Building Permit Data Analysis

Energy models that have been submitted with building permits to the City of Victoria, District of Saanich and District of Central Saanich since the Step Code was adopted have been analysed to determine the relationship between the GHG intensities of buildings and the energy systems that are being installed. A strong correlation has been found between electrification of major building systems and lower GHG intensities. In all cases buildings that are fully electric meet or are very close to meeting proposed zero carbon ready standards. Conversely, buildings that use primarily natural gas are rarely able to achieve even the medium carbon standard. While not the majority, many buildings are being built fully electric by industry leaders in the region.

## 6.1 Modelled Greenhouse Gas Emissions Analysis

Greenhouse gas emissions (GHGs) are reported using both an absolute annual GHG emissions estimate for kg of $CO_2e$/year and a GHG emissions intensity (GHGi) which divides that number by the square meters of the building. This metric is reported as $kgCO_2e/m^2$/year and is the metric commonly used to limit emissions from new buildings. Chart 1 shows the emissions intensity scores reported for new part 9 buildings in the City of Victoria, District of Saanich, and District of Central Saanich since Step Code was adopted.

**Chart 1: City of Victoria, District of Saanich and District of Central Saanich Part 9 GHG Emissions Intensity Scores**



## 6.2 Mechanical Equipment Analysis

Energy used for space and water heating makes up on average 77% of energy use in a house; 52% for space heating and 25% for water heating. As shown in Chart 2, Air Source Heat Pumps (ASHP) and electric baseboards are the most frequently used heating equipment from the energy model analysis. Chart 3 shows electricity is the dominant energy source for space heat with 19 buildings (20%) using natural gas as the only fuel for heating.

**Chart 2: Space Heating by Equipment Type**

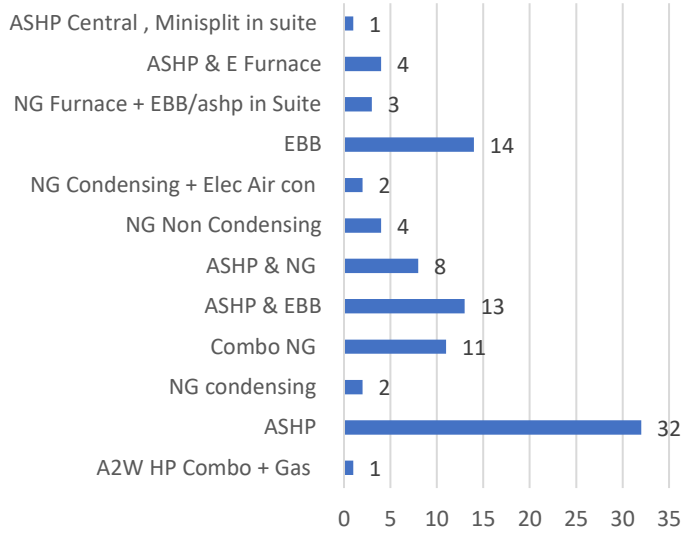
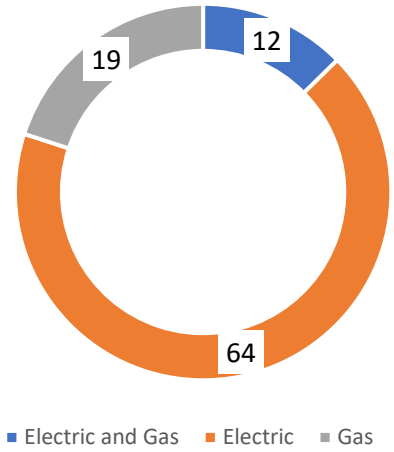



**Chart 3: Space Heating by Fuel Type**




Hot water is primarily provided by natural gas on-demand systems as shown in Chart 4 and Chart 5. Air-to-water heat pumps are rare (1), and just 14 electric tanks were installed based on the regional energy model analysis.

**Chart 4: Hot Water by Equipment Type**

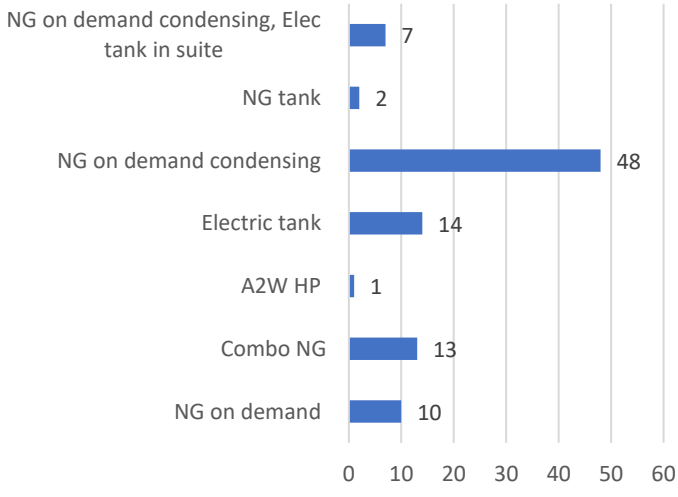
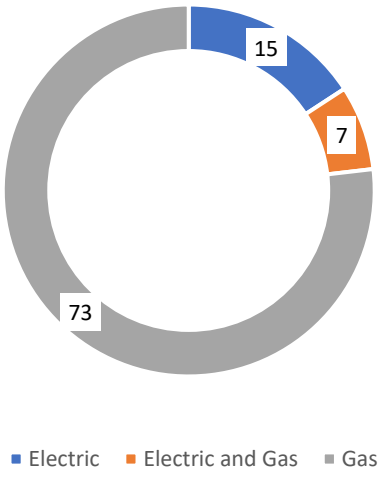


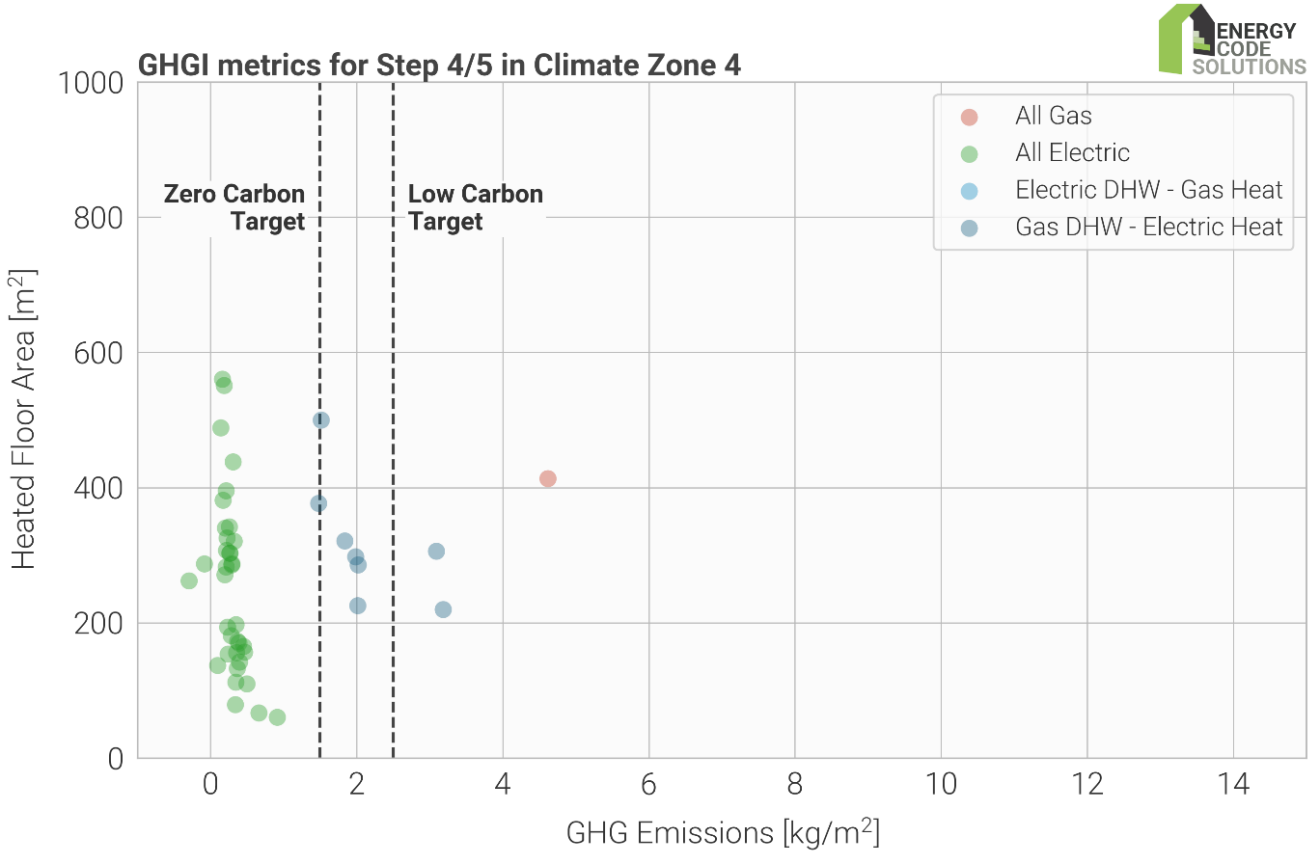

**Chart 5: Hot Water by Fuel Type**



## 6.3 Supplemental Data: Regional Step Code and GHGi Data

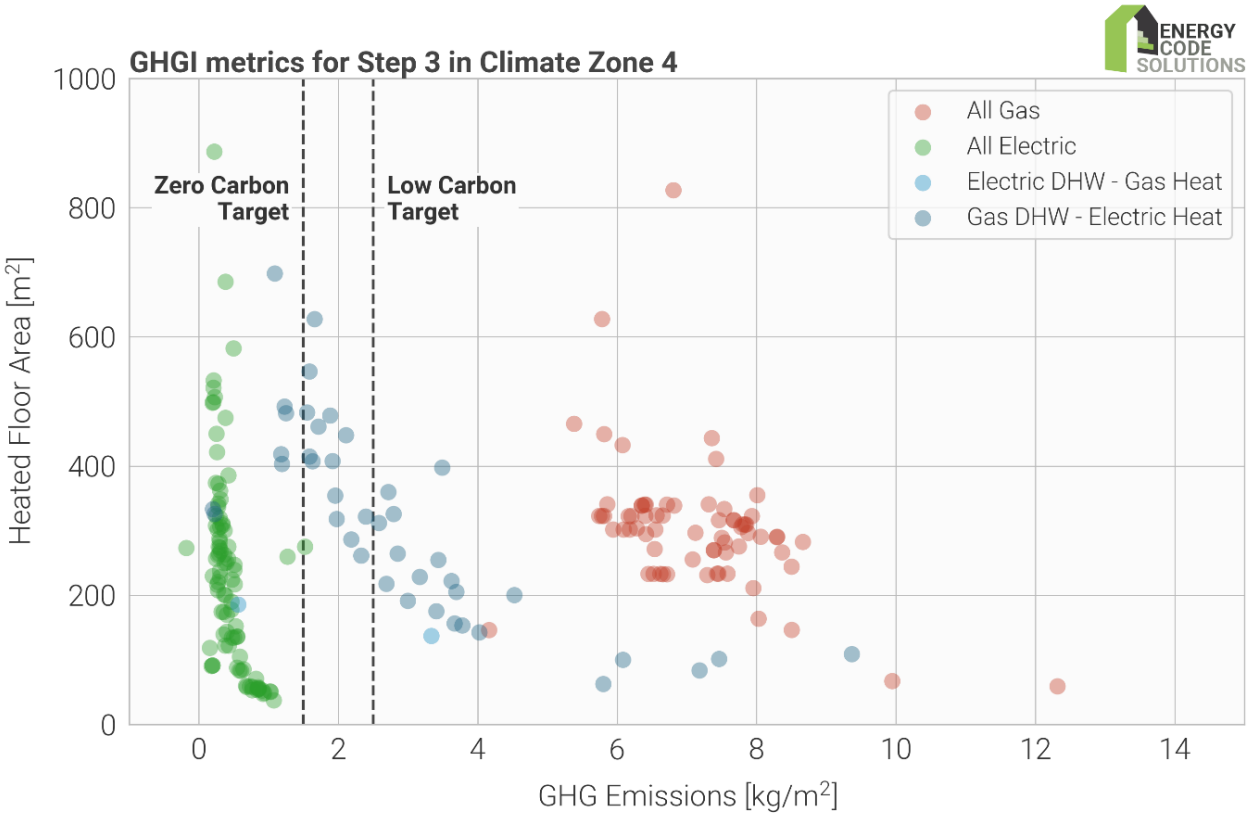
In addition to a review of regional data, analysis was also completed in June 2022 by Bernhardt Contracting Ltd. on the energy evaluations of 654 new home units within climate zone 4 in BC. This analysis is outlined in Charts 6 and 7 below and shows the relationship between mechanical system energy sources, the Step of the Step Code achieved, and GHG intensities. The dotted vertical lines indicate the GHGi limits being used in the draft carbon pollution standards for low and zero carbon targets. The data presented clearly shows the correlation between electric systems and low GHGi with many units being designed and built with all electric systems and meeting the zero carbon targets.[11]

**Chart 6: GHGi Metrics for step 4/5 new Part 9 units in Climate Zone 4**




[11] Data provided via email by Bernhardt Contracting

**Chart 7: GHGi Metrics for Step 3 new Part 9 units in Climate Zone 4**

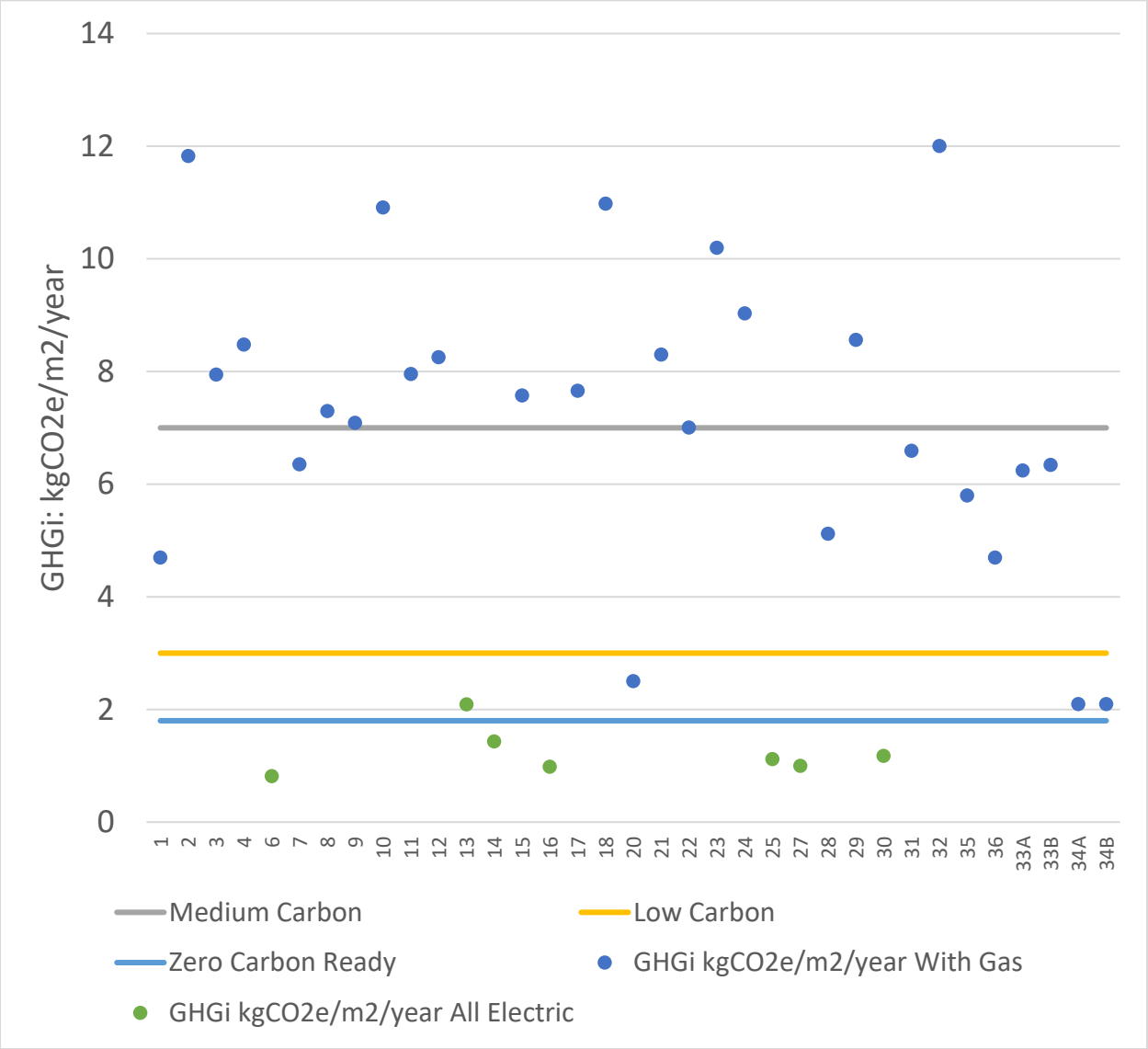



## 6.4 Part 3 Energy Model Review

An Energy Model review for new Part 3 developments was conducted in June 2022, and included calculating the GHGi of all the regional projects with energy models available to staff (primarily from the City of Victoria) and identifying the primary mechanical system's energy source. The results show that buildings that are fully electrified are consistently able to achieve the zero carbon ready standard, and that while those with gas have a broad range of GHG intensities, none of them have achieved a zero carbon standard to date.[12]

[12] City of Victoria internal analysis: June 2022

**Chart 8: Capital Region MURBS and Mixed-Use Part 3 Buildings GHGi and Approximate Carbon Pollution Standards Thresholds**



# 7.0 Provincial Costing and Modelling Study Summary

The cost of complying with low and zero carbon ready regulations will vary from building to building and project to project depending on the project type, goals of the project, and the decisions made during design. To assist with local government decision making the Building and Safety Standards Branch (BSSB) of the Provincial Government completed an energy modelling and costing study[13]. This was reviewed alongside a second costing study completed by the the City of Vancouver[14] to help better understand the potential cost implications of electrifying most, or all buildings' systems (i.e. moving to low and zero carbon).

These studies found that incremental capital costs for meeting low and zero carbon requirements for all building types within Climate zone 4 fell within a range of 0.1% cost savings to a high of 2.2% increased costs. These costs varied depending on the electric systems that were chosen and will vary further depending on what is considered to be the baseline building. Table 14 summarises this costing information alongside the incremental costs for reaching higher steps of the BC Energy Step Code taken from the Step Code costing reports[15].

**Table 14: Incremental Construction Costs (% increase from Step 3) for Low/Zero Carbon and Higher Steps**

| **Building Type** | **Incremental Construction Costs** (% increase from Step 3) | | | |
|---|---|---|---|---|
| | **Low Carbon** (at Step 3) | **Zero Carbon** (at Step 3) | **Step 4** | **Step 5** |
| **Small SFD** (approx. 100-200m$^2$) | | 0.6% | 1.8% - 2.8% | 7.1% - 8.8% |
| **Medium SFD** (approx. 200-300m$^2$) | | 0.6% | 1.0% | 2.8% |
| **Large SFD** | | 0.4% | 1.1% | 2.9% - 3.7% |
| **Multi-Family** (6 storey or less) | 1.3% | 0% - 2.2% | 2.6% | N/A |

Operating costs were also analysed. The modelled operating cost implications varied from a savings of 7% to an annual cost increase of 2.2%.

[13] Draft carbon pollution standards for Part 3 and Part 9 buildings in British Columbia: Data Tables. Building and Safety Standards Branch, Province of British Columbia, Feb. 25, 2022
[14] City of Vancouver Council Report, Climate Emergency – Bylaw and Policy Updates Applicable to New Buildings, May 17, 2022, available at: https://council.vancouver.ca/20220517/documents/R1a.pdf
[15] Step Code Costing reports available at: https://energystepcode.ca/reports/#cost.

## 7.1 Part 9 Costing Tables

Tables 15 - 19 provide details on the Part 9 costing analysis completed by the BSSB[16].

**Table 15: Laneway Home Incremental and Utility Cost Analysis**

| Laneway Data Tables | Base Scenario | Scenario 1 | Scenario 2 |
|---|---|---|---|
| | Step 3 Base Case (Current) | Step 3 AND Zero Carbon Scenario 1 | Step 3 AND Zero Carbon Scenario 2 |
| Space Heating Equipment | Gas Furnace | Air Source Heat Pump | Electric Baseboard |
| Water Heating Equipment | Tankless gas heater (95%) | Air Source Heat Pump | Electric Resistance |
| Annual Modelled GHGs | 15.8 $kgCO_2e/m^2/yr$ | 1.7 $kgCO_2e/m^2/yr$ | 1.9 $kgCO_2e/m^2/yr$ |
| Modelled GHGi | 1100 $kgCO_2e/yr$ | 116 $kgCO_2e/yr$ | 137 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | $13.50/m^2$ | $13.60/m^2$ | $16.70/m^2$ |
| Incremental Cost | -- | $56.10/m^2$ | $0/m^2$ |
| Incremental Cost % difference | -- | 2% | 0% |

**Table 16: Small Single-Family Home Incremental and Utility Cost Analysis**

| Small Single Family | Base Scenario | Scenario 1 |
|---|---|---|
| | **Step 3 Base Case (Current)** | **Step 3 AND Zero Carbon** |
| **Space Heating Equipment** | Gas Furnace | Air Source Heat Pump |
| **Water Heating Equipment** | Tankless gas heater (95%) | Air Source Heat Pump |
| **Modelled GHGi** | 12.5 $kgCO_2e/m^2/yr$ | 1.2 $kgCO_2e/m^2/yr$ |
| **Annual Modelled GHGs** | 1278 $kgCO_2e/yr$ | 126 $kgCO_2e/yr$ |
| **Annual Modelled Utility Cost** | $9.40/m^2$ | $9.90/m^2$ |
| **Incremental Cost** | -- | $38.40/m^2$ |
| **Incremental Cost % difference** | -- | 0.6% |

[16] Draft carbon pollution standards for Part 9 buildings in British Columbia: Data Tables. Building and Safety Standards Branch, Province of British Columbia, Feb. 25, 2022

**Table 17: Medium Single-Family Home Incremental and Utility Cost Analysis**

| Medium Single Family | Base Scenario | Scenario 1 |
|---|---|---|
| | **Step 3 Base Case (Current)** | **Step 3 AND Zero Carbon** |
| Space Heating Equipment | Gas Furnace | Air Source Heat Pump |
| Water Heating Equipment | Tankless gas heater (95%) | Air Source Heat Pump |
| Modelled GHGi | 8.9 $kgCO_2e/m^2/yr$ | 0.6 $kgCO_2e/m^2/yr$ |
| Annual Modelled GHGs | 2119 $kgCO_2e/yr$ | 138 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | $4.50/m^2$ | $4.60/m^2$ |
| Incremental Cost | -- | $13.20/m^2$ |
| Incremental Cost % difference | -- | 0.6% |

**Table 18: Large Single-Family Home Incremental and Utility Cost Analysis**

| Large Single Family | Base Scenario | Scenario 1 |
|---|---|---|
| | **Step 3 Base Case (Current)** | **Step 3 AND Zero Carbon** |
| Space Heating Equipment | Gas Furnace | Air Source Heat Pump |
| Water Heating Equipment | Tankless gas heater (95%) | Air Source Heat Pump |
| Modelled GHGi | 7.1 $kgCO_2e/m^2/yr$ | 0.3 $kgCO_2e/m^2/yr$ |
| Annual Modelled GHGs | 3637 $kgCO_2e/yr$ | 172 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | $2.50/m^2$ | $2.60/m^2$ |
| Incremental Cost | -- | $7.70/m^2$ |
| Incremental Cost % difference | -- | 0.4% |

**Table 19: Row Home Incremental and Utility Cost Analysis**

| Row Home Based on 6 Units. | Base Scenario | Scenario 1 |
|---|---|---|
| | **Step 3 Base Case (Current)** | **Step 3 AND Zero Carbon** |
| **Space Heating Equipment** | Gas Furnace | Air Source Heat Pump |
| **Water Heating Equipment** | Tankless gas heater (95%) | Air Source Heat Pump |
| **Modelled GHGi** | 8.8 $kgCO_2e/m^2/yr$ | 0.7 $kgCO_2e/m^2/yr$ |
| **Annual Modelled GHGs** | 8298 $kgCO_2e/yr$ | 721 $kgCO_2e/yr$ |
| **Annual Modelled Utility Cost** | $5.70/m^2$ | $4.70/m^2$ |
| **Incremental Cost** | -- | $3.30/m^2$ |
| **Incremental Cost % difference** | -- | 0.2% |

## 7.2 Part 3 Costing Tables

Tables 20 - 24 provide details on the Part 3 costing analysis completed by the BSSB[17].

**Table 20: Low Rise MURB Home Incremental and Utility Cost Analysis**

| Low Rise MURB | Base Scenario | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|
| | Step 3 Base Case (Current.) | Step 3 AND Low Carbon | Step 3 AND Zero Carbon scenario 1 | Step 3 AND Zero Carbon scenario 2 |
| Space Heating Equipment | Gas Condensing Boiler | Air source heat pump; 30% gas backup | Electric baseboard | Air-source heat pump, no natural gas back-up |
| Water Heating Equipment | High efficiency gas (95%) | Electric Resistance | Electric Resistance | Electric Resistance |
| Modelled GHGi | 9.8 $kgCO_2e/yr$ | 2.2 $kgCO_2e/yr$ | 1.2 $kgCO_2e/yr$ | 1.2 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | \$9.3/$m^2$ | \$9.50/$m^2$ | \$9.10/$m^2$ | \$9.30/$m^2$ |
| Incremental Cost | -- | \$42.40/$m^2$ | -\$3.40/$m^2$ | \$70.20/$m^2$ |
| Incremental Cost % difference | | 1.3% | -0.1% | 2.2% |

**Table 21: High Rise MURB Home Incremental and Utility Cost Analysis**

| High Rise MURB | Base Scenario | Scenario 1 | Scenario 2 | Scenario 3 |
|---|---|---|---|---|
| | Step 2 Base Case (Current) | Not modelled | Step 2 AND Zero Carbon scenario 1 | Step 2 AND Zero Carbon scenario 2 |
| Space Heating Equipment | Gas Condensing Boiler | | Electric baseboard | Air-source heat pump, no natural gas back-up |
| Water Heating Equipment | High efficiency gas (95%) | | Electric Resistance | Electric Resistance |
| Modelled GHGi | 11.7 $kgCO_2e/yr$ | | 1.3 $kgCO_2e/yr$ | 1.2 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | \$10.2/$m^2$ | | \$10.4/$m^2$ | \$9.50/$m^2$ |
| Incremental Cost | -- | | -\$3/$m^2$ | \$65/$m^2$ |
| Incremental Cost % difference | -- | | -0.1% | 2.1% |

[17] Draft carbon pollution standards for Part 9 buildings in British Columbia: Data Tables. Building and Safety Standards Branch, Province of British Columbia, Feb. 25, 2022

**Table 22: Home Incremental and Utility Cost Analysis**

| Offices | Base Scenario | Scenario 1 | Scenario 2 |
|---|---|---|---|
| | Step 2 Base Case (Current) | Step 2 AND Low Carbon Scenario 1 | Step 2 AND Zero Carbon Scenario 2 |
| Space Heating Equipment | Gas Condensing Boiler | Air source heat pump; 30% gas backup | Air-source heat pump, no natural gas back-up |
| Water Heating Equipment | High efficiency gas (95%) | Electric Resistance | Electric Resistance |
| Modelled GHGi | 6 $kgCO_2e/yr$ | 1.9 $kgCO_2e/yr$ | 0.9 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | \$9.3/$m^2$ | \$7.30/$m^2$ | \$7.00/$m^2$ |
| Incremental Cost | -- | \$42.00/$m^2$ | \$65.00/$m^2$ |
| Incremental Cost % difference | -- | 1.4% | 2.1% |

**Table 23: Retail Building Home Incremental and Utility Cost Analysis**

| Retail | Base Scenario | Scenario 1 | Scenario 2 |
|---|---|---|---|
| | Step 2 Base Case (Current) | Step 2 AND Low Carbon | Step 2 AND Zero Carbon |
| Space Heating Equipment | Gas Condensing Boiler with fan coils | Air source heat pump; 10% gas backup | Air-source heat pump, 10% natural gas backup |
| Water Heating Equipment | High efficiency gas (95%) | High efficiency gas (95%) | Electric Resistance |
| Modelled GHGi | 6.6 $kgCO_2e/yr$ | 2.1 $kgCO_2e/yr$ | 1.3 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | \$1.8/$m^{2`}$ | \$1.90/$m^2$ | \$2.00/$m^2$ |
| Incremental Cost | -- | \$43.00/$m^2$ | \$43.00/$m^2$ |
| Incremental Cost % difference | -- | 1.2% | 1.2% |

**Table 24: Hotel Home Incremental and Utility Cost Analysis**

| Hotels | Base Scenario | Scenario 1 | Scenario 2 |
|---|---|---|---|
| | Step 2 Base Case (Current) | Step 2 AND Low Carbon | Step 2 AND Zero Carbon |
| Space Heating Equipment | Gas Condensing Boiler with fan coils | Air source heat pump; 30% gas backup | Air-source heat pump, no natural gas backup |
| Water Heating Equipment | High efficiency gas (95%) | Electric Resistance | Electric Resistance |
| Modelled GHGi | 20.5 $kgCO_2e/yr$ | 3.3 $kgCO_2e/yr$ | 1.6 $kgCO_2e/yr$ |
| Annual Modelled Utility Cost | $\$11.80/m^{2`}$ | $\$11.00/m^2$ | $\$10.60/m^2$ |
| Incremental Cost | -- | $\$42.00/m^2$ | $\$65.00/m^2$ |
| Incremental Cost % difference | -- | 1.3% | 2% |