Implementing the BC Energy Step Code for Part 3 (Non-Residential) Buildings in Township of Langley

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August 2020

UBC Sustainability Scholars Program

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3. Foreword

This report is prepared keeping in mind a broad audience who have, at minimum, a basic understanding of energy efficiency for buildings. Furthermore, this report contains data which has been obtained from telephone and web-based interviews with personnel from various BC local government jurisdictions. The data shares their comments based off of the knowledge they had had at the time of interview. Hence some data is anecdotal in nature. The report contains anonymized, aggregated data and none of the participants have been identified. The author of this report accepts no liability whatsoever, legal or otherwise, arising out of usage/retention/transmission of data contained in this report to any source anywhere in the world.

4. Disclaimer

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organisations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region.

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

5. Acknowledgements

I would like to thank the UBC Sustainability Initiative for providing me this opportunity to undertake such a project of immense importance to the Township of Langley and the Province of BC at large. I would like to thank Kevin Ramlu for his able guidance and vision regarding this project. Furthermore, I would like to thank Sarah Maleska for her valuable feedback throughout this project journey. I would also like to thank Robert Baker, Assistant Chief Building Inspector, Township of Langley for his able guidance, Amy Weiss, Communications Co-ordinator for rolling out the Builder Survey and Shauna Vandenburg for arranging to provide relevant data. I would like to thank Russell Nelson for taking out time from his busy schedule to comment on future directions regarding P3 Buildings in the Township.

6. Abbreviations

AHJ	Authority Having Jurisdiction	For the purpose of the report, AHJ's are municipalities, or other government bodies.
BC	British Columbia	Refers to the Province of British Columbia
BC CLP	BC Climate Leadership Plan	The Climate Leadership Plan is British Columbia's next step to fight climate change. This plan highlights the first set of actions we are taking to help meet our 2050 emissions reduction target of 80 per cent below 2007 levels, while building a clean economy.
BC ESC	BC Energy Step Code	Provincial Regulation supporting energy efficiency for various building types.
BCBC	BC Building Code	The BC Building Code is a provincial regulation on how new construction, building alterations, repairs and demolitions are done. This code sets minimum requirements for safety, health, accessibility, fire and structural protection of buildings and energy and water efficiency.
DES	District Energy System	District energy systems centralize the production of heating or cooling for a neighbourhood. A system of pipes conveys heating and/or cooling to buildings, using energy from central plants as well as integrating energy supplied from multiple sources throughout the network.
GHGi	Greenhouse Gas Intensity	Defined as the level of Greenhouse Gas(GHG) Emissions which a building

		emits per unit of its footprint in a year.
HVAC	Heating Ventilation Air Conditioning	Various mechanical systems inside a building which provide space heating, cooling, air conditioning and ventilation functions.
ICI	Industrial, Commercial and Institutional	P3 non-residential buildings
LCES	Low Carbon Energy System	A mechanical system that provides space or/and domestic hot water heating that generates limited green house gas emissions.
MURB	Multi Uni Residential Buildings	A type of building occupancy used for residential purposes. Can refer to row houses, townhouses and residential apartment buildings.
NECB	National Energy Code for Buildings	A federally regulated energy compliancy path
P3	Part3 Buildings	*Part3* Buildings as defined by the to BC Building Code, include built area of more than 600 m^2 and contains more than 3 storeys.
P9	Part 9 Buildings	*Part 9* Buildings as defined by the to BC Building Code, include built area of less than 600 m^2 and contains less than 3 storeys. (BC Building Code)
RP	Registered Professionals	Typically, Architects and Professional Engineers
TOL	Township of Langley	Partner Organization for this project.
UDI	Urban Development Institute	The Urban Development Institute is a non-profit association of the development

		industry and its related professions that is non-partisan in its activities.

7. Executive Summary

This is report concerns the adoption and subsequent implementation of the BC Energy Step Code in the TOL. The BC Energy Step Code is a voluntary compliance framework which governs the construction of buildings in the Province through a series of performance-based metrics or "Steps". Applicable to new construction, the Step Code contains 3-5 steps depending upon the type of building considered. This project focusses on Part 3(P3) Buildings, hence 4 Step Levels are considered. Step 1 is enhanced compliance with respect to the BC Building Code and the Step 4 corresponds to the highest step or "Net Zero Energy Ready" building. The current provincial target for Net Zero Energy Ready Buildings is set for 2032 by the Province.

The report highlights the background leading to the development of Step Code framework in the Province of BC , and briefly introduces various legislative actions which were enacted and enforced in the Province. It briefly discusses the BC Building Code and presents the current target levels relating to the Step Code. So far, over 65 municipalities have adopted the Step Code and referenced it in their bylaws. The report further highlights current trends for Step Code in terms of policies and technical requirements. The report also reviews the Step Code Metrics Research Report Update 2018, focussing on the impact of Step Code regulation on construction costs for various types of Part 3 buildings.

Currently, the TOL has adopted the Step Code only for Part 3 Residential buildings. However, considering the growth of other types of Part 3 Buildings – Institutional , Commercial and Industrial type, the TOL is also considering adopting Step Code for these types of buildings. Therefore, this report conducts in depth research regarding experiences of implementation of Step Code for Part 3 Buildings in other jurisdictions, which could help inform Step Code adoption for TOL.

The reports main objectives are– to conduct interviews in key jurisdictions regarding their industry outreach and consultation process, their incentives and implementation aspects like resource planning, building permitting process and considering adoption of future steps. These interviews were supplemented by desktop research and literature review. Builder consultation involved carrying out a survey to gauge industry's experience in building to the Step Code.

In summary, the recommendations arising out of this analysis mainly centre around adoption of Step Code for other types of P3 buildings in the TOL and highlights it as the topmost priority. More detailed recommendations, in order of priority, are as follows:

1. Carry out an in-depth, phased consultation framework/process with industry consisting of presenting a draft policy, seeking feedback from various stakeholders(including industry and non-profit if applicable) and using that data to shape overall Part 3 Step Code policy. Carry out further in-person and online surveys to generate data points.

2. Include various non-financial incentives (supported by feedback provided by industry) in policy with adequate gates and safeguards. These could centre around density bonusing, expedited permit processing, increase floor area. Depending upon the type of P3 building being considered. Analysis regarding these incentives should be carried out before deployment.
3. Consider resource planning regarding step code implementation. This is a priority step considering the expected growth of permits for various other types of P3 Buildings in the future which would require resources in terms of plan checking and reviewing, technical compliance check etc.
4. Conducting an internal costing study using various local assumptions in order to examine the problem of cost overruns while building to the Step Code. This is an optional step.

Various other Step Code related topics have been covered in the report. These relate to emerging areas of building energy efficiency like Greenhouse Gas Intensity(GHGi) and Low Carbon Energy System(LCES) requirements and how they tie-in with policy. Although the recommendations section of the report presents exhaustive list of options that the TOL could exercise/deliberate on , these should be adequately prioritized, and step code adoption and policy rollout should take precedence above all. The nature of discussion of these concepts is more academic and included for completeness in the report.

8. Introduction

This report intends to highlight the main elements of the BC Energy Step Code (hereinafter referred to as "BC ESC" "Step Code" or simply " BC Energy Step Code") and discuss implementation strategies for the TOL.

This report discusses best practices and lessons learned through a variety of surveys which were carried out as a part of this project. The survey data has been analysed in conjunction with literature reviews and desktop research.

8.1 Introduction to the BC Energy Step Code

The BC Energy Step Code is currently a voluntary compliance path in the BC Building Code that local governments may use, if they wish, to require a level of energy efficiency in new construction that goes above and beyond the requirements of the BC Building Code((Energy Step Code, 2018). Builders must comply with the BC ESC to meet the energy-efficiency requirements of the BC Building Code if the municipality has adopted Step Code. The BC ESC is currently still voluntary but is slated to become part of the BC Building Code in the following years to come. This allows builders to gain experience in building high performance homes and buildings until high performance building become a standard regulation.

8.2 The BC Building Code

The BC Building Code is a provincial legislation which regulates building construction in the Province of British Columbia(BC). The textbook definition as per British Columbia codes website is that The *BC Building Code (BCBC) is a provincial regulation that governs how new construction, building alterations, repairs and demolitions are completed. This code establishes minimum requirements for safety, health, accessibility, fire and structural protection of buildings and energy and water efficiency. It applies throughout the Province except for some federal lands and the Municipality H*((British Columbia Codes, 2018)

The BCBC 2018 contains a section on Energy Efficiency (Section 10.2) which prescribes energy efficiency requirements which P3 buildings of various occupancy types are to achieve.

The BCBC references the National Energy Code of Canada for Buildings (NECB). Part 8 of the NECB relates to "Building Energy Performance Compliance Path" and is referenced in the requirements of the BC Building Code.

8.2.1 Relationship with Step Code

The BC ESC is a component of the BCBC. The BCBC is an existing regulation which references a section on Energy Efficiency for various building types. On the other hand, the BC ESC is basically a standard which forms a part of the building code. Currently, as of 2020, the BC Energy Step Code is voluntary, and builders could build to the Step Code if they wish ; they are not obligated by law to do so. This is done in order to increase the adoption of the Step Code among the municipalities as well the building industry, in order to help them build experience and become accustomed to building to various steps of the Step Code. Whenever builders build to higher steps, they accumulate knowledge and experience and deal with their learnings and develop best practices. Over the next few years, the Step Code is going to become a part of the BC Building Code and become mandatory for builders to follow. The future plans regarding when the Step Code would be incorporated within the BC Building Code is given below (Province of British Columbia, 2018)In fact, the incorporating the Step Code standard is also echoed in Government of Canada's "Build Smart Strategy" which aligns the BCBC and BC ESC and puts both of them in the context of federal policy. Following are the targets set forth by the BC ESC.

- 20 per cent more energy efficient by 2022
- 40 per cent more energy efficient by 2027
- 80 per cent more energy efficient by 2032, which is the net-zero energy ready standard.

A more comprehensive graphic regarding the BC Energy Step Code is given below:

Figure 1 Step Code Levels for various types of Buildings in BC. The focus of this report is P3 Buildings.

Figure 2 Energy Efficiency requirements for P3 Buildings(Source : Municipality M)

8.3 Journey towards the Step Code

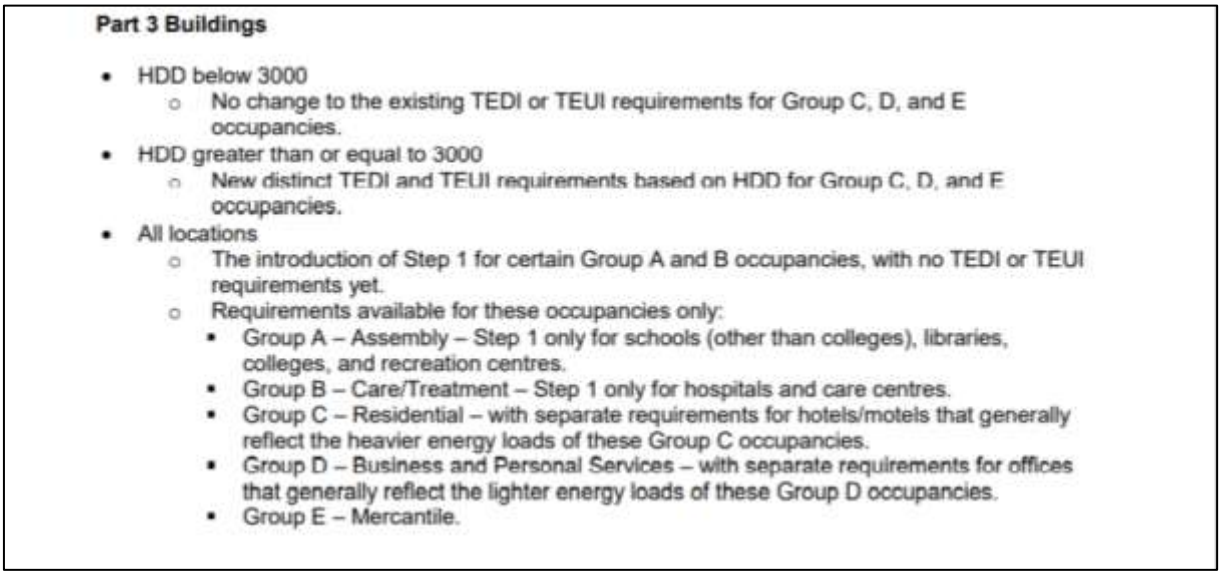
Before we do a deep dive in to the Step Code, it is important to provide certain historical context as to how the Step Code came about. Before the Step Code, there was a patchwork of different municipal energy efficiency standards across BC. The Step Code was enacted in April 2017 and as of December 2017, all the patchwork of various regulations which existed in various communities around BC ceased to exist and got superseded by the BC Energy Step Code. Thereafter, this meant that By December 2017, section 5 of the Building Act rendered local government bylaws that established technical building requirements of no legal force unless the bylaws concern what the Act calls 'unrestricted matters' (. Furthermore, two new matters regarding conservation of energy and greenhouse gas emissions were added in the Building Act General Regulation to enable local governments to require that new buildings constructed in their jurisdictions be constructed to one of the steps of the BC ESC. (Office of Housing and Construction Standards of British Columbia, 2017)

As of today, the BCBC has been amended and the latest revision of the BCBC came into effect on December 12th, 2019 which included updated details on building energy efficiency. (Buliding and Safety Standards Branch, 2019)

8.4 The current scenario of Step Code Adoption in BC Municipalities

The current state of the BC Energy Step Code is best understood by starting from the BCBC 2018 Revision 2 which changes certain parameters to be measured in order to adhere to the Step Code. More granularly speaking these pertain to:

1) Addition of Climate Zones – A Climate zone is a demarcation included by Environment Canada, in order to specify the number of Heating Degree Days or HDD, which further helps in the calculation of various energy efficiency metrics for buildings. The update also included P3 Buildings, for various group C (residential), Group D (business and personal services), and Group E (mercantile) occupancies outside of Climate Zone 4.
2) Requirements have also been established for certain Group A and Group B Occupancies like schools, colleges and hostels, libraries, recreation centres, hospitals and care centres. These currently have Step 1 Requirements, which means that they have to comply with baseline BC Building Code. For more information, please refer to the technical bulletin below or BCBC Section 10.2.



Part 3 Buildings

- HDD below 3000
  - No change to the existing TEDI or TEUI requirements for Group C, D, and E occupancies.
- HDD greater than or equal to 3000
  - New distinct TEDI and TEUI requirements based on HDD for Group C, D, and E occupancies.
- All locations
  - The introduction of Step 1 for certain Group A and B occupancies, with no TEDI or TEUI requirements yet.
  - Requirements available for these occupancies only:
    - Group A – Assembly – Step 1 only for schools (other than colleges), libraries, colleges, and recreation centres.
    - Group B – Care/Treatment – Step 1 only for hospitals and care centres.
    - Group C – Residential – with separate requirements for hotels/motels that generally reflect the heavier energy loads of these Group C occupancies.
    - Group D – Business and Personal Services – with separate requirements for offices that generally reflect the lighter energy loads of these Group D occupancies.
    - Group E – Mercantile.

Figure 3 Extract from the Technical Bulletin of the BC Building Code summarizing changes and additions(as applicable) for various P3 Building Types (Source : Technical Bulletin summarizing changes in the BC Building Code)

8.5 Metrics measured through the Step Code

There are several metrics measured as a part of the Step Code standard. They are namely:

- Thermal Energy Demand Intensity (TEDI), which is indicated by how the envelope interacts with the external environment and how much heat the envelope retains. It is defined as the energy in kWh per unit area of conditioned space (or the footprint of the building) per year consumed by the house in order to provide space heating. This figure is dynamic and is dependent on many factors such as, occupancy, direction in which the house is being built, heating degree days etc.
- Total Energy Usage Intensity (TEUI) – This is a metric which measures the amount of energy consumed by mechanical and electrical equipment within the conditioned space in kWh per unit area of the conditioned space on a per year basis.
- Air Tightness - This metric is a determinant of how well insulated the building is to air leakages. Strictly speaking it is defined as the number of air changes per hour at a specified pressure (for

e.g. 50Pa) and is therefore denoted by ACH_{50}. The number of air changes per hour is denoted by writing a multiple in front of the ACH figure as 2.5ACH, 3.5ACH, 4.5ACH and so on.

These metrics are referenced in the BC Building Code and form part of the voluntary compliance pathway for builders to demonstrate the performance of their buildings by exhibiting values contained in the schedules of the BCBC.

8.6 2018 Step Code Metrics Study Report – A Review

The 2018 Step Code Metrics Report Update 2018 was one of the costing studies carried out in the sphere of building energy efficiency. This section is going to summarize the exhaustive report, without going into much depth. Before the report is analyzed, the concept of Climate Zones is very important to understand since it affects everything ranging from the TEDI and TEUI Metrics to the more important metrics of the incremental construction costs , as will be discussed later.

The Step Code applies to any new construction of P9 Residential Buildings Province wide, (provided the municipalities have adopted it), with different performance requirements set for Climate Zones 4,5,6,7a 7b and 8(Metrics Research Report Update, 2018)).

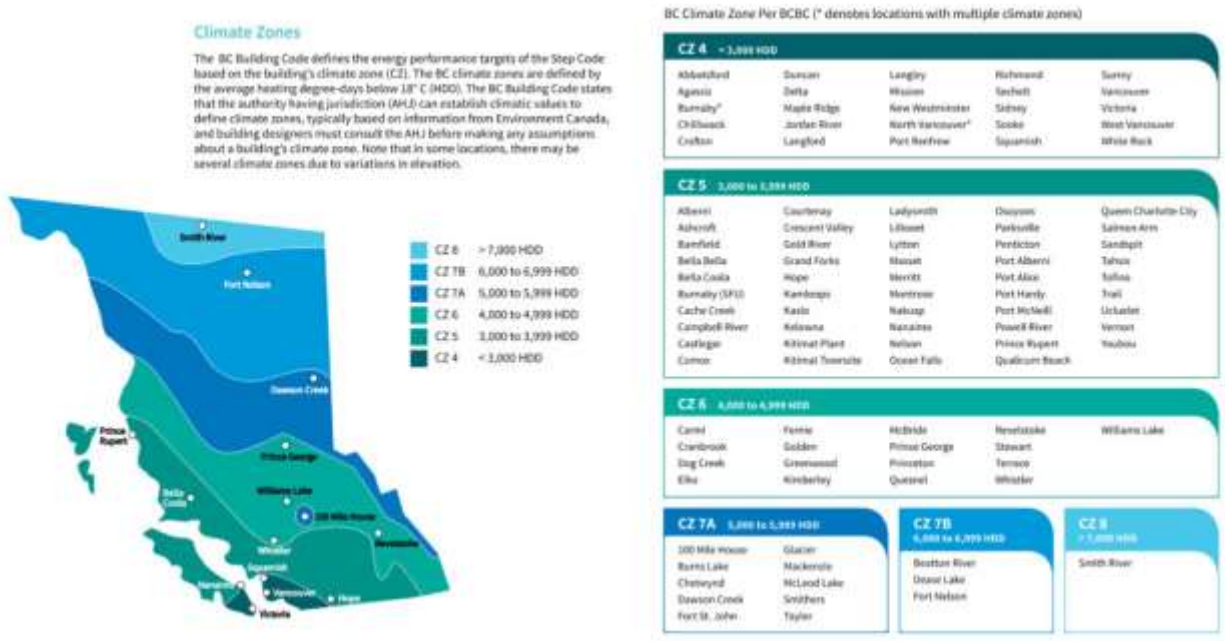


Figure 4 Climate Zones in British Columbia (Source : Better Homes BC)

The climate zones in which TOL lies is Climate Zone 4. This particular information is helpful in calculating the number of Heating Degree Days (HDD) ,which is in turn helpful in calculating the level of energy consumption of the buildings.

Furthermore, the report proposes certain targets for P3 buildings for various occupancy types (Group C – Multi-Family Residential, Commercial Office and Other Commercial like Mercantile and Personal Services (Groups D & E). Several variations to occupancies was modelled with several options (other variables included ventilation loads, process loads, construction type). The results were simulated using a specific simulation engine (not the focus of this report) and results for TEDI and EUI were plotted using several software. Furthermore, for P3 Buildings, base construction costs were developed by consultant teams utilising various different types of building archetypes (Low Rise MURB, High Rise MURB, Hotel, Office, Retail) and the costs were vetted by the Municipality H's Zero Emissions Building consultation process over the course of several years. The costing information was then multiplied by location specific multipliers (for specific climate zones). Certain assumptions relating to payback period, Net Present Value, GHG Intensity for natural gas and electricity sources and airtightness testing costs was built in and results were plotted.

The biggest variable which was plotted was the incremental capital cost. The incremental capital cost refers to the cost premium associated with going to a higher step within the Step Code framework and includes both materials and labour costs. It, however, does not include savings which might be realized from lower operating costs or likely reductions in cost of mechanical equipment due to better use of building envelopes. It also doesn't include design costs while these may be higher in the short run, in the long run these increases are likely to reduce due to market forces like competition etc.

To summarize the results, the report predicted that in Climate Zones 4-6 (where 95% of the population of BC Resides), P3 buildings modelled were able to achieve Step 4 for less than 3% incremental capital cost and achieve Step 3 for less than ~2.4% increase. The report also showed that for the P3 Buildings, the estimated impact on construction costs for Commercial Office Buildings were correlated to the choice of mechanical system. In all cases, the costs were less than ~3% from the baseline. For Commercial Office Buildings in Climate Zone 4 , Step 3 could be achieved for less than ~1% cost premium for most cases, the report suggests. A further NPV analysis was carried out and it showed that for Climate Zones 4, 5 and 6 NPV values were positive which signals that savings over the projection period at a specified discount rate might have outweighed the costs. A further analysis regarding Net Present Value is given in the following table highlighted in the report.

Table 23: Highest Net Present Value ($/m²) – Part 3 Buildings

Archetype	Step	CZ4	CZ5	CZ6	CZ7a	CZ7b	CZ
High-Rise MURB *Electric BB Mid Occupancy 0.6 VFAR 62-2001*	1	--	--	--	--	--	--
	2	15.1	-0.1	18.6	-44.6	--	--
	3	21.0	-14.0	24.0	-30.2	--	--
	4	-2.7	-16.1	15.5	-28.9*	--	--
Low-Rise MURB *Electric BB Mid Occupancy 0.6 VFAR 62-2001*	1	--	--	--	--	--	--
	2	27.5	20.8	51.9	0.1	-20.0	-1.3
	3	33.5	1.3	57.3	14.6	-16.1	-13.1*
	4	10.8	-1.8	47.0	-47.5	--	--
Hotel *50% WWR Common Area Fan Coils Heat Pump DHW Electric Laundry Load*	1	--	--	--	--	--	--
	2	34.4	35.8	-1.4	2.7	6.7	-33.9*
	3	30.9	6.9	-32.7	-44.8	-27.4*	--
	4	16.1	9.5	-27.9	-58.6*	--	--
Commercial Office *No IT Load Default Occupancy with ASHP*	1	--	--	--	--	--	--
	2	25.8	16.2	6.0	-26.7	--	--
	3	22.3	10.7	-22.7	-33.7	--	--
Commercial *No IT Load Default Occupancy with ASHP*	1	--	--	--	--	--	--
	2	25.8	16.2	6.0	-26.7	--	--
	3	22.3	10.7	-22.7	-33.7	--	--
Retail *Big Box with FC*	1	--	--	--	--	--	--
	2	16.9	9.4	-24.3	-32.3	--	--
	3	12.6	-2.5	-43.1	-42.7	--	--

** Measures and outcomes represent the most feasible scenario which approaches, but does not meet the performance requirements*

Figure 5 Table representing highest NPV values for P3 Buildings. Note that the values are positive for P3 buildings for various occupancy types except MURBs.

The impact of various mechanical equipment on building energy efficiency was also covered in the report. TEDI, which is a function of the envelope and TEUI, which is more correlated with by mechanical system choices, was also covered in the report. Also, in the case of usage of District Energy Systems, the TEUI value was impacted more than TEDI value. The report further highlights the benefits of connecting to a low carbon energy system, since it could contribute to lower community GHG emissions.

In conclusion, the recommendations of the report for P3 Buildings can be summarized as follows:

a) Performance targets were developed for Climate Zone 4 and can affordably be developed for higher Climate Zones as well
b) The Province should however consider developing performance targets for Climate Zones 4 and above, to enable buildings in colder climates achieve higher Steps.
c) Explore the adoption of a Greenhouse Gas Intensity (GHGi) Targets and their incorporation into the Step Code, as expressed by several local governments as well.

The report presents the consequences of adopting Steps 3 for both P3 and P9 as "aggressive but affordable base code". It goes onto further state that impact on cost are lower than the typical variations in construction rates observed over in the past. The report goes onto say that Step 3 for P3 buildings could be targeted is noteworthy.

8.7 Focus of this project and relationship with Step Code

The focus of this report is mainly to assess various factors regarding the implementation of the BC ESC in the TOL. To give sound recommendations regarding implementation of the Step Code, various research approaches in the form of literature review, best practice scan through municipality surveys were conducted. Furthermore, the project included builder outreach through online surveys which helped understand the concerns of builders regarding building to the Step Code.

9. Project Objectives

Project objectives are outlined as:

1. **Best Practice Research:** Conduct Research on relevant municipalities within the Province of BC with regards to the BC Energy Step Code. Focus themes include incentive programs, policy levers, industry engagement/outreach utilized by other jurisdictions.

2. **Stakeholder Engagement & Surveys:** Create and administer survey questionnaires for builder outreach, working in collaboration with the Mentor. Furthermore, create and administer the surveys for the local governments and key jurisdictions to understand their strategies and plans in relation to the Step Code.

3. **Analysis Forecast and Roadmap:** Analyze incentive schemes (if any) present in other jurisdictions, uptake strategies, etc. for P3 Buildings. If needed, based on this analysis, work with TOL Staff to chart out an implementation roadmap of the BC Energy Step Code for P3 Buildings considering the growth rate of P3 Buildings, responses obtained from the community, financial considerations, among others.

4. **Recommendations:** Identify the strategies which would work best in the TOL (with active collaboration from the TOL Staff). Recommendations could be in the form of Best Practices which can help inform TOL staff or could be in the form of a roadmap.

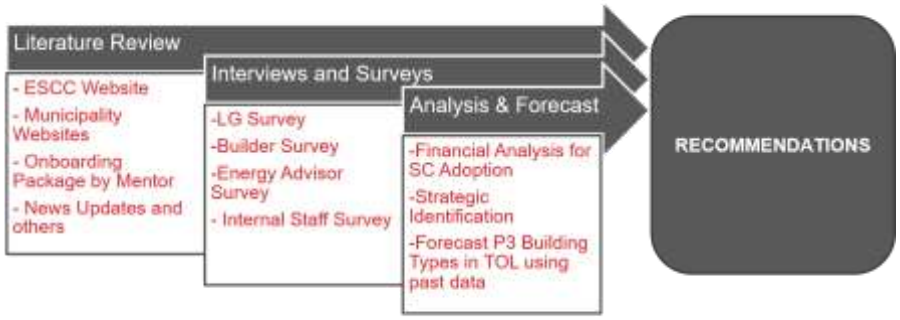


Figure 6 A brief outline of the project objective

10. Project Scope

A high-level approved Scope of the Project is displayed pointwise below.

1. Identify Jurisdictions around BC that already have P3 building energy efficiency/Step Code requirements.
2. Detail Strategies taken by jurisdictions to implement BC ESC for P3 buildings including successes and lessons learned.
3. Identify strategies that would have the greatest potential for successful implementation in the TOL (TOL).
4. Conduct desktop research and interviews with staff in key jurisdictions to understand their programs and identify factors for success in implementing P3 building energy efficiency/Step Code requirements.
5. Analyze incentives included in these programs and uptake strategies.
6. Internal Review: work with TOL staff to understand present conditions of P3 building energy efficiency in the TOL.
7. Prepare a report that gives an overview of other municipalities P3 building energy efficiency and/or Step Code requirements/programs, success stories and lessons learned , analysis of incentives offered for each program(if any), and provides recommendations to the TOL for our own P3 building energy efficiency program.
8. Conduct builder outreach to understand their experiences and lessons learned from P3 energy efficiency/Step Code policies in other jurisdictions (with direct support from TOL staff).
9. Forecast of growth rates of P3 buildings in the TOL and analysis of the financial implications of the BC ESC, and recommendations on funding requirements for Step Code Related incentive programs (with direct support from TOL Staff).
10. Additional Scope (added May 8th, deleted Aug 6th): Identify Jurisdictions where GHGi calculations are being conducted for P3 Buildings. Identify the personnel who are carrying out such tasks (i.e. Energy Advisors) and whether they have the resources to perform such calculations in TOL.

11. BC ESC for P3 Buildings: Interviews with BC Municipalities

As a part of this exercise, municipalities who have already adopted the BC ESC for P3 Buildings were interviewed. Email invites were sent to over 20 municipalities; out of these, eight municipalities were interviewed (Refer Appendix E for full interview transcript). Questions focused on the following themes:

- General (introductory)
- Policy
- Planning and Development
- Resources and Capacity and
- Initiatives

The following sections highlight the responses of the municipalities who agreed to interview. While only eight of over 20 municipalities agreed to be interviewed, because of their similarity in population and proximity to the TOL, it was decided to proceed with the best available information as these eight municipalities represent an adequate sample size for the purposes of this project.

11.1 Analysis of Interview Results

11.1.1 Industry Engagement

A commonality that emerged between municipalities in their adoption of the BC ESC for P3 buildings was their approach in involving the construction industry throughout the entire policy-making process. The spirit of arriving at a consensus and effective stakeholder engagement were key components of their adoption process. It can be seen from Figure 1 that a majority of the municipalities (>75%) undertook a consultation process with industry, in a variety of modes, in order to inform their policy regarding BC ESC implementation for P3 buildings.

Please note that, for all figures defined in this section the response “Unknown” means the respondent did not provide the information pertaining to the question asked.

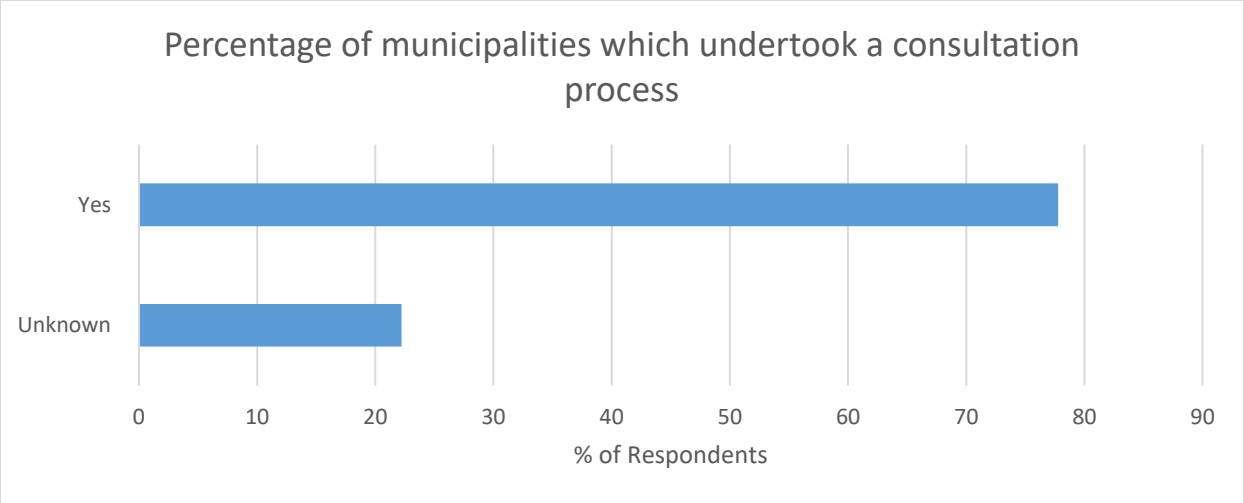


Figure 7. Survey responses on whether the municipality undertook a consultation process with Industry in order to inform their policy regarding BC ESC for P3 Buildings. The response unknown implies that either the respondent didn't provide the information or did not readily have the information available.

As can be seen from above, almost all municipalities undertook a consultation process with Industry in preparation for adopting the BC ESC for P3 Buildings(in the form of outreach events, workshops, working groups, etc.). The outreach process is not a one-off process but a continuous engagement which needs to be planned with an end goal in mind. The process is also expected to be iterative, with multiple rounds of interaction and outcome-based policy tweaking. Therefore, the main ingredient for success lies in effective stakeholder management. An example for the mode of engagement with building industry is known as "builder breakfasts". During these sessions, the local government provides the building industry with an overview of the proposed policy, seeks their feedback, and considers this feedback when reviewing and revising the policy.

Many of the municipalities also highlighted holding workshops along with industry professionals in order to better understand their concerns, familiarizing their internal staff with the Step Code technical requirements through working groups or sub-committees and also carrying out in person and online surveys in order to gather data which would could drive their policy formulation.

In the case of Municipality A, two builder breakfast sessions were held to involve industry – session 1 consisted of a general introduction to the BC ESC; in-person and online surveys were also conducted to gather feedback. In the second builder breakfast session, staff presented industry with three options for adopting the ESC for P3 buildings (informed in part by the previous session's survey results) – one of the options was to follow the provincial timeline, which was to adopt Net Zero Energy Ready Buildings by 2032, with pre-determined timelines and targets, a second option – gradual early adoption of the Step Code with Step 3 by 2025 and Step 4 by 2030 for specific types of buildings. The final option consisted of an accelerated adoption which shifted the timelines of the previous option to one year earlier.

By giving options to industry, the municipality ensured they considered industry's various concerns and opinions regarding the delivery and implementation of the BC ESC. Industry selected the middle option - gradual early adoption.

A common theme which is emerging is that the process of engaging with industry and other stakeholders was iterative. For the Municipality C, industry engagement consisted of an introductory workshop followed by a feedback session on the City's proposed BC ESC adoption schedule. This was followed by a

multi-stakeholder engagement session and a sub-committee update. After adopting the proposed schedule, there were training sessions on best practices for designing to meet the BC ESC for P3 Buildings.

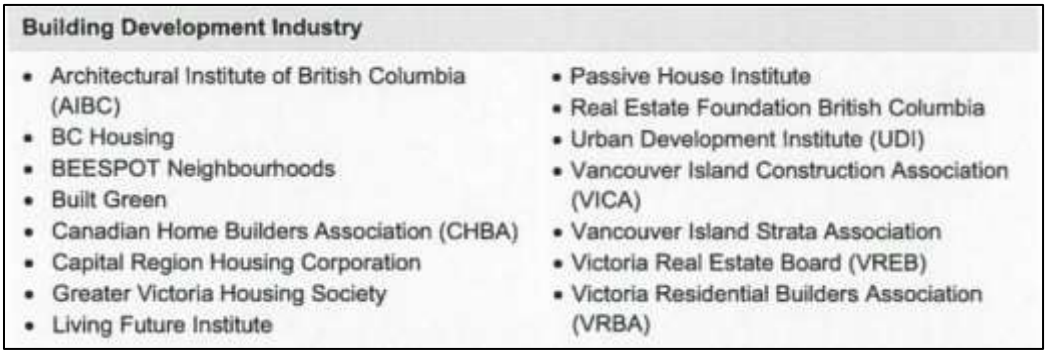
(*Municipality C Energy Step Code – Stakeholder Engagement - Oct 2017*, 2017)

In the case of Municipality D, industry architects and designers were invited, and policy was introduced and communicated to them in terms of achieving steps relating to the BC ESC. Feedback from industry professionals was collected (the mode of collection and incorporation of this feedback is unclear) and municipality staff took it back internally in order to discuss the pros and cons of incorporating specific feedback.

For the Municipality E, the outreach process with industry was a part of their "100% Resilient and Renewable Municipality E" program. The below reference highlights their climate plan and the engagement strategy adopted (Municipality E, 2018)

It is also important that the Key Stakeholder matrix (See Figure 8) be consulted in order to identify the potential stakeholders for community as well as targeted engagement. As per the builder survey carried out, some of the respondents were non-profit organizations which must be included in the overall stakeholder matrix.

The building development industry was a subset of a much larger stakeholder matrix engaged by the Municipality E in the formulation of its 100% Renewable and Resilient Municipality E Plan (Municipality E, 2018)**.** The Municipality E's process of industry engagement was guided by the International Institute for Public Participation's proprietary framework for Public Participation (P2) Processes. This framework is proprietary and might involve some prior groundwork before the consultation process is started, should the TOL choose to involve certain matrices.



Building Development Industry

- Architectural Institute of British Columbia (AIBC)
- BC Housing
- BEESPOT Neighbourhoods
- Built Green
- Canadian Home Builders Association (CHBA)
- Capital Region Housing Corporation
- Greater Victoria Housing Society
- Living Future Institute
- Passive House Institute
- Real Estate Foundation British Columbia
- Urban Development Institute (UDI)
- Vancouver Island Construction Association (VICA)
- Vancouver Island Strata Association
- Victoria Real Estate Board (VREB)
- Victoria Residential Builders Association (VRBA)

Figure 8. A typical building industry stakeholder matrix (Municipality E, 2018)

One of the evaluation criteria developed from the Phase 1 Feedback was Industry Capacity and Readiness, which centered around a clear timeline of future step requirements. Support was indicated to be provided to industry for current steps – indicating lower steps are current practice and some support would be required for higher steps.

For P3 Buildings, the major set of feedback emerged in Phase 2 of engagement, where there was a separate focus group held with Architects, Planners and P3 developers to garner more detailed feedback on the implications of the proposed approach given Step 3 is considered an upper step for some P3 building archetypes. Due to this detailed session, there were recommendations that resulted in a schedule drop from Step 3 to Step 2 for P3 buildings. In conclusion, having a detailed engagement session with industry for P3 Buildings might help ensure greater compliance in the long run.

One of the other reasons which makes the Municipality E stand out is the regional approach it took to reach out to the building industry and other stakeholders. Not only did this approach result in ensuring consistent policy across a number of local government jurisdictions but also saved time and costs and helped out municipalities which otherwise did not have enough resources to carry out their own consultation process.

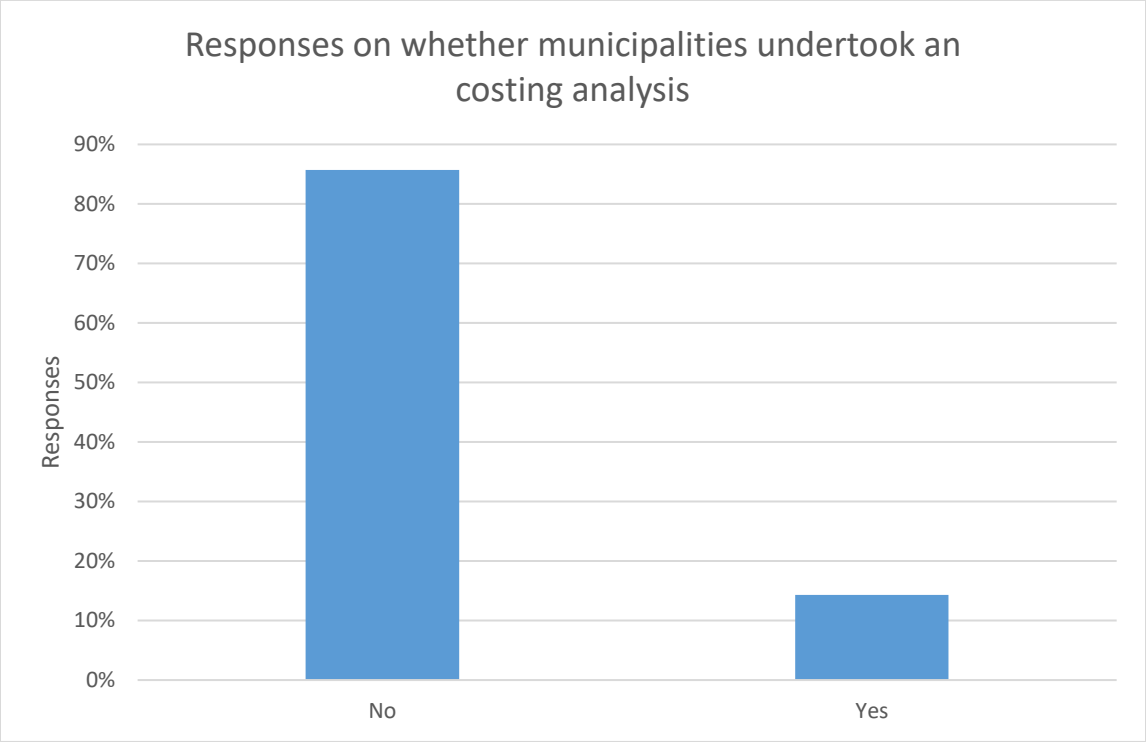


Figure 9 Responses on whether municipalities carried out a costing analysis in order to understand the estimated impact of the BC Energy Step Code on construction costs.

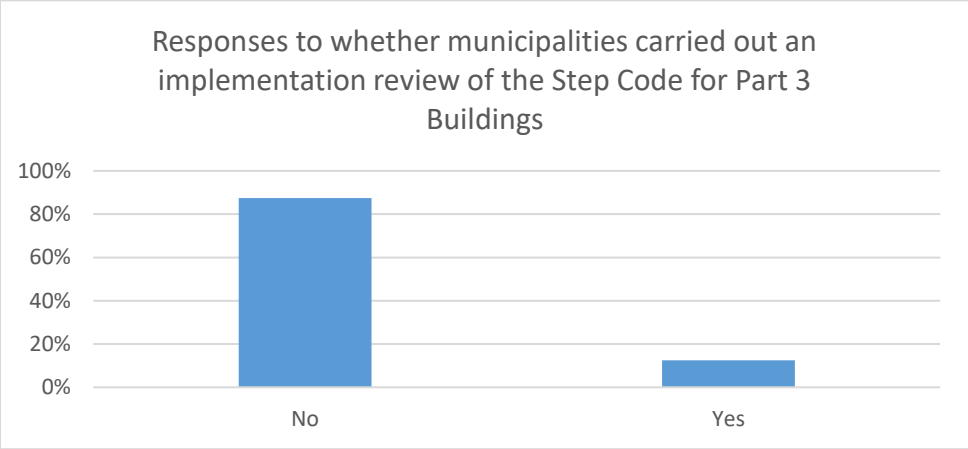


Figure 10 Municipality responses on Whether they carried out implementation review of Step Code for P3 Buildings.

Including non-profits such as the UDI should help to increase the efficiency of the stakeholder engagement process at least during the first round of BC ESC consultation, by bringing together various professionals

in the building industry on a common platform, ensuring a non-affiliated, industry driven consultation. This does not imply, however, that UDI be the only organization consulted. Municipality A, Municipality D, Municipality C and Municipality B have engaged the Urban Development Institute (UDI) as a part of their industry engagement process.

11.1.2 Success Factors and Lessons Learned

It should be noted that out of the municipalities highlighted, none highlighted having carried out an implementation review for BC Energy Step Code for P3 Buildings. The only municipality which indicated as having carried out one was Municipality H, which has been kept outside of the scope of this report as it is not subject to Step Code and has its own separate energy efficiency program.

One of the main learnings and lessons learned which were highlighted pertained to:

1. Process and the documentation review -how to incorporate the BC Energy Step Code into permit applications.

2. How Step Code integrates into Building Permits and Rezoning Applications process i.e. how to document the same as well. This is largely because municipalities rely on Letters of Assurance from Registered Professionals in form of a Letter or RP's are expected to fill out the permit applications.

3. Plan checking and permit review process - who the application gets passed onto as building officials didn't know what was agreed to for Building Permits and Rezoning Applications at the permit issuance stage while carrying out inspections.

In the case of Municipality D , Step code was extended for various kinds of building archetypes. Warehouse was one of the other building archetypes which was being advocated to be included into the Step Code, as per information available. One of the comments was that Greenhouse Gas Intensity (GHGi) is the real thing that's missing. It was also indicated by the respondent that the BC ESC itself didn't have the GHGi target.

Grandfathering provisions were, highlighted a lot during the course of the survey as a policy tool to deal with in-stream applications. During the transition period, there were a lot of applications, which could only be dealt with that provision.

Municipality E respondent also highlighted that Step Code Frameworks main highlights was that Greenhouse Gas Emissions weren't a part of it. The reasons for that are unknown. But wittingly or unwittingly, this has created a patchwork of standards yet again, mirroring the scenario which pre-dated Step Code. If more and more municipalities adopted GHGi metric in addition to the Step Code, it could defeat the purpose of having Step Code as one harmonizing regulation and could jeopardize achievement of higher steps of the Step Code.

11.1.3 Internal Step Code Schedule for Buildings

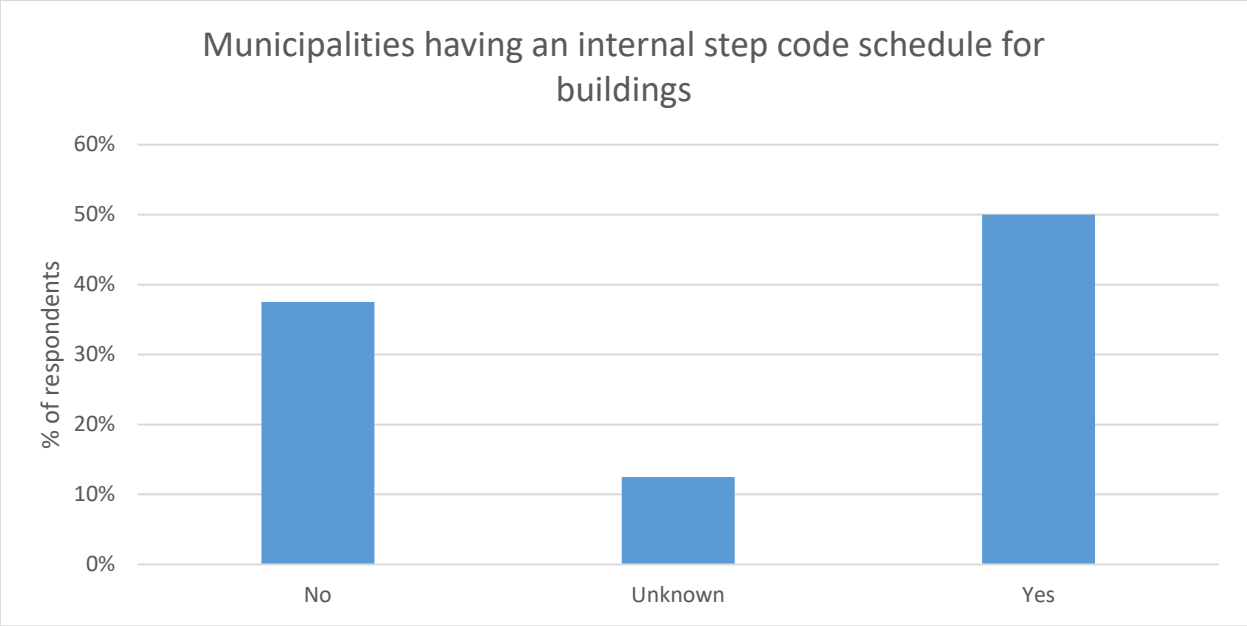


Figure 11 Municipality Responses on whether they have internal Step Code Schedule for P3 Buildings

Almost half of the municipalities have an internal step schedule for corporate buildings. The standards to which these municipalities adhere might be different as highlighted in Municipality B's response when asked about Step Code Schedule for Corporate Buildings.

The design and construction of new City-owned buildings, or new additions/major building renovations with a floor space greater than 500 square metres (or a minimum site area of 5,000 square metres) or greater, shall:

a) Achieve a minimum LEED Gold certification through Canada Green Building Council (CaGBC) standard; and

b) Achieve CaGBC' S Zero Carbon Building Standard certification for Design (in the case of a new building) or Performance (in the case of an existing building), where it is determined by the Energy Management Committee that a significant reduction in greenhouse gases (GHGs) can be achieved; and

c) Use the LEED rating system and accompanying Reference Guide as a design and measurement tool. Design and project management teams are encouraged to meet higher LEED rating levels, if feasible in a cost-effective manner.

In the case of Municipality C, which usually targets Passive House Standard, it is more of a one-off policy rather than a separate policy for corporate buildings. For the Municipality F, internal Step Code Schedule is being considered as a part of their work plan next year.

11.1.4 Alignment of Strategy with other jurisdictions

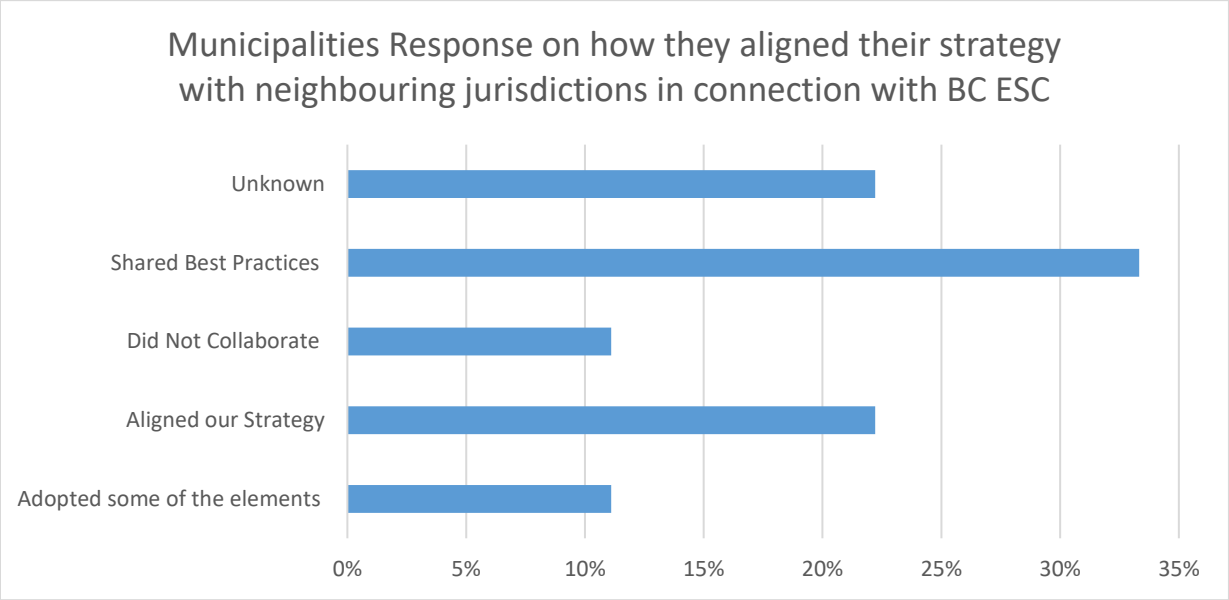


Figure 12 Municipality Responses on whether they aligned their P3 Step Code Strategy with neighboring jurisdictions.

Most of the municipalities shared best practices with other jurisdictions in some way or another. An observation which was interesting to note that Municipality D has aligned its strategy with the other municipalities including Municipality C, Municipality B and TOL, which just goes to show that several elements of Step Code strategy could be aligned based on their respective merits. The main takeaway from this graph that there was co-operation and collaboration between jurisdictions in some shape or form when it came to implement the BC ESC.

11.1.5 Green Building Targets other than Step Code

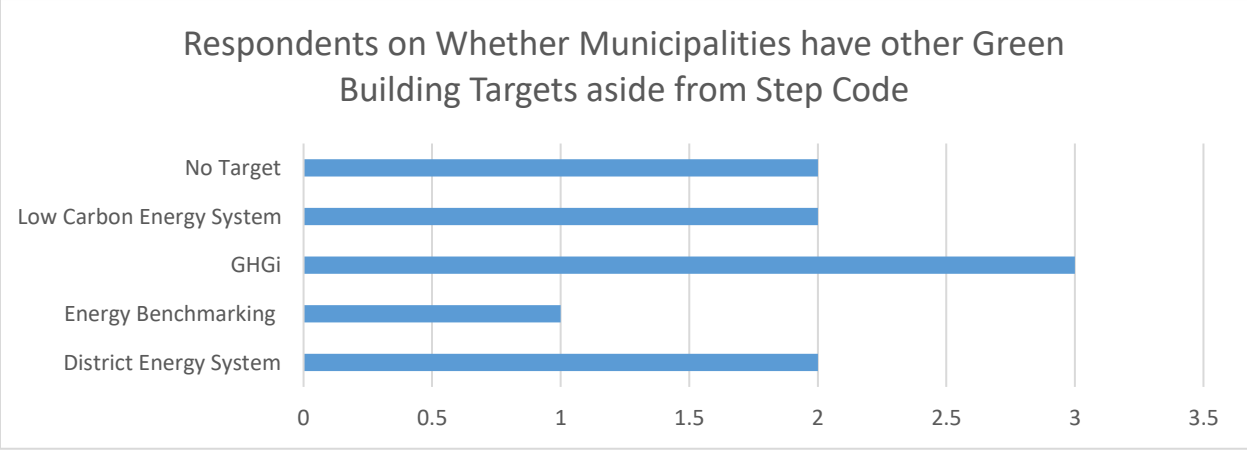


Figure 13 Chart explaining different Green Building Targets aside from Step Code.

A few of the municipalities indicated that they had other green building targets in addition to the Step Code. These are known as Greenhouse Gas Intensity (GHGi), Low Carbon Energy System(LCES), connection to District Energy System(DES). The latter two terms are more systems, than actual targets, whose usage is likely to contribute to decreasing greenhouse gas emissions, and whose adoption the municipalities encourage.

Municipality C, Municipality D and Municipality G are some of the municipalities are have specific targets of building to the GHGi. Greenhouse gas intensity have been set , to which builders, designers and architects have adhere either at the design stage. These targets , coupled along with the adoption of Low Carbon Energy Systems and District Energy Systems, have been instituted by the cities mentioned above in order to contribute increasingly to their own Climate Action Plans and Community Emissions levels.

In the case of Municipality C, the usage of District Energy System has been institutionalized by instituting an entity which runs the District Energy System (called the Lulu Island Energy Company which is 100% owned by the Municipality C) ensures that there is mass adoption of low carbon energy , but also that it ties with the cities objectives of obtaining Step Code levels. This is done through by a concept known as “low carbon energy system” or LCES , which is defined as a mechanical system which uses low carbon on non-carbon sources(like electricity, biogas, solar) and provides energy for the purposes of space heating, space cooling or other uses for the households. This achieves the twin objectives of ensuring compliance with Step Code related targets and reduced GHG Emissions.

A few of the municipalities like Municipality E highlighted that they still have not instituted these sorts of targets ; a response of “not yet” would imply that these targets are likely to be instituted, although the timeline was not clear. Municipality A highlighted that P3 Buildings had now been integrated into the Energy Star Portfolio Manager suite and energy benchmarking was underway.

11.1.6 Step Code Impact on BC Municipalities

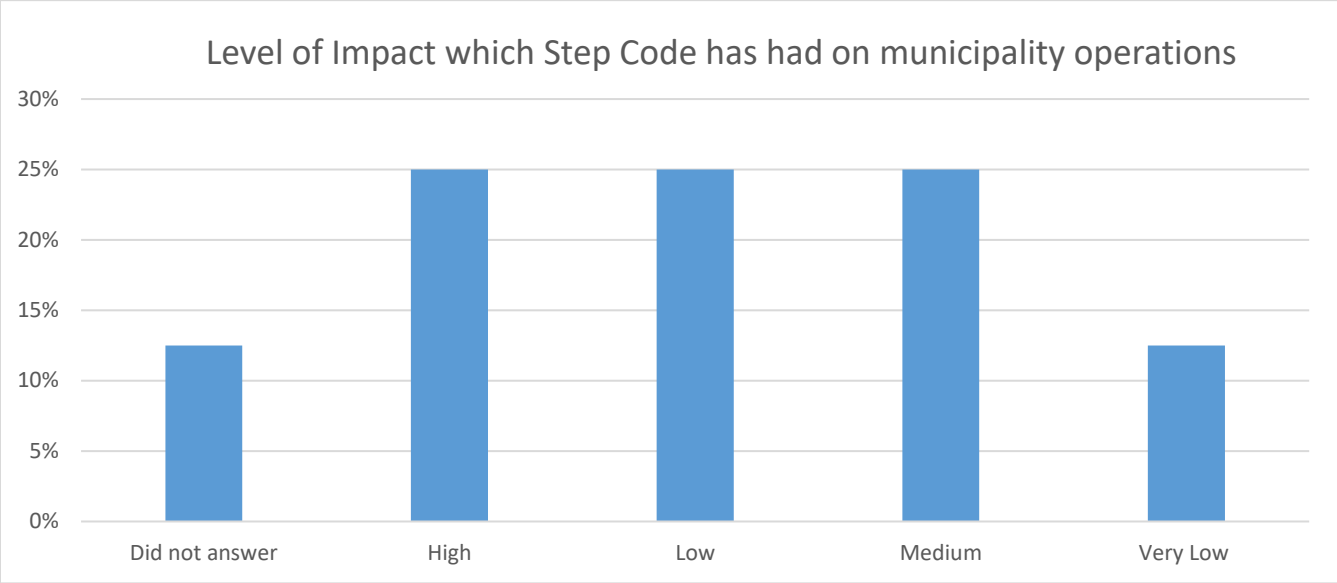


Figure 14 Graph depicting the level of impact the Step Code has had on various municipality operations. An Equal proportion of municipalities indicated high, medium and low impacts. This should be interpreted with caution.

An equal proportion of municipalities indicated the impact that the Step Code has had on their municipal operations. This result should be interpreted with caution as not all municipalities represent jurisdictions with the same population size. However, a general conclusion which can be drawn from Figure 14 is that half of the municipalities including Municipality B and Municipality A have highlighted that the Step Code has had medium to high impacts on their municipal operations.

In conclusion, municipality operations have been affected to varying degrees as a result of the Step Code.

When it comes to implementing GHGi related tasks, with the exception of Municipality G, no municipality has indicated a shift in resources. This is presented in Figure 15 below. In other words, most of the interviewed municipalities seemed to know little or nothing when it comes to processing compliancy reports pertaining to GHGi etc. Additional staff resources might become necessary should given increasing market trends in the backdrop of an expectedly stricter BCBC regulation.

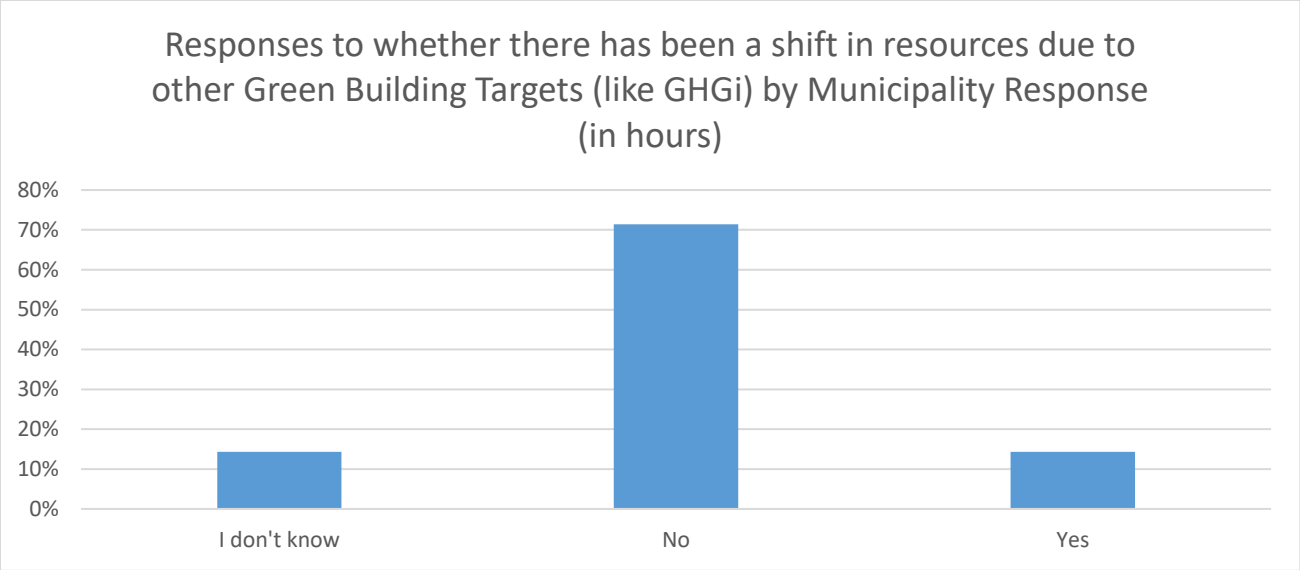


Figure 15 Responses to whether there has been a shift in resources when it comes to implementing targets other than GHGi.

Typically, municipalities rely on external professionals in order to inspect and certify permit application drawings and checklists related to Step Code compliance. However, as the regulation becomes more stringent (with BC Building Code being amended to include more and more upper steps requirement for the Step Code), the number of hours or minutes spent in analyzing one application is likely to increase.

Municipality	Number of P3 Permit Applications received per year (Survey Response)	Minimum Shift in Resources (hrs./week) (Survey Response)	Maximum Shift in Resources (hrs./week) (Survey Response)	Maximum Shift in Resources (hours/year) -	Permit Inspection Ratio = Maximum Shift in Resources Annually / Number of P3 Permit Applications per year	Number of Resources Required in terms of FTE (per week basis)
Municipality A	5*	0	10	480	96	0.250
Municipality B	4	0	10	480	120	0.250
Municipality C	300**	40	100	4800	16	2.500
Municipality D	150	100	140	6720	45	3.500
Municipality E	20*	0	0	0	0	0.000
Municipality F	109	0	0	0	0	0.000
Municipality G	0	0	10	480	N/A	N/A

*Table 1 Table indicating volume of P3 Permits compared against shift in resources as indicated in local government survey. * Number is assumed as the response was qualitative and not provided.** Number is considered average permit applications per year between 2014-18*

From Table 1, a very basic calculation using the survey responses pairing the shift in resources caused due to step code with permit applications revealed a substantial chunk of applications required more resources across various municipalities. For example, in order to check P3 applications for technical compliance in Municipality D, the minimum shift in resources indicated is a 100 hours per week. This amounts to around 2.5 FTE, which means that the municipality might have added 2 more resources. On the other hand, municipalities which indicated a zero shift in resources despite receiving P3 permit applications relied almost entirely on external professionals in order to check buildings for technical compliance. However, municipalities which indicated a shift of 10 hours per week due to Step Code lied somewhere in the middle and when asked about details provided that there were support positions regarding the Step Code compliance check. In conclusion, the human resource planning in the short term is an imperative if adoption of the Step Code is to be considered a priority.

11.1.7 Implementation Aspects

There is another aspect which emerges once the BC ESC is adopted, and that is how to implement it in day-to-day local government operations. It is important for policy to consider the issues at the working level, where applications are processed, drawings are inspected, and certificates are issued.

In the case of Municipality B, building permit applications which have been applied prior to June 2019 would not be subject to the BC ESC, forming part of the so-called *grandfathering provisions*. Those applications which are considered as "in-stream" i.e. they had been filed for permitting before the Step Code requirements came into force were dealt with grandfathering provisions, which means to either exempt the buildings or give time to industry in filing new permits which include Step Code related details. The procedures for P3 Buildings places much more emphasis on energy modelling reports at the design stage, mid-way of construction , and before issuing occupancy certificate.

In the Municipality C, a direct flow down of the policy on operational aspects was observed. To make an application to build to the requirements prior to the enactment ,there were several measures instituted which allowed buildings to progress ensuring compliance with the requirements which came into force before the Step Code. For outside the City Centre, the policies and provisions applied were in accordance to the BC Building Code.(*Municipality C Residential Occupancies Requirements*, 2018)

This grandfathering provision is important since it was also indicated during the interview that there were a lot of applications within the instream period between July-2018 and Dec-2019. Therefore, in order to ensure that there is not a mass influx of application revisions being received, grandfathering provisions could form part of the aspects on forming policy on implementing aspects of the B.C Energy Step Code.

Many municipalities, like the Municipality B for example, had rules in place for Development Permit applications, which is similar to grandfathering provisions. Applicants are given one-year time period in order to submit their revised applications. Furthermore, the relaxation given to builders if they install low carbon energy systems (please refer to Section 14.1 for more details), should also be noted that the Step Code relaxation was absent for P3 commercial buildings as signaled in their technical bulletin by the City and might form part of ongoing work. (Municipality B, 2020)

11.2 Experience of Implementing the Step Code for P3 Buildings in BC Municipalities

From the municipality interviews, it was apparent that challenges concerning the implementation of the BC ESC for P3 buildings centred around how resources are being deployed in order to check for

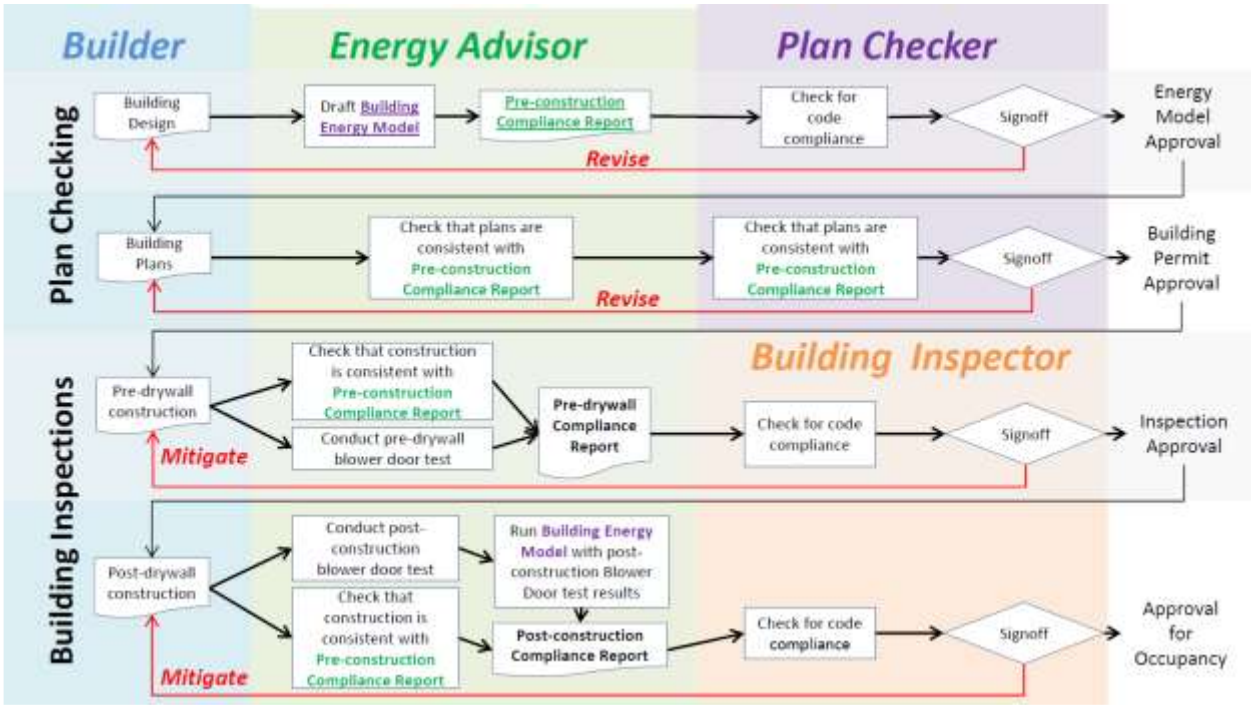


Figure 16. Typical scope split between Energy Advisor and Plan Checker (Courtesy : Municipality C)

compliance. Of all the municipalities surveyed, it was found that each municipality had these tasks completed by builders/planners, with the exception of Municipality E which relied on registered professionals. A typical work split between a plan checker and an energy modeller is shown in Figure 16. It can be seen that there are number of tasks performed by the plan checker (encompassing, checking for code compliance, checking whether plans are consistent with pre-construction compliance report, re-checking the code for compliance at other various stages). As the BC ESC becomes more and more widespread and stringent, there would be a need to have an audit process which would ensure that such tasks are being carried out with adequate accountability and efficiency.

Figure 17 shows the level of detail municipality staff go into while checking drawings for BC ESC compliance. A majority (>60%) of the respondents indicated that they go into low to moderate level of detail while checking drawings for BC ESC compliance, with 22% of municipalities indicating a high to very high level of detail.

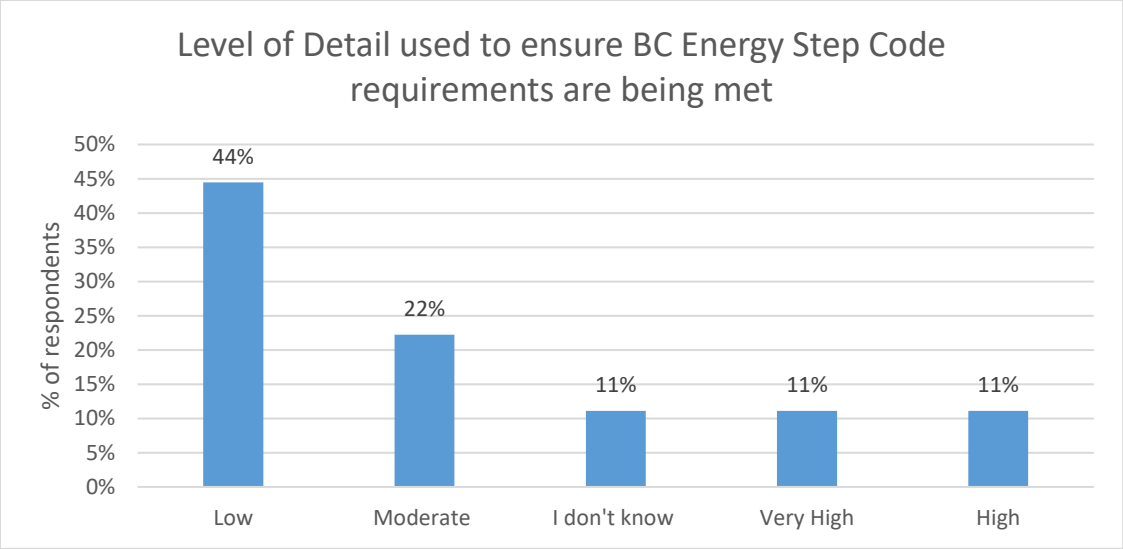


Figure 17. Survey responses as to the level of detail which staff go into while checking drawings for BC ESC Compliance.

One of the respondents from Municipality D stated that they look at one single application with a very high level of detail at random, instead of looking at each application with a very high level of detail. The municipality relies on Registered Professionals in order to complete the required documents and checklists carefully. There are certain support positions which are based internally within the local government organizations that supports industry but don't involve checking all the drawings with a very high level of detail completely. Municipality D staff also highlighted that unless there is a compelling need/requirement to check drawings for BC ESC compliance, there would be no resource pressure as such and staffing decisions, particularly relating to the BC ESC within municipalities, have to be made prudently and pragmatically. Municipality G responses that drawings were looked at with a low level of detail as there is lack of inhouse expertise for plan reviewing.

As Figure 18 suggests, of the total municipalities surveyed, >50% of the respondents indicated that they do not plan to hire additional staff in order to help them with implementation of the BC ESC for P3 Buildings. This might be because they do not receive enough P3 building permit applications per year to necessitate hiring a new full-time employee. This also might be due to budget constraints, which might push local government staff to increase the utilisation of their existing staff and supplement the additional skill set required to implement the BC ESC.

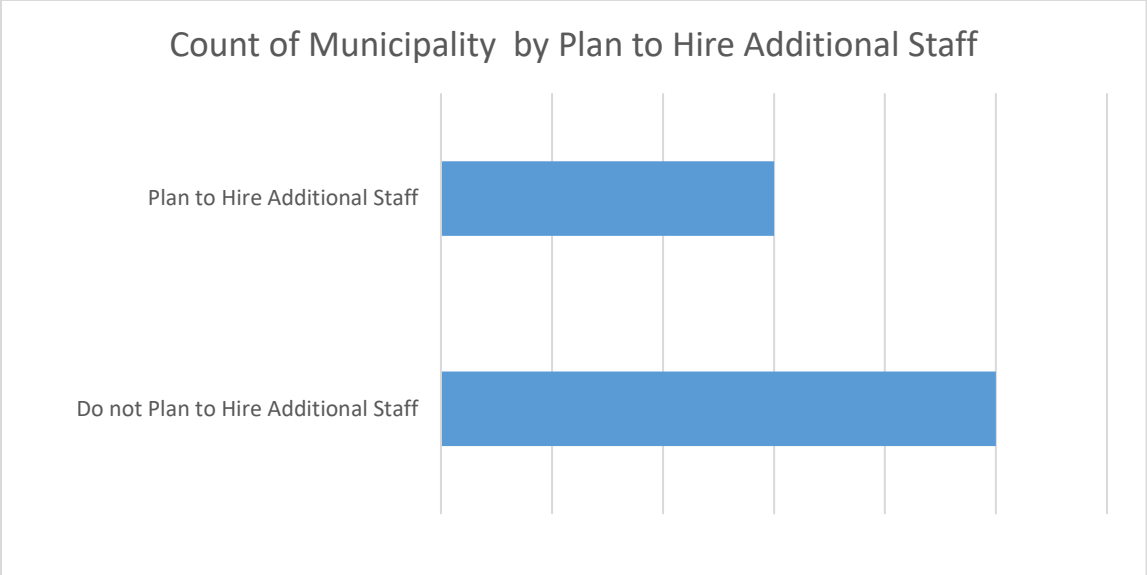


Figure 18. Graph depicting the number of municipalities that plan to hire additional staff vs. not plan to hire additional staff

The interviews also highlighted that municipalities trained different types of internal staff in order to equip them with the skills and competencies required to implement the BC ESC for P3 Buildings. These are briefly tabulated below in Table 2. Staff responsibilities for similarly named positions may vary slightly across municipalities.

Table 2 Types of staff which have been trained on the BC ESC for P3 Buildings in various interviewed jurisdictions

Municipality	Inspection Staff	Sustainability Staff	Clerks & Admin Staff	Other Staff
Municipality A	Yes	Yes	No	-
Municipality B	Yes	Yes	No	-
Municipality C	Yes	Yes	Yes	-
Municipality D	Yes	Yes	No	Yes (Plan Checkers)
Municipality E	Yes	Yes	Yes	-
Municipality G	No	No	No	-
TOL*	No	No	No	-

*TOL hasn't adopted Step Code for P3 Buildings

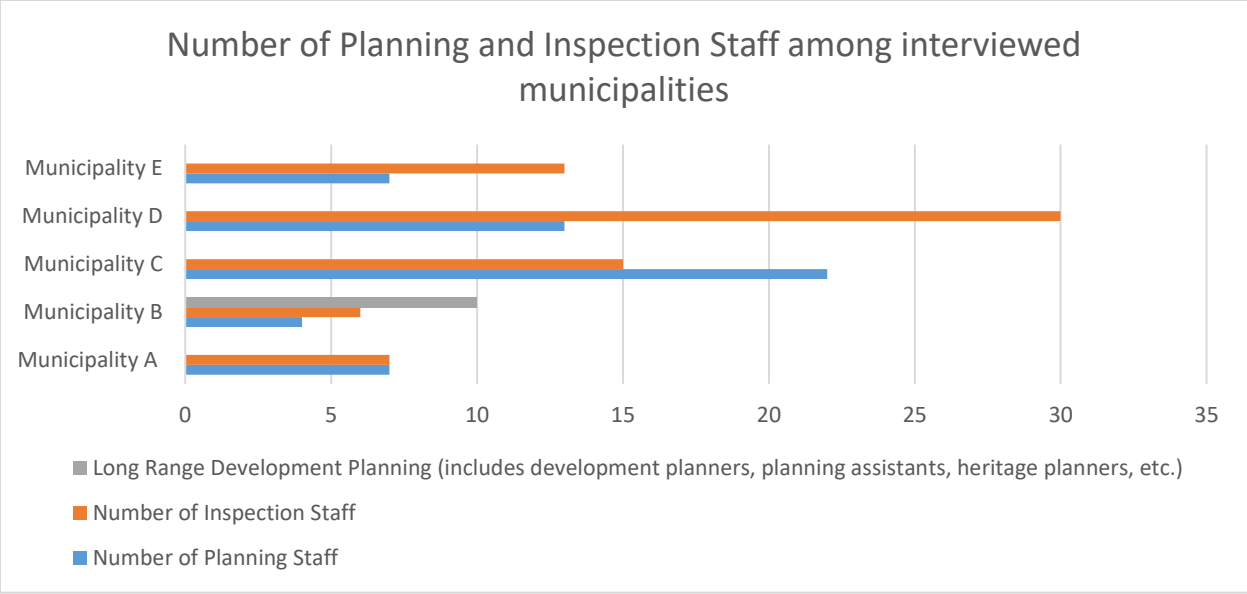


Figure 19 Staffing Levels Across various interviewed municipalities. Several municipalities did not provide the data; hence they are not presented here.

Figure 19 shows the staffing levels for municipalities. As one can see, the Municipality D has the most inspection staff and planning staff followed by Municipality C which is a close second. This is probably because these municipalities receive a large volume of permits per year.

The tasks of planning and inspection staff align more closely when it comes to implementing the Step Code. Compared to long range planning staff, whose roles and responsibilities gear more towards developing a planning vision for the local government and whose job roles are geared more towards policy rather than day to day tasks, the positions of building inspection and planning might be subject to a more significant shift in resource once Step Code adoption happens.

A more useful comparison and utilisation for staffing levels would be to compare them against the volume of P3 building permits received per year. Figure 20 displays the number of permit applications across the municipalities interviewed. As one can see Municipality C received the highest number of P3 applications in the last five years. If one compares it with the staffing levels, then one can see the logic behind resource deployment in their planning and inspection departments.

Referring back to Table 1, a useful metric for measuring potential staffing needs could be the time it takes for one person in the planning and/or inspection department to inspect one permit application for BC ESC compliance for P3 Buildings. This can be defined as the Total Number of Applications in one year divided by the number of hours spent on reviewing these applications. This would give us the total number of hours required to be spent in a single year which could then be used to assess position requirements.

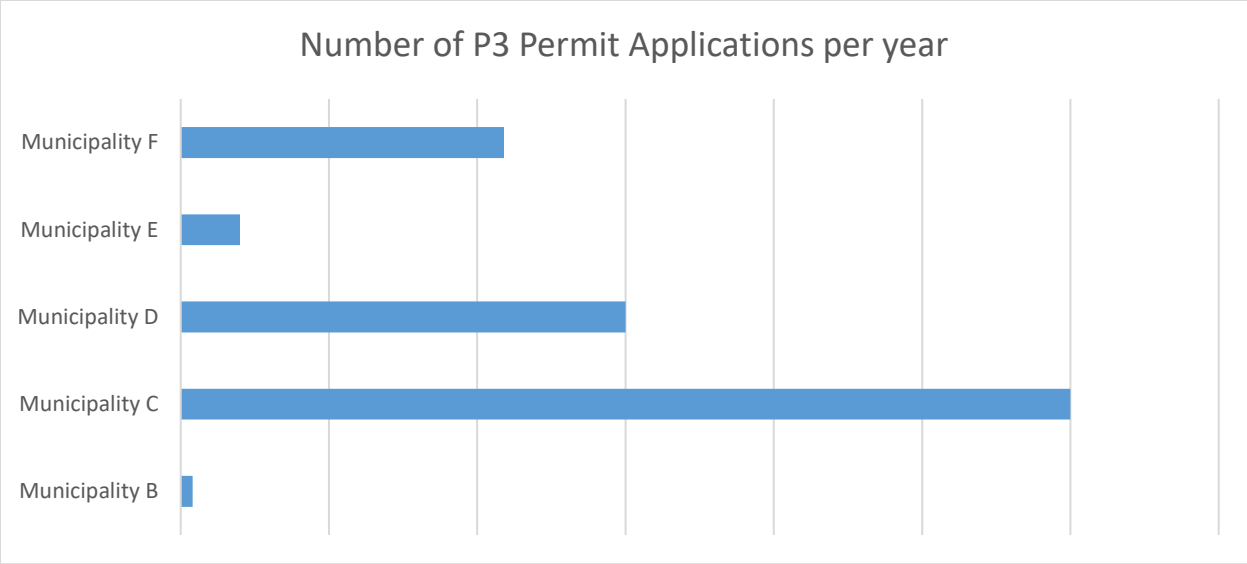


Figure 20 Number of P3 building permit applications received per year between for various municipalities. Municipalities which did not provide this information are not presented here.

11.2.1 Interaction of the Step Code with other initiatives

The responses regarding the question whether the BC Energy Step Code interfered with other initiatives or supplemented them was responded to in various ways by the municipalities.

Municipality A highlighted that the GHG Emissions reduction was one of the programs which was underway when Step Code came around. Infact, enforcing GHGi target was one of the work items for Municipality A. The Step Code, in combination with forthcoming regulations regarding GHGi, became a happy accident.

Municipality B staff indicated that they were pushing for higher sustainability standards(by instituting measures like sustainability checklists for architects and building regulatory tool, which could potentially monitor energy usage for P3 Buildings.

Municipality C had already embarked on its District Energy System program through its company, the Lulu Island Energy Company, whereas Municipality D told the Step Code interacted with its density bonusing program alongwith the Low Carbon Energy System Program.

Municipality G indicated that the Step Code was identified as a priority as far back as 2016 in Sustainability Strategy. It was described that the Step Code dovetails with their rezoning policies, which was substantiated by the fact that rezoning was one of the mechanisms through which they were pushing its adoption. As a city, BC ESC provided an opportunity to incentivise the industry by instituting appropriate policy. They also advised that going forward, the next step would be a two-pathway compliance model which would include Step 4 or Step 2 + LCES.

11.3 Analysis of Uptake Strategies and Incentives

Many of the municipalities responded that they did not have any incentives for BC ESC adoption, especially in the case of P3 buildings. Due to the recent nature of adoption of the BC ESC in many of the interviewed municipalities, there were not incentive strategies which were provided to the building industry. In one of the outreach efforts carried out by Municipality A it was mentioned that the building industry *"did not note any incentive requirement in the surveys which they had submitted".* This means that the industry itself does not see financial incentives as a route to increase the uptake of the BC ESC for P3 buildings.

At the time of writing this report, limited incentive mechanisms were available to help Industry meet the BC ESC. Hence, policy levers (rezoning, GHG DPA, LCES, etc.) discussed in the following sections could be considered.

As an option, several elements of the P9 incentive program could be considered. However, this constitutes potential future work and hence is not the focus of this report.

11.4 Case Studies for P3 Buildings in BC Municipalities

A goal of the municipality interviews was to compile examples of P3 Buildings which had successfully met the requirements of the BC ESC, which could help inform Step Code adoption for TOL. A majority of the municipalities responded that it was still early days for P3 Buildings, and that best practices were still uncertain. Therefore, only two buildings are briefly highlighted below for the purposes of this project. As time passes and P3 building subject to the BC ESC are completed, there is a chance case studies might emerge .

11.4.1 1545 Douglas and 455 Pandora – Municipality I

1545 Douglas St and 455 Pandora Ave are two completed projects which adhere to Steps 2 and 3, respectively, and are located in the Municipality I. These are office and retail complexes which have also achieved other certifications such as the v2009 Core & Shell system and also targeted LEED Platinum (CaGBC v2009 CS).

11.4.1.1 Methodology followed, and lessons learned

Through the course of design development and construction documentation, aspects of the design like exterior envelope components. All aspects were tested against energy modelling target inputs and implemented by the consultant team with extreme care to ensure anticipated energy performance would be maintained.

Modern mechanical systems such as Hybrid/Air-Source Heat Pump, Heat Recovery Ventilators (HRV's) and In-Floor Radiant Heating were incorporated. More information can be found in the reference (Various, 2018)

Some of the case studies' best practices have been highlighted below:

1) Using energy modelling at the schematic design stage and being very specific regarding goals of modelling for e.g. investigate various envelope and wall systems and test sensitivity of total annual utility consumption and energy cost, identifying potential thermal breaks or sources of high intensity energy consumption.

2) Develop energy targets (e.g. LEED)
3) Develop energy targets in terms such as TEUI and TEDI (in preparation for meeting the BC ESC)
4) Implementation of underfloor Displacement Ventilation Systems(DVS) requires buy-in from tenant/end-user early in design stage. A DVS is a ventilation system which uses density stratification in order to provide ventilation to a room. The lighter air which is hotter CO_2 escaping out of the residents of the room is ventilated out by the action of colder, much heavier which is delivered to the room.
5) Development of measurement and verification plan for implementation of digital controls and metering of utilities – defining how much information is required and how it will be used by the operator/landlord.

11.5 BC Energy Step Code in various other BC Municipalities

As mentioned earlier, over 20 municipalities had adopted the BC Energy Step for P3 Buildings. However, only seven out of the 20 municipalities had responded. Therefore, a literature search regarding positioning of various municipalities which had adopted the Step Code for P3 Buildings was carried out. The various aspects covered in this examination of the municipalities involved – whether they have referenced the Step Code in their relevant bylaws, what types of occupancy for P3 Buildings they have discovered, whether they have carried out an internal costing analysis to assess potential impacts with respect to the Step Code, whether they outlined preliminary plans regarding the adoption of future steps of the Step Code, what aspects of their strategy have they aligned well in order to adopt the Step Code for P3 Buildings, whether they have Step Code Relaxation in place and last but not the least how they have they dealt with in-stream applications in order to build to the step code for P3 Buildings. Certain jurisdictions were not covered in the literature review dur time limitations. A table concerning of municipalities which have adopted the Step Code is given in Appendix A.

11.5.1 – Municipality J

Municipality J has referenced the BC Energy Step Code in their bylaw (Sweeney & Buck, 2020) Just like other municipalities, Municipality J also carried out a consultation process with industry before adopting the Step Code. It had co-ordinated with the Town of Comox for its program. Their plans are included in the bylaw – which for P3 Buildings specify a minimum of Step 2 for P3 new construction buildings. However, no evidence was found for any LCES related Step Code Relaxation or Builders building to a GHGi target. The Building Services Department is the lead department in charge of implementing the Step Code. The bylaw, however, does not differentiate between various occupancy types which are subject to the Step Code. It should also be noted that Energy Efficient buildings is a part of their Climate Action Strategy which lists reduction of Greenhouse Gas Emissions from their P3 Buildings. Since there has been a discussion regarding the outreach process followed by various municipalities in relation to the Step Code, the process followed by Municipality J is noteworthy since they also carried out a development industry survey asking various questions about how the City can best support the building community. (Municipality J, 2019). One of the more wide-ranging responses were that the City Needs a clear line of sight when it comes to building to the step code without the rules being changed mid way. Furthermore, responses also included cost offsets and educational opportunities for the builder community.

11.5.2 – Municipality K

The Municipality K is one of the smallest municipalities in BC in terms of size. They have referenced the BC Energy Step Code(VILLAGE OF BELCARRA Zoning Bylaw No. 510,2018, 2018). The relevant section of the bylaw also includes both P3 and P9 buildings. The steps mentioned in this bylaw is Step 2 for P3 buildings and Step 3 for P9 buildings without going into details regarding the occupancy types. The terminology of "conditioned" and accessory buildings. There was no information regarding GHG emissions related Step Code relaxation.

11.5.3 – Municipality L

The Municipality L adopted the BC ESC by referencing the same in their bylaw(Municipality L Consolidated Building Bylaw, 2018) The requirements for P3 new construction are prescribed in the Districts publicly facing brochure , which is currently Step 2 for P3 Buildings. There are a lot of incentives for single-family dwellings, but the incentive programs for P3 buildings couldn't be located. There is also mention of the Municipality L aligning and standardizing building energy efficiency requirements, in tandem with North Shore Municipalities including Municipality R and Municipality M. More details regarding Step Code Requirements and future requirements are mentioned below :

Building Type	Current Requirements	Effective February 28, 2021
Part 9 residential (single family, townhouse and other Part 9 residential buildings)*	Step 3 of 5	Step 5 or Step 3 with low carbon energy system
Part 9 detached secondary suite*	Step 1 of 5	Step 5 or Step 2 with low carbon energy system
Part 3 residential (multi-family and apartment buildings)	Step 2 of 4	Step 4 or Step 2 with low carbon energy system
Part 3 business and personal service or mercantile (commercial, office and retail buildings)	Step 1 of 4	Step 2

*Compliance with the Step Code will require the input of an Energy Advisor at various stages of the project, including design, construction and building completion. Building Permit applications must include a performance modelling report along with construction details that show how the proposed house will comply with the BC Energy Step Code and the low carbon energy system pathway, if applicable.

Figure 21 Municipality L's Step Code Requirements for various building types (Source : Municipality L Website).

Provincial cost estimates have been utilized by the municipality, as per information available.

11.5.4 – Municipality M

The Municipality M was one of the first North Shore municipalities to adopt Step Code. It has referenced the Step Code in it's bylaw(" Construction Regulation Bylaw , 2003 , No . 7390 ," 2020) and applies for new construction for P3 Buildings. The municipality has utilized provincial cost estimates to assess the impact on Step Code for P3 Buildings. The graphics on the next page depict the Step Code Targets and the Municipality M's Step Code Plans and Targets for various types of building occupancies.

Figure 22 BC Energy Step Code Targets.

	Prior to Phase 1	Phase 1	Phase 2
	Prior to Dec. 15, 2017 Requirements	Dec. 15, 2017 Base Bylaw Requirements	July 1, 2018 Base Bylaw Requirements
Part 3 Residential Buildings	Enhanced Compliance	Step 1	Step 2*
Part 3 Commercial Building	Enhanced Compliance	Step 1	Step 1*

Figure 23 Municipality M's Step Code plans. The asterisk mark indicates that their rezoning policy prescribes one step above the requirement. (Source : Municipality M Website)

Municipality M introduced grandfathering provisions in order to streamline the process for P3 Buildings. This means that applicants have a specific time in order to submit permits by a specified due date and apply for a building permit within one year.

11.5.5 – Municipality R

The Municipality R's Step-Down implementation plans are shown below. The lead department regarding Step Code Implementation is the Building Department. The Step Code is referenced in its bylaw(DISTRICT OF MUNICIPALITY R CONSTRUCTION BYLAW 8271 , 2017, 2017). These plans are outlined although the split between building occupancy types is not mentioned.

Building type	Description	Required step
Part 9 residential	Single family home, coach house, smaller townhouse	Step 3
Part 3 residential	Larger multi-family and apartment projects	Step 2 (Step 3 if a rezoning was required)
Part 3 commercial	Larger commercial, office, and retail buildings	Step 1

Figure 24 Municipality R's Step Code targets. Please note the MUNICIPALITY R has suspended plans regarding adoption of upper steps for all building types till 2021.

The Step Code wasn't effective here until July 1, 2018; however, MUNICIPALITY R has required all the buildings to target much ahead of the provincial timeline. It has, also included different types of occupancies which includes schools colleges, hospitals recreation centres, in its energy efficiency plan.

One very distinct feature about the Step Code Adoption for MUNICIPALITY R so far, is that they have also applied the Step Code to building retrofits, which was not the intended purpose of the BC ESC. As per their Community Energy and Emissions Plan they have supposedly plans to "Implement a Building Retrofit program to gradually improve the energy efficiency and comfort of existing building stock in the District (including both residential and non-residential buildings ; publicly or privately owned)" (Municipality R & Integral Group LLC, 2019)

The following types of buildings have been mentioned in the MUNICIPALITY R CEEP Plan

- Commercial Buildings (e.g. offices)
- Retail and Service Stores
- Restaurants
- Accommodations(e.g. hotels)
- Schools
- Religious buildings
- Institutional Buildings(e.g. hospitals and libraries)
- Light industrial Buildings (e.g. warehouse)

Furthermore, their consultation process with industry has formed part of the Community Energy and Emissions Plan which has include the *"Development Industry as a stakeholder".*

The plans set out by the District also include exploring opportunities to diversify the District's energy portfolio with renewable energy systems.

The Municipality R also has something known as Energy Conservation, Water Conservation and Greenhouse Gas Reduction Development Permit Area(DPA). This is akin to the GHG DPA found in TOL and its key principles are

- An integrated design approach should be used to identify opportunities to reduce a building's energy and water consumption , improve overall building energy performance , reduce GHG

emissions and also improve the overall carbon footprint and take into consideration the source , type and future disposal /recycle fate of the building materials used.

- A qualified professional is required to be retained and co-ordinate an integrated design approach
- The development should be designed and constructed so that the energy budget for the proposed building and structures will be better than National Energy Code of Canada for Buildings (NECB) and American Society for Heating Refrigeration and Air-Conditioning Engineers by a specified percentage. (Municipality R, 2019)

11.5.6 – Municipality N

Municipality N has referenced the BC ESC in its Building Bylaw No. 7224,2016 in relation to the Step Code (Building Bylaw 2016 no. 7224, 2019).

The Step Code implementation strategy has laid out and phased implementation is needed in order to provide the builders time to familiarize themselves in order to be able to build to the Step Code. The following table references the plans for the Municipality N.

	Part 9 Buildings (Residential)	Part 3 Buildings
Step One (Enhanced Compliance)	**2020-APR-21** Perform Energuide or Energy Modeling to current BCBC requirements	**2020-APR-21** Conform to Part 8 of the NECB
Step Two	**2021-JAN-02** 10% greater than current BCBC requirements	**2022-JAN-02** 20% to 40% greater than current BCBC requirements
Step Three	**2022-JAN-02** 20% greater than current BCBC requirements	**TBD**

Figure 25 Step Code Adoption Plans for Municipality N(Source : Municipality N Website)

One of the main noteworthy policy manoeuvres by the City has been the amendment of Schedule D of their Zoning Bylaw(Municipality N Zoning Bylaw No . 4500, 2020), which provides density amenity provisions to those developments which exceed the Step Code Requirements mentioned in the Bylaw. This latest provision, passed in the recent past, allows for developers to acquire additional density in many zones as outlined in the Schedule D, which meet Step Code Three and above of the Energy Rebate Program.

Furthermore, the City has applied the requirement of Energy Advisor Assessment to both P9 and P3 Buildings as a part of it's Step Code Implementation Strategy. The City , in 2020, is considering a review of it's implementation Strategy of the Step Code which includes expedited implementation plan taking into account the City's Climate Emergency Declaration and also plans to submit a report regarding rezoning policy. (Municipality N, 2020).

11.5.7 – Municipality O

The Municipality O has adopted the Step Code for P3 Buildings(The Corporation of the Municipality O, Bylaw No. 3710, 2013). Below is the schedule and anticipated plans for Municipality O in relation to the Step Code.

Building Type	Oct 23 2019	Mar 1 2021	2022	2024	BC Building Code 2027	BC Building Code 2032
Small Residential (BCBC Part 9)	Step 1	Step 3	~	Step 4	~	Step 5
Large Residential Combustible (BCBC Part 3)	Step 2	Step 3	~	Step 4	~	~
Large Residential Non-Combustible (BCBC Part 3)	Step 1	~	Step 2	~	Step 3	Step 4
Commercial (BCBC Part 3)	Step 2	~	~	Step 3	~	~

Figure 26 Municipality O Step Code Adoption Schedule.

11.5.8 – Municipality P

Municipality P adopted the Step Code and referenced it in it's bylaw(Municipality P Building Bylaw No. 1822, 2004, n.d.), mentioning Steps for various types of P3 Buildings. The residential buildings are mandated to achieve Step 3 and P3 Commercial Buildings are mandated to achieve Step 2. The plans for Municipality P regarding adopting future steps are highlighted below

Part 9 Buildings	Phase 1 July 1, 2018	Phase 2 Jan 1, 2019	Phase 3 Jan 1, 2021
Part 9 Small Residential Buildings (1,000 sq. ft. and under in gross floor area, essential Carriage Homes)	Step 1		
Part 9 Residential Buildings (over 1,000 sq. ft. in gross floor area)	Step 2	Step 3	Step 4
Part 9 Commercial Buildings	Step 2		Step 3

Part 3 Buildings	Phase 1 July 1, 2018	Phase 2 Jan 1, 2019	Phase 3 Jan 1, 2021
Part 3 Residential Buildings Wood Frame	Step 3		Step 4
Part 3 Commercial Buildings	Step 2		Step 3

Figure 27 Implementation Plans for Municipality P. Note that there is a distinction between various building types.

11.5.9 – Municipality Q

The Municipality Q had already a successful Energy Efficiency Rebate Program in place before the Step Code adoption took place. In it's current form, the energy efficiency in buildings initiative for the Municipality Q includes Step 1 for Complex Buildings, which basically means P3 Buildings. (Building Bylaw No. 2620, 2018(Proposed), 2018)

The municipality also offers several incentives to industry in order to encourage investment in the industrial , commercial and institutional type buildings. This includes a 100% relief for the municipal portion of the property taxes subject to certain number of conditions. Kimberly also has both P3 and P9 Energy Advisors in the community which makes the process more streamlined (How the Municipality Q is implementing the Step Code : A short video).

For an exhaustive list of all BC Municipalities and their positioning regarding their Step Code plans, please refer Appendix A

In summary, many of the municipalities have adopted Step Code for P3 Buildings, although this has been more of recent trend. Most of the municipalities consulted with industry as to what is feasible to achieve and carried out a survey in order to understand the concerns of the industry better. In terms of implementation, some of the municipalities have sophisticated rules and regulations in place whereas others are behind the curve. A major take away from the interviews is that the Step Code is likely to cause shift in resources for municipalities because of increased compliance requirements coupled with increased permit volumes in the future, which is signalled by whether they plan to hire additional staff.

At least half of the municipalities indicated having plans to hire additional staff in connection with BC ESC implementation. This signals resource planning has followed Step Code adoption.

12 Builder Survey

In order to get a holistic view of Industry's experiences with the BC ESC for P3 buildings outside of the TOL, a survey was designed and emailed to the TOL's Green Buildings email list and made available between July 6-13, 2020. The survey covered Industry's experience working on P3 buildings, the challenges they faced in other municipalities, and how the BC ESC has affected their resources. Furthermore, the survey also included questions on technical aspects such as impacts on building practices, high performance wall assemblies, and mechanical and electrical systems.

For the list of survey questions, please refer to Appendix B

12.1 Analysis of Survey Results

12.1.1 Number of P3 Buildings subject to the BC ESC

A majority of the respondents (>80%) indicated that of the P3 Residential Buildings they work on, at least some are subject to the BC ESC. >20% of the respondents answered that many of the P3 Residential buildings are subject to the BC ESC. However, almost ~18% of the respondents responded that none of the P3 residential buildings they work on are part of the BC ESC. These respondents most likely work on P3 residential buildings in jurisdictions where the BC ESC is not yet adopted or only work on P3 non-residential buildings. Figure 28 highlights the results from the paragraph.

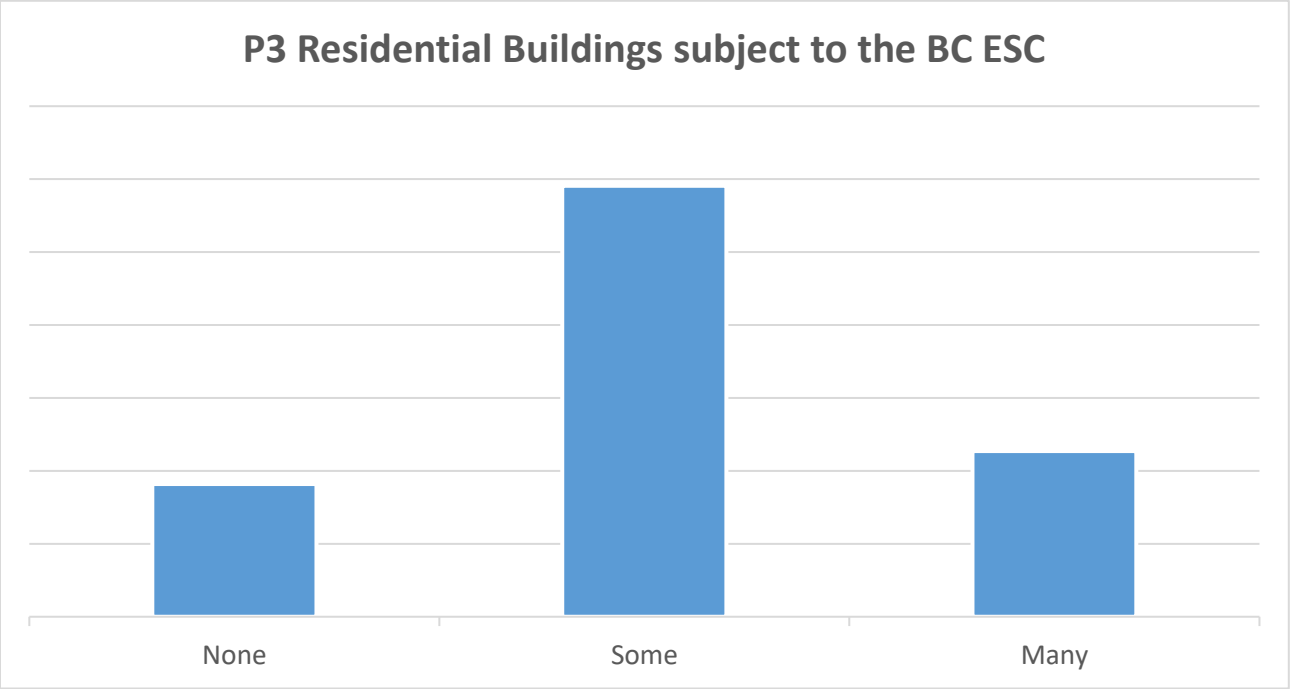


Figure 28. Survey responses on how many of the P3 residential buildings which they work on are subject to the BC ESC.

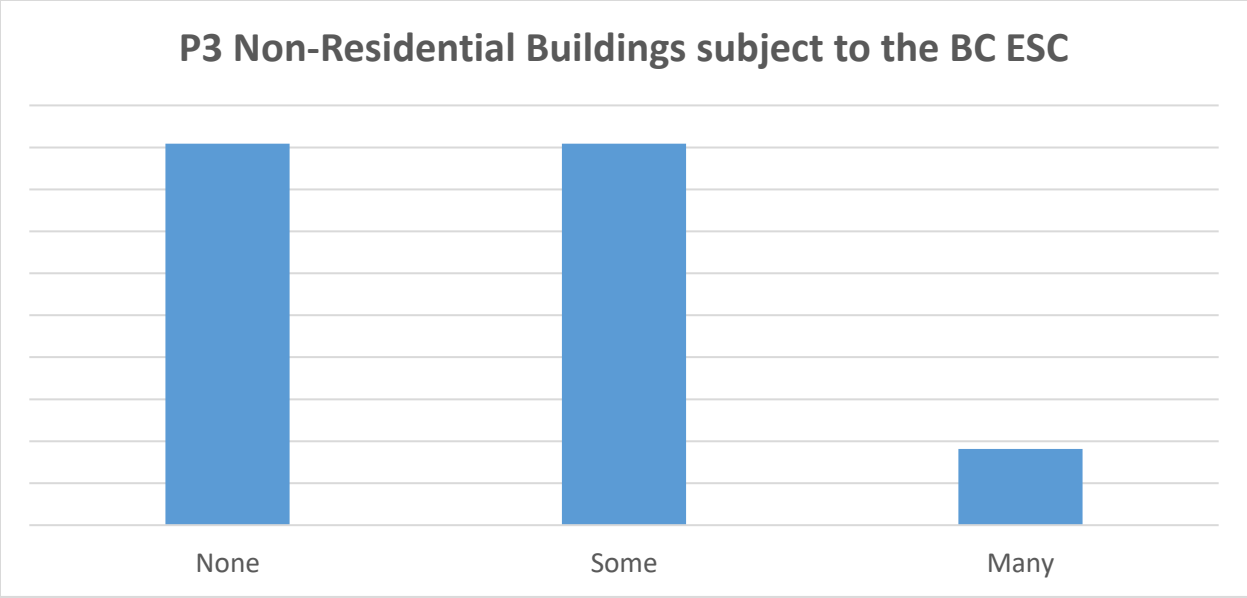


Figure 29. Survey responses on how many of the P3 non-residential buildings which they work on are subject to the BC ESC.

12.1.2 BC ESC Impact on Builder Resources

12.1.2.1 Industry Experience Building to the BC ESC

It is apparent from the survey that implementing BC ESC for P3 buildings has been challenging for Industry. A clear majority (~91% of the respondents) indicated they have faced challenges, to varying degrees, with only a minority saying that they have experienced no or very few challenges. The small minority of the respondents who indicated there had been no changes to process might form a target group for further consultation or outreach to learn how they have adapted to the new requirements of building to the BC ESC. Figure 30 displays the results discussed in the above paragraph.

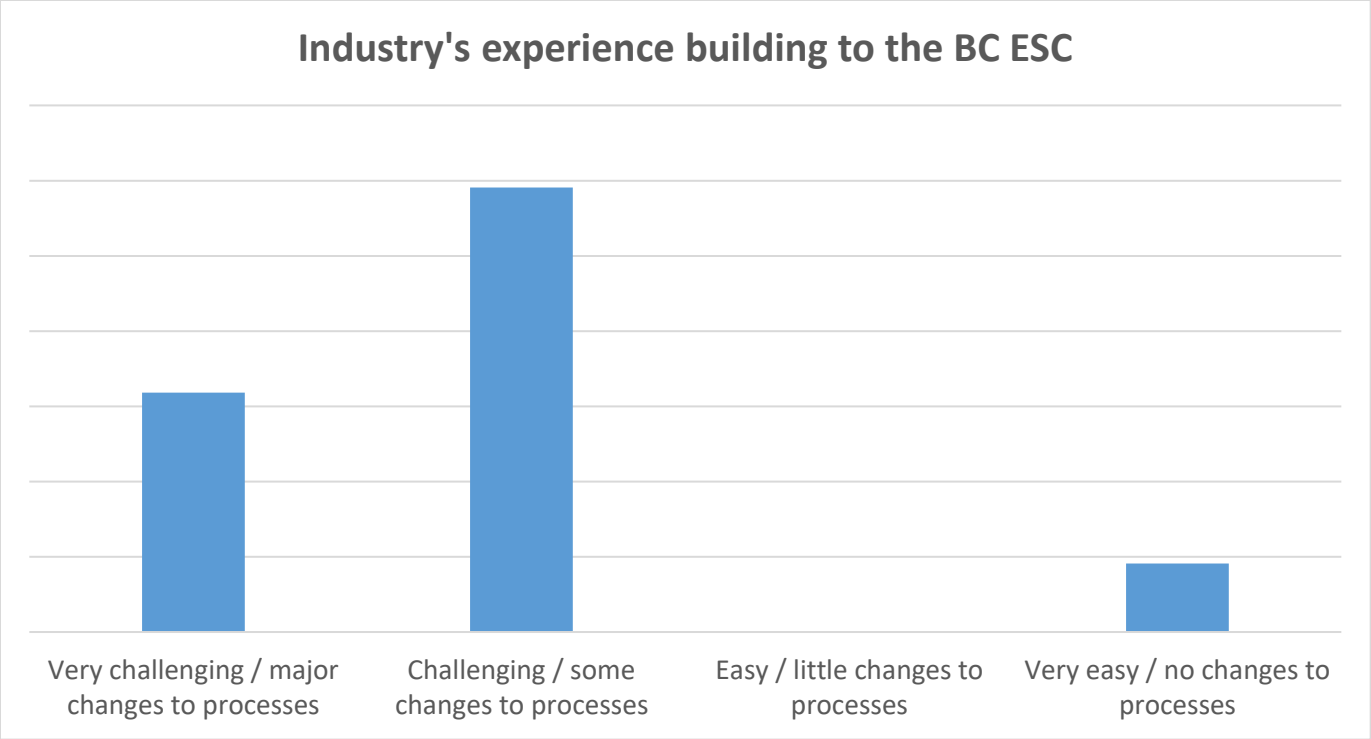


Figure 30. Survey responses regarding Industry's experience building to the BC ESC.

12.1.2.2 Design Issues, Cost Implications & Time Burdens

Figure 31 shows that 90% of the respondents expressed concerns with the BC ESC for P3 Buildings having a cost impact. Almost all that have highlighted cost impacts have also selected design issues as an area of concern. Almost half of the respondents have highlighted time burdens, meaning that the added complexity and detailing required might cause delays in their projects.

12.1.2.3 Capacity Issues

Capacity Issues were also highlighted by respondents as an area of concern. Building to the BC ESC is still new for everyone involved in the Industry, which likely means that finding qualified trades has been challenging for the respondents, as has been highlighted in one of the descriptive survey responses. Builder training and educating subtrades is one way that the TOL could address capacity issue concerns. Figure 31 presents these results.

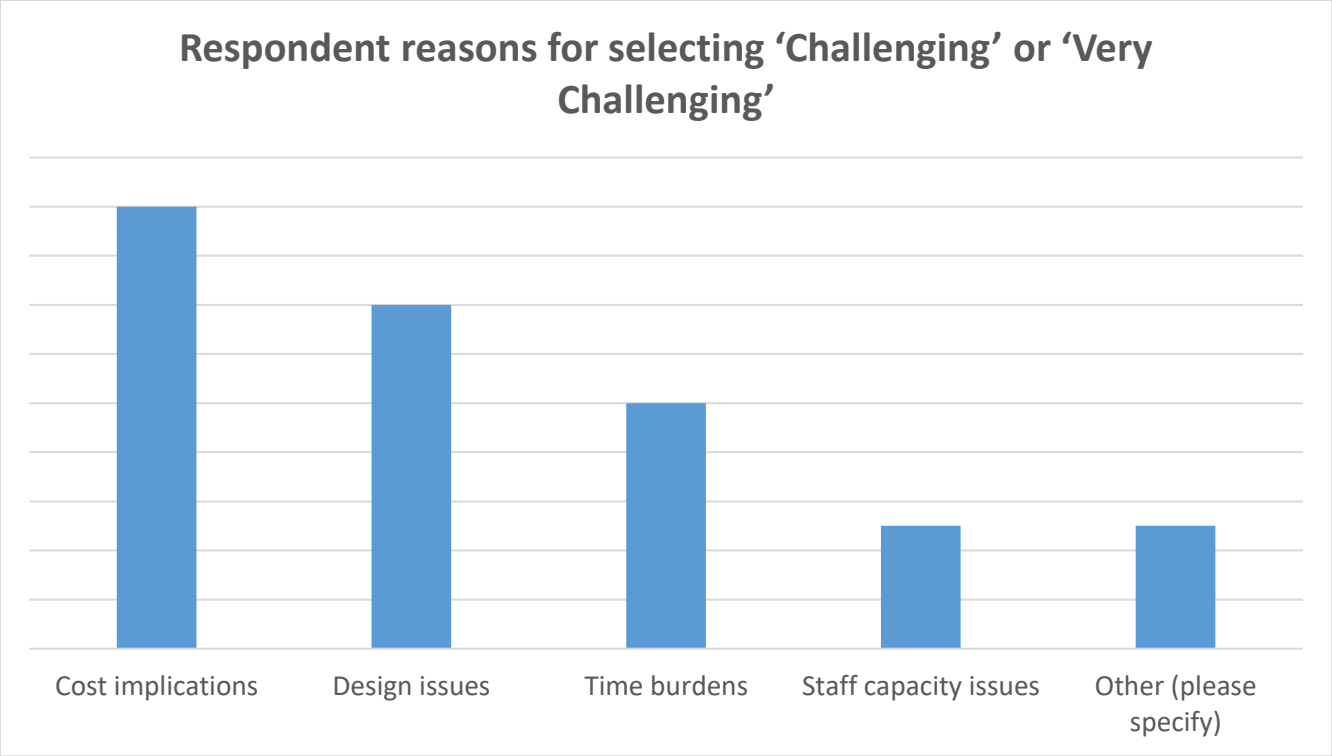


Figure 31. How the BC ESC has made building P3 projects more challenging for respondents.

12.1.2.4 Building to the BC ESC in other BC Municipalities

It can be seen from the results displayed in Figure 32, when asked about how the BC ESC has made them change their building practices in other jurisdictions, over 80% of the respondents indicated that they had to completely change their building practices. When asked to justify their choices, responses highlighted design issues, cost increases, more time with consultants, lack of dependability of energy modelling results, much more attention to detail, among others. One of the responses highlights lack of certainty regarding best practices and outcomes, and also because now there needs to be greater awareness regarding energy efficiency while designing. However, specific design issues were not asked for in the survey and might form part of an "across the table" consultation process which the TOL may choose to undertake.

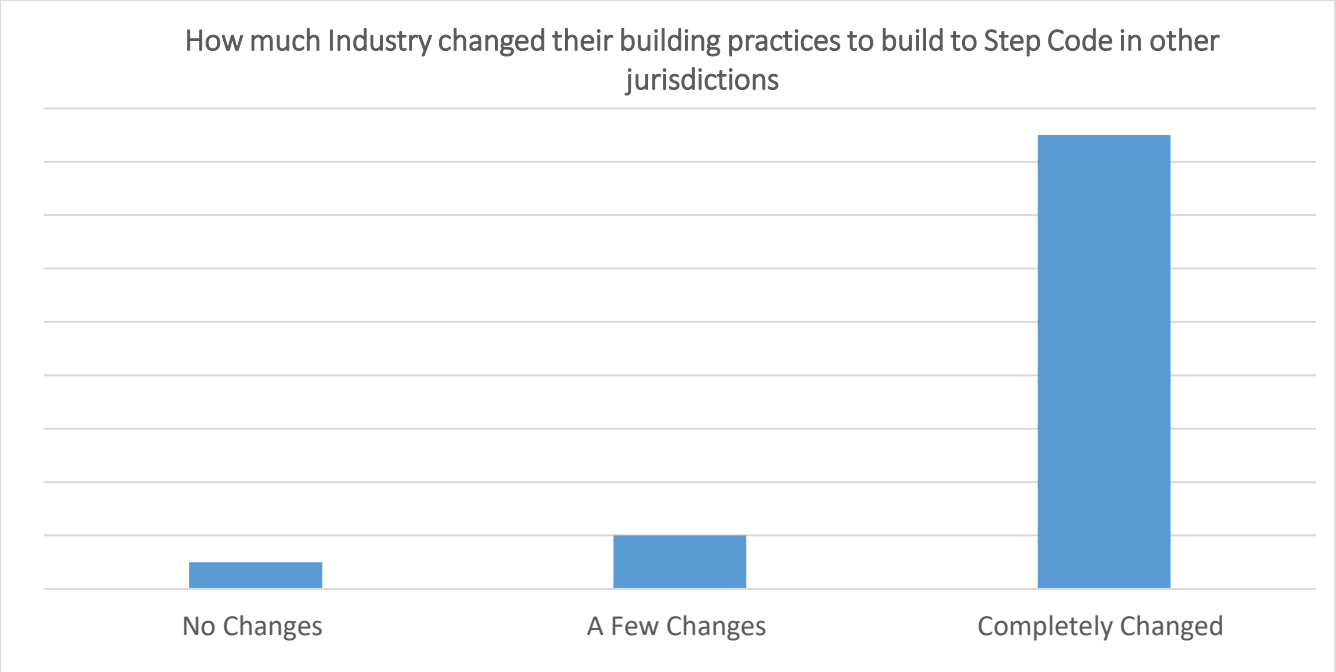


Figure 32. Survey responses regarding how much Industry has had to change their building practices while building to the BC ESC for P3 buildings in other municipalities.

An overwhelming majority (~95%) of the builders have at least made some changes to their building practices, with most of the respondents having made substantial changes to their building practices as a result of the BC ESC. A more detailed look at the justification for indicating such responses revealed one noteworthy remark regarding lack of best practices and outcomes for designing to BC ESC for P3 Buildings. This can be correlated with lack of case studies and might signal that industry might need some active discussion and support when it comes to best practices in connection with the BC ESC. Municipalities can play a critical role in facilitating this.

12.1.2.5 The Integrated Design Process (IDP)

The Integrated Design Process has been one of the cornerstones of market transformation relating to the BC ESC, whereby issues relating to design and construction are identified early as part of a multi-stakeholder participation session. The stakeholders usually include builders, developers, architects, energy consultants, mechanical, electrical, and lighting engineers, and others. A majority of the participants surveyed (68%) have indicated that they have participated in an IDP session (Figure 33) Therefore, a much lengthier discussion can be conducted regarding their experiences in the discussion in builder breakfast events. Such respondents may be asked deeper questions during industry interaction regarding early issue identification, interaction of different building occupancy types, among others.

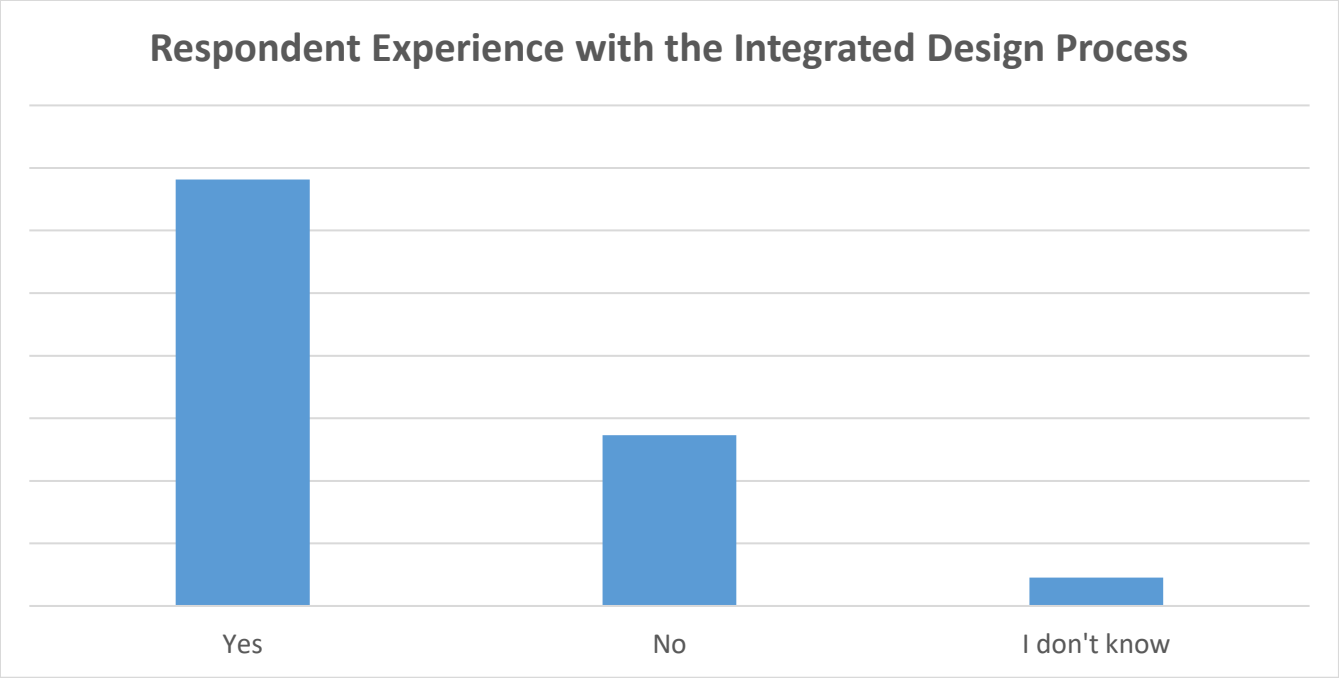


Figure 33. Responses regarding experience with participating in Integrated Development Process related Projects.

12.1.3 Implementation Aspects highlighted in builder survey

It is apparent from Figure 35 that increase in incremental construction costs while building to BC ESC for P3 Buildings, more than 90% of the respondents indicates increase in construction cost increase relative to pre-Step Code, but a significant proportion of respondents indicated otherwise. Over 46% of respondents said that the incremental construction cost was between 3%-9% . ~48% of the respondents

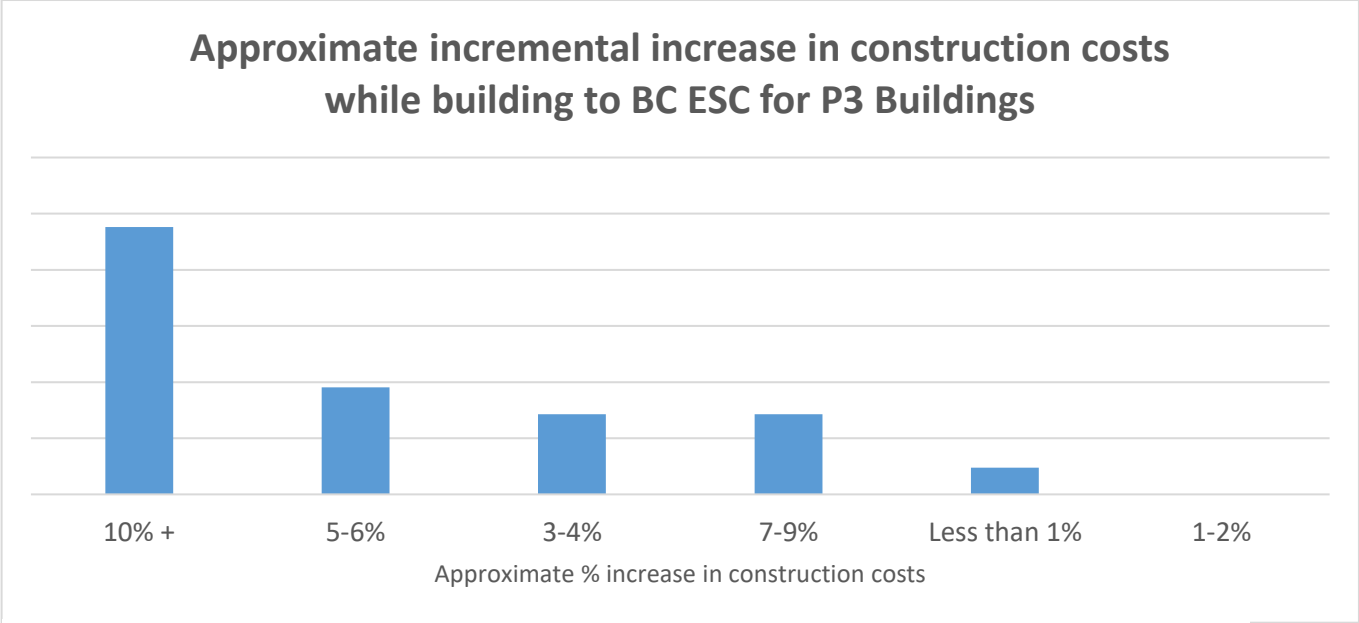


Figure 34 Approximate incremental increase in construction costs while building to Step Code as responded to during the survey. More information is needed in order to understand where exactly cost increase is happening.

indicated the cost increase was more than 10% and a small minority indicated that cost increase was less than 1%, making both of these data points interesting.

A more in-depth consultation session could involve asking these respondents questions about their costing heads and parameters which they feel they cannot control and are dependent on the regulation (a separate survey needs to be designed in order to understand this more in detail; this can also mimic both an internal costing study and a fact checking exercise) The questions could include topics from the project details and what elements of building construction were facing a cost increase.

As shown in Figure 35 , the respondents highlighted that HVAC and envelope experienced the highest cost increase when it came to build to the BC ESC for their P3 Buildings, followed by HVAC and Lighting.

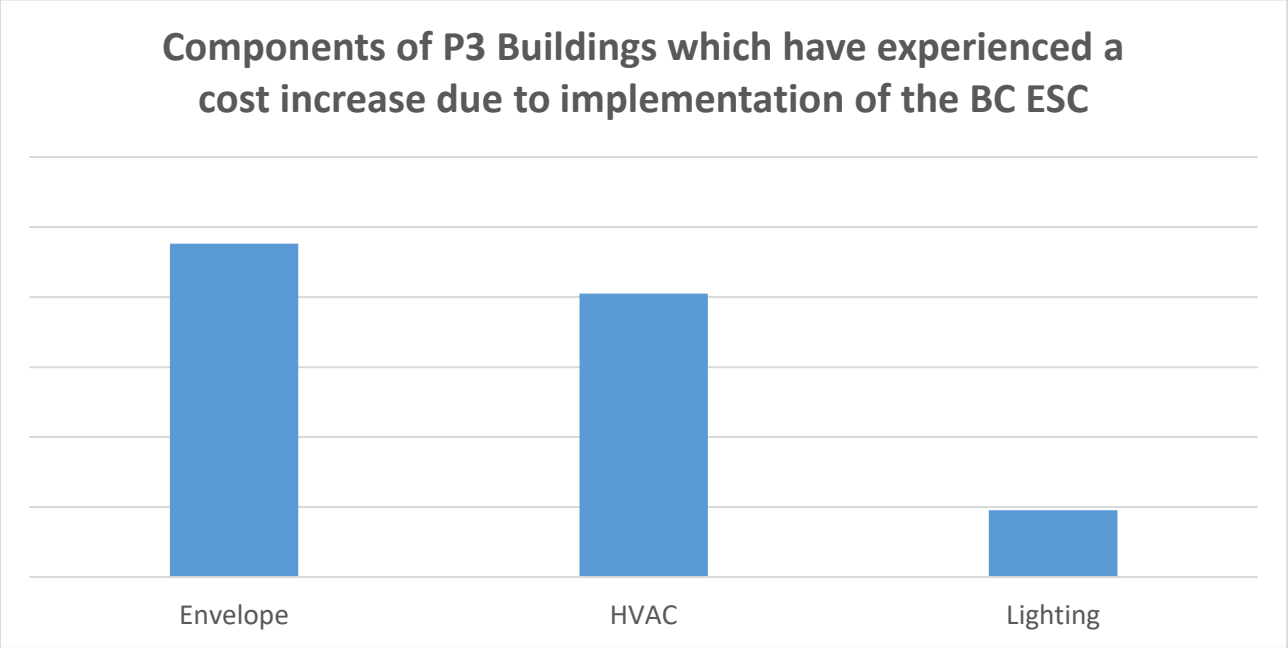


Figure 35 P3 building components which have experienced a cost increase due to BC ESC implementation.

Regarding the energy performance requirements of the BC ESC for P3 buildings, most of the respondents (~42%) said they have had difficulties in achieving the Total Energy Use Intensity (TEUI) metric (Figure 36). The TEUI metric reflects the energy usage from the building's mechanical equipment.

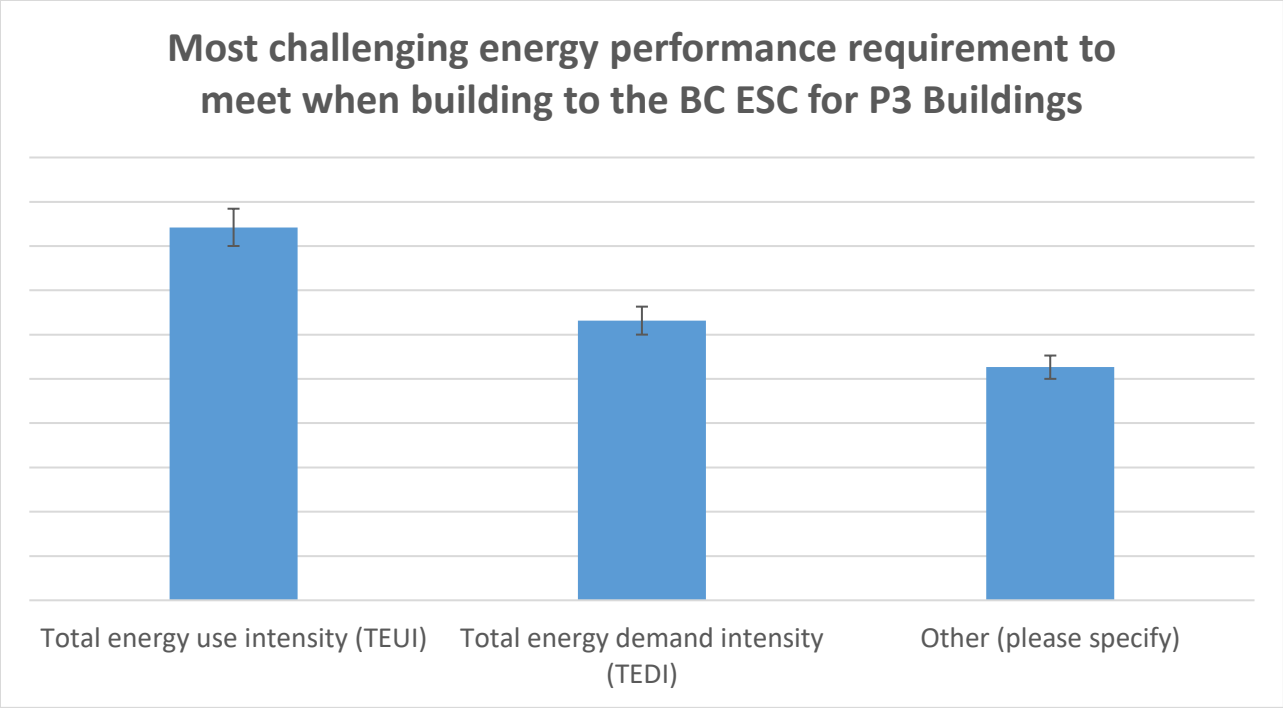


Figure 36. Energy performance requirements which are difficult to meet in achieving compliance with BC ESC for P3 Buildings.

Figure 36 also shows that builders have had other challenges in meeting the BC ESC for P3 buildings (26% of respondents). Respondents indicated that these challenges include meeting airtightness targets, which is a measure of how much air escapes from the building through unintended gaps and cracks in the building envelope. Overheating was highlighted as another aspect and is directly related to the unmet cooling hours of a building.

Regarding constructing high performance wall assemblies(Figure 37), 86% of builders have indicated that they have encountered moderate to major challenges. Two respondents highlighted that wall assemblies will need a major redesign to meet the BC ESC. Another respondent highlighted that air leakages near connections of different components is a challenging aspect. Some of the respondents have also highlighted that they have not faced any challenges as compared to pre-Step Code era. This is interesting and more data should be collected with regards to presence of any best practice which might have accumulated for the benefit of the community.

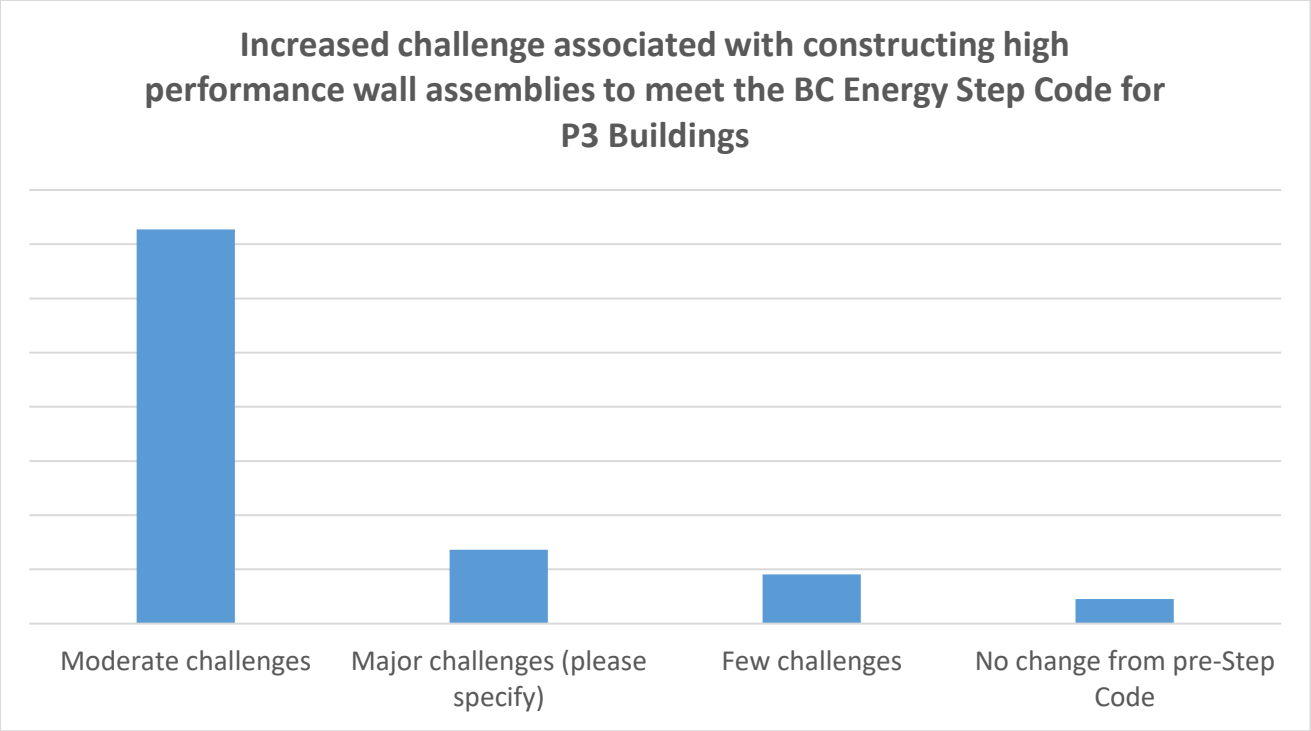


Figure 37. Challenges associated with constructing high performance wall assemblies while building to the BC ESC for P3 Buildings.

With regards to ease of building to the BC ESC in terms of mechanical and electrical equipment, most of the respondents (>60%) have indicated that building to the BC ESC for P3 Buildings has led to moderate challenges (Figure 38). Those which indicated major challenges highlighted that ventilation and selecting cost optimum solutions without compromising on TEUI numbers were some of the major challenges they faced.

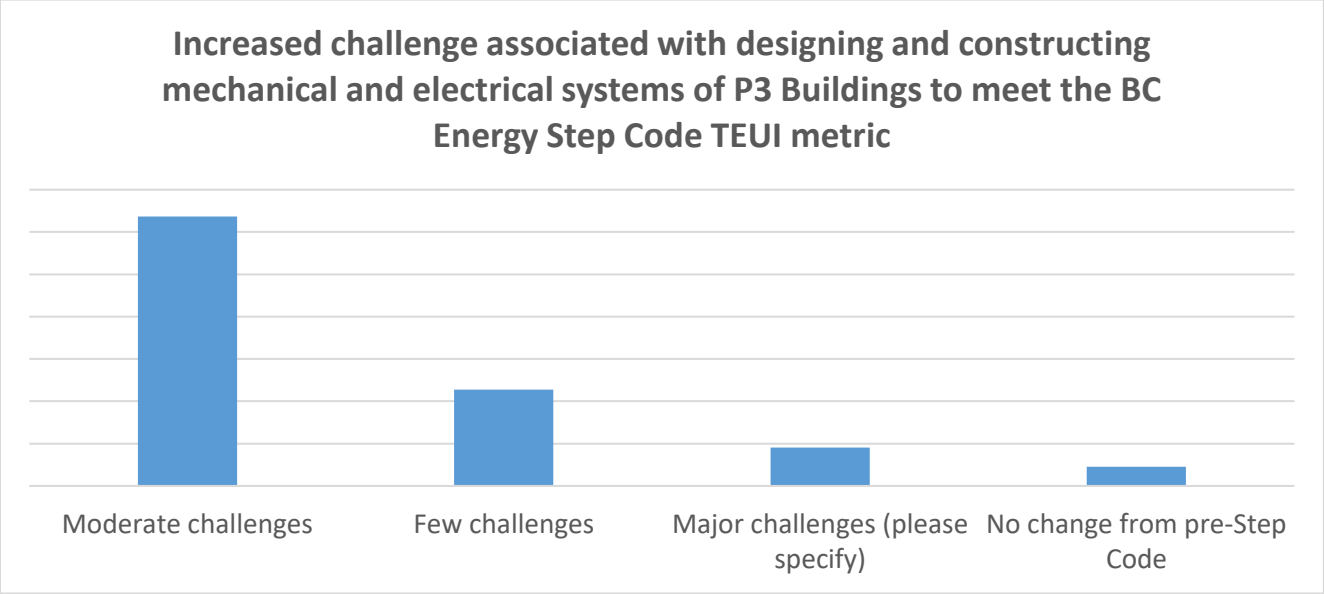


Figure 38 Builders' response to question regarding mechanical and electrical equipment design and construction to achieve BC ESC TEUI.

12.1.4 Industry Experience building to a GHGi target

A majority of the survey respondents (>70%) indicated that they have either not yet had experience building to a GHG intensity (GHGi) target, or they are unaware of it. This makes potential implementation more challenging from a policy perspective as most builders would likely need education and training before being mandated to meet GHGi targets (Figure 39). If the TOL were to implement a GHGi target for P3 buildings, this could have a measurable impact on building emissions as GHGi targets directly limit the amount of GHGs a building can emit, as well as making the TOL one of few BC municipalities to adopt a GHGi target for P3 buildings. However, this needs to be considered as low priority and only taken up once Step Code adoption and implementation has taken place. This also might require more research and deliberation once the Step Code has been fully adopted. The municipalities which are prescribing GHGi targets as part of their energy efficiency metrics in addition to BC ESC requirements are given below :

- Municipality C
- Municipality D
- Municipality G
- Municipality B
- Municipality H (does not come under Step Code jurisdiction)

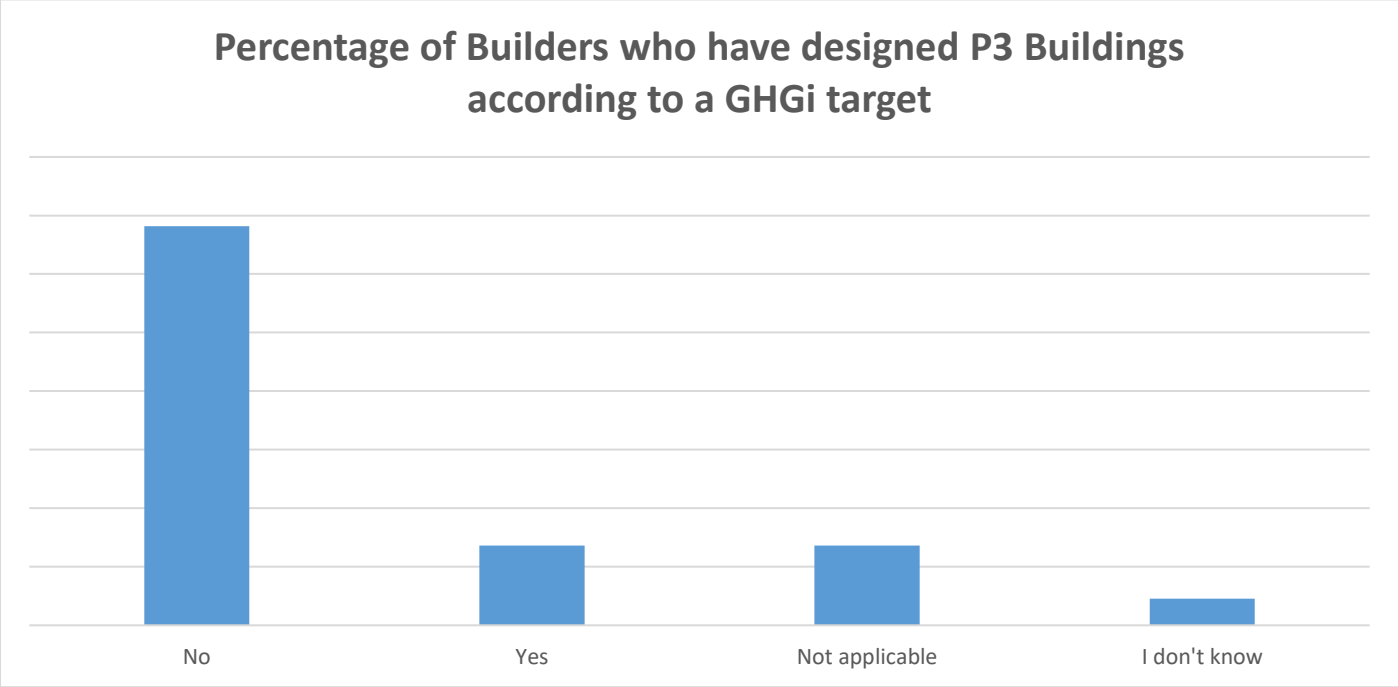


Figure 39. Survey responses regarding industry's experience in designing P3 buildings to a GHGi target.

12.1.5 Industry Experience with Low Carbon Energy Systems

Designing a P3 Building with a Low Carbon Energy System (LCES) is something half of respondents have had experience with. An LCES is defined, as per Municipality G's Green Building's Policy document: "*…a highly efficient, professionally operated and maintained mechanical system that supplies a building's space heating, cooling and domestic hot water heating demand primarily from renewable energy sources, at a carbon intensity that is low enough so that when applied to modelled building energy use, the development satisfies the City's defined GHG limits as outlined in the green building policy.*"

As a majority of the respondents (50%, shown in Figure 40) have already worked on some sort of an LCES system, it is feasible that the adoption of a LCES policy could also be considered for the TOL, but it is also important that if adopted, the TOL provides educational opportunities for Industry to learn about LCES's.

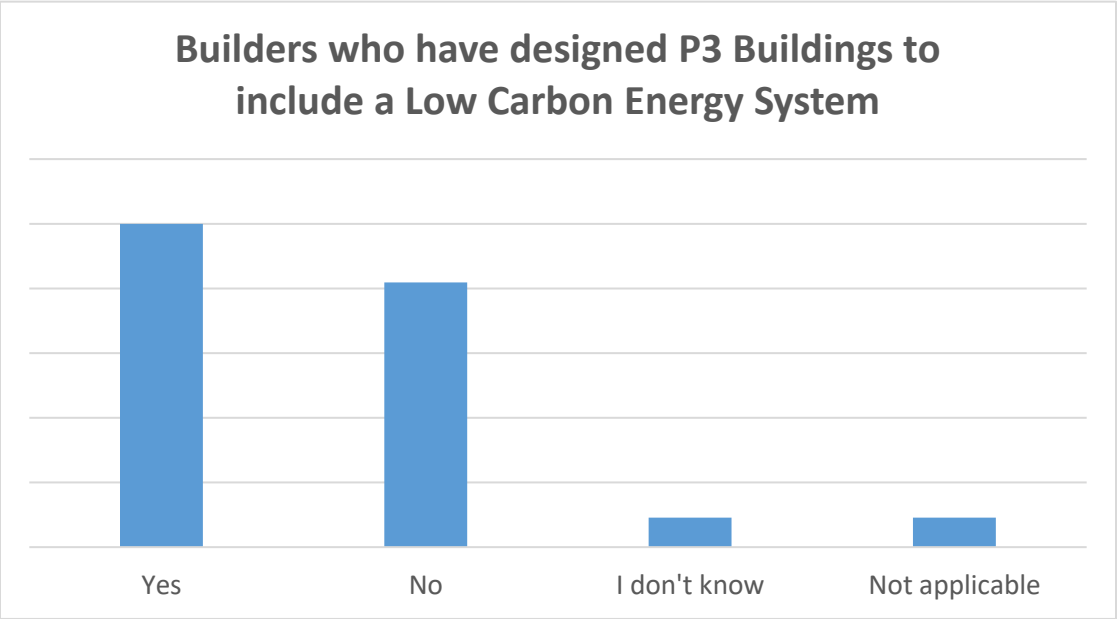


Figure 40. Survey Responses regarding *industry's experience designing P3 Buildings to include low carbon energy systems.*

12.1.6 Information about respondents

Survey respondents were asked which specific part(s) of the building industry they normally work in. Half of the respondents indicated they are a developer, then 41% indicated builder, and 23% indicated architects. Figure 41 presents the results discussed above.

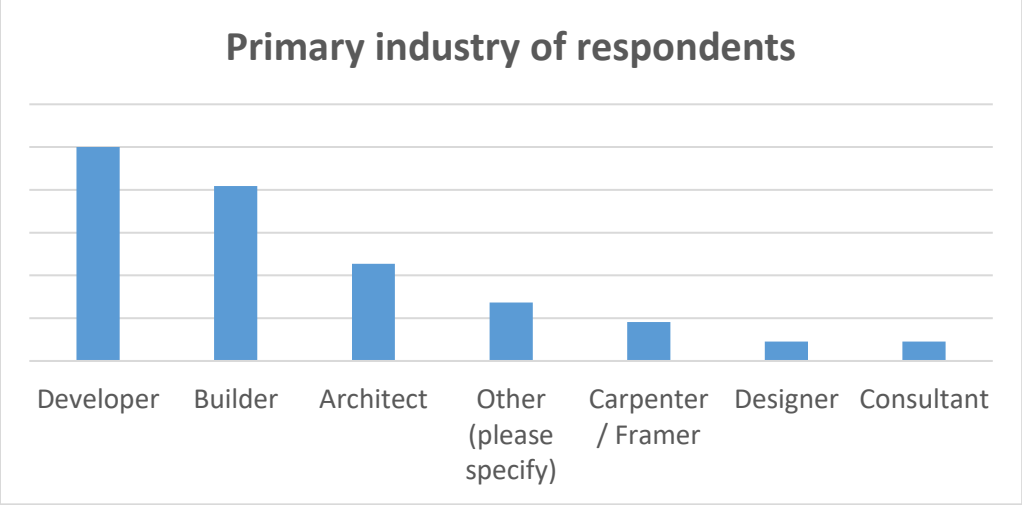


Figure 41. Specific building industry of respondents as indicated in the survey.

Figure 42 shows that approximately 76% of the respondents indicated that they work on multi-family residential buildings (these are apartment buildings which classified as “other residential” in the BC Building Code). However, considering the number of P3 building permits which are expected to be issued going forward, particularly commercial, industrial, and institutional buildings, those set of builders would form a part of the target priority group in order to carry out further engagement. For the respondents which indicated “Other” , worked on industrial buildings and hotels. It should be noted here that none of the builders’ work on hospitals.

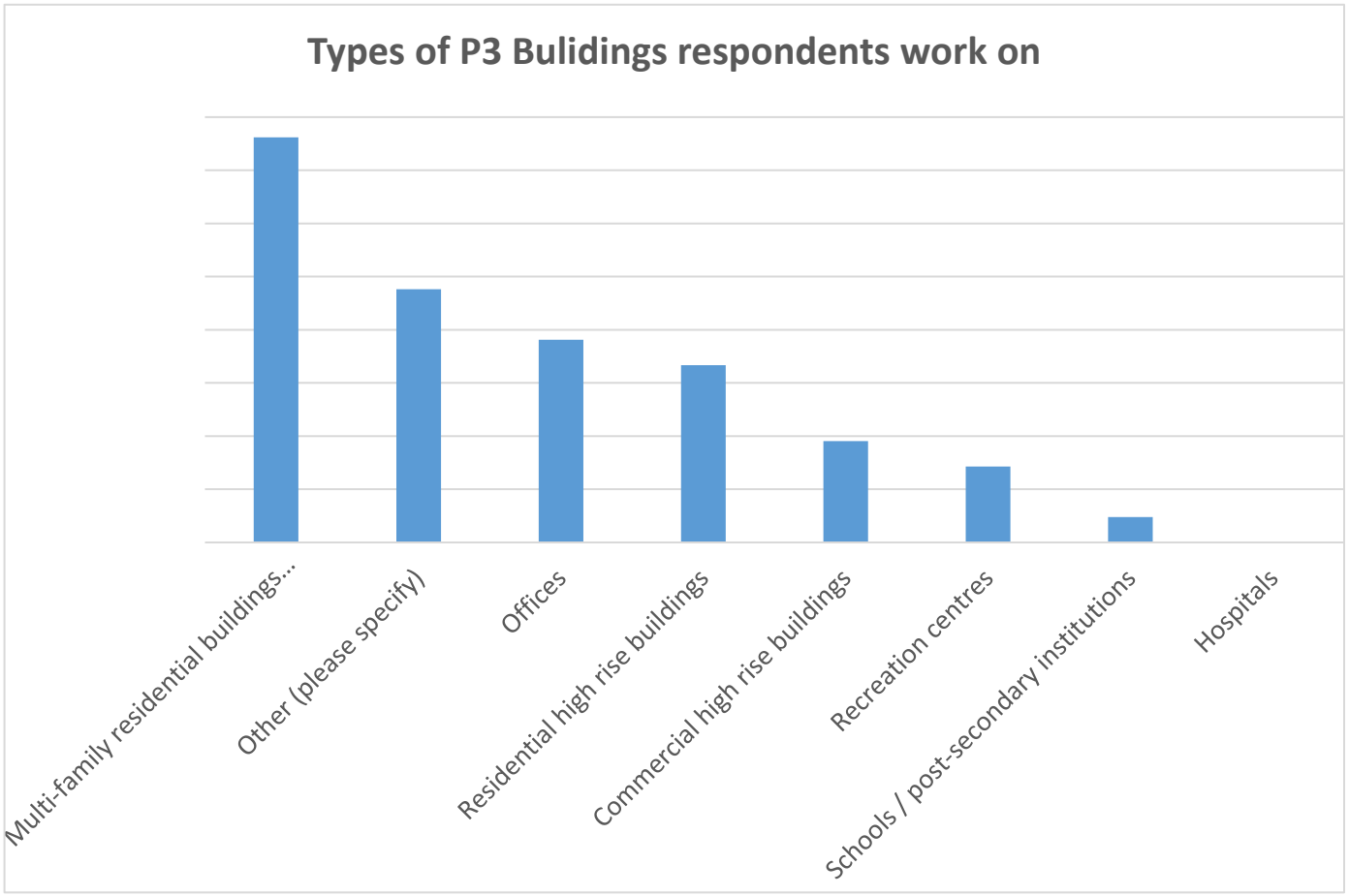


Figure 42. Types of P3 Buildings which respondents work on. Respondents can select multiple building types.

A final question asked to the respondents was which municipalities they primarily worked in (Figure 43). A wide range of municipalities were selected throughout the Lower Mainland, with TOL at the top with 91%, Municipality D following with 73%, and Municipality F close third at 50%. These results align well with previous Green Buildings surveys. An interesting inference is that Municipality F has adopted Step Code as latest as January 2019 but is still at Step 1 for P3 Buildings. A quick survey on its website revealed that the there is a current backlog of around ~76 P3 Permit Applications and that the city has not adopted Step Code for Single Family Residential Buildings.

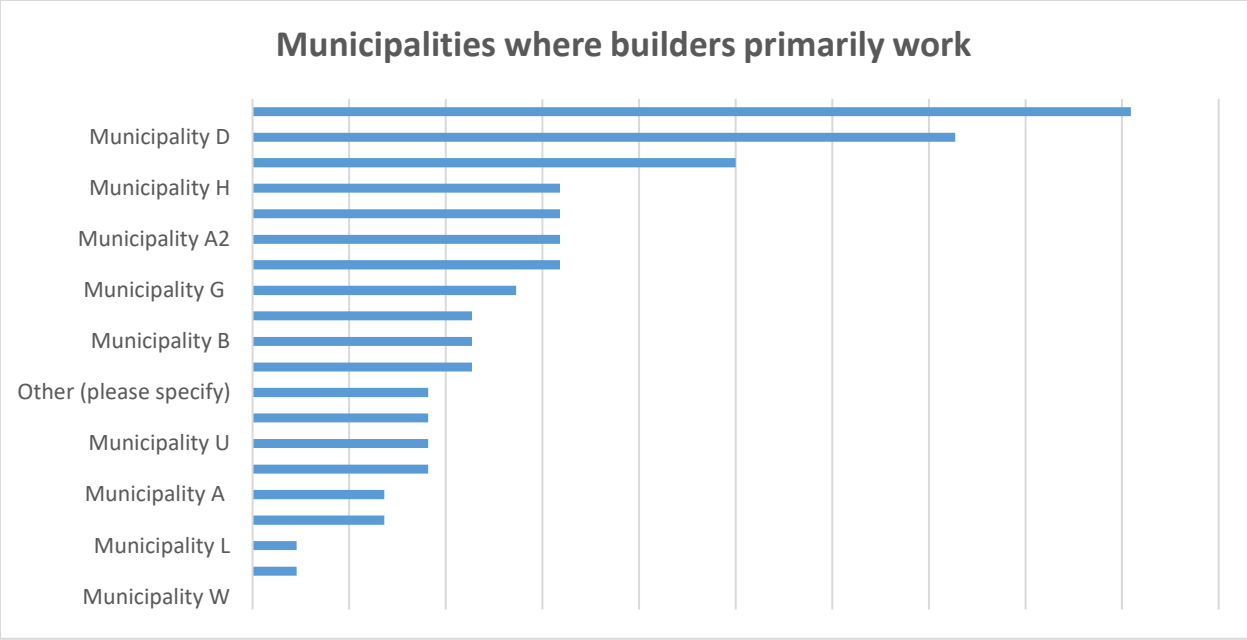


Figure 43. Graph highlighting which municipalities Industry works in. Respondents

In conclusion, it can be said that the TOL can hugely benefit from the industry's experience if it chooses to hold consultation, particularly with reference to their experience building to the Step Code in other jurisdictions. The industry seems to have built some experience while building to the Step Code and are aware of the pain points and issues. Reaching out to them results in a potential win-win situation, whereby both the TOL and the industry benefit through well informed policy making and implementation.

12.2 Analysis of Incentives and Uptake Strategies

Based on the survey, builders indicated an inflation in construction costs and costs associated with installing various equipment and conducting certain tests. Considering those extra pieces of feedback from builders, few of the incentives which are prevalent in literature are going to be investigated in this section. These incentives range from financial rebates to exemptions in terms of property tax and other such incentives. It should be noted that these incentives are purely financial in nature and do not include policy incentives like Step Code Relaxation, Density Bonusing, Expedited Permit Processing which lean more towards the policy side. Furthermore, only incentives related to P3 Buildings with occupancy other than single family residential are going to be discussed here.

Table 3 Various Incentive Programs relating to the Step Code for P3 buildings in BC.

Incentive Type	Offering Organization	Remarks
Building Permit Fee Discount	Energy Efficient Building Incentive Program (Kimberley, n.d.)	Applicants must submit an energy modelling and performance assessment report, completed by a Certified Energy Advisor , along with the Building Permit. A $500 discount will be applied to the building permit fee upon receipt of report confirming the building has been designed to comply with Energy Step Code requirements. A building permit will not be issued until a report confirming compliance has been submitted.
Energy Study Incentive	Clean BC New Construction Program (Clean BC, 2020)	The Provincial Commercial New Construction Program provides funding for the design and construction of new high-performance buildings that use high efficiency electricity in place of fossil fuels, in order to reduce GHG emissions. Paid upon approval of the energy study and review of applicable invoices .
Capital Incentives	Clean BC New Construction Program (Clean BC, 2020)	The Provincial Commercial New Construction Program provides funding for the design and construction of new high-performance buildings that use high efficiency electricity in place of fossil fuels, in order to reduce GHG emissions. Incentives provided are based on lifetime CO2e reduced and are relative to the baseline building code of the project. ($30/t CO2e - $120/t CO2e), subject to various payment terms. Electrification bonuses for project which electrify the building further from the baseline to 100% electric space , ventilation and domestic hot water heating (with no gas boiler as backup) are eligible to receive a 10% bonus over and above the capital incentive. All the subject to certain terms and conditions (including the design being at the end of the concept stage, and

Incentive Type	Offering Organization	Remarks
		result in at least 400t CO_2e in lifetime GHG savings and provide a technology that provides net electrical growth.
Design Expertise alongwith funding	BC Hydro New Plant Design Construction Program (BC Hydro, 2020)	Applicable for industrial plants in the early stages of expanding an existing facility or designing a new facility and if the expected increase in energy consumption is 5% or more and has potential energy savings of more than 300MWh/year.
Funding on incremental construction costs	BC Hydro New Plant Design Construction Program (Hydro, 2020)	Funding available for upto 75% of incremental construction costs above standard inefficient design options. The facility should use more than 500MWh of electricity per year. Eligible technologies include Compressed Air Systems between 40hp and 300hp and/or industrial lighting.
Incentives for carrying out energy modelling	BC Hydro New Construction Program (BC Hydro, 2020) New Program Construction Manual (Hydro, 2019)	Energy Modelling study incentives for a new construction – upto $15,000 for private developments and upto $30,000 for public projects like government, healthcare and others. Payment on production of an invoice of an approved energy modelling study report.

13. Potential Strategies for Adoption and Uptake of BC Energy Step Code for P3 Buildings in TOL

As highlighted below in Figure 45, buildings constitute a significant of the 2017 GHG emissions profile in the TOL. Buildings also consume a lot of natural gas , which builds a case for adoption of Step Code.

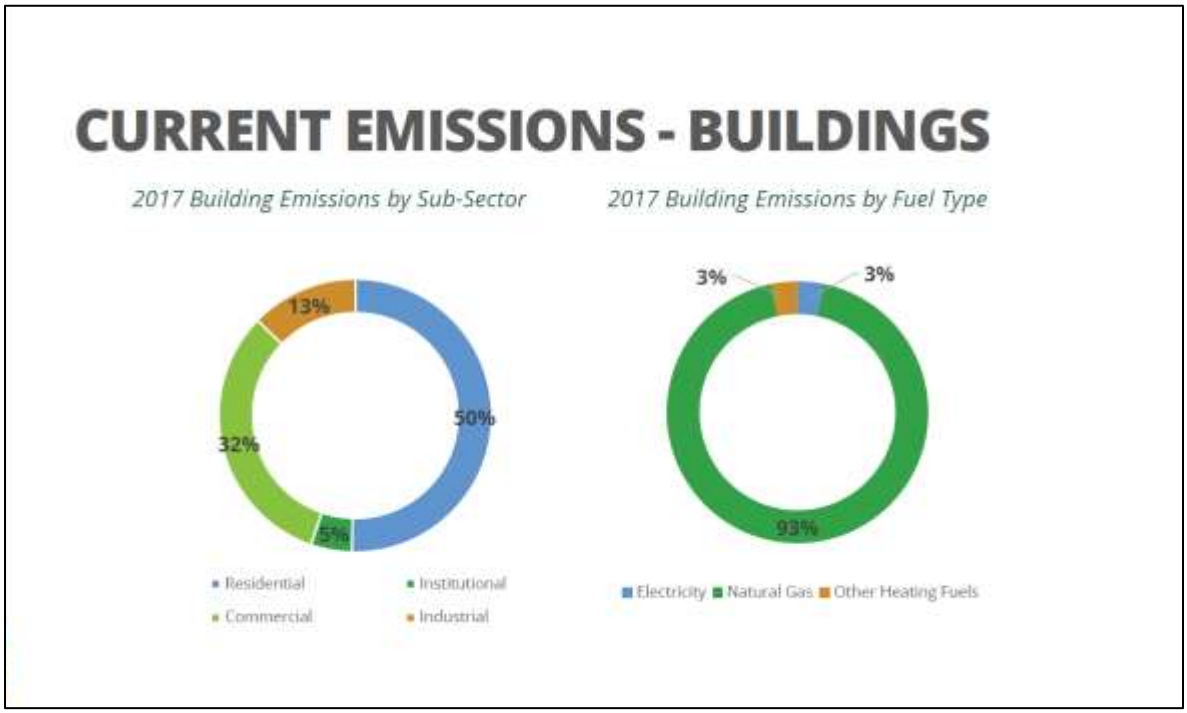


Figure 44 Data Regarding GHG Emissions from various sources in the TOL (Source : TOL)

Several of the potential strategies which the TOL could adopt as a starting point in it's Step Code Journey are:

- Prepare for an in-depth, phased consultation with industry whereby it presents a draft policy, seeks feedback from industry and uses the data to shape its policy in the short term, medium term and long term.
- In order to increase the uptake of Step Code for P3 buildings, include various non-financial incentives (based on the feedback provided by industry) in its policy with adequate gates and safeguards to prevent abuse. These could include density bonusing, expedited permit processing, etc. depending upon the type of P3 building.
- Conduct an internal costing study using various local assumptions in order to examine the problem of cost overruns in depth in the local context. This is optional and is upto the discretion of the TOL, (since the Province of BC has already carried out a costing study).
- Consider future growth projections regarding P3 Buildings in the TOL and consider human resource planning in terms of positions in order to help with implementation of Step Code.

13.1 Financial Implications of Implementing BC Energy Step Code

Although majority of the strategies are identified in the recommendations section of this report, a good way to start is to analyse what would be the impact on the incremental costs in case the BC Energy Step Code is adopted in the TOL.

It is estimated that the incremental costs of building to the Step Code would be offset in the long run by enhanced energy savings from building to the Step Code. Hence Step Code is expected to be cost neutral in the long run.

The methodology followed is based on savings accrued from energy performance related savings would far outweigh the initial incremental costs incurred while building to the Step Code. For this purpose, energy consumed due to both the building envelope and the mechanical and electrical systems are expected to contribute to cost savings. The main aspects of the methodology are adapted from the provincial cost estimates. This effect could be assessed and quantified when the cost increment is multiplied by the existing baseline costs for various building archetypes (Group C, D an E occupancies P3 buildings), suitably adapted from construction cost guides.

Furthermore, this increase in incremental costs could be compared against the cost of consuming energy in the long run by multiplying the prescribed TEDI and TEUI values in the BC Building Code against the applicable step in order to find out energy costs for total square footage of expected building occupancy types over the projection period between 2020-2032. The difference between these costs is expected to be positive and further reinforces the cost neutral assumption of adopting Step Code.

An exhaustive study is however out of the scope of this report and can be taken up as a future work for establishing as supporting evidence.

13.2 Projections for P3 Buildings in the TOL

A report on P3 building permits for the last 10 years was produced by TOL staff in order to derive projections for how many P3 building permits are expected for the future. For the projections , two cases were analyzed– one where the projection was done using permit data from the last 10 years and in the second case, using permit data from the past 5 years. The data was analyzed in Microsoft Excel using conventional forecasting algorithms, which did not consider seasonality of data. The algorithm forecasts assumed an expected linear trend, which is a good first approximation. The forecasting was carried out till years from 2020 to 2032 as a separate case. The year 2032 marks the year whereby all buildings are supposed to be “Net Zero Energy Ready” as per the BC ESC. Results were also plotted using forecasting algorithms which did consider data seasonality(out of the scope of this report), however they yielded the same upward trend in P3 permit issuance in the forecasting period.

For details regarding the full methodology and the results of projections , please refer to Appendix C.

Please note that the author of this report accepts no liability whatsoever, legal or otherwise, arising out of usage/retention/transmission of this data or forward-looking projections contained in this report to any source whatsoever.

The results arising out the analysis and projections are presented below:

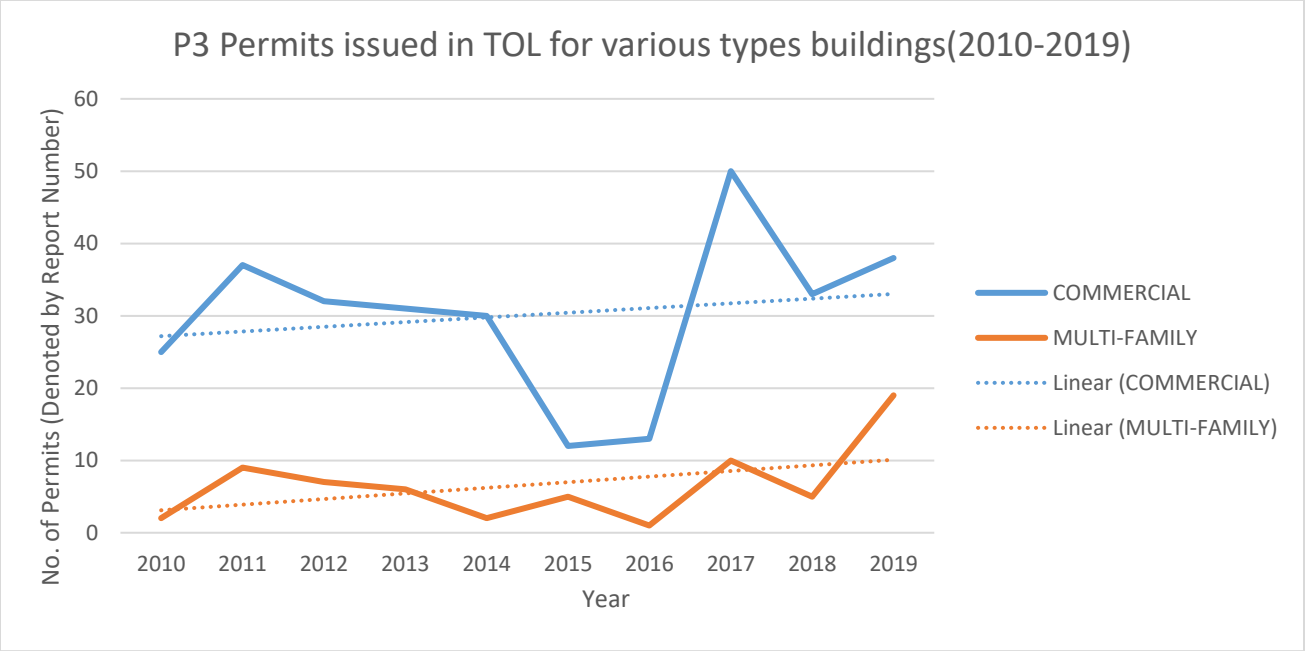


Figure 45 P3 Building Permits issued by the TOL for various broad categories of buildings. COMMERCIAL is further sub-categorized into Mixed Use, Industrial, Institutional and Commercial new construction.

Figure 45 displays the past 10 years of data regarding issuance of P3 Permit Applications. Approximately 20-30 more P3 commercial permits are issued each year than P3 residential permits. When the data was examined in depth, data presented in Figure 46 revealed that permits for institutional type issued have been the highest from years 2010-2019.

It should be noted that due to generation of certain anomalous results(negative numbers in the projection period between 2020-2032), past 5 years data was chosen instead of past 10 years data. For more details regarding the methodology and results obtained, please refer to Appendix C.

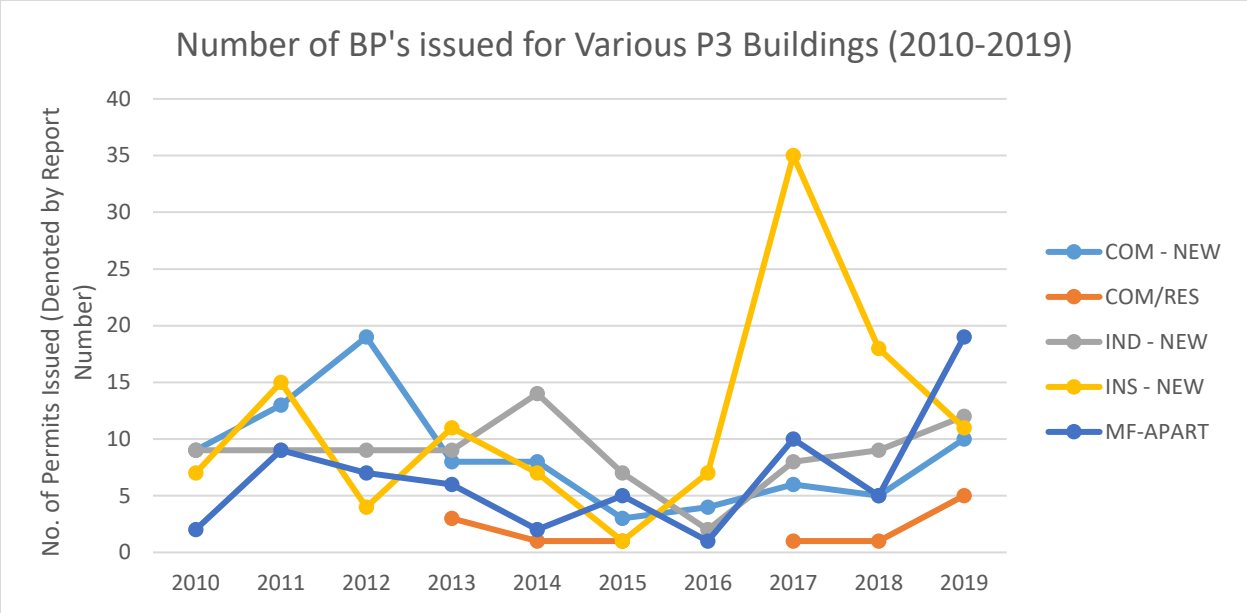


Figure 46 Building Permits issued by building sub-type, which includes commercial new construction, mixed use construction, industrial new construction, institutional new construction, multi-family residential new construction.

The projections for the same set of data is presented in Fig 47 below. It can be seen from the projections that there is an upward linear trend in the expected number of permits in the coming years till 2032. Furthermore, institutional type has the highest projection followed by multi family high rise residential type, industrial, commercial new construction type and commercial/mixed use type. Please note that this is not a cumulative graph, but instead presents data points year wise.

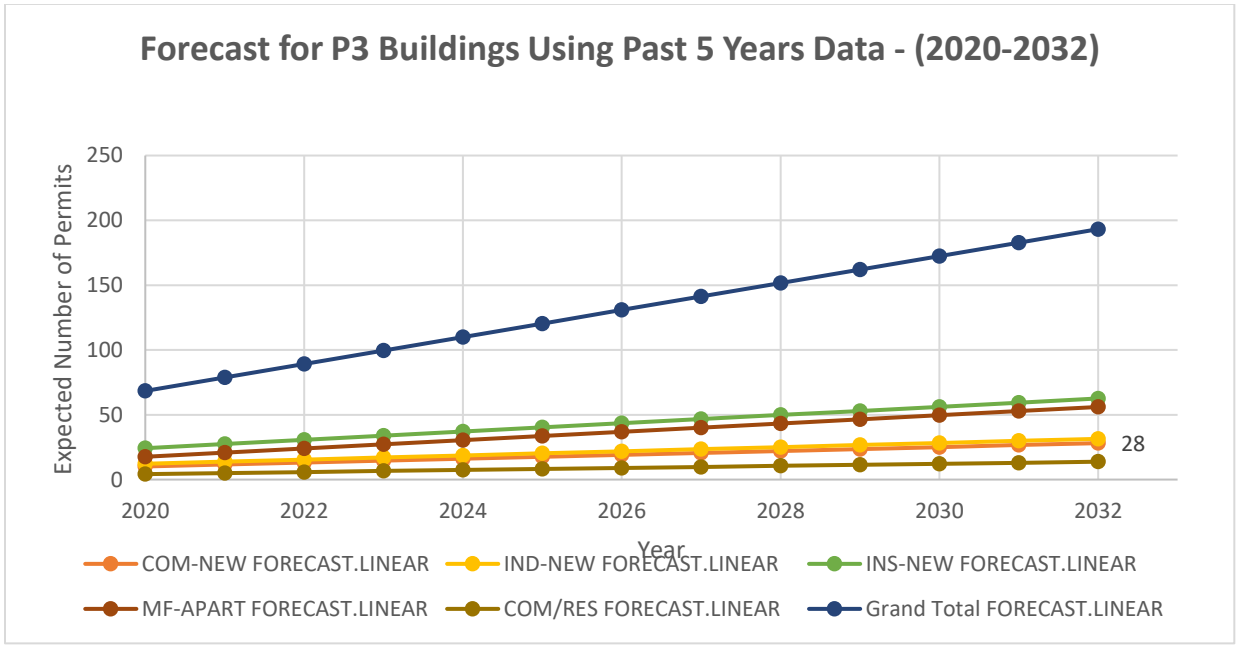


Figure 47 Projections for P3 Buildings based on past 5 years of permit data. It should be noted that using past 10 years data generated anomalous results. Hence for the sake of simplicity, past five years data was chosen.

If the analysis presented in this section were to be accurate even to the first degree of approximation, a conclusion which can be drawn is that there should be an increasing focus on the institutional type of permits which would include occupancies like office, , large government buildings, etc. Furthermore, industrial buildings could be another sphere of focus, since an increasing number of permits were issued in order to schedule their construction. Hence, more focus could be given to other P3 building types for step code adoption purposes.

Sources (TOL, 2019) and Fig 44 suggest that, P3 Non-Residential Buildings (Commercial, Institutional Industrial) account for as much GHG Emissions as residential buildings , with commercial buildings being one of the biggest contributors. Therefore, by adopting Step Code for P3 Non-Residential Buildings, the remaining of 50% of energy emissions generated by buildings, can be addressed through Step Code.

14. GHG Intensity – An emerging standard for reducing GHG emissions for buildings in BC

The GHG intensity (GHGi) metric is not a part of the BC ESC, but an additional metric introduced by several local governments as a part of their efforts to reduce GHG emissions from buildings. In addition to the metrics of energy demand(TEDI) , usage(TEUI) and airtightness which are a part of requirements to meet the BC ESC, GHGi levels for new construction are also set – indicating that emissions from newly constructed buildings should be less than a certain level. As of July 2020, the following jurisdictions have instituted GHGi requirements:

- Municipality C
- Municipality D
- Municipality G
- Municipality B
- Municipality H (does not come under BC ESC Jurisdiction)

Various local governments, in response to addressing calls for sustainability, have started to prescribe their own GHGi targets, which exist alongside their BC ESC policies.

The Municipality G defines the GHGi metric as: "*GHGI is a measure of the total amount of GHG emissions associated with a building's energy use. It is a calculated value determined through energy modeling: energy (kWh) supplied to a building, multiplied by the emissions factor of the energy (a measure of how many GHG emissions are associated with its use) and summed for each type of energy used (e.g. electricity, natural gas, hot water); the resulting value is divided by the building's floor area. GHGI is reported in kg of carbon dioxide equivalent (CO2e) per m² of floor area per year (kg CO2e/m²/y).*"

$$GHGI\ \left[\frac{kgCO_{2e}}{m^2 a}\right] = \frac{\sum\left(Site\ Energy\ Use\ \left[\frac{kWh}{a}\right] x Emissions\ Factor\ \left[\frac{kgCO_{2e}}{kWh}\right]\right)}{Modelled\ Floor\ Area\ [m^2]}$$

The above equation has been adapted. A GHGi of 6kg/m²/y is currently required under option 2(b) in Municipality G's Green Building Policy for P3 buildings. (Municipality G, 2019)

At a very broad level, it is projected that GHGi metrics will become increasingly prevalent as local governments aim to achieve 45% GHG reductions by 2030 and 100% by 2050. However, within the context of this report, this does not assume significance till Step Code is adopted and is hence not considered as high priority area in the short term.

14.1 Low Carbon Energy Systems

In order to decrease GHG emissions from their buildings, a few of the municipalities interviewed have implemented a BC ESC step relaxation option for certain P3 building types. A BC ESC relaxation implies that the builder can either build to the directed Step or they can build to one Step lower if their building is connected to a Low Carbon Energy System (LCES) in place. While the definition of a LCES can vary from municipality to municipality, generally a LCES is:

"[…] a highly efficient […] mechanical system that supplies a building's space, heating, cooling and domestic hot water heating demand primarily from renewable energy sources, at a carbon intensity that is low enough so that when applied to modelled building energy use, the development satisfies the City's defined GHG limits as outlined in the green building policy." – (Municipality G, 2019)

Generally speaking, using a low carbon energy system simply translates to using a non-fossil fuel source for a building's energy needs(for e.g. heat pumps for space heating and domestic hot water).

Many of the municipalities interviewed have used this instrument in order to promote the usage of Low Carbon Energy Systems. Almost all municipalities interviewed have highlighted that builders/homeowners can build to a lower Step if they demonstrate the usage of a LCES. (Municipality A Building Division, 2000). However, in the Municipality A a LCES policy has only been applied to P3 buildings with specific occupancy types. This includes concrete (or non-combustible) residential construction smaller than or greater than 6 storeys(Moody, 2019).

Many jurisdictions interviewed have applied LCES's as a policy tool used in conjunction with the BC ESC. The policy for Municipality A includes that for any development permit which requires rezoning, must submit an energy modelling report alongwith their Development Permit Applications.

Other jurisdiction includes Municipality G, which have linked the Step Code alongwith GHGi target to their rezoning process.

The Municipality B also has a BC ESC relaxation for P3 residential buildings provided they demonstrate the usage of a LCES. However, P3 commercial buildings like offices and hotels have not been included yet, with 2024 marking the first implementation of an LCES Step relaxation.

In the case of Municipality C similar policy objectives are included with the intention of increasing the adoption of a Low carbon energy system and reducing greenhouse gas emissions. What differs Municipality C from the other interviewed municipalities is that they already have an established District Energy System which new buildings can use when aiming to meet their LCES requirement. (Municipality C, 2020). Like other municipalities, Municipality C, currently excludes P3 Commercial buildings from LCES requirement and has signalled that it is likely to stay the same in the future. On the other hand, cities of Municipality D and Municipality G have a policy for LCES which includes Commercial Rezonings.

14.2 GHG Development Permit Areas

The Energy Conservation and GHG Development Permit Area (GHG DPA) is a policy tool present in the TOL, which mandates additional measures to be taken by developments if they are located within the GHG DP Area, to improve their energy efficiency and decrease GHG emissions. As per the Bylaw No. 4642, Subsection 7.5, which also references the BC ESC, buildings built within the GHG DPA have higher BC ESC requirements compared to buildings which are be built outside the GHG DPA(Langley Building Bylaw 2008 No. 4642, 2014). The following areas within the TOL are designated as GHG DPA's and have their own separate GHG DPA guidelines.:

- Latimer
- Smith
- Williams
- Carvolth
- Brookswood/Fernridge

The only municipality aside from the TOL that has instituted a GHG DPA is the Municipality R.

The Municipality R also has something known as an Energy Conservation, Water Conservation and Greenhouse Gas Reduction Development Permit Area(DPA). This is akin to the GHG DPA found in Municipality R and its key principles are

- An integrated design approach should be used to identify opportunities to reduce a building's energy and water consumption , improve overall building energy performance , reduce GHG emissions and also improve the overall carbon footprint and take into consideration the source , type and future disposal /recycle fate of the building materials used.
- Requirement of a qualified professional to be retained and co-ordinate an integrated design approach.
- The development should be designed and constructed so that the energy budget for the proposed building and structures will be better than National Energy Code of Canada for Buildings (NECB) and American Society for Heating Refrigeration and Air-Conditioning Engineers by a specified percentage. (Municipality R, 2019)

15. Conclusion and Recommendations

After conducting the literature surveys, surveys with builders, and desktop research, the main conclusion which can be drawn is that P3 Step Code Implementation is still in its infancy, with lack of best practices outcomes and lessons learned regarding its implementation. However, prima facie, the building industry seems to have accumulated some experience. However, as the Energy Step Code Council suggests, that building to higher Steps (Steps 4 and 5 in case of P9 and Steps 3 and 4 in case of P3 Buildings), would require more support from local governments and also an integrated approach in terms of design and other aspects, especially if it involves GHGi Target.

Figure 48 explains what a typical sequence for implementing the recommendations could look like. It should be noted that there is more significant overlap in terms of several of the initiatives and that could be considered, should the TOL choose the option of implementing them.

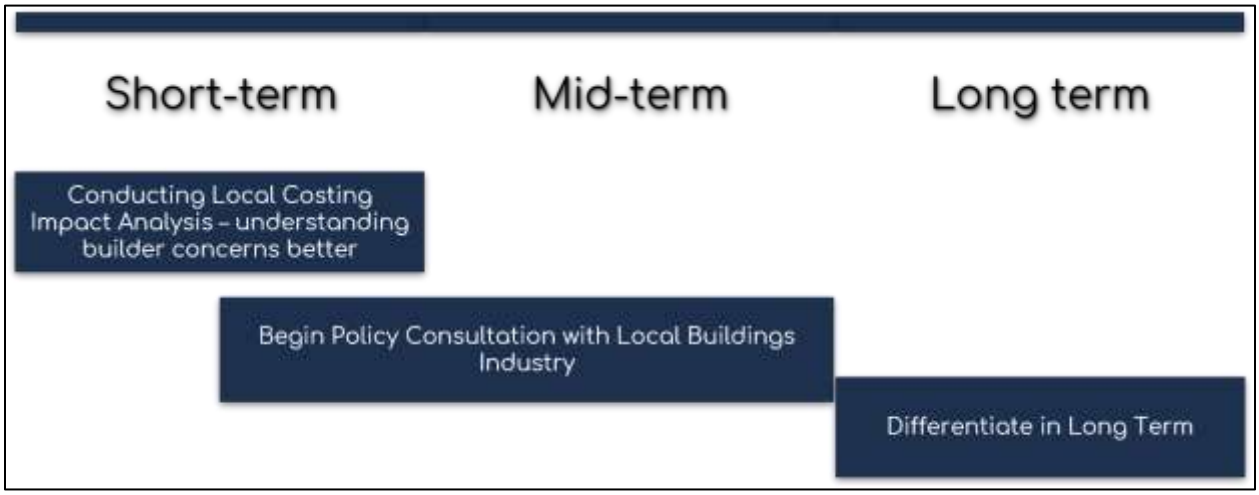


Figure 48 Broad Set of Recommendations which would be implemented in the Short Term(next 6 months), Mid-Term(next 6-12 months) and Long Term (18-36 months).

Starting with the short term, it is absolutely essential to carry out engagement/consultation with stakeholders including local building industry in order to understand their concerns better and to get more information about how costs are moving in response to the Step Code regulation. This can be through either builder breakfast sessions coupled with online targeted surveys in order to give TOL a clearer picture and help generate data , shaping their policy.

Subject to other priorities, The TOL might also carry out their own costing analysis, but it would really depend on the long-term priorities, as it likely to be time consuming and cumbersome. As an alternative it could consider doing with provincial cost estimates.

15.1 Recommendations Options Set 1 - Gradual Approach

Starting with conducting builder breakfasts sessions in the short term would be a feasible as well as a good first step order to collect data regarding Step Code Adoption. The results from the builder survey carried out as a part of this project could be used to inform the step code draft policy and adoption.

Training sessions for the building industry should be prioritized as some support would eventually be required in order to ensure compliance. If possible, options regarding implementation of Step Code could be provided to industry.

The builder breakfast sessions are recommended to be held in phases, involving Phase 1 Consultation covering introducing them the Step Code adoption framework (including targets, current scenario, etc.). Phase 2 consultation could be in the form of working groups whereby specific policy instruments could be discussed. A potential set of questions which can be asked during the interview are presented in Appendix D.

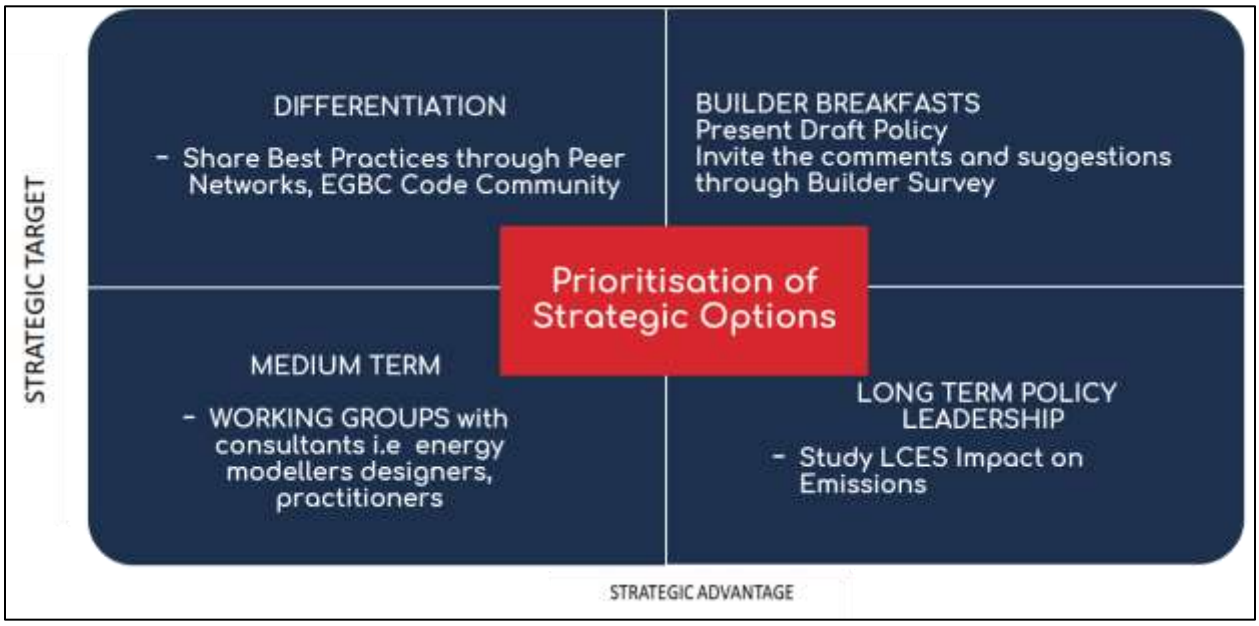


Figure 49 Strategic Options Set 1 - Gradual Approach.

The TOL could also assume a leading role in developing example buildings in its jurisdiction in order to set an example for the local building industry with regards to Step Code efficiency. This would not only help develop best practices but also serve as an example for the community. Inclusion of non-profit organizations is also important in the overall stakeholder matrix.

If the volume of permits is large, then post adoption of Step Code, grandfathering those applications could be considered, in order to avoid re-work on those designs and ensuring smooth transition.

In the long term , an option to study the impact of Low Carbon Energy Systems in P3 Buildings could be carried out. Employing low carbon energy system to achieve the dual purpose of greenhouse gas emissions and achieving step code is likely to become the norm and should be actively considered as an option should the TOL choose to adopt and implement Step Code.

GHGI's and LCES have the potential to have a major impact on GHG Emissions in buildings. However, adopting Step Code for P3 should be prioritized as a critical step.

15.2 Strategic Options Set 2 - Accelerated Approach

Figure 50 displays recommendations relating to the accelerated approach.

In this approach, the elements regarding the consultation with building industry and determination of a stakeholder matrix remain common. However, the level of engagement is further enhanced in the short/medium term with various other jurisdictions which already have Step Code for P3 buildings referenced and under implementation. Such an engagement could relate to working with best practices and co-ordinating certain aspects regarding implementation in order to save resources (if applicable).

In the short/medium term the TOL could also plan on resource analysis and planning for internal positions to support Step Code related tasks. These could be internal in the Green Buildings department or the Building Department. This would help position TOL as being one of the very few jurisdictions having dedicated positions for ensuring technical compliance. Other long-term initiatives should be treated as lower priority and should ONLY be taken up once Step Code adoption and implementation related initiatives have been fully addressed.

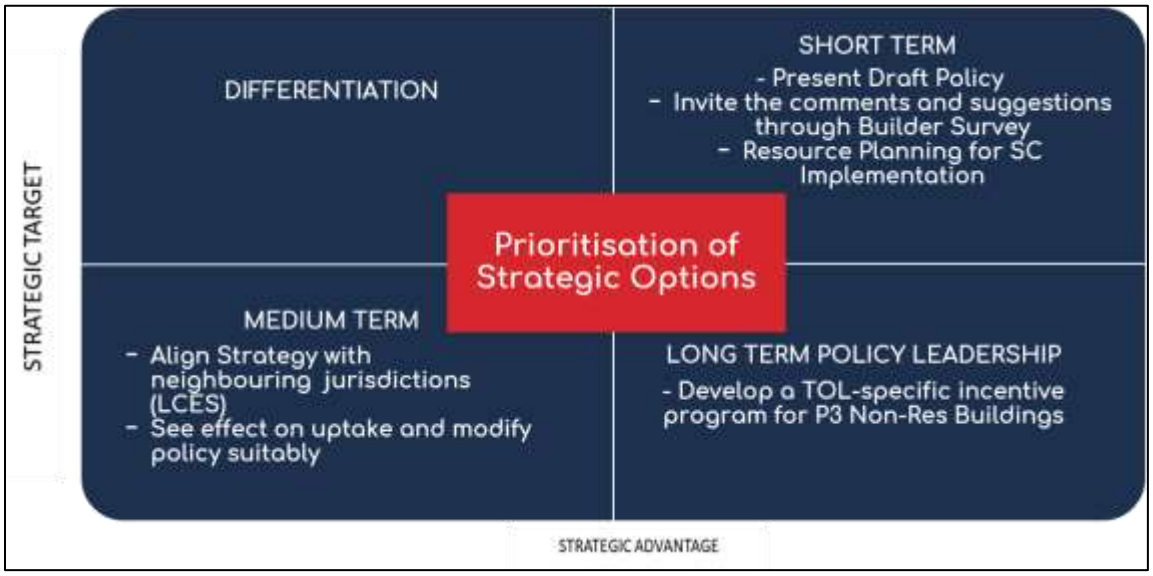


Figure 50 Recommendations Option Set 2 - Accelerated Approach

16. Conclusion and Future Work

The BC ESC serves as a means to a larger objective of demonstrating climate leadership in the Province. Various policies have been enacted as a part of such initiatives but much more needs to be done in order to truly realize the objective of achieving relevant climate goals. Several studies have highlighted that in the past(BC Housing ; Morrisson Hershfield ; Integral Group ; e3Eco Group, 2018)

Furthermore, for upper steps, not every municipality has considered form and character guidelines. As the Step Code becomes more and more ambitious and BC Building Code gets amended in the coming years, it is important that the TOL gears up suitably. Several other initiatives like adapting P9 rebate initiatives into P3 and incorporating GHGi targets into Step Code policies can also be taken up.

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18. Appendices A to E

The appendices for this project can be found in the subsequent pages.

Appendix A - BC ESC for P3 Buildings - Timeline in BC Municipalities

GHGi denoted by green text	Building type	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Municipality F	P3 Residential	1												
Municipality F	P3 Commercial	1												
Municipality G	P3 Residential, Rezoning	2/3[1]												
Municipality G	P3 Commercial, Rezoning	2/3[1]												
Municipality G	P3 Residential	1												
Municipality G	P3 Commercial	1												
Municipality J	P3 Residential	2												
Municipality J	P3 Commercial	2												
Municipality Q	P3 Residential	1												
Municipality Q	P3 Commercial	1												
Municipality N	P3 Residential	1		2										
Municipality N	P3 Commercial	1		2										
Municipality B	P3 Residential	2/3[1]				3/4[1]						4		

GHGi denoted by green text	Building type	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Municipality B	P3 Commercial	2												
Municipality M	P3 Residential, Rezoning	3												
Municipality M	P3 Residential	2												
Municipality M	P3 Commercial, Rezoning	2												
Municipality M	P3 Commercial	1												
Municipality O	P3 Residential - combustible	2	3			4								
Municipality O	P3 Residential - non-combustible	1												
Municipality O	P3 Commercial	2				3								
Municipality A	P3 Residential	1/2[1]	2/3[1]									3/4[1]		
Municipality A	P3 Commercial	1	2				3							
Municipality C	P3 Residential - combustible	3		4										
Municipality C	P3 Residential - non-combustible	2/3[1]		3			4							

GHGi denoted by green text	Building type	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Municipality C	P3 Commercial	2		3										
Municipality D	P3 Residential	2/3[1]												
Municipality D	P3 Commercial	2												
Municipality I	P3 Residential - combustible	3												
Municipality I	P3 Residential - non-combustible	2												
Municipality I	P3 Commercial	2												
Municipality O	P3 Residential, Rezoning	3												
Municipality O	P3 Commercial, Rezoning	3												
Municipality O	P3 Residential	1												
Municipality O	P3 Commercial	1												
Municipality P	P3 Residential	3												
Municipality P	P3 Commercial	3												
Municipality R	P3 Residential, Rezoning	3												
Municipality R	P3 Residential	2												

GHGi denoted by green text	Building type	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Municipality R	P3 Commercial	1												
Municipality S	P3 Residential	2												
Municipality S	P3 Commercial	2												
Municipality E	P3 Residential - combustible	3												
Municipality E	P3 Residential - non-combustible	2												
Municipality E	P3 Commercial	2												
Municipality P	P3 Residential - combustible	3	4											
Municipality P	P3 Commercial	2	3											
Municipality L	P3 Residential	2												
Municipality L	P3 Commercial	2												
TOL	P3 Residential	2	2/3[2]	3										
Municipality K	P3 Residential	2												
Municipality K	P3 Commercial	2												

[1] These buildings will receive a step relaxation if they have a LCES that meets specified requirements (different between municipalities). For example, in the Municipality A, where a LCES is defined as a building's space heating/cooling and water heating GHG emissions must not exceed 6 $kgCO_2e/m^2/yr.$, if a building does not have an LCES they must meet Step 3 in 2021, but if it does, it may meet Step 2 (a step relaxation).

[2] In 2021, the TOL will require P3 Residential buildings to meet Step 2, or Step 3 in GHG DPAs.

Table 2: BC ESC for P3 Buildings - Timeline in Municipality H

GHGi denoted by green text		2020	2025	2030
Municipality H	P3 Residential	TEDI: High-rise MURBs: 32 kWh/m^2/yr. (~Step 2), OR 40 kWh/m^2/yr. (~Step 2) if NRES-connected		Zero Emissions Buildings
Municipality H	P3 Residential, Rezoning	TEDI: 18 kWh/m^2/yr. (~Step 3) if rezoning		Zero Emissions Buildings
Municipality H	P3 Commercial	TEDI: Office: 27 kWh/m^2/yr. (~Step 2) OR 27 kWh/m^2/yr. if NRES-connected (~Step 2)	Offices: 21 kWh/m^2/yr.	Zero Emissions Buildings
Municipality H	P3 Commercial, Rezoning	21 kWh/m^2/yr. for Rezoning (~Step 3)		Zero Emissions Buildings

Appendix B – List of Builder Survey Questions

1. The BC ESC offers a consistent provincial standard for energy efficiency requirements for new buildings. Of the P3 **Residential** Buildings that you work on, approximately how many are subject to Step Code standards?

- None
- Some
- Many
- All

2. Approximately how many P3 **Non-Residential** Buildings that you work on are subject to Step Code standards?

- None
- Some
- Many
- All

3a. What has been your experience in building to the Step Code for P3 Buildings (both residential and non-residential) in other municipalities?

- Very challenging / major changes to processes
- Challenging / some changes to processes
- Easy / little changes to processes
- Very easy / no changes to processes

3b. If your response to the question above was 'Very challenging' or 'Challenging' please select the reason for
your answer *(Select all that apply)*.

- Design issues
- Staff capacity issues
- Cost implications
- Time burdens
- I don't know
- Not applicable
- Other (please specify)

4a. For your work in other jurisdictions, how much have you changed your building practices to meet Step
Code for P3 Buildings?

- No changes
- A few changes
- Completely changed

4b. Could you please explain your selection in the question above?

5. Have you ever participated in the Integrated Design Process for any of your P3 Building projects? The Integrated Design Process is a collaborative and iterative way of designing and constructing high performance buildings in which all potential stakeholders (client, builder, designers, engineers, architects, energy consultants) participate.

- **Yes**
- **No**
- **I don't know**
- **Not applicable**

6. To the best of your knowledge and experience, what has been the approximate incremental increase in construction costs while building to Step Code for P3 Buildings?

- Less than 1%
- 1-2%
- 3-4%
- 5-6%
- 7-9%
- 10% +

7. Which components of your P3 Buildings have experienced an increase in cost due to the implementation of Step Code? *(Select all that apply)*

- HVAC
- Lighting
- Envelope

8. Have you designed to a GHGi target for P3 Buildings in other municipalities?

- Yes
- No
- I don't know
- Not applicable

9. Have you ever designed to include a Low Carbon Energy System in your P3 Building projects? These include biomass, solar, heat pumps, etc.

- Yes
- No
- I don't know
- Not applicable

10. In your experience, which is the most difficult component of achieving compliance with Step Code for Part3 Buildings?

- Total energy demand intensity (TEDI)
- Total energy use intensity (TEUI)
- Other (please specify)

11. In your experience, has constructing high performance wall assemblies become more challenging for P3 Buildings covered by Step Code?

- No change from pre-Step Code
- Few challenges
- Moderate challenges
- Major challenges (please specify)

12. To what extent has designing and constructing mechanical and electrical systems, intended to help achieve P3 Step Code TEUI, become a challenge compared to pre-Step Code?

- No change from pre-Step Code
- Few challenges
- Moderate challenges
- Major challenges (please specify)

13. What is your current profession or industry? *(May select more than one)*

- Architect
- Builder
- Carpenter / Framer
- Cladding Installer
- Designer
- Developer
- Drywaller
- Electrician
- Flooring
- HVAC
- Inspection
- Insulation
- Masonry
- Painter
- Plumber
- Roofer
- Consultant
- Engineer

- Energy Advisor
- Other (please specify)

14. What type of P3 Buildings do you work on? *(May select more than one)*

- Residential high-rise buildings
- Multi-family residential buildings (apartment buildings 4-6 storeys)
- Commercial high-rise buildings
- Offices
- Schools / post-secondary institutions
- Hospitals
- Recreation centres
- Other (please specify)

15. Which municipalities do you primarily work in? *(Select all that apply)*

- TOL
- Municipality Y
- Municipality F
- Municipality G
- Municipality U
- Municipality O
- Municipality V
- Municipality W
- Municipality X
- Municipality A2
- Municipality B
- Municipality M
- Municipality Y
- Municipality A1
- Municipality A
- Municipality C
- Municipality D
- Municipality H
- Municipality L
- Other (please specify)

Appendix C - Methodology and Results for Projections regarding P3 Buildings in TOL

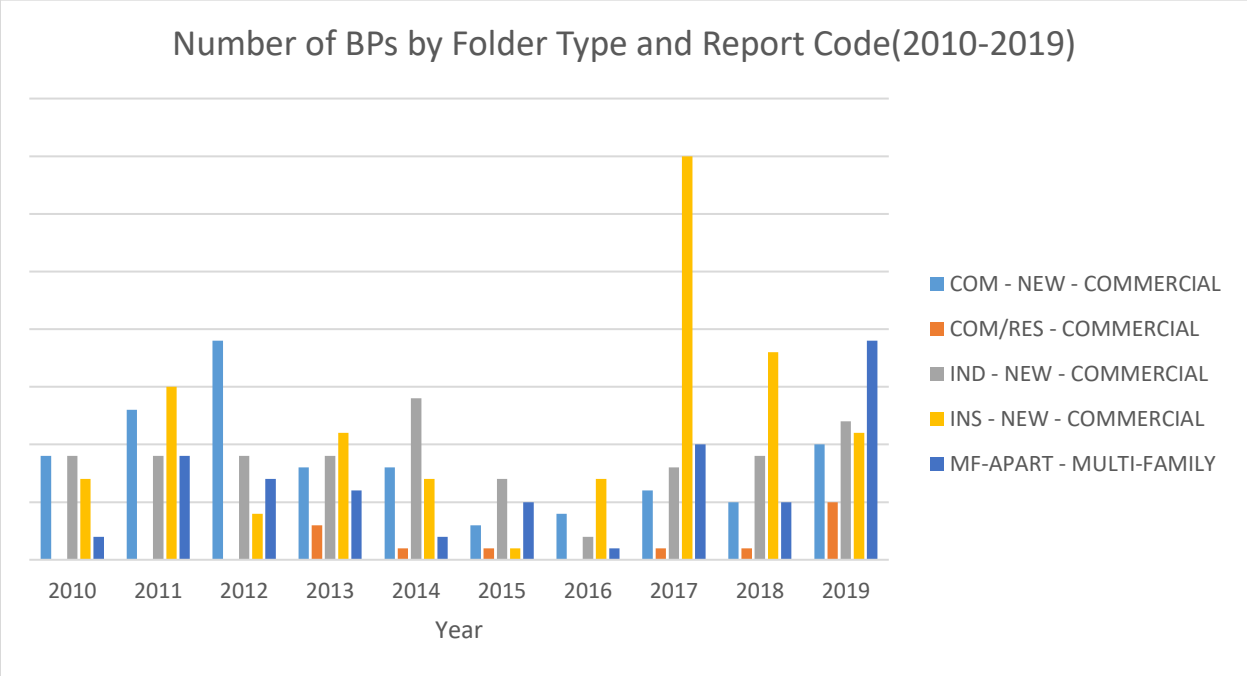
The following steps were followed while carrying out the projections for number of P3 Permit Applications from the TOL

1. Obtaining the data from TOL's permit application system called Prospero. An "IntelliSearch" query was run in order to pull out data about the following types of buildings
    a. COM-NEW – Stands for Commercial New Construction
    b. COM/RES – Stands for Commercial/Residential or Mixed Use
    c. IND-NEW – Stands for New Industrial Construction
    d. INS-NEW – Stands for New Institutional Construction
    e. MF-APART – Stands for Multi-Family Residential or High-Rise Residential Apartments
2. Data Cleaning – The following steps were carried out in order to make the data ready for analysis
    a. Standardizing formats for the dates – converting them to years to make the analysis easier
    b. Designating Various types of P3 Permit classifications described above into numbers. Commercial New was designated as "1", Industrial New was designated as "2", Institutional New was designated as "3" , Multi-Family High Rise was designated as "4" and Commercial Residential Mixed Use was designated as "5". These were only string characters which were introduced for the ease of analysis
    c. Pivot Tables were used in order to understand the data better. Pivot plots were constructed to observe the trend.
    d. It should be noted that only the permits issued part of the data was used for analysis. A major assumption of this analysis is that it does not consider whether or not the building had received an occupancy certificate or had completed construction.
3. Implementing the forecasting Algorithm – In this step, the data for the past 10 years was projected for the till 2030 and 2032 using a simple algorithm in Excel called " FORECAST.LINEAR". This algorithm does not consider seasonality in the data and gives us a linear projection. As an additional option, the data was also extrapolated using another algorithm known as "FORECAST.ETS" which uses exponential projections and considers the seasonality in the data.
4. Both the projections were plotted suitably in Excel. However, for the purposes of simplicity, linear projections for past 5 years data till 2020 and 2032 would be considered for the purposes of this analysis.

Assumptions and Nomenclature for analysis

Folder number	Stands for the location of the building number, like a "tag" number
Civic Address	Addres in the building permit (not used in the analysis)
Report Code	Displays the category which includes, Institutional, Commercial, Industrial, MF Apartment, Residential, Mixed Use,
COM-NEW	New Commercial
COM/RES	New Commercial/Residential (Mixed Use)
IND-NEW	New Industrial
INS-NEW	New Institutional
MF-APART	New Apartment (P3 Residentials)
	Note : Commercial and Multi-Family are the only two categories presented in this dataset
Assumptions & Assignments	COM-NEW = 1, IND-NEW = 2, INS-NEW = 3, MF-APART=4, COM/RES=5
	Each instance of building permit issuance i.e. the building report number being generated for a specific report code has been assigned a number. The number is an arbitrary and is carried for the ease of analysis only.

Number of Building Permits Issues by Type in the TOL (2010-2019)



Results Projections for P3 Buildings in TOL – FORECAST.LINEAR Algorithm													
Year	**COM-NEW**	**IND-NEW**	**INS-NEW**	**MF-APART**	**COM/RES**	**Grand Total**	**Year**	**COM-NEW**	**IND-NEW**	**INS-NEW**	**MF-APART**	**COM/RES**	**Grand Total**
2010	**9**	**9**	**7**	**2**		**27**	**2010**	**9**	**9**	**7**	**2**		**27**
2011	**13**	**9**	**15**	**9**		**46**	**2011**	**13**	**9**	**15**	**9**		**46**
2012	**19**	**9**	**4**	**7**		**39**	**2012**	**19**	**9**	**4**	**7**		**39**
2013	**8**	**9**	**11**	**6**	**3**	**37**	**2013**	**8**	**9**	**11**	**6**	**3**	**37**
2014	**8**	**13**	**8**	**2**	**1**	**32**	**2014**	**8**	**13**	**8**	**2**	**1**	**32**
2015	**3**	**7**	**1**	**5**	**1**	**17**	**2015**	**3**	**7**	**1**	**5**	**1**	**17**
2016	**4**	**2**	**7**	**1**		**14**	**2016**	**4**	**2**	**7**	**1**		**14**
2017	**6**	**8**	**35**	**10**	**1**	**60**	**2017**	**6**	**8**	**35**	**10**	**1**	**60**
2018	**5**	**8**	**19**	**5**	**1**	**38**	**2018**	**5**	**8**	**19**	**5**	**1**	**38**
2019	**10**	**12**	**11**	**19**	**5**	**57**	**2019**	**10**	**12**	**11**	**19**	**5**	**57**
2020	4	12	24	18	4	68	2020	4	8	18	11	3	**45**
2021	3	14	27	21	5	79	2021	3	8	20	12	3	**46**
2022	3	15	31	24	6	89	2022	3	8	21	12	3	**47**
2023	2	17	34	27	7	100	2023	2	8	22	13	4	**49**
2024	1	19	37	30	7	110	2024	1	8	23	14	4	**50**
2025	0	20	40	34	8	120	2025	0	8	25	15	4	**52**
2026	0	22	43	37	9	131	2026	0	8	26	16	4	**53**
2027	-1	23	47	40	10	141	2027	-1	8	27	16	4	**55**
2028	-2	25	50	43	11	152	2028	-2	8	28	17	5	**56**
2029	-3	27	53	46	11	162	2029	-3	8	29	18	5	**57**
2030	-4	28	56	50	12	172	2030	-4	7	31	19	5	**59**
2031	-4	30	59	53	13	183	2031	-4	7	32	19	5	**60**
2032	-5	31	63	56	14	193	2032	-5	7	33	20	5	**62**

Projection using past 10 years data

Projection using past 5 years data (considered for this project)

Appendix D – Potential Questions during builder breakfast sessions

1) Do they have P3 projects that are facing such cost overruns ? What are the names of those projects?
2) Which jurisdictions are those projects located in?
3) What are the specific costing heads under which cost inflation has been seen? What are the lessons learned ? What are the best practices?
4) What causes are attributable to this increased cost? Whether it is addition of more resources, energy regulation, others
5) What issues do you particularly face while aligning your building practices between different jurisdictions?
6) How much HVAC and Envelope individually contribute to the increase in costs? What specific costing heads do they accompany?

Appendix E – Local Government Survey Questions

Please see the attached pdf file for more information.