BC Energy Step Code Capacity Study

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Acronyms

AHJ	Authority Having Jurisdiction
AIBC	Architectural Institute of British Columbia
AR/VR	Augmented Reality / Virtual Reality
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTTBC	Applied Science Technologists and Technicians of British Columbia
AVM	Air Vapour Moisture
BC ABD	BC Association of Building Designers
BC BEC	British Columbia Building Envelope Council
BCCA	British Columbia Construction Association
BCICA	British Columbia Insulation Contractors Association
BCSEA	British Columbia Sustainable Energy Association
BIM	Building Information Modeling
BOABC	Building Officials Association of BC
BSSB	Building and Safety Standards Branch
CACEA	Canadian Association of Consulting Energy Advisors
CAGBC	Canada Green Building Council
CEA	Canadian Electricity Association
CHBA	Canadian Home Builders' Association
CIQS	Canadian Institute for Quantity Surveyors
CM	Construction Manager
CPD	Continuing Professional Development
CPL	Continuous Professional Learning
CM/PM	Construction Manager/Project Manager
CRN	Construction Research Network
CSME	Canadian Society for Mechanical Engineering
ECA BC	Electrical Contractors Association of British Columbia
EGBC	Engineers and Geoscientists of British Columbia
ERM	Enterprise Risk Management
ESC	Energy Step Code
EUI	Energy Use Intensity
GC	General Contractor
HAVAN	Homebuilders Association Vancouver
HRAI	Heating, Refrigeration and Air Conditioning Institute of Canada
HVAC	Heating, Ventilation and Air Conditioning
IBPSA	International Building Performance Simulation Association
ICBA	Independent Contractors and Businesses Association
IEEE	Institute of Electrical and Electronics Engineers
IPD	Integrated Project Delivery
KPI	Key Performance Indicators
LCU/CPD	Learning Credit Units / Continuing Professional Development
MCABC	Mechanical Contractors Association of British Columbia
NAIMA	North American Insulation Manufacturers Association
NRCA	Northern Regional Construction Association
PIBC	Planning Institute of BC
QS	Quantity Surveyor
RCABC	Roofing Contractors Association of BC
RICS	Royal Institute of Chartered Surveyors
RNG	Renewable Natural Gas
SICA	Southern Interior Construction Association
SMACNA BC	British Columbia Sheet Metal Association
TECA	Thermal Environmental Comfort Association
TEDI	Thermal Energy Demand Intensity
VDC	Virtual Design and Construction
VICA	Vancouver Island Construction Association
VRCA	Vancouver Regional Construction Association

Summary

The BC Energy Step Code (ESC) is intended to encourage energy efficient practices in construction and accelerate adoption of net zero energy practices. The ESC is designed to serve as a "roadmap" to industry by setting out forthcoming updates to the BC Building Code and by giving educators and local governments a clear long-range view of the technical expectations, so they have time to get ready. The ESC requires incremental improvements in 2022 and 2027, and then to meet goals of Net-Zero Ready for new construction by 2032.

Adoption of the ESC varies between local jurisdictions, but progress has been made in developing industrywide capacity to design and build energy efficient projects since the initial roll-out of the ESC in 2017. Generally, the key professions involved in achieving the ESC have acquired the skills necessary to achieve the lower levels of the ESC. However, the next Building Code update is anticipated in 2022 and with it, the expectation that key professions can deliver projects which – on average – need to be 20% more energy efficient than they are today. The key professions (developers, architects, engineers, energy modellers and advisors, builders, trades and building officials) will therefore need to become familiar with a range of new and/or enhanced technical skills. To deliver these projects effectively and efficiently, they also need to start to embrace new enabling practices such as digital tools, team integration and collaboration, new trade relationships and responsibilities, and, possibly, new forms of project delivery.

Looking ahead, knowledge gaps exist within some key professions that stand in the way of them playing their part in achieving the higher steps of the ESC effectively. These challenges are exacerbated by the fact that BC's construction workforce is aging. An estimated 22% of BC's construction labour force is expected to retire by 2030 leaving an "experience vacuum" whereby young workers might have not acquired sufficient practical experience (specifically of the type that comes from time in the field solving constructability issues) to design and construction complex projects – irrespective of the level of energy efficiency required.

Research Findings

There are many things that industry stakeholders can do to support key professions so that they not only appreciate the value of being "Step Code Ready" but also can acquire the necessary skills easily. Through consultation with industry practitioners, educators and other important stakeholders, this study highlights the need to the **Improve Communications and Engagement** on ESC requirements and how to achieve them, **Tackle Technical Challenges** associated with effective training delivery and ESC compliance, **Address Regional Issues** as highlighted by the varied rates of ESC adoption around the province, and **Resolve Profession-Specific Issues** that are disproportionately affecting some key professions.

1. Improve Communications and Engagement

Incentives to participate in training needed to increase enrollment.	Incentives that address the real cost of training, such as costs of programs, travel and accommodation, and forgone income would mitigate difficulties for key professions in taking time away from work to attend class. Providing workplace training (on jobsites) with live demonstrations would be an attractive alternative. Best-Practice Advisors that travel to different regions and provide mentorship and technical advice could also be constructive. Grants such as the Employer Training Grant could be expanded to cover this training.
Lack of clarity about the technical requirements of the 2022 update of the ESC and BCBC.	There is confusion surrounding the technical implications, timeline and anticipated changes to the ESC. Key professions are not clear about what is going to be required and by when. Industry-wide communication through a province-wide campaign could clarify issues. Lack of uniform adoption adds to this confusion as some upcoming requirements are viewed as voluntary.
Confusion about which courses address topics appropriate for each profession, at the right level of experience.	A lack of clear course descriptions means that key professions may have difficulty figuring out which course to take, which increases their hesitancy to enroll. The lack of profession-specific competency frameworks for most key professions is also a barrier. Without clear competency frameworks, it is difficult for professionals to know which courses to choose. Consistent language for describing EC courses including details of building types, applicable disciplines and sample materials would alleviate some confusion. A centralized hub that allows key professions to find and compare courses and get advice would be even better.
Uncertainty about course quality and lack of credentials/ training for trainers.	Professionals value the quality of training experience. Many believe effective training is best provided by those with practical experience and prefer direct mentorship. Testimonials from previous students that speak to the quality may answer some of these questions. Including trainers' credentials in course listings would lend confidence to the market.
When hiring individuals and procuring project teams, priority is given to those with practical experience – but such experience is hard to get.	Practical experience with energy efficient projects is highly valued by recruiters and by clients seeking to procure their project team. Such experience is hard to get. There is a lack of guidance on effective mentoring for ESC skills and, where it exists, the quality of mentorship opportunities varies. Standardized methods to evaluate a worker's experience with ESC will take the uncertainty out of hiring. A credential system that recognizes practical experience will allow assessment of skills competency.

Delivering information in bite-sized pieces may make it more accessible.	Shorter courses targeting specific skills can help to ensure specific competencies are captured. Providing interactive experiences using online learning and/or short videos offers a more focused approach whereby professionals only learn what they need when they need it. This is particularly useful for those working in the field.

2. Tackle Technical Challenges

Retirement of older seasoned professionals may leave an "experience vacuum".	Retirements in BC's construction sector are expected for more than 41,000 workers, or 22% of the current labour force, by 2030. Quality mentorship programs can be developed where recent retirees are trained as advisors and hired back as mentors.
Lack of cooperation, collaboration, and communication between trades.	Delivering high performance buildings effectively and efficiently requires project teams to work together and put the best interests of the project first. Training on new collaborative delivery methods and "building as a system" could provide a broader understanding of how trades affect each other and can work together to achieve desired project outcomes.
Cross-training between trades increasingly important as ESC Steps move higher.	Collaborative, hands-on training projects that bring together multiple disciplines and actively engage them to solve simulated technical issues can promote inter-trade awareness and communications. New courses and materials can be developed to provide these opportunities.
Education for building owners and developers needed on the impacts of ESC on building design and functionality.	Practical, easily accessible resources should be provided to improve awareness of the ESC among everyone involved in new construction, especially the owner or developer client. These resources can explain the advantages of the higher levels of the ESC and why they will benefit from them. If owners are asking for higher levels, construction professionals will meet demand. Lack of awareness and misperceptions can be minimized.
Tailored education needed for underserved populations with language barriers.	Attention must be paid to ensure opportunities for women, minorities, immigrants and Indigenous populations. As training or mentorship programs evolve, providing options in all commonly used languages and delivering training in partnership with community organizations will increase accessibility and understanding of technical concepts for these demographics.

3. Address Regional Issues

Incentives and customized training needed in areas outside urban centres.

Variations in ESC adoption, climate, availability of labour, equipment and materials, number of projects and experience across the province means that training and support needs to be tailored appropriately. Providing higher level “case study” projects for training in those areas that have not adopted new requirements will equip professionals with a means and motivation to learn new skills.

4. Resolve Profession-Specific Issues

Major obstacles exist for some professions in meeting higher levels of ESC.

Certain professions are discovering more obstacles in preparation for higher levels of the ESC. These include:

- Developers and Owners may have misconceptions about costs and lack of technical knowledge.
- Building Officials may lack tools to address increased expectations.
- General Contractors have difficulty finding appropriate training.
- Architects and Home Designers will be in short supply due to retirements in rural areas.
- Estimators and Cost Consultants lack dedicated ESC courses and may not be familiar with ESC-related equipment and materials.
- Energy Advisors are too few in number and will have increasingly limited ability to provide the support needed as ESC Steps move higher.

Energy Advisors are scarce in rural regions, making it difficult for trades and Building Officials to get the technical support they need.

In rural areas, Energy Advisor play an enhanced (and critical) role in the three-way collaboration between the builder, owner and Building Official in communicating ESC requirements and resolving technical issues. Unfortunately, it is in these rural areas where the shortage of Energy Advisors is most acute.

There is a lack of training for building operations and commissioning to maintain performance.

High-performance buildings require operational time to refine and balance systems for optimal performance. This increased importance of whole building commissioning, and the technical expertise required can be underestimated. Training of building operations professionals is important and must not be overlooked.

The future for gasfitters is evolving.

Confusion surrounding different policy goals addressing energy efficiency and (separately) GHG emissions has resulted in conflicting information on future requirements for gas fitters. While it is clear there will be ongoing demand for retrofits and maintenance, the future for those working with gas appliances is evolving. There will be growing demand for a variety of heat pumps and heat recovery equipment as the ESC is implemented and incentives for gas fitters to take training on these and other equipment installation would allow them to remain in similar roles in the construction workforce.

Current State of Readiness

Table 1 and Table 2 provide a summary of the current state of readiness of key professions as determined by the survey and interviews conducted in this study. They identify profession-specific differences between readiness in urban centers and the province as a whole, as well as differences between Part 3 and Part 9.

Table 1 State of Readiness by Profession for Part 3 Construction

Color saturation differentiates between readiness in urban centres from Province-wide

	Urban Centres – Part 3			Province-wide – Part 3		
	2022	2027	2032	2022	2027	2032
Developers	Yes	Yes	Partial	Yes	Yes	Partial
Architects	Yes	Yes	Partial	Yes	Yes	Partial
Engineers (Mechanical, Electrical, Building Enclosure)	Yes	Yes	Yes	Yes	Yes	Yes
Estimators and Cost Consultants	Partial	Partial	Partial	Partial	Partial	Partial
Energy Modelers	Yes	Yes	Yes	Yes	Yes	Partial
General Contractors (Construction Managers, Project Managers and Superintendents)	Yes	Partial	Partial	Yes	Partial	Partial
Carpenters, Framers, AVM Barrier Installers & Envelope Trades	Yes	Yes	Partial	Partial	Partial	Partial
Insulators	Yes	Yes	Partial	Yes	Yes	Partial
Electricians	Yes	Yes	Yes	Yes	Yes	Yes

	Urban Centres – Part 3			Province-wide – Part 3		
	2022	2027	2032	2022	2027	2032
HVAC Installers, Mechanical Design/Installers and Plumbers	Yes	Yes	Partial	Yes	Partial	Partial
Gas Fitters	Yes	Partial	No	Yes	Partial	No
Roofers	Yes	Yes	Yes	Yes	Yes	Yes
Glazers, Window and Glass Door Installers	Yes	Yes	Partial	Yes	Yes	Partial
Building Officials	Yes	Yes	Partial	Yes	Partial	Partial
Local Government Planning and Sustainability Staff	Yes	Yes	Partial	Yes	Partial	Partial

Table 2 State of Readiness by Profession for Part 9 Construction

Color saturation differentiates between readiness in urban centres from Province-wide

	Urban Centres – Part 9			Province-wide – Part 9		
	2022	2027	2032	2022	2027	2032
Architects	Yes	Yes	Partial	Yes	Yes	Partial
Engineers (Mechanical, Electrical, Building Enclosure)	Yes	Yes	Yes	Yes	Yes	Yes
Designers (i.e., Part 9 buildings not requiring an architect)	Yes	Yes	Partial	Yes	Yes	Partial
Energy Advisors & Modelers	Yes	Yes	Partial	Partial	Partial	Partial
Licensed Residential Builders (CMs, PMs and Superintendents)	Yes	Yes	Partial	Yes	Yes	Partial
Carpenters, Framers, AVM Barrier Installers & Envelope Trades	Yes	Yes	Partial	Partial	Partial	Partial
Insulators	Yes	Partial	Partial	Yes	Partial	Partial
Electricians	Yes	Yes	Yes	Yes	Yes	Yes

	Urban Centres – Part 9			Province-wide – Part 9		
	2022	2027	2032	2022	2027	2032
HVAC Installers, Mechanical Design/Installers and Plumbers	Yes	Yes	Partial	Yes	Partial	Partial
Gas Fitters	Yes	Partial	No	Yes	Partial	No
Roofers	Yes	Yes	Yes	Yes	Yes	Yes
Glazers, Window and Glass Door Installers	Yes	Yes	Partial	Yes	Yes	Partial
Building Officials	Yes	Yes	Partial	Yes	Partial	Partial
Local Government Planning and Sustainability Staff	Yes	Yes	Yes	Yes	Yes	Partial

Key Performance Indicators

Moving forward, it is important to begin to collect additional data to provide Key Performance Indicators (KPIs) of readiness of key professions. KPIs can be established for "responsible organizations" so they can gauge the capacity of their member professions and support them with training. These would be collected primarily by surveys. There are three core KPIs that are applicable to all key professions (Table 3). Additional survey questions can be added that are customized to those key professions that play a central role in the successful delivery of an energy efficient building (Table 4). There is also a series of KPIs that jurisdictions can collect so they can monitor progress and overall industry readiness (

Table 5).

Table 3 KPIs for all responsible organizations

KPI	Survey question	Rationale / considerations
Presence of Competency Framework for Key Profession	"Do you have a competency framework or profile that describes what skills and expertise are required to meet the energy efficiency requirements of the BC Building Code and the BC Energy Step Code?"	Competency frameworks clearly describe the skills and expertise required to achieve ESC.
Existence of ESC-specific education programs and resources	"What proportion of the competencies required to meet the energy efficiency requirements of the BC Energy Step Code are covered by currently available training programs?"	Key professions can develop the skills they need.

KPI	Survey question	Rationale / considerations
Quality of ESC-specific learning resources	"Do you have assessment programs in place to ensure the education programs and/or learning resources are meeting the needs of your members effectively?"	The training is effective and meets the needs of the key profession.

Table 4 Survey questions to track readiness amongst architects, engineers, builders and building officials

Key profession	Question	Rationale
Builders	"How confident are you that you have in your company (or can find people with) the required technical skills to build a Step 3 building? (Step number adjusted as appropriate)."	This will indicate readiness of trades since many are not represented by an organization. Data should be saved with region information if possible. Leading indicator of confidence in skillset of available labor in near term.
Architects Engineers Builders	"What proportion of the projects you have worked on over the past 12 months have targeted and/or achieved Step Code 3? (Step number adjusted as appropriate)."	Professionals who have completed or are in progress of completing Step Code projects can be considered ready or in process of becoming ready. Data should be tagged with region information if possible. Lagging indicator of readiness
Architects Engineers Builders	"The next update to the energy efficiency requirements of the BC Building code will be in 2022 (adjust year as appropriate). What are your challenges in meeting future Steps?"	Qualitative information regarding technical barriers and gaps in preparedness can be gathered. Anticipated popular responses could be provided as check boxes, with other issues able to be added. Leading indicator of readiness that may help shape future actions.
Architects Engineers Builders Building Officials	"How many training courses relevant to the Energy Step Code have you taken over the past 12 months?"	When combined with responses to the number of projects and challenges faced, this data would provide insight into the correlation of training, its effect on readiness, and continued challenges in meeting performance requirements.

Key profession	Question	Rationale
Building Officials	"When you think about the projects you were involved with over the past twelve months, what proportion of those projects required blower door / air tightness?" "Of these, what proportion passed the blower door / air tightness test first time?"	Identifies how frequently these tests are passed A lagging indicator of builders' readiness to build to the intended performance and how much rework is required to achieve goals. Data should be tagged with region information if possible.
Building Officials	"What percentage of occupancy permits were NOT issued on the first attempt as a result of energy step code related issues?"	Occupancy permits are a general indicator of construction quality and performance but will not pinpoint issues that are related to energy efficiency A lagging indicator of skillset readiness to achieve performance goals. Data should be tagged with region information if possible.
Building Officials	"The next update to the energy efficiency requirements of the BC Building Code will be in 2022 (adjust year as appropriate). Do you have access to training you need to be able to evaluate buildings as will be required by the next level of the Code?"	Indicates readiness of building officials A leading indicator of training availability to prepare building officials for future code updates. Data should be tagged with region information if possible.
Building Officials	"Are you prepared to evaluate buildings at a higher Step Code level than what is currently required?"	A leading indicator of effectiveness of training resources available. Data should be tagged with region information if possible.

Table 5 KPIs for policymakers and jurisdictions

KPI	Rationale / considerations
Predicted TEDI (Thermal Energy Demand Intensity) and EUI (Energy Use Intensity) for new projects	TEDI (Thermal Energy Demand Intensity) and EUI (Energy Use Intensity) are key performance criteria for energy efficient new construction projects. This would provide a leading indicator of readiness for project teams by recording intended building performance and comfort level with new Steps. This data is not routinely collected by local governments and resources would need to be made available to assist.

KPI	Rationale / considerations
Overall availability of training by region	This data would be a leading indicator. Enrollment statistics and student demographics may also be requested from the providers or may be available through statistics on Employer Training Grants. Costs may be incurred to collect this data from course providers, as well as to compile and analyze the data and host the results. Quality would be dependent upon response rate.
Industry satisfaction with training / training effectiveness	Training providers need to deliver training effectively – i.e., in formats, time frames and pedagogical approaches that suit the trainees. Exit surveys and/or feedback forms can be used to gather participants feedback on course effectiveness. The data provides leading indicators of: • Students can find the training they need • Students are satisfied with the training • Potential technical challenges and gaps.

Recommendations

The following recommendations (Table 6) have emerged from the research that offer a starting point for developing programs, actions and solutions to support BC's architecture, engineering and construction industry through the forthcoming updates of the ESC to 2032. Based on the information gathered from the research, the recommendations are positioned at a strategic level and each warrants further development. "Allied organizations" are suggested as those most aligned to the recommendation and those that, potentially, could play a role facilitating solutions.

Certainly, the challenge of ensuring all key professions are ready for forthcoming ESC updates requires multiple tactics and the more recommendations that can be acted upon, the more effective the result. There does not appear to be a logical means to prioritize – none of the recommendations need to be completed before another starts and, indeed, there is not sufficient time between today and 2032 to take a sequential approach.

Table 6 Summary of Recommendations

Recommendation	Allied organizations
Improving Communications & Engagement	
1. Offer financial incentives to help address the real cost of training for key professions. Includes cost of program, travel and accommodation, and cost of forgone income.	BC Government Utilities, BC Housing
2. Facilitate partnerships between project developers, training providers and industry associations to provide hands-on training on actual jobsites, such as a provincially sponsored housing project.	Industry associations Training providers BC Housing

Recommendation	Allied organizations
3. Adopt a system of "Best Practice Advisors" drawn from within key professions, whereby roving mentors and qualified experts check in on locations periodically to give advice and answer questions.	Industry associations NGOs (e.g., ZEBx, CAGBC, Passive House Canada, CEA)
4. Launch a province-wide campaign to help key professions understand the details of Building Code changes through to 2032.	Industry associations BC Housing
5. Develop communications materials for local governments to help them communicate with industry their intentions to adopt the ESC.	Municipalities PIBC, BOABC
6. Sponsor a centralized online hub listing current and relevant training offerings by region and by profession. Consider pairing this with a dedicated telephone hotline to provide support and advice. Also consider including a function where professionals can provide reviews and testimonials about which courses delivered the desired outcomes.	BC Government BC Housing
7. Work with training providers to develop and deliver training focused on subject matter in demand (notably air/vapour barriers and air sealing which was by far the most common theme).	Training providers
8. Develop a standardized evaluation tool to be used by students at the end of each course. Course credits could be linked with completing this survey to increase response rates.	Training providers Industry associations Licensing authorities (AIBC, EGBC, BC Housing)
9. Establish a "Certificate in Training in Low Carbon Buildings" targeted at professionals and instructors who are delivering training.	Training providers
10. Develop a "Prior Learning Assessment and Recognition credential" to recognize successful prior site experience with low carbon buildings.	Training providers Training authorities (e.g., ITA BC)
11. Develop a series of short and focused training options (i.e., micro-credentials or badges) for specific skills and equipment.	Training providers
Tackling Technical Challenges	
12. Develop knowledge sharing and mentorship opportunities to help knowledge transfer between workers of different ages, backgrounds and levels of experience.	Industry associations NGOs (e.g., ZEBx, CAGBC, Passive House Canada)
13. To foster a broad understanding of how trades can work together more effectively, combine curricula related to effective communication, teamwork, and collaboration with "building as a system" courses and "soft skills" training.	Training providers
14. Engage multiple disciplines in collaborative, hands-on training projects to solve technical issues such as air barrier awareness.	Training providers Industry associations NGOs (e.g., ZEBx, CAGBC, Passive House Canada)

Recommendation	Allied organizations
15. Support immigrant workers and newcomers to the province by developing training materials in other languages commonly spoken on construction sites.	Industry associations NGOs (e.g., SUCCESS, EmpowerMe)
Addressing Regional Issues	
16. Where local experts do not exist in a specific profession, sponsor experienced leaders to visit regions and share their knowledge.	BC Government Industry associations
17. Develop hands-on training opportunities specific to cold climate construction by sponsoring higher step “showcase” projects in Northern BC and other parts of the interior.	Industry associations Training providers
18. Consider incentives for workers in rural regions to overcome barriers in accessing training opportunities and projects.	BC Government
Resolving Profession-specific Issues	
19. Develop marketing materials aimed at Developers and Owners that explain the benefits, requirements, and costs to achieve compliance with the ESC.	Industry associations
20. Develop training for Building Officials that covers the practical aspects of design and construction (e.g., navigating energy reports, understanding building systems energy use and air barrier performance) as they relate to outcomes and compliance.	BOABC
21. Combine a revamped suite of training resources for General Contractors with an incentive program or regulatory requirements to take training.	Industry associations BC Housing
22. Develop training for Estimators and Cost Consultants that clarifies knowledge of ESC enhancements and requirements, to help support more accurate pricing and estimating services.	CIQS, ICBA, BCCA and affiliates
23. Provide incentives for regional colleges to deliver and students to complete Energy Advisor training. Incentives could include travel subsidies, tuition grants, and business start-up grants for program graduates.	BC Government Training Providers
24. Develop and provide training and ongoing support for building commissioning that enables participants to learn how to operate HVAC and other building systems to achieve desired energy-performance outcomes.	Industry associations Training Providers HVAC Manufacturers
25. Provide targeted incentives for gas fitters to take training on gas and electric heat pump installation and decarbonization of buildings.	BC Government Utilities

1. Background

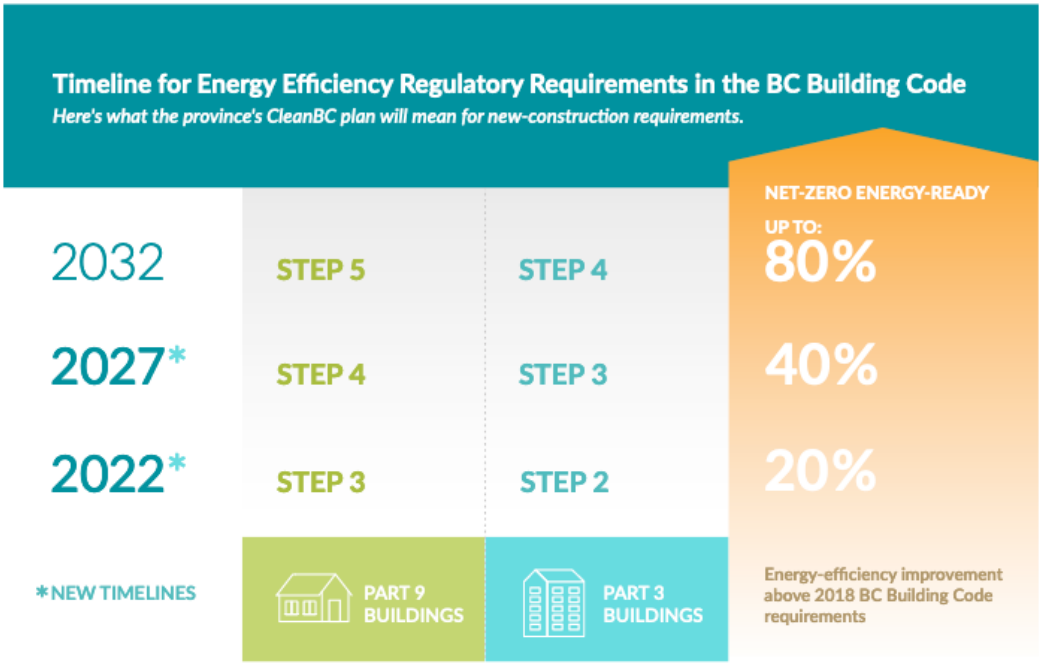
1.1. Context

The BC Energy Step Code (ESC) is intended to encourage energy efficient practices in construction and to accelerate the adoption of a net zero energy standard for residential and commercial buildings. The ESC serves as a “roadmap” to industry of forthcoming updates to the BC Building Code and gives educators and local governments a clear long-range view of the technical expectations so they have time to get ready. The performance-based approach defines desired outcomes while allowing for flexibility of design to achieve them. Adoption of the ESC varies between local jurisdictions but requires incremental improvements in 2022 and 2027 to meet the goals of Net-Zero Ready for new construction in 2032. The ESC not only empowers builders to use innovative methods earlier to prepare for expected requirements but also necessitates new skillsets among the workforce to be available.

With the forthcoming update of the BC Building Code in 2022, all jurisdictions will be required to meet the performance specified by Step 2 for Part 3 and Step 3 for Part 9 projects. This equates to an estimated 20% reduction in energy use compared to the current Building Code. Several jurisdictions have pledged to exceed those levels. By 2027, Step 3 will be required for Part 3 and Step 4 for Part 9. All projects are expected to be performing at the highest steps by 2032 and be “net zero energy ready” (Figure 1).

Achieving these performance levels requires an approach to design and construction that may be unfamiliar to some and, as a result, the successful implementation and uptake of the BC Energy Step Code will require the provision of training and support systems for trades and consultants as well as policymakers and regulators. It is envisaged that these systems will take a variety of forms but should be available in an equitable manner that enables readiness throughout all regions of the province and across ethnic groups and genders.

Figure 1 Timeline for Energy Efficiency Regulatory Requirements in the BC Building Code



1.2. Purpose of Study

Forthcoming BC Building Code updates will require new and/or enhanced technical skills and, potentially, the need for key professions to embrace new enabling practices such as digital literacy, team integration and collaboration, new trade relationships and responsibilities, and possibly new forms of project delivery. This study looks at the resources currently available to key professions to enable them to become prepared for pending and future code changes, and the transition from lower to upper Steps of the ESC. This review, supported by a survey of education providers and interviews with industry leaders, provided a means to assess the current state of readiness of key construction professions to implement the ESC requirements in the 2022, 2027, and 2032 BC Building Codes. The questions that this report aims to answer are:

1. Based on available competency frameworks, are required educational elements in place to support key construction professionals to acquire knowledge and skills to successfully implement mandatory ESC requirements in the BC Building Code through to 2032?
2. What is the current "state of readiness" of key construction professions to implement the ESC?
3. What barriers hinder key professions from acquiring the knowledge and skills they need?
4. How can capacity building efforts best be directed in the coming year(s) to support the development of needed knowledge and skills?

The results of this research are summarized in a "readiness snapshot" of key professions - notably, developers, architects, home designers, engineers, energy modellers and advisors, builders, trades and building officials – currently working in all regions of the province. It identifies the progress that has been made, the barriers that remain and offers recommendations as to how best to further encourage skills development. Support to address these gaps comes from many sources and, where appropriate, key organizations have been identified that could help to develop industry capacity and skillsets across the province.

The study is specifically focussed on mid-career professionals and those that are decision-makers and/or responsible for the installation and completion of critical tasks related to the building envelope and building systems performance. It is not intended to address apprenticeship training.

1.3. Research Methodology

The program of research for this study was organized around a process of desktop research, interviews, and a survey of training organizations. A detailed description of the methodology can be found in Appendix 1. However, to summarize, the key data collection tools comprised:

- A BC Building Code Capacity Survey which was conducted in March and April 2021 to capture insights from training program providers, industry associations, and other training delivery stakeholders across the province. Results of the Survey are found in Appendix 2.
- Twenty-one interviews which were conducted with management and training representatives from large organizations throughout BC, as well as a selection of industry professionals. A detailed summary of the results of those interviews can be found in Appendix 3.

Out of this process, a "Capacity Matrix" (presented in Section 2) was developed to provide a snapshot of the state of readiness of key professions in a concise manner that would help visualize readiness.

Research information gathering process

1. Identifying key professions necessary to successfully implement the ESC
2. Engagement with institutes, associations, warranty providers and certification bodies to validate findings, fill gaps in knowledge, and identify issues.
3. Engagement with organizations that support training and capacity building.
4. Identifying existing competency frameworks for each profession.
5. Identifying learning resources for each profession.
6. Identifying degree to which training is encouraged or mandated by each profession and understanding of acceptance of need for training.
7. Identifying utilization of training and reasoning if it is low.
8. Identifying real and perceived obstacles to training.
9. Clarifying differences between Part 3 and Part 9 construction.

To support the evaluation process, a comprehensive review of training resources was conducted for each key profession. These courses are assembled in an accompanying Excel document and organized into two categories - those “core” courses that specifically deliver ESC learning outcomes and other resources that offer complementary and useful training but are not ESC-specific.

A summary list of the core ESC courses that are regularly available for key professions is provided in Appendix 5 (refer to the Excel document for the full list of courses). Each list of courses identifies the type of course (online, classroom, workshop, etc.), the applicable skills addressed organized in accordance with the relevant competency framework, the technical level (entry or advanced), the type of project (Part 3, Part 9 or both), cost, location and whether the course offers professional learning credits.

In researching the ESC courses, a range of other resources were uncovered that are not training courses and do not target a specific key profession. These include guidebooks, videos and slide presentations and are presented in Appendix 4.

2. Capacity Matrix

A “Capacity Matrix” was developed to provide a high-level snapshot reflecting the current state of readiness for the implementation of the BC Energy Step Code but is not a comprehensive account of the opinions and readiness of all those involved in the industry.

The “Matrix” was developed through a standardized list of information organized into categories of indicators. The description of these categories and the data entered is presented in Table 7Table 7. These indicators were then colour coded using a traffic light system to provide a “heat map” that ranks the state of readiness from green (good), orange (partial / in progress) through to red (none / significant gaps exist).

Table 7 Capacity Matrix Fields

Category	Description	Data entered
Key Professions	Client	Developers
	Designers and consultants	Architects
		Engineers involved in construction of buildings, including mechanical, electrical, building envelope
		Estimators and cost consultants
		(Home) Designers (i.e., Part 9 buildings not requiring an architect)
		Energy Advisors & Modellers (Pt 9)
		Energy Modellers (Part 3)
		Estimators and cost consultants
	Builders & Trades	General contractors (Part 3)
		Licensed residential builders (Part 9)
		Carpenters, Framers, AVM Barrier Installers & Envelope Trades (inc. steel stud and drywall) - Part 3 & Part 9
		Insulators - Part 3 & Part 9
		Electricians - Part 3 & Part 9
		HVAC Installers/Mechanical Design and Installers - Part 3 & Part 9
		Gas Fitters - Part 3 & Part 9
		Roofers - Part 3 & Part 9
		Plumbers - Part 3 & Part 9

Category	Description	Data entered
		Glazers, Window & Door Installers
	Regulators	Building Officials
		Local Govt. Planning Department Staff &/or Sustainability Staff support Step Code
Key Organization Responsible or 'Natural or Potential Lead'	Associations, unions, warranty providers and NGOs responsible for and/or certify key construction professionals	Organization name (colour code – Membership required to operate, Voluntary membership, None identified)
Related or Supporting Organizations	Associations, unions, warranty providers and NGOs that may be important points of contact with key professions, offer training and or voluntary certification (e.g., Passive House Canada, NAIMA, some equipment manufacturers).	Organization name
Step Code Competency Framework Available?	Does the organization have a competency framework on their website or otherwise easily available for its constituents?	Yes Partial, In Progress (references the 2017 framework) No
Learning Resources available to Support Competencies?	Are there resources available for the key professions based on evaluation of course list per key profession?	Yes Partial, In Progress No
Learning Resources List for this Profession	Is there a resource list for this profession available on the key organization's website?	Yes Partial, In Progress No
Step Code Status	Evaluation of how strongly the program is encouraged by key organizations.	Strongly encouraged - Core and/or voluntary/self-reported LCU/CPD credits offered for the majority of courses. Other incentives to take the courses exist. Key organization hosts information about ESC on its website. Partially encouraged - LCU/CPD credits offered for some of the courses. Courses may contribute to self-reporting of LCU/CPD credits. Key organizations or supporting organizations have

Category	Description	Data entered
		some information related to energy efficiency on their websites. Not explicitly encouraged - No LCU/CPD credits available and there is no information on the key organization's website.
Who is taking training?	Additional information based on feedback from interviews	Estimate of # people trained - if available.
Differences - Part 3 vs Part 9	Additional information based on feedback from interviews	Major - Part 3 and 9 professionals can be considered two distinct groups for training and compliance Minor - Part 3 and 9 professionals have differences - training and experience is not always transferable, but there are also overlaps. None - Part 3 and 9 training and experience is considered transferable or the same
Regional readiness	Based on analysis	All - All regions can be considered ready and similar for training and compliance Some - Regional differences exist - training and compliance has differences between regions None - All regions are not ready.
Identified obstacles	Additional information based on feedback from interviews	Major - Factors exist that will make Code Update compliance impossible Minor - Factors exist that will make Code Updates compliance difficult None - Code Updates compliance is not expected to be an issue

The Capacity Matrix is based upon technical competencies that set out the knowledge and technical skills applicable to each key profession. To date, competency frameworks have been developed for Energy Modellers[1] and for Building Officials[2] (provided in Appendix 6). Where frameworks do not exist for key professions, the 2017 competency framework was used (Table 8) with updates identified through interviews in red.

[1] https://energystepcode.ca/app/uploads/sites/257/2021/01/BCESC_Compliance_Competency_Framework-November2020_v1.2.pdf

[2] https://boabc.org/wp-content/uploads/2020/05/EFP-Competency-Framework.pdf

Table 8 Updated 2017 Competency Framework

Part 3	Step 1, 2	Step 3, 4
Part 9	**Step 1, 2, 3**	**Step 4, 5**
Design, construction & regulatory process	• Basic understanding of the BC Energy Step Code • Principles of performance-based codes • Schedules for testing and demonstration of compliance	**All lower step learning outcomes, and:** • improved integration of project team
Building science	• Understanding of the "envelope first" building approach • Impacts of building form and massing on energy performance	**All lower step learning, and:** • Application of building science to determine insulation, glazing and airtightness requirements • Reducing overall loads and simplified equipment
Energy modelling & metrics	• Modelling tool outputs and how to integrate them into the design process • Thermal energy demand intensity (TEDI), energy use intensity (EUI), mechanical energy intensity and power transfer limit (PTL) standards	**All lower step learning outcomes, and:** • Advanced modelling tools
Airtightness	• Design and construction of an airtight building envelope to achieve 3.5 ACH • Conducting blower door testing • Detection and control of air leakages and managing envelope penetrations	**All lower step learning outcomes, and:** • How to design and build an airtight envelope to achieve <1.5 ACH
Building envelope assemblies	• Elements of an effective building envelope • Envelope quality control and assurance	**All lower step learning outcomes, and:** • Minimizing thermal bridging • Advanced framing, alternative envelope solutions (SIPs, box truss walls, etc.)
Insulation (Building envelope & mechanical)	• Envelope insulation requirements (defined by model, climate zone, etc.) • Temperature bearing systems required for insulation (heating and cooling)	**All lower step learning outcomes, and:** • Thermal bridge-free design, consideration of slab edges, balconies, etc. • Heavier and fatter walls, smaller windows, passive design, and shading

Part 3	Step 1, 2	Step 3, 4
Part 9	**Step 1, 2, 3**	**Step 4, 5**
Windows, skylights & doors	• Role of fenestration in heat loss calculations • Labels, standards, shading coefficients, and U-values	**All lower step learning outcomes, and:** • Thermal bridge-free installation strategies • Smaller and heavier windows, passive design, and shading
Supply chain	• Sourcing new/unfamiliar products and services required for compliance (energy model, blower door test, commissioning, etc.)	**All lower step learning outcomes, and:** • New forms of procurement to assure accountability • New forms of delivery methods that foster collaboration, use of digital tools and prefabrication • New / certified products and materials, labels, and standards
Mechanical systems & equipment (heating, cooling, and ventilation)	• Metering, monitoring and controls • Mechanical ventilation in homes, MURBs and ICIs • Heat pumps, heat recovery/recycling, low temperature hydronic solutions, solar, etc. • Commissioning	**All lower step learning, and:** • Simple systems (design, layout, and equipment) to minimize run lengths • Renewable energy solutions • Whole building commissioning, M&V • Basic building science and the importance of air barrier integrity
Electrical systems & equipment	• Ventilation equipment, lighting, appliances, electric HVAC equipment (fans, pumps, etc.) • Metering / submetering, monitoring and controls • Building commissioning	**All lower step learning, and:** • Renewable energy solutions • Whole building commissioning, M&V • Basic building science and the importance of air barrier integrity

The Capacity Matrix is a snapshot of the current state of readiness for the next update of the BC Building Code in 2022 using the fields described in Table 7 and the framework (Table 8) and is presented in Table 9 (next page). Many of the interviewees contacted for this study (and whose insights formed the basis of the Capacity Matrix) either were solely focussed on the question of readiness for the next code update in 2022 or did not have sufficient knowledge of the requirements for subsequent updates of the ESC to be able to provide a “readiness trajectory” to 2032.

Table 9 Capacity Matrix

Key Professions	Key Organization Responsible or 'Natural or Potential Lead'	Related or Supporting Organizations	Step Code Competency Framework Available?	Learning Resources available to Support Competencies?	Learning Resources List for this Profession	Step Code Status	Differences Part 3 vs Part 9	Regional Differences	Identified obstacles	
Metric	**Name (Green - required to operate, Orange - vol. membership, Red - none)**	**Name**	**Green - Yes, Orange - Partial / In Progress, Red - No**	**Green - Yes, Orange - Partial / In Progress, Red - No**	**Green - Yes, Orange - Partial / In Progress, Red - No**	**Green - Strongly encouraged, Orange - Info available but not explicitly encouraged, Red - No, TBD.**	**Major, Minor, None**	**Major, Minor, None**	**Major, Minor, None**	**Comment**
Consultants										
Developers and project managers (Part 3)	UDI	AIBC, CHBA-BC, VRCA, ICBA, EGBC	No	Partial	In progress	No	N/A	Minor; experienced developers concentrated in cities	Minor	Prepared in the short term. Will require training on the implications of ESC on building configuration, form and cost.
Architects	AIBC	RAIC, ASTTBC, CAGBC, Passive House Canada	Partial - Modelling Guidelines	Yes	Yes	Accredited (LCU) = Strongly encouraged	Minor	Minor; experienced Architects unavailable outside of cities - retirements eminent	Major	Shortage of experienced architects outside of cities is a major issue - which will critically affect compliance in regions
Engineers involved in construction of buildings, including mechanical, electrical, building envelope	EGBC	ASHRAE, BCBEC, CSME, IEEE Canada	Prof. Practice Guidelines & Modelling Guidelines	Yes	Yes	Self-reporting LCU = Not explicitly encouraged	Minor	Minor; experienced engineers concentrated in cities	Minor	Prepared in the short term. Hhowever, ability to support/advise construction activities is limited in some areas. Shortage of experienced mechancial enginees may become a problem in the future.
(Home) Designers (i.e., Part 9 buildings not requiring an architect)	BC Association of Building Designers	AIBC, ASTTBC, CAGBC, Passive House Canada	Partial (generic)	Yes	Partial	No	N/A	Minor; experienced designers unavailable outside of cities - retirements	Major	Shortage of experienced Home Designers outside of cities is a major issue - which will critically affect compliance in regions
Estimators and Cost Consultants	CIQS	RICS, AIBC, VRCA, ICBA, NRCA, SICA, VICA, CHBA-BC	No	No	No	No	N/A	N/A	Major	CIQS has no education related to energy efficiency or ESC - interviews varies widely on the relevance and impact of cost advice for ESC.
Energy Advisors & Modellers - Part 9	CACEA	IBPSA BC Chapter, Passive House Canada	Yes	Yes	Yes	Not explicitly encouraged	N/A	Major; Canada is suffering a shortage of Energy Advisor with practical construction experience	Major	Shortage of Advisors (esp. in rural locations);. Training needed to help EAs better support/advise construction and building officials - which will critically affect compliance
Energy Modellers - Part 3	IBPSA BC Chapter	ASHRAE BC, Passive House Canada, EGBC	Yes	Yes	Yes	Not explicitly encouraged	N/A	Minor; experienced engineers concentrated in cities	Minor	Prepared in the short term. However, ability to support/advise construction activities is limited. Lack of training on whole building airtightness testing a challenge.
Builders and Trades/subcontractors										
General contractors (Part 3)- CMs, PMs and Superintendents	None	BCCA, VRCA, ICBA, NRCA, SICA, VICA	Partial (2017 generic)	Yes	Partial	No	N/A	Minor; experienced Contractors concentrated in cities	Major	Experience in coordination, management and knowledge application required for Energy Code is mixed
Licensed residential builders (Part 9) - CMs, PMs and Superintendents	BC Housing Licensing	CHBA BC, HAVAN	Partial (2017 generic)	Yes	Yes	Yes	N/A	Minor; key gap is lack of local projects offering hands-on experience.	Minor	Taining available. Lack of local projects in rural locations offering hands-on experience will become a bigger problem if not addressed
Carpenters, Framers, AVM Barrier Installers & Envelope Trades (inc. steel stud and drywall)	None	VRCA, NRCA, SICA, VICA, ICBA, CHBA-BC. BCRCC (Union)	Partial (2017 generic)	Partial	No	No	Major	Major; trades with relevant experience or training concentrated in cities, with poor training availability in rural regions	Minor	Building envelope training needed - level of expertise dependent on trade/company experience applying skills to project and envelope types. Lack of local projects in rural locations.
Insulators	NAIMA, BCICA	VRCA, NRCA, SICA, VICA, CHBA-BC	Partial (2017 generic)	Partial	Partial	No	Minor	Minor; experienced installers concentrated in cities, but the skill difference is considered minor	Minor	Mechanical insulators are ready. Envelope insulators may require cross-training, training on air barrier and functional requirements.
Electricians	Technical Safety BC	ECA BC, VRCA, NRCA, SICA, VICA, ICBA, CHBA-BC, BC Hydro, FortisBC	Partial (2017 generic)	No	No	No	Minor	Minor; uncommon equipment familiarization	None	Generally prepared; core practices are not expected to change. However, renewable energy systems (although not technically required for ESC) require training.
HVAC Installers/Mechanical Design and Installers, and Pliumbers	Technical Safety BC	TECA, MCABC, HRAI, FortisBC, BCSEA, SMACNA BC, BC Hydro, FortisBC	Partial (2017 generic)	Partial	No	No	Major	Minor; uncommon equipment familiarization	Minor	Lack of familiarity with some new equipment and systems. Training required on "grey areas" relating to testing, commissioning, balancing, etc.
Gas Fitters	Technical Safety BC	FortisBC	Partial (2017 generic)	Partial	No	No	Minor	Minor; uncommon equipment familiarization	Major	Although ESC allows for gas appliances, the introduction of other policies relating to GHG emission reductions (as anticipated in the BC Electrification Roadmap) will result in a limited role in future codes.
Roofers	RCABC	VRCA, NRCA, SICA, VICA, CHBA-BC, ICBA	Partial (2017 generic)	Partial	No	No	Minor	Minor: some roof systems suited to ESC uncommon outside of cities	None	Generally prepared.
Glazers, Window & Glass Door Installers	Fenestration BC	VRCA, NRCA, SICA, VICA, CHBA-BC, ICBA	Partial (2017 generic)	Partial	No	No	Major	Major; experienced installers concentrated in cities, availability in other regions is uncertain	Minor	Required additional "environmental separators" training; uncertain envelope responsibility means some overlap with Envelope trades
Policymakers and regulators										
Building officials	BOABC	PIBC, EGBC, AIBC, ASTTBC	Yes	Yes	Yes	Accredited (CPD) = Strongly encouraged	Major	Major; the experience applicable with Energy Codes is concentrated in cities, with the leaders "few and far between"	Major	Energy Foundations Program available that supports all SC competencies but consistent ability to apply it in practices is considered limited - possibly constraining (esp. outside urban centres).
Local Govt. Planning Department Staff &/or Sustainability Staff support Step Code	PIBC		Partial (2017 generic)	Partial	Yes	Accredited (CPD) = Strongly encouraged	Major	Major the experience applicable with Energy Codes is concentrated in cities, with the leaders "few and far between"	Minor	Ability to articulate the practical implementation of ESC Regulations may be limited - especially within those AHJs that have not formally adopted ESC.

3. Key Professions

This section presents an analysis of the state of readiness of each of the key professions involved with delivering Part 3 and Part 9 projects that fall under the BC ESC. The analysis is based upon industry interviews, the survey of education providers and a review of training resources available. Industry readiness is summarized in the form of a "heatmap" (green = "yes", orange = "partial/some challenges", red = "no") for the 2022, 2027 and 2032 code updates. For example, a profession may already be prepared for the 2027 requirements but only partially ready for the requirements of 2032. The analysis also breaks out the state of readiness of urban centres as compared to Province-wide. The information for urban centres is shown in darker colors and province-wide in lighter shades to allow for ease of readability.

Key professions

- Developers
- Architects
- Engineers involved in construction of buildings, including mechanical, electrical, building envelope
- Estimators and cost consultants
- (Home) Designers (i.e., Part 9 buildings not requiring an architect)
- Energy Advisors & Modellers (Pt 9)
- Energy Modellers (Part 3)
- Estimators and cost consultants
- General contractors (Part 3)
- Licensed residential builders (Part 9)
- Carpenters, Framers, AVM Barrier Installers & Envelope Trades (inc. steel stud and drywall) - Part 3 & Part 9
- Insulators - Part 3 & Part 9
- Electricians - Part 3 & Part 9
- HVAC Installers/Mechanical Design and Installers - Part 3 & Part 9
- Gas Fitters - Part 3 & Part 9
- Roofers - Part 3 & Part 9
- Plumbers - Part 3 & Part 9
- Glazers, Window & Door Installers
- Building Officials
- Local Govt. Planning Department Staff &/or Sustainability Staff support Step Code

For each key profession, a readiness assessment is provided based on a review of the range of readiness indicators defined and described out in Table 7. This information is aggregated and summarized for comparison in the Capacity Matrix (Table 9).

An evaluation of available training courses is presented for each profession, organized by applicable technical competencies, and broken out by Part 3 and Part 9 (if applicable). The colour coding for available training ranges in a spectrum from green (plenty of courses) through yellow and orange to red (no courses) and is based on that evaluation of the number of training courses available.

The training-related competencies are derived from profession-specific competency frameworks or from the "generic" framework presented in Table 8. The evaluation also differentiates between "ESC-specific courses" and "all relevant courses". The priority for this research was to identify ESC-specific courses but, for some key professions, there are courses that offered useful complementary education. Learning resources may be produced or provided by the responsible organization listed for each profession or other sources.

Developers

State of readiness	2022	2027	2032
Urban centres	Yes	Yes	Partial
Province-wide	Yes	Yes	Partial

Developers are generally prepared but may require training to understand the implications of the highest levels of ESC on building configuration and costs to be ready for the 2032 update.

Responsible Organization	**Urban Development Institute (UDI)** - represents the largest multi-family (Part 3) development companies which build the majority of projects in urban centres but has no regulatory role and their membership is voluntary. The home builders who build Part 9 projects speculatively are considered under "Licensed Residential Builders".
Related or Supporting Organizations	AIBC, CHBA-BC, VRCA, ICBA, EGBC
Step Code Competency Framework	**There is no ESC competency framework specifically for developers.** Some may be licensed home builders and be required to complete CPD credits. A few companies may have staff who are members of AIBC and therefore be expected to remain informed with respect to the practice of architecture in BC and to complete ongoing education.
Learning Resources to Support Competencies	**Partial -** There are no courses that are explicitly designed to developers. There are 4 courses that address the design, construction & regulatory processes related to ESC that could be relevant to developers, although they are primarily geared to builders. UDI has hosted breakfast seminars on ESC for members in the past.
Learning Resources List for this Profession	**In progress -** UDI is in the process of adding resources to its website.
Step Code Status	**Not explicitly encouraged.**
Differences Between Part 3 and Part 9	N/A
Regional Differences	**Minor:** experienced developers are concentrated in cities

Identified Obstacles	**Minor:** Understanding the impact of Energy Codes is on-going. There are concerns around real and perceived cost of achieving ESC, as developers rely on cost studies that may not take into account ESC considerations. Often, mispricing by developers happens due to the uncertainty and higher perceived risk associated with the transition to Higher Steps
Additional notes on readiness:	• Education gaps include information about ○ The impacts of ESC on the form and configuration of buildings (e.g., window to wall ratio) ○ The importance of airtightness, the processes involved and the value of air barrier integrity ○ The amount of up-front work required to properly detail and coordinate the envelope and systems, ○ The costs and lead times for high performance windows and equipment ○ The importance of project team collaboration and early contractor involvement

Learning Resources Available to Support Competencies

	Design, construction & regulatory process	Building Science	Energy modelling & metrics	Airtightness	Building envelope assemblies	Insulation (Building envelope & mechanical)	Windows, skylights & doors	Supply chain
ESC COURSES	4	1	1	0	1	0	0	0

Architects

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Yes	Yes	Partial
Urban centres – Part 9	Yes	Yes	Partial
Province-wide – Part 9	Yes	Yes	Partial

Architects are generally prepared, but there is a projected "experience vacuum" looming with the retirement of senior architects over the next decade that may mean the profession needs training (especially on practical aspects such as detailing, constructability and project delivery) to be ready for the highest levels of the ESC in 2032.

Responsible Organization	**Architectural Institute of BC (AIBC)** – regulatory body that requires continual professional development.
Related or Supporting Organizations	ASTTBC, CAGBC, Passive House Canada
Step Code Competency Framework	**Partial –** There is no ESC competency framework specifically for architects, but EGBC has issued Professional Practice Guidelines relating to building enclosure and whole building energy modelling services in collaboration with the AIBC (though this document targets modellers and engineers rather than architects explicitly). To remain in good standing with the AIBC (and be licensed to practice), architects are expected to remain informed with respect to the practice of architecture in BC and are required to complete ongoing education.
Learning Resources to Support Competencies	**Yes** – There are 29 courses directly addressing all aspects of ESC and a further 16 complementary resources. 90% are offered online and available across the province. Gaps exist related to energy modelling and supply chain. As builders push for more collaborative and lean project delivery methods to improve productivity, architects will need to become familiar with digital tools (e.g., BIM), componentized and prefabricated solutions and where ESC products and materials can be sourced.
Learning Resources List for this Profession	**Yes** – The AIBC has a dedicated page for ESC resources including technical bulletins and compliance reports for Part 9 projects. Nothing specifically for Part 3 projects but it links to the ESC website. https://aibc.ca/2019/05/new-bc-energy-step-code-resources-now-available/

Step Code Status	**Strongly encouraged** - 11 of the ESC specific courses offer core LCUs and architects can report their participation in the other education.
Differences Between Part 3 and Part 9	**Minor** – architects are required to maintain their professional practice credentials and apply AIBC codes of practice irrespective of the type of project.
Regional Differences	**Minor** - experienced architects may be unavailable outside of urban centres although most firms travel province-wide, especially for larger projects.
Identified Obstacles	**Major** - Shortage of architects due to retirements could affect readiness over the next decade (i.e., by 2032) – especially outside of cities. This could impact ESC readiness because of the potential lack of seasoned professionals with experience of the practical implications related to constructability and project delivery.
Additional notes on readiness:	• The biggest change for architects will be in how project teams are structured and how risk related to building performance is allocated. • Issues around constructability and trade coordination design could impact readiness since these issues directly affect cost, schedule and construction outcomes. • Digital literacy and facility with BIM and VDC will be essential.

Learning Resources Available to Support Competencies

	Design, construction & regulatory process	Building Science	Energy modelling & metrics	Airtightness	Building envelope assemblies	Insulation (envelope & mechanical)	Windows, skylights & doors	Supply chain	Mech. systems & equipment (heating, cooling and ventilation)	Elec. systems & equipment
ESC COURSES Pt 3	24	12	2	6	11	7	3	1	1	5
ESC COURSES Pt 9	25	12	2	7	10	7	3	1	2	5
ALL APPLICABLE COURSES Pt 3	33	18	3	11	18	12	8	2	2	5
ALL APPLICABLE COURSES Pt 9	36	19	3	13	18	13	9	3	5	5

Engineers (Mechanical, Electrical, Building Enclosure)

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Yes
Province-wide – Part 3	Yes	Yes	Yes
Urban centres – Part 9	Yes	Yes	Yes
Province-wide – Part 9	Yes	Yes	Yes

Engineers are generally ready for all levels of the ESC assuming they can continue to receive training in a timely fashion on emerging technologies and systems as they enter the BC market.

Responsible Organization	**Engineers and Geoscientists of British Columbia (EGBC)** – regulatory body that requires continual professional development.
Related or Supporting Organizations	ASHRAE, BCBEC, CSME, IEEE Canada
Step Code Competency Framework	**Yes** – EGBC has issued Professional Practice Guidelines relating to building enclosure and whole building energy modelling services (see Appendix 6).
Learning Resources to Support Competencies	**Yes** - There are a total of 32 courses directly addressing all aspects of ESC and a further 24 complementary resources. 90% are offered online and available across the province. The majority of the courses address envelope and enclosure, there are fewer related to mechanical and electrical design.
Learning Resources List for this Profession	**Yes** - EGBC lists numerous institutional and industry resources, although does not specifically call out resources related to ESC
Step Code Status	**Partial** - Engineers are required to track and report their education, but ESC training is not explicitly encouraged.
Differences Between Part 3 and Part 9	**Minor** – engineers work on all types of projects and are required to maintain their professional credentials and apply EGBC codes of practice irrespective of the type of project.
Regional Differences	**Minor** - experienced engineers may be unavailable outside of urban centres although most firms travel province-wide, especially for larger projects.
Identified Obstacles	**Minor** – possible shortage of engineers due to retirements could affect readiness over the next decade (i.e., by 2032) – especially outside of cities.

	This could impact ESC readiness because of the potential lack of seasoned professionals with experience of the practical implications related to constructability and project delivery.
Additional notes on readiness:	• The biggest change for engineers will be in how project teams are structured and how risk related to building performance is allocated. • Issues around constructability and trade coordination design could impact readiness since these issues directly affect cost, schedule and construction outcomes. • As builders push for more collaborative and lean project delivery methods to improve productivity, engineers will need to become familiar with digital tools, componentized and prefabricated solutions.

Learning Resources Available to Support Competencies

Building Enclosure Engineers

	Design, construction & regulatory process	Building Science	Energy modelling & metrics	Airtightness	Building envelope assemblies	Insulation (building envelope)	Windows, skylights & doors	Supply chain
ESC COURSES - Pt 3	24	16	8	2	18	6	3	0
ESC COURSES - Pt 9	21	15	5	2	16	6	3	0
ALL APPLICABLE COURSES - Pt 3	30	16	8	2	20	7	4	1
ALL APPLICABLE COURSES - Pt 9	38	19	6	5	22	10	7	2

Mechanical and Electrical Engineers

	Design, construction & regulatory process	Building Science	Energy modelling & metrics	Insulation (mechanical)	Supply chain	Mechanical systems & equipment (heating, cooling and	Electrical systems & equipment
ESC COURSES - Pt 3	24	16	8	6	0	1	5
ESC COURSES - Pt 9	21	15	5	6	0	0	5
ALL APPLICABLE COURSES - Pt 3	30	16	8	7	1	7	6
ALL APPLICABLE COURSES - Pt 9	38	19	6	10	2	10	6

Home designers (i.e., Part 9 buildings not requiring an architect)

State of readiness	2022	2027	2032
Urban centres	Yes	Yes	Partial
Province-wide	Yes	Yes	Partial

Home designers are generally prepared, but there is a projected “experience vacuum” looming with the retirement of senior professionals over the next decade that may mean the profession needs training (especially on practical aspects such as detailing, constructability and project delivery) to be ready for the highest levels of the ESC in 2032.

Responsible Organization	**BC Association of Building Designers (BC ABD)** represents independent home designers, but has no regulatory role and membership is voluntary.
Related or Supporting Organizations	AIBC, ASTTBC, CAGBC, PassiveHouse Canada
Step Code Competency Framework	**Partial - There is no ESC competency framework specifically for home designers.** The 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Yes -** There are 37 courses directly addressing all aspects of ESC and a further 12 complementary resources. 90% are offered online and available across the province. Home designers can attend builder training as well as courses put on by the AIBC.
Learning Resources List for this Profession	**Partial -** BC ABD lists numerous institutional and industry resources but does not specifically call out resources related to BC ESC.
Step Code Status	**Not explicitly encouraged -** Home designers are not required to complete LCU/CPD credits. However, those that work within licensed home building companies may participate.
Differences Between Part 3 and Part 9	N/A
Regional Differences	**Minor –** In terms of disparity of expertise but experienced designers may be unavailable outside of cities which could become a major issue over the next decade.
Identified Obstacles	**Major -** Designers in rural regions are unfamiliar with using ESC relevant equipment. Also, there is a pending shortage of designers outside of cities, which could critically affect compliance in some regions by 2032.

Additional notes on readiness:	• Although BIM is not commonly used for home design, as the industry shifts towards prefabricated solutions, digital literacy may become important

Learning Resources Available to Support Competencies

	Design, construction & regulatory process	Building Science	Energy modelling & metrics	Airtightness	Building envelope assemblies	Insulation (Building envelope & mechanical)	Windows, skylights & doors	Supply chain	Mechanical systems & equipment (heating, cooling and ventilation)	Electrical systems & equipment
ESC COURSES	34	14	6	4	14	6	4	2	5	0
ALL APPLICABLE COURSES	43	18	7	4	17	8	5	2	7	0

Estimators and Cost Consultants - Part 3

State of readiness	2022	2027	2032
Urban centres	Partial	Partial	Partial
Province-wide	Partial	Partial	Partial

There are no dedicated training resources for estimators and cost consultants which means that there are barriers to them being ready as the ESC transitions from lower to higher Steps.

Responsible Organization	**Canadian Institute for Quantity Surveyors (CIQS)**
Related or Supporting Organizations	RICS, AIBC, VRCA, ICBA, NRCA, SICA, VICA, CHBA-BC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for estimators and cost consultants, although estimators can use much of the framework for General Contractors.
Learning Resources to Support Competencies	**No -** There are no courses that are explicitly designed for estimators**.**
Learning Resources List for this Profession	**No** - CIQS has no courses related to energy efficiency or ESC.
Step Code Status	**No** - Cost estimators are not required to complete LCU/CPD credits.
Differences Between Part 3 and Part 9	N/A
Regional Differences	**Minor** - Experienced firms are usually concentrated in cities, but most work can be done remotely, and many professionals will travel if necessary.
Identified Obstacles	**Major** ● Uncertainty around costs of materials and training around ESC requirements has led to some variation in price premium and cost advice.

Additional notes on readiness:	• Historically, estimators and cost consultants have not been identified as key professions in achieving ESC performance. With the shift to Higher Steps, estimators and cost consultants will not only need to know the costs of materials and equipment, but also the associated infrastructure needed to install and control them. • Costs can be quite uncertain for Higher Step ESC requirements. Price premiums may be added to hedge against lack of experience. Suppliers may not have good data or experience themselves.

Learning Resources Available to Support Competencies

None identified.

From interviews, it was learnt that estimators and cost consultants do look out for and attend training that is not specifically for their profession. However, it is worth noting that there are some profession-specific competencies for cost consultants and estimators missing from the generic competency framework – in particular, related to construction cost implications of assemblies, technologies and processes.

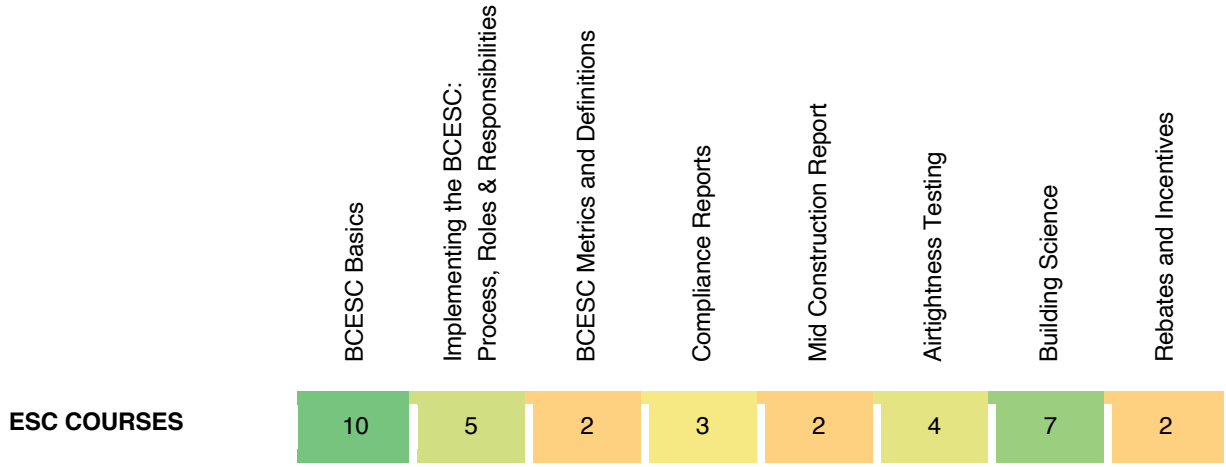
Energy Modellers - Part 3

State of readiness	2022	2027	2032
Urban centres	Yes	Yes	Yes
Province-wide	Yes	Yes	Partial

Generally, energy modellers working on Part 3 projects are ready with the minor exception of those based outside of urban centres who may not have access to training on the highest Steps.

Responsible Organization	**International Building Performance Simulation Association (IBPSA) BC Chapter** – membership is voluntary.
Related or Supporting Organizations	ASHRAE BC, Passive House Canada, EGBC
Step Code Competency Framework	**Yes** - EGBC Professional Practice Guidelines relating to whole building energy modelling services (see Appendix 6).
Learning Resources to Support Competencies	**Yes** - There are 18 courses directly addressing all aspects of ESC. 83% are offered online and available across the province. There are courses available that cover all key competencies.
Learning Resources List for this Profession	**Yes** - IBPSA BC Chapter lists numerous industry resources on its homepage but does not specifically call out resources related to ESC.
Step Code Status	**Information is available but learning is not explicitly encouraged -** Energy advisors are not required to complete LCU/CPD credits.
Differences Between Part 3 and Part 9	N/A
Regional Differences	Those that are based outside of urban centres may have experienced challenges finding practical training – especially during COVID. However, the majority of experienced firms are concentrated in cities, but most work can be done remotely, and many professionals will travel if necessary.
Identified Obstacles	**Minor** • Modellers' ability to support/advise construction activities is limited due to lack of practical on-site experience. • The lack of training on whole building airtightness testing is a barrier to achieve readiness.

Learning Resources Available to Support Competencies



Energy Advisors & Modellers - Part 9

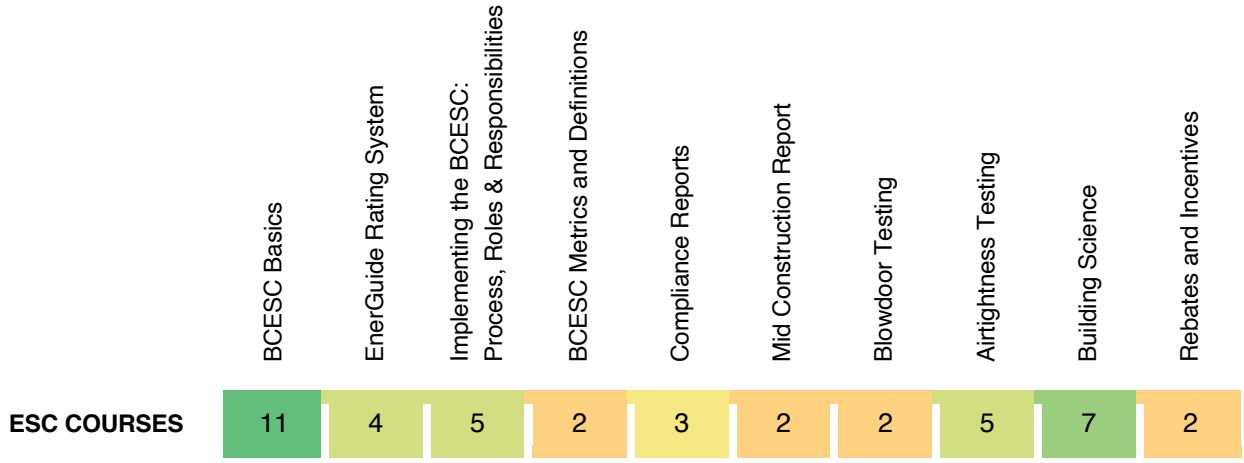
State of readiness	2022	2027	2032
Urban centres	Yes	Yes	Partial
Province-wide	Partial	Partial	Partial

Energy advisors (EAs) based in urban centres are generally ready, but more training may be needed as the ESC moves to the highest levels in 2032 and practical experience with constructing ESC compliant envelope assemblies and systems becomes important. Generally, there is a shortage of experienced EAs in BC. Outside of urban centres, this is a particular problem which could constrain adoption of ESC because EAs often find themselves in an enhanced role coordinating the ESC compliant measures between the builder and Building Official.

Responsible Organization	**Canadian Association of Consulting Energy Advisors (CACEA) -** – membership is voluntary
Related or Supporting Organizations	IBPSA BC Chapter, Passive House Canada
Step Code Competency Framework	**Yes** - BCESC has created a compliance competency framework for energy advisors and modellers, in context of Part 9 buildings. It also includes a list of relevant resources to meet each competency (see Appendix 6).
Learning Resources to Support Competencies	**Yes** - There are 18 courses directly addressing all aspects of ESC. 83% are offered online and available across the province. There are courses that cover all key competencies.
Learning Resources List for this Profession	**Yes** - CACEA has a dedicated page for ESC resources which includes the official presentation and guide to the ESC. It also provides a link to the BCESC website (https://cacea.ca/bc-step-code). In addition, there is a resources page which lists numerous institutional and industry resources. https://cacea.ca/resources/
Step Code Status	**Information is available but learning is not explicitly encouraged -** Energy advisors are not required to complete LCU/CPD credits.
Differences Between Part 3 and Part 9	N/A
Regional Differences	**Major** - BC is suffering a shortage of Energy Advisors with practical construction experience. Those working in rural areas may need to have more technical expertise as builders, building officials and others tend to rely on them more for “what to do and how to do it”.

Identified Obstacles	**Major** • Shortage of advisors (especially outside urban centres), which means they have limited ability to support construction and building officials. This will critically affect compliance. • Distribution of advisors might be misaligned with demand. For instance, the demand for advisors is lower in rural regions due to fears about cost and unfamiliarity with advisors. • Advisors usually gain training through mentorship and on-site experience, so formal training is not ideal for their capacity building. • Advisors have limited ability to support/advise construction and building officials which will critically affect compliance.

Learning Resources Available to Support Competencies



General Contractors - Part 3 (CMs, PMs and Superintendents)

State of readiness	2022	2027	2032
Urban centres	Yes	Partial	Partial
Province-wide	Yes	Partial	Partial

The lack of targeted courses for Part 3 contractors and the lack of requirement for ongoing professional development means that some companies may not be ready for the Higher Steps of the ESC (notably, what is required in terms of high-performance envelope construction, attention to detail, etc.)

Responsible Organization	**None** – There are multiple associations to which membership is voluntary. Part 3 builders are not required to be licensed.
Related or Supporting Organizations	BCCA, ICBA, VRCA, NRCA, SICA, VICA
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for General Contractors, although the updated 2017 framework is applicable.
Learning Resources to Support Competencies	**Partial -** There are 9 courses directly addressing all aspects of ESC and a further 17 complementary resources. The majority of the courses are offered online and available across the province. Among the competencies, “design, construction and regulatory process” competency is most widely covered. There is at least one course covering each competency. Many of the courses are not clear about applicability to Part 3 / multi-family construction.
Learning Resources List for this Profession	**Partial** – All the construction associations promote education courses generally and sometimes include ESC related events on an ad-hoc basis. There is no centralized list.
Step Code Status	**No** - There are no incentives or means of encouragement for general contractors to take training. Contractors do not require CPD credits.
Differences Between Part 3 and Part 9	**NA**
Regional Differences	**Minor** - Experienced contractors are usually more concentrated in cities, but travel province-wide.
Identified Obstacles	**Major** • There are not enough training resources for contractors, and they are one of the top groups who were identified as struggling with implementation and needing further support.

	• The courses that do exist are difficult for contractors to find. • There is confusion about whether Part 9 courses are applicable to Part 3 projects. Some may be, but most courses are not sufficiently well described. • The experience in coordination, management and knowledge application that required for Energy Code is mixed.

Learning Resources Available to Support Competencies

	Design, Construction & regulatory process	Building Science	Energy modelling & metrics	Airtightness	Building envelope assemblies	Insulation (Building envelope & mechanical)	Windows, skylights & doors	Supply chain	Mechanical systems & equipment (heating, cooling and ventilation)	Electrical systems & equipment
ESC COURSES	9	4	0	2	6	4	1	1	2	1
ALL APPLICABLE COURSES	17	9	1	3	8	4	1	2	3	6

Licensed Residential Builders - Part 9 (CMs, PMs & Superintendents)

State of readiness	2022	2027	2032
Urban centres	Yes	Yes	Partial
Province-wide	Yes	Yes	Partial

Licensed residential builders are largely ready for the next update of the ESC. However, builders learn by doing and as the ESC moves to the highest level, training opportunities that provide hands-on experience will become increasingly important.

Responsible Organization	**BC Housing Licensing**
Related or Supporting Organizations	CHBA BC, HAVAN
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for licensed residential builders. The 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Yes –** There are 45 courses that are specifically focused on ESC and an additional ten complementary courses. Majority of courses are available online and there are courses that cover all the key competencies.
Learning Resources List for this Profession	**Yes** – BC Housing has a comprehensive library of resources and training offerings in a number of formats conveniently located to where builders must log their CPD requirements.
Step Code Status	**Yes, strongly encouraged** – licensed builders are required to maintain continuing professional development (CPD) credits.
Differences Between Part 3 and Part 9	N/A
Regional Differences	**Minor -** Key gap is lack of local projects in rural locations offering hands-on experience in the Higher Steps of the ESC. This could become a major problem if not addressed.
Identified Obstacles	**Minor** ● There may need to be closer control on who within construction firms is attending the training programs, so the information gets transferred. ● Some challenges for builders in remote locations include getting access to hands-on training.

	• The key barrier to adoption of training is the degree to which ESC has been adopted by local governments. If it is not mandated, then builders are less motivated to get trained.
Additional notes on readiness:	• BC Housing has issued a Request for Proposal (RFP) to develop curriculum for licensed residential builders. • Energy Step Code training will become a requirement for builders and is anticipated as this report is being prepared.

Learning Resources Available to Support Competencies

	Design, construction & regulatory process	Building Science	Energy modelling & metrics	Airtightness	Building envelope assemblies	Insulation (building envelope & mechanical)	Windows, skylights & doors	Supply chain	Mechanical systems & equipment (heating, cooling and ventilation)	Electrical systems & equipment
ESC COURSES	**45**	**16**	**6**	**14**	**25**	**21**	**11**	**1**	**14**	**2**
ALL APPLICABLE COURSES	**55**	**21**	**8**	**15**	**27**	**22**	**11**	**2**	**15**	**8**

Carpenters, Framers, AVM Barrier Installers & Envelope Trades

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Partial	Partial	Partial
Urban centres – Part 9	Yes	Yes	Partial
Province-wide – Part 9	Partial	Partial	Partial

In the short term, carpenters, framers, Air/Vapour/Moisture (AVM) barrier installers and envelope trades in urban centres are prepared for the ESC. Those outside urban centres lack adequate access to training on energy efficient envelope construction. As the ESC moves to higher Steps, hands-on practical training will become increasingly important for all envelope trades for all project types.

Responsible Organization	**None**
Related or Supporting Organizations	VRCA, NRCA, SICA, VICA, ICBA, CHBA-BC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for carpenters. The updated 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Partial** - There are more courses with applicable training for Part 9 carpenters and framers, and fewer for those working on Part 3 projects. These courses are primarily directed to other key professions and do not make it clear they are applicable to carpenters, framers. There are insufficient training opportunities on Air Vapour Moisture (AVM) barrier application and whole building airtightness for Part 3 projects. However, there are courses that provide training on ESC compliant building and envelope techniques, as well as windows and door installation methods.
Learning Resources List for this Profession	**Partial -** For Part 9, BC Housing has listed some industry resources on green buildings. There is no key organization where carpenters, framers, AVM barrier installers & envelope trades would go to find energy efficiency courses.
Step Code Status	**Not actively encouraged** - There are no incentives or means of encouragement for carpenters, framers, AVM barrier installers & envelope trades to take training. They do not require CPD credits.

Differences Between Part 3 and Part 9	**Major** • Part 3 skills include steel stud and drywall. Part 9 is more commonly light wood frame. AVM application can be very different. • There are very different delivery approaches between Part 3 and Part 9 projects. Envelope trades on Part 3 projects may be independent specialized firms (and therefore motivated to stay up to date on the latest practices), whereas for Part 9, the builder may self-perform the work.
Regional Differences	**Major** - Trades with relevant experience or training are usually concentrated in cities, with poor training availability in rural regions.
Identified Obstacles	**Major** • **T**here are no ESC courses that explicitly state they are for carpenters, framers, AVM installers, etc. • There is confusion about whether Passive House and Zero Energy training is applicable to ESC (is it overkill?) • Several potentially applicable courses do not clarify if they focus on Part 3 or Part 9 which can be significantly different approaches (e.g., combustible versus non-combustible construction). • The trades are dependent on hands-on experience for applying skills to project and envelope types. • Outside of urban centres, there are concerns that the Part 3 envelope trades may not be ready for the requirements of the Highest Steps of the ESC by 2032.
Additional notes on readiness:	• On-site ad hoc training is very common for envelope trades through tests and mock-ups. This is often where the constructability of the envelope and the details (e.g., around windows) is worked out. While important, it is very difficult to track. • BCIT Carpentry apprenticeship incorporates Step Code related work at every level, which will help younger workers be ready by 2032.

Learning Resources Available to Support Competencies

	Building Science	Airtightness	Building envelope assemblies	Insulation (building envelope)	Windows, skylights & doors	Supply chain
ESC COURSES - Pt 3	**4**	**2**	**6**	**4**	**1**	**1**
ESC COURSES - Pt 9	**16**	**14**	**25**	**21**	**11**	**1**
ALL APPLICABLE COURSES - Pt 3	9	3	8	4	1	2
ALL APPLICABLE COURSES - Pt 9	21	15	27	22	11	2

Insulators (envelope and mechanical)

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Yes	Yes	Partial
Urban centres – Part 9	Yes	Partial	Partial
Province-wide – Part 9	Yes	Partial	Partial

Mechanical insulators[3] are ready for all levels of ESC. In the short term, envelope insulators are ready but will need cross-training and familiarization on high performance envelope construction to be ready for the higher Steps of ESC.

Responsible Organization	**North American Insulation Manufacturers Association (NAIMA)** – envelope **BC Insulation British Columbia Insulation Contractors Association (BCICA**) - mechanical.
Related or Supporting Organizations	VRCA, NRCA, SICA, VICA, CHBA-BC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for insulators. The updated 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Partial -** There are courses that provide training on all the key competencies including air barriers, insulation and envelopes as well as mechanical systems. However, none are specifically for insulators. There may be insufficient courses on airtightness and mechanical insulation for Part 3 projects.
Learning Resources List for this Profession	**Partial -** NAIMA has some training and resources on insulation installation and air barriers but it does not mention ESC https://www.naimacanada.ca/insulation-training/ BCICA has a **Quality Standards for Mechanical Insulation Manual** and a **Quality Assurance Certificate Program** which sets out QA/QC measures for mechanical insulators.
Step Code Status	**Not actively encouraged -** There are no incentives or means of encouragement for insulators to take training. They do not require CPD credits.

[3] Mechanical insulators are responsible for insulating pipes, ducts and mechanical systems. Envelope insulators work on walls, roofs, below grade/foundations.

Differences Between Part 3 and Part 9	**Minor** • Part 3 skills include steel stud and drywall. Part 9 is more commonly light wood frame. The products may be different, but the application process and best practices are relatively similar. Insulation firms usually move between Part 3 and Part 9 projects quite seamlessly. • There are very few differences when it comes to mechanical insulation.
Regional Differences	**Minor** - experienced installers are usually concentrated in cities, but the skill difference is considered minor.
Identified Obstacles	**Minor** • Insulators are dependent on trade or company experience for applying skills to project and envelope types
Additional notes on readiness:	• Manufacturer-led training is common for insulators, but this can be very difficult to track. • On-site ad hoc training is very common through tests and mock-ups. While important, it is very difficult to track.

Learning Resources Available to Support Competencies

	Building Science	Airtightness	Building envelope assemblies	Insulation (building envelope & mechanical)	Mechanical systems & equipment (heating, cooling and ventilation)
ESC COURSES - Pt 3	**4**	**2**	**6**	**4**	**2**
ESC COURSES - Pt 9	**16**	**14**	**25**	**21**	**14**
ALL APPLICABLE COURSES - Pt 3	**9**	**3**	**8**	**4**	**3**
ALL APPLICABLE COURSES - Pt 9	**21**	**15**	**27**	**22**	**15**

Electricians

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Yes
Province-wide – Part 3	Yes	Yes	Yes
Urban centres – Part 9	Yes	Yes	Yes
Province-wide – Part 9	Yes	Yes	Yes

Generally, electricians are ready for all Steps of the ESC.

Responsible Organization	Electricians are required to be qualified and registered with **Technical Safety BC**. Although this is a regulatory body, its mandate does not include energy efficiency.
Related or Supporting Organizations	ECA BC, VRCA, NRCA, SICA, VICA, ICBA, CHBA-BC, BC Hydro, FortisBC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for electricians. The updated 2017 generic framework is applicable. Renewable energy solutions are not required as part of the ESC, but this is the area where electricians will need to be ready post-2032 and decarbonization of building systems.
Learning Resources to Support Competencies	**No -** There are no courses specifically focused on ESC for electricians and only a few complementary courses that provide training on PV systems and on-site electricity storage.
Learning Resources List for this Profession	**No -** Technical Safety BC lists courses focused on safety training. There is no key organization where electricians working in residential construction would go to find energy efficiency courses.
Step Code Status	**Not actively encouraged -** Electricians do not require CPD credits.
Differences Between Part 3 and Part 9	**Minor.** Many electricians work on both Part 3 and Part 9 projects. For Part 3, electrical contractors work to the design set by a Professional Electrical Engineer who will specify all the equipment and installation details. For any issues, they usually discuss it with the Engineer. For Part 9, electricians may be required to design the electrical systems and be familiar with the equipment.
Regional Differences	**Minor** – The fact that electricians need to be qualified means that there are universal standards of professionalism and technical knowledge in place

	across the province. The only consideration is that there may be a lack of opportunity for those working outside urban centres to get direct experience with projects achieving the higher levels of ESC.
Identified Obstacles	**Minor** • There are no courses on the metering and monitoring requirements for energy efficient Part 9 projects. • There are also no courses that address the trades' involvement in the commissioning process.
Additional notes on readiness:	• As HVAC equipment electrifies, there will be convergence and/or integration between Mechanical and Electrical trades. • Some of the large electrical contractors are already getting to grips with BIM and VDC. All companies will require some level of digital literacy by 2032.

Learning Resources Available to Support Competencies

	Mechanical systems & equipment (heating, cooling and ventilation)	Electrical systems & equipment	Supply chain
ESC COURSES - Pt 3	2	1	1
ESC COURSES - Pt 9	14	2	1
ALL APPLICABLE COURSES - Pt 3	3	6	2
ALL APPLICABLE COURSES - Pt 9	15	8	1

HVAC Installers, Mechanical Design/Installers and Plumbers

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Yes	Partial	Partial
Urban centres – Part 9	Yes	Yes	Partial
Province-wide – Part 9	Yes	Partial	Partial

HVAC/ mechanical installation is ready in the short term but the understanding of the functional requirements of building systems may require more training as the ESC moves to higher Steps – in particular, HVAC installers may require cross-training on the implications and impacts of their scope of work on air tightness, so they understand the importance of the integrity of the air barrier.

Responsible Organization	HVAC installers and mechanical contractors are required to be qualified and registered with **Technical Safety BC**. Although this is a regulatory body, its mandate does not include energy efficiency.
Related or Supporting Organizations	TECA, MCABC, HRAI, BCSEA, SMACNA BC, BC Hydro, FortisBC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for insulators. The updated 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Partial -** There are 14 ESC-specific courses for Part 9 projects, but relatively few for Part 3. However, many equipment manufacturers (Delta, Zehnder, Mitsubishi, Honeywell, etc.) offer training to certified installers, but the number of people trained this way is difficult to assess. There are no courses on the metering and monitoring requirements for energy efficient Part 9 projects. There are also no courses that address the trades' involvement in the commissioning process (Part 3 or Part 9).
Learning Resources List for this Profession	**No -** Technical Safety BC lists courses focused on safety training. There is no key organization where HVAC installers, mechanical contractors or plumbers working in residential construction would go to find energy efficiency courses.
Step Code Status	**Not actively encouraged -** Do not require CPD credits.
Differences Between Part 3 and Part 9	**Major -** Some HVAC contracting firms work on both Part 3 and Part 9 projects, but the types of equipment and systems can be very different, with Part 3 systems in particular being quite complex.

Regional Differences	**Minor** – The fact that HVAC Contractors need to be qualified means that there are universal standards of professionalism and technical knowledge in place across the province. The only consideration is that there may be a lack of opportunity for those working outside urban centres to get direct experience with projects achieving the higher levels of ESC.
Identified Obstacles	**Minor** • New and unfamiliar equipment is entering the market rapidly and installers need to keep up in a timely fashion. • Many equipment manufacturers (Delta, Zehnder, Mitsubishi, Honeywell, etc.) offer training to certified installers on how to connect their equipment and the controls[4] but these focus on proprietary systems and there is little to help contractors figure out how to get different systems to "talk" to each other - an issue for Pt 3 projects. • HVAC installers require cross-training and air tightness training, so they understand the importance of the integrity of the air barrier. • HVAC/ mechanical installation is ready in the short term but the understanding of the functional requirements of building systems may require more training.
Additional notes on readiness:	• As HVAC equipment electrifies, there may be convergence and/or integration between Mechanical and Electrical trades. • FortisBC offers a training allowance to Trade Ally program members. • Some of the large HVAC contractors are already getting to grips with BIM and VDC. All companies will require some level of digital literacy by 2032. • Importantly, FortisBC offers training programs for Indigenous youth https://www.fortisbc.com/in-your-community/indigenous-relationships-and-reconciliation/training-education-and-careers.

Learning Resources Available to Support Competencies

	Supply Chain	Mechanical systems & equipment (heating, cooling and ventilation)
ESC COURSES - Pt 3	**1**	**2**
ESC COURSES - Pt 9	**1**	**14**
ALL APPLICABLE COURSES - Pt 3	**2**	**3**
ALL APPLICABLE COURSES - Pt 9	**2**	**15**

[4] Honeywell's online training program covers their own equipment and control products. https://www.honeywellprocess.com/en-US/training/Pages/default.aspx

Gas Fitters

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Partial	No
Province-wide – Part 3	Yes	Partial	No
Urban centres – Part 9	Yes	Partial	No
Province-wide – Part 9	Yes	Partial	No

Gas fitters are generally ready for the ESC in the short term. However, there is a shift to high-performance electric HVAC equipment underway across BC. Although ESC allows for gas appliances, the introduction of other policies relating to GHG emission reductions (as anticipated in the BC Electrification Roadmap[5]) may result in a declining role in new construction over the next decade.

Responsible Organization	Gas fitters are required to be qualified and registered with **Technical Safety BC**. Although this is a regulatory body, its mandate does not include energy efficiency.
Related or Supporting Organizations	FortisBC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for gas fitters. The updated 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Partial -** There are no ESC-specific courses on gas appliances. As the ESC continues to update through to 2032, there will be a shift to electrification of buildings (driven by BC's Climate goals). For gas fitters seeking to participate in new construction projects post 2032, there are opportunities to learn how to install heat pumps and electric HVAC systems (See HVAC installers above).
Learning Resources List for this Profession	**No -** Technical Safety BC lists courses focused on safety training. There is no key organization where gas fitters working in residential construction would go to find energy efficiency courses.
Step Code Status	**Not actively encouraged –** Gas fitters do not require CPD credits.
Differences Between Part 3 and Part 9	**Minor.** Many gas fitters work on both Part 3 and Part 9 projects.

[5] https://www.zebx.org/wp-content/uploads/2021/04/BC-Building-Electrification-Road-Map-Final-Apr2021.pdf

Regional Differences	**Minor** – The fact that gas fitters need to be qualified means that there are universal standards of professionalism and technical knowledge in place across the province. The only consideration is that there may be a lack of opportunity for those working outside urban centres to get direct experience with projects achieving the higher levels of ESC.
Identified Obstacles	**Major –** Although ESC allows for gas appliances, the introduction of other policies relating to GHG emission reductions (as anticipated in the BC Electrification Roadmap) may result in a declining role in new construction over the next decade.
Additional notes on readiness:	• FortisBC offers an annual training allowance to members of its Trade Ally program which may support gasfitters seeking training on new equipment.

Learning Resources Available to Support Competencies

Refer to HVAC Installers, Mechanical Design/Installers and Plumbers.

Roofers

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Yes
Province-wide – Part 3	Yes	Yes	Yes
Urban centres – Part 9	Yes	Yes	Yes
Province-wide – Part 9	Yes	Yes	Yes

Roofers are ready for all levels of the ESC.

Responsible Organization	**Roofing Contractors Association of BC** (RCABC) – warranty provider, membership is required.
Related or Supporting Organizations	VRCA, NRCA, SICA, VICA, CHBA-BC, ICBA
Step Code Competency Framework	**Partial - There is no ESC competency framework specifically for roofers.** The updated 2017 generic framework is applicable. RCABC's Roofing Practices Manual offers a general overview of roofing practices in BC.
Learning Resources to Support Competencies	**Partial** - there are no courses specifically focused on ESC for roofers but there are courses that address roofing and provide training on air tightness, building envelope and insulation.
Learning Resources List for this Profession	**No -** RCABC lists training focused on general roofing skills but nothing related to ESC.
Step Code Status	**Not actively encouraged -** There are no incentives or means of encouragement for roofers to take training. Only those seeking Master Roofer designation must be able to demonstrate that they have continued to learn about the industry and develop their skills since their certification in the trade.
Differences Between Part 3 and Part 9	**Minor –** Differences mainly related to types of products and assemblies.
Regional Differences	**Minor** - Some roof systems suited to ESC are uncommon outside of cities
Identified Obstacles	**Minor -** Generally prepared.
Additional notes on readiness:	• RCABC runs a Master Roofer program designed to build best practices and elevate the level of expertise and knowledge in roofing.

	• RCABC has a state-of-the-art training centre in the Fraser Valley and offers safety training and apprenticeship training. • RCABC's warranty program offers a potential role model for other building components such as air barrier installation and performance. • Training on application rooftop renewables will become important.

Learning Resources Available to Support Competencies

	Building Science	Airtightness	Building envelope assemblies	Insulation (building envelope)
ESC COURSES - Pt 3	**4**	**2**	**6**	**4**
ESC COURSES - Pt 9	**16**	**14**	**25**	**21**
ALL APPLICABLE COURSES - Pt 3	9	3	8	4
ALL APPLICABLE COURSES - Pt 9	21	15	27	22

Glazers, Window & Glass Door Installers

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Yes	Yes	Partial
Urban centres – Part 9	Yes	Yes	Partial
Province-wide – Part 9	Yes	Yes	Partial

Window and door, glazing system and fenestration installers are generally ready for the ESC in the short term. However, additional training may be required on air barrier integrity, integration of air barrier systems with the glazing as well as the installation of heavier triple glazed systems in the future.

Responsible Organization	Fenestration BC (FEN BC) – voluntary membership.
Related or Supporting Organizations	VRCA, NRCA, SICA, VICA, ICBA, CHBA-BC
Step Code Competency Framework	**Partial -** There is no ESC competency framework specifically for glazers, window and door installers. The updated 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Partial** - There are more courses with applicable training for Part 9 window installers, and fewer for those working on Part 3 projects. There are insufficient training opportunities on AVM barrier tie-in and whole building airtightness for Part 3 projects.
Learning Resources List for this Profession	**Partial -** For Part 9, BC Housing has listed some industry resources on green buildings. FEN BC has a list of resources, but it is not ESC-specific. It is planning to have online education and webinars on their website soon.
Step Code Status	**Not actively encouraged** - There are no incentives or means of encouragement for glazers, window and door installers trades to take training. They do not require CPD credits.
Differences Between Part 3 and Part 9	**Major** • Part 3 glazing can include curtain wall, window wall and involves steel stud and drywall systems. Part 9 is more commonly light wood frame. • There are very different delivery approaches between Part 3 and Part 9 projects. Glazing and facade trades on Part 3 projects may be independent specialized firms (and therefore motivated to stay up to date

	on the latest practices), whereas for Part 9, the builder may self-perform the work.
Regional Differences	**Major** - Trades with relevant experience or training are usually concentrated in cities, with poor training availability in rural regions.
Identified Obstacles	**Major** • **T**here are no courses that explicitly state they are for window installers. or whether they focus on Part 3 or Part 9 which can be significantly different approaches.
Additional notes on readiness:	On-site ad-hoc training is very common for all envelope trades through tests and mock-ups. This is often where the constructability of the envelope and the details (e.g., around windows) is worked out. While important, it is very difficult to track.

Learning Resources Available to Support Competencies

	Airtightness	Building envelope assemblies	Windows, skylights & doors	Supply chain
ESC COURSES - Pt 3	**2**	**6**	**1**	**1**
ESC COURSES - Pt 9	**14**	**25**	**11**	**1**
ALL APPLICABLE COURSES - Pt 3	3	8	1	2
ALL APPLICABLE COURSES - Pt 9	15	27	11	2

Building Officials

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Yes	Partial	Partial
Urban centres – Part 9	Yes	Yes	Partial
Province-wide – Part 9	Yes	Partial	Partial

In the short term, Building Officials are generally ready for ESC. With the shift to higher Steps, there Building Officials may need further training, so they have sufficient practical know-how of design and construction practice. Those working in communities that have yet to adopt ESC, the need for training will come sooner.

Responsible Organization	**Building Officials Association of BC** (BOABC)
Related or Supporting Organizations	PIBC, EGBC, AIBC, ASTTBC
Step Code Competency Framework	**Yes** - BOABC has established a comprehensive competency framework for building officials to successfully implement the Energy Step Code (see Appendix 6).
Learning Resources to Support Competencies	**Yes** - There are 10 courses directly addressing all aspects of ESC and 2 additional courses related to applications of Passive House designing. BOABC's Energy Foundations Program supports all ESC competencies.
Learning Resources List for this Profession	**Yes** - BOABC has a dedicated page for ESC resources including upcoming webinars on ESC relevant skills, and various energy modelling guidelines. https://boabc.org/bc-energy-step-code-information-and-resources/
Step Code Status	**Strongly encouraged** - 9 of the ESC specific courses offer core LCUs.
Differences Between Part 3 and Part 9	**Major -** For Part 3 and Part 9, Building Official work with engineers and energy advisors, respectively. The nature of collaboration differs across these different professions**.**
Regional Differences	**Major** - The experiences applicable with Energy Codes is concentrated in cities.
Identified Obstacles	**Major** -

	• Building officials may not have sufficient practical know-how of design and built-in practice which can be a major setback as they play a critical role in developing solutions. • For certain ESC relevant programs, building officials find it difficult to apply their new knowledge in practice. • Part 3 verification process may require high level of collaboration between officials and engineers, as the former may not have knowledge on design and construction and their impact on energy performance. • For Part 9, officials often rely heavily on energy advisor's advice (construction details, impact on final energy performance), who may or may not be prepared themselves.

Learning Resources Available to Support Competencies

	BCESC Basics	BCESC Metrics and Definitions	Implementing the BCESC: Process, Roles & Responsibilities	High Performance Mechanical Systems	High Performance Building Enclosures	Energy Modelling
ESC COURSES - Pt 3	**5**	**2**	**1**	**1**	**5**	**1**
ESC COURSES - Pt 9	**8**	**3**	**3**	**1**	**5**	**1**
ALL APPLICABLE COURSES - Pt 3	6	3	1	2	7	2
ALL APPLICABLE COURSES - Pt 9	9	4	3	2	7	2

Local Government Planning and Sustainability Staff

State of readiness	2022	2027	2032
Urban centres – Part 3	Yes	Yes	Partial
Province-wide – Part 3	Yes	Partial	Partial
Urban centres – Part 9	Yes	Yes	Yes
Province-wide – Part 9	Yes	Yes	Partial

Local government planning and sustainability staff are frequently the first to engage with the project team and need to be conversant on the implications of ESC on the project. In the short term, they are generally prepared but may need further training on the implications of the higher Steps on building design, form and configuration.

Responsible Organization	**Planning Institute of BC** (PIBC)
Related or Supporting Organizations	N/A
Step Code Competency Framework	**Partial** - There is no ESC competency framework specifically for local government planning department staff &/or sustainability staff. The updated 2017 generic framework is applicable.
Learning Resources to Support Competencies	**Partial –** there is a selection of courses that introduce ESC and address the key competencies for municipal planning and sustainability staff.
Learning Resources List for this Profession	**Yes** - PIBC lists webinars on a variety of energy and climate topics (though not ESC-specific). It also links to the Canadian Institute of Planners resource library: https://www.cip-icu.ca/Resources/Resource-Library#. It also provides a link to the ESC website. There are also several courses that provide a grounding in ESC that would be applicable to municipal planning and sustainability staff.
Step Code Status	**Yes, strongly encouraged –** PIBC operates a mandatory Continuous Professional Learning (CPL) System.
Differences Between Part 3 and Part 9	**Major** – The involvement of planning and sustainability staff on issues relating to energy efficiency and climate impacts of the built environment vary widely between Part 3 and Part 9 projects.

Regional Differences	**Major** - The experiences applicable with Energy Codes is concentrated in cities, with the leaders "few and far between".
Identified Obstacles	**Minor -** Local government staff and sustainability staff may find it difficult to articulate the practical implementation of Energy Code Regulations, which could be possibly detrimental for their readiness.
Additional notes on readiness:	There is a Step Code Local Govt Peer Network hosted by the CEA which could serve as a key learning resource for this group. https://energystepcode.ca/for-local-governments/

Learning Resources Available to Support Competencies

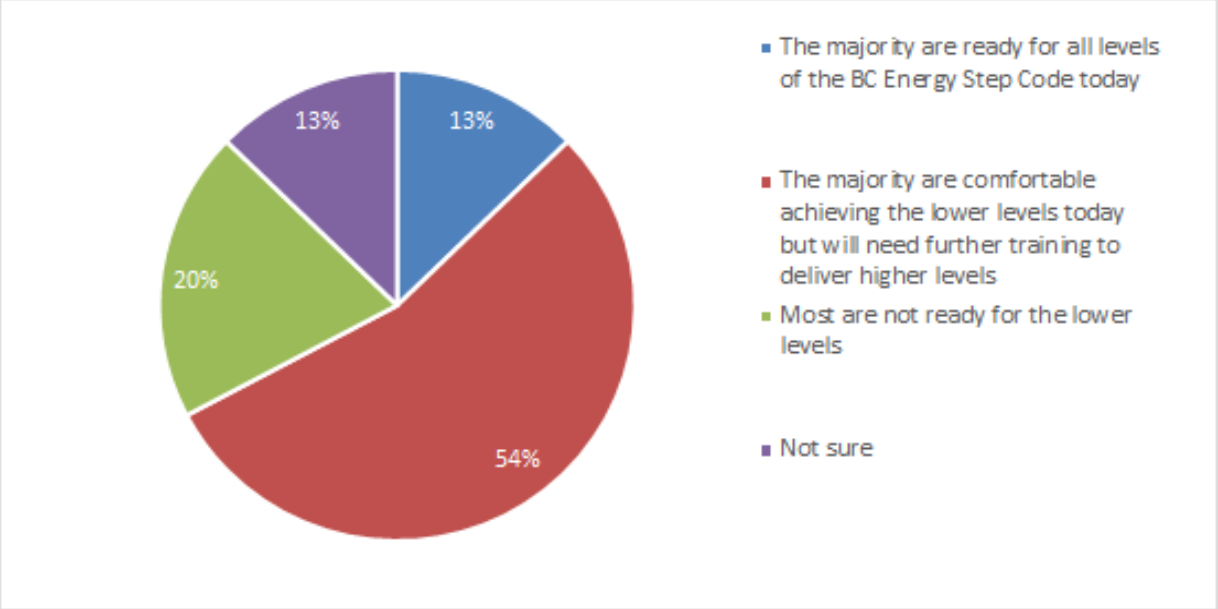
	BCESC Basics	BCESC Metrics and Definitions	Implementing the BCESC: Process, Roles & Responsibilities
ESC COURSES - Pt 3	4	2	1
ESC COURSES - Pt 9	7	3	3
ALL APPLICABLE COURSES - Pt 3	5	3	1
ALL APPLICABLE COURSES - Pt 9	8	4	3

4. Research Findings

Responses gathered from the survey and industry interviews generally agree that progress has been made on the journey to 2032 and Net Zero Energy Ready construction. Since the launch of the BC Energy Step Code in 2017, the availability and technical scope of ESC-related training has expanded, knowledge has been shared on job sites and the number of completed high performance projects that offer a glimpse of what the highest levels of ESC look like is growing (as measured by variety of building standards such as LEED, Passive House, EnergyStar, etc. – See Section 5 Key Performance Indicators).

As a result, it is reasonable to state that professionals in BC can (or should be able to) implement the requirements of the lower levels of the ESC. However, the majority still require further education to become comfortable delivering the quality needed by the higher levels of the ESC (Figure 2).

Figure 2 From the survey ""When you consider the key professions that your organization serves (in question 5 above), which statement best describes their state of readiness for updates to the BC Building Code and the BC Energy Step Code?" (n = 56)



The findings from this research have been coloured by the COVID-19 pandemic. Certainly, more courses have shifted online – improving overall availability and access. While online training options provide good grounding information, interviewees stressed the importance of hands-on practical training. The building industry learns best by doing – raising questions about the efficacy of online training to fully address ESC learning outcomes. Training delivery in rural areas has been particularly impacted by travel restrictions and limited classroom time.

The findings centre around four categories: **Communications and Engagement** on ESC requirements and how to achieve them, **Technical Challenges** associated with effective training delivery and ESC compliance, **Regional Issues** as highlighted by the varied rates of ESC adoption, and **Profession-specific Issues** that apply to a subset of the professionals working in the industry. From these findings, a suite of recommendations has been developed which are discussed in Section 6.

4.1. Improve Communications and Engagement

4.1.1. Incentives to participate in-training needed to increase enrollment

According to the survey, the primary barrier to acquiring the skills and knowledge needed for the higher levels of the step code was the lack of incentives or requirements to participate in training. There are several reasons why this is the case:

- Many key professions are not required to meet continuing professional development requirements. Regular training is not a condition of their license to operate their business or to deliver their services.
- For some key professions (especially trades), attending training requires missing days of billable work.
- There is a preference for on-the-job training with hands-on demonstrations under realistic conditions.
- There is a lack of trust that training providers have sufficient on-site experience and understand the practical realities of construction.
- Rural workers must pay travel and lodging expenses to attend training.
- Training is not valued in the market.

Training on real projects

For nearly three decades Thompson River University's School of Trades and Technology has partnered with the Canadian Home Builders Association Central Interior (CHBA CI) to give students hands-on learning experience on the job site. This approach could be replicated in other regions in partnership with local associations to reach those outside established apprenticeship programs.

Funding to cover course costs is available in some cases, but for those key professions that are not obliged to keep their training up to date, financial incentives could be offered to help address the real cost of training (cost of program, travel and accommodation plus cost of forgone income). As one survey respondent points out, "Stipends for training - mitigate the incurred costs of training for the whole building community (BOs, Trades & GCs)"

Providing training on an actual jobsite, such as a provincial housing project or Habitat for Humanity-type location where live demonstrations could take place might also be attractive. These projects could also be located in regions that have been slow to adopt changes and thus, bring in expertise to demonstrate those competencies that are lacking.

Peer-to-peer learning is highly valued. The concept of "Best Practice Advisors" drawn from within key professions has been successful in Canada and elsewhere whereby roving or "on-call" mentors and technical experts (possibly locally respected recent retirees) could check in on various

"To ensure mass learning, more free training and resources need to be made available. Many of the existing training and resources are focused on the industry segments requiring CPD (builders, designers, some contractor association memberships). These courses are not low cost and are rarely accessed by the trades, resulting in slow transfer of knowledge and skills..."

- Key professional

locations periodically and give advice or answer questions. For example, WoodWorksBC[6] offers free technical assistance related to the design and construction of wood buildings to key professions in the office or on site.

4.1.2. Lack of clarity about the technical requirements of the 2022 update of the ESC and BCBC

Both the survey respondents and interviewees noted that there is a lack of understanding about the 2022 updates to the Energy Step Code and the BC Building Code, and specifically the technical, procedural and cost implications on the design and construction of buildings. Many key professionals appear to be unclear about what the timeline and changes through to 2032 actually are. As one key professional explains, "...the lack of clarity, and relatively low level of communication to stakeholders about the 2022 target date, has not helped all the professions be ready." It is therefore very important that, starting as soon as possible, a province-wide communications campaign is launched to clarify what will be expected, the degree of "stretch" involved and the business impacts. Once industry grasps the technical implications, demand for training may increase.

> "The complete Step Code timeline and the voluntary adoption dates by municipalities are not clear, and what it actually means in practice."
>
> - Key professional

Although the ESC has not been uniformly adopted across the province, some jurisdictions are adopting higher levels of the ESC earlier than required and working hard to encourage project teams to develop innovative solutions. Nevertheless, construction is a risk-averse industry, and many businesses are unlikely to adopt new technologies and practices unless they are forced to. Several interviewees noted that it is only when regulations are imminent that key professions look for the necessary training. Thus, in regions where ESC has yet to be adopted there was relatively little demand for (and provision of) ESC-related training. As a result, the key professions in these communities are less ready to build to higher Steps of the ESC.

The lack of uptake in some regions may also be related to confusion about the voluntary nature of the BC ESC and a lack of understanding of how it relates to the BC Building Code.

> "It may seem counter-intuitive, but the City can do more to communicate its intention to regulate. Builders still think ESC is an option / voluntary, so not coming to the programs."
>
> - Educator

4.1.3. Confusion about which courses address topics appropriate for each profession, at the right level of experience. Lack of profession-specific competency frameworks a barrier.

There is no shortage of training programs that are relevant to the ESC, but key professions – particularly builders and trades – appear to have trouble finding them. Based on the research, the problem appears to be that there are too many courses, most of which are inadequately described. Many key professions are overwhelmed by the choice, confused about what they will (or should) learn and they do not want to get it wrong. The vast majority (over 90%) of BC's construction businesses are SMEs. They cannot afford the

[6] https://wood-works.ca/bc

time to properly research all educational offerings or to risk time off work on a course that does not deliver value.

This matter is not helped by the fact that most of the organizations representing the key professions do not have an ESC competency framework on their website. Only the Building Officials and the Energy Modelers and Advisors (Part 3 and Part 9) have profession-specific competency frameworks (although the residential homebuilders are expected to have one within the next year).

> "It is unrealistic to expect all colleges to update the curriculum without providing help. The government could do more in terms of money and labour - instructors have no incentives to update the course content. Colleges could do a better job collaborating and sharing curriculum, facilities, etc."
>
> - Educator

A review of the courses that are currently available (see Appendix 5) illustrates that there is little consistency of description, terminology or learning outcomes. Few course descriptions are clear about which key professions or disciplines the course is applicable to (estimator, superintendent, construction manager, etc.). or which building types (many just said "residential" without any mention if they are applicable to single family, mid-rise or high-rise buildings). It would be helpful if program providers could include a summary of the course materials, workbook examples, etc. available for review prior to registration, so trainees can see what to expect and what exactly they are going to learn. Feedback from previous students on the relevance of the material and the applicability to real world challenges would also provide valuable information to new students.

> "We would offer training if it was easily accessible and findable. We serve the ICI sector, and I haven't come across any trainers or orgs offering 1-2 day courses on this topic specifically targeting ICI sector needs."
>
> - Key professional

Providing a centralized hub with consistent language, perhaps one that includes a "live chat", or dedicated telephone hotline could provide support and advice about options, while giving feedback to the hub operators about what skillsets are most sought after or most difficult to find. Such a hub could provide training providers with standardized descriptions to make it easier for key professions to compare and find appropriate training. The UK's Considerate Constructor Scheme[7] provides a good example of such a hub. It provides access to training resources, news about innovations, best practices, logistics and safety, and spotlights topics of interest to construction workforce in the UK.

[7] https://ccsbestpractice.org.uk

4.1.4. Uncertainty about course quality and lack of credentials/training for trainers

In addition to the applicability of the technical content of the course, key professionals judge "effective training" on the basis of the practical experience of trainers, the degree to which they receive direct mentorship (which is why field-based or "mock" projects are preferred).

Thus, in addition to the challenges faced by key professions in finding courses with appropriate technical depth and breadth, questions were raised about how to find good quality training experiences. None of the courses reviewed provide testimonials about the trainers from previous students.

The survey revealed an interest in quality improvements for training in subjects such as:

> "How you deliver the education is as important as the technical content. Open education resources about energy efficiency can be really boring, and hard to find. Also, really hard to get subject matter and education providers to think about how to get the information across, mostly just want to deliver the facts."
>
> - Educator

> "It should also be assessed whether professionals who attended specific training actually change their building practices - does the education have its desired impact? There are very few organizations that evaluate their capacity building efforts in meaningful and consistent ways on an ongoing basis."

- Air/vapour barriers and air sealing (by far the most common theme)
    - Purpose, function, importance and how to properly install them
    - Air sealing and compartmentalization
    - Differences between air and vapour barriers, proper sealing
    - Preparing for and conducting Part 3 airtightness testing
- Ventilation
    - Sizing of HVAC and proper calculation, installation and commissioning of ventilation
    - HVAC mechanical design for Part 9 homes
- Electrification
    - Heat pump installation in existing buildings that avoid electrical panel upgrades
- Planning/systems
    - Delivering results cost-effectively
    - New types of construction such as Prefabrication
    - Building Systems Thinking
    - Embodied Energy
    - Lifecycle Costing
- Building Envelope
    - Design to reduce overheating concerns in Part 9 housing
    - High-performance building envelope construction
    - Heating system: heat load calculations, sizing, and commissioning

A standard evaluation at the end of each course comprising a few quick questions to provide feedback to both future students and course providers will reduce the uncertainty and may result in boosting quality where it is most needed. Completion of this short survey could be linked to the issuance of professional development credits where applicable.

There are no courses for training the trainers to ensure the quality of education is sufficient and the format is suitable for the desired audience. Nor is there any formal means for quality control. Trainers with credentials in training specific to energy efficient building design and construction would lend confidence to the market. Other jurisdictions have developed hand-in-hand programs that train both industry and the trainers to ensure quality expectations are met. For example, QualiBuild in Ireland[8] offers a Certificate in Training in Low Energy Buildings to up-skill trainers of construction related craft apprenticeship in low energy building technology and standards and the delivery of training on the fundamental principles of this subject area to construction workers.

4.1.5. When hiring individuals and procuring project teams, priority is given to those with practical experience – but such experience is hard to get.

Generally, ESC-specific training is not a high priority for key professions. However, relevant building science and energy efficiency training from BCIT, Passive House Canada, BC Housing, or professional associations is regularly reviewed for relevance when looking for hires. Whether discussing how firms recruit new hires or how clients procure teams for their projects, the emphasis is almost always on finding those with prior experience. However, if workers are not selected or hired to work on ESC projects, then they cannot get the experience – a "Catch 22" conundrum.

The architects and engineers interviewed generally felt comfortable with their ability to find and hire appropriately skilled staff, mentoring them, as necessary. However, there are no clear guidelines on what constitutes effective mentoring with many new hires and project teams being left to figure things out on their own. Generally, new recruits or new project teams are having to be self-reliant on learning both ESC-related topics while fulfilling their professional responsibilities at the same time. Further, without actual projects, mentorship and experience opportunities are limited.

> "The standard is to throw Architecture interns and EIT's into the deep end and see if they float. On one project, we had a young architect trying to learn Passive House details while managing the whole project. Sometimes the mentors don't know enough to be constructive, or they don't have the time to spare – either way, you are on your own."
>
> - Key professional

Builders, in particular, felt that without a standard way to recognize experience with the ESC, such as a credential program, industry is limited in their ability to assess skills competency when hiring professionals. Indeed, two interviewees noted that it might be useful to be able to recognize (e.g., through some form of Prior Learning Assessment and Recognition [PLAR] credential) successful prior site experience with low energy buildings. The value placed on practical building is reinforcing the belief that there is no better way to learn how to build a low energy project than by "doing it yourself."

> "Why do I need to take Passive House courses to be recognized if I have already built many Passive House projects?"
>
> - Key professional

[8] www.igbc.ie/projects/qualibuild

4.1.6. Delivering information in bite-sized pieces may make it more accessible.

There are several deep, technical multi-day courses generally delivered by BC Housing, BCIT or Passive House Canada. However, many builders tend to demand training that is "short, sweet and to the point" – that they can learn then apply right away. Training providers noted that courses with presentations lasting less than an hour tend to be the most popular with builders and trades. However, that limits depth and breadth of subject matter. A survey respondent suggested about funding and certification program by groups such as the University of Toronto - Palette[9] who provide short and focused skills to professionals, while working with industry, workers and educational institutions.

The idea of micro-credentials or "badges" was suggested several times as a way deliver "bite-sized" education to ensure very particular competencies are synthesised and delivered effectively (e.g., properly applying sealing tape around vents). Some training workshops offered by construction associations where peers discuss recent projects are also popular. There were several comments related to the potential to "gamify" the education process – to make the learning experience more dynamic, using technologies such as AR/VR. Another option might be to produce free, online, short videos explaining each step of the ESC, how they affect design and construction, and what each profession needs to do differently – perhaps in partnership with DIY stores (Rona, Home Depot, Dick's Lumber, etc.) to host videos in their store.

4.1.7. Data is not currently collected on the state of readiness.

Few relevant data points are currently collected and easily accessed that identify readiness, knowledge or skillsets applicable to the Energy Step Code. Resources must be allocated to collect information required for performance metrics as discussed in Section 5.

4.2. Tackle Technical Challenges

4.2.1. Retirement of experienced workforce may leave an "experience vacuum".

Retirements in BC's construction sector are expected for more than 41,000 workers, or 22% of the current labour force, by 2030. BC's aging construction workforce is already revealing an "experience vacuum" whereby young workers are being accelerated into senior positions without adequate practical "seasoning". They may not have access to sufficient mentorship opportunities. To maintain quality construction and improve building performance, there is an urgency to developing knowledge-sharing activities before that experience is lost. In other jurisdictions, "Best Practice Advisor" programs are being developed whereby recent retirees are trained as advisors and hired back as mentors.

4.2.2. Lack of cooperation, collaboration, and communication between trades.

Delivering high performance buildings effectively and efficiently requires project teams to work together and put the best interests of the project first. This means that everyone (trades, the consultant team and owner)

[9] www.PaletteSkills.org

needs to be involved earlier in the project as decisions taken up front can have significant, long-term impact on building performance. The traditional procurement process results in every project starting out with a new team with different dynamics and varying levels of interpersonal skills. While new project delivery methods such as integrated project delivery (IPD) are starting to be deployed to address the inefficiency arising from poor collaboration, they face challenges in the form of resistance to change, structural misalignment of the key organization involved, resistance to greater involvement in project management, lack of trust in the system and more[10]. A review of the training programs available reveals very little training dedicated to effective communication, teamwork and collaboration. Programs focused on developing soft skills could provide a broader understanding of how trades affect each other and can work together to achieve desired project outcomes.

The recently launched Construction Research Network[11] provides a single point of contact between British Columbia's Real Estate, Architectural, Engineering and Construction (RAEC) sector and the research and development community focussed on construction. Hosted by the Construction Foundation of BC, it was initially developed to help BC's RAEC firms easily find the resources and R&D partners they need to solve their next challenge. However, the CRN could also serve as a collaborative hub for industry to share ideas, exchange information about processes, technologies and practices – even provide feedback on training programs.

4.2.3. Cross-training between trades increasingly important as ESC Steps move higher.

Many builders and trades do not have adequate opportunity to "cross-train" with other key professions where workers learn about what the other trades that work alongside them do and how to work together to ensure the desired outcomes of the project are met.

> "A coordinated effort thru the residential contractors' association, the BOABC, BSSB, and the Energy Advisor's Association although there is no one collective EA Association."
>
> - Key professional

As ESC Steps move higher, a solid understanding of the "Building as a System" and an ability to collaborate effectively become critical. For example, mechanical trades need to be aware of the importance of air barrier integrity and be careful when creating penetrations in the envelope for exhausts, ducts, etc. For those that have experience or have been trained in other trades or how they may interact, there is no recognition or certification method to track this information, leading to some frustration when bidding, working with others, or attending training.

Collaborative, hands-on training projects that bring together multiple disciplines and actively engage them to solve simulated technical issues have been used in other jurisdictions[12] to promote constructive collaboration between trades. In interviews, the most frequently identified team issue was air barrier awareness, the ability to identify issues and repair them or who to alert. For Part 3, consultants and builders

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[10] Discussed in "Owners Perceived Barriers to IPD" prepared by Devarsh Bhonde, Dr. Puyan Zadeh, and Dr. Sheryl Staub-French from the BIM TOPiCSLab in the Department of Civil Engineering at the University of British Columbia and Helen Goodland from SCIUS Advisory Inc. and published by IPDA https://www.ipda.ca/site/assets/files/3071/barriers_to_ipd_july_2020.pdf

[11] www.constructionresearchnetwork.ca

[12] https://www.igbc.ie/projects/qualibuild/

need to work more closely. For Part 9, engineers on site are less common, so house designers, energy advisors, building officials and trades must work through issues collaboratively. Mechanisms that support more constructive teamwork between disciplines (e.g., collaborative project delivery methods) and programs that encourage sharing of lessons learned can help with knowledge and attitude about requirements of higher step code levels. New training or resources may be required for course instructors to develop instructional materials for these collaborative engagements.

4.2.4. Education for building owners and developers needed on the impacts of ESC on building design and functionality.

Non-technical practical resources should be developed and made easily accessible to improve awareness among everyone involved in new construction, especially the owner or developer client. These resources can explain the practical implications of higher levels of the ESC on the form, features and configuration of the building and what the benefits are.

At the practical level, there are tools, templates and checklists that could be deployed quickly such as developing template contract language ("General Conditions"), master specifications and RFP terminology so that owners and developers can hire teams with the right skills working on their project. This includes setting the tone for collaboration, requirements for the use of energy modelling, etc.

> "Developers and Architects often play an educational role on the benefits of Energy Step Code with building occupants – or explaining why an owner or tenant can't have wall-to-wall, floor-to-ceiling windows."
>
> - Key professional

Several interviewees felt that homebuyers are not asking for high performance buildings due to lack of awareness and some misperceptions about performance. Public messaging should be provided with regional perspectives.

Other insights from survey respondents:

- Education needs to include both the professional and the consumer, so they can have a conversation about what products and solutions are the right fit.
- It would be helpful to produce a series of free online videos explaining each step of the energy code, and how it affects design and construction.
- Industry would also benefit from a set of comprehensive summary tables and visuals explaining the changes from previous codes to new requirements.

4.2.5. Tailored education needed for underserved populations with language barriers.

While not specific to ESC considerations, opportunities for women and other underserved populations such as immigrants and racialized Canadians must be identified as the workforce responds to the imminent retirements of so many. Currently, only 4% of skilled trades in BC are women[13] and – long term - there are opportunities to leverage the shift to cleaner, greener construction as a way to attract new workers into the industry. That said, feedback from interviews and the survey clearly stated that the make-up of training today reflects the industry demographic. However, BCIT has been successful in delivering subsidized courses to members of Indigenous communities. They also have a "women in trades" program and (pre-Covid) 5-day intro camp for youth at risk.

> . "…work environment may be or feel unsafe for women. i.e. I would not want to work alone in a strange home (as may be the case for a female plumber or HVAC tech in residential retrofit) so I would avoid this career path"
>
> - Key professional

English is required for communication on most jobsites, but when the key to attracting people to training is to remove barriers, then many may be encouraged to participate if the course is in their first language. Training materials should be provided in the languages commonly spoken on construction sites[14] such as Cantonese, Mandarin, Punjabi and Farsi to ensure complex technical concepts related to the ESC can be explained and understood in a professionals' native language.

Organizations such as EmpowerMe[15] provide energy conservation education in multiple languages. Their partner in an energy management collective, Community Power, similarly works with Indigenous communities. Collaborating with organizations like these could allow training to reach a broader, more diverse, segment of the population.

4.3. Address Regional Issues

4.3.1. Incentives and customized training needed in rural areas.

Rural and remote regions of BC face a combination of barriers to developing the capacity to meet the higher-level performance requirements. There are fewer local training opportunities and those that exist may be far away. ESC and construction industry-specific incentives (e.g., to cover travel costs) should be considered to ensure communities and workers do not get left behind or endure unnecessary hardship in the process.

> "In the North, the attitude is, why do it if it's not mandatory. Unfortunately, until people are made to do it, they won't. Why spend the extra money if your competition isn't? That could apply to several professions."
>
> - Key professional

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[13] www.buildforce.ca/system/files/forecast_summary_reports/2021%20BC%20Constr%20Maint%20Looking%20Forward.pdf

[14] The most common languages spoken in BC are Cantonese, Mandarin, Punjabi, German, Tagalog, French, Korean, Spanish and Farsi https://www.welcomebc.ca/Choose-B-C/Explore-British-Columbia/Language-in-B-C

[15] www.empowerme.ca

There are many variations of conditions across the province, including climate, availability of labour, equipment and materials, etc. If experienced technical experts were available in remote regions to assist with projects that could be brought in by agencies such as BC Housing, key professions would have a better opportunity to learn new skills required by the ESC for their profession.

Higher Step projects in the North that address regional issues such as cold climate construction and build upon the wealth of local knowledge for those conditions will provide more opportunity for that workforce to be ready for changes in code.

> "I speak mostly for builders and designers from Northern BC. My experience is that very few builders have even done a blower door test, let alone tried building a home to any Step."
>
> - Key professional

Relatively few communities in the north have adopted the ESC. Without mandates or regulations there is little motivation to pursue the training required to meet higher standards. With few available projects to demonstrate techniques, there is little opportunity for on-site training. Further, the resulting lack of projects seeking higher levels of the ESC limits any incentive for those with experience to be based in rural communities. A holistic "building as a system" approach that gathers trades, consultants and building officials together is also difficult because of few and infrequent projects in rural areas. Costs to bring people together are much higher when longer distances of travel are required and are also more difficult to schedule.

4.4. Resolve Profession-Specific Issues

4.4.1. Major obstacles exist for some professions in meeting higher levels of ESC.

The ESC Capacity Matrix (Table 9) identified major obstacles for some professions to be ready for higher levels of the ESC.

- **Developers and Owners** often have misconceptions about costs and some lack the technical knowledge to understand what is required and where risks occur. They do not know what to ask for to achieve compliance, and do not know what it costs. Architects have found some clients are surprised by the constraints of the ESC. Marketing to explain benefits, requirements and costs is needed.
- **Building Officials** – Building officials play a critical role in the process of developing solutions and need to know the practical aspects of design and construction as they relate to outcomes and compliance. They may lack ESC-specific design and construction on the specifics of how to achieve outcomes. They are reliant upon energy advisors' input for Part 9 buildings to verify energy performance and ensure the building is working "as a system". For Part 3, they are similarly reliant upon project engineers' verification of energy performance based on whole building simulations. They may require training on understanding an engineer's energy reports or extrapolating the interconnected impact between air barrier performance and building systems energy use. Expectations of building officials have changed quickly, therefore they need the tools to adapt their work in both design and construction of what impacts energy performance.
- **General contractors** – There are not enough training resources for general contractors, construction managers, project managers and superintendents involved with Part 3 projects. The ones that exist are hard to find and/or poorly described. Unless they are also licensed

homebuilders, there are no incentives or means of encouragement for them to take training. Experience in coordination, management and knowledge application required for ESC is mixed.

- **Architects and home designers** – A shortage of architects outside of cities and due to retirements will critically affect compliance in some regions.
- **Estimators and Cost Consultants** – there is uncertainty around costs of materials and training around ESC requirements has led to some variation in price premium and cost advice. Estimators and cost consultants may require training on ESC enhancements and requirements to help minimize myths and misunderstandings about costs that affect pricing and estimating. Lack of experience and data equates to risk, which drives up estimates unnecessarily. Prices are driven up by the combination of unknowns of the pricing impact of the ESC with how it interacts with compliance with municipal regulations or requirements and the additional collaboration and coordination required.
- **Energy Advisors** – A shortage of Advisors (which is particularly acute outside urban centres) will limit their ability to support projects and will critically affect compliance.

Other insights from survey respondents:

- Some mechanical designers struggle with the highest levels of Part 3 step code buildings, specifically ventilation.
- There are inconsistencies between local jurisdictions in implementation and compliance forms, which makes things difficult for both builders and Energy Advisors. Training with a focus on consistency messaging will be essential for Building Officials and Energy Advisors.
- While there are training programs on implementing the ESC, there is still a gap - particularly with local governments and building officials. This is evidenced by the implementation and enforcement challenges in the jurisdictions that have been early adopters.

4.4.2. Energy Advisors are scarce in rural regions, making it difficult for trades and Building Officials to get the technical support they need.

Energy Advisors (EAs) have a contradictory depiction among interviewees, as some see a shortage and others see limited demand. Typically, EAs are concentrated in urban areas. To encourage EAs to serve rural locations (where there are fewer projects), incentives such as travel subsidizes may be necessary. It may also be helpful to set up an EA network outside urban centres to provide "locum" service if needed.

> "Building simulation only goes so far. Actual system conditions, where different pieces of equipment, etc. is connected together for the first time in actual climatic conditions, require monitoring and adjustment, preferably over 8 seasons (e.g., 2 years). This is especially true for high performance, air-tight buildings. Owners and project teams overlook this process, leading to poor energy performance, poor ROI and undermining energy efficiency."
>
> - Key professional

Rural regions are more sensitive to EA shortages because EAs play a critical role in the 3-way collaboration between the builder, owner and AHJ. Currently, to achieve Energy Step Code in Part 9 construction, the

Energy Advisor, Trades and Building Officials frequently work collaboratively to develop practical solutions – often in-person on site. In rural areas, where EAs are scarce, inexperienced Trades and/or Building Officials lose their critical real-time feedback on energy performance, making compliance more difficult. Practical onsite experience for EAs was seen by many interviewees as critical – especially in rural and northern locations where they play such a central role in facilitating on-site technical solutions.

Recent announcements from the federal government[16] to create more opportunities for recruitment, training and mentorship for up to 2,000 new energy advisors across Canada are anticipated to make an impact on this finding.

4.4.3. There is a lack of training for building operations and commissioning to maintain performance.

An often-neglected issue is the training of building operation professionals to fine tune mechanical and electrical controls during the first few years of operation. As ESC steps move higher, the mechanical systems are likely to become more complex to manage with less room for error. Interviewees noted that high performance buildings require operational time to refine and balance systems for optimal performance given in-situ conditions.

Commissioning is still not a universally accepted process – particularly for smaller projects. As buildings increasingly rely on an "envelope first" approach, whole building commissioning is increasingly important. Training and support on how to operate equipment specific to ESC enhancements and problem-solve to improve performance are not included in costs to complete a project, and without it these systems may get turned off or become non-functional in short amounts of time.

> "As HVAC systems become more complex to address energy efficiency, O&M training is needed to operate them properly. However, owners rarely invest in education for Building Engineers, leading to expensive, advanced equipment being switched off to prevent damage (to the expensive equipment), or result in occupant complaints when they are not operating correctly."
>
> - Building operator

4.4.4. The future for gasfitters is evolving.

There are multiple policies that are being brought to bear on the construction industry through to 2032. ESC is focused on energy efficiency but there are numerous policy goals related to addressing the climate emergency - notably the BC Electrification Road Map (ERM)[17] and the City of Vancouver's Zero Emissions Building Plan[18] - that are running in parallel and indicate that gas appliances will be phased out of new construction over the next decade. This is causing some confusion for those involved with installing

[16] www.newswire.ca/news-releases/canada-investing-10-million-to-create-jobs-for-new-energy-advisors-850489108.html

[17] www.zebx.org/wp-content/uploads/2021/04/BC-Building-Electrification-Road-Map-Final-Apr2021.pdf

[18] https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx

mechanical equipment because, at the same time, BuildForce data[19] shows that there is demand for gas fitters in BC through to 2030. FortisBC is pursuing use of Renewable Natural Gas (RNG)[20] as part of their low carbon pathway.

While it is clear there will be ongoing demand for retrofits and maintenance, it is fair to say that the future for those working with gas appliances is evolving. There will be growing demand for heat pumps and heat recovery equipment as the ESC is implemented and incentives for gas fitters to take training on heat pump and other electrical equipment installation would allow them to remain in similar roles the construction workforce. BC's construction industry is struggling with a labour shortage, and it cannot afford to lose these highly skilled workers. A key finding is that there is currently a lack of clear communication to the mechanical trade community on what the future looks like and where they fit.

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[19] www.buildforce.ca/system/files/forecast_summary_reports/2021%20BC%20Constr%20Maint%20Looking%20Forward.pdf

[20] www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas

5. Key Performance Indicators

5.1. Data quality and availability

Effective KPIs

To be useful, the measures and reporting mechanisms for performance management systems should be:

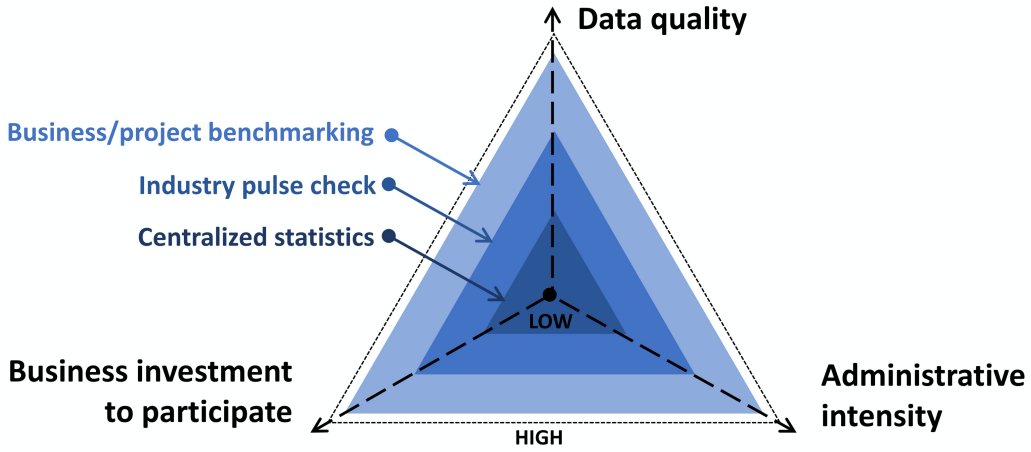
- Acceptable
- Meaningful to industry
- Easily understood (i.e., are simple, understandable and logical
- Repeatable
- Show a trend over time
- Suitable – they measure important things
- Feasible – they are easy and economical to collect
- Effective – they concentrate on encouraging the right behaviour
- Unambiguously defined
- Aligned – must link to strategic goals.

The data collected in this report through a survey and interviews provided insight into current capabilities and forms a "readiness benchmark" for a series of Key Performance Indicators (KPIs) that can be used to monitor progress over time. The goal of these metrics is to understand if the key professionals have the knowledge and skills required to meet the performance standards set forth by the ESC in time for the scheduled updates in 2022, 2027 and 2032. For the KPIs to be useful, they need to be timely, relevant and easy to collect (see text box).

This section discusses how the research methodology that underpins this report can be used to provide the starting point for the development of KPI and support an ongoing tracking process. This report therefore effectively serves as a draft application of those KPIs and the Matrix serves as a framework for assembling and reviewing the findings.

It is important, however, to note that establishing and monitoring KPIs effectively can be time consuming and complex. Generally, there is a three-way inter-relationship between the quality of data, the amount of resources required to gather and organize it and industry / stakeholder involvement, both in terms of degree of effort and the number of companies or individuals that need to participate in the process for the results to be useful.

Figure 3 Inter-relationship between data quality, business investment to participate and administrative intensity of three types of KPI models



The lack of industry-level data collection and performance benchmarking for BC's construction industry is well-documented.[21] Given the challenges, it is recommended that KPIs just be established for 1) "responsible organizations" so they can gauge the capacity of their member professions and support them with training, and 2) jurisdictions so they can monitor progress and overall industry readiness.

It is suggested that the data be collected annually using a short survey format and/or by providing a few targeted questions for key organizations to add to their existing market research. The survey that was conducted with this report provides a good foundation and can be used for education providers. Data hosting could be provided by a site such as https://www.data.gov.bc.ca/ for further analysis.

Recommendations when setting up a KPI program

1. Publish an annual report of the key KPIs for which data already exists and seek grant funding to build an online "dashboard".
2. Work with industry leaders across the province to resolve data gaps and establish consistent definitions and data collection standards.
3. Ensure the data is handled properly by working with a neutral third-party data management company.
4. Minimize administrative intensity by coalescing a leadership group of progressive industry associations around a pilot project.
5. Be patient. Program growth will be slow and conditional upon regular communication with key stakeholders.
6. Celebrate leadership.

Taken from "Measuring UP: Key Performance Indicators for BC's Construction Industry", VRCA and Construction Foundation of BC, 2018

5.2. KPIs for responsible organizations to gauge capacity of their member professions

Table 10Table 10 (next page) presents the KPIs for responsible organizations (e.g., industry association, licensing body, professional institute, etc.) that would, at a minimum provide a snapshot of industry readiness. Data for these KPIs would be collected via an annual survey.

[21] "Measuring UP: Key Performance Indicators for BC's Construction Industry", VRCA and Construction Foundation of BC, 2018 https://www.constructionfoundation.ca/wp-content/uploads/2019/05/Construction-Industry-KPI-report-FINAL.pdf

Table 10 KPIs for responsible organizations

KPI	Survey question	Rationale / considerations
Presence of Competency Framework for Key Profession	"Do you have a competency framework or profile that describes what skills and expertise are required to meet the energy efficiency requirements of the BC Building Code and the BC Energy Step Code?"	Competency frameworks clearly describe the skills and expertise required to achieve ESC.
Existence of ESC-specific education programs and resources	"What proportion of the competencies required to meet the energy efficiency requirements of the BC Energy Step Code are covered by currently available training programs?"	Key professions can develop the skills they need.
Quality of ESC-specific learning resources	"Do you have assessment programs in place to ensure the education programs and/or learning resources are meeting the needs of your members effectively?"	The training is effective and meets the needs of the key profession.

These KPIs will provide basic indicators of how the organizations are meeting the needs of membership regarding the ESC and forthcoming updates (short term). Additional survey questions can be added that are customized to those key professions that play a central role in the successful delivery of an energy efficient building. Table 11 presents a selection of sample questions, the key organization that could potentially gather the data and rationale for why the findings are important. Ideally, this data would be collected annually. However, the responsible organizations may need additional resources to field the surveys, then collect and analyze the data. The quality of information would be dependent upon response rate and could be high.

Table 11 Survey questions to track readiness amongst architects, engineers, builders and building officials

Key profession	Question	Question format	Responsible organization	Rationale
Builders	"How confident are you that you have in your company (or can find people with) the required technical skills to build a Step 3 building? (Step number adjusted as appropriate)."	Ranking (1= not confident, 5 = very confident). Option to add a comment	BC Housing	This will indicate readiness of trades since many are not represented by an organization. Data should be saved with region information if possible. Leading indicator of confidence in skillset of available labor in near term.

Key profession	Question	Question format	Responsible organization	Rationale
Architects Engineers Builders	"What proportion of the projects you have worked on over the past 12 months have targeted and/or achieved Step Code 3? (Step number adjusted as appropriate)."	Percentage of projects (0%, 10%, 20%, …100%). Option to add a comment	BC Housing AIBC EGBC	Professionals who have completed or are in progress of completing Step Code projects can be considered ready or in process of becoming ready. Data should be tagged with region information if possible. Lagging indicator of readiness
Architects Engineers Builders	"The next update to the energy efficiency requirements of the BC Building code will be in 2022 (adjust year as appropriate). What are your challenges in meeting future Steps?"	Comment	BC Housing AIBC EGBC	Qualitative information regarding technical barriers and gaps in preparedness can be gathered. Anticipated popular responses could be provided as check boxes, with other issues able to be added. Leading indicator of readiness that may help shape future actions.
Architects Engineers Builders Building Officials	"How many training courses relevant to the Energy Step Code have you taken over the past 12 months?"	Number. Option to add a comment	BC Housing AIBC EGBC BOABC	When combined with responses to the number of projects and challenges faced, this data would provide insight into the correlation of training, its effect on readiness, and continued challenges in meeting performance requirements.
Building Officials	"When you think about the projects you were involved with over the past twelve months, what proportion of those projects required blower door / air tightness?" "Of these, what proportion passed the blower door / air tightness test first time?"	Percentage of projects (0%, 10%, 20%, …100%). Option to add a comment. Percentage of projects (0%, 10%, 20%, …100%).	BOABC	Identifies how frequently these tests are passed A lagging indicator of builders' readiness to build to the intended performance and how much rework is required to achieve goals. Data should be tagged with region information if possible.

Key profession	Question	Question format	Responsible organization	Rationale
Building Officials	"What percentage of occupancy permits were NOT issued on the first attempt as a result of energy step code related issues?"	Percentage of projects (0%, 10%, 20%, …100%). Option to add a comment	BOABC	Occupancy permits are a general indicator of construction quality and performance but will not pinpoint issues that are related to energy efficiency A lagging indicator of skillset readiness to achieve performance goals. Data should be tagged with region information if possible.
Building Officials	"The next update to the energy efficiency requirements of the BC Building Code will be in 2022 (adjust year as appropriate). Do you have access to training you need to be able to evaluate buildings as will be required by the next level of the Code?"	Yes/No Option to add a comment	BOABC	Indicates readiness of building officials A leading indicator of training availability to prepare building officials for future code updates. Data should be tagged with region information if possible.
Building Officials	"Are you prepared to evaluate buildings at a higher Step Code level than what is currently required?"	Ranking; (1= not at all –5 = completely ready) Option to add a comment	BOABC	A leading indicator of effectiveness of training resources available. Data should be tagged with region information if possible.

5.3. KPIs for jurisdictions to monitor overall progress

KPIs are needed by provincial and regional policy makers and stakeholders to be able to monitor overall industry-level progress in adopting the energy efficiency requirements of the BC Building Code and the BC Energy Step Code. Table 12 presents a selection of KPIs sourced from local government permit information and surveys that jurisdictions can use to track overall progress.

Table 12 KPIs for policymakers and jurisdictions

KPI	Data and collection strategy	Rationale / considerations
Predicted TEDI (Thermal Energy Demand Intensity) and EUI (Energy Use Intensity) for new projects	Collection of building permit data Frequency – annual (ideally). At a minimum, every 5 years.	TEDI (Thermal Energy Demand Intensity) and EUI (Energy Use Intensity) are key performance criteria for energy efficient new construction projects. This would provide a leading indicator of readiness for project teams by recording intended building performance and comfort level with new Steps. This data is not routinely collected by local governments and resources would need to be made available to assist.
Overall availability of training by region	Survey questionnaire - The survey that accompanied this report can be performed annually to determine if key professions are getting access to the training necessary to deliver ESC compliant projects effectively. Frequency – annual	This data would be a leading indicator. Enrollment statistics and student demographics may also be requested from the providers or may be available through statistics on Employer Training Grants. Costs may be incurred to collect this data from course providers, as well as to compile and analyze the data and host the results. Quality would be dependent upon response rate.

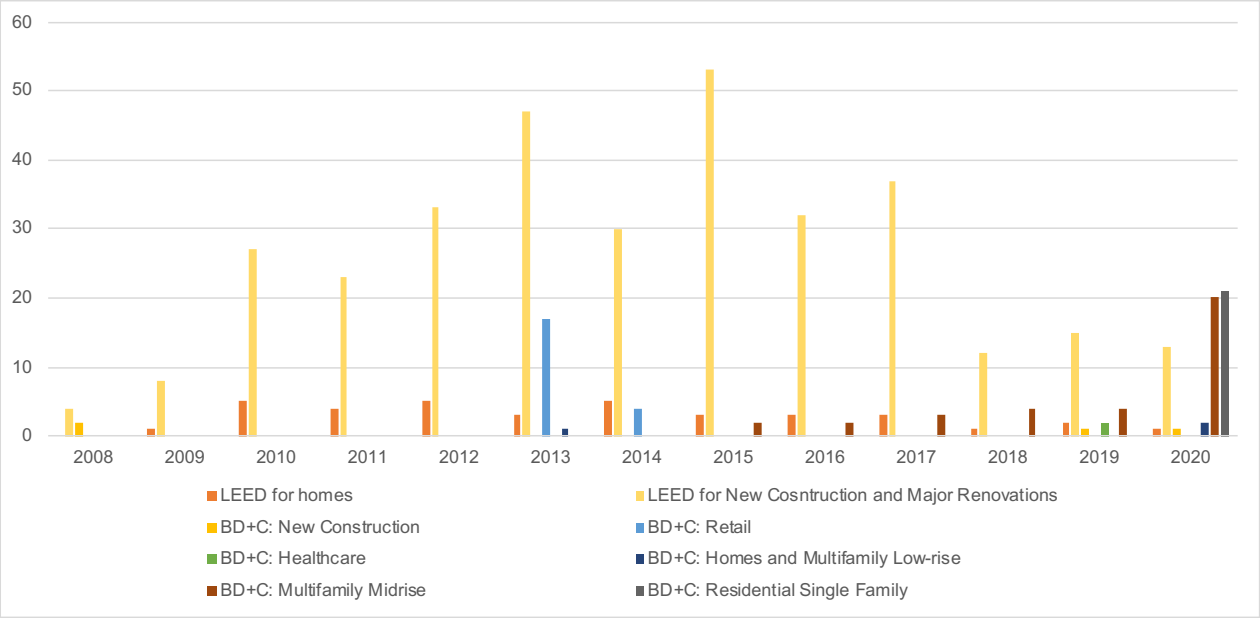
KPI	Data and collection strategy	Rationale / considerations
Industry satisfaction with training / training effectiveness	Survey questionnaire to course participants: • What version of the building code (or Step Code) was referenced for this course? (Check box). • To what extent did the course content align with your expectations when you signed up for it? (1 = it was not what I expected at all - 5 = it was exactly what I expected). • Will the information you learned in this course improve your ability to deliver projects at higher levels of the Energy Step Code than you were previously able to? (Yes, No, Not sure). • Did the instructor(s) have a good understanding of the practical requirements and challenges on a standard job site? (1 = not at all – 5 = very knowledgeable). • What other training would you like to see offered that is not currently available or accessible and would help you in your job delivering high-performance buildings? (Comment). Frequency – annual	Training providers need to deliver training effectively – i.e., in formats, time frames and pedagogical approaches that suit the trainees. Exit surveys and/or feedback forms can be used to gather participants feedback on course effectiveness. The data provides leading indicators of: • Students can find the training they need • Students are satisfied with the training • Potential technical challenges and gaps.

5.4. Other Available Data

The surveys and data collection efforts described above provide a framework for ongoing monitoring of the readiness of BC's construction professions to implement the ESC and can be applied regularly (preferably annually) through to 2032. To augment this effort, there are numerous sources of free, third-party complementary data that offer insights into the general health and progress of the industry in adopting energy efficiency. They are easy to track and – although there may shortcomings in terms of timeliness, granularity, etc. – collectively they may provide useful context. A selection of examples of charts and data are provided for illustration along with considerations (for and against).

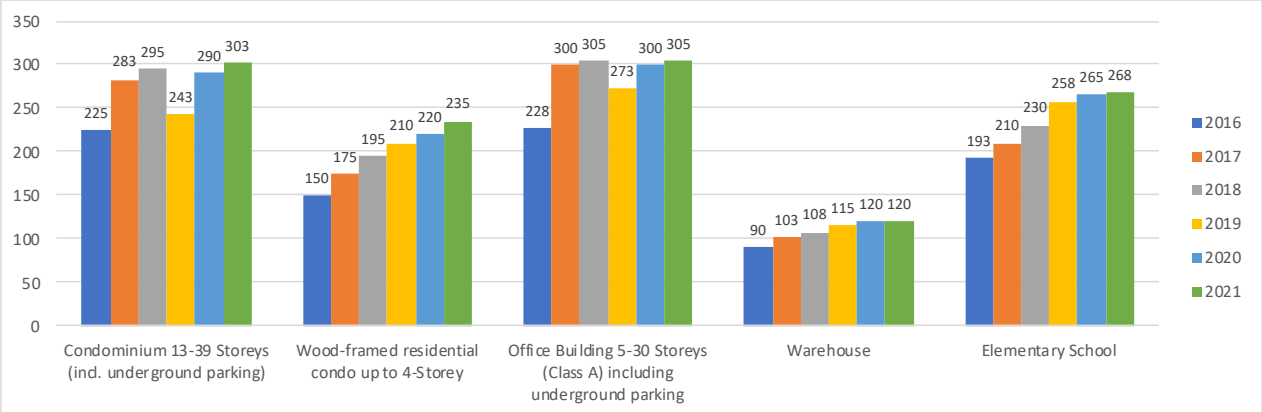
- The number of certified projects under a variety of building standards such as LEED, BuiltGreen Passive House, EnergyStar, etc. broken out by type of building and (if possible) region (Figure 4).
    - **Pros:** Free, easily accessible, historic data
    - **Cons:** Not representative of mainstream construction, only captures top percentage who seek certification. Residential projects may not be accurately represented (often included into "mixed, use", retail, etc.).

Figure 4 Number of LEED Certified projects in BC by year and category



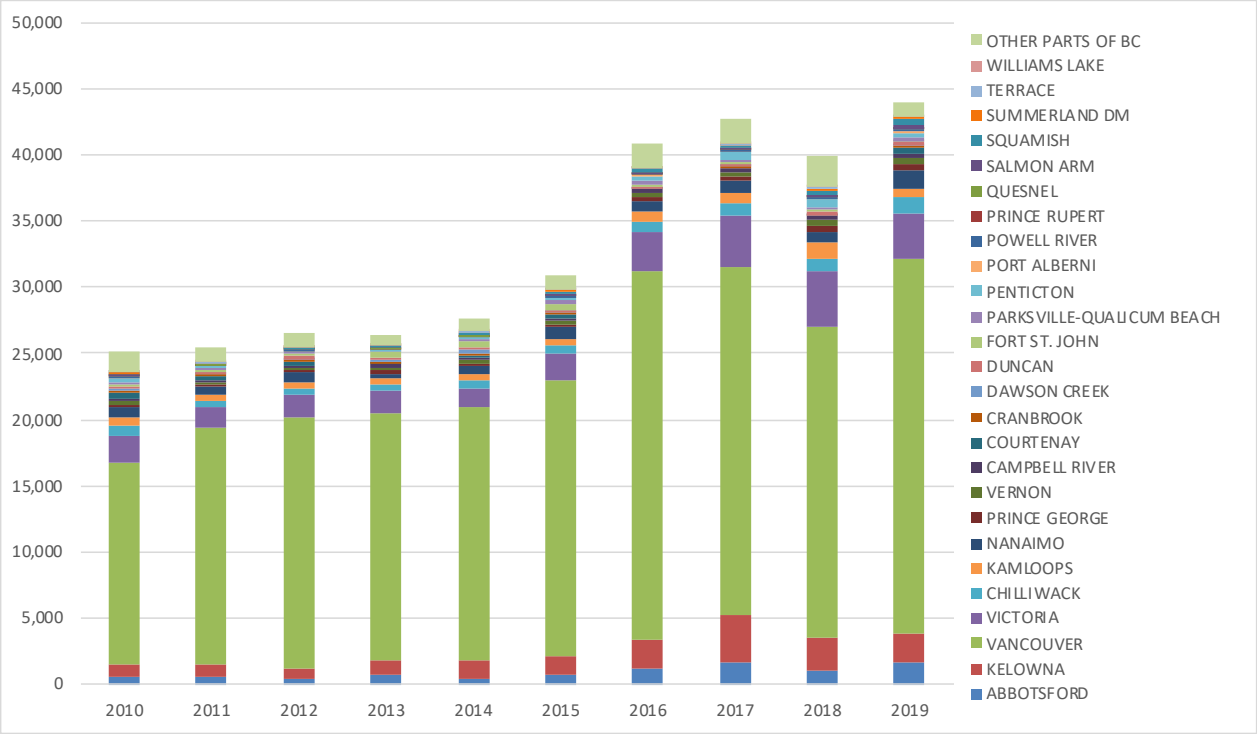
- Price per square foot of projects in different areas based on different levels of ESC adoption (Figure 5)
    - **Pros:** Check of incremental price premiums and if they are normalizing based on readiness
    - **Cons:** Data broken out by building type, not by region, so no data on ESC adoption.

Figure 5 Average Construction costs (dollars per square foot) for a selection of building types in Vancouver, 2016 - 2021 Source: Altus Group Canadian Cost Guides



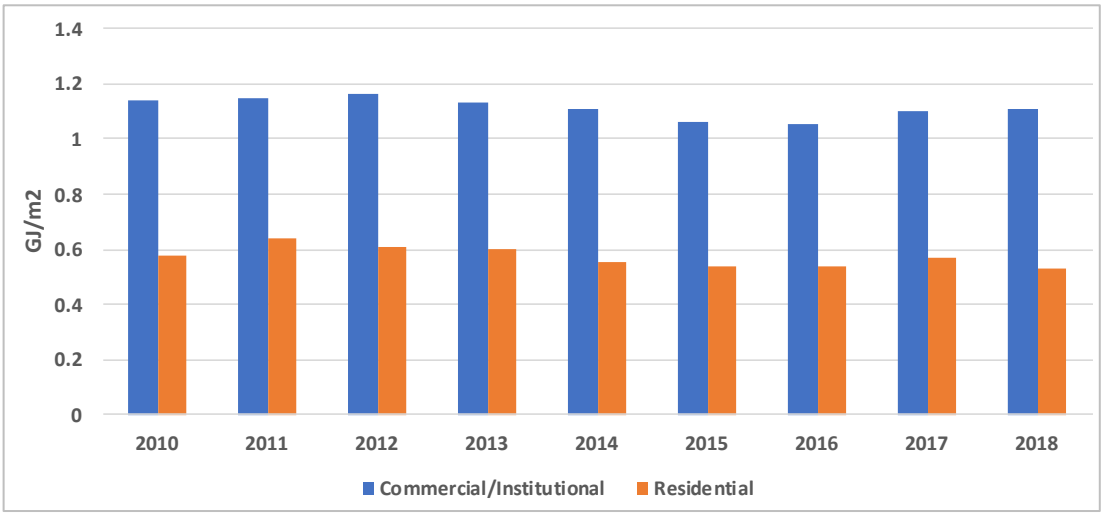
- The number of housing starts by region (Figure 6).
    - **Pros:** Indicator of impacts of ESC requirements
    - **Cons:** Not an indicator of ESC demand; does not address readiness.

Figure 6 Housing Starts by region. Source: Canada Mortgage and Housing Corporation (CMHC), British Columbia Housing Starts for Urban Areas and Communities, accessed June 14, 2021.



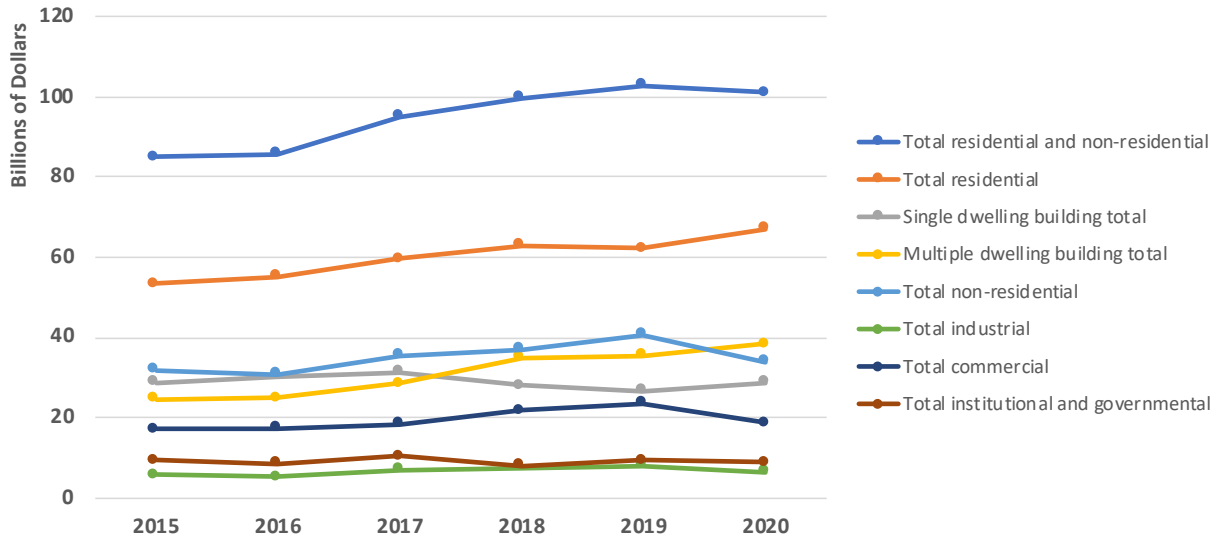
- Energy use and GHG emissions related to residential, commercial & institutional buildings in BC (Figure 7).
    - Pros: Meta-level indicator that the impacts of buildings are reducing overall.
    - Cons: Not possible to break out new construction projects; does not address readiness.

Figure 7 Energy Intensity, Secondary Energy Use in British Columbia. Source: Office of Energy Efficiency, NRCan



- Building permit values, broken out by building type and by local government (Figure 8).
    - **Pros:** Meta-level indicator or industry health and issues affecting construction economy.
    - **Cons:** No indication of ESC level of buildings; does not address readiness.

Figure 8 Annual Value of Building Permits in British Columbia, by type of structure and type of work. Source: Statistics Canada



- Number of LCUs/CPD credits awarded for energy efficiency related training programs.
    - **Pros:** Indication of key professions' choice of training to fulfill education requirements.
    - **Cons:** currently not public data - Information may not be currently recorded by type of course.
- Number of projects that receive high performance building incentives.
    - **Pros:** Leading indicators of how many builders hit the targets early.
    - **Cons:** Currently not public data. May not be representative of the mainstream; data may be proprietary; does not address readiness by profession.

6. Recommendations

The recommendations presented in Table 13 offer a starting point for developing programs, actions and solutions to support BC's building design and construction industry through the forthcoming updates of the ESC to 2032. Based on the information gathered from the research, the recommendations are positioned at a strategic level and each warrants further development. "Allied organizations" are suggested as those most aligned to the recommendation and those that, potentially, could play a role facilitating solutions.

Certainly, the challenge of ensuring that the industry is ready to meet the ESC requirements requires multiple tactics and the more recommendations that can be acted upon, the more effective the result. There does not appear to be a logical means to prioritize – none of the recommendations need to be completed before another starts and, indeed, there is not sufficient time between today and 2032 to take a sequential approach.

Table 13 Summary of Recommendations

Recommendation	Allied organizations
Improve Communications & Engagement	
1. Offer financial incentives to help address the real cost of training for key professions. Includes cost of program, travel and accommodation, and cost of forgone income.	BC Government Utilities, BC Housing
2. Facilitate partnerships between project developers, training providers and industry associations to provide hands-on training on actual jobsites, such as a provincially sponsored housing project.	Industry associations Training providers BC Housing
3. Adopt a system of "Best Practice Advisors" drawn from within key professions, whereby roving mentors and advisors check in on locations periodically to give advice and answer questions.	Industry associations NGOs (e.g., ZEBx, CAGBC, Passive House Canada, CEA)
4. Launch a province-wide campaign to help key professions understand the details of Building Code changes through to 2032.	Industry associations BC Housing
5. Develop communications materials for local governments to help them communicate with industry their intentions to adopt the ESC.	Municipalities PIBC, BOABC
6. Sponsor a centralized online hub listing current and relevant training offerings by region and by profession. Consider pairing this with a dedicated telephone hotline to provide support and advice. Also consider including a function where professionals can provide reviews and testimonials about which courses delivered the desired outcomes.	BC Government BC Housing
7. Work with training providers to develop and deliver training focused on subject matter in demand (notably air/vapour barriers and air sealing which was by far the most common theme).	Training providers

Recommendation	Allied organizations
8. Develop a standardized evaluation tool to be used by students at the end of each course. Course credits could be linked with completing this survey to increase response rates.	Training providers Industry associations Professional licensing authorities (AIBC, EGBC, BC Housing)
9. Establish a "Certificate in Training in Low Carbon Buildings" targeted at professionals and instructors who are delivering training.	Training providers
10. Develop a "Prior Learning Assessment and Recognition credential" to recognize successful prior site experience with low carbon buildings.	Training providers Training authorities (e.g., ITA BC)
11. Develop a series of short and focused training options (i.e., micro-credentials or badges) for specific skills and equipment.	Training providers
Tackle Technical Challenges	
12. Develop knowledge sharing and mentorship opportunities to help knowledge transfer between workers of different ages, backgrounds and levels of experience.	Industry associations NGOs (e.g., ZEBx, CAGBC, Passive House Canada)
13. To foster a broad understanding of how trades can work together more effectively, combine curricula related to effective communication, teamwork, and collaboration with "building as a system" courses and "soft skills" training.	Training providers
14. Engage multiple disciplines in collaborative, hands-on training projects to solve technical issues such as air barrier awareness.	Training providers Industry associations NGOs (e.g., ZEBx, CAGBC, Passive House Canada)
15. Support immigrant workers and newcomers to the province by developing training materials in other languages commonly spoken on construction sites.	Industry associations NGOs (e.g., SUCCESS, EmpowerMe)
Address Regional Issues	
16. Where local experts do not exist in a specific profession, sponsor experienced leaders to visit regions of the province and share their knowledge.	BC Government Industry associations
17. Develop hands-on training opportunities specific to cold climate construction by sponsoring higher step "showcase" projects in Northern BC and other parts of the interior.	Industry associations Training providers
18. Consider incentives for workers in rural regions to overcome barriers in accessing training opportunities and projects.	BC Government
Resolve Profession-specific Issues	
19. Develop marketing materials aimed at Developers and Owners that explain the benefits, requirements, and costs to achieve compliance with the ESC.	Industry associations

Recommendation	Allied organizations
20. Develop training for Building Officials that covers the practical aspects of design and construction (engineer's energy reports, building systems energy use and air barrier performance) as they relate to outcomes and compliance	BOABC
21. Combine a revamped suite of training resources for General Contractors with an incentive program or regulatory requirements to take training.	Industry associations BC Housing
22. Develop training for Estimators and Cost Consultants that clarifies knowledge of ESC enhancements and requirements, to help support more accurate and consistent pricing and estimating services.	CIQS, ICBA, BCCA and affiliates
23. Provide incentives for regional colleges to deliver and students to complete Energy Advisor training. Incentives could include travel subsidies, tuition grants, and business start-up grants for program graduates. These programs should build on recent announcements of support from the federal government.	BC Government Training Providers
24. Develop and provide training and ongoing support for building commissioning that enables participants to learn how to operate HVAC and other building systems to achieve desired energy-performance outcomes.	Industry associations Training Providers HVAC Manufacturers
25. Provide targeted incentives for gas fitters to take training on heat pump installation and electrification of buildings.	BC Government Fortis BC

7. Final Thoughts

This study offers a benchmark of the state of readiness for the BC ESC today. Since the launch of the ESC in 2017, BC's architecture, engineering and construction industry has become familiar with and able to implement the requirements of the lower Steps. As the ESC updates progress through to 2032 and start to stretch into the higher performance levels, ongoing training will be necessary. Fortunately, there is already a wide range of ESC training programs available and knowledgeable and committed educators ready to expand their offerings. Indeed, many of the training resources are already in place – they simply need to be promoted effectively. The research findings indicate that developing and promoting new training opportunities and activities will improve skillsets, comfort levels, and communication practices and, ultimately, enable widespread construction of high-performance buildings.

BC is home to numerous experts in innovative Part 3 and Part 9 building design and construction who have paved the way for the rest of industry to follow suit. That continues to be the case today, with more Passive House certified buildings (in terms of both numbers and floor area) than any other province. It continues to be important to leverage catalysts such as progressive local governments that have adopted ESC, industry associations and advocates such as Passive House Canada, the CAGBC and CEA to help these leaders disseminate their knowledge and skills to target audiences who provide ESC compliance services through established training delivery agents across all regions of BC.

Even though this study uncovered several barriers to the adoption of the ESC, it also recommends 25 actions that can be taken to address them. These actions require a collaborative effort that includes provincial and local governments, industry associations, utilities training providers and NGOs. Indeed, as the BC Building Code continues to be updated trough to 2032, Key Performance indicators become imperative to evaluate and track the continued state of readiness of the key professions. Collaboration with professional organizations, local jurisdictions, building officials and training course providers, is required to capture data and report on progress.

The investments made by ESC advocates over the past five years in the form of training, demonstration and support have resulted in a construction industry that is, by and large, conversant in the principles of energy efficient building design and construction. Template buildings that exceed the 2032 Net Zero Energy goals exist today. There is also a cohort of leaders in deep, energy efficient building and state of the art construction solutions on which to draw for inspiration and advice.

8. Appendices

Appendix 1 - Methodology

Resources and research previously completed was collected and reviewed before engaging with stakeholders for further information. Focus was given to innovative funding and partnership models for training delivery. A survey and key informant interviews were conducted to acquire relevant information and validate findings. Below is a description of the specific approach to each research task.

Task 2.1 Desktop Research and Matrix Development

The research and analysis began with a high-level review of existing resources and gathering relevant information from recent projects related to education and training models. In order to gather the information necessary to complete the Matrix, specific approaches were used for each piece of information.

1. **Key professions:** Key construction occupations and professions were reviewed based on a list provided by BSSB, with the addition of quantity surveyors/estimators, as understanding the cost impacts and value proposition of higher levels of building performance is critical. Outputs and insights included a list of key construction professions referenced in this project in the Matrix.

2. Key responsible organizations: Networks and relationships were leveraged to engage with the key institutes, associations, warranty providers, and those responsible for certifying key construction professionals. Organizations serving as the natural leads for key professions and relevant supporting organizations were highlighted. Outputs and insights included a list of key responsible organizations and certification agencies – existing and proposed - detailed within the Matrix.

3. Related / supporting organizations: Other organizations that support training and capacity-building for key professions and may be a source of major learning resources were also highlighted. These include public and private post-secondary education and trades training institutions and membership-based organizations such as regional construction associations and the regional chapters of the Canadian Home Builders Association of BC. Outputs and insights included a list of key related/supporting organizations in the Matrix.

4. BC Energy Step Code competency frameworks: The project team sought to identify whether an Energy Step Code competency framework exists for the key profession and, if so, what state of development it is at, whether it addresses all competencies and, if not, where the gaps are.

For example, an exemplary BC Energy Step Code competency framework exists for building officials that is organized around 6 key categories that include topics such as high-performance mechanical systems and high-performance building enclosures. It is used to evaluate existing and new courses for alignment with learning goals and learning objectives. It also helps to identify training gaps and indicate the need for new training opportunities.

Where no competency framework currently exists, we used a slightly updated version of 2017 competency framework sufficient to identify learning resources. Outputs and insights included the status of competency frameworks for each profession as provided by key responsible organizations and links to frameworks in the Matrix.

5. Learning resources available for competencies and separate lists for each key construction profession: In the inventory of resources prepared for the 2017 Capacity Assessment and Training Strategy report, 73 learning resources were identified (either in existence or planned) for Part 9 buildings, 50 for Part 3 residential buildings, and 38 for Part 3 commercial buildings that addressed higher levels of the Energy Step Code.

Through research this list was validated and updated with new learning resources available to key professions, and separate lists of learning resources for each key construction profession were generated and included in the Matrix. Outputs and insights included an updated inventory of learning resources, the competencies they address, weblink, cost, applicable building types, training format, provider organization, certification (if applicable), and location (if not online).

6. BC Energy Step Code status: The project team sought to determine and document the degree to which the training is encouraged or mandated for the profession. For example, Energy Step Code training that qualifies for Continuing Professional Development (CPD) credit, is voluntary though it may contribute to learning credit units (LCU) requirements or is not explicitly encouraged. Outputs and insights included a list of courses that are required for certification identified in the resource list and summarized in this Phase 1 report. This task was designed to provide insights into the state of acceptance by key professions of the need for training to achieve the higher steps of the BC Energy Step Code.

7. Who is taking the training: Previous research has identified that for many topics there is no shortage of training available, but it is often under-utilized due to access, cost, and demand issues. Through desktop research and key informant interviews, the project team sought to understand how many are taking the training programs, where they are located and if there are regional differences. Outputs and insights included a snapshot of the number of people in key professions who sought training in the past 12 months and on what topic.

8. Obstacles: Through the research process, we asked interviewees as well as conferred with staff at Omicron on real and perceived obstacles to acquiring the knowledge necessary to delivery projects to the higher levels of the BC Energy Step Code. As we analyzed potential obstacles to training, we also highlighted potential barriers to non-traditional groups. Outputs and insights included a summary of the barriers that hinder key professions from acquiring the necessary knowledge, commentary on specific barriers that may apply to underrepresented groups, along with observations included in the Phase 1 report.

9. Part 3 vs Part 9: Although there is some overlap for some trade professions, the professionals, responsibilities, ecosystems, and supply chains that support Part 3 (large format projects) and Part 9 (low rise and single family) can be quite different. We specifically identified the level of readiness in the two sectors. Outputs and insights included an understanding of the relative state of readiness between key professions working in Part 3 versus Part 9, and a description of situations where there may be differences between those involved in Part 3 versus Part 9 projects.

Task 2.2 Primary Research

1. BC Building Code Capacity Survey: As mentioned above, primary research activities in the form of a survey and series of key informant interviews were designed to fill information gaps. The survey was designed to capture insights from training program providers, industry associations, and other training delivery stakeholders across the province, with a specific emphasis on capturing regional programs and curriculum variations as they relate to the BC Energy Step Code and net-zero energy ready construction practices for the key professionals and trades in focus. We worked with our networks and the Project Advisory Group to support the survey's dissemination and ensure regional representation. The project team developed and disseminated the survey through SurveyMonkey, and results were summarized and included in Appendix 2.

2. Key Informant Interviews: Information gaps were also addressed, and additional insights were captured through 21 key informant interviews. The project team developed a priority list of key informants and worked with the client to ensure a range of perspectives were captured from experts that can speak to aspects of several key professions. The project team also conferred with Omicron staff to gain their insights on the learning resources identified. Interviews are summarized in Appendix 3.

Appendix 2 - Results of Survey

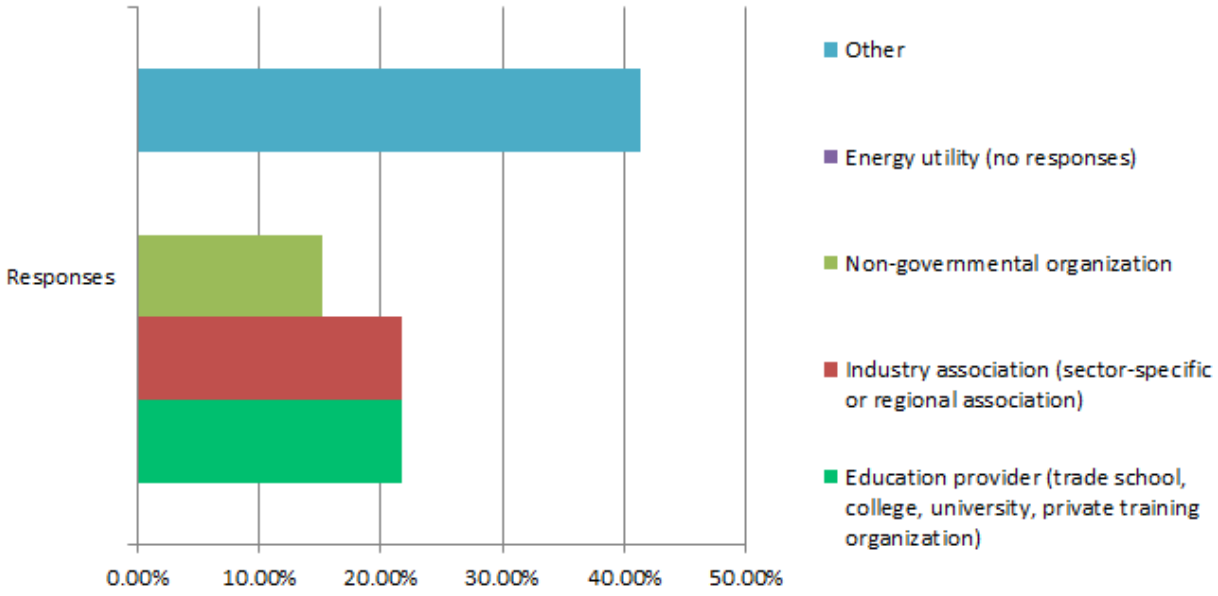
A BC Building Code Capacity Survey was conducted in March and April 2021 to capture insights from training program providers, industry associations, and other training delivery stakeholders across the province. The survey was designed with the guidance of the Project Advisory Group and disseminated to groups working to deliver training relevant to future updates of the BC Building Code and BC Energy Step Code.

The survey asked respondents about the type of training they deliver, its relevance to key professions across the construction sector, specific professions and topics that may need more focus and support, barriers to accessing and delivering effective training and, overall, the general readiness of professions being served. The survey was disseminated directly via email through the SurveyMonkey platform to over 300 individuals and organizations representing colleges and universities, industry associations, local government staff, and members of the Energy Step Code Council and various subcommittees. Multiple reminder emails were sent, and 56 responses were received after approximately 5 weeks.

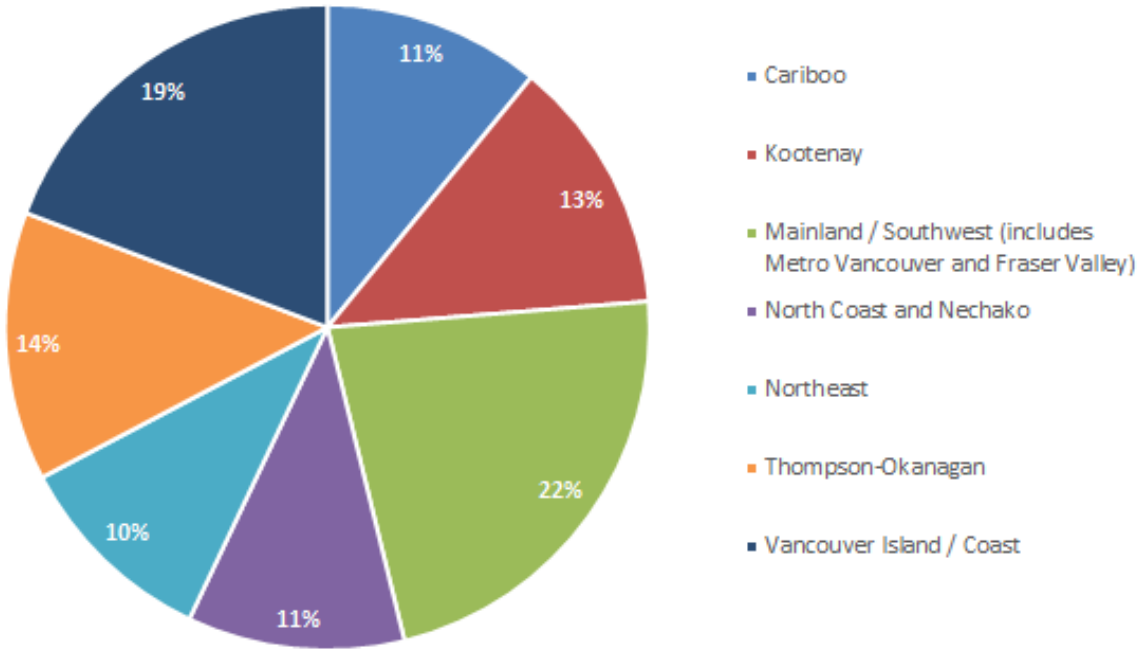
Respondent Type

Education providers and industry associations each had the largest number of responses (10), although it should be noted that many respondents that selected 'other' fall into these or multiple other categories (e.g., regulatory body, local government, member-based association).

Q. Which one of the following categories best describes your organization?



Q. Select any regions that fall within your organization's main scope and reach (recognizing that virtual training platforms allow for a broader reach, please select only those regions where your work takes place or where trainees are coming from)

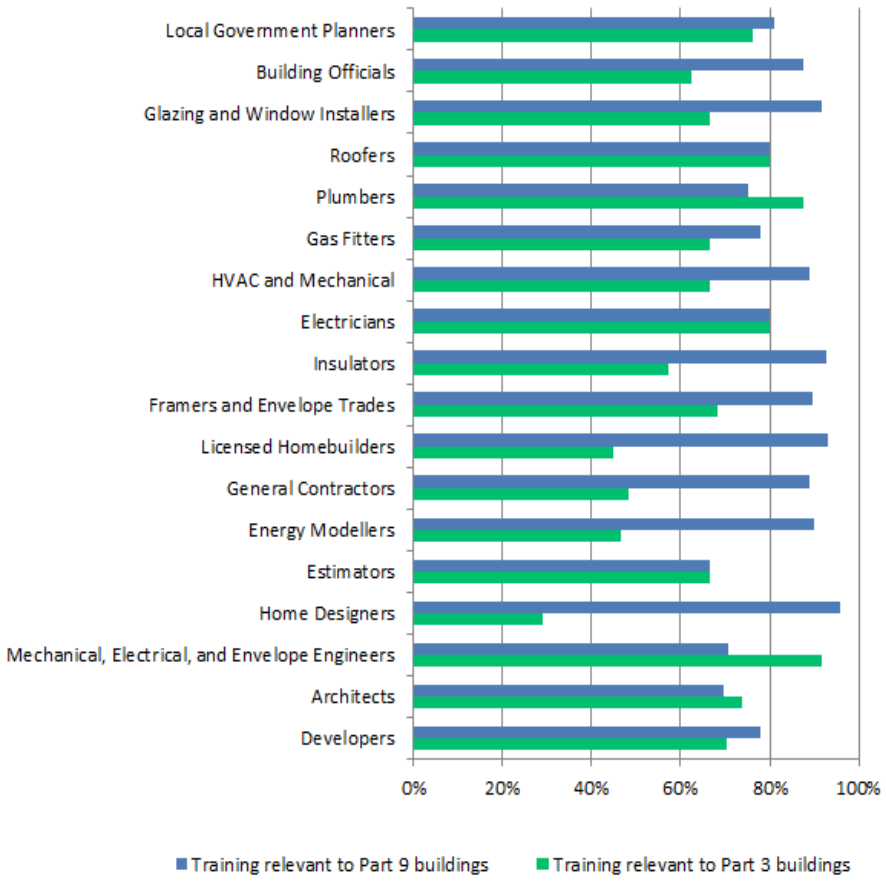


Key Professions Served

Respondents were asked **"Which of the following key professions and trades does your organization develop, deliver, or promote training and education to?**". The most common and least common responses were as follows:

Top Part 3:	Top Part 9:	Top Combined	Fewest Responses (combined)
Top Combined Engineers	Energy Modellers	Energy Modellers	Roofers
Developers	Licensed Homebuilders	Licensed Homebuilders	Estimators
Architects	General Contractors	General Contractors	Plumbers
Building Officials	Home Designers	Developers	Gas Fitters
			Electricians

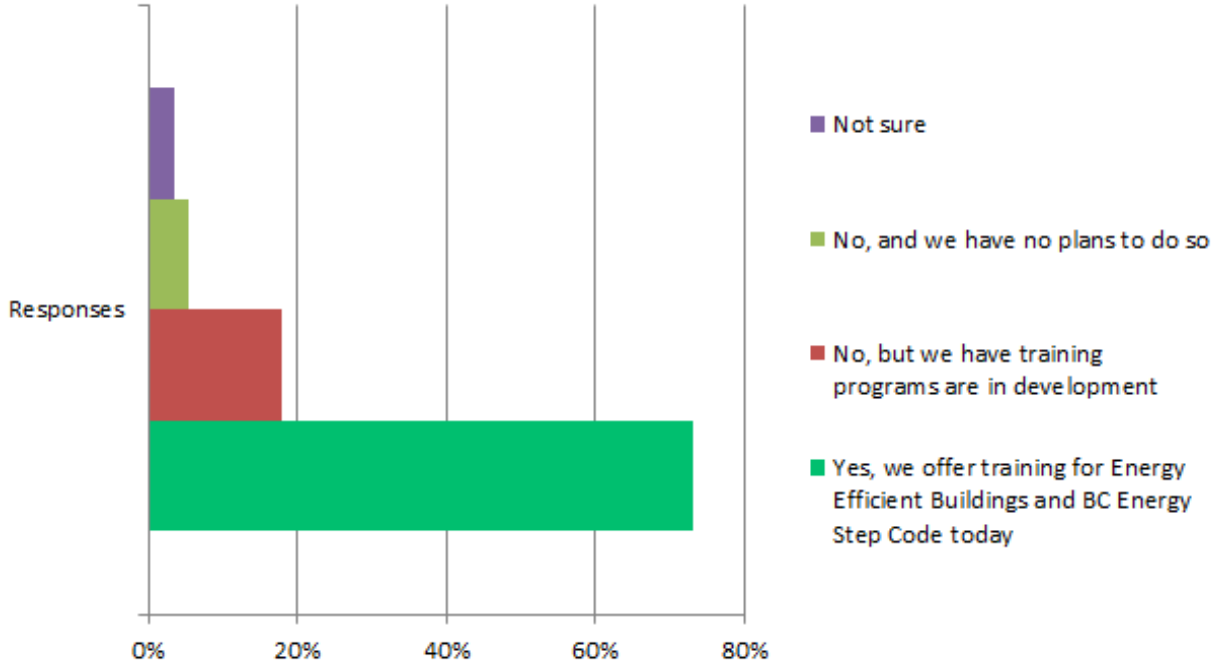
Q. Which of the following key professions and trades does your organization develop, deliver, or promote training and education to?



Relevance of Training to Energy Step Code

Respondents were asked whether **they "develop or promote training and education that specifically addresses the skills needed to successfully implement future updates to the BC Building Code and the BC Energy Step Code?"**. 73 percent of respondents indicated they currently offer relevant training, and an additional 18 percent indicated that they have relevant training programs in development. Only three respondents indicated they have no plans to develop training relevant to the Energy Step Code.

Q. Does your organization develop or promote training and education that specifically addresses the skills needed to successfully implement future updates to the BC Building Code and the BC Energy Step Code?



State of Readiness of Key Professions

Question 3 in the survey asked, "When you consider the key professions that your organization serves (in question 5 above), which statement best describes their state of readiness for updates to the BC Building Code and the BC Energy Step Code?". Responses were as follows:

13% of respondents stated that "*The majority are ready for all levels of the BC Energy Step Code today*".

55% of respondents stated that "*The majority are comfortable achieving the lower levels today but will need further training to deliver higher levels*".

20% stated that "*Most are not ready for the lower levels*".

One respondent commented "*I speak mostly for builders and designers from Northern BC. My experience is that very few builders have even done a blower door test, let alone tried building a home to any Step."* Another respondent commented "*The lack of clarity from the provincial government about what will actually happen in 2022 has led many stakeholders to take a wait and see approach. In other words, the lack of clarity, and relatively low level of communication to stakeholders about the 2022 target date, has not helped all the professions be ready."*

Sufficiency of Current Training Programs

Question 4 asked “Are there sufficient training programs and resources in place so that the key professions can learn how to successfully implement mandatory requirements in the BC Building Code and the BC Energy Step Code?”. Responses to this question were relatively evenly split, with 29% of respondents saying no, 35% of respondents saying yes for lower levels but not the higher levels, and 20% of respondents saying that there are sufficient programs in place.

One of the more representative comments received on this question (which relates to a key theme of the research findings) is “*It is one thing to have sufficient programs, another to ensure people take the train*ing.” Other respondents commented that there are less opportunities for trades and builders to complete the hands-on detailing and practice constructing high-performance assemblies outside the lower mainland.

Specific Topics Needing More Attention

Question 5 asked “In the context of energy efficient building design and construction, is there a specific technical topic that you feel is not adequately taught to key professions?”. Air / vapour barriers and air sealing was by far the most common theme in the responses to this question, followed by ventilation, electrification, planning, and systems.

Well-attended Training Programs

Question 6 asked “When you consider the programs and courses your organization promotes or delivers related to the BC Building Code and the BC Energy Step Code, how well attended are they?” 58% of the respondents said that these are “generally well-attended”, while 21% and 6% said “medium attended” and ``over-subscribed with wait lists” respectively. Only 2 respondents mentioned that it is “challenging to fill the spaces”

One of the responses mentions “*Early introduction seminars and brochures well attended. No follow thru to further develop and incorporate into our profession.”* The challenges with attendance in rural areas is also revealed through this question, as a respondent commented “*We are rural and a small community, so attendance is smaller. There are still some elements of the building industry not participating in the region.”*

Specific Professions Needing More Focus

Respondents were asked whether there are key professions that appear to be struggling with implementing the BC Energy Step Code and warrant specific education and training focus, and the most common responses were as follows:

Building officials

General contractors

Architects

Developers

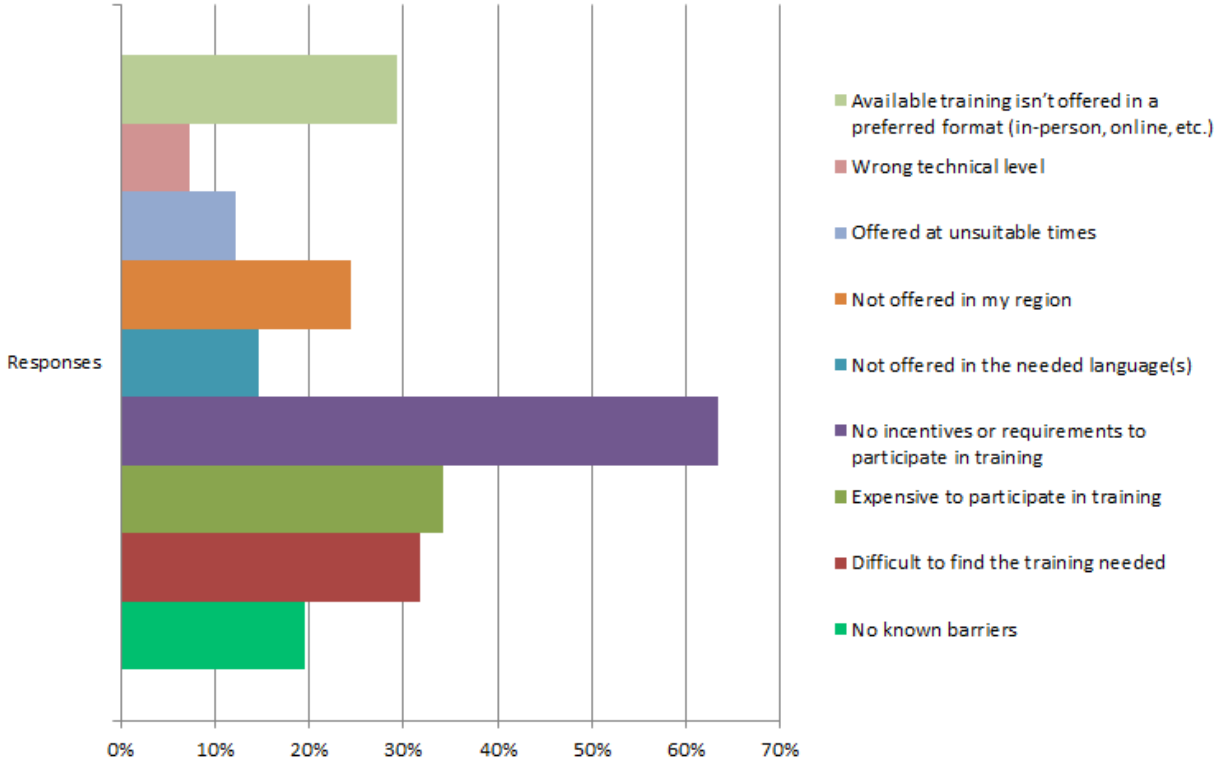
Realtors

Designers

Barriers Identified from the Survey

Respondents were asked “Are there barriers that hinder key professions from acquiring the knowledge and skills needed?”, and the top response (64%) was “No incentives or requirements to participate in training”. Cost and awareness were also commonly cited barriers.

Q. Are the barriers that hinder key professional from acquiring the knowledge and skills needed to successfully implement future updates to the BC Building Code and BC Energy Step Code? (Select all that apply)



Some significant comments on this question include:

- *Expensive in that the **training often takes away from the billable workday**.*
- *Few real drivers - i.e., the **training needs to result in something that has value in the market** or avoids some penalty.*
- ***Work environment may be or feel unsafe for women**. i.e., I would not want to work alone in a strange home (as may be the case for a female plumber or HVAC tech in residential retrofit) so I would avoid this career path.*
- *Covid hasn't helped this **- builders and trades like in person, tactile training**, but here in the Kootenays we often have to travel to the lower mainland to access all of the training needed - more time and more expense.*

- *Time.... right now, everyone is very busy (building boom), and **people don't have the time for training. Especially lower-level trades**.*
- *...We often hear the following: "as small business owner, it is too expensive to have employees training, especially when they may not stay", "there isn't sufficient hands-on training", "there is no requirement for ongoing CPD on this topic or for this trade".*
- *…What may be missing is figuring out how to do onsite training / instruction (at the job site). There may also be a need to have various trades required to complete a certain amount of training every year (education hours) that would also serve as a motivator.*

Respondents were also asked whether any of the barriers described above disproportionately affect underrepresented groups. Responses to this question were varied, but some common themes included language barriers, bias against newcomers without local experience, and inadequate training offerings for Indigenous people and women.

Further Comments and Suggested Actions

The following comments were retrieved from the survey.

- *Comprehensive summary tables on 'how it used to be done' and 'new requirements' for a quick visual.*
- *Sponsor Step 5 focused micro-credentials similar to Camosun's Advanced Skills for Clean Energy and Efficient Buildings program.*
- *Central site for training opportunities. Basically, expanding the training opportunities page on the ESC website and including a list of financial incentives for training on the same page.*
- *Education needs to begin with the first people in line. The general public. If people do not know what to ask for, what is needed, what is required, then they are relying on the "knowledge" of the person/people they are asking. If they are not knowledgeable then we are setting up for failure.*
- *A series of free online videos explaining each step of the energy code and how it affects design and construction.*
- *More training on heat pumps and electrification of buildings.*
- *Quality of implemented / offered training should be assessed. It should also be assessed whether professionals who attended specific training actually change their building practices - does the education have its desired impact? There are very few organizations that evaluate their capacity building efforts in meaningful and consistent ways on an ongoing basis.*
- *In rural areas, the access to energy advisors, travel cost impacting building starting the process of working with them. Developing a skilled EA network.*
- *The biggest challenge I see in small and remote communities is that many do not have a local Energy Advisor.*
- *In the North, the attitude is, why do it if it's not mandatory. Unfortunately, until people are made to do it, they won't. Why spend the extra money if your competition isn't? That could apply to several professions.*
- *There will need to be focus on the interior as there are many municipalities that have not adopted the ESC yet.*

- *Ensure that those providing education have the educational materials current and up to date with any changes that come out.*
- *Please recognize Residential and Building Designers as an important part of the industry, they are often lumped in with Architects which in BC is a significant difference.*
- *There are many training programs available through different organizations. Perhaps these could be organized into a recommended set of micro-credentials that provide the specific skills required by architects, engineers, skilled trades, etc. to design, build and possibly retrofit to Step 5.*
- *Central site for training opportunities. Basically, expanding the training opportunities page on the ESC website and including a list of financial incentives for training on the same page.*
- *The energuide system is currently a bottle neck to ensuring new homes meet performance and air tightness requirements. Getting an organization certified as an SO is woefully slow with a lot of requirements that don't make it easy for people to be ready to perform Energuide Audits. This needs to change.*
- *to ensure mass learning, more free training and resources need to be made available. Many of the existing training and resources are focused on the industry segments requiring CPD (builders, designers, some contractor association memberships). These courses are not low cost and are rarely accessed by the trades, resulting in slow transfer of knowledge and skills...*
- *1. Build capacity of trades and professionals designing and installing heat pumps. 2. Strengthen training and education in technical institutes and universities so the next generation doesn't have to be untrained. 3. Prepare trades, professions, policy makers for a big transition to prefabricated construction on assembly lines in small towns across B.C.*
- *Prescriptive requirements for Part 9 would be good. Performance based codes change the design requirements for every building. Why not have a simple recipe to achieve higher steps that any builder could follow? Over reliance on performance-based codes, doesn't give a clear indication for manufacturers in terms of what products will be required in the future...*

Appendix 3 - Results of Interviews

To get a clear picture of the current perceptions of those tasked with implementing the changes required by the ESC, 21 interviews were conducted with management and training representatives from large organizations throughout BC, as well as a selection of industry professionals. These interviews asked about general preparedness, training and availability, hiring qualified workers, incentives, under-served populations, regional differences, barriers and challenges.

General Observations by Profession

Overall, variations in basic knowledge about building envelope, construction quality and systems integration persist throughout most of the professions and interviewees expressed a need for these skills to be reinforced by industry. The following observations are organized by key professions:

1. **Developers and Owners** often have misconceptions about costs and some lack the technical knowledge to understand what is required and where risks occur. They do not know what to ask for to achieve compliance, and do not know what it costs. Architects have found some clients are surprised by the constraints of the Step Code. Marketing to explain benefits, requirements and costs is needed.
2. **Architects and Engineers** tend to believe they are mostly prepared for the higher levels of the Energy Step Code and Code update because of professional requirements for continuous education, expectations of expertise, and as a general extension of improving quality. Consultants are also generally prepared, but some gaps may surface due to system level issues such as constructability and trade coordination design impact on cost, schedule and construction outcomes. It was noted that there is an emerging gap in experience as senior consultants retire, there are not enough seasoned mid-level professionals available to move up. Junior professionals are rising quickly to decision-making positions and they generally require greater awareness of practicalities of construction.
3. **Energy Advisors** have a contradictory depiction among interviewees, as some see a shortage and others see limited demand. Limited demand issues are more prevalent in rural areas due to fears about cost, and lack of understanding of the process. Where shortages occur, mentorship and job experience are more highly valued than formal training. Recently announced funding for training Energy Advisors may alleviate this issue.
4. **For General Contractors and the trades working on Part 3 Projects**, there is a general lack of available training. There are fewer programs and resources available compared to licensed residential home builders. The lack of a single key responsible organization and a centralized hub for builder education makes the few courses available difficult to find. There is also confusion about the applicability of courses for home builders to those working on multi-family and commercial projects as many of the courses are not clear (e.g., they simply say they are for builders working on “homes” and only a few mentions if their courses are applicable to “mid-rise” or “high-rise”). Course descriptions also do not specify who should take the course in terms of level (junior, mid-level, senior) or which profession/discipline in a construction company would benefit (estimator, superintendent, construction manager, etc.).
5. **Licensed residential home builders and trade professionals working on Part 9 projects** generally have access to training necessary to meet the requirements of their trade but lack availability of “cross-training” for how other trades interact with theirs and how some activities may affect the building as a system. This is especially true for air barrier awareness among mechanical trades, who often have penetrations in the envelope for exhausts, ducts, etc. For those that have

experience or have been trained in other trades or how they may interact, there is no recognition or certification method to track this information, leading to some frustration when bidding, working with others, or attending training.

6. **Building Officials** need to know the practical aspects of design and construction as it relates to outcomes and compliance. They play a critical role in the process of developing solutions and must understand overall building performance. Building officials also require guidance and training on the specifics of how to achieve outcomes. They are reliant upon energy advisors' input for Part 9 buildings to verify energy performance and require "building as a system" solutions instead of individual items that can be evaluated. For Part 3, they are similarly reliant upon project engineers' verification of energy performance based on whole building simulations. Building officials do not have a good grasp on the specifics in both design and construction of what impacts energy performance and there is limited material available on their website.[22]

Training Content and Availability

Training has three important components: (1) online and in-class coursework to form a foundation; (2) mentorship to understand how to apply it to real projects; and (3) experience on multiple projects. Availability of all three components will best prepare workers to implement the Step Code. In rural areas this can be a major obstacle. There is also no tracking mechanism for job experience. Learning on-the-job is often the most realistic method, but there is no certification or recognition of competency. In BC, this training can sometimes be offered by product suppliers on-site.

1. **Training providers need to give clear information about what is going to get taught.** For professionals interested in upskilling, it can be difficult to assess the applicability, utility and quality of training to ESC requirements (i.e., competency framework). They may have limited time and want to learn techniques they can use immediately on the job.
2. **Collaborative, hands-on training projects.** Training projects that bring together multiple disciplines and actively engage them to solve simulated technical issues have been used in other jurisdictions[23] to promote constructive collaboration between trades. In interviews, the most frequently identified team issue was air barrier awareness, the ability to identify issues and repair them or who to alert. For Part 3, consultants and builders need to work more closely. For Part 9, engineers on site are rare, so housing designers, energy advisors, building officials and trades must work through issues live on site. More constructive collaboration between disciplines and programs that encourage sharing of lessons learned can help with knowledge and attitude about requirements of higher step code levels.
3. **Training for cost consultants and estimators needs to include pricing data.** Increased knowledge and awareness may also help minimize myths and misunderstandings about costs that affect pricing and estimating. Lack of experience and data equates to risk which drives up estimates unnecessarily. Prices are driven up by the combination of unknowns of the pricing impact of the Energy Step Code with how it interacts with compliance with AHJ zoning, regulations or requirements and the additional collaboration and coordination required.

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[22] https://boabc.org/energy-step-code/

[23] https://www.igbc.ie/projects/qualibuild

4. **Clear messages with deadlines for when ESC becomes mandatory.** Currently an important factor is that higher steps are voluntary, and professionals are reluctant to seek training until it is required either by code or awarded project. Professional organizations cannot force compliance with voluntary aspects of the Step Code. However, those who have sought the training have found they are comfortable with the higher steps.

Participation in Training and Rates of Attendance

Results from the survey suggested that courses are generally well-attended. Probing deeper into who attends which course and which courses where more popular than others, interviewees felt that courses which take deep dives into code and regulatory topics are generally not as well attended as those which discuss practical case studies.

1. **Builders tend demand training that is "short, sweet and to the point".** Training providers noted that courses with presentations lasting less than an hour tend to be the most popular with builders and trades. However, that limits depth of subject matter. The idea of micro-credentials or "badges" was suggested several times as a way deliver "bite-sized" education to ensure very particular competencies are captured. For example, properly applying sealing tape around vents. Some training workshops offered by construction associations where peers discuss recent projects can be well attended are also popular. Technical courses often favour BC Housing, BCIT or Passive House Canada.
2. **Challenges finding the "right" training.** Difficulties in finding appropriate training for mid-levels of experience has soured the perspective on attending for some, as classes can be either too theoretical or assume little experience. Taking time out to do training is a risk for small businesses, and unless the course description is really clear and, preferably, comes with a testimonial, it is too big a risk for the builder to pay to attend. Assessing applicability and material covered can be frustrating, and choosing the wrong course takes professionals away from other opportunities. A suggestion was made to better instruct the instructors to develop courses that are more applicable to the modern methods of construction, with hands-on, cross-disciplinary approaches with holistic and technical knowledge sharing.

Regional Differences

Overall, the urban / rural divide highlighted in the 2017 study appears to be narrowing. Interviewees generally agreed that the lower levels of the Step Code appear to be causing less difficulty. The pandemic has forced many courses online which may have helped those outside urban centres. Nevertheless, access to hands-on learning remains a challenge.

1. **Technical training on cold climate construction:** Rural and remote regions of BC face a combination of barriers to developing the capacity to meet the higher-level performance requirements – in particular, finding courses that deal with cold climate considerations, labour availability, material costs as well as the opportunity to get hands-on experience with projects (due to the fact that ESC is not mandated in most northern regions).
2. **The lack of local Part 9 energy advisors** in rural locations with familiarity of cold climate construction was particularly highlighted.
3. **Lack of ESC uptake in the North impacting uptake of training.** Relatively few communities in the north have adopted the ESC and the resulting lack of projects seeking higher levels of the ESC also limits any incentive for those with experience to be based in rural communities. A holistic "building as

a system" approach that gathers trades, consultants and building officials together is also difficult because of few and infrequent projects in rural areas. Costs to bring people together are much higher when longer distances of travel are required and are also more difficult to schedule.

GBA+ and Under-served Populations

The construction industry struggles to attract a diverse workforce. Compared to other industries, its approaches to equity, diversity and inclusion are in the early stages. For example, only 4% of BC's skilled trades are women compared to 28% in the manufacturing sector[24]. There is a recognized need for emphasis on a more diverse workforce and an urgency to recruitment due to expected shortages due to retirements. To this end, BCIT has been successful in delivering courses to members of First Nation communities and is promoting a "women in trades" program. They are working on a series of educational videos with NRCAN and are developing training camps after COVID.

Nevertheless, program providers interviewed did not, generally, track the diversity of participants in their programs. The consensus was that the program participants largely reflected the traditional construction demographic. There was no evidence of ESC-specific courses being offered in languages other than English.

Incentives

Continuing Professional Development (CPD) requirements are seen as a key reason to training and Part 9 technical up-skilling in particular appears to be going well. There are a range of quality courses among a variety of technical topics covering Energy Codes provided by BC Housing, CHBA and Passive House Canada. According to one interviewee, an unintended consequence of builders being required to take training to keep their CPD credits up to date is that "the same person (Builder/Contractor) keeps coming to take the training since he has to maintain his credential but actually, he needs to send his employees/trades or organize an in-house training".

Those interviewed highlighted some incentives that might assist with increasing Step Code implementation:

1. Compensating for lost productivity – opportunity costs of attending training.
2. Compensating for travel and lodging costs – rural professionals must often travel to cities.
3. Policy incentives – jurisdictional considerations for owners and developers in consideration of achieving ESC alongside design requirements (zoning, etc.).
4. Innovation incentives – developing and disseminating innovative practices and solutions should be encouraged.
5. Compensating for learning curve costs – doing things differently requires time and training during a project, often on-site during construction. Achieving municipal design requirements while simultaneously achieving step code has change-related costs that have a tangible impact on a project's pro forma, feasibility and costs.

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24 https://www.buildforce.ca/system/files/forecast_summary_reports/2021%20BC%20Constr%20Maint%20Looking%20Forward.pdf

Hiring Staff

The architects and engineers interviewed generally felt comfortable with their ability to hire appropriately skilled staff, mentoring them, as necessary. However, builders felt that without a standard way to recognize experience with Step Code, such as a credential program, industry is limited in their ability to assess skills competency when hiring professionals. As such, they tend to persistently hire a few professionals who have proven experience on projects. Thus, without actual projects, mentorship and experience opportunities are limited. Energy Step Code training is not generally sought but relevant building science and energy efficiency training from BCIT, Passive House Canada, BC Housing, or professional associations is regularly reviewed for relevance when looking for hires.

Climate Issues

Several of those interviewed noted that the Energy Step Code should be addressing the fundamental issues surrounding carbon emissions, and that energy performance is a bit restrictive in that goal. A more comprehensive approach may be to focus on GHGI as an environmental metric, or to use lifecycle carbon assessments. Alternative energy options seem to be missing, which could hamper innovative design options that may also help achieve the intent. A more holistic view of total building energy performance is required, not just heat pumps or envelopes in isolation.

Barriers Identified in the Interviews

While, overall, the professionals interviewed felt confident in their ability to achieve performance requirements of the lower levels of the ESC, challenges remain.

1. **Aging workforce resulting in an experience "vacuum".** Several key professions are battling demographics whereby those with experience are retiring and there are not enough seasoned mid-career professionals with the technical knowledge to take over. As a result, the lack of capacity noted within certain professions is as much to do with general inexperience as it is a lack of technical knowledge. This issue is prevalent among architects and home designers as well as many builders and trades. It was noted that BCIT's Carpentry apprenticeship program incorporates Step Code related work at each of the four levels so those entering the workforce have the technical skills.
2. **Lack of access to "hands-on" project-based training for Higher Steps.** The building industry learns by doing. Acquiring the knowledge and skills necessary to overcome the gap between Lower and Higher Steps of the ESC is perceived as difficult and is exacerbated as access to experience on actual projects is limited – especially in rural areas. System level and team skills can be overlooked, as inter-disciplinary training, "building as a system" and collaboration with other trades are not generally stressed. Interviewees noted that most designers and builders understand the general principles but do need help and experience translating those objectives into technical details, workflows and processes. Design constructability considerations are often mentioned as missing (which can simply be a result of inexperienced / junior workers being put in charge). Project planning was also mentioned as an area of concern. It is not just a question of understanding what work needs to get done, but how.
3. **Inconsistent adoption of ESC and unclear messaging.** The ESC has not been universally adopted province wide. The different rate of uptake between jurisdictions and the customization that has occurred whereby local governments have incorporated different elements or levels of the ESC has caused confusion. Where the ESC has not yet been adopted, builders have not been motivated to take training. There is a lack of appreciation of the fact that ESC is not an "if" but a "when". Clearer

messaging is necessary – that building to ESC requirements requires training and there is a window of time within which builders can gear up. Messaging to builders also needs to explain what they need to learn in practical terms.

4. **Improved collaboration and soft skills required.** The ability to collaborate and work together was mentioned several times ("soft skills" was specifically mentioned twice) as critical for achieving practical Step Code solutions. Understanding the technical considerations of how trades affect building performance is required, both in terms of elements being "within spec" but having a negative impact, and the cumulative effect of multiple trades interacting. Collaboration is a much larger industry question than the scope of this project, as interviewees noted it can encompass everything from owner knowledge to procurement to contracting.
5. **Digital literacy.** Several interviewees commented on the digitization of construction. This includes the use of virtual design and construction tools such as Building Information Modeling (BIM) as well as "smart building" technologies such as building automation systems and controls. As buildings become more complex, the value of developing and managing the information in a virtual collaborative platform will increase, even for small projects. None of the education programs reviewed consider the application of digital tools and smart building solutions. Training, where it exists, is provided proprietary systems to qualified contractors by manufacturers.
6. **Obstacles to non-traditional groups.** The construction industry continues to struggle to attract non-traditional workers regardless of ESC implementation. To start, it would be helpful to gather data on who is taking the training. It will also be important to engaging with those that are not in the classroom to better understand the gaps and obstacles. Down the road, it may be necessary for governments to lead by example by embedding training or certification requirements in RFPs.
7. **Building operations and commissioning.** An often-neglected issue is the training of building operation professionals to fine tune mechanical and electrical controls during the first few years of operation. Interviewees noted that high performance buildings require operational time to refine and balance systems for optimal performance given in-situ conditions. Commissioning is still not a universally accepted process – particularly for smaller projects. As buildings increasingly rely in an "envelope first" approach, whole building commissioning is increasingly important. Training and support on how to operate equipment and problem-solve to improve performance are not included in costs to complete a project, and without it these systems may get turned off or become non-functional in short amounts of time.

Appendix 4 - Energy Step Code Training and Information Resources

The following is a list of Energy Step Code training and information resources that can be used by various key professionals. These include, but are not limited to, guidebooks, videos, powerpoint presentations and so on. These resources are meant to supplement the courses previously discussed and to provide basic and high-level literacy on ESC to multiple key professions. It should be noted that this is not a comprehensive list of all the supplementary ESC resources.

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
BC Energy Step Code Builder Guide	Provides information on the key strategies and approaches those builders can use to meet the BC Energy Step Code for houses and low-rise (Part 3 and Part 9) wood-frame residential buildings up to six storey. It is a companion work to the BC Energy Step Code Design Guide.	Guidebook	BC Housing	December 2018					X		
BC Energy Step Code Design Guide	Provides information on the key strategies and approaches necessary to reduce the impacts of a warmer climate on mid- and high-rise (Part 3) wood-frame and non-combustible residential buildings within BC.	Guidebook	BC Housing	July 2019	X					X	
BC Energy Step Code Design Guide Supplement S3 on Overheating and Air Quality	Provides information on key strategies and approaches to meeting the Energy Step Code in mid- and high-rise (Part 3) and low-rise (Part 9) wood-frame and non-combustible residential buildings within BC.	Guidebook	BC Housing	June 2019	X					X	

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
BC Energy Step Code PPT - Part 3	Explain the BC Energy Step Codes for Part 3 to communicate accurate information about the standard to constituents, customers, or stakeholders.	Powerpoint	Energy Step Code	2019	X	X	X	X	X	X	Part 3
BC Energy Step Code PPT - Part 9	Explain the BC Energy Step Codes for Part 9 to communicate accurate information about the standard to constituents, customers, or stakeholders.	Powerpoint	Energy Step Code	2019	X	X	X	X	X	X	Part 9
Best Practices Guide Version 1	Resource for all local governments in BC interested in referencing the BCESC in policies, programs, or bylaws. Includes information on characteristics of each step, anticipated costs and benefits, suggested timelines, and community specific strategy for BCESC implementation.	Guidebook	Energy Step Code	September 2017						X	
Best Practices Guide Version 2	Resource for all local governments in BC interested in referencing the BCESC in policies, programs, or bylaws. Includes information on characteristics of each step, anticipated costs and benefits, suggested timelines, and community specific strategy for BCESC implementation.	Guidebook	Energy Step Code	July 2019						X	

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
Builder Insight 09 - Fenestration Energy Performance: Requirements for Residential Buildings in British Columbia	Summarizes fenestration energy performance requirements of the 2012 BCBC, the 2014 VBBL, and the BC EESR as of January 1, 2015.	Bulletin	BC Housing		X		X	X		X	
Builder Insight 14 - Heat Recovery Ventilation	Focuses on heat recovery ventilator (HRV) designs for Part 9 houses.	Bulletin	BC Housing			X	X		X		Part 9
Builder Insight 17 - BC Building Code Changes 2018	Overview of the changes in Part 9 of the BC Building Code (BCBC 2018), effective December 2018.	Bulletin	BC Housing			X	X			X	Part 9
Builder Insight 19 - Modelling the Future Climate in Passively Cooled Buildings	Overview of how designers can improve building resilience by considering the risk of overheating and meeting the BC Energy Step Code.	Bulletin	BC Housing								
Building a Legacy Toolkit	This toolkit was created to enable customized replication of the successful outreach, policy, and education program first delivered in the East Kootenay. Includes resources and customizable templates for use in a region's ESC implementation program.	Toolkit Webpage	Community Energy Association								

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
Building Envelope Thermal Bridging Guide	Aims to help the B.C. construction sector realize more energy-efficient buildings by looking at current obstacles and showing opportunities to improve building envelope thermal performance. Version 1.2 expands the thermal performance catalogue with additional data for many newly analyzed assemblies and details. This includes more cladding attachment systems, window interfaces, precast concrete interfaces, wood-frame and brick veneer walls, and other thermal mitigation systems.	Guidebook		2020	X	X		X		X	
Building Envelope Thermal Bridging Guide	Aims to help the B.C. construction sector realize more energy-efficient buildings by looking at current obstacles and showing opportunities to improve building envelope thermal performance. Version 1.2 expands the thermal performance catalogue with additional data for many newly analyzed assemblies and details. This includes more cladding attachment systems, window interfaces, precast concrete interfaces, wood-frame and brick veneer walls, and other thermal mitigation systems.	Video Series			X	X		X		X	

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
Building High Performance Homes through LEEP - Series One	The first series of five videos helps demystify the various solutions that builders will be using to construct comfortable and energy-efficient new homes in communities that incentivize or require the BC Energy Step Code.	Video series	Office of Energy Research and Development at Natural Resources Canada (NRCan)						X		Part 9
Building High Performance Homes through LEEP - Series Two	The second installment in this popular video series focuses on energy-efficient homes in Northern and Interior B.C. and how builders can meet the unique climate challenges in these regions. Each of the five videos focuses on key aspects of how to build energy-efficient homes including the importance of using an integrated design process and collaborating with industry professionals such as energy advisors early in the planning process.	Video series	Office of Energy Research and Development at Natural Resources Canada (NRCan)						X		Part 9
Energy Step Code 2017 Metrics Research - Full Report	Full report of comprehensive exploration of energy, emissions and economic impacts of the BC Energy Step Code in 2017 Findings suggest improved energy efficiency and affordability can go hand in hand.	Report	BC Housing	September 2017						X	
Energy Step Code 2017 Metrics Research - Summary Report	Summary report of the comprehensive exploration of the energy, emissions and economic impacts of the BC Energy Step Code in 2017.	Report	BC Housing	September 2017						X	

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
Energy Step Code 2018 Metrics Research - Full Report	Full report of comprehensive exploration of energy, emissions and economic impacts of the BC Energy Step Code in 2018.	Report	BC Housing	2018						X	
Handbook for Building Officials	Provides overview of the BC Energy Step Code, explains new processes and roles, and describes the key elements of high-performance buildings.	Handbook	BC Housing	2015						X	Part 9
Heat Recovery Ventilation Guide for Houses	Best practices for the design, installation and maintenance of heat recovery ventilators (HRVs) and energy recovery ventilators (ERVs) in single family, semi-detached and row housing.	Guidebook	BC Housing	2015		X			X		
Heat Recovery Ventilation Guide for Multi-Unit Residential Buildings	Best practices for the design, installation and maintenance of heat recovery ventilators (HRVs) and energy recovery ventilators (ERVs) in multi-unit residential buildings	Guidebook	BC Housing	2015		X			X		
Illustrated Guide - Achieving Airtight Buildings	Provides resource to design, build and test airtight buildings. Consolidates information on achieving airtightness in buildings, while ensuring building enclosure performance	Guidebook	BC Housing	September 2017		X			X		
Illustrated Guide - Achieving Airtight Buildings - Appendix A	Reference and overview of whole-building airtightness performance targets in codes and standards across British Columbia.	Appendix	BC Housing	September 2017		X			X		

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
Low Thermal Energy Demand for Large Buildings	Aims to broaden the common understanding of how large buildings can meet higher levels of performance as required by Passive House, BC Energy Step Code, City of Vancouver Zero Emission Building Plan and City of Toronto Zero Emissions Building Framework.	Guidebook	BC Housing	2018		X	X	X		X	
Best Practice Guide Air Sealing & Insulation Retrofits for Single Family Homes	Consolidates best practices for air sealing and insulation retrofits (i.e., building enclosure weatherization) for British Columbia homes. The Air Sealing and Retrofits guide is intended to be a reference tool for construction industry professionals and can help contractors learn how to perform weatherization work.	Guidebook	BC Housing	2020	X	X			X	X	
Whole Building Energy Modelling Services (Professional Practice Guidelines)	Provides guidance on the provision of services pertaining to building energy performance modelling and analysis, including, but not limited to, the responsibilities of members of a design team providing Building Energy Modelling services.	Guidebook	Engineers and Geoscientists BC and the Architectural Institute of BC	August 2018				X			
Provincial Policy: Local Government Implementation of the BC Energy Step Code	Explains policy intent of BCESC and its use and application by local governments and other local authorities under the Building Act.	Report	BC Office of Housing and Construction Standards	April 2017						X	

Resource Title	Brief Description	Type of Resource	Issuing Organization	Date Published?	Applicable to?						Part 3/ Part 9
					Architects	Designers	Engineers	Energy Modellers & Advisors	Builders & Trades	Building Officials	
Building a Legacy Video Series		Video Series	Community Energy Association		X	X	X	X	X	X	
Energy Step Code Case Studies	Provides “real-world” examples of homes that meets energy performance building standard with a modest construction cost premium. Features cases from Campbell River, Invermere, Kamloops, Langley, Victoria and Whistler.	Case Study	Energy Step Code						X		Part 9
City of Vancouver Guidelines Energy Modelling	Energy modelling guide to be used in addition to the applicable requirements for energy performance modelling as written in the National Energy Code of Canada for Buildings (NECB), Part 8.		City of Vancouver				X	X			Part 3

Appendix 5 - List of Regularly Occurring Relevant Courses by Professions

Developers

Course	Level	Provider	Description
Building Smart with 2018 BC Building Code Changes	Entry	BC Housing	Overview on changes to Part 9 of the BC Building Code that came into effect on December 10, 2018.
Building Smart by Mitigating Thermal Bridging	Entry	BC Housing	Overview on tools to adapt to energy-efficiency requirements and transform to net-zero buildings.
Building Better with the Energy Step Code	Entry	Community Energy Association	The full-day workshops are an extension of BC Housing's Building Smart with the Energy Step Code seminars and include a hands-on component. Building Better workshops will serve communities where Building Smart workshops are not easily accessible due to travel distance, but where CEA has established local government networks and in areas with a high volume of building permits and demand for additional builder training.
Building A Legacy	Entry	Community Energy Association	When the BC Energy Step Code was introduced in 2017, CEA addressed an identified knowledge gap in the East Kootenay region of BC by developing the 'Building a Legacy' program. Responding to feedback from key industry stakeholders, the program has supported the transition of the East Kootenay building industry to implement the BC Energy Step Code and the performance pathway approach to achieving Building Code standards.

Architects

Course	Level	Provider	Description
Effective Thermal Performance of the Building Enclosure	Entry	Cascadia Windows and Doors	Current wall assemblies closest to the ESC target performance levels, key differences, strengths and limits for difference thermally improved cladding support products.
Navigating Emerging Building Energy Performance Standards (BEPS)	Entry	Cascadia Windows and Doors	Review of the BC Step Code & the Seattle Energy Code-2018, 'building envelope first approach comprehensive and integrated approach to envelope and fenestration energy performance
Building Smart: Designing Building Enclosures in Wood-Frame Multi-Unit Construction	Entry	BC Housing	On-demand course that includes best practices for designing efficient, durable wood-frame building enclosures in new construction.
Building Smart with 2018 BC Building Code Changes	Entry	BC Housing	Overview on changes to Part 9 of the BC Building Code that came into effect on December 10, 2018.
Building Smart by Mitigating Thermal Bridging	Entry	BC Housing	Overview on tools to adapt to energy-efficiency requirements and transform to net-zero buildings.
CESA 1505 Zero Energy Buildings All-in-1	Entry	BCIT	Develop understanding of BCESC, airtight design and construction, execution of high-performance assembly details, and mechanical systems for Part 9 (Equivalent to CESA 1001, CESA 1110, CESA 1120 and CESA 1140 combined).
Building Smart for High Performance Buildings - 2020 Half-Day Workshop	Entry	BC Housing	Focuses on research results, case studies, as well as successful design and construction practices. Provides insight on government initiatives to support more efficient, functional and resilient buildings. Includes issues such as cost effective and energy efficient homes, indoor air quality and thermal comfort, building envelope systems, window and roof installation.

Course	Level	Provider	Description
Building Smart with High Performance Building Design	Entry	BC Housing	Focuses on innovation and building design considerations required for single and multi-unit buildings. Explores concepts and design rules to achieve higher standards for livability, high-performance sustainability, and durability of assemblies. Topics include wall, roof and attic performance, prefab assemblies, tall mass timber buildings, lighting and thermal comfort.
Building Smart with High Performance Concrete Envelopes	Entry	BC Housing	Discusses how concrete envelopes can help deliver results, as well as some of the most effective ways to meet the new BC Energy Step Code standards. Topics include precast concrete, sandwich concrete walls, insulating concrete forms, and cast-in-place concrete.
Building Smart with Safe and Durable Wall Assemblies	Entry	BC Housing	Focuses on thermal and moisture performance of highly insulated wall assemblies for new and retrofit buildings. Explores the use and effectiveness of low permeance materials, insulation strategies, cladding attachments and curtain-wall components to enhance thermal performance.
Building Smart with Basements and Parkades	Entry	BC Housing	Focuses on the design, construction, maintenance and remediation of basements and parkades in residential buildings. Topics include code requirements, soil condition assessments, building systems, remediation strategies, and depreciation reports.
Energy Efficiency – Large Residential Buildings	Entry	BC Housing	A series of five presentations to help understand Part 3 Building Code energy efficiency requirements for large residential buildings.
High Performance Wall Systems	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	This course is ideal for anyone seeking information on new best practices and practical assembly details for high performance wall systems. Graham Finch of RDH presents a variety of wall systems suitable for use in Net Zero and Passive Housing projects along with the science to explain "how" and "why."
Step Code 101 - Design Professionals and Builders	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	An introduction to the Step Code with a focus on the design principals. The class will cover strategies for success and include some cautionary tales of failure. The class will also touch on planned updates to the National Energy Code and how that will affect region’s that do not adopt Step Code. Instruction in this class will assume a high level of building knowledge but little to no exposure to Step Code

Course	Level	Provider	Description
The Building Envelope as a System – A Balanced Approach	Advanced	Morrison Hershfield	The webinar presents a methodology to use parametric analysis with whole building energy modelling to explore and understand the energy and carbon impacts of envelope options. The methodology and tools are straightforward and understandable by architects and owners and can enable designers to invest more wisely in their envelope.
Accelerating Toward Net Zero Energy Ready with Durable Building Enclosures Session 1 and 2	Advanced	Morrison Hershfield	Two-part webinar that focuses on the building enclosure requirements of Net Zero Energy Ready commercial buildings and also applicable to MURBs, emphasis on BC ESC & Passive House.
Energy Efficient Wood Curtain Walls	Advanced	WoodWorks	This session presents the advances in HEE glazed façade complying to the most stringent energy codes in the world. It provides an understanding of Façade System Design Flexibility by combination of various materials (aluminum, steel and timber). It also highlights the advantages of integrating a certified Passivhaus façade in the design of Carbon Neutral & Net Zero Buildings.
120A: Passive House Design and Construction - Vancouver	Advanced	Passive House Canada	Four-day course that covers the technical, economic and policy elements of Passive House buildings. Participants will learn how to apply Passive House principles in the context of building physics, windows and mechanical system
110: Introduction to Passive House High Performance Buildings	Advanced	Passive House Canada	An Introduction to the Passive House High Performance Buildings. This course provides an overview of the core principles of Passive House design and building energy efficiency regulations in Canada. The course also covers the history of energy efficient buildings, energy consumption data and environmental impact, case studies and the economics of creating high performance buildings.
Zero Net Energy Buildings	Advanced	Heatsprings	Master a comprehensive understanding of all of the key components of a zero net energy building—envelope, systems, and renewable energy sources—and how they fit together to confidently create your own designs.
Passive House Design	Advanced	Heatsprings	This course moves beyond theory into the realm of practical application and hands-on learning. At the end of the course, participants are asked to design a home using a simplified adaptation of the Passive House Planning Package (PHPP) to meet the most challenging design criteria: Passive House Space Heating and Primary Energy requirements.

Engineers

Course	Level	Provider	Description
Effective Thermal Performance of the Building Enclosure	Entry	Cascadia Windows and Doors	Current wall assemblies closest to the ESC target performance levels, key differences, strengths and limits for difference thermally improved cladding support products.
Navigating Emerging Building Energy Performance Standards (BEPS)	Entry	Cascadia Windows and Doors	Review of the BC Step Code & the Seattle Energy Code-2018, 'building envelope first approach comprehensive and integrated approach to envelope and fenestration energy performance
CESA 7100 - Energy Modelling for Building Professionals	Entry	BCIT	Reviews the principles, procedures and benefits of energy modelling to enable building professionals to usefully and efficiently incorporate energy modelling into the design process
Graduate Certificate in Building Energy Modelling	Entry	BCIT	Develop an understanding of the physical principles underlying building performance, and using these principles to systematically guide the synthesis, analysis, and interpretation of building energy models for optimized building life-cycle performance
CESA 5620 - Commissioning and Optimization	Entry	BCIT	Creating an optimized control system with more complex control strategies
Building Smart: Designing Building Enclosures in Wood-Frame Multi-Unit Construction	Entry	BC Housing	Includes best practices for designing efficient, durable wood-frame building enclosures in new construction
Building Smart: Key Considerations for High Performance Walls	Entry	BC Housing	Provides understanding of how high-rise residential buildings can meet the next generation of net-zero, or net-zero ready standards that are applicable to all climate zones in Canada.
Building Smart with Insulating Walls and Roofs	Entry	BC Housing	Overview on insulating wood frame buildings

Course	Level	Provider	Description
Building Smart with Airtightness Testing: Building Preparation	Entry	BC Housing	Overview on airtightness testing to meet BC Building Codes.
Building Smart by Mitigating Thermal Bridging	Entry	BC Housing	Overview on tools to adapt to energy-efficiency requirements and transform to net-zero buildings.
Bringing Passive House into the Cold	Entry	WoodWorks	Topics include: Wood Truss Passive House Envelope, HVAC Design concept in Passive House, Challenges and opportunities for workshop to be Passive House Certified, How to achieve good air tightness
Building Enclosures for 5 & 6 Story Mid-Rise Wood Buildings	Entry	WoodWorks	This 2-hour presentation will cover lessons learned and many of the recent trends in materials, details, and enclosure assemblies for creating durable and energy-efficient mid-rise wood frame buildings. The integration of mass timber elements including cross laminated timber (CLT) and use of pre-fabrication for mid-rise and taller wood-buildings will also be covered.
Energy Efficient Wood Curtain Walls	Entry	WoodWorks	This session presents the advances in HEE glazed façade complying to the most stringent energy codes in the world. It provides an understanding of Façade System Design Flexibility by combination of various materials (aluminium, steel and timber). It also highlights the advantages of integrating a certified Passivhaus façade in the design of Carbon Neutral & Net Zero Buildings.
Building Smart with Air and Vapour Barriers	Entry	BC Housing	Discusses building science principles, design considerations and practical installation details related to the use of air and vapour barriers in single and multi-unit residential buildings. Includes challenges and options for improving the durability, safety, comfort and energy efficiency of buildings through the effective use of barrier materials.
Mitigating Thermal Bridging	Entry	BC Housing	Introduces the Building Envelope Thermal Bridging Guide, a tool to help calculate and mitigate heat loss due to thermal bridging.
The Building Envelope as a System – A Balanced Approach	Entry	Morison & Hershefield	The webinar presents a methodology to use parametric analysis with whole building energy modelling to explore and understand the energy and carbon impacts of envelope options. The methodology and tools are straightforward and understandable by architects and owners and can enable designers to invest more wisely in their envelope.
Building Smart for High Performance Buildings - 2020 Half-Day Workshop	Entry	BC Housing	Focuses on research results, case studies, as well as successful design and construction practices. Provides insight on government initiatives to support more efficient, functional and resilient buildings. Includes issues such as cost effective and energy efficient homes, indoor air quality and thermal comfort, building envelope systems, window and roof installation
Building Smart with High Performance Building Design	Entry	BC Housing	Focuses on innovation and building design considerations required for single and multi-unit buildings. Explores concepts and design rules to achieve higher standards for livability, high-performance sustainability, and durability of assemblies. Topics include: wall, roof and attic performance, prefab assemblies, tall mass timber buildings, lighting and thermal comfort.

Course	Level	Provider	Description
Building Smart with High Performance Concrete Envelopes	Entry	BC Housing	Discusses how concrete envelopes can help deliver results, as well as some of the most effective ways to meet the new BC Energy Step Code standards. Topics include precast concrete, sandwich concrete walls, insulating concrete forms, and cast-in-place concrete.
Fiberglass: Simple & Cost-Effective Solutions to Stringent Energy Code Requirements	Advanced	Cascadia Windows and Doors	new fiberglass window technology which brings passive-house level thermal performance to a commercial-scale, cost effective fenestration system.
200: Building Enclosures for High Performance Buildings - Vancouver	Advanced	Passive House Canada	Provides an in-depth discussion of high-performance building enclosures for North American buildings, including single-family homes and large commercial buildings, with a focus on walls, roofs and window systems.
110: Introduction to Passive House High Performance Buildings	Advanced	Passive House Canada	An Introduction to the Passive House High Performance Buildings provides an overview of the core principles of Passive House design and building energy efficiency regulations in Canada. The course also covers the history of energy efficient buildings, energy consumption data and environmental impact, case studies and the economics of creating high performance buildings.
Accelerating Toward Net Zero Energy Ready with Durable Building Enclosures Session 1 and 2	Advanced	Morrison Hershfield	Two-part webinar that focuses on the building enclosure requirements of Net Zero Energy Ready commercial buildings and also applicable to MURBs, emphasis on BC ESC & Passive House.
Zero Net Energy Buildings	Advanced	Heatsprings	Master a comprehensive understanding of all of the key components of a zero net energy building—envelope, systems, and renewable energy sources—and how they fit together to confidently create your own designs.
Passive House Design	Advanced	Heatsprings	This course moves beyond theory into the realm of practical application and hands-on learning. At the end of the course, participants are asked to design a home using a simplified adaptation of the Passive House Planning Package (PHPP) to meet the most challenging design criteria: Passive House Space Heating and Primary Energy requirements.

Home Designers

Course	Level	Provider	Description
Fiberglass: Simple & Cost-Effective Solutions to Stringent Energy Code Requirements	Entry	Cascadia Windows and Doors	Presents new fiberglass window technology which brings passive-house level thermal performance to a commercial-scale, cost effective fenestration system.
Effective Thermal Performance of the Building Enclosure - Exterior Walls	Entry	Cascadia Windows and Doors	Reviews current wall assemblies closest to the ESC target performance levels, key differences, strengths and limits for difference thermally improved cladding support products.
Navigating Emerging Building Energy Performance Standards (BEPS)	Entry	Cascadia Windows and Doors	Review of the BC Step Code & the Seattle Energy Code-2018, 'building envelope first approach comprehensive and integrated approach to envelope and fenestration energy performance.
Building Smart: Designing Building Enclosures in Wood-Frame Multi-Unit Construction	Entry	BC Housing	Includes best practices for designing efficient, durable wood-frame building enclosures in new construction
Building Smart with 2018 BC Building Code Changes	Entry	BC Housing	Overview on changes to Part 9 of the BC Building Code that came into effect on December 10, 2018.
Building Smart by Mitigating Thermal Bridging	Entry	BC Housing	Overview on tools to adapt to energy-efficiency requirements and transform to net-zero buildings.
CESA 1505 Zero Energy Buildings All-in-1	Entry	BCIT	Develop understanding of BCESC, airtight design and construction, execution of high-performance assembly details, and mechanical systems for Part 9. (Equivalent to CESA 1001, CESA 1110, CESA 1120 and CESA 1140 combined)

Course	Level	Provider	Description
Bringing Passive House into the Cold	Entry	WoodWorks	Wood Truss Passive House Envelope, HVAC Design concept in Passive House, Challenges and opportunities for workshop to be Passive House Certified, how to achieve good air tightness.
Building Enclosures for 5 & 6 Story Mid-Rise Wood Buildings	Entry	WoodWorks	A 2-hour presentation that covers lessons learned and many of the recent trends in materials, details and enclosure assemblies for creating durable and energy-efficient mid-rise wood frame buildings. The integration of mass timber elements including cross laminated timber (CLT) and use of pre-fabrication for mid-rise and taller wood-buildings will also be covered.
Building Smart for High Performance Buildings - 2020 Half-Day Workshop	Entry	BC Housing	Focuses on research results, case studies, as well as successful design and construction practices. Provides insight on government initiatives to support more efficient, functional and resilient buildings. Includes issues such as cost effective and energy efficient homes, indoor air quality and thermal comfort, building envelope systems, window and roof installation
Building Smart with High Performance Building Design	Entry	BC Housing	Focuses on innovation and building design considerations required for single and multi-unit buildings. Explores concepts and design rules to achieve higher standards for livability, high-performance sustainability, and durability of assemblies. Topics include: wall, roof and attic performance, prefab assemblies, tall mass timber buildings, lighting and thermal comfort.
Building Smart with Safe and Durable Wall Assemblies	Entry	BC Housing	Focuses on thermal and moisture performance of highly insulated wall assemblies for new and retrofit buildings. Explores the use and effectiveness of low permeance materials, insulation strategies, cladding attachments and curtain-wall components to enhance thermal performance.
Building Smart with Basements and Parkades	Entry	BC Housing	Focuses on the design, construction, maintenance and remediation of basements and parkades in residential buildings. Topics include code requirements, soil condition assessments, building systems, remediation strategies, and depreciation reports.
A Fully Exterior Insulated House: An Illustrated Case Study with a Practical Perspective	Entry	Homebuilders Association Vancouver HAVAN	Step-by-step installation sequencing of exterior insulated foundation walls and slab, exterior insulated above grade walls, exterior insulated sloped roof, and exterior insulated flat roofs.

Course	Level	Provider	Description
A Holistic Approach Towards Improving Air Tightness	Entry	HAVAN	Supported by 30 mobile building envelope assemblies, the course will showcase various methods of improving air tightness of wood, concrete, and steel-framed buildings. Furthermore, it demonstrates how the presented methods will have an impact on moisture management, energy efficiency, and thermal comfort. In addition, all presented air barrier methods will be explored and reviewed in relation to long-term durability, adaptability to future repair and renovation.
ENERGY STAR® for New Homes: Builder Workshops	Entry	Community Energy Association	Provides everything builders need to know to get certified and build to EnerGuide and ENERGY STAR for New Homes. Also, covers how to work with an Energy Advisor and how to prepare for the Energy Step Code.
HRV/ERV Installation & Balancing Fundamentals	Entry	HRAI	Participants will receive the skills and knowledge to balance the airflows of Heat and Energy Recovery Ventilators (HRV/ERVs). They will also have an overview of the installation and measurement requirements. An HRAI checklist for installation and servicing of HRVs and ventilation systems will be made available, for use when on the job.
Residential Heat Loss & Heat Gain Calculations	Entry	HRAI	Students learn to accurately calculate room by room heat loss and gain while considering the influences of occupancy, exposure, ventilation, air leakage across the building envelope and more.
Residential Commissioning	Entry	HRAI	Through commissioning and start-up, a person can ensure the proper performance of the installed HVAC system as designed. This course will be invaluable to those installing, servicing and commissioning new or existing residential HVAC systems.
Building High Efficiency Homes	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	Presents recent changes to code and both the challenges and benefits that they bring, discusses efficiency science topics such as airtightness, heat transfer, and airflow, and addresses common concerns that arise from these discussions.
High Performance Wall Systems	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	This course is ideal for anyone seeking information on new best practices and practical assembly details for high performance wall systems. Graham Finch of RDH presents a variety of wall systems suitable for use in Net Zero and Passive Housing projects along with the science to explain "how" and "why."

Course	Level	Provider	Description
Leveraging Step Code to Right Mechanical Systems	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	A detailed look at how builders and design professionals can use the Step Code to improve the mechanical systems of their homes. This class will cover comfort improvements, lowering costs and reducing long term maintenance and call backs. We will also review available rebates and other incentives.
Step Code 101 - Design Professionals and Builders	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	An introduction to the Step Code with a focus on the design principals. The class will cover strategies for success and include some cautionary tales of failure. The class will also touch on planned updates to the National Energy Code and how that will affect region's that do not adopt Step Code. Instruction in this class will assume a high level of building knowledge but little to no exposure to Step Code.
The Building Envelope as a System – A Balanced Approach	Entry	Morrison Hershfield	The webinar presents a methodology to use parametric analysis with whole building energy modelling to explore and understand the energy and carbon impacts of envelope options. The methodology and tools are straightforward and understandable by architects and owners and can enable designers to invest more wisely in their envelope.
Accelerating Toward Net Zero Energy Ready with Durable Building Enclosures	Advanced	Owens Corning	Focus on the building enclosure requirements of a Net Zero Energy Ready commercial buildings, emphasis on BC ESC & Passive House.
200: Building Enclosures for High Performance Buildings - Vancouver	Advanced	Passive House Canada	Provides an in-depth discussion of high-performance building enclosures for North American buildings, including single-family homes and large commercial buildings, with a focus on walls, roofs and window systems.
Energy Efficient Wood Curtain Walls	Advanced	WoodWorks	This session presents the advances in HEE glazed façade complying to the most stringent energy codes in the world. It provides an understanding of Façade System Design Flexibility by combination of various materials (aluminium, steel and timber). It also highlights the advantages of integrating a certified Passivhaus façade in the design of Carbon Neutral & Net Zero Buildings.

Course	Level	Provider	Description
Zero Net Energy Buildings	Advanced	Heatsprings	Master a comprehensive understanding of all of the key components of a zero net energy building—envelope, systems, and renewable energy sources—and how they fit together to confidently create your own designs.
Passive House Design	Advanced	Heatsprings	This course moves beyond theory into the realm of practical application and hands-on learning. At the end of the course, participants are asked to design a home using a simplified adaptation of the Passive House Planning Package (PHPP) to meet the most challenging design criteria: Passive House Space Heating and Primary Energy requirements.

Energy Modellers and Advisors

Course	Level	Provider	Description
CESA 7100 - Energy Modelling for Building Professionals	Entry	BCIT	Reviews the principles, procedures and benefits of energy modelling to enable building professionals to usefully and efficiently incorporate energy modelling into the design process
Graduate Certificate in Building Energy Modelling	Entry	BCIT	Develop an understanding of the physical principles underlying building performance, and using these principles to systematically guide the synthesis, analysis, and interpretation of building energy models for optimized building life-cycle performance
Building Smart with Airtightness Testing: Building Preparation	Entry	BC Housing	Overview on airtightness testing to meet BC Building Codes.
Building Smart with 2018 BC Building Code Changes	Entry	BC Housing	Overview on changes to Part 9 of the BC Building Code that came into effect on December 10, 2018.
Building Smart by Mitigating Thermal Bridging	Entry	BC Housing	Overview on tools to adapt to energy-efficiency requirements and transform to net-zero buildings.
Energy Advisor Training - Stage 1	Entry	CHBA	Training for Energy Advisers. Note: Pre-requisite course: Building Science for New Homes
BC Energy Step Code For Builders and Energy Advisors - Energy Advisors Edition	Entry	CHBA	Provides knowledge to work with builders in building compliant part 9 new homes
Energy Modeling in eQuest	Entry	Heatsprings	This is a comprehensive commercial energy modeling course for you to master eQUEST, the free "Quick Energy Simulation Tool" developed by the U.S. Department of Energy and other industry leaders.
Building Better with the Energy Step Code	Entry	Community Energy Association	The full-day workshops are an extension of BC Housing's Building Smart with the Energy Step Code seminars and also include a hands-on component. Building Better workshops will serve communities where Building Smart workshops are not easily accessible due to travel distance, but where CEA has established local government networks and in areas with a high volume of building permits and demand for additional builder training.

Course	Level	Provider	Description
A Holistic Approach Towards Improving Air Tightness	Entry	HAVAN	Supported by 30 mobile building envelope assemblies, the course will showcase various methods of improving air tightness of wood, concrete, and steel-framed buildings. Furthermore, it demonstrates how the presented methods will have an impact on moisture management, energy efficiency, and thermal comfort. In addition, all presented air barrier methods will be explored and reviewed in relation to long-term durability, adaptability to future repair and renovation.
HRV/ERV Installation & Balancing Fundamentals	Entry	HRAI	Participants will receive the skills and knowledge to balance the airflows of Heat and Energy Recovery Ventilators (HRV/ERVs). They will also have an overview of the installation and measurement requirements. An HRAI checklist for installation and servicing of HRVs and ventilation systems will be made available, for use when on the job.
The Building Envelope as a System – A Balanced Approach	Entry	Morrison Hershfield	The webinar presents a methodology to use parametric analysis with whole building energy modelling to explore and understand the energy and carbon impacts of envelope options. The methodology and tools are straightforward and understandable by architects and owners and can enable designers to invest more wisely in their envelope.

Builders and Trades

Course	Level	Provider	Description
British Columbia Session 1 & 2 – Accelerating Toward Net Zero Energy Ready With Durable Building Enclosures	Entry/ Advanced	Morrison Hershfield	The session will be capped off with a review of strategies that have and have not worked in low TEDI (Thermal Energy Design Intensity) buildings to date. It will also place an emphasis on BC Step Code and Passive House in the BC market.
Windows and Details	Entry	BuildingItRight	High level building science explanations of the requirements for successful building enclosure design and construction focusing on windows and door installations.
Walls of Tomorrow, Today	Entry	BuildingItRight	Hands-On Training for Energy Step Code 4 and Beyond
Building the House of Tomorrow	Entry	BuildingItRight	10 courses full education series describing every step of the design and construction of a Net Zero home, off-grid and embracing some of the technologies that will become the new normal in the construction of residential homes.
Building Better with Energy Step Code	Entry	Community Energy Association	Provide builders with an introduction to the BC Energy Step Code with a focus on how to build to the lower steps.
BLDC 3050 and 3060 Building Envelope Performance and Lab	Entry	BCIT	The role of climate and the theory of heat flow, vapour flow, air flow, and the application of each principle to the evaluation of building envelope assemblies.
CESA 1501 - Passive House Tradesperson – Envelope Specialization	Entry	BCIT	Comprehensive study of residential Passive House
ZEB Courses on the Road	Entry	ZebX	Knowledge and skills to build to the BC Energy Step Code (airtight, thermal bridge free, super insulated assemblies) and Passive House standard.
200: Building Enclosures for High Performance Buildings - Vancouver	Entry	Passive House Canada	Provides an in-depth discussion of high-performance building enclosures for North American buildings, including single-family homes and large commercial buildings, with a focus on walls, roofs and window systems.

Course	Level	Provider	Description
Building Enclosures for 5 & 6 Storey Mid-Rise Wood Buildings	Entry	WoodWorks	2-hour presentation offers lessons learned and many of the recent trends in materials, details, and enclosure assemblies for creating durable and energy-efficient mid-rise wood frame buildings. The integration of mass timber elements including cross laminated timber (CLT) and use of pre-fabrication for mid-rise and taller wood-buildings is also covered.
Forced Air Guidelines	Entry	TECA	The course covers requirements for furnaces, A/C coils, and heat pumps including a new appliance selection sheet for variable capacity Heat Pumps without auxiliary heat. Duct layout & sizing to selected equipment capacity for standard and low-pressure systems.
Heat Recovery Ventilator Design & Installation	Entry	TECA	Includes instruction and examples for applying two of the four acceptable ventilation systems described in the BC Building Code: HRV with dedicated ventilation ductwork, and HRV integrated with a forced-air heating system.
Hydronic Systems Design	Entry	TECA	The course trains those working with hot water heating to properly design a residential hot water heating system to meet the guidelines established by the Residential Hot Water Heating Association of BC.
Principles of Moving Air (POMA)	Entry	TECA	Provides those designing or installing duct systems the ability to create quiet, efficient systems which deliver the required volumes while using the least fan energy. Furnaces, heat pumps and ventilation systems require larger volumes of air to be moved. Duct fitting shape, the number of fittings, air filters, coils all contribute to reduced flow in ductwork.
Ventilation Guidelines	Entry	TECA	TECA's Quality First™ Ventilation Guidelines course covers the latest (December 2018) requirements of BC Building Code Section 9.32 Mechanical Ventilation. The 4 acceptable methods to provide for the intake and distribution of the "Principal" air, The requirements for make-up air for large kitchen exhaust appliances and the code acceptable alternatives, The requirements for crawlspace ventilation. The requirements for the insulation of ventilation ducts and this course.
BC Energy Step Code For Builders and Energy Advisors - Builders Edition	Entry	CHBA	Provides knowledge to build compliant part 9 new homes.
A Fully Exterior Insulated House: An Illustrated Case Study with a Practical Perspective	Entry	Homebuilders Association Vancouver HAVAN	Step-by-step installation sequencing of exterior insulated foundation walls and slab, exterior insulated above grade walls, exterior insulated sloped roof, and exterior insulated flat roofs.

Course	Level	Provider	Description
Building Better with the Energy Step Code	Entry	Community Energy Association	The full-day workshops are an extension of BC Housing's Building Smart with the Energy Step Code seminars and also include a hands-on component. Building Better workshops will serve communities where Building Smart workshops are not easily accessible due to travel distance, but where CEA has established local government networks and in areas with a high volume of building permits and demand for additional builder training.
A Holistic Approach Towards Improving Air Tightness	Entry	HAVAN	Supported by 30 mobile building envelope assemblies, the course will showcase various methods of improving air tightness of wood, concrete, and steel-framed buildings. It demonstrates how the presented methods will have an impact on moisture management, energy efficiency, and thermal comfort. In addition, all presented air barrier methods will be explored and reviewed in relation to long-term durability, adaptability to future repair and renovation.
HRV/ERV Installation & Balancing Fundamentals	Entry	HRAI	Participants will receive the skills and knowledge to balance the airflows of Heat and Energy Recovery Ventilators (HRV/ERVs). They will also have an overview of the installation and measurement requirements. An HRAI checklist for installation and servicing of HRVs and ventilation systems will be made available, for use when on the job.
High Performance Wall Systems	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	This course is ideal for anyone seeking information on new best practices and practical assembly details for high performance wall systems. Graham Finch of RDH presents a variety of wall systems suitable for use in Net Zero and Passive Housing projects along with the science to explain "how" and "why."
Leveraging Step Code to Right Mechanical Systems	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	A detailed look at how builders and design professionals can use the Step Code to improve the mechanical systems of their homes. This class will cover comfort improvements, lowering costs and reducing long term maintenance and call backs. We will also review available rebates and other incentives.
Step Code 101 - Design Professionals and Builders	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	An introduction to the Step Code with a focus on the design principals. The class will cover strategies for success and include some cautionary tales of failure. The class will also touch on planned updates to the National Energy Code and how that will affect region's that do not adopt Step Code. Instruction in this class will assume a high level of building knowledge but little to no exposure to Step Code.

Course	Level	Provider	Description
Building Code for Residential Builders	Entry	ICBA	Participants learn how to read, interpret and use the BC Building Code (2018). The course is specifically targeted for constructors of small buildings and residential construction in order to allow them to discuss with confidence issues brought up by inspectors, plan checkers and/or consultants.
Framed Walls: Insulation, Humidity, and Risk	Entry	Morrison Hershfield	Learn how hygrothermal analysis can be applied to design limits that will aid designers and decision making on projects and the key findings from the assemblies that have been tested for several Canadian climates.
Mitigating Thermal Bridging Through The Building Envelope	Entry	Morrison Hershfield	What thermal bridging mitigation strategies are you using to improve thermal performance? Learn a comprehensive approach to assessing thermal performance that will allow designers to better understand thermal bridging concepts. Primarily for designers but could work for trades.
Drainage Capabilities and Heat Loss of Different Inverted Roof Assemblies	Entry	Morrison Hershfield	This presentation explores the effect of cold water under the roof insulation and its impact on the effective thermal performance in inverted roofs.
Energy and Air Barriers – Navigating the New Codes	Entry	Morrison Hershfield	Theory and historical progression of air tightness requirements and understand the metrics that provide the baseline for levels of air tightness.
Roof System Design and Installation	Entry	BC Housing	Focuses on roof system design, installation best practices and Building Code requirements for wood-frame single-family and multi-unit residential buildings.
Best Practices for Window Installation	Entry	BC Housing	Focuses on window design, installation best practices and Building Code requirements for wood-frame single and multi-unit residential buildings.
The 10 Foot Wall Challenge	Advanced	BuildingItRight	Cladding, Insulation (XPS or rigid mineral fibre), Capillary Break, Flashings, Sealants, Sheathing Membrane, Air Barrier, Vapour Barrier, & Drywall finish for walls for Net Zero Homes
CESA 1505 Zero Energy Buildings All-in-1	Advanced	BCIT	Comprehensive course on Part 9 residential Zero Energy Buildings (ZEB's). Students will develop an applied understanding of the BC Energy Step Code, building science in ZEBs, airtight design and construction, execution of high-performance assembly details, and mechanical systems for residential ZEB’s.
Air Barriers for Professionals	Advanced	NAIMA	Air Barriers for Professionals is practically oriented information for residential construction workers and renovators who deal with air tightness, insulation and various control barriers to improve the energy efficiency of homes.
Insulation and Air Sealing Training	Advanced	NAIMA	Background knowledge and skills required to install common residential insulation products in a safe and effective manner based on the most up to date building science principles behind the Building Codes in participating provinces.

Course	Level	Provider	Description
CESA 0178 – Introduction to Solar Thermal Energy	Advanced	BCIT	Introduces solar water heating technology and its common applications. Participants will be taught installation basics, and what decisions can help effectively implement common systems in today's solar technology market.
150 - Passive House for Canada Trades Course	Advanced	Passive House	This three-day course teaches practical Passive House building techniques alongside theory and prepares participants for the Certified Passive House Tradesperson exam. Construction process and quality assurance. Thermal insulation.
Phius Certified Passive House Builder Training	Advanced	RDH Building Science	Superinsulation, airtight envelopes, high-performance window installation, site management, component sourcing—passive house construction presents special challenges to builders. The PHIUS CPHB training program prepares construction professionals to meet the passive house challenge.
Zehnder Academy	Advanced	Zehnder	A range of e-learning resources related to the installation of Zehnder heat and energy recovery ventilation in high-performance buildings equipment.
Implications for Building Envelope Design on the path toward Net Zero	Advanced	Morrison Hershfield	Review how changing energy requirements impact envelope design. Discover new design guides and tools that can help achieve your project's building envelope performance.
Step Code 101 - Design Professionals and Builders	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	An introduction to the Step Code with a focus on the design principals. The class will cover strategies for success and include some cautionary tales of failure. The class will also touch on planned updates to the National Energy Code and how that will affect region's that do not adopt Step Code. Instruction in this class will assume a high level of building knowledge but little to no exposure to Step Code.
Step Code Voluntary Approach City of Kamloops	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	This course contains a trio of presentations pertaining to the use and voluntary implementation of Step Code in Kamloops. Participants will hear a Chief Building Inspector, a Community Energy Specialist, and a Fortis Energy Solutions Manager give their impressions of the voluntary incentive program that Kamloops has instituted and discuss why builders should be adopting Step Code practices earlier than the upcoming mandatory deadlines.

Building Officials & Planners

Course	Level	Provider	Description
Building Better with the Energy Step Code	Entry	Community Energy Association	The full-day workshops are an extension of BC Housing's Building Smart with the Energy Step Code seminars and also include a hands-on component. Building Better workshops will serve communities where Building Smart workshops are not easily accessible due to travel distance, but where CEA has established local government networks and in areas with a high volume of building permits and demand for additional builder training.
Building A Legacy	Entry	Community Energy Association	When the BC Energy Step Code was introduced in 2017, CEA addressed an identified knowledge gap in the East Kootenay region of BC by developing the 'Building a Legacy' program. Responding to feedback from key industry stakeholders, the program has supported the transition of the East Kootenay building industry to implement the BC Energy Step Code and the performance pathway approach to achieving Building Code standards.
ENERGY STAR® for New Homes: Builder Workshops	Entry	Community Energy Association	Provides everything builders need to know to get certified and build to EnerGuide and ENERGY STAR for New Homes. Also, this course covers how to work with an Energy Advisor and how to prepare for the Energy Step Code.
Building Officials Guide to Understanding HVAC Building Code Requirements	Entry	HRAI	This 7-hour course has been specifically designed for building officials. HRAI has put together a curriculum that outlines the building science related to ventilation and air change design (ducts); ventilation requirements, changes with the new CSA F280-12, CAN/CSA-F326, and a review of key requirements for heating and air-conditioning systems.
Step Code 101 - Design Professionals and Builders	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	An introduction to the Step Code with a focus on the design principals. The class will cover strategies for success and include some cautionary tales of failure. The class will also touch on planned updates to the National Energy Code and how that will affect region's that do not adopt Step Code. Instruction in this class will assume a high level of building knowledge but little to no exposure to Step Code.

Course	Level	Provider	Description
Step Code Voluntary Approach City of Kamloops	Entry	Canadian Home Builders' Association Central Interior (CHBACI)	This course contains a trio of presentations pertaining to the use and voluntary implementation of Step Code in Kamloops. You will hear a Chief Building Inspector, a Community Energy Specialist, and a Fortis Energy Solutions Manager give their impressions of the voluntary incentive program that Kamloops has instituted and discuss why you should be adopting Step Code practices earlier than the upcoming mandatory deadlines.
A Holistic Approach to Roofs and Below-Grade Assemblies for Thermal Performance, Air Tightness and Moisture Management	Entry	Community Energy Association	A hands-on workshop provides a holistic perspective of the overall performance of the building envelope when it comes to roofs and below grade wall assemblies. Supported by a wide range of mobile building envelope assemblies, the workshop will showcase various methods of improving thermal performance, air tightness, and moisture management, ranging from those that meet the minimum Building Code requirements, to those that offer superior performance beyond the Code.
120B: Understanding and Working with the Passive House Planning Package	Advanced	Passive House Canada	Participants learns the structure, inputs and outputs of PHPP, and how to select appropriate climate data sets and record building measurements. Includes modelling a sample Canadian project, where participants will assess building heat loss, energy demand and summertime overheating risk, as well as looking at the reliability of data sources and how design decisions impact the building energy demand.
200: Building Enclosures for High Performance Buildings - Vancouver	Advanced	Passive House Canada	Provides an in-depth discussion of high-performance building enclosures for North American buildings, including single-family homes and large commercial buildings, with a focus on walls, roofs and window systems.
Zero Net Energy Buildings	Advanced	Heatsprings	Master a comprehensive understanding of all of the key components of a zero net energy building—envelope, systems, and renewable energy sources—and how they fit together to confidently create your own designs.

Appendix 6 - Capacity Frameworks

There are profession-specific competency frameworks available for the following key professions.

Key Profession	Title	Link
Energy Modellers (Part 9)	BC Energy Step Code (BCESC) Compliance Competency Framework for Energy Advisors and Energy Modellers of Part 9 Buildings VERSION 1.2, November 2020	https://energystepcode.ca/app/uploads/sites/257/2021/01/BCESC_Compliance_Competency_Framework-November2020_v1.2.pdf
Engineers and Energy Modellers (Part 3)	EGBC Joint Professional Practice Guidelines Whole Building Energy Modelling Services Version 1.0 August 15, 2018	https://www.egbc.ca/getmedia/8f8f0579-ca25-4cfd-a92c-e3c75900d1b6/EnergyModellingGuidelines_FINAL.pdf.aspx
Building Officials	BOABC BCESC–Competency Framework Outline	https://boabc.org/wp-content/uploads/2020/05/EFP-Competency-Framework.pdf

Appendix 7 - Key Professions by The Numbers

The following employment statistics and growth projections were retrieved from WorkBC.[25]

Professions	Corresponding NOC	BC Labour Market Outlook Growth Projection 2019-2024	BC Labour Market Outlook Growth Projection 2024-2029	Employment in 2019
Developers and project managers (Part 3)	0711 Construction managers	0.5	0.3	18,130
	0712 Home building and renovation managers.	0.2	0.1	11,100
Architects	2151 Architects	1.8	1.6	3,740
Engineers involved in construction of buildings, including mechanical, electrical, building envelope	2131 Civil engineers	1.5	1.2	9,030
(Home) Designers (i.e., Part 9 buildings not requiring an architect)	2252 Industrial designers	1.2	0.8	1,270
Estimators and Cost Consultants (CMs?)	2234 Construction estimators	0.5	0.3	3,380
Energy Advisors & Modellers - Part 9		No data as a limitation of NOC codes		
Energy Modellers - Part 3		No data as a limitation of NOC codes		
General contractors / CM (Part 3)	7205 - Contractors and supervisors, other construction trades, installers, repairers and servicers	0.4	0.2	8,710
Licensed residential builders (Part 9)		No data as a limitation of NOC codes		
Carpenters, Framers, AVM Barrier Installers & Envelope Trades (inc. steel stud and drywall)	7271 Carpenters	0.3	0.1	2,940

[25] WorkBC Explore Careers https://www.workbc.ca/jobs-careers/explore-careers.aspx

Professions	Corresponding NOC	BC Labour Market Outlook Growth Projection 2019-2024	BC Labour Market Outlook Growth Projection 2024-2029	Employment in 2019
Superintendents and coordinators	6733 Janitors, caretakers and building superintendents	1	1	25,050
Insulators	7293 Insulators	0.4	0.1	1,420
Electricians	7241 Electricians (except industrial and power system)	0.4	0.2	17,070
HVAC Installers/Mechanical Design and Installers	7313 Refrigeration and air conditioning mechanics	0.4	0.1	3,250
	7441 - Residential and commercial installers and servicers	0.5	0.2	9,070
Gas Fitters	7253 Gas Fitters	0.4	0.3	1,350
Plumbers	7251 Plumbers	0.3	0.2	11,180
Roofers	7291 Roofers and shinglers	0.7	0.5	3,790
Trades involved in foundation prep work		No data as a limitation of NOC codes		
Glazers, Window & Glass Door Installers	7441 Residential and commercial installers and servicers	0.5	0.2	9,070
	7292 Glaziers	0.4	0.2	2,650
Building officials	2264 Construction inspectors	0.8	0.8	2,580
Local Govt. Planning Department Staff &/or Sustainability Staff support Step Code	4161 Natural and applied science policy researchers, consultants and program officers	1.2	1	3,450