Building Our Future

CAGBC

A Low-Carbon Training Strategy for the Trades

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Disclaimer

The information, concepts and recommendations expressed in this document are based on information available at the time of the preparation of this document. This report contains findings from interviews and workshops as well as secondary research as part of a broader suite of project activities to support the *Building Our Future: A Low-Carbon Training Strategy for the Trades*. Action or abstinence from acting based on the opinions and information contained in this document are the sole risk of the reader and CAGBC shall have no liability for any damages or losses arising from use of the information and opinions in this document. All information is provided "as is" without any warranty or condition of any kind. The document may contain inaccuracies, omissions or typographical errors.

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This report summarizes findings gained through primary and secondary research conducted between February 2023 and October 2023. It builds on existing knowledge from thought leaders across British Columbia and Canada, and from direct consultations with over 100 stakeholders engaged through the study. Insights into the study methodology can be found in Annex A.

Project Funding Partners

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MORE SOLUTIONS, LESS CARBON.

1 Executive Summary

The construction sector is known for its significant contribution to carbon emissions, yet it will play a crucial role in addressing climate change by adopting low-carbon building practices and techniques.

British Columbia's construction industry is impacted by standards and regulatory changes that aim to reduce greenhouse gas (GHG) emissions and the trades need low-carbon skills training to meet the requirements. These low-carbon skills involve an understanding of the techniques, materials, and technologies that minimize the environmental impact of buildings while maximizing energy efficiency. As BC advances its climate ambitions, builders with these skills will be better equipped to construct energy-efficient buildings with lower GHG emissions.

Building Our Future: A Low-Carbon Training Strategy for the Trades is a workforce training approach designed for construction trades working on large buildings (Part 3) such as offices, residential towers, and institutional buildings.

The low-carbon training strategy for the trades includes:

- Priorities for low-carbon curriculum content development;
- Pathways for new and practicing tradespeople to gain accreditation and recognition of their low-carbon building skills; and,
- Recommendations for process improvements to facilitate growth in the number of low-carbon skilled trades professionals.

The decarbonization of buildings requires the involvement of many trades, but some are more closely linked to emission reduction activities. A framework was created to determine which trades are a priority for building decarbonization by identifying key steps and measures for low-carbon buildings, such as reducing energy consumption, switching to cleaner fuels or electrification, using renewable energy sources on-site, and utilizing low-carbon materials. This framework identified the specific trades needed to carry out this work.

Priority Trades

Trade		Building Attribute
1	Electrician (Construction)	• Reduce demand • Switch to cleaner fuels • Add on-site renewables
2	Refrigeration and Air Conditioning Mechanic	• Switch to cleaner fuels • Lower embodied carbon
3	Sheet Metal Worker	• Reduce demand • Switch to cleaner fuels • Add on-site renewables
4	Plumber	• Switch to cleaner fuels
5	Glazier	• Reduce demand
6	Carpenters	• Reduce demand • Lower embodied carbon
7	Insulators	• Reduce demand • Lower embodied carbon
8	Instrumentation and Control Technicians	• Reduce demand • Switch to cleaner fuels

Training perspectives

There has been some action in British Columbia to keep apprenticeship curriculum in line with regulatory changes addressing climate change. Modifying curriculum is lengthy process with many competing challenges, including pressure to not increase classroom time. While some training providers have incorporated green technology elements into their curriculum, apprenticeship programming is guided by occupational standards that have not necessarily been reviewed through a green building lens.

Remaining challenges include:

- The pathways for curriculum changes are lengthy and involved;
- Funding mechanisms reinforce a time-based learning approach rather than an outcome-based (or competency) approach;
- Finding qualified instructors is difficult especially where industry employment offerings are more compelling;
- Labour shortages are projected well into the future, increasing pressures on recruitment and retention rather than curriculum changes; and
- There are no requirements for continuing education for practicing journeypersons or Red Seal trades.

Currently, any adjustments to training have taken place in alignment with market opportunities and as voluntary continuous education offerings. For example, training providers for electricians have adapted their training to reflect commercial opportunities in electric-powered transportation and smart buildings. However, there are limited education opportunities for trades working in envelope performance, high-efficiency mechanical systems (such as heat pumps and Variable Refrigerant Flow (VRF) Systems), mass timber construction, and low-carbon materials. Finally, there is a lack of overall environmental literacy or adoption of a whole-building approach to trades training.

Findings

An important outcome of the report is the number of trade competencies needed to meet the demands of low-carbon new construction and renovations. They are summarized below and in the table on the following page.

Envelope performance

Walls, roofs, windows and doors

Relevant trades:

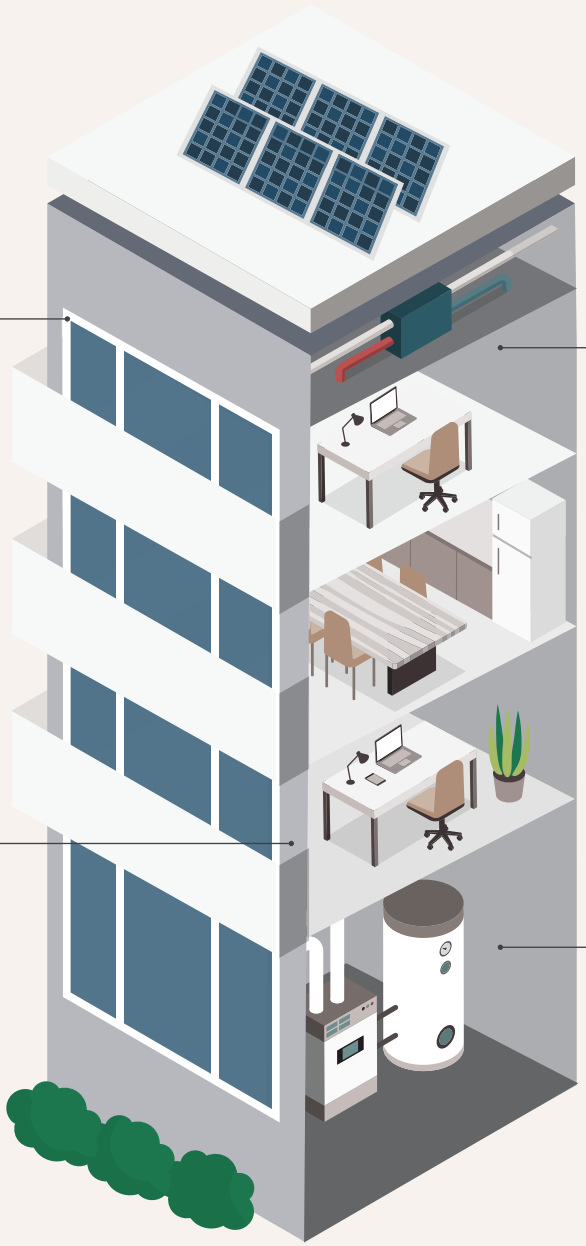
Carpenters, Sheet Metal Workers, Glaziers, Insulators, Electricians

Advanced electrical systems

- Lighting
- Plug loads and digitization

Relevant trades:

Electricians, Controls Technician



Mass timber construction

Low-carbon materials and construction innovation

Relevant trades:

Carpenters, Machinist, Riggers, BIM Modellers

High efficiency mechanical systems

- Space heating and cooling
- Ventilation
- Hot water heating

Relevant trades:

Plumbers, RAC Mechanics, Sheet Metal Workers, Controls Technicians, Electricians, BIM Modellers

Low-carbon materials

Materials and products

Environmental literacy

Whole-building approach

Relevant trades:

Insulators, Controls Technician, Glaziers, Plumbers, BIM Modellers, Controls Technicians, RAC Mechanics, Sheet Metal Workers, Controls Technicians, Electricians, Machinist, Riggers

Priority areas for trades training

Gap Rating indicating urgency to introduce training	Legend
Low Some progress has been made to address industry training gaps	
Medium Clear industry need to address skills gaps. Some industry and educator capacity available to deliver solutions today.	
High Clear industry need to address skills gaps. Limited industry and educator capacity available to deliver solutions today.	

Building Attribute		Competency	Relevant Trades	Gap Rating
General	Detail			
Advanced electrical systems	Lighting	• Knowledge of LED lighting systems, lamps and ballasts • Installation and configuration of control systems for lighting and mechanical systems	Electricians Control Technicians	
	Plug loads and digitization	• Peak demand and load management • Proficiency in working with Building Automation Systems • Expertise in handling Premium Efficiency Motors, EV Chargers, and Energy Storage		
Envelope performance	Walls, roofs, windows and doors	• Fundamentals for the evaluation, design, and construction of durable and energy-efficient building envelopes (enclosures) • Knowledge of the role of climate and the theory of heat flow, vapour flow, and air flow • Best practice assembly design and detailing fundamentals for above and below grade wall assemblies, roofs, and windows • Insulation and air barrier systems • Detailing approaches for air barrier systems, insulation methods, vapour barriers and cladding attachments • Application of thermal breaks to prevent heat transfer between two materials or components (e.g., balconies)	Carpenters Sheet Metal Workers Glaziers Insulators Electricians	
High efficiency mechanical systems	Space heating and cooling	• Knowledge of mechanical systems for low-load buildings • Familiarity with sizing considerations, installation methods, refrigerant handling, and troubleshooting techniques for heat pump systems (air, ground and water source) especially for retrofits • Understanding of system components, refrigerant piping layout, electrical requirements, and control settings for efficient installation of Variable Refrigerant Flow (VRF) Systems	Plumbers RAC Mechanics Sheet Metal Workers Controls Technicians Electricians BIM Modellers	
	Ventilation	• Installation requirements, including ductwork design, proper sealing, and electrical connections for Heat Recovery Ventilation (HRV) systems • Knowledge of demand-controlled ventilation (DCV) to provide fresh air and maintain indoor air quality based on the actual occupancy and pollutant levels		
	Hot water heating	• Installation and servicing of electric high efficiency domestic hot water systems and modulating burners. • Application of thermal batteries in heat pump water heater plants to store and release thermal energy efficiently		
Mass timber construction	Low-carbon materials and construction innovation	• Wood science (fire behavior, wet wood and seismic performance), • Knowledge of mass timber materials and construction techniques • Expertise in prefabrication techniques specific to mass timber components is essential. This involves knowledge of CNC machining, robotic assembly, integrated digital manufacturing processes, and quality control measures • Ability to read and interpret architectural plans, BIM Model specifications • Skilled use of hand and power tools for cutting, shaping, joining, and finishing wood components • Knowledge of proper lifting procedures, rigging techniques, sequencing strategies, and temporary bracing methods ensures safe and accurate installation	Carpenters Machinists Riggers BIM Modellers	
Materials and products	Materials and products	• Low-carbon product knowledge such as low-carbon concrete, wood fiber insulation etc. • Application of carbon accounting and Life Cycle Analysis (LCA), Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) • Knowledge of alternative refrigerants with low or zero Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) while ensuring their safety and efficiency in cooling systems	All trades	
Environmental literacy	Whole-building approach	• An awareness of how the trades scope of work can impact the environment and ways to minimize negative effects through energy-efficient design, waste reduction, and use of sustainable materials • A holistic approach to construction that acknowledges the interconnectedness of different trades' activities • Knowledge about local regulations related to environmental protection and compliance with green building standards	All trades	

Recommendations

Building Our Future considers the challenges and opportunities of the construction market alongside the urgency of climate crisis. It advances recommendations that include interventions at various stages in a tradesperson's career.

Recomendation	Details	Need
1. Create green building trades recruitment strategy	Develop and deliver a green construction marketing campaign to showcase the construction trades as a **climate action solution**; demonstrate **pathways for career growth**; and **increase the number of apprentices**. **Support anti-racism** and **gender-based sensitization training** for employers.	• Labour shortage • Outdated perception of the construction trades • Equity, Diversity, Inclusion and Reconciliation (EDIR)
2. Mobilize industry to meet new business paradigm	Strengthen market signals and create imperative for low-carbon training through changes to **procurement process**.	• Insufficient market demand
3. Enhance training pathways for in-demand occupations	Map pathways for existing tradespersons to complete **cross-training into new disciplines**. Assess market need and training pathways for new trades such as **BIM Modellers**.	• Specialized tradespersons to address market demand
4. Introduce green curriculum for apprenticeship programs	Continue to **evolve the apprenticeship training content** for priority trades by **leveraging training options** developed by national organizations. Ensure reviews of the Red Seal Occupational Standards (RSOS) and curriculum includes input from **low-carbon subject matter experts**.	• Limited low carbon training content for apprentices
5. Leverage continuing education for expanded skill development	**Leverage TradeUpBC to develop continuing education** opportunities that are accessible to multiple trades. Create **industry incentives** for **manufacturer training**. **Prioritize training development** opportunities based on identified skills gaps: peak load and demand management; high performance building envelops; advanced heat pump systems; mass timber manufacturing and installation; and embodied carbon materials and products.	• Limited low carbon training content for apprentices and journeypersons • Manufacturer training integration • Low carbon trades skills gaps

2

Introduction and context

Construction trades in British Columbia need training in low-carbon skills to adapt to changing industry standards and regulations aimed at reducing greenhouse gas (GHG) emissions.

Low-carbon skills involve using techniques, materials, technology, and solutions that minimize the environmental impact of buildings while maximizing energy efficiency. Builders with these skills are better equipped to construct energy-efficient buildings that produce fewer emissions.

There is also a growing market demand for sustainable construction practices paired with a complementary policy push. With these supports, builders that demonstrate expertise in low-carbon skills will be more competitive in the marketplace. They will also be able to meet evolving building codes that require greater energy efficiency and lower carbon footprints.

Building Our Future: A Low-Carbon Training Strategy for the Trades is a workforce training approach for construction trades that work on large buildings (Part 3), such as offices, residential towers and institutional buildings.

The strategy includes:

- Priorities for low-carbon curriculum content development;
- Pathways for new and practicing tradespeople to gain accreditation and recognition of low-carbon building skills; and,
- Recommendations for process improvements to facilitate growth in the number of low-carbon skilled trades professionals.

Low-carbon trades training strategy

In order to effectively train tradespeople in the construction industry, it is crucial to consider the main factors driving changes such as green building regulations, shortages of skilled labour, and increasing industrialization. The training strategies must be flexible enough to cater to the current market needs while also equipping workers with skills that will prepare them for future industry trends.

2.1 British Columbia action on climate change and buildings

British Columbia has been proactive in addressing climate change with various policies and initiatives aimed at reducing greenhouse gas emissions. These policies affect the construction trades that are responsible for building and renovating buildings that consume energy, products and materials.

CleanBC is a comprehensive plan that aims to reduce greenhouse gas emissions in British Columbia by 40 percent below 2007 levels by 2030. The policy includes measures such as electrification of transportation, promotion of renewable energy sources, and increased energy efficiency in buildings.

The BC Energy Step Code sets a series of performance targets for new buildings. The code requires builders to meet higher and more stringent energy efficiency standards than what is required by current building codes. Over time, the requirements for each step become more stringent, meaning that buildings must meet higher standards for energy efficiency to achieve each step. As of May 2023, Part 3 buildings must now meet Step 2 of the BC Energy Step Code for all new construction permit applications.[1] This is equivalent to 20% better energy efficiency and includes both most residential and commercial buildings. Step 3 of the BC Energy Step Code will become mandatory for Part 3 buildings starting in 2027 for new construction permit applications. These changes are part of a phased approach towards net-zero energy ready buildings by 2032 in British Columbia.[2]

The Zero Carbon Step Code builds on the BC Energy Step Code and requires newly constructed buildings to have net-zero carbon emissions. The Zero Carbon Step Code is a voluntary, provincial standard for reducing emissions in new buildings. Local governments reference the Zero Carbon Step Code in bylaws and programs to require or encourage lower carbon new construction in their communities. While an optional standard at this time, the Province intends to make operational carbon limits mandatory over time, with the ultimate objective for all new buildings to be zero carbon by 2032.

The Energy Efficiency Act sets minimum energy efficiency requirements for heating, ventilation, and air conditioning (HVAC) systems in commercial and institutional buildings. It is intended to encourage the adoption of more efficient HVAC equipment, which can significantly reduce building emissions. This standard is especially important as a driver of low-carbon retrofits in the Province.

2.2 Construction trades labour shortages

According to British Columbia's Labour Market Outlook, construction is the province's fourth-largest industry and employed 216,000 workers in 2021. Between 2022 and 2032, the construction industry will post 72,700 job openings, accounting for more than 7 percent of the total job openings in the province. According to a report by BuildForce Canada, British Columbia is expected to face a shortage of approximately 14,600 workers in the construction trades by 2028. This includes shortages in various trades such as carpenters, electricians, plumbers, and welders. Other trades that may experience shortages include heavy equipment operators, pipefitters and crane operators. The report also states that retirement will account for over half of these projected shortages.

There are several factors driving this labour shortage. A main cause is an aging workforce; many skilled tradespeople are approaching retirement age and there are not enough younger workers entering the industry to replace them. Overall, the construction trades are not attracting women, Indigenous peoples, and visible minorities relative to the population. For example, only 4.7 percent of the province's construction trades filled by women. Additionally, the booming economy in British Columbia as well as climate policy driving building retrofits, has led to increased demand for construction services, which has put additional strain on an already tight labour market.

In 2023 the Province of British Columbia responded to the need for skilled workers in construction trades through StrongerBC: A Future Ready Action Plan. The province will invest in training programs and apprenticeships to prepare individuals for careers in construction trades. This includes increased funding for technical education programs at secondary schools and post-secondary institutions as well as providing financial incentives for employers who hire apprentices.

[1] Local governments can choose to require or incentivize builders to meet higher steps of the BC Energy Step Code, as an alternative to the compliance paths set out in the base BC Building Code.

[2] The City of Vancouver is not subject to the BC Energy Step Code, as it has its own building code and zero emissions building plan. The Plan has four strategies to require the majority of new buildings to have no operational greenhouse gas emissions by 2025, and all new buildings to have no greenhouse gas emissions by 2030.

The Future Ready BC report also highlights the importance of promoting diversity within the construction industry by encouraging more women, Indigenous people, and other underrepresented groups to pursue careers in trades. To achieve this goal, the provincial government is working with community organizations and industry stakeholders to provide mentorship, advocacy, and support for individuals from diverse backgrounds.

The labour shortage in the construction trades and lack of diversity in British Columbia's workforce can significantly impact the province's ability to deliver on its climate goals. With a labour shortage in the construction trades, there is a limited pool of workers available to carry out critical projects such as low-carbon new construction or existing building retrofits. Moreover, the lack of diversity in the construction workforce may further exacerbate the problem by limiting access to skilled workers from diverse backgrounds who bring unique perspectives and experiences that can be particularly valuable when working on complex climate-related initiatives.

2.3 Industrialization of construction

One of the key drivers of change in the construction industry is technology. Over the past several years, there has been a significant shift towards digitalization, automation, and use of advanced materials and techniques. This trend is expected to continue in the future as firms seek ways to improve efficiency, reduce costs, and enhance safety on job sites. This shift towards more advanced technologies and processes is transforming the landscape for construction trades in several ways:

1. **Increased Automation:** With automation playing an increasingly important role in modern construction, traditional manual labour jobs are being replaced by automated machinery and robotics. This means that workers need to be trained in new skills such as programming, maintenance, and operation of these machines.
2. **Prefabrication:** The use of prefabricated building components and modular systems is also becoming more common in construction. This requires specialized knowledge and expertise to assemble these elements into larger structures efficiently.
3. **Digitization:** Digital tools like Building Information Modeling (BIM) are revolutionizing the design process and making it easier for architects, engineers, and contractors to collaborate on complex projects. Workers must be skilled in using these digital tools to remain competitive in the industry.

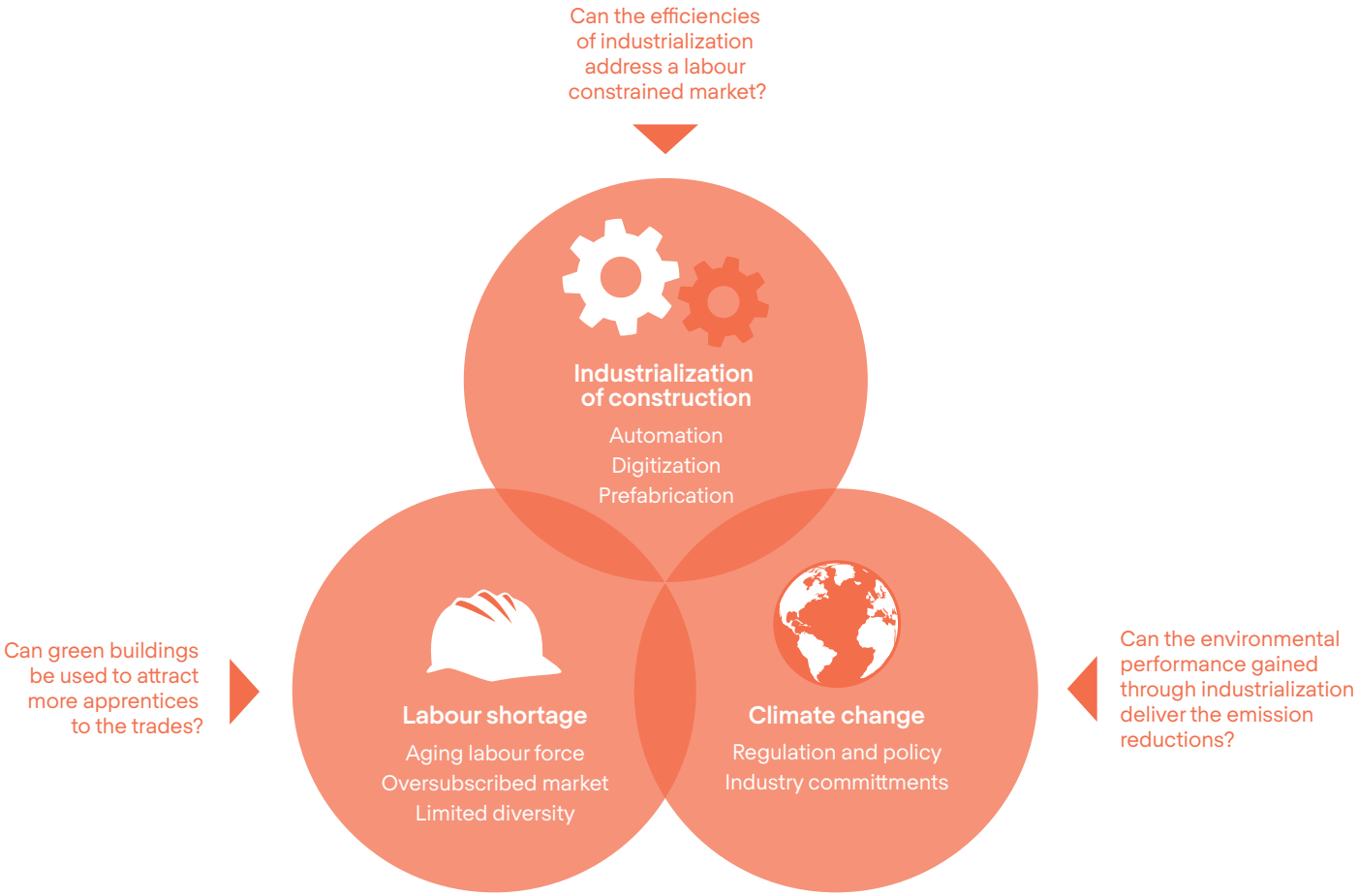
Mass timber buildings

British Columbia is known for its leadership in mass timber construction and has been at the forefront of advancing wood-based building systems. The Province has implemented a Wood First Act, which requires that provincially funded buildings use wood as the primary building material where possible.

Mass timber buildings are part of the industrialization of construction because they use prefabricated components that are manufactured in a factory and assembled on-site. Panels or beams made from engineered wood products like cross-laminated timber (CLT) or glued laminated timber (glulam) are cut to size and shape using computer-controlled machines in a factory setting. These components can be produced with high precision and quality control, resulting in reduced waste and improved efficiency compared to traditional stick-built construction methods.

Once these mass timber components are delivered to the construction site, they can be quickly assembled using cranes and other equipment. This results in faster construction times and lower labor costs compared to traditional building methods. Additionally, mass timber buildings have a smaller carbon footprint than conventional steel or concrete structures, making them more sustainable and environmentally friendly.

The construction industry has always been a major contributor to the economy of British Columbia. The industry is expected to continue growing in the coming years, fueled by population growth, infrastructure development, and demand for new homes. However, the future of construction trades in British Columbia will depend on several factors that are likely to shape the industry. *Building Our Future* recognizes the challenges and opportunities presented by these trends in construction and identified recommendations that are anchored in the realities of a climate conscious workforce, labour shortages and rapidly changing technology.



3
Low-carbon framework and priority trades

There are 66 trades that operate in British Columbia and support the construction and renovation of large buildings (SkilledTradesBC, 2023).

While all trades will play a role in the decarbonization of the Province's building stock, the scope of work for certain trades is more closely tied to building decarbonization. To discern the priority trades, a framework was developed to identify the critical pathways and associated measures for low-carbon buildings. This pathway was then used to identify the trades necessary to deliver the scope of work.

3.1 Low-carbon building framework

1. **Reduce demand:** Implement energy-efficient technologies and practices to reduce the amount of energy consumed by the building. Some examples of this include improving insulation and overall enclosure airtightness, upgrading lighting systems, installing occupancy sensors and timers, and optimizing HVAC systems.
2. **Replace fossil fuels:** Reduce fossil fuels like natural gas and replace with low-carbon alternatives. In British Columbia this is synonymous with the move to electrify all buildings to leverage hydro-electric power.
3. **Add on-site renewables:** Generate renewable energy on-site using technologies like solar panels or wind turbines. By generating clean energy on-site, the building can reduce its reliance on grid electricity.
4. **Lower embodied carbon:** Choose construction materials that have a lower embodied carbon than traditional materials. Examples of low-carbon materials include low-carbon concrete, and sustainably sourced mass timber products.

Low-carbon building framework

1

Reduced demands

Implement energy-efficient technologies and practices to reduce the amount of energy consumed by the building.

2

Replace fossil fuels

Reduce fossil fuels like natural gas and replace with low-carbon alternatives

3

Add on-site renewables

Generate renewable energy on-site using technologies like solar panels or wind turbines.

4

Reduced embodied carbon

Choose construction materials that have a lower embodied carbon than traditional materials.

3.2 Technical solutions, building attributes and measures

Technical solutions	Building attribute		Measures
	General	Detail	
Reduce demand 	Electrical	Lighting	• LED lighting systems • Lamps and ballasts • Control systems for lighting and mechanical systems
		Plug loads and digitization	• Building Automation Systems • Premium Efficiency Motors • EV Chargers
	Enclosure	Windows and doors	• Clips, frames, cladding • Energy efficient windows/doors • High R-value Roll-up Receiving Doors
		Walls and roofs	• Insulation and air barrier systems • High efficiency curtain walls • Wall recladding systems • Thermal break technology
Switch to cleaner fuels 	Mechanical	Space heating and cooling	• Heat Pump Rooftop Unit and Make-Up Air Units • Air to Water Heat Pumps • Heat Recovery Chillers • Wastewater Heat Pumps • Gas back-up systems and controls • Ground Source Heat Pumps • In-Suite Packaged and Mini-Split Heat Pumps • Variable Air Volume (VAV) Systems • Airside economizer damper controls • Variable Refrigerant Flow (VRF) Systems and LEV Kits
		Ventilation	• Very High Efficiency Dedicated Outdoor Air Systems • Heat and energy recovery systems • Demand controlled ventilation • Distribution system insulation
		Hot water heating	• Heat Pump Water Heaters • Gas back-up systems and controls • Demand Response Water Heaters
Add on-site renewables 	Renewables	Renewable energy system	• PV systems • Solar domestic hot water • Building Integrated Photovoltaics • Hybrid (Wind and Photovoltaics) • Energy Storage
Lower embodied carbon 	Materials and products	Materials and products	• Low-carbon concrete, steel etc. • Mass timber and wood products • Life Cycle Analysis (LCA), Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) • Low GWP Refrigerants (including A2L and A3 Flammability)

3.3 Priority Trades

Trade		Building attribute
1	Electrician (Construction)	• Reduce demand • Switch to cleaner fuels • Add on-site renewables
2	Refrigeration and Air Conditioning Mechanic	• Switch to cleaner fuels • Lower embodied carbon
3	Sheet Metal Worker	• Reduce demand • Switch to cleaner fuels • Add on-site renewables
4	Plumber	• Switch to cleaner fuels
5	Glazier	• Reduce demand
6	Carpenters	• Reduce demand • Lower embodied carbon
7	Insulators	• Reduce demand • Lower embodied carbon
8	Instrumentation and Control Technicians	• Reduce demand • Switch to cleaner fuels

Electrician (Construction)
Skilled Trades Certification[3]

Electricians install, commission, test, maintain and service electrical systems and equipment. They are responsible for installing and maintaining energy-efficient lighting systems, heating and cooling systems, renewable energy sources such as solar panels or wind turbines, and other electrical components that reduce energy consumption.

Electricians ensure that all wiring and connections meet safety standards and are properly integrated with building automation systems to optimize energy efficiency and sustainability. They work closely with architects, engineers, and contractors to ensure that low-carbon building designs are executed correctly, making sure that the buildings operate efficiently while minimizing environmental impact.

Additionally, electricians install or upgrade electrical circuits to accommodate the power requirements of HVAC systems such as heat pumps. They are also critical in the installation of electric vehicle charging stations.

What is a Mechanical Contractor?

Mechanical contractor members specialize in plumbing, heating, ventilation, air conditioning, sprinkler systems, fire protection, control systems, refrigeration, insulation, specialized process systems, medical gases, hydronics, site services and welding. Installations, service, and retrofitting are performed in both the Industrial Commercial & Institutional (ICI) and residential sectors.

[3] Skilled Trades Certification means uncertified workers in selected trades will need to become certified or register as an apprentice with SkilledTradesBC to be legally able to work in that trade. Once a trade officially requires certification, uncertified workers will have a year before they must register as an apprentice or challenge a certification exam to become a journeyperson.

Refrigeration and Air Conditioning Mechanic
Skilled Trades Certification

Refrigeration and Air Conditioning Mechanics (RAC Mechanics) install, maintain, and repair residential central air conditioning systems, commercial and industrial refrigeration and air conditioning systems, and combined heating, ventilation, and cooling systems.

In low-carbon buildings, HVAC systems must be designed to minimize energy consumption while still providing adequate cooling and heating. Refrigeration and Air Conditioning Mechanics install and service systems such as heat pumps, Variable Air Volume (VAV) Systems and Variable Refrigerant Flow (VRF) Systems. They also renovate older buildings that have outdated HVAC systems that consume more energy than necessary. Mechanics can retrofit these systems with newer, more efficient components or recommend replacement options.

Heat pumps use refrigerants to transfer heat from one location to another, such as removing heat from a building during the summer and transferring it outside. The mechanics must ensure that the refrigerant levels are correct and that there are no leaks in the system. Additionally, refrigeration and air conditioning mechanics must stay current on regulations surrounding refrigerants due to environmental concerns regarding their impact on the ozone layer and global warming potential. They need to know which refrigerants are legal and safe to use in different types of equipment, how to handle them safely, and how to dispose of them properly.

A VAV system uses air handling units (AHUs) to regulate airflow into a building. The AHUs adjust the volume of air according to the temperature requirements of each room or zone. This means that only the required amount of cool air is supplied to each area of the building, reducing energy consumption. RAC mechanics can install VAV systems in new buildings or retrofit them into existing ones. By doing so, they can reduce the amount of energy needed to cool a building while maintaining occupant comfort levels.

A VRF system uses refrigerant to cool or heat individual rooms within a building. These systems have multiple indoor units connected to one outdoor unit, which provides greater flexibility in controlling temperatures throughout the building. RAC mechanics can install VRF systems in small or large buildings, depending on their size and occupancy needs. These systems offer high efficiency levels, reduced maintenance costs, and lower carbon emissions compared to traditional HVAC systems.

Sheet Metal Worker
Skilled Trades Certification

Sheet metal workers make, install, and maintain metal components for heating, ventilation, and air duct systems (HVAC), renewable energy systems, building envelopes, and green architectural features such as cool roofs or hot or cold walls. Sheet metal workers help to reduce energy consumption and greenhouse gas emissions while improving indoor air quality and occupant comfort.

Sheet metal workers are responsible for creating and installing components for HVAC systems, which are essential for maintaining a comfortable indoor environment while minimizing energy consumption. These systems include ductwork, which distributes heated or cooled air throughout the building, as well as ventilation systems that remove stale air and bring in fresh outdoor air.

Renewable energy systems also require sheet metal expertise. For example, solar panels must be mounted on frames to prevent them from being damaged by strong winds or other weather events. Sheet metal workers also install thermal collectors that capture heat from the sun and use it to provide hot water or space heating.

Building envelopes – the exterior surfaces of buildings that separate interior spaces from the outside environment – are another important area where sheet metal workers contribute to low-carbon construction. They install insulation materials such as foam board or fiberglass batts, which help reduce heat loss through walls, floors, and roofs. In addition, they create vapor barriers that prevent moisture from entering the building envelope and causing damage over time.

Green architectural features such as cool roofs or hot or cold walls can also benefit greatly from sheet metal work. Cool roofs are designed to reflect sunlight rather than absorb it, reducing the amount of heat that penetrates the building below. Sheet metal workers can install reflective roofing materials such as aluminum sheets or coatings that help achieve this effect.

Hot or cold walls are another way to reduce energy consumption in buildings. These walls incorporate materials with high thermal mass – such as concrete – to store excess heat during the day and release it at night when temperatures drop, keeping rooms warmer without relying on mechanical heating systems. Sheet metal workers can fabricate steel frames to support these walls and attach panels made from concrete or other high-mass materials.

Plumber

Plumbers install, repair, and maintain plumbing fixtures including HVAC systems, hot water heating, greywater management, and renewable energy technologies like solar panels.

Regarding HVAC systems, plumbers install piping systems that distribute heated or cooled water or air throughout the building. This allows for more efficient temperature control, which can help reduce energy consumption and lower carbon emissions.

Another area where plumbers are essential is hot water heating. Plumbing systems are used to deliver hot water for various uses such as showers, washing machines, and dishwashers. Low-carbon buildings rely on high-efficiency water heaters that use renewable sources like solar power or geothermal energy.

Greywater management also falls under the purview of plumbers and refers to non-potable wastewater generated from activities such as showering or laundry. Instead of wasting this resource, greywater can be treated and reused for non-drinking purposes like irrigation or flushing toilets. Rainwater can also be collected and reused for non-drinking purposes.

Plumbers design and install greywater collection systems that divert this waste from the sewage system into a treatment system.

Finally, plumbers have a critical role in renewable energy integration within low-carbon buildings. Technologies such as solar panels require specialized piping systems that transfer heat collected by panels into storage tanks or distribution networks within the building's plumbing infrastructure. The installation of these pipes requires skilled workmanship by experienced plumbers who understand how to integrate them seamlessly into existing plumbing structures.

Glazier

Glaziers install and maintain energy-efficient windows and doors that help reduce the building's energy consumption for heating and cooling.

A glazier plays a crucial role in building envelope performance as they are responsible for the installation and maintenance of windows, doors, skylights, and other glazed elements. Properly installed and maintained glazing systems can significantly improve energy efficiency, thermal comfort, and indoor air quality. Glaziers also ensure that the building envelope is protected from water infiltration, air leakage, and structural damage caused by extreme weather conditions. They work closely with architects, engineers, and contractors to select the right type of glazing system based on factors such as climate zone, orientation, building use, and aesthetic appeal.

When working with mass timber buildings, glaziers must consider the unique properties of wood as a building material and carefully assess the load-bearing capacity of the timber beams to ensure they can support the weight and stress caused by the glass elements. Mass timber attachment points are unique and not the same as we see in steel and concrete structures. Glaziers also must consider the behaviour of wood under various elements and the protections required in the installation.

What is a Prime Contractor?

A prime contractor on a construction project is the main contractor who is responsible for managing and overseeing all aspects of the project, including hiring subcontractors and ensuring that all work is completed on time, within budget and to the required standard. The prime contractor is typically selected through a bidding process and acts as the point of contact between the owner or client and all other parties involved in the project. Plumbing companies often act as the prime contractor on Part 3 buildings.

Glaziers can also be involved in the installation of high R-value roll-up receiving doors. These are industrial doors designed to provide excellent insulation and energy efficiency. They consist of multiple layers of insulation material, such as polyurethane foam or fiberglass, sandwiched between sturdy steel panels. The R-value refers to the thermal resistance rating of the insulation, with higher values indicating better insulation performance. Roll-up doors are often used in warehouses, distribution centers, and other commercial and industrial settings where large openings need to be sealed off quickly and efficiently. High R-value roll-up receiving doors can help reduce heating and cooling costs by minimizing heat transfer through the door surface, while also providing strong protection against wind, rain, dust, and other environmental factors.

Carpenters

Carpenters play a role in framing, forming and roofing Part 3 buildings. Carpenters' work typically affects envelop performance, though creating forms for concrete, framing for insulation, and installing and connecting mass timber beams.

In addition to their technical skills, carpenters must be able to read blueprints and follow building codes and safety regulations. Concrete forming carpenters are carpenters who specialize in creating molds or forms for concrete structures in buildings. They use wood, metal, and other materials to create the forms according to blueprints and specifications. Concrete forming carpenters may also be responsible for pouring and leveling the concrete mixture into the formwork.

A carpenter plays a crucial role in the construction of a mass timber building. They work on-site to assemble and install prefabricated timber components such as cross-laminated timber (CLT) panels, glulam beams, and other engineered wood products. Carpenters also fabricate custom millwork pieces, install finishes, and perform other tasks related to the interior and exterior finish of the building. Overall, carpenters are responsible for ensuring that all structural elements of the mass timber building are installed correctly and according to design specifications.

Insulators

Insulators handle, install, and remove insulation and other materials. In Part 3 buildings, they play a crucial role in ensuring adequate thermal and acoustic insulation. By preventing heat loss or gain through walls, roofs, floors, and mechanical systems, insulators help to regulate temperature and reduce energy costs. They install various types of insulation materials such as foam, fiberglass or cellulose between walls, ceilings, floors, piping, tanks, vessels, and HVAC systems to minimize the transfer of heat through conduction, convection, and radiation. This results in interior spaces that are warmer during cold weather and cooler during hot weather while also reducing noise levels within the building. Furthermore, insulation can act as a fire retardant by slowing down the spread of flames and reducing smoke generation.

Increasingly, insulators are asked to advise on the total environmental impact of different types of insulation materials and help builders make informed decisions about which products to use in construction projects.

Instrumentation and Control Technicians

An instrumentation and control technician is responsible for installing, maintaining, testing, and repairing all types of control systems that are used to regulate the equipment and machinery in a building. This includes heating, ventilation, air conditioning (HVAC) systems, lighting systems, security systems, fire alarm systems, and other electronic devices. The technician must ensure that these systems operate efficiently and safely by monitoring their performance with specialized tools and instruments such as oscilloscopes and multimeters. They also diagnose problems with these systems when they malfunction or break down and provide corrective actions to fix them. Additionally, they may be involved in designing new control systems or upgrading existing ones to improve their efficiency or functionality. The advent of "connected" buildings, with data from formerly isolated systems being integrated and sent to the internet cloud for third party analysis and diagnostics, is another driver for the increased demand for this role

What is a BMI Modeller?

A BIM (Building Information Modelling) modeller is an emerging role in industry that is proving to be a critical member of a construction trades team a key contributor to sustainability objectives and the industrialization of construction. BIM modellers are responsible for creating and managing the digital 3D models of buildings using specialized software. There is not a direct path to gain the skills and competencies needed to become a BIM Modeller however two industry groups have created workarounds to identify, employ and train the profession.

When it comes to mass timber buildings, a BIM modeller would use advanced computer-aided design (CAD) software to optimize material utilization and create precise digital models of the building components. These models guide automated machinery that cuts and mills the timber pieces according to exact specifications. This precision allows for high-quality, standardized elements that can be easily assembled on-site. They also focus on incorporating the unique properties and requirements of wood-based construction into their modelling process. This may include accurately representing the dimensions and structural elements of mass timber components, such as cross-laminated timber (CLT), glued laminated timber (GLT), or nail-laminated timber (NLT). Additionally, they may work closely with architects, engineers, and contractors to ensure that the building's design and construction plans are optimized for efficient assembly and installation of the mass timber elements. **For mass timber companies the pathway to employment is to complete an Architectural Technologist certificate and then commit to approximately 3 years of on-the-job training.**

A BIM modeller, in collaboration with HVAC contractors, engineers and designers, creates the 3D models of HVAC systems using Building Information Modelling (BIM) software. They consider all aspects of the HVAC system such as ductwork, piping, equipment locations, and ventilation requirements as they relate to the building structure. The BIM modeller is responsible for ensuring that all components are integrated correctly and working efficiently to meet design specifications. Additionally, they may perform clash detection analysis to identify potential conflicts between various building systems and make necessary adjustments to avoid issues during construction. **Large scale mechanical or prime contractors seek out individuals with experience in the gaming industry – either as a player themselves or as designers.**

4

Trades training pathways and low-carbon content

There are several steps to becoming a journeyperson in British Columbia.

The apprenticeship system for construction trades in British Columbia is designed to provide individuals with the necessary skills and knowledge required to become certified journeypersons in their respective trades.

While there are no high school prerequisites, dependent on the trade, most recommend education which ranges from grade 10 to 12. At that point prospective apprentices can either complete a pre-apprenticeship program or enter directly into an apprenticeship program with a registered sponsor.

Since apprenticeships require the support and sponsorship of an employer[4], some individuals choose to complete a pre-apprenticeship program as this equips students with basic knowledge and skills for their chosen trade and the hands-on training needed to attract an employer's attention and get hired as an apprentice. However, it is not a necessary pathway to becoming a tradesperson and individuals (with a registered sponsor) can enter directly into an apprenticeship program and forgo a pre-apprenticeship program.

To become an apprentice in BC, one must first find an employer who is willing to take them on as an apprentice. Once hired, the apprentice will work under the supervision of a certified journeyperson, complete a certain number of hours of on-the-job training as well as attend classroom instruction at a designated training centre, technical institute or college. The duration of the apprenticeship varies

[4] While the majority of apprentices require sponsorship of an employer, there are examples of training providers such as the Joint Apprenticeship Training Committees that can and do sponsor thousands of apprentices and then dispatch them to different employers.

depending on the trade but typically lasts from three to five years. They must also pass various exams and assessments throughout their in-classroom training.

Upon completion of their apprenticeship, individuals are required to write a certification exam administered by SkilledTradesBC. If they pass this exam, they will receive their certificate of qualification and be recognized as a certified journeyperson in their trade. Experienced trade workers (domestic or those with foreign credentials) who haven't gone through any form of technical training can also challenge the exams and become certified.

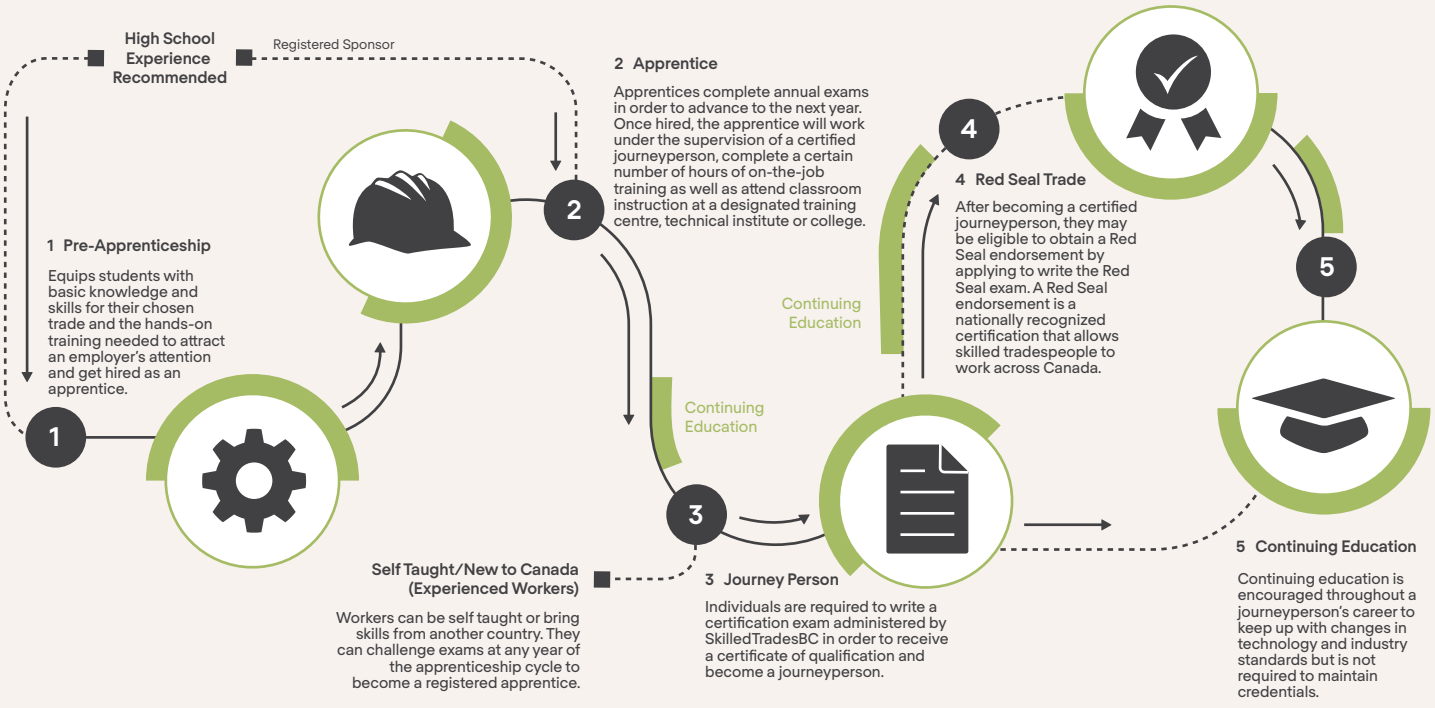
After becoming a certified journeyperson, they may be eligible to obtain a Red Seal endorsement by applying to write the Red Seal exam. A Red Seal endorsement is a nationally recognized certification that allows skilled tradespeople to work across Canada without having to re-certify. It indicates that the individual has met the national standards for their respective trade and has passed a standardized exam. The Red Seal program is available for over 50 skilled trades, including carpentry, plumbing, electricians, sheet metal and more.

Continuing education is encouraged throughout a journeyperson's career to keep up with changes in technology and industry standards but not required to maintain credentials. Practicing tradespersons may also choose to pursue additional certifications or specializations within their trade.

Priority Trades

Trade		Red Seal Trade
1	Electrician (Construction)	✓
2	Refrigeration and Air Conditioning Mechanic	✓
3	Sheet Metal Worker	✓
4	Plumber	✓
5	Glazier	✓
6	Carpenters	✓
7	Insulators	✓
8	Instrumentation and Control Technicians	✓

Pathway



4.1 Exposure to career pathways to the trades

In Canada, there are several barriers to promoting careers in the trades that may contribute to a shortage of skilled workers:

1. **Negative perceptions:** Many people believe that trades jobs are low-paying and less prestigious than white-collar professions. This perception can discourage young people from considering these careers.
2. **Lack of awareness:** There is often a lack of awareness about the types of careers available in the construction trades, which can make it difficult for young people to understand what opportunities exist.
3. **Unclear career pathway:** prospective tradespeople cannot see a pathway for professional advancement from working with tools through to management and oversight.
4. **Limited diversity:** Many careers in the construction trades are still male dominated, which can be discouraging for women and other minorities who want to pursue these careers.
5. **Stigma against technical training:** There is sometimes a stigma associated with vocational education and technical training, which can make it harder for students to choose this path since it may be discouraged by parents and school counselors.
6. **Lack of flexibility:** One key factor is that construction work is often project-based and time-sensitive. Construction workers may need to be physically present at the job site for extended hours or even overnight shifts to meet deadlines. In addition, they often must contend with adverse weather conditions such as extreme heat or cold, rain, snow, or high winds. These factors can make it challenging to maintain a consistent work-life balance.

Overall, marketing efforts to promote awareness of available opportunities within the construction trades highlight benefits such as good pay rates, opportunities to work with your hands and the benefits of apprenticeships ("earn while you learn"). Here are some ways in which careers in the construction trades may be promoted in middle school, high school and through pre-apprenticeship programs in British Columbia:

1. **Career fairs:** Many schools organize career fairs where students can interact with professionals from different industries, including construction trades. These events provide students with an opportunity to learn about various career options available to them.
2. **Guest speakers:** Schools may invite guest speakers who work in the construction industry to talk about their experiences and share information about job opportunities in the field.
3. **Skills competitions:** Skills competitions such as the annual Skills Canada competition showcase the skills of young tradespeople and encourage others to pursue a career in the trades.

The average age of an apprentice in Canada is 27 years old (Statistics Canada, 2022)

First-year apprentices typically have already spent some years in the workforce and are seeking a career change or want to improve their skills. They come from various backgrounds, including those who have worked in unrelated industries, trade assistants, or those who have completed pre-apprenticeship courses. Generally, these individuals are in their late twenties to early thirties and bring with them a wealth of experience that can benefit their apprenticeship training. It's not uncommon for mature-aged apprentices to have families and other commitments outside of work, which can present unique challenges when balancing work and study requirements.

4. **High school programs:** Many high schools offer programs to introduce students to the construction trades. These programs can range from shop classes to co-op placements with local contractors. SkilledTradesBC offers a number of high school programs through partnerships with school districts and training providers.
5. **Workshops and training programs:** Schools may also offer workshops and training programs that teach students basic skills related to construction trades, such as carpentry, plumbing, electrical work, etc.
6. **Social media campaigns:** Industry associations and government stakeholders[5] have invested in social media campaigns to raise awareness and attract apprentices to building construction opportunities, and to highlight the lifestyle that comes with trades employment opportunities.
7. **Scholarships and grants:** To encourage more students to pursue careers in the construction trades, government and several organizations offer scholarships and grants specifically for those interested in this field.
8. **Pre-apprenticeship programs:** These programs expose potential apprentices to careers in the trades. They prepare individuals for entry into an apprenticeship by providing basic knowledge and the skills necessary to succeed in the chosen trade or occupation.

[5] The BC Construction Association launched a social media campaign in 2022 to find apprentices for employers to hire, and it does it by promoting the lifestyle that people working in the trades can enjoy.

Sample: Pre-apprenticeship Programs in British Columbia

Skilled Trades Employment Program (STEP):

The Skilled Trades Employment Program (STEP) is a pre-apprenticeship program designed to address the shortage of skilled workers by providing training and employment opportunities to individuals interested in a career in the skilled trades. Participants get access to apprenticeships, on-the-job training and classroom instruction, allowing them to develop the skills and knowledge required for their chosen trade. STEP supports both job seekers and employers, helping to meet the demand for skilled workers while offering individuals an avenue for stable and well-paying careers.

SkilledTradesBC Foundation Programs:

The SkilledTradesBC Foundation Programs provide individuals with the essential skills and knowledge needed to pursue a career in skilled trades. These programs offer hands-on training and theoretical instruction in fields such as plumbing, electrical work, carpentry, welding, and automotive mechanics. Participants gain practical experience through simulated workplace environments and learn from experienced professionals. The Foundation Programs aim to equip students with skills that can lead to further apprenticeship opportunities or employment in the skilled trades. Learners can also gain credit for Level 1.

Sample: Programs aimed at diversifying the trades

Trades Training and Employment Program:

BCWITT's Trades Training and Employment Program, operating under a Workforce Development Agreement (WDA) through SkilledTradesBC, addresses the underrepresentation of women (including transwomen) in construction, maintenance, and industrial trades. The program assists women in overcoming employment barriers by offering skills training, career exploration, essential skills assessment, resume preparation, mentorship, and networking opportunities. Participants may also receive funding for occupational certificates, personal protective equipment, tools, childcare, and transportation. The program recognizes the benefits of workplace diversity, such as increased employee satisfaction, collaboration, and workplace health and safety, while supporting women in achieving journey status in the trades.

Be More Than a Bystander (BMTAB):

Be More Than a Bystander (BMTAB) is a training and educational program aimed at creating welcoming, healthy, safe, and respectful workplaces by addressing bullying, harassment, and violence in the skilled trades industry. The program offers a three-day Train-the-Trainer option for industry leaders to learn effective intervention strategies. Additionally, a two-hour workshop is available for organizations interested in introductory training. BMTAB, in partnership with EVA BC, focuses on addressing gender-based bullying and harassment and plans to expand to include content on other forms of bias and discrimination.

RRP Leadership Training Program:

The Regional Representative Program Leadership Training, a collaboration between BCCWITT and SkilledTradesBC, aims to increase the representation of equity priority groups (such as Indigenous, people of colour, 2SLGBTIAQ+, immigrants, people with disabilities, and women) in leadership positions within the skilled trades sector in British Columbia. Successful applicants undergo an intensive five-day Core Training, fully funded with accommodations and travel provided. Participants build leadership skills, learn about resources and barriers, develop a peer mentorship network, and engage in volunteer activities. The program invests in tomorrow's leaders by empowering underrepresented tradespeople to make a difference in the future of trades in BC.

Workplace Alternative Trades Training

The Workplace Alternative Trades Training (WATT) Program is a collaboration between Western JETS, IBEW Locals 230, 993, and 1003, and the Construction Foundation of British Columbia. WATT addresses the shortage of electricians by providing accessible applied electrical skills training that leads to employment. The program targets individuals who face barriers accessing traditional training, such as youth, Indigenous communities, newcomers, and women. Participants receive hands-on training, safety certifications, tools, and boots. Upon completion, they are recommended for sponsorship into a registered apprenticeship and offered paid work placements with electrical contractors. The program is funded by the Government of Canada's Skilled Trades Awareness and Readiness Program.

4.2 Promotion of green construction trades

Despite direct connections between the construction trades and climate change mitigation, steps have not been taken to promote opportunities in the construction trades as a pathway for making an impact on climate change.

The CleanBC plan identifies the importance of promoting careers in sustainable industries, investing in training and education programs for clean energy, green technology, and other sustainable fields. The plan also supports new job opportunities in these industries through incentives, tax credits, and funding for research and development. Additionally, the plan includes initiatives to retrofit buildings to be more energy-efficient, which creates jobs in construction and other related fields.

The Canada Building Trades Union conducted interviews and focus groups with apprentices and found that there was a great interest in low-carbon skills training. However, instructors were not equipped with the skills and expertise to integrate new content into the apprenticeship programming.

The Canada Green Building Council (CAGBC) hosted a workshop with apprentices to capture their views on the roles of the trades in addressing climate change. Many attendees articulated that they were motivated to becoming an apprentice in part because of the opportunity to make a positive impact on the environment, in particular noting interests in renewable energy installation, and sustainable architecture and electric charging. Additionally, there was recognition that construction trade career paths offer opportunities for innovation and creative problem-solving, theoretically allowing apprentices to actively participate in finding solutions to environmental challenges. Despite an interest, a large majority of attendees found that industry practices did not align with their aspirations for green building techniques and practices.

4.3 Balance between in-classroom and workplace learning

The labour shortage, coupled with an increased workload, poses a challenge for the industry to spare employees for traditional classroom training, as their absence for 8-10 weeks can be hard to manage. Concerns persist that inclusion of more low-carbon curriculum will only worsen this situation, making it tougher for the industry to release apprentices - despite their dedication towards low-carbon solutions.

One solution to create more flexibility in construction trades classroom training is to split the in-classroom learning into two blocks. This means that students can attend classes in shorter stretches (4-5 weeks), once in the Fall and another in the Spring. By doing so, students will have more time to work and earn money while still being able to attend classes at a convenient time. For the employer, it is easier to accommodate a shorter absence than one that is over two months in duration.

Quotes on Green

"Younger generations are motivated by making an impact and securing meaningful work."

- Industry stakeholder

"A green building approach would be a great recruitment tool for young people. To them, building a better future absolutely matters."

- Educator stakeholder

"We are an industry that is offering challenging, interesting work that offers a tangible pathway to have an impact on climate change."

- Industry stakeholder

Another option is to offer training in the evenings or during the summer. Many individuals interested in pursuing a career in construction may already be working full-time during the day.

Offering evening classes or courses during summer allows them to continue earning an income while receiving a valuable education. Additionally, this approach can help reduce overcrowding during peak school hours, making it easier for students to focus on their studies.

Lastly, increasing the number of seats available for certain oversubscribed construction trade programs (such as HVAC in the Lower Mainland) can also lead to greater flexibility in classroom training. With more seats available, there will be less competition for enrollment spots, helping to address labor shortages within the industry by encouraging more people to enter and stay engaged.[6] Ultimately, creating more flexible classroom training options benefits both students and employers alike by producing well-trained professionals who are prepared to tackle real-world challenges within the construction sector.

[6] A challenge that would not be resolved with the introduction of more seats would be the availability of qualified instructors. This remains a challenge for many colleges, institutes and private training providers.

4.4 Making changes to the apprenticeship system

There are several steps involved in adjusting the apprenticeship system and three main approaches to evolving the trades to meet industry needs such as the introduction and elevation of low-carbon skills. These include revising training content that is taught in-classroom, introducing a new skilled trade, and designating a trade as part of the Red Seal Program. Other steps include:

1. **Revising the Red Seal Occupational Standards (RSOS):** Changes may be driven by national harmonization and program review efforts, as well as provincial industry needs. The Red Seal Occupational Standards (RSOS) are reviewed on a national level and then provincial level. At the national level this includes a situational analysis that includes a proposal for changes. Industry consultations are conducted and targeted input from subject matter experts (SMEs) completed. Lastly a impact assessment is undertaken leading to a resolution and approval of new RSOS.
   With the approved national RSOS, the province considers the RSOS in light of the BC context. It also consults the industry and seeks SMEs to weigh in on details. This allows SkilledTradesBC to issue an Official Program Standards Notification (OPSN), conduct transition planning, support implementation and exam development.
2. **Becoming a Red Seal trade:** For a trade to be considered for Red Seal designation, it must meet specific criteria. Firstly, the trade must have been designated for apprenticeship and certification by authorities in at least five jurisdictions (provinces/territories). Secondly, there should be national demand within the industry for the trade to receive Red Seal endorsement. Thirdly, the trade must have a significant number of common tasks in each participating jurisdiction. Even if the name of the trade varies by jurisdiction, if the tasks are common, it can receive Red Seal endorsement. Furthermore, industry support is crucial for any designated trade to maintain and promote Red Seal endorsement within each participating jurisdiction. Lastly, there should be sufficient activity within the trade demonstrated by having 500 or more apprentices currently registered in participating jurisdictions (combined total), 300 or more current examination challengers (combined total), and an anticipated number of challengers for Red Seal endorsement.

4.5 Continuing education

Construction trades are not required to complete education after they have been certified as a journeyperson or Red Seal trade. That said, to keep up with changes to technology and processes, continuous training is encouraged and offered in various ways through training providers and employers. There are some instances where regulations (e.g., WorkSafeBC, Technical Safety BC) require certain trades to complete courses to practice their occupation and perform specific tasks.

1. **Manufacturer Training:** Many manufacturers in the construction industry require contractors to complete their proprietary training to install, maintain, and repair their product correctly. Those who complete training have access to discounted prices as well as extended warranties. Manufacturer training drives new skills in the construction industry by providing workers with the knowledge and expertise needed to use specific products, tools, and equipment effectively.

   When workers receive manufacturer training, they become more familiar with the latest tools and techniques used in their trade, which increases their productivity and reduces the risk of errors or accidents on the job site. Moreover, workers learn about advanced installation methods that can improve durability, energy efficiency, and performance of building products.

   In addition to improving worker skills and knowledge, manufacturer training also fosters improved communication between manufacturers and contractors. Collaboration helps ensure that projects are completed efficiently and successfully while maintaining the quality standards set by the manufacturer.

   Manufacturer training requirements are particularly prevalent for mechanical systems such as HVAC. They are not part of the practice in the mass timber industry and carpentry contractors are not required to complete training on connectors or fasteners – for example.

2. **Certificates:** Advanced certifications are another way that tradespeople can upgrade their skills and expertise. Certificates are often awarded by universities, community colleges, or vocational schools, and provide a broader understanding of a particular subject area or field of study. Many union training providers can develop, procure and offer continuing education in the form of certificates.

3. **Regulated Training:** Government bodies at the federal, provincial, and local government level can require and specify training for tradespeople. Technical Safety BC delivers training to strengthen the capacity of the construction trades to install and operate technical systems and equipment across the province, including refrigerants which are a critical component for Refrigeration and Air Conditioning Mechanics. Work Safe BC is another example of a provincial agency dedicated to reducing safety risks safe and supporting healthy workplaces through training. There are also examples where regulatory bodies have required training to ensure competencies for green building. For example, to install a heat pump in the City of Vancouver, you must have a Municipal Heat Pump Certification and be registered as a certified heat pump installer.

Advanced Lighting Controls Training Certificate

The Electric Joint Training Committee (EJTC) offers an Advanced Lighting Controls Training Certificate to individuals looking to enhance their knowledge and skills in the field of lighting controls. This certificate program is designed for electricians who want to learn about the latest technology and techniques used in advanced lighting systems.

The EJTC's training program covers topics such as energy codes and regulations, daylight harvesting, occupancy sensors, dimming controls, and networked lighting systems. The course also provides hands-on training on various types of lighting control equipment and software.

4. **Micro-credentials:** Micro-credentials are a form of credentialing that validates an individual's specific skills and knowledge in a particular area. They are usually smaller than traditional degrees or certifications and can be earned through short-term, focused training programs. Micro-credentials provide opportunities for individuals to quickly obtain new skills and access high-demand employment. In the context of the construction trades, they are not designed to replace the apprenticeship system but rather complement it with continuing education offerings.

   The development of a Micro-credential Framework for British Columbia aims to establish a cohesive approach to micro-credentials across the public post-secondary system, promoting clarity and transparency for learners and employers alike. The release of this framework in September 2021 marks an important milestone in ongoing efforts to strengthen micro-credentials in British Columbia. To date, the Ministry has funded over 130 micro-credentials since 2020 and plans to continue enhancing these programs under the **StrongerBC: Future Ready Action Plan** announced in May 2023. This plan will prioritize short-duration training that can quickly respond to changing labour market needs and economic trends such as a move toward low-carbon skills and expertise. The plan also includes a grant which provides $3,500 funding for approved short-term training. Many qualifying courses are relevant to construction, including Net-Zero and Passive House Construction, Construction for Energy Efficient Buildings, Building Construction Technology, and others.

   Some private training providers also offer micro-credential courses in the construction trades which are recognized by many employers as valuable additions to a candidate's resume.

5. **Workplace programs:** Some construction companies prioritize continuing education by providing supports to employees to upgrade their skills and expertise on the job and through training offered on site. In many cases this is to stay on top of changes to technology and investments in skills to deliver low-carbon solutions. Chandos Construction integrates training into their work with trades and subtrades. It provides education on high performance building standards such as Zero Carbon Building standards™ and LEED® (Leadership in Energy and Environmental Design) as well as guidance to ensure preparedness and a strategy for tackling sustainable projects.

TradeUp BC

TradeUpBC was launched in 2023 to address the gap in continuing education for the Province's construction trades. It connects tradespeople in British Columbia to post-secondary institutions and provides access to micro-credentials and other professional development offerings. TradeUpBC also offers flexible training options through online, virtual, in-person, or blended formats, including night and weekend classes.

The program focuses on skill development in areas of current workplace demand such as technology adaptation, climate change impacts, leadership skills, mentorship training, inclusive workplaces, and educator training. Examples of climate-ready micro-credentials include:

- Applied Circular Economy: Zero Waste Buildings
- Essentials of Net-Zero and Passive House Construction
- Supervising Net-Zero and Passive House Construction
- Introductory Studies in Mass Timber Construction

TradeUpBC helps tradespeople advance their careers, strengthen their businesses, and create welcoming work environments for everyone to ensure they are future ready.

4.6 Low-Carbon Skills

In British Columbia, there has been a lack of comprehensive action to revise and modernize apprenticeship curriculum in accordance with regulatory changes that tackle climate change. Modifying the apprenticeship curriculum can be a time-consuming task and comes with its fair share of challenges. While the main goal is to ensure that the content reflects current (and projected) market demands, there are also pressures to not increase the number of days spent in the classroom. Some training providers have managed to incorporate elements of green technology into their existing curriculum, using examples like energy conservation and resource utilization. However, many training providers have yet to thoroughly review their apprenticeship content to make changes that focus on green building principles. In fact, trades such as HVAC and plumbing still heavily emphasize traditional gas-based approaches. On the other hand, certain priority trades like electricians have shown a commitment to adapting their training offerings for both apprentices and experienced professionals. They have responded to the growing commercial opportunities in electric-powered transportation and heating and cooling systems and have adjusted their curriculum accordingly.

One area of concern that emerged through the stakeholder engagement process was the level of skills and education available for carpenters working on mass timber buildings. Industry stakeholders found that the carpentry apprenticeship was unable to support the education requirements for carpenters working on mass timber buildings and several critical skills were missing including:

- The characteristics and properties of mass timber products (fire performance, seismic and when wet);
- Advanced knowledge of structural components, connections, and building systems, as well as site installation (rigging) for mass timber construction; and,
- Main types of building enclosures based on climate considerations and code requirements.

While apprenticeship training that incorporates a low-carbon lens is not widespread, there has been a move by private, public and non-profit training providers to offer continuing education to address green building content. The British Columbia Institute for Technology (BCIT)'s ZEB Learning Centre is a leading example of how upskilling trades can be achieved. The Centre began developing and offering hands-on low-carbon training for the building construction trades in 2017.

The Zero Energy & Emissions Buildings Learning Centre High Performance Building Lab (HPBL)

The ZEB Learning Centre (ZEBLC) at BCIT is an applied learning centre offering a range of hands-on training spaces to upskill the workforce with a focus on trades. The Centre's High Performance Building Lab and Residential Heat Pump Lab provide a variety of envelope, mechanical, and electrical system mock-ups, practice workstations, and testing equipment focused on building knowledge and skills needed for Net Zero Energy-ready and Zero Carbon Building™ construction and retrofits.

The Centre's activities are closely informed by industry needs to build workforce capacity and resolve specific skill gaps. Through short duration courses and micro-credentials, workers can easily start upskilling and companies can access hands-on training through tailored private course offerings.

The lab learning's building envelope, PV, and mechanical mock-ups showcase some of the leading details and approaches to achieve zero energy with a range of materials and components. The variety of equipment (e.g., HRV's and heat pumps) and materials (e.g., windows, doors, insulation materials, tapes and membranes, plus low-embodied carbon products) provide opportunities to practice installation, evaluate the constructability and performance, and learn from industry expert instructors.

Priority areas for trades training

Gap Rating indicating urgency to introduce training	Legend
Low Some progress has been made to address industry training gaps	
Medium Clear industry need to address skills gaps. Some industry and educator capacity available to deliver solutions today.	
High Clear industry need to address skills gaps. Limited industry and educator capacity available to deliver solutions today.	

Building Attribute		Competency	Relevant Trades	Gap Rating
General	Detail			
Advanced electrical systems	Lighting	• Knowledge of LED lighting systems, lamps and ballasts • Installation and configuration of control systems for lighting and mechanical systems	Electricians Control Technicians	
	Plug loads and digitization	• Peak demand and load management • Proficiency in working with Building Automation Systems • Expertise in handling Premium Efficiency Motors, EV Chargers, and Energy Storage		
Envelope performance	Walls, roofs, windows and doors	• Fundamentals for the evaluation, design, and construction of durable and energy-efficient building envelopes (enclosures) • Knowledge of the role of climate and the theory of heat flow, vapour flow, and air flow • Best practice assembly design and detailing fundamentals for above and below grade wall assemblies, roofs, and windows • Insulation and air barrier systems • Detailing approaches for air barrier systems, insulation methods, vapour barriers and cladding attachments • Application of thermal breaks to prevent heat transfer between two materials or components (e.g., balconies)	Carpenters Sheet Metal Workers Glaziers Insulators Electricians	
High efficiency mechanical systems	Space heating and cooling	• Knowledge of mechanical systems for low-load buildings • Familiarity with sizing considerations, installation methods, refrigerant handling, and troubleshooting techniques for heat pump systems (air, ground and water source) especially for retrofits • Understanding of system components, refrigerant piping layout, electrical requirements, and control settings for efficient installation of Variable Refrigerant Flow (VRF) Systems	Plumbers RAC Mechanics Sheet Metal Workers Controls Technicians Electricians BIM Modellers	
	Ventilation	• Installation requirements, including ductwork design, proper sealing, and electrical connections for Heat Recovery Ventilation (HRV) systems • Knowledge of demand-controlled ventilation (DCV) to provide fresh air and maintain indoor air quality based on the actual occupancy and pollutant levels		
	Hot water heating	• Installation and servicing of electric high efficiency domestic hot water systems and modulating burners. • Application of thermal batteries in heat pump water heater plants to store and release thermal energy efficiently		
Mass timber construction	Low-carbon materials and construction innovation	• Wood science (fire behavior, wet wood and seismic performance), • Knowledge of mass timber materials and construction techniques • Expertise in prefabrication techniques specific to mass timber components is essential. This involves knowledge of CNC machining, robotic assembly, integrated digital manufacturing processes, and quality control measures • Ability to read and interpret architectural plans, BIM Model specifications • Skilled use of hand and power tools for cutting, shaping, joining, and finishing wood components • Knowledge of proper lifting procedures, rigging techniques, sequencing strategies, and temporary bracing methods ensures safe and accurate installation	Carpenters Machinists Riggers BIM Modellers	
Materials and products	Materials and products	• Low-carbon product knowledge such as low-carbon concrete, wood fiber insulation etc. • Application of carbon accounting and Life Cycle Analysis (LCA), Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) • Knowledge of alternative refrigerants with low or zero Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) while ensuring their safety and efficiency in cooling systems	All trades	
Environmental literacy	Whole-building approach	• An awareness of how the trades scope of work can impact the environment and ways to minimize negative effects through energy-efficient design, waste reduction, and use of sustainable materials • A holistic approach to construction that acknowledges the interconnectedness of different trades' activities • Knowledge about local regulations related to environmental protection and compliance with green building standards	All trades	

5 Recommendations

Building Our Future considers the challenges and opportunities of the construction market alongside the urgency of the climate crisis.

It advances recommendations that include interventions at various stages in a tradesperson's career. To enable action and promote continued collaboration, each recommendation identifies a possible lead, partners and/or funders as well as key stakeholders. An assessment of timelines for execution is also included with details on any background which might have already taken place to advance the work or will need to take place.

"Not all green jobs are construction jobs, but all construction jobs need to be green jobs."

- The Skills Centre, UK

Recommendation	Details	Need
5.1 **Create green building trades recruitment strategy**	Develop and deliver a green construction marketing campaign to showcase the construction trades as a **climate action solution**; demonstrate **pathways for career growth**; and **increase the number of apprentices**. **Support anti-racism** and **gender-based sensitization training** for employers.	• Labour shortage • Outdated perception of the construction trades • EDIR
5.2 **Mobilize industry to meet new business paradigm**	Strengthen market signals and create imperative for low-carbon training through changes to **procurement process**.	• Insufficient market demand
5.3 **Enhance training pathways for in-demand occupations**	Map pathways for existing tradespersons to complete **cross-training into new disciplines**. Assess market need and training pathways for new trades such as **BIM Modellers**.	• Specialized tradespersons to address market demand
5.4 **Introduce green curriculum for apprenticeship programs**	Continue to **evolve the apprenticeship training content** for priority trades by **leveraging training options** developed by national organizations. Ensure reviews of the Red Seal Occupational Standards (RSOS) and curriculum includes input from **low-carbon subject matter experts**.	• Limited low carbon training content for apprentices
5.5 **Leverage continuing education for expanded skill development**	**Leverage TradeUpBC to develop continuing education** opportunities that are accessible to multiple trades. Create **industry incentives** for **manufacturer training**. **Prioritize training development** opportunities based on identified skills gaps: peak load and demand management; high performance building envelops; advanced heat pump systems; mass timber manufacturing and installation; and embodied carbon materials and products.	• Limited low carbon training content for apprentices and journeypersons • Manufacturer training integration • Low carbon trades skills gaps

5.1 Create green building trades recruitment strategy

5.1.1 Develop and deliver a green construction marketing campaign

Develop and deliver a green construction marketing campaign to:

- Showcase the construction trades as a climate action solution;
- Demonstrate pathways for career growth and impact in the trades;
- Increase the number of first year apprentices registering, inclusive of under-represented groups; and,
- Socialize the opportunities for the trades in middle and high school.

Lead	Contributors/Partners	Participants
BC Construction Association and/or Non-profit Trades Training Associations (Construction Foundation of BC, Trades Training BC, BC Building Trades)	• Federal, provincial, and local government • Private sector companies and industry associations	• School boards • Immigrant serving organizations

Timeline
Medium-term (1-3 years)

- Leadership, funding strategy and campaign development (and alignment) will take time.
- Possible September 2024 start (In alignment with school year).

5.1.2 Continue to support anti-racism and gender-based sensitization training

Offer sustained and expanded training for private sector companies to create safe spaces, build up internal champions, and advance changes to the workplace culture that encourages more women, people of colour, and LGBTQ+ identifying apprentices to contribute to the construction industry.

Lead	Contributors/Partners	Participants
Non-profit organizations	• Provincial government • Other funders such a foundations • Industry associations	• Private sector companies

Timeline
Immediate (0-1 year)

- Programs and leadership exist.
- Requires ongoing commitments from funders.
- Imperatives for industry to participate.

5.2 Mobilize industry to meet new business paradigm

5.2.1 Strengthen market signals and create imperatives for low-carbon training through changes to procurement processes

- Require all government building contracts with general contractors and subtrades to include demonstrated skills or training in low-carbon solutions and a commitment to the Integrated Design Process (IDP).
- Create templates that can be leveraged by private sector developers to include in the bid process that will align with regulatory levers (e.g., the BC Energy Step Code, Zero Carbon Step Code and Energy Efficiency Standards Regulation) and industry standards (e.g., LEED® (Leadership in Energy and Environmental Design) rating system and the Zero Carbon Building Standard™).

Lead	Contributors/Partners	Participants
Federal, provincial, and local government	• Public and private training providers	• Private sector companies

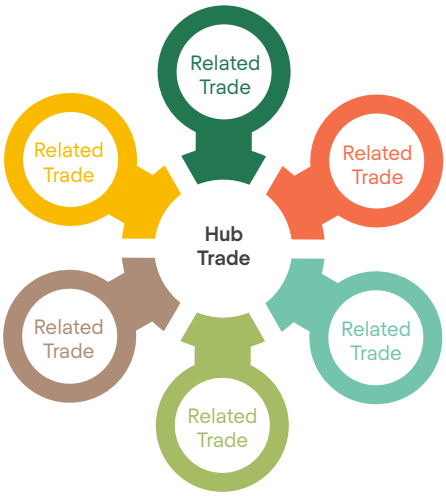
Timeline
Immediate (0-1 year)

- Several governments and industry already have commitments to low carbon construction and identify requirements in procurement documents.
- References to training and skills are additions that fit within the current framework and have precedents.

5.3 Enhance training pathways for in-demand occupations

5.3.1 Map pathways for existing tradespeople to complete cross-training into new disciplines

- Leverage lessons learned from Cross-Trade Pathways, designed to help apprentices and journeypersons start training in a related trade, recognizing skills developed by their previous training and work experience. This resulted in a cross-trade pilot to become a welder for closely related trades such as boilermaker, industrial mechanic (millwright), sheet metal fabricator and steamfitter/pipefitter.
- Priority trades for consideration would include **in-demand low carbon trades** and possibly **trades at risk with the move to electrify buildings** such as gasfitters.
- Priorities for exploration: **Refrigeration and Air Conditioning Mechanics** (hub trade) and their related trades of plumbers, steamfitters/pipefitters, gasfitters etc., and mass timber **carpenters** (hub trade) and some of their related trades including ironworkers[7] and crane operators.



Lead	Contributors/Partners	Participants
Heating, Refrigeration and Air Conditioning Institute (HRAI) BC Regional Council of Carpenters Mechanical Contractors of BC	• Relevant trades training providers (public and private) • SkilledTradesBC	• Mass Timber Industry • Mechanical Contractors

Timeline
Medium-term (1-3 years)

- A model pathway has been developed and tested in British Columbia, reducing the upfront work required to introduce a new program. The piloted initiative would also offer guidance and insights into what opportunities and limitations exist.
- Leadership from within hub trades and related trades would be necessary to advance initiative.

[7] In the United States steel trades have been leveraged to erect mass timber buildings, leveraging their knowledge of installing large rig beams, columns and floor plates. The learning curve relates to the connection technology and the understanding of wood as a material to protect it.

5.3.2 Assess market need and training pathways for new trades such as BIM Modellers marketing campaign

- BIM Modellers have emerged as a key component of a construction team and low carbon building solutions.
- Convene industry stakeholders employing BIM Modellers to collect data on the prevalence of the trade, the skills required and the current educational pathways.
- Findings would be reviewed by SkilledTradesBC and the Ministry of Post-Secondary Education and Future Skills to assess potential path for designation.
- Outcome from assessment would inform pathways for BIM Modeller designation and training pathways.

Lead	Contributors/Partners	Participants
Architectural Institute of British Columbia Canada Green Building Council Zero Emissions Innovation Centre	• SkilledTradesBC • Ministry of Post-Secondary Education and Future Skills	• Mass Timber Industry • Mechanical Contractors

Timeline
Long-term (3-5 year)

- Low-carbon buildings and the move towards industrialization have resulted in a reliance on BIM Modellers as part of trades teams. However, no work has been undertaken to review and assess the possibility of introducing BIM Modellers as a trade.
- Leadership on this option is not certain and further consultation would be necessary.

5.4 Introduce green curriculum for apprenticeship programs

5.4.1 Continue to evolve the apprenticeship training content for priority trades

- Leverage training options developed by the Canada Building Trades Union (CBTU) to offer environmental literacy training and technical training for instructors and apprentices.
- Leverage training options developed by Colleges and Institutes Canada to upskill instructors within the construction trades departments.

CBTU Building it Green

The Building It Green initiative, funded by the Government of Canada's Union Training and Innovation Program, aims to enhance skilled trades workers' education and understanding of constructing and maintaining net-zero projects. Through an environmental scan, needs analysis, curriculum development, and training evaluation, the initiative seeks to integrate climate literacy into skilled education and training in Canada's construction sector through 14 priority trades. Working with major partners and an Advisory Committee, CBTU aims to support the movement towards a greener construction industry and help Canada achieve its climate objectives.

Lead	Contributors/Partners	Participants
CBTU CICan	• BC Building Trades • Trades Training BC • SkilledTradesBC	• Union training providers (trainers and apprentices) • Trades training colleges (trainers and apprentices)

Timeline

Medium-term (1-3 years)

- In 2023 content was developed and piloted in British Columbia, establishing a precedent and case for integration into the apprenticeship training process.
- Strong leadership through CBTU and CICan to advance objectives.
- Significant work is still required to map out a pathway to adjust apprenticeship content to leverage green building content.
- Consideration of capital funding implications of program changes (i.e., training facility and equipment upgrade), curriculum development costs along with upskilling requirements for instructors to effectively deliver new content.

5.4.2 Ensure reviews of the Red Seal Occupational Standards (RSOS) and curriculum includes input from low carbon subject matter experts (SMEs)

- Review pathways to leverage low carbon subject matter experts at both the standard review stage as well as curriculum development (public sector training institutions and private training providers)
- Identify and secure subject matter experts for priority trades.
- Onboard low-carbon SMEs into Red Seal Occupational Standards (RSOS) review workshops, articulation committees, program advisory committees (PACs) and other existing vehicles for input.

Lead	Contributors/Partners	Participants
Canada Green Building Council Zero Emissions Innovation Centre	• BC Building Trades • Trades Training BC • SkilledTradesBC • Ministry of Post-Secondary Education and Future Skills	• Industry associations • Private sector companies • Public and private training providers

Timeline

Medium-term (1-2 years)

- This recommendation would leverage existing pathways to inform what content is covered in apprenticeships meaning that no new consultation pathways would need to be developed.
- Identifying and securing low-carbon SMEs would be an evolution in the review process and a net-new activity.

5.5 Leverage continuing education for expanded skill development

5.5.1 Create industry incentives for manufacturer training

- Review manufacturer training options for trade contractors in BC and define how to replicate and expand the model.
- Support the expansion of manufacturer training provisions for the HVAC sector and encourage mass timber suppliers (e.g., CLT and fastener manufacturers) to develop and deliver training.
- Support the development of training to help to address the absence of manufacturer training in key sectors such as mass timber.
- Make training a requirement for contractors seeking to purchase, install and service equipment. Added benefits would include discounts to contractors and extended warranties to be passed on to clients.

Lead	Contributors/Partners	Participants
Manufacturers and suppliers of low-carbon products	• Public and private training providers • Provincial government	• Private sector companies

Timeline

Medium-term (1-3 years)

- Current model exists through manufacturers and distributers of HVAC equipment.
- Translation and expansion of model would require time before it could be introduced to market.
- Incentives may be necessary to support training adoption.

5.5.2 Develop continuing education opportunities through TradeUpBC

Develop continuing education opportunities through TradeUpBC that:

- Focus on short-term skill development offerings, including part-time courses, microcredentials and certificates;
- Create a system that recognizes and encourages continuing education;
- Can be developed and delivered by public and private training providers;
- Reflect the interconnected responsibilities and dependencies of tradesperson
- Make training accessible to apprentices in their third year and beyond as well as journeypersons; and,
- Prioritize the following training development opportunities based on identified skills gaps:
  - Peak load and demand management;
  - High performance building envelops;
  - Advanced heat pump systems;
  - Mass timber manufacturing and installation; and,
  - Embodied carbon materials and products.

1 Peak Load and Demand Management

1. **Understanding Peak Demand:** Participants would learn about the concept of peak demand, which refers to the highest amount of electricity consumed during a specific period. They would gain insights into how peak demand affects energy costs, grid reliability, and the environment.
2. **Load Management Techniques:** Participants would gain knowledge about various load management techniques that can be employed in buildings to reduce peak demand. This may involve strategies such as load shifting, where energy-intensive activities are scheduled during off-peak hours, or load shedding, which involves temporarily reducing non-essential electrical loads during peak periods.
3. **Energy Efficiency Practices:** This would include promoting an understanding of efficient HVAC systems, lighting solutions, insulation methods, and building automation systems that optimize energy usage while maintaining occupant comfort.
4. **Smart Grid Technologies:** Participants would cover technologies that enable effective load management in buildings. These technologies may include advanced metering infrastructure (AMI), real-time energy monitoring systems, and automated control systems that allow for more precise tracking and control of electricity usage.
5. **Policy and Regulatory Considerations:** Participants would understand how regulations impact building codes, utility rates, financial incentives for energy-efficient upgrades, and other factors that influence load management strategies.

Relevant Trades/Occupations

- RAC Mechanics
- Electricians
- Instrumentation and controls technicians
- Energy managers
- Facilities managers

2 High Performance Building Envelopes

1. **Understanding the importance of building envelopes:** Participants would receive an overview of high-performance building envelopes in terms of energy efficiency, sustainability, and occupant comfort.
2. **Knowledge of envelope materials and technologies:** Covering various materials and technologies used in constructing high-performance building envelopes, participants would learn about advanced insulation materials, such as spray foam or aerogel, as well as efficient glazing systems like low-emissivity (low-e) glass or triple pane windows.
3. **Thermal bridging mitigation:** Thermal bridging refers to areas where heat easily flows through a material, leading to energy loss and potential condensation issues. Learners would understand how to identify and mitigate thermal bridges by using appropriate insulation techniques or incorporating thermal breaks into the building envelope design.
4. **Air sealing strategies:** Effective air sealing is crucial for maintaining indoor air quality, reducing drafts, and improving energy efficiency. Participants would learn about different methods and products available for air sealing within the building envelope.
5. **Moisture management:** Managing moisture within the building envelope is essential to prevent mold growth and structural damage. The program would educate learners on moisture control strategies, such as vapor barriers or breathable membranes, that help maintain an optimal balance between moisture retention and dissipation.
6. **Integration with HVAC systems:** Participants would understand the importance of integrating high-performance building envelopes with heating, ventilation, and air conditioning (HVAC) systems. They would learn about strategies like heat recovery ventilation (HRV) or mechanical ventilation with heat recovery (MVHR) that enhance indoor air quality while minimizing energy consumption.
7. **Performance evaluation metrics:** They would learn how to assess energy efficiency, airtightness, thermal conductivity, and other key parameters using tools like blower door tests or infrared thermography.
8. **Compliance with building codes and standards:** Understanding the relevant building codes and standards related to high-performance building envelopes is essential. Participants would gain knowledge about local regulations, green building certifications (such as LEED® or Passive House), and industry best practices that ensure compliance and promote sustainable construction.

Relevant Trades/Occupations

- Carpenters
- Sheet metal workers
- Insulators
- Glaziers
- Other professionals involved in the design or renovation of the exterior walls or roofs of commercial or residential buildings

3 Advanced Heat Pump Systems

1. **System Design and Installation:** Participants would learn how to design and install advanced variable refrigerant flow (VRF) and heat pump systems for various applications, taking into account factors like building size, heating and cooling requirements, energy efficiency goals, and environmental considerations. They would understand the importance of proper sizing, selecting components (compressors, coils, expansion valves), ductwork design, and system control strategies.
2. **Energy Efficiency Optimization:** Offers techniques to optimize the energy efficiency of heat pump systems. Participants would learn about advanced controls, variable speed drives, thermal storage integration, and other technologies that can enhance system performance while minimizing energy consumption.
3. **Troubleshooting and Maintenance:** Participants would acquire troubleshooting skills to identify and rectify common issues with advanced heat pump systems. They will also learn about preventive maintenance practices to ensure optimal system performance and longevity.
4. **Refrigerants:** Content would cover lower global warming potential (GWP) refrigerants. Participants would learn about the selection, installation, and commissioning of environmentally friendly refrigerants that have reduced impact on global warming. The course would also emphasize safety measures and guidelines associated with handling these alternative refrigerants to minimize risks during their use in various cooling systems.
5. **Environmental Impact:** The microcredential would highlight the environmental benefits associated with using advanced heat pump systems compared to traditional heating and cooling methods. Participants will explore topics such as reducing greenhouse gas emissions through decarbonization efforts and utilizing renewable energy sources for powering heat pumps.
6. **Regulations and Standards:** Participants would familiarize themselves with relevant regulations, codes, and standards governing the installation and operation of advanced heat pump systems. This includes knowledge of safety protocols, refrigerant handling guidelines, local building codes compliance, and understanding incentives or subsidies available for promoting clean energy solutions.
7. **Integration with Renewable Energy Systems:** Integration possibilities between advanced heat pump systems and renewable energy sources like solar photovoltaics or wind power. Participants would learn how to maximize the benefits of combining these technologies to achieve higher energy efficiency and further reduce carbon footprint.

Relevant Trades/Occupations

- Plumbers,
- RAC Mechanics
- Sheet metal workers
- Instrumentation and controls technicians
- Electricians

4 Mass Timber Manufacturing and Installation

1. **Understanding of Mass Timber:** Participants would gain a comprehensive understanding of mass timber, including its various types such as cross-laminated timber (CLT), glued laminated timber (glulam), and nail-laminated timber (NLT).
2. **Manufacturing Processes:** Learners would become familiar with the manufacturing processes involved in producing mass timber components. This includes knowledge about wood selection, cutting techniques, adhesive application, and assembly methods for creating panels or beams. They would also gain skills in quality control measures to ensure the production of high-quality mass timber products.
3. **Design Considerations:** Participants would understand the design considerations specific to mass timber structures. They learn about load-bearing capacities, connections between different components, and how to optimize designs for structural efficiency and safety. Additionally, they explore architectural possibilities offered by mass timber construction and how to integrate it into building projects.
4. **Installation Techniques:** There is a need for practical skills related to handling, transporting, and installing mass timber components on construction sites. Participants would learn best practices for safely erecting large-scale mass timber structures while considering factors like temporary bracing, alignment accuracy, connection detailing, and finishing procedures.
5. **Safety Regulations:** One crucial aspect to be covered is the adherence to safety regulations throughout the manufacturing and installation processes. Learners would gain an understanding of safety guidelines specific to working with mass timber materials, including proper handling techniques, personal protective equipment (PPE) requirements, fire protection measures, and site-specific safety protocols.
6. **Sustainable Practices:** Participants would learn about the responsible sourcing of raw materials from certified forests, waste reduction strategies during manufacturing processes, carbon sequestration benefits of using wood-based materials over traditional construction materials, and the overall positive environmental impact of mass timber construction.

Relevant Trades/Occupations

- Carpenters
- Ironworkers
- Glaziers
- BIM Modellers
- Steelworkers
- Other trades working in the construction of mass timber buildings

5 Embodied Carbon Materials and Products

1. **Understanding the concept of embodied carbon:** Providing an overview of what embodied carbon is and how it relates to construction materials and products, participants would learn about the different sources of embodied carbon, including extraction, manufacturing, transportation, and disposal.
2. **Assessing embodied carbon in materials and products:** Participants would gain knowledge on how to calculate and assess the embodied carbon in various building materials and products. This includes understanding life cycle assessment (LCA) methodologies and tools used to measure carbon footprints.
3. **Identifying low-carbon alternatives:** Explore alternative materials and products with lower embodied carbon content. Participants would learn about sustainable design strategies that prioritize using environmentally friendly options such as recycled or renewable materials.
4. **Evaluating environmental impact:** In addition to considering embodied carbon, participants would also learn about other environmental impacts associated with construction materials, such as resource depletion, water usage, and air pollution. They would gain an understanding of how these factors relate to sustainability goals.

Relevant Trades/Occupations

- Plumbers
- RAC Mechanics
- Sheet metal workers
- Instrumentation and controls technicians
- Electricians

6 Conclusion

Building Our Future highlights the crucial need to prioritize and invest in the training and education of building construction trades.

The strategy clearly demonstrates that simply adapting existing training and education programs is not enough. It is imperative that we invest in initiatives that encompass all aspects of workforce development, including recruitment campaigns, curriculum enhancements, industry partnerships, apprenticeship programs, and continuous learning opportunities.

By placing an emphasis on strengthening the training and education of building construction trades, we can ensure that workers are equipped with the necessary skills and knowledge to construct energy-efficient buildings that contribute to a more sustainable future. This will not only benefit the environment but also create new job opportunities, drive economic growth, and improve overall societal well-being.

To achieve these goals, collaboration between government agencies, educational institutions, industry stakeholders, and trade associations is essential. Together, we must ensure adequate support for training providers, promote awareness of career opportunities in construction trades, and establish robust mechanisms for ongoing professional development.

Ultimately, investing in the training and education of building construction trades is an investment in our collective future. By equipping workers with the skills needed to construct low-carbon buildings, we can mitigate the impacts of climate change and create a more sustainable built environment for generations to come.

Annex A: Key Stakeholders roles and responsibilities

The Governance Committee, which composed of organizations that inform the key pathways for trades training in British Columbia, advanced the ***Low-Carbon Trades Training Strategy*** by participating in conference calls to offer insights and utilizing their specialized expertise in reviewing and providing feedback as requested by the Project Manager.

The Governance Committee comprised of the following members:

- BC Building Trades
- Trades Training BC
- SkilledTradesBC
- Building to Electrification Coalition
- Ministry of Energy, Mines and Low-Carbon Innovation – Built Environment
- Ministry of Post Secondary Education and Future Skills

Various industry associations, private companies, B.C. trades training schools, regulators, government bodies, and non-profit organizations actively engaged in the development of the strategy through interviews and workshops, offering invaluable feedback. Their collective expertise in educating tradespeople, introducing green skills training, navigating apprenticeship recruitment, and outlining effective training pathways significantly contributed to shaping the low-carbon framework, refining the strategy development, and providing insights into future possibilities and innovative opportunities.

Stakeholders engaged are listed below:

Industry Associations (Organization)
Heating, Refrigeration and Air Conditioning Institute of Canada
Thermal Environmental Comfort Association
Mechanical Contractors Association of BC
Independent Contractors and Businesses Association of BC
ASHRAE BC
BC Building Envelop Council
Canadian Institute of Plumbing & Heating
BC Insulators Contractors Association
BC Regional Council of Carpenters
Private Sector Companies
Olympic International
Sustainable Refrigeration & Air Conditioning
Trane Commercial
Small Planet Supply
Mitsubishi Electric Sales Canada Inc.
Westport Mechanical
Airtec Energy Systems Limited
Whirlwind Consultants
Chandos Construction
Seagate Mass Timber
Mass Timber Connections Solutions
Kalesnikoff Mass Timber
Pitt Meadows Plumbing

Education Organization
Colleges and Institutes Canada
Canada Building Trades Union
Construction Foundation of BC
BC Centre for Women in the Trades
Union-backed Training Provider
Sheet Metal Industry Training Board (SM Local 280)
Electrical Joint Training Committee (IBEW Local 213)
Western Jets
Colleges and Institutes
British Columbia Institute of Technology
Thompson Rivers University
Vancouver Island University
Okanagan College
Selkirk College
North Island College
College of the Rockies
Coast Mountain College
Nicola Valley Institute of Technology
Government and Regulators
Ministry of Post Secondary Education and Future Skills
BC Hydro
Metro Vancouver
City of Victoria
Climate Action Secretariat
Office of Mass Timber
Building and Safety Standards Branch
Non-profits and Supporters
Future Skills Centre
Passive House Canada
Pembina Institute
Community Energy Association
Vancity Community Foundation

Initial Review: Member(s) of the following organizations provided initial feedback and comments on the draft strategy:

- The Canada Green Building Council's Technical Advisory Groups
- The City of Calgary

Apprenticeship workshop:

To validate the findings and recommendations gathered from the workshops and interview engagements, we conducted an in-person workshop at the BCIT campus. The workshop brought together 43 apprentices from priority trades, including carpenters, electricians, security systems technicians, gas fitters, pipe fitters, and HVAC professionals. Its primary objective was to assess apprentices' interest in acquiring low-carbon skills, evaluate the effectiveness of their training, identify training-related challenges and opportunities, and address barriers for equity-deserving groups.

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