



MARCH 2024

Making mass timber in Northern BC

An evaluation of the readiness of workers and policies for producing more mass timber products in North-Eastern British Columbia

About the PLACE Centre

The PLACE Centre, which stands for Propelling Locally Accelerated Clean Economies, focuses on the complex challenges limiting clean economic growth in Canadian communities. Our core approach is “place-based,” meaning the PLACE team works with all levels of government, industry, and civil society organizations to ensure regions across Canada have the solutions needed to overcome the challenges they face in advancing clean economic growth. With this approach, the PLACE team can create practical, place-based recommendations where everyone involved can collaborate and work towards making progress in solving these problems. That way, every region and community across the country can be included in, and benefit from, Canada’s growing clean economy.

placecentre.smartprosperity.ca

About Smart Prosperity Institute

Smart Prosperity Institute is a national research network and policy think tank based at the University of Ottawa. We deliver world-class research and work with public and private partners to advance practical policies and market solutions for a stronger, cleaner economy.

institute.smartprosperity.ca

About the Future Skills Centre

The Future Skills Centre (FSC) is a forward-thinking centre for research and collaboration dedicated to driving innovation in skills development so that everyone in Canada can be prepared for the future of work. We partner with policymakers, researchers, practitioners, employers and labour, and post-secondary institutions to solve pressing labour market challenges and ensure that everyone can benefit from relevant lifelong learning opportunities. We are founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada, and are funded by the Government of Canada’s Future Skills Program.

fsc-ccf.ca

Acknowledgements

This report is written by Caroline Meier, Hem Dholakia, and John McNally. Editing support was provided by Rebecca Babcock. Design was provided by Karianne Blank. The authors would like to thank the team at the College of New Caledonia for their support and expertise in this project. The authors would also like to thank Pablo Crespell-Montero, Alexander Stephens, and Jianhui Zhou for their comments and review. This report does not necessarily reflect the views of the funder or any of the reviewers. Any errors remain the sole responsibility of the authors.

Suggested Citation

Meier, C., Dholakia, H., & McNally, J. (2024). *Making mass timber in Northern BC: An evaluation of the readiness of workers and policies for producing more mass timber products in North-Eastern British Columbia*. The PLACE Centre. Smart Prosperity Institute.

March 2024

With support from



**Smart Prosperity
Institute**



**Future
Skills
Centre** Centre des
**Compétences
futures**

Canada 

The report *Making mass timber in Northern BC: An evaluation of the readiness of workers and policies for producing more mass timber products in North-Eastern British Columbia* is funded by the Government of Canada’s Future Skills Program. The opinions and interpretations in this publication are those of the author and do not necessarily reflect those of the Government of Canada.

Abbreviations

3D	Three-dimensional
BC	British Columbia
BCIT	British Columbia Institute of Technology
BFH	Bern University of Applied Sciences
BIM	Building information modelling
CLT	Cross-laminated timber
CNC	Computer numerical control
NLC	Northern Lights College
SME	Small and medium-sized enterprises
TH Rosenheim	Rosenheim Technical University of Applied Sciences
TU Graz	Graz University of Technology
UBC	University of British Columbia
UNBC	University of Northern British Columbia

Table of contents

Executive Summary	1
Introduction	5
Report overview	6
Overview of Northern British Columbia	7
Forestry and Northern BC	7
The future of the forestry sector in Northern BC.....	8
What is a skills ecosystem approach?	11
Case study: DACH region	13
Training and educational providers	13
Employers	17
Learners/workers	17
Policymakers	18
Coordinating bodies.....	19
Key Observations	20
Analysis of the existing mass timber skills ecosystem in Northern BC	21
Training and educational providers	22
Employers	27
Policymakers	28
Coordinating bodies.....	30
Learners/Workers.....	31
Discussion: How ready is the North-Eastern BC skills ecosystem for mass timber projects?	32
Level of readiness: educational providers.....	32
Level of readiness: employers.....	33
Level of readiness: policies and programs	33
Level of readiness: coordinating bodies.....	33
Priorities for North-Eastern BC's skills ecosystem to integrate mass timber	34
Conclusion	36
Appendix 1: Methodologies used in this report	37
Appendix 2: Relevant degrees and programs: production of mass timber	38
Appendix 3: Summary of relevant wood manufacturing programs offered at the University of British Columbia	40
Appendix 4: Currently available federal and provincial grants for mass timber-specific courses in North-Eastern BC.....	41
Appendix 5: Assumptions and limitations	42
Endnotes	43

List of Tables

Table 1: Summary of select existing occupations impacted by mass timber growth and new skills requirements throughout the mass timber supply chain	10
Table 2: Overview of relevant degrees offered at the Rosenheim Technical University of Applied Sciences	14
Table 3: Overview of relevant degrees offered at the Bern University of Applied Sciences School of Architecture, Wood and Civil Engineering	15
Table 4: Overview of relevant degrees offered at Graz University of Technology	16
Table 5: Summary of specialized mass timber courses currently available in North-Eastern BC	24
Table 6: Highest certificate, diploma, or degree for the population aged 25 to 64 years in private households, adapted from Statistics Canada, 2021 Census	25
Table 7: Summary of programs funded through the Canada-British Columbia Workforce Agreement.....	29
Table 8: Relevant degrees and programs: production of mass timber	38
Table 9: Summary of relevant of relevant wood manufacturing programs offered at the University of British Columbia	40
Table 10: Currently available federal and provincial grants for mass timber-specific course in North-Eastern BC	41

List of Figures

Figure 1: Map of select communities in North-Eastern BC	7
Figure 2: Key stakeholders in a skills ecosystem and their core functions, adapted from the Conference Board of Canada	12
Figure 3: Map of all campus locations	23



Executive Summary

Rural and resource communities in Northern British Columbia (BC), impacted by the downturn of the primary forestry sector, are increasingly exploring avenues to capture and produce greater economic value within the forestry sector. Mass timber products, a category of wood products often used in prefabricated construction projects, offer an opportunity for realizing economic benefits, such as investment attraction and job creation, as well as climate benefits, such as lowering the emissions intensity of construction projects. Yet capturing these economic and climate benefits is not a simple task and will require reducing the uncertainties stakeholders currently face and developing a strong foundation of talent (and investor interest) upon which prosperity can be built. One critical aspect of this foundation is ensuring that a robust skills ecosystem—a network of stakeholders and institutions, including post-secondary institutions, employers, coordinating bodies, learners, and governments, working on skills and labour challenges in a given region or sector—exists to support the development of a skilled and capable workforce. A lack of skilled workers is far from the only relevant factor impeding future growth in the sector—current market demand, fibre supply challenges, infrastructure gaps, and other barriers will also need to be addressed—but it is indisputably important. When mass timber has become an established economic opportunity in other regions globally, the emergence of a skills ecosystem has played a critical role in supporting this shift. Given the desire of policymakers to ensure that new investments in the forestry sector offer economic benefits to communities that have historically not benefitted when the sector changes, identifying the readiness of Northern BC's skills ecosystem to support the emergence of mass timber is essential.

This report evaluates the skills ecosystem in North-Eastern BC against two standards: First, how well does this ecosystem line up with the skills changes mass timber will bring throughout the supply chain? Second, how well does it compare to other mass timber production and adoption success stories globally? We find the ecosystem, as one component of building an industry, is currently fairly well positioned to support this growth. Programs exist from post-secondary institutions, such as the University of Northern British Columbia (UNBC), the College of New Caledonia, and Northern Lights College (NLC). These institutions offer many of the degrees and diplomas required to fill skilled positions within the mass timber supply chain. While mass timber-specific knowledge and skills (such as advanced wood manufacturing, carpentry, and engineering) will still need to be further emphasized or added to existing curriculums, these adjustments will largely build on high-quality programming already in the region. Additionally, coordinating bodies like the Quesnel Forestry Initiatives Program¹ and Forestry Innovation Investment² can be useful in helping secure this opportunity.

When compared to global success stories in mass timber, many of the region's post-secondary institutions and their associated education programs, as well as coordinating bodies (i.e., industry networks, career counsellors, etc.), are well-positioned to play a role. There are also striking similarities to the thriving mass timber ecosystem located in the DACH region (a wood manufacturing cluster located in Germany (D), Austria (A), and Switzerland (CH)). However, where Northern BC falls short is that there is currently a lack of employers in mass timber manufacturing. A strong ecosystem requires employers to be present in the region, both to hire learners and to ensure coordination

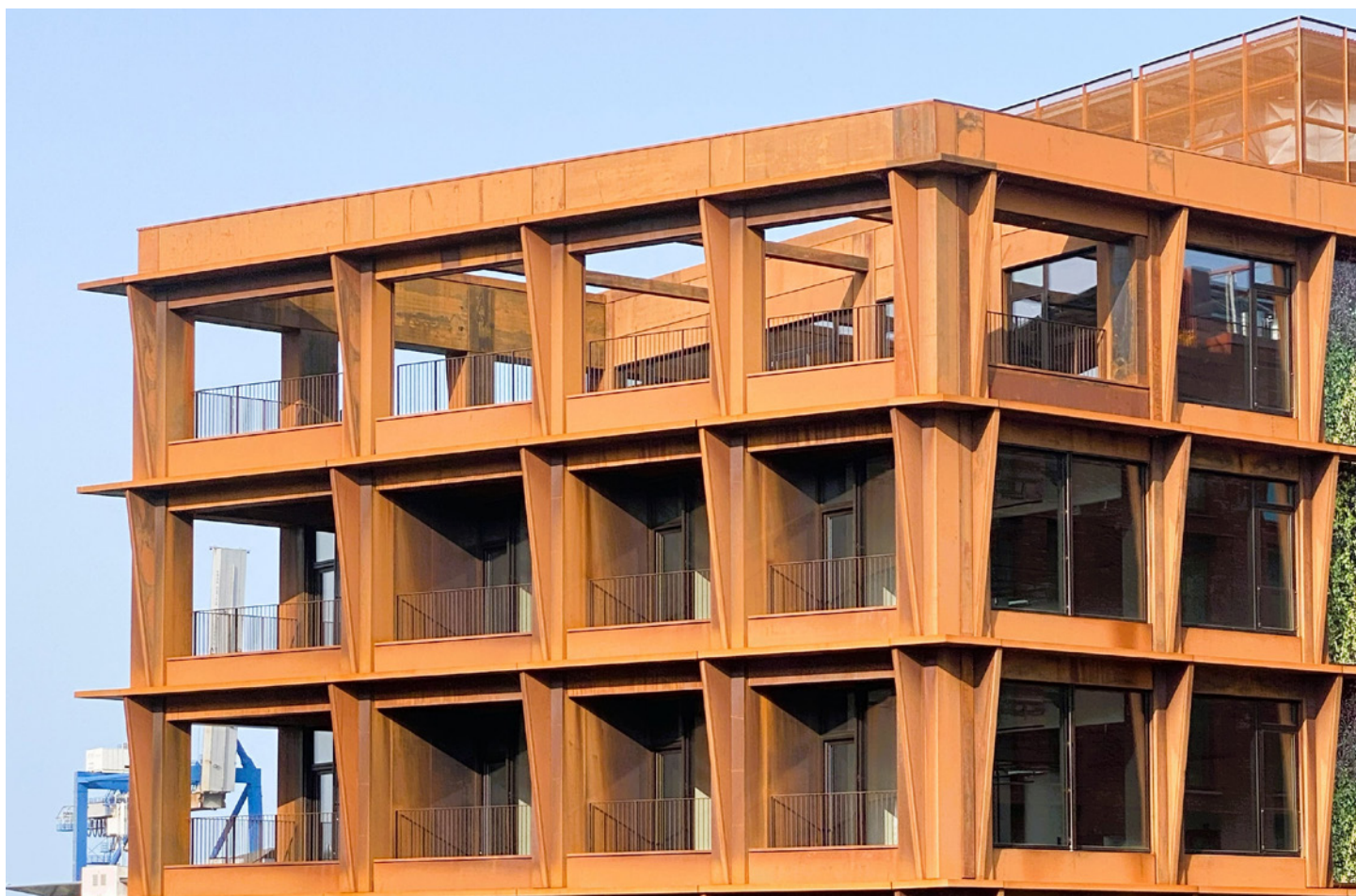
between employers and educators/training groups. In the absence of a strong employment base, the ecosystem's efficacy will always be limited.

For mass timber production to thrive within Northern BC, the first step is therefore to attract mass timber production or manufacturing capacity to the region. Here, challenges beyond skills needs must be addressed. A lack of supporting infrastructure (such as a lack of railways and other transportation infrastructure to bring products to market), uncertain market demand tempering investment attractiveness for panel manufacturing, and the challenges small and medium-sized enterprises (SMEs)—which the majority of mass timber producers are—face in securing adequate timber supply all need to be addressed. In recent years, a wood manufacturing project in Mackenzie, did not come to fruition due to no local access to fibre. Similarly, in Fort St. John, the plan for a wood pellet plant has been put on hold due to a lack of railway infrastructure. These two challenges should be prioritized to get employers to invest in the region. If this occurs, then this analysis shows the current skills ecosystem will largely be able to support the growth of mass timber.

To help secure this growth, this report has identified six priorities for the provincial government to advance in order to round out this skills ecosystem and bolster its potential to service a future mass timber sector.

Priority 1: Attracting employers

The biggest gap in the current skills ecosystem in North-Eastern BC is the lack of mass timber manufacturers. Therefore, attracting employers within mass timber manufacturing specifically, as well as value-added wood manufacturing more broadly, should be one of the key priorities for the region. While North-Eastern BC needs to attract employers in general, various barriers must be addressed to make this more feasible (see Priority 2). In the absence of these barriers being meaningfully addressed, the region could prioritize opportunities with fewer barriers by focusing on communities that have no transportation issues and have existing SMEs (such as sawmills) with reliable fibre access. Combining the growing interest from several sawmills to diversify their operations and enter the mass timber manufacturing space with existing funding opportunities for capital investments and programs for on-the-job training could help more existing SMEs begin to manufacture mass timber in the region. One strategic approach that North-Eastern BC could adopt from the DACH region is adopting a broader, more diversified approach to wood manufacturing. This approach resulted in the setting up of many diversified wood manufacturing businesses in the DACH region, which ultimately boosted the skills ecosystem. Most of the well-established mass timber manufacturers in the DACH region started as small family-run SMEs, such as sawmills. They gradually diversified into a variety of wood products, including mass timber. Other mass timber manufacturers within BC have followed a similar path, notably Kalesnikoff.



Priority 2: Addressing major barriers, with a special focus on infrastructure and fibre access

A lack of transportation infrastructure and access to fibre have been major bottlenecks preventing the recent establishment of value-added opportunities in North-Eastern BC, notably in Mackenzie and Fort St. John. In Mackenzie, an interested manufacturer was unable to secure access to fibre. Furthermore, the Mackenzie region has some of the highest transportation costs for wood in the province, which could impact the competitiveness of a potential local mass timber manufacturer. In Fort St. John, a required railway upgrade did not receive the necessary provincial funding, preventing the needed access to deliver locally manufactured products to markets further South. Northern BC requires appropriate transportation infrastructure, notably railways, to support greater market access for their locally manufactured wood products, including mass timber. Considerations also need to be given to enhancing transport accessibility for SMEs to help drive down regional production costs. While this is a priority for the whole region, it is more of an immediate bottleneck for some of the more remote, northernmost communities, such as Mackenzie and Fort Nelson, and less of a concern for less remote and better-connected communities like Prince George. Additionally, the difficulty for SMEs to access fibre must be addressed since this is one of the most significant concerns stakeholders have expressed. The German Charter for Wood 2.0 can be seen as a useful example of an initiative that seeks to increase the value of the local wood sector and aims to tackle various issues and bottlenecks along the value chain of wood products.³ Finally, it should be noted that some stakeholders expressed concerns about uncertain market demand for mass timber products. This report acknowledges that taking these steps is unlikely to resolve this uncertainty.



Priority 3: Enhancing the funding and accessibility for mass timber-related education in Northern BC and beyond.

The BC and federal governments provide funding for various upskilling and reskilling initiatives, including certain micro-credentials. Additionally, the federal government has fully funded the mass timber micro-credential at British Columbia Institute of Technology (BCIT) so that it was available to learners at no cost. It has, however, experienced such high demand that the available funding has been exceeded. Meanwhile, the Mass Timber Development micro-credential at UNBC was only partially funded by the provincial government. Micro-credentials are a useful tool to provide additional skills to qualified professionals within a field, but they cannot replace complete degree requirements for highly skilled professionals crucial to the growth of mass timber, notably engineers and skilled trades professionals. Still, full degrees at both universities and colleges remain expensive for many Northern BC learners. Micro-credentials may also not be the best tool for training all occupations, as skilled trades professionals would likely benefit more from expanding existing training. North-Eastern BC has a general shortage of workers in occupations such as engineering, and many communities have a population decline with people moving away. Opportunities should be explored to improve the affordability of specific education programs, ideally providing an incentive for graduates to stay within the region. One example could be a tuition rebate program, such as the Saskatchewan Graduate Retention Program.

Priority 4: Developing deeper partnerships between North-Eastern BC institutions and international leaders in wood manufacturing training and education.

Developing new programs and courses typically takes several years, which can make it difficult to quickly adapt to newly emerging skills requirements and to fill knowledge gaps for innovative opportunities, including mass timber. Other jurisdictions, notably the DACH region, already have developed highly relevant curricula and programs, which offers an opportunity for increased collaboration between these institutions with more established programs and North-Eastern BC institutions. Individual professors at the College of New Caledonia, NLC, and UNBC have highlighted their established relationships with professors in the DACH region and support increased collaboration with these institutions, including around adapting existing curriculums. Currently, there are very few mechanisms in place that would promote institutional collaboration and create knowledge transfer opportunities, including student and faculty exchange or opportunities for joint projects. By embracing collaboration across universities, it will be easier to fill knowledge gaps and promote innovation within the mass timber space in Northern BC and could fast-track the development of highly relevant programs.

Priority 5: Broadening the focus of micro-credentials, diplomas, and degree programs to include wood skills more broadly, not just mass timber.

Mass timber is a growing clean growth opportunity, but it should be viewed in the larger context of a growing forest bioeconomy and wood-related skills. Presently, mass timber is a relatively minor economic opportunity for most learners, especially in North-Eastern BC, which (as previously stated) currently has no mass timber manufacturers. It is therefore difficult to justify focusing solely on the mass timber opportunity for educational institutions, communities, and learners alike. Instead, wood-specific skills and training should be heavily prioritized in curriculums for degrees and programs that are not already focused on wood, including the one-year foundational engineering program at the College of New Caledonia and NLC, the longer engineering programs at UNBC, and the business management-related programs at the College of New Caledonia, NLC and UNBC (to inspire and prepare wood entrepreneurs). Curriculums should be developed in close collaboration with local companies as well. Ideally, the College of New Caledonia, NLC, and UNBC revisit the idea of creating a local wood technology program. This program had previously been developed in the region but was then suspended. This is also supported by a key finding from the DACH region, which has a highly developed mass timber skills ecosystem built upon a strong wood skills ecosystem combined with a focus on fostering entrepreneurship. Most mass timber-related skills are taught as part of broader wood-related programs and courses, such as wood technology, allowing learners to explore mass timber as one of many innovative wood products. A broader, more generalized wood-focused curriculum also produces graduates that can occupy a variety of

positions and occupations along the supply chain of mass timber and other wood products, equipping them all with digital skills, such as three-dimensional (3D) modelling, computer-aided design, building information modelling (BIM) and the use of computer numerical control (CNC) machines, and high levels of practical work experience. Different mechanisms, such as exchange opportunities with DACH region universities and more funding for dedicated degrees in wood technology, could also help local institutions structure their curriculum and encourage more people to register. While mass timber-specific micro-credentials are a great way to upskill and reskill the existing workforce, a broader awareness and knowledge of wood is key. This would ideally also be supported by more work-integrated learning opportunities for students, but this is currently not feasible in the absence of local mass timber manufacturers.

Priority 6: Creating a platform to offer an overview of all educational offerings

There are currently a multitude of relevant courses, programs, micro-credentials, and diplomas available to interested learners and companies in the wood manufacturing and mass timber space, and offerings, including virtual programs, are rapidly growing. Learners are therefore able to tap into a greater pool of potential educational offerings. However, stakeholders note that what is missing is a well-maintained platform providing an overview of all educational offerings, similar to what the Swiss Timber Construction Industry Association offers.⁴ Such a platform would help students know what learning options are available, and could also support coordinating bodies, such as employment agencies, to better connect individuals with upskilling opportunities and would make knowledge and skills gaps in education programs more visible.





Introduction

Producing more mass timber products represents a clean economic opportunity in British Columbia (BC).⁵ However, many stakeholders in the mass timber space, including in manufacturing and construction, perceive it as a relatively niche opportunity in its early stages. This perception of limited economic impact influences discussions around supporting this technology and the extent to which stakeholders should prepare for the growth of an opportunity where the impact could be small. Yet regardless of how big the market may be eventually, there is consensus that it will grow from today's levels, and provincial policies have been developed to support that outcome. The Government of British Columbia has launched a variety of initiatives and programs, including creating the Office of Mass Timber Implementation, drafting a Mass Timber Action Plan,⁶ and funding programs such as the BC Manufacturing Jobs Fund.⁷ In fact, this fund already has dedicated funding for creating new mass timber facilities or expanding existing mass timber manufacturing plants in Williams Lake and Mill Bay.⁸ According to the Government of BC, the province could have ten net new mass timber manufacturers by 2035, which could create up to 4,400 additional jobs in sectors along the supply chain of mass timber, including manufacturing, construction, and design.⁹

Given mass timber's likely growth, an important question that arises is where this growth might occur. Answering this question involves understanding which regions are best suited or prepared to invest in (and capture the benefits of) forest product innovation. These regions are not always aligned with areas where the economic benefits of new investments could be largest, nor where policymakers may ideally wish to create jobs and drive investment. One region that may not be considered but where greater growth is desired amongst its communities is North-Eastern British Columbia, a region that includes

communities such as Prince George, Mackenzie, Chetwynd, Fort Nelson, and Quesnel. Unfortunately, even with a legacy of forestry activity, the downturn of the traditional forestry sector impacted this region. Stakeholders in the region noted an active interest in pursuing more value-added manufacturing opportunities for forest products, however they were also frank in their beliefs that investment and attention from policymakers would be needed to make the region more attractive to investors in mass timber production.

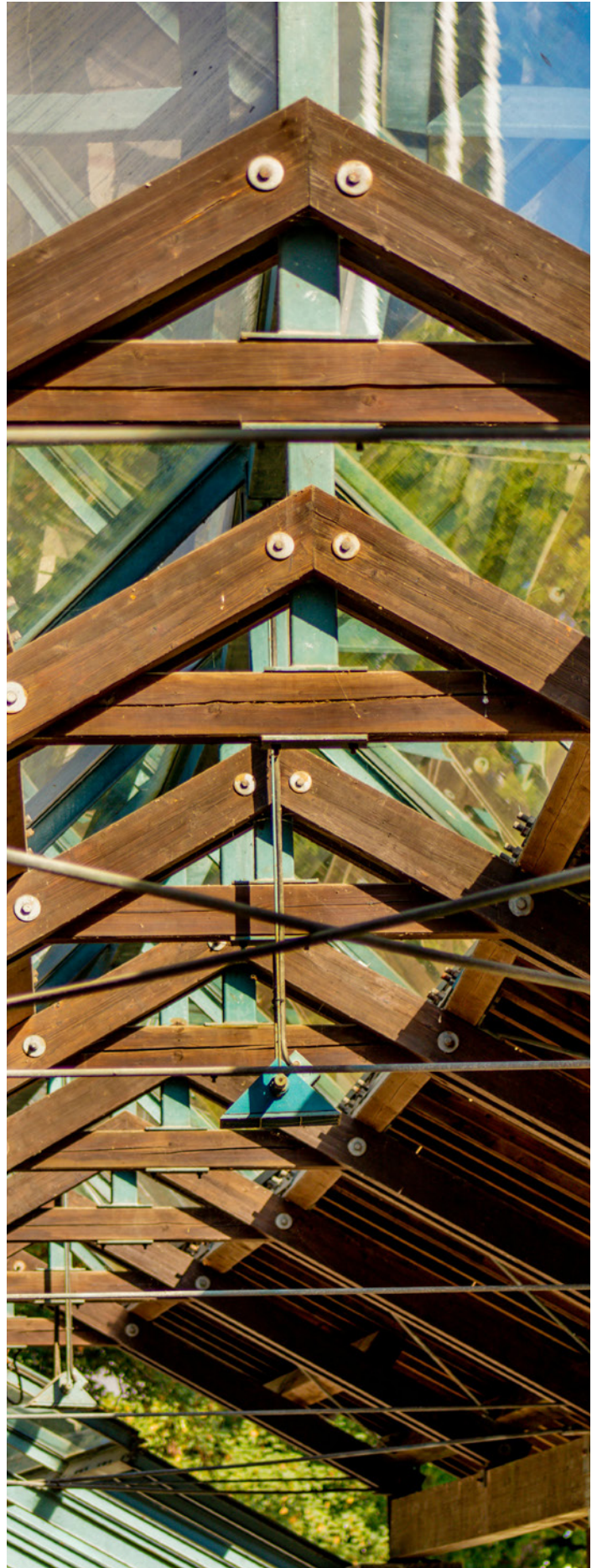
Focus must be given to improving the readiness of regions like North-Eastern BC for innovation and investment, otherwise a worrying trend of widening existing economic disparities may accelerate. The current growth trajectory of mass timber production and adoption already shows significant regional differences, with all mass timber manufacturing facilities in the province located in more Southern regions of BC. Stakeholders note that this centralization of forestry processing operations around the Lower Mainland, with wood transported to large mills from more Northern, rural regions, has already contributed to widespread mill closures and jobs lost in many Northern communities.¹⁰ If unaddressed, this centralization could further existing economic disparities, impacting workers and families, and forestry communities in the province's North may lose out yet again.

This outcome is not inevitable. This report proposes policy solutions to help ensure more communities in Northern BC, with a specific focus on North-Eastern BC, can realize the benefits of investments in mass timber production. Careful planning, thoughtful coordination, and bold decision-making at all levels of government will be needed to create jobs and attract investment in the communities that need it most. Key to the success of any regional economic initiative is the need for investments

in skilled talent. Investments in a skills ecosystem (a network of stakeholders and institutions, including post-secondary institutions, employers, coordinating bodies, learners, and governments, working on skills and labour challenges in a given region or sector) for example, allow for individuals to access high-quality education more readily, support local companies by creating a strong local talent pool, and can serve as an economic engine to support communities. For the mass timber opportunity to be captured in North-Eastern BC, the skills ecosystem will need to be capable of supporting individuals, educating and training workers efficiently and effectively, and helping transition individuals into employment opportunities.

Report overview

This report focuses specifically on the readiness of the skills ecosystem in the North-Eastern communities within the province. By doing so, it seeks to complement important work that is already being done in the mass timber space and aims to fill gaps that have been identified as part of this research, specifically the sidelining of the skills discussion and the lack of exploration into the mass timber opportunity for Northern BC. This report begins by detailing the challenges facing Northern and North-Eastern BC, offering insights into the current state of affairs. It then outlines the analytical framework used in this report—a skills ecosystem perspective, focusing on value-added wood manufacturing. This analytical framework is then applied to two regions: The first is a case study of a recent success story of value-added wood manufacturing in the DACH region (a region representing Germany (D), Austria (A) and Switzerland (CH)), which identifies why the opportunity was successful in the region. The same framework is then applied to North-Eastern BC to help policymakers identify the areas of strength and the opportunities for improvement in a region aiming for the growth of a similar sector, which is in part based on the skills and labour needs identified in [Framing BC's low-carbon future: Identifying the skills and workforce needs of British Columbia's growing mass timber sector](#). Finally, this report concludes with recommendations about how the gaps identified in the skills ecosystem can be plugged and what lessons the DACH region may be able to offer to communities in North-Eastern BC.





Overview of Northern British Columbia

Forestry and Northern BC

The specific geographic boundaries of Northern BC differ based on several factors, and this report will not attempt to determine where the “North” begins and ends. Rather, this report focuses on communities in North-Eastern BC regularly mentioned by the stakeholders engaged in this project, including communities such as Prince George, Mackenzie, Chetwynd, Fort Nelson, and Quesnel. The town of Quesnel has been included in our discussion due to its significant involvement in discussions around value-added manufacturing with other Northern communities.

Northern BC is rich in various natural resources. During the mid-20th century, the focus on natural resource exploration, development, and extraction led to the formal creation and incorporation of various small and often dispersed communities in BC’s North into the towns known today, such as Chetwynd (1957), Mackenzie (late 1960s), and Fort Nelson (1971). This process was further supported by the expansion of the Pacific Great Eastern Railway from Prince George to communities such as Mackenzie and Chetwynd, reaching as far North as Fort Nelson. This expansion connected the province’s Northern regions with the Vancouver area, mainly to transport natural resources such as lumber and other wood products.¹¹ Many of these small resource-dependent towns typically had, and continue to have, relatively low levels of economic diversification and few ready economic alternatives to resource extraction and production. This reality has made their economic fortunes highly dependent on resource management-related decisions made by the provincial government and large corporations, typically located in much more metropolitan areas outside of Northern BC.¹²

Figure 1: Map of select communities in North-Eastern British Columbia



The economic downturn experienced in the 1980s is often referred to as a turning point for BC's economy,¹³ including for the forestry sector and Northern BC.¹⁴ During its booming years, BC's forestry sector expanded, focusing on ever-larger volumes of commodity-based wood products. However, global competition, market forces, and a declining fibre supply have been eroding this growth strategy since the early 1980s.¹⁵ The downturn in the forestry sector has led to an increasing centralization of forestry processing operations over several decades.¹⁶ This centralization trend has led to the closure of smaller sawmills in remote communities with higher transportation costs (due to longer distances) and the establishment of "super mills," such as the one in Houston, launched in 2004, which was at the time the world's largest sawmill.¹⁷ Even super mills are not safe from closures however, and in January 2023, Canfor announced the closure of this sawmill in Houston and another sawmill in Chetwynd.¹⁸ This trend of closures has been exacerbated by increased fibre supply destruction from natural disasters and insects, including high rates of climate change-driven wildfires and outbreaks of mountain pine beetles and spruce beetles.

The centralization of forestry operations has had particularly negative impacts on smaller resource-dependent communities in Northern BC,¹⁹ especially those with a high reliance on the forestry sector and low levels of economic diversification. Communities such as Chetwynd, Fort Nelson, Houston, Mackenzie, Quesnel, and Prince George have all been heavily impacted by the closure of numerous mills. In 2023 alone, over 600 people were affected by closures in Prince George, Chetwynd, and Houston.²⁰ In addition to lost jobs, communities affected by mill closures also face a decrease in future revenues vital to providing municipal services. For example, Mackenzie lost \$900,000 annually in expected tax revenues following the closure of a local pulp mill.²¹

The future of the forestry sector in Northern BC

The changes seen in the traditional forestry sector have affected not only these Northern communities but also the provincial economy. As such, discussions around the need to move away from a high-volume forestry sector towards a high-value forestry sector have been underway since the 1980s.²² To support these objectives, the Government of BC has introduced multiple policies and visions for the forestry sector over the years in an effort to move towards a high-value, diversified sector.²³ These include more recent supports for mass timber. However, despite long-standing discussions on, and the growing recognition of, the potential of a high-value, diversified forestry sector, the BC forest sector mostly remains a high-volume rather than a high-value sector.

Amidst the absence of successful provincial action on moving towards a high-value sector, some of the communities most severely affected by the latest rounds of mill closures have started exploring opportunities in the value-added wood product space to diversify their local economies, as well as to maximize the value of the available fibre supply. Quesnel, for example, created their Forestry Initiatives Program and has been holding regular strategy and planning sessions since 2018 to tackle some of the most pressing and interconnected issues facing the community, convening local stakeholders to create 'home-grown' solutions for generating higher economic value from the available fibre.²⁴ Priorities include adequately preparing the workforce, improving the community's resilience against wildfires, advocating for landscape-level analysis and restoration, and supporting the formal application process for the creation of a community forest by the Lhtako Dene, Nazko, ?Esdilagh, and Lhoosk'uz Dene First Nations.²⁵

Other communities, such as Mackenzie and Fort Nelson, have also been exploring value-added opportunities that have not materialized yet due to specific local challenges. In the case of Mackenzie, local small and medium-sized enterprises (SMEs) interested in pursuing value-added opportunities have difficulties accessing local fibre. Canfor closed the local mill, which was the biggest supplier for a local secondary manufacturer. Since the mill closure over three years ago, Canfor has continued to log in the region but processes the lumber in a facility elsewhere, forcing the local secondary manufacturer to import fibre from Alberta.²⁶ In the case of Fort Nelson, the lack of provincial funding for railway infrastructure upgrades has prevented the establishment of a local pellet mill.²⁷

Currently, there are no established mass timber facilities in North-Eastern BC. Still, the region has already completed a couple of major mass timber building and construction projects, such as the Prince George Airport Extension,²⁸ the Quesnel Junior School,²⁹ and the Upper Skeena Recreation Centre in Hazelton.³⁰

Summary of labour and skills needs for the mass timber supply chain in BC

The mass timber supply chain encompasses a variety of established industries, such as forestry, wood manufacturing, transportation, design and engineering, and construction. [Table 1](#) summarizes key impacted occupations and their associated education requirements. The rest of this section outlines the scale of change expected in each sector throughout the mass timber supply chain. For additional details on these subjects, please read [Framing BC's low-carbon future: Identifying the skills and workforce needs of British Columbia's growing mass timber sector](#).

Forestry: While occupations within forestry will likely not experience shifting skills requirements solely due to mass timber, the sector will have to adapt to trends in the field more broadly, including climate change, changing societal needs, technological advancements, and changing forestry regulations and policies. For instance, the growing role of value-added wood products, which includes mass timber, increases the importance for forest technologists to be able to evaluate the potential of trees for varying types of wood products.

Additionally, the sector will need to adapt to the growing importance of carbon accounting tools and the life cycle analysis of wood products. This will increase the requirements for sustainable forest management practices that prioritize forest health and resilience. This is of particular importance for products such as mass timber, given that one of their key features is its ability to sequester carbon and reduce greenhouse gas emissions when compared to traditional concrete and steel construction.³¹ However, not all production processes for mass timber yield the same environmental benefits, and forest management practices that minimize the overall life-cycle emissions of a mass timber building should be prioritized.³²

Wood processing and manufacturing: The manufacturing of mass timber requires expertise in the production of a new, highly engineered product that needs to be

manufactured to the highest standards and with great attention to detail, fulfilling crucial specifications related to fire safety, moisture content, and load bearing capacities, amongst others. Many modern mass timber manufacturing plants have high levels of automation and use digital tools and technologies, such as computer-aided design, three-dimensional (3D) models, robotics, and computer numerical control (CNC) machines. Additionally, depending on the extent of the vertical integration of a mass timber plant, a manufacturer may be responsible for various aspects of the supply chain of the final product beyond just the manufacturing of the specific product; certain mass timber manufacturers, for example, also manage their own forest. This can result in required expertise across a multitude of associated sectors, including forest management and primary wood processing.

Design, engineering, and construction: Architects and engineers are required to understand the unique requirements and properties of mass timber as a construction material, such as specific building codes, as well as properties related to fire safety, moisture management, acoustics, and load-bearing capacities of mass timber. Additionally, proficiency in digital tools, such as building information modelling (BIM) and computer-aided design, as well as in engineering methodologies, such as Design for Manufacturing and Assembly, are gaining importance. Greater uptake of mass timber will also significantly change the typical construction workflow. Construction with mass timber requires a different, more integrated process across most of the supply chain compared to traditional construction projects, with a significant focus on prefabrication off-site and rapid on-site assembly. This requires greater collaboration across the supply chain between manufacturers, designers, engineers, skilled tradespeople, and construction crews. This also requires expanding soft skills and knowledge of digital tools, as coordination, teamwork, and digital literacy are becoming an even more integral part of their work.

“Through the [educational] instruction [of forest technologists], we have a lot of discussions around timber cruising, but I’m bringing in more of a focus to forest evaluation and being able to evaluate the trees for the products that could be produced from those trees...I like to go over the value-added products. What different products can come about from Douglas Fir? What are the specifications for [different products]? So that when they’re walking through the forest and they’re conducting a timber cruise, they have the idea of... what kind of products are going to be the focus here.” —Workshop attendant

Table 1: Summary of select existing occupations impacted by mass timber growth and new skills requirements throughout the mass timber supply chain, adapted with modifications from *Framing BC's low-carbon future*

Occupation	Tasks traditionally performed	Change due to mass timber
Silviculture and forestry workers	Reforestation and management, improvement and conservation of forests	No specific skills changes due to mass timber. Skills and knowledge requirements regarding forest management practices are changing due to larger trends, such as climate change, which has impacts such as the northward migration of tree species and wildfire prevalence.
Forestry technologists and technicians	Conduct surveys, monitor harvest and reforestation operations, and ensure legal compliance	
Forestry professionals	Prepare forest management plans, plan surveys, manage harvest and reforestation activities	
Lumber graders and other wood processing inspectors and graders	Inspection of wood products and classify them according to industry specifications	New industry classification for mass timber products, specific focus on the moisture content of wood
Other wood-processing machine operators	Run drying kilns to reduce wood moisture	Increase the amount or intensity of the drying cycles to reduce wood moisture
Woodworking machine operators	Use computer numerical control (CNC) machines to produce furniture, use glueing machines to join pieces of wood	More extensive use of digital tools, produce precise building components
Other wood-processing machine operators	Glue layers of wood to produce veneer and plywood	Produce stronger, thicker layers of wood using adhesive
Supervisor, wood product processing	Supervise and manage workflow	Align work schedule with construction, increased knowledge of construction and design processes
Manufacturing manager	Plan plant activities to meet production targets, plan resource use	Increased communication with external stakeholders (i.e., designers, construction managers, etc.), plan resource use under a 'just-in-time' approach
Architect	Prepare building design, prepare building plans	Engage with manufacturers and construction professionals, prepare building design according to wood's structural properties
Engineers	Design, develop and manage building projects	Engage with manufacturers and construction professionals, design systems according to the properties of wood
Construction managers	Plan construction projects according to building design, oversee construction activities	Involved in the design stages, use of building information modelling (BIM), coordinate with designers and manufacturers
Carpenters	Form building foundation, install floor beams, walls, and roofs	Provide inputs in the design process, assemble building components on site, increased precision in work, and knowledge about wood and connectors
Construction trade helpers and labourers	Load and unload construction material, support tradespersons and heavy equipment operators, mix various materials	Support moisture management, manage construction site for on-site assembly
Plumbers	Install, maintain, and repair plumbing systems	Involved in design, coordination with engineers and manufacturers, precision in working with finished products
Electricians	Install, maintain, and repair electrical and power systems	Involved in design, coordination with engineers and manufacturers, precision in working with finished products
Heating, refrigeration and air conditioning mechanics	Install, maintain, and repair heating and cooling systems	Involved in design, coordination with engineers and manufacturers, precision in working with finished products



What is a skills ecosystem approach?

A skills ecosystem is defined as a regional or sectoral network in which workers' capabilities are developed and deployed for productive purposes.³³ The overarching goal of a skills ecosystem approach is to improve the alignment between training and industry development needs, which can foster growth and innovation, increase the sustainability of the workforce, and reduce social inequities.³⁴ It focuses on the development, supply, demand, and utilization of skills,³⁵ as well as the creation of local networks. These local networks concentrate on workforce development of a specific region and industry, requiring close collaboration between all major stakeholders in a skills ecosystem.³⁶ A skills ecosystem is often seen as a critical factor for a region's (or industry's) ability to grow, innovate, and compete, as well as to adapt to the changing needs of the economy and society.³⁷ These ecosystems are made up of the following types of stakeholders:

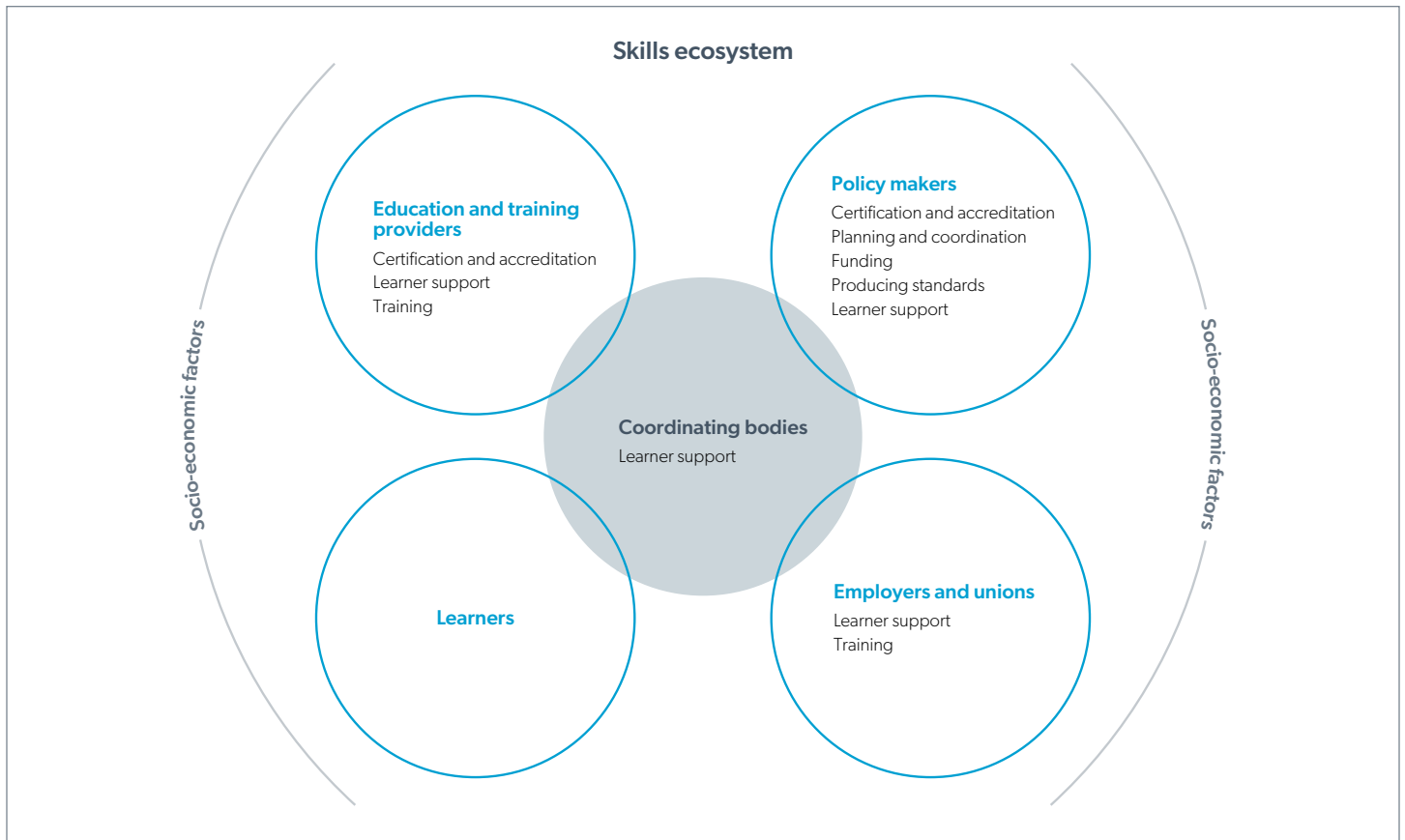
- **Training and educational providers:** Training and educational providers have a variety of functions beyond just delivering training: they train instructors, arrange work-integrated learning opportunities in collaboration with employers, design and adapt curriculums in collaboration with other stakeholders, and issue certifications and accreditations. Additionally, they provide crucial support to learners, including financial aid, student housing, cultural and linguistic supports, career awareness, and career guidance.³⁸
- **Employers:** Employers can fulfill a variety of functions in a skills ecosystem, including training and providing work-integrated learning opportunities. They can also provide support to learners, such as flexible work arrangements. Employers also offer learners the opportunity to utilize their skills, which is a critical component of a

healthy skills ecosystem. Notably, Northern BC does not have any mass timber manufacturing facilities presently, which is a significant gap in the local mass timber skills ecosystem.

- **Policy makers:** Policy makers are crucial stakeholders in a skills ecosystem. They fulfill important functions such as conducting labour market research, defining occupations and identifying specific skills, making capital investments, and providing operational funding for a variety of programs. Policy makers also coordinate communication between actors within the skills ecosystem. Additionally, policy makers greatly influence some of the supports available to students, such as social infrastructure like childcare.³⁹
- **Learners/workers:** Some of the key functions of a learner in a skills ecosystem are participating in learning opportunities, utilizing relevant services and supports, and supplying and utilizing skills in the local labour market. A skills ecosystem is shaped by the needs, interests, and abilities of learners, as well as by how learners interact with available services, supports, and infrastructure.⁴⁰

Additionally, **coordinating bodies** support the information flow and collaboration between the different stakeholders and will be discussed as part of the groups of stakeholders identified above, wherever appropriate. Coordinating bodies can include industry associations, networks, and labour market committees, as well as informal relationships.⁴¹

Figure 2: Key stakeholders in a skills ecosystem and their core functions, adapted from the Conference Board of Canada⁴²



Thinking about learners/workers, educational institutions, and training bodies as a skills ecosystem rather than as stand-alone entities allows stakeholders to move away from a relatively narrow focus on providing formal training for specific jobs or companies based on the supply and demand of skills. Instead, stakeholders can consider the larger context within which skills are developed, needed, and utilized.⁴³ This approach highlights the interdependencies, alongside the need for close collaboration and synergies, between a variety of stakeholders within a given region and/or sector and their objectives, including employers, workers, and education and training providers. Additionally, coordinating bodies are crucial to ensure collaboration and coordination between the different stakeholders, and they can be both formal and informal in nature. Examples of coordinating bodies can include industry associations, employment agencies, unions, and community organizations.⁴⁴ A skills ecosystem approach also recognizes the importance of the larger socio-economic context, which is often unique to a specific place. Factors such as industrial relations, availability of childcare, health care, and retirement patterns and migration, amongst others, are all seen as also shaping a given skills ecosystem. More recently, this approach has been applied in the context of the green transition, highlighting the importance of a strong place-based approach to skills development for just transitions, or labour transitions more broadly.





Case study: DACH region

The DACH region stands for Germany (D), Austria (A), and Switzerland (CH). These countries have been credited with pioneering the early development and research of a variety of mass timber products during the 1990s.⁴⁵ In 2021, the DACH region accounted for close to 80% of the global production capacity of cross-laminated timber (CLT).⁴⁶ Austria, in particular, has become a leading manufacturer of mass timber globally,⁴⁷ accounting for 40% of global production capacity in 2021,⁴⁸ with local companies such as Binderholz and KLH representing key manufacturers within the global CLT market.⁴⁹ Globally, the region is well known for its mass timber-related expertise, including in North-Eastern BC, making it an interesting and highly relevant example of a mass timber skills ecosystem to local stakeholders in Canada. The mass timber skills ecosystem in BC, including in North-Eastern BC, has also been influenced by and has relied on the expertise of the DACH region. Various local manufacturers and industry experts have an educational background in Germany, Austria, or Switzerland, such as the founder of International Timberframes in Golden, and the instructor of the Mass Timber Development Micro-credential at University of Northern British Columbia (UNBC).

It should be noted that the case study provides a select overview of the most relevant local stakeholders and examples for the BC context. Greatest relevance has been determined through stakeholder conversations and research. Additionally, while the DACH region provides a highly relevant example of a thriving mass timber skills ecosystem, there are significant differences between their education systems compared to Canada, and regional differences exist within the DACH region as well. This case study details the skills ecosystem present in the DACH region, organizing stakeholders using the framework outlined above. Once all the actors and stakeholders are detailed,

observations and discussion offer details into the strengths and important attributes of the ecosystem that should be replicated. This same framework is then applied to North-Eastern BC, which is useful for highlighting differences and areas of improvement between the two regions.

Training and educational providers

The DACH region has post-secondary education institutions called 'Fachhochschule,' which translates to 'university of applied sciences.' These institutions typically differ from traditional universities due to their highly practical orientation, and are somewhat comparable to Canadian colleges. They do not, however, directly educate apprentices, who typically complete their coursework at separate vocational schools. Instead, they offer programs and degrees at the bachelor's and master's levels akin to traditional universities, but admission requirements differ and there are also pathways for graduated apprentices to enter these programs. For example, Swiss learners who have completed an apprenticeship, such as in carpentry or drafting technology, can qualify for an undergraduate degree in both architecture and civil engineering at the Bern University of Applied Sciences (BFH).⁵⁰

Within the DACH region, several recognizable educational institutions offer training and programs tailored to wood construction techniques and systems, including mass timber. These include the Rosenheim Technical University of Applied Sciences (TH Rosenheim) in Germany, BFH in Switzerland, and the Graz University of Technology (TU Graz) in Austria, all of which have been important contributors to a strong regional mass timber skills ecosystem.

Rosenheim Technical University of Applied Sciences (TH Rosenheim)

TH Rosenheim offers a variety of degree programs relevant to mass timber, with a key focus on architecture, engineering, and wood technology.⁵¹ Both its architecture and engineering programs at the bachelor level include a focus on wood as a construction material as a core element of the respective curriculums.⁵² Furthermore, the institution's various engineering programs allow for specializations in areas such as wood construction and energy efficiency, wood technology, and sustainability in construction.⁵³ TH Rosenheim also offers a joint Master of Science in Wood Technology with BFH, where students study at both institutions. Most degrees also require students to complete a practicum with a local employer.⁵⁴ As part of the Bachelor of Engineering with a specialization in Wood Technology, students learn about all the relevant processes of manufacturing wooden products, from product development to the planning of production processes.⁵⁵ Meanwhile, at the master's level in wood technology, students acquire a broad set of skills and knowledge

related to wood technology, and students can further specialize in wood processing, innovation management and new product development, or supply chain management, amongst others. The focus on a wide variety of skills and knowledge is intentional, recognizing the evolving requirements for engineers and the needs of the industry.⁵⁶

In addition, having recognized the need for more trained educators and teachers, TH Rosenheim recently started offering an engineering degree with a focus on pedagogy, which blends providing students with a traditional wood engineering education with preparing them for a teaching career. Graduates can pursue a traditional career in engineering but can also pursue further education towards a career in teaching at schools and post-secondary institutions.⁵⁷ A similar program in Canada could be employed to help tackle labour shortages amongst teachers and instructors within the skilled trades. Degree programs at TH Rosenheim also teach a variety of digital tools and skills, such as computer-aided design, computer-aided manufacturing, BIM, and CNC machines.

Table 2: Overview of relevant degrees offered at the Rosenheim Technical University of Applied Sciences (TH Rosenheim)

General field	Degree	Relevant specializations	Cost
Architecture	Bachelor in Architecture	N/A	Free
Engineering	Bachelor of Engineering	<ul style="list-style-type: none"> • Civil Engineering • Wood Building and Construction • Wood Technology • Engineering Pedagogy 	Free
Wood Technology	Master of Science in Wood Technology	<ul style="list-style-type: none"> • Systems Engineering • Special Aspects of Wood Processing • Change Management • Supply Chain Management • Quality Management • Furniture Safety and Testing • Innovation Management and New Product Development • Simulation 	Free
Continuing Education (part-time)	Certificate	<ul style="list-style-type: none"> • Wood Building and Energy Efficiency 	€13,400 (\$19,300 CAD as of October 2023)

TH Rosenheim also prioritizes knowledge transfer, emphasizing close collaboration with employers, policymakers, and society to make its education practical and relevant to real-world needs.⁵⁸ One form of industry and public sector collaboration is TH Rosenheim’s offer to create custom-made educational programs and seminars for companies, communities, and public institutions, which previously included courses around digital production and 3D printing.⁵⁹

All primary education degree programs at TH Rosenheim are free since no German universities charge tuition fees, making education highly accessible to learners of different socio-economic backgrounds. Continuing education programs and courses, on the other hand, charge tuition fees. TH Rosenheim is a university of applied sciences and accepts a variety of qualifications, including an apprenticeship in a relevant discipline, and typically requires practical work experience from all applicants. As a result, the student body has a diverse professional background.

Bern University of Applied Sciences (BFH)

Housed in its School of Architecture, Wood and Civil Engineering, BFH offers bachelor’s and master’s degrees in architecture, wood technology, and civil engineering.⁶⁰ The degrees prioritize interdisciplinary collaboration between students from all three disciplines through various interdisciplinary projects, courses, and project weeks. Furthermore, wood

as a building material is a part of the core curriculum across all degrees. There is also a great focus on a variety of digital tools, including virtual reality, BIM, computer-aided design, and CNC machines.⁶¹

The same two minors are offered on all bachelor levels at the School of Architecture, Wood and Civil Engineering, fostering high levels of interdisciplinary collaboration. The minors allow for the extended specialization in circular and sustainable design and construction or integrated digital building, teaching skills such as lifecycle analysis as well as circularity and recycling of construction materials.⁶² Meanwhile, the Bachelor of Science in Wood Technology allows students to specialize in wood construction or wood manufacturing for construction and related sectors, where they learn skills such as product development, production management, digital production, and quality control. For the Master of Science in Wood Technology, students can specialize in timber construction, innovation management and digital manufacturing, or bio-based materials. Within the Management of Processes and Innovation specialization, students create an innovative project from ideation to essentially being ready for market launch, including presenting a business case to a potential investor. Similarly, under the Innovation in Bio-based Materials specialization, students develop a new sustainable bio-based product in collaboration with a business partner.⁶³ Students also have the opportunity to pursue a joint Master of Science in Wood Technology in collaboration with the TH Rosenheim.

Table 3: Overview of relevant degrees offered at the Bern University of Applied Sciences (BFH) School of Architecture, Wood and Civil Engineering⁶⁴

General field	Degree	Relevant specializations	Cost
Architecture	Bachelor in Architecture	<ul style="list-style-type: none"> Minor: Circular and Sustainable Design and Construction Minor: Integrated Digital Building 	750 CHF/semester (\$1,130 CAD as of October 2023)
	Master in Architecture	<ul style="list-style-type: none"> Architecture and Wood Architecture and Area 	750 CHF/semester (\$1,130 CAD as of October 2023)
Engineering	Bachelor of Science in Civil Engineering	<ul style="list-style-type: none"> Minor: Circular and Sustainable Design and Construction Minor: Integrated Digital Building 	750 CHF/semester (\$1,130 CAD as of October 2023)
Wood Technology	Bachelor of Science in Wood Technology	<ul style="list-style-type: none"> Minor: Circular and Sustainable Design and Construction Minor: Integrated Digital Building 	750 CHF/semester (\$1,130 CAD as of October 2023)
	Master of Science in Wood Technology	<ul style="list-style-type: none"> Complex Timber Structures Management of Processes and Innovation Innovation in Bio-based Materials 	750 CHF/semester (\$1,130 CAD as of October 2023)

Students can also add courses related to entrepreneurship and the creation of start-ups to their curriculums. Additionally, the school offers several continuing education courses within the field of wooden construction, from a general course on the construction with wood to courses specializing in complex timber structures, fire safety, management of moisture, acoustics and heat in wood construction, earthquake safety, and business administration within the forest bioeconomy. A variety of courses are also offered for the manufacturing of wood-based panels, which include mass timber products. These courses include wood-based panel manufacturing technologies as well as adhesives and emissions.⁶⁵ While there is no specific focus on mass timber, wood is a crucial teaching component of all core curriculums at BFH's School of Architecture, Wood and Civil Engineering. Additionally, there are high levels of interdisciplinary collaboration between the degrees, which aligns well with the changed project flow of a typical mass timber project, which requires close collaboration between manufacturers, architects, engineers, and construction managers.

Furthermore, according to stakeholders in BC, graduates from BFH's School of Architecture, Wood and Civil Engineering tend to have a broad set of skills, which benefits both students starting their career and employers.

“What I find hiring a graduate, say from [BFH], is that these young people are able to do most of these [create shop drawings, BIM models, CNC machinery operations, etc.]. They have this general education to jump into several roles in companies. This is what is so remarkable about these graduates, that they have the base to be the project manager, to do the computer-aided design work, to know enough to be the operator of that CNC.”

— Workshop attendant

Overall, there is high overlap between the diverse skills taught in BFH's programs and the needs of employers.

Students are required to pay tuition for all courses and programs, but costs are relatively low, making all degrees fairly accessible for learners of all socio-economic backgrounds. Additionally, as a university of applied sciences, BFH accepts a variety of prior qualifications and education levels for most degrees, especially at the bachelor's level. This policy aims to create a more diverse student body, including learners with completed apprenticeships in highly relevant sectors, such as the construction sector.

Graz University of Technology (TU Graz)

TU Graz offers a variety of post-secondary programs relevant to mass timber, including architecture and engineering. Wood is a core part of a variety of their curriculums, including for their engineering degrees.⁶⁶ Additionally, students are taught a variety of digital tools and skills, including 3D printing, robotics, and CNC machines. TU Graz has been a crucial institution in furthering technical mass timber research from the beginning: in the early 2000s, the Construction Technology Centre (Bau Technik Zentrum), an early mass timber building, was constructed at TU Graz. The Centre housed the timber-engineering department at the university, where significant initial mass timber technical research took place, including the development of CLT as a practical building material.⁶⁷ This strong focus on research and innovation remains a priority today, with the university now housing the Institute of Timber Engineering and Wood Technology, which provides education and conducts research for timber construction. As an example of an industry-relevant research focus, one of the current research priorities is the use of alternative tree species for load-bearing wooden elements.⁶⁸

While students are required to pay tuition for all courses and programs, costs are relatively low, making degrees generally fairly accessible for learners of all socio-economic backgrounds.

Table 4: Overview of relevant degrees offered at Graz University of Technology (TU Graz)⁶⁹

General field	Degree	Relevant specializations	Cost
Architecture	Bachelor in Architecture	N/A	€363 per semester (\$524 CAD as of October 2023)
	Master in Architecture	N/A	€363 per semester (\$524 CAD as of October 2023)
Engineering	Bachelor in Civil Engineering	N/A	€363 per semester (\$524 CAD as of October 2023)
	Master in Civil Engineering	N/A	€363 per semester (\$524 CAD as of October 2023)

Employers

There are a variety of wood manufacturers in the DACH region producing mass timber, many of which are highly vertically integrated and are managing some or all aspects along the mass timber supply chain, including forest management, primary wood processing in in-house sawmills, manufacturing mass timber products, and providing project management services for mass timber construction projects. These manufacturers typically manufacture mass timber products alongside other wood products, such as lumber, biofuels, other building components, and furniture.

Many of today's largest manufacturers in the mass timber space in the DACH region originally started as family-owned SMEs and gradually expanded their production size, type of products manufactured, employee numbers, and production locations. Binderholz, for example, was founded during the 1950s in Austria⁷⁰ and was initially a small sawmill operation.⁷¹ Nowadays, the company remains family-owned but employs over 6,300 people and has sawmills and production facilities in Austria, Germany, Finland, Latvia, Great Britain, and the United States. The company produces a variety of wood products, including CLT and glue-laminated timber, biofuels, sawing products like lumber and planed timber, and pallets and horse litter.⁷² In 2021, the company's annual capacity for manufacturing CLT was 220,000 m³,⁷³ which is considerably larger than Canadian companies (e.g. Kalesnikoff produces ~50,000 m³ a year)⁷⁴. Many of the other largest manufacturers in the region,⁷⁵ such as KLH, Mayr-Melnhof Holz,⁷⁶ and Hasslacher Norica Timber,⁷⁷ share similar histories: starting as family-owned SMEs with relatively simple sawmill or pulp mill operations and gradually expanding over several decades. KLH is especially known for having developed CLT (the most commonly used type of mass timber in Canada) in collaboration with the Technical University of Graz during the 1990s. The family business has since become one of the market's leaders and currently runs two major production facilities in Austria, manufacturing wall, ceiling, and roof elements for the international market, with an annual capacity of around 175,000 m³.⁷⁸ Another major manufacturer with production facilities in the region is Stora Enso, founded in 1998 through the merger of a Finnish and Swedish company.⁷⁹ The company produces a variety of wood-based products, including mass timber products, lignin, packaging solutions, and pellets. The company employs over 21,000 people and is active globally, including in the DACH region and across Europe, as well as in China and the United States.⁸⁰

Employers in the DACH region play a significant and well-established role in providing relevant education and training in the DACH region, both through the formalized dual apprenticeship system and by providing on-the-job training. All major mass timber manufacturers in the DACH region typically hire apprentices for a variety of positions, including wood technicians, wood and saw technicians, metal technicians for machinery, and electrotechnicians. While there are no trades exclusively related to mass timber, learners have the opportunity to pursue apprenticeships with mass timber manufacturers for a variety of occupations specific to wood manufacturing. All apprentices, independent

of the specific trade, learn the in-house production processes, which are often unique to each company. Apprentices are typically hired directly after completing compulsory education, and as a result, requirements for apprentices do not include relevant work experience. In addition to completing compulsory school, apprentices in wood-related trades are typically asked to have an interest in working with wood, a willingness to learn, and abilities such as spatial thinking and dexterity.⁸¹

Similarly, requirements for workers in production facilities are relatively broad, with manufacturers playing a significant role in training employees on the job and providing continuing education for various occupations. Binderholz, for example, requires plant/machine operators who conduct quality control for CLT elements to have general production experience in the timber industry.⁸² Similarly, requirements for the senior designer/technician position in timber construction are not mass timber-specific and relatively broad, with a preference for a technical degree in wood and a willingness to learn.⁸³ Meanwhile, for a project manager role, mass timber-specific knowledge is strongly preferred.⁸⁴

Learners/workers

Across the DACH region, apprenticeships are common education paths. For example, around 40% of youth in Austria complete an apprenticeship following their compulsory education,⁸⁵ while in Switzerland the rate is around 65%.⁸⁶ For comparison, around 3% of Canadians aged 18–24 were registered apprentices in 2021.⁸⁷ Apprentices tend to be relatively young on average across the DACH region. In 2018, the average age for new apprentices in Germany was 19.9 years.⁸⁸ In Switzerland, most learners enter an apprenticeship at around the age of 15–16.⁸⁹ And in Austria, new apprentices are typically 16 years old when starting their apprenticeship.⁹⁰ This has important implications; while apprenticeship wages tend to be relatively low, the young age of the average apprentice means that a majority of them still live at home and can rely on family support throughout their apprenticeship, which is a significant difference from the Canadian context.

Apprenticeship offerings vary between the countries in the DACH region, but they all have a multitude of different country-specific trades and associated apprenticeships centred around construction with wood, the production of wood products, and wood carving. Wood technicians (Holzbearbeitungsmechaniker),⁹¹ for example, are taught to create a variety of wooden elements for construction, such as boards, panels, veneered chipboards, and mass timber products. Graduated apprentices also have the opportunity to pursue higher education at universities of applied sciences. In Switzerland, for example, carpenters or drafting technologists, amongst other related occupations, can qualify for an undergraduate degree in both architecture and civil engineering at BFH.⁹²

Policymakers

Various policies in the DACH region support a strong regional skills ecosystem, some of which are unique to specific countries or regions and others which are relevant to the entire DACH region. This is not a comprehensive list of all policies underpinning the skills ecosystem. Still, it represents policies that stakeholders flagged as valuable and policies targeting challenges identified throughout the research process.

Education Affordability

Education affordability is a key priority across the DACH region, with various funding mechanisms in place. Public education at all levels is heavily funded by the German, Austrian, and Swiss governments, allowing for no or minimal tuition fees for most learners. Public universities, including universities of applied sciences, charge no tuition fees in Germany and Austria and minimal tuition fees in Switzerland. Similarly, vocational schools for apprentices are generally of no cost to learners. This makes education highly affordable for most learners.

In addition, there are other mechanisms to ensure the affordability of continuing education and lifelong learning opportunities. For example, in Switzerland, the government can, at the request of an industry, establish mandatory industry-specific training funds (Berufsbildungsfonds), which require all companies of a specific industry to contribute towards a collective training fund.⁹³ Training funds are used to develop courses, organize courses, and advertise occupations within the industry, amongst other tasks. The training fund for the timber construction industry was established and made mandatory for the industry in 2008.⁹⁴

Country-specific initiatives and policies

Similar to the educational institutions and employers in the DACH region having a broader focus on a diversified wood manufacturing sector rather than a specific focus on individual products like mass timber, various policies exist to support a diverse wood industry. Below is a summary of select initiatives.

Forest Fund (Austria)

In 2020, Austria established a Forest Fund of €350 million (\$510 million CAD as of October 2023).⁹⁵ The Forest Fund provides funding for ten key priorities, one of which is the increased use of wood. They also issued calls for proposals for specific topic areas to promote innovation and foster ongoing research efforts. Previous calls for proposals included the establishment and operation of a central hub for coordinating, digitizing, and modernizing education across primary, secondary, and tertiary levels of education along the wood-based value chain; supporting education related to wood at universities, universities of applied sciences and technical education institutions; the establishment of endowed professorships in the areas of wood construction research and planning; and sustainable building with wood. A previous call also included the establishment of a network in preparation for the creation of a bioeconomy cluster.⁹⁶ As an additional incentive, the Forest Fund also provides funding for each kilogram of wood used in construction.⁹⁷

Forest and Wood Research Funding (Switzerland)

The Swiss government coordinates Forest and Wood Research Funding Switzerland, an initiative which aims to improve the overall competitiveness of the forestry and wood industry in Switzerland. The initiative also seeks to provide rapid knowledge and experience transfer between research and educational institutions and the forest and timber industry. As such, it provides start-up grants to conduct applied research, including for developing wood production and wood use, and knowledge transfer is a requirement for all projects.⁹⁸

Charter for Wood 2.0 (Germany)

The Charter for Wood 2.0 was brought forward by the German Federal Ministry of Food and Agriculture. It outlines the key priorities related to forests and the use of wood as a raw material. The primary objectives of the charter are centred around mitigating climate change, promoting value-added products, and using resources sustainably and efficiently. A steering committee and working groups for six fields of action have been set up to coordinate and implement the charter. One of the six fields of action is 'the forestry and wood cluster,' which includes critical focus areas such as sector networks, competitiveness in globalized markets, education and training, a focused effort on enhancing education and promoting innovation, and communication.⁹⁹ To overcome the competitiveness in globalized markets challenge, the charter provides core objectives, including dialogue and knowledge transfer between practice and research, overcoming structural drawbacks of SMEs, improving the image and appeal of the cluster for workers, attracting apprentices and skilled workers to the cluster, and establishing wood sciences and wood construction educational programs at universities. The charter also recommends that the federal states integrate wood construction and the bioeconomy more heavily into their curricula.¹⁰⁰

Available programs and policies in Bavaria (Germany)

Bavaria is a German federal state within which TH Rosenheim is located. Recently, the local government has established various highly relevant policies for mass timber. In 2022, the federal state established a Wood Construction Promotion Program. The program aims to promote the climate effectiveness of wood, rather than just wood as a construction material, by funding each ton of sequestered carbon in construction projects.¹⁰¹ In January 2023, the new Higher Education Innovation Act came into effect in Bavaria. The legislation aims to formalize close collaboration between various stakeholders, including educational institutions, government, the private sector, and citizens, to support greater knowledge transfer.¹⁰² As a result of the adoption of the Innovation Act, TH Rosenheim published its knowledge transfer strategy, describing the institution's role in actively shaping the local innovation system around the research priorities, including the bioeconomy, wood technology, and construction products.¹⁰³ Overall, the Innovation Act can be seen as a useful example of regulatory action shaping greater connections within a skills ecosystem.

Coordinating bodies

There is a wide variety of coordinating bodies in the DACH region that improve the collaboration and cooperation between employers, educational institutions, and learners, including local industry associations and initiatives coordinated by the government.

Industry Associations

There are a variety of industry associations across the DACH region, such as Holzindustrie Österreich and proHolz in Austria, and Holzbau Schweiz in Switzerland. Holzindustrie Österreich is an industry association for the local wood processing industry, specifically those working on timber construction products, with furniture and panels, as well as in sawmills and within the ski industry. In addition to marketing wood and promoting businesses to gain access to new markets, education is also a key priority of the association. For example, the association ensures knowledge transfer between those responsible for training at companies and educational institutions. They also collaborate with proHolz to promote and support occupations within the sector.¹⁰⁴ ProHolz currently runs, for example, a campaign targeting youth on various social media channels to promote occupations within forestry and wood manufacturing as safe, highly technological, and in touch with nature.¹⁰⁵

Holzbau Schweiz is a Swiss industry association specifically for the local timber construction industry, with the key purpose of delivering up-to-date knowledge, promoting lifelong learning, and connecting member companies with learning opportunities.¹⁰⁶ Holzbau Schweiz provides access to an online learning

platform for self-paced learning, providing a variety of relevant courses and resources, including for apprentices and working professionals seeking continuing education opportunities. They also offer courses and resources for company-internal training, as well as for new workers who have been trained abroad and require upskilling for the Swiss context. Learners are also encouraged to maintain their portfolios to showcase their projects and achievements to other learners.¹⁰⁷ In addition to online learning, Holzbau Schweiz also connects companies and their employees to continuing education opportunities at learning institutions across Switzerland. Institutions offering relevant courses can register their course offerings, ensuring visibility to all interested employers and learners.¹⁰⁸ Various financial funds are available to support the development and offering of courses, including the mandatory industry-specific training funds for the timber construction industry mentioned previously.¹⁰⁹ An additional focus of the association is providing information about the latest updates and innovation within timber construction.

The Charter for Wood 2.0

The German Charter for Wood 2.0 includes a requirement for the federal government, federal states, and relevant experts within science, teaching, and business (and other areas of expertise if needed) to join working groups with the objective of tackling the biggest challenges along the wood value chain. This effort is an additional example of what a coordinating body can look like, given its role in convening decision-makers and focus on implementation.¹¹⁰



Key Observations

The DACH region's mass timber skills ecosystem is best understood as being an extension of a strong local wood skills ecosystem. While a few mass timber-specific courses have been identified, there is no unique focus on mass timber specifically as a single degree program or as a new skilled trades occupation, as examples. Similarly, many of the largest mass timber manufacturers in the region do not solely specialize in mass timber, but are highly diversified and offer a suite of wood products. Policies such as the German Charter for Wood 2.0 and the Austrian Forest Fund focus on a diversified forest bioeconomy as well, rather than singling out and over-focusing on single opportunities, such as mass timber.

Across the three institutions analyzed, there is a strong focus on teaching wood-related knowledge and skills across a variety of degrees and in an interdisciplinary manner, such as teaching students of architecture and engineering about wood as part of their core curriculum. This is further exemplified by some of Austria's largest global mass timber manufacturers requiring a general familiarity with wood and/or production processes for many of their positions, but not requiring mass timber-specific education (except for more senior positions).¹¹¹ All three post-secondary institutions discussed also have a specific focus on wood technology, and two (TH Rosenheim and BFH) promote a strong focus on entrepreneurship, including in the context of producing innovative wood products.

According to stakeholders, graduates from the DACH region have the ability to work across a variety of occupations and positions and are highly capable of collaborating across sectors. They also graduate with a variety of relevant practical skills, including drafting, BIM, and the use of CNC machines. This broader, more generalist approach to education is valuable. First, it prepares students to work with a variety of wood products, not just mass timber, which helps with the employability of learners. Additionally, it offers opportunities for interdisciplinary cross-pollination of innovation and ideas. BFH, for example, teaches a variety of specializations in an interdisciplinary manner, bringing students of their architecture, engineering, and wood technology programs together. Collaboration across disciplines is a key change brought about by mass timber construction, and the approach by BFH is an excellent example of how this collaborative and interdisciplinary mindset can be taught.

Additionally, a variety of factors make education highly accessible. For instance, most institutions are tuition-free, or their fees are significantly lower than tuition costs in Canada, making education significantly more accessible to learners of different socio-economic backgrounds. There are also multiple pathways for learners to advance their careers and a high level of recognition of previous skills and relevant work experience, which is exemplified, for example, by existing pathways for graduate apprentices to continue their education at universities of applied sciences and earn bachelor's and master's degrees. This creates graduates with a wide variety of backgrounds, for example an engineer with construction or carpentry expertise.

The DACH region also has a strong apprenticeship system, with around 40-65% of local youth pursuing an apprenticeship after their compulsory education. As a result, employers play a crucial and highly formalized part in the local education system, reflected in a broad set of apprenticeships. These apprenticeships include a variety of options that are wood-centric, such as wood technicians. Furthermore, most apprentices are relatively young and can still rely on family support, which provides greater compatibility with the reality of typically modest apprentice wages.





Analysis of the existing mass timber skills ecosystem in Northern BC

The following section takes a closer look at the main groups of stakeholders in a mass timber-specific skills ecosystem that could be developed in North-Eastern BC, namely training and educational providers, employers, policymakers, coordinating bodies, and learners/workers. This analysis establishes a baseline with existing programs and initiatives and compares them to the skills and educational needs-related findings from [Framing BC's low-carbon future](#) to highlight gaps and alignments in educational offerings and approaches to skills development. It also provides a discussion comparing findings to the mass timber skills ecosystem in the DACH region to highlight further gaps and opportunities. The analysis and discussion are overlaid on top of specific challenges identified within workshops and stakeholder discussions to ensure solutions target critical gaps and support the realization of economic opportunities within the forestry and wood manufacturing sector in North-Eastern BC.



Skills ecosystems in a Northern context

Skills ecosystems in Northern Canada differ from typical skills ecosystems as Northern communities or provinces face several unique structural challenges. The first is remoteness and low population density, which often creates challenges in the delivery of education. Second, there are typically only a few post-secondary education institutions with limited course offerings, many of which face challenges related to teacher shortages. Teacher shortages are especially pronounced in fields such as medicine, education, and engineering. Third, there are also unique social and cultural challenges associated with skills development in the North, such as learners and workers often having to leave their communities to access education opportunities, difficulties related to internet access, and many Northern regions having large Indigenous populations with distinct needs for culturally appropriate education offerings and supports.¹¹²

Northern Canada is also characterized by typically lower overall education levels, including lower high school graduation rates, resulting in the need for many learners to take academic upgrading classes at local colleges prior to enrolling in a post-secondary program.¹¹³ Empirical studies have also shown that communities dependent on natural resources have a significant negative correlation with human capital accumulation (i.e., the economic value of a worker's

abilities and skills). These communities often experience a reduction in public investment in education, which is important to achieve economic growth and mitigate the negative impacts of natural resource dependence (e.g., high dependency on a single large employer in a region). This may partly explain the lower education levels observed in many Northern regions, including North-Eastern BC.

Coordinating a skills ecosystem across a large region with sparse populations, such as Northern Canada, is complex, often resource-intensive, and requires the presence of strong local networks and coordinating bodies.¹¹⁴ In Canada's North, skills needs are typically shaped by a local economy's high reliance on the natural resources sector. Employment in these sectors is typically dominated by a few large corporations, which are highly susceptible to commodity cycles with boom-and-bust periods. This poses challenges for educational providers to ensure that their programs are relevant and are keeping up with traditional commodity cycles, especially since the designing of new programs can take several years and can take up to six years in total until the first graduates are entering the job market. Strong local networks and coordinating bodies can help with these challenges by improving local coordination and collaboration.

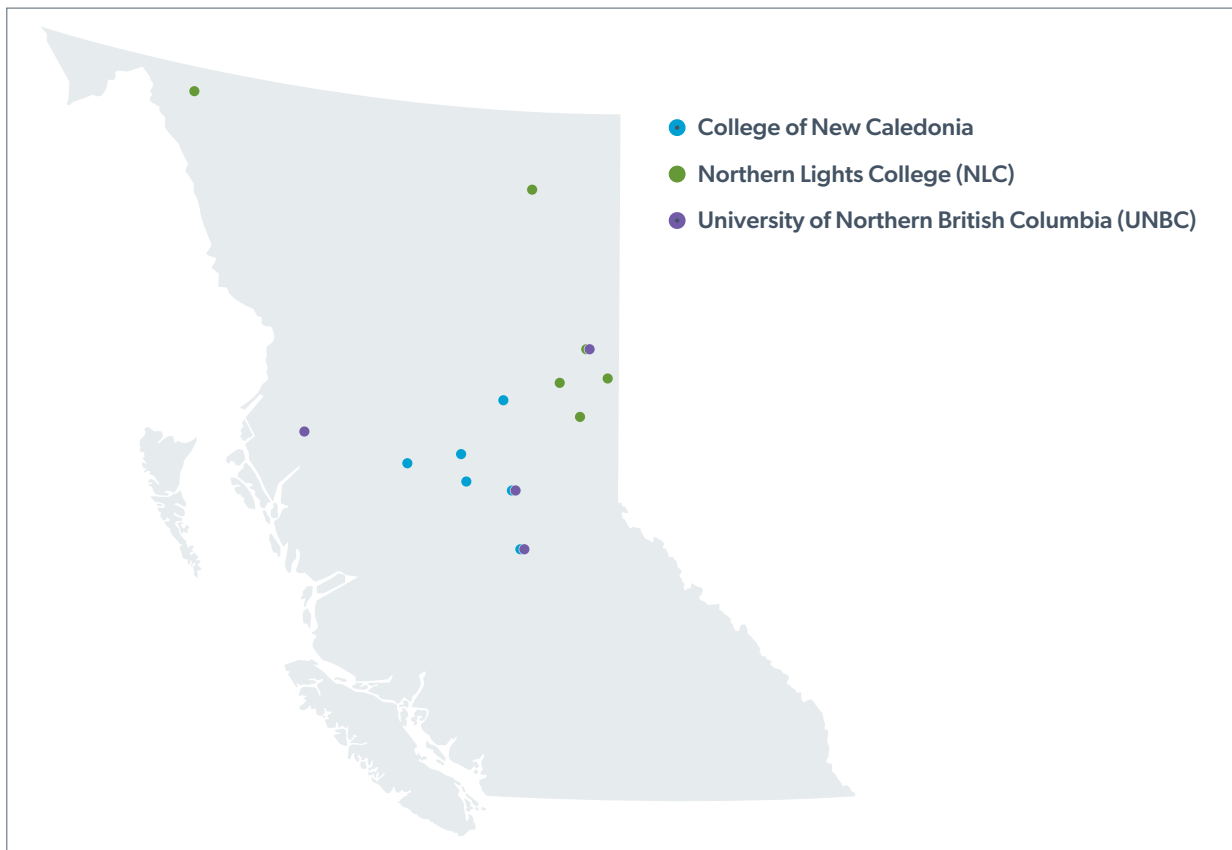
Training and educational providers

Current education offerings relevant to BC's mass timber skills ecosystem can be grouped into two groups. The first is short-term courses, programs, and seminars, such as micro-credentials, one-off seminars, and online resources. The second is established post-secondary education programs and apprenticeships that train occupations relevant to the supply chain of mass timber. Short-term courses typically aim to upskill and reskill the existing workforce by delivering highly specific skills that have been identified as critical skills for mass timber specifically, such as using CNC machines to manufacture mass timber panels, assembling a mass timber building, or learning to apply the DfMA methodology or digital tools such as computer-aided design and BIM. On the other hand, established post-secondary education programs and apprenticeships play a crucial role in providing the foundational education necessary for many occupations along the mass timber supply chain, such as within forestry, architecture, engineering, and construction. While current curriculums may already contain relevant mass timber educational components, they often do not specifically prepare students for a career related to mass timber, which currently leads to the need of shorter-term courses to provide mass timber specific skills and knowledge.

In North-Eastern BC, some mass timber-relevant educational resources, training, and educational seminars are provided by other agencies and organizations. An example of such an agency or organization is the Forestry Innovation Investment, a Crown agency by the Government of BC. The Forestry Innovation Investment has developed the online information resource called Naturally:Wood, which is an important information resource on BC's forests and BC's forest products, including technologies such as mass timber, biomass, and wood fibre products. However, post-secondary educational institutions and universities are the key providers of skills training for this region. There are currently two major post-secondary institutions and one university with multiple physical campuses across North-Eastern BC: the College of New Caledonia, Northern Lights College (NLC), and the UNBC. The College of New Caledonia has six campuses, including in Quesnel, Prince George, and Mackenzie. NLC has seven campuses, including in Chetwynd. And UNBC has a main campus in Prince George and three regional campuses, including in Quesnel and Fort St. John.

In addition to institutions with physical locations in Northern BC, other educational providers offer virtual and hybrid courses on mass timber, which are fully or partially accessible to learners in Northern BC, such as the British Columbia Institute of Technology (BCIT) and the University of British Columbia (UBC).

Figure 3: Map of all campus locations



Specialized mass timber courses

While all the available mass timber-specific courses seek to fill skills gaps specific to mass timber, each institution targets specific occupations or steps along the supply chain of mass timber. The supply chain of mass timber can be roughly divided into activities focusing on the adoption of the technology, such as designing and building with mass timber, as well as the production of mass timber. BCIT's courses are mainly focused on the construction of mass timber (adoption), UBC's courses mainly target architects and engineers (adoption), and UNBC's courses are focused on the production of mass timber products (production). [Table 5](#) summarizes currently available short certificate courses in North-Eastern BC with a distinct focus on mass timber. A complete list of programs available for all occupations that will be impacted by the growth of mass timber can be found in [Appendix 2](#). The list of programs offered at UBC that are relevant to mass timber stakeholders can be found in [Appendix 3](#). One-off seminars, events, and online resources have not been included, and the College of New Caledonia and NLC currently offer no specialized mass timber courses.

Of all the currently available mass timber micro-credentials, UNBC's Mass Timber Development micro-credential is the only one with a distinct focus on mass timber production, specifically focused on the manufacturing side of the supply chain. Training digital and practical skills, like using computer-aided design, BIM, CNC machines, and a vacuum press, is highly relevant and aligns well with the identified skills needs for mass timber production as per [Framing BC's low-carbon future](#).



Table 5: Summary of specialized mass timber courses currently available in North-Eastern BC

Provider	Type of education, course name, and focus area	Length and mode of training, entrance requirements	Cost	Location
BCIT (British Columbia Institute of Technology)	Micro-credential: Introductory Studies in Mass Timber Construction ¹¹⁵ Focus: Construction (Adoption)	Online self-paced No mandatory prerequisites, but recommended: <ul style="list-style-type: none"> Minimum one year of experience in one of the following construction-related fields: carpentry, ironworking, construction management, building inspection, design, development, manufacturing, or estimating 	Free for Canadian citizens and permanent residents (C2R2) Regular cost: \$671.43 <i>Demand currently exceeds funding; new learners have to pay the regular cost</i>	Online
	Associate Certificate: Construction of Mass Timber Structures ¹¹⁶ Focus: Construction (Adoption)	Hybrid (online and two-week practicum course), six months No mandatory prerequisites, but recommended: <ul style="list-style-type: none"> Training programs like Carpentry Framing and Forming Foundation or Ironworker Foundation or equivalent Minimum one year of relevant work experience on a construction site Current (within three years) Fall Protection Training Certification 	\$8,160	Online Practicum at Burnaby campus <i>The in-person component would require travelling outside of the region</i>
UNBC (University of Northern British Columbia)	Micro-credential: Mass Timber Development ¹¹⁷ The micro-credential is comprised of seven courses that can also be taken independently Focus: Manufacturing of Mass Timber, including relevant tools (CNC, computer-aided design, building information modelling (BIM), vacuum press) (Production)	Hybrid (online self-paced and in-person) No prerequisites	\$1,350 <i>Current promotional price for the full certificate</i>	Online, Prince George Campus
UBC (University of British Columbia) ¹¹⁸	Micro-Certificate: Tall Wood Structures Focus: Architecture and Engineering (Adoption)	Online, eight weeks No prerequisites	\$2,400 (full certificate) \$650 (individual courses) <i>Eligible for the StrongerBC Future Skills grant</i>	Online
	Micro-Certificate: Engineered Bamboo for Sustainable Construction Focus: Architecture and Engineering (Adoption)	Online, eight weeks No prerequisites	\$2,400 (full certificate) \$650 (individual courses)	Online
	Micro-Certificate: Fire Safety for Timber Buildings Focus: Fire safety for a broad audience, including forest product professionals, architects, engineers, fire services personnel, authorities, and insurance companies (Adoption)	Online, eight weeks No prerequisites	\$2,400 (full certificate) \$650 (individual courses) <i>Eligible for the StrongerBC Future Skills grant</i>	Online
	Micro-Certificate: Hybrid Timber Construction Focus: Architecture and Engineering (Adoption)	Online, eight weeks No prerequisites	\$2,400 (full certificate) \$650 (individual courses)	Online
	Micro-Certificate: Zero Carbon Building Solutions Focus: Architecture, Engineering, Construction (Adoption)	Online, eight weeks No prerequisites	\$2,400 (full certificate) \$650 (individual courses)	Online

Education levels in North-Eastern BC (select communities), compared to the provincial average

Compared to average education levels across BC, many North-Eastern communities have overall lower levels of education, with over half of the local population typically having no post-secondary education. While levels of post-secondary certificates and degrees are lower in North-Eastern communities compared to BC as a whole, the importance of local colleges is evident, with slightly above-average numbers of diploma recipients compared to the province overall. The number of post-secondary graduates from universities, on the other hand, is significantly lower across the region. For instance, the provincial average of people with a post-secondary certificate, diploma, or degree (aged 25 to 64 years) in BC is 66.1%. In North-Eastern BC, the average varies from 56.9% for Prince George to 49.1% for Chetwynd. These lower education levels have important implications for initiatives to reskill and upskill workers, given that many roles throughout the mass timber supply chain have post-secondary education requirements.

Table 6: Highest certificate, diploma, or degree for the population aged 25 to 64 years in private households, adapted from Statistics Canada, 2021 Census¹¹⁹

	BC	Mackenzie	Quesnel	Prince George	Fort Nelson	Chetwynd
No certificate, diploma, or degree	8.0%	13.5%	16.5%	11.0%	19.0%	15.5%
High school diploma or equivalency certificate	25.8%	32.9%	33.7%	32%	27.2%	35.7%
Post-secondary certificate, diploma, or degree	66.1%	53.8%	49.8%	56.9%	53.1%	49.1%
Apprenticeship or trades certificate or diploma	8.1%	14.5%	10.2%	11.1%	11.8%	15.2%
College, CEGEP, or other non-university certificate or diploma	18.8%	22.7%	20.3%	20.6%	25.6%	19.9%
University certificate or diploma below bachelor level	4.2%	2.6%	3.2%	2.3%	2.3%	2.2%
Bachelor's degree or higher	35%	14.0%	16.1%	22.9%	13.4%	11.9%

General programs relevant to mass timber

A key finding from [Framing BC's low-carbon future: Identifying the skills and workforce needs of British Columbia's growing mass timber sector](#) was that most occupations do not need to fully retrain due to the growth of mass timber. Instead, workers require specific, targeted additional skills and knowledge. While upskilling and reskilling courses are crucial to fill immediate skills gaps, it is also necessary for educational institutions to closely collaborate with employers and other stakeholders to identify points in their existing curriculums, such as within engineering, where mass timber-related skills and expertise could be better incorporated, as well as to stay up-to-date on the latest developments in the field. This will help institutions to train the next wave of workers.

For learners and workers in North-Eastern BC, the College of New Caledonia, NLC, and UNBC all offer a variety of degree programs and continuing education courses relevant to the supply chain of mass timber production and adoption, without

being specifically about mass timber, such as within forestry, architecture, engineering, and construction. These are detailed by sector below.

Forestry

There are a variety of courses highly relevant to mass timber within forestry offered in North-Eastern BC. Courses are available both at the college and university level, and most courses are currently offered in Prince George. There are currently no online programs available. While forestry-related occupations are crucial to all types of wood products, stakeholders have identified a decreasing interest in forestry-related education amongst youth. One major reason for this drop in interest is likely the downturn of the traditional forestry sector, including continued announcements about job cuts, as well as the overall reputation of the sector. Recognizing this, various stakeholders have highlighted the importance to promote forestry careers to young students, including groups that are underrepresented in the sector, such as women.

Various occupations within wood manufacturing, such as wood-processing machine operators and lumber graders, typically require no formal post-secondary education. Instead, employers play a crucial role in educating workers in-house, as no specific degree programs are currently offered at any of the institutions in North-Eastern BC. Interested learners have opportunities to acquire mass timber manufacturing-related skills through short-term programs like the Mass Timber Development micro-credential offered at UNBC. However, without local mass timber manufacturers, mass timber-related skills training for occupations that rely on employer training will not occur, highlighting the importance of a mass timber manufacturing to be established in the region.

On the other hand, wood manufacturing managers typically require an educational background in engineering or business administration. Full engineering degrees are currently only offered at UNBC in Prince George, but various general project management-related courses are available across the region, including online. The region currently does not offer a wood-specific management program, although UBC offers an online Management Skills Training Program specifically for wood products manufacturers, which is also available to learners in North-Eastern BC. UBC also offers highly relevant programs, which currently require in-person attendance, including a Certificate in Kiln Drying as well as in-plant training to interested companies and their employees, teaching skills such as CNC manufacturing, new product design, and lumber drying. However, these trainings and programs are not necessarily accessible for learners and companies in North-Eastern BC.

Design and engineering

Currently, there are no pathways to become a certified architect in North-Eastern BC. Instead, learners would have to leave their communities, a requirement which could possibly prevent them from pursuing this education. If Northern learners do leave their communities for their education, it is common for them not to return to their communities.¹²⁰ This reduces the likelihood of North-Eastern BC developing a regional workforce capable of advancing mass timber projects.

Unlike architecture students, learners in engineering can pursue a traditional engineering degree at UNBC or a Civil Engineering Technology Diploma at the College of New Caledonia. Learners also have the opportunity to complete the first foundational year of engineering at either the College of New Caledonia or NLC, including in Fort St. John, and transition into a university engineering program afterwards. At the master's level at UNBC, engineering graduates can specialize in wood design (there is currently no opportunity to specialize in wood at the undergraduate level), and stakeholders have expressed that the program makes an effort to introduce wood through its regular curriculum. However, since there is an overall scarcity of engineers in Northern BC, many students directly enter the workforce after graduating from their undergraduate programs and never have the opportunity to specialize in wood design.

“In Northern B.C., like many other areas (except the big urban areas), there’s a shortage of professional engineers. So our bachelor students, before they graduate, already have found a job in general civil engineering. Therefore, they are not very motivated to get into our one-year master’s program to specialize in timber design.” —Workshop participant

Undergraduate programs should formally introduce and establish wood technology and timber and wood engineering as part of the core curriculum, including as part of the Civil Engineering Technology Diploma at the College of New Caledonia and as part of the foundational courses at the College of New Caledonia and NLC. Additionally, while stakeholders noted how BIM and computer-aided design-related courses are currently offered as electives at the engineering undergraduate level at UNBC, a greater number of students need to be taught a variety of relevant mass timber-specific skills, including BIM, computer-aided design, and working with CNC machines, amongst others. Ideally, curriculums are adjusted in close collaboration with industry associations and employers to ensure that the latest technological advancements are appropriately included. The need to increase the number of students pursuing an education in engineering is well documented in the region and has led to the creation of the Civil Engineering Technology Diploma at the College of New Caledonia.¹²¹ However, there remain a couple of barriers for learners, including location and the need to move, as well as the financial burden of pursuing an engineering degree.

Construction

North-Eastern BC currently offers apprenticeships for all the identified occupations most critical to the construction of mass timber. All apprenticeships, most notably carpentry, would benefit from providing a general introduction to mass timber technologies to their students wherever feasible, if not already the case. This would require an assessment of current curriculums and the addition of new components. However, in the absence of significant mass timber construction activity, this remains a lower priority. NLC’s Dawson Creek campus already offers a major training space for a variety of programs, including for skilled trades such as carpentry, as well as for clean energy technologies, specifically wind turbines.¹²² Currently, the only practical training program available in BC for the assembly of mass timber buildings is provided by BCIT. While a majority of the course is online, the program includes an in-person learning component at their Burnaby campus. This in-person need could be a significant barrier for learners in North-Eastern BC to attend. NLC could collaborate with BCIT to offer the practical component at their Dawson Creek campus, making the course more accessible to learners in North-Eastern BC.

Institutional cooperation with European institutions

European institutions have a well-developed mass timber curriculum and Canadian institutions stand to benefit through international cooperation around curriculum design and student exchange. Furthermore, adapting lessons and best practices from around the world to the local context for improving quality has been a strategy previously used in the education sector.¹²³

One major challenge for educational institutions is the rapid development of new programs and courses to match the demand for newly arising skills, such as for mass timber. The development of new programs is typically a slow process, and it takes an additional two to four years until the first graduates are ready to enter the workforce. The skills ecosystem for mass timber is significantly more mature in the DACH region. As such, stakeholders in the educational space in North-Eastern BC have identified that there could be opportunities to partner with TH Rosenheim, BFH, and TU Graz, adapt their mass timber curriculums to suit the BC context, and provide more student exchange options between the institutions. The stakeholders also highlighted how various local professors already had established relationships with professors at these schools, which would further facilitate cooperation and knowledge exchange. However, this idea has anecdotally been met with resistance, and there is a tendency for educational institutions across BC to want to develop their own programs and curriculums rather than adapting what has proven to work elsewhere, namely the DACH region. As such, there is a gap between what sectors and employers require in graduates, and what academic programs focus on teaching to students.

“Our academic institutions can learn [about mass timber] from [institutions in Europe]. And our industry can learn from industries over there how they’re integrated”

— BC mass timber manufacturer

In order to facilitate such types of collaboration, which would be highly beneficial for developing the mass timber skills ecosystem in North-Eastern BC, appropriate institutional processes would likely have to be created. While some educators have personal connections with academics from Europe, there are no formal mechanisms for collaboration in the field of mass timber.

Establishing these partnerships will also require enablers, such as financial support and placement availability, as well as reducing entry barriers and procedural complexities.¹²⁴ Initial efforts to provide financial support are already underway. The BC Ministry of Jobs, Economic Development and Innovation announced funding of \$3.3 million for a new mass timber training hub at BCIT. This grant will support two new training courses to complement current programs.¹²⁵ A combination of institutional partnerships and funding to support collaboration could boost BC’s mass timber skills ecosystem.

“I think the forest industry is tired with always having to go through the academic process, which just seems to bog things down and then delivers what an academic wants to teach, not what the sector needs. [A college] is there to [prepare] people [for] jobs, not [just to know] theories. And this is where I think there’s a strong argument that you partner with TH Rosenheim or BFH or TU Graz, because they do what [we’re] trying to do. They teach people to work in the industry in a myriad of jobs with one course. It’s not isolated.”

—Workshop attendant

Employers

Mass timber-specific employers can be found both on the production and adoption side of mass timber. However, given the local focus on the forestry sector, this report emphasizes those involved in mass timber production in North-Eastern BC. North-Eastern BC currently has no operating mass timber manufacturers, which is the most critical gap in the local skills ecosystem as it reduces demand for skilled workers and prevents any ability to develop partnerships between employers and other members of the ecosystem. While educational institutions in North-Eastern BC play a key role in formally teaching skills and knowledge

related to forestry, engineering, and construction trades, employers play a vital role in training workers within wood manufacturing, especially given the general lack of post-secondary education programs for occupations such as wood-working machine operators. This is a tendency also reflected within mass timber manufacturing. Based on input from mass timber manufacturers in other parts of BC and across Canada, as well as based on insights in the DACH region, it is typical for manufacturers to play a crucial role in training their staff on the specific mass timber skills required to work at their plant. Many manufacturers follow processes unique to their facility, somewhat limiting the transferability of skills across workplaces. Given these

differences in production processes, stakeholders emphasized the need for broad familiarity with wood and production processes as prerequisites for many positions. Additionally, in the context of North-Eastern BC, and BC more broadly, few people already have the skills and experience required to work in a mass timber manufacturing facility.

“We do most of our training in-house as it is difficult to find people with the right skills. There are labour shortages and most of the training is construction focused.”

— Mass timber manufacturer

Current training options for mass timber-specific skills are limited, and largely focus on design and construction-specific skills of mass timber, rather than the skills requirements for the manufacturing of mass timber. Interested learners might therefore choose to relocate to other parts of BC and find employment with different manufacturers, leading to regional outmigration. There are a variety of reasons that can explain the absence of mass timber manufacturers in North-Eastern BC. Some common barriers preventing the growth of value-added opportunities such as mass timber are fibre supply, lack of demand, lack of financial capital, and lack of skilled workers.

Policymakers

The following section will provide an overview of relevant programs, initiatives, and funding provided by the federal government and the Government of BC that either already support the mass timber skills ecosystem in North-Eastern BC or seem highly relevant to the region but currently do not support the local skills ecosystem. These include grants for reskilling initiatives and mass timber-specific education, as well as support for forestry communities affected by the downturn of the forestry sector.

Federal government

The federal government currently provides funding for a variety of skills development initiatives and labour market programming, some of which already directly fund initiatives in BC’s North-East and are highly relevant to the region.

Canadian Colleges for a Resilient Recovery Program (C2R2)

The federal government currently funds the C2R2 program through Employment and Social Development Canada.¹²⁶ The program brings together a coalition of colleges, CEGEPS, institutes, and polytechnics across Canada to offer relevant micro-credentials for sustainability and climate roles, which are linked to broader green recovery efforts. Canadian citizens, permanent residents, and protected persons can access these micro-credentials for free, learning essential skills for a net-zero economy.¹²⁷ Temporary foreign workers and international

students are not eligible for this funding. The only currently funded mass timber-specific course is the Introductory Studies in Mass Timber Construction micro-certificate offered by BCIT (see [Appendix 4](#) for a summary of currently available mass timber courses and their funding status).¹²⁸ Since the coalition does not include universities, neither UBC’s nor UNBC’s course offerings are part of the scope of this program. Ideally, the program would be expanded to include micro-credentials at universities, especially in regions such as North-East BC, which already have limited educational offerings.

Community Workforce Development Program

The federal government recently developed the Community Workforce Development Program. The program encourages collaboration between educational and training providers, employers, community organizations, and other stakeholders, and projects must focus on local economic development strategies. Two additional criteria include supporting rural and remote communities seeking to diversify local economies¹²⁹ and having a strong focus on equitable outcomes for underrepresented groups, including Indigenous people, women, persons with disabilities, older workers, and racialized individuals.¹³⁰ One currently funded initiative is the Community Action for Workforce Development project, which will pilot intersectional, community-led workforce planning models in three rural communities in Canada. In addition to community-based organizations and coordinating agencies, local SMEs are key stakeholders of the initiative.¹³¹ One of the target communities is Golden, located in South-Eastern BC. Golden also has a local mass timber manufacturer, which is currently the Northernmost mass timber manufacturer in BC.¹³² While North-Eastern BC is presently not part of this pilot, it is an interesting and promising approach that aligns well with the needs of North-Eastern BC.

BC Government

Canada-British Columbia Workforce Agreement

Funded by the federal government through the Canada-British Columbia Workforce Agreement, the BC Ministry of Post-Secondary Education and Future Skills works with a variety of stakeholders, including employers, communities, and industry organizations, to deliver a variety of skills training programs and services, summarized in [Table 7](#).¹³³ Although there is no specific focus on mass timber, all programs focus on communities, sectors, and individuals directly affected by the downturn of the forestry sector.

Table 7: Summary of programs funded through the Canada-British Columbia Workforce Agreement

Program name	BC employer training grant ¹³⁴	Community workforce response grant ¹³⁵	Skills training for employment programs for vulnerable and underrepresented groups ¹³⁶
High-level summary	Companies can receive funding to train their existing workforce and prospective hires	Communities and sectors can receive funding for emerging and urgent labour and skills needs under four streams: Emerging Priorities, Indigenous Communities, Workforce Shortages, and Community Response	The program has several streams to support skills training of vulnerable individuals, including workers affected by mill closures and older workers
Funding	80% of the cost of training, up to \$10,000 per employee, with a maximum annual amount per employer of \$300,000	Covers up to \$10,000 per participant and provides up to \$5,000 for other services and supports to help participants overcome training and employment barriers	N/A
Relevance to North-Eastern BC	Workers in forestry affected by the downturn of the sector are also eligible for funding to reskill themselves/their employees and to train and hire workers from other companies at risk of losing their job	All streams are of high relevance to the region, but the Community Response Stream is specifically designed to address the skills training needs of communities affected by the downturn of the forest sector	Through the Impacted Workers stream, individuals affected by mill closures and reductions in shifts can receive employment supports and skills training
Examples of funded projects in North-Eastern BC	Quesnel, in partnership with the local employer Freya Logging, offered unemployed individuals to train as forwarders (forwarders operate forestry vehicles to transport harvested logs) ¹³⁷	N/A	N/A

StrongerBC’s Future Ready Action Plan

The Future Ready Action Plan aims to better prepare the province for future skills and labour needs, and is focused on five pillars: improving post-secondary education accessibility and affordability, reskilling initiatives, addressing barriers to employment, Indigenous peoples’ workforce priorities, and ensuring that people find employment in fields that match their training.¹³⁸ The plan also includes various action items and plans directly impacting the mass timber skills ecosystem in North-Eastern BC, including the StrongerBC future skills grant. The grant funds individuals to participate in short-term skills training at public post-secondary institutions across BC, covering up to \$3,500. Each resident of BC (including Canadian citizens, permanent residents, and protected persons) above the age of 19 is eligible for a one-time grant to cover tuition costs as well as program and course material costs. Childcare, living allowances, and transportation, amongst others, are not eligible costs.¹³⁹ The grant currently also covers two mass timber courses at UBC, which focus on the adoption of mass timber. As a result, the only micro-credential specializing in mass timber production (the Mass Timber Development micro-credential at UNBC) is not eligible for full federal or provincial funding. Additionally, temporary workers and international students cannot benefit

from this grant. Additional focus areas in the action plan relevant to North-Eastern BC are the delivery of mass timber-specific education and the ForestWorker Transition Support Program. The latter is a new training initiative set to launch in October 2023, for which no additional information is currently available.¹⁴⁰ The Action Plan also contains deliverables such as boosting teacher recruitment and retention in rural areas by investing in training and recruitment initiatives.

Other Relevant Policies

In addition to programs and grants specifically aimed at supporting skills development more broadly, the province also has brought forward various policies supporting mass timber and the value-added wood manufacturing sector specifically. Many of these policies include skills-related components, or seek to have a direct impact on the creation of local employers. Examples include the Mass Timber Action Plan and the BC Manufacturing Jobs Fund, which provides funding for capital projects and final-stage business and project planning.

“Right now the province has various funding programs, such as the manufacturing jobs fund. The problem is we see a lot of really small startup companies trying to apply to the funding, but we don’t see small and medium size established companies trying to expand or trying to explore new opportunities.”

—Workshop attendant

Coordinating bodies

In addition to employers and policymakers, institutions, individuals, and both formal and informal networks can act as coordinating bodies that help with the flow of information between stakeholders. Specific examples relevant to North-Eastern BC include employment agencies, career counsellors, industry associations, and local networks, such as the Forestry Initiatives Program in Quesnel. These groups provide a range of services, including skills evaluation, information about labour markets, individual coaching, or a collective voice for the industry.

Forestry Initiatives Program

The Forestry Initiatives Program was created in Quesnel in 2018 with the purpose of holding regular strategy and planning sessions to tackle some of the most pressing and interconnected issues facing the community. It convenes local stakeholders to create ‘home-grown’ solutions for generating higher economic value from the available fibre.¹⁴¹ The current key priority of the network is improving the community’s resilience against wild-fires. However, it includes other priorities, such as preparing the workforce adequately for a value-added wood bioeconomy, advocating for landscape-level analysis and restoration, and supporting the formal application process for a community forest by the Lhtako Den, Nazko, ?Esdilagh, and Lhoosk’uz Dene First Nations.¹⁴² As such, it is a strong example of a local network that supports the flow of information between key stakeholders, including educational institutions and provincial policymakers, and supports setting local priorities and objectives. The program could be an interesting foundation for a larger regional network with a more dedicated focus on developing a strong mass timber skills ecosystem.

Employment agencies

Employment agencies perform three key functions across a skills ecosystem. They evaluate workers’ skills on behalf of companies, match job seekers to advertised positions, and assist companies with recruitment.¹⁴³ Most agencies have access to tools for skills evaluation and information about the hidden job market. This helps people find roles aligned with their skills, expectations, and profiles. However, supports like these tend to connect

individuals with existing opportunities and do little to support an economic transition to, and the growth of, a mass timber opportunity. In Northern BC, several programs have been designed to support communities impacted by mill closures and shift reductions, such as the Work Connect, DeNovo, and Elevation to Employment Programs. Services offered include specific skills training, wage subsidies, and matching participants with relevant employers.¹⁴⁴ Programs like these focus on connecting participants with existing employment opportunities, meaning there are currently no mechanisms in place to, for example, transition mill workers and leverage their transferable skills in a local mass timber manufacturing plant (since there is not currently a local mass timber manufacturing plant). This is also a direct result of North-Eastern BC’s lack of a local mass timber manufacturing facility and regional plan for training individuals to establish mass timber manufacturing capacities.

Industry associations

Industry associations have typically provided a collective voice for individuals within a business or industry. Several associations are operating in the BC Forestry space. Some of the key ones include the Council of Forest Industries (COFI), Forest Products Association of Canada (FPAC), Canadian Wood Council (CWC), Interior Lumber Manufacturers Association (ILMA), and WoodWORKS BC. Several of these associations have been optimistic about the outlook for mass timber technology in BC broadly. However, they have also echoed the need to address labour shortfalls, the need for training, and developing interest in wood construction:

“I think the biggest question for me is that you have these programs, but how do you actually get the message to the people so they are aware and willing to participate.”

—Workshop participant

From a skills perspective, industry associations are working on different aspects of the ecosystem related to mass timber. For example, associations such as CWC have several tools and knowledge materials on building with wood. This includes a repository of resources related to mass timber awareness, building systems, and codes and standards. COFI’s jobs reports focus on growing Indigenous participation and building a skilled workforce for the future of forestry in BC. FPAC has been working with communities and providing them access to cutting-edge tools, as well as promoting diversity through programs such as Women in Wood.¹⁴⁵

Learners/workers

Overall, educational institutions in North-Eastern BC seem well-positioned to offer and scale courses related to mass timber technology. However, it is also important to consider the degree to which learners are aware of and interested in the course offerings, highlighting the importance of marketing and flexible course offerings.

The learning community in North-Eastern BC is highly diverse, comprised of people with different socio-economic backgrounds, including urban individuals in cities like Prince George, rural and remote individuals in communities such as Mackenzie or Fort Nelson, and individuals from many local First Nations communities. There are younger learners pursuing their primary education, older learners seeking or needing to transition careers, and lifelong learners of all ages and backgrounds participating in continuing education opportunities.

Diversity in learners also leads to learners having different needs regarding the delivery of education and supports for a career in mass timber. Some learners only require upskilling, for which a popular mode of training includes micro-credentials, which also resonates well with students who want shorter courses. This might, however, not be the best approach for all learners, and some would benefit from full programs, more practical courses, or courses that are more culturally appropriate. Furthermore, since these short-term courses are relatively new, a longer-term evaluation of their efficacy in delivering skills will be needed, as well as to establish how applicable they are to learners in different situations, including workers affected by larger transitions in the forestry sector, amongst others.

While stakeholders have noted a general trend of learners wanting shorter and more flexible courses, other learners require longer training through traditional degrees, such as engineering, that typically require a commitment of at least four years. The Master in Wood Design at UNBC is an example of a great program that is highly relevant for the mass timber supply chain. However, the engineering shortages in the region signify that undergraduate students are highly employable and do not need to pursue education at the master's level. This creates a disconnect between the supply of relevant education and its demand.

Local stakeholders have also identified the importance of promoting forestry to youth and trying to attract more diverse learners.

Programs therefore have to be agile and adapt to changing societal, environmental, and economic needs, including the growing impact of climate change on forest health, as well as larger trends in the forestry sector, such as the growing role of First Nations communities in managing forest tenures and a shift towards a value-added forest sector.

Workforce diversification in BC

The cultural and demographic characteristics of any workforce impact the productivity and performance of organizations. A large body of work has shown the importance of a diverse workforce in reducing systemic inequalities and promoting creative solutions to complex problems.¹⁴⁶ Promoting workforce diversity has been challenging in BC, with women and immigrants being underrepresented in the natural resources sector.¹⁴⁷ Women have historically been underrepresented in forestry, and in 2016, women made up only 15% of the forestry labour force in BC.¹⁴⁸

Stakeholders have noted how mass timber could provide an opportunity for underrepresented communities to enter the workforce, including women or people with physical disabilities. They attribute this to a variety of factors, including lower physical requirements due to highly automated manufacturing processes and cultural shifts due to high levels of innovation in traditional sectors. As a result, in addition to creating new jobs, mass timber may have the potential to contribute to the diversification of the workforce.¹⁴⁹ Empowering underrepresented communities with skills training and job-ready learning for mass timber can open possibilities to attract more diverse talent.

“Part of the Forestry Initiatives Program is rebranding forestry for youth. We see really big opportunities in bringing a simulator to high school kids so they can see how running a single group harvester or running a forwarder can actually be part of the ecological solutions, and that forestry can be innovative and high tech. And it’s really beneficial to have women and young people learning to operate this type of machinery, rather than retraining a long-time machine operator that’s done the clear-cutting method.”

— Workshop attendant

A key challenge identified by smaller manufacturers is discrepancies between wages they deem appropriate for workers being taught on the job and salary expectations from learners. Unlike in the DACH region, where apprentices are typically teenagers when starting their apprenticeship and still live at home, apprentices tend to be older in BC. Only 10% of apprentices are 16–19 years old, most are 20–24 years old, and 28% are 25 and older.¹⁵⁰ As a result, apprentices in BC can typically rely on less family support throughout their education, adding pressure to salary requirements.



Discussion: How ready is the North-Eastern BC skills ecosystem for mass timber projects?

Overall, there are many promising signs that show the potential of a strong mass timber skills ecosystem emerging in North-Eastern BC, but one core component is currently lacking: employers. Without the presence of employers, all other components of the skills ecosystem are struggling to develop the stronger interconnections that are present in the DACH region. The absence of employers has also furthered the creation of silos in which actors currently operate, as a core component of the ecosystem is currently missing. Several policies are currently in place to support community workforce development, but most have a strong focus on supporting individuals, despite the reality that individuals leaving education or training will ultimately need jobs to enter into. Therefore, one approach to targeting greater employment is to take a more regional perspective that seeks to attract greater investment. In this perspective, it should be acknowledged that much of the current strengths of the ecosystem in the DACH region (engaged post-secondary institutions, the presence of coordinating bodies, and pathways for learners) exist in some form in North-Eastern BC. While there remains room for improvement in all areas, any gains would be marginal if there remains a dearth of employment capacity within the marketplace. Developing a regional plan to attract these employers should be viewed as the top priority of all stakeholders within the ecosystem looking to develop this sector in North-Eastern BC.

Level of readiness: educational providers

Overall, educational institutions seem well-positioned to offer courses aligned with the skill needs for mass timber technologies. The establishment of courses directly related to mass timber, notably the creation of a mass timber-focused micro-credential at UNBC, suggests that these institutions are already moving in this direction. Still, they would benefit from the improved readiness of other stakeholders in the system, specifically the presence of relevant employers and a strong coordinating body, such as a local network, that outlines a larger plan for the region. The College of New Caledonia, NLC, and UNBC provide a variety of programs that are highly relevant to the supply chain of mass timber, with efforts being made by individual professors to teach students about wood and value-added products, including mass timber. Additionally, the new micro-credential in mass timber development at UNBC teaches some of the most critical skills for mass timber production and is unique in Canada, showcasing that there are experts in the region who can teach mass timber production skills. The region currently lacks a degree in wood technology and industry stakeholders have flagged that as being of great importance. However, the design of this program may not generate the enrollment needed until there is a regional employer to spur demand. In addition to the local institutions, learners also have the opportunity to participate in courses and

programs offered outside of the region, such as at BCIT. Virtual courses are highly accessible, but it is unclear how and if they are being marketed to learners in North-Eastern BC. There is currently no single platform providing an overview of all existing educational offerings, making it difficult for interested learners and companies to find relevant course offerings, especially those that might be offered outside of the region but are delivered virtually. Individual professors at the College of New Caledonia, NLC, and UNBC have also highlighted their established relationships with professors in the DACH region and support increased collaboration with these institutions, including around adapting curriculums, which showcases the potential for knowledge transfer opportunities as well.

Level of readiness: employers

North-Eastern BC currently has no mass timber manufacturing facilities, which is a significant gap in the local skills ecosystem in terms of skills utilization and development since employers play a critical role as education providers. While existing SMEs, such as sawmills, have expressed an interest in producing mass timber panels within the region, concerns such as a lack of knowledge around building codes and product marketing have made them hesitant about pursuing this opportunity. There are other issues for SMEs interested in entering the market, such as difficulties accessing the necessary fibre. However, when mass timber was relatively novel within the DACH region, regional employers in the value-added wood manufacturing space who could offer employment opportunities and hire new graduates were still present. This speaks to the importance of having a diverse network of employers in the wood manufacturing space to employ young people, a quality that North-Eastern BC would strongly benefit from.

Level of readiness: policies and programs

Overall, there are a wide variety of programs and policies in place that are highly relevant to communities in North-Eastern BC, with many of the programs focusing on supporting small, rural, and remote communities affected by the downturn of the forestry sector. However, many existing policies focus on individual programs and individual learners. There are also specific gaps in the existing programs. For example, while both BCIT and UBC receive either provincial or federal funding for some of their micro-credentials, UNBC's micro-credential receives no such support for learners. Additionally, while funding for short upskilling and reskilling courses are useful, they need to be balanced with similar considerations for other longer-form education pathways for occupations critical to the supply chain of mass timber and other value-added wood products, such as engineering and degrees related to forest management. A useful example BC could consider replicating is the Saskatchewan Graduate Retention Program, which provides a rebate of up to \$20,000 of tuition fees and is paid out over several years following graduation if the graduate remains in the province.¹⁵¹ Impact studies have found that individuals aged 23 to 28 were

5.3% more likely to graduate from university following the program and were 4.5% less likely to migrate across provinces.¹⁵² However, for younger people between the ages of 18 and 23, the program did not impact university enrollment, completion of courses, or migration to other provinces.¹⁵³

Level of readiness: coordinating bodies

Coordinating bodies such as employment agencies tend to focus on providing support and skills development to individuals, which ideally would be tied in better with local efforts of creating a mass timber supply chain. In the absence of local mass timber manufacturing facilities and a clear local plan to establish such facilities, it is difficult to recommend individuals to pursue skills training that would be relevant for mass timber. The Quesnel Forestry Initiatives Program can be seen as a strong example of a local network covering a variety of interconnected areas, including the manufacturing and use of innovative wood products such as mass timber, and connecting a variety of stakeholders together, including policymakers, industry associations, and educational institutions.

To meaningfully support the creation of a local mass timber skills ecosystem, it would be critical to create specific targets, such as creating a local manufacturing facility, which would then allow for streamlining education, training, and coordinating efforts toward such a goal. The Quesnel Forestry Initiatives Program could be seen as an example of a local network that could play a key part in such an undertaking, but it might also be necessary to create a more extensive regional network.



Priorities for North-Eastern BC's skills ecosystem to integrate mass timber

Priority 1: Attracting employers

The biggest gap in the current skills ecosystem in North-Eastern BC is the lack of mass timber manufacturers. Therefore, attracting employers within mass timber manufacturing specifically, as well as value-added wood manufacturing more broadly, should be one of the key priorities for the region. While North-Eastern BC needs to attract employers in general, various barriers must be addressed to make this more feasible (see Priority 2). In the absence of these barriers being meaningfully addressed, the region could prioritize opportunities with fewer barriers by focusing on communities that have no transportation issues and have existing SMEs (such as sawmills) with reliable fibre access. Combining the growing interest from several sawmills to diversify their operations and enter the mass timber manufacturing space with existing funding opportunities for capital investments and programs for on-the-job training could help more existing SMEs begin to manufacture mass timber in the region. One strategic approach that North-Eastern BC could adopt from the DACH region is adopting a broader, more diversified approach to wood manufacturing. This approach resulted in the setting up of many diversified wood manufacturing businesses in the DACH region, which ultimately boosted the skills ecosystem. Most of the well-established mass timber manufacturers in the DACH region started as small family-run SMEs, such as sawmills. They gradually diversified into a variety of wood products, including mass timber. Other mass timber manufacturers within BC have followed a similar path, notably Kalesnikoff.

Priority 2: Addressing major barriers, with a special focus on infrastructure and fibre access

A lack of transportation infrastructure and access to fibre have been major bottlenecks preventing the recent establishment of value-added opportunities in North-Eastern BC, notably in Mackenzie and Fort St. John. In Mackenzie, an interested manufacturer was unable to secure access to fibre. Furthermore, the Mackenzie region has some of the highest transportation costs for wood in the province, which could impact the competitiveness of a potential local mass timber manufacturer. In Fort St. John, a required railway upgrade did not receive the necessary provincial funding, preventing the needed access to deliver locally manufactured products to markets further South. Northern BC requires appropriate transportation infrastructure, notably railways, to support greater market access for their locally manufactured wood products, including mass timber. Considerations also need to be given to enhancing transport accessibility for SMEs to help drive down regional production costs. While this is a priority for the whole region, it is more of an immediate bottleneck for some of the more remote, northernmost communities, such as Mackenzie and Fort Nelson, and less of a concern for less remote and better-connected communities like Prince George. Additionally, the difficulty for SMEs to access fibre must be addressed since this is one of the most significant concerns stakeholders have expressed. The German Charter for Wood 2.0 can be seen as a useful example of an initiative that seeks to increase the value of the local wood sector and aims to tackle various issues and bottlenecks along the value chain of wood products.¹⁵⁴ Finally, it should be noted that some stakeholders expressed concerns about uncertain market demand for mass timber products. This report acknowledges that taking these steps is unlikely to resolve this uncertainty.

Priority 3: Enhancing the funding and accessibility for mass timber-related education in Northern BC and beyond.

The BC and federal governments provide funding for various upskilling and reskilling initiatives, including certain micro-credentials. Additionally, the federal government has fully funded the mass timber micro-credential at BCIT so that it was available to learners at no cost. It has, however, experienced such high demand that the available funding has been exceeded. Meanwhile, the Mass Timber Development micro-credential at UNBC was only partially funded by the provincial government. Micro-credentials are a useful tool to provide additional skills to qualified professionals within a field, but they cannot replace complete degree requirements for highly skilled professionals crucial to the growth of mass timber, notably engineers and skilled trades professionals. Still, full degrees at both universities and colleges remain expensive for many Northern BC learners. Micro-credentials may also not be the best tool for training all occupations, as skilled trades professionals would likely benefit more from expanding existing training. North-Eastern BC has a general shortage of workers in occupations such as engineering, and many communities have a population decline with people moving away. Opportunities should be explored to improve the affordability of specific education programs, ideally providing an incentive for graduates to stay within the region. One example could be a tuition rebate program, such as the Saskatchewan Graduate Retention Program.

Priority 4: Developing deeper partnerships between North-Eastern BC institutions and international leaders in wood manufacturing training and education.

Developing new programs and courses typically takes several years, which can make it difficult to quickly adapt to newly emerging skills requirements and to fill knowledge gaps for innovative opportunities, including mass timber. Other jurisdictions, notably the DACH region, already have developed highly relevant curricula and programs, which offers an opportunity for increased collaboration between these institutions with more established programs and North-Eastern BC institutions. Individual professors at the College of New Caledonia, NLC, and UNBC have highlighted their established relationships with professors in the DACH region and support increased collaboration with these institutions, including around adapting existing curriculums. Currently, there are very few mechanisms in place that would promote institutional collaboration and create knowledge transfer opportunities, including student and faculty exchange or opportunities for joint projects. By embracing collaboration across universities, it will be easier to fill knowledge gaps and promote innovation within the mass timber space in Northern BC and could fast-track the development of highly relevant programs.

Priority 5: Broadening the focus of micro-credentials, diplomas, and degree programs to include wood skills more broadly, not just mass timber.

Mass timber is a growing clean growth opportunity, but it should be viewed in the larger context of a growing forest bioeconomy and wood-related skills. Presently, mass timber is a relatively minor economic opportunity for most learners, especially in North-Eastern BC, which (as previously stated) currently has no mass timber manufacturers. It is therefore difficult to justify focusing solely on the mass timber opportunity for educational institutions, communities, and learners alike. Instead, wood-specific skills and training should be heavily prioritized in curriculums for degrees and programs that are not already focused on wood, including the one-year foundational engineering program at the College of New Caledonia and NLC, the longer engineering programs at UNBC, and the business management-related programs at the College of New Caledonia, NLC, and UNBC (to inspire and prepare wood entrepreneurs). Curriculums should be developed in close collaboration with local companies as well. Ideally, the College of New Caledonia, NLC, and UNBC revisit the idea of creating a local wood technology program. This program had previously been developed in the region but was then suspended. This is also supported by a key finding from the DACH region, which has a highly developed mass timber skills ecosystem built upon a strong wood skills ecosystem combined with a focus on fostering entrepreneurship. Most mass timber-related skills are taught as part of broader wood-related programs and courses, such as wood technology, allowing learners to explore mass timber as one of many innovative wood products. A broader, more generalized wood-focused curriculum also produces graduates that can occupy a variety of positions and occupations along the supply chain of mass timber and other wood products, equipping them all with digital skills, such as 3D modelling, computer-aided design, BIM and the use of CNC machines, and high levels of practical work experience. Different mechanisms, such as exchange opportunities with DACH region universities and more funding for dedicated degrees in wood technology, could also help local institutions structure their curriculum and encourage more people to register. While mass timber-specific micro-credentials are a great way to upskill and reskill the existing workforce, a broader awareness and knowledge of wood is key. This would ideally also be supported by more work-integrated learning opportunities for students, but this is currently not feasible in the absence of local mass timber manufacturers.

Priority 6: Creating a platform to offer an overview of all educational offerings

There are currently a multitude of relevant courses, programs, micro-credentials, and diplomas available to interested learners and companies in the wood manufacturing and mass timber space, and offerings, including virtual programs, are rapidly growing. Learners are therefore able to tap into a greater pool of potential educational offerings. However, stakeholders note that what is missing is a well-maintained platform providing an overview of all educational offerings, similar to what the Swiss Timber Construction Industry Association offers.¹⁵⁵ Such a platform would help students know what learning options are available, and could also support coordinating bodies, such as employment agencies, to better connect individuals with upskilling opportunities and would make knowledge and skills gaps in education programs more visible.



Conclusion

The mass timber skills ecosystem in North-Eastern BC is growing and shows promising signs of continued prosperity, such as the enthusiasm of local communities and educational providers to explore mass timber and other value-added opportunities. Local post-secondary institutions, including UNBC, the College of New Caledonia, and NLC, already offer a variety of highly relevant degrees, certificates, and micro-credentials. By building upon the existing programming, such as by adding or expanding mass timber and wood technology-specific skills and knowledge to existing curriculums, the region could prepare learners to fill a variety of the skilled positions required along the supply chain of mass timber.

The interest in pursuing value-added opportunities in North-Eastern BC has also led to the creation of local networks, such as the Forestry Initiatives Program in Quesnel. Still, more work is required to truly advance regional objectives in the value-added space. One of the region's major shortcomings is the lack of local mass timber manufacturers. In order to strengthen the emerging mass timber skills ecosystem in the region, attracting employers is one of the most critical priorities at this time. Various factors have made it difficult for local mass timber manufacturers to emerge, some of which are unique to individual communities, while others affect most of North-Eastern BC or even the entire province. Addressing structural bottlenecks, such as a lack of transportation infrastructure and the difficulty for SMEs to reliably access fibre, must also be prioritized.

Without a clear provincial pathway, communities and regions in North-Eastern BC and beyond will be stifled in pursuing collective efforts to diversify their local economies and leverage clean growth opportunities such as mass timber. Without local employment opportunities, learners pursuing mass timber-specific education, for example, are being prepared for employment outside the region. Worse, they risk not being able to use the skills they are developing without more employment opportunities. Without adequate fibre supply and infrastructure investments, new, innovative SMEs will have difficulties entering the market. Addressing this gap will require clear objectives and transition plans for individual regions and communities, including an education and skills development approach focusing on regions and significant investments in infrastructure, including railways.

Appendix 1: Methodologies used in this report

Interviews and Workshops

Interviews were conducted with stakeholders across the supply chain. The insights from these interactions were transcribed, and relevant themes were identified.

Survey

A perception survey was created to understand the skills that will play an important role in the mass timber sector in the future. The online survey had nearly 40 questions that captured stakeholders' perceptions of the most important future skills for the mass timber sector. The survey received ethics approval from the University of Ottawa Ethics Committee. The survey was disseminated using the SurveyMonkey platform. Publicly available information was used to send the survey to respondents across the forestry, manufacturing, architecture, design, engineering, and construction sectors. A total of 20 responses were received, of which 16 were complete. This was one method of data collection to inform the research and was supplemented by a foresight exercise, interviews, and a workshop.

Appendix 2: Relevant degrees and programs: production of mass timber

Occupations included in this table are those identified in [Framing BC's low-carbon future: Identifying the skills and workforce needs of British Columbia's growing mass timber sector](#) as being more impacted by mass timber growth and relevant in mass timber labour force discussions.

Table 8: Relevant degrees and programs: production of mass timber

Occupation	Typical post-secondary education, if applicable	College of New Caledonia	Northern Lights College (NLC)	University of Northern British Columbia (UNBC)
Forestry				
Silviculture and forestry workers	College or other specialized program for silviculture workers or forestry crew workers	Natural Resources and Forest Technology (Prince George)	Land and Water Resources Diploma (Fort St. John)	Bachelor of Science in Forest Ecology and Management (Prince George)
Forestry technologists and technicians	College program in forestry technology or renewable resources, or forest ranger program	Natural Resources and Forest Technology (Prince George)	Land and Water Resources Diploma (Fort St. John)	Bachelor of Science in Wildlife and Fisheries (Prince George)
Forestry professionals	Bachelor in Forestry / Forestry Engineering	N/A	N/A	Bachelor of Science in Forest Ecology and Management (Prince George) Environmental and Sustainability Studies BA (Prince George) Natural Resources and Environmental Studies (Prince George) Bachelor of Science in Environmental Science (Prince George)
Wood Manufacturing				
Lumber graders and other wood processing inspectors and graders	N/A			
Other wood-processing machine operators	N/A			
Woodworking machine operators	N/A			
Supervisor, wood product processing	N/A			
Manufacturing manager	Diploma / Certificate / Bachelor / Master in Engineering or Business Administration	Business Management Diploma / Certificate (Prince George) Applied Science Engineering Certificate (Prince George) <i>First-year credential only, transfer required for year 2</i>	Business Management Diploma / Certificate (Dawson Creek, Fort St. John, online) Management Advanced Certificate (Dawson Creek, Fort St. John) Engineering Studies Certificate (Fort St. John) <i>First-year credential only, transfer required for year 2</i>	Bachelor of Commerce, General Business (Prince George) Business Administration (MBA, MSC) Project Management Certificates (online) Engineering (Prince George) Integrated Wood Design Civil Engineering (Prince George)

Occupation	Typical post-secondary education, if applicable	College of New Caledonia	Northern Lights College (NLC)	University of Northern British Columbia (UNBC)
Construction millwrights and industrial mechanics	Apprenticeship	Apprentice Industrial Mechanic – Millwright (Quesnel)	Millwright Apprenticeship (Dawson Creek)	
Architecture				
Architect	Bachelor / Master in Architecture	N/A	N/A	N/A
Engineering				
Engineering	Bachelor / Master in Engineering	Applied Science Engineering Certificate (Prince George) <i>First-year credential only, transfer required for year 2</i>	Engineering Studies Certificate (Fort St. John) <i>First-year credential only, transfer required for year 2</i>	Engineering, Integrated Wood Design Specialization (Prince George)
Civil Engineers	Bachelor / Master in Engineering	Civil Engineering Technology Diploma (Prince George)	N/A	Civil Engineering (Prince George)
Construction				
Construction managers	Bachelor / Master in Construction Management, Engineering	N/A <i>Engineering, see above</i>	Construction Project Management (online) <i>Engineering, see above</i>	N/A <i>Engineering, see above</i>
Carpenter	Apprenticeship	Apprentice Carpenter (Prince George, Quesnel)	Carpenter Apprenticeship (Dawson Creek) Enhanced Carpentry Foundation Certificate (Dawson Creek)	N/A
Construction trade helpers and labourers	N/A			
Plumber	Apprenticeship	Apprentice Pipe Trade (Prince George)	Plumber Apprenticeship (Dawson Creek)	N/A
Electrician	Apprenticeship	Apprentice Electrical (Prince George)	Electrician Apprenticeship (Fort St. John)	N/A
Heating, refrigeration and air conditioning mechanics	Apprenticeship	Apprentice Heavy Mechanical Trades (Prince George)	Heavy Mechanical Trades Apprenticeship (Fort St. John)	N/A

Appendix 3: Summary of relevant wood manufacturing programs offered at the University of British Columbia (UBC)

Table 9: Summary of relevant of relevant wood manufacturing programs offered at the University of British Columbia (UBC)

Program name	Objective	Length, mode of training	Cost	Location
<p>Management Skills Training Program¹⁵⁶</p> <p>Available courses:</p> <ul style="list-style-type: none"> • Business Finance • Factory Planning • Green Marketing • HR and Safety • New Product Development • Production Planning • Quality Management • Sales & Marketing • Supply Chain Management 	<p>To support entrepreneurs in the wood products industry:</p> <ul style="list-style-type: none"> • Management/supervisory-track employees within wood products companies who need to gain new skills to move into positions of greater responsibility • Employees who need to understand specific functions within their company in order to do their jobs more efficiently (e.g., salespeople who need to know how production decisions are made and vice versa) • People from non-wood products backgrounds who are preparing to take on supervisory or management roles in the industry 	<p>Each course module requires about 35-45 hours, online delivery</p>	<p>\$445 (6-week courses)</p> <p>\$495 (8-week courses)</p>	<p>Online</p>
<p>Certificate in Kiln Drying</p>	<p>To provide industry-respected training in the area of kiln drying, specifically geared toward secondary and advanced primary manufacturing of wood</p>	<p>The full program entails approximately 150 hours of instruction, offered via a series of six modules ranging in duration from two to five days.</p>	<p>N/A</p>	<p>UBC and external locations</p>
<p>In-plant training¹⁵⁷</p>	<p>To provide instruction on a variety of themes and topics. Additionally, they offer the creation of customized course contents to match the specific needs of a plant.</p> <ul style="list-style-type: none"> • Industrial wood finishing • Lumber drying • Machining — general operations and specialized operations • CNC (computer numerical control) manufacturing • Marketing and business strategy for wood products manufacturers • New product design • Operations management, industrial engineering, factory and facilities planning • Quality control • Technology evaluation, selection and maintenance • Tooling issues • Wood anatomy, properties and species identification 	<p>Variable</p>	<p>N/A</p>	<p>On-site at the company</p>

Appendix 4: Currently available federal and provincial grants for mass timber-specific courses in North-Eastern British Columbia (BC)

Table 10: Currently available federal and provincial grants for mass timber-specific course in North-Eastern British Columbia (BC)

Institution	Course name	Federal funding (Canadian Colleges for a Resilient Recovery program)	BC provincial funding (StrongerBC Future Skills grant)
BCIT (British Columbia Institute of Technology)	Introductory Studies in Mass Timber Construction (Adoption)	Yes <i>Funding has currently run out since demand exceeded the available funds</i>	N/A
	Construction of Mass Timber Structures (Adoption) <i>Limited accessibility, in-person component outside of the region</i>	N/A	N/A
UNBC (University of Northern British Columbia)	Micro-credential: Mass Timber Development (Production)	N/A	N/A <i>The program has received separate provincial funding, subsidizing tuition fees</i>
UBC (University of British Columbia)	Tall Wood Structures (Adoption)	N/A	Yes
	Engineered Bamboo for Sustainable Construction (Production/Adoption)	N/A	N/A
	Fire Safety for Timber Buildings (Adoption)	N/A	Yes
	Hybrid Timber Construction (Adoption)	N/A	N/A
	Zero Carbon Building Solutions (Adoption)	N/A	N/A

Appendix 5: Assumptions and limitations

A major limitation was that our survey had a limited number of responses (n=16) despite several attempts to increase the response rate. Therefore, a detailed statistical analysis was not possible due to the small sample size. Nonetheless, several common themes that respondents shared were identified, and these are presented in the report.

According to the survey responses, crucial occupations, such as crane operators, mass timber detailers, and code consultants, may not have been included. We acknowledge that every sector has several occupations, and we focused on the top five occupations (in terms of number) across every sector. Future studies should look at other related occupations where skills changes may be impacted due to mass timber.

Endnotes

- 1 City of Quesnel. (n.d.). *Forestry Initiatives Program*. Retrieved October 30, 2023, from <https://www.quesnel.ca/our-community/forestry-initiatives-program>
- 2 Forestry Innovation Investment. (n.d.). *Helping to Grow the BC Forestry Industry – Forestry Innovation Investment*. Retrieved November 27, 2023, from <https://www.bcfii.ca/>
- 3 Federal Ministry of Food and Agriculture. (2021). *Mitigating climate change. Creating value. Utilising resources efficiently. Charter for Wood 2.0*. https://www.bmel.de/SharedDocs/Downloads/EN/_Forests/charter-for-wood-2.pdf?__blob=publicationFile&v=7
- 4 Holzbau Schweiz. (n.d.). *Branchenverband Schweizer Holzbaubetriebe*. Retrieved October 27, 2023, from <https://www.holzbau-schweiz.ch/de/>
- 5 Government of British Columbia. (2022). *B.C.'s Mass Timber Action Plan*. https://www2.gov.bc.ca/assets/gov/business/construction-industry/bc_masstimber_action_plan_2022.pdf
- 6 Government of British Columbia. (2022, April 7). *Mass Timber Action Plan*. Retrieved May 12, 2023, from <https://www2.gov.bc.ca/gov/content/industry/construction-industry/mass-timber/mass-timber-action-plan>
- 7 Government of British Columbia. (2023, January 18). *BC Manufacturing Jobs Fund*. Retrieved October 30, 2023, from <https://www2.gov.bc.ca/gov/content/employment-business/economic-development/support-organizations-community-partners/rural-economic-development/manufacturing-jobs-fund#programoverview>
- 8 Jobs, Economic Development and Innovation. (2023, June 17). *B.C. creates value-added manufacturing jobs in Williams Lake* [News Release]. Government of British Columbia. <https://news.gov.bc.ca/releases/2023JEDI0036-000967>; Jobs, Economic Development and Innovation. (2023, July 18). *More value-added manufacturing projects coming to Vancouver Island* [News Release]. Government of British Columbia. <https://news.gov.bc.ca/releases/2023JEDI0043-001157>
- 9 Jobs, Economic Development and Innovation. (2022, April 7). *Mass Timber Action Plan launched, four new projects announced* [News Release]. Government of British Columbia. <https://news.gov.bc.ca/releases/2022JERI0015-000519>
- 10 Markey, S., Pierce, J.T., Vodden, K., & Roseland, M. (2005). *Second Growth: Community Economic Development in Rural British Columbia*. UBC Press.
- 11 Burns, A. (2023, June 12). *Pacific Great Eastern Railway*. American-Rails.com. <https://www.american-rails.com/pge.html>
- 12 Markey, S., Halseth, G., & Manson, D. (2006). The Struggle to Compete: From comparative to competitive advantage in Northern British Columbia. *International Planning Studies*, 11(1), 19–39. <https://doi.org/10.1080/13563470600935016>
- 13 Markey, S., Halseth, G., & Manson, D. (2006). The Struggle to Compete: From comparative to competitive advantage in Northern British Columbia. *International Planning Studies*, 11(1), 19–39. <https://doi.org/10.1080/13563470600935016>
- 14 Markey, S., Halseth, G., & Manson, D. (2006). The Struggle to Compete: From comparative to competitive advantage in Northern British Columbia. *International Planning Studies*, 11(1), 19–39. <https://doi.org/10.1080/13563470600935016>
- 15 Edenhoffer, K., & Hayter, R. (2013). Restructuring on a vertiginous plateau: The evolutionary trajectories of British Columbia's forest industries 1980–2010. *Geoforum*, 44, 139–151. <https://doi.org/10.1016/j.geoforum.2012.10.002>
- 16 Markey, S., Pierce, J.T., Vodden, K., & Roseland, M. (2005). *Second Growth: Community Economic Development in Rural British Columbia*. UBC Press.
- 17 Kennedy, P. (2004, February 10). Canfor unveils jumbo sawmill. *The Globe and Mail*. <https://www.theglobeandmail.com/report-on-business/canfor-unveils-jumbo-sawmill/article18259310/>
- 18 Link, R. (2023, April 5). *Mill closure brings on period of uncertainty*. Houston Today. <https://www.houston-today.com/news/mill-closure-brings-on-period-of-uncertainty/>
- 19 Markey, S., Pierce, J.T., Vodden, K., & Roseland, M. (2005). *Second Growth: Community Economic Development in Rural British Columbia*. UBC Press.
- 20 Kurjata, A. (2023, April 6). *Hundreds lose jobs as northern B.C. mill closures come into effect*. CBC News. <https://www.cbc.ca/news/canada/british-columbia/canfor-job-losses-1.6803157>
- 21 Bennett, N. (2023, May 4). Northern B.C.'s economy is still strong despite forestry industry downturn. *Business in Vancouver*. <https://biv.com/article/2023/05/northern-bcs-economy-still-strong-despite-forestry-industry-downturn>
- 22 McIlhenney, K., & Hayter, R. (2014). Sustaining jobs and environment? The value-added wood industry in Metro Vancouver, British Columbia. *Local Environment: The International Journal of Justice and Sustainability*, 19(6), 605–625. <https://doi.org/10.1080/13549839.2013.854755>
- 23 Grace, P., Kozak, R., & Nelson, H. (2018). Understanding SME Success in the Value-added Forest Products Sector: Insights from British Columbia. *BioProducts Business*, 3(9), 107–117. <https://biobus.swst.org/bpbj/index.php/bpbj/article/view/44>
- 24 City of Quesnel. (n.d.). *Forestry Initiatives Program*. Retrieved October 30, 2023, from <https://www.quesnel.ca/our-community/forestry-initiatives-program>
- 25 City of Quesnel. (n.d.). *Forestry Initiatives Program*. Retrieved October 30, 2023, from <https://www.quesnel.ca/our-community/forestry-initiatives-program>
- 26 Mansukhani, H. (2023, March 3). *Politicians, experts gather to discuss forestry industry solutions*. Prince George Post. <https://princegeorgepost.com/news/local-news/politicians-experts-gather-to-discuss-forestry-industry-solutions>
- 27 Bennett, N. (2022, September 30). Logistics threaten to derail Fort Nelson revitalization plans. *Business in Vancouver*. <https://biv.com/article/2022/09/logistics-threaten-derail-fort-nelson-revitalization-plans>
- 28 naturally:wood. (n.d.). *Prince George Airport Expansion*. Retrieved September 15, 2023, from <https://www.naturallywood.com/project/prince-george-airport-expansion/>
- 29 Beam Craft. (n.d.). *Projects: Quesnel Junior School*. Retrieved September 15, 2023, from <https://www.beamcraft.ca/projects/project/quesnel-junior-school>
- 30 naturally:wood. (n.d.). *Upper Skeena Recreation Centre*. Retrieved September 15, 2023, from <https://www.naturallywood.com/project/upper-skeena-recreation-centre>

- 31 Abed, J., Rayburg, S., Rodwell, J., & Neave, M. (2022). A Review of the Performance and Benefits of Mass Timber as an Alternative to Concrete and Steel for Improving the Sustainability of Structures. *Sustainability*, 14(9), 5570. <https://doi.org/10.3390/su14095570>
- 32 Stiebert, S., Echeverría, D., Gass, P., & Kitson, L. (2019). *Emission Omissions: Carbon accounting gaps in the built environment*. International Institute for Sustainable Development. <https://www.iisd.org/system/files/publications/emission-omissions-en.pdf>
- 33 Finegold, D. (1999). Creating self-sustaining, high-skill ecosystems. *Oxford Review of Economic Policy*, 15(1), 60–81. <https://doi.org/10.1093/oxrep/15.1.60>
- 34 Buchanan, J., Scott, L., Yu, S., Schutz, H., & Jakubauskas, M. (2010). Skills Demand and Utilisation: An International Review of Approaches to Measurement and Policy Development. *OECD Local Economic and Employment Development (LEED) Working Papers*, No. 2010/04. <https://doi.org/10.1787/5km8zddfr2jk-en>
- 35 New South Wales Department of Education and Training. (2008). *Skills in Context: A guide to the skill ecosystem approach to workforce development*. Australian Government. <https://oce.uqam.ca/wp-content/uploads/2011/11/Guide.pdf>
- 36 Organisation for Economic Cooperation and Development. (2013). *Skills Development and Training in SMEs*. <https://doi.org/10.1787/9789264169425-en>
- 37 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 38 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 39 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 40 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 41 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 42 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 43 Organisation for Economic Cooperation and Development. (2013). *Skills Development and Training in SMEs*. <https://doi.org/10.1787/9789264169425-en>
- 44 Cooper, J. (2021). Skills development in the North: an ecosystem shaped by distinct challenges. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 45 Fleming, P. H. (2021). Genealogy of Cross-Laminated Timber (CLT). In P.H. Fleming & M. Koshihara (Eds.), *Cross-Laminated Timber: Pioneering innovation in massive wood construction*. ETH Zurich. <https://doi.org/10.3929/ETHZ-B-000501847>
- 46 Maximize Market Research. (2023). *Cross Laminated Timber Market: Global Industry Analysis and Forecast (2023-2029)*. <https://www.maximizemarketresearch.com/market-report/global-cross-laminated-timber-market/65493/>
- 47 Ebner, G. (2017, July 12). Market Analysis: Several CLT projects in the pipeline. https://www.timber-online.net/wood_products/2017/07/brettsperholz-produktion-100-km-radius--2016-2020.html
- 48 Maximize Market Research. (2023). *Cross Laminated Timber Market: Global Industry Analysis and Forecast (2023-2029)*. <https://www.maximizemarketresearch.com/market-report/global-cross-laminated-timber-market/65493/>
- 49 IMARC Group. (n.d.). Top 5 Cross-Laminated Timber Manufacturers Worldwide. Retrieved July 26, 2023, from <https://www.imarcgroup.com/top-cross-laminated-timber-manufacturers-worldwide>
- 50 Berner Fachhochschule. (2022, November 1). *Reglement über die verwandten Berufe und die gleichwertigen Vorbildungsausweise* [Admission Regulations]. <https://www.bfh.ch/dam/jcr:7ce94b42-bf10-48e1-8fb5-5e42be8f3aeb/reglement-ueber-die-verwandten-berufe-ahb.pdf>
- 51 Technische Hochschule Rosenheim. (n.d.). *Studiengänge der TH Rosenheim*. Retrieved October 2, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/studiengaenge-der-th-rosenheim>
- 52 Technische Hochschule Rosenheim. (n.d.). *Studiengänge der TH Rosenheim*. Retrieved October 2, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/studiengaenge-der-th-rosenheim>
- 53 Technische Hochschule Rosenheim. (n.d.). *Studiere Ingenieurwissenschaften an der TH Rosenheim*. Retrieved October 26, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/masterstudiengaenge/masterstudiengang-ingenieurwissenschaften>
- 54 Technische Hochschule Rosenheim. (n.d.). *Studiengänge der TH Rosenheim*. Retrieved October 2, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/studiengaenge-der-th-rosenheim>
- 55 Technische Hochschule Rosenheim. (n.d.). *Bachelorstudiengang Holztechnik*. Retrieved October 26, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/bachelorstudiengaenge/holztechnik-bachelor>
- 56 Technische Hochschule Rosenheim. (n.d.). *Masterstudiengang Holztechnik*. Retrieved October 26, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/masterstudiengaenge/holztechnik-master>
- 57 Technische Hochschule Rosenheim. (n.d.). *Ingenieurpädagogik*. Retrieved October 26, 2023, from <https://www.th-rosenheim.de/studium-und-weiterbildung/studienangebot-der-th-rosenheim/bachelorstudiengaenge/ingenieurpaedagogik>
- 58 Technische Hochschule Rosenheim (n.d.). *Transfermanagement Wissens- & Technologietransfer*. Retrieved October 2, 2023, from <https://www.th-rosenheim.de/forschung-innovation/forschungsservice/transfermanagement-wissens-technologietransfer>
- 59 Technische Hochschule Rosenheim (n.d.-b). *Transfermanagement Wissens- & Technologietransfer*. Retrieved October 2, 2023, from <https://www.th-rosenheim.de/forschung-innovation/forschungsservice/transfermanagement-wissens-technologietransfer>
- 60 School of Architecture, Wood and Civil Engineering. (n.d.). *Designing sustainable solutions using wood*. Bern University of Applied Sciences. Retrieved October 26, 2023, from <https://www.bfh.ch/ahb/en/wood-division/>
- 61 Departement Architektur, Holz and Bau. (n.d.). *Studienmöglichkeiten in Architektur*. Berner Fachhochschule. Retrieved October 26, 2023, from <https://www.bfh.ch/ahb/de/architektur/studium/>

- 62 B Departement Architektur, Holz und Bau. (n.d.). *Studienmöglichkeiten in Architektur*. Berner Fachhochschule. Retrieved October 26, 2023, from <https://www.bfh.ch/ahb/de/architektur/studium/>
- 63 Berner Fachhochschule. (n.d.). *Alle Weiterbildungen*. Retrieved October 2, 2023, from <https://www.bfh.ch/de/weiterbildung/alle-weiterbildungen/>
- 64 Bern University of Applied Sciences. (n.d.). *All our degree programmes*. Retrieved October 2, 2023, from <https://www.bfh.ch/en/studies/all-degree-programmes/>
- 65 Berner Fachhochschule. (n.d.). *Alle Weiterbildungen*. Retrieved October 2, 2023, from <https://www.bfh.ch/de/weiterbildung/alle-weiterbildungen/>
- 66 TU Graz. (n.d.). *Überblick Studienangebot*. Retrieved October 26, 2023, from <https://www.tugraz.at/studium/studienangebot/ueberblick-studienangebot>
- 67 Barker, N. (2023, March 14). *BTZ laboratory at TU Graz was the early home of mass-timber research*. Dezeen. <https://www.dezeen.com/2023/03/14/btz-tu-graz-nussmueller-architekten-timber-revolution/>
- 68 Institute of Timber Engineering and Wood Technology. (n.d.). *LIGNUM*. TU Graz. Retrieved October 26, 2023, from <https://www.tugraz.at/en/institutes/lignum/home>
- 69 TU Graz. (n.d.). *Überblick Studienangebot*. Retrieved October 26, 2023, from <https://www.tugraz.at/studium/studienangebot/ueberblick-studienangebot>
- 70 Binderholz GmbH. (n.d.). *The Company: Family-managed Company*. Retrieved October 26, 2023, from <https://www.binderholz.com/en-us/family-managed-company/>
- 71 Jonsson, P. (2023, July 27). *A family-owned success story*. NordicWoodJournal. <https://nordicwoodjournal.com/editorial/a-family-owned-success-story/>
- 72 Binderholz GmbH. (n.d.). *The Company: Family-managed Company*. Retrieved October 26, 2023, from <https://www.binderholz.com/en-us/family-managed-company/>
- 73 Jauk, G. (2022, July 11). *Sustained strong growth*. Timber-Online.net. https://www.timber-online.net/wood_products/2022/11/sustained-strong-growth.html
- 74 Ellson, J. (2022, October 11). *All in: Kalesnikoff invests, expands, inspires*. Canadian Forest Industries. <https://www.woodbusiness.ca/all-in-kalesnikoff-invests-expands-inspires/>
- 75 Timber-Online.net. (n.d.). *The biggest CLT producers in Central Europe: Update 2021/2022*. <https://www.timber-online.net/content/holz/holzkurier/en/blog/biggest-clt-producers.html>
- 76 Mayr Melnhof Holz. (n.d.). *Unternehmensgeschichte*. Retrieved September 18, 2023, from <https://www.mm-holz.com/ueber-uns/geschichte>
- 77 Hasslacher Norica Timber. (2023). *History*. Retrieved October 26, 2023, from <https://www.hasslacher.com/history>
- 78 KLH Massivholz GmbH. (2019). *Company*. Retrieved October 26, 2023, from <https://www.klh.at/en/company/>
- 79 Stora Enso. (n.d.). *Our history*. Retrieved October 26, 2023, from <https://www.storaenso.com/en/about-stora-enso/our-history>
- 80 Stora Enso. (n.d.). *Job Opportunities*. Retrieved October 26, 2023, from https://storaenso.wd3.myworkdayjobs.com/Stora_Enso_site_opportunities
- 81 Stora Enso. (n.d.). *Lehrling Holz- und Sägetechniker:in Werk Bad St. Leonhard* [Job Posting]. Retrieved October 26, 2023, from https://storaenso.wd3.myworkdayjobs.com/en-US/Stora_Enso_site_opportunities/job/Bad-St-Leonhard/Lehrling-Holz-und-Saetechniker-in-Werk-Bad-St-Leonhard_JR102580
- 82 Binderholz GmbH. (2023a). *Plant / Machine operator (m/f)–Job-ID: BU-0002* [Job Posting]. Retrieved October 26, 2023, from <https://www.binderholz.com/en-us/career/job-vacancies/permanent-employment/burgbernheim-bayern/plant-machine-operator/>
- 83 Binderholz GmbH. (2023b). *Senior designer / technician timber construction (m/f/d)—reference number: HA-0058* [Job Posting]. Retrieved November 1, 2023, from <https://www.binderholz.com/en-us/career/job-vacancies/permanent-employment/hallein-salzburg/senior-designer-technician-timber-construction-ha-0058/>
- 84 Binderholz GmbH. (2023b). *Senior designer / technician timber construction (m/f/d)—reference number: HA-0058* [Job Posting]. Retrieved November 1, 2023, from <https://www.binderholz.com/en-us/career/job-vacancies/permanent-employment/hallein-salzburg/senior-designer-technician-timber-construction-ha-0058/>
- 85 National Policies Platform. (2023, November 28). *Austria - 3. Employment & Entrepreneurship: 3.5. Traineeships & apprenticeships*. European Commission. <https://national-policies.eacea.ec.europa.eu/youthwiki/chapters/austria/35-traineeships-and-apprenticeships>
- 86 SWI swissinfo.ch. (2022, September 22). *Apprenticeships in Switzerland*. <https://www.swissinfo.ch/eng/politics/apprenticeship-system/43796482>
- 87 Klarka, Z. (2023). *From high school, into postsecondary education and on to the labour market*. Statistics Canada. <https://www150.statcan.gc.ca/n1/pub/81-595-m/81-595-m2023004-eng.htm>
- 88 Bundesinstitut für Berufsbildung. (2020). *Datenreport / A5.8 Alter der Auszubildenden und Ausbildungs-beteiligung der Jugendlichen im dualen System*. <https://www.bibb.de/datenreport/de/2020/127226.php>
- 89 Leybold-Johnson, I. (2019, April 15). *Sind 14-Jährige alt genug für die Berufswahl?* SWI swissinfo.ch. https://www.swissinfo.ch/ger/gesellschaft/bildung-in-der-schweiz_sind-14-jaehrige-alt-genueg-fuer-die-berufswahl-/44889906
- 90 Gillmann, B. (2022, January 25). *Was bringt eine Ausbildungs-garantie nach österreichischem Vorbild?* Handelsblatt. <https://www.handelsblatt.com/politik/deutschland/fachkraeftemangel-ampelplaene-was-bringt-eine-ausbildungs-garantie-nach-oesterreichischem-vorbild-/28002968.html>
- 91 Bundesagentur für Arbeit (n.d.). *Holzbearbeitungsmechaniker*. Retrieved January 30, 2024, from <https://web.arbeitsagentur.de/berufenet/beruf/29057>
- 92 Berner Fachhochschule. (2022, November 1). *Reglement über die verwandten Berufe und die gleichwertigen Vorbildungsausweise* [Admission Regulations]. <https://www.bfh.ch/dam/jcr:7ce94b42-bf10-48e1-8fb5-5e42be8f3aeb/reglement-ueber-die-verwandten-berufe-ahb.pdf>
- 93 Staatssekretariat für Bildung, Forschung und Innovation. (n.d.). *Berufsbildungsfonds gemäss Art. 60 BBG*. Retrieved October 26, 2023, from <https://www.sbf.admin.ch/sbf/de/home/bildung/bwb/berufsbildungsfinanzierung/berufsbildungsfonds.html>
- 94 Staatssekretariat für Bildung, Forschung und Innovation. (2009). *Reglement Holzbaugewerbe* [Legal Document]. https://www.sbf.admin.ch/dam/sbf/de/dokumente/reglement_holzbaugewerbe.pdf.download.pdf/reglement_holzbaugewerbe.pdf
- 95 Gruber, B. (2021, July 2). *20 Mio. € Förderung für Holzbau*. Holzbau Austria. <https://www.holzbauaustria.at/content/holz/holzbau-austria/de/news/2021/07/20-mio-foerderung-fuer-holzbau.html>

- 96 Bundesministerium für Land- und Forstwirtschaft, Regionen und Wasserwirtschaft. (n.d.). *Maßnahme 9: Verstärkte Verwendung des Rohstoffes Holz*. Retrieved October 27, 2023, from https://info.bml.gv.at/themen/wald/waldfonds/massnahme_9.html
- 97 Gruber, B. (2021, July 2). *20 Mio. € Förderung für Holzbau*. Holzbau Austria. <https://www.holzbauaustria.at/content/holz/holzbau-austria/de/news/2021/07/20-mio-foerderung-fuer-holzbau.html>
- 98 Bundesamt für Umwelt. (n.d.). *Wald- und Holzforschungsförderung Schweiz (WHFF-CH)*. Retrieved October 27, 2023, from <https://www.bafu.admin.ch/bafu/de/home/themen/wald/fachinformationen/vollzug-massnahmen/wald-und-holzforschungsforderung1.html>
- 99 Federal Ministry of Food and Agriculture. (2021). *Mitigating climate change. Creating value. Utilising resources efficiently. Charter for Wood 2.0*. https://www.bmel.de/SharedDocs/Downloads/EN/_Forests/charter-for-wood-2.pdf?__blob=publicationFile&v=7
- 100 Federal Ministry of Food and Agriculture. (2021). *Mitigating climate change. Creating value. Utilising resources efficiently. Charter for Wood 2.0*. https://www.bmel.de/SharedDocs/Downloads/EN/_Forests/charter-for-wood-2.pdf?__blob=publicationFile&v=7
- 101 Bayerisches Staatsministerium für Wohnen, Bau und Verkehr. (2022, June 1). *Holzbauzuschuss: Bayern zahlt Klimaprämie für Holzhäuser* Bayerisches Staatsministerium für Wohnen, Bau und Verkehr. https://www.stmb.bayern.de/med/aktuell/archiv/2022/220601bayfholz/?fbclid=IwAR0PheO17rb_yyI94dkN6cq4__iq-E2LCD9QXejI291IWjruReiM_Dkfvuk
- 102 Technische Hochschule Rosenheim. (2022). *Transferstrategie der Technischen Hochschule Rosenheim*. https://www.th-rosenheim.de/fileadmin/forschung_und_innovation/Forschung_und_Innovation_Neu/Transferstrategie_der_TH_Rosenheim_TA_V4.0.pdf
- 103 Technische Hochschule Rosenheim. (2022). *Transferstrategie der Technischen Hochschule Rosenheim*. https://www.th-rosenheim.de/fileadmin/forschung_und_innovation/Forschung_und_Innovation_Neu/Transferstrategie_der_TH_Rosenheim_TA_V4.0.pdf
- 104 Holzindustrie Österreich. (n.d.). *Bildung*. Retrieved October 27, 2023, from <https://www.holzindustrie.at/unser-fachverband/was-wir-tun/bildung/>
- 105 proHolz. (2023, October 23). *In der Holzbranche landen? Wood be nice*. <https://www.proholz.at/news/detail/in-der-holzbranche-landen-wood-be-nice>
- 106 Holzbau Schweiz. (n.d.). *Branchenverband Schweizer Holzbaubetriebe*. Retrieved October 27, 2023, from <https://www.holzbau-schweiz.ch/de/>
- 107 [Bildung Holzbau Schweiz]. (2022, January 21). *Holzbau-LAB – deutsch* [Video]. YouTube. <https://www.youtube.com/watch?v=dqhEhMXjgTg&t=2s>
- 108 Holzbau Schweiz. (n.d.). *Bildungskalender für die Holzbaubranche*. Holzbau Schweiz. Retrieved October 27, 2023, from <https://www.holzbau-schweiz.ch/de/kurssuche/>
- 109 Holzbau Schweiz. (n.d.). *Finanzielle Unterstützung für Ihre Aus- und Weiterbildung im Holzbau*. Retrieved October 27, 2023, from <https://www.holzbau-schweiz.ch/de/bildung/finanzielle-unterstuetzung/>
- 110 Federal Ministry of Food and Agriculture. (2021). *Mitigating climate change. Creating value. Utilising resources efficiently. Charter for Wood 2.0*. https://www.bmel.de/SharedDocs/Downloads/EN/_Forests/charter-for-wood-2.pdf?__blob=publicationFile&v=7
- 111 KLH Massivholz GmbH. (n.d.). *Karriere—KLH Massivholz GmbH*. Retrieved October 2, 2023, from <https://www.klh.at/karriere/>
- 112 Cooper, J. (2021). *Skills development in the North: an ecosystem shaped by distinct challenges*. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 113 Cooper, J. (2021). *Skills development in the North: an ecosystem shaped by distinct challenges*. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 114 Cooper, J. (2021). *Skills development in the North: an ecosystem shaped by distinct challenges*. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 115 British Columbia Institute of Technology. (n.d.). *Introductory Studies in Mass Timber Construction*. Retrieved October 2, 2023, from <https://www.bcit.ca/programs/introductory-studies-in-mass-timber-construction-microcredential-part-time-0800cm/>
- 116 British Columbia Institute of Technology. (n.d.). *Construction of Mass Timber Structures*. Retrieved October 2, 2023, from <https://www.bcit.ca/programs/construction-of-mass-timber-structures-associate-certificate-part-time-5225acert/>
- 117 University of Northern British Columbia. (n.d.). *Mass Timber Development Micro-credential*. Retrieved June 20, 2023, from <https://www2.unbc.ca/continuing-studies/courses/mass-timber-development-micro-credential>
- 118 UBC Faculty of Forestry. (n.d.). *Online Certificates*. University of British Columbia. Retrieved October 2, 2023, from <https://forestry.ubc.ca/future-students/certificates/>
- 119 Statistics Canada. (2023, November 15). *Census Profile, 2021 Census of Population*. Government of Canada. Retrieved September 25, 2023, from <https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E>
- 120 Cooper, J. (2021). *Skills development in the North: an ecosystem shaped by distinct challenges*. The Conference Board of Canada & Future Skills Centre. <https://fsc-ccf.ca/research/northern-skills-development-distinct-challenges/>
- 121 College of New Caledonia. (2018). *Institutional Accountability Plan and Report*. https://www2.gov.bc.ca/assets/gov/education/post-secondary-education/institution-resources-administration/accountability-framework/iapr/2017-18/cnc_iapr_2017-18.pdf
- 122 Northern Lights College. (n.d.). *Dawson Creek Campus*. Retrieved October 2, 2023, from <https://www.nlc.bc.ca/campus/dawson-creek/>
- 123 Kinsella, E. A., Bossers, A., & Ferreira, D. (2008). *Enablers and challenges to international practice education: a case study*. *Learning in Health and Social Care*, 7(2), 79-92. <https://doi.org/10.1111/j.1473-6861.2008.00178.x>
- 124 Alstete, J. (1995). *Benchmarking in Higher Education: Adapting best practices to improve quality*. ASHE-ERIC Higher Education Report No. 5. Association for the Study of Higher Education, ERIC Clearinghouse on Higher Education, George Washington University, & Office of Educational Research and Improvement. <https://eric.ed.gov/?id=ED402801>
- 125 Wilson, C. (2023, July 25). *Province earmarks \$3.3M for BCIT's mass-timber training hub*. Business In Vancouver. <https://biv.com/article/2023/07/province-earmarks-33m-bcits-mass-timber-training-hub>
- 126 Employment and Social Development Canada. (2022, February 22). *Government of Canada invests in training for workers in a net-zero economy* [News Release]. Government of Canada. <https://www.canada.ca/en/employment-social-development/news/2023/02/government-of-canada-invests-in-training-for-workers-in-a-net-zero-economy.html>

- 127 Mohawk College. (n.d.). *Canadian Colleges for a Resilient Recovery*. Retrieved September 21, 2023, from <https://www.mohawkcollege.ca/centre-for-climate-change-management/industry-partners/canadian-colleges-for-a-resilient-recovery>
- 128 Quick Train Canada. (n.d.). *Microcredentials*. Retrieved September 21, 2023, from <https://quicktraincanada.ca/microcredentials/>
- 129 Employment and Social Development Canada. (2022, June 30). *Solicited call for funding under the Community Workforce Development Program—National Stream*. Government of Canada. Retrieved November 1, 2023, from <https://www.canada.ca/en/employment-social-development/services/funding/community-workforce-development-national.html>
- 130 Employment and Social Development Canada. (2022, June 30). *Solicited call for funding under the Community Workforce Development Program—National Stream*. Government of Canada. Retrieved November 1, 2023, from <https://www.canada.ca/en/employment-social-development/services/funding/community-workforce-development-national.html>
- 131 Canadian Community Economic Development Network. (2023, August 29). Launch of Community Action for Workforce Development. <https://ccednet-rcdec.ca/launch-of-community-action-for-workforce-development/>
- 132 International Timberframes. (2023). About Us. <https://itimerf.com/about-us/>
- 133 WorkBC. (n.d.). *Workforce Development Agreement and Annual Reports*. Retrieved October 2, 2023, from <https://www.workbc.ca/research-labour-market/bcs-economy/reports/workforce-development-agreement-and-annual-reports>
- 134 WorkBC. (n.d.). *B.C. Employer Training Grant*. Retrieved October 2, 2023, from <https://www.workbc.ca/find-loans-and-grants/industry-and-employers/bc-employer-training-grant>
- 135 WorkBC. (n.d.). *Community Workforce Response Grant*. Retrieved October 2, 2023, from <https://www.workbc.ca/find-loans-and-grants/community/community-workforce-response-grant>
- 136 WorkBC. (n.d.). *Skills Training for Employment Program*. Retrieved October 2, 2023, from <https://www.workbc.ca/explore-training-and-education/skills-training-and-supports/skills-training-employment-program>
- 137 City of Quesnel. (n.d.). *Forestry Initiatives Program*. Retrieved October 30, 2023, from <https://www.quesnel.ca/our-community/forestry-initiatives-program>
- 138 Government of British Columbia. (2023). *StrongerBC: Future Ready Action Plan*. <https://news.gov.bc.ca/files/Future-Ready-May2023.pdf>
- 139 WorkBC. (2023). *StrongerBC future skills grant*. Retrieved September 27, 2023, from <https://www.workbc.ca/find-loans-and-grants/students-and-adult-learners/strongerbc-future-skills-grant>
- 140 Government of British Columbia. (2023). *StrongerBC: Future Ready Action Plan*. <https://news.gov.bc.ca/files/Future-Ready-May2023.pdf>
- 141 City of Quesnel. (n.d.). *Forestry Initiatives Program*. Retrieved October 30, 2023, from <https://www.quesnel.ca/our-community/forestry-initiatives-program>
- 142 City of Quesnel. (n.d.). *Forestry Initiatives Program*. Retrieved October 30, 2023, from <https://www.quesnel.ca/our-community/forestry-initiatives-program>
- 143 The Headhunters. (n.d.). *What you need to know about recruitment agencies in Canada*. Retrieved July 15, 2023, from <https://www.theheadhunters.ca/blog/what-you-need-to-know-about-recruitment-agencies-in-canada/>
- 144 WorkBC. (n.d.). *Impacted Workers*. Retrieved September 27, 2023, from <https://dev.workbc.ca/explore-training-and-education/skills-training-and-supports/skills-training-employment-program-0>
- 145 Forest Products Association of Canada. (n.d.). *Programs: Women in Wood*. Retrieved February 2, 2024, from <https://www.fpac.ca/resources/programs#women>
- 146 Govendo, J. (2005). Workforce, diversity and corporate creativity. *Handbook of Business Strategy*, 6(1), 213-218. (Vol. 6, pp. 213–218). <https://doi.org/10.1108/08944310510557495>
- 147 Buchanan, C., Markey, S., & Breen, S-P. (2022). Breaking Down Barriers: Planning for a Gender Diverse Mining Workforce in the Kootenay Region of British Columbia. *Canadian Planning and Policy*, 2022(1), 71-87. <https://doi.org/10.24908/cppapc.v2022i1.14818>
- 148 Forest Products Association of Canada. (n.d.). *Programs: Women in Wood*. Retrieved February 2, 2024, from <https://www.fpac.ca/resources/programs#women>
- 149 Reed, M. G. (2003). Marginality and gender at work in forestry communities of British Columbia, Canada. *Journal of Rural Studies*, 19(3), 373–389. [https://doi.org/10.1016/S0743-0167\(03\)00021-4](https://doi.org/10.1016/S0743-0167(03)00021-4)
- 149 Greer, B., Luethge, D., & Robinson, G. (2017). Utilizing Virtual Technology as a Tool to Enhance the Workforce Diversity Learning. In Information Resources Management Association (Ed.) *Discrimination and Diversity: Concepts, Methodologies, Tools, and Applications*. IGI Global. <https://www.igi-global.com/chapter/utilizing-virtual-technology-as-a-tool-to-enhance-the-workforce-diversity-learning/182117>
- 150 Canadian Apprenticeship Forum & R.A. Malatest and Associates Lts. (2023). *The Business Case for Apprenticeship in British Columbia*. WorkBC & B.C. Ministry of Post-Secondary Education and Future Skills. [https://www.workbc.ca/media/1840/download?inline=#:~:text=Most%20apprentices%20\(59%25\)%20were,hired%20\(see%20Table%203.3\)](https://www.workbc.ca/media/1840/download?inline=#:~:text=Most%20apprentices%20(59%25)%20were,hired%20(see%20Table%203.3))
- 151 Government of Saskatchewan. (n.d.). *Graduate Retention Program*. Retrieved October 2, 2023, from <https://www.saskatchewan.ca/residents/education-and-learning/graduate-retention-program>
- 152 Mikola, D., & Webb, M. D. (2023). Finish it and it is free: An evaluation of college graduation subsidies. *Economics of Education Review*, 93, 102355. <https://doi.org/10.1016/j.econedurev.2023.102355>
- 153 Mikola, D., & Webb, M. D. (2023). Finish it and it is free: An evaluation of college graduation subsidies. *Economics of Education Review*, 93, 102355. <https://doi.org/10.1016/j.econedurev.2023.102355>
- 154 Federal Ministry of Food and Agriculture. (2021). *Mitigating climate change. Creating value. Utilising resources efficiently. Charter for Wood 2.0*. https://www.bmel.de/SharedDocs/Downloads/EN/_Forests/charter-for-wood-2.pdf?__blob=publicationFile&v=7
- 155 Holzbau Schweiz. (n.d.). *Branchenverband Schweizer Holzbaubetriebe*. Retrieved October 27, 2023, from <https://www.holzbau-schweiz.ch/de/>
- 156 Faculty of Forestry - Centre for Advanced Wood Processing. (n.d.). *Registration Fees, Schedule and Contact Information*. The University of British Columbia. Retrieved October 2, 2023, from <https://cawp.ubc.ca/training/wmc-management-skills-training-program/registration-fees-schedule-and-contact-information/>
- 157 Faculty of Forestry - Centre for Advanced Wood Processing. (n.d.). *In-Plant Training*. The University of British Columbia. Retrieved October 2, 2023, from <https://cawp.ubc.ca/training/in-plant-training/>



**Smart Prosperity
Institute**



PLACE Centre
Smart Prosperity Institute

1 Stewart Street, 3rd Floor
Ottawa, ON K1N 6N5