# The Mass Timber Roadmap

## An integrated forest-to-buildings value chain

*in partnership with*

The Transition Accelerator / L'Accélérateur de transition

FPAC.ca
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65th CANADIAN WOOD COUNCIL
CONSEIL CANADIEN DU BOIS

energyfutureslab

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**Cover Image:**
Photo: KK Law, courtesy naturally:wood

## About the partners

The Transition Accelerator exists to support Canada's transition to a net-zero future while solving societal challenges. The Transition Accelerator works with innovative groups to create visions of what a socially and economically desirable net zero future will look like and build out transition pathways that will enable Canada to get there. The Accelerator's role is that of an enabler, facilitator, and force multiplier that forms coalitions to take steps down these pathways and get change moving on the ground.

transitionaccelerator.ca

FPAC provides a voice for Canada's wood, pulp, paper, and wood-based bioproducts producers nationally and internationally in government, trade, and environmental affairs. As an industry with annual revenues exceeding$73-billion, Canada's forest products sector is one of the country's largest employers operating in hundreds of communities, providing 205,000 direct jobs and over 600,000 indirect jobs across the country. FPAC and its members are committed to collaborating with Indigenous leaders, federal and provincial governments, labour partners, community groups, and other rightsholders and stakeholders to secure and advance the sector's environmental, social, and economic potential for the long-term.

fpac.ca

Founded in 1959, the Canadian Wood Council (CWC) is Canada's unifying voice for the wood products industry. As a national federation of associations, our members represent hundreds of manufacturers across the country. Our mission is to support our members by accelerating market demand for wood products and championing responsible leadership through excellence in codes, standards, and regulations. We also deliver technical support and knowledge transfer for the construction sector through our market leading WoodWorks program.

cwc.ca

The Energy Futures Lab was created to address a growing sense of polarization in Canada. Since its inception in 2015, the EFL has brought together stakeholders from across the energy system to collaboratively develop solutions for a low-emissions energy future. This approach has highlighted the importance of drawing on diverse perspectives to address complex, system-level challenges.

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Surrey Memorial Hospital Critical Care Tower
Surrey, BC
Photography: Ed White Photographics, courtesy CEI Architecture and Parkin Architects
*Source:* naturally:wood

# Executive summary

## The case and need for mass timber

**After more than a decade of hard work to unlock and demonstrate the potential for mass timber in Canada, the industry is ready to scale. Almost 700 mass timber buildings have been completed in Canada, with more than 140 projects under construction or in planning stages.[1] Canada has excellent wood resources and expertise all along the supply chain. Demand for mass timber beams, panels, and buildings is strong and growing.[2] The industry is advancing rapidly, but there is work to do to realize this opportunity of increasing manufacturing value-added products to the forest sector.**

Mass timber presents a unique opportunity because it can help meet three critical needs in Canada:

- support the drive to net-zero buildings;
- help address the housing crisis; and
- create good jobs in rural and Indigenous communities.

*Using wood products alongside other cost-effective decisions can reduce embodied carbon by as much as 40%.*

## Support net-zero buildings

Mass timber helps to reduce the carbon intensity of construction by eliminating concrete and steel emissions and by providing long-term carbon storage.[3] Using wood products alongside other cost-effective decisions can reduce embodied carbon by as much as 40%. Since embodied carbon in materials represents the majority of lifecycle emissions from the construction of buildings, mass timber can have a huge impact.

New construction of high-rise buildings in Burnaby, Vancouver

*Mass timber designs, especially those incorporating prefabrication and modular approaches, offer a promising strategy to accelerate the construction of multi-unit residential structures, at greater speeds and lower costs.*

## Address the housing crisis

Mass timber can also help address Canada's housing crisis. Mass timber made its name in "tall wood" buildings and showpiece non-residential buildings. Many of these buildings were "one-off" designs. But now, mass timber is primed to become a mainstream material of choice in residential applications, especially the 4-6 storey range and more common 7-12 storey buildings, including hybrid structures, combining wood with steel and concrete.

Mass timber designs, especially those incorporating prefabrication and modular approaches, offer a promising strategy to accelerate the construction of multi-unit residential structures, at greater speeds and lower costs.[4] Mass timber panels, particularly cross-laminated timber, create opportunities for prefabrication because it allows entire wall assemblies to be manufactured and customized offsite. Window and door openings can be pre-cut and standardized connections can be used to assemble components quickly. These elements of prefabrication can be used to create highly customizable buildings.

Mass timber can shorten construction times by as much as 20%.[5] This lowers constructions costs (and financing costs), which are a major part of a building's lifetime cost. Prefabrication and modularization could drive costs even lower. Canada needs a national task force to accelerate Canadian wood solutions for the housing crisis.

## Create good jobs in rural and Indigenous communities

Additionally, mass timber will create good jobs in rural and Indigenous communities. These communities have to see themselves as part of the net-zero transition. Too often, Canada's resource communities feel left out of the future economy. Mass timber can help bring them back in.

## Forest to buildings value chains: A global race

As a result, countries are in a race to seize these benefits and the economic opportunities mass timber provides in the transition to a net-zero world.[6] Countries are using industrial policies to position their firms in rapidly forming global value chains. Critical to this competition are efforts to capture manufacturing value-added products: transforming primary resources into high value products that incorporate innovative technologies and advanced skills.[7] Manufacturing is critical to long-term economic success because it can increase productivity and drive growth.

At the moment, Canada is falling behind in this race: many mass timber projects in Canada source mass timber products, such as CLT panels, from Europe rather than Canadian manufacturers.

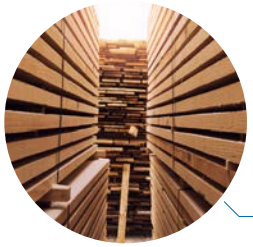
To compete globally, **Canada needs to create an efficient, integrated forest-to-buildings value chain.** Time is of the essence. The country needs net-zero building solutions and the green jobs a rapidly growing mass timber industry will bring to forestry communities.

## Our vision and roadmap

In 2023, the *Forest Products Association of Canada* (FPAC), the *Canadian Wood Council* (CWC), the *Energy Futures Lab* (EFL) and the *Transition Accelerator* convened a group of 50+ participants from Canada's mass timber value chain representing business, government, research institutions, Indigenous communities, and non-governmental organizations (NGOs). Over a series of workshops, these participants worked together to co-create "The Mass Timber Roadmap."

The Roadmap takes the position that to build a world-class mass timber industry, Canada needs to adopt a strategic approach to the use of its forestry resources. Canada needs to treat its forests as a national resource that can add value to the economy, rather than a commodity-based, volume-driven approach.

*The roadmap proposes an ambitious vision of increasing the mass timber market to $1.2 billion by 2030 and doubling that to $2.4 billion by 2035.*



As such the roadmap proposes an ambitious vision of **increasing the mass timber market to $1.2 billion by 2030 and doubling that to $2.4 billion by 2035**, reflecting the expected growth in market demand in both Canada and the US. Scaling Canada's share of that growth, in both domestic use and exports, requires coordinated efforts to address three critical action areas that have been laid out in this roadmap.

1. **Create a public-private collaboration to develop and advance a policy package that will add value to Canada's forest resources while building homegrown capacity along the supply chain.**
2. **Standardize building archetypes, wood specifications, and connectors across the whole supply chain.**
3. **Develop and implement a skills development plan that covers all aspects of the supply chain.**

To coordinate and clarify more specific actions, the roadmap divides the mass timber ecosystem into five workstreams, each with its own specific near-term goal:

» **Forestry and wood supply:** Advance mass timber specific milling and drying needs while scoping out the transformative changes to harvesting and timber grading that would be needed to create an integrated mass timber supply chain.

» **Manufacturing:** Increase production capacity, including pre-manufacturing of lamina and billets and prefabrication.

» **Architecture, building codes, design, and fire safety:** Identify strategic niches for pre-fabricated connections and secure low-hanging fruit changes in building codes.

» **Construction:** Drive the uptake of mass timber as mainstream material in construction and expand beyond one-off buildings into repeatable forms, large building markets, and hybrid construction.

» **Policy, programs, and sustainability:** Develop a policy package—with measures such as grants, tax incentives, R&D programs, and LCA synthesis, among others—that would help the industry scale-up while building homegrown capacity along the supply chain.

This Roadmap details specific targets, goals and actions in each of these workstreams needed to advance the mass timber industry in Canada today. To highlight the highest priorities, a summary table of relevant workstream actions for the three critical action areas is provided below.

| THREE CRITICAL ACTION AREAS | HIGHEST PRIORITY ACTIONS FROM WORKSTREAMS |
|---|---|
| **Create a public-private collaboration to develop and advance a policy package** | • Create a public-private coordination body to develop and advance policy and program priorities |
| | • Create a government plan to deploy strategic finance |
| | • Explore an embodied carbon requirement as part of the Green Building Strategy |
| | • Changes to building and fire code to enable further market penetration |
| | • Adjusting the Greening Government Strategy to help mass timber scale through procurement |
| | • Develop a forest sector innovation strategy |
| **Standardize building archetypes, wood specifications, and connectors across the whole supply chain** | • Develop a standardized product suite for lumber (size, grade, moisture) |
| | • Develop priority standardized products for main growth segments |
| | • Develop standard connector opportunities |
| | • Develop affordable and practical systems for building archetypes |
| | • Identify niche high-value building elements that could be used as test cases to bring prefabrication down the cost-curve |
| **Develop and implement a skills development plan that covers all aspects of the supply chain** | • Assess skills needs and develop appropriate and targeted training programs |
| | • Education for architects, engineers, financing and development teams |
| | • Develop a national training program for skilled mass timber workers |
| | • Develop regional educational hubs |

## A call to action: A mass timber alliance

To scale, mass timber needs the right incentives to overcome a chicken-and-egg situation in the value chain, e.g. manufacturers need to see market demand to justify large capital investments; building designers and developers need to have assurance of timely supply of mass timber products.

Given the integrated and dynamic nature of the challenge, this roadmap now needs to be advanced by an alliance of industry and other stakeholders, working closely with government. A coordinating council should oversee implementation of the roadmap, supported by individual taskforces for each of the five respective workstreams.

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We invite governments—at various levels—to play a critical role in the implementation of the roadmap. They need to be active participants in the process, as members of the council and taskforces. The federal government and relevant provincial governments should treat the mass timber roadmap process as a strategic priority initiative. Learning from the success of initiatives elsewhere, the implementation of the roadmap can best be approached as partnership between public and private sectors.

Canada has a significant opportunity to scale the mass timber sector in response to significant market demand, both domestically and internationally. This will generate regional economic development opportunities, including skilled jobs. Mass timber can also play a major role in addressing Canada's housing shortfall, combining faster and less costly construction with reduced carbon footprints, lasting through the coming decades. Seizing this opportunity requires an intentional and concentrated effort now of businesses and other actors throughout the ecosystem.

# Building the mass timber industry

*In North America, production of mass timber products in 2022 has been estimated at approximately 350,000 $m^3$, with a production capacity of at least 800,000 $m^3$.*

## State of the industry

**Globally the mass timber industry is experiencing substantial growth. In Central Europe (including Austria, Germany, Italy, Switzerland and Czechia) manufacturers produced about 1.3 million $m^3$ of CLT in 2022, an increase of almost 20 percent over 2021. Elsewhere in Europe, two large CLT plants were added in Sweden, and one was added in New Zealand.[8]**

In North America, production of mass timber products in 2022 has been estimated at approximately 350,000 $m^3$, with a production capacity of at least 800,000 $m^3$.[9] While lagging behind Europe, North American production has grown about 15 percent in 2022, with an even larger increase in production capacity. There are at least 23 operating or potential mass timber manufacturing facilities in North America—of which seven are in Canada (AB, BC, MB, ON, QC).[10]

The use of mass timber in construction in North America is demonstrating robust growth and the potential to take off. In 2022, the building square footage constructed with mass timber products increased about 40 percent over 2021, with almost all of that increase accounted for by the use of CLT.[11]

For the purposes of this roadmap, mass timber includes glulam (glue laminated posts and beams), cross laminated timber (multi-ply panels of boards laid in crosswise layers), as well as nail and dowel laminated timber.[12]

Over 600 mass timber buildings have now been completed in Canada, with 124 projects under construction or in planning stages.[13] Canada has excellent wood

resources and expertise all along the supply chain. Demand for mass timber beams, panels, and buildings is strong and growing.

The modern mass timber sector began in Europe in the 1990s with sawmills looking to diversify their product lines. KLH, which led the commercialization of mass timber, emerged from three small sawmills. They developed the industry by going downstream from the mill to manufacturing to architecture and development. KLH is a fine example of a fully integrated mass timber firm. This business model was necessary in the early days of mass timber because firms had to create their own construction market as they went.[14]


Uqac Arena, University of Quebec at Chicoutimi
Chicoutimi, Québec
*Source:* Nordic Structures

More recently, established mills such as Binderholz and Pfeifer (two of Europe's largest lumber companies) have moved into mass timber.[15] These firms specialize in creating value-added wood products, including include sawn timber, 3-ply board, concrete form work, pallet blocks, pellets, and horse bedding.[16] Adding mass timber to the product slate diversified their product lines, thereby reducing seasonal and business cycle volatility. Because the mass timber industry was driven by sawmills, manufacturers could create the exact lamellae (dimensional boards) needed for production. In Europe, sawmills buy logs from private and public loggers and specialize in maximizing the wood's value. It is a very different tenure system, which has implications for what kind of business models will be successful along the supply chain.

In Canada, two mass timber companies, Kalesnikoff and Nordic Structures, developed from mills into mass timber production. Kalesnikoff started as a small mill looking to add value to its products.[17] Nordic is owned by the family that operates Chantiers Chibougamau, a mill with a long history of value added wood products. Another company, Western Archrib, has vertically integrated up the supply chain for Spruce Pine glulam production.

But many Canadian mass timber producers emerged from the midstream, rather than upstream as in Europe. Like KLH, many companies have needed to be involved in manufacturing, engineering, and architecture in order to create their own market. But many companies lack control over their wood supply. That has created challenges in securing the lamellae needed for mass timber production. Generally, the Canadian forestry industry is integrated from the forest to the mill to markets. Large lumber companies have logging rights and focus on producing high quality structural and specialty lumber products. Traditionally Canadian lumber producers have been the most efficient and competitive in the world, however, this competitiveness is being challenged by high regulatory and operating costs. This provides a greater rationale to diversify product lines, as done earlier by many European counterparts facing similar pressures on their margins.

> *Over 600 mass timber buildings have now been completed in Canada, with 124 projects under construction or in planning stages. Canada has excellent wood resources and expertise all along the supply chain. Demand for mass timber beams, panels, and buildings is strong and growing.*

University of Alberta Botanic Garden
Main Entry Pavilion, Edmonton, Alberta
*Source:* Western Archrib

The implication is that the Canadian mass timber industry, if it is to scale, must develop in a unique way. Canadian firms and governments can learn from the experience in Europe, but the business models and incentives must be structured in and for the Canadian context. For example, European producers are geographically located much closer to larger domestic markets than in North America, where transportation costs and logistics play a larger role. Vertical integration from the forest to the manufacturers is key to achieving scale and making the Canadian mass timber industry competitive globally.

The best way to accelerate integration of the supply chain in Canada is through an industrial policy that increases communication and problem-solving capacity within industry (up and down the supply chain) and between the industry and government. The work on this roadmap was motivated by the desire to create this kind of communication and problem-solving capacity.

## Developing a clean competitiveness roadmap

**This roadmap was developed with an approach to defining clean competitiveness opportunity areas that identifies priority actions, policies and investments to reach specific goals and targets in key sectors.**

A clean competitiveness roadmap is part of a broader strategy to build the industries needed to achieve net-zero goals in Canada and globally. This combines decarbonization objectives with maximizing the potential value-added production to be captured domestically.

A key aim of a roadmap is to align the whole supply chain from upstream resources and business to downstream customers and markets. The articulation of clear timelines and sequenced actions provides a framework to catalyze investment and other initiatives required to rapidly scale a new or emerging industry.[18]

To produce this roadmap, the Forest Products Association of Canada (FPAC), the Canadian Wood Council (CWC), the Energy Futures Lab (EFL) and the Transition Accelerator convened a series of consultations and workshops, complemented by targeted analysis. A wide range of businesses and actors across the mass timber value chain—from forestry, to wood products, to building design and construction—participated in co-creating this roadmap.

A first step was to establish a technical council of experts from industry associations, mass timber manufacturers, architects, construction firms, and

policy. The Transition Accelerator collaborated with this group to develop targets—for 2030 and 2035—and a straw dog version of a roadmap for the Canadian mass timber sector.

The "straw dog" roadmap and the targets were then the focus of a series of virtual workshops designed and facilitated by the EFL. Two ecosystem workshops and three sessions of the technical council. The workshops were structured around the four key stages in the supply chain, with one cross-cutting theme:

- **» Forestry and wood supply**
- **» Mass timber manufacturing**
- **» Architecture, building codes, engineering and fire safety**
- **» Construction**
- **» Policy, programs, and sustainability**

For each workstream, the Transition Accelerator put forward a dashboard which includes a vision for success in 2035, a near-term goal to focus efforts, and a comprehensive list of priority actions needed to achieve the targets and catalyze industry growth. Workshop participants, organized by workstream, reviewed, refined, and if necessary, revised the goals and priority actions. Priority actions were also categorized between those already being advanced and those requiring additional, deliberate attention. The resulting roadmap represents a robust strategy and action plan for scaling the mass timber sector in Canada. The roadmap is based on current market situation, the state of technology, practices, policies, and expected trends for the future. All of these are certainly subject to change.

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# Roadmap targets

*Increase mass timber market value to $1.2 billion by 2030 and double that to $2.4 billion by 2035.*

- **Canada's mass timber sector serves 25 percent of world mass timber market.**
- **That is 1 million cubic metres, as measured by production capacity, of Glulam, CLT, DLT, and NLT by 2030 and 2 million cubic metres by 2035.**
- **That includes a domestic target of 5 percent of all construction materials, including in 25 percent of all multifamily residential structures and nonresidential buildings (4-6 and 7-12 storeys), making use of significant modular or prefabricated elements.**
- **The goal should be a forest-to-buildings supply chain that maximizes manufacturing and services value-added in Canada.**

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## How we arrived at the targets

Canada has long had a number of glulam producers, but modern mass timber products have appeared more recently. Following the development in the 1990s of CLT in Europe, partly as an innovative strategy to deal with rising fibre costs in the wood sector, the first manufacturing plant in Canada was established in 2007 in Quebec followed by a second facility in B.C. in 2010.[19] This was followed by the production of DLT in Canada in 2017.

Given the range of mass timber products (Glulam, GLT, CLT, NLT, DLT, LVL, LSL, etc.), it is more practical to define a target for aggregate production, rather than targets for each product class. The information and statistical base is not detailed enough to breakdown current trends by product class. Ongoing changes and innovation in both product development and building construction mean there are too many uncertainties concerning the precise growth opportunities at the product level (with the possible exception of CLT and maybe Glulam). A production target that aggregates across all products accommodates different market segments growing as market context evolves.

Glulam beams

Estimates of current production of mass timber in Canada are not readily available, and the information needs to be strengthened (see below). FP Innovations has estimated that approximately 100,000 m³ of mass timber was used in construction in 2022.[20] The NRCan database on mass timber includes 19 manufacturing facilities with a reported production capacity of approximately 420,000 m³. Nominal capacity typically exceeds effective capacity in facilities, meaning that effective capacity might be closer to 300,000 m³. And discussions with various industry players indicate that many facilities are operating below effective capacity. This leaves a fairly wide margin of uncertainty on current production volumes, between 100,000 and 300,000 m³, which would also include exports. A conservative mid-level estimate of current production is 200,000 m³.

Many companies are understandably reluctant to share precise production figures. Furthermore, tracing actual use in construction both domestically and through exports also involves data challenges. It is therefore more expedient to set targets in terms of market size, rather than production or production capacity. A target of $1.2 billion in annual revenue in 2030 corresponds to between a doubling and tripling of current estimates of the Canadian market size, and is matched with a doubling of that again by 2035, to $2.4 billion.

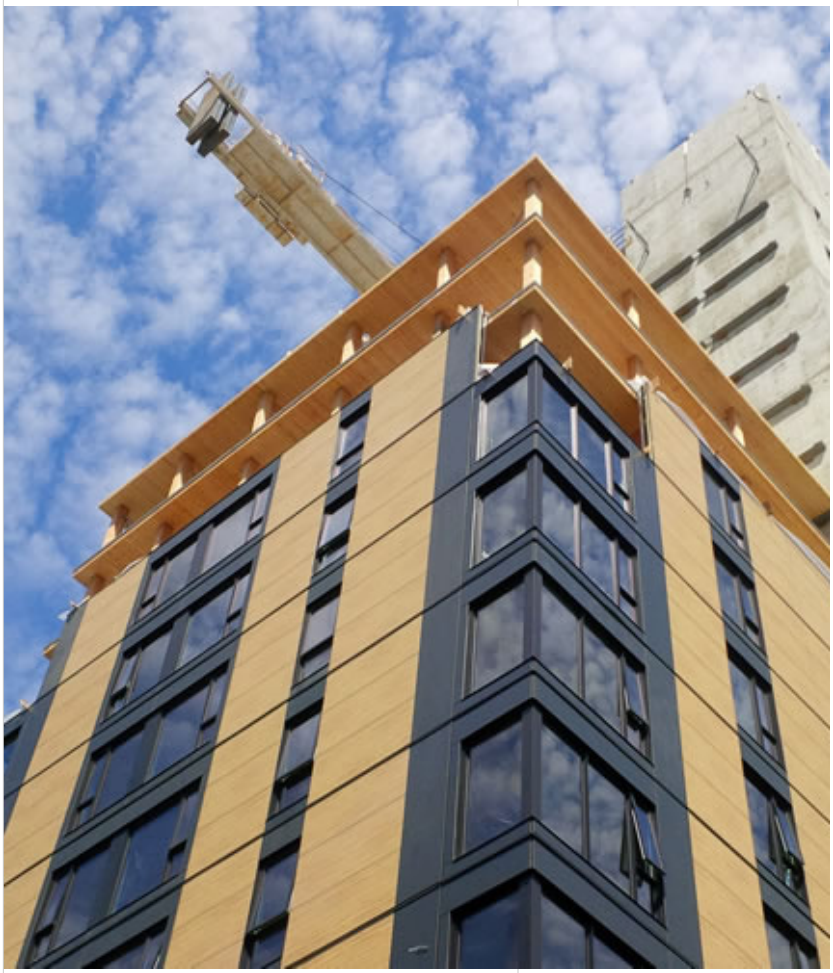
On the demand side, it appears that market growth—as in the technically feasible growth in use of mass timber given current construction demands—does not present a constraint to meeting a target of doubling production. Issues do arise though concerning costs, investment timelines, and other factors that enable that potential demand to be realized. Many of these, such as construction segments, coding requirements, and incentives, are addressed in other sections below.

The current global mass timber market (as of 2023) is estimated to be $1.6-2.3 billion, with the Canadian share of that estimated at $379 million.[21] This corresponds to about 20 percent of a central estimate of the global market and so a target of 25% of global market share essentially reflects only a modest increase in market share, while keeping pace in Canadian production with overall market growth.

*The current global mass timber market (as of 2023) is estimated to be $1.6-2.3 billion, with the Canadian share of that estimated at $379 million.*

Projected annual growth rates for the mass timber sector both in North America and globally are 13-14 percent, through 2030, representing an increase of approximately 150 percent. Building on these and other projections of demand growth in the North American market, the revenue targets for 2030 and 2035 seem realistic.

It is also possible to look at prospects in the Canadian market alone, based on physical production projections. The 2019 CLT Handbook published by FP Innovations examined three market segments for CLT panels only. If 40 percent of 7-12 storey residential buildings – based on current total project numbers (which is conservative)—used a CLT system, this would amount to about 521,000 m³ of consumption.[22] In 2022, total mass timber use in this storey group was estimated at 29,000 m³, a market penetration of barely 2 percent.



Brock Commons tall wood demonstration building
*Source:* Natural Resouces Canada

The 2019 CLT Handbook also refers to potential penetration of about a quarter of the non-residential buildings in the 7-12 storey group, implying 57,000 m³ of CLT use, while the 2022 market share study estimated this use at 8,000 m³. Finally, the CLT Handbook calculated that the use of CLT in all elevator shafts of all new 4-6 storey buildings would equate to about 166,000-321,000 m³ of consumption per year. A modest target for market penetration, somewhat aligned with that proposed for 7-12 storey buildings, would be 100,000 m³. Combining the three-storey classes suggests a total potential of 675,000 m³ of CLT use in Canada, again ignoring other mass timber products and also potential growth in construction. That amount would be 6-7 times estimated use in 2022 of 100,000 m³. And this projection is not even taking into consideration the potential in buildings up to 6 stories, which accounted for more than half of mass timber use in Canada in 2022 at 58,000 m³.[23]

Turning to the U.S., the SLB Mass Timber Outlook 2021 projected a demand opportunity in the U.S. construction for mass timber to grow from about 300,000 m³ in 2020-2021 to 1.3 million m³ in 2025, 2.9 million m³ in 2030, and 5.1 million m³ in 2035.[24] This corresponds to an increase of almost 10-fold from 2020 just to 2030. If Canadian manufacturers could serve just 25 percent of that US market demand, this would translate to 735,000 m³ of exports in 2030 and 1.3 million m³ in 2035.[25]

The projected growth in U.S. mass timber demand is highest in the South and Northeast markets, with the former accounting for almost half of the total, and the latter, more than a third. The trees grown in the southern U.S. are less suitable for mass timber applications. Together, this suggests greater opportunities for producers in Central and Eastern Canada to serve a growing U.S. market, to reduce transportation costs. This comes on top of the current regional imbalance between production capacity and market demand. FEA estimated in 2022 that three quarters of North American demand for mass timber is found in Eastern regions, which account for only a bit more than a third of the continent's production capacity.[26]

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# Thriving mass timber workstreams

**To organize the work, the roadmap process divides the industry into five workstreams or action areas.**

## Forestry and wood supply

Includes all aspects of wood supply, from forest management practices to harvesting and milling.

## Manufacturing

Production capacity including pre-manufacturing of lamina and billets and prefabrication.

## Architecture, building codes, design, and fire safety

Technical elements of building design and safety.

## Construction

All aspects of construction, including building types and associated targets.

## Policy, programs, and sustainability

Including grants, tax incentives, R&D programs, and LCA synthesis.

# Forestry and wood supply

## Success in 2035

Canada adds significant manufacturing value-added to its primary forestry production through an integrated supply chain into mass timber production within the context of national bioeconomy strategy.

## Near-term goals

Advance mass timber specific milling and drying needs while scoping out the transformative changes to harvesting and timber grading that would be needed to create an integrated mass timber supply chain.

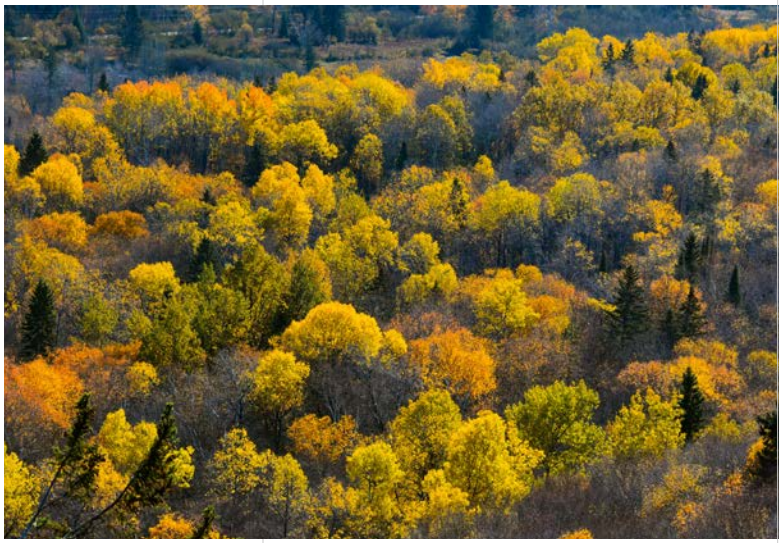
## Strategic assessment

- Canada is well positioned with the most certified forests in the world, with 158 million ha certified to third-party standards of sustainable forest management, which represents 43 percent of Canadian forest and 35 percent of global certified forest area.[27] Non-certified forests are also managed at standards near to those of certified forests. Canada should continue to lead on sustainability and leverage into a high-ESG market position.
- Canada's forests produce high-quality wood resources, well-suited for mass timber products.
- Currently mass timber, at 200,000 to 300,000 $m^3$ per year, accounts for not even one percent of Canada's wood supply (softwood and hardwood), and only 1-2 percent of North America's softwood lumber production (as of 2021).[28] The long-term economic goal should be to use mass timber, as one of a range of net-zero aligned opportunities, as a way to add value to Canada's primary forest production before export.

Panorama of green boreal coniferous forest in Northern Ontario

- The projected long-term trend for log prices in real terms is constant or increasing (given constraints on increasing supply of logs), putting pressure on forestry companies to develop new value-add opportunities.
- Supply planning takes place 3-5 years in advance and refined in last year. Contracts for downstream delivery are generally determined one year ahead.
- Margins are narrow and forest operations require specifying wood to be milled at point of planning harvests.
- Mass timber offers opportunities for improved, longer-term carbon storage, over conventional wood products, improving the emissions profile for Canada's forestry sector.
- New value-added forest products offer opportunities for economic reconciliation between Indigenous nations, government and industry. Agreements with First Nations for harvests require more effort in regions where the land areas are smaller and overlapping. Some provinces have more promising agreements or treaties with First Nations for harvests.
- Current lack of integration in the supply chain provides challenges for delivery and scaling of mass timber sector, given that sawmill machinery needs to be adjusted while demand volumes remain low.
- Mass timber has specific needs for drying and milling. Achieving the scale necessary for mass timber-specific milling is the real challenge for wood supply.
- In a fully integrated supply chain, mass timber would receive S4S (surfaced four sides) feedstock in specific sizes which might deviate from Canadian Lumber Standard (CLS). The wood must also be dried to 15% moisture content—below the 19% required by CLS.
- It only makes sense for sawmills to mill to these specifications mass timber if the order is big enough to occupy the mill for at least a week. That would correspond to a minimum order of 250,000 Board Feet (BF).

Canada's forestry sector has excelled at delivering and innovating in traditional products. The shift to greater use of biobased materials offers new opportunities for the sector, but require shifts in supply chains. With growing demand and relatively constrained supply, fibre will become a more valuable commodity providing incentives for higher-value products, including both wood and secondary products from milling.



Boreal forest in Quebec

The high sustainability standards in Canadian forest management mean that the sector is well-placed to serve growing mass timber demand, driven in part by increased incentives and attention to the environmental profile of building construction.

Forests of both Eastern and Western Canada provide suitable species mix, particularly spruce, pine and fir (SPF), for mass timber. In comparison to faster-growing softwoods in the U.S. South, Canadian forests currently provide more suitable wood quality for most mass timber products.[29] While softwoods currently provide the majority of feedstock, there are opportunities to exploit more hardwood species in certain market segments. European producers have developed glulam and LVL from species such as beech and oak, and these technologies can be expected to be applied to North American hardwoods, providing mostly opportunities for Eastern Canada, as well as the U.S. Northeast.[30]

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Mass timber emerged in the 1990s in Europe as producers there addressed the challenge of increasing fibre prices due to growing demand and expanding adoption of sustainable forest management practices.[31] Canadian forestry companies can expect to benefit from increasing demand for lumber products as both Canada and its main export market, the US, are forecast to enjoy strong housing and construction needs. In addition, increased development and deployment of bio-based materials, such as biofuels, will add to demand for fibre. Ongoing climate change is already putting pressure on Canada's forests and this is projected to increase in the future. So, while the forest products sector can count on strong demand-side prospects, its thin margins will come under strain.

Mass timber provides one diversification and innovation strategy to address these secular trends.[32] In terms of the numbers, the use of such engineered wood products can grow substantially without diverting considerable amounts of fibre from existing markets. As such, mass timber should be seen as one very promising option for value-added products from Canadian forests, as part of a broader bioeconomy strategy, emphasizing alternative construction materials that sequester carbon (embodied carbon), and have a lower carbon footprint of production. This strategy would build upon but go beyond the Forest Bioeconomy Framework of the Canadian Council of Forest Ministers.[33]

Despite pressures on forests, there is potential to increase substantially the supply of lumber to the mass timber sector in Canada, and this need not necessarily displace much of current lumber production in coming years.[34]

In aggregate, the total harvesting of softwoods has been 20-30% below the annual allowable cut (AAC), implying that there should be room for growth in supplying increased demand for mass timber without diverting other wood for other products.[35] Regional variations need to be taken into account. But as about two-thirds of lumber production is exported to the US, increasing domestic use can generate economic benefits and reduce trade tensions that arise through the Softwood Lumber Agreement (SLA).

Even with growth over the coming decade, mass timber will still occupy a fairly modest share of the softwood market. Nonetheless, the issue of access to fibre needs to be seen in the context of the forest products sector as a whole. The year 2023 has been characterized by wildfires and associated GHG emissions far in excess of recent averages. Climate change projections predict that such occurrences will become more the norm than the exception in Canada's boreal forests, driven by less precipitation and warmer temperatures.[36]

Yet, rather than constraining access to fibre, this highlights the opportunity for a wider adoption of active forest management, in order to reduce the risks posed by pests, disease and wildfires, while simultaneously supporting increased harvest levels. Through such an approach, Nordic countries, including Finland and Sweden, are obtaining between 5 and 7 times the amount of biomass out of their forests than Canada, with much lower natural disturbance rates.[37] This underscores the value of placing mass timber within the context of a broader forest bioeconomy strategy.

Producers of mass timber have specific requirements for lumber, particularly a lower moisture content of 15% (as compared to 19% for dimensional lumber products). Wood also needs to be sawn to different dimensions (following S4S). For sawmills, this means an adjustment of machinery, implying time and cost. For existing mills, managers want a minimum production run of a week for this reconfiguration, implying 250 $m^3$ of production, which is quite large compared to typical order sizes for existing projects. Growth in larger storey mass timber buildings (including mass timber-hybrid approaches) offer one means for the mass timber producers to place larger orders with sawmills.

There are several reasons to follow a regionalized approach in scaling mass timber production. Transport costs and associated carbon footprints are one. Scaling of the Canadian and North American markets for mass timber needs solutions to the longer transportation distances to relevant markets, as compared to Europe. A second factor is the existing imbalance between the location of production capacity and demand. The strongest demand prospects in Canada for mass timber are in the fastest-growing construction market of Ontario, also offering prospects for neighbouring provinces.

Aanischaaukamikw (Cree Cultural Institute)
Oujé-Bougoumou, Québec
*Source:* Nordic Structures

Currently, nascent clusters of mass timber manufacturing plants are found in lower mainland B.C., southern interior B.C., and southern Ontario. The four facilities in Quebec are quite a distance from each other. Supporting the development of these clusters into hubs, and adding others (such as in southern Manitoba) can help by aggregating demand for lumber from mills, to increase the number of orders placed and increasing incentives to mills. Another benefit could be concentrating skills development initiatives.

At the same time, First Nations involvement is a key element to success and should be a priority strategy for moving forward. Mass timber provides an opportunity to combine economic reconciliation and sustainable resource management objectives. There are opportunities for participation by First Nations as forest owners and stewards through licensing agreements with sawmills, or possibly joint venture arrangements for new facilities dedicated to mass timber milling and production. In addition, employment and skills development for Indigenous communities can be integrated into further development of the sector. In some places, there is strong interest from First Nations to build with mass timber in construction. Existing examples of mass timber buildings in Indigenous communities include, for example, Squamish Lil'wat Cultural Centre, the Nadleh Whut'enne Yah Administration and Cultural Building, and the Aanischaaukamikw (Cree Cultural Institute), to name just a few.[38]

A mapping of First Nations territory, timber supply areas, current licensing agreements, and existing sawmills could support zeroing in on more appealing

*First Nations involvement is a key element to success and should be a priority strategy for moving forward. Mass timber provides an opportunity to combine economic reconciliation and sustainable resource management objectives.*

locations for regional hubs, including the possibility of new facilities for mass timber manufacturing. A critical factor in such an analysis is that of transportation distances and costs, as well as associated GHG emissions. Many First Nations, particularly smaller ones, are lacking capacity to engage in these issues. This means a deliberate effort is needed to engage and build relationships.

The mass timber sector can be enabled by improved traceability of products. In order for real estate developers and construction companies to market the sustainability advantages of mass timber, verifiable information is required that the wood has been sourced from forests certified with a sustainable forest management accreditation. There might also be potential to even include a connection with specific forest tracts. Traceability also supports more accurate life-cycle assessment of the total embodied carbon in buildings. These assessments have been identified by stakeholders as falling short of including forest management issues.[39]

*A critical factor in such an analysis is that of transportation distances and costs, as well as associated GHG emissions. Many First Nations, particularly smaller ones, are lacking capacity to engage in these issues. This means a deliberate effort is needed to engage and build relationships.*

## Critical gaps

- Key locations for growth and linking supply of fibre and demand.
- Opportunities for Indigenous participation.
- Possibility of marketing mass timber products with specific forest provenance information.

## Key actions needed to deliver on the near-term goal

### 1. Identify regional locations for mass timber hubs. Focus efforts to aggregate demand on a small number of regional hubs.

- Analyse the regional distribution of mass timber growth opportunities.
- Provinces and territories with most potential to develop integrated supply chain (timber sourcing, Indigenous treaties and partnerships, manufacturing capacity, proximity to markets) should work to standardize needed products (size, strength, and moisture content) in order to aggregate demand.[40]
- In provinces and territories with no available allowable cut, a special crown allocation for value-added products could be made available.

## 2. Develop a standardized product suite for lumber (size, grade, moisture).

» Mass timber producers need lamallae in standardized sizes (European industry uses 20mm, 30mm, and 40mm). Industry groups and governments can work with mills of all sizes to explore the creation of standards.

» Expand the stock of mills available to dry to required moisture content (15%). Kiln acquisitions can be supported by government programs at the provincial and federal level.

## 3. Establish chain of custody systems for wood supply.

» Developers and residents care about the source and the sustainability of their wood supply. Canada can leverage its certified forests by establishing a chain of custody to show that mass timber projects are using sustainable, Canadian wood.

## 4. Innovation: explore options for more flexibility in species use.

» The manufacturing of mass timber from Eastern species of wood such as pine is in early development. More research and demonstration is needed to ensure its long-term role in the mass timber industry.

# Manufacturing

## Success in 2035

Canada's mass timber sector generates $2.4 billion in annual revenue and serves 25 percent of world mass timber market.

## Near-term goals

Increase Canada's mass timber sector to $1.2 billion in annual revenue by 2030, accounting for 25 percent of the global market.

## Strategic assessment

- Current global mass timber market (as of 2023) is estimated to be $1.6-2.3 billion, with the Canadian share of that estimated at $379 million, about 20 percent of a central estimate of the global market.[41] Projected annual growth rates for the mass timber sector both in North America and globally are 13-14 percent, through 2030.
- Canada's mass timber sector currently has almost 20 established manufacturing facilities producing about 0.5 million cubic metres per year. Total production capacity is estimated at close to 1 million cubic metres.
- Demand for mass timber products is strong and producers in some market segments have been running at or near effective capacity. Expansion of existing facilities and the construction of new, larger integrated facilities is needed to bring down unit costs and drive demand beyond one-off showpiece buildings and into the mainstream market.
- Mass timber manufacturers generally purchase lumber from mills and are not integrated with forestry or wood production (in contrast to the integrated nature of European companies).

*Some mass timber producers find it harder to access needed timber on a timely and predictable basis, given the fluctuations and ongoing uncertainties in downstream markets.*

- Given the small size of their market, mass timber manufacturers generally purchase dimensional wood that is not optimal for efficient production (wrong size/too thick, grade, moisture content).
- Standardization of products, as well as required milled wood, and scaling are needed to bring down the per unit costs of mass timber.
- Mass timber manufacturing offers some employment growth opportunities, particularly related to higher economic value-add jobs.[42]
- Specific skills shortages constrain expansion of the sector, for example detailing engineers are in short supply.

How will the supply chain develop as it scales? Given the earlier development of the sector in Europe, experience there might offer some clues. A certain amount of vertical integration has taken place there, as demonstrated by firms such as KLH. This process has been driven by smaller forest product companies, often with their own forests, and which tend to be smaller, private or family-owned businesses. Adjusting sawmills and investing downstream in mass timber production has been a logical response to cost increases in fibre production.

The organization of the sector in Canada is different, with fewer private companies at the forestry and milling stage, and much productive forest land held by government. Some mass timber producers find it harder to access needed timber on a timely and predictable basis, given the fluctuations and ongoing uncertainties in downstream markets. Lumber represents more than half of the operating cost of a mass timber manufacturing facility.[43] Vertical integration of mass timber manufacturers with mills, and also design firms can offer advantages.

In Europe, major manufacturing companies have their own lumber supply. This allows them to optimize harvesting, grading, and milling. Mass timber production

requires boards ("lamstock" or "lamellas" surfaced-four-sides) that are milled to specific sizes. Since many European manufacturers emerged from mills, they control their own feedstock and produce what they need when they need it. The European industry has standardized on lamellas in 20mm, 30mm, and 40mm thicknesses.

In Canada, standard lumber dimensions for the wood construction market do not use these measurements and there is no standards. Without it, mass timber manufacturers must plane standard lumber down to the desired thicknesses, wasting time, money, and wood. A Canadian (ideally North American) standard for both panel and then lamella thicknesses would improve efficiencies and reduce costs across production and building.

There are two potential solutions to this in the Canadian context: backward integration (manufacturers obtain logging licenses) or standardization (existing loggers and mills produce to manufacturers specifications). The problem with the latter is that mass timber is currently too small to warrant a change in mill operations. Canadian forestry companies have the capacity to mill to specifications, however, the entire Canadian mass timber market would account for just a few weeks of a large mill. There is no incentive for these companies to step into that market until mass timber reaches scale.

It's not clear what it would take for a smaller scale mill to make the proper lamstock. Larger supermills are currently not incentivized to change out the milling heads to make lamstock, given the small scale of the market. Large mills can be adapted to all sizes and species of logs, but operations are productive when the milling equipment can be set and left to run on a specific log size. Presorting the logs into specific sizes and grades increases efficiency and lowers costs.

Overall, standardization is a means to reduce cost, create efficiency, standardize and expedite approvals. Pre-approved building designs reduce cost and time to permitting and offer some certainty to manufacturing. Where the owner of the building is government, it can help simplify the process as well (and reduce risk). Possible priorities for priority standardized products and building assemblies are mid-size rental housing and warehouses. But such standardization needs to emerge from firm collaborations encouraged and supported by public and private entities throughout the ecosystem.

*A Canadian (ideally North American) standard for both panel and then lamella thicknesses would improve efficiencies and reduce costs across production and building.*

## A diverse manufacturing ecosystem

The analysis thus far has focused on primary mass timber manufacturing: creating beams and panels. But there are two key forms of mass timber manufacturing: primary and secondary. In secondary manufacturing, panels are customized and integrated into specific building markets and projects. Other countries are also home to a variety of business models and a vibrant mass timber industry is a diverse ecosystem of firms.

Canada has a number of capable integration firms with world-leading engineering expertise. It also makes sense to encourage and support these smaller secondary

manufacturers. They can be separate entities that support the output of the presses (engineering and CNC can be a bottleneck) in a vertically integrated operation. There are also opportunities in smaller scale DLT and NLT production that do not require the same level of investment as a glulam or CLT press.

## Capital needs, market certainty, and the role for government

*There is an important role for government in providing catalytic investments and creating demand certainty. Canada's mass timber industry is a strong candidate for strategic investment through the Canada Growth Fund.*

To scale, manufacturers of all kinds need access to capital for expansion. A key need is financing that supports ramp up over an extended period of time (up to three years). However, just as in other new industries for the energy transition, capital can be hard to secure because banks do not have a record of lending to firms in the space. Financing is also hampered by uncertain demand in emerging markets. Banks need to know that sales targets will be met. Creating long-term stable demand is critical for an industry looking to scale.

There is an important role for government in providing catalytic investments and creating demand certainty. Canada's mass timber industry is a strong candidate for strategic investment through the Canada Growth Fund. The Growth Fund has a mandate to help Canadian firms scale low-carbon technologies, including low-carbon natural resource development.[44] Its first investment in Eavor (a geothermal energy company) is a great example: investing in a Canadian world-leader poised to scale.[45] The Canadian mass timber industry is in a similar position: Canadian firms are respected throughout the world and ready to capture a share of a rapidly growing market. Investments in the capital expenditure needed to scale would be strategic and timely.

A strong government procurement program could create demand certainty. One way to make procurement more effective is to offer manufacturers and

developers multi-project contracts. In Germany, the federal government has provided a modular construction firm a long-term contract with a commitment for multiple buildings.[46] This allows the firm to expand production capacity effectively, bringing costs down and therefore expanding the potential market of modular mass timber.

## Critical gaps

- Supply of timber and dedicated mills
- Capital and investment sources
- Standardized lamella and panels
- Market information
- Skills

## Key actions needed to deliver on the near-term goal

### 1. Develop priority standardized products for main growth segments.

- Taskforce with participation from architects and construction to establish priority products companies, according to typology of structures (both domestic and export markets).
- Cluster demand into regional hubs built around forest communities, sawmills, and markets to concentrate demand sufficiently to develop new milling and drying practices in concentrated locations.

### 2. Develop a strategic plan to create the financial conditions necessary for an expansion of mass timber manufacturing capacity in Canada.

- Based on the targets laid out in this roadmap, Canada's manufacturing capacity needs to double by the end of the decade. Even though demand is currently strong, new facilities are not being sited and constructed.

- Strategic financing from the government of Canada (through the Growth Fund and the Infrastructure Bank) could help the industry scale and access new markets.
- Loan guarantees, authorized under both institutions, would be a powerful tool.
- Determine conditions for smaller scale mills to make required lamstock, in terms of location, scale/volume.

### 3. Assess skills needs and develop appropriate and targeted training programs.

- Determine needs and scope for new or adjusted credentials or certificates (national or provincial).
- Encourage existing mass timber manufacturers to serve as training/ cooperative centers.

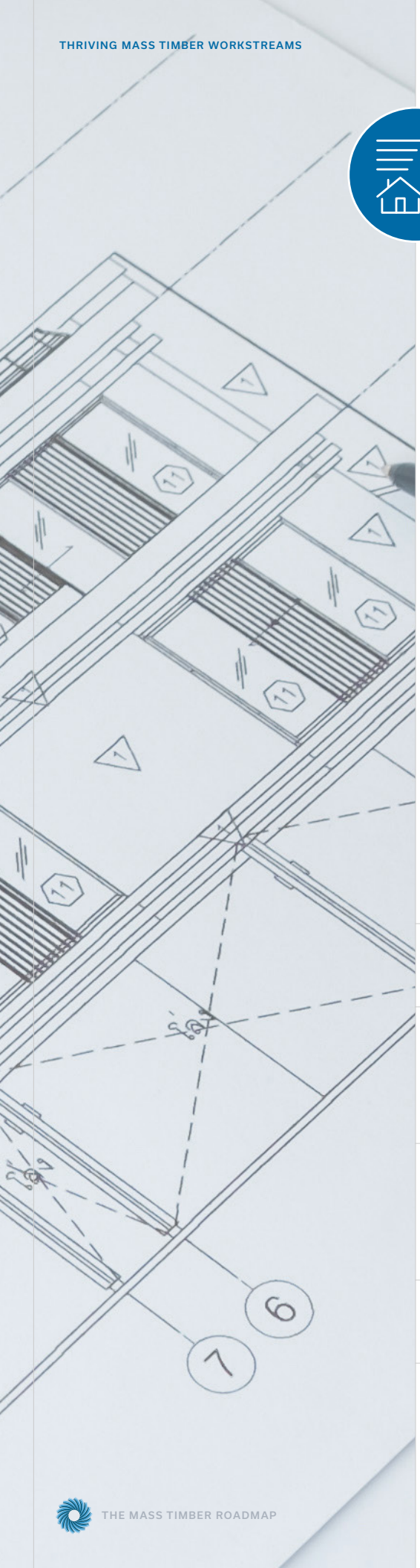
### 4. Identify opportunities for Canadian production of associated products (membranes, hardware, chemicals).

- A mass timber strategy needs to be situated within a broader bioeconomy strategy that seeks to realize the full value of the tree.
- The best value-added opportunities in building materials beyond mass timber need to be identified. Insulation offers one lower value-add possibility.

### 5. Manufacturers must work with designers and developers to identify prefabrication opportunities in high priority building segments, particularly affordable and Indigenous housing.

- Realizing standardization opportunities in modular and prefabricated design would help the industry scale and demonstrate the power of mass timber to the building ecosystem.

### 6. Explore the opportunity to tap into offshore markets that are rapidly adopting mass timber solutions. Engage in market development activities to expand the demand and awareness for mass timber products in these regions.



# Architecture, building codes, design, and fire safety

## Success in 2035

Mass timber is recognized as a safe, simple construction material and has a suite of prefabricated connectors between panel, beam, and column to ensure code compliance, fire safety, and cost effectiveness.

## Near-term goal

Secure low-hanging fruit code changes and identify strategic niches for prefabricated connectors.

## Strategic assessment

- Mass timber is prized for its aesthetic qualities, biophilic benefits, durability, ease of use in construction, and low carbon footprint.
- Education and innovation have helped to build the mass timber architecture and design community in Canada. Code changes have enabled wood materials to be used in more applications. The mass timber architecture and design community is poised to grow and go mainstream.
- Mass timber made its name in “tall wood” buildings and showpiece non-residential buildings. Many of these buildings were “one-off.” To increase market penetration, it needs to become a mainstream material of choice in residential applications and more common 7-12 storey buildings.
- The design process for mass timber is challenging because the supply of panels and products is limited and there is a lack of standardization across the industry.
- In order to grow, mass timber needs to penetrate new building classes and realize the benefits of standardization. The emergence of standardization can now be seen in repeatable envelopes, connections, and design elements.

*To increase market penetration, mass timber needs to become a mainstream material of choice in residential applications and more common 7-12 storey buildings.*

- To scale further, mass timber must become widely used in hybrid buildings as a low-carbon, low-cost component integrated with steel and concrete.[47] It could even be deployed just for elevator cores or podiums in buildings that do not have the trademark aesthetic qualities of mass timber buildings.
- Prefabricated connectors simplify design, enable scaled production, and reduce construction times. Mass timber would benefit from a suite of prefabricated connectors modelled on those emerging in the steel industry.[48]
- Building and fire codes label wood as a combustible material, which limits its applications and raises costs by imposing additional construction elements. Replacing existing language with performance-based fire and seismic codes would remove this disadvantage and enable further scaling.
- While it is clear that mass timber reduces the embodied carbon of buildings, there are still big questions around what accounting standards should be used in embodied carbon regulations and whole building lifecycle analysis.

This workstream focused on the technical details in architecture and design, such as code compliance.

Canada has world-leading mass timber architects and engineers, with Canadian firms involved in mass timber projects throughout the globe.[49] Having demonstrated its potential in showpiece buildings, the challenge now is for mass timber to go mainstream and become a mainstream option in architecture and design. The building classes with the best opportunities for scaling mass timber include mid-rise residential including rental and warehouses. There are also possibilities with hybrid buildings, combining mass timber with concrete and steel.

From an engineering and design perspective, the availability of prefabricated connection systems between panel, beam, and column would facilitate the work of

architects and designers, while also reducing construction times. Various proprietary systems currently exist and ease of centralized availability of their design values for shear and withdrawal strength constitutes a challenge to accelerated building design. This situation works sufficiently well for designing bespoke structures, with higher margins, but is a hindrance to more rapid construction, including prefabricated structures.

Standardized connection systems have emerged in the steel industry and a similar evolution is needed to reduce costs and accelerate the use of mass timber. Useful experience can be tapped from Europe where Rothoblaas has emerged as a leader provider and trainer.[50] While a suite of products is now available in both Europe and North America, more work could be done to integrate product development with architectural advances and training. Architectural, engineering, and construction costs could be lowered by coordinating on specific connection systems, especially in midrise and 7-12 storey buildings. If a suite of standardized connections for post and beam, envelope, and other applications can be integrated into design software, it will make mass timber more accessible.

A key selling point for mass timber is its lower carbon footprint. Clear and verifiable lifecycle assessment can boost demand. But lifecycle assessment and carbon accounting is just beginning to be standardized in Canada. A review of existing embodied carbon assessments in the greater Toronto-Hamilton area found methodological differences that impinged on comparisons across projects.[51] Assessments are using a variety of data sources, including product-specific and industry-average environmental product declarations (EPDs), as well as generic software/database entries. In terms of assessments that involve mass timber, there are substantial variations in the embodied carbon depending on the specific location of both timber supply and manufacturing facilities.[52]

*A key selling point for mass timber is its lower carbon footprint. Clear and verifiable lifecycle assessment can boost demand. But lifecycle assessment and carbon accounting is just beginning to be standardized in Canada.*

There is currently no consensus on how to account for carbon sequestration in undertaking whole-life and embodied carbon assessments building materials made from wood (including mass timber).[53] This is due in part to the range of forestry practices around the world and how to model carbon stocks, as well as downstream issues, such as uncertainty around a building's service life and subsequent use of materials.[54] Some coordination and technical leadership is needed here. National Research Council has prepared guidelines on whole building LCA which can serve as a basis, and be promoted through the federal Greening Government Strategy.[55]

This requires GHG lifecycle analysis for all new government buildings.[56]

All the same, some large municipalities, such as Toronto and Vancouver, are advancing on

Tsleil-Waututh Administration & Health Centre
North Vancouver, BC
Photography: Dr. Roman Trubka, courtesy naturally:wood

It took only four months, from December 2016 to April 2017, to erect the wooden structure of Quebec City's Origine: a 13 storey high, remarkable landmark and tallest wood building in eastern North America.
*Source:* Think Wood

guidelines for embodied carbon in buildings. The fourth and latest version of the Toronto Green Standard, effective since May 2022, includes voluntary requirements for reporting on emissions from building construction materials. Toronto is undertaking a study that will form the basis for future standards for embodied emissions in building materials.[57]

To capture the potential embodied carbon benefits of mass timber buildings, increased attention to building end-of-life and disassembly is required (Design for Manufacturing, Assembly, and Disassembly—DfMAD). Mass timber construction offers advantages relative to traditional concrete and steel structures. Disassembly of mass timber construction can be relatively straightforward with suitably-designed connection points. This can increase the potential reuse of materials.[58] This lengthens the carbon sequestration time of wood construction materials because the carbon stored in wood is more likely to remain in building materials beyond the expected life of the building. This will increase mass timber's carbon advantage over other materials.

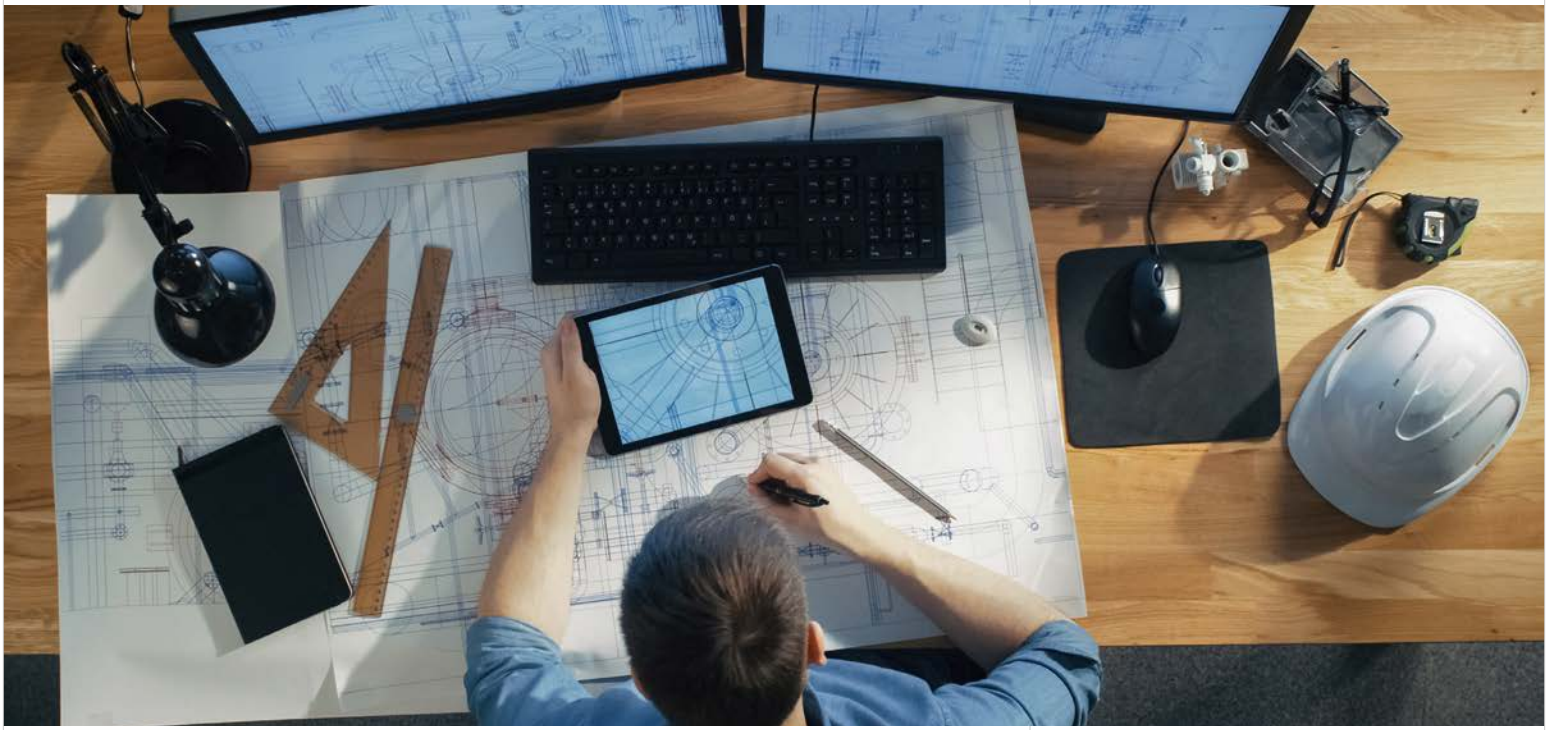
At the moment, carbon is the principal metric in LCAs and there is a need to build in other key metrics, such as water use, for which wood products may also offer an advantage. Use of land and other materials could also be considered. But long-term, we should aim to capture the broader value of using a low-carbon, bio-based, and renewable material. Focusing on carbon alone can potentially reduce the environmental conversation to a numbers game.

Code changes have been essential to the growth of mass timber. Further building and fire code changes could help address problems with insurance and broader public education. Currently the National Building Code (NBC) of Canada and provincial codes categorize materials as combustible or noncombustible. The development of materials properties means this simplistic distinction does not reflect fire safety standards for mass timber structures. Building codes are now under revision to move to performance-based standards. A new construction type, encapsulated mass timber construction has been included in the 2020 update to NBC, to complement the current set of types (combustible, heavy timber, and noncombustible construction). The current code allows the construction of mass timber buildings up to 12 storeys but further code changes should consider increasing this to 18 storeys. Code revisions also need to account for hybrid buildings, such as those consisting of mass timber floors with concrete or steel frames (including in structures over 18 storeys). Further changes in the transition jumps in the building code for fire rating should be examined, including an additional category for a 90-minute rating for 7-12 storey buildings.

*The current code allows the construction of mass timber buildings up to 12 storeys but further code changes should consider increasing this to 18 storeys.*

CWC, the National Research Council, and a range of public and private organizations collaborated to mount a series of fire safety demonstration tests.[59] Canadian building codes should also keep pace with such developments.

The results of these have confirmed the fire resilience of mass timber components relative to conventional building materials. Insurance remains more expensive



and further work is needed to identify and overcome remaining challenges and information gaps. This is a priority topic for the Climate Smart Buildings Alliance, formed in 2023.[60]

Non-standardized lateral systems, such as timber brace frames and balloon-frame CLT shearwall systems are frequently used in mass timber buildings. Woodworks has advanced standards for such systems and provides design guides, for example for CLT diaphragms.[61] Canadian building codes should also keep pace with such developments.

Working with mass timber continues to be a dynamic and fast-moving field. To support deployment, knowledge and expertise on mass timber needs to be developed among architects, designers and engineers. Areas such as wood building types, structural properties of wood and mass timber products, sound transmission, fire safety, moisture management, thermal properties of wood, and building codes are all advancing rapidly. Training new and existing professionals in these areas is relatively easy, but gaining experience is instrumental in extending awareness and application.

More generally, improved understanding and "myth-busting" concerning mass timber is still needed, such as regarding fire safety, among finance, insurance, and developers. Upfront costs for mass timber projects are typically higher than for traditional construction. Banks and financers need to understand the unique project flow relative to more traditional construction methods. Development teams for mass timber projects need a stronger understanding of construction industry processes and procedures. In particular, improved proficiency in digital tools and design/engineering methodologies (such as DfMA, BIM, CAD) is a gap. As experience in these areas accumulates, costs will decline to be more competitive.

*Improved proficiency in digital tools and design/engineering methodologies (such as DfMA, BIM, CAD) is a gap. As experience in these areas accumulates, costs will decline to be more competitive.*

## Critical gaps

- Standardized LCA methodologies and data (capturing forest carbon)
- Building code changes
- Design and engineering skills

## Key actions needed to deliver on the near-term goal

### 1. Develop standard connector opportunities.

- Mass timber design and construction would benefit from a suite of standard connectors similar to what the steel industry has. These would specify connections between panel, beam, and column.
- There should be simple tables (including design values for shear strength and withdrawal strength) for designers to use that prevent redundant engineering studies.
- The first step is to identify connection opportunities and commission engineering and design studies necessary to advance the ideas.

### 2. Create simple, credible embodied carbon and lifecycle assessment standards and supporting data.

- Carbon is principal metric but LCA should include other impacts (land, water, materials).
- Methods for carbon metrics to be included in bid documents.
- Database of Environmental Product Declarations (EPD) needs to be expanded to cover new products (not just mass timber but connections, etc), to reflect regional specificity and ideally specific forest tracts (traceability).

### 3. Building and fire code changes to enable further penetration.

- » Remove "combustible" language from building and fire codes and replace with a performance-based standard. This will put wood on a level-playing field with other materials.
- » Add additional category for 90-minute fire rating for 7-12 storey buildings.
- » Explicitly incorporate mass timber and clarify distinction with heavy timber.
- » Allow encapsulated mass timber construction (EMTC) up to 18-storeys.
- » Incorporate balloon framing into National Building Code.
- » Advance requirement for GHG standard in National Building Code from 2030 to 2025.

### 4. Fill in critical design gaps with a focused program of research.

- » Glulam design values: weak axis bending, additional lower strength grades for lower strength/stiffness lumber, etc.
- » CLT design details: lintels, balloon frame (into building code).
- » NLT/DLT: Hardwood nails to allow processing of NLT using CNC.
- » Diaphragm behavior needs to be assessed and better understood (NHERI Tallwood project may have findings).
- » Fire design: develop solutions to allow more exposed timber (e.g., research for fire retardant treated wood to reduce flame spread, testing on delamination of fire-retardant treated wood, research for non-concrete toppings.)
- » Tested assemblies: ULC in the building codes for fire rating and acoustic STC/IIC.

### 5. Education for architects, engineers, financing and development teams.

- » Additional structural wood courses in universities need to be developed, building on UBC's lead, and the education roadmap program developed by CWC, including the woodSMART resource.[62] Explore possibilities of online courses, or short courses to increase accessibility.
- » Existing university programs incorporate fire engineering.
- » Tailored programs to be developed for Authorities Having Jurisdiction (AHJ).

## 6. Circular economy: advance design for disassembly.

- A shift is needed from Design for Manufacturing and Assembly (DfMA) towards Design for Manufacturing, Assembly, and *Disassembly* (DfMAD) - moving from demolition to reuse of building materials.
- Mass timber offers compelling opportunities for end-of-life building disassembly, given nature of connections (particularly if bolted).[63]
- Advancing design for disassembly will lengthen carbon sequestration times and increase mass timber's carbon advantage.

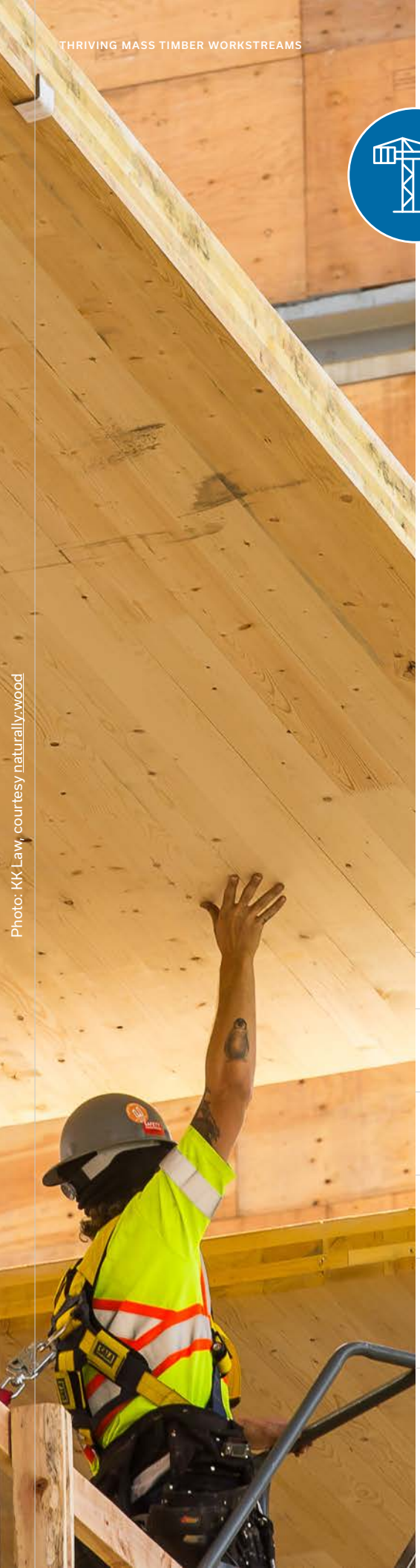


Photo: KK Law, courtesy naturally:wood

# Construction

## Success in 2035

Mass timber is a mainstream material that accounts for 5% of all construction materials, including in 25% of all multifamily residential structures and nonresidential buildings (4-6 and 7-12 storeys), making use of significant modular or prefabricated elements.

## Near-term goal

Drive the uptake of mass timber as mainstream material in construction, reaching 2% of all construction materials. Expand beyond one-off buildings into repeatable forms, large building markets, and hybrid construction.

## Strategic assessment

- Mass timber currently accounts for barely 1 percent of construction materials.[64]
- Due to important public-facing work, the desire for mass timber buildings is growing.
- Mass timber has important benefits for construction: buildings can be built faster with a smaller workforce.
- However, cost management has been a concern for builders. The industry needs to lower costs and increase certainty.
- Persistently high demand for housing, especially given Canada's immigration targets over the next decade, make housing a priority building segment. It is an opportunity for off-site construction and standardization.
- Public sector infrastructure is also aging and provides a large market to feed into.

- Housing needs in Indigenous communities also present opportunities for partnerships that create economic benefits for the communities.
- There are major opportunities for modular construction, prefabricated elements, and other offsite construction pieces. Mass timber can help reduce the costs and expedite construction.

*The potential for lower building costs and rapid construction times offers clear advantages in solutions to address the housing crisis. But to seize these advantages, the mass timber industry must organize to create a set of building archetypes that integrate expertise from across the supply chain.*

The vision for the construction sector is that mass timber becomes a mainstream material that is used in a variety of building types. Mass timber made its name in one-off, showpiece buildings. But if it is to be a significant economic engine, it needs to be a key component of residential homes and mid-market housing. Many of these applications will be hybrid buildings, in which mass timber works alongside concrete and steel to make strong, affordable, and lower-carbon structures.

Mass timber has enormous potential in these spaces. It is already price competitive in many applications, with premiums not exceeding 5%. But as the industry scales the price of mass timber construction can come down further. This is because mass timber structures can be built up to 25 percent faster.[65] Mass timber construction also requires less labour. As the construction industry struggles to find skilled labour, mass timber will offer significant advantages.

Lots of work must be done to achieve this potential. The roadmap outlines priority actions that would enable the construction industry to benefit from mass timber. First, the lack of a reliable, accurate costing tool is big impediment to developers, designers and other quantity surveyors properly estimating a MT project. This results in higher uncertainty and contingency and longer time for planning mass timber projects. It also leads to roadblocks with clients in both private and public sectors.

Skills development for mass timber construction also poses challenges. One key issue with in-person courses with practical components (e.g., carpenters learning how to build a mass timber structure) is how to scale these courses. The BC Institute of Technology only has capacity for about 16 students per 6 months. It is nonetheless investing $3.3 million in a mass timber skills hub.[66]

The potential for lower building costs and rapid construction times offers clear advantages in solutions to address the housing crisis.[67] But to seize these advantages, the mass timber industry must organize to create a set of building archetypes that integrate expertise from across the supply chain. The construction industry must also seize the potential for prefabrication to lower costs and labour time on the job site. This will increase productivity and produce broad societal gains.

## Prefabrication opportunities in mass timber

There are three types of prefabrication elements: open panels, closed panels, and structural insulated panels.[68] Open panels are simple wall assemblies. Closed panels include sheathing, insulation, windows, and even mechanicals (plumbing, electrical). Structural insulated panels are generally an insulating layer glued between two layers of sheathing. There are now Canadian firms with a number of solutions for all three types in light-frame wood construction.

Mass timber panels, especially cross-laminated timber, create opportunities for open panel prefabrication because it allows entire wall assemblies to be manufactured and customized offsite.[69] Window and door openings can be pre-cut and standardized connections can be used to assemble quickly. However, these elements of prefabrication can be used to create highly customizable buildings.

Thus, the full mass timber value chain includes an integration step between manufacturing, design, and construction. European firms have incorporated this step into a hub and spoke model whereby forestry operations and panel manufacturing are co-located, but integration hubs are located close to major population centres.[71]

But mass timber also has incredible potential for closed panel fabrication, which could spawn another integration industry. Timber Engineering's On5 project pioneered the use of prefabricated closed panels.[72] The main CLT panels had finishes and the rain screen pre-applied for quick installation and immediate protection from the elements. But the real opportunity highlighted by the project is still yet to be seized: no firm has provided a solution providing mass timber panels with a full envelope.

**FIG 1:** Open panel installation [70]

*Source:* Nordic Structures

European firms have also developed a number of prefabricated options and there are CLT kit homes on the market in the United States.[73]

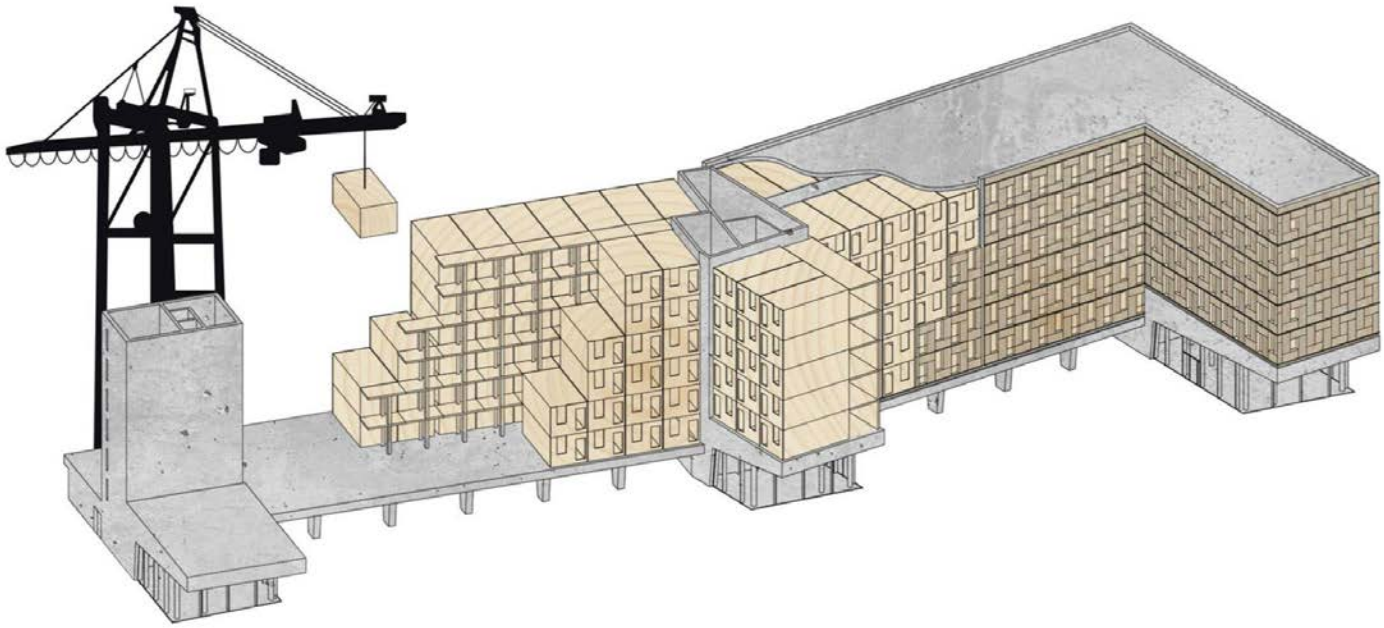
Europe is making advances in volumetric (or 3D) modular construction using mass timber. Kaufmann Bausysteme prefabricates complete CLT boxes from panels prepared by CNC. Modules are arrayed in a straight line, allowing trades to pass through quickly and efficiently. The units are complete with electrical and plumbing. The system has been used to make government buildings and university housing.

While Canada has capacity and experience with modular buildings, it has yet to take advantage of the potential of marrying mass timber and modular construction. National, provincial and municipal procurement should seek to advance this pathway as a tool to resolve the housing crisis.

**FIG 2:** Kaufmann Bausysteme's 3D module production.

*Source:* konstruktiver-holzbau.de

**FIG 3:** Kaufmann Bausysteme's university housing project in Hamburg.[74]



*Source:* konstruktiver-holzbau.de

## Critical gaps

- Building archetypes for key structure classes targeted for growth.
- Prefabrication solutions.
- Costing information that is accurate and easily accessible.
- Mass timber construction skills.

## Key actions needed to deliver on the near-term goal

### 1. Develop affordable and practical systems for building archetypes.

- To increase standardization, building archetypes in target building segments are needed.
- Work should begin in the single family home and 8-12 storey building markets.
- A critical near-term objective is to ensure that mass timber residential construction has options in the forthcoming national home design catalogue.[75]
- Archetypes should be regionally tailored, for example smaller (4-6 storey) will be more appropriate further from big urban centres.

### 2. Identify niche high-value building elements that could be used as test cases to bring prefabrication down the cost-curve.

- For example, elevator cores have been identified as a major market for CLT panels.[76] Prefabricated fasteners and connectors also have potential to reduce cost and time.[77]
- Prioritize automated pre-fabrication facilities.

### 3. Create a pro-forma costing database for mass timber buildings.

- Building archetypes should form basis of elements included.

### 4. Innovative construction methods.

- Develop better methods of moisture management. Moisture can have significant impact on schedule and aesthetics.
- Develop integer units to go beyond 2x4 and also used in composed mass timber elements.
- Develop mobile harvesting, milling, element manufacturing and prefabrication facilities to move with demand and build local.

### 5. A national training program for skilled mass timber workers.

- The mass timber construction industry needs better training and education for skilled labor.
- Technologists with skills in detailing and reliable cost estimation are priority gaps to address.
- Continue outreach to universities and technical colleges to design courses at various levels to support mass timber construction, within existing curriculum of education programs and apprenticeships to create talent pipeline (e.g. engineers, architects, carpenters).
- Introduction to timber architecture courses for trades/craftspeople, including visits to successful projects.
- Include architects and technicians in practical workshops on building with mass timber.
- Support the quick and periodical release of books and educational publications (especially online) while larger courses and programs are developed.

# Policy, programs, and sustainability

## Success in 2035

A robust set of policies and programs supports a growing, high value-added mass timber industry.

## Near-term goal

Develop a policy package that would help the industry scale-up while building homegrown capacity along the supply chain.

## Strategic assessment

- Mass timber presents an opportunity to build an industry that will contribute to net-zero goals while creating economic benefits for rural communities from coast-to-coast-to-coast.
- The Inflation Reduction Act, the European Industrial Plan, and the Made-in-Canada Plan bolster clean energy industries with strategic investments and targeted manufacturing tax credits.
- As we have seen in other industries, scaling up Canadian firms into world-leading players has been a challenge. Innovative financial supports from technology readiness levels 6-9 is critical.
- Sector-level clean energy policies should seek to align supply and demand. At this time, the demand-side for mass timber is strong. There are large existing markets if supply can scale and come down the cost curve. This suggests supply-side policies should be the current focus.
- Supply-side policies need to support manufacturers in securing financing to expand and construct facilities. Such policies also need to respect Softwood Lumber Agreement and be designed to avoid trade disputes. As such, they must

provide specific support to wood products, though broader incentives for clean technology could be designed to bolster low-carbon building materials.

- Innovation along the whole supply chain is needed to create a world-leading mass timber industry that can export into other jurisdictions.
- Mass timber is a low-carbon building material. It substitutes for conventional materials (high-emissions materials) and sequesters carbon in buildings. As such, it lowers the total carbon footprint (with both sequestered and embodied carbon) of buildings.[78]
- Training programs are needed across the supply chain. A critical need is in detailing.
- Insurance for mass timber buildings is a challenge. With limited safety data, insurers charge a premium to building owners. A program to keep these costs low would help bridge the market.
- Procurement by federal and provincial governments could help low-carbon building materials scale. Governments undertaking multiple building projects could support manufacturing expansions by offering large offtake agreements to manufacturers.
- Incentives at the municipal level through zoning and application processes to encourage building with mass timber can reduce uncertainty for developers.

## Critical gaps

- An integrated policy package
- Industry cooperation and coordination
- Financial incentives and investment

Building the mass timber industry in Canada requires an innovative and forward thinking set of policies. These policies can and should be informed by best practices in other industries in the energy transition.[79] After all, like many industries needed for the energy transition, mass timber is growing, but still emerging and thus is subject to the challenges of new markets.

New markets often suffer from a chicken-and-egg problem for supply and demand. In order to create a cost effective supply chain at scale, there must be strong demand. But to create demand for a new problem, the products must be

*On the demand-side, mass timber has a huge advantage: a massive potential downstream market. The construction industry is one of the largest in the country and provides a stable long-term market to feed into.*

price competitive and therefore already at scale. This situation calls for smart industrial policies that seek to stimulate and align supply and demand together.[80]

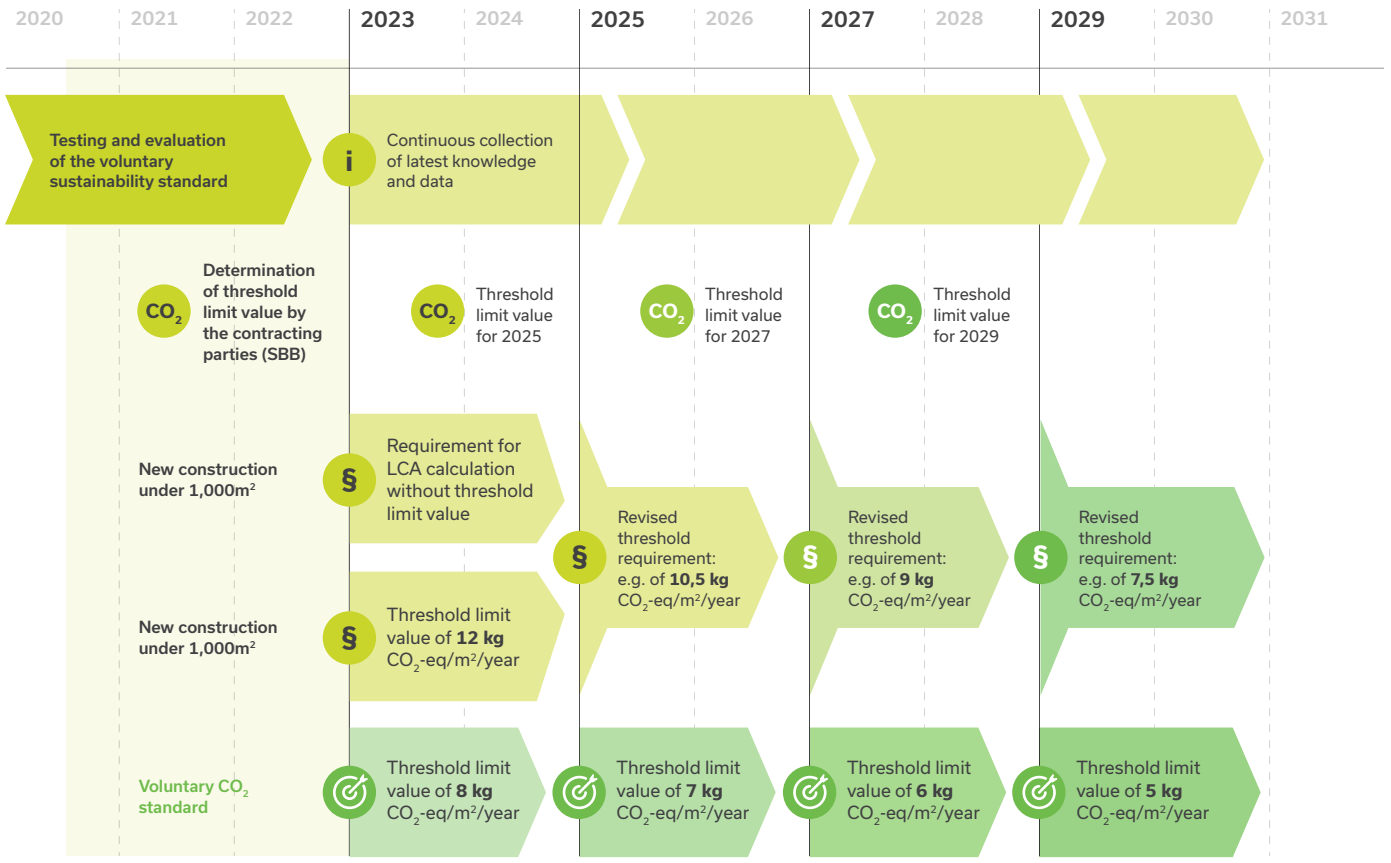
On the demand-side, mass timber has a huge advantage: a massive potential downstream market. The construction industry is one of the largest in the country and provides a stable long-term market to feed into. Currently, mass timber comprises 1% of the building materials market.[81] The North American construction materials market is $277.7 billion.[82] If mass timber can go mainstream, it has a major demand driver built in.

The keys to going mainstream are:

- Integrating the supply chain
- Scaling production
- Mainstreaming demand

To do all three of these things at the same time, mass timber needs a policy package that includes public-private collaboration, support for mass timber producers, regulatory and code changes, and procurement.

**FIG 4:** Denmark's phased embodied carbon regulation.[91]



*Source:* Canadian Wood Council

## Public-private coordination

Good industrial policy requires that high quality information flows back and forth between governments and firms up and down the supply chain. This information exchange, when done right, can facilitate integration of the supply chain and ensure that government policy is calibrated to support industry.

This roadmap makes the challenges of integrating the supply chain clear. A key need is to create a platform for communication amongst industry to facilitate the kinds of partnerships that build and integrate supply chains. The Canadian Wood Council is the ideal home for this platform, but many firms are not connected to the CWC, or misunderstand its mandate. A coordination body that is framed and facilitated in a simple way to discuss and develop solutions to the problems that arise in industry formation would help.

This platform should also be used to create healthy exchanges of information between firms and government. This is critical to good policy design. Industry has information that the government needs to get regulation out of the way and create enabling structures. The key is finding ways to create open exchange between government and industry without allowing the government to be captured by specific firm interests. Convening through an independent but publicly funded entity like the CWC helps to avoid that outcome.

In sum, the mass timber industry needs a public-private coordination body. The first task for this body should be to help advance solutions to the housing crisis and a policy package that aligns supply and demand supports for Canadian industry.

## Demand-pull: Embodied carbon

Embodied carbon regulations can be a critical component of a policy package for mass timber. They can generate a powerful incentive to use mass timber, which has lower emissions than concrete and steel.[83] This would create the demand-

*Embodied carbon refers to all the greenhouse gas emissions associated with creating building materials, including manufacturing, transportation, installation, maintenance, and disposal.-Embodied carbon is critical because it represents 8-11% of global emissions.*

pull necessary to bring the mass timber industry to scale. Good green industrial policy uses smart regulations to incentivize demand for green products that will provide economic benefits to local communities.[84]

Embodied carbon refers to all the greenhouse gas emissions associated with creating building materials, including manufacturing, transportation, installation, maintenance, and disposal.[85] Embodied carbon is critical because it represents 8-11% of global emissions. Operational carbon is the emission associated with operating a building and it represents 20% of global emissions.[86] But in jurisdictions that already have low-carbon grids, such as Vancouver, Toronto, and Montreal, the embodied emissions of a new high-performance building will account for 83%-93% of the buildings whole-lifecycle emissions in 2050. One Danish study estimates that embodied carbon represents 64% of whole-life emissions.[87] Thus, to be serious about net-zero buildings, embodied carbon must be taken into account.[88]

There are now a variety of policy experiments taking place with Denmark, California, and North American cities setting out leadership positions.[89] Denmark has instituted the world's first national embodied carbon regulation as part of its national strategy for sustainable construction.[90] The regulation creates a phased cap on the carbon footprint of buildings of 12kg $CO_2e/m^2$/year for new buildings over 1000$m^2$. In 2025, buildings under 1000$m^2$ will also be subject to the cap, which tightens to 10.5kg $CO_2e/m^2$/year. The standard ratchets down again in 2027 and 2029 to reach 7.5kg $CO_2e/m^2$/year.

California is also exploring an embodied carbon regulation. Bill 2446 mandates the California Air Resources Board, the powerful regulator driving decarbonization in California, to develop a framework that would reduce embodied carbon by 20 percent by 2030 and 40 percent by 2035.[92] Once again, California is positioning itself as a policy and market leader in North America. The embodied carbon regulation would build on the Buy Clean California Act to support the market for low-carbon building materials.[93]

Aerial view of Toronto city and harbourfront along Lake Ontario

Canadian cities are also leading in this area. The City of Toronto has instituted an embodied emissions cap of 250 kg $CO_2e/m^2$ on all new city-owned buildings and created a voluntary standard for non-city buildings.[94] This "tier 2" voluntary standard is likely to become a tier 1 (mandatory) standard in the next version of the Toronto Green Standard, due in 2025.[95]

The City of Vancouver has set a target to reduce embodied emissions by 40% by 2030.[96] City council has signaled that in 2025 it will require 1-6 storey buildings "that can be built of wood or mass timber construction" to reduce embodied carbon by 20% and that buildings over 7 storeys and those not amenable to wood solutions must reduce emissions by 10%. Vancouver

now has embodied carbon reporting requirements in place for new buildings. New buildings must demonstrate that they are on a pathway to expected requirements.[97] In addition, the city has moved to offer incentives for applications mass timber buildings by allowing increased heights above 6 storeys and a faster approval process.[98]

Canada also has a disclosure standard for major construction projects as part of its Greening Government Strategy.[99] Like other green procurement policies, this promises to help scale the market for low-carbon materials and develops familiarity with the frameworks necessary to create an embodied carbon standard.[100]

## Supply-push: Strategic finance in a smart industrial policy approach

Looking at embodied carbon through the lens of industrial policy suggests a unique policy approach. Rather than focus solely on emissions reductions, it highlights the importance of producing local economic benefits. Since mass timber would build a made-in-Canada supply chain, it would create opportunities for rural and resource communities. This would justify a new regulation if the regulation was calibrated to provide such benefits. But an industrial policy lens also highlights cost controls: successful climate policies combine supply-side incentives with demand-pull from regulations.

An embodied carbon regulation could be combined with production incentives offered through Canada's clean technology support programs. The Made-in-Canada plan announced in Budget 2023 outlines how demand-side regulations and more targeted support can be powerfully combined in critical focus areas.

BC's Mass Timber Action Plan exemplifies this approach.[101] On the demand-side, there is the use of mass timber in public-sector buildings and Vancouver's proposed embodied carbon regulations. These both encourage the use of

mass timber, though a systematic policy to incentivize low-carbon materials at the provincial level would be even more powerful. On the supply side, BC has created a $180 million fund to add manufacturing value added in the province, with a focus on the forestry sector.[102] Mass timber projects are eligible for up to $10 million in capital support.[103]

Supply and demand could be more directly linked as well. Canada could introduce a voluntary cap on embodied emissions in which qualifying buildings also received a subsidy calculated per $m^2$ through the Canada Infrastructure Bank. As in the Bank's retrofit program, a standardized set of parameters could be developed to ensure ease of application and disbursement.

This would help create more certainty. Certainty is a key need for businesses planning expansions in manufacturing capacity and the investors that would finance those projects. Regulations calibrated to confidently create long-term demand will have a stronger effect than the piecemeal demand created by one-off public-sector investments.

Another way to create certainty would be through a direct production or investment tax credit. The Made-in-Canada plan advances a number of investment tax credits to compete with the Inflation Reduction Act's slate of manufacturing production tax credits.

In Austria, the 2020 Forest Fund Act provides a € grant per kg of panel for buildings with a high proportion of renewable raw materials.[104] This option could be considered in Canada. However, it may not address the financing problems facing manufacturers. They need bankable incentives to finance expansion and new facilities, but an instrument centered on buildings would not likely achieve this. Moreover, to comply with the Softwood Lumber Agreement, any policy instrument would need to be material-neutral in that it did not specifically apply to wood.

An IRA-style production tax credits could nonetheless be indexed to the embodied carbon of the material. All materials meeting the standard per $m^2$ or $m^3$ would be eligible for the credit. This would be a way to offset any potential costs of an embodied carbon credit, making it funded, just as the federal carbon tax is refundable. Such a policy package, an embodied carbon requirement with cost controls for manufacturers, could align supply and demand supports in a powerful way.

In 2010, Japan enacted a program to support wood buildings which included government procurement policies and support for mass timber manufacturing through loans and incentives. This policy was motivated by the goal of maximizing manufacturing value-added from the now mature cedar stands created by post-Second World War forestry management strategies.[105]

*On the supply side, BC has created a $180 million fund to add manufacturing value added in the province, with a focus on the forestry sector. Mass timber projects are eligible for up to $10 million in capital support.*

## Key actions needed to deliver on the near-term goal

### 1. Create a public-private coordination body to develop and advance policy and program priorities, including the development of building archetypes for the housing crisis and a policy package that will add value to Canada's forest resources while building homegrown capacity along the supply chain.

» A "Mass Timber Alliance" could bring together existing leaders like the Canada Wood Council, Forest Policy Innovations, Forest Innovation Investment, the Forest Products Association of Canada, firms, and government agencies into a collaborative enterprise to build the industry. The Alliance could be hosted by the CWC in conjunction with other partners.

» The near-term priority (1-6 months) for the Alliance should be to feed into the national homes catalogue with a set of single family home and mid-rise building archetypes pre-approved for MLI Select—CHMC's new mortgage insurance program.[105]

» The medium-term priority (6-18 months) should be to precisely design a package of incentives that would bolster mass timber supply and demand.

### 2. Create a government plan to deploy strategic finance to support mass timber.

» The Made-in-Canada plan announced in budget 2023 establishes a tiered system of tools to advance decarbonization priorities. A key tier is "strategic finance": the Canada Growth Fund ($15bn) and the Canada Infrastructure Bank ($33bn). These institutions could bolster the mass timber industry with low-cost finance, loan guarantees, grants, and equity stakes.

» The Canada Infrastructure Bank has developed a lending portfolio and strategy for building retrofit investments. It could develop a similar program for net-zero buildings or mass timber production. Such a program could lower the cost of or cover capital expenditures necessary to expand production.

### 3. Explore an embodied carbon requirement as part of the Green Building Strategy.

» An embodied carbon requirement would drive demand for wood, which sequesters carbon and has a lower emissions production profile than concrete and steel. A performance-based measure would be material-neutral and would drive deep decarbonization in the materials sector.

» A first analytical task is to quantify the carbon benefits contribution mass timber could make to the GHG MT reductions required from built environment

### 4. Create a government procurement strategy to help mass timber scale.

» Standardization and scaling are needed to bring down the per unit costs of mass timber. Large government purchases could help build new facilities and drive down costs.

» The federal government could direct its own purchasing to use wood first, collating together a group of buildings in multiple regions. It could also lead provinces and municipal governments into bulk purchases to help scale the industry.

» Wood first requirements, such as BC's procurement preference, can also support though these are weaker tools for achieving scale.

### 5. Develop innovation strategy.

» CRIBE and other organizations have advanced the research and development agenda for mass timber and wood components.[106] Canada needs a systematic analysis of the innovation opportunities along the whole supply chain that is supported by R&D funds.

» Innovation strategy should be integral part of a National Forestry Sector Strategy.

### 6. Develop education.

» Education: specific courses to train Engineers, Project Managers, Modelers, CNC operators, installers, Architectural Coordinators, and detailers (expanding current programs by NRCan and CWC).

» Develop regional educational hubs to grow and develop skills amongst all these groups, led by local trades/technical schools already offering training in these specific occupations.


# Conclusion

*The opportunities for mass timber to contribute to decarbonizing the building sector, generating growth in clean competitiveness sectors, and addressing unmet demand for housing are evident.*

**This roadmap articulates a vision, including specific targets, for Canada's mass timber sector that is ambitious but feasible. The opportunities for mass timber to contribute to decarbonizing the building sector, generating growth in clean competitiveness sectors, and addressing unmet demand for housing are evident. With demand in the U.S. and other export markets growing substantially, this roadmap aims to see Canadian mass timber production double by 2030 and quadruple by 2035.**

To realize this potential opportunity, this roadmap is based on a clear strategy: developing an integrated supply chain from forest to buildings. This strategy has been proven by the European companies that initiated and have scaled the mass timber sector there. With vertical integration, wood is managed and harvested to optimize the feedstock necessary for manufacturing mass timber panels and beams. These elements are then easily incorporated into easily repeatable buildings with faster construction times.

The roadmap details targets and key gaps at each stage of the value chain, forming a set of workstreams—forestry and wood supply, manufacturing, architecture and building design, and construction—with separate attention to the policies and programs leveraging growth at one or more of these stages.

This roadmap identifies **three critical action areas** are needed to focus efforts and move the mass timber value chain forward:

1. Create a public-private collaboration to develop and advance a policy package that will add value to Canada's forest resources while building homegrown capacity along the supply chain.
2. Standardize building archetypes, wood specifications, and connectors across the whole supply chain.
3. Develop and implement a skills development plan that covers all aspects of the supply chain.

## Next step: A mass timber alliance

This roadmap now needs to be advanced by an alliance of industry and other stakeholders, working closely with government. A coordinating council should oversee implementation of the roadmap, supported by individual taskforces for each of the five respective workstreams.

The task forces should first develop workplans based on the priority action items identified in this roadmap. Further elaboration on specific deliverables and timelines will be needed.

These timelines and deliverables should give members of the alliance focus and direction, but implementation should not be rigid. Rather, the council and its taskforces should address the set of key actions in an ongoing and iterative manner. This entails real problem-solving of challenges that arise and also initiating experimentation and pilot exercises where necessary. During this process, this roadmap will be updated and adjusted, fed by learnings generated along the way, as well as by new market developments. Monitoring these developments will lead to actions to enhance further the growth of the mass timber sector. The roadmap thus represents a living document that will evolve, as opposed to a one-off strategy report gathering dust on a shelf.

Governments—at various levels—have a critical role in the implementation of the roadmap. They need to be active participants in the process, as members of the council and taskforces. The federal government and relevant provincial governments should treat the mass timber roadmap process as a strategic priority initiative. Learning from the success of initiatives elsewhere, the implementation of the roadmap can best be approached as partnership between public and private sectors.

Canada has a significant opportunity to scale the mass timber sector in response to significant market demand, both domestically and internationally. This will generate regional economic development opportunities, including skilled jobs. Mass timber can also play a major role in addressing Canada's housing shortfall, combining faster and less costly construction with reduced carbon footprints, lasting through the coming decades. Seizing this opportunity requires an intentional and concentrated effort now of businesses and other actors throughout the ecosystem.

# Endnotes


1 https://experience.arcgis.com/experience/58e313c4ac0247138ba5057d655ed1d4

2 Mass timber comprises a range of engineered wood products, the most common of which are cross-laminated timber panels (CLT), glulam beams, glue-laminated timber panels (GLT), nail-laminated timber panels (NLT), dowel-laminated timber panels (DLT). This roadmap does not draw any sharp distinctions on the scope of mass timber products. The most widely used products, by market share, are CLT and glulam.

3 https://www.canadianarchitect.com/technical-mass-timber-through-a-life-cycle-lens/

4 https://www.naturallywood.com/resource/the-state-of-prefabrication-in-canada/

5 https://www.cisc-icca.ca/ciscwp/wp-content/uploads/2017/12/NRC-COST-COMPARISON.pdf

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7 Cimoli, Mario, Giovanni Dosi, and Joseph E. Stiglitz. 2009. *Industrial policy and development: The political economy of capabilities accumulation.* Oxford University Press.

8 2023 International Mass Timber Report.

9 2023 International Mass Timber Report. Canadian production capacity alone has separately been estimated at 1.1 million $m^3$ by NRCan.

10 As of early 2023; see 2023 International Mass Timber Report.

11 2023 International Mass Timber Report.

12 NRCan's classification includes LSL and LVL, which we exclude from our focus here as they work with and displace conventional wood materials rather than requiring the difficult work of opening new markets and applications. But some existing engineered wood products, such as LVL, Paralan, I-joints, timber strand lumber, and engineered wood trusses can be used in conjunction with the newer mass timber products. See, NRCan. 2021. The State of Mass Timber. https://cfs.nrcan.gc.ca/publications?id=40364

13 https://experience.arcgis.com/experience/58e313c4ac0247138ba5057d655ed1d4

14 Interview with Wolfgang Wierer, KLH founder. Innsbruck, Austria, December 1, 2023.

15 https://www.timber-online.net/blog/europe-s-top-sawn-timber-producers.html

16 https://www.pfeifergroup.com/en/

17 https://www.woodbusiness.ca/making-a-mark/

18 https://transitionaccelerator.ca/reports/the-c-saf-roadmap/ ; https://transitionaccelerator.ca/reports/a-roadmap-for-canadas-battery-value-chain/

19 The State of Mass Timber in Canada 2021, NRCan.

20 This includes a wide range of panel products: Glulam, CLT, GLT, DLT, NLT. *Canadian Market Share 2022*, FPInnovations, March 2023.

21 Based on estimates from RBC, Timber Rising: How Wood Can Spur Canada's Green Building Drive (2023) and The State of Prefabrication in Canada (https://www.naturallywood.com/resource/the-state-of-prefabrication-in-canada/)

22 219 MMBF of CLT, Canadian CLT Handbook, 2019 Edition, p. 19.

23 According to FPInnovations Canadian Market Share 2022 All Canada Report.

24 Converting from projections of bbf lumber used in mass timber.

25 These estimates are roughly consistent with the base case scenario developed in RBC's *Imagine 2021: Build it and they will come* report, which also include a more ambitious bull case scenario for U.S. lumber demand for mass timber of an additional 4.2 bbf by 2030 and 6.7 bbf by 2035.

26 Forest Economic Advisors, July 2022.

27 The State of Canada's Forest Annual Report 2022 (https://natural-resources.canada.ca/our-natural-resources/forests/state-canadas-forests-report/16496).

28 Calculated using data reported in the 2022 International Mass Timber Report: estimated mass timber production of approximately 1 million $m^3$ and softwood lumber production of approximately 70 bbf.

29 RBC, "Imagine 2021: Build it and they will come", https://mcusercontent.com/38b56f4a32b1ab75636758048/files/02ba60af-cd26-4931-a280-4d57b6ecff43/Mass_Timber_Build_it_and_they_will_come_Imagine_2025_002_.pdf

30 2022 International Mass Timber Report, p. 16.

31 KLH. 2014. Cross-laminated timber: A revolution in timber construction. https://bct.eco.umass.edu/wp-content/uploads/2014/10/KLH_Company-presentation_UMass-Amherst.pdf

32 Other complimentary strategies could be based on other opportunities for using forest products for various building components, such as rooftops, building envelope, interior walls, flooring, lignin-based asphalt, insulation, and even energy from biomass district heating.

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39 https://www.dezeen.com/2023/03/31/mass-timber-carbon-assessment-timber-revolution/

40 Coordination across jurisdictions is necessary though, as ultimately, standards need to be defined and adopted at the national level.

41 Based on estimates from RBC, *Timber Rising: How Wood Can Spur Canada's Green Building Drive* (2023) and *The State of Prefabrication in Canada* (https://www.naturallywood.com/resource/the-state-of-prefabrication-in-canada/).

42 British Columbia Office of Mass Timber Implementation; https://news.gov.bc.ca/releases/2023JEDI0041-001123

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