Building A Low Carbon Future: Exploring Feedstocks & Products For Canada’s Construction Sector

Purpose

In 2023, CanmetENERGY initiated a project to advance the use of carbon storing materials in building enclosures designed for industrial construction. While some of these materials are established and proven, many promising alternatives require research. This report identifies and assesses low carbon and carbon storing feedstocks and products with near term potential for integration into industrialized construction, highlighting actionable opportunities that align with Canada’s climate goals. These solutions offer not only significant environmental benefits, but also opportunities to strengthen regional economies, enhance domestic manufacturing, and support Canadian farmers, foresters, and waste management industries.

About Builders for Climate Action

Builders for Climate Action is a dedicated social enterprise at the forefront of meaningful climate action. We collaborate with builders, designers, developers, policy-makers, researchers and manufacturers to tackle the serious impact of buildings on our climate and work toward real zero-carbon buildings. Central to our commitment is the provision of essential tools, cutting-edge research, and valuable resources that empower practitioners and policymakers to realize the vision of genuine zero-carbon buildings.

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Executive Summary

Canada has an opportunity to stack solutions to three of its most pressing challenges: reducing carbon emissions, meeting growing housing demand, and revitalizing domestic manufacturing. By converting more than **100 million tonnes** of underutilized agricultural residues, forestry byproducts, and recycled waste streams into low-carbon building materials, Canada can support economic development, create skilled jobs, and strengthen its global leadership in sustainable construction.

Bio-based building materials have a long history in Canada but are often overlooked as core components of a modern, industrialized building sector. That is changing. Globally, manufacturers are producing high-performance, carbon-storing products from low-cost biomass feedstocks. Many of these – wheat straw, corn stover, forestry residues, post-consumer wood, paper, and glass – are abundantly available in Canada.

The federal government has recognized the significant role of embodied carbon emissions – greenhouse gases emitted over the life cycle of building materials – in the construction sector. With commitments to cut national greenhouse gas emissions 40 to 45 percent below 2005 levels by 2030 and reach net-zero by 2050, Canada has a major opportunity to lead in the use of materials that store more carbon than they emit. Bio-based products offer this immediate climate solution, turning buildings into long-term carbon sinks.

This report explores how these feedstocks can be transformed into building products that are cost-competitive while delivering climate, economic, and health benefits. Canada is well-positioned to lead in this space – building healthier homes, creating new markets for farmers and foresters, and embedding millions of tonnes of carbon directly into the national building stock.

Key Findings:

- Canada produces approximately **80 million tonnes** of agricultural residues annually, largely untapped feedstocks for a wide range of building products.
- Forestry operations generate **over 20 million tonnes** of residues each year – material that could be processed into building products.
- Canada produces **6.5 million tonnes** of wood, paper, cardboard, and glass waste, much of which is landfilled but could instead supply the construction industry.
- Over **100** bio-based building products are currently manufactured in the world using feedstocks that are abundant in Canada.
- Grain straw, forestry residues, recycled wood and paper/cardboard are the most promising Canadian feedstocks, suitable for manufacturing into **60** unique, carbon-storing building products.

- Insulation is the most promising product category for these feedstocks, (including loose-fill, batt, and board formats), as stricter energy efficiency requirements drive increased demand for resilient, high performance homes.
- Corn stover, hemp, seaweed and mycelium are among the innovative and emerging feedstocks in Canada that could transform our building products industry into a world leader in carbon storage.
- By using carbon-storing products, new Canadian homes could store over 3 megatonnes of carbon annually – turning the housing sector into a powerful tool for climate action.

Canada is uniquely positioned to lead the world in developing and commercializing carbon-storing building materials. Targeted investment in regional processing hubs, modernized building codes, and certification pathways can unlock these opportunities – creating jobs, advancing rural economic development, and positioning Canada as a global leader in climate-smart construction.

1. Introduction

1.1 Context: The Need for Low-Carbon Buildings

The construction industry is a major source of Canada's carbon emissions, with embodied carbon from material production and construction posing a growing challenge. Without intervention, new housing could add 18 megatonnes (MT) of greenhouse gases to the atmosphere annually [1] – the equivalent of adding more than 5 million gasoline powered passenger vehicles to the road each year [2]. Canada's 2030 Emissions Reduction Plan (ERP), under the Canadian Net-Zero Emissions Accountability Act [3], highlights the importance of reducing emissions across all sectors. By embracing low-carbon and carbon-storing strategies and products, Canada has a unique opportunity to turn agricultural, forestry, and waste streams into climate solutions—supporting farmers and foresters, stimulating local manufacturing, and creating stable, well-paying jobs in communities across the country.

Bio-based products often store more carbon in their raw materials than is emitted during manufacturing. NRCan estimates that by using carbon-storing products, new Canadian homes could store over 3 MT of carbon annually [4]. Beyond emissions reductions, bio-based products can improve indoor air quality, have positive effects on human wellbeing, and support a circular economy by repurposing byproducts from agriculture, forestry, and industry. Incorporating products that store biogenic carbon – particularly from waste streams, regenerative agriculture, or sustainably managed forests – can prevent its release into the atmosphere for the duration of a building's life, and potentially longer.

Internationally, bio-based construction is expanding rapidly. The UNEP report "Building Materials and the Climate" identifies bio-based building materials as key to reducing atmospheric carbon [5]. While European countries have introduced regulations to incentivize and require their use, Canada has yet to capitalize on its own vast biomass resources. With targeted action, Canada can unlock these feedstocks to build a sustainable, low-carbon construction sector aligned with its net-zero goals.

1.2 Actionable, Low-Carbon Industrial Solutions for Canada

The transition to prefabrication, panelization, and volumetric construction (compared to traditional, onsite construction) can increase efficiency, reduce waste, and accelerate the deployment of climate-aligned housing solutions. Industrialized construction also provides a scalable pathway for integrating novel, low carbon, bio-based, and recycled products into mainstream building practices, reducing the carbon footprint of construction while lowering costs and improving build quality.

Feedstocks are arranged and considered by source, and include:

- Agricultural residues
- Purpose-grown crops
- Forestry residues

- Waste and recycling streams
- Innovative and emerging feedstocks

This report identifies practical, near-market opportunities to integrate carbon-storing feedstocks into Canada's construction sector through prefabrication and industrialized construction. It evaluates the availability, feasibility, and infrastructure needs of Canadian feedstocks, demonstrating how they can contribute to reducing embodied carbon emissions, strengthening domestic manufacturing, supporting rural economies, and accelerating progress toward Canada’s housing and emissions targets [6].

2. Low-Carbon Buildings and Carbon Storage

2.1 Decarbonization Through Embodied Carbon Reduction

Embodied carbon includes the greenhouse gas emissions from extracting, producing, transporting, and installing building materials. It also includes emissions generated over a product’s life cycle, including maintenance, repair, and disposal at end-of-life. Unlike operational emissions, which accrue gradually over a building’s lifetime, most embodied carbon is released upfront, before the building is even occupied, making early reductions essential. Simple product substitutions, such as low-carbon insulation, cladding, and concrete alternatives, can significantly cut emissions without increasing costs [4]. Despite the cost-effectiveness of many of these substitutions, uptake remains limited due to market inertia, knowledge gaps, and regulatory barriers. Clear policies and incentives are needed to establish low-carbon products as the industry standard and accelerate the shift toward net-zero construction.

Low-carbon products have lower life cycle emissions than conventional alternatives, achieved through reduced emissions intensity in harvesting, transportation and manufacturing processes. Examples include concrete made with secondary cementitious materials to reduce reliance on emissions-intensive Portland cement, steel produced from electric arc furnaces, and insulation formulated with lower-impact blowing agents. Starting in 2025, the Canadian federal government’s Buy Clean policy approach is supporting the shift toward low-carbon products by requiring disclosure of embodied carbon, whole building life cycle assessments, and a 30% reduction in embodied carbon for major construction projects [7].

Carbon-storing products are a specific subset of low-carbon building products made from feedstocks that removed CO_2 from the atmosphere through photosynthesis. This atmospheric carbon is stored in the biomass and can remain out of the atmosphere for decades or longer when converted into long-lived building products.

To determine whether a product qualifies as carbon storing, we assess its net global warming potential (GWP) over the A1–A3 stages – raw material supply, transport, and manufacturing. Using Environmental Product Declarations (EPDs), we compare the biogenic carbon stored in the product to the emissions generated during production. If storage exceeds emissions, the product has a net-negative GWP and is considered a carbon-storing material. See Section 2.3 for further analysis of valuation of durable carbon storage.

2.2 Determining Carbon Content of Feedstocks

Agricultural residues, purpose-grown crops, and forestry byproducts all contain significant carbon by mass, meaning their use in construction locks carbon into buildings. The Phyllis Database [8], compiles carbon composition values for a wide range of feedstocks over multiple samples (see Table 1). The carbon content of surveyed feedstocks ranges from 45 to 55 percent of dry mass. This substantial carbon volume can allow final products to achieve net carbon storage, even after accounting for harvesting, transportation, and processing emissions.

2.3 Biogenic Carbon Accounting and the Valuation of Carbon Storage

There is no scientific consensus on how to value the positive climate impact of storing carbon in durable building products and there is a great deal of confusion surrounding the topic for two reasons: the accounting principles used in life cycle assessment (LCA) and the dominance of virgin timber as a biogenic feedstock and the complications associated with assessing the climate impact of forestry operations.

When viewed through the lens of LCA, biogenic carbon is rendered carbon neutral because LCA methodology simply tracks biogenic carbon flows through each life cycle module for a product [9], [10]. Called the -1/+1 approach, this accounting system credits carbon removal when it enters a product system (-1 kilogram of carbon dioxide for every kilogram of carbon dioxide sequestered from the atmosphere during plant growth) and assumes this carbon dioxide is re-emitted at end-of-life (+1 kilogram returning to the atmosphere). This system is effective for tracking carbon flows but is often misinterpreted as meaning there is no climate benefit from storage. Because the carbon removed from the atmosphere is later released, the balance appears neutral (–1 + 1 = 0).

However, time horizons are crucial when assessing climate impacts. Bio-based products can store carbon in buildings for decades after it is removed from the atmosphere through photosynthesis. Preventing emissions today by storing carbon that would otherwise enter the atmosphere has clear, well-understood climate benefits.

Several approaches in life cycle assessment – dynamic LCA, GWPbio, ton-year accounting, and spatiotemporal LCA – all propose systems to value the impact of this temporary storage [11]. Each offers a different lens, but all agree that delaying emissions reduces warming. Storing carbon longer strengthens climate mitigation and greatly increasing this type of storage has increasingly positive climate impacts.

This report does not attempt to select a specific method for valuing stored biogenic carbon. Still, the underlying principle of climate science is clear: converting biomass that would emit CO_2 today into building products delays emissions for decades, even centuries, depending on the material and application. While no single standard for quantifying this benefit has emerged as a consensus default, the opportunity is immediate – scaling bio-based products now delivers near-term emission reductions and long-term climate gains regardless of how this is calculated.

2.4 Human Health Benefits of Bio-Based Products

Bio-based products share several key characteristics that make them a healthier choice for manufacturers, builders and occupants. Unlike many traditional building products, which may contain toxic additives, off-gas volatile organic compounds (VOCs), and require extensive protective measures during installation, bio-based products are generally free of potentially harmful synthetic chemicals. These products support better indoor air quality, reduce exposure to irritants and hazardous particulates, and allow for safer handling with minimal protective equipment.

The Informed Product Guidance system from Habitable ranks many of the bio-based feedstocks and products discussed in this report among the highest for health and sustainability [12]. Products such as hemp and wood fiber insulation are recognized for their minimal chemical content and superior moisture regulation, reinforcing their suitability as safer alternatives. Choosing these products means building spaces that are better for both the environment and the people who live and work in them.

It is important to note that some bio-based products are manufactured using adhesives or binders that contain harmful chemicals, so prioritizing systems that avoid toxic and/or fossil fuel based glues and resins helps maintain the health and sustainability benefits.

2.5. Circular Potential of Bio-Based Products

Circular construction reduces reliance on virgin resources by keeping materials in use and preventing waste. Repurposing agricultural byproducts, forestry residues, industrial byproducts, and recycled materials avoids emissions from extraction, processing, and disposal. Feedstocks such as straw, corn stover, cardboard, forestry residues, and waste wood – often discarded or burned – can be transformed into durable building products, extending resource value and supporting a circular economy that lessens pressure on primary resource extraction.

Some materials go further, enabling continuous recycling back into the same product. This reflects circular economy principles, designing products for perpetual reuse – either as biological nutrients that safely decompose or technical nutrients that can be endlessly remanufactured. For example, wood fibers can be recovered at the end of a building's life, processed, and reformed into new insulation or fiberboard, maintaining its usefulness without generating waste [13], [14].

Designing buildings for disassembly and reuse further enhances circularity by ensuring products, whether bio-based, recycled, or conventional, can be recovered, repurposed, or reintegrated into new products or systems at the end of their service life. Strategies like using mechanical fasteners instead of adhesives, modular components, and adaptable assemblies simplify material recovery, extend product lifespan, and reduce construction waste. This approach maximizes the duration of carbon storage, strengthens material loops, reduces costs, and promotes a more resource-efficient built environment.

3. Canadian Agricultural Feedstocks for Building Products

3.1 Vast Resource Potential

Canada's agricultural sector produces significant residues from corn, grain, and other crop production. Recent estimates indicate that anywhere between 28 to 80 million tonnes of agricultural residues are generated annually, particularly from staple crops like wheat, soy, corn, and canola [15]. With every tonne of dry biomass containing the equivalent of 1.5 to 2 tonnes of sequestered CO_2 [16], these agricultural residues represent a substantial carbon storage opportunity if used to manufacture low-carbon building products. The use of residue feedstocks does not require additional land use or impact from inputs, making these agricultural byproducts advantageous from a life cycle perspective.

Some crops can be grown specifically as feedstocks for use in the built environment. Purpose-grown crops can offer opportunities to produce low-carbon products while improving soil health, supporting crop rotation, and providing additional income for farmers. When exploring crops grown specifically to create building products, it is important to consider issues of land use change. Displacing land used for forests or food production raises environmental and social concerns that must be weighed alongside the climate and economic benefits of purpose-grown crops. Ideal purpose-grown stocks would come from crops that grow on marginal land that is otherwise unproductive or sourced from harvests that already take place.

Together, agricultural residues and purpose-grown crops can create a pathway to expand carbon storage in the built environment, without competing with food production or requiring additional land use. Residue based products, in particular, offer an opportunity to generate new products while preserving farmland for food crops.

3.2 Soil Health and Carbon Sequestration Benefits

Soil is a critical carbon sink, but unsustainable land management is depleting it, threatening food security and ecosystem stability [17]. Regenerative agricultural practices – such as cover cropping, reduced tillage, crop rotation, and livestock integration – help restore soil health, increase biodiversity, and enhance carbon sequestration in the soil [18].

Crops provide a dual climate benefit: they remove carbon from the atmosphere as they grow and return carbon to the soil through root systems and organic matter. Perennial crops can offer even more advantages, with deep root systems that improve soil structure, prevent erosion, and store more carbon than annual crops.

Prioritizing feedstocks from regenerative agriculture enables the construction sector to support land stewardship while reducing embodied carbon in buildings, reinforcing the mutual benefits of agriculture and climate action.

3.3 Economic Opportunities for Farmers and the Manufacturing Sector

Bio-based building products can create new revenue streams for Canadian farmers by transforming crops and residues into building products. By using agricultural residues such as straw, hemp shiv, and corn byproducts in construction, farmers can unlock new market opportunities. Perennial crops grown on marginal lands expand these opportunities. They offer a productive use for land unsuitable for conventional crops, while providing harvest flexibility and lower input costs.

Integrating these feedstocks into the construction sector can diversify farm income and insulate farmers from commodity price volatility. Scaling up the bio-based construction industry can strengthen rural economies by creating demand for processing facilities, manufacturing, and skilled labor located near feedstock sources – supporting local jobs while reducing transportation costs [19].

Canada's manufacturing sector stands to benefit from investment in low-carbon, bio-based building products – creating jobs, revitalizing rural communities, and strengthening Canada's competitiveness in sustainable materials. Aligning construction with agriculture links soil health, rural livelihoods, and climate action. By utilizing bio-based feedstocks, the sector can cut emissions, restore degraded lands, and create new economic opportunities across the value chain, from farming and processing to manufacturing and advanced research.

4. Forestry Residues and Byproducts for Construction

4.1 An Abundant Resource

Canada's forestry sector is among the largest in the world, with 225 million hectares of managed forests [20]. This vast resource generates approximately 21 million tonnes of forest residues annually, including sawdust, wood chips, bark, logging slash, and pulp byproducts – much of which remains underutilized [21]. These raw materials arise across the supply chain, from sawmills and pulp mills to timber processing. Forest thinning operations – used to promote forest health and reduce wildfire risk – also generate additional fiber that is frequently discarded or burned.

Many of these byproducts can be repurposed into durable, low-carbon building products such as fiberboard, wood fiber insulation, and engineered wood products. Expanding the use of forestry residues reduces waste, extends the value of harvested wood, and cuts emissions from disposal methods such as burning or decomposition. With further market development and innovation, these feedstocks could reduce reliance on virgin wood while strengthening Canada's economy.

4.2 Economic and Employment Opportunities

Scaling up forestry residues in construction presents a major economic opportunity. It creates new revenue streams for sawmills and pulp mills while stabilizing an industry vulnerable to fluctuations in global timber demand. Increased demand for wood-based byproducts can drive investment in processing facilities and advanced manufacturing, generating skilled jobs in forestry regions.

Forestry residues provide a scalable, low-carbon alternative to emissions-intensive building products. By creating new markets and jobs, investing in forestry byproducts ensures that Canada's forestry sector continues evolving toward sustainable, high-value applications – enhancing rural economies while lowering the carbon footprint of residential construction.

5. Evaluating Canadian Feedstocks for Building Products

The use of bio-based feedstocks in construction is not merely a futuristic ambition – it is achievable today. Table 1 includes a range of viable feedstocks in Canada capable of producing high-performance, low-carbon building products. This section explores promising near-market opportunities alongside emerging feedstocks, providing a foundation to guide future research and strategic investments that will maximize climate, economic, and social benefits.

It is important to account for other demands on these byproducts, such as maintaining soil health, providing animal bedding and feed, while also accounting for losses from harvesting and storage inefficiencies. To reflect these considerations, this report applies a 50% reduction factor to the total volume of available biomass residue as a highly conservative estimate to allow for a wide range of competing feedstock uses and to avoid overestimating the material available for construction. This approach, consistent with methods used by other industry leaders, helps ensure that only surplus material is considered available for building applications.

Each feedstock section includes a table summarizing some of the building products currently made from these materials. This information is drawn from an evolving building products spreadsheet, submitted as supplementary documentation. As this is a rapidly developing field, the spreadsheet is continuously updated to capture new products and innovations. Products with at least one Canadian manufacturer are marked with an asterisk (*).

Table 1: Availability, distribution, carbon percentage, and building product application of Canadian feedstocks

Canadian Feedstock	Seeded Hectares	Harvested Yield, t	Grain-to-Residue Factor [10]	Total Residue, t	Available Residue, t	$/tonne	Highest Feedstock Concentration	Carbon % by Mass	Products	Building Application	Potential Building Applications
Wheat	10,834,700[5]	34,958,232[5]	1.5	52,437,348[5]	26,218,674	$305[1]	Saskatchewan, Alberta, Manitoba[3]	47	25	Insulation Block/Bale, Structural Sheathing, Pre-fab SIP, Insulation Loose-Fill, Insulation Continuous/Board, Interior Finishes, Insulation Batt	Mineralized for below grade insulation, Pyrolized for biochar
Barley	2,592,300[5]	8,143,897[5]	1.0	8,143,897[5]	4,071,949	$285[1]	Saskatchewan, Alberta, Manitoba[3]	45	0	N/A	Same products as wheat straw, Mineralized for below grade insulation, Pyrolized for biochar
Oats	1,173,500[5]	3,357,551[5]	1.0	3,357,551[5]	1,678,776	$335[1]	Saskatchewan, Manitoba[3]	47	0	N/A	Same products as wheat straw, Mineralized for below grade insulation, Pyrolized for biochar
Grain Corn	1,477,500[5]	15,344,938[5]	1.0	15,344,938[5]	7,672,469	$225[1]	Ontario, Quebec, Alberta[3]	46	4	Interior Finishes, Insulation Continuous/Board, Structural Sheathing	Mineralized for below grade insulation, Pyrolized for biochar
Flax	203,800[8]	257,974[8]	N/A	386,961[8]	193,481	$610[1]	Saskatchewan, Alberta, Manitoba[3]	49	2	Insulation Batt, Interior Finishes	Insulation Block/Bale, Mineralized for below grade insulation, Pyrolized for biochar
Sunflower	24,400[8]	50,680[8]	N/A	76,020[8]	38,010	N/A	Manitoba and Ontario[3]	55	0	N/A	Insulation Block/Bale, Insulation Loose Fill, Insulation Batt, Insulation Continuous/Board, Structural Sheathing, Mineralized for below grade insulation, Pyrolized for biochar
Hemp	14,800[8]	17,551[8]	N/A	26,327[8]	12,163	$1,000[1]	Alberta, Saskatchewan, Manitoba[3]	50	15	Insulation Batt, Insulation Continuous/Board, Aggregate, Insulation Loose-Fill, 2-in-1 Structure & Insulation, Insulation Block/Bale, Cladding, Structural Sheathing	Mineralized for below grade insulation, Pyrolized for biochar
Forestry Residue (2022 data)	225,000,000[4]	131,555,229**	N/A	21,000,000[4]	10,500,000	N/A	British Columbia, Quebec, and Ontario[4]	52	17	Cladding, Interior Finishes, Pre-fab SIP, 2-in-1 Structure & Insulation, Insulation Continuous/Board, Insulation Batt, Insulation Loose-Fill	Mineralized for below grade insulation, Pyrolized for biochar
Recycled/Reclaimed Wood (2020 data)	N/A	N/A	N/A	N/A	2,461,000[2]	N/A	Cities/Urban centers	45	2	Framing/Structure	Mineralized for below grade insulation, Pyrolized for biochar
Recycled Glass (2022 data)	N/A	N/A	N/A	N/A	455,000[7]	N/A	Cities/Urban centers	N/A	4	Aggregate, Insulation Continuous/Board	
Recycled Paper/ Cardboard (2022 data)	N/A	N/A	N/A	N/A	3,571,000[7]	N/A	Cities/Urban centers	N/A	15	Insulation Loose Fill, Prefab SIP, Insulation Blanket, Insulation Batt, Structural Sheathing, Interior Finishes	
Perennial Grasses	N/A	N/A	N/A	N/A	N/A	N/A	N/A	53	1	Structural Sheathing	Insulation Continuous/Board, Insulation Loose Fill, Pre-fab SIP, Insulation Batt, Structural Sheathing, Mineralized for below grade insulation, Pyrolized for biochar
Mycelium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	Framing/Structure, Insulation Block/Bale, Insulation Continuous/Board, Insulation Loose-Fill, Pre-fab SIP	

* - *meters cubed*

'Seeded Hectares' for each crop are based on 2024 Canadian data unless otherwise noted.

Harvested Yield' is reported in metric tonnes and reflects the primary crop output (e.g., cereal grain, flax seed, corn cobs), not the residue.

'Total Residue' is estimated using residue factors drawn from R. Lal. For crops lacking published factors, an average residue factor of 1.5 was applied, representing the average ratio of byproduct to harvested crop. For forestry residues, a separate dataset was used to determine values.

'Available Residue' represents the portion of total residue potentially usable for manufacturing. A 0.5 availability factor was applied to account for competing uses like animal bedding, soil amendments, harvesting losses, and bioenergy demand

'Cost per tonne' is provided to offer insight into the economic feasibility of each feedstock. It is important to note that these values reflect the price of the main crop, not the residue itself. Further research is needed to better understand residue-specific cost

Carbon % by Mass': Carbon content values are drawn from the Phyllis Database and represent average dry mass carbon percentages for each feedstock.

'Products' column reports a number of known building products made from each feedstock. This offers a snapshot of current market use but does not capture the full scope of emerging products in this rapidly developing field

'Product Types' column identifies the range of formats developed for each feedstock, representing feedstock versatility and market potential. A wider range of applications increases the economic viability of scaling production in Canada.

Potential Applications' column outlines future opportunities based on Builders for Climate Action's internal knowledge of feedstock properties and product requirements, highlight promising directions for further research and industry development

5.1 Agricultural Residues and Purpose Grown Crops

5.1.1 Grain Straw

Grain straw is one of the most promising agricultural residue feedstocks for low-carbon building products in Canada. Estimates suggest that up to 34 million tonnes of straw could be available annually for building applications. Its abundance, favorable material properties, and minimal processing requirements make it an immediately viable option for scaling carbon-storing construction products. Globally, at least 25 unique building products – from insulation and panels to interior finishes – are already manufactured using straw. At least three of these products are made in Canada, with significant market space for more domestic production to develop. This versatility and proven performance position straw as a scalable feedstock ready for greater use in Canadian construction.

Material Qualities

Straw is a lightweight yet durable material with favorable thermal, moisture, and fire performance qualities that make it well suited for construction. Its cellular structure provides natural insulation and moisture buffering, while dense packing and lime or clay coatings improve fire resistance. Historical examples, such as century-old straw bale buildings in Nebraska, demonstrate straw's remarkable longevity when properly detailed. In Canada, straw bale walls have been used in code approved homes since the early 1990s, when Canada Mortgage and Housing Corporation research confirmed the fire, thermal and moisture performance of straw bale walls met National Building Code objectives [22], [23], [24], [25]. Hundreds of straw bale homes have been constructed across Canada, reinforcing straw's proven viability in Canadian climates and regulatory contexts.

Growing, Harvesting and Processing Considerations

Straw is a byproduct of grain production, requiring no changes to crop rotations or land use. Harvesting, baling, and chopping are standard agricultural practices across Canada, and most farmers already have the equipment, knowledge, and workflows in place to manage these tasks efficiently. The straw handling processes required for most of the recommended building products – such as baling, chopping, or densifying – align directly with existing farm operations and do not demand new machinery or specialized skills.

The timing of straw collection is important, as it occurs after grain harvest when the stalk must be dry enough for storage and further processing. Moisture management is important to prevent mold or degradation, but these considerations are already part of straw management practices.

Environmental Impacts

Grain production can carry significant environmental impacts, but as a by-product straw does not create additional land-use or farming burdens. In fact, diverting straw from common disposal methods like burning or decomposition helps avoid associated carbon emissions. Repurposing straw into long-lived construction products effectively stores carbon that would otherwise be released. Adoption of regenerative farming practices – such as reduced tillage, cover cropping, and crop rotation – can further reduce the environmental impact of grain production while improving soil health and increasing carbon sequestration potential in the agricultural system.

Availability

In 2024, Canada harvested approximately 46.5 million metric tonnes of cereal grains, primarily in Alberta, Saskatchewan, and Manitoba, though regions in Ontario and Quebec also produce grain. For every tonne of grain harvested, roughly 1 - 1.5 tonnes of straw are produced [26], generating an estimated 64 million tonnes of straw annually. Considering existing and potential uses, including as animal bedding, soil amendments, and bioenergy, it is assumed that approximately 32 million tonnes of straw could be available for building products.

As a byproduct of staple food production, straw supply is expected to remain stable and grow alongside Canada's grain sector. Forecasts suggest continued expansion of grain production, increasing the supply of straw as a scalable feedstock for construction applications [27].

Given Canada's vast agricultural land base and concentration of cereal production, straw is a regionally distributed resource well-suited to local and national supply chains. Growing demand for low-carbon building products presents an opportunity to strengthen straw markets, creating new value streams for farmers while supporting Canada's low carbon construction sector.

Supply Chains and Market Considerations

Straw's abundance and integration into existing farm operations make it a practical, low-cost feedstock for building products. Most farmers already harvest and handle straw, requiring minimal additional processing for use in loose-fill insulation and bale construction, which typically involve only basic drying, sizing, or chopping. Other product types, such as continuous insulation, compressed straw panels, interior boards, and MDF alternatives, involve additional manufacturing steps, including binding agents, and heat or pressure treatments. While these processes are more involved, EPDs for these product types typically demonstrate carbon storage that is greater than processing emissions.

Because straw is a byproduct of staple food production, its supply is expected to remain stable and grow alongside Canada's expanding grain sector. The scale of existing cereal production and Canada's vast agricultural land base make straw a uniquely abundant and regionally distributed feedstock. Increased market demand for straw-based construction products could further strengthen supply chains, driving investment in processing capacity and creating new value streams for Canadian farmers.

Building and Product Use

Grain straw is used in a wide range of construction products globally, outlined in Table 2.

Table 2: Building products from grain straw

Feedstock Form	Product Category	Building Application
Straw bales	Insulation blocks*	Wall insulation (site built and prefabricated panels)
Long straw	Compressed straw board (CSB)	Partition walls and continuous insulation boards
Shredded straw	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels	Continuous insulation boards
Shredded straw	Straw MDF*	Trim, cabinetry, millwork
Chopped straw	Loose fill insulation*	Wall, roof and floor cavity insulation
	Oriented straw board	Structural sheathing for exterior and interior walls, roofs and ceilings

A variety of these straw products are used in the manufacture of panelized wall, roof and floor systems in Canada and around the world.

With its abundance, versatility, and proven performance, straw is uniquely positioned to become a cornerstone feedstock for Canada's low-carbon construction sector. The technology and products exist – targeted investment could transform millions of tonnes of Canadian straw into durable, carbon-storing building products that meet our climate, housing, and economic goals.

Code Compliance

With so many different product types, there is no single code pathway for all straw-based products.

Straw bale construction is recognized in Appendix S of the International Residential Code (IRC) in the United States [28]. Appendix S outlines performance parameters for baled straw as wall insulation, specifying thermal values between R-1.55 and R-1.85 per inch depending on bale orientation, and a one- to two-hour fire resistance rating based on exterior coatings. It also addresses moisture protection, plaster thickness, and structural requirements, allowing straw bale walls to serve as either load-bearing or non-load-bearing assemblies when properly designed.

In Canada, there is no explicit national code recognition for straw-based construction. Projects are typically approved through site-specific engineering reports or alternative compliance pathways at the municipal level. Appendix S provides a strong precedent for developing clearer Canadian compliance pathways. As interest in straw-based construction grows, particularly in industrialized applications like straw panels, there is an opportunity to advance standardized testing and certification, paving the way for broader market adoption.

5.1.2 Corn

Corn is a widely available crop, and its residues show strong potential as a renewable feedstock for low-carbon building products. Produced in large volumes alongside corn grain, residues – including stalks, leaves, husks, and cobs – offer a scalable resource without requiring additional land use. There are fewer products on the market using corn byproducts as feedstocks, but a number of product innovations show its potential for insulation, panels, and interior finishes, positioning corn stover as a promising feedstock for Canada's bio-based construction sector.

Material Qualities

Corn stover – consisting of stalks, leaves, and husks left after corn harvest – is an abundant agricultural byproduct currently underutilized, except as livestock bedding or soil amendment [29]. Representing nearly half of a corn crop's dry mass, stover offers significant potential as a sustainable construction feedstock without requiring additional land use [27], [30].

Its fibrous, low-density structure and high cellulose content make corn stover well-suited for fiber-based construction products, while its abundance adds to its appeal as a renewable resource. After harvest, stover moisture content typically ranges between 15–25% by weight and must be managed during storage to prevent deterioration or mold growth [30].

Corn cobs, produced separately in large quantities when grain is removed, represent approximately 18 kg per 100 kg of harvested corn grain [31]. While often challenging to dispose of, corn cobs also present opportunities for conversion into bio-based building products.

Growing, Harvesting, and Processing Considerations

Corn is commonly grown in rotation with soybeans or a combination of soybeans and winter wheat, promoting soil health and nutrient cycling [32]. However, without additional organic inputs like manure, continuous stover removal can gradually deplete soil organic matter, impacting long-term productivity. Stover is typically stored in bales but can also be collected in bulk. Dirt and ash contamination is a risk depending on harvest date and method, impacting material quality and processing efficiency [33].

The primary challenge in utilizing corn stover is harvesting and processing logistics. Conventional corn harvesting equipment often leaves stover on wet fields, increasing contamination, thereby accelerating equipment wear. While specialized harvesters can improve feedstock quality by reducing dirt and ash, adoption remains limited due to cost. Establishing secondary harvesting teams to gather stover immediately after grain harvest has the potential to minimize schedule disruptions on farms, improve feedstock quality, and increase the feasibility of corn stover as an input for building products. In contrast, corn cobs can be easily collected from grain-processing facilities, where they are typically discarded as waste.

Environmental Impacts

Corn stover represents a low-carbon, renewable feedstock that leverages existing agricultural outputs without requiring new land use. Diverting excess stover into construction products offers significant carbon storage potential, while preserving soil health through partial retention of biomass.

Balancing stover utilization with soil health is vital; experts recommend leaving 30–50% of stover in the field to maintain fertility and prevent erosion [33], [34]. The remaining stover offers a viable construction feedstock while supporting agricultural sustainability [35].

Availability

Corn is one of Canada's largest crops. In 2024, Canada produced over 15 million tonnes of corn, primarily in Ontario, Quebec, and Manitoba. For every tonne of corn harvested, approximately one tonne of residue remains. With production projected to reach 19.4 million tonnes in the 2024–25 growing season [27], corn stover represents a significant and growing byproduct stream. While a portion of this residue supports soil health and livestock bedding, substantial surplus remains available for building product development. Proximity to urban centers further reduces transportation costs and strengthens economic viability.

Supply Chains and Market Considerations

Corn stover's market value varies by region, influenced by nutrient replacement costs and competition from feed, bioenergy, and straw markets [30]. Harvesting and processing remain key barriers – specialized equipment improves feedstock quality but requires investment. Targeted support for harvesting systems and processing infrastructure could make stover a scalable, affordable feedstock for Canada's bio-based economy.

Building and Product Use

Corn stover, while still emerging in construction markets, presents strong potential as a renewable feedstock for fiber-based building products, with building product examples outlined in Table 3.

Table 3: Building products from corn residue

Feedstock Form	Product Category	Building Application
Corn stover	Rigid lightweight panels	Continuous insulation boards
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Corn OSB	Structural sheathing for exterior and interior walls, roofs and ceilings
Corn cob	Rigid panels	Interior wall and ceiling finish

These innovations demonstrate corn residue's potential as scalable, renewable resources for construction, replacing products like fiberglass insulation, rigid foam, OSB, and interior cladding. With substantial agricultural supply and growing product innovation, corn-based products could unlock new value streams for Canadian farmers while supporting low-carbon, high-performance buildings.

Code Compliance

Currently, corn stover-based insulation products are in active development and testing phases. Explicit compliance with Canada's National Building Code has not yet been fully established; however, the proven compliance of similar agricultural fiber-based insulation products strongly suggests a viable pathway for future approval.

5.1.3 Hemp

Hemp became legal to grow in Canada in 1998, after being prohibited as a commercial crop since 1938 under the Opium and Narcotic Drug Act [36], [37]. Historically used as a building product in Europe and Asia, hemp is now re-emerging as a versatile, low-carbon feedstock. Hemp used for building products can either be residues from primary markets like seed oil or textiles, or purpose-grown specifically for construction, making it unique in fitting multiple feedstock categories considered in this report.

Research conducted for this report identified 15 hemp-based building products, including 10 manufactured in Canada, highlighting both market potential and emerging domestic capacity. However, hemp cultivation and processing for construction applications remain limited. Increased use of hemp in building products could drive market demand, supporting the expansion of hemp farming and processing infrastructure across Canada.

Material Qualities

Hemp consists of strong bast fibers surrounding a lightweight woody core known as hurd or shiv. The bast fibers are durable, lightweight, and flexible, making them ideal for insulation and composites. Hemp hurd is porous and silica-rich, contributing to excellent thermal and acoustic performance in products such as hempcrete and fiber panels. When combined with lime, hemp products become naturally fire-resistant, and their fibrous structure enhances sound absorption, creating energy-efficient and quiet interior spaces.

Growing, Harvesting, and Processing Considerations

With a short growing season of 90 to 120 days, hemp can thrive in many of Canada's diverse climates with minimal chemical inputs [36]. Its deep taproots stabilize soils and break pest and disease cycles, making it well-suited to regenerative agriculture [38]. However, maximizing fiber yields may require fertilizers, and hemp's tough stalks can accelerate wear on harvesting equipment, increasing production costs [39].

After harvest, hemp stalks undergo retting – either naturally in the field or accelerated via water, enzymes, or chemicals – to separate the fibers from the woody core. This is followed by mechanical decortication to extract bast fibers and hurd.

Further research and investment are needed to optimize harvesting methods, processing techniques, and fiber storage. Current farm equipment may require modifications to efficiently handle hemp fibers, and storage methods must be refined to ensure fiber quality for construction applications.

Environmental Impacts

Hemp offers significant environmental benefits. As a fast-growing annual crop, it absorbs and stores substantial volumes of CO_2 in the soil, storing carbon both in the plant and in soils. Over the same land area, hemp can produce up to four times more biomass than the same acreage of forest [40]. Additionally, hemp can thrive with minimal inputs, reducing reliance on synthetic fertilizers and pesticides. This not only lowers environmental impact but also makes hemp more cost-effective for farmers, who benefit from reduced input costs and improved soil health.

Availability

Since industrial hemp was legalized in Canada in 1998 [37], 90% of the cultivation has developed in Alberta, Saskatchewan, and Manitoba [41]. In 2024, approximately 14,800 hectares were cultivated, primarily for food and fiber, despite regulatory changes in 2018 that broadened the legal cannabis market in Canada [42], [43].

Although hemp farming remains concentrated in the Prairies, Canada’s expansive agricultural land base and suitable climate offer considerable potential to scale hemp production as market demand grows. Increased food and cannabis production could yield valuable byproducts, providing additional fiber and hurd for construction. Furthermore, rising demand for hemp-based building products may encourage dedicated hemp cultivation nationwide, supporting agricultural diversification and regional processing infrastructure.

Supply Chains and Market Considerations

Currently, only a limited number of Canadian processors – concentrated in the Prairies – are equipped to decorticate hemp at construction-grade scale [42]. Emerging initiatives, such as mobile decorticators, aim to address this bottleneck. In the absence of sufficient domestic capacity, some projects rely on hemp hurd shipped from across Canada or imported from Europe. High transportation costs push prices over $1,000 per tonne, creating a significant barrier to market uptake [44].

Building and Product Use

Hemp is among the most versatile feedstocks assessed, with applications spanning insulation, interior finishes, structural composites, acoustic panels, and cladding. Both bast fiber and hurd are used across a wide range of products, demonstrating hemp’s adaptability in both structural and non-structural roles. Examples of hemp-based building products are outlined in Table 4.

Table 4: Building products from hemp

Feedstock Form	Product Category	Building Application
Bast fiber	Flexible batt insulation*	Wall, roof and floor cavity insulation
	Rigid lightweight panels	Continuous insulation boards
	Thin lightweight roll	Carpet underlayment
	Loose fill insulation*	Wall, roof and floor cavity insulation
Complete stalk	Compressed board	Flooring, trim
	Rigid panels	Interior wall and ceiling finish
	Rigid panel	Structural sheathing for exterior and interior walls, roofs and ceilings
Hurd/shiv	Semi-rigid insulation (hempcrete)	Wall, roof and floor cavity insulation
	Insulation block (hempcrete)*	Wall insulation
	Mineralized aggregate	Aggregate for concrete

Despite this range of applications – and growing markets in Europe and the U.S. – hemp remains an underutilized resource in Canada. Currently, several smaller Canadian companies produce hemp-based building products. Growing domestic production and processing capacity would unlock hemp's potential as a scalable, low-carbon feedstock, capable of replacing carbon-intensive materials across multiple building product categories.

Code Compliance

Each variety of hemp-based product requires unique code considerations. Hempcrete construction – a composite of hemp hurd and a lime-based binder – is recognized under the International Residential Code (Appendix BL), providing reliable thermal properties (R-1.2 to 2.1 per inch, depending on compaction and binder ratios) and excellent fire resistance [45]. European codes and testing confirm hempcrete's exceptional moisture regulation, mold resistance, and Class A fire performance.

Hemp insulation batts have been tested to meet code requirements in the U.S. and several European countries. A Quebec-based manufacturer recently obtained approval through the Canadian Construction Materials Centre (CCMC), signaling a growing pathway toward mainstream acceptance [46].

5.1.4 Perennial Grasses

Perennial grasses, including switchgrass, big bluestem, and miscanthus, are emerging as sustainable, carbon-storing feedstocks for construction. Their ability to thrive on marginal land, improve soil health, and sequester carbon makes them a promising Canadian resource. Early market examples show potential for these grasses to complement or replace resource-intensive products.

Material Qualities

Perennial grasses can produce biomass with a variety of densities and fiber length, all potentially well-suited for products such as panels and insulation [47]. Properly dried grass fibers demonstrate the same resistance to mold, pests, and decay as other agricultural biomass, supporting their durability as building products [48].

Growing, Harvesting, and Processing Considerations

Farmers can readily integrate perennial grasses into existing operations due to their low-maintenance nature and flexible harvest schedules. Switchgrass, for example, can be harvested mid-summer as livestock feed or left standing into the fall or spring for biomass use, allowing farmers to adjust harvest timing to suit operational needs. Miscanthus, while non-native, offers higher biomass yields, enhancing its economic attractiveness.

Since most equipment used for haying can also be used for growing and harvesting perennial grasses, transitioning to these crops requires little additional investment [49]. Perennial grasses are typically stored in bales, which should be kept dry, ideally indoors. Outdoor storage, more feasible for many farmers, can lead to some degradation of the top layer, but underlying bales remain protected and usable.

Environmental Impacts

Perennial grasses thrive on marginal lands with minimal chemical inputs and labor, offering high yields alongside valuable erosion control. Their deep root systems improve soil health, enhance water retention, and contribute to carbon sequestration in both biomass and soil. Each growing season, perennial grasses deposit atmospheric CO_2 in the soil, functioning as a continuous carbon sink [50].

The environmental benefits extend beyond carbon storage. Permanent root structures minimize soil disturbance, reduce erosion, protect topsoil, and limit sediment runoff into waterways. Miscanthus, in particular, requires little to no pesticide or fungicide use, minimizing the risk of nutrient leaching and chemical runoff [48]. Compared to annual crops, these systems preserve soil organic matter, reduce fertilizer demand, and protect biodiversity by providing habitat and stabilizing ecosystems.

Availability

Switchgrass and miscanthus have been research focal points in Ontario, driven by industry groups and academic institutions exploring their potential as low-input, high-yield crops, though comprehensive national data remain limited [51]. Southern Ontario and the Prairie provinces offer ideal conditions for these grasses to thrive without competing directly with food production. Additionally, perennial grasses harvested as part of regular maintenance – such as mowing at airports, highways, and industrial sites – provide biomass for construction without requiring new land use.

Supply Chains and Market Considerations

Due to minimal cultivation inputs and high yields, perennial grasses have low-to-moderate production costs. Their adaptability to marginal land further enhances economic appeal. To remain attractive to farmers, returns should match conventional crops like corn and soy, typically around $200–$300 per tonne over direct costs [33]. Recognizing their environmental benefits, Ontario's Ministry of Agriculture, Food, and Agribusiness (OMAFA) offers financial support programs to encourage farmers to grow these perennial grasses.

Additional Considerations: Economic Implications

Beyond construction applications, perennial grasses offer broader economic potential. Advocates within the farming community see them as a game-changer, capable of driving regional economic growth through job creation in harvesting, transportation, processing, and related supply chains. Emerging carbon markets and supportive policy frameworks could further incentivize adoption by rewarding sustainable agricultural practices.

Building and Product Use

Perennial grass-based construction products are beginning to emerge, demonstrating potential to significantly impact Canada's low-carbon building sector. Examples of grass-based building products are outlined in Table 5.

Table 5: Building products from grass

Feedstock Form	Product Category	Building Application
Bales	Insulation blocks	Wall insulation (site built and prefabricated panels)
Chopped grass	Loose fill insulation	Wall, roof and floor cavity insulation
	Oriented grass board	Structural sheathing for exterior and interior walls, roofs and ceilings
Shredded grass	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels	Continuous insulation boards

	Grass MDF	Trim, cabinetry, millwork

Given their structural similarity to straw, perennial grasses could be readily adapted into many of the same product categories. Combined with their low-cost cultivation, high productivity, and minimal environmental risks, perennial grasses are a promising and scalable feedstock for low-carbon construction.

Code Compliance

Currently, there are no grass-based products with explicit compliance recognition under Canada's National Building Code. There are international precedents for insulation batts and oriented grass board, demonstrating potential for achieving code compliance following standardized testing and documentation processes [52].

5.2 Forestry Residues

Forestry residues are one of Canada's most abundant and underutilized low-carbon feedstocks for construction, with an estimated 21 million tonnes generated annually [53]. Produced as byproducts of timber harvesting and processing, materials like slash, bark, sawdust, and wood chips represent a scalable domestic resource supported by existing handling infrastructure. Small diameter trees harvested to reduce fuel load in fire-prone areas are another substantial resource. These residues already support a wide range of construction products, including several made in Canada, demonstrating strong potential to expand domestic production and transform this waste stream into durable, carbon-storing building materials. With strong international precedents and growing domestic interest, forestry residues are well-positioned to support Canada's transition toward low-carbon, circular construction.

Material Qualities

Forestry residues – including wood chips, sawdust, bark, and shavings – are dense, carbon-rich materials with well-understood physical properties. When processed into wood fiber insulation, these residues achieve thermal performance values of R-2.5 to R-4 per inch and have good moisture buffering capability [54], [55]. Dense packing contributes to natural fire resistance, while added treatments can enhance fire performance where required.

Moisture content varies significantly through the supply chain. Freshly harvested residues typically contain 30–60% moisture content by weight [56], requiring drying or conditioning before use in construction products. In sawmills, sawdust and shavings are often stored indoors, reducing exposure, while other residues may remain outdoors, increasing moisture uptake and the potential need for drying or treatment prior to manufacturing [57].

Wood-based products provide good moisture buffering and vapour permeability, helping regulate humidity levels and reduce mold risk in wall assemblies [56]. These qualities position forestry residues as comparable to other bio-based feedstocks, offering reliable thermal and moisture performance when processed appropriately.

Growing, Harvesting, and Processing Considerations

Canada's forestry sector generates large volumes of residual biomass – including thinnings, bark, offcuts, sawdust, and shavings – through logging and milling. Sawmill residues are typically cleaner and better suited for construction products, while forest floor residues require additional drying and processing due to higher moisture and contamination [58], [59]. Additional research is needed to determine how best to process and utilize this diverse range of residues.

Environmental Impacts

Forestry residues represent a low-carbon feedstock opportunity because they make use of existing byproducts from timber harvesting and sawmill operations. Using residues in building products avoids additional land use impacts and offers carbon storage benefits when residues are turned into long-lived construction products rather than burned for energy or left to decompose.

Availability

Canada's forestry sector spans 225 million hectares of managed forest land [20]. According to the State of Canada's Forests report, harvesting levels remain below sustainable supply limits, with only two-thirds (147.3 million m^3) of the estimated 215 million m^3 sustainable supply harvested annually [60].

Forestry generates significant byproducts – thinnings, wood chips, sawdust, and bark – much of which has historically been burned or left to decay [59]. Roughly one-fifth of harvested roundwood ends up as residue – sawdust, bark, and shavings – with significant potential for value-added use [58]. Recent reports estimate 21 million tonnes of forestry residues are produced annually [53]. After accounting for competing uses such as bioenergy and pulp production, approximately 10.5 million tonnes could be available for low-carbon building products. Recognizing this potential, the Canadian government is emphasizing the conversion of forestry biomass into higher-value bioproducts, positioning residues as valuable resources for construction products [61].

While forestry biomass has historically been used for bioenergy – rising from 3–4% of Canada's energy supply in the 1970s to 5–6% by 2020 – diverting residues into durable building products would maximize their carbon storage potential [62]. The majority of this available residue is concentrated in British Columbia, reflecting the province's large-scale forestry operations, with additional supply potential in Quebec and Ontario.

Supply Chains and Market Considerations

Canada's well-established wood fiber collection systems mean residue costs are primarily linked to local production capacity, not collection challenges [61]. However, tracking forestry residues remains inconsistent, creating data gaps that limit supply chain optimization. While initiatives like the National Wood Residue Database and BIMAT aimed to improve visibility, these tools are outdated. Recent efforts by the Canadian Wood Fibre Centre and IEA Canada are working to quantify residue availability and improve supply chain efficiency [53], [63].

Scaling construction uses of forestry residues will require more research on whether existing equipment can efficiently collect and separate residues for high-value construction uses and how optimal storage and pre-processing methods can maintain residue quality, reduce moisture content, and streamline integration into manufacturing. Further study is also required to understand broader constraints, such as insufficient processing facilities, challenges in raw feedstock collection, and competing uses for forestry residues, including bioenergy production.

Economic Implications

Canada's forestry industry, historically impacted by market volatility – exemplified by the closure of hundreds of mills and substantial job losses – could gain stability through diversification into high-value bio-based products [64]. Strategic investments, improved spatial inventories, and supportive policies would enable scaling of forestry residue-based building products [61]. These actions not only align with Canada's decarbonization and circular economy goals but also promise substantial economic and social benefits, revitalizing rural communities while addressing the pressing need for sustainable construction solutions [65].

Building and Product Use

Forestry residues have broad market potential, supporting a wide range of building product types, seen in Table 6.

Table 6: Building products from forestry residues

Feedstock Form	Product Category	Building Application
Wood fiber	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels*	Continuous insulation boards
	MDF	Trim, cabinetry, millwork
Wood wafers	Oriented strand board	Structural sheathing for exterior and interior walls, roofs and ceilings
Wood chips	Rigid lightweight panels*	Insulated concrete forms, continuous insulation (above and below grade)
	Structural insulation blocks	Load-bearing, insulated wall systems
Wood wool	Rigid lightweight panels	Continuous insulation boards, sound attenuation panels
Small diameter logs	Light mass timber panels	Wall, roof and floor structure

	Framing lumber	Wall structure
Shredded bark	Loose fill insulation	Wall, roof and floor cavity insulation

Despite Canada's extensive forestry resources, domestic production of residue-based products remains limited. Notable Canadian examples include MSL's SONOclimat ECO4 panel, a rigid wood fiber insulation board made entirely from recycled and recyclable wood fibers with a wax-based binder and Nexcem's insulated concrete forms and insulation panels, which provide for below-grade use.

With one of the world's largest forestry sectors, expanding domestic production could reduce imports, create skilled rural jobs, and strengthen Canada's competitiveness in low-carbon construction. Targeted investment and code development are needed to unlock the full potential of forestry residues, positioning Canada as a leader in next-generation, carbon-storing building products.

Code Compliance

Each variety of residue wood-based product requires unique code considerations. CCMC approvals exist for Canadian produced wood fiberboard products and insulated concrete forms. International code approvals have been obtained for all of the product types, indicating that Canadian codes could be satisfied with adequate testing.

5.3 Industrial Byproducts and Post Consumer Waste Streams

Post-consumer biomass, including wood, paper, cardboard, boxboard, drinking boxes and recycled glass, offer an opportunity to produce low-carbon building products from resources already in circulation. Of the 34 million tonnes of waste sent to landfill each year, 11% is paper, cardboard, and boxboard, 9.9% is wood products, and 1.8% is glass [66].

Recovering and repurposing these materials reduces demand for emissions-intensive virgin materials while storing carbon in durable construction applications. With abundant supply concentrated in urban areas, these waste streams offer reliable, scalable feedstocks for manufacturing insulation, panels, and structural components, directly supporting Canada's low-carbon building goals.

5.3.1 Waste Paper, Cardboard & Boxboard

Waste newsprint has been converted into cellulose insulation for decades, making it one of the few carbon-storing products with incumbency in the Canadian construction industry. Internationally, other sources of recycled fibers – including cardboard, boxboard, and drinking boxes – are increasingly used in construction products. These fibers can also reinforce established composite materials such as fiber cement cladding and drywall, as well as emerging composites.

Material Qualities

Fibers from post-consumer paper products can be extracted using well-established industrial processes. Lightweight yet strong, these fibers can serve as loose-fill insulation or be compressed and bound for greater density and structural integrity. These fibers can provide strong thermal performance, moisture buffering, and air-tightness, though fire protection treatments are typically required.

Growing, Harvesting, and Processing Considerations

Recycling programs across Canada already collect, sort, and bundle paper-based waste, providing easily accessible feedstocks for building product manufacturers. While recycled feedstocks can have varying contamination levels from other materials or food waste, industrial methods to clean and process recycled paper fibers are well-established, posing minimal barriers for manufacturers.

Environmental Impacts

Using recycled materials in construction offers significant carbon benefits beyond simply diverting waste from landfills. Recycled paper products avoid the extraction and processing of virgin materials and prevent waste-related methane emissions from decomposition in landfills.

Depending on product type, manufacturing residues from fiber cleaning processes may require special handling and disposal as hazardous waste.

Availability

Canadians send more than 3.5 million tonnes of paper, cardboard, and boxboard to recycling programs each year, ensuring a stable and abundant supply. These materials are primarily collected through well-established municipal recycling systems, concentrated in urban and suburban areas across the country. This consistent, geographically diverse supply positions recycled paper products as reliable feedstocks for scaling up production of sustainable building materials.

Supply Chains and Market Considerations

Strategic investment in recovery infrastructure and local processing capacity is needed for improving material flows, reducing transportation impacts, and scaling regional supply chains for waste paper products. Developing local processing capacity would reduce transportation impacts, strengthen regional supply chains, and create economic opportunities.

Building and Product Use

Post-consumer paper fibers have a broad range of building product applications, as shown in Table 7.

Table 7: Building products from waste resources

Feedstock Form	Product Category	Building Application
Newsprint fiber	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
Cardboard fiber	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Framing studs	Interior wall framing, strapping
Shredded drinking boxes	Rigid panels	Structural sheathing for exterior and interior walls, roofs and ceilings
Textile fibers	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
All fibers	Loose fibers	Reinforcement of composite materials

Code Compliance

Each variety of recycled paper fiber product requires unique code considerations. CCMC approvals exist for several Canadian brands of cellulose insulation. International code approvals have been obtained for all of the product types, indicating that Canadian codes could be satisfied with adequate testing.

5.3.2 Waste Wood

Material Qualities

Post-consumer wood holds potential, with qualities like strength and durability that make it well-suited for reuse – especially old-growth or previously milled lumber. However, structural reuse is limited by concerns around hidden damage, embedded fasteners, or inconsistent quality. Further research, improved grading protocols, and engineering solutions could broaden structural applications of reclaimed wood. Wood unsuitable for structural reuse can still be effectively processed into fiberboard, insulation, or composite materials, performing similarly to products made from forestry residues.

Growing, Harvesting, and Processing Considerations

Availability of post-consumer wood depends heavily on building deconstruction practices, effective material separation, and dedicated processing infrastructure. Shifting from demolition to careful building disassembly creates opportunities to recover high-quality materials, reduce reliance on virgin timber, and support regional economic development [67]. Provinces like Ontario, Quebec, and British Columbia, home to the largest volumes of wood waste [68], could benefit from adopting deconstruction ordinances, incentives, and investment in local reuse markets, some of which are already beginning to emerge in regional pilot programs and municipal policies [69].

Health and safety considerations are critical in deconstruction, including hazardous materials abatement and risk assessment to manage potential exposure to lead, asbestos, or other contaminants present in older buildings.

Urban recovery faces logistical challenges, including transportation, storage, and sorting. Without dedicated facilities and market pathways, valuable feedstocks are often lost to landfill. Targeted investment is needed to build systems that keep recovered materials accessible and usable for designers and builders.

Environmental Impacts

Using reclaimed wood in construction offers substantial environmental benefits, including significant emissions reductions beyond landfill diversion. Reclaimed wood reduces emissions by avoiding virgin material extraction and processing, and by preventing methane generation from decomposing wood in landfills.

Availability

Wood waste from construction, renovation, and demolition activities constitutes one of Canada's largest solid waste streams, amounting to approximately 2.4 million tonnes annually [66], [67], [70], [71]. Despite considerable reuse potential, significant quantities of recoverable wood, including durable lumber and structural components, continue to be discarded in landfills, leading to unnecessary waste, emissions, and loss of valuable material [66].

While deconstruction ordinances and recovery practices are slowly expanding, a substantial portion of this wood waste still goes unused – material that could instead supply reliable, urban-sourced feedstocks for low-carbon building products [71]. As recovery networks and market demand grow, post-consumer wood could become a valuable, consistent resource stream.

Supply Chains and Market Considerations

Recycled wood products typically fall within a moderate cost range. While automated nail-removal machinery shows promise for efficient preparation of reclaimed lumber, any additional manual labour increases costs. Strategic investment in recovery technologies, specialized tools, infrastructure, and local processing facilities would improve material flows, reduce transportation impacts, and strengthen regional supply chains, creating local economic opportunities in low-carbon construction.

However, widespread adoption remains limited by regulatory barriers, inefficient material handling systems, and insufficient financial incentives for deconstruction and material recovery.

Addressing these challenges will be critical to unlocking the full potential of reclaimed wood as a scalable, low-carbon building resource.

Building and Product Use

Post-consumer wood can be put to many of the same uses as virgin wood, depending on the source and format, illustrated in Table 8.

Table 8: Building products from waste wood

Feedstock Form	Product Category	Building Application
Wood fiber	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels*	Continuous insulation boards
	MDF	Trim, cabinetry, millwork
Wood wafers	Oriented strand board	Structural sheathing for exterior and interior walls, roofs and ceilings
Wood chips	Rigid lightweight panels*	Insulated concrete forms, continuous insulation (above and below grade)
	Structural insulation blocks	Load-bearing, insulated wall systems
Wood wool	Rigid lightweight panels	Continuous insulation boards, sound attenuation panels
Dimensional lumber	Finger-jointed light mass timber panels	Wall, roof and floor structure
	Finger-jointed framing lumber	Wall structure
	Structural wood bricks	Wall structure

Reclaimed wood offers value as both structural material and feedstock for fiberboard, insulation, and engineered products. Feedstock quantities are largest in major urban centres, and manufacturers of products using waste wood internationally tend to be small and regionally-focused.

Code Compliance

Code considerations for reclaimed wood products vary based on intended product use. Structural applications of reclaimed wood present particular challenges due to material-strength verification and grading requirements. Some jurisdictions, including the U.S. states of

Washington and Oregon, allow the use of reclaimed lumber if it is re-graded or approved by the building official [72]. The International Building Code (IBC) also permits reclaimed materials provided they meet the requirements for new materials [73]. Developing Canadian guidance and testing protocols could support wider adoption of reclaimed wood in structural applications.

Reclaimed wood products intended for non-structural uses generally face fewer regulatory hurdles, benefiting from well-established international precedents and standards.

5.3.3 Waste Glass

Material Qualities

After multiple uses as food and beverage containers, glass eventually must be downcycled into secondary applications. Downcycled glass retains consistent, reliable physical properties, including strength, durability, and resistance to moisture and weather – qualities that are highly valuable for construction applications.

Growing, Harvesting and Processing Considerations

Glass recycling is well-established across Canada. The manufacturing processes required to clean, sort, and convert recycled glass into construction materials are well understood and widely implemented.

Environmental Impacts

The use of recycled glass in building products delivers environmental benefits by reducing demand for virgin materials. The cleaning process generates waste byproducts, some of which require specialized handling and disposal. Protocols for managing these byproducts are well-established within the glass recycling industry.

Availability

Glass containers are commonly collected through municipal recycling programs in most Canadian regions. Nationally, approximately 455,000 tonnes of glass are recycled annually, with availability concentrated in more densely populated areas [74].

Supply Chains and Market Considerations

Due to its density, glass has high transportation costs, making proximity to recycling centers a key factor for manufacturing viability. Establishing manufacturing facilities near major recycling hubs would minimize transportation emissions and enhance economic efficiency, creating local employment and reducing overall environmental impacts.

Building and Product Use

Crushed recycled glass has proven effective in multiple building products, as outlined in Table 9.

Table 9: Building products from glass

Feedstock Form	Product Category	Building Application
Crushed glass	Lightweight aggregate*	Sub-slab insulation, concrete aggregate
	Rigid lightweight panels	Continuous insulation boards

Code Compliance

Manufacturers of aggregate and rigid lightweight panels have achieved code compliance in international jurisdictions. This demonstrates clear potential for Canadian producers to meet domestic building code requirements through standardized testing and documentation processes

5.3.4 Biochar

Biochar is created by burning biomass in the absence of oxygen, a process known as pyrolization. This ancient technique has seen significant innovation over the past decade, with equipment ranging from small, portable units to large, centralized facilities. Heat generated during pyrolysis can be used for industrial processes, to generate electricity, or provide heating for buildings.

Pyrolysis converts the majority of carbon in biomass feedstocks to a stable, long-lasting form of carbon known as carbon black [75]. Carbon black can be used in a range of building products, many of which are still in early development phases. Among the most promising is biochar concrete aggregate, which has demonstrated structural performance and durability requirements while offsetting most or all emissions typically associated with concrete.

Material Qualities

Biochar is lightweight with an open, cellular structure, making it ideal as a lightweight additive or aggregate in construction products. Carbon black does not degrade like cellulosic materials when exposed to moisture or sunlight, and its highly fire-resistant nature results from the removal of flammable elements during pyrolysis.

Growing, Harvesting and Processing Considerations

Biochar characteristics vary significantly based on feedstock, pyrolysis temperature, and conditions. Forestry and agricultural residues, along with municipal sewage sludge, have all been subjects of biochar research and development.

Developing biochar production presents an important circular opportunity: bio-based building products at the end of their useful lives could be converted into biochar, capturing most of their carbon content in a durable form rather than re-releasing it through combustion or decomposition in landfills. This creates a circular pathway, turning waste into feedstock for new carbon-storing products.

Environmental Impacts

Biochar production does not emit large quantities of CO_2, however, feedstock type influences other emissions, such as fine particulate matter and chemical residues. Although emissions controls for pyrolysis have improved rapidly, they remain unregulated. Proper regulation will be essential for mitigating potential environmental impacts and encouraging sustainable industry growth.

Producing biochar from environmentally problematic feedstocks – particularly municipal sewage sludge – can alleviate serious disposal challenges, and can be explored as a means of converting hazardous waste into valuable construction feedstocks.

Availability

In Canada, biochar is primarily available through small-scale producers. Although markets in the U.S. and Europe are somewhat more advanced, biochar production remains a nascent industry globally.

Supply Chains and Market Considerations

Properties of biochar can vary widely based on feedstock and pyrolysis conditions. Specific properties are required for unique product types and the market will need to develop the type of specifications common to other manufacturing feedstocks.

Building and Product Use

Biochar is being introduced into building products as a high-carbon-content addition to concrete, boards, and tiles, (see Table 10) with a growing body of research exploring additional applications and testing results for expanded use in other product types [76], [77], [78].

Table 10: Building products from biochar

Feedstock Form	Product Category	Building Application
Biochar	Lightweight aggregate	Concrete & mortar aggregate
	Lightweight aggregate	Cement and drywall boards
	Lightweight aggregate	Ceiling and wall tiles

Code Compliance

Each product type made with biochar will require unique testing for code compliance. A U.S. manufacturer has successfully demonstrated that biochar concrete aggregates can meet ASTM standards for concrete strengths up to 40 MPa [79], establishing a clear pathway toward achieving compliance in Canada and internationally.

5.4 Innovative and Emerging Feedstocks and Technologies

Numerous innovative feedstocks and technologies for low-carbon and carbon-storing building products are emerging in Canada and internationally.

5.4.1 Agricultural Residues

A wide range of Canadian agricultural residues show potential as building product feedstocks but remain under-researched and developed. Where abundant, these residues could enable new pathways for innovative construction products. In some cases, these emerging residues may even be used interchangeably with more established feedstocks such as grain straw and hemp. Table 11 summarizes these feedstocks and their potential products.

Table 11: Building products from agricultural residues

Feedstock Form	Product Category	Building Application
Sunflower stalks	Semi-rigid insulation (hempcrete)	Wall, roof and floor cavity insulation
	Insulation block (hempcrete)*	Wall insulation
	Mineralized aggregate	Aggregate for concrete
Soybean straw	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels	Continuous insulation boards
Flax straw	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels	Continuous insulation boards

5.4.2 Mineralized Biomass

Mineralization processes can be applied to bio-based feedstocks to remove or modify sugars in the biomass, significantly reducing the propensity for decomposition in wet and subgrade applications. For decades, mineralization has stabilized wood fibers used in insulated concrete forms and insulating boards. Recently, several companies have begun commercializing mineralized versions of hemp hurd. Table 12 outlines examples of mineralized bio-based products. Other agricultural residues may prove equally adaptable to mineralization and use in these types of products.

Table 12: Building products from mineralized biomass.

Feedstock	Product potential	Use
Hemp hurd	Mineralized aggregate	Wall, roof and floor cavity insulation
		Concrete aggregate
		Lightweight cladding and ceiling tiles
Wood chips	Mineralized aggregate*	Insulated concrete forms
		Wall, roof and floor cavity insulation
		Concrete aggregate
		Lightweight cladding and ceiling tiles

5.4.3 Seaweed

Seaweed has a long history of use as building insulation, roof thatching and wall cladding in coastal regions worldwide. Manufactured seaweed-based products are experiencing renewed interest, particularly in European countries with coastal access (see Table 13).

Table 13: Building products from seaweed

Feedstock Form	Product Category	Building Application
Seaweed	Loose fill insulation	Wall, roof and floor cavity insulation
	Flexible batt insulation	Wall, roof and floor cavity insulation
	Rigid lightweight panels	Continuous insulation boards
	Thatching	Roofing and wall cladding
	Bricks	Cladding, wall structure

Commercially available seaweed building products today primarily use beach-harvested material. Research into purposeful seaweed cultivation as a building feedstock is ongoing internationally.

With extensive coastlines, Canada could emerge as a leader in developing and producing seaweed-based building products. However, care must be taken to ensure responsible harvesting and cultivation methods to protect ocean ecosystems.

5.4.4 Micro-algae

Micro-algae have recently demonstrated potential as a feasible alternative to cement, and compressed micro-algae products have shown promising results as cladding and structural sheathing (see Table 14). Grown in controlled indoor environments, micro-algae can provide large quantities of useful biomass for building products without major land-use impacts.

Table 14: Building products from micro-algae

Feedstock Form	Product Category	Building Application
Micro-algae	Cement	Concrete
Compressed micro-algae	Boards	Cladding and sheathing

Micro-algae-based cement presents an opportunity to replace emissions-intensive Portland cement, reducing climate impacts from a leading emitter of greenhouse gases.

5.4.5 Mycelium Composites

Mycelium has been demonstrated to create composite materials with many potential uses in buildings, including insulation, structure and finishes (see table 15). Composites are created by growing mycelium in a matrix of agricultural residues, including many of the feedstocks identified in this report. Hemp hurd, in particular, has shown great promise in mycelium composites.

Table 15: Building products from mycelium

Feedstock Form	Product Category	Building Application
Mycelium & agricultural residue	Lightweight panels	Interior finishes, sound attenuation
	Rigid lightweight panels	Continuous insulation boards
	Rigid boards	Framing and structural sheathing, door cores, interior partitions

Mycelium is naturally fire-resistant and can withstand repeated wetting and drying cycles without significant degradation. Produced indoors in controlled conditions, mycelium composites avoid land-use change concerns.

5.4.6 Carbonation of CO_2 Feedstocks

The nascent carbon dioxide removal (CDR) industry can provide feedstocks for building products. Table 16 shows a few examples. Among the most promising is concrete aggregate produced through recarbonating of captured CO_2. Numerous composite materials utilizing captured CO_2 are undergoing research and development.

Table 16: Building products from captured CO_2

Feedstock Form	Product Category	Building Application
Captured CO_2	Gas*	Injection into curing concrete
	Aggregate	Concrete aggregate

As volumes of captured CO_2 increase and the costs decline, recarbonated CO_2 feedstocks could play a substantial role in carbon-storing products for the building industry.

6. Near-Term and Promising Opportunities

6.1 Near Market Opportunities

Canada has a rare opportunity to stack solutions to three national priorities: reducing carbon emissions, meeting urgent housing demand, and creating new manufacturing opportunities across the country. By converting millions of tonnes of undervalued agricultural and forestry biomass and recycled feedstocks into building products, Canada can strengthen its economy, support farmers and foresters, and deliver the low-carbon housing needed to meet climate and economic goals.

Effectively scaling these solutions requires regionally tailored strategies, given Canada's diverse geography and feedstock distribution. Targeted investment in processing infrastructure, compliance pathways for emerging products, and market development for recycled content will maximize impact – avoiding a one-size-fits-all approach.

Among the most strategic opportunities is prioritizing feedstocks for insulation products. As building codes drive higher thermal performance, demand for insulation will grow. Investing in bio-based, low-carbon insulation ensures this shift supports climate goals while creating domestic economic benefits.

This report evaluated a range of bio-based and recycled Canadian feedstocks against criteria such as material qualities, environmental impacts, cost, human safety, code compliance, availability, and versatility. Several feedstocks emerge as near-market opportunities for immediate investment, while others show strong potential with the right infrastructure and market support.

6.1.1 Grain Straw - An Abundant Agricultural Residue

Grain straw offers immediate large-scale potential, with cereal grain production generating millions of tonnes annually, particularly in Alberta, Saskatchewan, and Manitoba. Its availability, affordability, and high carbon storage capacity make it a compelling low-carbon feedstock.

Internationally, straw bale and panelized straw construction are established, yet Canada's market remains largely untapped.

By modeling a 220 m^2 home with R-20 walls and R-60 roof insulation, a typical Canadian house insulated with straw would require approximately 9.4 tonnes of material. To meet national goals, Canada needs to build 700,000 homes annually. In 2024, Canadian farms produced an estimated 64 million tonnes of grain straw. Applying a conservative reduction factor to account for competing uses leaves 32 million tonnes potentially accessible for construction. Insulating 700,000 homes would require 6.6 million tonnes of straw – just 20% of that supply. This calculation highlights an exciting opportunity: even a modest share of Canada's existing straw harvest could help deliver climate-aligned housing at scale.

Investing in straw-based insulation and prefabricated panels could rapidly reduce embodied carbon in residential construction, strengthen agricultural economies, and support rural communities. Scaling these products requires no additional equipment or specialized processes for farmers, making implementation straightforward and immediately feasible.

Case Study: Savick Panels – Scaling Straw-Based Prefabricated Construction

Savick Panels, based near Edmonton, Alberta, is using chopped wheat straw as blown insulation in prefabricated wall and roof panels in Canada. Unlike traditional straw bale construction, Savick's approach processes wheat straw into loose fill, densely packed into panels using techniques similar to cellulose insulation. This method increases flexibility and scalability by enabling straw insulation to be used to insulate any cavity size while maintaining the low-carbon benefits of an agricultural byproduct. Savick's panels use conventional framing lumber and wood fiberboard continuous insulation, and can be ordered in a variety of whole-panel R-values.

Blown at high density (100 kg/m^3), chopped straw achieves R-values between R-3 and R-4 per inch, offering a viable alternative to conventional insulation. Sourcing directly from regional farms can reduce transportation emissions and supports local agricultural economies. By turning this byproduct into a high-performance product, Savick provides carbon storage benefits while reducing reliance on synthetic, high-embodied-carbon insulation products.

A key focus for Savick is advancing third-party certification to enable broader code acceptance. They are investing in the code compliance pathway by working with agencies such as the Canadian Construction Materials Centre (CCMC) to certify that their panels meet minimum building code requirements – a process widely recognized by building officials across Canada. By establishing structural, fire, and thermal performance benchmarks, Savick is working to break down regulatory barriers for biobased insulation products. Their approach offers a replicable model for rural supply chains and product innovation, demonstrating how Canada's agricultural residues can support scalable, low-carbon construction solutions

6.1.2 Forestry Residues - Expanding Canada's Timber Industry

Forestry residues, concentrated in British Columbia, Quebec, and Ontario, present a high-impact opportunity due to vast availability, mature supply chains, and well-understood material properties. Wood fiber insulation, engineered wood composites and mineralized wood chip composites are valuable near-market opportunities with some precedents already in the Canadian market and plenty of international examples to demonstrate broader feasibility for more product types.

In 2022, Canada generated 21 million tonnes of forestry residues. Applying a 50% reduction factor to account for other uses and accessibility leaves 10.5 million tonnes potentially available for construction. A 220 m^2 home using wood fiber batts as cavity insulation (R-20 in the walls and R-60 in the roof). Insulating 700,000 homes would require 2.5 million tonnes of wood fiber – about 24% of that supply. This presents another compelling opportunity: forestry residues already available in Canada could help scale low-carbon, climate-resilient housing while creating new value from existing resources.

Investments in enhanced residue tracking and regional processing capacity could improve collection efficiency, support manufacturing growth, and help revitalize rural economies, counteracting declines in forestry-sector employment. Prioritizing these products would also reduce reliance on imports, strengthen Canada's bioeconomy, and lower embodied carbon in construction.

6.1.3 Deconstructed Lumber - A Feedstock for Urban Use

Deconstructed lumber presents an immediate opportunity due to high volumes generated from construction, renovation, and demolition waste streams, particularly in the urban centers of Ontario, Quebec, Alberta, and British Columbia. Given its durability and structural integrity, deconstructed lumber can be reused in framing, interior finishes, and engineered wood products, reducing virgin timber demand and landfill burdens. Beyond that, its proximity to major construction markets makes it an immediately viable feedstock for urban and suburban applications.

Beyond material recovery, deconstruction offers significant climate benefits by reducing the emissions associated with both new material extraction and landfill decomposition. Diverting wood waste prevents methane emissions from landfills while simultaneously reducing the need for virgin timber processing, amplifying the carbon savings of reuse.

Establishing regional deconstruction hubs, alongside supportive policy incentives and clear regulatory frameworks, could rapidly scale material recovery. Increased investment in regional sorting and processing centers would quickly scale availability, significantly enhancing market adoption and local economic resilience.

Case Study: Deconstruction - Unlocking the Value of Salvaged Wood

Deconstruction – carefully dismantling buildings to recover materials – was once common practice. After the Second World War, demolition took over, prioritizing speed and waste over reuse. Today, construction and demolition waste fills 40% of Canada's landfills. Tearing down a 2,000-square-foot home creates enough waste to fill seven dumpsters – much of it high-quality, old-growth lumber, lost to landfill.

Their team dismantles buildings in stages, sorting, reselling, or recycling materials. One of their most impactful practices is reclaiming lumber. Under Ontario's building code, salvaged wood must be regraded before reuse in structural applications. Ouroboros commissions certified inspectors and engineers to regrade and resell the material – returning valuable first-growth lumber to the market. A single timber-frame home can yield 14,000 board feet of reclaimed lumber.

Scaling this model means solving storage challenges. Recovered materials need space until they find a new use. Matchmaking services like B.C.'s Building Material Exchange are helping connect salvaged materials with builders ready to reuse them. Policy support is also needed to accelerate this shift. Vancouver offers a leading example: in 2011, the city introduced a voluntary deconstruction permit requiring at least 75% of materials be diverted from landfill. Early projects achieved diversion rates over 85%, with an average of 200 tonnes of material recovered per house [69]. The program has since evolved, positioning Vancouver as a model for how deconstruction policies can reduce waste, support green jobs, and grow the circular economy.

Incentives like expedited permitting could help scale deconstruction across Canada. With Canada needing millions of new homes by 2030, deconstruction and material reuse offer a pathway to meet housing demand while cutting emissions, preserving resources, and growing circular economy jobs.

6.2 Promising Feedstocks

Canada has a wealth of promising feedstocks that can be characterized in three ways:

1. Feedstock is abundant but product development is nascent
2. Product development is reasonably mature but feedstock quantities are small
3. Product development and feedstock quantities are nascent

6.2.1 Corn Stover and Cob - An Emerging Near Market Opportunity

Corn stover and cob are widely available in Ontario, Quebec, and Manitoba, with early product development – such as sheathing and rigid insulation panels – demonstrating strong potential. Scaling will require targeted investment in harvesting logistics, processing capacity, and product testing to validate performance. With improved harvesting techniques and secondary collection networks, corn stover could become a viable, affordable feedstock for construction products and should be prioritized for near-market development.

Case Study: Hundred Year Materials – The Potential of Agricultural Residues

Hundred Year Materials (HYM) is pioneering the use of corn stover in high-performance rigid insulation panels, designed as a bio-based alternative to rigid foam and mineral wool. The panels combine agricultural fibers with a bio-resin binder and bio-based wax for water resistance – all made from non-petroleum feedstocks with 100% non-toxic additives. And corn is abundant - HYM estimates they could fully scale insulation production using just 30% of available feedstock within a 100 km radius, highlighting strong regional supply.

With funding from the Canadian government, HYM has advanced product development and scaled up production research. In 2025, HYM is producing industrially matched samples in collaboration with SEREX, Innofibre, and InnoTech Alberta. Testing is underway to validate performance to ASTM C518 (steady-state thermal resistance) and ASTM C165 (compressive resistance), with ongoing refinements improving fiber processing efficiency. HYM is also exploring additional product lines, including OSB alternatives made from perennial grasses.

The next phase of research includes partnering with a building science laboratory to conduct testing on thermal resistance, vapour transmission, water absorption, long-term aging, and computer modeling. Additional testing is planned to meet ASTM C208 and CAN/ULC S706 standards. HYM is now looking ahead to pilot projects and partnerships that will help bring these carbon-storing materials into real buildings.

6.2.2 Residues from Major Crops

Feedstocks like soybean straw, sunflower stalks, and canola residues are all grown in significant quantities in Canada. However, few building products use these feedstocks despite sharing many material qualities with more explored crop residues. Undertaking research to explore products where these feedstocks could be substituted and potential new product types could reveal opportunities that have not yet been explored.

6.2.3 Hemp – Established Products Looking for Increased Supply

Hemp is grown predominantly in the Prairie provinces (Alberta, Saskatchewan, Manitoba) and demonstrates outstanding carbon sequestration and exceptional product versatility. With many existing product precedents, including hempcrete, insulation batts, fiberboard, acoustic panels, and biocomposites, hemp has a well-established foundation for broader market adoption including several small Canadian manufacturers. Scaling remains dependent on expanding the number of acres planted, processing infrastructure and market acceptance; targeted investments here will position hemp prominently in Canada’s sustainable construction sector.

6.2.4 Perennial Grasses – Expanding Possibilities for Farmers

Perennial grasses share many properties with grain straw and, pending research, can likely be used in many existing straw-based applications. Suitable for growth across diverse regions, including marginal lands, these crops offer significant carbon storage benefits – not only through the carbon locked into harvested feedstock, but also through their deep root systems – alongside economic opportunities for farmers. Programs aimed at elevating perennial grasses could help in providing additional economic stability for farmers while delivering long-term climate benefits.

6.2.5 Emerging Feedstocks – Ready for Canada to Lead

There are a remarkable number of feedstocks and related products which are only just beginning to emerge. Canada has the potential to lead the world in exploring these feedstocks and products, helping to create new domestic markets and export technology, knowledge and products internationally. Biochar, seaweed, micro-algae and mycelium composites are all feedstocks in their infancy, having demonstrated great promise. Canadian researchers, product developers and builders can be mobilized to quickly lead development of a host of new feedstocks and products.

6.2.6 Panelized Systems – Accelerating Market Entry for Emerging Materials

Panelized framing systems offer a promising pathway to integrate a wide range of low carbon and carbon storing feedstocks into the built environment. These systems combine multiple components into a prefabricated wall, roof and floor assemblies, manufactured off-site in controlled conditions. This approach supports quality control, reduces jobsite waste, and enables a direct pathway to integrate emerging materials that might not yet be common in construction.

Panelized systems provide a flexible platform for incorporating bio-based insulation, sheathing, and structural members into a single assembly. Testing and certification can be performed at a system level, rather than on individual components, potentially reducing barriers for individual products that are not yet certified on their own.

Business-to-business partnerships streamline adoption. By working directly with panel producers, product manufacturers can scale production without the upfront investment required for retail distribution or widespread installer training – allowing new products to reach market faster and more effectively. With at least 10 panel manufacturers already operating in Canada, there is an established industry base that could support the integration of new low-carbon materials into panelized systems.

These systems can be produced at a range of scales, from small shops located near specific feedstock sources to major manufacturers serving broader markets. By enabling regional manufacturing tailored to local feedstocks and desired performance levels, panelized systems support scalable innovation, localized climate solutions, and the creation of jobs to support the local economy.

Many of the products identified in this report can be combined into viable panel systems. By mixing and matching specifications, costs, availability, and code pathways, manufacturers can create a variety of high-performance, low-carbon assemblies, opening the door to a range of low-carbon building solutions.

7. Next Steps

The transition to a low-carbon built environment will benefit from immediate action on available feedstocks and sustained investment in research and innovation. Targeted efforts can accelerate adoption, drive economic growth, support rural industries, and position Canada as a leader in sustainable building solutions. This report identifies the following key steps to advance the low-carbon and carbon-storing built environment:

1. **Improve Data and Feedstock Assessment.** Further research is needed to develop robust Canadian data on feedstock volumes, grain-to-byproduct ratios, and regional availability of feedstocks. This report applies a conservative 50% reduction factor to account for other potential feedstock uses but more detailed studies are needed to quantify actual availability. A key factor in these assessments is regionality: while national and provincial statistics are available, transportation costs make it essential to understand how much feedstock is available within feasible distances of existing or potential manufacturing hubs. Accurate, regionally specific data will support reliable supply chain planning, guide targeted investment, and help identify underutilized feedstocks with the greatest potential for low carbon construction applications.

2. **Create a System for Valuation of Temporary Carbon Storage.** Confusion in the market about durable carbon storage stems from misinterpreting the -1/+1 approach to biogenic carbon accounting in LCA as an assessment of climate impact. Canada can lead research to establish a consistent valuation system for biogenic carbon based on unique feedstock factors, anticipated lifespan within the built environment and realistic end of life scenarios. A nationally-endorsed valuation system supported by climate science will provide manufacturers with certainty for claims about their products and enable the country to include this kind of carbon storage in national inventories.

3. **Advance Research and Testing of Feedstocks and Products.** Create pathways for researchers and product developers to test emerging products and innovative feedstocks both in the lab and in demonstration buildings. This can accelerates development, commercialization, and regulatory approval. Refining manufacturing processes before scaling will ensure quality, cost-effectiveness, and market readiness.

4. **Target Federal Investment to Accelerate Market Readiness.** Targeted federal investment can play a pivotal role in advancing carbon-storing products from concept to widespread adoption. Priority areas include: supporting research and development to determine optimal fibre size, orientation, and moisture content for enhanced thermal performance; developing CCMC Technical Guides that clearly define code acceptance pathways for key product categories; and creating robust carbon quantification protocols to integrate biogenic materials into Canada’s federal offset system.

5. **Modernize Building Codes.** Support development of simplified performance-based pathways for new products can enable bio-based and recycled low carbon products to compete on merit, while ensuring safety and performance. Standardize protocols for obtaining permits on projects utilizing innovative products that have not yet received CCMC certification.

6. **Support for Manufacturers of Low-Carbon Products.** Target investment and business development support for start-ups and existing manufacturers expanding into low-carbon and carbon-storing products to accelerate adoption, strengthen domestic manufacturing, and ensure these solutions compete effectively in Canada's construction and housing sectors.

7. **Product Health Research and Funding Requirements.** Undertake research to identify appropriate material health requirements for funding associated with product research and development. Focus research and manufacturing funding on products that do not incorporate high-carbon and/or toxic inputs.

8. **Demonstrate Impact Through Canadian Housing Case Studies.** The new Canadian Housing Design Catalogue [80] offers an opportunity to select representative low-rise designs and demonstrate material substitutions using the feedstocks in this report. This would quantify embodied carbon and storage impacts, showing how domestic materials can support Canada's housing and climate goals.

8. The Shift from Bespoke to Scalable Solutions

For decades, bio-based products have been championed by bespoke builders in small-scale projects, demonstrating their durability, performance, and sustainability. While these efforts have validated their potential, mainstream adoption remains limited. Scaling up from one-off innovations to broader application offers a major opportunity for Canada to reduce embodied carbon in construction while supporting a thriving, low-carbon building economy.

Integrating Canadian feedstocks into manufacturing, prefabrication, and regulatory frameworks will move low carbon construction beyond experimental applications and into widespread use. This shift not only advances climate goals but also strengthens Canada's economy, creating new revenue streams for farmers, generating jobs in the forestry and waste handling sectors, and expanding domestic manufacturing. Regenerative agriculture plays a key role in this transition, not only benefiting the environment through carbon sequestration and soil restoration but also supporting healthier communities, resilient food systems, and long-term economic stability for farmers. With vast agricultural and forestry resources, Canada is well-positioned to lead in building a robust, regenerative product economy.

By strategically investing in feedstock infrastructure, modernizing building codes, and fostering market acceptance, Canada has the opportunity to scale up bio-based innovations and accelerate the transition to sustainable construction. Early action on feedstocks like straw, forestry residues, and reclaimed wood could rapidly reduce emissions, unlock rural economic opportunities, and help position Canada as a global leader in sustainable building practices..

The urgency of the climate crisis demands immediate action, using products and systems already available to us. Scaling up plant-based products and industrialized construction offers a rare opportunity to align environmental progress with economic resilience - supporting farmers, manufacturers, and regional economies while delivering high-quality, low-carbon housing. More than just a climate strategy, this is a once-in-a-generation chance to reshape the built environment with products that are innovative, sustainable, and fundamentally better for people and the planet. Investing in these feedstocks and products supports not only emissions reductions but also innovation, equity, inclusion, and reconciliation, reinforcing the broader benefits of a low-carbon supply chain in Canada.

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