Canadian Council of Forest Ministers

Conseil canadien des ministres des forêts

A Forest Bioeconomy Framework for Canada

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EXECUTIVE SUMMARY

Canada's forests are world renowned for their vastness and majestic beauty. They have been a vital part of this country's history and continue to play a central role in the cultural, spiritual, recreational, and economic pursuits of Canadians. The unique combination of biomass availability and technical capacity within Canada is an unprecedented opportunity. As the transition toward a low-carbon, sustainable economy gathers pace, the forest industry is well positioned to advance the next generation of transformation and diversification by supplying biobased solutions.

In the 150th anniversary year of Confederation, the Canadian Council of Forest Ministers (CCFM) has developed *A Forest Bioeconomy Framework for Canada*. This framework outlines a comprehensive approach to stimulating new economic activity by converting sustainably managed renewable forest-based resources into value-added products and services using novel and repurposed processes.

The CCFM and the Forest Bioeconomy in Canada

The CCFM comprises 14 federal, provincial, and territorial ministers responsible for forests. Since its inception in 1985, the CCFM has provided a forum for discussion and a vehicle to work cooperatively on common forest and forest-related issues. In 2015, the CCFM released the *Kenora Declaration on Forest Innovation*, which committed to advancing forest sector innovation through collaboration, engagement, and mobilization.

The forest sector in Canada leads in several important bioeconomy fields and technologies. Constantly changing market conditions have accelerated innovation and spurred forward thinking on new ways of using wood fibre. Canada contains the most biomass per capita in the world and is the second-largest exporter of forest-based products. At the same time, domestic and international concerns about climate change are ever increasing, leading consumers to seek clean technologies, energy sources, and manufactured products that limit or reduce carbon outputs while preserving biodiversity.

By leveraging its efficient biomass supply chains and robust innovation ecosystem, Canada can meet part of its future energy, chemical, material, and advanced building system needs with renewable forest biomass. Shifting toward a bioeconomy, coupled with innovative forest management practices, will help Canada meet its greenhouse gas emission reduction targets under the Paris Agreement.

Recognizing these challenges and opportunities propelled the CCFM to launch an engagement campaign in 2016 to garner input from Canadians on their vision for Canada's future bioeconomy. Over 350 stakeholders from a wide range of backgrounds contributed input through facilitated dialogues, regional outreach, and an online survey. This valuable feedback was instrumental in the CCFM's development of the framework.

A Forest Bioeconomy Framework for Canada

VISION

The vision behind this framework is simple yet bold: Canada will be a global leader in the use of forest biomass for advanced bioproducts and innovative solutions. There are multiple sources of clean energy in Canada—hydroelectric, wind, tidal, geothermal, solar, and bio (for electricity, heat, and fuels)—yet biomass is the only renewable source that can substitute the carbon from fossil fuels found in chemicals, plastics, and composites.

PILLARS

The framework is built on four pillars to enhance policy coherence and collaboration across jurisdictions. **Pillar 1** is Communities and Relationships, which focuses on creating green jobs, offering opportunities for rural communities through education and skills training, improving overall quality of life, and enhancing partnerships with Indigenous peoples.

Pillar 2 is Supply of Forest Resources and Advanced Bioproducts. The future demand for forest biomass and biomass projects can only be met with a predictable, stable, and secure supply. Establishing effective standards will enable the purchase and trade of forest biomass and advanced bioproducts, including for the construction of tall wood buildings. Modelling tools and better data management of forest biomass supply are needed to help researchers and investors understand and quantify the bioeconomy's opportunities and de-risk projects.

Pillar 3 is Demand for Advanced Forest Bioproducts and Services, which recognizes that public perception of the sustainability of the forest bioeconomy is imperative for growth. Coordinated outreach and marketing can actively engage consumers and businesses to make more sustainable choices. Governments can be proactive by instituting procurement programs that influence markets and stimulate demand for green products, including those derived from forest biomass. Governments also have a role in developing effective and updated regulations to reduce barriers to entry and stimulate demand for projects, including for advanced bioproducts and bioheat production.

Finally, **Pillar 4** is Support for Innovation, which focuses on facilitating a healthy and vibrant innovation ecosystem to expand the pipeline of projects. A seamless array of mechanisms is needed to achieve success for the research, development, demonstration, and deployment of new technologies, which includes embedding innovation systems within regional land-use planning processes. Financing these efforts requires significant capital and knowledgeable strategic partners. Updating tax measures to reflect the beneficial outcomes of forest bioproducts and leveraging carbon pricing mechanisms that support the forest bioeconomy are important aspects in sustaining the forest sector's competitiveness.

Assessing progress toward a low-carbon forest bioeconomy can be measured in various ways, taking into account regional priorities. Five potential areas and examples of indicators are proposed.

PURPOSE

A Forest Bioeconomy Framework for Canada seeks to increase the use of forest biomass throughout the economy. It can also help meet other priorities, including the objectives of the Pan-Canadian Framework on Clean Growth and Climate Change, clean technology innovation, green infrastructure, and green job creation. With new investment, more jobs, continued engagement with Indigenous peoples, new technologies, and better supply inventory and modelling, the forest industry can sustain its history of innovation, sustainability, and competitiveness. This framework is a clear signal that CCFM members are ready, in a spirit of collaboration, to tackle the forest sector's ongoing challenges while ensuring the vibrancy and character of Canada's forests for generations to come.

INTRODUCTION

Canada's forests have played a critical role in our history and they continue to be a defining feature of our country. They maintain a central role in our cultural, spiritual, recreational, and economic pursuits; they are part of our Canadian identity and experience. In addition to representing a large percentage of the land base, forests also provide ecological services that sustain our communities and industries. Acting as responsible stewards of these globally significant assets requires new thinking on ways of maximizing the value of Canada's forests while continuing to enhance the well-being of all Canadians.

This year is an important milestone as we mark the 150th anniversary of Confederation. It is an occasion to take stock and envision the century ahead. As Canada shifts toward a low-carbon, sustainable economy, its forest industry has entered a renewed era of transformation. The unique combination of biomass availability and technical capacity presents Canada with an unprecedented opportunity to provide global leadership in the forest bioeconomy. *A Forest Bioeconomy Framework for Canada* lays out a vision for the next generation of the forest sector.

BACKGROUND

Canada's Forest Sector: A History of Innovation and Transformation

Canada's forests have played a key role in the history of this country and been at the forefront of innovation. For thousands of years, the forest has been fundamental to the lives of the Indigenous peoples. Indigenous communities created many innovative products from trees, including birch bark and cedar canoes, shelters, ointments, medicines, and maple syrup. Upon contact, Indigenous peoples shared their forest knowledge and innovations with early European settlers.

In the 17th century, settlers began logging to supply the shipbuilding industry, particularly in the Atlantic provinces and Québec. Vessels were built for Britain, France, and the United States—for 200 years ship construction was the largest industry in the colonies. Beginning in the 1830s, there was a significant shift in technology. Steam replaced water power in sawmills while railways allowed new access to inland forest areas. More efficient mills, a longer operating season, and better access to forests resulted in increased production and the opening of new international markets. Wood products formed the basis of Canada's international trade throughout the 1800s, fuelling Canada's economic development.

In the early 20th century, the sawmill industry faltered but the paper industry boomed. Until the mid-1800s, paper was made from cotton or linen. With the invention of techniques for making paper out of wood, a new market for Canadian forest resources flourished. By the mid-1920s, paper and pulp products had overtaken sawmilling as the forest sector's largest output and, by the end of the First World War, Canada was the largest pulp and paper exporter in the world.

In the 1930s, the Canadian Forest Service pioneered innovative surveying techniques, including measuring forest inventories via aerial photography. During the economic boom after World War II, demand for wood products grew exponentially creating new needs. Canadian scientists responded by conducting cutting edge research on forest threats, such as pests and forest fires. By the 1960s, the Canadian Forest Fire Danger Rating System was launched by collecting data on fire hazards and danger levels for regions across Canada. Today, Canada is a global leader in forest fire science and innovation.

In response to the growing environmental movement of the late-20th century, Canada developed some of the strongest environmental standards in the world. In 1995, the Canadian Council of Forest Ministers (CCFM) produced a national framework of criteria and indicators to help track the country's performance with regard to sustainable forest management (SFM).

Canadian Council of Forest Ministers

There has been a long tradition of cooperation between the federal, provincial, and territorial governments on forestry matters. The CCFM comprises the 14 federal, provincial, and territorial ministers responsible for forests. Its role is to share information and act as a vehicle to work toward four primary objectives:

- Promote cooperation between governments regarding emerging forest and forestry-related issues of common interest and of intergovernmental or international significance.
- Cooperate in developing and maintaining the scientific information base required to support forest management decision making.
- Demonstrate international leadership on sustainable forest management.
- Share information on issues that impact the forest sector.

The CCFM has been steadfast in its commitment to advancing forest sector innovation. In July 2015, it convened a National Forest Innovation Summit in Kenora, Ontario, that brought together forest-sector stakeholders from across the country and concluded with the release of the *Kenora Declaration on Forest Innovation,* based on three pillars: collaborating, engaging, and mobilizing. In June 2016, CCFM jurisdictions endorsed the *Innovation Action Plan (2016–2020)*, which sets forth an ambitious approach to maximizing forest sector competitiveness and moving toward greater sustainability, the hallmarks of the forest bioeconomy of the future.

Bioeconomy Definition

The forest bioeconomy refers to economic activity generated by converting sustainably managed renewable forest-based resources, primarily woody biomass and nontimber forest products, into value-added products and services using novel and repurposed processes. Although there is no single, accepted definition of the bioeconomy, it is generally recognized that the key attribute of a healthy bioeconomy is the knowledge-based, competitive, and innovative production and sustainable use of biological resources, processes, and principles to provide eco-friendly goods and services.

This definition distinguishes between the economic activity generated from producing traditional forest products (e.g., pulp, paper, lumber) and new, advanced bioproducts, including biofuels, biochemicals, and other biomaterials as well as advanced building systems (e.g., cross-laminated timber). It also recognizes that the creative application of existing processes to new situations can achieve new solutions. Advancing the bioeconomy requires advancing new knowledge areas, including those based on either advanced genomic research or traditional ecological and Indigenous knowledge.

Potential forest biomass comes from a variety of sources:

- sustainable wood supply and biomass plantations (e.g., fast-growing willow species);
- residues or co-products from manufacturing processes;
- harvesting residues;
- nonmerchantable or unmarketable trees;
- trees and branches removed when rural and urban forest stands are thinned;
- construction and demolition wood waste; and
- trees killed by natural disturbances such as fire, insects, or disease.

Purpose of the Framework

The framework's aim is to advance the next generation of forest sector transformation and diversification efforts in Canada by responding to the critical need for improved policy coherence. It also represents an opportunity to better collaborate and mobilize initiatives, identify and address knowledge gaps, and measure progress. The framework affirms that the CCFM is taking action to stimulate the forest bioeconomy as part of a monumental Canadian effort to shift our society toward a low-carbon, highly innovative, and sustainable future. This framework is the next step toward achieving a robust bioeconomy in Canada.

The framework is uniquely Canadian. It reflects our geography and history, in particular our multijurisdictional approach to resource management as well as federal and provincial relationships with Indigenous peoples. This approach recognizes that implementation may differ across jurisdictions and that the framework is nonbinding. Finally, the framework establishes clear links between the forest bioeconomy and other strategic priorities, including implementing actions to address climate change, developing innovation clusters and clean technologies, and creating meaningful employment.

Engaging Canadians on the Future of Canada's Forest Bioeconomy

In October 2016, the CCFM launched an engagement campaign to garner input from Canadians on how to advance Canada's forest bioeconomy. The CCFM engaged stakeholders not traditionally involved in the forest sector who could benefit from and promote innovation in this sector. Broad-based, facilitated engagement sessions were held in Montréal, Vancouver, and Moncton. Targeted outreach also occurred in smaller communities to examine local and regional variations. To increase access and allow for greater diversity in participation, there was an online component to the campaign.

In total, over 350 people contributed input, including 54 through the online survey. Participants represented a wide range of backgrounds, including the forest sector, academia, research organizations, granting agencies, Indigenous groups, bioenergy firms, gas utilities, and financial institutions. These engaging dialogues were instrumental in creating this vision to transform Canada's forest bioeconomy.

OPPORTUNITIES, CHALLENGES, AND THE NEED FOR TRANSFORMATION

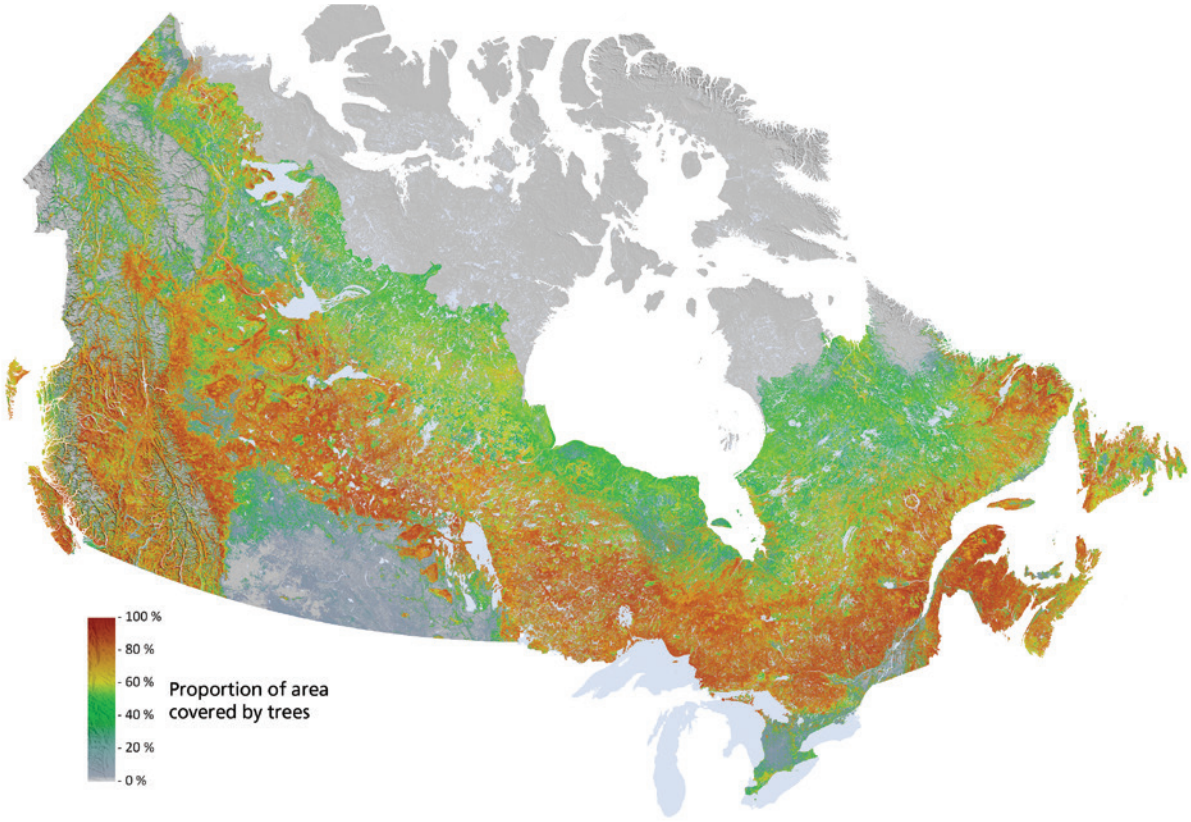
The desire to develop the Canadian forest bioeconomy stems from its potential to respond to several key challenges facing our country. Constantly changing market conditions have spurred the forest sector to seek new opportunities through more effective forest management and operations, increased competitiveness, and the commercialization of innovative products that will reach new markets and help revitalize the industry.

Canada's potential to be a world leader in sustainable biomass supply presents an opportunity to develop a new industry based on the conversion of biomass into manufacturing inputs. At the same time, domestic and international concerns about climate change are ever increasing. More and more, consumers seek clean technologies, energy sources, and manufactured products that limit or reduce carbon outputs while preserving biodiversity. The forest bioeconomy requires investment in innovative supply processes, biomass conversion technologies, and value-added products that will revitalize an important Canadian industry, bring employment to rural communities, and help to mitigate climate change all while catalyzing Canada's innovation sector.

Canada's Biobased Advantage

Canada contains the most biomass per capita in the world and represents 6.5 percent of the world's theoretical bioenergy potential. Canada's 347 million hectares of forests represents 9 percent of the world's forests resources. The total volume of wood in Canada's forests is estimated at 47 billion cubic metres as of 2016 and the majority of Canada's forests, 94 percent, are on public lands. Approximately 166 million hectares of forests are third party certified as sustainably managed. In 2014, only 0.72 million hectares were harvested, which is only two-thirds of the allowable cut. During that same year, 3.9 million hectares were burned in forest fires across Canada.

In terms of production, Canada is the second-largest exporter of forest products in the world. Canada has a mature and efficient wood fibre collection system. Federal, provincial, and territorial governments and the Canadian forest industry have continually improved operational efficiencies in collecting and processing wood fibre, as well as in characterizing wood fibre inventories



and attributes. By leveraging these supply chains, Canada can meet part of its future energy, chemical, material, and building needs with renewable forest feedstock.

Canada also has a robust and dynamic agricultural sector. Canada's agricultural and agri-foods supply chains are efficient and well integrated into global markets. By working together and sharing knowledge, the agriculture and forest sectors can tackle shared challenges and promote shared opportunities to encourage product and technology innovation as well as develop robust markets.

Forest biomass supply chain modelling remain a challenge for the evolving bioeconomy industries. Improved spatial inventories of fibre availability by type and region are required to connect supply with current and future demand.

Innovation in Canada

Canada is recognized as one of the world's best countries for attracting investment with a business friendly institutional environment. It has a sound banking system, a competitive tax regime, a well-educated and highly skilled labour force, clean and low-cost power generation, and trade networks that are highly integrated with the global economy.

Despite these advantages, Canada faces persistently low levels of productivity growth. The Advisory Council on Economic Growth notes that, based on current trends, annual growth in the gross domestic product (GDP) in Canada could slow significantly, perhaps to as low as half the rate of the past 50 years. Canada invests about 1.6 percent of GDP ($31.6 billion per year) in research and development (R&D) compared to an average of 2.4 percent in other Organisation for Economic Co-operation and Development (OECD) countries. Similarly, private investment in R&D by Canadian companies is below the OECD average. Furthermore, clean technology venture capital and debt financing remains relatively thin, limiting the ability of entrepreneurs to commercialize their ideas. According to Sustainable Development Technology Canada (SDTC), the quality of Canadian R&D is high and researchers are strong in generating publications, but gaps remain in idea commercialization.

The bioeconomy is an area with high-growth potential in both urban and rural areas. Traditional forestry supply chains are integrating with advanced manufacturing through new conversion sites and more efficient transportation networks. In Canada, bioeconomy revenue growth is estimated to be substantially faster than the rest of the Canadian economy, at greater than 10 percent per year over the last decade. Globally, compound annual growth rates from 2009 to 2015 for a variety of bioproducts ranged from 5 to 24 percent. The global market for low-carbon goods and services is valued at over $5.8 trillion, with an annual growth rate of 3 percent.

The forest bioeconomy could open new revenue streams for producers. The challenge for Canada is to realize this potential.

Canadian Forest Sector Innovation: *Collaborating, Engaging, Mobilizing*

Today, we see a critical need for forest industry transformation that is focused on innovation. Canada's markets for books, newspapers, telephone books, flyers, and directories have shrunk as the Internet and smartphones fundamentally alter the way people access information. Proactive measures and forward thinking on new ways of using wood fibre and maximizing the value derived is crucial.

Canada is a recognized thought-leader in devising new pathways for using forest biomass. Important strides have already been made toward developing our forest bioeconomy. The bioeconomy is an important component of industrial renewal and transformation, and of market diversification to reduce trade risks.

Beginning in 2009, the Bio-pathways Project conducted a comprehensive investigation into the opportunities for Canada's forest products industry to produce a wide range of bioproducts from wood fibre. The Forest Products Association of Canada, FPInnovations, and the Canadian Forest Service guided this project. The Bio-pathways Project concluded that Canada's forest products industry is ideally positioned to excel in the new, dynamic, high-growth global marketplace for bioproducts.

Some of the wood fibre that is traditionally used for making paper is being redirected to other innovative uses. For example, by breaking down wood into its central components—cellulose, hemi-cellulose, and lignin—it is possible to produce a range of substances that can be used to manufacture a variety of common household products, including makeup, toothpaste, and LCD screens. Cellulose extracted from woody biomass can be processed into cellulose nanocrystals, a high-strength, electro-magnetic product that can be used to manufacture new and advanced materials using nanotechnology or cellulose filaments. Public-private partnerships have been fueling these endeavours. Technological advances and partnerships with biotech companies are creating new, viable transformational pathways.

Achieving our Climate Targets

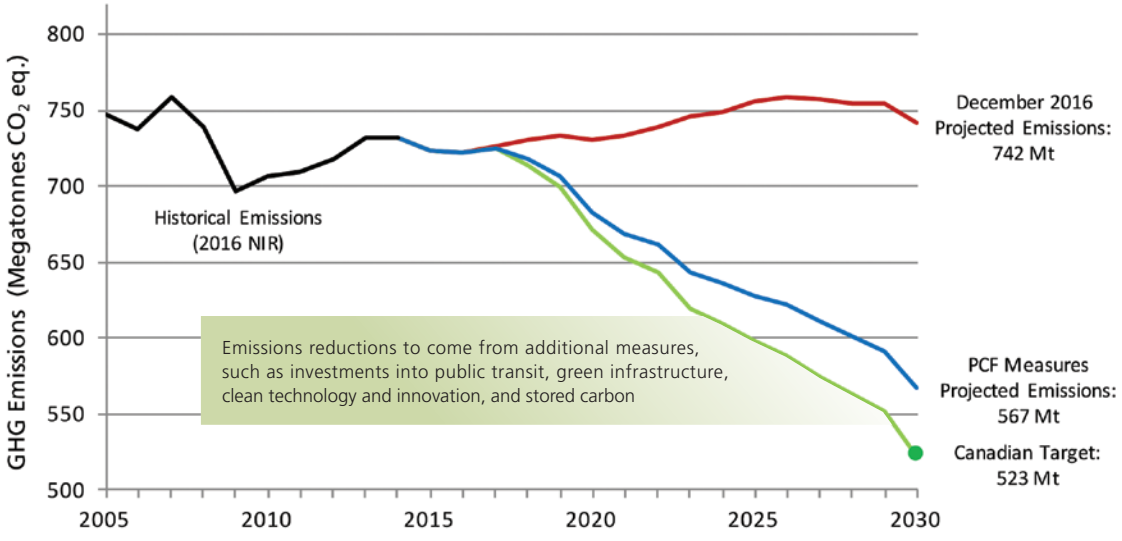
Climate change is an ever-present and accelerating issue of concern for Canadians and the international community. Under the Paris Agreement, Canada's target is a 30 percent reduction in greenhouse gas (GHG) emissions below 2005 levels by 2030. Under the Pan-Canadian Framework on Clean Growth and Climate Change (PCF), jurisdictions have made commitments to price carbon, accelerate innovation, support clean technology, and take additional complementary actions to encourage market adoption of low-carbon products and technologies. The pathway to meeting Canada's 2030 commitments requires new actions that will reduce Canada's emissions by 219 megatonnes of carbon dioxide equivalent.

The need to address climate change presents an opportunity for the forest sector. The PCF outlines specific, new actions for reducing emissions and increasing carbon sequestration via the forest, including:

- Protecting and enhancing carbon sinks in forests through land-use and conservation measures.
- Increasing the use of wood in construction, including through updated building codes.
- Generating bioenergy and bioproducts that are substitutions for more emissions-intensive products.
- Enhancing innovation in GHG-efficient management practices in forestry.

The management of forests can be adjusted to reduce emissions. Because trees grow by absorbing CO_2 from the atmosphere, increasing forest cover can increase carbon sequestration and storage. Also, the use of solid wood products and advanced bioproducts can help mitigate the increase in atmospheric CO_2 concentration. For example, harvest residues and other waste wood can be used for energy in place of fossil fuels. Harvested wood products, such as building construction materials, are essentially long-term stores of carbon while bioproducts can be substituted for fossil fuel-intensive products such as steel, cement, chemicals, and plastics. Carbon offset protocols are under development, as are carbon accounting standards, to better understand the carbon footprint of the bioeconomy.

Finally, building green infrastructure and green spaces is another pathway to a low-carbon future and healthier communities. The addition of urban forests would cool urban cores and reduce energy consumption while improving air quality and well-being for community members.



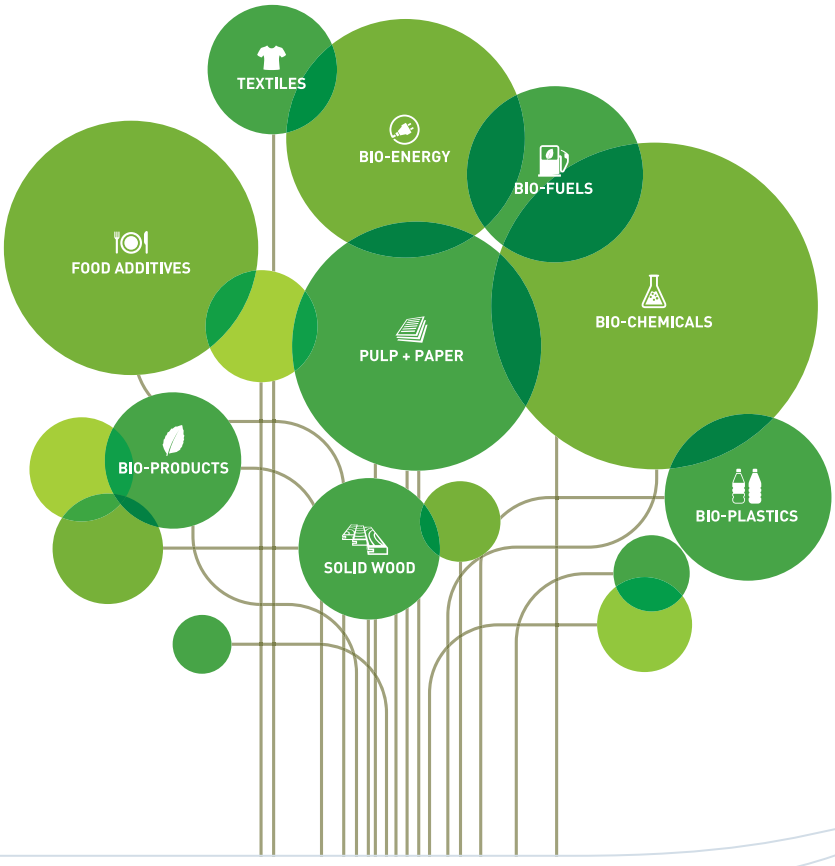
Emissions projections to 2030, including Canada's target under the Paris Agreement

Clean Technology and Biorefineries: A Role for Biomass

The forest bioeconomy is an important part of the "cleantech" ecosystem. Cleantech refers to technologies that improve business performance, use resources more responsibly, and reduce or eliminate negative environmental impact. Cleantech products that use forest biomass can lower the impact of natural resource development in Canada. For example, the chemical industry uses significant amounts of fossil fuels, which contributes to climate change and emits toxic substances; forest biomass presents a greener alternative.

Biorefineries are facilities that integrate biomass conversion processes and equipment to produce fuels, including biojet fuel, and other advanced bioproducts, such as power and chemicals. Like oil refineries, which produce multiple fuels and products from a barrel of oil, biorefineries maximize the value of biomass by turning it into a variety of end products. Biorefineries can be considered an extension of traditional pulp and paper production processes. For example, a biorefinery could produce a high volume of liquid transportation fuel while at the same time generating heat for internal use, electricity for sale, and chemicals and plastic-like polymers historically derived from oil—all while reducing GHG emissions. Lignin can also be used to generate power with a lower carbon footprint than traditional methods.

Rural and remote communities face different challenges from urban and suburban centres. Energy costs are high in many areas of Canada and biofuels could be a cost-effective alternative that can stimulate regional economic growth. The high cost of living is a barrier to residency in many outlying regions of the country. Small communities are well positioned for district heat distribution systems, in particular those located in northern and remote communities. Biomass can be cheaper than oil, and communities can realize savings on heating costs. An increased demand for wood pellets, wood chips, and other biomass supports opportunities to build local industries.



DESIRED FUTURE STATE

Vision

The vision behind this framework is simple yet bold: Canada will be a global leader in the use of forest biomass for advanced bioproducts and innovative solutions. Canadians and the global community are increasingly seeking low-carbon, sustainable options. There are multiple sources of clean energy in Canada: hydroelectric, wind, tidal, geothermal, solar, and bio (for electricity, heat, and fuels). However, biomass is the only renewable source that can substitute the carbon from fossil fuels found in chemicals, plastics, and composites. As consumer awareness increases and expectations change, the framework will position Canada's forest bioeconomy as a leader in renewable and innovative solutions without significantly disrupting the daily activities of Canadians.

Emerging demands will drive the transformation and expansion of Canada's forest industry to heightened levels of competitiveness and foster a culture change within the industry while crowding-in new investment. At a societal level, the forest bioeconomy is more than the application of innovative technologies to forest biomass. It also includes forest and biomass supply management, building design, community resilience, consumer behaviours, and the sustainable production of ecological goods and services from Canada's forests. A forest bioeconomy will maintain and enhance the role that forests play in shaping cultures, our shared heritage, and the economic future of Canadians.

An optimal forest bioeconomy involves clever thinking to facilitate a circular economy, whereby resource inputs and wastes, including emissions, are minimized and resources are utilized for as long as possible to extract maximum value. The forest bioeconomy seeks to transform the Canadian economy by eliminating the landfilling of organic materials since these waste assets will be fully used as valuable inputs. Buildings made from wood will be deconstructed not demolished, residents of cities will enjoy the health benefits of urban forests, and consumers will have options to shop for biodegradable products and products made from recycled biomaterials. The circular economy will emerge from forestry management based on high-quality data and cutting-edge technology, including virtual reality, that is calibrated to local needs and conditions to maximize efficiency and minimize waste.

Expected Outcomes

This framework seeks to increase the use of forest biomass in Canada's economy. The anticipated results include new investments, more jobs, more revenues, better engagement with Indigenous peoples, new businesses, new partnerships, new supply chains, new technologies, better inventory information, and greater overall awareness of the integral role forests play in the Canadian economy.

The framework seeks to establish world-leading conditions for forest bioeconomy companies to do business, attract international investment, and conduct collaborative research. The industry's history of innovation and past investment as well as existing infrastructure can be leveraged to jump-start the forest sector's transformation. The framework will support further progress by providing the information needed to make strategic decisions about supporting cutting-edge, low-carbon alternatives, and developing the skills needed to capitalize on evolving opportunities.

Meeting these goals requires new regional and local models as well as new biomass delivery mechanisms. Finding solutions and boosting the economies of remote communities (e.g., by producing heating and energy from biomass) are as important as the development and commercialization of breakthrough technologies in urban research hubs. Overall, enhancing inclusiveness is imperative.

Sustainable Forest Management and Forest Science

Canada has one of the highest standards for sustainable forest management practices in the world. The forest industry operates within a framework of multiple jurisdictions and legislation covering various aspects of land management, including land tenure and forest operations on public lands, pollution control, water use, wildlife management, protected areas, invasive alien species, transportation, and timber export. Canada's provinces and territories have jurisdiction over the vast majority of the country's forests, and they develop and enforce forest laws, regulations, and policies.

Healthy forests are important for many reasons, including their effects on air quality, surface and groundwater quantity and quality, wildlife populations, and human health. Governments are exploring new methods of analysis, including more quantitative and integrative approaches, to assess the value of ecological services from living forests and the cumulative effects of development.

The forest bioeconomy requires robust sustainable forest management practices, which cannot succeed without sound science. Science plays a key role in managing forests and in developing new bioproducts and manufacturing systems. It also supports market access and informs regulations and standards, including the environmental, social, and economic criteria that form the basis of sustainable forest management. As the body of evidence demonstrating these effects across a range of geographic scales continues to build, policy makers need a more detailed and comprehensive accounting of the costs and benefits of the current and planned use of forests.

ACHIEVING OUR VISION

COMMUNITIES and Relationships

Pillar 1 Communities and Relationships

Communities are at the centre of Canada's forest bioeconomy. Balancing the goals of forest companies with the needs of communities, including creating green jobs and generating income, is essential. The forest bioeconomy offers opportunities for women, Indigenous peoples, and new Canadians to find employment in this growing sector. Education and skills training must be accessible to all Canadians. In particular, Indigenous people must be engaged early and often. They have a cultural and spiritual relationship with the forest, which is increasingly integrated into forest management and operations. The forest bioeconomy will help build bridges between urban and rural communities. As metropolitan populations continue to rise, urban Canadians represent the core consumer base for advanced bioproducts. Furthermore, municipalities tasked with improving quality of life are actively seeking sustainable solutions and products.

OBJECTIVE 1A ADVANCE GREEN EMPLOYMENT

The forest sector is already a significant source of "green" or sustainable employment. The opportunities for green jobs will continue to grow as the bioeconomy advances and as the Canadian economy creates more green jobs in other sectors. Already the forest bioeconomy experiences intense competition with other sectors to attract new graduates and talent. Private forest owners play an integral role in advancing green employment, particularly in rural communities. Training programs in relevant engineering, technology, and forestry skills need to be widely available and schools must successfully connect new graduates with employment opportunities. Skilled tradespeople are the key to maintaining and advancing a low-carbon, sustainable economy.

Example policy measures

- Engage youth to increase participation in the forest bioeconomy, including the promotion of career paths in the traditional and nontraditional forest sector (e.g., advanced engineering and manufacturing, drone technology, virtual reality).
- Enhance skills development to ensure workers can participate in innovative bioeconomy operations, in particular in rural communities.
- Engage with municipalities and communities to promote the benefits to health and well-being of urban forests (e.g., smart cities, resilient communities).
- Recognize the potential role of cooperative or regional biomass aggregator models and private forest owners.
- Work with communities to implement solutions to reduce reliance on diesel in rural and remote communities.

OBJECTIVE 1B PROMOTE PARTNERSHIPS WITH INDIGENOUS PEOPLES

Already, the forest industry directly or indirectly employs approximately 10 000 Indigenous persons, primarily in silviculture and woodland operations, and does business with more than 1400 Indigenous firms. In recent times, growing recognition of Indigenous rights to land and natural resources has resulted in more Indigenous involvement in forest management decisions and more partnerships between Indigenous peoples, governments, and forest-based businesses. Formal science and traditional knowledge can co-create sustainable forest practices and renewable product development. Communities can be involved in the transformation of the forest sector in many ways, including as decision makers, workers, forest resource managers, business partners, landowners, and neighbours.

Example policy measures

- Continually engage Indigenous peoples on their respective visions for Canada's long-term bioeconomy future.
- Recognize Indigenous peoples as key partners in the forest bioeconomy, including as business owners, biomass suppliers and consumers, knowledge partners, and tenure holders.
- Develop tools and practices and use traditional ecological knowledge to balance traditional use of lands and resources with ways to participate in the bioeconomy.
- More effectively enable Indigenous participation in integrated natural resource development through business planning, capacity building, and employment opportunities.
- Explore opportunities to enhance the use of traditional Indigenous bioproducts.

SUPPLY of Forest Resources and Advanced Bioproducts

Pillar 2 Supply of Forest Resources and Advanced Bioproducts

To produce advanced bioproducts at commercial levels and meet market demands for biobased goods and services, bioproduct industries require predictable and secure access to biomass in order to de-risk projects. Supplying sufficient amounts requires the sustainable production of forest fibre and new supply chain arrangements to support conversion facilities. Although Canada's forest sector has highly integrated and efficient supply chains for traditional products, harvesting and processing rates depend on global macroeconomic trends. This dependency affects the supply of residual fibre. Partnering strategically, particularly with established forest companies, is a proven method for accessing inventory information, de-risking supply, and diversifying revenue streams. Private woodlot owners can offer flexibility and innovative approaches to supplying fibre as well as offering long-term supply contracts.

OBJECTIVE 2A ESTABLISH EFFECTIVE STANDARDS

Standards and certification are critical components of a thriving industry. They guide and protect market participants and can influence market incentives and pricing to support nascent technologies. Advancing Canada's forest bioeconomy requires updated standards that enable the purchase and trade of forest biomass resources and advanced bioproducts. Clear processes for establishing new standards would accelerate the growth of the bioeconomy, as would standards for biomass feedstock. Schemes to certify product quality have been introduced so that biomass suppliers can demonstrate compliance with national and international regulations on the quality and sustainability of their products. Finally, modern building codes and standards need updating since existing codes and standards were developed based on cement and steel structures, not heavy timber or engineered wood products.

Example policy measures

- Formalize cross-jurisdictional platforms to increase the efficiency of commercializing new bioproducts.
- Work with industry and municipalities to amend building codes to increase opportunities for engineered wood products (e.g., for tall wood buildings).
- Support establishing and promoting classifications for biomass feedstock (e.g., lignin, pellets, cellulose nanocrystals).
- Continue to advance science to support a resilient, long-term fibre supply.

OBJECTIVE 2B ENHANCE DATA COLLECTION AND MANAGEMENT

There is limited official data on Canada's bioeconomy. Modelling tools that can determine the benefits of using innovative bioproducts are not readily available. Many start-up companies lack in-house expertise and financial resources to provide the necessary data and life-cycle analyses required by granting agencies, financial institutions, and venture capitalists. Collecting and updating comprehensive data as well as developing new modelling tools will have multiple impacts on the bioeconomy. First, it will help researchers and investors to understand and quantify the bioeconomy's many opportunities. Second, it will improve decision-making capabilities regarding new project development and the analysis of new project sites. Finally, it will enable strategic partners to predict the scalability of the models. Improved life-cycle analysis and measures, such as establishing environmental product declarations, would inform consumers and investors about product sustainability and could enable more accurate pricing mechanisms.

Example policy measures

- Catalyze investment by establishing mechanisms to capture official data on size and growth of Canada's bioeconomy (e.g., Statistics Canada) and standardizing data communication.
- Leverage programming results to work with the financial sector and industry and to develop methodologies for measuring the performance of the forest bioeconomy as an asset class (e.g., data sharing, roundtables).
- Increase data on information of environmental benefits of forest bioproducts (e.g., environmental product declaration, life-cycle analysis).
- Develop and enhance biomass inventory models and tools for improving information on biomass supplies, including waste streams.
- Explore innovative mechanisms and improved analytics to de-risk supply chains.

DEMAND for Advanced Forest Bioproducts and Services

Pillar 3 Demand for Advanced Forest Bioproducts and Services

Public perception can generate a level of excitement sufficient to motivate the next generation of innovators and entrepreneurs and attract international finance and global talent to Canada's forest bioeconomy. The success of the bioeconomy relies on society changing its consumption habits yet behavioural patterns will not change without a high level of public confidence in the sustainability of bioproducts. Regulations that are cumbersome, redundant, or outdated will hurt the productivity and competitiveness of emerging industries. The forest industry transformation of recent years is evident in the diversification and differentiation of products, the development of new processes, and the creation of niche operations.

OBJECTIVE 3A COORDINATE OUTREACH AND MARKETING

A positive public perception is essential to increase the demand for forest bioproducts. Actions can be taken to better inform consumers and businesses, allowing them to consider alternatives and make more sustainable choices on housing, transport, consumer goods, and chemicals. Governments in Canada have a key role to play in actively engaging consumers and communicating the advantages and sustainability of Canada's forest management regime. Effort is required to provide international markets with robust evidence that new, innovative bioproducts have tangible ecological benefits. Communication, outreach, and marketing efforts can be strengthened through science-based approaches to ensure transparency and instill confidence in stakeholders.

Example policy measures

- Communicate the advantages of investing in Canada's forest bioeconomy, including the environmental and carbon benefits.
- Engage domestically and internationally to communicate the environmental, economic, and social benefits of Canada's forest sector to expand market opportunities.
- Outreach internationally to promote the sustainability of Canadian forest bioproducts and services and their environmental and carbon benefits.
- Work with designers, architects, builders, and code officials, and across governments, to communicate the benefits of building with wood in nonresidential and multiresidential construction.

OBJECTIVE 3B SUPPORT BIOECONOMY PROCUREMENT PROGRAMS

The purchasing power of the public sector is a powerful economic driver. It can influence markets and stimulate demand for green products, including those derived from forest biomass. Governments should consider the full effects of ecologically beneficial alternatives

while still protecting taxpayer resources. Using government purchasing to provide innovative companies with stable off-take agreements would help them establish a proven track record and instill confidence in other potential purchasers. There is also an opportunity to collaborate across jurisdictions by supporting demonstration projects, identifying best practices, and sharing information.

Example policy measures

- Include forest bioproducts as key components of a procurement strategy to green government operations.
- Recognize the relative reductions in GHG emissions from using wood in awarding contracts for public works.
- Introduce green "bio" procurement programs that can include forest bioproducts (e.g., use of environmental performance indicators).

OBJECTIVE 3C DEVELOP EFFECTIVE AND UPDATED REGULATIONS TO MAXIMIZE MARKET OPPORTUNITIES

Regulations affect the advancement of Canada's forest bioeconomy in two general ways: regulations can act as barriers to project development or regulations requiring biocontent can stimulate demand. First, bioeconomy projects, such as bioheat production, face barriers because regulations may be outdated or inappropriate for the technologies deployed, leading to project delays and increased costs, ultimately causing viable projects to fail. Jurisdictions have implemented initiatives to improve Canada's regulatory framework, but more can be done. Second, regulatory requirements for biocontent, such as clean fuel standards, are a powerful tool for increasing demand. Overall, streamlined and targeted regulations are needed to facilitate the production and sale of a broad range of low-carbon energy sources and technologies.

Example policy measures

- Consider increasing the biobased content of fuels, heat, and materials.
- Review regulatory processes to ensure they are updated and appropriate, including to enable community-level bioheat and power projects (e.g., air and water emissions regulations).
- Collaborate to enhance forest carbon sinks through actions such as planting trees, improving forest management, and minimizing losses from fires and invasive species.

Support for INNOVATION

Pillar 4 Support for Innovation

Increased demand for bioproducts necessitates the testing of a variety of innovative concepts, particularly those solutions that can meet or exceed the performance of existing petroleum-based products. Researchers need access to world-class laboratories and support from skilled technicians as well as access to networks that challenge their thinking, pollinate new ideas and disseminate findings. After these products and technologies are demonstrated and proven, entrepreneurs require clear pathways to scale up. Innovators need access to investment funding and markets while investors expect financial returns commensurate with perceived risks. A range of mechanisms are required to promote the development of new products and level the innovation playing field. Support should cover the full innovation system from early stage partnerships through to initial commercial uptake.

OBJECTIVE 4A FACILITATE AN INNOVATION ECOSYSTEM

Concerted efforts are required to expand the project pipeline of high-quality and bankable projects that use forest biomass. Focusing on both new entrants and on public and private actors would increase the flow of investment opportunities. A bioeconomy hub would help increase the appetite for investment and provide guidance on leading practices that will enable funding agencies and financial institutions to close on projects faster and more cost effectively. Advanced manufacturing drives the forest bioeconomy. Encouraging the development of clusters around the bioeconomy concept will leverage the cross-sectoral nature of the industry: a technology-driven business cluster will create stronger links and partnerships and leverage existing infrastructure to attract anchor companies from around the world.

Example policy measures

- Mobilize a bioeconomy hub to act as a convenor among collaborators, facilitate access to data and resources, and promote experimentation in delivery.
- Convene forest industry and other sectors to facilitate a bioeconomy cluster.
- Collaborate with the agricultural sector to identify common challenges and to promote common benefits of advanced bioproducts.

OBJECTIVE 4B SUPPORT CONTINUED RESEARCH, DEVELOPMENT, AND DEPLOYMENT

The transformation of the Canadian forest sector is still in its early stages. Support for the innovation pipeline is necessary if the development of new products and processes is to continue. Although support exists for research, development, demonstration, and the deployment of new technologies, a seamless array of mechanisms is needed to fully achieve success. Optimizing the growth of the forest bioeconomy also requires embedding innovation systems within regional land-use planning processes. Overall, new science-based forest

management tools would ensure that available options contribute effectively to climate change mitigation.

Example policy measures

- Prioritize programming that supports novel concepts and breakthrough technologies, including with FPInnovations and the National Research Council.
- Collaborate to develop a long-term strategic approach to supporting foundational research that advances the forest bioeconomy (e.g., Natural Sciences and Engineering Research Council of Canada, Mitacs).
- Recognize the cross-sectoral nature of the forest bioeconomy to promote partnerships with nontraditional stakeholders.
- Advance research to quantify the value of forest-related ecosystem goods and services.

OBJECTIVE 4C DEVELOP INNOVATIVE FINANCIAL MECHANISMS

Financing the forest bioeconomy requires significant capital investments and knowledgeable strategic partners. Investment options must include patient approaches because commercializing new ventures takes time, often more than anticipated. Canada's venture capital and debt financing markets are highly competitive hence one-off investments are difficult to secure. Securing capital requires astute investors and a suite of products available to de-risk projects. Tax policy incentives provide opportunities to level the playing field between forest bioeconomy ventures and traditional natural resources extraction operations. Updating tax measures to reflect the beneficial outcomes of forest bioproducts is an important aspect in keeping Canada competitive while encouraging green growth. Carbon pricing will be in effect across Canada by 2018. A conscious effort is needed to ensure that carbon pricing mechanisms support the forest bioeconomy as a green alternative.

Example policy measures

- Catalyze both debt and equity financing to help commercialize new technologies (e.g., first in kind, replication, scale-up) and biorefineries, including supporting infrastructure.
- Seek to level the playing field through tax measures (e.g., accelerated capital cost allowances, tax credits), including for forest biochemicals and biomaterials.
- Collaborate to increase the representation of forest bioeconomy companies in current programs by funding agencies (e.g., Export Development Canada, Business Development Bank of Canada, Sustainable Development Technology Canada).
- Facilitate new entrants into the forest sector.

Measuring Results

Canada's progress toward achieving a high-value, low-carbon forest bioeconomy can be measured in many different ways, taking into account the priorities of each jurisdiction. The framework outlines five potential areas and examples of indicators. The specifics of what will be tracked and how information will be obtained and shared will be finalized over the next two years, with the goal of establishing baselines by 2019.

SIGNIFICANCE OF THE FOREST BIOECONOMY IN THE CANADIAN ECONOMY

The CCFM could monitor the contributions of new and innovative products and other forest bioeconomy activities to the Canadian economy. Examples of indicators:

- Contribution of the forest bioeconomy to GDP.
- Number of forest bioeconomy workers.
- Number of partnerships with Indigenous peoples.
- Biomass inputs available for advanced processing.
- Value of advance bioproducts as compared to traditional forest products.

SUPPORT FOR FOREST BIOECONOMY SCIENCE

The CCFM is uniquely placed to support and monitor collaboration in the forest bioeconomy and could monitor and encourage collaboration initiatives. Examples of indicators:

- Number of forest bioeconomy academic networks and centres of excellence.
- Number of research chairs, research programs, and students.

SUPPORT FOR THE FOREST BIOECONOMY

The CCFM could track successes across the country and across jurisdictions, as well as ensure information on progress is readily available to share best practices. Examples of indicators:

- Number/value of existing or emerging federal/provincial/territorial initiatives, efforts, and projects.
- Investment in bioeconomy diversification initiatives.
- Number of forest bioeconomy businesses supported by funding agencies.
- Information availability on forest bioeconomy products and processes.

VALUATION OF ECOSYSTEM GOODS AND SERVICES

The CCFM could work to advance our understanding of the value of these forest ecosystem goods and services, on a regional basis. Example of indicators:

- Quantifying the value of forest ecosystem goods and services, as available regionally.

IMPACT OF THE FOREST BIOECONOMY

The forest bioeconomy can contribute to GHG reductions. Examples of indicators:

- GHG emissions avoided annually from bioeconomy activities.
- Carbon sequestered from increased use of bioproducts.
- Number of rural and remote communities with decreased reliance on diesel due to increased use of forest resources.
- Increase in wood use for nonresidential construction and multi-unit construction, including tall wood buildings and infrastructure made from wood.
- Amount of biorefining capacity in Canada, including for biofuels.