

Forest Sector Innovation in Canada

2015

The Canadian Council of Forest Ministers brings together provincial, territorial and federal government representatives with interests in the forest sector to address inter-jurisdictional issues of mutual relevance. As a key pathway to enable the ongoing transformation of the Canadian forest industry, this Council identified innovation as a priority area for action in 2013-2014. This white paper, consisting of lessons learned from other countries and other industrial sectors, was designed to complement the 2015 Compendium of Current Forest Sector Innovation Initiatives, with a view to informing pathways for action for the CCFM moving forward. This paper is based on the analyses of independent consultants and does not necessarily reflect the views of the Council.

White Paper:
Opportunities
for the
Canadian
Council of
Forest Ministers

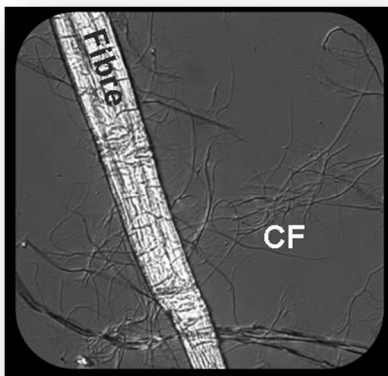


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Introduction

The Canadian forest industry provided direct employment for about 209,000 Canadians in 2013, primarily in highly skilled jobs offering attractive wages. In 2013, the sector contributed \$20.9 billion—or 1.2%—to Canada’s total gross domestic product, and generated the world’s largest forest product trade balance (\$19.2 billion). No nation derives more net benefit from trade in forest products than Canada.

Although not immune to the boom-bust cycles typical of natural resource-based industrial sectors, the Canadian forest sector was traditionally regarded as a low-cost producer of top-quality pulp, paper and lumber, enviably positioned adjacent to the United States – the world’s largest, most lucrative forest products market. In 2007-2008, however, this story changed abruptly with the arrival of a ‘perfect storm’ of cyclical and structural pressures that called into question the economic viability of the forest industry. The collapse of the American housing market and imploding demand for newsprint, in combination with the rise of the Canadian dollar and intense international competition shook the sector to its foundations. The ensuing period saw the closure of more than 150 mills, the bankruptcies of eight major firms and more than 130,000 jobs lost across Canada.

As Canada and the world began the slow process of recovering from the recession, it became apparent that the operating context for Canadian forest product producers had changed. Despite relentless cost-cutting and consolidation measures, the business model that had served the sector for decades had become economically unsustainable for many of this country’s major players. Both industry and governments recognized that, without a fundamental transformation, many forest industry sub-sectors were set on a fast course to marginalization, with far reaching effects on vulnerable forest dependent regions.

Forest sector innovation, including the development and commercialization of novel products, processes, business models, markets and applications, is critical to the transformation necessary for sector renewal. Through innovation, the forest sector can capitalize on high-value opportunities such as those in the emerging bioeconomy¹, which is expected to be worth more than \$200 billion globally in 2015². By incorporating and expanding the production of bioenergy and bioproducts at existing facilities, firms can maximize the value derived from each unit of forest fibre harvested, thereby accessing new revenue streams while generating environmental benefits, rural development and energy security for Canadian communities. Innovation is also the mechanism by which the forest industry will be able to harness emerging technologies to adopt client-driven business

¹ The bioeconomy refers to economic activity based on the production of innovative (non-conventional) products, including bioenergy, from biomass (forest, agriculture, marine and waste) using novel technological processes.

² Forest Products Association of Canada. 2011. The new face of the Canadian forest industry: The emerging bio-revolution and the bio-pathways project.

approaches that facilitate movement beyond commodity-focused production, and pave the way for renewed economic viability moving forward.

Although the 2008 recession marked an extreme intensification of the pressure for innovation, at that point, the Canadian forest sector had already taken strides towards an innovation-focused industry transformation. In 2003, the Canadian Forest Innovation Council set forth a framework for the creation of a public-private forest research organization that would bring together industry, government and academic experts with the goal of advancing innovation in the sector. In 2006-2007, the pillars of this framework were implemented, with the creation of FPIInnovations, the world's largest not for profit forest research organization. Since that time, other significant developments have occurred. Beginning in 2008, Natural Resources Canada's Canadian Forest Service (CFS), in collaboration with FPIInnovations and the Forest Products Association of Canada (FPAC), began the Future Bio-pathways Project, an analysis of the economic and employment impacts of developing bioeconomy applications in Canadian forest products facilities (Phase 1 released February 2010). Today, federal initiatives including the Forest Innovation program³, the Expanding Market Opportunities program and the Investments in Forest Industry Transformation (IFIT) program, often in partnership with provincial or territorial initiatives, are building on the themes and conclusions in Bio-pathways, and supporting the development and commercialization of a range of market driven innovations (often world-first technologies!), from cellulose nanomaterials and lignin, to biomethanol and engineered fibre mats.

In conjunction with these federal activities, provinces and territories are also undertaking targeted measures to support forest sector innovation. Many have developed strategies or roadmaps to assist firms attempting to navigate regional bioeconomy opportunities (Figure 1). In addition, provincially-funded research, infrastructure investments and innovation-focused funding intermediaries have brought about numerous regional successes.

Although significant forest sector innovation advancements have taken place, further sector transformation is required to enable the economic sustainability of many industry sub-components in the medium term. At present, the majority of large forest industry firms in Canada remain focused on core business models and improving the production efficiency for conventional commodity

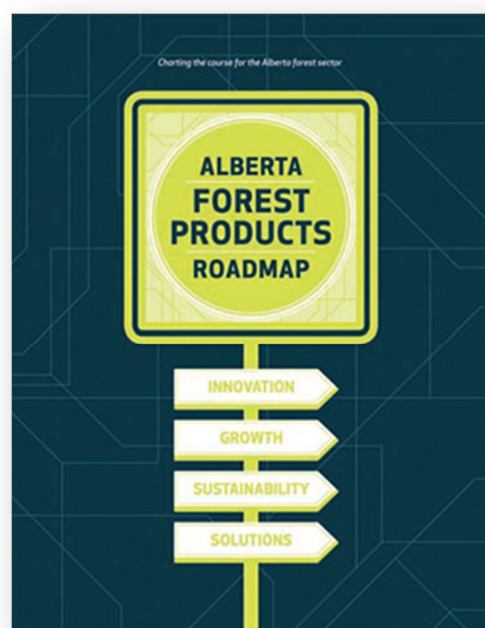


Figure 1. Alberta's forest products roadmap: *Charting a course for the Alberta forest sector* (2012), assesses the sector's strengths, weaknesses and opportunities and sets forth a series of milestones toward the bioeconomy.

³ Encompasses the Transformative Technologies program.

goods. Private investment in research and development initiatives by forest sector companies mirrors wider national trends for Canadian industry, with rates well below those seen in other countries^{4,5}. Barriers to innovation persist, including limited access to investment capital, high technical and business risk associated with technology scale-up, difficulties accessing highly qualified personnel, cultural aversion to moving outside core business lines and missing linkages in the forest sector innovation system. Much remains to be done before the Canadian forest industry as a whole is positioned to capitalize on the strong growth and high value associated with emerging markets for innovative forest products.

⁴ Natural Resources Canada – Canadian Forest Service. Internal Analysis. 2014-2015.

⁵ OECD, Main Science and Technology Indicators; cited in Seizing Canada's Moment: Moving forward in science, innovation and technology. Industry Canada 2014.

Canada's Forest Sector Innovation System

Innovation involves the application of knowledge and ingenuity in a novel way to solve problems and take advantage of opportunities. Innovation occurs in several stages: it is initiated through basic R&D, advanced through pilot projects and demonstrations, and finally commercialized and replicated at full-scale industrial facilities. Some innovation activities include technology development, changing business models, shifting methods of workforce education and securing new markets and new applications for products. Innovation also encompasses supporting activities like adaptation of the regulatory framework to include emerging products, processes and practices (e.g., development of product standards for an emerging biochemical, changing building codes to match the properties of next-generation building materials).

In the forest sector, innovation takes place along the entire value chain, from silviculture activities, harvesting practices and log transportation to the manufacturing of wood products, pulp, paper, bio-energy and next generation bioproducts. Innovation permits the sector to enhance economic competitiveness and to maintain or improve its environmental sustainability in the context of changing regulatory frameworks and environmental conditions.

In order to capitalize on synergies, many of the actors who undertake innovation in the forest sector have joined together to form an innovation system. This system reduces transaction costs, improves knowledge transfer and enables other efficiencies. Ideally, innovation systems also work to improve uptake of novel products and processes by consumers and end-user industries, thereby generating greater returns (e.g., revenues, jobs, etc.) for the sector.

The Canadian forest sector innovation system is complex, with a variety of actors undertaking a diverse array of projects with varying degrees of coordination/linkages (Figure 2). In addition to the complex nature of the system, defining the Canadian forest sector innovation system is made even more difficult due to the ephemeral nature of the associated initiatives and changing levels of involvement among partners/agencies. That said, the following section provides an overview of the primary actors in the Canadian forest sector innovation system.

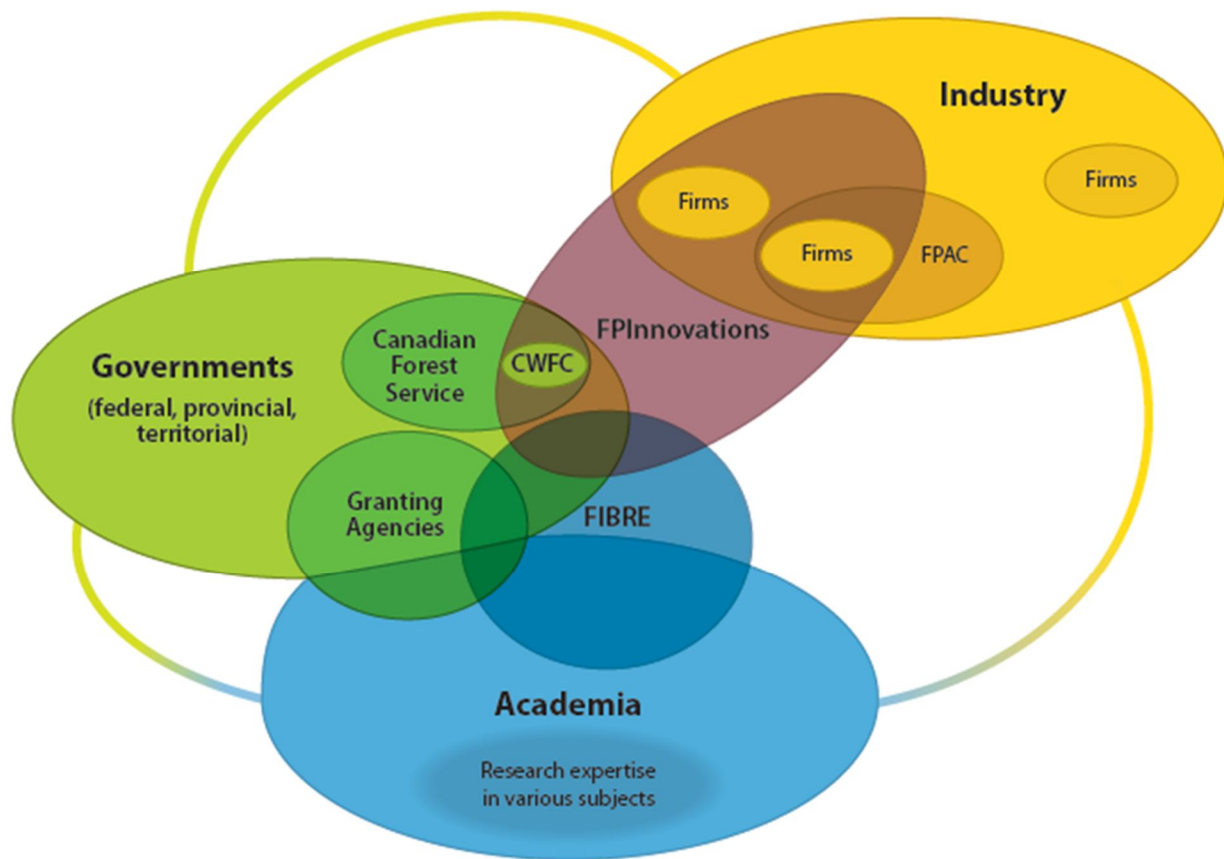


Figure 2: Major players in Canada's forest sector innovation system. (Natural Resources Canada, 2014)

Government

Provincial and Territorial Governments:

Canada's provinces and territories own the majority of the country's forests and are thus accountable for the sustainable development of these resources. Provincial and territorial governments contribute directly to forest sector innovation through targeted industry initiatives (refer to the Canadian Council of Forest Ministers' *2015 Compendium of Current Forest Sector Innovation Initiatives*), general investments in R&D, support for funding intermediaries⁶, as well as participation in FPIInnovations. Many provincial government departments are also key strategic players, developing roadmaps, sector frameworks and other policy tools to promote transformation and bioeconomy development.

⁶ For example, the Government of Alberta's investments in Alberta Innovates - Technology Futures provides innovation, research and commercialization services delivering economic and social benefits to Canadians with significant positive impacts on the competitiveness of forest sector facilities.

The Federal Government:

The department of Natural Resources Canada is the federal authority on matters pertaining to Canada's forests through the Canadian Forest Service (CFS). Over the past ten years, that CFS laid the preliminary groundwork for a revolutionary new R&D governance system that resulted in the formation of FPIInnovations and the Canadian Wood Fibre Centre (CWFC). Today, guided by its Strategic Framework⁷, the CFS is supporting innovation in the forest sector through investment programs that target gaps along the innovation continuum in order to encourage the development and commercialization of novel products and processes in support of long-term sector sustainability. These investment programs are leveraging significant contributions from collaborators in industry and across other levels of government, and help to address the lack of investment capital which was of particular concern to the sector following the 2008 recession. One such program, the Investments in Forest Industry Transformation (IFIT) program, helps forest product facilities commercialize innovative technologies by providing up to 50% of total project costs. The program encourages the diversification of the forest sector product mix by requiring technology advancement and granting preference to projects which involve non-traditional partners. To-date, IFIT has de-risked 14 innovative forest-fibre based technologies, funding a range of projects focussed on bioenergy, biomaterials, biochemicals and next-generation building materials. The CFS continues to provide direct financial support for forest sector innovation to FPIInnovations and the CWFC⁸.

The Canadian Council of Forest Ministers (CCFM)

Created in 1985, the CCFM brings together provincial, territorial and federal governments with interest in the forest sector to address issues relevant across jurisdictions. Given the distribution of forest sector mandates across governments, the CCFM provides a key forum for collaboration and information sharing – helping to align efforts across jurisdictions and unite perspectives and messaging to external stakeholders. Functionally, the CCFM consists of multiple committees, including topic-focussed working groups and the Forest in Mind program which seeks to enhance international recognition of Canada's strong record of sustainable forest management. CCFM activities are funded via contributions from member governments.

Innovation has been a topic of interest for the CCFM for a number of years. In 2008, the Council released "A Vision for Canada's Forests: 2008 and Beyond", a document that presented a long-term, strategic vision for achieving sustainable forest management in Canada focussed on two key areas: industry transformation and climate change. As a complement to that document, the CCFM also produced a Forest Sector Innovation Framework (2008) that set forth a series of target outcomes and supporting CCFM actions with an overarching goal of enhancing the sector's ability to adapt to a changing world. With the sharp economic pressures associated with the global recession (2007-2008) and the severe associated fallout, maintaining focus on innovation was difficult. That said, the structural shifts in competitive advantages that accompanied this period further emphasized the

⁷ Available at <http://cfs.nrcan.gc.ca/publications?id=35238>

⁸ In 2014-2015 Natural Resources Canada contributed approximately \$32 million to FPIInnovations and the CWFC.

importance of innovation, and resulted in this subject again being selected by CCFM Deputy Ministers as a priority area for action in 2012.

FPIinnovations

FPIinnovations was established as a hub of forest sector innovation in Canada through the merger of the three leading Canadian forest research institutions: Paprican, FERIC and Forintek. As such, it is now the largest public-private forest research organization in the world, with representation across a significant portion of Canada's forest sector—FPIinnovations includes 181 members comprising approximately 50% of the forest sector's contribution to Canada's GDP.

As a forest research organization, FPIinnovations focuses on optimizing innovation activities along the entire value chain to generate value for the forest industry in response to market demands. Other work includes efforts to strengthen linkages between actors in the innovation system to accelerate knowledge adoption by forest sector firms. As a private-public entity, FPIinnovations receives funding from Natural Resources Canada, provincial governments and its industry members. As such, its priorities necessarily reflecting the goals and objectives of its members who provide strategic direction by way of the National Research Advisory Committee (NRAC).

Innovation is accomplished by FPIinnovations through two avenues: directly through R&D at its own laboratories or with industry collaborators, and indirectly by participating in priority setting exercises for partners in academia and the Canadian Wood Fibre Centre (CWFC). This two-pronged approach to innovation ensures a high degree of alignment among Canadian research activities and high responsiveness to sector objectives and market needs. In addition, this entity is of sufficient scale to attract contributions and opportunities for collaboration from other funding agencies and industries. FPIinnovations is recognized as a significant and unique advantage of the Canadian industry and was highlighted as a model example of innovative efficiency in the 2011 Jenkins report⁹.

The Canadian Wood Fibre Centre (CWFC)

The CWFC is a collaborative effort between the CFS and FPIinnovations designed to increase the economic return from Canada's unique forest resources through upstream forest research services. The CWFC is composed of CFS staff that conduct research according to the strategic directions set by FPIinnovations. CWFC-led projects seek to increase the value of fibre grown and harvested through state-of-the-art research and collaborative work with industry. For example, in Ontario, enhanced inventory on Tembec Inc.'s 650,000-hectare Romeo Malette Forest is saving the company approximately \$2.4 million per year, just one of many highly successful innovations CWFC is helping to integrate in commercial operations.

⁹ "Innovation Canada: A Call to Action". 2011. Review of Federal Support to Research and Development – Expert Panel Report.

Academia

Universities and colleges are key players in the forest sector innovation system, educating highly qualified people and conducting research that is crucial to the transformation of the forest sector. The Natural Sciences and Engineering Research Council (NSERC) Forest Sector R&D Initiative was established in 2008 through the collaboration of CFS, FPIInnovations and NSERC to leverage the capacity of academic institutions to develop commercially relevant research opportunities. Eight NSERC funded forestry research networks came together in 2011 to form FIBRE (Forest Innovation by Research and Education), a partnership that built synergies among the forest research networks, connecting the 30 Canadian universities, over 100 professors and over 400 graduate students and post-doctoral fellows involved in the networks (current funding for FIBRE networks is set to expire in 2015). In addition, applied research at Canadian colleges and institutes has expanded greatly over the past several years and continues to grow, contributing to innovation in Canada's forest sector. Over 30 colleges and technical institutes in Canada have forest programs and certifications, many of which are conducting forest research initiatives in collaboration with universities and industry.

2008 also saw the creation of a sub-committee, now referred to as the Partner's Committee, to bolster linkages between academia and the forest sector. The Partner's Committee brings together representatives from NSERC, the Social Sciences and Humanities Research Council of Canada, universities, Colleges and Institutes Canada, FPIInnovations, industry and federal and provincial governments, and serves as a key portal for the refinement of the *Forest Industry Innovation Framework* described in the section below.

Industry

Forest sector firms are distinct from other actors in the innovation system, because in addition to participating in the system, they also commercialize innovations in order to remain competitive and respond to changing market forces and the regulatory context. Firms undertake R&D and leverage linkages to the wider innovation system in accordance with their assessment of the return on investment from engaging in a particular innovation activity. Firms typically under-invest in innovation as a result of organizational culture, economic pressures and difficulty in securing capital for activities that are perceived as high-risk by investors. In recent years, the CFS and FPIInnovations have worked closely with individual forest companies and major industry associations such as the Forest Products Association of Canada (FPAC) to mitigate this gap and ensure that promising technologies are supported by firms from invention to commercialization.

FPAC has worked closely with FPIInnovations and the CFS on the Bio-pathways project¹⁰, which has demonstrated that the production of new high-value forest products is most successful when integrated with conventional production activities to leverage current forest industry infrastructure

¹⁰ Forest Products Association of Canada. 2011. The new face of the Canadian forest industry: The emerging bio-revolution and the bio-pathways project.

and capital to generate highly profitable revenue streams. Through the Bio-pathways project and other efforts to develop a national strategy on forest sector transformation, FPAC seeks to improve the alignment of the innovation system with market needs. FPAC recently announced its 2020 Vision, "Canada's Natural Advantage", which highlights its members' priorities for the coming years, including innovation and the development of new markets, improving the sector's environmental footprint, and renewal of the forest industry's workforce. Notably FPAC's Vision sets an aspirational target of \$20 billion in revenues from new products and markets by 2020.

In order to realize the stretch goals of Vision 2020 and deliver on transformation, FPAC, FPIInnovations and CFS have led the development of a national *Innovation Framework for Industry Transformation* that describes the sector's innovation needs and how they can be addressed. This Framework is intended to offer a high level perspective from the three organizations as the basis for broader engagement, to: help guide partnerships with academia and others to highest priority areas and best bets; build upon recent commitments, plans and analysis (such as Vision 2020 and the CFS Strategic Framework); and, reflect the roles and contributions of the broader range of players within the forest sector innovation system, as they relate to industry transformation. The overarching goal of this initiative is to provide a common framework for understanding the innovation needs and opportunities that will drive forest industry transformation, and offer a tool to players within the system to help align efforts toward common goals and interests.

The Canadian Council of Forest Ministers' Work on Innovation

In 2012, the Deputy Ministers that support the CCFM renewed their focus on forest sector innovation as a priority area for action. In recognition of the need for continued sector transformation and the key role governments play in supporting this transformation, the CCFM committed to improving information sharing across jurisdictions to encourage adoption of best practices, reducing the risk of duplication and highlighting possible synergies.

The *2015 Compendium of Current Forest Sector Innovation Initiatives* delivers on this commitment, serving as a mechanism to disseminate information on current forest sector innovation initiatives occurring across Canadian jurisdiction¹¹.

This white paper was designed as a complement to the Compendium, helping to contextualize the list of current initiatives and spark discussion of pathways forward. It is comprised of two parts: an analysis of lessons learned from other countries and other industrial sectors performed by subject matter expert Dr. Jack Saddler (University of British Columbia); and an assessment of opportunities and next steps for CCFM governments to support forest sector innovation in Canada by former Deputy Minister Mr. Don Avison (Avison and Associates).

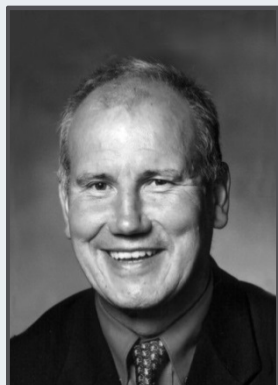
The ten lessons in Part I are informed by Dr. Saddler's significant experience and network of professional contacts within both the American and Scandinavian forest sector innovation systems, as well as his past work on technology and systems innovation models across sectors. In Part II, Mr. Avison synthesizes Dr. Saddler's analysis into a series of recommendations for CCFM members, grounded by Mr. Avison's consultations with a network of senior forest sector executives and academic leaders. Given the author's significant experience with inter-jurisdictional councils, these recommendations are designed to capitalize on the strengths of the CCFM, while recognizing the challenges inherent in pursuing activities through such a forum.

The CCFM recognizes that transformation of the Canadian forest sector is essential for the long-term prosperity of this industry and the viability of the communities and regions it supports. Given the breadth and diversity of innovation-focused initiatives taking place across Canada, this white paper in conjunction with its sister document the 2015 Compendium, seeks to facilitate the sharing of information across jurisdictions. Through the development of this product, the CCFM aims to encourage adoption of successful models, align actors across the innovation system, and where possible, improve collaboration to maximize the success of government initiatives in supporting a vibrant and prosperous future for Canada's forest sector.

¹¹ The *2015 Compendium of Current Forest Sector Innovation Initiatives* is available online from www.ccfm.org.

Expert Profiles

Dr. John (Jack) Saddler



Dr. John (Jack) Saddler is the endowed Professor of Forest Products Biotechnology / Bioenergy (originally an NSERC Industry Chair) and former Dean, Faculty of Forestry at the University of British Columbia. Professor Saddler has been involved, for more than 30 years, in various national and international organizations that have advanced the global understanding of how woody biomass can be converted to useful fuels and chemicals. He is a Fellow of the Royal Society of Canada and has received many other awards, including the International Union of Forest Research Organizations (IUFRO's) Scientific Achievement Award and the Charles D. Scott award for contributions to the field of "Biotechnology for fuels and Chemicals". From 2014-2015 Professor Saddler served with the International Energy Agency, conducting key analysis on the growth of bioenergy/bioproducts markets in support of the 2015 World Energy Outlook.

Mr. Don Avison



Don Avison is a lawyer and a former senior public servant. Mr. Avison spent 10 years as the President of the University Presidents' Council of British Columbia and its successor organization, the Research Universities Council of B.C. In this role he was closely involved with numerous initiatives to improve post-secondary education in the province, including several major access initiatives. Before taking on the senior leadership role with B.C.'s universities, Mr. Avison served as a Deputy Minister with the Province of British Columbia, with assignments as Deputy Minister of Health, Crown Corporations, Education and Advanced Education. Mr. Avison has also had a distinguished legal career, having spent several years with the Attorney General of Canada and as the Director General of the federal Aboriginal Justice Initiative. In 1994 he was appointed Deputy Minister of Justice for the NWT.

Part I: The role of government in forest sector industrial innovation

This section is based on analyses by Dr. Jack Saddler of lessons learned from other countries and other industrial sectors. Rather than attempting to be comprehensive, Dr. Saddler's analyses instead focus on his areas of expertise, in order to highlight successful models whereby governments have supported industrial innovation and/or bioeconomy development for discussion and consideration by the CCFM.

Lesson 1:

Governments should encourage industry to gravitate towards the development of speciality products to enhance international competitiveness.

Despite incremental progress towards the development of high-value bioeconomy products, the Canadian forest products sector remains essentially focused on conventional commodity goods—that is, our forest products lack diversity and many of these products (including pulp, paper, lumber, etc.) are produced more cheaply and quickly elsewhere. Faster growing trees, lower labour costs and newer equipment will continue to grant many of Canada's international competitors (e.g., Brazil, Indonesia, New Zealand and Chile) significant advantages in commodity production. In comparison to other “boreal-based” forest companies and countries, the Canadian forest industry as a whole has not made significant progress developing higher value/niche products, such as diaper/sanitary products (American companies Proctor & Gamble and Kimberly-Clark), novel packaging solutions (Sweden's Tetra Pak) or high-value co-products like vanillin and nutraceuticals (Norway's Borregaard). Governments in these countries have facilitated better connectivity between forest sector producers, suppliers (equipment manufacturers), and consumers in novel markets (packaging, green chemicals, etc.) and have prioritized movement up the value chain. In particular, these countries have seen public investment in strategic programs that encourage innovation, diversification and clustering and allow companies to become world leaders in their respective fields.

A particularly successful case where a government initiative has supported a company's movement up the value chain is found in Norway, where forest products company Borregaard has taken full advantage of the Norwegian government's *Innovation Norway* suite of innovation and commercialisation programs. An important component of these programs is the facilitation of an internal corporate culture shift in order to compensate for Norway's high labour costs and geographical distance from markets. Originally a traditional sulfite pulping company, Borregaard now produces high value chemicals and pulps and has become a global leader in bio-based chemicals (specialty cellulose, lignin, fine chemicals, vanillin, etc.) with annual sales of €204 million - 18% of which are from new products that they did not make five years ago.

Similarly, many of the companies within the Finnish and Swedish forest products sectors have successfully moved up the production value chain, with governments playing a key role in facilitating this transition. Finnish government programs in support of the country's bioeconomy strategy, such as EffTech and FuBio, are characterized by an emphasis on the balance between traditional processes/products and high-value niche products. Such programs have helped Finnish pulp, paper and timber manufacturer UPM build on its traditional forest products and markets to become a world class biorefinery company that also produces biochemicals, biofibrils, biofuels and bioenergy (Figure 3). Sweden's funding of clustering efforts, including the development of infrastructure and pilot plants and co-location of company R&D on university campuses, resulted in the establishment of the "Packaging Arena" of southern Sweden and success for companies like Tetra Pak and SCA.

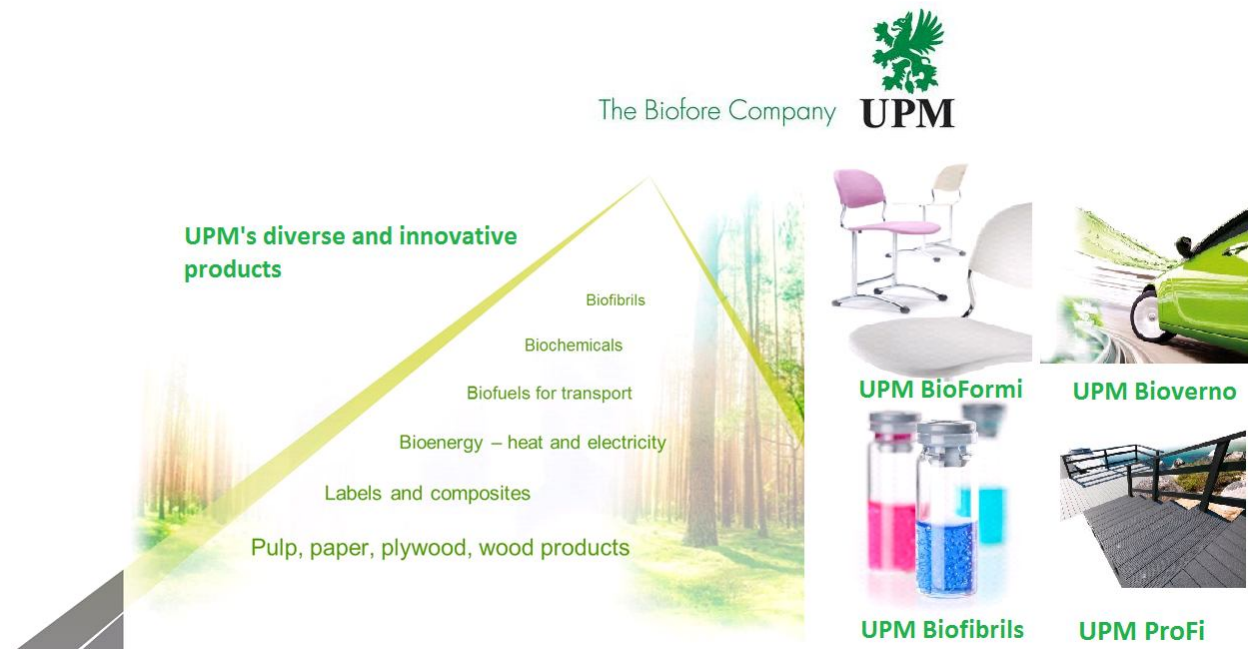


Figure 3: Finnish company UPM has successfully diversified and innovated in order to move up the value chain, rebranding itself as "The Biofore Company" with sub divisions/brands that include UPM Biofibrils, BioFormi, and others that specialize in niche, high value products (Figure Source: UPM).

Canada's Investments in Forest Industry Transformation (IFIT) program is a good start in trying to emulate this Scandinavian success, although success will require that such a program receives ongoing funding and be expanded to include involvement from the provinces.

It should be noted that although government funding specifically targeted at the commercialization of innovative high-value products can incent firms to move beyond conventional products, it is important that at least a portion of funding is directed solely at truly innovative first-of-kind technologies—otherwise firms may embrace less risky, incremental pathways to access funding.

Lesson 2:

Innovation partnerships are most effective when delivered under stable, long-term timelines with strong support from all levels of government and across the innovation spectrum.

Canadian federal and provincial governments have had some noted successes in encouraging innovation and investment in both people and infrastructure. Although Canada's federal structure can result in instances of discord and/or duplication, some recent programs have been successful in avoiding duplication and encouraging innovation and networking in enabling technologies such as genomics, nanotechnology and information technology. Two such examples are the highly successful and competitive Canadian Foundation for Innovation (CFI) and Canadian Research Chairs (CRC) programs, where a 40% federal government contribution is matched by provincial and local (i.e., institutional) contributions of 40% and 20%, respectively. This is an excellent example of how ongoing, stable funding has allowed Canada to be at the forefront of enabling technologies through the establishment or reinforcement of clusters of excellence (e.g., Ontario automotive cluster, Montreal aerospace, BC forest genomics, etc.). As these innovation programs are intended to last longer than an election cycle, universities, polytechnics and companies are able to plan appropriately and take part in the establishment of centres of excellence and innovation clusters. The legacy of long term, ongoing Canadian programs like CFI have been critical in establishing Canadian predominance in nanotechnology and tree genetics.

An international example of long term support that encourages continuous innovation is Sweden's Vinnväxt program. The program is governed by a stable partnership of companies, researchers and the public sector, that results in a strong cluster with close ties to universities and polytechnics and their international partners. Vinnväxt seeks to speed innovation and commercialisation processes by encouraging cooperation between companies and groups, thereby facilitating industrial symbiosis. Funding through Vinnväxt is conditional on at least 50% regional co-funding, and is awarded based on competition between regions, with the winners receiving funding for up to 13.5 years (funding is initially allocated for 3.5 years, with an additional 10 years of funding contingent on an evaluation). Although the program is not specific to the forest sector, a number of projects have received support through the program, including the "Biorefinery of the Future" in Ornskoldsvik (Figure 4), the "Paper Province" in Värmland.

Similar examples in the U.S. include Department of Energy (DoE) funding of innovative energy clusters. The three DoE Bioenergy Research Centers at Berkley (California), Great Lakes (Michigan) and Oak Ridge (Tennessee) receive multi-year support and bring together diverse companies (oil, chemicals, biotech, engineering, etc.) with universities, polytechnics and Government National Labs. The longer term nature of the DoE funding commitment allows the centres to train the highly qualified personnel (HQP) needed for these emerging industries and facilitates the establishment of enduring relationships between industrial partners, ensuring a high level of commercial success.

Consistent across these examples is the substantial participation (and financial support) from the all levels of government: regional, provincial or state level, and federal government. Long-term government support is required to build the competencies, develop the expertise and personnel, and attract the players needed to successfully identify, develop and commercialize novel or disruptive technologies, processes and products.



Figure 4: Players and participants in the Biorefinery of the Future, Ornskoldsvik, Sweden
 (Figure Reference: http://www.york.ac.uk/org/cnap/SUNLIBB/partner_08.html)

Lesson 3:

Governments can help attract foreign direct investment and venture capital to the innovation arena, increasing the forest products sector’s international focus and investment in innovation.

Increased foreign direct investment (FDI) is generally associated with increases in the level of innovation research, development, demonstration and deployment (RDD&D) carried out by the recipient company. FDI can be an effective mechanism to boost expenditures on innovation, especially in capital-strapped small and medium-sized enterprises (SMEs). Investment-driven internationalization is an important component of the Swedish growth strategy, and the country’s investment promotion agency, Business Sweden, coordinates these activities on behalf of the government. In addition to being a comprehensive source of information for international investors interested in business opportunities, Business Sweden provides practical advice on how to establish business operations and contacts. They help investors liaise with the appropriate Swedish authorities and facilitate partnership with Swedish industries. As a result, Swedish SMEs have been very

effective in using FDI as a tool to develop important growth markets and as a potential channel for both technology development and market diffusion.

Facilitating FDI and assisting in the development of international markets is one of the key successes of Sweden's Vinnväxt programs. Business Sweden and its predecessor, Invest Sweden, have helped establish local networks in regional clusters with the goal of internationalizing the region's products and expertise. For example, the regional network in Värmland, called the Invest in Värmland Agency (INVA), was formed to attract FDI in the areas of information and communications technology, wood, paper and packaging products, steel and engineering, and tourism. By involving Invest Sweden in these cluster initiatives, the region successfully attracted several large, foreign-owned companies (Metso, Stora Enso), thereby effectively internationalizing the innovative RDD&D in Värmland.

Another example of the importance of an international focus is illustrated by the success of Business Sweden's Invest Packaging & Fiber consortium, a network of Swedish packaging organizations. The primary goal of the consortium is to develop international collaboration, strategic alliances and joint ventures to stimulate economic growth within the Swedish packaging and fibre-based industries. Packaging Mid Sweden, a member of the consortium, and Mid Sweden University have a memorandum of understanding with the China Packaging Federation to strengthen cooperation between the packaging industries in China and Sweden, and a similar cooperative agreement with Japanese organizations intends to create business opportunities, identify and carry out joint projects, and promote the development of joint R&D projects. These arrangements, catalyzed by government agencies, not only attract foreign investment, but help to create markets and identify distributors in these countries for products produced in Sweden.

One aspect that has limited the commercialization and scale up of emerging technologies in Canada has been the scarcity of venture capital (VC) funds and the associated valley of death, wherein promising emerging technologies stagnate due to a lack of funding for scale-up stages. The situation is made worse by Canada's close geographic proximity to a relatively rich VC market, the U.S., which often results in valuable Canadian innovations being brought to commercialization outside this country. Recognizing the importance of accessible venture capital, Finland has developed mechanisms to provide these funds via government financing enterprises that target particular business phases. For example, Vigo supports the growth of new innovation enterprises, while the Finnvera program encourages entrepreneurship and the development of SMEs. Other government venture capital funds include the Finnish Industry Investment and Sitra programs, while Finnpro provides business support services for the internationalization of firms.

Following the example of Finnpro and Vinnväxt, areas in Canada that could benefit from international investment include Thunder Bay, Prince George, Fredericton and Quebec City, where an established forest products sector and a local university are in place, thereby laying the groundwork for an innovation cluster. The development of such clusters could become part of an expanded IFIT program that includes direct provincial involvement and avenues for FDI.

Lesson 4:

Partnering with international innovation blocks grants access to larger resource pools to fund the capital-intensive demonstration and deployment aspects of innovation.

Despite the success of programs like IFIT that support the demonstration and deployment aspects of RDD&D, these aspects are notoriously expensive and difficult to deliver successfully. As Canada is not part of the two established international innovation blocks (the U.S. and European Union) or the rapidly developing Asian (Japan, South Korea, China) innovation block, Canada needs to seek out alternative funding to finance capital-intensive projects.

Despite a history of competition rather than cooperation, Canada's best option will likely be to partner with the American forest products innovation sector in order to access funds delivered by the U.S. Department of Energy (DoE), Department of Agriculture (USDA), Department of Defense (DoD) and others. Given that competition for such funding includes the diverse industries of concrete, steel, and computer tablets—not each other's traditional forest products markets—Canada and the U.S. can follow in the footsteps of Norway, which has collaborated with the Technology Strategy Board of the UK to access EU funds. There is currently an opportunity for Canada to partner with the U.S. from a position of strength, as the American innovation sector (TAPPI, Forest Products labs, universities, etc.) lacks alignment and has yet to establish synergies and take full advantage of the federal programs available. Although U.S. DoE funds for investment in energy self-sufficiency were well-accessed by the American agriculture and oil and gas sectors, there has been little activity on the part of the U.S. forest products sector. In fact, several companies supported by the U.S. DoE, including Ensyn, Enerkem, Lignol and Iogen, are Canadian.

In the same way Finland has used its membership within the EU's innovation programs to increase the frequency of projects being realized in Finland, a partnership with the U.S. could serve Canada well, provided we continue to be flexible when it comes to championing innovative projects that we are willing to partially support at the demonstration level.

In both Finland and Sweden, projects supported by domestic innovation programs were able to leverage EU funding for demonstration and process/market development. For example, the €30 million UPM-Rauma integrated fast pyrolysis bio-oil plant, which produces 50,000 tonnes of bio-oil per year from forest residues and is based on an integrated pyrolysis project supported by Finland's BioRefine program since 2007, is now on the reserve list to receive funding from the EU's New Entrants' Reserve (NER300) program. This project involved collaboration between Finnish companies Metso, UPM, VTT and Fortum, and was awarded €8.1 million from the Finnish Ministry of Employment and the Economy to help build a commercial scale facility based on this technology.

Established Scandinavian forest innovation clusters were instrumental in developing the goals of EU programs and were subsequently major recipients of program funding. Similarly, Canadian clusters could help define and influence North American innovation programs. If the Canadian forest

products sector had been able to provide input into the development of large U.S. stimulus programs through vehicles such as the Bio-pathways initiative, the American (and Canadian) forest sector (and Canadian innovation providers such as Lignol, Enerkem and Ensyn) may have obtained a much higher proportion of available RDD&D funds.

An important consideration is that success in competing with other regions/countries for limited innovation funds requires an established regional innovation cluster. Canada's provinces/regions would be best served by working together to establish such clusters, modeled on those such as Sweden's Paper Province, Biorefinery Cluster or Packaging Arena. Competition between provinces should be avoided and a united front presented to potential partners. Additionally, forums such as the CCFM should be leveraged to promote open discussion of win-win solutions and regional advantages – in this way, duplicative investments like those currently being seen in Alberta and Quebec (nanotechnology) and British Columbia and New Brunswick (novel building systems), may be avoided.

Lesson 5:

Establishing innovation clusters along geographical and programmatic lines maximises productivity by achieving economies of scale and moving up the value chain.

Governments can facilitate connectivity among forest sector actors by building on established geographical locations of innovation providers, resulting in higher productivity and more efficient implementation as illustrated by the success of Silicon Valley, the Skane region of Southern Sweden and Denmark, and the Boston life sciences cluster. Similarly, the cluster approach to innovation centres for forest products in Finland and Sweden has created a favorable environment for innovation by ensuring effective linkages among the organizations that carry out most of the RDD&D (i.e., universities, research institutes, suppliers and companies with receptor capacity¹²).

Within a regional cluster, key participants include engineering, equipment and chemical suppliers that work with industry to carry out most of the demonstration and commercialisation aspects of innovation. Engineering companies (e.g., Metso in Scandinavia and Andritz in Austria) are key “innovation suppliers” in such clusters as they are typically international in their perspective and thus bring with them innovative approaches and processes. In addition, the long term nature of these relationships with industrial partners facilitates the transition from research through to commercialisation.

The “Paper Province” project in Värmland can be considered a typical example of the Swedish regional forest innovation cluster. The Paper Province is a 90-member-company grouping with over

¹² Receptor capacity is defined as those individuals within companies who have the mandate, skills, education and networks to monitor global RDD&D and identify where it can best be deployed within their company.

8,400 employees and a total turnover of SEK 18 billion (approx. \$3 billion CAD). The project was initiated in 2013 and has a total budget of SEK 130 million (over 10 years) and is jointly funded by Vinnova, a Swedish government agency that supports research and development, and regional co-financiers (the municipality of Värmland, Karlstad University, Värmland counties, the Paper Province's member companies and others). The primary objective of the project is to rejuvenate the traditional forest industry in the Värmland region, creating an internationally attractive innovation environment for the development of a forest-based bioeconomy. Although the overall number of mills in Värmland has been reduced significantly over the past 10-15 years, the number of companies (particularly SMEs) within the cluster has increased dramatically.

National and regional governments were instrumental in facilitating the development of an internationally competitive innovation cluster in Värmland. The effective involvement of R&D groups, consultants, equipment & process suppliers, machinery manufacturers, pulp and paper mills, etc. has resulted in an industrial symbiosis that not only benefits the core paper sector, but pulls together expertise and talent and creates spinoff benefits for other sectors within the region. In addition to encouraging the reorganization of the traditional forest industry, the program also promotes the development of new products and services based on the forest value chain via three main strategies. The first strategy consists of an evaluation of mill residues and waste streams to determine if there is an opportunity to use them for additional value generation. In the second, forest production units are linked to other regional industries to develop new services and processes. The third strategy is to collect information about new technologies and explore ways of achieving technological advancements to meet emerging business needs. The Paper Province has a goal of developing 1000 new jobs and 25 new businesses over the course of the ten years of funding. A large number of projects and collaborations are currently under development and involve various national and international programs, including the EU's Horizon 2020 program, which helps to extend innovation across the entire value chain.

In Canada, possible regional clusters could be established by building on the current industry structure (e.g., pulp and paper in the east, solid wood in the west, and hardwoods/flooring in Quebec). Possibilities for overlap with related industries (including SNC Lavalin and Bombardier in Quebec and the oil and gas industry in Alberta), universities, FPIinnovations and National Research Council locations could also be considered in order to establish a network of clusters across the country with specific and complementary areas of excellence.

Lesson 6:

Government supported mechanisms can serve to increase innovation receptor capacity at forest industry facilities.

Over the last couple of decades, many of the Canadian institutions that gave us world-leading innovative products, such as MacMillan Bloedel (parallam) and the Alberta Research Council (the

expertise to adapt so-called “weed species” such as poplar for pulp or oriented strand board production), have faded or even disappeared completely. In addition, the amalgamation of Forintek, Paprican and FERIC to create FPInnovations, although more administratively efficient, has resulted in fewer scientists and engineers and a subsequent reduction in the range (and depth) of expertise covered by Canada’s innovation providers.

Perhaps more concerning, however, is the lack of receptor capacity within the companies and mills themselves, relative to international competitors. A review of Scandinavian sawmills showed that management teams typically included members with a greater variety of educational background, as well as complementary responsibilities for interacting with trade, R&D, and marketing organisations (such as Inventia in Sweden, VTT in Finland), such that the sawmills were well integrated both nationally and internationally. In contrast, the educational profile of Canadian sawmill management teams is often comprised of fewer degrees, with the most common degree being a forestry degree. Management teams are only represented at FPInnovations and interact with universities and polytechnics at the senior officer level, rather than the mill level. In Canada, there are insufficient individuals within forest sector companies with the mandate, skill, training and education to monitor RDD&D and identify where such activities can best be deployed within their company.

Scandinavia, Austria, and Germany are all good examples of areas where sawmill companies have achieved a critical mass of receptor capacity. The management teams of these companies contribute more directly to their respective equivalents of FPInnovations, and they include individuals who supervise graduate students at universities and polytechnics, thereby helping to train and recruit the next-wave of highly qualified personnel (HQP) involved in leading edge ideas that could influence the future of the sector (e.g., cellulose nanomaterials, 3D-printing, etc.). In comparison, the Canadian university-based FIBRE network has little direct representation from the traditional forest products industry on its advisory boards (although related industries such as biotech, chemical, energy, etc. are well represented), and FPInnovations (FIBRE’s frequent partner) struggles to find forest industry personnel to participate on its advisory boards. A few companies, such as Canfor and possibly Tembec and Domtar, have residual R&D groups, but the capacity of such groups is much less than the Macmillan Bloedel and Domtar research centres of 15-20 years ago.

In Canada, much of the current innovation is provided by suppliers, who have found more efficient ways to produce the same products. This reliance on suppliers has limited the ability of companies to consider more fundamental change and think outside the box. However, the forest sector can look to the IT and chemicals sectors for successful examples. In order to transfer knowledge from innovators to Canadian industry, programs that encourage academics to spend significant periods of time working with industry should be expanded. The federal government’s executive interchange program and the use of university sabbaticals are good examples of such interactions. Moving forward, this program could be adapted to encourage sabbatical-like exchanges between industry, FPInnovations and academia, even introducing systems for permanent cross-appointments across these groups, with a view to increasing mill-level receptor capacity. Locating NSERC-Industry-

Provincial Chairs with FPInnovations could also support the development of a cross-appointment model.

Lesson 7:

Proactive engagement and strategic approaches can enable the Canadian forest industry to access global 'mission-oriented' initiatives for innovation activities.

Major governments and government organizations (i.e., the US and EU) have an established track record of investing significant resources 'mission-oriented' initiatives that create major spin-off benefits for established industries while catalyzing the development of new ones (e.g., the Manhattan Project, which met its goal of producing the atomic bomb, led to developments in nuclear power, radio isotopes, and radiation treatment). Given the magnitude of such initiatives and the diverse industries often involved in their delivery, it is possible for strategic intervention by particular sectors to influence the overall direction of these programs, and contribute to decisions on items such as eligible products/recipients, timelines, project types, focus areas etc. Given that the Canadian forest sector is economically small with limited financial resources, global mission oriented initiatives represent a critical potential source of funds for investment in innovation. That said, to facilitate access to such initiatives a concerted and strategic approach by the sector is needed, including proactive engagement and advocacy with administering groups.

Such an approach is seen in the US agriculture sector's response to the 2009 the United States American Recovery and Reinvestment Act. This Act included significant funding for energy security programs. Although energy is not the core business of the sector, the American agriculture sector was successful in strategically positioning itself to receive combined funding of US\$564 million¹³ for biorefineries and cellulosic ethanol projects. The sector successfully responded to the goal of developing a national, sustainable energy supply by producing new markets and products like ethanol, biochemicals and nutraceuticals, which are traditionally outside the scope of the sector. The funding was leveraged to transform many corn-to-ethanol facilities into true biorefineries, producing bioethanol or biodiesel, biochemicals, nutraceuticals, fructose-sweeteners and other high-value products.

In Canada, the forest products sector has made some use of the federal funding available through Sustainable Development Technologies Canada's Tech Fund (SDTC), which aims to finance and support the development and demonstration of clean technologies that provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians. The best practices and opportunities highlighted by the federally

¹³ Next-Generation Biofuels: Near-Term Challenges and Implications for Agriculture by W. Coyle. May 2010. p12.

supported Bio-pathways initiative could help bolster the number and quality of funding submissions to SDTC from the forest products sector.

In addition, many provinces have mechanisms to support projects that parallel those funded by SDTC, such as Alberta Innovates and the BC Bioenergy Network (BCBN). Encouraging coordination of applications to SDTC and its provincial counterparts may enable the forest products sector to extend beyond the sector's conventional core business in the same way that the U.S. agricultural sector made good use of stimulus funds and Scandinavian forest companies made use of EU funds to support the development and deployment of innovative manufacturing processes.

Lesson 8:

Provincial and territorial governments should partner with federal programs to support demonstration and deployment of innovation efforts.

In comparison to other forest product exporting countries like Sweden, Finland, US, Russia and Chile, Canada has well-defined funding programs to support forest innovation and a range of organizations that aim to stimulate innovation (including FPInnovations, academia, suppliers, etc.). Unlike the federal government, which is currently delivering direct initiatives such as the Forest Innovation Program (FIP), the Expanding Market Opportunities Program (EMO), and the Investments in Forest Industry Transformation Program (IFIT) while supporting FPInnovations and universities through NSERC and the FIBRE networks, provinces and territories have not, historically, been major investors in forest sector innovation. Given that forests and forest products are essential to the survival of many communities and that stumpage revenues are an important source of income, it is perhaps surprising that provinces have failed to become significant contributors to innovation.

Provincial and territorial governments need to make better use of existing assets to support companies and communities. Such assets include some of the strongest and most innovative tree genomics researchers in the world (Genome Canada), as well as the federally supported FIBRE network, which encourages links between the forest products sector and non-traditional partners (e.g., biotechnology, chemical, energy, and agricultural sectors). A potential model for greater provincial/territorial government involvement could be the NSERC Cooperative Research and Development (CRD) program; funding for forest products innovation could thus be cost-shared through equal financial support from each of the federal and provincial governments and industry, with the requirement that a traditional forest industry organization or company is paired with a non-traditional industry partner.

Given the considerable response among companies in the Canadian forest products industry to IFIT's first call for proposals, with \$2 billion worth of proposals requesting \$500 million in government support, it is reasonable to conclude there exists sufficient industry appetite for

enhanced provincial involvement. Due to the small size of Canadian firms relative to their counterparts in Europe, Japan and the US, such public support is essential to reduce the risks associated with significant investments in innovation. Cost sharing initiatives with one third supplied by each of the federal government, provincial/territorial government and the interested company have also been used with success, as made evident by the Canadian Foundation for Innovation (CFI). The CFI brings together federal, provincial and university/polytechnic funding to develop infrastructure (buildings and equipment); this program has successfully rejuvenated Canada's academic R&D potential and increased international competitiveness. Federal and provincial governments should be encouraged to use the competitive aspects of the CFI program while incorporating the innovative criteria pioneered by the IFIT program (i.e., giving particular attention to projects that include a non-traditional industry partner). Active provincial/territorial involvement and support will aid in the expansion of IFIT-like programs and projects going forward, while also increasing the role of specific regions or clusters in the deployment aspects of innovative products and processes.

Lesson 9:

Governments should take action to develop new markets and applications for both traditional and novel forest products.

With annual exports of approximately \$10 billion CAD that represent approximately 25 percent of total merchandise export earnings, New Zealand is the world's largest exporter of dairy products. Accounting for almost one third of the world's international dairy trade, the key strengths of New Zealand's dairy industry include its large-scale processing and high levels of investment in R&D, which have increased efficiency while maintaining the quality of production. The dairy industry in New Zealand is one of the best examples of a vertically integrated, co-ordinated global supplier industry, with value-added products accounting for about half of New Zealand's dairy exports.

New Zealand's central and regional governments were key facilitators in the development of this industry. With the UK's entry into the European Union, New Zealand's captive market in Europe for dairy products evaporated, and a strategy was needed to support the industry in realigning and adjusting to this new reality. In order to find alternative markets for their products, New Zealand governments targeted Asia, where dairy products are not traditionally popular. First, dairy products were introduced to the market by identifying the need for an inexpensive, reliable source of baby formula; subsequently, the industry has moved up the value chain to develop Asia's taste for more profitable cheeses and yogurt.

The global recession in 2008 had a similarly dramatic effect on British Columbia's ability to export lumber to the US housing market, necessitating expansion of the market for B.C.'s forest products. Founded in 2003, Forestry Innovation Investment (FII) is the Government of B.C.'s market development agency for forest products, and in response to this downturn in the province's forest

industry, a greater emphasis was put on diversifying the market for the industry's products. Through FII's work to position B.C. as a global supplier of world-class environmentally-friendly forest products, B.C.'s forest product exports outside North America have increased from less than one-sixth in 2003 to 41% today¹⁴. In particular, sales to China have increased more than 1,500% in that time, following the establishment of a joint China market development program by FII and industry with federal government support. As a result of these efforts, the B.C. forest sector has rebounded from the 2008 recession much more quickly than it likely would have otherwise.

FII is much more than a marketing agency; FII coordinates product development and innovation by maintaining strong industry, government and university support. The organization has been involved in such activities as modifying codes and standards and coordinating trade missions. Extending this model to a pan-Canadian federal/provincial partnership could benefit the forest products sector by establishing new markets for the full range of innovative products that are currently and soon-to-be derived from Canada's forests. Given the smaller size of most Canadian firms in the forest products sector, relative to international competitors, a coordinated approach is essential to help develop non-traditional markets (Asia, Africa, South America) and innovative products for these evolving markets that take advantage of Canada's national and regional strengths, including Canada's fibre advantage and the close interaction and coordination of our innovation providers.

Lesson 10:

Governments should highlight the sustainability and green credentials of forestry and forest products to drive demand for innovative Canadian forest products.

Although Canada has the largest area of third-party independently certified forest in the world (with 38% of the world's certified forest area), the majority of consumers are unaware of the sustainable manner in which forests in Canada are managed. The high level of external scrutiny and international recognition of Canada's forestry practices should be expounded upon for the purposes of A) increasing consumer recognition of the positive environmental attributes of Canadian forest products; and B) driving demand for these products.

Nordic Ecolabelling campaigns have been employed in a similar manner to market a wide range of products as environmentally sustainable. Many of Canada's federal innovation programs, including the \$1-billion Pulp and Paper Green Transformation Program (PPGTP) and Sustainable Development Technology Canada (SDTC), require an element of environmental sustainability; however, there may be a role for government to play in facilitating increased awareness of this fact. A focus on sustainability may also help to legitimise the green credentials of the forest sector; increasing this sector's attractiveness to other industries as a partner for corporate social

¹⁴ About BC FII - <http://www.bcfii.ca/aboutus/>

responsibility. This implication is likely to grow in importance as interactions increase between the evolving forest sector and the Canadian oil and gas sector (e.g., British Columbia's Forest Carbon Offset Protocol).

As criteria are developed for certification and standardization of environmental sustainability for new products and sectors, it is critical that all levels of government in Canada work to ensure that Canadian norms are aligned with (or drive) international standards, thus setting the bar high and giving Canada an international competitive advantage.

Part II: Opportunities for governments to advance innovation

This section summarizes the recommendations provided by consultant Don Avison regarding opportunities for CCFM governments to support innovation in Canada's forest sector. This list is not intended to capture the full depth and breadth of potential activities, but rather synthesizes the lessons in Part I into options relevant for consideration by the Council – options informed by the consultant's familiarity with the advantages and disadvantages of acting through federal/provincial/territorial tables.

Despite the forest sector's important role in Canada's economy, the industry has faced a number of difficult issues in recent years. Implications of the 2008 world economic downturn have included stagnation in housing starts in the U.S. and elsewhere, overall declines in demand for wood products, and emerging lower-cost competitors for traditional wood products, all while the Canadian dollar is nearly par with the USD and access to capital is constrained. Other issues affecting the forest sector include escalating environmental challenges, such as the frequency and severity of environmental disturbances like insect and disease outbreaks, wildfires, droughts, storms and changes to average temperatures. These factors are already having significant impacts on Canada's forests, and, as noted by Genome Canada, climate change means these effects will accelerate over time, ultimately requiring increased use of adaptive management practices. Given these pressures, innovation will become an increasingly critical issue for the forest sector in order to sustain the important role that the sector plays in the Canadian economy.

The lessons learned in Part I help to illustrate the important catalytic role governments can play in working with industry, as well as the competitive realities associated with the rapidly shifting global context within which Canadian forest sector companies now operate. A number of the key findings highlight the need to focus on some clear challenges, many of which—if managed thoughtfully—can be transformed into opportunities. Such opportunities may emerge through the development of initiatives designed to promote or deepen forest industry engagement with Canadian innovation and research assets, through initiatives that bring together the shared interests of the forest sector as a whole, and through increased engagement between the federal and provincial/territorial governments on forest sector issues.

Recommendations for the Canadian Council of Forest Ministers

In order to transforming challenges in the forest products sector into opportunities, a number of recommendations have been developed for the Canadian Council of Forest Ministers (CCFM). These recommendations aim to provide a suite of actions in answer to the following questions:

- How can the CCFM governments work more effectively together to develop greater capacity and additional mechanisms to support inter-governmental engagement and information-sharing on forest sector issues and innovation?
- What can be done to achieve better alignment and more consistent outcomes on the shared innovation objectives of Canada's forest sector?
- Given the substantial investments made by the Government of Canada and provinces and territories that have established Canada as the G7 leader in publicly supported research and innovation investments, what steps can be taken to ensure that the forest industry is able to take full advantage of these investments?

Opportunities for governments to advance Canadian forest sector innovation

Creating the conditions necessary for improved forest sector innovation in Canada will depend on a number of factors, one of which is the need for a higher degree of effective and consistent inter-governmental engagement and information sharing. Although there are mechanisms that exist to support inter-governmental action, there has been a somewhat surprising decline in the level of engagement on this front. Accordingly, there are several areas where improvements can be made to increase such engagement at both regional and national levels.

In order to support the development of innovative practices, the question may not be how to develop new structures, but rather what steps the Canadian Council of Forest Ministers (CCFM) can take to effectively revitalize and mobilize existing mechanisms and, further, how this might be done to make clear that the CCFM table intends to occupy a substantial leadership position in advancing forest sector interests. Despite the nature and extent of the many complex issues facing the forest sector, the CCFM has rarely convened in recent years at the senior official level, and meetings of Ministers are even less frequent¹⁵. Moving to establish a consistent pattern of focused engagement at the CCFM level is a critical component in creating the conditions necessary for improved forest sector innovation and transformation.

In order to bring about more effective information sharing, inter-jurisdictional collaboration and improved CCFM leadership in advancing forest sector issues on an ongoing basis, there are three areas for improvement should be addressed. First, individual provinces and territories need access to consistent and accurate information regarding initiatives in other Canadian jurisdictions in order to inform policy development, reduce duplication and encourage more robust regional collaborations. Second, although regional engagement and collaboration does take place, improvements can and should be made to ensure the best possible use of available resources and to help facilitate the development of regional clusters. And third, ensuring that regular CCFM meetings at the senior official and Ministerial levels take place is fundamental to any effort to improve information-sharing and inter-governmental engagement. Maintaining and updating CCFM's 2015 Compendium of

¹⁵ Prior to the June 2014 Ministerial meeting, the previous meeting of the CCFM took place in January 2010.

forest sector innovation initiatives across Canada represents a useful step towards establishing more effective information sharing.

Recently, Canadian governments have used sectoral federal/provincial/territorial (FPT) tables to facilitate dialogue, engagement, collaboration, cooperation and dispute resolution on matters of common concern. Some of those processes have been more effective than others, but success is often reliant on the degree of focus around such tables, the level of commitment to common purpose, and the presence of strong leadership. Given that Canada is characterized by divided jurisdictional responsibilities between the federal government (national taxation policy, international affairs) and provinces and territories (resource and land ownership), it is imperative that strong FPT mechanisms be maintained for both formal and, perhaps as importantly, the informal information sharing and relationship-building that frequently result from such processes.

Regular inter-governmental exchanges offer important opportunities for discussion. With respect to forest sector issues, consistent CCFM meetings will be important to ensure forest sector priorities are addressed as the fiscal demands of other sectors, such as healthcare and education, escalate. The CCFM and other bodies can play an important role in making the case for preserving and building on the strengths of revenue-generating sectors that are fundamental to governmental capacity for social spending. It is worth noting that, in contrast to the more recent experience of the CCFM, other FPT processes continue to be highly active. The Council of Ministers of Education (CMEC), Forum of Labour Market Ministers (FLMM), the national table of Finance Ministers, the Council of Ministers of Justice and several others are, by comparison, constantly engaged in information sharing and, to at least some extent, policy development. Some of those entities meet at least twice per year and, while there may be some mixed views regarding the utility of such F/P/T processes, many would agree that, even despite the complexities of convening national tables in a country as large and as diverse as Canada, the value of doing so is considerable. Similar tables concerned with education, labour, finance, justice and others are, by comparison, consistently engaged in information sharing and policy development.

There is, however, a further important reason for revitalizing and more fully mobilizing the cross-government engagement role that the CCFM can, and must, play in the forest sector context. As was observed in Part I, other countries like Norway, Sweden and Finland have experienced significant success in deploying a tripartite (industry/government/academia) approach to accelerate their respective forest sector innovation agendas. This, may be an easier thing to do in smaller, geographically similar jurisdictions that, for the most part, also have fewer divisions of responsibility between national and sub-national levels of government. That said, if that approach generates a competitive advantage, and there is compelling evidence to suggest that is indeed the case, then it becomes even more important to replicate the model as much as possible in the Canadian context. Achieving similar levels of forward momentum will require strong provincial and regional mechanisms, but success over the longer term will also substantially depend upon the capacity of governments, perhaps via the CCFM, to “occupy the leadership space” at the national and, where necessary, the international level.

The Council of the Federation may provide an additional mechanism for inter-governmental collaboration. The Council brings together the First Ministers from each province and territory and, on occasion, does so in conjunction with meetings with the Prime Minister on matters of national importance. The summer 2014 meeting of the Council of the Federation saw the table joined by Ministers from the Forum on Labour Market Ministers to discuss the question of critical skill shortages in Canada and what action might be taken to address this and other human capital supply issues that, if left unresolved, could slow economic growth. Given the nature of the issues and opportunities that lie ahead for the Canadian forest sector, it might be appropriate for CCFM Ministers to consider invoking a similar forest-sector focused conversation.

Recommendation 1:

Given the nature and extent of the challenges and opportunities facing the Canadian forest sector, and those related to accelerating innovation and transformation in particular, the CCFM should commit to meeting annually. The status of innovation and transformation initiatives should be identified as a standing item on the CCFM agenda.

Recommendation 2:

In order to expand effective and ongoing inter-governmental information sharing, the Compendium of current forest sector innovation initiatives should be regularly updated and disseminated to all CCFM members.

Recommendation 3:

The CCFM should encourage greater inter-provincial and/or -regional information sharing and collaboration to facilitate more efficient use of available resources and limit duplication.

Opportunities for government investment and market diversification

It is important to remember that the forest sector has a record of success, with leaders who are determined to succeed. This sector is also positioned for success with a significant resource advantage – with the largest sustainable managed forests in the world. Although challenges exist, there are a number of highly promising examples of Canadian companies that are performing well, and poised for the next step toward innovation-based transformation and growth.

With respect to upcoming opportunities, although the strengthening of the North American economy and resurgence of U.S. housing starts is encouraging, the significant growth exhibited by expanding markets such as China and India also warrants serious consideration. Recent trade developments in South Korea may also prove to offer considerable promise in that market. The relatively recent increased interest in building with wood in China, coupled with the emergence of new technologies such as cross laminated timber, presents an exceptional market opportunity. However, Canada will not be alone in seeking that business; Canada currently enjoys a significant

competitive advantage in this market, but it is important to solidify this advantage. Governments (federal, provincial and territorial) have critical roles to play in facilitating this.

Bringing together all levels of government and industry could do much to expand demand for wood products both domestically and internationally. It is important, for example, to consider the degree of compatibility between building codes and new technologies that permit the construction of larger wood structures. CCFM could serve as a valuable instrument through which to build consensus across jurisdictions regarding the timely adoption of innovative technologies, thus supporting market growth for these products.

There have been a number of important developments at the national level that make government/industry engagement more achievable. The presence of a national body, like the Forest Products Association of Canada (FPAC), with the capacity to engage senior industry leaders, the reorganization of otherwise dispersed resources into the now more coordinated FPIInnovations and the establishment of the FIBRE networks have all improved the potential for constructive and ongoing dialogue.

A recurring issue for the support of innovation initiatives in the forest sector is the availability of longer-term dedicated resources. Among Scandinavian competitors, funding levels for innovation initiatives are well-established and available over much longer periods of time (up to ten years) than those available to Canadian companies, which are often limited to a single business or electoral planning cycle (three years). A similar timeframe in the Canadian context, particularly for highly regarded programs like IFIT, would likely receive an extremely positive response from industry, much like the well-received four-year IFIT extension announced as part of the February 2014 Federal Budget. Continued extension of IFIT beyond 2018 would likely be similarly welcome.

CCFM governments should collectively explore the value of taking a new approach to programs like IFIT, based on best practices gleaned from the Scandinavian model¹⁶ and the approach used to develop program requirements for the Canada Foundation for Innovation (CFI) and the Canada Research Chairs (CRCs). In the case of both the CFI and CRC programs, federal research investments were matched by investment from provinces/territories and further contributions from institutional or other sources.

Similar longer-term extension of the Bio-pathways initiative is also recommended. However, the CFI experience should inform this activity through the encouragement of greater provincial/territorial engagement and funding. This approach is rooted in the view that the effectiveness of an innovation partnership model is maximized when delivered under stable, long term timelines with support from both federal and sub-national levels of government.

¹⁶ It is recognized that the high degree of subsidization characteristic of Scandinavian R&D programs would need to be evaluated for appropriateness in the Canadian context.

Further government action to support innovation in the forest sector could include a new partnership with American government counterparts and forest industry actors to develop a North American innovation block with the collective capacity to mount demonstration and deployment projects and gain access to any emerging 'mission-oriented' initiatives. The increased exposure from such a partnership could expand opportunities for foreign direct investment, thereby expanding the pool of available innovation investment resources.

In order to support the development of human capital in the forest innovation arena, there may be a role for government to support mechanisms that improve the forest sector's receptor capacity with respect to new technological innovations in response to reduced internal R&D capacity. Support from governments, particularly the federal Executive Interchange Program, may allow for the rebuilding and redesign of this capacity. Although this approach has merit, a more expansive program could include elements of programs like the "Accelerate Now" initiative of MITACS (Mathematics, Information Technology and Complex Systems), which has had tremendous success in engaging graduate students with industrial sectors. Supplementing industrial R&D receptor capacity with academics from universities and polytechnics could prove to be a powerful combination.

Although there is regional variation across the country driven by the relative significance of the forest sector within different provincial jurisdictions, the level of engagement between government, industry and the academic community tends to be fairly robust. That being said, the experience of European competitors may provide important lessons for how provincial governments engage with industry and academia in order to accelerate opportunities for transformation and innovation.

Recommendation 4:

The CCFM, with input from industry, should actively seek to expand domestic and international markets for Canadian wood products, including promotion of Canadian technologies that facilitate construction of larger wood structures.

Recommendation 5:

The CCFM should support efforts to align federal and provincial/territorial building codes with the characteristics of innovative emerging products (e.g., in construction of tall wood structures).

Recommendation 6:

The CCFM, with input from industry, should develop options for stable longer-term funding for the Investments in Forest Industry Transformation (IFIT) program and Bio-pathways for collective consideration by member governments. Funding and candidate selection models should be modeled on those used in the development of the Canada Foundation for Innovation (CFI) program.

Recommendation 7:

In order to enhance facility-level R&D receptor capacity, the CCFM should consult with industry and academia to assess the potential of interchange programs and/or short-term graduate student assignments (through a mechanism like MITACS) to support the development of the forest sector's human capital endowment.

Recommendation 8:

The CCFM, with input from industry, should consider forming a task team or working group to explore the potential for a Canada-U.S. partnership focused on forest sector innovation to better position both countries' industries to capture increased foreign investment and funding from mission-oriented initiatives.

Opportunities to increase engagement among forest sector actors

Since the late 1990s, Canada has made massive public investments in research and development and in the implementation of programs designed to promote innovation. These programs include the Canada Foundation for Innovation (CFI), Canada Research Chairs (CRCs), the Canadian Institutes for Health Research (CIHR) and initiatives in the areas of genomics and proteomics. These federal programs have been further strengthened through matching investment of resources from provinces and territories.

Canada now ranks first among G7 nations in spending on research and development in universities and colleges as a share of GDP¹⁷. Although this level of investment is impressive, there remain serious questions about the degree to which these resources are accessed and applied by industry to improve the adaptability of Canadian industry and enhance productivity. While governments have taken action to harness the power of innovation assets in pursuit of improving Canadian competitiveness, the forest sector has not kept pace with counterparts in other jurisdictions like Norway, Sweden and Finland. While other industrial sectors have dramatically increased their commitments to research and innovation as core elements of their growth strategies, investments in R&D in Canada's forest industry have actually declined dramatically. This has likely impeded progress in the development of new products in general, and the development of products linked to the bioeconomy and with biofuels more specifically.

It may also be the case that Canada has not been able to capture the full benefit of significant investments in research. Canada has been responsible for the development of some of the world's most advanced forest-related genomic science capacity, and Canadian technology related to climate adaptation is second to none; however, such competitive advantages have not been adequately exploited. There is thus a risk that such assets could be deployed elsewhere to the benefit of competing jurisdictions.

¹⁷ "Seizing Canada's Moment: Moving Forward on Science, Technology and Innovation" 2014. Ministry of Industry http://www.ic.gc.ca/eic/site/icgc.nsf/eng/h_07419.html

Given the level of investment available for research, development and innovation in Canada, it is imperative that forest sector priorities are understood and championed by governments. Provincial and territorial governments, through the CCFM, have a significant role to play in supporting linkages between industry and the academic research community: although there are some exceptions, this does not appear to be happening at the level that it could and likely should.

There may also be considerable value in having the CCFM engage directly with senior leadership of the Association of Universities and Colleges of Canada, Polytechnics Canada and Colleges and Institutes Canada. Together with representatives of FPAC, FPIInnovations and the FIBRE Network, such engagement would allow for a higher degree of integration in support of maximizing opportunities for forest sector innovation across the country.

Together with FPAC and FPIInnovations, the CCFM could raise the profile of forest sector innovation through sponsorship of a national innovation summit. An event of this scale would also be an excellent opportunity for the CCFM to assert a renewed national leadership position in this space.

Engagement at the provincial level is critical for success in forest sector innovation. To that end, there are potential lessons to be learned from the Scandinavian experience with respect to shaping the content and scope of dialogue between industry, government, the academic research community and other research assets including provincially-mandated innovation councils. In each of the Scandinavian examples, strong relationships have developed between national governments (that play a role more closely aligned with provincial jurisdiction in the Canadian context), regional decision-makers, industry and universities and polytechnics. These governments use their position as conveners, tax policy and R&D resources to facilitate a culture of innovation within their respective forest sectors. An important feature of these relationships is that engagement is systematic, rather than ad hoc or periodic, and this appears to be a central element of their success.

The successes seen in Scandinavian countries exemplify how active and consistent engagement by governments, coupled with a clear vision regarding innovation objectives, can profoundly and positively impact forest sector innovation and transformation. In each of these jurisdictions, the joint engagement of industry, government and academia furthered the development and use of innovative technologies. While there are some fundamental differences in terms of geography and political structures between Scandinavian countries and Canada, adaptation of best practices to the Canadian forest sector would appear to be promising, or at least worthy of further exploration.

A final point to note for consideration is the general trend for provincially-supported innovation bodies designed to help accelerate or promote technology development to focus attention and funding predominantly on emerging industrial sector (e.g., ICT or Life Sciences) as opposed to the forest sector. This reality may, in part, be perpetuated by the manner in which the boards of such entities are populated but it would be highly beneficial to build a better bridge between what is perceived to be the “old” and the “new” – that is, increase recognition of the many emerging high-tech elements associated with the forest sector. To accomplish this, an expanded form of the

aforementioned executive interchange program could be developed: one that creates opportunities for exchanges of innovation leaders from entirely different sectors with the objective of “cross-pollinating” innovation cultures from different industrial contexts. In this way, recognition of the forest sector as a vibrant and highly innovative client for investment may be increased in these organizations.

Recommendation 9:

The CCFM should engage directly with senior academic leadership and representatives from FPAC, FPIInnovations and the FIBRE Network to ensure full integration and exploitation of existing opportunities for forest sector innovation. In particular, CCFM should convene a high-level summit of industry, FPIInnovations and senior academic leaders to engage in focused discussion of priority challenges and barriers to innovation in the forest sector.

Recommendation 10:

Governments should strive to re-establish the profile of the forest sector, and natural resource sectors more broadly, in high-level academic and governmental discussions, ensuring that sufficient resources are allocated to supporting basic and applied R&D that is directly linked to the forest products sector.

Conclusion

This white paper in conjunction with its sister document the 2015 *Compendium: Forest Sector Innovation in Canada*, represents a first step toward improving cross-jurisdictional information sharing on forest sector innovation and provides a platform for future discussions. Canadian jurisdictions are actively pursuing forest sector innovation on a number of fronts – and significant progress has been achieved. With vast sustainably managed forests, technology leadership in a number of areas, and a globally unique forest sector innovation system, this country's forest sector is poised for continued transformation and long-term competitiveness.

Significant challenges remain, however. Uptake of emerging bioeconomy technologies remains low, with commodity production continuing to dominate investment decisions and corporate attention. A lack of partnerships across governments continues to limit the degree to which funding initiatives can drive real transformation, while a somewhat fractured approach to pursuing opportunities for international markets and investors constrains overall success.

Moving forward, it will be critical that efforts to further align forest sector innovation system actors are intensified, in order that a united front is presented to external stakeholders – from international investors, standards development agencies and other industrial sectors, to domestic lenders and prospective employees. In this way, the sector as a whole will be positioned for greater access to foreign markets and investment, while being better able to take advantage of high level mission-oriented initiatives that emerge.

The Canadian Council of Forest Ministers has a critical role to play in supporting this alignment – being a key portal for information sharing and advantaged with significant convening power. Moving forward, the lessons and recommendations presented in this document, as well as the analysis in the *Innovation Framework for Industry Transformation*, should be considered in the development of an innovation-focussed action plan for this Council.

Canada's forest industry companies are relatively small by world standards, with limited financial resources. This context creates an undeniable necessity for federal, provincial and territorial innovation initiatives to be world-class in terms of focus, alignment and vision and capitalize on the strengths of this country's unique forest sector innovation system. Significant progress has been achieved to-date, however, opportunities for improvement must be continually evaluated. By further advancing efforts on innovation, including investigating the lessons and recommendations contained herein, the Canadian Council of Forest Ministers is poised to play a major role in supporting innovation in the forest sector – helping to position this industry as a global leader in competitiveness and sustainability into the future.