

OUR NAME IS INNOVATION



Annual Report
and Review of Activities
2013-2014



2013 - 2014

In the news

April

GUIDE FOR DESIGNING ENERGY-EFFICIENT BUILDING ENCLOSURES

FPIinnovations published this new industry resource, in partnership with the Homeowner Protection Office, Canadian Wood Council and RDH Building Engineering, to help architects, engineers, designers and builders improve the thermal performance of building enclosures of wood multi-unit residential buildings.

July

CONSTRUCTION OF TALLER WOOD BUILDINGS IN QUÉBEC

FPIinnovations and the *Régie du bâtiment du Québec* produced a guide on the construction of five- and six-storey wooden residential buildings to promote and support the use of wood in the construction of mid-rise residential buildings in Québec.

September

RESEARCH COLLABORATION IN ALBERTA

FPIinnovations and Alberta Innovates-Technology Futures entered into two collaborative agreements to strengthen their research partnership in the areas of cellulose nanocrystals and engineered composite products.

May

MARCUS WALLENBERG PRIZE

Dr. Derek Gray was awarded the prestigious Wallenberg prize, considered the "Nobel Prize for forestry," in recognition of his cutting-edge research on cellulose nanocrystals during his career with McGill University and FPIinnovations.

October

RESEARCH PARTNERSHIP

FPIinnovations and Northern Hardwoods Research Institute signed a Memorandum of Understanding to establish a joint framework for information exchange and resource leveraging in the areas of hardwood stand management and harvesting.

October

PROFESSORSHIP AWARDED

FPIinnovations' Professorship in Pulp and Paper Engineering was awarded to Prof. James Olson, director of the Pulp and Paper Centre at the University of British Columbia, for his leadership in helping position British Columbia's pulp and paper sector to prosper in the emerging bio-economy.

November

LEADING-EDGE CELLULOSE FILAMENT PLANT

FPIInnovations and Kruger Inc. announced a joint project to implement the world's first five-ton-per-day cellulose filament demonstration pilot plant at Kruger's Trois-Rivières paper mill.

January

COLLABORATION IN NOVA SCOTIA

The Province of Nova Scotia approved a \$1.1 million investment towards the forestry sector and announced that it is working with FPIInnovations to identify future options for the industry.

February

TECHNOLOGY CERTIFICATION PROGRAM

The Performance Innovation Transport group of FPIInnovations introduced PIT Power. It is a new certification program that fleets can use to quickly and accurately identify the fuel efficiency value of a technology.

March

TALL WOOD BUILDING GUIDE PUBLISHED

FPIInnovations published the *Technical Guide for the Design and Construction of Tall Wood Buildings in Canada*, a multi-discipline, peer-reviewed document intended to provide experienced teams with the concepts and background required to design beyond the prescribed code limits.



Pierre Lapointe President and Chief Executive Officer

Mark Feldinger Chairman of the Board

Message from the CHAIRMAN OF THE BOARD and PRESIDENT AND CHIEF EXECUTIVE OFFICER

The Canadian forest sector has transformed radically in the past few years and is now very sophisticated, involving cutting-edge science and game-changing technology. FPInnovations is at the centre of incredible technological advances, as the industry adapts to the rapid pace of these scientific and technological changes.

More than ever, the need for innovation and strategic alignment is crucial to the success of FPInnovations.

This year, it was obvious that the forest innovation ecosystem has become a reality. Canada now has a collaborative approach to forest sector research, and it is truly inspiring. FPInnovations is very excited to be the catalyst that fosters alliances among organizations that have complementary objectives.

Working as a team, FPInnovations can achieve faster progress and is proud of its strategic partnerships with industries, universities, governments and research institutions. These partnerships facilitate pooling of resources and providing complementary expertise to ensure efficient and cost-effective research within each organization.

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FPIInnovations has a long history of partnerships in many different forms. A striking example is that of the Canadian Wood Fibre Centre (CWFC) of the Government of Canada's Canadian Forest Service. The CWFC provides FPIInnovations with forest-level research services and responds to the strategic research direction set by FPIInnovations' National Research Advisory Committee (NRAC) to improve forest productivity and increase the value of Canada's wood resources. Also reporting to the NRAC, the Program Advisory Committees (PACs) review research projects that feed into the NRAC strategy and are composed of representatives from the science community as well as industry and government partners. This two-tier approach provides guidance and oversight for each research program and a unique perspective that cannot otherwise be captured.

Indeed, FPIInnovations was built on a foundation of collaborative thinking and its unique culture of working together delivers the best solutions from across Canada. By building an effective connection among organizations for targeted research, and even providing linkage to sectors outside the traditional avenues, including the oil and gas and transportation industries, interests and expertise become aligned, resulting in more innovation.

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In the *Review of Activities*, there are details of FPIInnovations' valuable outreach and collaboration successes with industry stakeholders from across Canada. Such strategic alignment of interests encompasses the pre-competitive research and development stage in the

laboratory, through to the pre-commercial phase and demonstration level. One such noteworthy achievement is the joint project with Kruger to build the world's first cellulose filament (CF) demonstration pilot plant at Kruger's Trois-Rivières paper mill in Québec, with support from Natural Resources Canada and a grant from the Québec Ministry of Natural Resources. A highly innovative wood-fibre based biomaterial, CF is expected to have an immediate impact on Canada's forest industry due to its capacity to be integrated into other materials and to its high strength, light weight and flexibility. CF will be used in a wide range of applications as a lightweight strengthening additive to produce lower-cost commercial pulps, papers, packaging, tissues and towels. Looking onwards, CF may be combined with many materials to develop high-value products ranging from flexible packaging and films to structural and non-structural panels in building construction. This project is an excellent example of how collaboration and targeted investment in research and development can positively impact traditional markets while leading to the development of innovative new products, enabling the industry to gain a foothold in non-traditional markets while building on its existing manufacturing capacity in forest-dependent communities across Canada.

By coordinating efforts to partner with university networks, FPIInnovations is proving to be effective in enticing students to work in the industry. The organization must continue to show them that it is a world leader in innovating and delivering state-of-the-art solutions for every area of the sector's value chain.

"In the News" provides other strategic alignment efforts, highlighting FPInnovations' important partnerships among industries, universities, research institutions and provincial governments. FPInnovations is extremely proud of these accomplishments as they demonstrate its determination to deliver on the forest sector's Vision 2020: "that the Canadian forest products industry will power Canada's new economy by being green, innovative and open to the world."

FPInnovations is delighted to say that its efforts are working. Vision 2020 focuses on three components that are essential to the industry's future – attracting talent, improving the environmental footprint, and generating additional economic activity from new innovations and growing markets.

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FPInnovations' industrial expertise, combined with its commitment, helps member companies innovate and compete on the global stage. It is applying its technological knowledge to assist member companies step up their environmental efforts by engaging in sustainability initiatives.

FPInnovations helps its members grow their business through novel products rooted in the bioeconomy, diversifying into new markets and continued expansion in existing markets.

No wonder that during the International Day of Forests ceremony, the Honourable Greg Rickford, Canada's Minister of Natural Resources, said that "from an innovation perspective, Canadian forestry companies are now leading the world in demonstrating the viability of advanced new technologies aimed at improving efficiencies, reducing environmental impacts and creating higher-value products from Canada's enviable forest resources." Without a doubt, Canada is at the forefront of the international race to develop game-changing technology and eco-friendly materials.

FPInnovations' management team and Board of Directors wish to thank its members, employees and everyone working with the organization for their valuable commitment and support over the past year. It is the tireless work of all involved that has enabled FPInnovations to continue to innovate as shown in our *Review of Activities*. After all, FPInnovations doesn't just talk about innovation... it *is* innovation.

Pierre Lapointe



President and Chief Executive Officer

Mark Feldinger



Chairman of the Board



Yves Nadon Chief Financial Officer

FPIInnovations is in a unique position which allows it to clearly and quickly identify needs , technologies and challenges that affect industries across Canada.

Message from the CHIEF FINANCIAL OFFICER

The 2013-2014 fiscal year was truly a favourable one for FPIInnovations. Strong market conditions combined with strategic real estate management set the stage to ensure the long-term sustainability of the organization's innovation capacity. FPIInnovations confirms yet again that it is, and will remain, a strong organization with sufficient financial leverage to attract world-class leaders and take on world-class challenges.

FPIInnovations is in a unique position which allows it to clearly and quickly identify needs, technologies and challenges that affect industries across Canada. Maintaining strong financial health ensures that through research and development, FPIInnovations' research team will continue to deliver cost-efficient, timely and innovative solutions derived from forest sector expertise and materials. Strong financial health also enables the organization to fulfill its promise to the industry to support its competitiveness in traditional markets while developing the next generation of transformative products for non-traditional and international markets.

Strategic financial elements

The needs of the Canadian forest industry and markets continue to evolve and shift. New players and technologies enter the market every year. One of the key factors to FPIInnovations' success is the constant concern about maintaining the investment in collaborative research and strategic alliances aligned with the changing challenges of its members and the future needs of markets.

In 2013-2014, over 185 member companies benefited from FPIInnovations' collaborative research programs, representing revenue of \$69.7 million.

Collaborative research programs are the basis for FPIInnovations' core R&D strategy. They are evaluated by collaborative advisory committees and are designed to share benefits, costs and risks. In 2013-2014, over 185 member companies benefited from FPIInnovations' collaborative research programs, representing revenue of \$69.7 million. FPIInnovations' members provide a broad representation of the needs and challenges faced by the Canadian forest industry. Along with the member organizations, the Canadian and provincial governments remained committed to the forest industry this year with major investments in research and development, as well as technology transfer activities through FPIInnovations that amounted to \$36.8 million. Even with signs of recovery from the forest sector, FPIInnovations expects that revenue from the federal government and the provinces will decrease and then stabilize in the coming years. In 2013-2014, the Atlantic provinces benefited from FPIInnovations' expertise by signing a

multi-year research agreement worth \$1.3 million. The provinces of Québec and British Columbia also significantly contributed to specific research and development efforts, notably in the field of bioproducts.

FPIInnovations also stepped up its efforts in 2013-2014 to develop pre-competitive and pre-commercial strategic alliances as well as an array of

high-value products and services to demonstrate the potential of recently developed technologies. This approach allows FPIInnovations to meet members' increasingly specific competitive needs, and also to act as a true integrator of wood-based products both in traditional and non-traditional markets.

Included in FPIInnovations' operating strategy for the past three years, strategic alliances brought in close to \$5.8 million in 2013-2014, mainly owing to technology development projects involving cellulose filaments. Revenue from strategic alliances has more than doubled since 2012-2013 and is expected to grow incrementally over time.

In terms of delivery, FPIInnovations is proud to have developed technologies, knowledge transfer, logistical support and business development. Revenue from royalties on various technological licences increased by 19% in 2013-2014 compared with the previous year, and reached \$1 million.

The sale of the 3800 Wesbrook Mall building in Vancouver, B.C., combined with the consolidation of activities in the buildings on East Mall in Vancouver, allowed an investment of \$4.8 million in British Columbia to relocate research teams and modernize facilities. These actions also decreased operational costs of general services by 8% compared to 2012-2013.

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This year's active expense management strategy provided the necessary income to increase the organization's financial stability and to finance promising high-value innovative projects. Strong equity market conditions combined with advantageous rates in 2013 put FPIInnovations' pension plan in a very good position, representing a great step towards sustainably reducing the pension deficit.

It is with great pride that FPIInnovations is continuing its mission to help members stay competitive and help the industry gain a foothold in non-traditional markets. The success and momentum of this fiscal year are a testament to FPIInnovations' desire to remain a strong organization that is truly committed to sustaining its ability to innovate.

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Yves Nadon

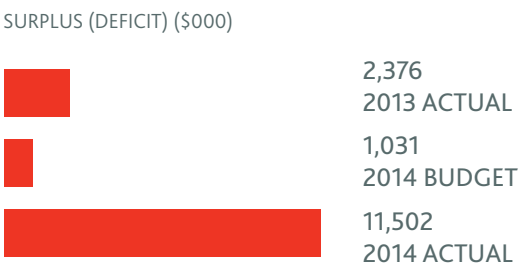
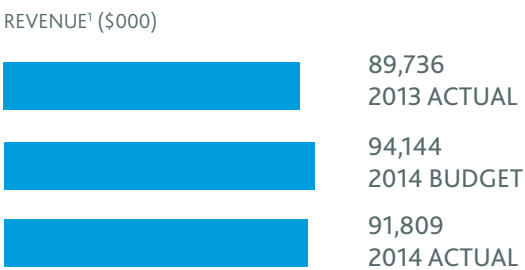
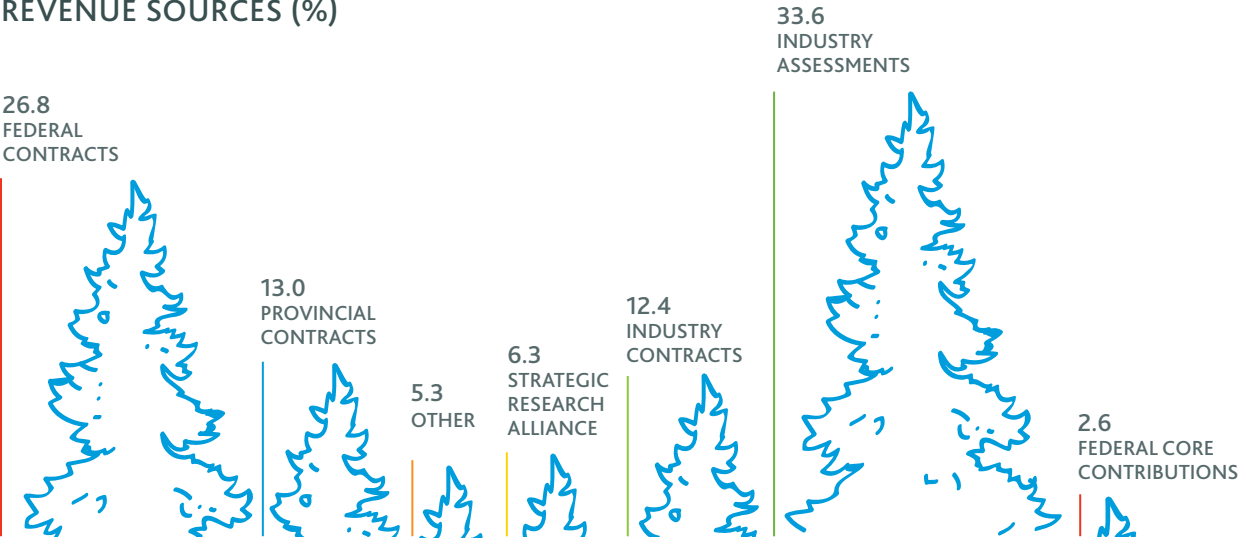
A handwritten signature in dark ink, appearing to read 'Y. Nadon', is centered below the name.

Chief Financial Officer

FINANCIAL RESULTS as at March 31, 2014

CONSOLIDATED

REVENUE SOURCES (%)



BUSINESS DEVELOPMENT

REVENUE SOURCES (%)



¹BEFORE NON-RECURRING PROJECTS.

WOOD PRODUCTS

REVENUE¹ (\$000)



PULP, PAPER AND BIOPRODUCTS

REVENUE¹ (\$000)



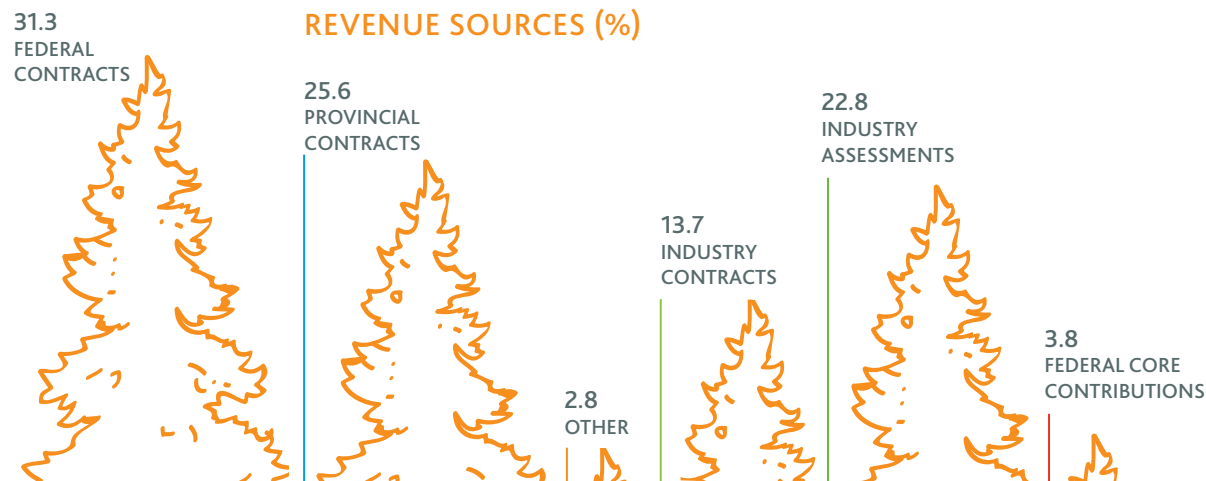
FOREST OPERATIONS

REVENUE¹ (\$000)

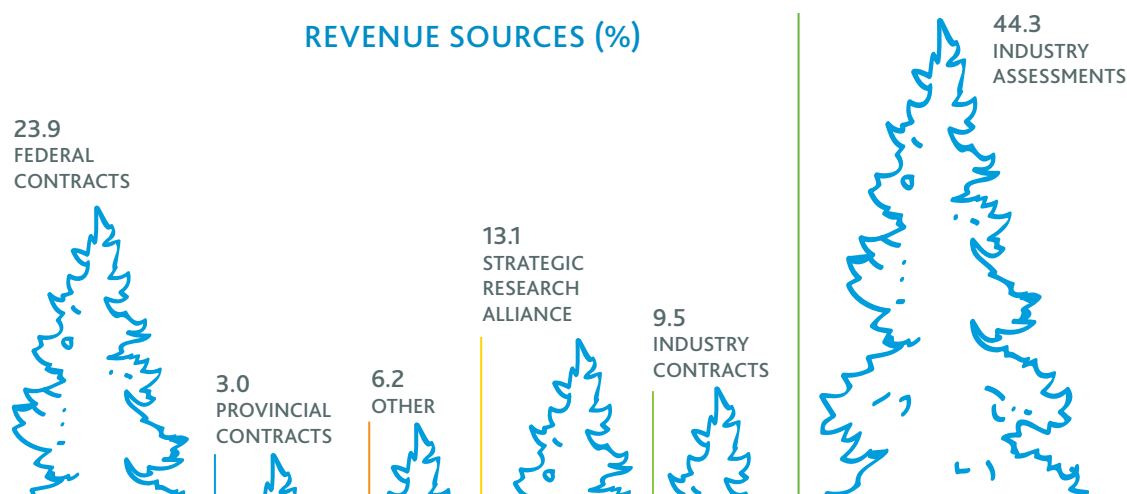


¹BEFORE NON-RECURRING PROJECTS.

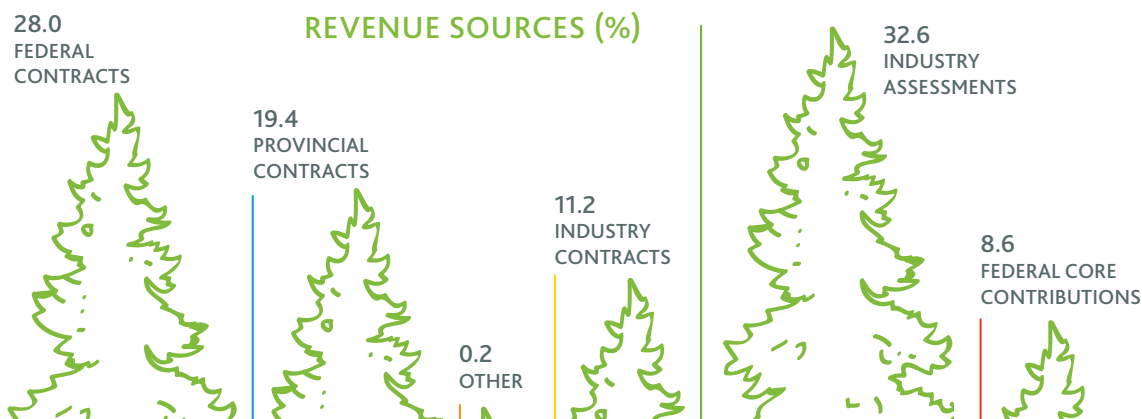
REVENUE SOURCES (%)



REVENUE SOURCES (%)



REVENUE SOURCES (%)



AWARDS 2013 – 2014

Dr. Derek Gray received the prestigious Marcus Wallenberg Award, considered the “Nobel Prize for forestry” in recognition of his cutting-edge research on cellulose nanocrystals.



Erol Karacabeyli, Research Manager, Advanced Building Systems, received the 2013 Wood Engineering Lifetime Achievement Award by the Forest Products Society for his cumulative contributions to the discipline of wood engineering.

Doug Pitt, Researcher, Canadian Wood Fibre Centre, was awarded the Canadian Institute of Forestry's 2013 Canadian Forestry Scientific Achievement Award. The award recognizes individuals for their unique and outstanding achievement in forestry research in Canada.

Dr. Paul Morris, Research Leader, Advanced Building Systems - Durability and Sustainability, received the Award of Merit from the American Wood Protection Association.



Sylvain Gagnon, Associate Research Leader, Advanced Building Systems - Structural Performance, and FPLInnovations' partners at Université Laval and Chantiers Chibougamau, were honoured for their cutting-edge expertise and worldwide reputation in the field of cross-laminated timber during the *Célébrons le partenariat 2013* organized by l'ADRIQ.



Mark Partington, Researcher, Resource Roads, was appointed to the Canadian Standards Association, Sustainable Forest Management Technical Committee and will assist with the sustainable forest management standard (wetlands).

Brad Wang, Scientist, Engineered Wood Products Manufacturing, was elected as one of eight International Academy of Wood Science (IAWS) Fellows for 2014. Fellows of the IAWS are wood scientists demonstrating high scientific standards.



Glen Légère, Research Leader, Resource Roads, was appointed to the Transportation Research Board's (TRB) Committee on Low-Volume Roads. TRB is a division of National Research Council Canada.



REVIEW OF **ACTIVITIES** 2013 – 2014

My name is
Dave Lepage
I am contributing
to value chain
maximization





My name is
Vladimir Strimbu
I am a Researcher
in Harvesting
Operations

FOREST

In recent years, the Canadian forest industry has focused on innovation to help the sector adapt to new challenges, set the stage for long-term prosperity and remain competitive in the global marketplace. Naturally, FPIInnovations is at the centre of this transformation, ensuring that innovation is integrated into all aspects of the forest sector value chain. In doing so, FPIInnovations has developed tools and processes for forest operations equipment and harvesting operations.



Unmanned aerial systems

Unmanned aerial systems (UAS) are growing in use as people discover ways to use them that are more efficient and safer than traditional survey methods. The forest industry can likely benefit from UAS as increased fly times and new multi-purpose sensor arrays make them more and more useful to the sector.

This year, a new innovative program was initiated by FPIInnovations to research and investigate the applications of UAS in forestry operations. FPIInnovations is also conducting studies with the *Centre de Géomatique du Québec* on available technologies, vehicles, controls, sensors and post-processing software. A series of trials based on the applications identified is already in the pipeline with members across the country.

FPIInnovations has also signed a two-year agreement with Alberta Enterprise and Advanced Education to investigate where UAS can benefit the forest industry.

Biomass harvesting

FPIInnovations is working closely with the Ontario Forest Research Institute, the Canadian Wood Fibre Centre, the University of Toronto and Tembec to ensure that Ontario provincial

regulations are aligned with the present and future needs and practices of the industry in a cost-effective and sustainable fashion.

As part of this initiative, FPIInnovations conducted studies that showed the possibility of harvesting greater volumes of fibre in shelterwood cutting blocks in Ontario's Great Lakes–St. Lawrence Forest Region for biomass and pulp products; while at the same time lowering harvesting costs on a volumetric basis, improving regeneration conditions and respecting the objectives of existing regulations.

Shelterwood methods are of interest to resource managers because they are partial-cutting systems that are intermediate between clearcut and selection systems, both in stand structure and complexity of planning. Full-tree harvesting in a first pass of a shelterwood system produced over 50% of additional volume at roadside (pulp and biomass) compared to the traditional tree-length system. At the regional level, this represents about 150,000 m³ of

additional pulpwood and 250,000 m³ of biomass that could be produced annually.

In Québec, FPIInnovations is working with the Québec Federation of Forestry Cooperatives towards the development of innovative biomass supply chain solutions for commercial and institutional heating plants. Funded by Natural Resources Canada through the ecoENERGY Innovative Initiative Research & Development Projects, the program investigates, analyzes and compares different supply chains for forest biomass used for bioenergy in local heating plants and within forest communities.

Silvicultural operations

FPIInnovations conducted a study to assist a member company with the development of semi-mechanized precommercial strip thinning treatments which also tested two fully mechanized treatment patterns. Mechanical mulching costs are lower than motor-manual spacing costs, so a semi-mechanized treatment is able to meet target stocking

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objectives at less cost than a conventional motor-manual spacing treatment. The productivity (hectares per hour) of the motor-manual treatment was higher in the semi-mechanized treatments compared to a conventional motor-manual operation. In 2014–2015, FPIInnovations will refine the treatment as the company completes more mechanical thinning trials.

Direct seeding

Interest in direct seeding has been on the rise as past trials become established enough to start showing germination success.

In June of 2013, FPIInnovations worked with a member in Dryden, Ont., to test the effectiveness of a Seedgun precision seeder using two different seed types. The study will evaluate the effectiveness of the seeding by returning to the sites in subsequent years to assess survival and growth. FPIInnovations also collected machine productivity data to assess the treatment. The post-treatment assessment of germination success will take place after 1, 3 and 5 years.

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Similarly, in September 2013, a member in British Columbia initiated a direct seeding experiment using a Bracke disc trencher and seeder. FPIInnovations was tasked to evaluate the treatment at initiation, monitor the equipment used and evaluate the treatment success after 1, 3 and 5 years.

Researchers at FPIInnovations are continuing to refine the seed delivery process for number of seeds, size of seeds and mixed species.

Wildfire operations

Mulching is often used as fuel treatment along linear corridors such as hydro line rights of way in forested areas to reduce the potential of line contact with vegetation, and convert the fuel loading under the hydro lines and structures to a less flammable state.

Research and documentation of fire behaviour in mulched fuel beds along linear corridors is limited. Even though there is general acceptance that mulching is an effective fuel treatment for reducing fire intensity, questions remain regarding the conditions under which

mulched fuel beds will act as a fuel break or serve as a wick for sustained fire spread.

With this in mind, FPIInnovations launched a project to study how mulched fuel beds in linear corridors respond to point source ignition or line ignition. Experimental burns will be conducted under varying weather and fuel moisture conditions.

Researchers at FPIInnovations are also working with the Government of Alberta on a project involving an aerial torch tracking system. FPIInnovations developed a GPS-based system that will document when and where an aerial torch is applying burning fuel to ignite the forest in front of a fast-moving wildfire. The prototype has already been completed and is now in the evaluation phase.



My name is
Jean-Philippe
Gaudreau
I am a
Researcher in
Harvesting
Operations

HARVESTING

Maximizing log value recovery, enhancing productivity, reducing harvesting costs, improving sustainability of harvesting practices, developing innovative approaches to access additional fibre — FPIInnovations' Harvesting research program is all about contributing to a more competitive forest industry.

Maximizing log value

A key element of the value chain is the wide range of hardwood and softwood forest operation practices. This year, they have come under the microscope in order to identify sound, cost-effective ways to conduct harvesting activities. The ultimate goal is to obtain the best log value in a timely fashion.

To do so, FPIInnovations' researchers have been busy deepening their understanding of the many parameters that affect the cost of wood processing methods. Hardwood specifications, for example, are known to be both diverse and very client-specific. To understand local conditions and investigate best practices when using cut-to-length harvesting systems, FPIInnovations' research teams visited tolerant hardwood operations that spanned sites from Ontario to New Brunswick, and quantified the impact of variations in market conditions on output volume and quality.

As an outcome, industry will benefit from value-oriented wood processing parameters that are adaptable to local conditions and end-user needs, while being environmentally sustainable and cost-effective.

Improving hardwood's competitiveness

FPIInnovations' Hardwood Initiative, financially supported over the years by the provinces of New Brunswick, Ontario and Québec, and by Natural Resources Canada through the Transformative Technologies Program, has helped further an understanding of the challenges and opportunities the industry faces. Globally uncompetitive, the hardwood industry has long been affected by the limited availability of quality raw material and by difficult economic situations. Dedicated to increasing the industry's competitiveness, FPIInnovations' hardwood research program has focused on challenges related to harvesting, sawmilling and product manufacturing. For example, harvesting studies have proven that FPIInnovations' 1-2-3 method applied in hardwood stands could lead to cost reductions of up to \$1.50/m³ and to greater sustainability when used in shelterwood cuts and selection cuts.

The many benefits to be gained from FPIInnovations' efforts in developing improved harvesting strategies include an increase in stand availability through cost reductions associated with adaptable practices, as well as improved log supply. These initiatives will also help further local bio-industry development by determining the right conditions and method for viable biomass extraction in hardwood forests.

Leveraging scanners for scaling

Industry has suggested using scanners as a way to reduce both scaling costs and the impact of a future shortage of scalers. Before they can be used for scaling, scanners have to be certified by Measurement Canada and meet provincial scaling requirements. To help Measurement Canada develop certification procedures, FPInnovations demonstrated scanning technology to the agency's managers and technical specialists at its labs in Vancouver and Québec. FPInnovations collaborated with the Canadian Standards Association (CSA) technical committee to write a CSA scanner scaling standard. FPInnovations also worked with the B.C. Provincial Scanner Scaling Committee, which identified the need for a method to determine species and grade in scanner scaling. To that end, FPInnovations tested a new technique called "top scaling" to determine if it could meet species and grade requirements on pre-sorted log bundles delivered by water to coastal sawmills. Early results indicate this could be a viable approach although further testing is still required.

Assessing forest machines on steep slopes

The significant volumes of fibre available on steep slopes are normally considered inaccessible to ground-based harvesting

systems. Yet technologies like levelling-cab loader-forwarders and tethered harvesting machines have the potential to expand the range of sites where ground-based equipment could replace cable yarding equipment and improve access to timber. By moving workers out of a hazardous work environment and into an enclosed cab, these technologies could also offer significant safety benefits compared to manual felling. In order to enable development, more knowledge on these recent innovations and their suitability for Canadian conditions is required. With financial support from Natural Resources Canada through the Transformative Technologies Program, FPInnovations' researchers made headway in 2013 with these technologies, for example when operating under coastal steep slope conditions in British Columbia.

Boosting heavy machinery performance

Typically, delivered wood fibre represents between 50 and 60% of production costs at most Canadian softwood sawmills, and between 25 and 40% at pulp and paper mills. Any improvement in

the highly capital-intensive forest-to-mill supply chain will not only boost the competitiveness of traditional industries, but support the emerging bioeconomy as well.

To support this effort, FPInnovations has tested an integrated monitoring platform (FPSuite™) that aims to improve harvesting and transportation operations. One of the FPSuite tools is FPDat™, a rugged on-board computer for heavy machinery that collects data on equipment performance and productivity, with potential applications in forest, mining or construction operations. With an advanced GPS navigation system, FPDat gathers data to keep operators and managers informed in real-time

via FPTrak™, a data management Web site with information on utilization, fuel consumption, treated areas, GPS track logs, productivity and downtime causes.

More than 400 FPDat units are already in use across Canada. In testimonials, FPDat users report efficiency improvements ranging from 5 to 10%. For typical forest machines like feller-bunchers, these efficiency gains can represent additional revenue of \$25,000 to \$30,000/year.

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The FPDat/FPTrak platform has no equivalent on the market. Companies that are only interested in specific features, like navigation, will find less expensive systems but none that automatically communicate integrated spatial and production data and enable customized reports. Interest in the system is steadily growing as additional features —like the Transport and Grader modules —are being developed. In Canada, the estimated demand for FPDat is between 1,000 and 1,500 systems, with an additional 2,500 to 5,000 units for the Transport module.

FPDat Grader

FPDat Grader improves grader performance and facilitates strategic decision-making for investment in resource road maintenance. This new FPSuite module consists of the FPDat data logger and a vibration sensor designed to be mounted on the grader blade. The production data are first analyzed by the FPDat system and then sent to the Web-based FPTrak software, where managers can view and analyze them.

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FPDat Grader is also equipped with a touch screen, providing the operator with useful navigation features and enabling both the operator and manager to stay informed about grader performance in real time.

FPDat Loader

To further enhance FPDat's usefulness for the industry, the development team has come out with the FPDat Loader module equipped with enhanced load ticket functionality. This allows operators to print customized load tickets that

display reliable and relevant information, including load origin, destination, species, targeted product, transport company and more. The information is contained on an easily scanned 2D bar code and is sent automatically to FPTrak, where it can be viewed in the form of a detailed report. The system can also automatically locate targeted cutblocks, making data entry easier and reducing the risk of errors.

FPDat Machine-to-machine communications (M2M)

Another new feature, the M2M system allows FPDat-equipped machines up to 300 metres apart to exchange GPS track log information while operating in the cutblock, using Wi-Fi modems. This feature also opens the door to the development of smart phone applications designed to easily provide data to operators and managers about the machinery production and GPS track record in real time. The modems can be used to develop mesh networks, where every machine equipped with a Wi-Fi modem acts as a transmission and reception node, cooperating in the distribution of data throughout the network. The objective is to extend the use of this feature to all other data collected through FPDat.

TRANSPORTATION

Through research and innovation in key aspects of transportation, FPInnovations is creating greater opportunities to enhance competitiveness and reduce the environmental footprint of the forest value chain.

Reducing aerodynamic drag

Thousands of trucks with loaded and unloaded log trailers travel on forest roads and highways across Canada during forest operations or on their way to supply mills. Today, transportation can account for up to half the delivered wood costs for the forest industry. But that percentage may rise as resources are transported over increasingly longer distances to be sold or processed. As a result, transportation is putting additional pressure on both the Canadian industry's competitiveness and the life cycle of forest products. With rising fuel prices and a desire to reduce the environmental footprint, companies can only stand to gain by learning more about fuel-efficient operating practices and technologies. Since between 40 and 50% of total consumption is due to aerodynamic drag, FPInnovations' researchers are vigorously tackling this issue. In 2013, FPInnovations developed a comprehensive toolbox to measure and analyze the impact of a truck's profile on aerodynamic drag. The focus is two-fold: to identify the best technologies for reducing aerodynamic drag, and those that will reduce the impacts of various trailer configurations.

My name is
Vincent Roy
I am a
Researcher in
Transportation
and Energy



Enhancing transportation performance innovation

In 2013, furthering the development done previously, new testing activities in the field of transportation were added to FPInnovations' accreditation to ISO/IEC 17025:2005 (CAN-P-4E), granted by the Standards Council of Canada. These new activities include fuel consumption testing for heavy-duty vehicles, such as testing according to SAE Type I, II and Type III procedures, and EPA SmartWay interim test methods; fuel consumption testing for light-duty vehicles; emissions' testing using portable emission measurement systems (PEMS) according to EPA regulations; and fuel consumption and emission testing for conventional and hybrid heavy- and light-duty vehicles according to specific SAE standards.

Through financial support from Economic Development Canada, the Performance Innovation Transport (PIT) group also acquired more than \$800,000 worth of high-tech equipment, expanding the range of available tests for both the Fleet and Municipal PIT

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programs. With these acquisitions, PIT equipment now includes high-pressure flow meters to measure the consumption of vehicles—whether run on gasoline, diesel or biodiesel fuel. These instruments are excellent additions to PIT's gravity measurement system, which now allows gravimetric consumption on vehicles to be studied while they are on the road. A new dynamic sensor system also enables PIT to accurately measure acceleration, speed and the distance covered by a vehicle. Studies on braking, acceleration, stability and various manoeuvres, as well as coast-down tests—which are useful in testing rolling resistance or parasitic loss measurement—may now be carried out with unmatched precision. The most spectacular acquisition is the trailer-mounted dynamometer. This device is similar to a trailer and makes it possible to apply resistance—behind the

PIT now not only has the expertise, but also the tools to support fleet improvements and to speed up the development of technologies.

trucks being tested and in a reproducible way—that simulates a slope of up to 25%. PIT now not only has the expertise, but also the tools to support fleet improvements and to speed up the development of technologies.

Major research projects in 2013–14

- Two Energotest campaigns for testing technologies, methods and practices developed to improve energy efficiency, which offer great visibility to PIT and its members and clients.
- Investigation of temperature-controlled trailer performance during winter conditions to compare the fuel consumption of heating units on 53-ft. van semi-trailers of various ages, with different rear door insulations, and for various temperature settings.
- Investigation of refrigerated trailer performance to benchmark fuel consumption of reefer units, and to measure the impact of trailer insulation, door type and age on reefer fuel consumption and for various temperature settings.

- Investigation of the effectiveness of driver training programs (longevity of information retention).
- Comparison of fuel efficiency and traction performance of 6 × 4 and 6 × 2 tractors.
- Investigation of tire pressure management systems, among several promising technologies.
- Improvement of idle time, with the use of smart anti-idling systems for both heavy- and light-duty vehicles that minimize idle time to save fuel, but allow longer idle time in specific weather conditions to meet the driver's needs.





My name is
Vincent
Lavoie
I am a
Scientist in
Drying and
Energy

WOOD PROCESSING and MANUFACTURING

Intelligently designed and sustainably produced lumber and engineered wood products provide the perfect foundation for better secondary wood products. To help member companies effectively produce and market value-added products and construction materials, FPInnovations provides research, development, technical support and awareness of the attributes and advantages of the growing number of wood-based options available for building materials.

Nano-coatings for tooling

Although reducing tool wear and power requirements would lower manufacturing costs and increase production, little is understood about the tool wear mechanism. A better understanding of the factors affecting tool wear, tool failure, coating selection and performance will facilitate applications throughout the sawmill, as well as in other products and sectors. To support this effort, FPInnovations continued to work on determining wear and failure mechanisms in 2013, as well as nano-coating options for different base materials and wood species. Field testing of coated tools highlighted increases of 30 to 1000% in tool life, as well as a significant reduction in power needs. The estimated benefits of up to \$200,000 per year helped foster commercial partnerships to develop new applications for the industry.

Preserving wood chip volumes

As a first step in a broader pan-Atlantic strategy, FPInnovations developed a partnership with the Nova Scotia Department of Natural Resources in 2013 to support the transformation of the province's sawmill industry. Every year, the industry sees substantial financial losses through the loss of chips in inventory caused by a reduction in demand and deterioration in yards. To assess wood chip volume reduction scenarios, the research team uses Optitek, FPInnovations' sawing simulator, which provides various sawing models for a wide variety of sawmill resource, machinery and process configurations.

Improving sawmill yields

Global competitiveness studies show that British Columbia's coastal sawmills have among the highest manufacturing costs in North America. There is an ongoing need to improve productivity and efficiency in all sawmills, particularly as capital upgrades tend to shift bottleneck activities. Similar needs, including enhanced mill productivity and efficiency, also exist in eastern Canada. Nova Scotia's hardwood sawmilling industry is one example. The province has acknowledged the need to modernize equipment, improve processes and maximize production. This year, FPInnovations offered its support by providing the knowledge and expertise to conduct studies on selected mills. Analysis studies showing current and potential equipment performance were done for each mill, with and without capital investment, to present improvement opportunities and guidelines for the production of lumber suitable for the secondary manufacturing industry. In coastal British Columbia, these studies have identified opportunities valued at well over \$1 million/yr/mill.

Improving high-speed sawing

Among the novel research and improvement services at FPInnovations that contributed to the industry's competitiveness in 2013 were the testing and development of high-speed circular

sawing. Improving the use of this technology allowed the industry to increase feed speeds by 10% at selected mills, while reducing target size and kerf. Ongoing sawmill process monitoring efforts also enabled FPInnovations' researchers to develop new metrics to better capture overall sawmill performance. Sawmill machines are complex and fast, and improvement is critical as a 1% error translates into \$100,000 lost per 100 million board feet. Among these machines, circular saws that are used continuously experience constant physical and thermal strains. It is estimated that circular saws in some cuts perform 30% below optimum speeds. In addition, unexpected or premature failures requiring saw changes create significant downtime. FPInnovations continues to work on identifying and developing suitable sensor technologies that enable real-time monitoring for quick diagnosis of sawing issues.

Adapting advances in drying technology

There is a pervasive need for something of a revolution in the drying industry: new technologies and processes that get the

industry closer to fast, flexible, continuous and precise drying. Through one concept introduced in the United States, mills have already reported several benefits, including energy, productivity and quality improvements. FPInnovations provided technical support to adapt this technology to Canadian mills and took the opportunity to characterize the industrial process. The benefits of continuous drying include energy savings of up to 30%, improved productivity, inventory reduction, narrower moisture content distribution and improved grade recovery. Researchers have also started to investigate alternative drying solutions for high-value products requiring extra precision.

Global competitiveness studies show that British Columbia's coastal sawmills have among the highest manufacturing costs in North America.

Adding value with colours

This year, researchers investigated ways to develop industrial biotech processes for wood colouration, reflecting the need to manufacture innovative products that are unique to the market. Promoting

high-value products that possess attractive wood colours and patterns will help reduce value losses of otherwise unwanted stained wood, and increase the average value of the lumber product mix. Part of this ongoing

research effort involves the assessment of the physical properties of bio-coloured wood. It also includes the establishment of a network of partnering designers and architects interested in this new type of product, as well as the evaluation of its technological feasibility.

BC Coastal and Bio-Economy Initiatives

Much has been done this year to assist FPIInnovations' partners and members in British Columbia. Through the BC Coastal Initiative, financially supported by Natural Resources Canada's Transformative Technologies Program and the British Columbia government, FPIInnovations has provided the knowledge to support decisions concerning a wide range of initiatives: high-speed sawing, semi-automated grade sawing for edgers, value-chain planning and improvement tools like FPIInnovations' ForestPlan technology for optimal log length profile, as well as an improved bucking decision process. The BC Coastal Initiative also took drying efficiency and market development one step further, either by developing innovative technology or strategically partnering to identify and prototype novel product concepts.

Through another program, the BC Bio-Economy Initiative, researchers have built strong business cases to support the pre-commercialization of new bio-energy and bio-products such as wood-wool cement boards. Known for their

durability in any climatic conditions, these composite boards can be used in many industrial applications, including roofing, acoustic and thermal insulation and shuttering.

The road to continuous improvement

Low inventories, technology for producing on demand, and relocation to smaller premises are proven continuous improvement solutions that many companies have developed over the last few years. Yet companies frequently face the challenge of how to put smart theory into practice on the plant floor. In 2013, with the objective of supporting the industry's competitiveness, FPIInnovations led a technical mission on how lean manufacturing supports company strategies for economic growth and sustainability. Close to 30 participants had the opportunity to tour seven innovative, leading-edge lean manufacturing companies recognized nationally for their success in developing continuous improvement principles. They included the Toyota manufacturing plant in Cambridge, as well as Boeing Canada and Duha, both in Winnipeg. Now more than ever, companies need to look outside to learn what others are doing differently. In order to guide future development and improvement, this five-day technical mission offered an exclusive opportunity for participants to see, learn and share innovative technologies, processes and manufacturing best practices.

New wood drying era: piece by piece, precise, continuous and using radio-frequency

The increase in demand for specific wood products destined for secondary manufacturing wood products is prompting lumber producers to plan the manufacture of a wider range of specialized products. Secondary manufacturing wood products, however, require final moisture contents that are generally not only lower, but also more precise than commodity products such as construction lumber. The Drying and Energy research team together with its partners at Hydro-Québec's *Laboratoire des technologies de l'énergie (LTE)* has been working with FPIInnovations' industrial members to develop a continuous and automated redrying system that enables control over moisture content, piece by piece, and that benefits from the speed of radio-frequency drying technology.



My name is
Francine Côté

I am a
Technologist
in EWP
Manufacturing
and Product
Development

CODES and STANDARDS

In 2013, FPInnovations continued to work closely with the Canadian Wood Council, American Wood Council, APA - The Engineered Wood Association, the Canada Wood Group and other stakeholders directly involved in codes and standards in North American and overseas markets. It has the technical expertise and experience to provide a coordinated, holistic approach to develop new opportunities.

FPInnovations scientists chair or participate in over 130 committees, sub-committees and task groups responsible for drafting critical pieces of regulatory documents being considered for adoption. No other organization in North America has this level of participation in national and international codes and standards.

Key accomplishments in this area in 2013–14:

- The ongoing development and monitoring of design for all major Canadian species groups to ensure that wood maintains its dominance in single-family (19 billion board feet in North America) and low-rise (4 billion board feet in North America) building construction.
- Collaboration with the wood-based panel industry to produce two guides for designers and builders, thus integrating knowledge gained through previous development: the *Guide for Designing Energy-Efficient Building Enclosures for Wood-Frame Multi-Unit Residential Buildings in Marine to Cold Climate Zones in North America* (released in spring 2013, with 20,000 downloads within a year), and *Pathways to High-Performance Housing in British Columbia* (for release in spring 2014).

- Ongoing support to diversify Canadian wood products for overseas markets (5 billion board feet exported to East Asia in 2013) by working with Chinese experts and code committees in three areas: the recognition and acceptance of Canadian timber grades and species, the acceptance of up to 7-storey hybrid structures (3-storey wood frames on top of 4-storey concrete/masonry), and the development of a seismic design guide for 7-storey hybrid structures/buildings.
- Among the many ISO Technical Committees involved in these discussions, ISO/TC 165, Timber Structures, chaired by FPIInnovations staff, is the most prolific in developing international standards for the structures. The committee represents many timber-producing and consuming regions, with a total of 55 countries either participating or observing its work. Its secretariat is currently held by Canada.
- FPIInnovations staff is also involved in ISO/TC 165, Wood-based Panels, contributing to the development of the ISO 12460 formaldehyde emissions standard methods which also take into account existing North American standards. The committee is directly responsible for 20 standards and related test methods, as well as quality requirements for composite panels like

fibreboards, particleboards and plywood. A total of 63 countries are either participating or observing its work; FPIInnovations provided the technical support for North American industry associations involved in this committee.

- FPIInnovations provided further reinforcement for the forest sector's expansion into mid-rise (5- and 6-storey) construction markets (29 million board feet in Canada). It produced a design and construction guide to support the decision by the *Régie du Bâtiment du Québec (RBQ)*, the Québec building code regulator, to permit residential wood construction up to 6 storeys as of June 2013. For the design of mid-rise wood-frame construction, FPIInnovations scientists also led the development of code change proposals on high-capacity shear walls and diaphragms in the Canadian wood design standard (CSA O86).
- FPIInnovations scientists also participated in the implementation of cross-laminated timber (CLT) in construction codes both in Canada and the U.S. In the U.S., FPIInnovations supported the successful proposal by the American Wood Council and APA - The Engineered Wood Association to recognize CLT as Type IV construction in the U.S. International Building Code in 2015. Design provisions for

CLT have also been proposed in the U.S. Wood Design Standard (NDS) following the publication of the U.S. *CLT Handbook* in 2013.

- In Canada, FPIInnovations scientists supported the inclusion of references for CLT in the RBQ *Mid-rise Construction Guide*, as well as in CSA O86.
- With the help of FPIInnovations' scientists, a British Columbia developer obtained the first permit in the province for a concrete building with wood infill walls. FPIInnovations' key contribution was to provide the developer with the evidence needed to convince the local building authority to grant this code-permitted but unusual form of construction. The potential market in Canada is up to 14 million board feet of lumber and 9 million square feet of sheathing for 7 storeys and higher (assuming light-frame already captures up to 6 storeys).

Supporting mid-rise construction

To provide additional technical information for mid-rise wood-frame construction based on experts and on previous development, a collaborative project of the National Research Council Canada, the Canadian Wood Council, and FPIInnovations has been launched, financially supported by Natural Resources Canada and

several provinces. In 2013, FPIInnovations and its partners worked on a handbook for mid-rise wood-frame buildings that goes hand-in-hand with the Canadian Wood Council's proposal on 5- and 6-storey buildings.

A guide for tall wood buildings

In one of this year's major achievements, FPIInnovations produced and published the *Technical Guide for the Design and Construction of Tall Wood Buildings in Canada*. In addition to providing valuable support for tall wood construction over six storeys, the guide aims to provide information to the Authorities Having Jurisdiction to help facilitate acceptance of projects using the alternative solutions path in building codes.

Strategies for high-performance housing

Another success this year was the publication of the research guide *Pathways to High-Performance Housing in British Columbia*. The guide focuses on design and construction strategies and detailed measures to improve home energy efficiency in the province. The main objective is to provide interested designers and builders with guidelines for the construction of single-family and small multi-family buildings that are substantially more energy efficient and lower in environmental impact than traditionally built homes.

Value-added solutions for wood products

Another area of significant activity in 2013 was the development of value-added solutions in flooring and appearance wood products. Supported by industrial members, as well as by Natural Resources Canada through the Transformative Technologies Program, FPIInnovations' secondary manufacturing team made great strides in developing wood products that allow Canadian manufacturers to compete with the growing number of alternative solutions and bring innovative products to market.

New high-performance substrates were developed and tested to allow manufacturers to produce lighter and stronger products like engineered sub-flooring and floor strips. Other crucial properties driving the market, including acoustic and thermal resistance performance, as well as the speed of installation, were also taken into account.

Improved finishes and finishing technologies were another area at the heart of FPIInnovations' efforts this year to improve value-added wood products. One particularly promising approach consists of developing multi-layer systems produced by the plasma spraying process. These ultra-thin barriers feature combinations of properties such as

selective absorption of light (e.g., UVA and UVB), mechanical protection, optical clarity, vapour barrier or even super-hydrophobic qualities. These projects support the secondary manufacturing industry in their efforts to provide customers with highly durable, sustainable and budget-friendly wood products.

Semi-transparent coatings containing heat-reflecting pigments were central to the efforts to further the development of next-generation coatings. Building on the industry's need to offer coating products that can significantly reduce heat build-up, which in turn decreases surface colour changes and resin exudation, FPIInnovations' research projects this year demonstrated that this can be achieved by adding infrared reflective pigments in semi-transparent coatings. These reflective coatings were applied on samples of cross-laminated timber and helped limit the appearance of cracks associated with premature drying.



My name is
Gail Sherson

I am a
Research
Manager for
Market Pulp

PULP, PAPER and BIOPRODUCTS

FPIInnovations' scientists know that innovation is the key to transforming Canada's forest sector and keeping it prosperous. Thus, innovation in the pulp and paper sector, long a pillar of Canada's forest industry, is a primary focus of FPIInnovations' pulp, paper and bioproducts researchers, who are creating true innovation by developing new processes, specialized wood fibre-based products and biomaterials, and new technologies.

Market pulp: reduce costs, increase output and expand market

Rising cost pressures have always been a major concern for the pulp and paper industry and FPIInnovations' research team is working hard to improve the competitiveness of market pulp mills by turning theories into practical solutions that can reduce production costs, increase productivity and support market development.

FPIInnovations' market pulp program helps producers—including kraft, high-yield pulp and dissolving pulp mills—reduce production costs, increase productivity and retain market share in traditional markets while increasing sales in growing market segments.

Member companies are turning to FPIInnovations for support to stay ahead. The performance of market pulps in tissue grades, and energy management and improvement in kraft pulp mills, are the major research focus areas.

In 2013, the program helped market pulp makers develop cost reduction projects in areas such as kraft digester control and improvement, high-yield pulp properties' on-line measurement, chemical recovery improvement, and energy management and use.

Many member company kraft mills have installed and commissioned condensing turbines purchased with funding assistance from Natural Resources Canada's Pulp and Paper Green Transformation Program. It is challenging to find sufficient excess steam within the mill to maximize turbine output and electricity sales, while continuing to meet process demands for heat. FPIInnovations has initiated a new project in collaboration with CanmetENERGY to help mills develop a cost-effective process by which they can analyze and improve heat and water balances to meet this new demand for steam.

Reduced process steam demand and optimal utility management allow additional electricity sales by kraft pulp mills. As part of the collaboration with CanmetENERGY, FPIInnovations is performing case studies to illustrate the tools and methods for improving steam usage and management in kraft pulp mills with electricity cogeneration.

By helping Canadian kraft pulp mills become more cost-effective and reduce their environmental footprint, FPIInnovations is contributing to making Canada's forest sector more economically competitive and environmentally sustainable.

Benchmarking for success

One of the most significant barriers to growth is the inability to adapt to changing markets, environments and competition. Understanding one's competitive position is very important, and failure to evaluate and adapt can make a company insignificant in the global arena. It is therefore critical to compare a company's performance against a practice standard established by a respected, third-party organization.

To assist Canadian pulp manufacturers compete more effectively in global markets, FPInnovations has been conducting programs every five years to research the quality of bleached kraft market pulps from major pulp-producing countries worldwide. The goal is to develop comprehensive databases of mechanical, chemical, surface and optical properties to provide Canadian market pulp manufacturers with relevant information about the typical ranges of fibre and pulp attributes so they can benchmark their products against competitors' pulps and use this knowledge for further development.

In 2013, FPInnovations released a research report to help pulp producers evaluate, test and adjust their products and businesses to a recognized high standard of achievement. The report is particularly useful for market pulp manufacturers in defending the quality of their pulps to

prospective customers, and for positioning their products against competitors' pulps with respect to papermaking potential. It can also be used by market pulp customers as a decision-making tool and for assessing the quality of purchased pulp for its particular end-use application.

Paper, packaging & consumer products

The declining market demand for printing and writing paper has been putting pressure on Canadian manufacturers to relentlessly pursue improved manufacturing efficiencies, new applications for their products and new product development. FPInnovations has been developing new technologies and tools, and providing support to its members in technology and new product developments.

In one thermo-mechanical pulp mill, for example, the development of a simple stock preparation strategy led to cost savings. The facility implemented FPInnovations' recommendation, which reduced annual operating costs by more than \$750,000 per year.

3D printing meets biomaterials

The exploding 3D printing technology is already being used to make items such as clothes, art pieces, medical implants and even food in space. FPInnovations has entered the 3D printing world, using 3D printing for the

development of potential applications of new biomaterials such as cellulose filaments, cellulose nanocrystals and lignin.

The emergence of 3D printing will help accelerate the acceptance of biomaterials derived from wood fibres to replace oil-based products in the marketplace.

Anticipated products include prototypes, building system parts and moulds which can be found in virtually every industrial sector. The 3D printed objects incorporating biomaterials promise great benefits such as the development of products that are difficult to fabricate by conventional techniques and with enhanced physical properties (hardness, stiffness, satisfaction of tactile impression) and biodegradability. One possible example of application in the electronics industry concerns 3D-printed interface components for electronic devices with modified cellulosic nanomaterial that could integrate sockets, interactive features and actuators.

Printed electronics is a great example of technology where 3D printing can help significantly increase the speed of R&D to market time. Biomaterials from the pulp and paper industry may be applied in the next generation of intelligent/smart packaging, flexible displays, or low-cost and disposable diagnostic devices.

Strengthening tissue R&D capabilities and innovations

FPIInnovations now has the capability to test key tissue performance attributes such as softness and water absorption—a very important feat as consumer preferences for improved quality and performance play a major role in the global success of current and future tissue businesses.

Dubbed the “holy grail” of the tissue industry, softness is one of the key performance attributes of tissue. The search to perfect it while keeping in balance other important attributes such as strength has been a high priority for tissue product improvement and new product development.

Water absorption is another important performance attribute for not only tissue, but also towel and hygiene products. However, quick, accurate and reliable measurements are difficult for mills to perform. To address this, FPIInnovations has developed and experimented with a new automated water absorption tester based on ISO Standard 12625, which was validated through successful mill trials in collaboration with member companies. Measurements by this new tester are faster and more reproducible than existing methods, and the instrument has the ability to measure average absorption rate, water retention and

total water absorption capacity. This information will help mills monitor and control water absorption properties and develop new products. The new water absorption tester has been made available to members and already supplied to a member mill.

After successfully converting its pilot paper machine into tissue production in 2007, FPIInnovations has built a research program around tissue and offered pilot tissue trials to many companies. The tissue offering is now further strengthened by a handfeel softness panel and the automated water absorption tester.

Developed as a measurement tool, the handfeel softness panel has already tested its strict methodology to evaluate softness of tissue made on FPIInnovations’ pilot paper machine. This represents a great opportunity for FPIInnovations to take the lead in improving and standardizing the handfeel panel method, and to support its members and customers in developing more competitive products.

This is fantastic news for Canadian tissue producers: world tissue demand is forecast to

After successfully converting its pilot paper machine into tissue production in 2007, FPIInnovations has built a research program around tissue and offered pilot tissue trials to many companies.

grow by an average of 4.1% annually between 2010 and 2021. Exports to the competitive United States and other emerging markets now account for roughly half of Canadian production, with the trend swinging toward ultra-quality products in household towels and toilet tissue. This has prompted Canadian suppliers to launch new premium category products.

In addition, FPIInnovations’ Paper, Packaging & Consumer Products and Market Pulp programs recently worked together to investigate the Chinese tissue market to analyze the overall tissue production, collect product intelligence, identify key tissue performance requirements, and gather Chinese product specifications and standards.

With the printing and writing paper grade falling steadily in North America, FPIInnovations’ tissue research program, strengthened by its new capabilities, can help Canadian pulp and paper companies, particularly market pulp producers, take advantage of the growing global tissue demand.

My name is
Stéphanie Houde
I am a
Technologist
in Wood Products
Extractives





BIOMATERIALS

One of FPIInnovations' goals is to develop non-traditional wood and fibre-based products to enhance the value of all parts of the resource by diversifying wood markets and supporting the development of a new bioeconomy.

World's first cellulose filament plant

Canada leads the international race to develop the next generation of game-changing technology and eco-friendly materials. In December 2013, FPIInnovations and Kruger Inc. announced a strategic alliance to develop the world's first five-ton-per-day cellulose filament (CF) demonstration pilot plant at Kruger's paper mill in Trois-Rivières, Que. This important research and innovation project represents investments totalling \$41.3 million, including funding from Natural Resources Canada through the Investments in Forest Industry Transformation (IFIT) Program, funding from the Québec Ministry of Natural Resources, funding from the British Columbia Ministry of Forests, Lands and Natural Resource Operations, a loan from Investissement Québec, a contribution from Kruger Inc. and funds from FPIInnovations' pulp, paper and bioproducts industrial members.

Cellulose filaments are expected to have an immediate impact on Canada's forest industry because of their innate capacity to be integrated into other materials, as well as their high strength, high surface area and aspect ratio. As a strengthening additive, CF will be used in a wide range of applications to produce novel grades of commercial pulps, papers, packaging, tissues and towels. Combining CF with many materials will allow the creation of high-value products ranging from flexible packaging and films to structural and non-structural panels in building construction.

Cellulose filaments are set to become a key element in the transformation of the Canadian pulp and paper industry enabling the industry to gain a foothold in non-traditional markets while building on its existing manufacturing capacity in forest-dependent communities across Canada. By enabling the Canadian forest industry to diversify into non-traditional markets, CF production will help protect existing jobs and create opportunities for new highly qualified jobs across the country.

Cellulose filaments are expected to have an immediate impact on Canada's forest industry because of their innate capacity to be integrated into other materials, as well as their high strength, high surface area and aspect ratio.

The potential initial market for CF as a strength-reinforcing agent for traditional pulp and paper products is conservatively estimated at 120,000 tons per year in North America alone. In addition, a similar-sized, non-traditional market is forecast for thermoplastics, reinforced plastics, thermosets, adhesives, and non-woven fabric and coatings, representing a total revenue potential of \$500 million per year for companies that make use of CF.

Novel absorbent textile fibres

Earlier this year, FPIInnovations' researchers Alois Vanerek, Jessica Carette and Stephanie Beck, along with Theo van de Ven (McGill University, Innovative Green Wood Fibre Products Network) conducted a pilot trial that aimed to produce absorbent textile fibres using a newly developed process using cellulose. The new technology that was developed in close collaboration between FPIInnovations and McGill University is a good example of successful collaboration with the universities that leads to new technologies from

fundamental research. Under development for the past three years, unconventional absorbent textile fibres were manufactured. The advantage of these novel fibres lies in their high liquid absorption capacity. This property can be exploited in combination with commercial pulps and additives available in the areas of infant diapers, adult incontinency pads, personal hygiene, medical applications, textiles and nonwoven products. FPIInnovations has successfully demonstrated that the newly developed technology is robust and compatible with an industrial process. This is a very important factor when the new technology will be used commercially. The trial also outlined the next steps of the research that are required to get the new novel material closer to operation.

Nonwoven products

Wood fibre-based nonwovens are destined to be integrated in numerous applications such as thermal and acoustic insulation and automobile interiors. This year, with the financial support of Natural Resources Canada's Forest Innovation Program, FPIInnovations developed nonwovens panels from plain cellulosic fibres to evaluate manufacturing possibilities as well as key properties. Naturally hydrophilic in comparison to the commercial synthetic fibres used in nonwovens, wood fibres were coated with different chemicals to improve specific attributes such as moisture resistance and fire resistance.

Produced at different density levels, different nonwoven mats were tested in floor systems with different topping materials. Both concrete slabs and dry toppings (cross-laminated timber) were tested. Acoustic tests showed comparable or even better results compared with commercial products such as regular low-density fibreboard and felt.

Pilot-scale trials were carried out at the facilities of a nonwoven equipment manufacturer using high yield pulp or BCTMP blended with synthetic fibres to demonstrate that short pulp fibres could be used to produce nonwoven mats.

Wood fibre-based nonwovens containing different types and proportions of wood and bioplastic fibres with specific additives were hot-pressed and characterized by their mechanical, physical and flammability properties, then compared to commercial products used by the automotive industry.

FPIInnovations' research team managed to improve the flexural properties and impact strength of

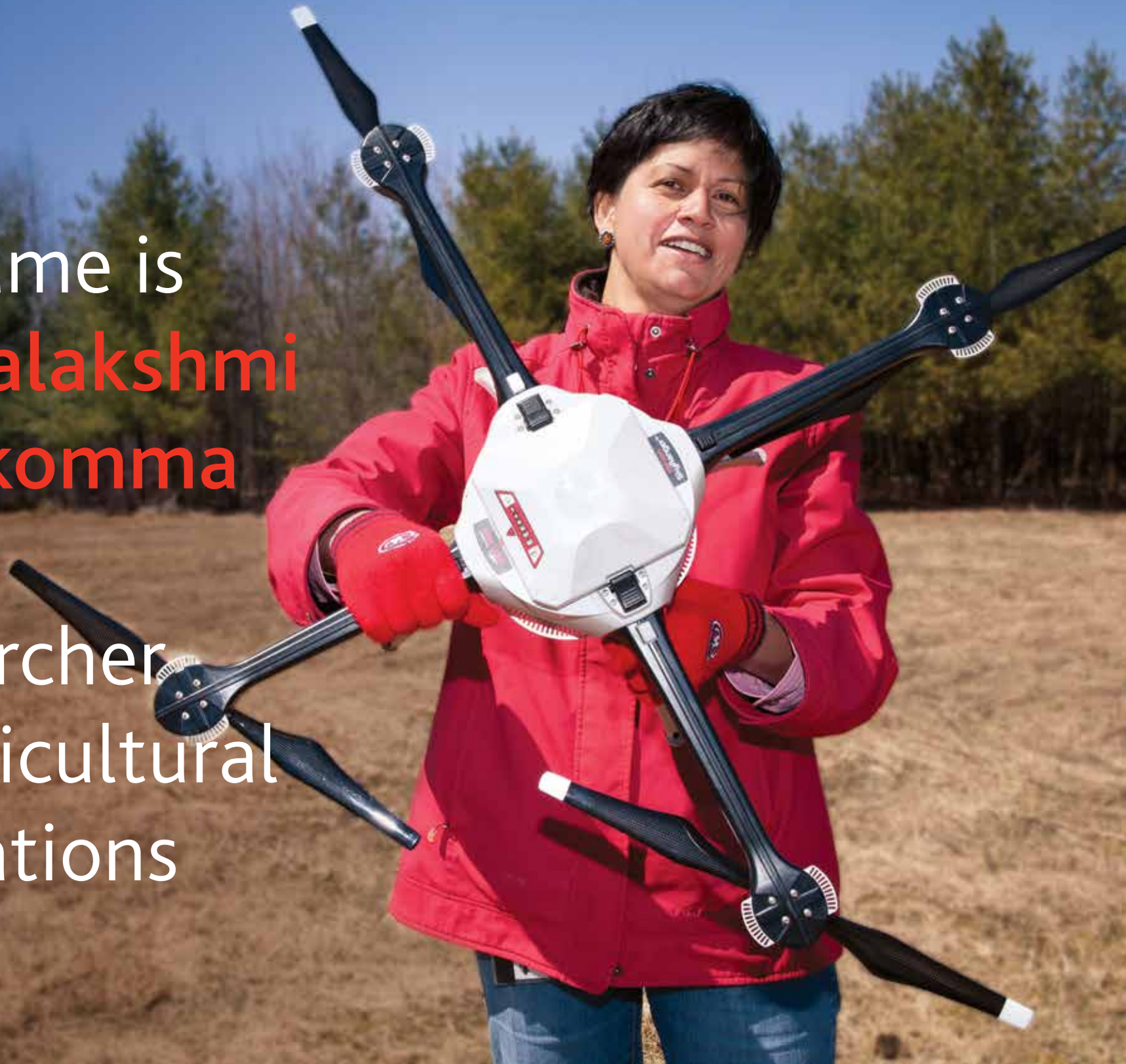
nonwovens. However, surface treatments used in this study did not seem to significantly affect water absorption and flammability performance. In fact, wood fibre-based nonwoven panels pass the flammability test regardless of the surface treatment.

The overall performance of the wood fibre-based nonwovens was comparable or better than the commercial product except for the water absorption, proving that short wood fibres can replace a significant portion of the natural and synthetic fibres currently used for industrial applications such as automotive interiors.

This year, with the financial support of Natural Resources Canada's Forest Innovation Program, FPIInnovations developed nonwovens panels from plain cellulosic fibres to evaluate manufacturing possibilities as well as key properties.

My name is
**Udayalakshmi
Vepakomma**

I am a
Researcher
in Silvicultural
Operations



ENVIRONMENT and SUSTAINABILITY

The quest for being green and sustainable has been changing the way companies think about their business models, products, technologies and processes. Consumers are clamouring for innovation in green technologies that can lessen carbon footprints, reduce reliance on fossil fuels and mitigate climate change while expecting superior performance at a lower cost for their products.

FPIInnovations is committed to sustainability and is leading the way in sustainable business practices. The organization believes that by treating sustainability as a goal and helping its members step up their environmental efforts, both the organization and its members will develop competencies that will be hard to match.

In the forest products industry, FPIInnovations has been a leader in sustainable, innovative processes and green practices and strategies. In fact, a significant amount of research has been accomplished this year with regard to sustainability and best management practices.

Enhanced forest inventory program

One example is the Enhanced Forest Inventory (EFI) program, which enjoyed a huge surge in interest from industry and provinces across Canada in 2013. A best management practices guide focusing on the implementation of the tools and technologies developed by the program was published by the Canadian Wood Fibre Centre (CWFC), and set records as the most downloaded publication from the Canadian Forest Service in 2013. In addition, knowledge transfer e-lectures delivered by the Canadian Institute of Forestry on behalf of the CWFC attracted over 1,000 participants in two sessions alone. The member companies who have been the early adopters of the technology are reporting significant measurable improvements in costs and planning efficiency as a result of

the quality and accuracy of the EFI information obtained on their operating areas.

A growing number of other companies and provinces are now actively applying EFI in their jurisdictions. Scientists at the CWFC, along with researchers from the Canadian Forest Service and several universities, are now also developing other forest applications of the same technology. Examples include the development of improved digital elevation models, whose sub-metre accuracy enables very precise assessment of drainages, ensuring better protection of water quality and better location of stream crossings. One study being conducted at the Petawawa Research Forest in Ontario is coupling extensive automated sampling of bird populations with EFI-generated profiles of forest stand structure to evaluate wildlife habitat suitability and sustainability. Extensive existing data on forest growth and yield is being used with EFI to project future forest inventories—accurately. FPInnovations' researchers are testing EFI technology in the Harvesting, Value Maximization and Precision Forestry programs.

Interest continues to grow and FPInnovations is at the forefront of this exciting area of research, which is likely to trigger new applications of value to the forest sector that will result in tangible environmental, operational and economic benefits.

Environmental sustainability of mill process changes and new operations

Life cycle assessment (LCA) employs a standardized ISO approach that allows the environmental impact for a number of different categories (e.g., global warming, ozone depletion respiratory effects, ecotoxicity) to be determined. Through the use of this tool, the changes to a mill process or the addition of a new operation can be evaluated in terms of environmental benefits. A recent case study using LCA at a BCTMP mill was conducted to examine the benefits of fuel switching for power generation (changing from an oil to electric boiler) as well as the implementation of anaerobic treatment for the generation of green biomethane as a diesel displacement for pulp drying. The baseline mill scenario indicated a number of environmental impacts related to both the use of diesel and the nutrients added to the activated sludge treatment plant. As the anaerobic plant will be producing biomethane, nitrogen and phosphorus, its operation was

expected to lead to an impact reduction for a number of environmental categories. While the anaerobic treatment system is still ramping up to full-scale operation, initial estimates indicate that significant environmental benefits will be realized with reductions of 40% for eutrophication, 30% for global warming, 20% for ecotoxicity and 10 to 20% for the remaining 9 categories. The use of LCA is currently being employed to study the environmental implications of two of FPInnovations' new biorefinery technologies related to lignin precipitation at a kraft mill and the biomass

fractionation process at a TMP mill.

FPInnovations' research team responsible for transport and energy efficiency has developed and tested a comprehensive toolbox to measure and analyze the impact of a truck's profile on aerodynamic drag.

Guide for designing energy-efficient building enclosures

Incorporating energy efficiency and sustainable green design in buildings has become a priority for the building and design communities.

Hence, FPInnovations has published *Designing Energy-Efficient Building Enclosures for Wood-Frame Multi-Unit Residential Buildings in Marine to Cold Climate Zones in North America*, in partnership with the Homeowner Protection Office, Canadian Wood

Council and RDH Building Engineering, to help architects, engineers, designers and builders improve the thermal performance of building enclosures of wood multi-unit residential buildings. The guide focuses on the management of heat, air and moisture transfer in highly insulated enclosure assemblies for low- to mid-rise wood-frame applications.

Whether one is designing single-or multi-family dwellings, this design guide is packed with valuable design information and the relevant science behind each design.

Greenhouse gas reduction with improved trailer aerodynamics

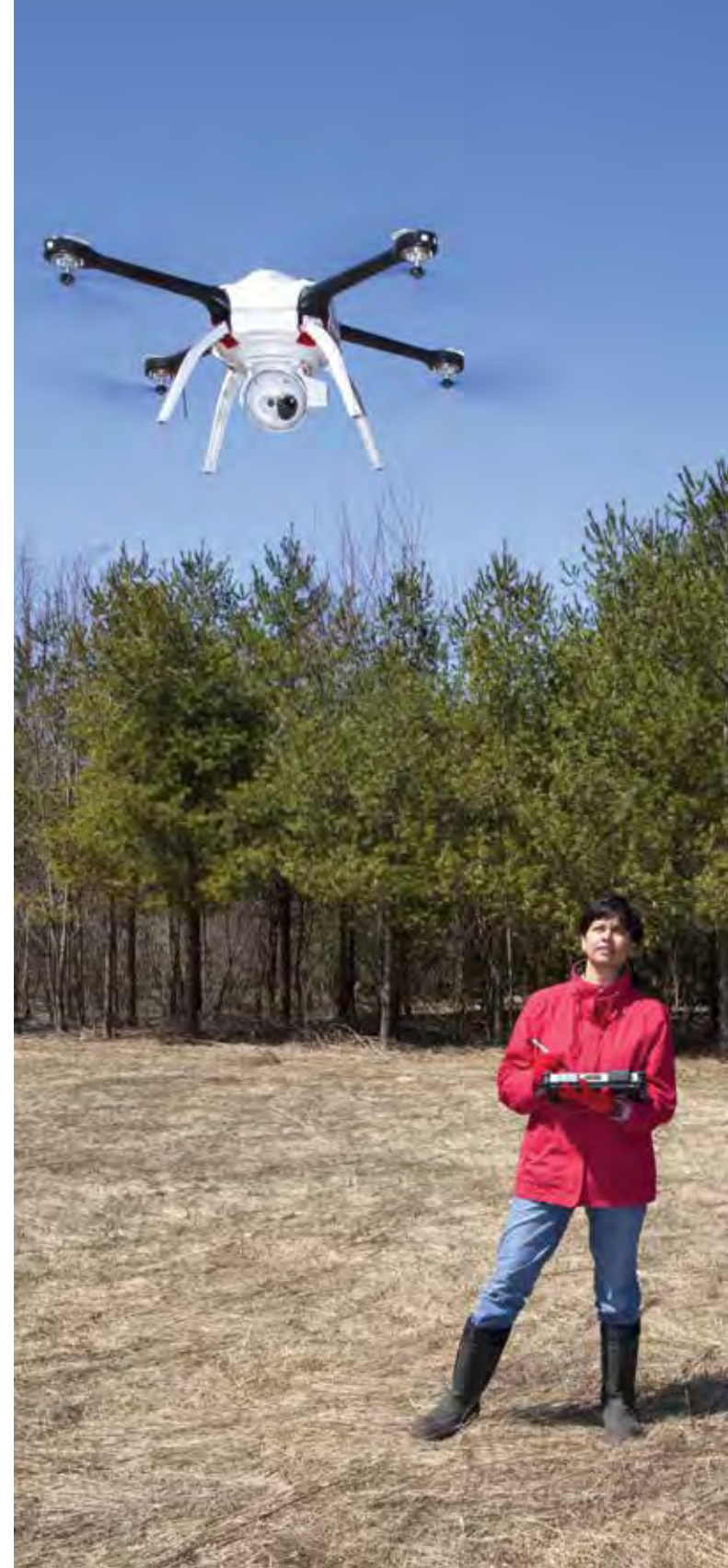
Transportation is a huge cost for the forest industry, representing up to 50% of the delivered cost of raw fibre. In Canada, roughly 2.7 billion litres of fuel are consumed each year, which equates to 7.3 million metric tonnes of greenhouse gas. With haul distances expected to increase in the future, transportation activities will likely have an even greater impact on the competitiveness of the Canadian forest industry and will also significantly affect the life cycle analysis of forestry.

In addition, rising fuel prices and a goal to minimize the industry's carbon footprint are making forest companies look at ways to reduce their consumption of diesel fuel during harvesting operations and during the delivery of

fibre to mills. Forest companies require a program of targeted fuel studies to identify operating techniques and technology that can reduce their fuel consumption and/or increase their productivity. This project primarily aims to reduce energy costs by focusing on improving trailer aerodynamics.

FPIinnovations' research team responsible for transport and energy efficiency has developed and tested a comprehensive toolbox to measure and analyze the impact of a truck's profile on aerodynamic drag. The computational fluid dynamics (CFD) and wind tunnel studies show that aerodynamic drag of logging trucks may be reduced by 35%, and track tests showed 15% less fuel was consumed by applying simple practices requiring little or no investment. This fuel economy could translate into annual savings of \$2,500 to \$4,500 per truck.

In addition, the Performance Innovation Transport (PIT) group of FPIinnovations introduced a new certification program that fleets can use to quickly and accurately identify the fuel efficiency value of a technology. The accreditation program, PIT Power, uses stringent testing protocols to reliably rank fuel efficiency. Suppliers receiving a PIT Power rating are then able to display a PIT Power logo on their equipment and fleets can look for these logos to as proof of performance.





30 mois

Canada

Europe

Japon

Brésil

Chine

+ 18 à 36 mois
Cet...

MARKETS

My name is

Natacha

Mongeau

I am a Manager
in Intellectual
Property

Market expansion and strategic agreements

The hard work aimed at diversifying markets continues as part of the ongoing transformation and renewal in the Canadian forest sector. FPIInnovations was busy this year helping member companies expand and developing new innovative products.

Collaboration with its partners in research and development has made FPIInnovations a world leader, and successful partnerships remain a key factor in its efforts to help the Canadian forest products industry increase its global reach.

The collaboration between FPInnovations and Kruger to create the world's first five-ton-per-day cellulose filament demonstration pilot plant is a great example of how collaboration and targeted investment in research and development can positively impact traditional markets while leading to the development of innovative new products. Canada is now well-equipped to compete with global industries in the United States, China, Finland, Brazil and Sweden to develop the next generation of cellulose-based bio-materials.

Diversification and expansion remain essential components of the industry's innovation and transformation strategy. For this reason, FPInnovations has signed two collaborative agreements with Alberta Innovates-Technology Futures that reinforce their research partnership in the areas of cellulose nanocrystals (CNC) and engineered composite products. This cooperation will see both organizations working together to advance opportunities for CNC across Canada and continue the excellent work in the area of strand-based forest products.

FPInnovations is a world leader and successful partnerships remain a key factor in its efforts to help the Canadian forest products industry increase its global reach.

In the Atlantic provinces, FPInnovations has authorized HiTech Communications to provide local technical support and installation services for the FPDat and FPTrak product line in Newfoundland and Labrador and in Nova Scotia. Two other distribution agreements have been signed with firms in Alberta (TimberNorth Consulting) and in Ontario (KBM Forestry Consultants Inc.). KBM will also provide FPInnovations product services to clients in Manitoba and Saskatchewan.

Competition in the forest products industry is driven, in part, by fibre costs. By creating opportunities to reduce fibre costs through improved operations, FPDat holds the potential to increase the competitiveness of traditional industries.

Similarly, FPInnovations signed a partnership agreement with

Diversification and expansion remain essential components of the industry's innovation and transformation strategy.

Consultants forestiers DGR Inc., which will provide FPInterface software in the province of Québec where there is a growing demand for FPInnovations' forestry operations planning services. FPInterface software was initially developed to simulate the various forestry operations: routes, harvesting, silviculture, biomass and transportation. Today, the latest version of FPInterface allows users to carry out analyses on the entire value chain, directly on the forestry map. In fact, all Canadian wood processing plants are now geo-referenced in FPInterface.

In the wood products segment, possible strategic alliances with European manufacturing experts are being explored. The changing building energy codes, densification in urban areas, the need for alternate uses for wood chips and low-quality logs, and the demand for renewable green products are four trends supporting the development of the wood fibre insulation board business in North America.

In this context, FPInnovations investigated current European manufacturing technologies for flexible and rigid

insulation panels. European dry manufacturing technology for flexible and rigid insulation boards is already mature and the European manufacturers that FPInnovations met were open to discussing partnerships and sharing their expertise, following an assessment of the suitability of the Canadian wood species for manufacturing rigid insulation boards using the European dry process technology. One of the most obvious benefits of such partnerships for the Canadian wood industry is finding new and profitable uses for the secondary products of its primary manufacturing sector and low-grade wood. The products are expected to be fully compatible with Canadian construction systems, and the Ottawa-Montreal region emerged from the market analysis as the most promising with good potential for a mill implementation.

Diversified markets are key to building a resilient Canadian forest economy and FPInnovations is at the forefront of helping the industry maintain its competitiveness on the global stage.

Diversified markets are key to building a resilient Canadian forest economy and FPInnovations is at the forefront of helping the industry maintain its competitiveness on the global stage.

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Adfast Corporation (Adchem Adhesives)
AEF Global
Agropur
Ainsworth Lumber Co.
Airex Energy
AkzoNobel Bois Peintures
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Alpa Lumber
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AV Cell
AV Nackawic
AV Terrace Bay

B

Barrett Enterprises
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Bherco
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Bois D'Oeuvre Cedrico
Bois Ditton
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BP Building Products of Canada
Brisco Manufacturing
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C

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Canadian Tire Corporation
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Canoe Forest Products
Cariboo Pulp & Paper Company
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Centre de formation du Transport Routier de Saint-Jérôme (CFTR)

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Chantiers Chibougamau

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Conférence régionale des Élus de la Gaspésie et des Îles-de-la-Madeleine (CREGIM)

Conférence régionale des Élus du Bas-Saint-Laurent

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Coopérative Forestière de la Matapédia

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Wildfire Operations (WFORC) program
Performance Innovation Transport (PIT) program

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Groupe Forestra

Groupe G.D.S.

Groupe Lebel (2004)

Groupe Jules Savard

Groupe Morneau

Groupe Savoie

Groupe TYT

H

Hultdins

Hybrid Joist Inc.

I

ICL Performance Products

Interbois

International Forest Products

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J

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K

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L

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Lauzon Industries

Les Industries JSP

Les Industries Piekouagame

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R

Réné St-Cyr 1996

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Rosenau Transport

S

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Resource Management**

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Scierie St-Fabien

Scieries Chaleur

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Vanderwell Contracting

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Viance

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Z

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Yves Nadon

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FPInnovations wishes to thank
these former Board members for
their valuable contribution to
the Corporation.

Our ADVISORY COMMITTEES as at March 31, 2014

NATIONAL RESEARCH ADVISORY COMMITTEE (NRAC)

The role of the National Research Advisory Committee (NRAC) is to support research and long-term strategic development. This committee also ensures that all research aligns with the National Forest Sector Transformation Strategy (NFSTS).

NRAC members meet twice a year. The chair is appointed from the members of FPInnovations' Board of Directors. The other NRAC members are drawn from FPInnovations' partner organizations and academic circles.

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Our ADVISORY COMMITTEES as at March 31, 2014

PROGRAM ADVISORY COMMITTEES (PACS)

Program Advisory Committees (PACs) provide guidance to ensure the various FPInnovations research programs are relevant to the industry's greatest needs. They also ensure that research activities are geared towards operational improvements, best practices and technology transfer. PACs evaluate and approve research project proposals; they also evaluate the performance of projects that have been set in motion. They report to the NRAC on the progress and performance of the various research programs.

The members of each Program Advisory Committee (PAC) are representatives of FPInnovations' member organizations. The National Research Advisory Committee (NRAC) appoints a PAC chair from among the committee members. PACs meet twice a year.

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Maria Ricci, Technologist, Impact Assessment

Mihai Pavel, Researcher, Value Maximization

Ayse Alemdar, Scientist, Pulp Performance and Markets

ON BACK COVER

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Gabor Szathmary, Technologist, Drying and Energy

Shannon Huntley, Scientist, Fibre Cost and Quality

Adime Bonsi, Researcher, Performance Innovation Transport (PIT)

Steve Mercier, Researcher, Performance Innovation Transport (PIT)

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