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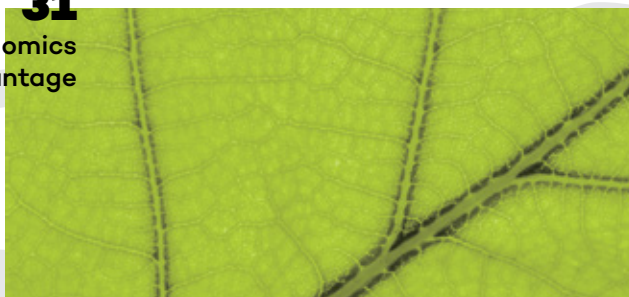


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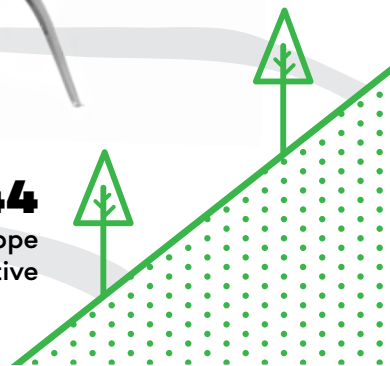
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570 SAINT-JEAN BLVD., POINTE-CLAIRE, QUÉBEC, H9R 3J9 CANADA

fpinnovations.ca

PRODUCTION: COMMUNICATIONS DEPARTMENT
OF FPINNOVATIONS

DESIGN:
ABSOLU.CA

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Cover page photo credit:
www.naturallywood.com

FPInnovations 

Printed in Canada on paper produced
by a member company



TERRY KNEE

Director, Communications
FPInnovations

08.21.2015

Welcome to **IMPACT**, FPInnovations' review of some of our most exciting project results from the past year. And quite an impressive year it has been!

Though I have been with FPInnovations for quite some time, I continue to be impressed by the broad range of research and innovations that are developed in our laboratories and with our collaborators. From the promise of cellulose filaments to mid-rise and tall wood buildings to drones providing forest inventory data to lignin extraction, it has been a year of firsts as our research teams continue to lead the sector in idea generation and implementation.

Beyond those popular projects that seem to grab all of the media attention, there are hundreds of lesser-known but no less significant projects happening in the back-ground—using wood ash as a liming agent, improving logging truck configurations, and creating glossy coating formulations for commercial inkjet web presses are just a few that come to mind.

And it has not gone unnoticed. Nationally and internationally, other industry sectors and R&D institutes see the results and are looking at FPInnovations as the model to emulate. In FPInnovations, the Canadian forest sector has an R&D and innovation organization of which they can be proud.

Never willing to rest on our laurels, we also spent the past year looking toward the future. Our new Vision—a world where products from sustainable forests contribute to every aspect of daily life—is a bold and forward-thinking statement on the promise we believe the future holds. Coupled with redefined Mission and Value statements, and a highly ambitious five-year strategic action plan, we believe the stage is set for FPInnovations and the Canadian forest sector to thrive.

Finally, I hope you enjoy this new magazine-style approach to our traditional review of activities. I am confident that you will find this new format as exciting to read as it was to create, and that it will **IMPACT** your view of the forest sector's future and the game-changing innovations that are being developed.

FPIinnovations



YOU'LL FIND US IN THE MOST UNEXPECTED PLACES.

One of the largest
non-profit forest
research centres in the
world, our impact goes
far beyond the forest
sector. Together, our
researchers and industry
partners are unlocking
the potential of Canada's
forest resources for
innovations that touch
all of our lives.



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WOOD REACHING NEW HEIGHTS

Canada has a long tradition in wood construction, but for many decades, steel and concrete have dominated non-residential construction. The emergence in recent years of new engineered wood products has provided an innovative way for constructing taller buildings that are both safe and cost-competitive, while responding to increasing environmental concerns.

Numerous well-preserved post-and-beam wood buildings built nearly a hundred years ago can still be observed in Canada. However, changes made over the years to the National Building Code of Canada (NBCC) limited the use of wood in construction to light-frame structures comprised of four to six storeys.

In the wake of growing interest around the world in high-rise wood construction, and to support changes in some provincial regulations that promoted the construction of buildings of up to six storeys through alternative solutions, FPInnovations began to compile and disseminate knowledge for the Canadian wood-based construction industry. To that end, the organization has undertaken various actions over recent years to provide industry with the tools and understanding needed to compete with steel and concrete, and, in collaboration with partners, to develop standards that facilitate the acceptance of increasingly taller wood buildings. The results are convincing since there are an increasing number of tall wood buildings now appearing on the Canadian landscape.

ALWAYS AIMING HIGHER

To meet the growing interest in high-rise wood construction and to address the lack of adequate technical data, FPInnovations brought together experts from different fields and published the *Technical Guide for the Design and Construction of Tall Wood Buildings in Canada*. The objective of this multidisciplinary document was to fill the gap between designers, contractors, and relevant authorities by providing comprehensive data with which to facilitate the acceptance of projects that use alternative solutions in building codes.

Under the coordination of FPInnovations and the direction of a working group composed of experts and design consultants from FPInnovations, the National Research Council Canada, and the Canadian Wood Council, more than 80 technical experts and professionals participated in the development of the first version of this Guide, with impressive results!

Launched in August 2014 during the *World Conference on Timber Engineering* held in Québec, which brought together nearly 900 participants from many countries and various professional backgrounds, the Guide includes 500 pages and nine chapters featuring the combined knowledge of experts. It is intended as a reference tool to address many areas, including structural performance, safety and fire protection, acoustic insulation, and floor vibration.

The Honourable Greg Rickford, Canadian Minister of Natural Resources and Minister for the Federal Economic Development Initiative for Northern Ontario, officially launched the Guide during his opening address at the conference. He highlighted FPInnovations' role in spreading a wind of change anchored in renewable resource throughout an industry in need of something new.

"Once again, the Guide demonstrates how FPInnovations continues to be a leader by encouraging architects, designers, and engineers to make wood their material of choice for construction, and pave the way for wood-based life solutions," said Pierre Lapointe, President and CEO of FPInnovations.

Erol Karacabeyli, Research Manager for FPInnovations' Advanced Building Systems group, agrees: "The *Technical Guide for the Design and Construction of Tall Wood Buildings in Canada* is the most comprehensive document produced so far on the subject thanks to the contribution of more than 80 experts. It is an essential tool for achieving multidisciplinary, systemic change toward the construction of high-rise wood-frame buildings that goes beyond the limits as to the height and area prescribed by building codes."

The Guide is part of the Canadian initiative on tall wood buildings, a joint project of Natural Resources Canada and the Canadian Wood Council. Intended for experienced design and construction teams, it provides the necessary concepts and foundations to answer questions that inevitably arise when designing buildings that go beyond the surface and height limits prescribed by the NBCC's acceptable solutions.

Every effort invested in producing the Guide was rewarded. It won two major awards at the 2014 Contech Building Exposition, including the 3RV Recognition Award in the Housing Innovative Practices category. These awards were presented at a special event rewarding innovation and sustainable development by a jury of influential construction industry professionals.

The Guide is a model that reflects FPInnovations' commitment to advancing science and promoting the expansion of wood construction in Canada. Another guide for the construction of mid-rise wood-frame buildings is in preparation. Its launch will take place in the next few months.

NEW MEASURES TO ADVANCE PROJECTS

NEW MEASURES TO ADVANCE PROJECTS

Canada has sustainable forests and timber resources for construction. Nonetheless, until recently, the rules in place only allowed a few options for wood construction higher than a few storeys.

The Province of Québec has followed the example of British Columbia, which amended its building code in 2009, and adopted measures to facilitate the use of wood in mid-rise buildings.

In this respect, the Wood Charter adopted by the Québec provincial government in May 2013 set a target to establish practical ways to allow for the equitable use of the resource in construction while achieving the safety level required by the building codes.

The *Régie du bâtiment du Québec* (RBQ) received a mandate from the provincial government to implement these recommendations as soon as possible, which it started doing with the publication of technical guidelines explicitly developed for the construction of five- to six-storey wood buildings. FPInnovations made a significant contribution to the production of these guidelines. From the beginning, the RBQ was able to rely on the technical expertise of FPInnovations' researchers for the support it needed in technical areas. This was the case for fire and structural massive timber construction safety.

NEW MEASURES TO ADVANCE PROJECTS

One of the first examples was the FondAction Building in Québec City. The construction was made possible through the use of "alternative solutions" to the NBCC and the demonstration, by the RBQ, that measures applied could ensure occupants' safety. This six-storey building represented a North American first in non-residential construction.

The province is now going further with the recent announcement of the construction, again in Québec City, of a 13-storey residential tower entirely made of wood. The building, which should be started in the fall of 2015, will be made of cross-laminated timber (CLT). CLT is a European technology that was brought to Canada, and the guidelines for its use were produced by FPInnovations. Natural Resources Canada invested in CLT pilot-demo projects and there are now two manufacturing plants in Canada. The tower, which will be the tallest building in North America entirely made of wood, will serve as a reference for future multi-storey tall wood buildings.

KEEPING UP WITH THE TIMES

Various measures adopted by Canada and some provinces have changed the rules of wood construction in recent years. Many examples are now visible in British Columbia and Québec landscapes, and two more provinces – Ontario and Alberta – have modified their regulations to facilitate mid-rise wood-frame construction.

On January 1, 2015, Ontario amended its building code to allow wood-frame construction of buildings up to six storeys for residential and commercial use. This change is the result of a review process by technical advisory committees, which included experts from FPInnovations. The decision taken by the Ontario government will, among other things, help develop and promote a new urban landscape using wood construction. It did not take long for these changes to generate interest.

Since the revised code came into force, a permit has already been issued, announcing the construction of the first mid-rise wood-frame building in the province. It is estimated that growing demand for mid-rise buildings of wood could contribute to the increased demand for high value-added forest products, in addition to supporting many direct and indirect jobs.

The City of Calgary decided to follow the example of the provinces of British Columbia, Québec, and Ontario, and announced the implementation on January 1, 2015, of new rules for the construction of wood-frame buildings up to six storeys. After Calgary's adoption of mid-rise wood construction, the Province of Alberta followed suit.

The addition of these new participants can only be beneficial to Canada's reputation and determination in becoming a leader in mid- and high-rise wood construction.





WOOD
REACHING
NEW HEIGHTS

DEMONSTRATING BETTER SAFETY PERFORMANCE

In order to extend the rules on the use of mass timber construction elements, FPInnovations, in collaboration with the National Research Council Canada, began a full-scale demonstration fire of mass timber building shafts. These trials were designed to demonstrate that such structures could withstand severe fire conditions in an adjacent apartment.

Current standards require that the construction of buildings higher than four storeys be of incombustible materials. The demonstration fire aimed to create fire conditions that were more severe than those currently provided in CAN/ULC S101, in order to recreate an intense hypothetical situation proving that the design meets the objectives of Canada's building code.

The demonstration fire confirmed that stair and elevator shafts made from massive wood construction, such as CLT, can easily meet the performance objectives prescribed by the codes. In other words, they offer two-hour fire resistance for the safe evacuation of occupants.

This additional research conducted by FPInnovations with the financial support of the Québec Ministry of Forests, Wildlife and Parks will help support the rules already established in Canada to promote construction that is safe, cost-effective, and that meets the objectives for sustainable development of wood buildings.

BUILD TALL WITH WOOD

FPInnovations' expertise and knowledge gathered in three publications intended for building professionals:

CLT Handbook : Cross-laminated timber

Technical guide for the design and construction of tall wood buildings in Canada

Mid-rise wood frame construction handbook – COMING IN 2015

Electronic and printed copies available at publications.fpinnovations.ca

AIM HIGH WITH WOOD

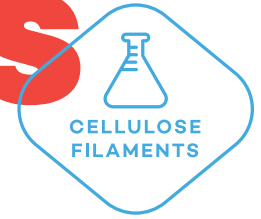
**AFFORDABLE
SAFE
LONG-LASTING
EFFICIENT
COMPLIANT WITH THE
NBCC**



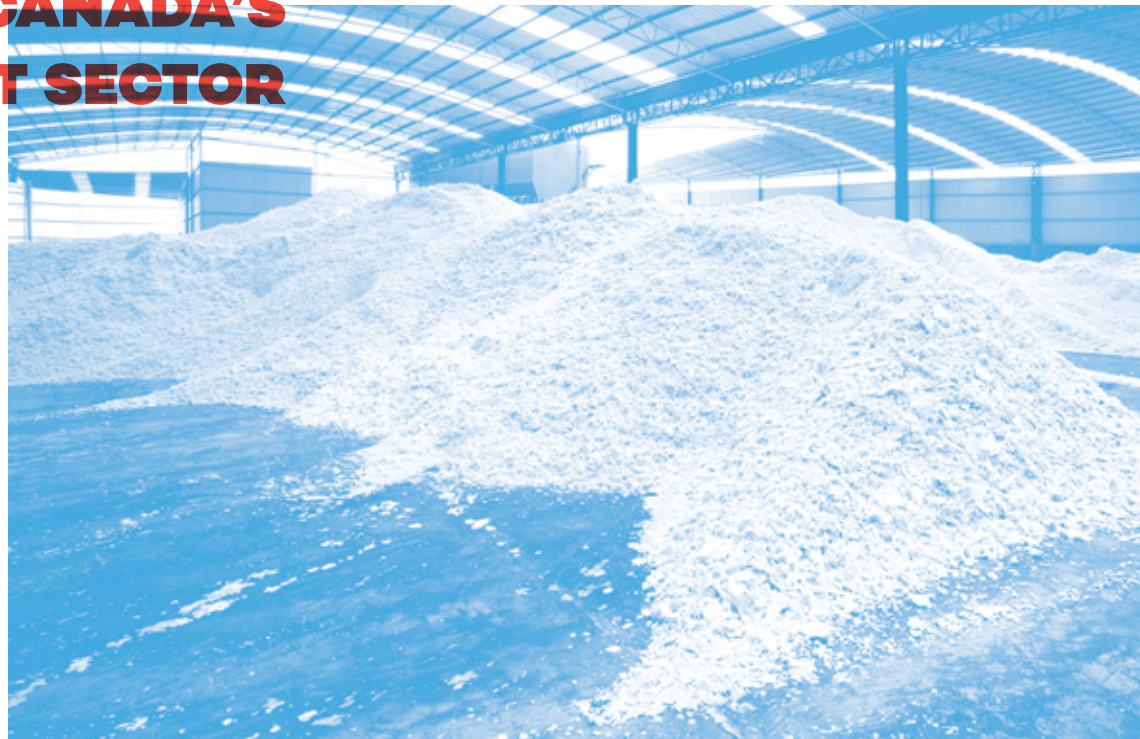
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CELLULOSE FILAMENTS



**AN EXCITING
OPPORTUNITY
FOR CANADA'S
FOREST SECTOR**



CELLULOSE FILAMENTS



The future of a viable Canadian forest industry and its transformation lies in sustainable innovations. By capitalizing on the unique attributes of Canada's forest resources, the forest products industry is positioning itself to develop new products and penetrate new markets.

One such innovation comes in the form of cellulose filaments (CF) – a revolutionary material that is extracted from wood pulp fibres and can dramatically improve pulps, papers, bioplastics, and other composites. CF is 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, maintaining a competitive position with existing products while building on its existing manufacturing capacity.

Product diversification is essential to maximizing the total value of fibre from Canadian forests. CF has the capacity to radically transform and boost the competitiveness of the Canadian forest sector by revolutionizing the properties of pulp, paper and packaging products. What's more, it has great potential for use in renewable products across different industries, such as bioplastics, adhesives, as well as paints and other coatings.

CF is obtained by mechanically peeling the filaments from wood fibres without using chemicals or enzymes and without producing effluents. This unique process provides a significant advantage to the Canadian forest sector. As the peeling is completed in a gentle manner, very thin and long filaments are obtained, which give an extreme and unique length-to-width ratio for a fibre material. This means CF is extremely flexible and provides a unique bonding capacity that makes it an exceptional reinforcement additive.

This unique bonding capacity allows CF to be combined with many materials to develop high-value products currently sought after by industry sectors such as automotive, marine, oil and gas, aerospace, and manufacturing, as well as consumer products and electronics.

CF is expected to be used in a wide range of applications. In the short term, CF will act as a lightweight strengthening additive to produce new grades of commercial pulps, papers, packaging, tissue, and towels. Looking to the future, CF may be integrated into high-value products ranging from flexible packaging and films to structural and non-structural panels in building construction. And as the CF manufacturing process is expected to use only commercially available and well-proven equipment, substantial savings in capital investment are expected by simply modifying the existing infrastructure of Canadian pulp and paper mills.

A NEW INNOVATIVE AVAILABLE AND SUSTAINABLE MATERIAL



GAME CHANGER



A MARKET GAME CHANGER

After less than five years of intense research and development in FPInnovations' laboratories, a five ton/day CF plant was built within Kruger's newsprint mill in Trois-Rivières, Québec. The plant provides enough CF tonnage to enable new application development and to permit mill trials and possible commercialization by industry. Inaugurated in June 2014, the new CF demonstration plant is now producing a high-quality, world-class, strengthening bioproduct equivalent to that produced in FPInnovations' laboratory environment.

FPInnovations is evaluating potential markets for CF as a strength-reinforcing agent in industries ranging from thermoplastics, reinforced plastics, thermosets, adhesives, non-woven fabric and coatings. FPInnovations is currently working with several of the top pulp and paper companies in Canada to maximize the value from these scenarios—research teams have been conducting trials and working through detailed engineering studies to evaluate feasibility. The companies engaged are ramping up for rapid implementation and the entire industry is showing great interest in either producing or using CF.



AND TARGETED INVESTMENT

RESULT OF COLLABORATION AND TARGETED INVESTMENT



CF is a shining 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.

This important research and innovation project represents investments to date totalling \$43.1 million, including funding from Natural Resources Canada, through the Investments in Forest Industry Transformation (IFIT) program, financial support from the Québec Ministry of Forests, Wildlife and Parks, the Government of British Columbia, and Investissement Québec, as well as a contribution from Kruger Inc. and funds from industry members of FPInnovations' pulp, paper and bioproducts program.



A NEW, INNOVATIVE AND SUSTAINABLE MATERIAL

Canada is currently in the pole position of global competition to develop the next generation of cellulose-based materials with eight Patents filed or in the process of being filed.

FPInnovations is helping the Canadian forest sector stay ahead of its competitors thanks to the simplicity of the CF manufacturing process, the intellectual property protection of the process and the product, and the availability of industrial refiners. However, the USA, Japan, China, Finland, Sweden, Germany, and France are also in the race with advanced CF-like development programs. Time is of the essence as the worldwide industry is racing to catch up and get their share of the international CF market.



FPIinnovations is currently **RECRUITING**

Our name is innovation.

What's yours?

FPIinnovations is the largest R & D not-for-profit employer in Canada. We specialize in the creation of scientific solutions in support of the Canadian forest sector's global competitiveness. If our profile connects with your professional experience and career objectives, we would like to meet you.

- Technologists
- Technicians
- Scientists
- Engineers
- Researchers

In the fields of:

Pulp, paper and bioproducts; wood products; forest operations; transportation; business development; markets and economics; and other positions in finance, human resources, IT and communications.

SEND YOUR RESUME TO:

recruitment_recrutement@fpinnovations.ca

OUR LOCATIONS:

Pointe-Claire, QC | Vancouver, BC | Québec, QC



PLAN STRATEGIC PLAN CTION



BRINGING A TRANSFORMATIVE VISION TO LIFE

Inspired by an ambitious new Vision, FPInnovations has developed a comprehensive Strategic Action Plan to drive the transformation of Canada's forest sector over the next five years.

Our plan, unveiled in June 2015, builds on what we do best: delivering world-class innovation and providing strategic leadership across the forest value chain. Developed in consultation with a wide range of stakeholders, the Strategic Plan lays out the transformative changes we envision over the next five years.

Through initiatives that go beyond existing boundaries and traditional approaches, our collective efforts can ensure the competitiveness and sustainability of current and future Canadian, North American, and international wood and wood fibre processing industries.

HOW OUR PLAN TOOK SHAPE

Multiple stakeholders were involved in developing our Strategic Action Plan. In addition to the Canadian Forest Service (CFS) and the Forest Products Association of Canada (FPAC), we consulted with FPInnovations' Board of Directors, Partners Committee, and the National Research Advisory Committee (NRAC). We carried out 360° assessments with our staff, members, potential members, universities and colleges, and then completed a comprehensive analysis of market and industry trends.

ACTION

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ACTION

OUR ROLES

FPInnovations already plays a critical leadership role in delivering impact across the forest sector. The success of our research and innovation uptake reflects our ability to adopt high-quality innovation management practices in a flexible and responsive way.

Over the next five years, these will be further aligned under the Forest Industry Innovation Framework. Within this structure, by 2020, we will take on overarching roles as an **Efficient Innovator** and a **Facilitative Leader**.

As a fully **Efficient Innovator**, we commit to delivering the right solutions and making the most of our investment in innovation while partnering with others to bring new innovations from elsewhere. To truly accomplish this, we must become the sector's **Facilitative Leader**, linking and empowering people and organizations to deliver transformation to Canada's forest industry and governments. In this way, we will collaboratively help shape the future direction of the sector.

To succeed in the enormous challenge that these newly defined roles present, we will focus on four key priorities.



01

**PRIORITY 1:
CULTURE OF INNOVATION
EXCELLENCE**

**Nurturing our people
and scientific excellence
within a diverse workplace**

People are the single most important factor in our success. To attract and retain the best people, in an innovation environment that motivates and inspires both excellence and ingenuity, we will invest in the creation of a **Culture of Innovation Excellence**. To do so, we will create new programs that will ensure our people succeed and prepare FPInnovations' leaders of tomorrow.



02

**PRIORITY 2:
COMPETITIVENESS
AND SUSTAINABILITY**

**Developing solutions to enhance
competitiveness and sustainability**

The transformation of the traditional forest industry will rely to a great extent on our ability to generate solutions. Working with industry members, we will focus on identifying short-term gains and providing direct assistance at the mill level.



03

**PRIORITY 3:
SHAPING
THE FUTURE**

**Creating and seizing opportunities
beyond traditional markets and borders**

With a resilient opportunity pipeline, we will continue to deliver the innovations that enable our industry to stay ahead of the international curve. Recognizing the evolution of Canada's forest industry, we will also develop the means to extend our R&D activities beyond traditional markets and Canadian-based operations.



04

**PRIORITY 4:
FAST-TRACKING
INNOVATION AND
PARTNERSHIPS**

Open Access Innovation Ecosystem

We will broker closer relationships among research providers, government, and industry, and support effective use of their investment capacity. This includes a host of initiatives to accelerate innovation across the forest sector. These initiatives include Federal and Provincial partnerships, that will see us recommend strategic and investment priorities, co-author White Papers on major technology and market opportunities, and provide tools to maximize open access to a burgeoning information database.



DRIVING TRANSFORMATION

This Strategic Action Plan will not only shape FPInnovations, but also have a direct impact on the industry we serve. From providing employees with an exciting place to work and opportunities to grow, to showing leadership and direction to an industry in transition, this ambitious plan will drive the transformation of Canada's forest sector over the next five years. To learn more about our Strategic Action Plan, please visit our website.

BOUNDLESS CREATIVITY: RESEARCH AND INNOVATION PLAN

Over the next five years, our Research and Innovation Plan will focus on strong value propositions that address technical or scientific needs, and assist with transforming the industry. We will focus our research resources on:

- Maintaining a Quality Fibre Supply;
- Developing Innovative Manufacturing Processes and Products; and
- Environmental Sustainability and Social Licence.

This approach will enable FPInnovations to provide increased value to members and governments while leveraging expertise from organizations focused on other research areas.

AFTER ONE YEAR IN HIS ROLE AT FPINNOVATIONS, TREVOR STUTHRIDGE SHARES HIS VIEWS ON WHERE THE INDUSTRY MAY BE HEADED AND HOW FPINNOVATIONS WILL SUPPORT ITS EVOLUTION.

PERSPECTIVES ON A SECTOR IN TRANSITION

After one year in his role at FPIInnovations, Trevor Stuthridge shares his views on where the industry may be headed and how FPIInnovations will support its evolution.

“Over the last decade, the Canadian industry has clearly undergone profound and often difficult changes, adapting to a whole new market paradigm and economic environment,” Trevor says. “Today, it is still very much an industry in transition. **With the high costs and decreasing availability of timber supply in some areas, the need to ensure a high-quality, high-recovery, low-cost fibre supply is a big challenge.** Whilst at first glance the solid wood market appears relatively healthy, this can only be sustained if the rest of the value chain downstream is also robust.”

Going forward, the traditional sector’s main challenge is to continually improve its performance and stay competitive in a strengthening global processing environment. “To deliver value in target markets, it has to remain at the cutting edge technically. For solid wood markets,

this means developing product lines to meet market needs for engineered wood products, advanced building systems, and medium- to high-rise wooden buildings. For fibre processing, changes are also required as the pulp and

paper industry refocuses from market pulps, such as newsprint, into more high demand options, such as hygiene products and packaging.”



EMBRACING CHANGE

Another transition involves the emergence of a new bioeconomy sector based on Canada's wood resource. By embracing this change, the sector can generate new product classes, such as bio-based materials, chemicals and fuels, with a focus on non-traditional markets and customers. "The industry is well aware of this shift, and **some are already taking steps to begin the transition, such as trialing new process technologies, testing applications of bioproducts, and building their internal human capital in this space.**

To me, this suggests the Canadian sector is starting to actively move into the bioeconomy, rather than reactively. That's good news for Canada and the sector as a whole. These are the markets that will add significant value to processing residues, future-proof existing infrastructure, and ensure the entire value chain is more effective."

The solid wood market is also moving into added-value products. "We have to capitalize on the unique advantage afforded by Canada's high-quality wood supply and maximize its added value. If we don't adapt, we may face a real problem: many of our competitors elsewhere who don't have this advantage are actively adapting their products to match some of the performance attributes of our high-quality wood and wood fibre, but at lower costs."

THE POWER TO CHOOSE

Previously, the sector was forced to undergo change due to negative circumstances – there really wasn't a choice. "Now, we have the opportunity to make choices, maintain some control over the transition, and with perspectives that we didn't have before. It also means that we can better define and shape the sector's design to provide maximum economic and societal value."

With these opportunities, new, non-traditional players, such as the bio-based chemicals industry, will enter the sector and take on more importance.

It may also see Aboriginal and First Nations communities play a greater role – and a positive one – in the sector. "Based on experiences in my home country of New Zealand, I think Aboriginal and First Nations will likely become significant influencers in the sector's future direction," Trevor emphasizes.

LEVERAGING TRANSITION OPPORTUNITIES

The nature of the new bioeconomy and the need to add value to the existing sector call for a much more structured approach to research, innovation, and technology commercialization by industry. "Organic innovation won't be enough to meet sector needs. It will take a much greater understanding of market and performance requirements, much more integration of our R&D capability across all research providers, and a more multidisciplinary approach; going beyond the materials scientists, chemists, and engineers to include business and market analysts, social scientists, and others to ensure its uptake."

Another opportunity lies in providing more open and efficient access to the wide range of industry information available across the value chain. "This is a sector that gathers an enormous amount of potentially useful data in, for example, forest resource assessment, log and lumber scanning, and fibre qualities, but typically only uses it at the unit operations or business level. By better integrating and analyzing this information, we can understand and identify performance improvement opportunities and correlations up and down the value chain, improving decision-making around innovation, research investment, and industry uptake."

EVOLVING FPINNOVATIONS' ROLE

Over the medium term, FPInnovations will undergo its own transition to guide and enable the sector's evolution. "Our original mandate gave FPInnovations a unique role in supporting the sector. Going forward, we will reinforce and consolidate that leadership position, as reflected in our new five-year Strategic Action Plan," says Trevor.

To improve decision-making, FPInnovations will provide stakeholders across the value chain with objective evaluation, analysis, and direction. "We have to do this in a manner that is seen to be strictly unbiased, serving the sector and not our own purposes. With our unique access to industry, government, and research information, we can provide context and a broad understanding of industry needs. In addition to serving as an objective evaluator, we also have a responsibility to use our knowledge to ensure the right people are connected up and down the innovation value chain."

In an open-access innovation ecosystem, efficiency is essential. "We need to find ways to ensure our evidence-based innovation is well-delivered to those who invest in us and ensure its uptake by the industry we serve. **In addition to internal efficiency, we need to better integrate with universities, colleges, and other research organizations to help shape their efforts, and ensure we tap into their resources without replicating their capabilities.** It's important to acknowledge the value they add to our work, to reach out to them, and use their capabilities in our research."

BUILDING TRUST

To fulfil its original mandate, FPInnovations must build trust across the sector and its research, industry, and government stakeholders. "They need to have confidence in our ability to provide the facilitative leadership that will ensure a healthy sector, with robust decision-making, a resilient opportunity pipeline to enable sector evolution and competitiveness, and investment in the latest innovations and opportunities beyond traditional markets."

Making sure that FPInnovations and Canada's forest sector don't remain insular is equally important. "We can't be afraid to search for opportunities elsewhere and bring

them here. We need to look beyond borders to actively harness outside innovation, to learn from it, adopt and adapt it, and use it to evolve the sector. This will accelerate our transition into the bioeconomy and new wood processing markets."

On the home front, Trevor emphasizes the importance of customizing delivery to the right scale and region. "We must continue to deliver regionally focused initiatives that respect and acknowledge the differences in wood resource, sector composition, and market opportunities. One of FPInnovations' unique features is that we are geographically dispersed. We should make that one of our strengths and ensure it is put to good use for the sector we serve through well-coordinated engagement with our provinces and the various subsectors."

The road ahead for the industry and for FPInnovations doesn't end with a fixed destination. "With its challenges, promising opportunities and multiple choices, the way forward is all about our continued evolution. It's a journey we're well-prepared to make, one that will sometimes take us off the beaten path – and into a thriving future."



FOREST OPERATIONS



FOREST OPERATIONS



FPDat CONTINUES TO GROW

Sales of the FPDat/FPTrak system—FPInnovations' powerful navigation and data collection platform—have increased significantly during the past year. Thanks to new distributors for Québec and BC, FPInnovations now has a distribution and service network throughout Canada. This made it possible to reach an important milestone near the end of 2014 with the sale of the 500th unit.

Developed in response to industry needs, FPDat is an on-board computer that collects spatial and productivity data on forest operations, then informs the operator and managers on performance, areas treated, efficiency, and real-time costs via the FPTrak website. FPDat and FPTrak are part of FPSuite, an integrated monitoring platform for the timber supply chain. New modules are currently being developed and implemented in member company operations, including the FPDat Grader module with a blade sensor and FPDat Transport, specially designed for forestry truck applications.

INCREASING COST RECOVERY FROM WINDTHROW

Mountain pine beetle (MPB)-killed stands continue to be targeted in order to mitigate the shortfalls of mid-term timber supply. The rate of windthrow in these stands is increasing with time—reducing fibre recovery and increasing harvesting costs. FPInnovations conducted a study in the summer of 2014 to assess the use of alternate harvesting methods designed to address these issues.

Results suggest that, while feller bunchers remain the most efficient system in low levels of windthrow, the grapple processor recovered more merchantable fibre, was nearly 6 m³/PMH more productive and cost approximately \$9/m³ less in stands with greater than 60% windthrow.





GROUPE INITIATIVE MAURICIE— A UNIQUE PROJECT

Several FPInnovations research teams are actively involved in the *Groupe Initiative Mauricie*, a collaborative project set up by local industry and government stakeholders to counter the waning profitability of forestry activities in this region of Québec. The project is designed to kick-start economic diversification in the forest industry and enhance the value of processed wood. The collaborative approach is being promoted to find a region-wide solution.

Phase 1, launched in 2014, aimed at assessing the forest sector value chain in the region and determining where and when changes should be made, for example in harvesting, processing and sorting prescriptions. The *Groupe Initiative Mauricie* has already set up a number of projects. Phase 2 will soon move into action, taking into account and implementing the results obtained in Phase 1.

DRYING TRIAL TO IMPROVE BIOMASS FEEDSTOCK QUALITY

Moisture content is one of the key characteristics in determining the calorific or heating value of biomass. In 2014, FPInnovations collaborated with member companies and undertook drying trials to monitor the moisture content of roundwood piles. Reducing biomass moisture content reduces transportation costs and improves heat value. For example, reducing moisture content by 10% can increase heat value by approximately \$10/ODT (oven-dried tonne). This translates into annual savings of up to \$500,000 for a 5-MW plant purchasing about 50,000 ODT/yr. The goal of the project was to help improve the supply logistics associated with moisture content fluctuations over seasons and to reduce supply costs.

To achieve the expected results, custom-manufactured steel drying bins equipped with load cells for continuous weight measurements were used to track the moisture of stored roundwood for a full year. Results obtained provide a better understanding of how moisture content of roundwood fluctuates when stored for different lengths of time and under multiple storage conditions. This data will help FPInnovations' members optimize their supply chains and limit storage times.

NEW DIAGNOSTIC ROAD SAFETY APPROACH

FPInnovations' Resource Roads Group is currently evaluating the potential of short-range photogrammetry. While vehicle-based LiDAR has already been tested to assess road geometry, this technology aims to offer road safety diagnostic tools at the best possible cost.

Road mapping is carried out by means of a video camera. The images are then converted to scatter plots and sent to calculation models, making it possible to issue clear diagnostics of the road geometry and optimal visibility distances in curved areas. This work is continuing in 2015 in order to identify the configuration providing the best quality-to-price ratio.



TURNING WOOD WASTE INTO BIOPRODUCTS

To enhance environmental sustainability, FPInnovations helps members find better ways of using residual woody debris. The Forest Feedstocks research group has been working with member companies to determine how current waste streams from sawmills, pulp mills, and sort yards could be sorted, washed, and separated. While rock can be used or sold as gravel, hog fuel and bark can be burned for cogeneration or used for other products, such as mulch.

Early results indicate that by redirecting 50% of organics to other uses, the cost of debris disposal could be reduced by nearly \$4 per cubic metre. Furthermore, earlier studies have shown significant benefits for members in extended lifespans of landfills and delayed landfill investment that can be in the millions of dollars.

IMPROVING TRUCK CONFIGURATIONS TO INCREASE PRODUCTIVITY

As one of its many services, FPInnovations' Transport and Energy Group is assisting members by

evaluating their trucking needs, assessing the functionality of their current fleet, and developing purchase specifications that are superior to their current equipment. The focus is on reducing tare weight, optimizing payload, and improving fuel efficiency. FPInnovations worked in close cooperation with member companies and their contractors to create truck specifications that have improved payloads by up to 2 tonnes, saving \$15,000 per truck annually, and significantly decreased energy intensity.

Further, FPInnovations continues to support the industry in getting approvals for new, more productive truck configurations. The organization has been working on initiatives throughout Canada, including: 9-axle tridem and tandem drive log trucks (up to 7 tonnes more payload) and a 10-axle chip van in BC (up to 9 tonnes more payload), and a heavy truck corridor for New Brunswick. Progress on the 9-axle initiative in BC resulted from numerous engineering studies and reports submitted to the BC government over the last 1½ years. This work will save the industry over \$1.40/m³ or more than \$30M annually!



WITH THE PIT GROUP

TRANSPORT PERFORMANCE WITH THE PIT GROUP



JUST LIKE THE FOREST INDUSTRY, THE TRANSPORTATION INDUSTRY IS A KEY SECTOR OF THE CANADIAN ECONOMY. IN FACT, THESE TWO ENTITIES ARE INEXTRICABLY LINKED AND CONTRIBUTE TO EACH OTHERS VITALITY. AND WHAT IF WE COULD HELP TRUCKING FLEETS BECOME MORE EFFICIENT WHILE MAKING THEM SAFER? WITH A HELPING HAND FROM THE PIT GROUP, IT IS NOW POSSIBLE. THAT'S WHAT WE CALL A WIN-WIN SITUATION!

750,000	+38,000	\$40.8 BILLION
THE NUMBER OF TRUCKS, MEDIUM AND HEAVY-DUTY, THAT TRAVEL ON CANADIAN ROADS EVERY DAY*	THE NUMBER OF KILOMETRES THAT MADE UP OUR NATIONAL HIGHWAY SYSTEM IN 2010*	THE OPERATING INCOME OF THE TRUCKING INDUSTRY IN 2010*

* Data obtained from Transport Canada's Policy/Research and Statistics



PIT – A NAME THAT GOES A LONG WAY

Without innovation, the trucking industry would face real challenges to increase its competitiveness, reduce its environmental footprint, and operate safely. That is why FPIInnovations set up the Performance Innovation Transport (PIT) Group, which specializes in innovations in the transportation industry. To date, close to 50 public and private North American fleets along with a large number of technology suppliers and several governments are benefitting from the PIT Group's innovative services.

In practical terms, the PIT Group independently tests, analyzes, and compares the most promising industry innovations. Highlighting technologies whose advantages have been demonstrated in a controlled test environment ensures that true innovations are brought to the forefront to the benefit of all participating fleets. What's more, lessons learned by the PIT Group are also transferred to the Canadian forest sector through our Roads and Transportation Group.

"To date, close to 50 public and private North American fleets (...) are benefitting from PIT Group's innovative services."

Over the past year, the PIT Group focused on addressing its members' most important issues. They were selected by Natural Resources Canada to develop and promote unbiased technical information to fleets willing to switch to natural gas—a move that could lead to fuel cost savings of up to 30% and reduce greenhouse gas emissions. And it worked: more than 150 fleets participated in at least one of the information events. The PIT Group also evaluated driver fatigue detection systems and in-cab camera systems to measure their effectiveness in preventing unsafe behaviours and accidents. Evaluation results indicate that although there are several well-established camera technologies that identify unsafe driver behaviour, fleets still face the daunting task of convincing drivers that these camera systems are there to help improve safety and are not a "big brother". Furthermore, the PIT Group determined that implementing the right driver fatigue detection technology may improve safety, but fleets must adopt a driver fatigue management program to effectively reduce the associated risks.

Today, the PIT Group is a proud leader with a clear vision of the transport industry's future. To get there, PIT's well-oiled machine is geared to ensuring that fleet managers and technology suppliers can drive this road together for years to come. After all, the road is much more enjoyable if you trust what's ahead!

A FORMIDABLE CATALYST FOR DEVELOPMENT

THE THREE COMPONENTS OF **PIT-POWER**

1 CERTIFICATION

The Certification component attests to the real impact of a product on fuel economy. This information is a powerful selling feature for suppliers and a decision-making tool for fleet managers.

2 RESEARCH AND DEVELOPMENT

The R&D component offers the necessary support for maximizing a technology's performance. The supplier therefore has access to the expertise of engineers and developers.

3 PRE-COMMERCIALIZATION

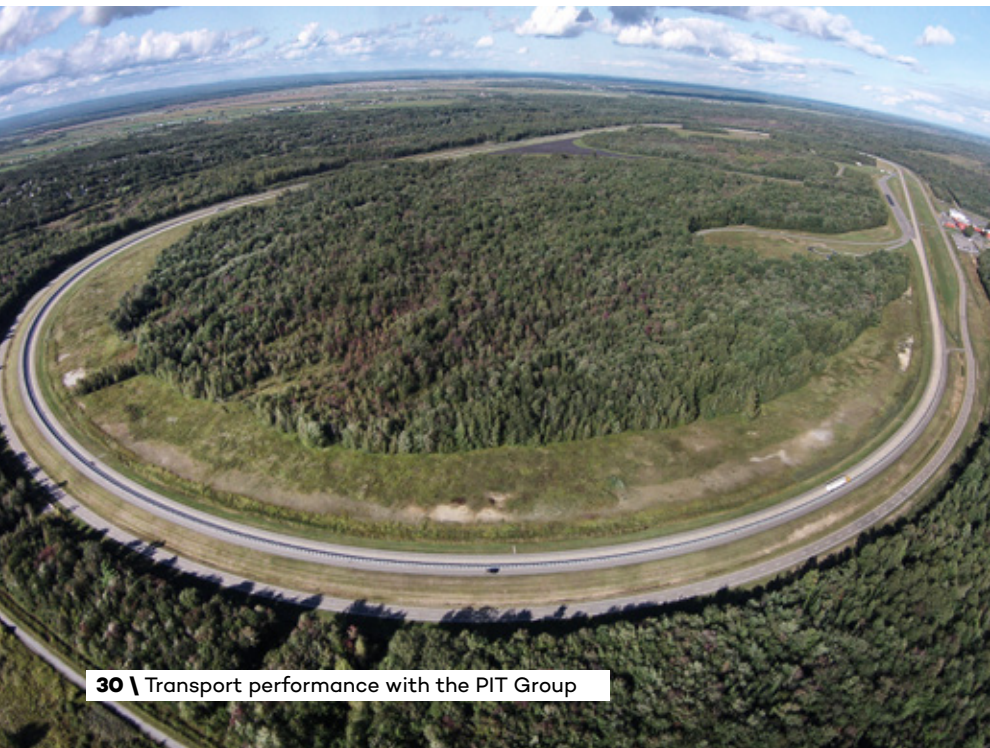
The Pre-Commercialization component is the key step for giving technology suppliers the means to launch their commercial activities and offer their products and technologies to the market.

The year 2014 marked the official launch of PIT POWER. The idea is simple. Previous to 2014, the PIT Group provided advice to its members on reliable technologies but was only reaching the demand side of the market—the users. With the creation of PIT POWER, the group moved to the supply side of the market and is now also directly helping those who provide new technologies to the transport industry.

PIT POWER is a program that aims to speed up the adoption of technological and energy-efficient solutions. In other words, the program encourages technology suppliers to develop and market products that meet the highest industry standards and through PIT POWER, promote industry uptake.

CERTIFICATION YOU CAN TRUST

PIT POWER has three separate components, including a unique certification program to highlight a product's performance to fleet managers. The effectiveness of a specific product can be identified by a PIT POWER certification logo that shows the potential fuel economy rating if the technology is used. This certification is the result of a stringent test program, ENERGOTEST, which is performed on a controlled test track with highly accurate measurement tools and cutting-edge analyses.



ENERGOTEST

ROAD TEST LABORATORY

ENERGOTEST is a fully independent road test laboratory using a closed track. Its stringent protocols use state-of-the-art equipment to ensure results of undeniable quality and reliability.



THE GENOMICS ADVANTAGE

KEEPING CANADA COMPETITIVE: THE GENOMICS ADVANTAGE

Faced with intense global competition, Canada's forest sector is seeking improved solutions and new ways to add value for customers and end-consumers. FPInnovations continues to play a leading role in developing transformative breakthroughs in science. Among such game-changing opportunities are technologies based on the rapidly advancing study of genes, known as genomics.

"Genomics has created waves of innovation all around the world, particularly in the areas of human health and medicine. Now, the game-changing potential of genomics is ready to be brought to our forests," says Pierre Lapointe, FPInnovations' CEO.



GROWING BETTER TREES FASTER

The promise for the forest sector lies in the insight genomics gives into what makes an organism, such as a tree, tick. Already, Canada's forest research community has completely or partially sequenced genomes for a few commercially important tree species and for some pest species that impact the forest resource.

A research team centred at Laval University and led by Dr. Jean Bousquet, Canada Research Chair in Forest Genomics, is using genomic selec-

tion to accelerate tree breeding. In the case of white spruce, conventional methods require up to 30 years to breed and test trees in the field for improved growth, adaptation, and wood fibre value. With genomic selection, the time is reduced to six years, permitting nurseries to rapidly select trees for reforestation programs.

"Genomic selection is also very promising when it comes to breeding trees that will be more resistant to pests and pathogens, and current efforts focus on developing planting stock with such attributes," says Bousquet.

An advantage of this approach is that it does not modify the genetic material of an organism. Its focus is on learning how genes naturally control physical characteristics, then using this knowledge to support particular management objectives.

WHAT IS GENOMICS?

Genomics is the study of a species' DNA, known as its genome. In sequencing the genome of individuals of a species, scientists find differences between them at given positions in their DNA. These differences are called DNA markers. These markers help identify genes that code for particular traits expressed in individual organisms of that species.

Today, Canada has a highly capable forest genomics research workforce and has experienced early successes in developing genomics-based solutions for forest sector challenges. For FPInnovations, the next step is to help members benefit from these advances while bridging the gaps between members' needs and research developments to give the sector a powerful competitive advantage.

PROTECTING THE FOREST RESOURCE

Genomics also has a role to play in protecting Canada from invasive species. "The increase in international trade means that we are constantly under threat of attack from invasive species and pathogens that could be devastating to Canada's forest sector," notes Dr. Richard Hamelin, a senior research scientist with Natural Resources Canada's Canadian Forest Service and professor at the University of British Columbia.

Hamelin's research team has developed DNA diagnostic kits to detect markers of pathogens before there are visible symptoms, permitting the early identification that is key to quarantining and destroying the infected plants before the contagion spreads. Likewise, these diagnostic kits can be used to identify traces of pests when the insects are too early in their development for a reliable visual identification.

SPI



THE STUDY OF A SPECIES' DNA, KNOWN AS ITS GENOME.



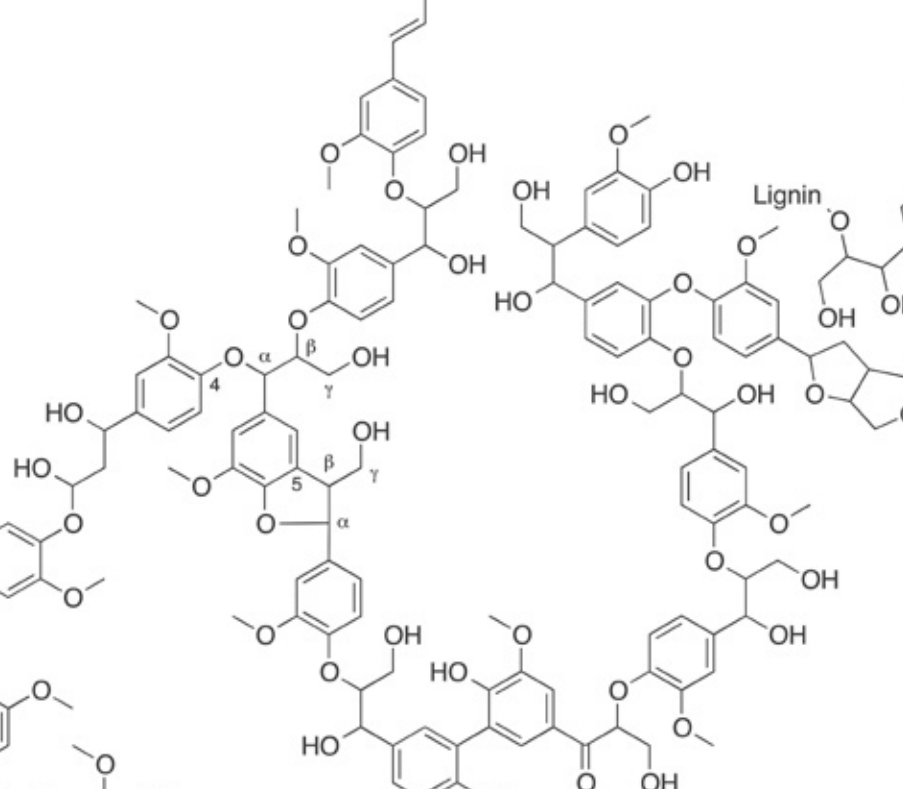
GENOMICS IS THE STUDY OF A SPECIES' DNA, KNOWN AS ITS GENOME.

MORE THAN JUST PROMISE

There is more than promise to the rapidly progressing field of forest genomics. Tools are available or in mature stages of development to change the way industry does business, from rapidly producing genetically improved planting stock, to reliably detecting the presence of damaging agents, to certifying the quality of raw materials and end products. It all adds up to a greater ability to manage for value along the supply chain.

While genomics brings great potential for the forest sector, the transfer of forest genomics science and technology from the research lab to end-users in industry and government is a special challenge. Ongoing collaborative engagement is needed to develop a common "language" – a common understanding of each other's needs and capabilities. FPInnovations is committed to working with others to develop this common language, using its strong base of science, technology and innovation to ensure members reap the rewards offered by genomics.

GENOMICS IS THE STUDY OF A SPECIES' DNA, KNOWN



2ND

MOST ABUNDANT ORGANIC MOLECULE ON EARTH AND MOST ABUNDANT AROMATIC COMPOUND, LIGNIN IS A BINDER OF CELLULOSE, GIVING STRENGTH TO TREE AND CONFERRING BIOLOGICALLY IMPORTANT HYDROPHOBIC QUALITIES TO CELL WALLS

LIGNIN: DID YOU KNOW THAT...

\$1/KG
\$ 1000/TON

Value of lignin



LIGNOFORCE™

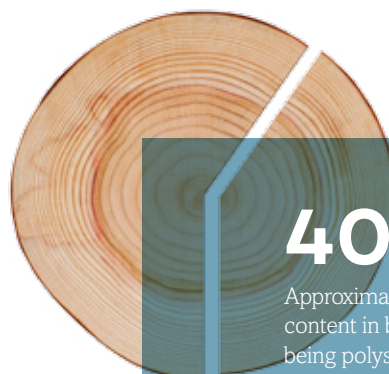
Recovery process of lignin from black liquor, developed by FPInnovations and NORAM Engineering

15 KG/DAY

AMOUNT OF LIGNIN PRODUCED AT THE FPINNOVATIONS' DEMONSTRATION PLANT IN THUNDER BAY

23.5 GJ/T

Caloric value of lignin (or heat produced by kraft pulp lignin, if burned) which, in addition, can earn GHG credits



40%

Approximate percentage of lignin content in black liquor solids, remainder being polysaccharides, organic acids, salts, methanol, and inorganics

52,500
TONS

1 YEAR

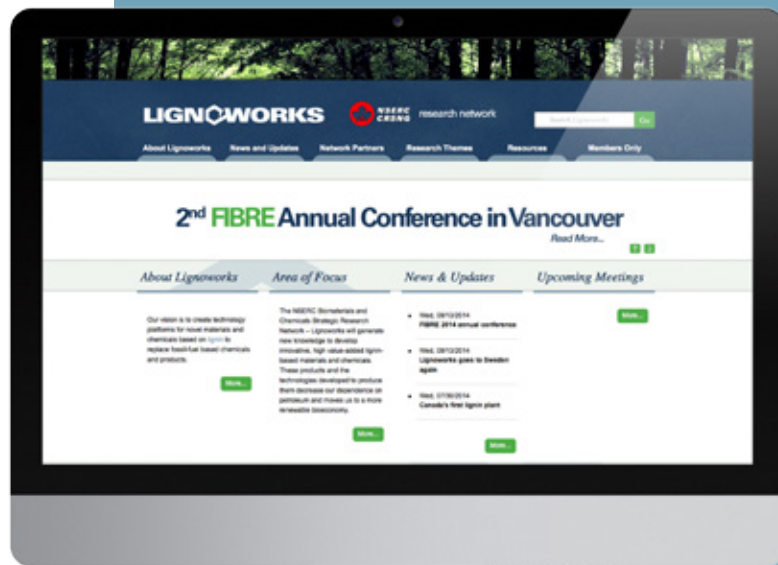
150
TONS

24 H

6.25
TONS

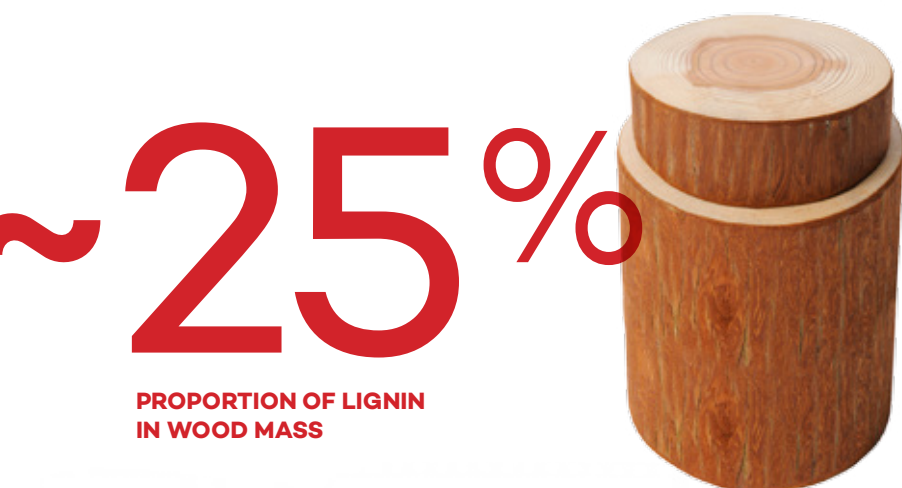
1 H

Maximum quantity of lignin that can be extracted from black liquor in a typical Canadian softwood kraft pulp mill, which corresponds to 1,000 tons of pulp per day



LIGNOWORKS

NSERC BIOMATERIALS AND CHEMICALS STRATEGIC RESEARCH NETWORK WILL GENERATE NEW KNOWLEDGE TO ALLOW DEVELOPING INNOVATIVE, HIGH VALUE-ADDED LIGNIN-BASED MATERIALS AND CHEMICALS



PROPORTION OF LIGNIN IN WOOD MASS

**HINTON,
AB**

Location of the new commercial-scale lignin recovery process LigniForce™ plant, the first in Canada to extract lignin from black liquor.

**10,000
TONS**

EXPECTED QUANTITY OF COMMERCIAL LIGNIN TO BE PRODUCED PER YEAR AT FULL CAPACITY AT THE HINTON LOCATION



Potential uses for lignin include: adhesives in wood products, polyol in polyurethane foams, thermoplastics and composites, dispersant/flocculant, packaging, carbon black, activated carbon, carbon fibre, epoxy resins, adhesive in foundry resins, and adhesives in pellets made from biomass.

PULP, PAPER AND BIOPRODUCTS

PULP, PAPER AND
BIOPRODUCTS

MAKING FOOD PACKAGING GREENER

A new, paper-based technology that enables microwave ovens to make food crispy has been developed and tested in FPInnovations' Paper, Packaging and Consumer Products research program. Susceptors, the components of microwaveable food packaging that makes food such as popcorn crispy, have recently been developed using paper and conductive ink. Whereas susceptors are typically made of metal and petroleum-based plastics, FPInnovations' paper-based approach creates a product that is a major step toward fully compostable products while providing a new market opportunity for the paper sector. A large-scale trial was performed confirming the possibility of the technology.

Although the product has a relatively small market in terms of tonnage, it is of interest for some members as a specialized product. As such, further development will be offered through a strategic research alliance with interested parties.





NEW VALUE-ADDED APPLICATIONS FOR NONWOVEN PRODUCTS

A pilot plant trial recently enabled FPInnovations' researchers to demonstrate the use of various market pulps in manufacturing many types of nonwoven acoustic insulation products. Acoustic insulation products are typically used underneath the top surface of flooring in buildings and as underlayment under concrete topping. Studies performed by researchers at the FPInnovations' Québec laboratory using newly developed sound insulation testing methods (dynamic stiffness and apparent impact insulation class) confirmed that nonwoven insulation products had comparable physical and mechanical performances to existing commercial products, in addition to superior impact sound insulation characteristics.

CAPTURING NEW OPPORTUNITIES IN DIGITAL PRINTING PAPERS

Over the last year, FPInnovations has achieved great results expanding lightweight coated paper beyond its traditional use in offset printing. Research has led to the development of low-cost glossy coating formulations for use on commercial inkjet web presses. Potential applications could include production printing of personalized magazines and catalogues, a new market niche for high-speed presses.

Pilot coating and full press trials have shown very positive results. The new glossy coating formulations will allow paper mills to expand the range of grades offered for web inkjet printing, which is currently the only growing segment in commercial printing.

BIOTREATMENT COST REDUCTION OPPORTUNITIES FOR PULP MILLS

Each year, Canadian pulp and paper mills spend millions of dollars on supplemental nutrients to treat effluent discharge. Use of this biotreatment approach ensures that effluent meets performance criteria established by government regulations.

Recently, FPInnovations worked with two Québec mills—selected for their relatively high reduction potential—implementing biotreatment nutrient cost reduction through a stepwise approach. Close monitoring of treatment performance demonstrated that both mills were able to reduce their demand of supplemental nutrients with no impact on the quality of effluent discharged. This resulted in substantial cost reduction of the nutrients used and led to full implementation in the mills.

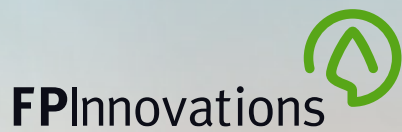
PULP, PAPER AND
BIOPRODUCTS

WOOD ASH AS A LIMING AGENT

A growing number of forest product manufacturers use wood residues to generate green energy for their mills. However, this practice leads to a large quantity of wood ash, which is mostly landfilled. Research performed by FPInnovations and the Canadian Wood Fibre Centre found that wood ash is a powerful liming agent that could be used in agriculture and forestry. It offers the dual benefit of supplying valuable nutrients for the crops while utilizing by-products of the wood energy systems.

Research showed that the application of wood ash to soil helped increase its pH and modify physical properties, and could even be preferable to conventional lime treatments in some applications.





The Next Generation of Absorbent Products

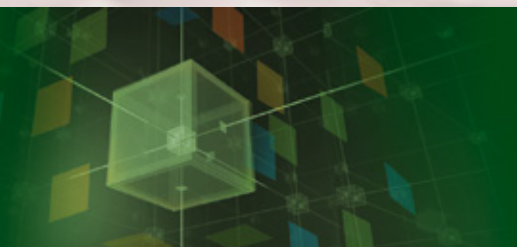
At FPInnovations, our researchers are developing new bio-materials to improve hygiene and absorbent product performance with a focus on enhanced wood fibres. Our team of scientists and pulp and paper experts is committed to helping members grow their market share, control costs, and meet the challenges of a changing industry.



follow us



fpinnovations.ca



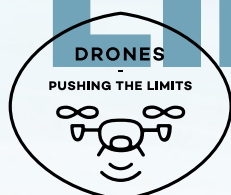
PUSHING THE LIMITS

The total weight of the drone is approximately 2.5 kg and its battery provides up to 50 minutes of non-stop flying

The camera makes it possible to take hundreds of sequential photos, which can then be stitched together to produce a larger image or to create a 3D forest model

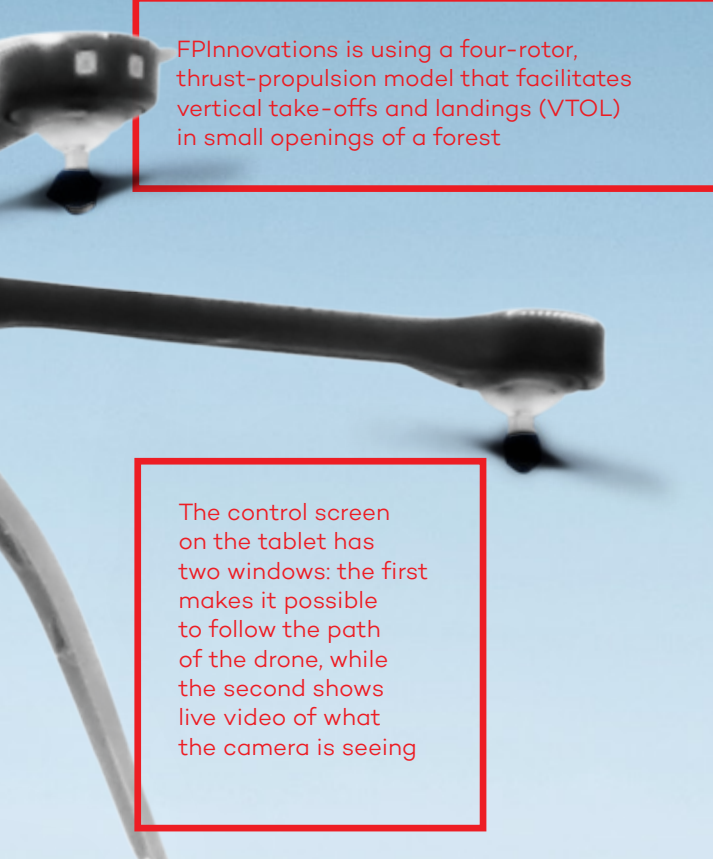
The drone's gimbal mount guarantees the clarity of the photos, even on days with strong winds where the stability of the drone is more difficult to maintain

DRONES: PUSHING THE LIMITS



“WE ARE CURRENTLY SCRATCHING THE SURFACE OF A NEW TECHNOLOGY THAT WILL LEAD TO SURGICAL PRECISION OF FOREST INVENTORY AND OPERATIONS MONITORING.”

DRONES PUSHING THE LIMITS



FPIInnovations is using a four-rotor, thrust-propulsion model that facilitates vertical take-offs and landings (VTOL) in small openings of a forest

The control screen on the tablet has two windows: the first makes it possible to follow the path of the drone, while the second shows live video of what the camera is seeing

Some of the potential forestry applications can be classified into the following themes: monitoring and inspection; stand inventory and regeneration surveys; volumetric applications for chip piles and roundwood; thermal imagery for hot-spot detection; and multispectral sensing for forest health and species recognition. FPIInnovations is also partnering with numerous colleges, service providers, and manufacturers to improve our research capacity and to ensure that results are quickly implemented by our members and provincial partners.

“Drones have unlimited possibilities in many industries,” points out Lance Loggin, Silviculture Coordinator at West Fraser, “and our goal within West Fraser is to see where there is a good business case for either better data or cheaper data than current collection methods. The trial conducted by FPIInnovations was directed at facilitating the surveying and planting of Not Satisfactorily Regenerated areas within blocks which were dragged to encourage natural regeneration.”

There is still a lot of progress to be achieved in order to make the most of drones in the forest sector. For instance, regulations on flying drones are still quite restrictive and are a concern that must not be neglected.

Nevertheless, we can well imagine the great potential of drones that we will be able to realize. All that's left is to let our imagination run free. And that's what we could call “pushing the limits”!

We call them drones, remotely piloted aircraft or, properly speaking, unmanned aerial vehicles (UAVs). For the past few years, these miniature flying machines have been the focus of a lot of media attention, and the forest industry is no exception to the immense enthusiasm that drones have aroused.

There is national interest in UAVs within the forest sector, and we currently see many practical and economic advantages of this technology. Numerous missions have been performed so far, and other projects are in the pipeline—to identify potential new applications and to validate the financial return of using drones over traditional methods. FPIInnovations is investigating operational-scale applications where the technology can show good return over labour-intensive ground surveys and where the local scale of operation cannot justify extensive missions with conventional aircraft. The research is not just about taking photos—the post-mission data treatment and the automation of the data into useful information are also key components.

4-STEP TRIALS IN THE FIELD

1

PRE-TRIAL PRELIMINARIES

Planning begins well before the trial day, by determining the mission objectives. Once the needs have been clearly defined, the site to be flown over must be identified, the constraints of the terrain checked, the flight plan developed, and that is not all...

In addition, at least 48 hours before conducting a trial, FPInnovations must provide Transport Canada with the flight plans.

Flight authorization

- > Permits are granted by Transport Canada
- > The drones are authorized to fly at a maximum altitude of 90 metres (unless a special permit is issued)
- > Some annual permits may be issued for specific regions, making it possible to shorten the wait time for flight authorization
- > The request for authorization to fly must explicitly mention the objective of the mission, the location of the trials and the flight plan
- > Since 2014, certain exemptions are allowed in order to avoid the permit application process

DRONES

PUSHING THE LIMITS



2

SETTING UP ON TRIAL DAY

At flight time, a technical inspection of the drone is required and it must be ensured that the site is well secured. Usually, plans are made for a window of one week to carry out 2 or 3 days of flying, giving priority to the most important objectives at the beginning of the mission.

Poor weather conditions generally may not affect drone operations, but good light and a stable camera can ensure quality images.

Training of FPInnovations' pilots

- > Special three-day training given by the drone provider
- > Ground-school pilot training to become familiar with flight safety basics, weather, and communication protocols
- > Practice sessions in the field, in areas authorized by a Transport Canada permit, where mission conditions are simulated

3

MISSION FLYOVER

The drone flies over the specified area on predetermined flight lines, taking many successive photos, which will then be analyzed. The number of photos taken and the speed of the aircraft depend on the application, aircraft altitude, and the image overlap. If a 3D model is needed, generally a 60 to 80% overlap is used. Moreover, if high resolution photos are required, the drone moves very slowly.

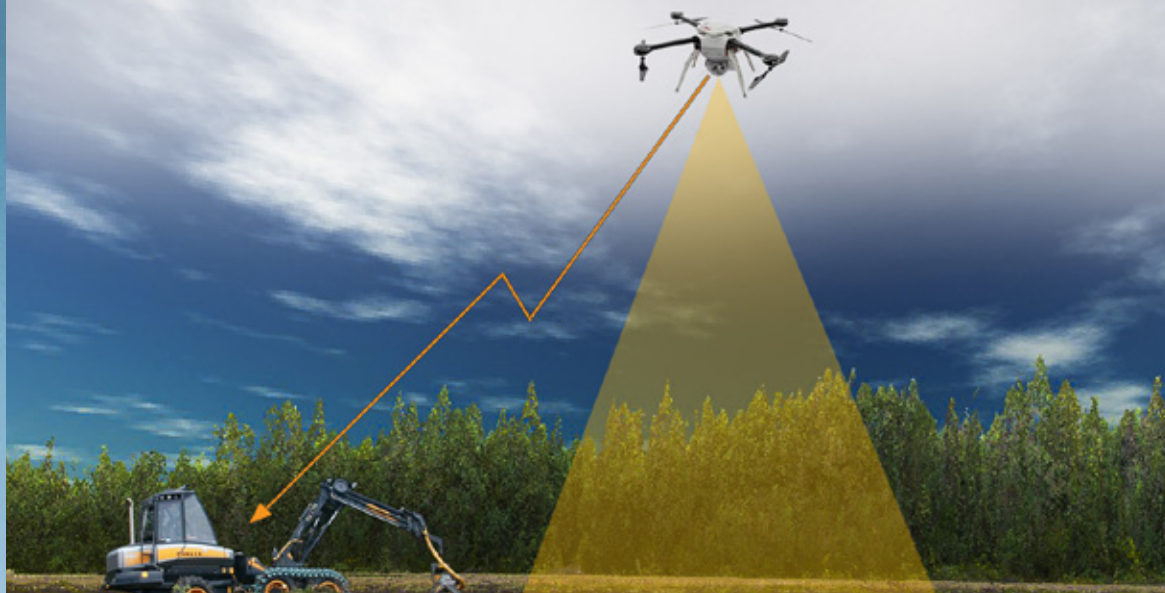
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DATA COLLECTION AND ANALYSIS

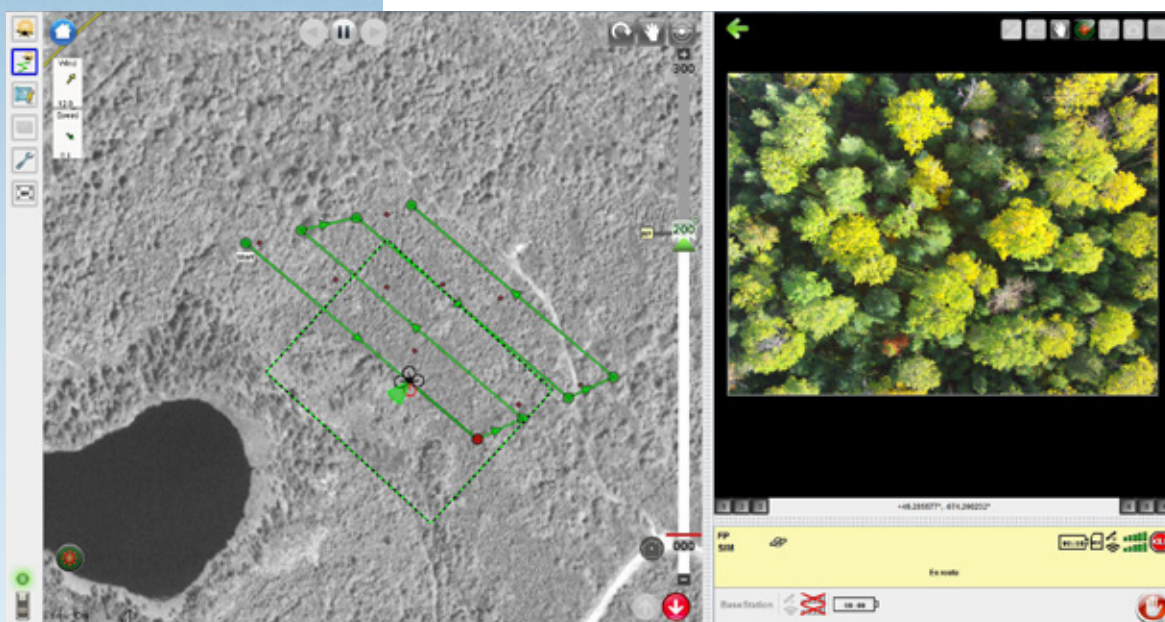
Once the drone is back on land, the photos are assembled into a single image of the site. The overlap among images enables the third dimension for a better visual appreciation and 3D analysis. At the present time, FPInnovations is working on developing algorithms that automate image interpretation.

When the drones are used for reconnaissance purposes, the drone data is transmitted in real-time directly to

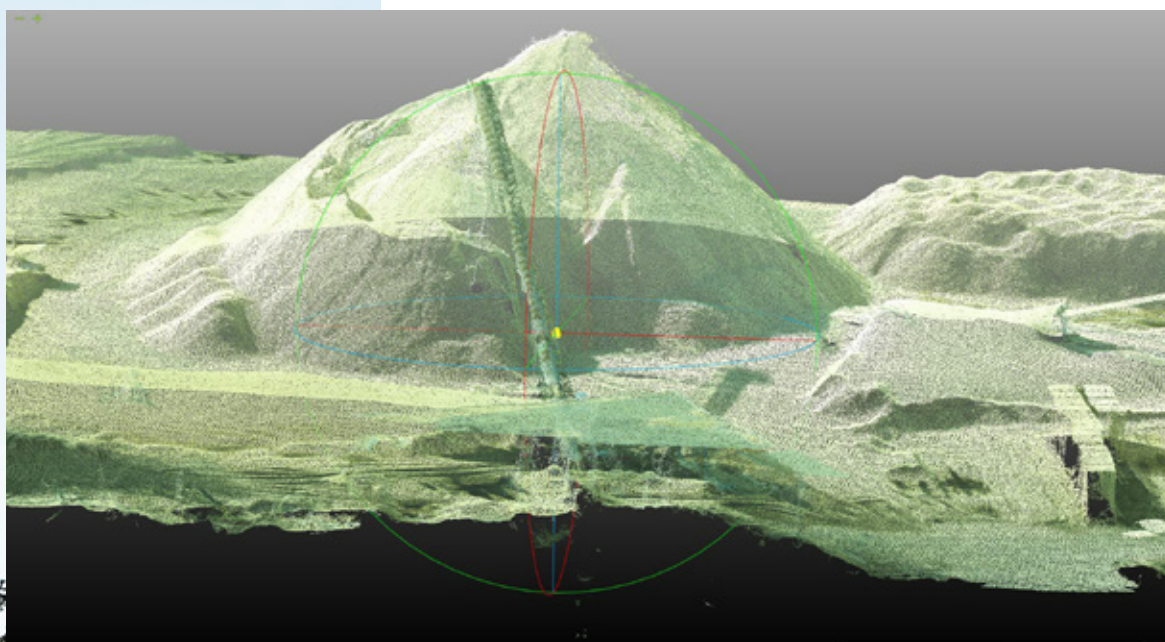
the operator. This data makes it possible to obtain a better overall view of the terrain, evaluate the risks, and in general, help to make informed decisions.



↑ Schematic of a VTOL drone flying over a site.



↑ Representation of the screen view of a remote control during a flight



↑ Textured 3D rendering of a chip pile in a mill yard

LAUNCHING OF THE STEEP SLOPE HARVESTING INITIATIVE



FPInnovations' members in western Canada are increasingly turning to steep slopes as a source of fibre. However, timber harvesting on steep terrain presents challenges around safety, costs, investment in equipment, regulatory compliance, environmental impacts, availability of skilled labour, and planning. There is a strong need for increased research and development focused on new technologies and innovations for harvesting, trucking, and road construction in steep slope environments.



In response to demand from its members, FPInnovations is taking a lead role in finding solutions to these challenges, by launching a new program, the **Steep Slope Initiative**. This five-year research and development plan is identifying and developing best practices and new harvesting technologies to provide the forest industry with safe, economic, and sustainable access to fibre located on steep slopes. The Initiative is engaging forest industry members, equipment manufacturers and distributors, regulators, and other stakeholders. Two committees, an industry-led steering committee and a manufacturer working group, were recently formed to help guide the Initiative and facilitate knowledge transfer.

An important component of the Steep Slope Initiative is to identify and adapt new technologies that are emerging outside of Canada. For example, winch-assisted systems, where ground-based machines are tethered to anchors using cables to aid in their stability, are now being used safely and productively in several countries. Of special interest to the Initiative are several mechanized harvesting technologies that have been developed in New Zealand to help reduce unacceptably high levels of worker injuries associated with hand falling. FPInnovations and New Zealand's Future Forest Research Group, which leads the steep slope harvesting research in that country, enjoy an excellent relationship and have signed a Memorandum of Understanding (MOU), an information exchange benefiting both countries.

LAUNCHING OF THE STEEP SLOPE

Another priority of this Initiative is to deliver safe and effective steep slope operating solutions that minimize environment impacts. Work will be done by FPIInnovations' research partners to identify best practices and knowledge gaps or areas requiring improved operating methods.

During the five-year Steep Slope Initiative, targeted communication efforts will be undertaken to ensure all stakeholders are kept informed and engaged. The Initiative will provide resources, such as workshops, best practices manuals, and demonstrations, in support of the safe implementation of new technologies.

The first activities conducted under the Initiative include the development of a five-year road map, formation of industry and manufacturing working groups, completing tilt-table tests

of static machine stability of feller-bunchers, a tour of steep slope operations in Europe, two workshops, and the first exploratory field studies of novel technologies operating on steep terrain. As a result of FPIInnovations' efforts, a second winch-assist machine has been imported from New Zealand and is now operating on the BC Coast. Additional winch-assist machines will be arriving this fall.

A number of harvesting, road construction, and trucking projects will form part of the Steep Slope Initiative in 2015 and 2016, including assessments of new winch-assisted equipment, an international technology watch, more work on machine stability ratings, systems evaluations and developments, and enhanced communication on steep slope research.

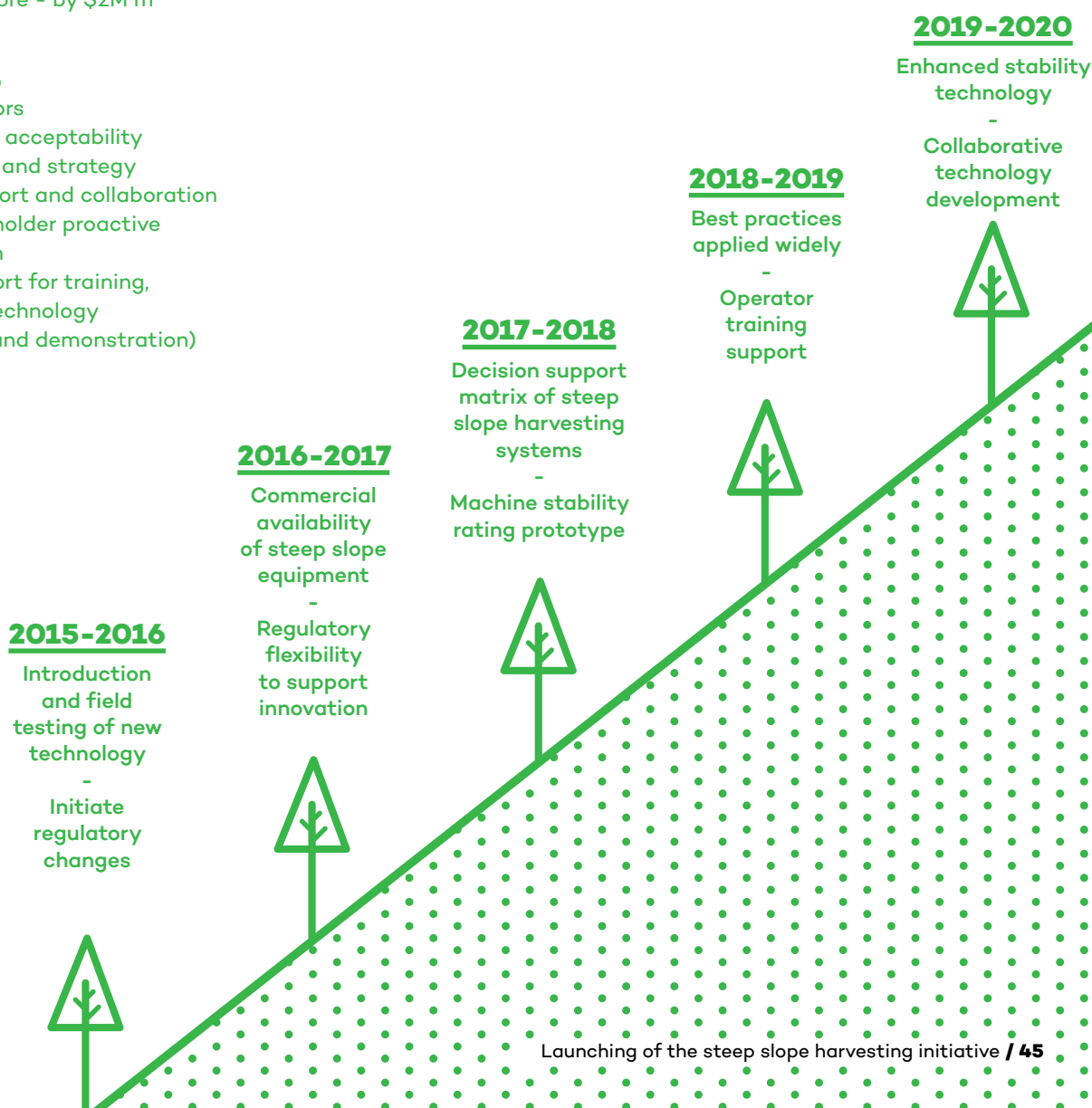
The Steep Slope Initiative Road Map

GOALS

- Increase safety - reduce accidents by 50%
- Increase margin - by \$5/m³
- Access more fibre - by \$2M m³

ENABLERS

- Trained operators
- Maintain social acceptability
- Effective team and strategy
- Regulator support and collaboration
- Member/stakeholder proactive communication
- Financial support for training, research and technology (development and demonstration)



FIRST NATIONS: COLLABORATION, SUPPORT, INNOVATION



In 2014-2015, FPInnovations continued to provide technical and business development support to Aboriginal communities engaged in the forest sector. No less than 26 projects were completed this year, allowing for the creation or preservation of 139 jobs, the launch of traditional as well as innovative products, and the implementation of several new businesses. The projects helped communities use wood to create social, environmental, and economic added value. They also directly helped FPInnovations' industry members in areas such as improving harvesting contractors' performance. Following are short illustrations of the type of work done within seven of the projects.

ALEXIS CREEK FIRST NATION'S TSIDELDEL TIMBER DEVELOPMENTS LIMITED PARTNERSHIP

Data was provided to Tsideldel on the long-term productivity and performance of their harvesting equipment. Comparing this data to baseline productivity data maintained by FPInnovations led to the identification of several areas for improvement. Monitoring fuel consumption of log trucks with on-board computers was also done to help Tsideldel optimize its log hauling operations.

MORICETOWN BAND KYAHWOOD FOREST PRODUCTS

FPInnovations' staff made a series of visits to the finger jointing operation to improve the optimizer system, in addition to implementing new cleaning, calibration, and daily quality control procedures. Initial indications are that recovery has been significantly improved.

ULKATCHO FIRST NATION

Ulkatcho First Nation engaged FPInnovations to perform an opportunity assessment of the West Chilcotin Forest Products mill in order to address the challenges related to operating a sustainable sawmill in such a remote area. The study supported the reopening of the mill and made numerous recommendations on various aspects of the operations. FPInnovations' staff worked closely with the Nation to make this happen, thereby creating 65 direct jobs and 20 indirect jobs in the community. At the Nation's request, FPInnovations also conducted studies on the costs and benefits of wood waste-fueled combined heat and power systems for the community.



↓ West Chilcotin Forest Products -
Nation Ulkatcho

HAIDA NATIONS' TAAN FOREST PRODUCTS

Work has been ongoing to develop entry strategies into the wood musical instruments and decorative timber

design markets. The work included a visit to Japan's second largest piano maker to understand Sitka spruce requirements and discussions with a CNC processing facility to identify a timber-based building product on which to incorporate Haida designs. Work is also continuing to facilitate transforming Taan's current utility poles business into value-added products used in residential and commercial construction.

NUXALK FIRST NATION

Nuxalk Nation's Totem sawmills requested a feasibility assessment for the distilling of conifer essential oils. The assessment concluded that sawmills would support the inclusion of the proposed operation within the existing load levels and with additional training and skills development of employees.

ESK'ETEMC BAND

FPInnovations' researchers spent several days at Ecolink's harvesting operations to conduct an operational assessment using FPInnovations' DiagFor model. The assessment was presented to Ecolink staff and Board of Directors, who will be implementing the recommendations as part of management's goal of continuous improvement within its harvesting operations.

THE UNIVERSITY OF BRITISH COLUMBIA AND EMILY CARR UNIVERSITY OF ART & DESIGN

The University of British Columbia, Emily Carr University of Art & Design, and FPInnovations are working together to expand the tradition of BC Aboriginal art. The project intends to bring BC Aboriginal communities together to create uniquely designed, Aboriginal wooden door panels that could become part of a high-end product line offered by a BC door company. This project has two key goals: to explore the feasibility of successfully branding a line of Aboriginal niche products that combine the uniqueness of Aboriginal-sourced western cedar with traditional carving design and techniques; and to develop a business plan for producing such a unique product line.

GLENN HARGROVE COMES FULL CIRCLE

DIRECTOR GENERAL

Canadian Wood Fibre Centre (CWFC)

VICE PRESIDENT

Resource Assessment
FPInnovations



THERE'S A UNIQUE TWIST TO GLENN HARGROVE'S ROLE AS HEAD OF THE CANADIAN WOOD FIBRE CENTRE (CWFC) AT NATURAL RESOURCES CANADA AND VICE PRESIDENT, RESOURCE ASSESSMENT, AT FPINNOVATIONS. YEARS BEFORE HE STEPPED INTO THIS ROLE IN JANUARY 2015, GLENN WAS THE LEAD AUTHOR OF SUBMISSIONS TO CANADA'S CABINET AND TREASURY BOARD THAT CREATED THE FIBRE CENTRE AND PROVIDED FEDERAL SUPPORT FOR THE CREATION OF FPINNOVATIONS IN 2007. "IT FEELS LIKE I'VE COME FULL CIRCLE," HE SAYS.

In an interview, Glenn shared other interesting aspects of his background.

Canadian Wood Fibre Centre

The CWFC, which delivers the national Resource Assessment Program, has a team of science, policy, and administrative staff in six regional centres across the country, from Victoria, BC, to Corner Brook, NL, as well as a small headquarters team in Ottawa, ON. The centre takes roughly 10% of the scientific capacity within the Canadian Forest Service and directs it toward the sector's upstream research priorities.

PULP AND PAPER'S GREEN TRANSFORMATION

Among other achievements, Glenn led the team that delivered the highly successful billion-dollar capital investment program (2009-2012), which enabled Canadian pulp and

paper mills to improve their environmental performance. The acclaimed program made a huge difference in reducing greenhouse gas emissions and increasing renewable energy production in Canada's pulp and paper sector.

STRENGTHENING ABORIGINAL RELATIONSHIPS

In 2013, Glenn led the federal support for Doug Eyford, the government's Special Representative on West Coast Energy Infrastructure. Mr. Eyford's recommendations to the Prime Minister – which were based on extensive engagement with Aboriginal communities, governments, and industry across BC and Alberta –

have helped improve relations and promote Aboriginal participation in West Coast energy development.

BEST PART OF THE JOB

"FPInnovations does great work!" Glenn really enjoys working with FPInnovations and the Senior Leadership Team; learning more about the science done in the CWFC, the people who make it happen and the opportunities going forward; and getting to know staff across the country in the CWFC's regional labs.

BIGGEST CHALLENGE

Staying connected with Canadian Forest Service and FPInnovations staff and colleagues, and other sector stakeholders is no small task. "As a national organization that provides a critical link between FPI and the CFS, we have to ensure engagement at all levels. While technology enables virtual communication, there's often no substitute for face-to-face in building initial relationships."

KEY MOTIVATORS

Glenn's professional and personal motivation stems from the desire to make a difference in the sector and the outside world, build strong, positive team environments, and learn, improve, and develop new skills. "It's important to me that our work makes a real difference – we're not shuffling paper."

PASTIMES

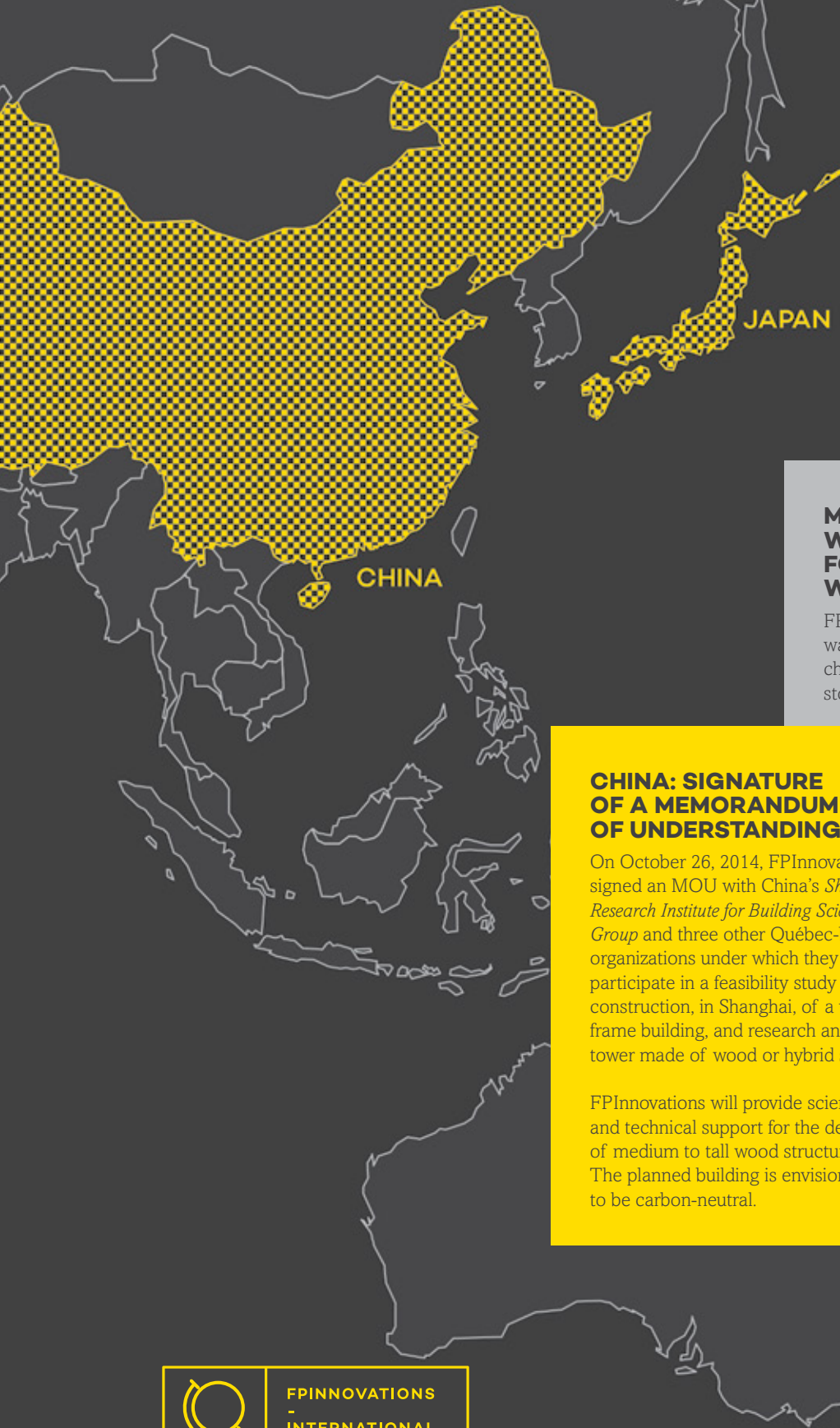
While work and family commitments limit his spare time, Glenn likes to squeeze in a lot of exercise. Over the years, his sports have included touch football, kick-boxing, basketball, volleyball, softball, dragon-boating, and more. "I've also enjoyed becoming a 'hockey dad' since my son started playing."

FAMILY AND EARLY CAREER

Glenn and his wife, Sara, live in Ottawa with their 7 year-old son and 3 year-old daughter. Born and raised in Burnaby, British Columbia, Glenn studied economics at Simon Fraser University and after graduation, initially did consulting work for Western Economic Diversification Canada and the Vancouver Economic Development Commission.

FORESTRY BECKONS

In 2001, a federal government job in Vancouver sparked his interest in forestry: it included looking at the labour market impact of industry changes in BC and issues such as the Softwood Lumber dispute. In 2003, he moved to a job in trade policy with the Canadian Forest Service (CFS) in Ottawa.



MIDPLY™ WOOD SHEAR WALL SYSTEM CHOSEN FOR JAPAN'S LARGEST WOOD BUILDING

FPInnovations' Midply™ wood shear wall system was the winning design chosen for the construction of a five-storey building in Tokyo, the largest

wooden building ever built in Japan. This system, an innovative high-capacity shear wall, will allow for superior resilience to severe earthquakes and extreme winds.

The Midply system was recently implemented in the Canadian Design Code for Wood.


CHINA: SIGNATURE OF A MEMORANDUM OF UNDERSTANDING

On October 26, 2014, FPInnovations signed an MOU with China's *Shanghai Research Institute for Building Sciences Group* and three other Québec-based organizations under which they will participate in a feasibility study for the construction, in Shanghai, of a wood-frame building, and research and testing tower made of wood or hybrid systems.

FPInnovations will provide scientific and technical support for the design of medium to tall wood structures. The planned building is envisioned to be carbon-neutral.



INTERNATIONAL SECTION



CANADA

UNITED STATES

MEXICO

MEXICO: RECOGNITION OF CANADA'S WOOD HEAT TREATMENT PROGRAM

Wood exports to Mexico are now expected to increase after the country agreed to recognize Canada's heat-treated lumber certification program based on treatment schedules developed by FPInnovations. Accredited producers of Canadian lumber will now be able to export heat-treated wood species such as spruce, pine, and fir to Mexico without a phytosanitary certificate.

Using FPInnovations' custom heat treatment schedules, which received approval from the Canadian Food Inspection Agency, helps shorten kiln times and minimize grade reductions due to overdrying.

FPFMS™ CROSSES NATIONAL BORDERS

At the end of 2013, Canadian and U.S. patents were granted for FPInnovations' FPFMS™ OSB Fines Monitoring System, that allows for online monitoring of fines in OSB production, with an expected reduction of 1 to 2% over the 10 to 30% usually produced by OSB mills. Studies conservatively estimate that a typical OSB mill can save approximately \$500,000 annually for every percentage point reduction in fines.

Currently in operation in numerous Canadian OSB plants, the system is now entering the international market, with the sales of the first systems outside Canada.

COLLABORATION WITH SOFTWOOD LUMBER BOARD

FPInnovations' expertise was called upon through a contract with the Softwood Lumber Board (SLB), an industry-funded initiative focussed on increasing the demand for appearance and softwood lumber products in the United States. Under the agreement with the SLB, FPInnovations provided market analysis and building system expertise, producing several reports covering markets, mid-rise construction, and environmental impacts of building with wood. These reports will be available to SLB members.

Collaborating with the United States to strengthen the position of softwood lumber in the marketplace through FPInnovations' expertise benefit the Canadian wood industry by increasing the market for wood. FPInnovations is continuing to work with the SLB on other opportunities.

INT
SEC

WOOD PRODUCTS



MULTI-FUNCTIONAL WOOD PANELS TO REDUCE INSULATION COSTS

Changes in the U.S. building energy codes requiring increased insulation could be a serious threat to the wood sheathing market. Following market research to validate interest by builders, FPInnovations designed a cost-effective, wood-based, multi-functional panel system that would meet mandated higher energy savings requirements, and compete effectively with rigid plastic foam insulation and other alternative products. At the time this work was initiated, APA – The Engineered Wood Association, estimated that substitution of rigid plastic foam for OSB or plywood sheathing could result in a loss of 20% of the wall sheathing market, or 1 billion ft².

Wood-frame walls sheathed with these multi-functional panels, made with OSB faces and two types of rigid insulation core, showed equal or better structural performance when compared with regular OSB sheathing. A cost analysis also revealed that the use of FPInnovations designed panels could be 6 to 7% more economical than alternative solutions to achieve the same insulation values, and they could save over half a day of construction time per house.



↑ Multi-functional wood panels

↓ Testing on a CLT floor to determine the floor's fundamental natural frequency



FLOOR VIBRATION TEST METHODS TO BECOME STANDARDS

FPInnovations has developed and implemented vibration control design methods for different types of wood floors. Working in collaboration with Dr. Chui at the University of New Brunswick, a proposal has been submitted to the International Organization for Standardization (ISO) for adoption of the test methods as an ISO standard. The test methods which have just been approved are expected to be published before the end of 2015.

In addition, the design method for cross-laminated-timber (CLT) floors is currently under consideration by the Canadian Standards Association's Committee on Design in Wood (CSA O86).



CO₂ EMISSIONS LOWER IN CLT BUILDINGS

To support the increasing interest of architects and engineers in the use of CLT in the construction of mid- and high-rise buildings, FPInnovations' researchers conducted a life cycle analysis (LCA) of a four-storey CLT building recently built in Québec. The building was found to have improved environmental performance compared to an equivalent concrete building in two out of six impact categories, including CO₂ emissions. The other four categories were roughly the same despite containing considerably more lumber than a similar light platform-frame building.

FPInnovations' study also considered the cooling effects associated with changes in forest surface reflectivity over the harvest cycle, as well as methane emissions from landfilled wood products.

HIGH PERFORMANCE COATINGS FOR EXTERIOR APPLICATIONS

Coatings are commonly used on wood products for exterior applications to prevent visual and structural changes caused by ultra-violet (UV) light and humidity penetration, but the efficiency of these coatings diminishes over time.

In 2014–2015, FPInnovations evaluated two types of commercially available coatings: sealers, used to prevent resin sweating; and transparent finishes, used to prevent surface oxidation by UV light. For the commercial sealers, solvent-based products outperformed water-based products; the industrial sealers showed similar results. Testing of the transparent finishes is in progress. The objective for 2015–2016 is to develop more efficient coatings based on the results obtained from these assessments.

LASER LOG SCANNERS ACCEPTED FOR SCALING

FPInnovations assisted Measurement Canada with developing procedures for testing scanner accuracy by conducting trials at sawmills and at FPInnovations' Vancouver laboratory. As a result, Measurement Canada is now accepting scanners for testing and approval. FPInnovations will be participating in a scanner scaling pilot project at a BC sawmill, planned to take place next fall.

Log scanners can measure the gross volume of each log, but the species, grade, and net volume of each log must also be determined. As current scanning technology cannot capture this information, alternative procedures needed to be developed. Canadian forest companies have a strong interest in using laser log scanners for scaling as they offer the potential for lowering costs while maintaining an accurate scale.

WOOD DRYING



RADIO FREQUENCY PRECISION WOOD DRYING

The Drying and Energy research team, together with its partners at Hydro-Québec's *Laboratoire des technologies de l'énergie* (LTE), has established the technical feasibility of a high-frequency, continuous pilot dryer by conducting trials on two types of products requiring a precise range of final moisture content levels. In addition, exploratory work conducted in collaboration with Université Laval (For@c) has shown that a computer simulation tool could be used to determine the best approach to implement this technology in an industrial environment.

Evaluation of the economic feasibility of the technology has been initiated and will be completed in 2015–2016. Should the evaluation show promising results, FPInnovations will search for industry partners to perform a mill-level demonstration.





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2014-2015
RETROSPECTIVE

March 2015

March 2015



↑
March 2015

Erol Karacabeyli
receives Lifetime
Achievement Award
from Wood WORKS!

March 2015

March 2015



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2014-2015 RETROSPECTIVE



↑
April 23, 2014

**BC announces financial support
for cellulose filaments research**

August 2014



August 2014

↑
August 2014

**Minister Rickford launches
the Tall Wood Building Guide
during WCTE 2014**

←
March 2015

**Minister Rempel meets
with Trevor Stuthridge
at FPInnovations' laboratory**

February 5, 2015



February 5, 2015

→
February 5, 2015

-
Pierre Lapointe was presented the John S. Bates Memorial Gold Medal by the Pulp and Paper Technical Association of Canada (PAPTAC)

December 2014



December 2014

←
December 2014

-
Peter Lister signs agreement with First Nations' West Chilcote Forest Products

November 2014



November 2014

→
November 2014

-
Pierre Lapointe is part of a trade mission in China

November 21, 2014

-
Kruger and FPInnovations win ADRIQ Innovation award

↓

November 21, 2014



November 21, 2014

2014-2015 RETROSPECTIVE

June 2014

June 2014



June 2014

-
**Richard Berry wins TAPPI's
International Nanotechnology
Division's Technical Award**



August 2014

August 2014

August 2014

→
August 2014

-
Fashion week in Montréal

2014-2015

-
Pulp and paper course

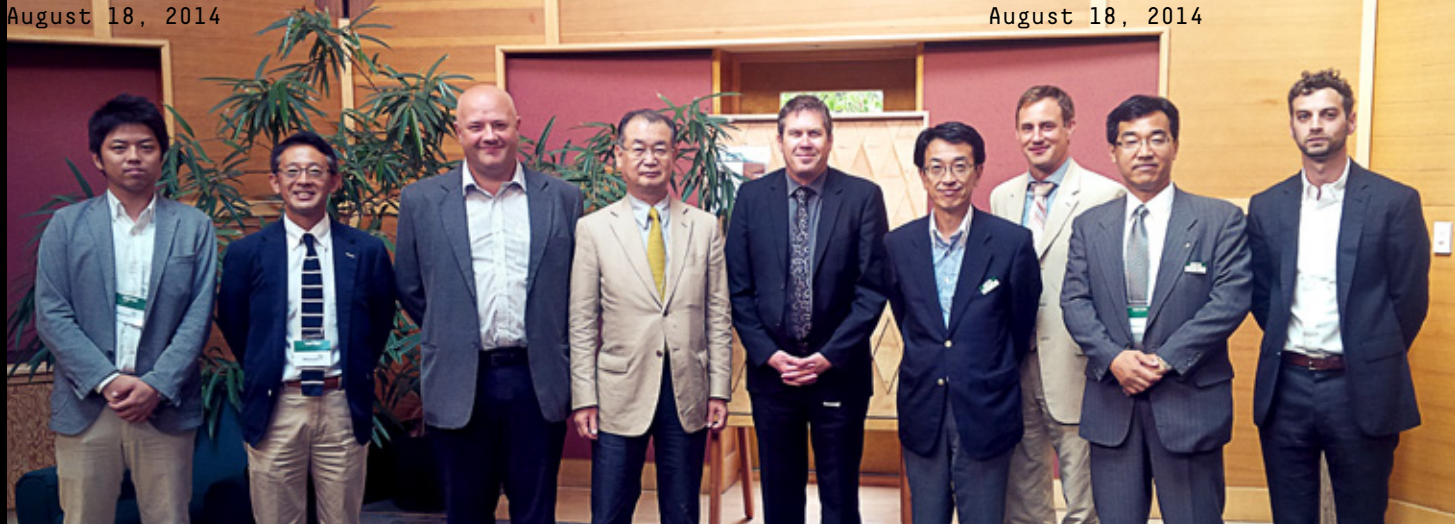


2014-2015

2014-2015

August 18, 2014

August 18, 2014



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August 18, 2014

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**Japanese delegation visits
Vancouver laboratory to hear
about CLT building systems**

→

August 10 to 14, 2014

-

**Québec City hosts
international WCTE**



July 2014

-

**FPInnovations performs drone
trials in Hinton, Alberta**

↓



Photo from Hinton Parklander

June 17, 2014

-

**Inauguration of the
world's first CF
demonstration plant**

↓



June 17, 2014



**2014-2015
RETROSPECTIVE**

**A WORLD
WHERE
PRODUCTS
FROM
SUSTAINABLE
FORESTS
CONTRIBUTE
TO EVERY
ASPECT OF
DAILY LIFE**



NUMBER 1