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Investments in Forest Industry Transformation (IFIT)

Performance Report



2010–2014

Canada

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Minister's message

In 2010, the Government of Canada invested $100 million to transform Canada's forest sector. The Investments in Forest Industry Transformation (IFIT) program has played a pivotal role as a catalyst for transformation in the Canadian forest industry.

With almost 350 million hectares of forests, Canada is, by all accounts, a forest nation. And this industry is critical to our nation's growth and prosperity. In 2013, the sector contributed $20.9 billion to Canada's nominal GDP and $19.2 billion to our balance of trade, and it provided 200,000 jobs in over 200 communities across the country.

Since 2007, our government has invested an unprecedented $1.8 billion to help transform the forest industry. These investments have accelerated innovation deployment, including reducing the environmental footprint of the industry, and are ensuring that the sector will continue to provide prosperity and jobs across Canada, including in rural communities. The IFIT program is an important part of the Government of Canada's commitment to helping Canada's forest industry diversify markets and bring innovative, high-value products to the marketplace.

The results are impressive: innovative, first-in-kind technologies were commercialized, and private investors embraced the technical and economic feasibility of new forest products and technologies. In short, the forest sector's international competitiveness is improving.

Projects funded under our government are helping to create a more prosperous, environmentally responsible forest sector in Canada. For example, with support from the IFIT program, Kruger Biomaterials Inc. built a demonstration plant in Trois-Rivières, Quebec, that is producing cellulose filaments (CF), a revolutionary, chemical-free, renewable and recyclable material that dramatically improves the quality of pulp, paper, bioplastics, adhesives, paints and coatings.

In New Brunswick, Irving Pulp & Paper Limited is constructing a state-of-the-art mechanized facility at its Sussex Tree Nursery that will produce up to four million high-quality seedlings per year through a process known as somatic embryogenesis — a technology developed by Natural Resources Canada.

Following the success of the initial investment, Economic Action Plan 2014 committed an additional $90.4 million over four years to extend the IFIT program. Through this renewal, our government is accelerating the transformation of Canada's forest sector and will continue to work in partnership with industry, provinces and stakeholders to ensure that our forest sector and rural communities stand at the forefront of new economic opportunities.

I am pleased to share the program's first performance report, which focuses on the first five fully completed IFIT projects. I am certain that you will recognize that IFIT is helping Canadian forest companies commercialize innovative technologies, reduce environmental impacts and create high-value products from our world-class forest resources.

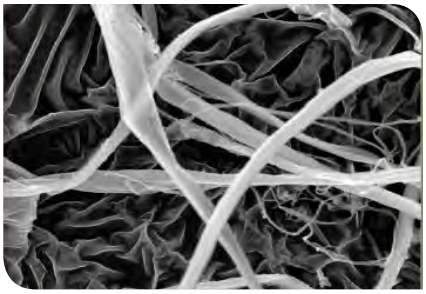
Greg Rickford

Minister of Natural Resources Canada and Minister for the
Federal Economic Development Initiative for Northern Ontario

Investments in Forest Industry Transformation

Objective of the IFIT program

Support forest industry transformation by investing in innovative technologies that lead to a more diversified, higher-value product mix including bioenergy, bio-materials, biochemicals and next generation building products to ensure a more commercially and environmentally sustainable forest industry.



Contents

Executive summary

The **purpose** of this report is to provide a summary of the Investments in Forest Industry Transformation (IFIT) program (launched in 2010 with a budget of $100 million) and the projects it funded between 2010 and 2014. Because the program was renewed until 2018 under Canada's Economic Action Plan 2014, the intent is to provide a periodic update to profile new technology, innovation and transformation as projects are completed. Over the years, we will inform the reader on a) how and why projects were selected; b) what they have achieved; and c) why they are innovative and transformative for the Canadian forest sector. Moving forward, this report and periodic follow-ups will be published on our departmental website so that interested stakeholders can follow the progress of projects and see the outcomes realized by forest product companies across Canada.

Expected outcomes

A more commercially and environmentally sustainable forest sector.

Commercial availability of new forest bio-products and processes.

Increased capacity of the forest sector to develop and supply novel bio-products.

Collaboration between forest sector companies and non-traditional sectors on initiatives related to bio-products.

Eligibility for IFIT

Eligible recipients are companies that produce forest products and have existing forest product manufacturing facilities in Canada. Eligible projects are those in which the company provides at least 50 percent of total project costs; demonstrates innovative technologies from the pilot to commercial scale in the Canadian forest sector; and implements new technologies that produce or lead to the production of new bio-products that use wood fibre.

Anticipated benefits

In the first four years of the program (2010–2014), IFIT had many accomplishments. The first two calls for proposals received 107 unique applications, valued at more than $2 billion. Of these, 14 projects were funded across five provinces.

107 applications; **14** projects; **5** provinces

IFIT projects are expected to generate four types of benefits for Canadians.

- **Environmental**
  Reduce greenhouse gas (GHG) emissions by 60 kilotonnes (kt) per year and increase Canada's green electricity capacity by 7.2 megawatts (MW).
- **Social**
  Create 75 new jobs and secure another 2,500 jobs in forest resource-dependent communities.
- **Financial**
  Generate more than $66 million per year in new revenues for companies.
- **Technology leadership**
  Commercialize eight world-first technologies and develop new or diversified products in 75% of the projects.

How IFIT fits in

Natural Resources Canada's Canadian Forest Service (CFS) provides science and policy expertise on national forest sector issues. To achieve this mandate, the sector is pursuing three strategic priorities to deliver on its vision:

supporting forest sector competitiveness

optimizing forest value

advancing environmental leadership

To support these priorities, CFS has several business lines and activities that it undertakes across the country. These activities support the forest sector in Canada while it is undergoing significant changes.

Canada has long been the world's top exporter of primary forest products. However, the forest industry has been negatively impacted by the global economic recession, while simultaneously facing numerous additional challenges that are unique to this sector. These include:

Decreased demand for newsprint.

Increased **low-cost competition** from South America and Asia.

Diminished access to credit.

Effects of the **mountain pine beetle epidemic** in Western Canada.

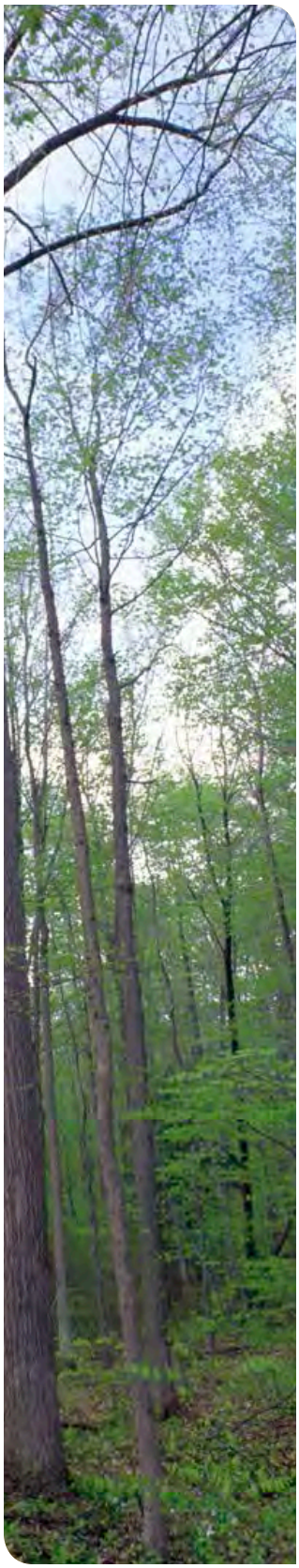
Collectively, these factors have greatly reduced the ability of the sector to invest in new, innovative technologies. Consequently, the sector continues to rely on traditional forest products, which makes the sector increasingly vulnerable to fluctuations in the business cycle and the market.

Moving forward, both governments and industry acknowledge that a significant shift from business as usual is essential to sustain many of Canada's major forest sector players. This shift toward innovation and commodity production at existing and new forest industry facilities will be key to long-term competitiveness.

New transformative technologies that are emerging from several sources, such as FPInnovations, academia and foreign technology providers, have the potential to create significant economic opportunities for Canada's forest industry and forest communities. To achieve this vision, strategic investments are required to support **"next generation" technologies** and first-in-Canada applications of existing technologies.

To that end, IFIT is supporting forest sector competitiveness by working with forest companies to "de-risk" and deploy new high-value products and optimize the use of underutilized wood fibre. IFIT is also improving the environmental performance of forest companies in Canada by increasing renewable energy production, increasing energy efficiency and reducing GHG emissions. This will lead to a more diversified, higher-value product mix that includes bioenergy, bio-materials, biochemicals and next generation building products.

Investments by the IFIT program support the strategic priorities of the CFS and ultimately the forest industry in Canada.



IFIT – The initial four years

IFIT was announced in Budget 2010 with a $100 million commitment ending March 31, 2014.

Over the initial four years, the IFIT program aimed to "de-risk" new technologies to encourage their broader adoption across the industry. The program also helped bridge the "valley of death" at the pilot, demonstration and first-of-kind commercial scale (see the Valley of death section). To date, the **14 world-first and Canadian-first technologies** supported by the program represent nearly $300 million in investments by the Government of Canada and industry.

Although IFIT's funding played a large role in de-risking and catalyzing projects, companies are still leveraging the program's funds by investing more than $2.60 for every $1.00 invested by IFIT.

These projects support a range of subsectors (pulp and paper, engineered wood products, bio-composites and lumber); establishment sizes (from large integrated companies to small and medium-sized enterprises); and locations (British Columbia, Alberta, Saskatchewan, Quebec and New Brunswick).

The program's first two calls for proposals were oversubscribed. IFIT received applications for projects totaling $2 billion in total project costs, $500 million of which was requested in IFIT funding. This response demonstrated that IFIT is meeting a key industry need – offering risk capital for projects that would not otherwise take place.

Once completed, IFIT projects will inject new products and revenues into the Canadian economy; generate new green energy; reduce GHG emissions; and help secure the future of the communities in which they take place.

IFIT was renewed in Canada's Economic Action Plan 2014 with an additional $90.4 million over four years. The renewal was based on the success of the early investments and the continuing need to support business transformation in the forest sector. This continued commitment will help bring the next wave of innovation to the market and will solidify Canada's position as a leader in forest industry transformation.

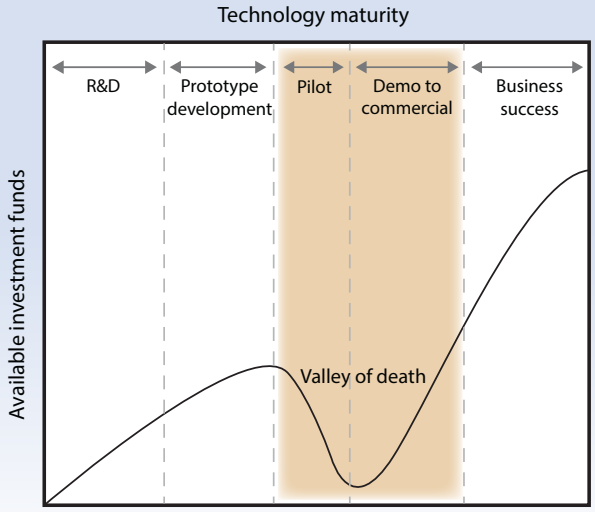
The IFIT program is continuing to work with the forest industry through its third call for proposals which closed in October 2014. IFIT will highlight the new projects and new innovations that will be funded over the next four years in future performance reports.




Valley of death – How does it happen?

The high-costs and associated risk necessary to shift a technology from the prototype to commercial stage is a major barrier for companies. This barrier is even more pronounced in the forest industry where companies operate with tight margins and therefore need to demonstrate a low-risk profile. Even when potential return on investment is high, costly investments in risky, first-in-kind technologies are difficult to justify.

This reluctance, coupled with the high cost of many of the technologies in question, produce a "valley of death," a point along the innovation continuum where promising technologies fail before commercialization because funding is no longer available. The valley of death is a significant barrier to the commercialization of innovative technologies in the Canadian forest sector. Unless addressed, it has the potential to inhibit the realization of benefits from past investments in research and development (R&D); stall industry transformation; and create an opportunity for international competitors to acquire these unproven technologies and commercialize them overseas.



Visions to actions

During the initial four years, and with its continuation under Budget 2014, the IFIT program responds to four key objectives.

Demonstrate and deploy first-in-kind technologies in the Canadian forest sector.

Prove technical and economic feasibility to private investors.

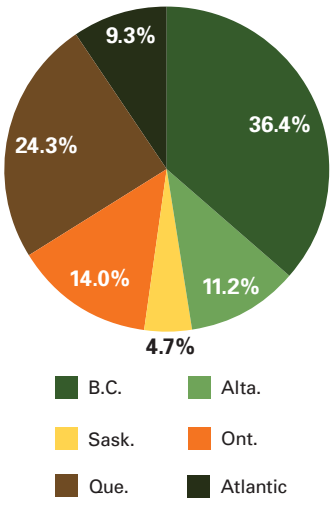
Catalyze broader replication.

Improve sector competitiveness.

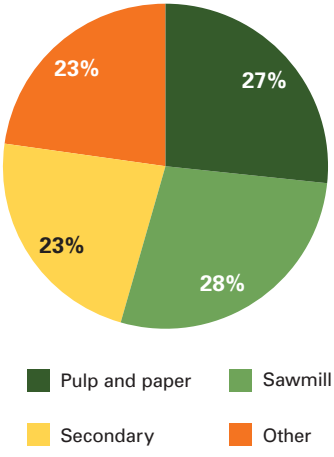
Over the initial IFIT mandate from 2010–2014, the program held two successful calls for proposals. The program received 107 unique proposals from across Canada. Over a quarter of the applicants were highly ranked and moved to a "short list" (projects that met all mandatory criteria and were highly ranked on rated criteria). Of the shortlisted applicants, half were funded following the due diligence process outlined in the IFIT evaluation process section. From application to funding, 13 percent of applicants from across the country, subsectors and project types received funding.

Total Applications

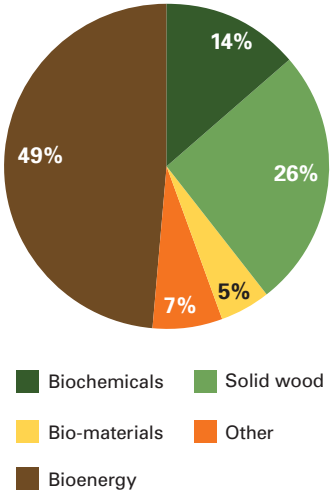
Across regions



Across subsectors



Across project types



The program was able to implement its key objectives by funding projects that:

- Deployed innovative technologies in the forest sector often with a high proportion of Canadian technology content.
- Were at the pilot to commercial scales, advancing the technology further toward full commercialization than had been previously applied in Canada.
- Deployed technologies that produced or would lead to the production of new non-traditional bio-products and bioenergy, including novel applications of technologies not traditionally found within the sector.
- Involved value-chain optimization by matching the wood fibre attributes to the needs of the end products.
- Increased environmental performance while diversifying markets with new, higher value products.
- Leveraged non-government financing and proposed non-traditional partnerships.

These results are summarized in the company profiles found later in this report and will be featured in future reports for projects yet to be completed.

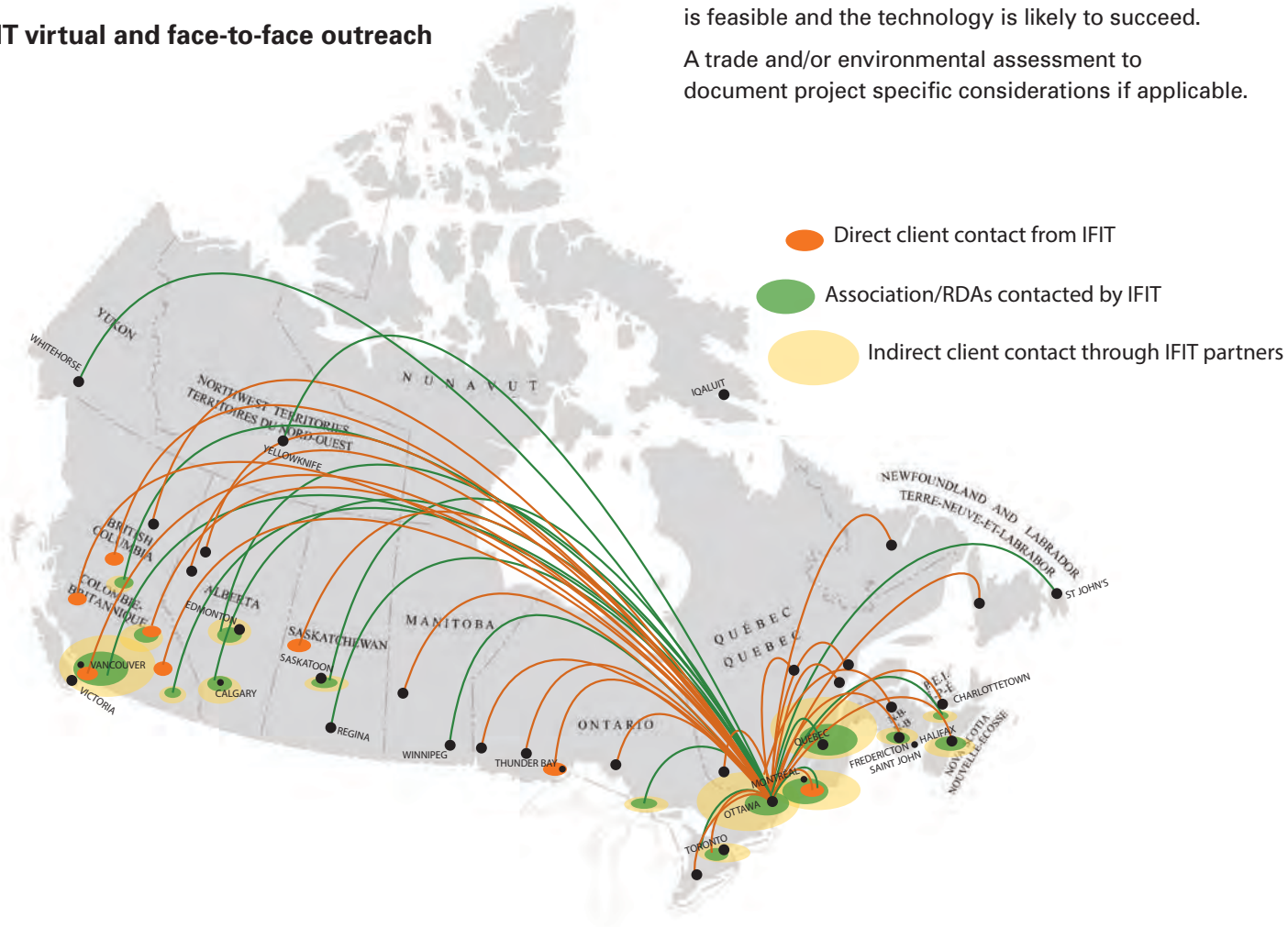
IFIT evaluation process

The IFIT program funds innovative capital projects by using a competitive call for proposals process. During the call for proposals, IFIT used many avenues, from webinars and direct emails to messaging through forest associations and regional development agencies, to promote and discuss the open application process and encourage submissions. These efforts were about 90 percent virtual and 10 percent face-to-face. After the call for proposals closes, the evaluation process begins. The applications are assessed against mandatory and rated criteria by a multidisciplinary panel of forest industry experts from the public and private sectors. The panel uses a consensus-based approach to generate a short list of highly ranked projects that are then considered for further due diligence.

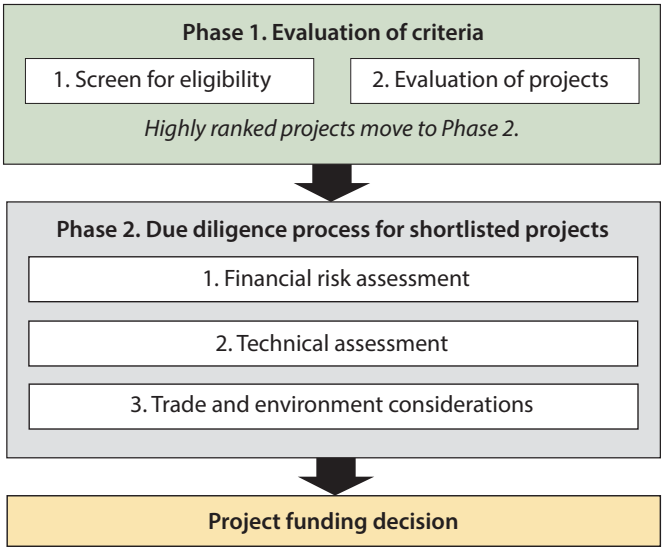
The due diligence process for each project consists of:

- A financial assessment to establish detailed project costs, sources of funding and contingency planning.
- A company financial risk profile to determine the financial soundness of the company and their capacity to successfully execute the project.
- A technical risk assessment to ensure that the project is feasible and the technology is likely to succeed.
- A trade and/or environmental assessment to document project specific considerations if applicable.

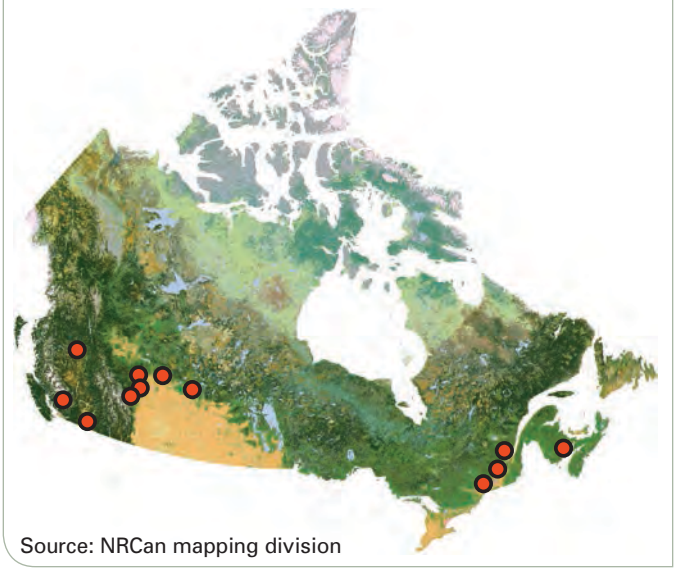
IFIT virtual and face-to-face outreach



The evaluation and due diligence processes were designed to ensure transparency for applicants and accountability on the projects selected for funding. It also fostered an opportunity for a positive dialogue between applicants and the department in order to clarify expectations of the work being undertaken, timelines for completion and results expected.



Locations of the 12 announced IFIT projects



Source: NRCan mapping division

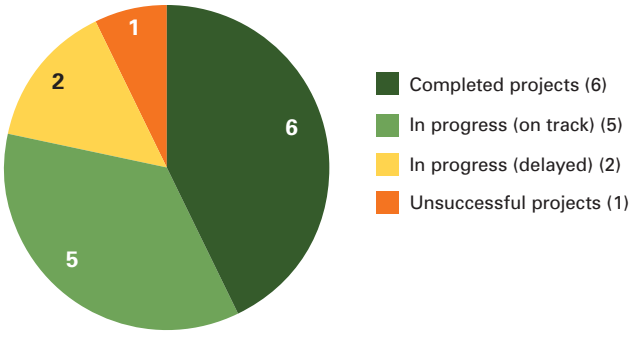
The innovative projects supported by the IFIT program have demonstrated a strong track record of progress and successful completion. To date, nearly half the projects have been successfully completed and another third are on track for completion. Only a small portion of IFIT projects have been delayed or have not come to fruition. Considering the significant levels of technical, financial and market risk that first-in-kind projects often face, this success rate strongly supports the due diligence process IFIT applications undergo. IFIT's dedicated team navigates projects through a rigorous process from evaluation to reporting. IFIT's flexible funding mechanisms have also catalyzed and contributed to the success of many projects.

Project data

The performance information provided in this report is based on rolled-up data provided at various reporting stages by companies of the 14 IFIT projects. The due diligence process necessarily employs long-term anticipatory figures for the projects that were developed using well vetted documentation and company reports. The IFIT program will periodically report on the performance of the program as supported projects continue to be commercialized and project data is received. Each performance report will provide the latest figures on IFIT's impact as well as new company profiles and lessons learned. Also, as mentioned previously, the data and profiles of projects in this report are those from the initial mandate of 2010–2014. Because the program's third call for proposals is under way, future results and projects will be profiled in upcoming reports.

Strong project performance

Project outcomes (as of December 2014)



Lessons learned

Innovation always costs more

Even with strong cost projections and contingency funds in place, many companies saw their costs increase rapidly through both due diligence processes and project execution. Depending on the region, many projects saw costs exceed planned contingencies and required alternative financial arrangements and project adjustments. Innovation invariably costs more as unforeseen aspects of the project emerge.

Potential mitigation strategies

Include performance guarantees or other security mechanisms in supplier contracts.

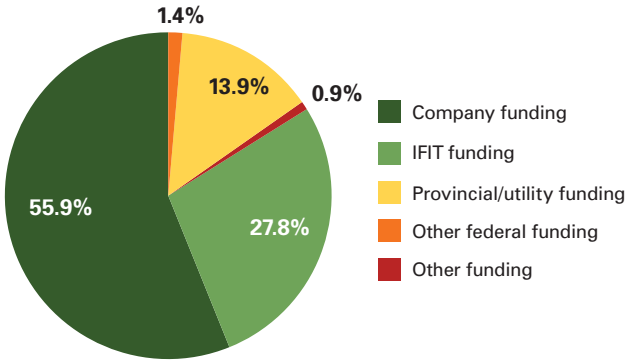
Increase the levels of contingency beyond the industry standards.

Know the local labour market and the potential impact on labour access and costs.

Be prepared to bear the full cost of any overruns because funding partners rarely have extra capacity.

IFIT funding has played a critical role in catalyzing projects. By investing early and establishing project validity, companies have been able to attract additional funding. IFIT provided an average of 28 percent of project costs, thereby leveraging IFIT's investment at a 2.6 to 1 rate. Although eligible to receive up to 50 percent of the project costs from IFIT, the companies contributed the majority of project funding. This is a strong indication that they are fully committed to the technology and just needed support in order to surpass certain financial hurdles or secure additional funding.

Funding by source, as a percentage of total projects costs



Lessons learned

Know your market

One reason many companies withdrew from the IFIT short list during the due diligence process or struggled through other implementation phases was the difficulties associated with accessing new markets. While a great deal of time and engineering goes into the technical implementation side of a project, often not enough effort or investment is dedicated to developing market intelligence. The lead time on market development, regulatory approval and product cycle requirements for new products and markets needs to be considered thoroughly, well in advance. Otherwise, projects run the risk of being caught in a position where developing market access takes longer than commercializing the new technology or product, which leads to lost profits or projects being stranded.

Potential mitigation strategies

Hire industry specialists when you pursue unfamiliar markets.

Avoid focussing all efforts on a single new product's offtake pathway. Pursue many avenues and industries concurrently to create options and mitigate risk.

Offset costs by selecting projects that also accrue internal benefits.

Anticipated program performance and benefits

The IFIT program builds the potential for new pathways into the emerging bio-economy through its emphasis on supporting the deployment of capital-intensive, first-in-kind technologies. This contributes to transforming the Canadian forest sector and generating benefits for forest companies across Canada and the communities they support. This section will detail the anticipated economic, social and environmental benefits that will accrue as IFIT projects come to fruition.

Economic results

Projects supported by IFIT focus on improving economic sustainability through diversifying product portfolios, increasing revenue streams and reducing internal cost. It is anticipated that the IFIT-funded projects will increase revenues by $66 million per year once at full capacity. The revenues will come from generating renewable electricity, more efficient fibre usage, and the sale of new products. Also, cost reductions will come from saving energy, using less fossil fuel, using fewer chemicals and decreasing waste treatment requirements. IFIT projects demonstrate significant return on investment (ROI), averaging about a 25 percent ROI for most projects.

In particular, projects focused on biochemicals and bio-materials have demonstrated strong financial performance for reasonable project investment. Bioenergy projects provide stable investments and returns, justifying the higher initial project costs. While solid wood products projects produce fewer significant overall financial benefits, they can be implemented quickly and have shorter payback periods. These features provide better short-term gains while still maintaining the potential for growth and positive financial returns while the market acceptance of the new and/or improved products continues to grow.

	Avg. project cost (millions $)	**Avg. payback period** (years)	**Avg. project ROI** (percentage)	**Avg. new revenues** (millions $/year)
Biochemicals	21.4	5.3	14.2	6.0
Bioenergy	36.9	5.3	21.4	5.2
Bio-materials	9.0	5.1	22.5	11.5
Solid wood	5.9	2.9	35.9	2.9
All signed projects	**18.3**	**4.5**	**25.3**	**4.7**

"There are also a number of community benefits, as it is estimated an additional $6 million will be pumped into the local economy and generate 40,000 man hours of employment in construction, which will be a benefit in the short term. In the long term, it will strengthen the economic viability of the Whitecourt mill."

Janet Millar, Communications coordinator
Millar Western Forest Products Ltd.

Socio-economic results

Throughout Canadian history, the forest products industry has been one of the most significant contributors to employment. Job numbers are anticipated to grow as the sector expands and innovates and as the industry hires new employees to meet new demands. IFIT investments in the forest industry have benefited Canadian communities by directly fostering job security, and injecting money back into the local community. To date, IFIT projects are anticipated to lead to the creation of 75 new permanent jobs, secure nearly 2,500 existing positions and provide more than 600,000 hours of temporary employment during the construction and implementation phases. As well, employees in many facilities are receiving hundreds of hours of training and skill enhancement to operate new equipment and learn new processes.

Local economies are also aided greatly through IFIT-funded projects because major investments like these make a noticeable difference for the local businesses. Estimates anticipate that more than $75 million will have been injected in the local economies of IFIT recipients once projects have been implemented.

	Avg. new jobs created per project	**Avg. jobs secured per project**	**Avg. local investment** (millions $)	**Avg. employment during construction** (hours)
Biochemicals/ Biomaterials	4.0	214.2	9.8	70,000
Bioenergy	3.0	125.0	6.2	30,000
Solid wood	8.4	159.2	2.0	40,000
Estimated total for all signed projects	**75.0**	**2,456.0**	**78.0**	**640,000**

"This employment effect provides a skilled labour pipeline for the graduates of the University of Northern B.C., the College of New Caledonia and northern youth who venture out to other centres but have the chance to migrate back and work in positions within these technology-heavy forestry firms."

Frank Peebles, "Partnerships coming from forestry innovation,"
The Prince George Citizen, October 25, 2014

Environmental results

The Canadian forest sector has been very proactive in reducing its environmental footprint. As home to about 9 percent of the world's forests and more than 161 million hectares of certified forests, Canada's forest sector has emerged as a global environmental leader. With this in mind, Natural Resources Canada (NRCan) continues to support environmental progress in reducing waste streams, limiting air and water pollutants, and seeking renewable energy alternatives.

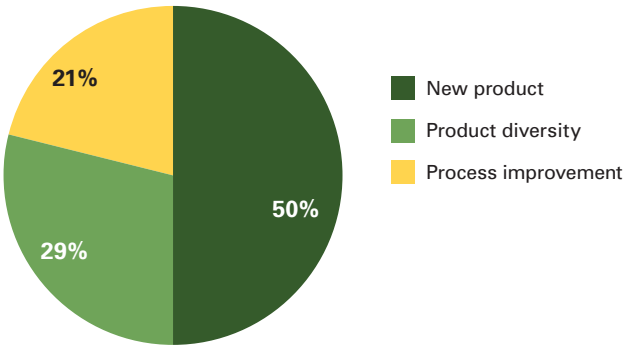
Although it is primarily an innovation program, IFIT also seeks to invest in projects that offer environmental benefits. It is anticipated that once fully commercialized, IFIT projects will add 7.2 MW of renewable electrical capacity, reduce GHG emissions by 60 kt each year, result in substantial water savings and waste reductions, and improve effluent treatment efficiency.

New products, new markets

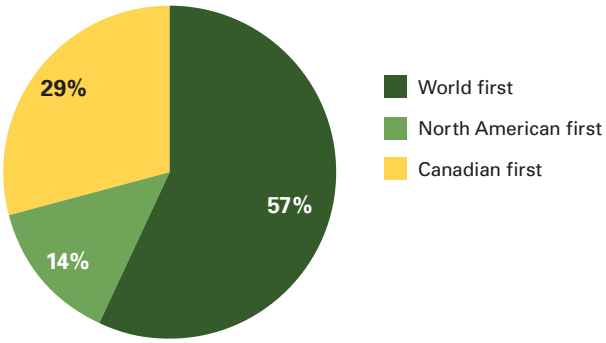
Traditional lumber products and pulp and paper will continue to play a role in the forest products industry in Canada. However, the opportunity for new uses of wood fibre from Canada's renewable forests has no boundaries. The forest products industry has a long history of partnering with academia and institutes such as FPInnovations to adopt new innovative technologies and processes to maximize the value from Canada's forests. Industry and governments have realized that bringing new innovation in knowledge, products, processes and policy is necessary for the industry's future success.

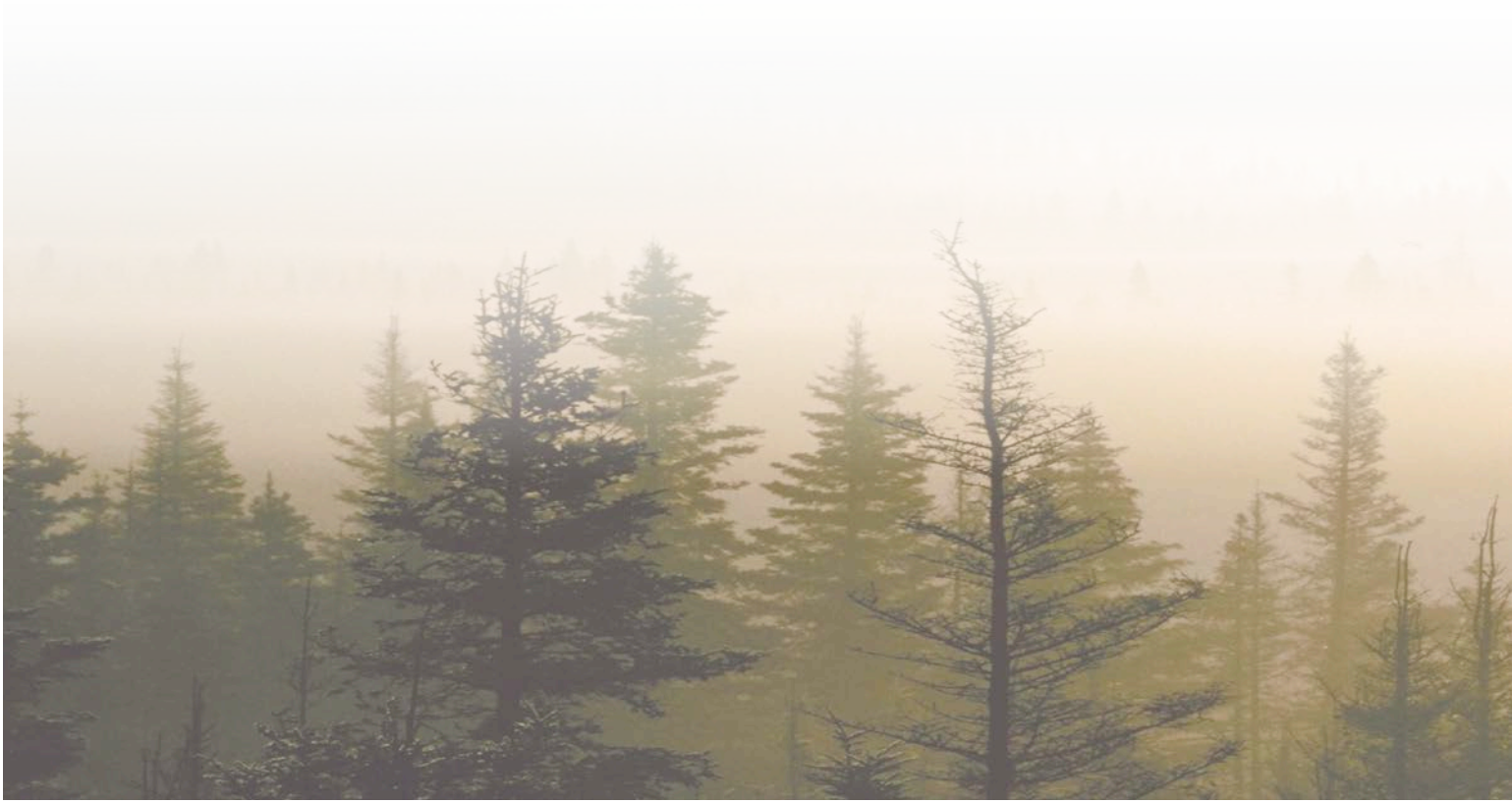
Conceiving new products and entering new markets does not happen overnight, but rather takes a vast amount of research, adaptation and testing of equipment, and investment of resources. IFIT has helped fuel the commercialization of numerous new products (50 percent of projects are generating new forest products) and provided support to diversify and improve processes so they operate at maximum efficiency and produce optimal results. With 57 percent of the projects representing world-firsts in the forest sector, Canada is positioning itself as a leader in several emerging markets and technology areas.

Types of innovation



Levels of innovation





The success of the program is driven by the creative vision and firm dedication of IFIT funding recipients to seek out innovative new products and markets, diversify their companies' portfolios, and bring new opportunities to the Canadian forest sector. These forest sector leaders have demonstrated that, despite potential hurdles and roadblocks, significant progress can be made to the benefit of the company, sector and all Canadians. The remainder of this report details the first wave of innovative technologies that have been successfully implemented as a result of the IFIT program.

Opening the door to innovation

- $100 million investment that leveraged another
  - $260 million in forest sector innovation
- $66 million/year in new revenues for companies
- 75 new jobs
- 2,500 secured jobs
- 60 kt/year reduction in GHG emissions
- 7.2 MW of new electrical capacity

"IFIT is a smart program that is successfully paving the way to a next generation forest products industry. Canada is part of a global race to find innovative new uses for wood fibre, and IFIT is a critical support that is helping Canadian companies vie for leadership in the emerging bio-economy."

David Lindsay, President and CEO
Forest Products Association of Canada

Nechako Lumber Co. Ltd.
Green energy project

At Nechako Lumber Co. Ltd. in Vanderhoof, British Columbia, a newly installed **organic Rankine cycle** (ORC) system is providing environmentally friendly energy for the mill's operations. The ORC system generates all of the electricity needed for the pellet plant and provides additional heat for sawdust drying. In fact, it is expected to produce 2.2 MW of electricity – enough power to supply about 1,300 homes.

Funding of $2.1 million from the IFIT program, coupled with nearly $5 million of investments from Nechako and BC Hydro, enabled the plant to purchase the ORC equipment from Turboden s.r. (a commercial supplier) and become the first user of this technology in the Canadian forest sector.

Innovation at its finest

The Nechako Green Energy (NGE) project was selected for IFIT funding because of the success ORC systems have consistently demonstrated in other sectors and regions. This technology was successfully used in Europe but had yet to be attempted in Canada's forest sector.

Why go organic?

These systems offer significant savings for wood manufacturing operations. There are no costs for fuel, transportation or fuel handling because this is all managed as part of the plant's day-to-day operations.

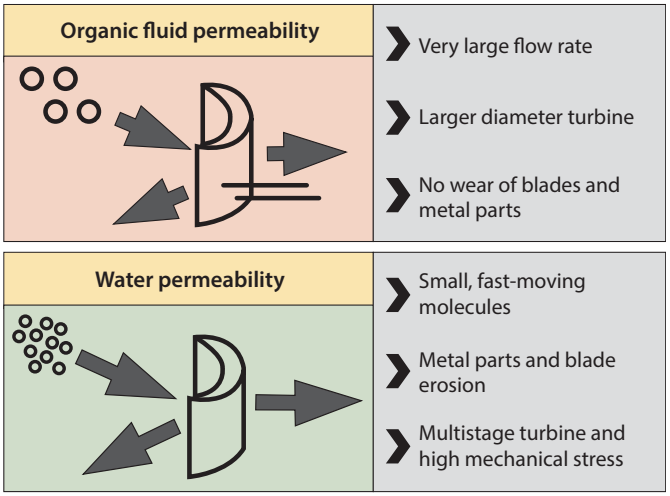
ORC technology has great potential to be replicated throughout the forest products sector because of the ideal fit between the need for small-scale heat and power at the mill and the ready access to wood residues.

The NGE project building, built on the mill site, is the first biomass heat recovery plant in the Canadian forest industry. Heat waste from the company's mill operations is turned into electric power. This innovative technology creates opportunities to dramatically reduce the carbon footprint and operating costs of sawmills and offers the potential to provide surplus power to new projects in support of economic development in northern communities.

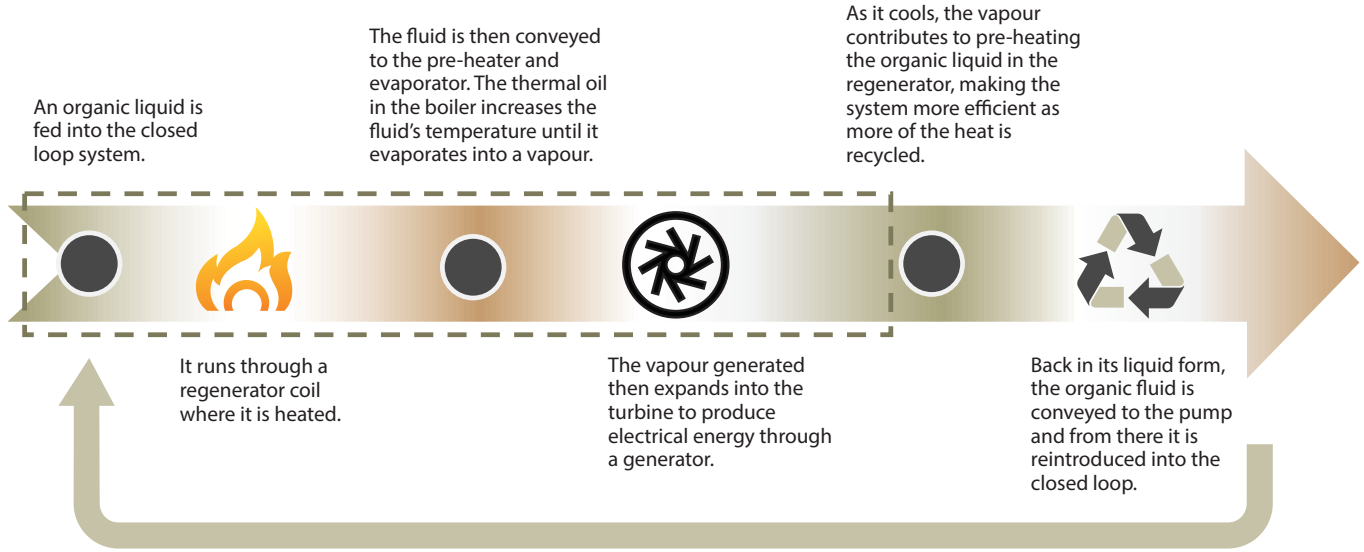
The new system is part of an effort to improve the mill's energy efficiency and its ability to generate renewable electricity. Using a highly experienced internal capital project team, the NGE project was on time and on budget. Potential future applications are being considered and include using the remaining heat for drying sawdust for wood pellet production.

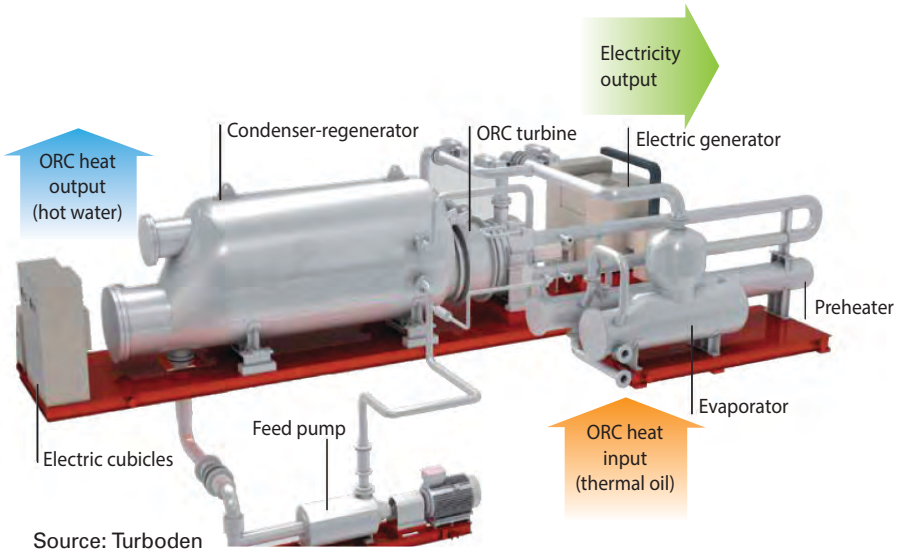
Why not water?

The ORC's principle is based on a turbogenerator working as a normal steam turbine to transform heat into mechanical energy and then into electrical energy by using an electric generator. Instead of making water steam, the ORC system vaporizes an organic fluid. This fluid has a molecular mass higher than water, which leads to a slower rotation of the turbine and lower pressure and erosion of the metallic parts and blades.



Organic Rankine cycle systems





Source: Turboden

How it works

An ORC system is a technology for small-scale energy production. Simply stated, the system takes excess heat from the bioenergy system, which combusts byproducts such as sawdust and bark to generate power.

ORC system technology uses an organic fluid that vaporizes at a lower temperature than the change from water to steam. The vapour then passes through a turbine to generate electricity. The cycle is complete when the fluid is cooled, condensed and brought back to the beginning of the loop.

Advantages of an ORC system in biomass applications

- High cycle efficiency
- Very high turbine efficiency (up to 90 percent)
- Low mechanical stress of the turbine, due to low peripheral speed
- Low RPM of the turbine allowing the direct drive of the electric generator without reduction gear
- No erosion of the turbine blades due to the absence of the moisture in the vapour nozzles
- Very long operational life of the machine due to the characteristics of the working fluid (non-eroding and non-corroding for valve seats tubing and turbine blades)
- No water treatment system required

Recognition and awards

Firsts

One of the first companies in British Columbia to submit a safety management plan under the 2011 *Alternative Safety Approaches* regulation.

The first company to have its safety management plan accepted by the BC Safety Authority.

Awards

2012 – Project of the Year for Outstanding Energy Efficiency Project (Clean Energy BC)

2012 – Forest Innovator Award (Northern B.C. Business & Technology)

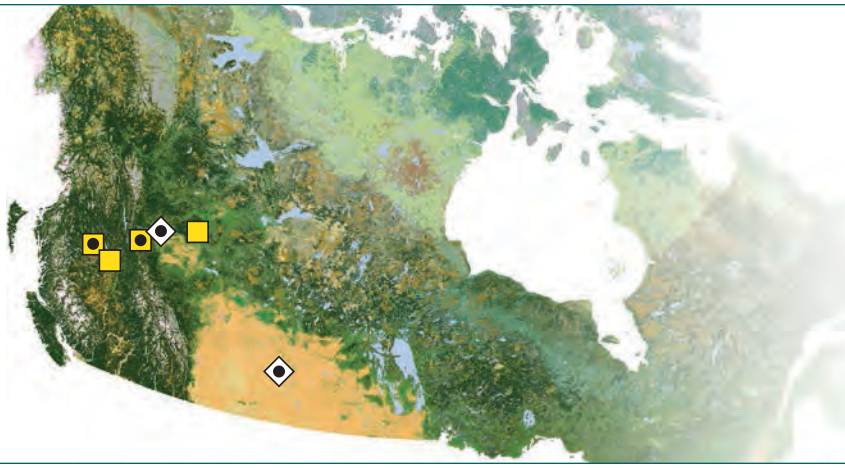
2013 – Lieutenant Governor Safety Award for Excellence in Boiler, Pressure Vessel & Refrigeration Safety (BC Safety Authority)

2014 – Power Smart Excellence Award (BC Hydro)

Replicability

Another forest industry company is installing four Turboden systems in British Columbia as a direct result of the NGE project. In addition, Nechako receives inquiries about the project from other companies across Canada on a regular basis.

Other Turboden Projects in Canada



Chetwynd, B.C.	**13 MW**
Fort St. John, B.C.	**2 MW**
Fraser Lake, B.C.	**13 MW**
Manning, Alta.	**3 MW**
Rosetown, Sask.	**0.95 MW**
Vanderhoof, B.C.	**2.2 MW**

Biomass applications

Other applications

Installed

"ORC technology is an efficient, clean and reliable way of producing electricity. This project opens a whole new realm of possibilities for the Canadian forest industry."

Jean-François Levasseur, IFIT Program Lead, NRCan

Alberta-Pacific Forest Industries Inc.
Methanol purification project

In Boyle, Alberta, Alberta-Pacific Forest Industries Inc. (Al-Pac) operates the largest single line bleached kraft pulp mill in North America. In addition to its traditional business lines, Al-Pac has been looking for opportunities to transition toward being a modern bio-refinery.

The $4.9 million of funding from the IFIT program, along with over $5 million from Al-Pac, has been used for the methanol purification project, which will enable the mill to produce sellable methanol from a waste stream of the kraft pulping process called stripper off gas (SOG). SOG is a mainly methanol and steam mixture that contains impurities such as ammonia. The objective of this project was to produce commercial-grade methanol from the SOG stream for use in the on-site production of chlorine dioxide for bleaching.

Innovation at its finest

Funding was provided to Al-Pac to install a world-first application of a Canadian technology that enables them to produce both pulp and a value-added biochemical without any additional wood fibre. Al-Pac will now be able to use its own methanol in the bleach plant (eliminating the need to purchase methanol) and make the excess available for sale externally. Ultimately, the methanol extracted will generate a consistent revenue stream for a product that has not traditionally been associated with the pulp market.

Why purify?

Conventional kraft pulp mill processes such as the one used at the Al-Pac facility generate a waste gas stream from the digester that contains as much as 70 percent methanol. However, this gas stream also contains turpentine and other components that prevent methanol from being separated for higher value use. Traditionally, this gas stream is burned in the lime kiln.

How it works

A new process for extracting and purifying bio-methanol has been developed by Canadian engineering firm A.H. Lundberg Systems Limited that produces grade AA bio-methanol. This process collects the methanol produced by the digester, distills it and removes impurities. The mill will be able to use it in its pulp bleaching operations. The liquid bio-methanol is easily stored and transported, allowing excess quantities to be sold for use in other industrial processes and products.

Presently, methanol is used for the on-site production of chlorine dioxide, used in the company's pulp bleaching operations. With this new technology, Al-Pac aims to produce 99.85 percent methanol, the highest purity ever achieved by a kraft mill. The new bio-methanol will meet the mill's internal needs, with the surplus available for sale externally to create green industrial products such as solvents, antifreeze or fuel.

Benefits

The growing demand for environmentally preferable products makes bio-methanol an attractive alternative to conventional methanol.

Two side benefits of the project are:

Reducing equipment maintenance costs (i.e. lime kiln ring formation).

Steam savings – The steam that is used in the stripper can now be used elsewhere in the mill, saving Al-Pac about $288,000 annually.

Reverse osmosis installation

During the project implementation, Al-Pac added a reverse osmosis (RO) unit. RO is a purification technology that uses a semi-permeable membrane to separate hard-to-isolate impurities from target chemicals. An applied pressure is used to overcome the osmotic pressure, thus isolating many types of molecules and ions from the solution to yield a purer methanol.

Benefits of the methanol purification project

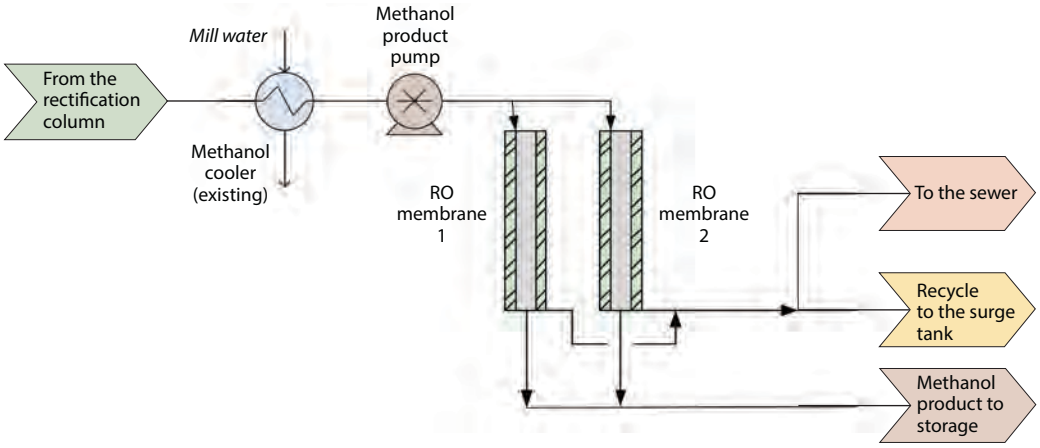
Sharing technology
The bio-methanol extraction and purification technology could be used in many Canadian kraft mills, and the bio-methanol can be a platform chemical for producing new products that could be sold by the Canadian forest products industry.

Revenue stream
Ultimately, the bio-methanol extracted will generate a consistent revenue stream for a product outside traditional pulp markets. One of the side economic benefits to the mill is that it takes the variability of methanol costs out of the equation.

Significant environmental benefits
Producing bio-methanol does not require using any extra wood fibre. As well, methanol sourced from natural gas is generally produced a long distance from domestic manufacturers of derivative products such as antifreeze. Al-Pac's production of bio-methanol will help offset the use of methanol derived from fossil fuel and will eliminate the energy consumption associated with its transport.

The result of this process is that the solute is retained on the pressurized side of the membrane, and the solution is allowed to pass. To be effective, the membranes must be fitted to remove impurities, but still allow the methanol through. Once the methanol has been purified by RO, the components will be recycled, purged or stored, depending on their further usage.

Reverse osmosis process for purifying methanol



Source: Al-Pac

Tolko Industries Ltd.

Strand screening for product diversity

Tolko Industries Ltd. is a private, family-owned forest products company based in Vernon, British Columbia, that manufactures and markets forest products to world markets. Tolko's Meadow Lake oriented strand board (OSB) facility is located in northern Saskatchewan and is considered one of the larger OSB-producing facilities in North America.

The IFIT program's funding of $4.9 million and Tolko's $5 million investment allowed the plant to install technology to screen the wood strands used, remove the unusable wood dust and classify the remaining strands. The new installation will increase the mill's ability to produce different product types for different customer needs.

Innovation at its finest

The Tolko strand screening project was selected for IFIT funding because it enables the plant to produce a wide range of specialty products and commodity products on a single production line, while also maintaining or enhancing product quality and performance. The new production line also improves mill efficiency by using wood dust and unusable fines as a fuel source, reducing resin addition rates, decreasing product density, minimizing the risk of fire, and improving the overall quality of the mill air. This new technology is being implemented for the first time in North America. It will provide stability to the mill by adding greater product diversity that is not dependent on the housing market and by letting the mill respond better to changing customer preferences.

The **project objectives** for Tolko were to:

- Engineer specialty panels specific to customer needs.
- Make a broad range of OSB-type products on one production line. This is an innovative approach compared to a capital-intensive, two-line facility.
- Have the capability to sort and use high grade strands for specialty products and to sort and use medium grade strands for commodity products.

Benefits of strand screening

Recycling wood dust
The unusable wood dust is used for fuel. The classified strands and usable fines are managed in a way that best suits whatever product the facility is producing on any given day.

More products, lower cost
Having control of classified strands and usable fines allows the mill to produce a wider range of specialty products and reduce production costs on commodity products while maintaining or enhancing quality and performance.

New fuel source
Tolko discovered how to burn ash from the energy system as fuel. The ash will now be kept out of the landfill, thus eliminating an environmental concern.

Reduced costs
The new technology improved resin distribution significantly, thus allowing the powder resin system to be decommissioned. Savings of about $1.74 million annually are expected.

Replicability

The project is replicable within the OSB industry. Tolko is considering a similar upgrade at their Slave Lake, Alberta, OSB facility.

Environmental benefits

Because of resin optimization, the facility will use about 1.65 million kilograms less resin each year. This reduction in resin deliveries equates to about 15,000 litres of diesel fuel saved annually, which helps reduce the demand on crude oil.

Tekle Technical Services Inc.
Engineered fibre mat plant

Incorporated in 1998 in Edmonton, Alberta, Tekle Technical Services (TTS) Inc. is a leading bio-composite company that focuses on applied research and development of natural fibre-based products. TTS has acquired an international reputation for technical and innovative excellence in the forest products industry and operates a world-class bio-composite development and testing facility.

The $4.5 million of funding received from the IFIT program matched the $4.5 million invested by TTS and enabled them to develop a proprietary **engineered fibre mat** (EFM) technology. The EFM technology can produce several non-woven products such as Fiber510™ from a wide range of natural fibre materials, including wood fibre residuals (aspen, spruce, pine, fir), municipal wood waste, hemp and flax fibre from waste straw, and synthetic fibres. Engineered fibre mats are currently being used as biodegradable erosion control mats and as interior trim parts and moulded panels for cars.

Innovation at its finest

Funding was given to TTS for their EFM plant because the high percentage of natural fibre in the TTS mats makes them significantly lighter and easier to recycle than mats currently available in the North American market.

TTS' EFM technology also minimizes production costs by making use of wood and agri-fibre residuals that are:

- Lower-cost.
- Have limited or no current market applications.
- Not subject to rapid price fluctuations like petroleum-based materials are.

TTS is the *first company in North America* that is well-positioned to manufacture natural fibre insulation (NFI) from wood fibre. The only environmentally friendly alternatives to conventional fiberglass insulation currently manufactured in North America are made from cotton fibre from recycled denim or from sheep's wool. These are extremely expensive and use scarce feedstocks.

TTS' NFI will cost up to 34 percent less than these competing products. The project aligns well with IFIT's objectives through its targeted investment and demonstration of a new innovative technology for the Canadian forestry sector.

Replicability

The total North American market for EFM products is projected to potentially triple in size over the next few years. The TTS EFM plant can play a pivotal role in demonstrating how underperforming medium-density fibreboard (MDF) operations can diversify into new applications that utilize their fibre-refining capacity.

New and diversified products created	
Market	**Number of new products**
Automotive	• 5 parts, each with 2 to 5 formulations • 10 to 25 new products
Geotextiles	About 10 variations of EFM geotextile mats can be developed and sold.
Oil absorption products	TTS has been approached regarding eight formulations. There are likely many others to come.
Total new products created	28 to 43

No other Canadian company produces fibre mats for automotive composites from wood fibre. The TTS line is extremely flexible, enabling the use of diverse natural and synthetic fibres. Both forest-based and agricultural fibres are environmentally friendly, lighter and cost-effective alternatives to acrylic and confer excellent performance characteristics to the final product.

Why Fiber510™?

Fiber510™ makes use of unutilized organic fibre to produce more than 100 non-woven engineered bio-fibre mat products.

Rapidly renewable natural fibre is an environmentally friendly material with unique properties:

Low density, high tensile strength, reduced noise transmission and recyclability at the end of life.

Entirely made of sustainable bio-fibres that significantly reduce GHG emissions and energy consumption.

Biodegradable, recyclable, compostable.

Composed of more than 80 percent rapidly renewable resources.

Fiber510™ offers a range of bio-fibre mats that can

- Achieve weights of 30 to 50 percent less than fibreglass resin infusion or injection moulded parts.
- Have higher stiffness-to-weight ratios.
- Sell at a competitive price.

Fiber510™ thermoset and thermoplastic mats can be used in 2D or 3D molding applications for composites.

Environmental benefits of producing engineered fibre mats

Reduce pollution
By using rapidly renewable natural fibre residuals that are currently combusted to replace fibreglass and petrochemical-derived plastics, the EFM plant will reduce air pollutants and GHG emissions, including carbon dioxide (CO_2), methane and nitrous oxide. At full capacity, the plant will avoid more than 16,000 t of immediate emissions by transforming the fibre residues into more durable products every year, the equivalent of taking 2,900 cars off the road.

Save energy
EFMs also reduce processing time for composite manufacturers, thus saving more energy.

Benefits to local forest product companies

Do business with local firms
The EFM business will purchase wood fibre residue from local forest products operations (within 200 kilometres). Working relationships have been established with operations such as the Weyerhaeuser Company Limited sawmill, the Brisco Wood Preservers Ltd. transmission pole processing and treatment plant, and the West Fraser MDF operation at Blue Ridge, Alberta.

Transform expense into revenue
By selling fibre residue, the fibre suppliers add value to their current waste streams and transform waste disposal costs into revenue streams. In the forest products industry, profit margins are very thin so this will substantially improve the economic viability and sustainability of these operations.

BC Passive House

Prefabricated panelized passive house system

BC Passive House (BCPH) has built a new plant in Pemberton, British Columbia, to manufacture advanced prefabricated panels from Canadian wood that meet some of the highest standards for home energy efficiency.

The $1.4 million of funding received from the IFIT program, coupled with $1.5 million from BCPH, enabled the new facility to lead the industry in manufacturing prefabricated panelized building systems that meet the stringent Passive House (PH) standard. The use of wood in BCPH's panelized system provides a sustainable and healthy building structure.

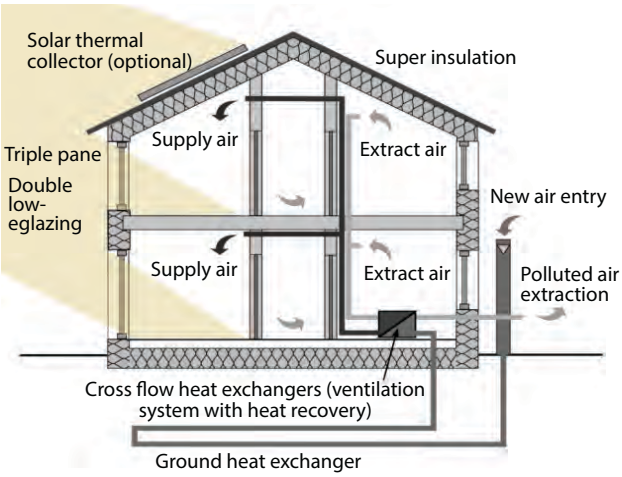
Innovation at its finest

The BCPH prefabricated panel system was chosen for funding because of the huge success Passive Houses have demonstrated in European countries. This project represents Canada's first manufacturing plant that prefabricates a panelized system according to the rigorous PH standard. The new manufacturing methods will create an innovative, value-added wood building product that meets stringent building efficiency requirements. Prefabrication benefits include allowing construction in a climate-controlled environment and on a horizontal surface and reducing in-plant and on-site waste. Thus efficiency and quality control are increased while construction costs are reduced.

What is a Passive House?

Passive House is a European concept and performance-based building standard that focuses on dramatically reducing or eliminating the need for an active heating or cooling system to maintain a comfortable interior climate. This is achieved through efficient design that utilizes passive heating and cooling techniques and an optimized building envelope that is airtight, has a high level of insulation, extremely energy-efficient windows and a heat recovery ventilation system (HRV).

Cross-section of a Passive House



Source: BCHP

Benefits of a Passive House

Energy efficiency
Up to 85 percent savings for heating and cooling compared to current building code construction.

Healthy buildings
Constant circulation of fresh filtered air, excellent noise control and comfortable, consistent temperatures.

Sustainable development
Building to the PH standard offers a construction solution that dramatically increases building efficiency, thus reducing energy dependence, making the PH standard a great starting point for achieving certifications, including Net Zero™, LEED®, The Living Building Challenge™ and other CO_2 initiatives.

It works
There are about 30,000 PH structures world-wide that have proven time and time again the accuracy of PH building requirements and the PH design software.

The panels are constructed from wood and wood by-products such as wood fibre insulation that can help slow potential heat loss from the home. The combination will result in a reduction in energy consumption for heating and cooling of between 80 and 90 percent.

Jobs and skills training

This project provides job skill training in:

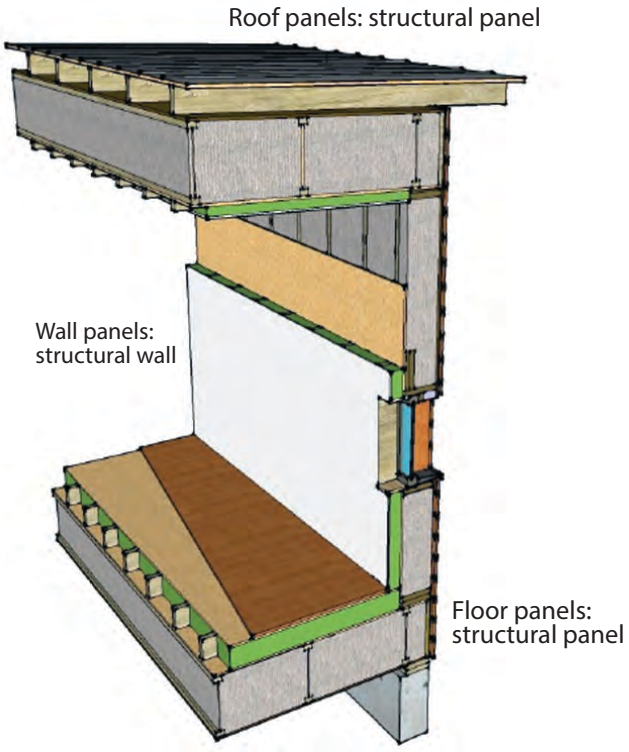
- Construction techniques required to meet the PH standard for prefabrication.
- Training and certification on the new plant machinery and systems.
- 3D drawing using CadWorks software.
- An introduction to the building science behind the system.

The project created 12 direct employment opportunities, and the execution of the project included about 17,000 person hours.

How it works: The panels

- **Rainscreen system**: The siding blocks the flow of bulk rainwater from the wall system, while the strapping produces an air space that allows any moisture that makes it way past the siding to evaporate.
- **Breathable moisture barrier**: A diffusion board (an engineered wood product that is waterproof yet breathable) prevents rainwater from entering the structural wall, while still allowing any moisture caught in the structural wall to move to the outdoors.
- **Structural wall**: The structural wall is insulated with blown cellulose insulation and has no thermal bridge. The wall provides the high level insulation that reduces heat transfer through walls and the structural requirements for the house.
- **Sealed air barrier and vapour retarder**: The OSB acts as both an air barrier and vapour retarder, controlling the flow of air through the panel assembly while slowing the rate of vapour diffusion through the structural wall.
- **Service wall**: To minimize penetrations to the airtight barrier, the plumbing, electrical and other services are separated into and run through the insulated interior wall. The most efficient service plan is designed dependent on the house, maintaining a minimum amount of entry points.

Panel construction for a Passive House



Source: BCHP

Replicability

The project is highly replicable and has been already investigated by a timber frame company in Squamish and a contracting company in Vancouver, British Columbia. A manufacturing company from Vancouver Island that currently manufactures partial systems for PH projects and is hoping to prefabricate similar systems has also approached BCPH. Similar interest has been shown by other companies in British Columbia.

"These prefabricated panels combine Canadian wood and wood by-products with advanced design, superior insulation and increased airtightness to create ultra-low energy use buildings."

Glenn Mason, Assistant Deputy Minister
Canadian Forest Service, NRCan

Why wood?

Wood is Canada's only truly renewable building product and is now being recognized by governments and organizations world-wide as an integral solution to mitigating climate change.

Wood has a low embodied energy and is renewable and recyclable.

The manufacturing of building materials requires the greatest amount of energy in the entire construction process. Wood requires less energy to manufacture than concrete and steel, making it the most efficient building product. It is naturally grown, has low embodied energy and can be recycled.

Wood is half carbon by weight, and this carbon remains in the wood after harvesting if the wood is used for long-lasting products such as lumber in houses.

It can store more carbon than is emitted during harvest, transportation and manufacturing, combined. Substituting a cubic metre of wood for concrete or brick building materials can save up to 1 t of CO_2.

Wood contributes to a building's efficiency and is strong, flexible and an effective management tool for water and thermal bridging.

It is comprised of millions of tiny air pockets, giving it natural thermal efficiency. This makes wood 400 times better than steel and 10 times better than concrete in resisting heat flow. Wood is strong, having a similar weight to strength ratio compared to steel.

Wood is also durable and adaptable, making it easily reusable and recyclable at the end of its life cycle.

Globally, the construction and operation of buildings are responsible for 25 to 40 percent of all energy use and 30 to 40 percent of GHG emissions. Trading wood for concrete or steel is an innovative and efficient way to improve climate change.

Conclusion

NRCan's IFIT program supports innovative technologies that lead to a more diversified, higher-value forest sector product mix that includes bioenergy and renewable power, bio-materials, biochemicals, and next generation building products. The 14 projects funded by IFIT between 2010 and 2014 have celebrated many successes and, in the years to come, will provide many additional ongoing benefits to the environment, the economy and the people of Canada.

IFIT's next performance report will be available in the spring of 2017 and will report on the second wave of projects and highlight results from the third call for proposals.

"People don't thank the federal government very often, and we'd like to thank them for their IFIT program. It's an investment in forest innovation and technology. It's helped us and other companies innovate. For our operations it has meant taking discovery through to commercialization which has led to investment in a new lab facility and jobs. It is a well-run program and we think Canada is getting good value from it. It has helped address some of our challenges and improved our competitiveness."

James D. Irving, Co-chief executive officer, J.D. Irving, Limited

Acknowledgments

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