



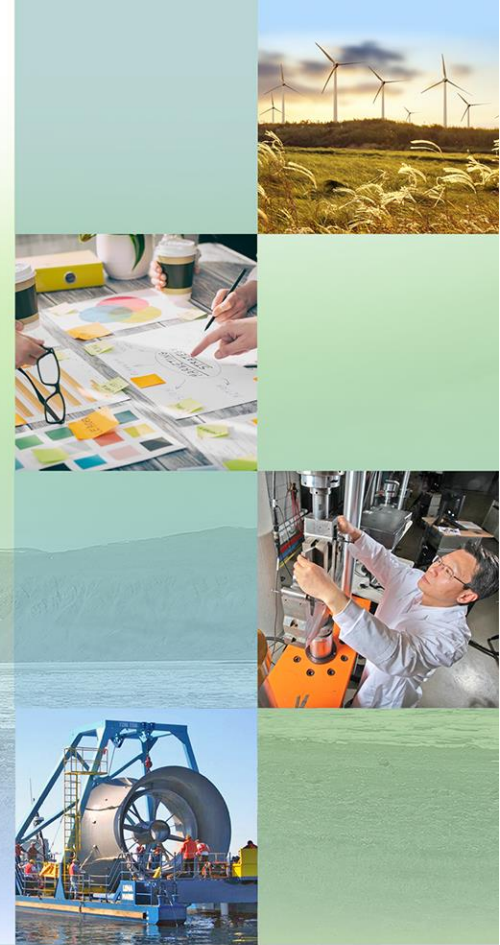
Ressources naturelles
Canada

Natural Resources
Canada

AUSTRIAN BIOREFINING STAKEHOLDER WORKSHOP

Biorefining in the Pulp & Paper Sector in Canada

Eric Soucy, Director
Industrial Systems Optimization Program
CanmetENERGY
October 23rd, 2017



CanmetENERGY

Three Scientific Laboratories across Canada

CanmetENERGY is the principal performer of federal non-nuclear energy science & technology (S&T):

- Fossil fuels (oil sands and heavy oil processing; tight oil and gas);
- Energy efficiency and improved industrial processes;
- Clean electricity;
- Buildings and Communities; and
- Bioenergy and renewables.

Areas of Focus:

- Oil sands & heavy oil processes
- Tight oil & gas
- Oil spill recovery & response

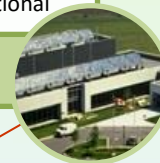
Devon



Areas of Focus:

- Buildings energy efficiency
- **Industrial processes**
- Integration of renewable & distributed energy resources
- RETScreen International

Varennes



Areas of Focus:

- Buildings & Communities
- Industrial processes
- Clean fossil fuels
- Bioenergy
- Renewables

Ottawa



What we do

The CanmetENERGY-Varenes Industrial Systems Optimization Group **develops knowledge and decision-making tools** necessary to demonstrate and deploy process optimization methodologies in Canadian industries in order to achieve **efficient use of energy and natural resources** with **reduced environmental impact**.



Energy

Environment

Economic

Social



What we do

CanmetENERGY's ISO Program focuses on innovative **facility-wide optimization** techniques (i.e. systems approach):

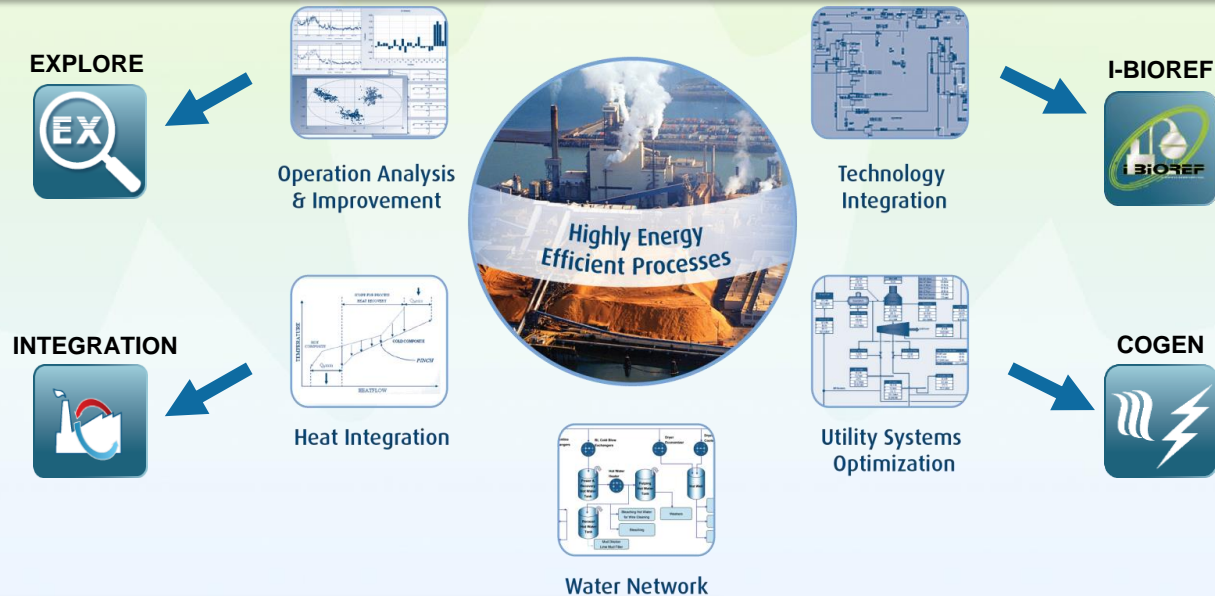
- Improve plants design and operation
- Effective introduction of new technologies and processes (e.g. cogeneration, biorefinery pathways, CO₂ capture, new energy systems)
- Four main R&D areas:
 - Heat Management
 - Cogeneration Optimization
 - Advanced Data Analytics
 - Biorefinery and Bioeconomy
- Energy-intensive industries: pulp and paper, refining, petrochemicals, oil sands



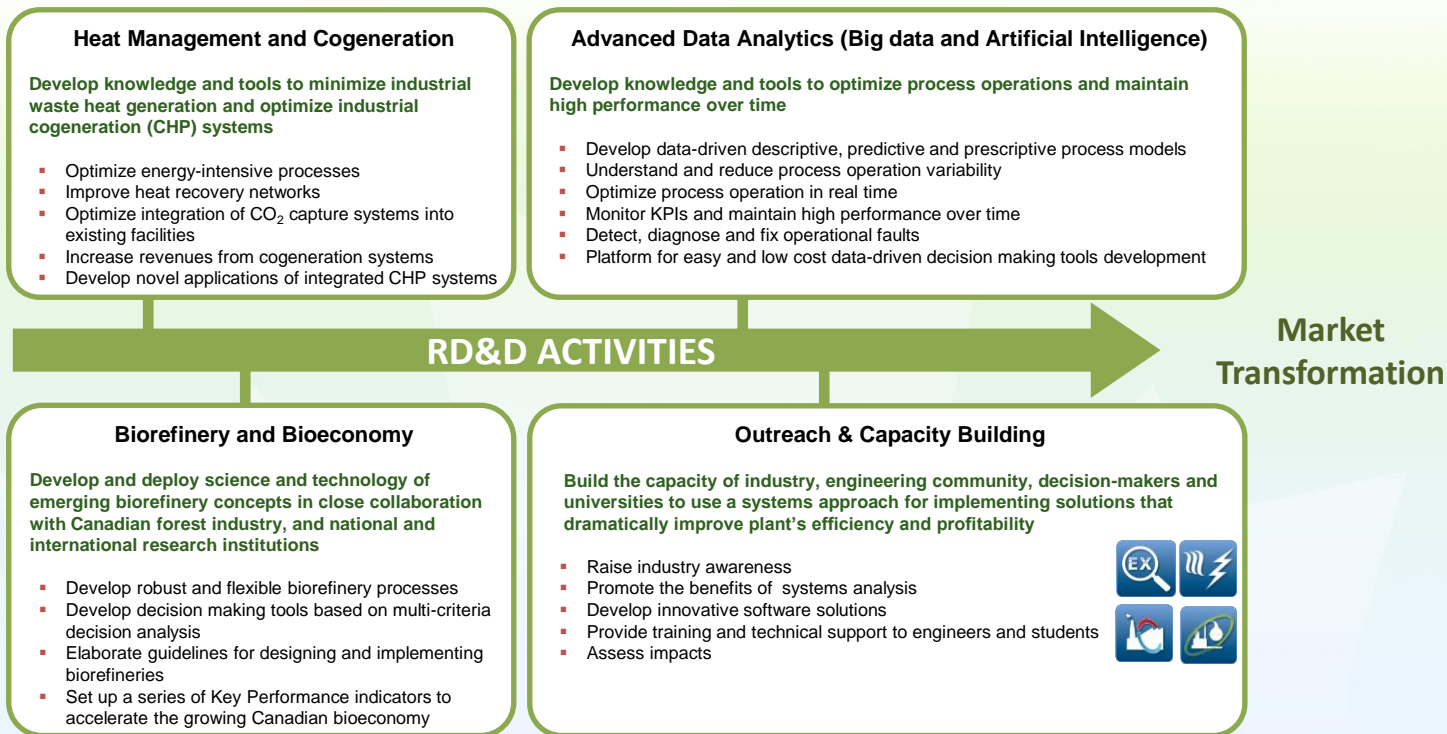
Industrial Systems Optimization Program

Approach combining several systems analysis tools

Innovation Through Integrated Solutions

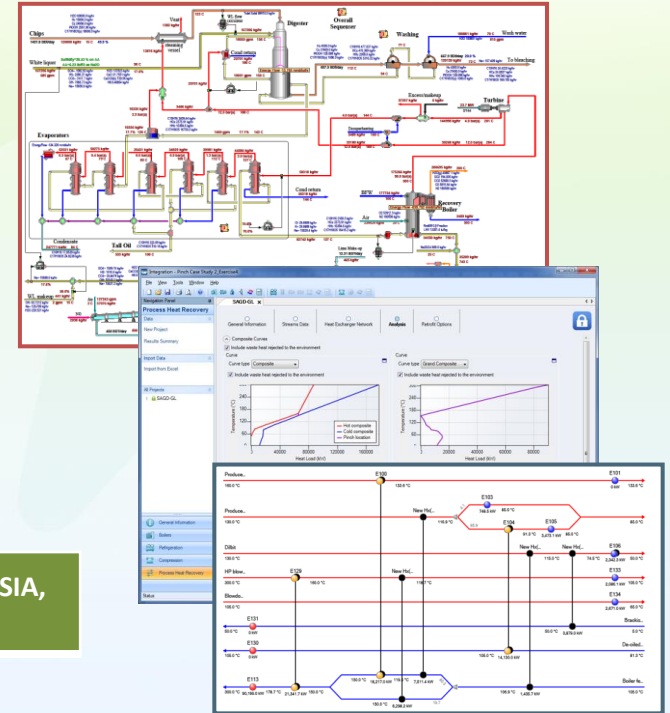


Industrial Systems Optimization Program



Heat Management and Cogeneration R&D Program – *Heat Management*

1. **Improved heat management** represents a great opportunity in most industrial plants but finding the best solutions is challenging
2. **Introducing new technologies** (e.g. CO₂ capture and conversion, biorefinery pathways) has major impacts on existing processes
 - CanmetENERGY develops process and energy optimization tools to help industry improve their plant assets:
 - Develop novel design solutions to reduce waste heat
 - Debottleneck production processes
 - Minimize the impact of new processes on existing plants



FPIInnovations, CFS, pulp and paper mills, oil companies, COSIA,
CO₂ Solutions, CO₂ capture providers

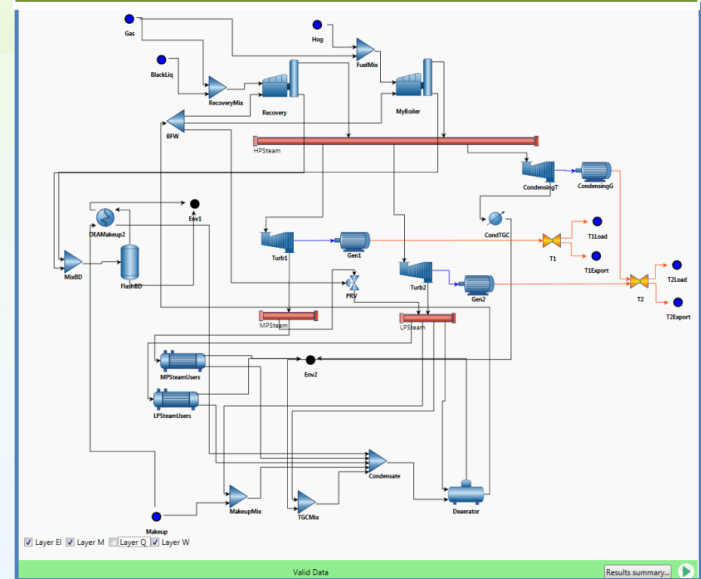


Heat Management and Cogeneration R&D Program – Cogeneration Optimization

1. **Most industrial cogeneration systems are not used in an optimal way**
 2. **Opportunities for novel cogeneration applications in industry exist**
- CanmetENERGY develops detailed models and state of the art optimization algorithms to maximize benefits from cogeneration systems:
 - Produce more power, more efficiently in existing systems to maximize economic benefits
 - Minimize fossil fuel used in biomass blend
 - Develop new cogeneration applications

CE-O, FPIInnovations, CFS, pulp and paper mills, cement plants

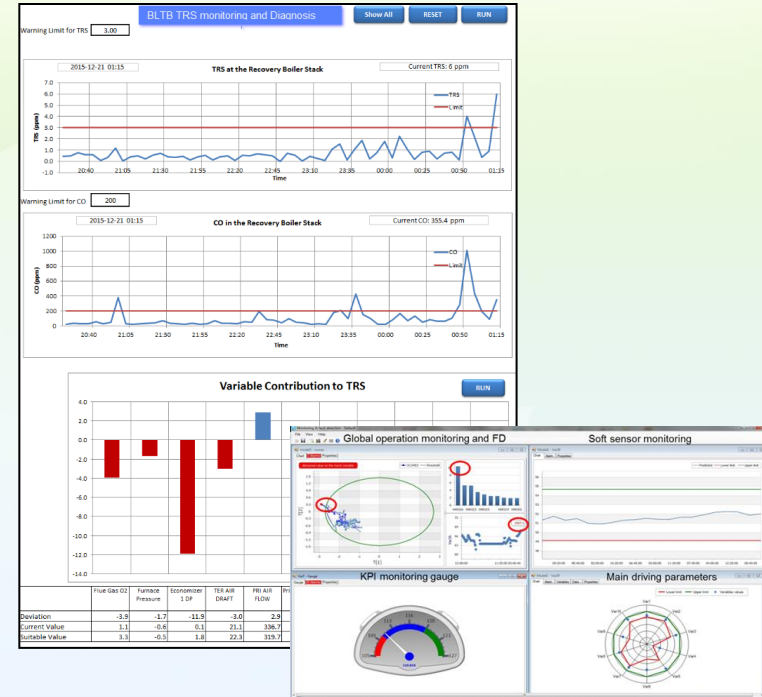
Constraints related to energy, environment, capital, technologies, operations, electricity contracts



Advanced Data Analytics R&D Program – *Big Data and Artificial Intelligence (AI)*

- Massive sets of operation data are available** in industrial facilities
 - Valuable process knowledge is hidden in these datasets
 - Less than 1% of the collected data is analysed
- Data analytics can help extract this valuable knowledge and help improve processes performance:
 - Explain and reduce efficiency and quality variability
 - Predict and optimize process performance in real time
 - Monitor and diagnose process operation performance

Demonstrated in various industries, processes and equipment leading to very cost-effective benefits.



Pulp and Paper Industry Context

- Pulp and paper industry is in an on-going transformation to increase profitability:
 - **Lower production costs** → Energy efficiency projects, reduce cost of GHG emissions, reduce losses, improve operations
 - **Increase annual revenues** → Install new turbines and produce additional "green" power; tackle new markets
 - **Diversify production** → Change grade of commodity products; develop innovative new bio-products



Optimizing energy integration is essential to reduce operating costs, lower GHG emissions, add new revenues and prepare pulp and paper mills for the low-carbon economy.

Pulp mills are perfect host site for biorefinery technology integration!



Pulp and Paper Industry Context

The need for a system approach

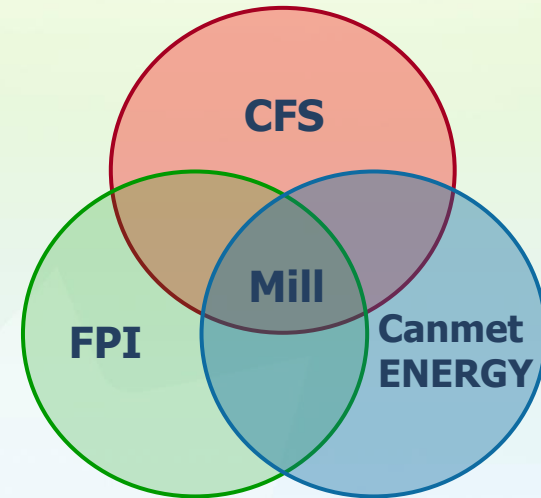


Pulp and paper lose enormous amounts of energy.
There are also complex with numerous interrelated energy systems.
Where do we start? Where are the best opportunities?



FPInnovations – CanmetENERGY – CFS Partnership

- Strategic support to the forest industry
- Create added-value through an innovative system approach for efficient energy, power generation and biomass management in Canadian mills
- Solutions with no commercial bias
- Unique complementary capabilities and tools



- **FPInnovations:** deep know-how and understanding of pulp and paper process, product quality and operability impacts
- **CanmetENERGY:** utility and process optimization tools, process integration and energy efficiency expertise
- **CFS:** industry knowledge, policy and program development.

FPInnovations 

CanmetENERGY
Technology for Sustainability

Canada
Natural Resources Canada
Canadian Forest Service



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Our Global Approach to Maximize Impacts

1. Benchmarking
2. Process water and heat recovery
3. Operational improvements using data mining
4. Cogeneration system optimization
5. Analysis of integrated biorefinery potential
6. Monitoring of impacts and technical support
7. Awareness and capacity building



Benefits

- **Operational improvements**
 - Improve the utility system management to enhance the cogeneration potential and take advantage of contractual flexibilities;
 - Optimize the operation of energy-intensive equipment to improve their performance and minimize their energy use;
- **Retrofit design**
 - Optimize resources utilization (fuel, biomass, chemicals and water);
 - Identify untapped waste heat sources causing excessive use of thermal energy;
 - Uncover process steam generation opportunities;
 - Maximize heat recovery and green power production;
- **Convert the identified opportunities in practical project implementation paths**
 - How to select and sequence the improvement modifications?
 - How to leverage the short-term modifications with sustainable long-term savings?



Optimizing Existing Assets: Participating Mills

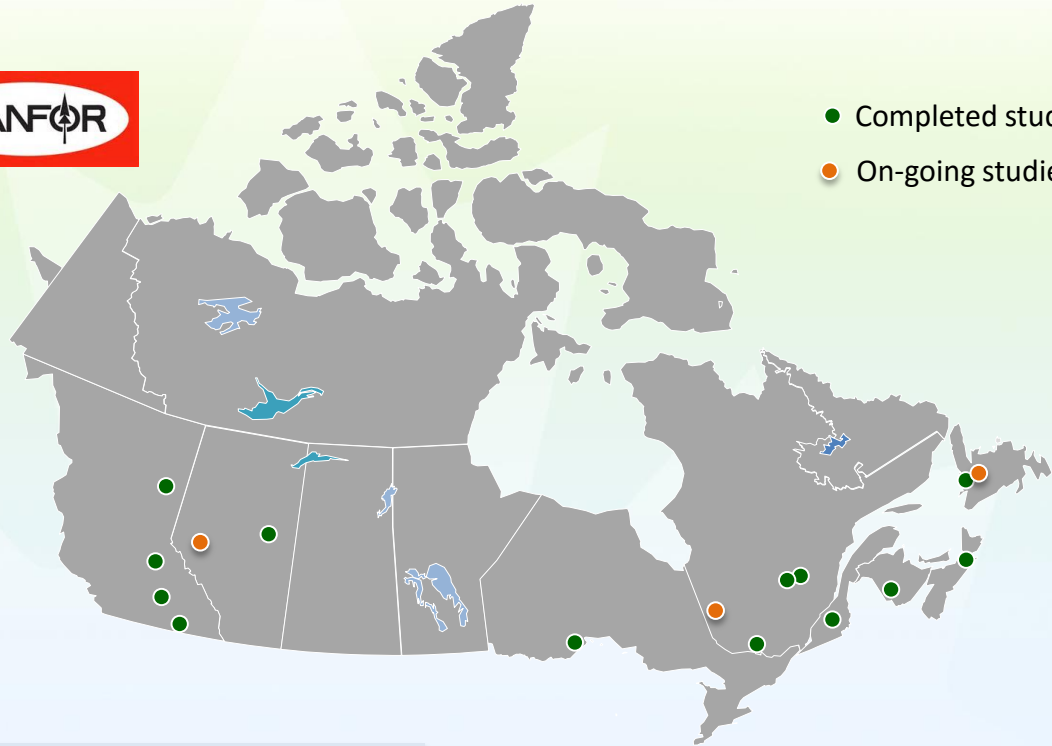
- Since 2012, energy optimization studies performed at 15 FPInnovations member pulp and paper mills in 7 provinces across Canada
 - Various pulp and paper processes and mill configurations:
 - Market pulp mills (kraft, TMP, BCTMP, dissolving) or integrated mills (pulp and paper are produced in the same mill)
 - Mills with and without cogeneration systems
- In 11 out of the 13 mills, biomass is the main fuel
 - Challenging to find low payback projects
 - Fuel savings do not translate in direct GHG reductions



Optimizing Existing Assets: Participating Mills



- Completed studies
- On-going studies



Process Optimization in Pulp & Paper mills

FPInnovations – CanmetENERGY – CFS Successful Partnership



Results obtained by combining Heat Management, Cogeneration Optimization and Data Analytics

\$50M+ in cost-effective annual savings and additional revenues identified in 13 mills

An impact study is underway among participating mills



Testimonial

"FPInnovations and CanmetENERGY have the expertise, the tools and a unique approach to conduct energy management studies in a time-efficient manner. The power contract optimization study performed at Resolute's Thunder Bay, Ontario, pulp and paper mill was very successful, generating significant additional revenue."
(Robert Dufresne, Vice-President, Operations)



Impact Analysis: additional benefits

In addition to financial benefits and GHG reductions, the following benefits were obtained by some mills:

- Developed strategic action plan for energy and GHG management
- Improved data and knowledge for contract negotiation with utility companies
- Reduced boiler trips and unplanned shut down
- Better understanding of the cross-effects between mill departments
- Reduced water usage and effluent generation



Knowledge Transfer

Industries
Engineering firms
Utilities
Universities



- Webinars and courses
- Post-training technical support



Raise Awareness
Build Capacity

Energy Integration

- Learn the Heat Integration concepts for a more efficient use of energy in industrial facilities
- Understand, identify and evaluate heat recovery opportunities in utility systems and processes



Data Analytics

- Learn advanced data analysis to understand process and reduce process variability
- Uncover the most critical variables affecting process operations
- Identify low-cost improvement measures



Better informed
decision-
makers

Cogeneration (CHP)

- Model and optimize CHP systems
- Understand production, equipment, environmental and contractual constraints
- Produce heat and power cost effectively



Skilled labour

Biorefinery and Bioeconomy

- Understand biorefinery technologies
- Evaluate the economic viability and environmental benefits of a biorefinery (integrated into existing pulp and paper operations or standalone)



Strategies to Increase Industry Adoption

Capacity building: target audience



- **Increasing the systems analysis and optimization culture towards existing and new generation of engineers**
 - Industrial companies
 - Process engineers
 - Plant and corporate energy managers
 - Engineering firms
 - Energy efficiency consultants
 - Process design engineers
 - Governments and utilities
 - Programs developers, managers and officers
 - Universities
 - Undergraduate and graduate students
 - Professors

Partnership



Biorefinery R&D Program

Canada has unique bio-based advantages



- Canada has one of the largest biomass resources in the world (agriculture, forest, marine)
- World-class forest sector innovation system based on strong collaboration

And has...



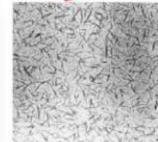
An abundance of
skilled labour



Mature forestry
fibre supply
infrastructure
and secure
property rights



Emerging clusters
that draw upon
existing
infrastructure



A technology
advantage in
several areas (eg.
cellulose
nanomaterials, agri-
breeding and
agronomics)



Strong and broad-
reaching S&T and
academic network



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February 2017



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Biorefinery & Bioeconomy R&D Program: Focus Areas



Bioenergy

- Technological intelligence
- Data analysis
- Cogeneration

CFS, FPInnovations, pulp and paper mills



Biofuels

- Markets
- Bioenergy La Tuque

CFS, BELT, UQTR, FPInnovations, Polytechnique Montréal, Université Laval, VTT



Biochemicals

- Markets
- Rich-Sugar streams
- Biobutanol
- Organic acids

CÉPROCQ, CRIBIQ, UQTR, Forestry COOPs



Advanced Biomaterials

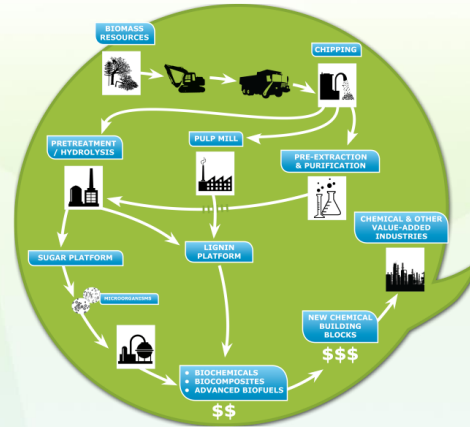
- Markets
- Tannins
- Lignin-based polyols
- Carbon fiber

NRC, CRIBIQ, Forest COOPs, Domtar, Enerlab, Pure Lignin Environment Technology Ltd., Renmatix

National and international collaboration



Biorefinery & Bioeconomy R&D Program: I-BIOREF

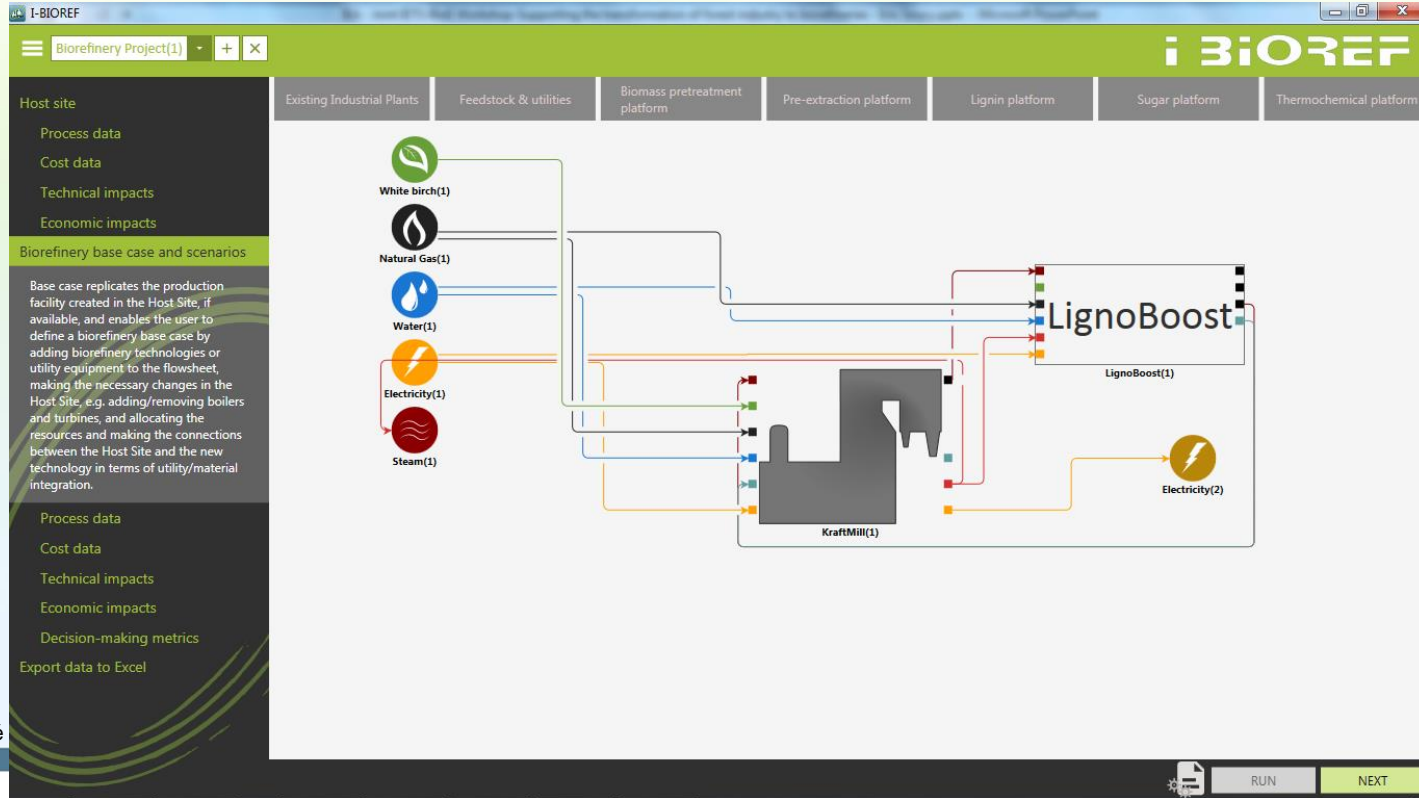


- How can a company succeed in **identifying a strategy** to enter the bioeconomy that is **robust** for future market scenarios, and at the same time, yields high margins?
- What are the **benefits of integrating** a biorefinery technology into an existing mill?
- In an integrated biorefinery, what are the **impacts on the existing mill**?
- Under what conditions does a biorefinery project become **economically and environmentally viable**?

Make the analysis easier, faster and... less expensive!



I-BIOREF: A Biorefinery Pre-Feasibility Analysis Software



Approach

Market assessment and technological intelligence

- Mapping of resources utilization in pulp and paper mills
- Data on available biomass and competitive pricing strategy
- Market data on bioenergy, biochemicals and biomaterials
- Critical review of Canadian bioenergy and biorefinery demonstration projects
- Extensive technological intelligence on biorefinery processes and innovations

Modeling, algorithms development, simulation, and experiments

- **Experiments**
 - Extractives
 - Pre-treatment/fractionation
 - Detoxification of cellulosic hydrolysates
 - Sugar extraction and fermentation
 - Lignin recovery from black liquor
 - Full characterization of lignin properties from various sources (up to 90 samples)
- **ASPEN Plus® Modeling**
 - Pre-treatment/fractionation
 - Lignin recovery
 - Sugar extraction and fermentation
 - Separation/purification
- **Multi-criteria analysis**
 - Technical performance
 - Economic viability
 - Environmental footprint
 - Risk assessment

Computer Modeling, Simulation & Optimization of Integrated and Standalone Biorefineries



Outputs:

- **Prefeasibility scenarios for integrated and standalone biorefineries**
- **Industrial case studies**
- **Guidelines, engineering rules and expert tips for designing and implementing biorefineries**
- **Knowledge, know-how and technology transfer**

I-BIOREF Software: What it does?

- ❑ **I-BIOREF** supports decision-makers in selecting viable biorefinery solutions
- ❑ **I-BIOREF** evaluates the benefits of integrating commercially available biorefinery processes
- ❑ **I-BIOREF** provides several criteria to assess the biorefinery project from different perspectives
- ❑ **I-BIOREF** performs sensitivity analysis to evaluate the impacts on resources utilization

- ❑ **Comprehensive mass and energy balance, and chemical balance**
- ❑ **6 economic metrics (PBP, IRR, NPV, ROCE, ROI, EBIDTA)**
- ❑ **2 competitiveness metrics (CAB, RTMU)**
 - ❖ Competitive access to biomass
 - ❖ Resistance to market uncertainties
- ❑ **17 LCA-based metrics**
 - ❖ Mid-point impact category (carcinogens, respiratory inorganics, land occupation, etc.)
 - ❖ Damage category (*climate change, human health, ecosystem quality, etc.*)



- ❑ **Pulp and paper processes:** Kraft and TMP
- ❑ **Biomass pretreatment processes:** Steam explosion; Liquid hot water; Acid hydrolysis; Alkaline hydrolysis; Instant controlled pressure; Organosolv; Torrefaction
- ❑ **Pre-extraction processes** Supercritical fluids (e. g. CO₂); Hot water; Enzymatic
- ❑ **Lignin recovery processes:** LignoBoost™, LignoForce™
- ❑ **Sugar streams conversion processes:** Detoxification; Fermentation; Separation/Purification
- ❑ **Thermochemical processes:** Gasification; Pyrolysis; Catalysis



Biorefinery targets, policies and legislation

Mission Innovation

Canada is joining the international community in the fight against climate change through Mission Innovation: a commitment to **double investments in clean energy innovation** over five years, accelerating global clean energy innovation, ensuring clean energy technologies are widely affordable and driving economic growth.

MISSION INNOVATION

23 Members

Australia, Brazil, Canada, Chile, China, Denmark, European Union, Finland, France, Germany, India, Indonesia, Italy, Japan, Mexico, Netherlands, Norway, Republic of Korea, Saudi Arabia, Sweden, United Arab Emirates, United Kingdom, United States

Along with 22 other members, Canada has committed to supporting clean energy by:

Doubling federal clean energy investment in R&D **x2** over 5 years

Encouraging private investment in transformative clean energy technologies

Increasing domestic and international collaboration

Canada has already made significant progress on its Mission Innovation objectives. In 2015–16, Canada increased energy research, development and demonstration (RD&D) funding by 24% relative to the previous year. Investments announced in Budget 2017 will further increase energy RD&D funding, including:

- \$400 million to develop and demonstrate new clean technologies;
- \$229 million to continue clean energy and transportation R&D;
- \$200 million to support research and adoption of clean tech in Canada's natural resource sectors; and,
- \$75 million for a new "challenge" to accelerate problem-solving efforts, such as helping rural and remote communities adopt more affordable clean energy technologies.

Through Mission Innovation, Canada is also supporting **Innovation Challenges** designed to accelerate global clean energy innovation. Examples include:

- **Sustainable Biofuels Innovation Challenge:** Canada is co-leading 16 countries to make progress toward affordable, advanced biofuels for transportation and industrial applications;
- **Smart Grids Innovation Challenge:** Encouraging research to advance the technology needed to bring cleaner, renewable energy onto a smarter electricity grid;
- **Off-Grid Access to Electricity Innovation Challenge:** Encouraging research and policy developments aimed at advancing clean energy solutions for rural and remote communities; and,
- **Carbon Capture Innovation Challenge:** Encouraging research in technologies to capture carbon, building on Canada's leading carbon capture and storage expertise.



Biorefinery related funding programs

Investments in Forest Industry Transformation (IFIT) and Forest Innovation Programs (FIP) starting in 2017–18

- IFIT: \$55 million over three years;
 - FIP: \$63 million over three years
-
- Natural Resources Canada's Investments in Forest Industry Transformation and Forest Innovation Programs have been extended to continue **to position Canada's forest sector at the forefront of the emerging bio-economy** and reduce reliance on traditional products.
 - These programs help drive innovation from research and development to commercialization and aim to **support the development of new technologies and higher-value products** that will reduce GHG emissions and contribute to clean economic growth and jobs.
 - This new funding will help the forest sector **generate new business opportunities that can help diversify its product portfolio** and help position Canada as a global leader in new technology areas.



Commercial biorefinery facilities

NYSE : BIOA

FIRST PLANT IN OPERATION, SALES RAMPING

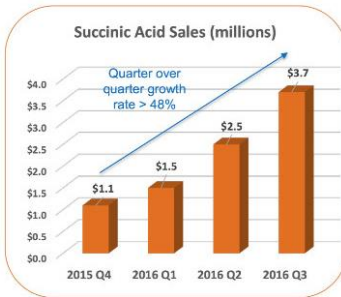
Commercial plant started production in October 2015



Plant #1 (Sarnia) Nameplate Capacity:
30,000 MT / year of SA

World's Largest SA plant is a Joint Venture
60% BioAmber, 40% Mitsui & Co.

Over 180 companies globally have qualified our succinic acid



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7

Enerkem begins commercial production of cellulosic ethanol from garbage at its state-of-the-art Edmonton biofuels facility

MONTRÉAL, Sept. 15, 2017 /CNW Telbec/ - Enerkem Inc. (www.enerkem.com), a world leading biofuels and renewable chemicals producer, announced today it has started the commercial production of cellulosic ethanol. Enerkem's game-changing facility in Edmonton, AB, Canada, is the first commercial-scale plant in the world to produce cellulosic ethanol made from non-recyclable, non-compostable mixed municipal solid waste.



The company has been producing and selling biomethanol since 2016, prior to expanding production to include cellulosic ethanol with the installation of its methanol-to-ethanol conversion unit earlier this year.



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Regional initiatives

NEB report addresses biomass power generation in Canada

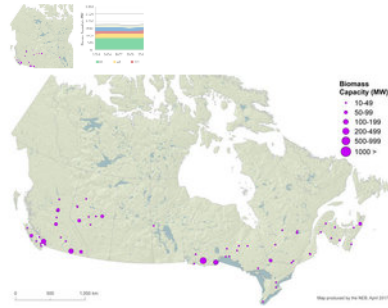
By Erin Voegelé | May 08, 2017

The National Energy Board recently released a report on Canada's adoption of renewable power sources, reporting the country generates a larger share of its electricity from renewable sources than most other developed economies in the world.

The report includes direct comparisons of how Canada ranks internationally for renewable power adoption and covers factors that affect the uptake of renewable power sources, including financial costs, reliability and environmental impacts. It addresses a wide range of renewable technologies, including biomass.

The report shows Canada had approximately 70 biomass generating power plants in 2014 with a total installed capacity of 2,408 MW.

This includes facilities that rely on wood, wood byproducts and landfill gas. Overall, biomass accounts for 1.7 percent of Canada's electric generation capacity, and 1.9 percent of actual generation. In 2015, 12,161 gigawatt hours of biomass-based electricity were produced. From 2005 to 2015, biomass generation grew by 54 percent.



National Energy Board



Currently promoting a project which aims to use 650,000 to 1,200,000 green metric tons per year of **forest residues** as feedstock for a commercial scale biorefinery that would produce up to 207 million liters/year of **bio-diesel** in the province of Québec.



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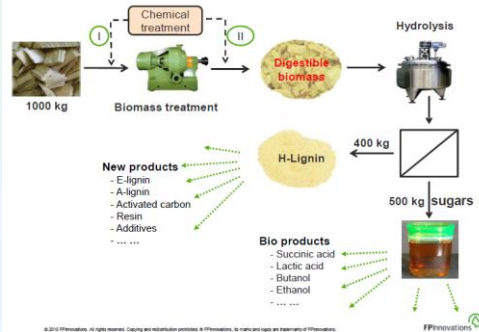
Demo and pilot plants

Ontario pledges \$4.5M for Thunder Bay bio-refinery pilot plant
 FPInnovations to oversee development of pilot plant in Resolute pulp and paper facility



Resolute Forest Products will contribute \$3.5 million to host pilot plant, while the Northern Ontario Heritage Fund Corporation adds \$4.5 million.

TMP-Bio Process



S2G BioChem Announces Build of Advanced BioRefinery in Sarnia, Ontario Funding Support Provided by Bioindustrial Innovation Canada

June 20, 2017 | BIC & S2G BioChem

Production of Xylitol to Begin in 2018

VANCOUVER, British Columbia – S2G BioChem (S2G), a developer of natural biotechnology conversion processes, announced today that it has started work on the company's first standalone biorefinery demonstration plant that it intends to build in Sarnia, Ontario.

The commercial-scale facility will refine local, sustainable forestry and agricultural residues using S2G's patented process to produce the lowest-cost and highest-value food ingredient xylitol available on the market today while co-producing value-add bioglycols for a new generation of consumer, industrial and packaging and products.



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Demo and pilot plants (cont'd)

IFIT-Funded projects

Green Energy

- AE Côte-Nord Canada Bioenergy Inc.
- Alberta-Pacific Forest Industries Inc.
- Millar Western Forest Products Ltd.
- Nechoko Lumber Company Ltd.
- Pacific Bioenergy Prince George Limited Partnership
- Woodland Biofuels Inc.

Biomaterials

- Corruven Canada Inc.
- Domtar Inc. - Espanola, ON
- Enerlab 2000 Inc.
- Kruger Biomaterials Inc.
- Papier Masson WB L.P.
- Tekle Technical Services
- West Fraser Mills Ltd.

Solid Wood

- BC Passive House Inc.
- Dynamic Windows & Doors Inc.
- Irving Pip & Paper, Limited
- Lauzon, Planchers de bois franc exclusifs inc.
- Louisiana-Pacific Canada Ltd.
- Structurcraft Builders Inc.
- Structurlam Products Ltd.
- Tolko Industries Ltd.
- Uniboard Canada Inc. - Mont-Laurier, QC
- Uniboard Canada Inc. - Sayabec, QC

Biochemicals

- Cascades Canada ULC
- Domtar Inc. - Dryden, ON
- Fortress Specialty Cellulose Inc.
- Natures Affinity Inc.



AN IFIT PROJECT

GREEN ENERGY FROM WASTE

Alberta Pacific Forest Industries Inc. created an opportunity to be the first pulp mill in the world to produce commercial grade purified bio-methanol from its waste streams for use in operations and external sale.

- The Canadian-developed process for extracting and purifying bio-methanol will be performed using the novel distillation technology
- The process requires no additional wood fibre and runs continuously to the pulping process

UTILIZING CANADA'S FORESTS: RESULTS EXPECTED



ON-SITE PRODUCTION FOR PULP WHITENING OPERATIONS

EXTERNAL USES IN SOLVENTS, ANTIFREEZE, OR FUEL

INNOVATING WITH WOOD

- The waste stream goes to a condenser to separate water from bio-methanol and then to a distiller which removes water (organic compounds)
- It is then passed through two distillation columns. The first column removes low boiling materials and the second removes high boiling chemicals

POTENTIAL OPPORTUNITIES

ECONOMIC, STABILITY AND PROFITABILITY OF THE MILL IMPROVED WITH ADDITION OF SECONDARY PRODUCT METHANOL

ENVIRONMENT: REPLACES FOSSIL-FUEL DERIVED METHANOL

COMMUNITY: LONG-TERM SUSTAINABILITY AND MAINTENANCE OF DIRECT AND INDIRECT EMPLOYMENT

ENVIRONMENT: ELIMINATES ENERGY CONSUMPTION ASSOCIATED WITH TRANSPORTATION OF METHANOL TO SITE



ALBERTA PACIFIC FOREST INDUSTRIES PRODUCES BOTH HARDWOOD AND SOFT WOOD PULP IN NORTH AMERICA'S LARGEST SINGLE-LINE BLEACHED KRAFT MILL

PROJECT LOCATION: BOYLE, ALBERTA

The bio-methanol extraction and purification technology can be replicated in many Canadian pulp mills and the bio-methanol could arrive at a chemical plant for the production of numerous new "green" products from the Canadian forest products industry

— Chris Meigs, Business Development Manager, Canadian Forest Service



<http://www.nrcan.gc.ca/forests/federal-programs/15867>

2017-2018 Federal Budget: Investing in the Future of Canada



AN IFIT PROJECT

LOW CARBON FUELS FROM FOREST RESIDUES

AE Côte Nord Bioenergy, a partnership between an Ensyn affiliate and Arbec, a major eastern Canada forestry company, is building the world's first commercial facility using technology designed specifically for the conversion of forest residues to liquid biofuels for energy applications.

- Ensyn's Rapid Thermal Processing, or RTP™ technology, is the global leader in the thermal conversion of biomass residues to liquid biofuels
- Historical production using RTP™ has focused on food ingredients and specialty chemicals
- RTP™ technology is a fast thermal conversion process using moderate temperatures without the need for catalysts, hydrogen or significant pressure
- the technology is expected to be highly replicable

UTILIZING CANADA'S FORESTS: RESULTS EXPECTED



65,000 METRIC TONNES OF #3 WOODMILL RESIDUE PER YEAR

40 MILLION LITRES OF RENEWABLE FUEL OIL PER YEAR

30 DIRECT & MORE THAN 400 INDIRECT JOBS

INNOVATING WITH WOOD

- a world first RTP™ facility that converts logs and other forest residues to higher value biofuels for energy applications
- a replicable, modular model with potential impact across the forest industry in Canada
- low complexity, high processing speed and high product yields leads to low capital and operating costs

POTENTIAL OPPORTUNITIES

ENVIRONMENT: LESS NEED FOR OIL AND GAS BY USING RENEWABLE FEEDSTOCKS

MARKET: BIODEGRADABLE PRODUCT TO BE SOLD FOR HEATING AND AS A REFINERY FEEDSTOCK IN THE U.S. AND QUEBEC

ENVIRONMENT: REDUCTION IN LIFE-CYCLE GHG EMISSIONS OF BETWEEN 70-90% AND VIRTUALLY SULPHUR-FREE

ENSYN'S RTP™ HEATING FUELS HAVE BEEN SUCCESSFULLY DEMONSTRATED ON A COMMERCIAL SCALE IN A QUEBEC HEATING OPERATION AND SHOWN IT IS POSSIBLE TO REPLACE APPROXIMATELY 20% OF THE HEATY FUEL OIL NEEDED TO OPERATE THE PLANT.



AE CÔTE-NORD CANADA BIOÉNERGIE IS A PARTNERSHIP BETWEEN ENSYN, OWNER OF THE RTP™ TECHNOLOGY AND ARBEC, A MAJOR EASTERN CANADA FORESTRY COMPANY

PROJECT LOCATION: PORT CARTIER, QUÉBEC

The RTP™ technology and process has the potential to significantly impact local economies as a wood-dependent community by converting low-value residue and converting them to a high-value biofuels that replaces fossil fuels

— Serge Meunier, President, AE Côte-Nord Canada Bioenergy Inc.





AN IFIT PROJECT

PULP BY-PRODUCT BECOMES LEADING-EDGE BUILDING MATERIAL

Ensyn's R9000 will revolutionize building and structure framing panels using recycled lignin, which have the potential to reduce greenhouse gas emissions.

- Lignin is a new waste by-product being produced by Ensyn's R9000
- The new production line will be capable of manufacturing up to 10 million square feet of Ensyn's R9000 annually and will be a major Canadian project

UTILIZING CANADA'S FORESTS: RESULTS EXPECTED



20 MILLION SQUARE FEET OF PANELS

INNOVATING WITH WOOD

- Ensyn's R9000 will produce a lignin by-product that can be used as a building material or other industrial applications
- Ensyn's R9000 will produce a lignin by-product that can be used as a building material or other industrial applications

POTENTIAL OPPORTUNITIES

ECONOMIC: NEW MATERIAL, COSTS REDUCED BY UP TO 20%

ENVIRONMENT: REDUCED GREENHOUSE GAS EMISSIONS

MARKET: COMPETITIVE NEW MATERIALS WITH ADVANCED PROPERTIES AVAILABLE TO ENVIRONMENTALLY FRIENDLY CONSUMERS



ENSYN'S R9000 IS A LEADING-EDGE BUILDING MATERIAL PRODUCED USING PULP BY-PRODUCTS

PROJECT LOCATION: TROIS-RIVIÈRES, QUÉBEC

Ensyn's R9000 will produce a lignin by-product that can be used as a building material or other industrial applications

— Serge Meunier, President, Ensyn Inc.





AN IFIT PROJECT

STRENGTH FROM WOOD

Kruger Biomaterials has built the world's first commercial-scale quality structural composite beams — laminates with exceptional strength properties.

- The composite beams have a wide range of potential applications to replace more expensive steel or traditional composite, aluminum, stainless steel, and cast iron.
- The composite beams are made from wood and resin, making them a sustainable and environmentally friendly building material.
- The composite beams are made from wood and resin, making them a sustainable and environmentally friendly building material.

UTILIZING CANADA'S FORESTS: RESULTS EXPECTED



5 TONNES OF RESIN

ESTIMATED 120,000 M3 OF WOOD POTENTIAL PER YEAR

INNOVATING WITH WOOD

- Ensyn's R9000 will produce a lignin by-product that can be used as a building material or other industrial applications
- Ensyn's R9000 will produce a lignin by-product that can be used as a building material or other industrial applications

POTENTIAL OPPORTUNITIES

ENVIRONMENT: REDUCED GREENHOUSE GAS EMISSIONS

MARKET: COMPETITIVE NEW MATERIALS WITH ADVANCED PROPERTIES AVAILABLE TO ENVIRONMENTALLY FRIENDLY CONSUMERS



KRUGER BIOMATERIALS HAS BUILT THE WORLD'S FIRST COMMERCIAL-SCALE QUALITY STRUCTURAL COMPOSITE BEAMS — LAMINATES WITH EXCEPTIONAL STRENGTH PROPERTIES

PROJECT LOCATION: TROIS-RIVIÈRES, QUÉBEC

The major potential of cellular composite beams is that they will be made from wood and resin, making them a sustainable and environmentally friendly building material.

— Serge Meunier, President, Kruger Biomaterials Inc.



Major innovation activities

Government of Canada launches historic job-creating superclusters initiative

News Release

From [Innovation, Science and Economic Development Canada](#)

\$950-million initiative will help grow the economy

May 24, 2017 — Ottawa — Innovation, Science and Economic Development Canada

Canadians will benefit from the well-paying middle-class jobs that will be created as a result of a \$950-million initiative designed to jumpstart innovation in high-growth sectors.

The Honourable Navdeep Bains, Minister of Innovation, Science and Economic Development, today launched an initiative to select up to five innovation superclusters that will qualify for this historic investment from the Government of Canada.

This program, a centerpiece of the Government's [Innovation and Skills Plan](#), represents a federal investment in innovation on a scale that has never been seen in Canada. The purpose of this initiative is to create more middle-class jobs and more opportunities for Canadian businesses to grow into globally successful brands.

Successful proposals will be evaluated based on their strategy for creating and growing new companies, creating jobs that require advanced skill sets, equipping Canadians with the knowledge and skills for the jobs of the future, attracting private investment and generating meaningful economic activity that leads to prosperity for Canadians.

- Canadian leadership in artificial intelligence and data science
- Mobility systems and technologies
- Clean resources, clean technology and responsible sourcing of metals
- Advanced manufacturing protein innovations Canada
- Smart agri-food
- Advanced digital communications and interconnected applications to improve design and construction
- Digital technology

Impact Canada Fund

- On June 2, 2017 the Prime Minister of Canada announced the creation of the **Impact Canada Fund**, a new Government of Canada initiative to *help focus and accelerate efforts toward solving Canada's big challenges*.
- This includes **\$75M to pursue breakthrough solutions** to pressing problems in the Clean Technology sector, led by Natural Resources Canada.

Initial Challenges

- Making lives better for northern and remote communities ('off-diesel')
- Reducing aviation GHG emissions ('biojet')



Forest - Pulp and Paper Industry: Concluding Remarks

- Process optimization is key to design highly-efficient Biorefinery pulp mills
- Leveraging on existing assets is key in supporting the transformation
- In retrofit situations, **steam and water savings of 10 to 20%** are possible cost-effectively. **Increased power generation** is also typical
- Develop a **long term vision for implementing energy saving projects and robust biorefinery technologies:**
 - Permits a gradual implementation that mitigate the implication of short-term modifications over long-term high impact solutions
 - Analysis of biorefinery pathways for integration at existing mills
 - Analysis of biorefinery pathways and how mill existing assets can evolve to reduce implementation costs, notably by debottlenecking key process equipments
 - Assessment of economic and environmental impacts of biorefinery technology integration into existing or new industrial facilities
- Decision support tools such as I-BIOREF, for evaluating bioeconomy transformation strategies, are key in supporting the forest industry



Thank you for your time !

Eric Soucy, ing., P. Eng., MBA

Directeur | Director

Optimisation des procédés industriels | Industrial Systems Optimization

Intégration des procédés | Process Integration

CanmetÉNERGIE | CanmetENERGY

Ressources naturelles Canada | Natural Resources Canada

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