NATIONAL RESEARCH COUNCIL CANADA

Industrial Biomaterials

Superior Transportation and Construction, Naturally

Martin N. Bureau
Flagship Technology co-Lead, NRC

An NRC Flagship Program
in Development – October 2011

National Research Council Canada
Conseil national de recherches Canada

Canada

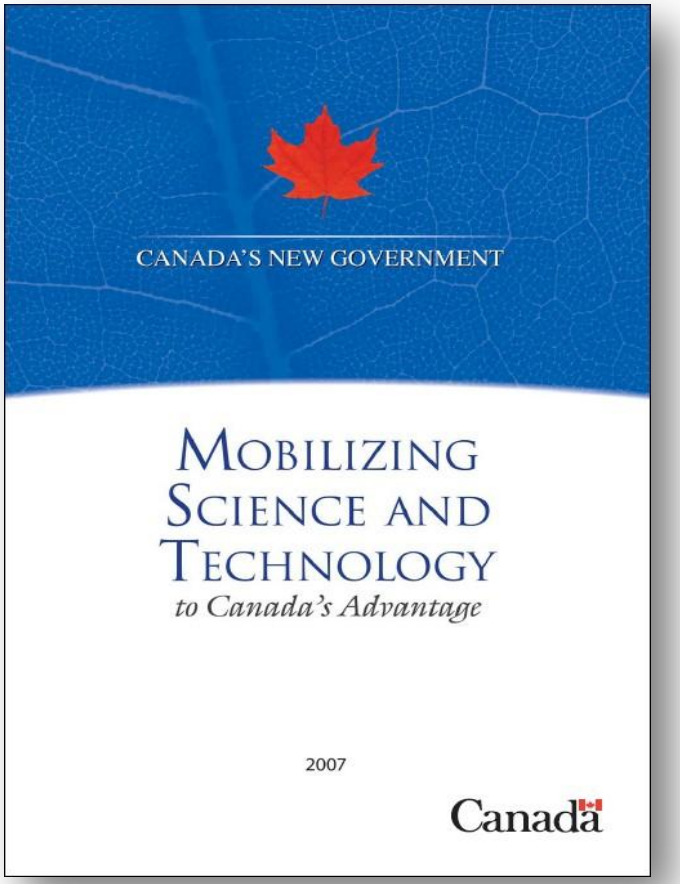
Innovation: A National Priority

Science & Technology Strategy

- Commits $1.3 billion to S&T research through national granting councils.

Automotive R&D Partnership Initiative

- Commits $145 million over 5 years from several agencies:
  - NSERC ($85M)
  - NRC ($30M)
  - CFI ($15M)
  - SSHRC ($5M)
  - IC ($10M)

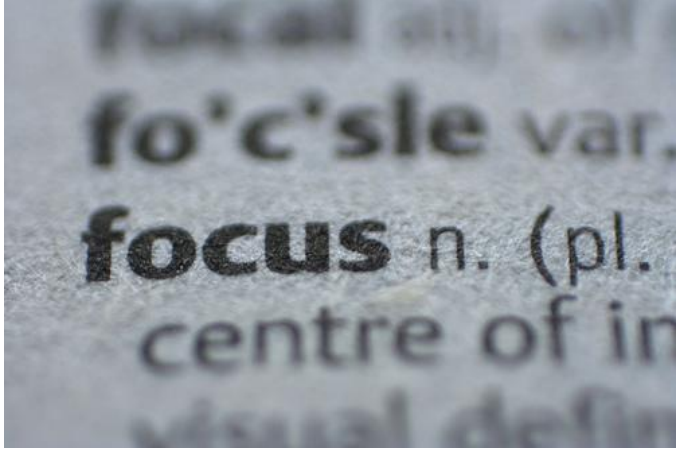


NRC's National Scope

Over **4,000** employees
and **1,500** visiting workers

2010-2011 budget:
$749M

NRC Flagship Programs



Flagship programs are focused, national-scale initiatives:

- With sufficient critical mass to deliver high economic and environmental impacts for Industry in Canada
- Which demonstrate the capacity of NRC to make a real, measurable difference to domestic prosperity

Flagships represent the research challenges with the greatest potential for collaboration and partnership as we place greater emphasis on engaging industry and other partners.

Why a Flagship Program on Industrial Biomaterials ?

- There is a growing worldwide market for industrial biomaterials that can deliver lighter, stronger and lower-cost products
- There is a growing demand for less environmentally impacting products
- Canada has some of the world's largest volumes of agricultural and forestry biomass
- NRC's existing strengths
  - Several institutes: BRI, IMI, PBI, IAR, IRC
  - Track record: NBP, AMI,…

In Canada there is extensive expertise and infrastructure for growing, harvesting and initial processing of biomass.

Bioresins and biocomposites are expected to replace 25 to 30% of traditional materials in many industrial sectors.

Flagship Addresses Key Technology Gaps

- Reliable and consistent raw materials
- Compatibility with manufacturing processes and end product requirements
- High-throughput, reliable manufacturing processes
- Bioproducts performance

Flaghsip Program Scope

Seed-to-product ***De la fourche à la fourgonnette***

Engages industry and support the development of the entire supply chain

BIOMASS
Supply, selection, harvesting, standards

RAW MATERIALS TREATMENT
Characterization, fitness for use, handling

PROCESSING/ MANUFACTURING
Flexible platforms, high throughput, reliability, new markets

APPLICATIONS
Cheaper, lighter, stronger materials for the contruction, automotive

The Flagship Program: What's New?

- Flagship Program builds on existing expertise and programs
  - NBP-2, AMI, internal NRC R&D
- Closer to commercialization
- Program: Portfolio of projects
  - Outcome-driven, market pull, client-focused
  - One-on-One; Multiclient
  - Selection based on commercialization and impact potential

From Key Capabilities to ...Applications & Products

Construction

- Structural insulated panels
- Green building biomaterials : siding, windows and doors
- Biocomposite decking & railing
- Flexible roofing biomaterials: shingles, membranes
- Hybrid biocomposites for infrastructure
- Biofibre cement composites

Automotive / Transportation

- Automotive body panels
- Automotive structures: Chassis and frame components
- Automotive interiors
- Flexible biofoams
- Lignin-based Biopolyols & Thermoplastics

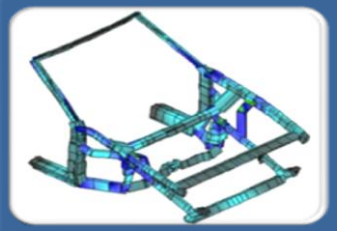
Three Areas of Expertise to Offer

Biofibres and Bioresins

- Biomass and raw materials production
- Wood, agri-fibres
- Bioresins

Manufacturing of Advanced Composites

- Efficient manufacturing processes
- Process simulation
- Design



Materials and Systems Performance Evaluation

- Structural Analysis
- Thermal, Fire and Sound Performance
- Durability, Life-Cycle Analysis (LCA)

First Area: Biofibres and Bioresins

Biofibres: Develop high performance biofibres

- Optimisation of fibre extraction and functionalization
- Mechanical and enzymatic approaches
- Processing of fibre into tows, mats and fabrics
- Short and long biofibres : Flax, hemp and wood

Bioresins: Develop high performance bioresins

- Lignin, vegetable oils extraction, modification for resin synthesis
- Formulation for processing and performance
- PHB, PLA, thermoplastic/lignin (PP, PE, PVC, PA…), lignin/vegetable oil thermoset (PU, UPE, VE, Epoxy,...)

Biocomposites

- Compatibilisation, formulation for performance and processing
- Nanoparticles to optimise properties
- Thermosets and thermoplastics

Second Area: Manufacturing of Advanced Composites

Processes

- High-throughput/productivity, Cost-effective: Liquid moulding, Compression moulding, Forming-stamping
- Adapted to industrial biomaterials

Applications

- Construction: Windows, siding, fences, roofing
- Automotive: Trays and covers, tanks and pans, shields, beams and structures, front end carriers, body and chassis

Materials and Systems

- Synthetics: Glass, carbon or basalt reinforced polymers; thermoplastics and thermosets
- Biofibres: wood (P&P) and agri-fibres (flax, hemp)
- Bioresins: lignin/vegetable oil derived TS and TP

Third Area: Materials and Systems Performance Evaluation

Structural Performance

- Static, fatigue and seismic structural response
- Acoustic and vibration behaviour

Physical and Chemical Performance

- Thermal, fire and sound performance, volatile emissions
- Chemical stability, compatibility of dissimilar materials in composites

Materials and Systems Performance Evaluation

- Degradation mechanisms
- Environmental durability and ageing
- Life cycle analysis (LCA)

Flagship's Value Proposition

To enable Canadian firms to create value by profitably transforming Canadian biomass into engineering products in key industrial sectors

These successful companies will in turn create jobs and produce products that have less impact on the environment

Working with the Flagship Program

- NRC actively seeking clients and collaborators:
  - To ensure that industry requirements drive our R&D capabilities
  - To commercialize industrial biomaterials innovations
- NRC consulting to validate the strategic direction
- Business plan to be implemented shortly

Key Contacts

Flagship Lead: Michel Dumoulin (michel.dumoulin@nrc-cnrc.gc.ca)

- Martin Bureau: martin.bureau@nrc-cnrc.gc.ca
- Andrew Johnston: andrew.johnston@nrc-cnrc.gc.ca
- Christian Bélanger: christian.belanger@nrc-cnrc.gc.ca

Questions?