ALBERTA INNOVATES

Alberta Bio Future Program Achievements

April 1, 2015 to March 31, 2019

The Alberta Bio Future program is the province's flagship initiative to advance the bioeconomy. Launched in 2014-15, this program offers funding and connections to develop sustainable and profitable products and technologies from Alberta biomass in the areas of advanced biomaterials, biochemicals and bioenergy. The program is administered by the Alberta Innovates Bioindustrial Innovation Team and is co-funded by Alberta Innovates and Alberta Economic Development, Trade and Tourism.

ABF FUNDING
$33.7 MILLION

TOTAL PROJECT COSTS
$104 MILLION

SUPPORTING
135 PROJECTS

PROJECT LEVERAGING
$1 ABF : $2 OTHERS

About the Alberta Bio Future program

The Alberta Bio Future (ABF) program aims to add value to many sources of Alberta biomass by developing new products and technologies for a multitude of end-use market sectors. With a strong industry focus, the program is accomplished through a series of subprograms in areas of immense opportunity for Alberta's agricultural and forest industries, including in cellulose nanocrystals (CNC), lignin and green building products.

As of March 31, 2019, after five years of program delivery, $33.7 million in ABF funding has resulted in 135 projects worth over $104 million in total project costs. This is a leveraging ratio of $1 from ABF to $2 from other sources. Alberta Economic Development, Trade and Tourism has contributed $12.5 million in cash to co-fund the ABF program and Alberta Innovates has contributed more than $21.2 million in cash and in-kind resources.

The ABF program, which launched in 2014-15, concludes on December 31, 2020. The ABF team is hopeful the program will receive renewed funding from the Alberta government. In summer 2019, the ABF team is starting a strategic analysis initiative, including a market assessment to create a roadmap for future bioindustrial investments.

SOURCES OF ALBERTA BIOMASS

Agriculture

- Algae
- Brown grease
- Canola (lipids)
- Hemp
- Oats (bioactives)

Forestry

- Pulping waste streams
- Wood residue from logging, sawmills
- Wood waste in municipal landfills

END-USE MARKET SECTORS

- Construction materials
- Cosmetics
- Food packaging
- Functional foods
- Horticulture
- Medical devices
- Natural health products
- Nutraceuticals
- Personal care products
- Pharmaceuticals
- Plastics
- Renewable natural gas
- Specialty chemicals
- Transportation fuels

Alberta's Bioproducts Innovation Hub

Thanks to the ABF program and other strategic investments, Alberta has developed a thriving bioproducts innovation hub. The hub is anchored by many leading-edge facilities that can develop a wide range of renewable and sustainable products from Alberta biomass: cellulose nanocrystals, lignin, green building products and other sources.

BIOPRODUCTS INNOVATION TIMELINE

- Cellulose Nanocrystals
- Lignin
- Green Building Products
- Other Sources

1980s
InnoTech Alberta forest products laboratory (Edmonton)

2009
InnoTech Alberta pilot hemp decortication plant (Vegreville)

2011
University of Alberta laboratory for NSERC's Industry Research Chair in Engineered Wood & Building Systems (Edmonton)

2013
InnoTech Alberta CNC pilot plant (Edmonton)

2014
ALBERTA BIO FUTURE PROGRAM LAUNCHES

2014
Radient commercial cannabinoid oil manufacturing plant (Edmonton)

2015
BioComposites Group's commercial hemp product manufacturing plant (Drayton Valley)

2016
West Fraser commercial lignin recovery plant (Hinton)

2016
Hexion Canada commercial R&D laboratory (Edmonton)

2016
Ceapro commercial oats bioactive manufacturing plant (Edmonton)

2018
Bio-Resource Information Management System (www.BRIMS.ca)

2018
SBI Bioenergy Ltd. commercial demonstration biofuel from canola manufacturing plant (Edmonton)

2019
University of Alberta CNF pilot plant situated at InnoTech Alberta (Edmonton)

2019
Hexion Canada commercial production plant for lignin-based resins (Edmonton)

2019
Natural Fibre Technologies' commercial hemp decortication plant (Nisku)

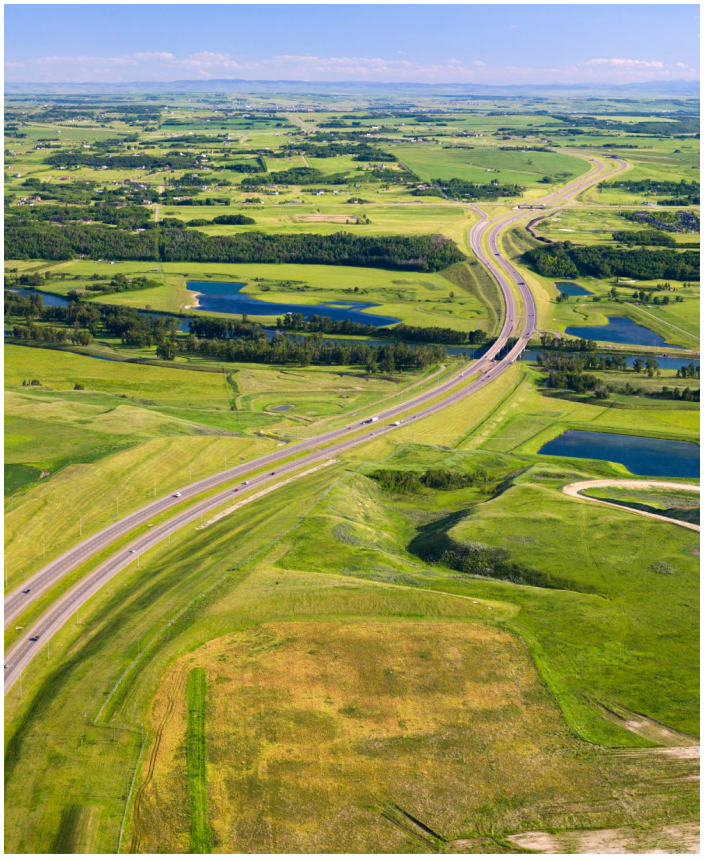
2021 (tentative)
Al-Pac commercial plant (Boyle)

Products and Technology Under Development

BIOENERGY, BIOMATERIALS AND BIOCHEMICALS

The world is focused on achieving a lower carbon future through many greening initiatives. This focus has stimulated much clean technology development in Alberta's energy industry, including in the bioenergy sector. Bioindustrial and bio-based technologies from Alberta biomass have become part of the province's overarching clean technology solution to climate change.

Economic activity in the Canadian and Alberta forest industry continues to decline in the face of many challenges, including the U.S. housing market collapse in 2008 and the rising popularity of the Internet as a source of news, shrinking the need to produce newsprint and other paper products. Experts have recommended development of new value-add biomaterial and biochemical products from the pulping waste stream (i.e. cellulose nanocrystals and lignin) as an area of new business opportunities. They also advise to diversify the forest industry with an increased range of green and engineered wood biomaterial products.



Bioenergy

Bioenergy products from agricultural and forestry biomass are turning waste into value-add products that can help Alberta reduce greenhouse gas emissions, diversify its energy portfolio and increase its renewable energy capacity.

Unique properties:
Lower carbon footprint, green, renewable and more.

ABF investment:
Since 2014-2015, ABF has invested in 15 projects worth total project costs of $11.8 million.

ABF achievements:

- bioenergy from fast growing willow plantations
- renewable diesel from non-food grade canola oil
- renewable natural gas from wood waste
- drop-in jet fuel from brown grease
- diluents and hydrogen from algae

Alberta has enough forest and agriculture biomass to support 14 large commercial plants with G4 Insight Inc.'s wood-based renewable natural gas technology (RNG) that would require 2,500 full-time operational staff. RNG holds great potential to become a viable renewable energy source of the future, reduce greenhouse gas emissions, stimulate rural economic development and create skilled jobs.

Cellulose Nanocrystals

Alberta is one of only a few places in the world that can produce CNC.

Unique properties:

High tensile strength, emulsifier stabilization, optical properties, biodegradability and more.

ABF investment:

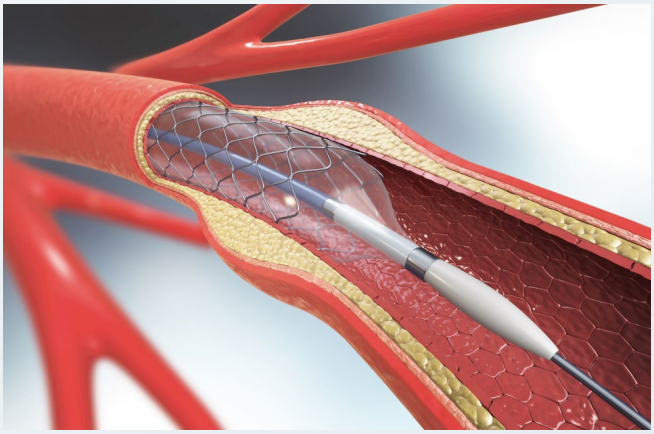
Since 2014-2015, ABF has invested in 59 projects with a total project value of $7.7 million, not including the CNC pilot plant at InnoTech Alberta in Edmonton.

ABF achievements - medical:

- saliva for patients with mouth cancer
- bone reconstruction scaffolding
- antimicrobial paint additive for hospitals that activates by turning on the room lights
- heart stents that are inserted closed and then open with body heat
- artificial living nerve tissue for lab testing

ABF achievements - other:

- drilling mud
- airplane de-icing additive to make the solution thicker and adhere to the wings longer
- window coating to convert sunlight into electricity that is stored on the window like a battery



Heart stents made with a 3D printer using a base material reinforced with CNC could be inserted in a closed position and opened fully with body heat.

Some examples of how ABF researchers are using cellulose nanocrystals...

...with zinc oxide in food packaging sensors or hand-held devices to tell when meat has spoiled.

...in new oral care products like gel, mouthwash and sprays to provide long-lasting relief from mouth dryness.

...in a coating in urinary catheters to prevent the adhesion of bacteria leading to urinary tract infection.

...by combining them with excessive greenhouse gas emissions and waste cooking oil to create biodegradable plastic bottles.

...to reconstruct bone.

...for the strong microneedles needed for low-cost vaccination of pigs against swine influenza.

...to produce stronger and lighter hockey sticks.

ABF researchers are exploring ways to use lignin to reduce methane emissions, a greenhouse gas, from oilsands tailings ponds.

Source: *Alberta Innovates*

Lignin

Experts believe that lignin, a waste stream from pulp mills that is commonly burned for energy, has a potential value that is 10 to 20 times greater as a biomaterial than as a fuel, especially in the areas of engineering plastics, polymer foams and carbon fibres.

Unique properties:

Binding, flocculance, adhesion, biodegradability and more.

ABF investment:

Since 2014-2015, ABF has invested in 20 projects worth total project costs of $2.3 million, not including the West Fraser lignin recovery plant in Hinton, AB.

ABF achievements - medical:

- medical bioimaging to better diagnose diseases

ABF achievements - other:

- drilling mud
- soil remediation
- sensors
- electrodes
- biodiesel
- biojet fuel
- lubricants
- dispersants
- batteries
- panel-board and plywood adhesive resin
- protective foams and coatings in products like truck beds and boats
- toxic contaminant removal in wastewater
- bioplastics packaging
- 3D printing
- flexible electronics
- solar cells
- sponges and other insulation materials
- methane greenhouse gas removal from tailings ponds

Green Building Products

The construction industry is looking to meet strict environmental regulations with green and engineered wood building products that have a lower carbon footprint than concrete and steel.

Unique properties:

Carbon-neutral biomaterial can sequester carbon for more than 50 years. Engineered wood products are exempt from the softwood tariffs on dimensional lumber and have superior finishing qualities as they are precise, true and straight, with no waning.

ABF-funded researchers are finding new ways to use oriented strandboard panels. Structural insulated panels (SIP) use OSB to encase rigid foam from canola that is strengthened with cellulose nanocrystals to create a wall system that does not need studs or a vapour barrier.

ABF investment:

Since 2014-2015, ABF has invested in seven projects worth total project costs of $12 million, not including the NSERC networks.

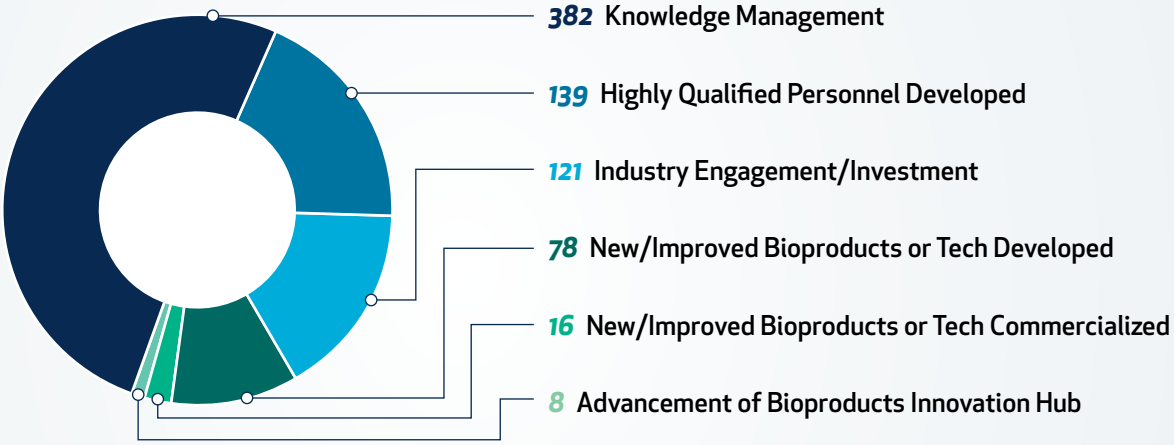
ABF achievements:

- structural insulated panels
- concrete hemp fibre reinforcement
- composite laminated panels

ABF researchers are developing technical information to enable increased use of engineered wood products such as laminated veneer lumber (shown in photo) in wall, roof and floor systems.

SUMMARY OF PERFORMANCE MEASURES, 2015-2019

As of March 31, 2019



Advancement of Bioproducts Innovation Hub

 # grand openings, # networks, other indication of growing critical mass.

Industry Engagement/Investment

 # companies involved.

New/Improved Bioproducts or Tech Developed

 # technologies developed, # patents, # licences, # successful scale-ups, # proof of concepts, # new concepts, # non-disclosure agreements. (To avoid double-counting, for each new product/ tech only one of these measures was counted in the final total regardless whether each measure was achieved.)

New/Improved Bioproducts or Tech Commercialized

 # products experiencing first-time sales, # spin-off companies, # jobs created.

Highly Qualified Personnel

 # HQP developed

Knowledge Management Occurrences with Industry, Government or Others

 # events hosted, # speaking opportunities, # articles, # news releases, # interviews, # trade shows with booth, # newsletter editions.

Knowledge Management Occurrences with Academia

 # events hosted, # speaking opportunities, # trade shows with booth, # papers published, # abstracts published

TO LEARN MORE, VISIT:

albertainnovates.ca/funding-alberta-bio-future/