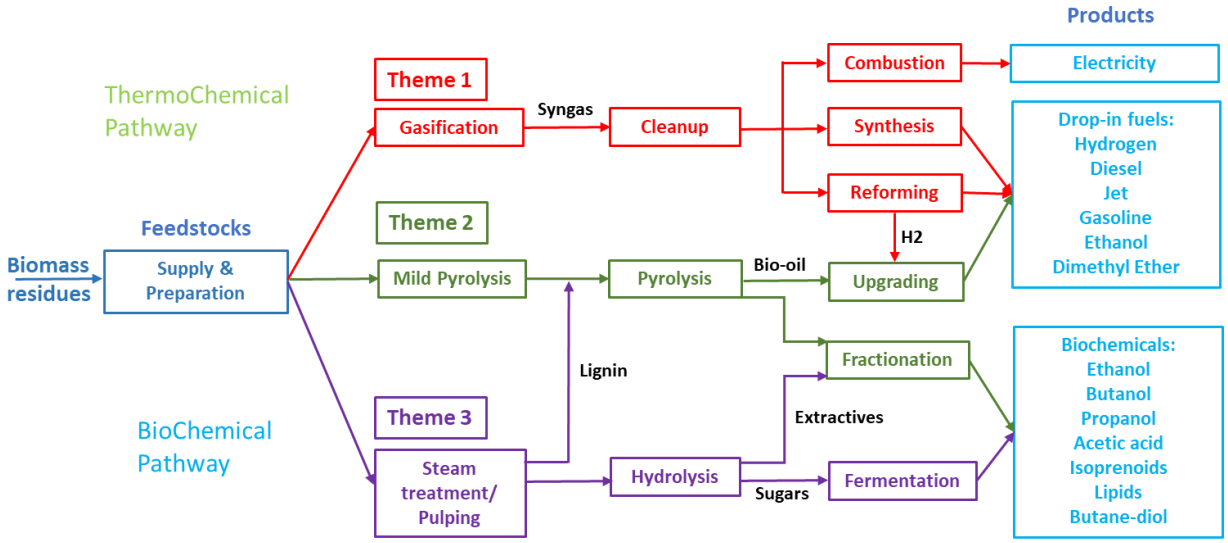
Biorefining Research and Innovation Centre (BRIC)

PROJECT SIZE: C$6 M
Funding sources: Canada Foundation for Innovation, Western Economics Diversification, BCKDF, UBC
LOCATION: Vancouver Campus
GOVERNMENT PRIORITIES: Clean Energy Sustainability
KEY RESEARCH LINKAGES: Renewable & sustainable energy, Biofuels & biochemicals, Greenhouse gas emission reduction, Solid waste utilization

The BRIC research program will translate fundamental research outcomes into new prototypes which, in partnership with industry, will be refined into commercializable, market-ready bioproducts. The research plan is organized across three Themes: (1) Gasification (thermochemical conversion of biomass to synthetic gas, biofuels and biochemicals); (2) Pyrolysis (thermochemical conversion of biomass to bio-oil, biofuels and biochemicals); and (3) Biochemical conversion (of biomass to biofuels and high-value chemicals).



Background

Since the 1980s, the UBC CERC and FRC have been researching biomass thermochemical conversion to syngas, bio-oil, biohydrogen, and biofuels, with a focus on catalyst development, novel reactor design, and biofuel characterization.

The creation of the Biorefining Research and Innovation Centre (BRIC) aligns directly with UBC's Strategic Research Plan in the Sustainability/Environment priority area. It also aligns with the strategic areas of BC government's Low-Carbon Fuel Standards and Forest Sector Strategy– Building BC's Bioeconomy: product diversification, fostering collaborations with academia, and supporting robust rural and First Nations communities.

The program will leverage the strong biomass (thermo- and biochemical) conversion research and innovation capacity across UBC's campus, as well as nationally and internationally, and generate unique opportunities for integrating various technologies for potential commercialization.

Current Status

BRIC will be housed in a 3,000 sq. ft. high-head space to be created within the existing $28M Bioenergy Research and Demonstration Facility (BRDF) at UBC's Vancouver campus, which already provides 14% of the campus' clean heat. The $6.1M budget has been funded in full. Design of the construction is underway and it is expected to open in April 2021.

There are three themes of research and development activities that will be carried out in this centre:

- Gasification (thermochemical conversion of biomass to synthetic gas, biofuels and biochemicals)

  PIs: Naoko Ellis, Xiaotao Bi, John Grace, Jim Lim, Patrick Kirchen, Kevin Smith

The ultimate goal of this theme is to develop and demonstrate an integrated and efficient biomass steam gasification pathway for converting biomass residues to power, biohydrogen, biofuels, and biochemicals. The short-term target is to: (i) demonstrate, at pilot scale, a novel, dual fluidized bed, steam gasification technology, (ii) utilize a red mud derived tar cracking catalyst for syngas clean-up, (iii) develop a new catalyst for catalytic synthesis of syngas to oxygenated biofuels/chemicals, and (iv) produce biohydrogen from a membrane catalytic reforming reactor.

- Pyrolysis (thermochemical conversion of biomass to bio-oil, biofuels and biochemicals)

  PIs: Kevin Smith, Xiaotao Bi, Naoko Ellis, Patrick Kirchen, Jim Lim, Shahabaddine Sokhansanj

This theme will develop and demonstrate new, robust pyrolysis and hydro-treating catalysts and novel reactors, at the pilot scale, for converting biomass to bio-oil and then upgrading bio-oil to "drop-in" biofuels or biochemicals. Over the first five years, the research will address four major technical challenges: (1) produce high quality bio-oil and biochar using a novel microwave-assisted catalytic pyrolysis technology, (2) formulate fractionation strategies to

extract valuable chemicals from bio-oil, (3) upgrade bio-oil to liquid biofuels by hydro-deoxygenation using new catalysts developed at UBC, and (4) test combustion performance of biofuels. Based on a joint feasibility study by UBC and Boeing, catalytic pyrolysis and hydro-thermal liquefaction in conjunction with catalytic hydro-deoxygenation are the most promising pathways to producing liquid biofuels. The key challenges are developing robust pyrolysis catalysts to target desirable functional groups of bio-oil so as to reduce hydrogen consumption in the hydro-deoxygenation operation and to maximize the yields of desired biochemicals extractable by fractionation.

- Biochemical conversion (of biomass to biofuels and high-value chemicals
  PIs: Jack Saddler, Heather Trajano, Shahabaddine Sokhansanj, Jim Lim, Xiaotao Bi

This theme is to biologically convert biomass to value-added fuels and chemicals, with a focus on developing and demonstrating novel steam treatment strategies at pilot scale, based on adapting Canada's current pulping equipment, infrastructure, and supply chain. As part of this initiative, novel steam pre-treatments will be developed for the production of high-quality pellets that could be utilized for energy, fuel, and chemical applications, as well as enhanced enzymatic conversion and fractionation of woody biomass to useful cellulose, hemicellulose, lignin, and extractives fractions. The extractive components of the woody biomass will be subjected to novel fractionation, derivatization, and upgrading technologies. The four subthemes, each with its specific targets, are all interconnected components of the biochemical conversion pathway.

Benefits to Canada

BRIC aims to play an important role in building Canada's emerging bio-based economy and rejuvenating and accelerating its sustainable forest products industry. The technology transfer activities will enable multiple chemicals, fuels and bioproducts to be assessed for their technical, economic and sustainability potential. BRIC researchers have established highly integrated and productive partnerships with key players and receptors of biorefining innovation. They will further empower Canada to support this essential pipeline from discovery to commercialization in partnership with Canadian and international companies.

Contact

Tony Bi
Director, Clean Energy Research Centre
tony.bi@ubc.ca
+1 604 822 4408
2360 East Mall, Vancouver, BC V6T 1Z3