

# HYDROTHERMAL TORREFACTION OF HIGH MOISTURE CONTENT BIOMASS

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## BACKGROUND

This theme is focused on the utilization of biomass-based materials for production of fuels and energy. Lignocellulosic biomass; materials derived from living or recently-living organisms, come from agricultural sources, forest sources and wastes. Because of Canada's large agricultural and forest industries, there are potentially large amounts of biomass available to produce energy.

Lignocellulosic biomass can be converted to energy through two key sets of pathways that are currently under development; thermochemical and biochemical conversions.

key challenge in using biomass for energy that this research study is trying to address are:

- Accommodating the variation in biomass feedstocks,
- Large costs of collection and transportation and the availability of feedstock,
- Challenges in the thermochemical and biochemical conversion pathways in terms of scale up of technologies, process development and economic viability.

## OBJECTIVES

**Short Term Objectives:** It is important firstly, to explore and identify the operating regimes for these processes is a parametric study in the short term.

- Selection and advanced characterization of the feed biomass and biomass slurry,
- Design of experimental plan for tests for pipeline and HT process,
- Investigate the operating regimes of different pipeline transport and HT processes for biomass.

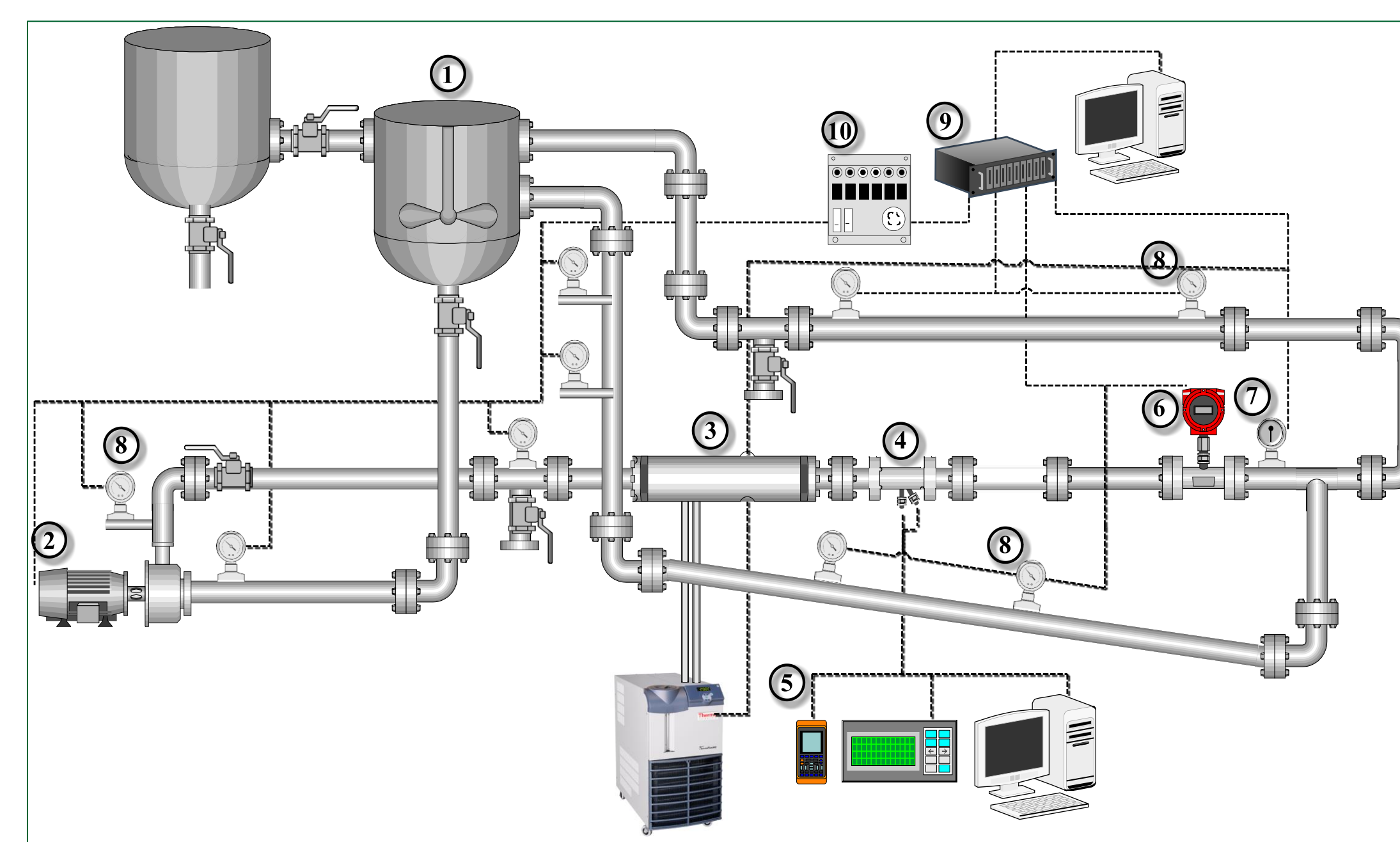
**Long term objectives (realizable in seven years):**

- To optimize conditions for a scaled up operation for a particular product or a given product distribution from techno-economic point of view,
- Optimization of the process conditions for the hydrothermal conversion of biomass in a pilot scale facility,
- Techno economic study of the process.

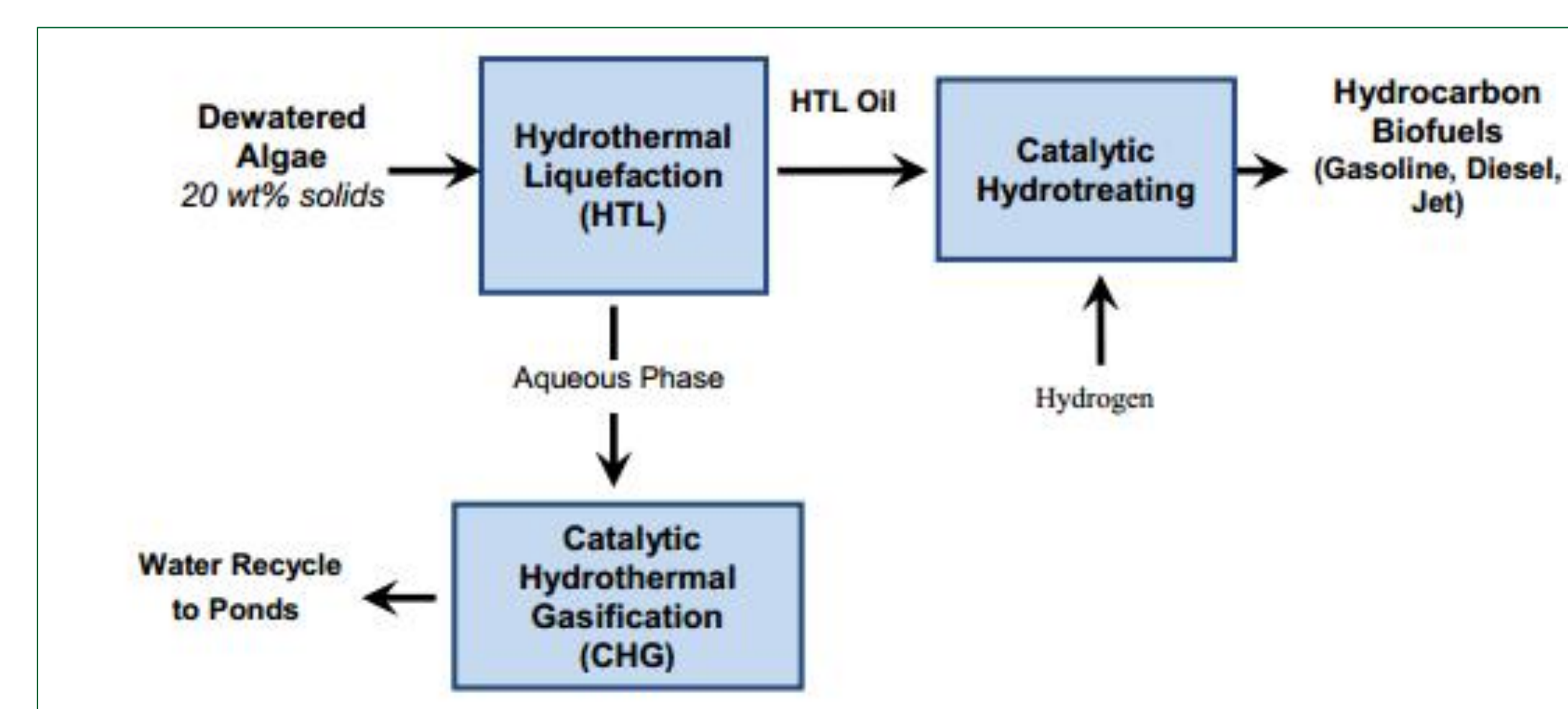
## PROJECT OVERVIEW

There is a lot of potential for biofuel and bioenergy production from forests and agriculture residues. However, delivery cost of biomass by trucks to a conversion facility is high and have distinct economic and technological challenges. Pipeline transport of forest biomass in the form of slurry (a wood chip-water mixture), on the other hand, provides an alternative approach that enables bio-based energy facilities achieve higher capacities, since pipeline delivery receives benefits through economies of scale. Forest biomass slurry would enter the facility directly with or without minor adjustments in the biomass-water ratio.

Biomass transported through pipeline in the form of a slurry with water would have high moisture content. However, integrating pipeline delivery with efficient hydrothermal (HT) biomass processing technologies could transform the bioeconomy. HT processes uses biomass in the form of a slurry and produces liquid fuel/gas/solids which can be used for production of fuels and energy.



Pipeline facility in Large Scale Fluids laboratory - schematic diagram



Hydrothermal liquefaction of algae to bio-oil to Diesel & Naphtha

HT processing is a state-of-the-art thermochemical conversion using biomass feedstock with high moisture content (60-80%) especially in slurry form. This conversion process converts biomass into useful solid product with high calorific value and very low moisture content which can be for producing fuels and electricity.

This integration of technologies can help in producing biofuel and power at significantly lower cost. The proposed project is aimed at developing a transformative solution through integration of the pipeline transport of biomass with HT processing technologies. Pipeline transport helps in reducing the transportation cost compared to truck and rails and HT technologies help in processing biomass with high moisture content. Hence marrying these two technologies could be transformative and help in solving key challenges in development of a bioeconomy in Canada.

## EXPECTED OUTCOMES

- Obtaining in-depth understanding of technical challenges of integrating pipeline transport with hydrothermal processes,
- Developing a procedure for preparing and transporting biomass slurry adoptable to hydrothermal processing facility,
- Obtaining clear understanding of hydrothermally processing pipeline-delivered biomass via experimentally investigating HT processes,
- Gaining critical information for the scale-up of the pipeline transport facility integrated with hydrothermal technologies in lab scales,
- The deployment of the biomass conversion technology in the domestic market for abundant forest and agricultural biomass residues in Canada, contributing to the sustainable development of Canadian economy.

Wheat straw biomass-water mixture (slurry) in closed-circuit pipeline facility in Large Scale Fluids Lab. at the University of Alberta



## THEME OVERVIEW

Biomass

We already know how to create fuels from certain types of biomass, but many other feedstocks can potentially be transformed in a similar manner. In order to identify new viable sources, we must develop more a sophisticated understanding of the technological processes that might be used to convert biomass to fuel, and assess the potential business cases for adopting certain sources that might have other economic uses, or compete with established cash crops. We can also explore the potential for tailor-made fuels for the transportation sector, developed from biological sources.

## EXTERNAL PARTNERS

The proposal is part of larger initiative on pipeline transport of biomass. This initiative has been supported by NSERC, Alberta Innovates and Canadian Dewatering Inc.

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