ALBERTA INNOVATES

CLIMATE CHANGE INNOVATION AND TECHNOLOGY FRAMEWORK

Awardee Summary

CCITF PROGRAM	Clean Technology Development
PROJECT TITLE	Advanced biorefinery technology for chemicals production from waste and biomass
SECTOR	Waste to Value-Added
ORGANIZATION	Enerkem Inc., R&D Advanced Energy Research Facility
PROJECT LEAD	David Lynch
AI PROJECT ADVISOR	Mehr Nikoo
GRANT AMOUNT	$508,000
START DATE	10/1/2018
END DATE	9/1/2021

PROJECT OBJECTIVE: To develop the conversion of syngas and methanol to six higher value products that are used as fuels and chemicals including dimethyl ether, acetic acid, and acrylic acid.

PROJECT PROFILE: The current proposal seeks to develop the conversion of syngas and methanol to six higher value products that are used as fuels and chemicals including DME, acetic acid, and acrylic acid. The development builds on Enerkem's core technology that converts waste materials to syngas, and then synthesizes methanol or ethanol from that syngas. Production of acetates and acrylates via the new technologies proposed will further diversify the Alberta economy and reduce GHG emissions from a broad range of available waste materials in Alberta. The products identified for development have maximum potential for CO2 utilization and GHG emission reduction while promoting Alberta's industrial development and economic diversification. The proposed technology represents an opportunity to fulfill regional and international market needs for chemical and solvent feedstock. Currently, Alberta imports approximately 49,000 MT (2012 Data) of acrylic polymers annually. In addition to acrylic polymers, chemicals are imported in the form of Acrylate esters and acetate esters and are used in various formulations for paints, solvents, and emulsions. Production of these products in Alberta also allows access to multi billion dollar global markets through sustainably produced green acetic acid (~ $5 Bln USD annual Sales) and acrylic acid (~ $20 Bln USD annual sales).

The chemical advancements to be further developed in this project have been identified through research previously supported by Alberta Innovates and Emission Reduction Alberta. When used in conjunction with technologies such as dry reforming, the synthesis techniques and products we are developing can capture carbon from CO2 in the product molecules with a capture rate as high as 56% of the input CO2.
The three chemical processes that are proposed for further development are Reactive distillation, Iodide free Carbonylation and Aldol condensation. Each of the 3 processes described has specific challenges that must be addressed to fully characterize its commercial potential. The new carbonylation process is using a

new and novel catalyst that has performed very well in laboratory testing but has yet to be proven in full industrial conditions. Specifically, a new test apparatus will be built with a proper reactor configuration to best perform both the synthesis of methyl acetate and characterize the required reactivation protocol of the catalyst. The reactive distillation process to be developed needs to be tested to verify both standalone DME production and combined DME and methyl acetate performance (process intensification) for product purity of both the resulting acetic acid and DME. The third process to be tested will use acetic acid and formalehyde to make acrylic acid. This pathway to acrylic acid is taylored for production from biomass and can result in yields of acrylic acid from biomass 46% higher than going through the more traditional methanol to propylene route to acrylic acid. The 3 technologies coupled with Enerkem's modular facility design and manufacturing approach represent an unprecedented opportunity to establish Alberta as a leader in the renewable chemicals market.

GHG EMISSION REDUCTION SUMMARY: