

# CLEAN RESOURCES

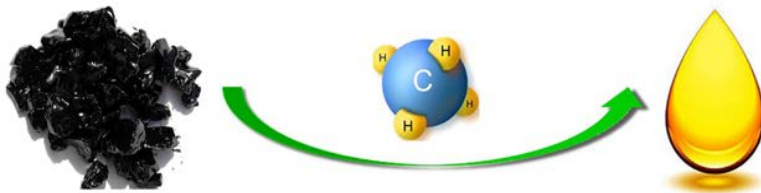
## ADVANCED HYDROCARBONS

INNOVATIVE HYDROCARBON PRODUCTS – PARTIAL UPGRADING

### FUNDING DETAILS

## Catalytic Heavy Oil Partial Upgrading under Natural Gas

Alberta abundant heavy crude cannot be directly sent to refineries as feedstock for fuels and petrochemicals production due to its poor physical properties. The goal of the current project is to enhance the quality of heavy crude oil for satisfying the pipeline transportation specification by using a technology based on catalytic incorporation of natural gas into heavy crude at moderate reaction conditions. Results are expected to lead to reduced capital and operating cost, thus improving profitability compared to conventional hydroconversion technologies. Furthermore, such natural gas incorporation into the liquid product could minimize greenhouse gas emission from the upgrading process, making it more environmentally friendly.



#### RECIPIENT:

University of  
Calgary - Dr. Hua  
Song



#### TOTAL BUDGET:

\$1,000,000



#### PROJECT DATES:

MAR 2019 –  
MAY 2021



#### PARTNERS:

Kara Energy  
Service, NSERC



#### AI FUNDING:

\$400,000



#### PROJECT TRL:

Start: 2-3  
End: 4-5

## APPLICATION

The innovative technology developed by this project aims to provide the current oil market with a greener low-cost pipeline transportable synthetic light crude intermediate with enhanced quality. This will have higher value and is easier to be processed by the downstream refineries, and will create additional capacity in existing pipelines by reducing the diluent requirement.

# ALBERTA INNOVATES CLEAN RESOURCES

## ADVANCED HYDROCARBONS

### INNOVATIVE HYDROCARBON PRODUCTS – PARTIAL UPGRADING

#### PROJECT GOALS

- Finish catalytic performance evaluations at lab scale under batch mode and at 1 barrel per day small pilot scale under continuous mode
- Validate process performance with and without catalysts and methane
- Quantify the incorporation of methane and define the resulting products
- Gain a better understanding of the catalytic reaction mechanism and catalyst deactivation mechanism beneficial for catalyst rational design for pilot testing
- Deliver catalysts in an extruded form with optimized dimensions, which can effectively upgrade heavy crude under natural gas to produce synthetic crude with the following characteristics: liquid yield  $\geq 98$  wt.%, density  $\leq 940$  kg/m<sup>3</sup>, viscosity  $\leq 350$  cSt, Olefin content  $\leq 1$  wt. %, vapor pressure  $\leq 95.103$  kPa, solid content  $\leq 0.5$  wt.%, TAN  $\leq 1.1$  mg KOH/g at a temperature of 380-430 °C; and pressure of  $\leq 5$  MPa

#### BENEFITS TO ALBERTA

- Reductions in GHG emission by more than 90% compared to the conventional hydroconversion technologies
- Reductions in capital and operating costs by more than 70% compared to the conventional hydroconversion technologies
- Improvements of the quality and value of the produced pipeline transportable synthetic crude for downstream refining
- Partnerships between industry and academia for better training highly qualified personnel
- Commercial use of this developed technology for upgrading heavy crude at a scale of no less than 200,000 barrel/day
- Provision of essential insights and improved technology that could subsequently be applied to oilsands bitumen and other low-cost hydrocarbon feeds



2 Publications



4 Students  
Trained



3 Patents



1 Project Job



30-50 Future Jobs



3 New  
Products/Services



10 - 20 T/yr Project  
GHGs Reduced



10-20 kT/yr Future  
GHGs Reduced

#### CURRENT STATUS

#### April 2020

- Completed 1 barrel per day research prototype fabrication and shakedown which is nearly ready for long-term operation
- Gained a better understanding of the involved catalytic reaction mechanism
- Identified a broader application of the developed technology to other low-cost feeds