Scaled Production of High Octane Biofuel from Biomass-Derived Dimethyl Ether

WBS# BETO.2.3.1.305

Jesse Hensley, NREL

Project Info

- *TCF Topic 2*
- *Bioenergy Technologies*
- *Partner Enerkem*

Timeline

- *Start – October 2016*
- *End – September 2018*
- *100% Complete*

	Total Funding Pre-FY17	FY 17 Funding	FY 18 Funding	Total Planned Funding
DOE Funded	$0	$740k	Carry from FY17	$740k
Project Cost Share	$0	$250k in-kind $512k cash	Carry from FY17	$762k

Management Approach

NREL — Transforming ENERGY

Jesse Hensley
NREL

- Catalyst scaleup
- Bench-scale optimization
- Reaction engineering
- Fine distillation
- Product analysis & fuel properties

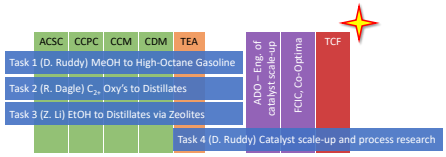
time-bound pilot ops and production goals, on-site meetings

Enerkem

Stephane Marie-Rose
Enerkem

- Reaction engineering
- Pilot design/configuration
- Supervise pilot operations
- Rough distillation
- Bench scale performance validation

Integral part of higher-TRL research associated with BETO's Indirect Liquefaction projects

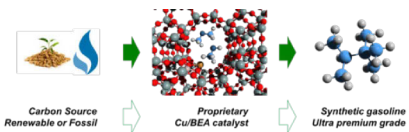


Acknowledgments

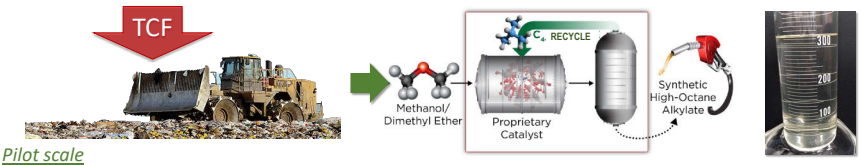
U.S. DEPARTMENT OF ENERGY
Bioenergy Technologies Office

ChemCatBio Chemical Catalysis for Bioenergy
Energy Materials Network U.S. Department of Energy

Purpose of Project



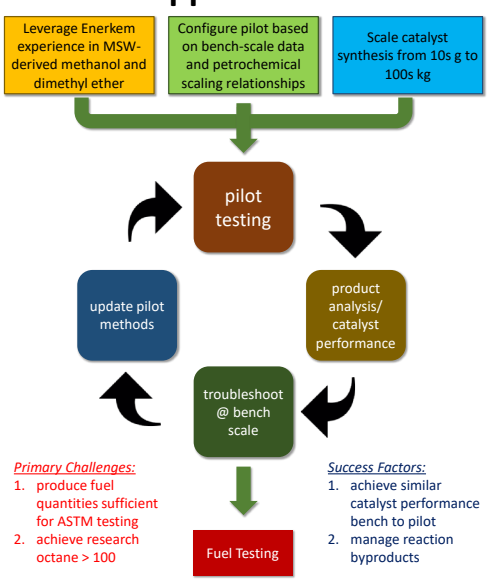
Lab scale (BETO project Liquid Fuels via Upgrading of Intermediates)
Great for catalyst development and testing…
Can't produce liquids in quantities to:
- Validate fuel properties with ASTM
- Allow commercial sector to "touch, feel, smell" product



Pilot scale
Produce meaningful quantities of liquid
- Confirm catalyst selectivity and stability
- Produce gallons product from MSW
- ASTM testing of fuel properties

Attract commercial interest

Technical Approach



Primary Challenges:
1. produce fuel quantities sufficient for ASTM testing
2. achieve research octane > 100

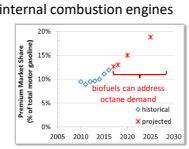
Success Factors:
1. achieve similar catalyst performance bench to pilot
2. manage reaction byproducts

Relevance and Impact

To the bioenergy industry

High octane gasoline rich in 2,2,3-trimethylbutane:

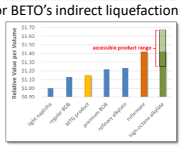
- Is eligible for high-value RINs when produced from non-food carbon, and can be made from biogas, MSW, agricultural waste, or energy crops
- Works synergistically with ethanol to improve fuel efficiency, emissions (GHG and particulates), and power in internal combustion engines
- Provides an opportunity to eliminate lead additives from aviation gasoline
- Allows biofuels to once-again address petroleum refiners' growing octane demand



To BETO

This TCF project supports research goals for BETO's indirect liquefaction projects:

- Increase yields in catalytic processes
- Produce high-value products
- Advance technologies to higher TRL
- Demonstrate feedstock flexibility



To the advancement of TRL

This project moves the high octane gasoline technology from TRL4 (lab demonstration) to TRL6 (pilot operation) and has provided significant insight and lessons to move toward TRL7 in the future

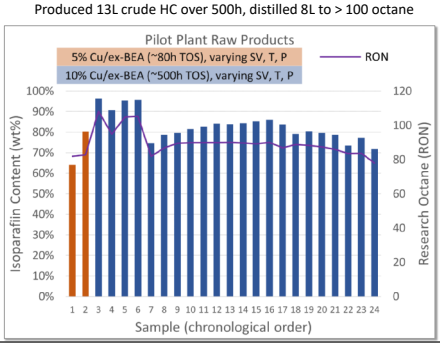
Technology transfer

Greatest impact of this project. By having liter-quantity samples in hand, we can provide samples to technology adopters. To date fuel from this TCF project has been tested (with positive reviews) by Shell, ExxonMobil, Honda, and Afton Chemical. *ExxonMobil is currently evaluating @ scale economics before negotiating a 5000 gallon demo of NREL's high octane technology*

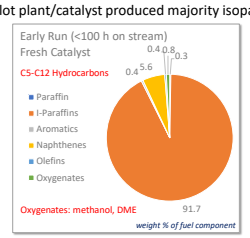
Data Highlights

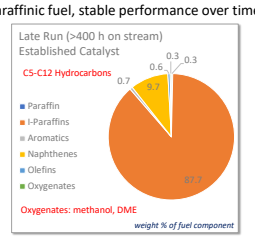
Successfully produced 150 kg catalyst

Produced 13L crude HC over 500h, distilled 8L to > 100 octane

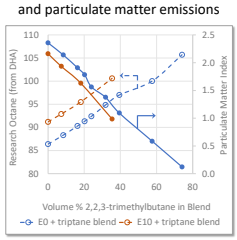


Pilot plant/catalyst produced majority isoparaffinic fuel, stable performance over time

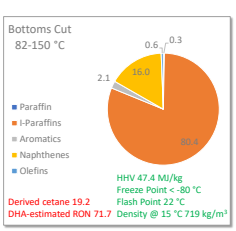




Product blended with conventional gasoline significantly improves octane and particulate matter emissions



Distillation bottoms may have application as jet blend



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