THE BIOFINE PROCESS

A proprietary, continuous, fast chemical refining process that enables the production of high value renewable chemicals and biofuels from cellulosic residues.

- Initial funding: Private funds, US DOE and NYSERDA
- Semi-works demonstration plant (presently UMO owned)
- 1999 Presidential Green Chemistry Challenge award
- Strong intellectual property portfolio (in-house/licensed)
- Key primary product: levulinic acid;
- Key derivative: ethyl levulinate (EL)
- Focus on biofuels - heating and jet fuel (NORA, Texaco, others)
- Longer term – sustainable derivative chemicals
PROCESS FLOW: BIOFINE PLANT

Feedstock → Biofine Hydrolysis → Product Recovery

Byproduct Conversion → Ethanol

Esterification/Purification

Bio-Char Pelletizing → Bio-Char Pellets

Formic Acid/Methane

Ethyl Levulinate

Levulinic Acid
THE VALUE CHAIN

Cellulosic Feedstock
- Wood
- Wood pulp
- Cellulosic Sludge
- Waste Paper/OCC
- Crops
- MSW

Biofine Process
- Levulinic Acid
- Formic Acid
- Ligneous Char

Downstream Conversion
- 3-HPA
- Acrylic Acid
- Succinic Acid
- Ethyl Levulinate
- TDO Hydrocarbons (UMO)
- DALA
- Diphenolic Acid

Drop-In Product Demand
- Heating Fuels
- Jet Fuels
- Plastics/Plasticizers
- Agriculture
- Cosmetics
- Flavor & Fragrance
- Resins & Coatings
- Carbon Fiber
FUEL DEVELOPMENT

- Compatible with both light and heavy fuels
- High flash point
- Very high octane numbers (gasoline)
- Route for ethanol into heavy fuels
- High lubricity (hydro-treated low sulfur fuel)
- Oxygen content 33%
- Reduces diesel smoke (soot) significantly
- Excellent cold flow properties
- Suitable as a blendstock for FAME esters
- Projected production cost - $0.50/lit. ($17/GJ)
 TECHNICAL BENEFITS AS A HEATING FUEL

• NEGATIVE CARBON DIOXIDE LIFE CYCLE ASSESSMENT AS A FUEL (DUE TO BYPRODUCTS)
• INCREASES COMBUSTION EFFICIENCY OF FUEL BLENDS: EL = 33% OXYGEN
• REDUCES COMBUSTION PARTICULATE (SOOT) AND CARBON OXIDES
• REDUCTION IN BLEND SULFUR EMISSIONS (zero sulfur in EL)
• GIVES HEATING OIL A LOWER GHG FOOTPRINT THAN NATURAL GAS @ 10% BLEND
• BIGGER REDUCTION IN GHG FOOTPRINT THAN SOY BIO-DIESEL
• ALLOWS ZERO OR NEGATIVE CARBON EMISSIONS FOR HOME AND COMMERC’L FUELS
• IMPROVES LOW TEMPERATURE HANDLING (GELL PT. CLOUD PT., CFPP)
• INCREASES LUBRICITY AND LOWERS VISCOSITY OF FUEL OIL BLENDS
• EASILY BLENDS WITH BASE FUELS AND BIODIESELS
• GREATLY INCREASES OXIDATIVE STABILITY OF BIODIESEL (RANCIMAT DATA)
POTENTIAL CARBON DIOXIDE EMISSION REDUCTION USING EL IN HEATING FUEL (LB/HOUSE/YEAR)

Ethyl Levulinate Production Efficiency 100 Year Atmospheric Lifetime

Lb CO₂e/Year

ULSD HO/EL

Natural Gas
TIMELINE
TEST MARKET - COMMERCIALIZATION

2017 - 2018 Residential Field Test of EL blends = 10 - 20 homes for full season
  • Location: Maine
  • Partners: Oil Company, NORA – Production, Operations, Logistics, Monitoring, Evaluation

2018 Commercial Field Test of EL 100% = 2-3 month test
  • Location: Maine
  • Partners: Oil Company, NORA – Production, Operations, Logistics, Monitoring, Evaluation

2018 – 2020 Expected Commencement of Full Scale Plant Design and Construction in Maine

2021 First Plant Operational - Manufacturing EL from waste biomass
  • 3 Million gallons/year EL + limited specialty chemicals
  • Fuel priced at par with #2 heating fuel
  • EL is potentially eligible for D7 cellulosic RINS
  • Feedstocks – MSW-derived and waste forest biomass

2021 – 2023 Construction of Larger Plant in Maine
  • Approximately 10 Million gallons per year EL for heating fuel
  • Larger scale eliminates dependency on RINS
  • Potential Blending with UMO TDO-derived hydrocarbons
ACKNOWLEDGEMENTS

National Oil-heat Research Alliance (NORA)

The Dead River Company (DRC)

The University of Maine (Orono)

U.S. Department of Defense
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