



**CATALYTIC CONVERSION OF
BIOMASS TO GASOLINE, DIESEL, JET
FUEL AND OTHER HYDROCARBONS**

Virent Energy Systems Overview



- **Founded in 2002**
- **Based in Madison, WI**
- **> 70 Employees**
- **16 Pilot Plants in Operation**
- **29,000 sq. ft. facility**
- **> \$ 30 MM of Venture Financing**

Virent is commercializing proprietary low temperature catalytic processes that convert biomass into hydrocarbon fuels, chemicals, or hydrogen.



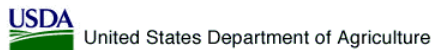
Tier-One Global Partners

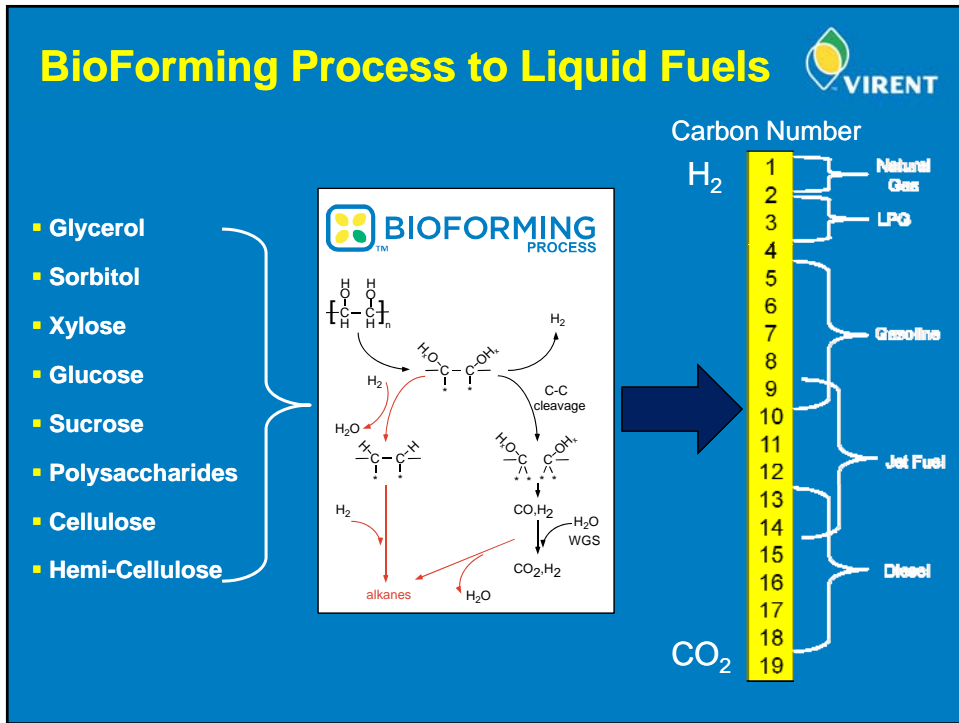
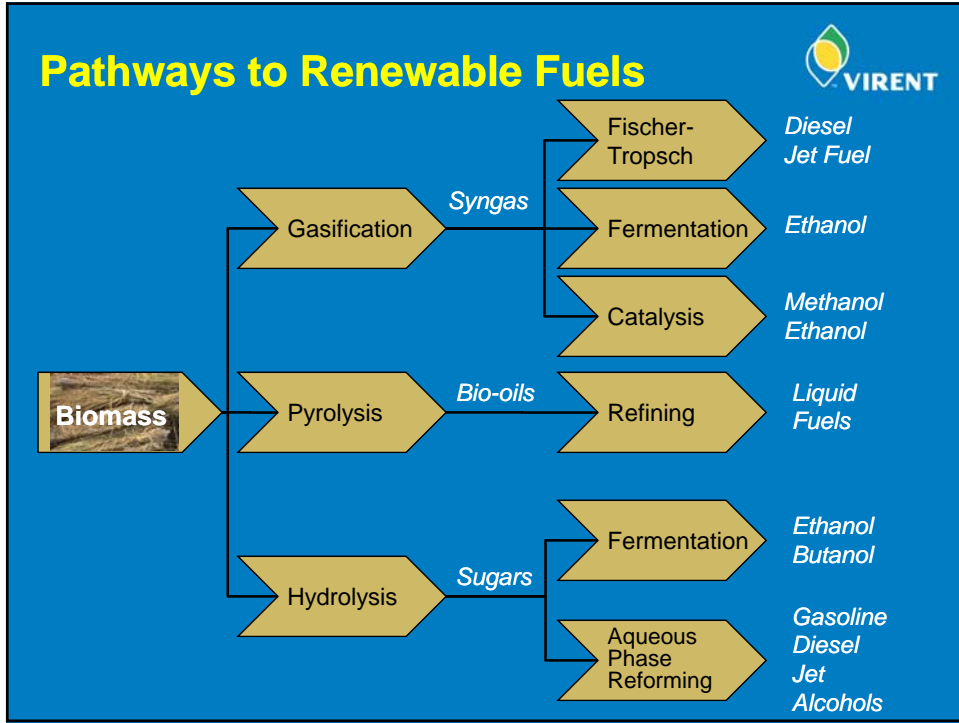


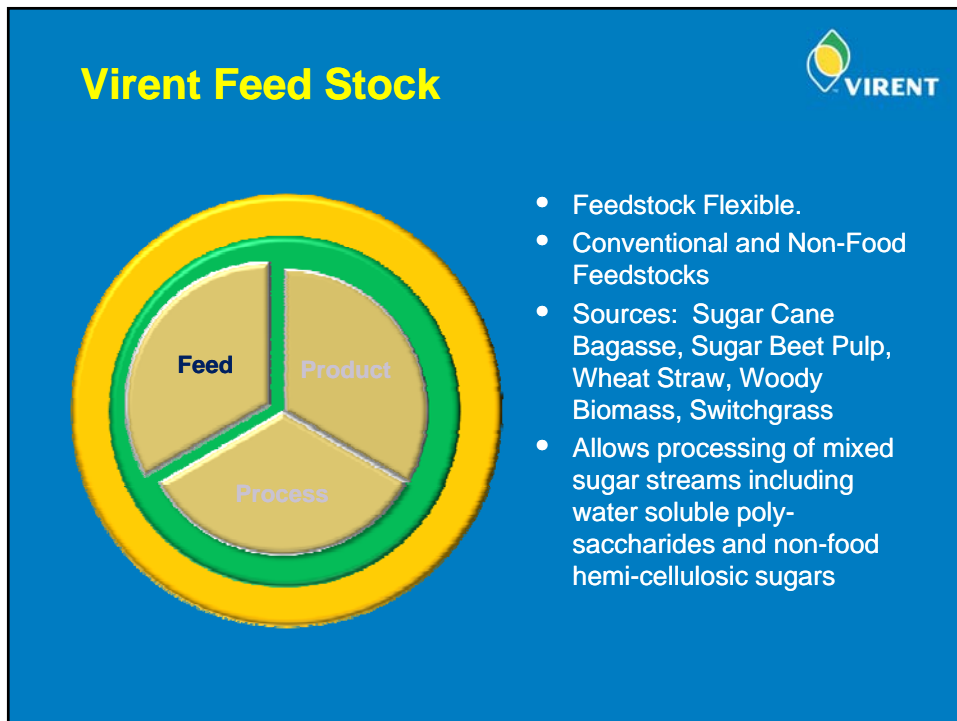
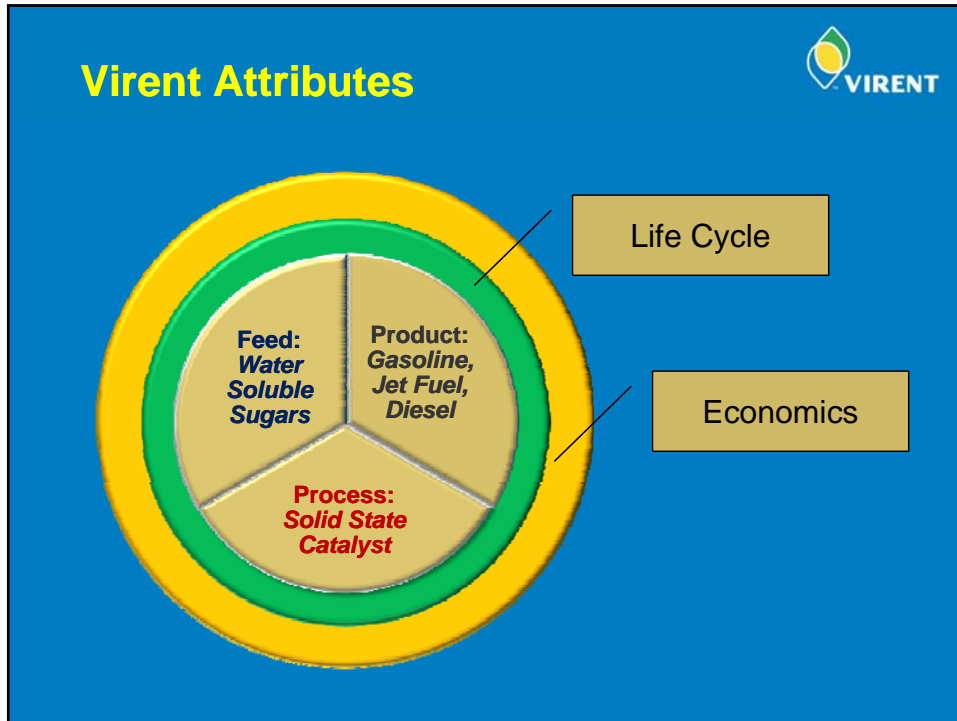
Government Funded Programs



Over \$11 million in Competitive Federal funding







Virent Process



- Inorganic Catalysts not Living Organisms.
- Low temperature process.
- Liquid fuel products separate naturally from aqueous feedstocks; no distillation needed.
- Product slate is tunable.
- Achieved high yields of biogasoline from C-5's, C-6's, corn syrup and sucrose feedstocks.

Virent Products



- Conventional Hydrocarbons- Gasoline, Jet Fuel, Diesel
- Product can be blended or used as a drop-in replacement.
- 50% higher energy density than ethanol.
- Will avoid massive fueling & engine infrastructure investment.
- Process can be tuned to alter yields to hydrogen, light hydrocarbons, heavier hydrocarbons, and alcohols.

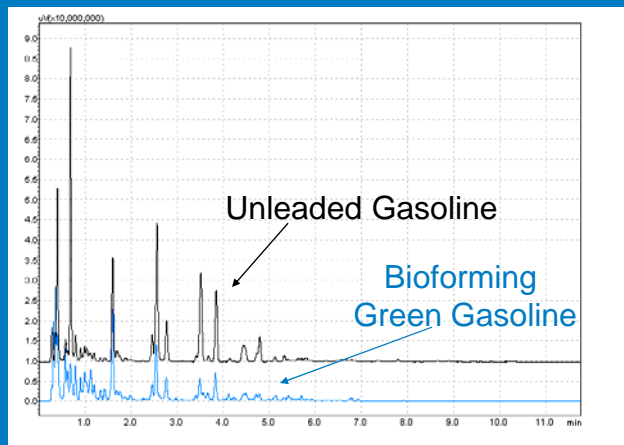
Cane Sugar and Xylose to Bio-Gasoline



Bio-Gasoline Composition



Same Components as Unleaded Gasoline



Unleaded Gasoline
115,000 BTUs/Gal

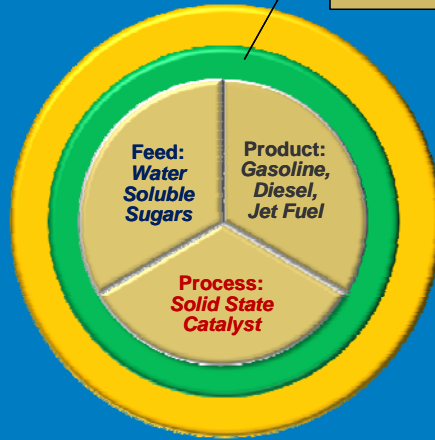
Bioforming
Green Gasoline
115,000 BTUs/Gal

Ethanol
76,000 BTUs/Gal

Virent Life Cycle



Life Cycle

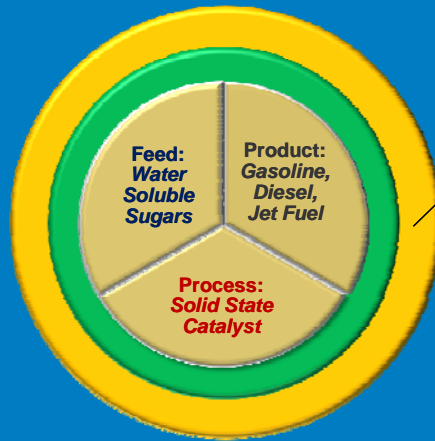


- Energy Balance: Produces gasoline with >50% higher net energy yield per acre than the corn ethanol process.
- Water Positive: The BioForming reaction is a net producer of water.
- CO2 Neutral: Low energy input and biomass based feedstocks offer near-zero CO2 process emissions.
- Low Energy Separation: Liquid Hydrocarbons naturally separate from water.

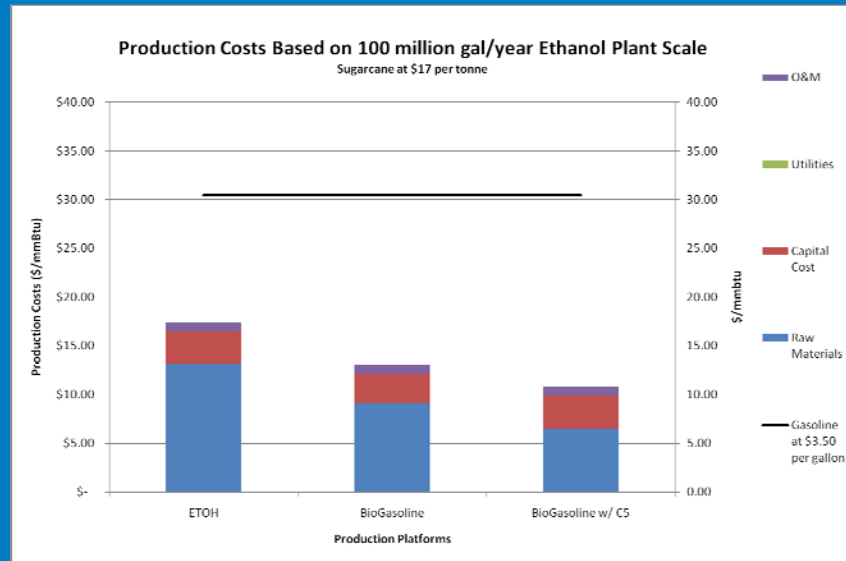
Virent Economics



Economics



Sugar Mill Cost Model (FOB)



Conclusions



- Virent's BioForming Process
 - Produces Conventional Liquid Fuels Economically and Efficiently
 - Based on Heterogeneous Catalysis
 - Feedstock Flexible
 - Tunable to Alter Product Yields
- Virent and Shell are collaborating to commercialize the BioForming process for gasoline production.
- Biorefineries incorporating next generation biofuel technologies will produce higher quality fuel products and a broader range of renewable chemicals and materials.

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