ISCC Global Sustainability Conference
Brussels, Belgium
February 15th, 2017
Our Process

Alcohol to Hydrocarbons

Biocatalyst (yeast)  Gevo integrated fermentation technology (GIFT®)  Isobutanol  Alcohol to Jet (ATJ)
How We Produce Isobutanol (GIFT®)

START: Feedstock

- Fresh & Recycled Water
- Steam
- Enzymes
- CO₂

Jet Cooker

Fermentation

- Isobutanol Recovery

CO₂

Isobutanol

Water

Drum Dryer

- Wet Grain
- Syrup

Evaporation System

- Thin Stillage

Finished Product

Animal Feed

Distillation System

Syrup

Molecular Sieves

Beer

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IBA to Hydrocarbons: Simple Economic Process

Technology overview

- Proprietary processing based on standard unit operations leads to high yields, with minimum of co-products.
- Gevo has been producing jet fuel and isoctane since 2011.
- Simple product mix of isoctane and jet, yields at 98% of theoretical.

Process Flow
Specifications

ASTM D7566 Annex 5
Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons
A5. ALCOHOL-TO-JET SYNTHETIC PARAFFINIC KEROSENE (ATJ-SPK)
First History Commercial Flight with 20% Blend ATJ Cellulosic Renewable Jet Fuel
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<tbody>
<tr>
<td>Freezing Point (ASTM D2386)</td>
<td>-40°C max Jet A -47°C max Jet A-1</td>
<td>-50°C</td>
<td>Below -80°C</td>
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<tr>
<td>Flash Point (ASTM D3828)</td>
<td>38°C min</td>
<td>48°C</td>
<td>48°C</td>
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<tr>
<td>Energy Density (Net Heat of Combustion) (ASTM D3338)</td>
<td>42.8 MJ/kg min</td>
<td>42.9 MJ/kg</td>
<td>43.2 MJ/kg</td>
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<tr>
<td>Thermal Oxidation Stability (JFTOT) (ASTM D3241)</td>
<td>pass</td>
<td>pass</td>
<td>pass</td>
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<tr>
<td>Total Sulfur Content (ASTM D2622)</td>
<td>0.3% max</td>
<td>0.05%</td>
<td>0%</td>
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Renewable Fuels Required to Meet Emissions Cap in 2020

- There is a cap on emissions starting in 2020.
- Any growth must be carbon neutral to this 2020 baseline.
- This will require displacement of fossil carbon in fuels
- **Scope:** Worldwide through **Global Market-Based Measure (GMBM)**

Technological improvements alone can not close this gap, therefore, renewable fuels will be required.
Basket of Measures to Reduce Aviation CO2 Emissions

ICAO and its Member States work together to achieve their collective global CO2 reduction goals through a multi-faceted approach – a basket of mitigation measures from which States can choose.

Green aircraft technologies
Fleet renewal, lighter materials, higher engine performance, aerodynamics improvements, etc..

Operational measures
Flexible use of airspace, air traffic flow management, dynamic and flexible route management, etc.

Market-based measures (MBMs)
Economic measures are cost-effective and can provide emissions reductions. (i.e. Purchasing Carbon Credits)

Alternative fuels for aviation
Sustainable drop-in fuels
Thank you

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