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Biofuels Categories



Lower left quadrant:

Liquid phase = smaller equipment.

Catalytic = faster = smaller equipment.

= Lower capital costs.

	Liquid phase	Gas phase
Fermentation	Amyris Solazyme Gevo Traditional Ethanol	LanzaTech Coskata INEOS Bio
Catalytic conversion	Virent Traditional Biodiesel Mercurius	KIOR Enerkem Envergent Anellotech Dynamotive

Modified from Biofuels Digest, 4/18/2011

REACH Technology



Renewable Acid-hydrolysis Condensation Hydrotreating

- Acid-hydrolysis – breaks down biomass to non-sugar intermediates.
- Condensation – puts molecules together to customize carbon chain length.
- Hydrotreating – deoxygenates to drop-in hydrocarbon fuel.





Cost Structure

OpEx:

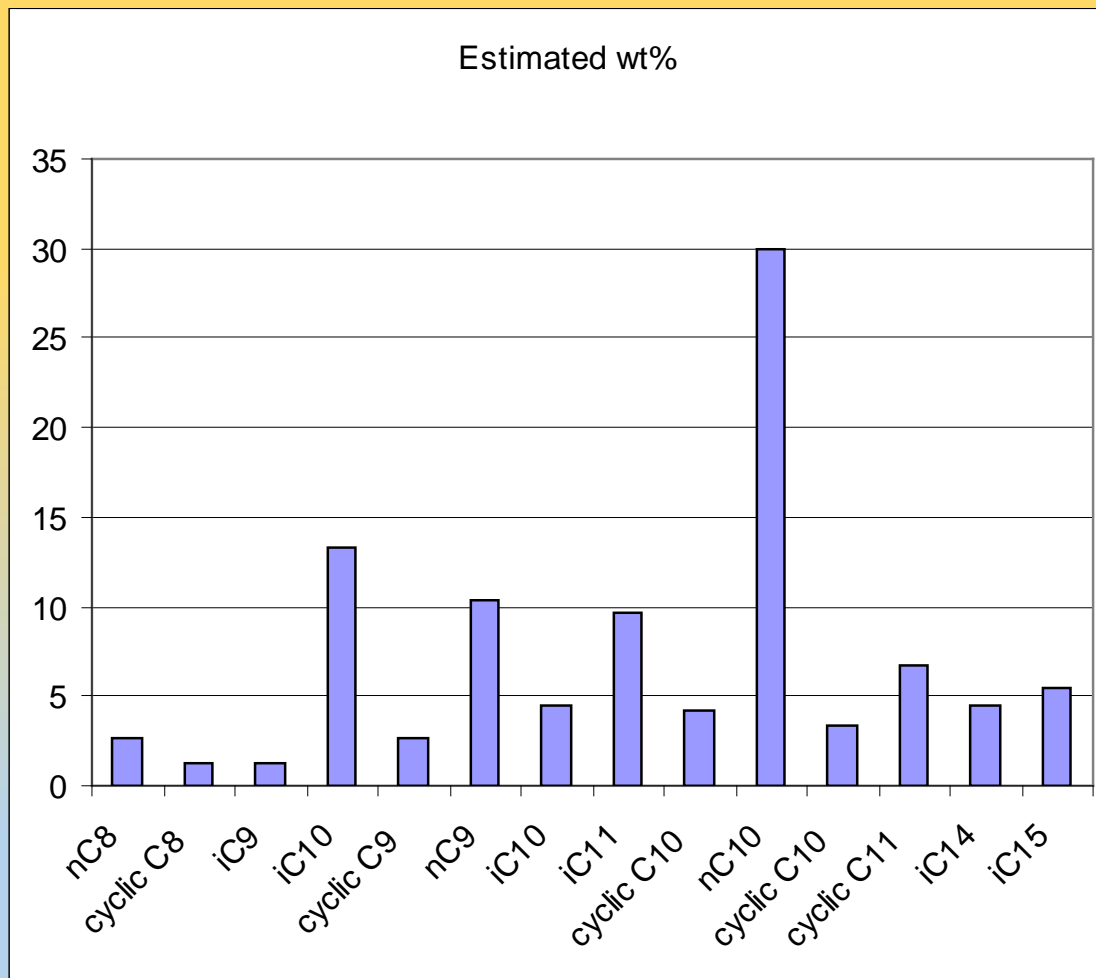
- \$1.06 /gal excluding capital charges
- \$1.62 /gal including capital charges

CapEx: \$3-5 /annual gal capacity. For example, a 15 mil gal/yr plant at \$4/annual gal capacity would cost \$60 million

Fuel Products



- Drop-in Hydrocarbon Jet Fuel
- Drop-in Hydrocarbon Diesel Fuel



Freeze Point = - 48.4 C
JP-8 (Mil.) spec < -47 C

Technology Development Advantages



- Scalable, proven methodologies
- Hydrolysis similar to pulp & paper technologies
- Condensation/Hydrotreating similar to petroleum refining
- Chemical products
- Independent of genetic research

DOE I-Pilot Plant Project



- Build and operate at Michigan State University Bioeconomy Institute (MSUBI)
- \$4.6 million matching grant from the US DOE
- 10 Dry Metric Tons/day - Hydrolysis/Condensation
- Hydrotreating - existing small scale facilities available
- Initial feedstock – local corn stover

Key Partners



- CSIRO (Australia) – process optimization research
- Purdue University – scientific/engineering/aviation expertise
- MSUBI - Pilot plant facilities
- UC Davis – Hydrolysis technology and IP
- Pacific Northwest National Laboratory (PNNL) – past hydrotreating and catalyst development
- Haldor Topsoe - catalyst / hydrotreating technology

Purdue



- Agriculture and biomass preparation
- Life cycle analysis
- Science/engineering – micro pilot
- Aviation expertise



MSUBI



- Existing reactor systems
- Existing infrastructure
- Experienced workforce



Thanks!

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