Aviation Biofuels Projects

Technical Advisory Committee

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DOE Funded Integrated Biorefinery Locations

http://www.eere.energy.gov/biomass/integrated_biorefineries.html

DOE Biomass Program and Hydrocarbon Fuels

- 7 integrated biorefinery projects are investigating hydrocarbons from biomass resources:
  - Haldor-Topsoe
  - REII
  - Solazyme
  - ClearFuels
  - Amyris
  - Sapphire
  - UOP
- Projects are all pilot or demonstration scale.

For more information visit:
http://www.eere.energy.gov/biomass/integrated_biorefineries.html

Advanced Biofuels for DoD

- **President Obama:** DOE + USDA + Navy to collaborate with the private sector to initiate “drop-in” biofuels industry to meet the transportation needs of DoD and the private sector

- **DOE, USDA & Navy:** MOU signed by Secretary Chu, Vilsack, and Mabus to support sustainable, commercial-scale biorefineries to produce hydrocarbon jet and diesel biofuels in the near-term

- **Construct / retrofit several “Pioneer” Biorefineries:**
  - Drop-in hydrocarbon biofuels meeting military specifications
  - Geographically diverse locations to enable market access
  - No adverse impact on food / feed supplies
  - Demonstrate commercial viability to encourage private-sector investment
  - Utilize Defense Production Act (DPA) for flexible joint funding and spending

DOE Funded Innovative Pilot/Demo FOA

- Objective – Production of hydrocarbon fuels at pilot or demonstration scale facilities that meet military blend fuel specifications. Two topic areas will be supported:
  - Technologies that utilize algae (micro, macro, cyanobacteria, heterotrophic
  - Technologies that utilize ligno-cellulosic biomass and other waste feedstocks

- The innovative pilot FOA will:
  - Enable the production of hydrocarbon blendstocks at pilot or demonstration scales – JP-5 (jet fuel primarily for the Navy), JP-8 (jet fuel primarily for the Air Force, or F-76 (diesel)
  - Lead to better understanding of the cost of production, fuel characteristics, and emissions impacts of biofuels

Innovative Pilot Awards

- On April 22nd, the Department of Energy announced the four projects selected for negotiation for the innovative pilot FOA for the production of advanced biofuels. Each project that was selected will be working to produce biofuels that meet military specifications for jet and diesel fuel.
  - Frontline Bioenergy LLCM, Ames, Iowa

  Up to $4.2 million to produce FT liquids from woody biomass, municipal solid waste, and refuse derived fuel. These liquids will be upgraded to produce samples of biofuels that meet military specifications.
  - Cobalt Technologies, Mountain View, California

  Up to $2.5 million to operate a pilot-scale integrated biorefinery to convert switchgrass to bio-jet fuel.
  - Mercurius Biorefining, Inc., Ferndale, Washington

  Up to $4.6 million to operate a pilot plant converting cellulosic biomass into drop-in bio-jet fuel and chemicals.
  - BioProcess Algae, Shenandoah, Iowa

  Up to $6.4 million to produce hydrocarbon fuels meeting military specifications from an algae-based integrated biorefinery.

An F/A-18 Green Hornet Fighter plane operating on a 50/50 biofuels blend. Photo courtesy of the U.S. Navy.

Aviation Biofuels Techno-Economic Analysis Workshop

When: November 27th, 2012 **Where:** Washington, DC

Workshop Objectives

- Benchmark current and future cost-of-production and performance characteristics of biomass-based processes that can produce jet fuel

Scope

- Processes
  - New pathways for aviation fuels
  - Biochemical conversion
  - Thermochemical conversion
  - Algae-derived methods
  - HEFA/HEFA algae
  - Gasification/FT
- Feedstocks
  - Productivity and handling

Hydro-processed Esters and Fatty Acids (HEFA) – Robert Malina, MIT

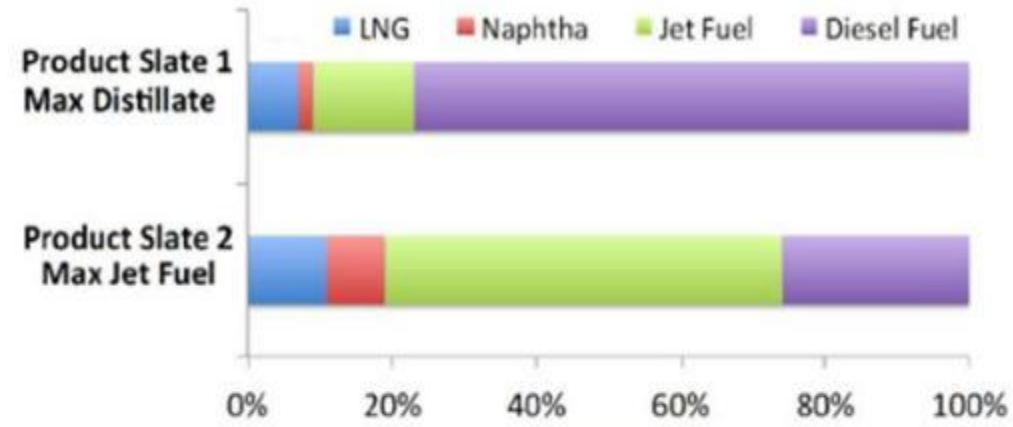
- **Methodology:** bottom up cost studies: sustainability metrics, air quality, public health impacts, water footprint, land use, costs of production, GHG emissions; based on Aspen Plus models; includes some sensitivity analysis.
- **HEFA Assumptions**:
  - Calculates min selling price for HEFA jet fuel (no price supports); variable product slates considered
  - Capital/operating costs estimated; 20% equity
  - Assumes co-product market price
  - Feedstocks bought on open market, fuel products sold to consumers
  - Specified rate of return for investment (15%)
  - Market prices from DOE or based on breakeven analysis

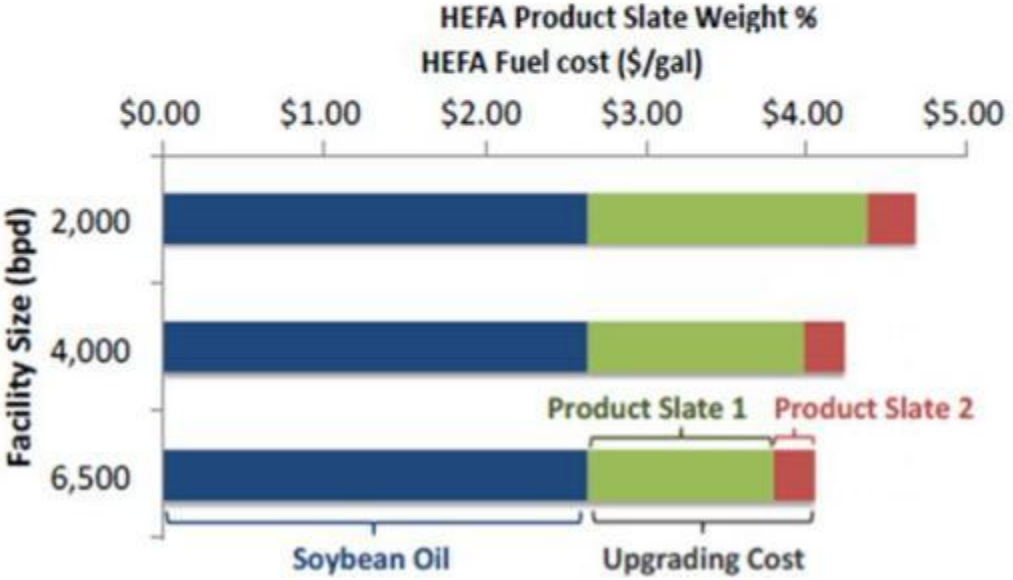
Projected cost of HEFA Minimum Fuel Selling Price

HEFA process results in multiple fuels, including jet fuel
Fuel product slate can be varied by changing H2 use and operating conditions

HEFA fuel cost predominantly driven by feedstock price

Maximizing jet fuel production requires extra $0.25 to $0.30 per gallon to break even





Source: Pearlson (2011) and Pearlson et al. (2012)

Workshop Summary

- Workshop provided a unique opportunity for stakeholders to discuss cost of biofuels production via multiple pathways.
- Challenge to make this knowledge accessible. Research results and data needs to be more broadly communicated; greater awareness of ongoing R&D is needed.
- As fuels are being qualified, costs should be considered. Fuel producers and key stakeholders should be brought into this process.
- Data from facilities under construction is difficult to obtain (IP, etc.), however, it is needed to provide a reality check.
- Common terms, units, and techniques are needed for techno-economic analysis to enable consistent comparison of technologies.
- Presentations at http://www1.eere.energy.gov/biomass/meetings.html, summary fact-sheet at http://www.caafi.org