The Commercial Aviation Alternative Fuels Initiative (CAAFI)

Presented to: Aviation Alternative Fuels Side Event
Bon, Germany

By:  Dr. Lourdes Maurice
Acting Director and Chief Scientist,
FAA Office of Environment and Energy
Environment Lead, CAAFI

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Aviation Environmental Drivers

- Aviation impacts community noise footprints, air quality, water quality, energy usage and availability, and the global climate.

- Trends show environmental impacts from aircraft noise and aviation emissions will be a critical constraint on capacity growth.

- Fundamental changes ongoing from economic downturn, fuel costs, and financial turmoil.

➢ The challenge is to ensure energy availability and affordability and reducing aviation’s environmental footprint, even with projected aviation growth.
U.S. Experience: Aviation Emissions Performance

U.S. commercial aviation outpaces other modes in energy efficiency improvements...

...while absolutely reducing its carbon footprint since 2000.
The Challenge - U.S. Aviation Fuel Use Scenarios

US Fuel Use Growth

- Scenario 1: FESG Baseline
- Scenario 2: FESG Baseline w/Low-Trend Technology
- Scenario 3: ST Adjusted Baseline w/Low-Trend Tech.
- Scenario 4: ST Adjusted Baseline w/Higher-Trend Tech & High US Op1 Efficiency
- Scenario 5: ST Adjusted Baseline w/Higher-Trend Tech, High US Op1 Efficiency & High Price Fuel

Source: FAA Preliminary Analysis
Measures to Tackle the Challenge

NextGen Vision

*Provide environmental protection that allows sustained aviation growth*

Key Initiatives:

- Continued Local Mitigation
- Better Scientific Understanding
- Accelerate Operational Changes
- Mature New Aircraft Technology
- Develop Alternative Fuels
- Policy Options
A consortium of government agencies, airlines, manufacturers, airports, and current and prospective fuel suppliers

Foster the development and deployment of alternative jet fuels

Share Information and Coordinate research and development of alternative jet fuels, including technical specifications, environmental assessment, production and distribution.

To enhance energy security, aviation economics and environment
Who is CAAFI?

- **Members**
  - Air Transport Association (ATA)
  - Airports Council International – North America (ACI)
  - Aerospace Industries Association (AIA)
  - Federal Aviation Administration (FAA)
  - Aircraft OEMs
  - Aircraft Engine OEMs
  - Aircraft Equip Cos
  - Consultants
  - Universities
  - Think Tanks
  - IATA
  - NetJets
  - Airlines
  - ALPA
  - Airport Operators
  - ASTM
  - CRC
  - Bio-Fuels Companies
  - Energy Companies
  - Oil Companies

- **Sponsors**
  - NIST
  - NASA
  - DESC
  - USAF
  - US Army
  - DARPA
  - USN
  - USDA
  - DOE
  - DOC

**Who is CAAFI?**

- Airlines
- ALP
- Air Cargo
- Airport Operators
- NetJets
- IATA
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- Oil Companies

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Commercial Aviation Alternative Fuels Initiative

June 3, 2009
CAAIFI Structure and Strategy

- Certification-Qualification Panel
  - Enable Supply
- R&D Panel
  - Generate Ideas/Solutions
- Environmental Panel
  - Assess Impact
- Business & Economics Panel
  - Generate Demand & Target Funding
## CQ: CAAFI Targeted* Certification Timing

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<tr>
<th>YEAR</th>
<th>FUEL TYPE</th>
<th>STATUS</th>
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| 2009 | - 50% FT generic blends including biomass/ coal / gas | - ASTM vote targeted for June ’09  
- Rapid Adjudication process with producers/ OEM’s / USAF |
| 2010 | - 50% HRJ Blend  
- 100% FT generic including biomass | - Working with ASTM, FAA and engine/aircraft OEMS  
- Supporting low sulfur cost/benefit starting 4/08 |
| 2013 | - 100% HRJ  
- Other Biofuel processes | - DARPA program complete. Fuels available for FFP tests  
- DARPA Algae program underway. |

* Generic Targets based upon outcomes to date anticipated fuel availability for tests
R&D: Feedstocks Roadmap

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R&D: Three Successful HRJ Biojet Flight Programs

* Graphics Courtesy J. Holmgren, UOP

- **Successful ANZ Flight Demo Date:** December 30 2008
  - Feedstock: Jatropha oil

- **Successful CO Flight Demo Date:** Jan. 7 2009
  - Feedstock: Jatropha and algal oil

- **Successful JAL Flight Demo Date:** Jan. 30 2009
  - Feedstock: Camelina, Jatropha and algal oil
Results showing observed reductions in primary PM in a CFM56-7B engine burning a mixture of 50% F-T fuel and 50% Jet A-1 (PARTNER Center of Excellence)

\[ y = 66.634x - 82.189 \]
\[ R^2 = 0.9342 \]
Environment: Life Cycle Analysis (LCA)

Need to determine “well-to-wake” life-cycle emissions

Fossil feedstock

Bio feedstock
Environment: Quantifying LCA Uncertainties

Chart courtesy of J. Hileman, MIT
Environment: Biomass Needs for 2050 Carbon Neutrality

- Assessed potential for carbon neutral growth from 2000 to 2050.
- Palm and soy unable to meet needs for a carbon neutral growth.
- CBTL w/ CCS and 25% biomass usage unable to meet carbon neutrality past 2021.
- Algal biojet (HRJ) presents opportunity for carbon neutral growth past 2050.
- Expanding feedstock options to consider jatropha and multiple feedstock solutions.

Need feedstocks with high yield and low life-cycle emissions that do not require arable land.

Source: GIACC/3-IP/4 (2009). Subject to modification. Recall that corn stover is also used for diesel production.

Chart courtesy of J. Hileman, MIT
Business: Facilitating a Future Market

Potential Funding Sources
- Morgan Stanley
- OPIS (Oil Pricing)
- Colonial Pipeline
- Solarc (Taxes)
- Magellan Pipeline
- Kinder Morgan

Alt Fuel Producers
- A2BE Carbon Capture
- Adv Bio-Energy Tech’s
- Agromass Biofuels
- Air BP
- Amyris Biotech
- Baard Energy
- ConocoPhillips
- Chevron
- Neste Oil
- SASOL
- Shell
- Solazyme
- SolArc
- Syntroleum
- UOP

Airlines & Operators
- ATA
- ALPA
- Alaska
- American
- Continental
- Delta
- FedEx
- Airbus
- Boeing
- JetBlue
- NetJets
- Northwest
- Southwest
- Star Alliance
- United
- US Airways
- UPS

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U.S. Strategy to Reduce Aviation’s Carbon Footprint

1.00 (Relative CO₂ increase)

- Growth with currently available solutions
- Growth with operational improvements
- Growth with technology improvements
- Growth with alternate fuels

Possible standards?
Market-based measures?

Carbon neutral growth
Closing Thoughts

- Aviation dependent on hydrocarbon based liquid fuels
- Concentrated Airport Distribution allows rapid deployment (80% of fuel in 35 locations in U.S.)
- Timely Fuel Certification crucial for market
- Establishing GHG LCA crucial for decisions (policy and investment)
- Alternative fuels are technically feasible but need to get to deployment
- CAAFI helping to bring these pieces together
- ICAO key to global harmonization