Overview of FAA Alternative Jet Fuel Activities

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To: Biomass R&D Technical Advisory Committee, Washington D.C.

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### Aviation Environmental Challenges

<table>
<thead>
<tr>
<th>NOISE</th>
<th>AIR QUALITY</th>
<th>WATER QUALITY</th>
<th>ENERGY</th>
<th>GLOBAL CLIMATE</th>
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</table>

- Aviation impacts community noise, air quality, water quality, energy usage, and climate change
- Environmental impacts from aviation could pose a critical constraint on capacity growth
- Alternative jet fuels could reduce the environmental impact of aviation:
  - Carbon neutral growth by 2020 compared to 2005
  - 1 billion gallons of renewable jet fuel in use by aviation by 2018
  - Absolute reduction of significant air quality impacts, notwithstanding aviation growth
United States Climate Action Plan for Aviation

The U.S. is pursuing a multi-pronged approach to address greenhouse gas emissions from aviation

- Aircraft and Engine Technology Improvement
- Operational Improvements
- Alternative Fuels Development and Deployment
- Policies, Environmental Standards, and Market Based Measures
- Scientific Understanding Through Research, Modeling and Analysis

U.S. Climate Action Plan for Aviation is available at:
Challenges for Alternative Jet Fuels

- Feedstock Availability
- Competitive cost for alternative fuel
- Approved for performance/safety
- Environmentally sustainable
- Commercially produced
Coordinating USG Efforts across Supply Chain

**Facilitating Deployment and Investment**

<table>
<thead>
<tr>
<th>Feedstock Production</th>
<th>Feedstock Logistics</th>
<th>Fuel Conversion</th>
<th>Conversion Process Scale-up/Integration</th>
<th>Fuel Testing/Approval Fuel Performance</th>
<th>Environment Assmnt</th>
<th>Enable Production</th>
<th>End User/Buyer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture: Feedstock Development Center Grants</td>
<td></td>
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**Logistics**

- USDA
- Department of Energy
- NASA
- Federal Aviation Administration

**Federal Aviation Administration**

**EPA:** Renewable Fuel Standard
High level description of agency effort:

• Fund Certification/Qualification testing to inform ASTM approval
• Environmental & cost analysis
• Government & Industry coordination & cooperation
• Additional support and studies
Alternative Jet Fuel Pathways

Biomass and Fossil Feedstocks
- Pyrolysis
- Gasification
- Oil Extraction
- Fischer Tropsch Synthesis
- Hydro-processing

Industrial Waste Gases
- Biological Conversion
- Sugar Extraction
- Alcohol
- Fermentation
- Aqueous Phase Processing
- Dehydration & Oligomerization

Oils & Esters
- Biological Conversion
- Hydro-processing

Alternative Jet Fuel and Blending Components
Current FAA Alternative Jet Fuel Activities

• Testing
  ▪ Material compatibility
  ▪ Certification / Qualification
  ▪ Emissions measurements

• Analysis
  ▪ Environmental sustainability
  ▪ Techno-economic analysis
  ▪ Future scenarios

• Coordination
  ▪ Interagency
  ▪ State & Regional
  ▪ International
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How a Fuel Gets Approved (ASTM D4054)

- **Specification Properties**
- **Fit-For-Purpose Properties**
- **Component/Rig Testing**
- **Engine/APU Testing**

- **ASTM D7566 Revision**
- **ASTM Balloting Process**
- **FAA & OEM Review & Approval**
- **ASTM Research Report**

**ASTM Review & Ballot**
- Accept
- Reject
- Re-Eval As Required

**ASTM Specification**
# Alternative Jet Fuels Test Matrix

<table>
<thead>
<tr>
<th>Genre</th>
<th>Synthetic Paraffinic Kerosene</th>
<th>Synthetic Kerosene w/ Aromatics</th>
<th>Alcohol-to-Jet</th>
<th>Cellulose to Hydrocarbon</th>
<th>Direct Sugar to Hydrocarbon</th>
<th>Synthetic Kerosene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acronym</td>
<td>FT-SKP</td>
<td>HEFA</td>
<td>FT-SKA</td>
<td>HEFA-SKA</td>
<td>CH</td>
<td>ATJ-SKA</td>
</tr>
</tbody>
</table>

### Process

- Gasification/FT Hydroprocessing
- Deoxygenation / Hydroprocessing
- Gasification/FT & Hydroprocessing
- HEFA w/ Renewable Aromatics
- Catalytic Hydrothermolysis
- Fermentation
- Hydro-treated Depolymerized Cellulosic Jet
- Fermentation
- Catalysis of Sugars

### Legend

- Planned or completed testing by GE
- Planned or completed testing by PW
- Planned or completed testing by RR/LW
- Planned or completed testing by Honeywell
- Planned or completed testing by AFRL

### Key Points

- **Matrix is under development (subject to revision)**
- **Need to add ongoing US Navy testing**
- **Focusing on near-term candidates**
- **Working to streamline process**
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• Coordination
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  ▪ International
Environmental and Economic Analyses

- Environmental analyses
  - Focus on well-to-wake GHG, including climate impacts of combustion emissions
  - Results incorporated into ANL GREET model and EPA analysis

- Economic analyses
  - Techno economic analysis that are coordinated with DoE efforts
  - Identifying opportunities for cost reduction
  - Examining production scenarios

- Research being conducted by PARTNER Center of Excellence

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3. [http://www.masbi.org/content/assets/MASBI_Report.pdf](http://www.masbi.org/content/assets/MASBI_Report.pdf)
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Commercial Aviation Alternative Fuels Initiative

• Public-Private coalition for commercial aviation to engage the emerging alternative fuels industry
• Goal is development of non-petroleum jet fuel production with:
  – Equivalent safety & performance (drop-in)
  – Comparable cost
  – Environmental improvement
  – Security of energy supply for aviation
• Enables diverse stakeholders to build relationships, share and collect data, identify resources, and direct research, development and deployment of alt jet fuels

www.caafi.org
CAAFI Comprehensive Approach

- Addressing challenges to adoption
- Engaging at state/regional & international level

Environmental Team
- Life Cycle GHG, Particulate Matter, Sustainability

Certification-Qualification Team
- ASTM D7566

R&D Team
- Multiple "Drop-in" Solutions

Business & Economics Team
- Facilitate Deployment, Investment
Future FAA Alternative Jet Fuel Activities

Center of Excellence for Alternative Jet Fuel & Environment
- Continues research carried out by PARTNER CoE
- Ten technical areas – include feedstock, infrastructure
- Address strategic needs and gaps
- Solicitation closed and evaluations are complete
- On schedule to have center operational in 2013

Continuous Lower Energy, Emissions and Noise (CLEEN) II
- CLEEN I: 2010-2015 effort
- Reduce aircraft fuel burn, emissions and noise & advance Alternative Jet Fuels
Observations

• Government & Industry leadership has led to significant successes
  – Drawing focus to aviation
  – Aerospace manufacturers acceptance of alt fuels
  – ASTM approvals of two alt jet fuels
  – Inclusion of alt jet fuels in life-cycle models (GREET)
  – Increased interagency coordination & collaboration

• Near term next steps
  – Continued Testing & Analysis
  – Coordinate Domestic and International Stakeholders
  – Facilitate State & Regional Deployment
Closing Thoughts:

• Alternative jet fuels are a key component of FAA strategy in meeting environmental goals
• FAA efforts are directed to overcoming key challenges via testing, analysis and coordination
• CAAFI, a public-private partnership, helping to catalyze promising, renewable jet fuel technologies
Thank you

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