Fuel Approval
Process & Status
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Many slides provided by Mark Rumizen, FAA
FAA Efforts Relating to Jet Fuel

Testing
- Support ASTM Intl Certification/Qualification testing and improve process
- Measure combustion emissions

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

Coordination
- Interagency
- Public-Private
- State & Regional
- International
May 24, 2006
Commercial Aviation Alternative Fuels Initiative (CAAFI) Established

June 2009
ASTM D7566 Issued

June 2009
FT-SPK Annex A1

July 2011
HEFA-SPK Annex A2

December 2009
ASTM D4054 Issued

June 2014
SIP Annex A3

November 2015
FT-SPK/A Annex A4

April 2016
ATJ-SPK Annex A5
Isobutanol Feedstock Only

June 2018
ATJ-SPK Annex A5
Ethanol Feedstock Added

Over a Decade of Progress
How a Fuel Gets Approved for Use

1. FAA Approved Operating Limitations Based on ASTM Fuel Specifications

2. D4054 Fuel Evaluation Process
   - If New Fuel Meets Conventional Jet Fuel Spec & Properties

3. D7566 Drop-In Jet Fuel Spec
   - Then New Fuel Annex Added to Drop-In Fuel Spec

4. D1655 = D7566
   - Conventional Jet Fuel Spec = Drop-In Jet Fuel Spec

   New Fuel Meets Existing Operating Limitations, Therefore Approved to Use on Virtually All Existing Aircraft

ASTM Specification = FAA Certification
ASTM D4054 Alternative Jet Fuel Evaluation Process

Tier 1: Specification Properties
Tier 2: Fit-For-Purpose Properties
Tier 3: Component/Rig Testing
Tier 4: Engine/APU Testing

FAA Review
ASTM Review & Ballot
ASTM Specification
ASTM Balloting Process

OEM Review & Approval
Jet Fuel Composition

- Conventional jet fuel composed of variety of hydrocarbons
- Fuels approved thus far composed mostly of normal and isoparaffins
- Next set of fuel approvals contains larger variety of “jet fuel” hydrocarbons
## Estimated Requirements for Fuel Approvals

As a result of the investments made by FAA and others, time and fuel requirements for ASTM Intl approval have fallen over time.

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Date ASTM began data review</th>
<th>Date final phase II research report submitted</th>
<th>Date of addition to ASTM Specification (D7566)</th>
<th>Estimated gallons of fuel produced for testing</th>
<th>Estimated time from first review to approval</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT-SPK</td>
<td>9/2007 est.</td>
<td>09/2008</td>
<td>09/2009</td>
<td>710,000</td>
<td>3 years</td>
<td>Largely normal/iso-paraffins</td>
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<tr>
<td>HEFA-SPK</td>
<td>6/2008 est.</td>
<td>05/2010</td>
<td>07/2011</td>
<td>626,000</td>
<td>3 years</td>
<td></td>
</tr>
<tr>
<td>SIP</td>
<td>6/2011</td>
<td>04/2013</td>
<td>06/2014</td>
<td>16,000</td>
<td>3 years</td>
<td></td>
</tr>
<tr>
<td>Gevo ATJ-SPK (isobutanol)</td>
<td>12/2010</td>
<td>04/2015</td>
<td>06/2016</td>
<td>93,100</td>
<td>5 1/2 years</td>
<td></td>
</tr>
<tr>
<td>Lanzatech ATJ-SPK (ethanol)</td>
<td>09/2016</td>
<td>07/2017</td>
<td>04/2018</td>
<td>50</td>
<td>1 1/3 years (16 months)</td>
<td></td>
</tr>
<tr>
<td>ARA CHJ</td>
<td>6/2012</td>
<td>10/2018</td>
<td>2019 (expected)</td>
<td>79,000</td>
<td>7 years</td>
<td>Wider range of molecules</td>
</tr>
</tbody>
</table>

1 USAF fuel purchases in 2007 and 2008 for fleetwide qualification
2 USAF & Navy fuel purchases in 2009-11 for fleetwide qualification
3 USAF, Navy and CLEEN fuel purchases in 2012-2014
4 Only tier 1 & 2 testing needed for Lanzatech due to existing knowledge base and similarity to previously approved fuels.
Potential Benefits of Additional Fuel Approvals:

- Wider range of biomass could be used
- Reduced cost of fuel production
- Greater environmental benefit
- Greater blend level

Diversity of options results in greater opportunity for success in more places
ASTM D4054 Clearinghouse Concept

- Structured as a Cost Share Arrangement
- Accepts In-Kind Contributions (testing partners)
- Also Accepts Direct Contributions
- FAA Seed Money Under ASCENT Center of Excellence
- Stakeholder Engagement /Support Needed!
- Final Research Report Out

University of Dayton Research Institute (UDRI)

Candidate Fuel In

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ASTM D4054 Fast Track Annex
For new fuels with conventional hydrocarbon composition

ASTM Balloting Completed April 1
D4054 with Fast Annex Available Mid-May
Closing Observations

• Fuel approvals are essential to developing a robust sustainable aviation fuel industry
• We have achieved considerable progress in approving fuels due to robust governmental support and a strong partnership with industry
• Much work remains to be done to approve additional new fuels – we need to work in collaboration across the globe to leverage scarce resources