Fuel costs kill off a US airline every week

James Doran in New York
The Observer, Saturday 24 May 2008

Fuel-cost worries extend to Pentagon

May. 18, 2008 - 07:27AM | Last Updated: May. 18, 2008 - 07:27AM |

Jet fuel prices hurt local businesses and airports

Posted: Jun 06, 2008 6:12 PM EDT
Updated: Jun 11, 2008 2:25 PM EDT

NEW YORK (AP) – Oil prices made their biggest single-day leap ever Friday—clearing $139, dragging the Dow Jones industrials down nearly 400 points and raising the once-unthinkable prospect of $150 oil and even higher gas prices by the Fourth of July.

The meteoric rise of nearly $11 for the day piled atop an increase of almost $5.50 the day before, taking oil futures more than 13 percent higher in just two days, easily a record on the New York Mercantile Exchange.
Airline stocks slide as jet-fuel prices rise

How High Oil Prices Will Permanently Cap Economic Growth

Syria sends oil to 2-year high, $150 spike feared

US still vulnerable to oil shocks, say generals
AGENDA

* Pathway Status/Overview
* Break (3:10PM – 3:30PM)
* Challenges, Lessons Learned, Process Improvements
  * OEM Review Panel Proposal: George Wilson, SWRI
  * FAA R&D Initiatives: Mark Rumizen
  * Round Table Discussion: Producers & OEMs
  * Q&A From Audience
  * Go-Forward Discussion/Recommendations
  * Conclusions
ASTM D7566 TASK FORCES

Alternative Jet Fuel Pathways

- **Crude oil**
  - lipid-based fuels
    - camelina, algae, etc.
  - **lipids**
    - Catalytic Hydrothermolysis
    - hydroprocessing
      - HEFA Annex A2
        - Co-Procss’d Task Force
          - July 2011
          - Chevron, BP, Phillips66
      - CH Task Force
        - Amyris/Total
        - ARA
      - DSHC Task Force
        - Byogy, LanzaTech, Swed Biofuels
      - ATJ Task Force
        - GEVO, Cobalt/USN, UOP, LanzaTech, Swed Biofuels
        - SpK
        - SKA
          - SK, SAK Task Force
            - Virent
        - FT-SKA Task Force
          - SASOL, Rentech
          - Sept 2009
      - HDCJ Task Force
        - KiOR, UOP
        - FT-SPK Annex A1
        - R
        - R
        - R

- **carbohydrate-based fuels**
  - sugar cane, etc.
  - sugars
    - catalytic upgrading
      - alcohol
      - bio-oil
      - syngas
    - saccharification
    - bagasse
    - lignocellulosic biomass
      - gasification
      - Thermal-catalytic or pyrolysis

Adapted from Brown, Iowa State, 2012 and Tim Edwards, USAF/AFRL

Draft ASTM Research Report

May 9, 2013
ATJ: Alcohol to Jet
CH: Catalytic Hydrothermolysis
DSHC: Direct Sugar to Hydrocarbons
FT: Fischer-Tropsch
FT-SKA: FT Synthetic Paraffinic Kerosene with Aromatics
FT-SPK: FT Synthetic Paraffinic Kerosene
HDCJ: Hydroprocessed Depolymerized Cellulosic Jet
HEFA: Hydroprocessed Esters and Fatty Acids
SAK: Synthetic Aromatic Kerosene
SK: Synthetic Kerosene
SPK: Synthetic Paraffinic Kerosene
SKA: Synthetic Paraffinic Kerosene with Aromatics
ASTM Alternative Jet Fuels
January 28, 2014

Mark Rumizen
Senior Technical Specialist
Federal Aviation Administration
How to Work Backwards to Prove New Fuel Is Acceptable for Existing Fleet of Engines?

Integrate ASTM Industry Qualification Process with FAA Certification Process
Integrated ASTM/FAA Approval

ASTM Qualification (D4054)

D7566 New Annex
Drop-In Fuel

New Spec
Non-Drop-In
Fuel

Unchanged
Operating
Limitation

Approved for
Commercial Operations

Airworthiness Certification

Re-Certify All Engines

Re-Certify All Aircraft

Approved for Airline Operations

Mark Rumizen, FAA/CAAFI
January 28, 2014
Thank You

Mark A. Rumizen
Senior Technical Specialist
Aviation Fuels
Aircraft Certification Service

Tel: 781-238-7113
Email: mark.rumizen@faa.gov

Federal Aviation Administration
12 New England Executive Park
Burlington, MA 01803
FAA/OEM Review Panel

George R. Wilson, III
Principal Scientist
Southwest Research Institute
FAA/OEM Review Process

Is Not Participation in Task Force Efforts

- TF Participation is a Personal Involvement
- Provides Insight Into Important Topics
FAA/OEM Review Process

Is a Formal Effort to Achieve OEM Consensus for FAA to Proceed

- FAA Sponsored Advisory Group
- Comprised of Members with Known Fuel Expertise
- Expressed Corporate Opinion
FAA/OEM Review Process

Research Report
- Spec Results
- Fit-for-Purpose Testing
- Component Testing
- Engine Testing
- Process Control

OEM Review
- Engineering Analysis
- Proprietary and Trade Secret Analysis
- Operational Impact
- Service Impact
- Customer Impact

Panel Member
FAA/OEM Panel Member

- Convert Research Report to Internal Engineering Document
- Distribute to Key OEM Decision Makers
- Produce and Conduct Internal Presentations
  - Work with TF to Answer Questions
- Polls Company
- Provides Official Response
  - Not Recommended – Why Not?
  - More Info Needed – What Needs to be Done?
  - Recommended – OK for FAA to Proceed to ASTM Consensus Process
#1 Job – Provide Technical Support to Manufacturing

Alternative Fuels May Not Be Part of the Business Plan
  – May Support Anyway
    » A “General Good” Approach
  – May Require Funding
    » Many Companies Require “Overhead” to Justify Efforts at All Levels
  – May Not Support
    » De Facto Withdrawal (Pocket Veto Not Allowed)

Funding Potential
  – Direct by Prospective Producer
  – Public/Private Funding
  – OEM by Regulation
FAA CLEEN II and COE
(FAA Alternative Fuels R&D Programs)
January 28, 2014

Mark Rumizen
Senior Technical Specialist
Federal Aviation Administration
## FAA Environmental/Alt Fuels R&D Support Initiatives

<table>
<thead>
<tr>
<th></th>
<th>CLEEN II</th>
<th>ASCENT</th>
<th>SEMRS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What?</strong></td>
<td>Continuous Lower Emissions, Energy, Noise</td>
<td>Aviation Sustainability Center of Excellence</td>
<td>Sustainability, Environmental Management and Research support</td>
</tr>
<tr>
<td><strong>How Much?</strong></td>
<td>$100M FAA Funding with 50% industry cost share</td>
<td>$40M FAA Funding with 50% industry cost share</td>
<td>TBD as Required for FAA Support</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>RFP mid-2014</td>
<td>Established Sept. 2013</td>
<td>RFP now open until Feb 11</td>
</tr>
<tr>
<td><strong>Alt Fuels Elements</strong></td>
<td>TBD, considering D4054 Support</td>
<td>Wide-Range of Research Topics Possible Including “Fuel Performance Testing”</td>
<td>Alternative Jet Fuel Research Support including “Conduct D4054 Testing” and “Develop Analytical Methods Based on Fuel Composition”</td>
</tr>
</tbody>
</table>
Synthesized Iso-Paraffins From Fermented Hydroprocessed Sugars (generically aka DSHC)

**Pathway Overview**

- **Fermentable Sugars**
  - (including cellulosic)
- **Fermentation**
- **Farnesene C15 Precursor**
- **Hydroprocessing - Separation**
- **Farnesane Aviation Blending Component**
  - ... diesel and other products

**ASTM D4054 Qualification Timeline**

- **2012**
  - DSHC TF established
  - Azul/E170 demo flight

- **2013**
  - TF proposed SIP (DSHC) specs
  - Airbus/A321 demo flight
  - Research Report v1 review

- **2014**
  - Research Report v3 acceptance
  - Initiate ASTM balloting process*
  - Etihad/B777 demo flight
  - (ANP process engagement)
  - D7566 SIP Annex*
  - (ANP adoption)*
  - (WC ‘14 launch events)*

*projected

>4 MM liters to date

~2 MM liters of diesel grade and 32,000 liters aviation grade to date
## ATJ-SPK Processes Today

### Fischer-Tropsch Processes (FT-SPK)

<table>
<thead>
<tr>
<th>Natural Gas, Coal, Biomass, Waste...</th>
<th>Gasification</th>
<th>Fischer-Tropsch Synthesis (CO, H₂)</th>
<th>Fischer-Tropsch Synthesis (H₂, CO)</th>
<th>Hydrocracking</th>
<th>Hydroisomerization</th>
<th>C₁-C₂₀₀ n-paraffin &amp; olefins</th>
<th>C₈-C₁₆ iso- and n-paraffins</th>
<th>Fractionation</th>
</tr>
</thead>
</table>

### Alcohol to To Jet Process (ATJ-SPK)

<table>
<thead>
<tr>
<th>Biomass, Waste...</th>
<th>Alcohol Synthesis</th>
<th>Alcohol (C₂-C₅)</th>
<th>Dehydration</th>
<th>Oligomerization</th>
<th>C₃-C₄ olefins</th>
<th>C₈-C₁₆ iso-olefins</th>
<th>Hydrogenation &amp; Fractionation</th>
<th>ATJ-SPK</th>
</tr>
</thead>
</table>

### Hydroprocessed Esters and Fatty Acids Process (HEFA-SPK)

<table>
<thead>
<tr>
<th>Cleaned bio-derived oil</th>
<th>Press</th>
<th>Triglycerides</th>
<th>Hydrotreating Deoxygenate</th>
<th>Hydroisomerization Hydrocracking</th>
<th>C₁₂-C₂₄ n-paraffins</th>
<th>C₈-C₁₆ iso- and n-paraffins</th>
<th>Fractionation</th>
<th>HEFA-SPK</th>
</tr>
</thead>
</table>

### Fischer-Tropsch Processes (FT-SPK)

- **Natural Gas, Coal, Biomass, Waste...**
  - Gasification
  
  **Syngas (CO, H₂)**
  - Fischer-Tropsch Synthesis (CO, H₂)
  
  **C₁-C₂₀₀ n-paraffin & olefins**
  - Hydrocracking
  
  **C₈-C₁₆ iso- and n-paraffins**
  - Fractionation

### Alcohol to To Jet Process (ATJ-SPK)

- **Biomass, Waste...**
  - Alcohol Synthesis
  
  **Alcohol (C₂-C₅)**
  - Dehydration
  
  **C₃-C₄ olefins**
  - Oligomerization
  
  **C₈-C₁₆ iso-olefins**
  - Hydrogenation & Fractionation

### Hydroprocessed Esters and Fatty Acids Process (HEFA-SPK)

- **Cleaned bio-derived oil**
  - Press
  
  **Triglycerides**
  - Hydrotreating Deoxygenate
  
  **C₁₂-C₂₄ n-paraffins**
  - Hydroisomerization Hydrocracking
  
  **C₈-C₁₆ iso- and n-paraffins**
  - Fractionation

### Other Processes

- **Fischer-Tropsch Processes (FT-SPK)**
  - High temperature
  
  **Oligomerization**
  
  **C₈-C₁₆ iso-olefins**
  - Hydrogenation & Fractionation

- **Fischer-Tropsch Processes (FT-SPK)**
  - Low temperature
  
  **Hydroisomerization**
  
  **C₁-C₂₀₀ n-paraffin & olefins**
  - Hydrocracking

- **Hydrocracking**
  
  **FT SPK**
ATJ-SPK Feedstock-Alcohols

Biomass
Off-gases
Municipal Solid Waste

Alcohol Synthesis → C2 to C5 Alcohols

1) Dehydration
2) Oligomerization
3) Hydrogenation
4) Fractionation

ATJ-SPK Blending Fuel
ASTM Timeline

**ATJ-SPK Development Timeline**

- **Feb-09**: Built demo jet process in walk-in hood
- **Mar-09**: Submitted to AFRL for Tier II testing
- **Oct-08**: Submit jet fuel sample to AFRL for Tier I testing
- **Mar-09**: Tier I results AFRL “Sample meets JP-8 specifications”
- **Oct-09**: Tier II results AFRL “Scale up Sample resembles Tier I results”
- **Jun-09**: First LCA Completed Gevo Jet
- **Mar-10**: Indepent Consultant Review Gevo LCA Biojet
- **Jun-10**: First ASTM Task Force Established ASTM
- **Dec-10**: First ASTM Task Force mtg
- **Dec-11**: SHR Pilot Plant Construction Begins
- **Dec-11**: First Delivery ATJ-8 200 USG USAF
- **Jan-12**: SHR Pilot Plant Start Up
- **Apr-12**: USAF A-10 Fligh!
- **Jun-12**: USAF A-10 Fligh!
- **Apr-13**: Honeywell Aerospace CRC ATJ-8 Presentation
- **Aug-13**: Rolls Royce Engine Testing Rpt
- **Sep-13**: OEM Mtg Silsbee, TX
- **Oct-13**: First Draft ASTM Data Report

---

**Gevo**

**Cobalt**

**UOP**

**LanzaTech**

**Swedish BioFuels**
Catalytic Hydrothermolysis (CH) - Pathway
Biofuels ISOCONVERAION (BIC) Process = CH + Hydrotreating (Chevron Lummus Global)

Feed Stocks
- Triglycerides
- Plant oils
- Tallow
- Algal oils
- Fatty acids
- Water

Intermediate Products
- n-paraffins
- Iso paraffins
- Cycloparaffins
- Aromatics
- Olefins
- Organic acids

Conversion

Hydrogenation
Fractionation

Jet Fuel
“Drop-in”
ASTM D1655
Equivalent w/o blending

D4054 Timeline
- 1st Pilot production
- 2nd Pilot production
- “HEFA SKA” Task Force Formed
- NRC Flight test on 100% ReadiJet
- On-site OEM/TF meeting
- Fit-for-Purpose testing
- PW 615 test
- 3rd Pilot prod
- Start-up 100 bpd demo plant
- Ballot Research report
- Ballot HEFA SKA spec
- Submit Research Report

2011 2012 2013 2014 2015

“HEFA SKA” Task Force Formed
Hydrotreated Depolymerized Cellulosic Jet (HDCJ)

Pathway Overview

Renewable Biomass Feedstock
- Abundant supply
- Non-food resource
- Lignocellulose

Depolymerization
- KiOR’s BFCC
- UOP’s Pyrolysis
- Licella’s Hydrothermal

Bio-crude Hydrotreating
- Hydrotreating
- Refinery proven tech.
- Hydrocarbon product

Blendstock Fractionation
- Fungible hydrocarbons
- Gasoline, Jet, Diesel
- Aromatic rich (30-45%)

ASTM D4054 Qualification Timeline

- ASTM Task Force Established
- 1st Task Force Meeting
- 1st Draft of ASTM Research Report
- On-Site Meetings at KiOR DEMO Plant
- ASTM Research Report
HDO-SK: Hydro-Deoxygenated Synthesized Kerosene

Pathway Overview

- Biomass
- Sugar Cane
- Corn

Natural Gas

H₂ (optional)

APR/HDO Processing

Distillate Processing (Condensation + Hydrotreating)

HDO-SK

Naphtha Diesel+

- 80% Cycloparaffins
- 20% Paraffins
- >80% retention of bio-carbon in fuel

Distillation

ASTM D4054 Qualification Timeline

- ASTM Taskforce Assembled
- 1st Task Force Meeting
- 1st Draft of ASTM Research Report

Targeted OEM Feedback

- Seeking 50% blend
- Spec + FFP complete
- All within experience
- Advantaged
  - Thermal stability
  - Freeze point

2010 2011 2012 2013 2014
HDO-SAK: Hydro-Deoxygenated Synthesized Aromatic Kerosene

Pathway Overview

- Seeking blend up to aromatics limit
  - Balancing blendstock
- Spec + FFP complete
- All within experience
- Advantaged freeze point

ASTM D4054 Qualification Timeline

- 2010: ASTM Taskforce Assembled
- 2011: 1st Task Force Meeting
- 2012: 1st Draft of ASTM Research Report
- 2013: Targeted OEM Feedback
- 2014: HDO-SAK Gasoline Diesel+

**Biomass**
**Sugar Cane**
**Corn**

**Natural Gas**

H2 (optional)

**APR/HDO Processing**

**Aromatics Processing** (Modified ZSM-5)

Distillation

**HDO-SAK**
Gasoline
Diesel+

- 95% Mono-Aromatics
- 5% Indans/Tetralins
- >80% retention of bio-carbon in fuel

**Biomass**
**Sugar Cane**
**Corn**

**Natural Gas**

H2 (optional)

**APR/HDO Processing**

**Aromatics Processing** (Modified ZSM-5)

Distillation

**HDO-SAK**
Gasoline
Diesel+

- 95% Mono-Aromatics
- 5% Indans/Tetralins
- >80% retention of bio-carbon in fuel
Synthesized Kerosene with Aromatics, SKA

SKA Task Force
Objective: Develop D7566 Annex defining synthesized kerosenes with aromatics

Scope: 3 methods of synthesizing aromatics
- F-T product
- Hydrocracked F-T wax
- Alkylated benzene

Approach: 3 Phases
- F-T kerosenes
- Renewable kerosenes
- Uni-molecular products

Results:
- Successful D4054 eval.
- Successful def’n of arom.

Sasol IPK + Alkylated Benzene

Syngas → F-T → C₁ to C₄₀ Hydrocarbons → Sep. → C₃ + C₄ Olefins → H’treat. H’rt cut → Benzene (+ C₆’s)

Oligomerization → Alkylation

H’treat. Fract. → Iso-paraffinic Kerosene + Alkylbenzenes

1st IPK/A Production Sample

IPK/A Research Report to UK AFC

OEM Review of ASTM IPK/A Report

2nd IPK/A Production Sample

New ASTM IPK/A Report

1st SKA Research Report

ASTM Straw Ballot

2nd ASTM Research Report

Generic SKA rejected

New Tests

2009  2010  2011  2012  2013  2014

ASTM SKA Task Force Established
Round Table Discussion
CAAFI CQ Breakout Session
January 28, 2014

Mark Rumizen
Senior Technical Specialist
Federal Aviation Administration
<table>
<thead>
<tr>
<th><strong>Producers</strong></th>
<th><strong>OEMs</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing/Volume Req’ts/Logistics not clear</td>
<td>Generally positive comments</td>
</tr>
<tr>
<td>How to account for co-processing?</td>
<td></td>
</tr>
<tr>
<td>Composition-Based approval, not feedstock/process based</td>
<td>Should be subject to improvement based on experience</td>
</tr>
<tr>
<td>Better up-front involvement and coordination relative to test requirements/results</td>
<td>Who pays for engine and aircraft analysis?</td>
</tr>
<tr>
<td>Difficult to find lab to perform some tests</td>
<td>Test fuel not from full-scale production facilities</td>
</tr>
<tr>
<td>OEMs may not fully accept some test methods</td>
<td></td>
</tr>
<tr>
<td>High cost, need FAA/DOD support</td>
<td></td>
</tr>
<tr>
<td>Can testing not being used be removed from requirements?</td>
<td></td>
</tr>
<tr>
<td>OEM/FAA Review step outside of normal ASTM procedures</td>
<td></td>
</tr>
<tr>
<td>Specific rationale for rejection should be communicated</td>
<td></td>
</tr>
</tbody>
</table>
## Fit-For-Purpose Testing

<table>
<thead>
<tr>
<th>Producers</th>
<th>OEMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is World Survey/CRC Handbook acceptable pass/fail criteria?</td>
<td>Upcoming revision addresses scope of experience of some FFP properties</td>
</tr>
<tr>
<td>Need OEM Feedback on Test Methods/Results</td>
<td>Lack of definition of acceptable difference from reference properties</td>
</tr>
<tr>
<td>Involvement of Smaller OEMs (Cessna, Embraer)?</td>
<td>Same issues each time with some properties</td>
</tr>
<tr>
<td>OEMs always seem to find additional test requirements beyond D4054</td>
<td>Some variability in how data is presented</td>
</tr>
<tr>
<td>Evaluation of bulk physical properties for hydrocarbon, kerosene type fuels is not necessary – results always the same. Remove unnecessary tests.</td>
<td>Producers with minimal contact with OEMs may have incomplete/inappropriate data</td>
</tr>
<tr>
<td>Lack of or poorly defined pass/fail criteria</td>
<td>Some data lacks specific details</td>
</tr>
<tr>
<td>• Water separation</td>
<td></td>
</tr>
<tr>
<td>• Toxicology</td>
<td></td>
</tr>
<tr>
<td>• API 1581 Filter testing</td>
<td></td>
</tr>
</tbody>
</table>
# Materials Compatibility Testing

<table>
<thead>
<tr>
<th>Producers</th>
<th>OEMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many of these materials actually need to be soak tested?</td>
<td>Upcoming revision will address subjectivity.</td>
</tr>
<tr>
<td>How to move to more real-world testing such as dynamic testing?</td>
<td>Need to incorporate ultra-short materials list</td>
</tr>
<tr>
<td>How to harmonize different dynamic methods?</td>
<td></td>
</tr>
<tr>
<td>Need to make sure OEMs are engaged up front rather than after testing completed</td>
<td></td>
</tr>
<tr>
<td>Complex list of materials, pass/fail requires expert knowledge</td>
<td>Some problems if baseline fuel not run at same time as test fuel</td>
</tr>
<tr>
<td>Not necessary for hydrocarbon fuels in kerosene range, base on materials technical requirements, aromatics only issue</td>
<td>Test data and reports have improved over time, now can quickly review and make determination</td>
</tr>
<tr>
<td>Testing of metallics unnecessary</td>
<td></td>
</tr>
<tr>
<td>Test fuels differ only in trace materials, which don’t impact materials compatibility</td>
<td>Test data is variable depending on fuel producers engagement with OEMs</td>
</tr>
<tr>
<td>Need initial testing to determine if more extensive testing necessary</td>
<td>Often need to do testing ourselves on specific materials</td>
</tr>
<tr>
<td>Base on chemistry in lieu of testing</td>
<td></td>
</tr>
</tbody>
</table>
## Component/Rig/Engine Testing

<table>
<thead>
<tr>
<th>Producers</th>
<th>OEMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are we maximizing read-across based on composition and properties?</td>
<td>Lack of clearly defined pass/fail criteria</td>
</tr>
<tr>
<td>HW testing is well-defined, but other rig testing is not (pass/fail criteria)</td>
<td>Some OEMs only report general information due to proprietary concerns</td>
</tr>
<tr>
<td>Pass/fail criteria needs to be defined</td>
<td></td>
</tr>
<tr>
<td>Pass engine test but have issues on components test; doesn’t make sense</td>
<td>When producers fully engaged, test is well defined and results usable</td>
</tr>
<tr>
<td>Some tests not being done, need better up-front criteria for need for performing tests; difficult to plan</td>
<td>Often component tests required by OEM without technical basis to support a need for the test (not considering fuel chemistry or FFP results)</td>
</tr>
<tr>
<td>Need standardized rigs to only test once</td>
<td></td>
</tr>
<tr>
<td>Why need to wait until FFP done before rig/component test begins?</td>
<td>Too engine focused, process needs to be clear that airframe testing is equally important</td>
</tr>
<tr>
<td>Is HW testing enough? Most demanding environment? Why test at other OEMs?</td>
<td></td>
</tr>
</tbody>
</table>
## Pathway/Process Definition

<table>
<thead>
<tr>
<th>Producers</th>
<th>OEMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can we broaden feedstock/process definitions and focus on final composition/properties?</td>
<td>Should now direct focus on certifying a fuel based on final properties with less emphasis on process</td>
</tr>
<tr>
<td>If a number of process variations involved, may need to adjust definition detail depending on criticality to product composition</td>
<td></td>
</tr>
<tr>
<td>Need to ensure production batches give the same composition/performance as test batches</td>
<td>Should be defined such that controls do not allow unforeseen deviations</td>
</tr>
<tr>
<td>Approving fuel by process OK for now, but ATJ limitations on alcohol feedstock seems too restrictive</td>
<td>As an OEM, don’t have process expertise, can’t comment except that end product needs to fit current fuel property distribution</td>
</tr>
<tr>
<td>Need to move toward more generic pathways and away from company specific approvals</td>
<td>Should we require documentation of conventional petroleum fuel processes?</td>
</tr>
<tr>
<td>Process should be controlled via product quality specs, not process conditions</td>
<td></td>
</tr>
</tbody>
</table>
## Use of Compositional Characteristics to Guide D4054 Process

<table>
<thead>
<tr>
<th>Producers</th>
<th>OEMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of acceptable range for hydrocarbons and trace materials would improve approval process</td>
<td>Compositional characteristics can be used to define testing, if fuel properties the same, should consider not testing</td>
</tr>
<tr>
<td>Should require carbon number distribution, then only concern is oxygenates and inorganic contaminants</td>
<td>Compositional controls should cover both bulk composition and trace materials</td>
</tr>
<tr>
<td>Fuel performance is a function of composition, should understand performance differences based on composition, not run same tests repeatedly</td>
<td>Broad distribution of hydrocarbons should result in fewer tests, need detailed rig and engine data to predict based on composition</td>
</tr>
<tr>
<td>Ultimately a composition-based D7566 makes sense</td>
<td>Airframers don’t have expertise to link composition to D4054 process</td>
</tr>
<tr>
<td>Streamline process to only FFP for similar compositions</td>
<td></td>
</tr>
<tr>
<td>Replace rigs/engine testing with compositional models</td>
<td></td>
</tr>
</tbody>
</table>
## How Can D4054 Process be Improved?

<table>
<thead>
<tr>
<th>Producers</th>
<th>OEMs</th>
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<tr>
<td>No guidance on based on composition</td>
<td>Shorten list materials</td>
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<tr>
<td>No guidance on reference petro-Jet</td>
<td>Require technical basis for determining need for component/rig/engine testing</td>
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<tr>
<td>How to overcome OEM “cartel” approach?</td>
<td>Discourage redundant or non-standard testing, select representative component/engine tests</td>
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<tr>
<td>Economize test matrix to what is only necessary</td>
<td>Better definition of FFP properties and materials (where to get them)</td>
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<tr>
<td>Ensure timely OEM response, stop adding additional requirements</td>
<td>Decision matrix to determine component testing requirements</td>
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<tr>
<td>Process lost credibility with FAME project, need clear pass/fail criteria</td>
<td>Provide airframer input/requirements</td>
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<tr>
<td>Gov’t sponsored testing best way to go</td>
<td>Need to project management to avoid log jams</td>
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<tr>
<td>Est. stage gate process with periodic reviews</td>
<td>Need to make it clear airframe fuel system testing may also be required</td>
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<tr>
<td>Remove subjectivity, base on FDA’s process</td>
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<tr>
<td>OEMs who don’t participate should not be able to hold-up approval at last minute</td>
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### Other Questions/Comments?

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<tr>
<th>Producers</th>
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<tr>
<td>Concern if D4054 process not improved, producers will move away from jet fuels or start selling unapproved streams</td>
<td>Lengthy/costly process necessary to ensure airworthiness/safety</td>
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<tr>
<td>How can we continue with fuel approvals with defunding of USAF/AFRL/AFCO?</td>
<td>OEMs need to make sure there is no impact on flight safety</td>
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<tr>
<td>CAAFI should screen candidate processes to ensure commercial viability before proceeding down D4054 process</td>
<td>OEMs must have veto to block processes not technically acceptable for the safety/performance of their products</td>
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<td></td>
<td>When’s lunch?</td>
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