
2014 EIA Conference

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Why Airlines Want Alternative Fuels

» New Supply Chain
  • Energy Security/Supply Reliability
  • Competitor to Petroleum-Based Fuels

» Environmental Benefit/Imperative
  • Greenhouse Gas (Carbon) Emissions Benefits
  • Reduce Emissions Affecting Local Air Quality
  • Do Not Induce Other Environmental Problems
U.S. Airlines’ Fuel Costs Are High, Volatile and Rising
Average Price Paid for Jet Fuel Rose 272% between 2000-2013

Using Less Fuel But ...  
Million Gallons per Day

Due to Rising Prices ...  
USD per Gallon (Avg. Price Paid)

... Incurring Higher Costs  
Billion USD per Year

Source: BTS (T2: 921) for U.S. airlines
Source: BTS (Form 41 P-12(a) for U.S. airlines)
Source: BTS (Form 41 P-12(a) for U.S. airlines)

Using Less Fuel But...

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<tr>
<th>Year</th>
<th>Gallons per Day</th>
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Due to Rising Prices...

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<th>Price (USD)</th>
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... Incurring Higher Costs...

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<th>Cost (Billion USD)</th>
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Jet-Fuel Prices Remain Volatile
And They Continue to Exceed Gasoline Prices

Jet Fuel Price Volatility
Daily Average Spot Price per Gallon

Source: A4A and Energy Information Administration (U.S. Gulf Coast)

Jet Fuel vs. Motor Gasoline
Weekly Average Spot Price per Gallon

Source: A4A and Energy Information Administration (U.S. Gulf Coast)
Global Aviation Has Aggressive Carbon Targets
CNG from 2020 Agreed by Countries at United Nations Body (ICAO*)

2010
1.5% annual fuel efficiency improvement (average)
Working towards CNG

2020
Carbon Neutral Growth (CNG) from 2020

2050
50% reduction in net CO2 emissions over 2005 levels

ICAO = International Civil Aviation Organization
How Do We Meet Our Aggressive Emissions Targets?
Technology & Alternative Fuels, Operations & Infrastructure

Potential Role for Carbon Credits to Bridge
Notional Example

Forecasted Emissions Growth Absent Reduction Measures
Ongoing Fleet Renewal / Technology Development
ATC/NextGen/Operational Improvements
Low Carbon Fuels (lifecycle basis)

Potential role for carbon credits

Carbon Neutral Growth and Reduction Timeline
What an Airline Needs to Deploy Sustainable Alternative Jet Fuels

1) Safety
   - This is addressed through
     (a) The jet fuel specification; and
     (b) Application of procedures to assure fuel quality is maintained

2) Environmental Benefit
   - This is being addressed through
     (a) Lifecycle greenhouse gas emissions; and
     (b) Sustainability review

3) Commercial Viability
   - Need cost competitiveness &
   - Supply reliability

We now know how to do this

Need regulatory and contract acceptance

Poses the highest hurdles at this stage
A4A & Sustainable Alternative Aviation Fuels
Working Within Coalitions to Achieve Success

» Co-Founded and Co-Lead the Commercial Aviation Alternative Fuels Initiative® (CAAFI)

• Co-Leads: A4A, FAA, ACI-NA (airports) and AIA (airframe & engine manufacturers)
• Four Teams Aimed at Addressing Key Questions – Over 300 Participants
  • Certification/Qualification (e.g., jet fuel specs)
  • Research and Development (e.g., suitable fuels)
  • Environment (e.g., methodologies and case studies)
  • Business/Economics (e.g., finance/commercial terms)
Drive to “Drop-In” through Jet Fuel Specs
Safety/Quality – But Also Important to Supply & Cost

» **ASTM International: New Jet Fuel Spec (D7566) for Alternative Jet Fuels**
  
  • Fischer-Tropsch-Derived (FT) Jet Fuel – 2009
  • Hydrotreated Esters & Fatty Acids (HEFA) – 2011
  • Synthesized Iso-Paraffinic (SIP) – 2014
  • Working on Alcohol-to-Jet; others

  All pathways can generate “advanced biofuels”

» **Drop-In Allows Use of Same Infrastructure**
  
  • Working up fuel quality protocols specific to alternative fuel (already have for traditional jet fuel)
Jet Fuel Spec Enables Commercial Flights
Over 1500 Commercial Flights!
Getting to Commercial Viability
What Is Needed for Supply & Cost-Competitiveness to Meet Demand

» Market Signals from Fuel Purchasers (Beyond Demo Flights to Full Off-Take Agreements)

» Consistent Energy/Biofuels Policy from Governments

» Scale-up Capability and “Positive” Economics (Relative to Petroleum-Based)
  • Feedstock costs and availability are particularly critical
A4A Carrier Off-Take Agreements
Starting with Millions of Gallons; Key Step to Scale-Up

» Demonstrating What Is Possible

- Innovation in financing
- Leveraging the product slate

» More U.S. Airline Commercial Agreements in the Works

Supply 2014

Supply 2018
Examples of Alt. Jet Fuel Projects Around the World
Off-Take Agreements, Production & Developing New Pathways

» Off-Take:
  • KLM (The Netherlands) – SkyNRG
  • GOL (Brazil) – Amyris

» Off-Take Plus Direct Engagement in Production:
  • BA (United Kingdom) – Solena (new facility in London)

» Production:
  • UOP/Honeywell & Petrixo Oil & Gas (UAE)

» Development/Commercialization:
  • Lufthansa (Germany) – GEVO; Virgin Atlantic (United Kingdom) & Lanzatech; Etihad (UAE) & Masdar; Virgin Atlantic & Delta

Boeing & Airbus are partners in several projects
Pushing for Commercial Viability: What A4A Is Doing

» Public-Private Coalitions to Marshal Resources

• CAAFI® - alliances with Brazil, EU, Australia, etc.
• Strategic Alliance with the U.S. Military (Defense Logistics Agency)
  • Combining experience and potential demand (market signals)
• Farm to Fly with the U.S. Department of Agriculture, CAAFI, Boeing (and other partners)
  • Primary focus on linking feedstock supply chain with fuel production and end users; leverage agricultural programs
  • Goal is 1 billion gallons of alternative jet fuel in 2018
• Regional U.S. initiatives: e.g., Pacific Northwest & Midwest
Commercial Viability: What A4A/Airlines Are Doing

» Achieved Eligibility for RFS/RIN Credit

» Developed Key Guidance for Doing Deals
  • “Guidance for Selling Alternative Fuels to Airlines”

» Advocating Appropriate Government Policy
  • In support of scale-up and cost-competitiveness
  • But, clearly a challenge in today’s political climate

» Engaging in Global Aviation Coalitions
In-Progress Public-Private Deployment Initiative

» U.S. Defense Production Act Project
  - USDA, Department of Energy and Navy (Aviation & Marine Alternative Fuels)
  - Scale-up full supply chain
  - Up to $510 million government investment over 3 years (2013-2015)
  - Public-private partnership (so industry financial contribution too)

» Helping to “Kick-Start” the Industry
  - A “bridge” to self-sustaining commercial viability
Advantages of Coalition Approach
Recipe for Success

» It Would Be Difficult for Individual Airlines to Replicate the CAAFI Process and Other Cooperative Efforts

» Spread Financial Risks for Airlines & Potential Suppliers

» Commercial & Military Aviation Connection Leverages Demand, Experience and Market Opportunities

» Accelerate Deployment of Projects

» Global Engagement for a Global Industry
If You Want to Feel Good About the Future, Look Up!

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www.airlines.org

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