The Commercial Aviation Challenge

Carbon-Neutral Growth

Use less fuel
- Efficient airplanes
- Operational efficiency

Change the fuel
- Lower lifecycle CO₂
- No infrastructure modifications
- “Sustainable Biofuels”

Sustainable Biofuels Enable Continued Growth

Presented to ICAO GIACC/3 February 2009 by Paul Steele on behalf of ACI, CANSO, IATA and ICCAIA
Boeing pursuing sustainable biofuel strategy

*Enable the industry to achieve market viability – by 2015*

Success Criteria
- 600+ million gallons/yr of bio content
- 5-10 feedstock/fuel production projects

**Five Focus Areas**

**Fuels Approval**
- Specification approach enables viable new fuel types and is not process-specific

**Feedstock Viability**
- Feedstock providers able to support 600M gallons/yr

**Airport Infrastructure**
- Infrastructure to deliver increasing quantities of sustainable biofuels

**Commercial Production**
- Commercial production capacity & business models

**Aviation-Prioritized Sustainable Biofuels**
- Support & advocacy for aviation-prioritized, sustainable biofuels

Boeing Acting as a Catalyst to Accelerate Commercialization
Boeing Leading ASTM Fuels Subcommittee –
Certifying aviation synthetic and biofuel

Test Program

- Fuel Specification Properties
- Fit-for-Purpose Properties
- Component or Rig Tests
- Engine Endurance Test

OEM Internal Review

- OEM Internal Review
- Now ASTM D7566 as well
- Research Report (Boeing lead author)

FAA Review
- Reject or Additional Data as Required
- FAA Review

OEM Approval
- Incorporate into Fuel Specification with FAA Consensus
- OEM Approval
- ASTM Specification

Specification Change

- ASTM Review & Ballot
- Reject or Additional Data as Required
Candidate sustainable biofuel feedstocks

*Current technology – hydroprocessing triglycerides (fats & oils)*

### Camelina
- **Ready Now**

**Challenges**
- Limited total yield
- Tied to grain markets

### Jatropha
- **Ready in 2 to 4 years**

**Challenges**
- Warm climates only
- Still manual harvest

### Halophytes
- **Ready in 2 to 4 years**

**Challenges**
- Prove at scale
- Optimize agronomy

### Algae
- **Ready in 8 to 10 years**

**Challenges**
- Bio-optimization
- Competing approaches
- Processing costs

***Viability Based on Timing, Technology, and Local Resources***
Other sustainable pathways still needed

*Much more biomass available to other pathways*

Technology and sustainability issues to be addressed
Sustainable Aviation Biofuel Projects by Region

- SAFUG-Europe Member Projects
- Working Together MOUs with PetroChina
- Life Cycle Analysis
- Aviation Biofuel Road Map
- Sustainable Aviation Fuels Northwest
- Project Flight Path
- Masdar Research Project
- Aviation Biofuel Assessment Project
Sustainable Biofuels – Progress Report

Progress
- Low lifecycle CO₂ sustainable bio-based fuels
- Flight tests – met / exceeded expectations
- Excellent fuel – ASTM approval expected 1Q11
- Comprehensive regional assessments underway
- Stretch goal: market quantities by 2015

Action Required
- Continued emphasis on sustainability
- Research in expanded feedstock and processing pathways
- Long term contract authority
- Continued engagement with USDA

Clean Energy AND Energy Security