Perspective on the Alternative Fuel Development

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Alternative fuels are part of the solution

• Today, CO₂ emissions are proportional to fuel burn
• The ultimate goal is to reduce CO₂ emissions through
  – Continuous improvements in fuel burn reduction
    • Engine improvements (SFC, lower weight and drag...)
    • Aircraft weight reduction
    • Airplane aerodynamic improvements
    • Better integration and simulation techniques in design process
  – Reduce the amount of CO₂ per unit of fuel: the role of alternative fuels for aviation
  – Industry engaged to foster the commercialisation of biofuels for aviation

• Need support from government through public initiatives to foster R&D synergies, including incentives towards a scalable introduction of alternative fuels for aviation
Alternative fuels implementation - major challenges

- Oil and carbon price
- Pressure for low carbon fuels
- Positive CO2 life cycle
- Biomass availability
- Competition for alternative fuels
- Scaling up production

- Biojet fuel x Biodiesel
- Technology maturity needed

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Where we are... Fuel approval targets (ICAO 2009)

- HBO Research (2009)
- HBO 50% Blend in D7566 (2010)
- 100% HBO Fuel Approved (2011)
- 100% FT Fuel Approved (2013)

FT = Fischer Triposch
HBO = Hydrogenated Biomass Oils
BTL = Biomass to Liquide

ASTM BTL approval exists today and HBO fuels soon!
Engine tests conducted by the different OEMs
Demonstrate technical feasibility - 2008

- Feb 1\textsuperscript{st}, 2008
  - Airbus A380 – Rolls-Royce Engines
  - Blend 40\% GTL (Shell Technology Centre – UK)

- Feb 24\textsuperscript{th}, 2008
  - Virgin Boeing 747-400 – GE Engines
  - Blend 20\% - Gen-1 FAME, babassu nuts and coconuts

- Dec 30\textsuperscript{th}, 2008
  - ANZ Boeing 747-400 – Rolls-Royce Engines
  - Blend 50\% - HRJ from jatropha

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Demonstrate technical feasibility - 2009

- **Jan 7th, 2009**
  - Continental Boeing 737-800 – CFM Engines
  - Blend 50% - HRJ from algae / jatropha

- **Jan 30th, 2009**
  - JAL Boeing 747-300 – P&W Engines
  - Blend 50% - HRJ from camelina / jatropha / algae

- **Nov 23rd, 2009**
  - KLM Boeing 747 – GE Engines
  - Blend 50% - HRJ from Camelina
Revenue flights – October, 2009

- October, 9th, 2009
  - Qatar Airbus A340-600
  - Engines: Rolls-Royce
  - Engines: Blend 50% - GTL (all four engines)
Demonstrate technical feasibility - 2010

- April 30th, 2010
  - United Airbus A319
  - Engines: IAE V2500
  - Blend 40% - GTL (one engine)
Flight test – Check objectives

Before the flight
- extensive pre-test analysis of the fuel
- demonstrate the viability of the fuel
- Material testing

During the flight
- Engine running on alternative fuel was highly challenged (accelerate, decelerate, wind-mill restart...)
- A list of various parameters recorded

After the flight
- Report of engine performance and behaviour
- No major difference when compared to conventional fuel
- Analysis of the parameters

Departure  Enroute  Arrival  Approach
Lessons from different tests

- Technical Viability
  - Variety of potential feedstocks
  - Different production routes
  - Draw attention of suppliers for alternative fuels

- Important to address sustainability analysis
  - Pending standardization

- Local vs Global Solutions

- Substantive information for qualification and certification issues:
  - ASTM D7566 – “Specification for Aviation Turbine fuels containing Synthesised Hydrocarbons” – Sept09
  - HRJ (Bio-SPK) under review by ASTM - fuel spec for up to 50% blend expected to be approved by the end of 2010
Future flights

• 2\textsuperscript{nd} Half, 2010
  – TAM Airbus A320 – CFM56-5B
  – Blend 50% - Jatropha
  – Set the value chain in Brazil
  – Sustainability analysis from RSB

• 1\textsuperscript{st} Half, 2012
  – AZUL Airlines Embraer E-190 – GE CF34-10E
  – Blend 50% - Renewable Jetfuel from Sugar cane
  – First demo flight using a sustainable biojet fuel from fermentation process
  – Feedstock with large scale production
Next steps towards the alternative fuels developments

• Additional tests, using:
  – Other types of blends
  – Higher blend levels
  – Monitor the repetitive usage of alternative fuels (labs, rigs, engine tests...)
  – Other types of fuels / process (FRJ, BTL, ....)

• Participation on development / revision of alternative fuel certification standards (Global and regional level)

• Work towards the Roundtable Sustainable Biofuels to support tasks related to alternative fuels sustainability

• Availability, affordability and sustainability of sufficient quantities of feedstock are necessary → SAFUG and ABRABA
Conclusions (1/2)

a) Proven technical feasibility of using alternative drop-in fuels – It works!

b) Encourage certification of new drop-in fuels

c) Foster the utilization of different feedstock and production processes

d) Support ICAO recommendations at ICAAF

e) Support harmonization of alternative aviation fuel sustainability standards
Conclusions (2/2)

f) Encourage governments to establish public policies that:
   - foster appropriate investments and incentives
   - accelerate R&D and commercial scale production
   - specifically target alternative drop-in fuel use for aviation
   - stimulate aviation alternative fuels implementation in a successful case