SUSTAINABLE ALTERNATIVE FUELS FOR AVIATION

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Aspirational goals

CO$_2$ Emissions Trends

“Basket of measures”
Basket of measures

- Improve efficiency
- Aircraft technology
- Aircraft operations
- Economic measures
  - "Market-based Measures"

Introducing low carbon footprint fuels → Sustainable alternative fuels
Sustainable alternative fuels

- To reduce the carbon footprint of the fuel
- Without changing aircraft and infrastructure
- Using “drop-in” fuels
“Low carbon footprint” fuel

Example: biofuels

Crude oil → Fossil CO₂

Combustion

Biofuel → Neutral CO₂ (up-taken by plant growth)

⇒ Combustion emissions accounted as zero emissions

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Life cycle GHG emissions

Fossil
- Extraction
- Transport
- Refining
- Transport
- Distribution
- Combustion

Well-to-wake

Biofuel
- Land use change
- Cultivation
- Transport
- Conversion
- Transport
- Distribution

Field-to-Tank
• Biofuels used in road transportation are not suitable for use in aviation

• Severe constraints in use on aviation fuels
  – Freezing point (-47 °C)
  – Energy content
  – ...

• Compatibility with existing system
  ⇒ “DROP-IN” fuel

• Aviation fuels need to be approved
  – ASTM, DEFSTAN,...
  – First alternative fuels approved in 2009 and 2011
Pathways to sustainable fuels

Simplified view of pathways for alternative jet fuels

Micro-algae → Waste gases → Tri-glycerides → Yeast, microalgae → Sugars

- Enzymatic Hydrolysis → Sugars → Fermentation
  - Alcohol → "Alcohol-to-Jet"
  - Farnesene → Hydroprocessing (HEFA) → Approved

- Hydroprocessing → "Alcohol-to-Jet"
  - Catalytic conversion
  - Fischer-Tropsch → Approved

- Pyrolysis / catalytic cracking

- Residues
- Cellulosic plants
- Macro-algae
- Sugar crops
- Cereals
- Animal fats
- Recycled oil
- Municipal wastes

Drop-in Jet Fuel (& diesel)

Components

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Example of biofuels potential GHG savings

Potential GHG emissions of biofuels

- Camelina: -67%
- Jatropha: -68%
- Rapeseed: -50%
- Microalgae: -62%
- Miscanthus: -90%
- Short rotation forestry: -86%
- Switchgrass: -84%
- Conventional kerosene: -84%

Variation range (depending on cultivation conditions)

Source: SWAFEA

* with no land use change

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• 2 alternative fuel pathways approved
  6 additional approvals underway at ASTM

• First commercial flights in 2011
  More than 1500 flights by July 2012

• First regular flights initiated in 2013

• First supply agreements signed by airlines

⇒ Feasibility is demonstrated, next step is to deploy
In a nutshell

• **Potential for significant emissions reductions**
  – Depends on feedstock type and cultivation, conversion process...

• **Emissions reductions achievable with existing aircraft**

• **Benefits will depend on:**
  – the availability of such fuels and the time profile of their deployment;
  – their actual lifecycle emissions reduction.

• **Challenges**
  – Decreasing production cost
  – Investment in feedstock production and conversion facilities
  – Ensuring sustainable deployment

⇒ **Policy support from States is required**
ICAO’s Work on Alternative Fuels

Resolution A36-22
Promote improved understanding

Resolution A37-19

Rio+20: the ICAO’s “Flightpath” Initiative

Resolution A38-18

2007
Rio Conference
ICAO as a facilitator
GFAAFAF Created

2009
Workshop
States, financial institutions and stakeholders

2010

2011

2012

2013
ICAO SUSTAF Group
Input to Assembly
Resolution A38-18 - Key elements

- Development of coordinated national policy actions to accelerate the appropriate deployment of sustainable alternative jet fuels

- Measures to ensure sustainability of the fuels that should:
  - Achieve net GHG emissions reductions on a life cycle basis
  - Respect areas of high importance for biodiversity, conservation and benefits from ecosystems
  - Contribute to local social and economic development, and avoid competition with food and water

- Cooperation through ICAO to exchange information and best practices

- Need for increased harmonisation for sustainability
• Member States, industry, financial institutions and other international organizations to actively participate in exchange of information and best practices and in further work under ICAO on sustainable alternative fuels for aviation

• Continue to maintain the ICAO Global Framework for Aviation Alternative Fuels (GFAAF)

• Collect information on progress of alternative fuels in aviation, to give a global view of the future use of alternative jet fuels and to account for changes in life cycle GHG emissions in order to assess progress toward achieving global aspirational goals

• Work with financial institutions to facilitate access to financing infrastructure development projects dedicated to sustainable aviation alternative fuels and incentives to overcome initial market hurdles
On-going activities

CAEP Alternative Fuels Task Force

Methodology to assess fuel life cycle emissions for use in the Global Market Based Measure

Assessment of potential emissions reductions from alternative fuels

Global Market Based Measure Task Force

Trends Assessment Modeling and Database Group

Fuel production

LCA

CO₂
Conclusion

• Promising solution but many challenges to address

• Cooperation among aviation stakeholders and with the energy sector is key, in particular to addressing sustainability and securing access of aviation to sustainable fuels

• International cooperation is the core of ICAO’s activities
  – Information/best practices sharing and dissemination
  – Global view to support decision making built on States’ contributions
• Visit the GFAAF website
   http://www.icao.int/environmental-protection/GFAAF/Pages/default.aspx

• Read the SUSTAF experts group report (available on the GFAAF)

• Read Environmental Report 2013 chapter 4