SUSTAINABLE ALTERNATIVE FUELS FOR AVIATION

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Aspirational goals

CO₂ Emissions Trends

- 2010 Fleet and Operational Efficiency
- ATM & Infrastructure
- Aircraft Technology
- Sustainable Alternative Fuels and Market-Based Measures

“Basket of measures”

Carbon Neutral Growth from 2020
Basket of measures

- Improve efficiency
- Economic measures
- Aircraft technology
- Aircraft operations
- "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

Combustion

Biofuel

Neutral CO₂
(up-taken by plant growth)

⇒ Combustion emissions accounted as zero emissions
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

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“Drop-in” fuels

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

Waste gases
Tri-glycerides
Yeast, algae
Sugars
Enzymatic Hydrolysis

Fermentation
- Alcohol
- "Alcohol-to-Jet"

Catalytic hydrothermolysis
Hydroprocessing (HEFA)
Farnesene
Hydroprocessing

Catalytic conversion
Fischer-Tropsch
Pyrolysis / catalytic cracking

Drop-in Jet Fuel (& diesel)
Components

Alcohol
Farnesene
Example of biofuels potential GHG savings

Indicative mean values*

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

GHG emission gCO2eq/MJfuel

* with no land use change

Source: SWAFEA

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Progress status

- 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

2010

2011
Workshop
States, financial institutions and stakeholders

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
ICAO’s Mandate from A38-18

- 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
Forthcoming activities

Forthcoming activities

- States’ Action Plans
  - Methodology for fuel LCA
  - Assessment of potential emissions reductions from alternative fuels
  - CAEP Alternative Fuels Task Force

- Trends Assessment
  - CAEP 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
For more information

- 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