Introduction to
Sustainable Alternative Fuels for Aviation
and ICAO’s activities

Ph. Novelli – ICAO Environment Branch
Content

- Introduction to sustainable alternative fuels
- ICAO’s activities
Emission trends and aspirational goals

ICAO Assembly Resolution A37-19

- 2% annual fuel efficiency improvement
- Stabilizing its global CO2 emissions at 2020 levels

Projected fuel efficiency gains

Emission trends and aspirational goals
Sustainable alternative fuels

- Hydrocarbon “drop-in” fuels
- Sourced from renewable biomass or wastes
- If properly produced, potential for significant emissions reduction on a life cycle basis
GHG emissions on a life cycle basis
Sustainable alternative fuels

Simplified view of pathways for alternative jet fuels

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

Waste gases

Tri-glycerides

Hydroprocessing (HEFA)

Approved

Yeast, algae

Sugar & starch

Fermentation

Hydrocarbons

Hydroprocessing

"Alcohol-to-Jet"

Hydrolysis

Lignocellulose

Fischer-Tropsh

Approved

Municipal wastes

Drop-in Jet Fuel (& diesel)

Components
Corner-stones in alternative fuels development for aviation

- First “drop-in” fuels approved for aviation
  - ASTM 2009 (FT) and 2011 (HEFA)

- Demonstration flights (2008-2011)
  - Virgin Atlantic (2008), Airbus (2008), Air New Zealand (2008), Continental (2009), JAL (2009), KLM (2009)…
  - Demonstration of performance and safety

- Emergence of commercial flights (2011 ⇒ …)
  - Proof of safe and harmless regular use
  - Proof of airlines interest and engagement

⇒ It works – The challenge is now to deploy
Resolution A37-19 (2010): requests States to

- develop policy actions to accelerate appropriate development and use
- work together through ICAO to exchange information and best practices
- consider measures and incentives to support:
  - research and development,
  - investments in feedstock cultivations and production facilities
  - commercialization and use

ICAO: a facilitator for the emergence of alt. fuels
Achievements and on-going initiatives

- **ICAO’s conference and workshops**
  - Rio November 2009: Conference Aviation and alternative fuels

- **Rio+20: the ICAO’s “Flightpath” initiative**
  - Four connected flights using biofuels from Montréal to São Paulo
  - “Green flights”: biofuels + flight optimization
  - [http://www.icao.int/environmental-protection/Pages/Rio+20.aspx](http://www.icao.int/environmental-protection/Pages/Rio+20.aspx)
Global Framework for Aviation Alternative Fuels (GFAAF)

(www.icao.int/environmental-protection/GFAAF/Pages/default.aspx)
The SUSTAF experts group

- **Mission:** “to facilitate the development and deployment of alternative fuels for aviation”
  - Initiated in July 2012
  - 40 experts from various geographic areas and stakeholders

- **Deliverable:** recommendations to support States and industry in developing and deploying sustainable alternative fuels
  - To be presented to ICAO Assembly in October

- **Work focused on possible options**
  - To overcome near-term challenges for deployment
  - To address sustainability
The SUSTAF experts group

- Economics: critical issue
- Need to create a market perspective
  - Defining renewable energy policy considering aviation
- Multidisciplinary coordinated approach at State’s level
- Sustainability needs to be part of policy
  - Existing approaches to be combined to ensure sustainability
- Potential benefit from increased harmonization or mutual recognition
Next steps

- **ICAO engaged in:**
  - Sharing information and successful practices
  - Building trends and projection for long term aviation emissions

- **Need to develop:**
  - a global view of future alternative fuel production
  - Means to account for change in GHG emissions

- **Aviation needs to connect with other sectors:**
  - In areas that would benefit from increased harmonization (e.g. sustainability, LCA emissions)
  - Projection for biomass availability and use
SAAFA

This page gathers news and activities related to alternative fuels for aviation since 2006 and is regularly updated with the last announcements.

- The items can be sorted by date, entity, country, product by clicking on the corresponding column title, or filtered by category.
- Plan text search is possible through the search function which will return all items containing the searched word.

Click here to change the SAAFA list.

<table>
<thead>
<tr>
<th>Date</th>
<th>Summary</th>
<th>Entity</th>
<th>Country</th>
<th>Product</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-01-11</td>
<td><strong>USDA Announces Investments in Bioenergy Research and Development</strong>&lt;br&gt;In the frame of President Obama's strategy to spur innovation of clean bioenergy in the United States and reduce dependence on foreign oil, Agriculture Secretary Tom Vilsack announced $250 million to fund research and development of next-generation renewable energy and high-value bio-based products from a variety of biomass sources. Four projects have been selected for funding through USDA's National Institute of Food and Agriculture (NIFA):&lt;br&gt;- <strong>Kansas State University</strong> (5 M) to make the oilseed crop camelina a cost-effective biofuel and bioproduct feedstock - Camelina production will be incorporated into a cropping system with wheat-based crop rotations in Montana and Wyoming;&lt;br&gt;- <strong>Ohio State University</strong> (6.5 M) for an anaerobic digestion system for the production of liquid transportation fuels and electricity from animal manure, agricultural residues, woody biomass and energy crops - the novel anaerobic digestion system will be integrated with partial oxidation and Fischer-Tropsch technologies to produce gasoline;&lt;br&gt;- <strong>CeramaTec, Inc.</strong> (6.5 M) for the conversion of lignocellulosic biomass to infrastructure-compatible renewable diesel, biolubricants, animal feed and biopower - new hybrids of energy sorghum will be developed, and other biomass resources include switchgrass and forestry residues, the biomass will be converted to hydrocarbons using innovative pretreatment, fermentation and electrochemical technologies;&lt;br&gt;- <strong>USDA-Agricultural Research Service</strong> (6.8 M) to develop an on-the-farm distributed technology for converting forest residues, horse manure, switchgrass and other perennial grasses into biofuels and high-value specialty chemicals - the process will use a patented process that will mimic the petroleum industry's catalytic cracking process.&lt;br&gt;Grant recipients are required to contribute a minimum of 20 percent matching funds for research and development projects and 50 percent matching funds for demonstration projects.&lt;br&gt;Read more</td>
<td>USDA</td>
<td>U.S.A</td>
<td>Biofuels</td>
<td>R&amp;D</td>
</tr>
<tr>
<td>2013-01-11</td>
<td><strong>Introduction of synthetic GTL jet fuel at Doha airport</strong>&lt;br&gt;A Qatari Airways Airbus A340-600 flight from Doha to London on Wednesday 9 February marked the introduction of commercial-scale synthetic jet fuel produced in Qatar. The natural gas-to-liquid (GTL) jet fuel, which is blended 50/50 with conventional Jet A1, is being produced by the French GTL plant - a joint venture between Qatar Petroleum and Total.</td>
<td>Qatar</td>
<td>Qatar</td>
<td>FT-GTL</td>
<td>Deployment</td>
</tr>
</tbody>
</table>

Qatar Petroleum, Shell
Initiatives and Projects

This page is still under construction and will be complemented with additional projects and initiatives in a near future.

ICAO encourages States/Organizations/Companies/Initiators/Research Institutes to share their initiatives on sustainable alternative fuels for aviation by completing this form.

Click here to Edit List

<table>
<thead>
<tr>
<th>Country / Region</th>
<th>Name of Initiative / Project</th>
<th>Category</th>
<th>Value-chain step</th>
<th>Type of pathway</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>ABRADA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>Aviation Initiative for Renewable Energy in Germany - AIREG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>Bioqueroseno</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>Sustainable Way for Alternative Fuels and Energy In Aviation (SWAFEA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>European Advanced Biofuels Flight Path</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.A.</td>
<td>Commercial Aviation Alternative Fuels Initiative - CAAAF1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia, New-Zealand</td>
<td>Flight Path to Sustainable Aviation Fuels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.A.</td>
<td>Northwest Advanced Renewables Alliance (NARA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>Sustainable Aviation Fuel User Group (SAFUG)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.A.</td>
<td>Sustainable Aviation Fuels Northwest (SAFN)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Sustainable Aviation Fuels Northwest (SAFN)**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFN's goal was to map a flight path to develop a safe, sustainable and economically viable aviation biofuels industry in the Northwest.</td>
<td>Feasibility study</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Value-chain step</th>
<th>Type of pathway</th>
<th>Starting time and duration</th>
<th>Stakeholders</th>
<th>Regional scope</th>
<th>Involved countries</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>The initiative was launched in July 2010 by Boeing, Alaska Airlines, the operators of the region's three largest airports - Port of Seattle, Port of Portland and Spokane International Airport - and Washington State University, a center for advanced biofuels research. Climate Solutions, a Northwest clean-energy nonprofit, was retained to manage a stakeholder process that included more than 40 organisations ranging across aviation, biofuels production, environmental advocacy, agriculture, forestry, federal and state government agencies, academic research and technical consultancies. The SAFN initiative:</td>
<td>All</td>
<td>All</td>
<td>July 2010 - May 2011</td>
<td>All types</td>
<td>Regional</td>
<td>U.S.A</td>
<td>Closed</td>
</tr>
</tbody>
</table>

- Analyzed the most promising local biomass sources for commercialization;
- Assessed all phases required to develop a sustainable biofuel industry, including biomass production and harvest, refining, transport infrastructure and use; and
- Prioritized state and federal policy recommendations needed to spur creation of sustainable fuels for aviation.

<table>
<thead>
<tr>
<th>Partners</th>
<th>Achievements to date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska Airlines, Boeing, Port of Portland, Port of Seattle, Spokane International Airport, Washington State University +40 stakeholders</td>
<td>SAFN published its report and recommendation in May 2011.</td>
</tr>
</tbody>
</table>
### Reference Documents

This page is currently under construction.

<table>
<thead>
<tr>
<th>Category</th>
<th>Title</th>
<th>Authors/Organization</th>
<th>Year</th>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability</td>
<td>Environmental Analysis Report</td>
<td>SWAFEA European Study - D6.2 report</td>
<td>2011</td>
<td>Link</td>
</tr>
<tr>
<td>Sustainability</td>
<td>The GBEP Sustainability Indicators for Bioenergy</td>
<td>Global Bioenergy Partnership (GBEP)</td>
<td>2011</td>
<td>Link</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Bioenergy Decision Support Tool</td>
<td>FAO - UNEP</td>
<td></td>
<td>Link</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Good Environmental Practices in Bioenergy Feedstock Production</td>
<td>FAO - BEFSCI</td>
<td>2012</td>
<td>Link</td>
</tr>
<tr>
<td>Overview and synthesis</td>
<td>SWAFEA Final Report</td>
<td>Ph. Novelli - SWAFEA European Study</td>
<td>2011</td>
<td>Link</td>
</tr>
<tr>
<td>Overview and synthesis</td>
<td>Review of the potential for biofuels in aviation</td>
<td>A. Bouen, J. Howes, L. Bertuccioli, C. Chudziak - E4tech (for CCC)</td>
<td>2009</td>
<td>Link</td>
</tr>
<tr>
<td>Overview and synthesis</td>
<td>Near-Term Feasibility of Alternative Jet Fuels</td>
<td>James I. Hileman &amp; al. - MIT (RAND-TR554)</td>
<td>2009</td>
<td>Link</td>
</tr>
</tbody>
</table>

Showing 1 to 9 of 9 entries