We are the future of climate-friendly aviation.

Introduction on International Activities, Targets and Progress on Flying with Renewable Fuels

ILA International Aviation Exhibition
Berlin, April 26th
aireg at a glance

• aireg was founded on June 8th, 2011
• Founders were Airbus Industrie, Lufthansa German Airlines and Munich Airport

• Mission: Ten percent of Germany’s aviation fuel demand in 2025 to be covered by climate friendly alternative fuels
• aireg is a non-profit association with its headquarters in Berlin
Founding Ceremony at Hotel Adlon with Secretary of Transport, Dr. Ramsauer
Organizational structure

General Assembly

Advisory Council

Auditors

Board

S. Knecht
Chairman

Dr. J. Buse
Deputy Chairman

Prof. J. Raps
President

Prof. Dr. M. Aigner
President

Dr. D. Müller-Wiesner
Member

Working Groups

Head Office

Coordinating Committee
Working groups

Provision of Feedstock

Technologies of Fuel Production

Fuel Utilisation

Quality and Certification

Sustainability

5 Working groups cover the core areas from crop to tank
2008-2018: Where are we today?

Several fuels have been certified since 2008:

• Alcohol to Jet (AtJ)  GEVO
• Biomass to Liquids (BtL-FT)  UOP, Red Rock Biofuels
• Gas to Liquid (GtL-FT)  Sasol, Shell, CCS
• Hydrotreated Esters and Fatty Acids (HEFA)  Neste Oil, AltAir
• Synthesized Iso Paraffins (SIP)  TOTAL-Amyris
• Municipal Waste to Liquid (FT)  Fulcrum

....and more pathways to come
# Alternative Fuels are up in the air

<table>
<thead>
<tr>
<th>Airline</th>
<th>Route</th>
<th># of flights</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>KLM Royal Dutch Airlines</td>
<td>Amsterdam – Paris</td>
<td>200</td>
<td>2011</td>
</tr>
<tr>
<td>Lufthansa</td>
<td>Hamburg – Frankfurt</td>
<td>1200</td>
<td>2011</td>
</tr>
<tr>
<td>Thomson Airways</td>
<td>Birmingham – Arrecife</td>
<td>42</td>
<td>2011</td>
</tr>
<tr>
<td>Alaska Airlines</td>
<td>Seattle – Portland</td>
<td>75</td>
<td>2011</td>
</tr>
<tr>
<td>KLM Royal Dutch Airlines</td>
<td>JFK – Amsterdam</td>
<td>26</td>
<td>2013</td>
</tr>
<tr>
<td>GOL</td>
<td>domestic Brazil</td>
<td>200</td>
<td>2014</td>
</tr>
<tr>
<td>KLM Royal Dutch Airlines</td>
<td>Amsterdam – Aruba</td>
<td>20</td>
<td>2014</td>
</tr>
<tr>
<td>Lufthansa</td>
<td>Oslo–Continental flights</td>
<td>5000 SAS KLM</td>
<td>2015</td>
</tr>
<tr>
<td>Cathay Pacific</td>
<td>Toulouse - Bangkok</td>
<td>46</td>
<td>2016</td>
</tr>
<tr>
<td>United</td>
<td>Paris – Nizza</td>
<td>20</td>
<td>2016</td>
</tr>
<tr>
<td>LAX – Outbound flights</td>
<td>daily operations</td>
<td></td>
<td>2017</td>
</tr>
</tbody>
</table>
First steps to market implementation - but slow progress

<table>
<thead>
<tr>
<th>Airline</th>
<th>Producer</th>
<th>Technology</th>
<th>Start</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNITED</strong></td>
<td>AltAir Fuels</td>
<td>HEFA</td>
<td>2016</td>
</tr>
<tr>
<td><strong>Southwest</strong></td>
<td>Red Rock Biofuels</td>
<td>BtL-FT</td>
<td>delayed</td>
</tr>
<tr>
<td><strong>Cathay Pacific</strong></td>
<td>Fulcrum BioEnergy</td>
<td>MunWasteFT</td>
<td>delayed</td>
</tr>
<tr>
<td><strong>Alaska Airlines</strong></td>
<td>Hawai`i Bioenergy</td>
<td>?</td>
<td>delayed</td>
</tr>
</tbody>
</table>
The Commodity Trap

Alternative Fuels are competing with conventional (fossil) Jetfuel
The project was finally started in 2015 to demonstrate the supply chain for renewable aviation kerosene from European biomass sources (Camelina from Spain). The Project was funded by the EU with 10.0 million €. Due to lack of feedstock and renewable kerosene the project finally merged with the Biokerosene project at Oslo Airport – financed by AVINOR, the Norwegian Airport Authority.
For a period of several months, AVINOR – the Norwegian Airport Authority financed approx. 16 million € for a biokerosene blend that was delivered commencing March 2015 to all airlines fueling at Oslo’s Gardermoen Airport. However, the CO₂ savings were attributed to Lufthansa, SAS and KLM. The fuel was provided as a dedicated batch to Norway.

This project has been Europe’s largest biokerosene project since Lufthansa’s burnFAIR project in 2011.
The Nordic Initiative for Sustainable Aviation (NISA) was found in 2015 by several Airlines and Airports in Scandinavia.

The target of the initiative is to enable biofuel producers and consumers to use the initiative as a platform to develop the market.

NISA is committed to create the Fly Green Fund Nordic, a voluntary fund to support the development of new production facilities and research.
The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) was settled as the outcome of the 39th ICAO General Assembly in Montreal.

The CO₂ emissions measured in 2019 and 2020 will form the basis for a CO₂ neutral growth of aviation.

With Marked Based Measures (MBM) the airlines can compensate CO₂ emission exceeding the 2020 level by acquisition of certificates. The system is voluntary until 2026 and becomes binding from 2027 to 2035.
Prevailing Obstacles for Alternative Fuels

- Moderate Crude Oil Prices prevent airlines from transiting from fossil to green Jetfuels
- European NGOs are massively opposing against biomass-based synthetic fuels despite highest certification standards of ISCC, RSB
- Airlines and IATA promoted ICAO Marked Based Measures as a “less costly” alternative to green Jetfuels
- While all other types of green energy receive subsidies, green Jetfuels are not promoted in the EU
Political support in Germany

The Mobility and Fuels Strategy (MFS) of the German Federal Government – Ministry of Transport - has included green Jetfuels as part of the long term strategy to reduce emissions in the transport sector.

The MFS calls for more activities for the benefit of our climate!
DEMO – SPK

The demonstration project of synthetic paraffinic kerosene blends
Germany’s largest biokerosene project since burnFAIR in 2011.

We are grateful that the Ministry of Transport funded this project as part of the MFS.
Outlook

- aireg member CCS has got firm support by the State of Lower Saxony for the construction of a pilot plant of bio-methan based GtL-FT green Jetfuel.
- This pilot plant may be the catalyst for Germany‘s first step towards a continuous supply of green Jetfuel.
- Lead: Dr. Rüdiger Schwarz
Project GG2L – Green Gas to Liquid

• Production of green fuel and green basic chemicals based on biogas
• Site of facility: Province of Lower Saxony, Germany
• Start of production: May 2019
• Capacity: 10 bpd (1500 l/d) FT-product
• Offtake of complete production secured
• Feedstock: standard biogas plant

Potential: 8000 biogas plants in Germany alone
GG2L – Technology pathway

Feedstock preparation
• Production of raw biogas

Gas clean-up and Syngas production
• Gas clean-up
• Reforming
• Syngas generation

Fischer-Tropsch-Synthesis
• Synthesis
• Product generation
• Product beneficiation

Product upgrading and distribution

Diesel
Wax
Chemicals
Kerosene

• Improving carbon cycle economy
• Bio-Economy Value chain development
Summary

• Still a long distance to fly until aireg‘s goal of ten percent green Jetfuel will become reality!
• Obviously, the airlines are unable to create a level playing field within their industry for ramping up of green Jetfuels.
• However, DEMO-SPK and new technologies may stimulate German and EU politics to review their attitudes towards climate friendly fuels.

Thank you for joining the DEMO-SPK workshop!
Contact

Melanie Form
Acting Managing Director

aireg e.V.
Haus der Luftfahrt
Friedrichstr. 79
10117 Berlin
Germany

melanie.form@aireg.de
www.aireg.de