The role of aviation alternative fuels in climate change mitigation

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Overview

- Why the interest in alternative fuels?
- Three questions for 2009
- Hurdles to overcome for alternative fuels
- Other policy instruments to reconsider
- Conclusions
Biofuels in aviation: jumping the gun?

- **Much action and interest**
  - Numerous commercial trials attracting public attention
  - USAF seeking biofuels for blend certification by 2013

- **But...**
  - Compelling evidence that GHG emissions from today’s biofuels higher than conventional petroleum fuels
  - Supply constraints severe:
    - Meeting USAF demand for 300,000 gallons (~0.00035% of annual commercial use) “tricky”!

- Little reason to believe that biofuels will significantly reduce GHG emissions in the short to medium term --> need to think broadly about a range of mitigation options

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Date</th>
<th>Biofuel blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgin Atlantic</td>
<td>Feb 2008</td>
<td>20% (coconut and babassu)</td>
</tr>
<tr>
<td>Air New Zealand</td>
<td>Dec 2008</td>
<td>50% (jatropha)</td>
</tr>
<tr>
<td>Continental</td>
<td>Jan 2009</td>
<td>50% (algae and jatropha)</td>
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<tr>
<td>Japan Airlines</td>
<td>Jan 2009</td>
<td>50% (camelina, jatropha, algae &lt; 1%)</td>
</tr>
</tbody>
</table>

GHGs Forcing (2005) = 3 Wm\(^{-2}\)
Committed Warming = 2.4 C

Realized Warming = 0.6 C
Ocean Storage (0.5 Wm\(^2\)) = 0.5 C
Masked (1.4 Wm\(^2\)) = 1.2 C

Committed warming derived from IPCC Forcing & IPCC climate sensitivity.
Aviation is the second largest transport contributor to climate change

Future temperature change (K) due to transportation with constant 2000 emissions

Source: Berntsen and Fuglesvedt, PNAS, 2008.
Anticipated two to fivefold increase in aviation CO$_2$ emissions by 2050

Global aviation CO$_2$ essentially unregulated today

Kyoto protocol coverage of global aviation CO$_2$ emissions
assuming no post-2004 growth

## ICAO Action to Date

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Action</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel taxes</td>
<td>Reaffirms opposition</td>
<td>2001</td>
</tr>
<tr>
<td>GHG emission standard</td>
<td>Rules out</td>
<td>2001</td>
</tr>
<tr>
<td>Closed emissions trading</td>
<td>Opposes</td>
<td>2001</td>
</tr>
<tr>
<td>Global ETS</td>
<td>Dismisses in favor of existing schemes</td>
<td>2004</td>
</tr>
<tr>
<td>GHG emissions charges</td>
<td>Three year moratorium</td>
<td>2004</td>
</tr>
<tr>
<td>EU ETS</td>
<td>Attempts to block inclusion of foreign carriers</td>
<td>2007</td>
</tr>
<tr>
<td>Alternative fuels</td>
<td>TBD</td>
<td>2009</td>
</tr>
</tbody>
</table>

Three questions to address in 2009

1. How can aviation’s current and future climate impact be reconciled with the need for 60~80% reductions in GHG emissions from developed countries by mid-century?

2. What role can alternative fuels play in reducing emissions?

3. What other policy instruments need to be incorporated into a post-Kyoto agreement to bridge the gap?
Key hurdles to alternative fuel use

- **Environmental**
  - Should not compete with food production
  - Must provide significant, verifiable GHG emission reductions measured on a lifecycle basis
  - Consider opportunity costs (biomass for electricity generation)

- **Economic**
  - Supply (esp. competition with other transport modes)
  - Cost

- **Operational**
  - Energy density critical
  - Freeze point, engine restart, etc.

- **Infrastructure/distribution**
  - Separate infrastructure for fuel delivery?
  - International use feasible, or domestic only?
Many alternative jet fuels not likely to meet environmental criteria

Lifecycle GHG emissions relative to baseline conventional jet fuel

Aviation will compete with other modes and sectors for alternative fuels

Without regulatory requirements how will aviation compete for capital and low-carbon feedstocks with other transport modes and sectors?
What is a realistic outlook for the supply of renewable fuels for aviation?

US Ethanol Production, 1980 to 2007

Annual Growth rates
1980 -- 2007: 14%
2000 -- 2007: 22%
Even optimistically, aviation unlikely to reduce emissions significantly in medium term through alternative fuels alone

Emissions reduction due to fleetwide 10% use of alternative fuels with half the lifecycle CO$_2$ emissions of petroleum jet fuel in 2025

Source: ICCT, using AERO2K data and linear introduction from 2016.
ICAO needs to reconsider other policy measures

- **GHG emission/efficiency standards:**
  - LD vehicle efficiency widely regulated worldwide
  - HD: regulated today in Japan, action pending in US and China
  - IMO: efficiency standard under consideration in 2009
  - ICAO: ????

- **Market-based measures**
  - Global ETS under GIACC
  - International kerosene tax
  - En-route charges

- **Flanking measures for NOx, contrails/cirrus**
  - Cruise NOx emission standards
  - Emission-based landing/en route charges
  - Aircraft rerouting to reduce contrail formation?
Conclusions

- Caution needed, particularly for today’s biofuels
- Undeniable need for GHG action from aviation this year
  - Large climate impact
  - Fast growth
  - Essentially unregulated by UNFCCC or ICAO
- Industry focus on sustainable fuels acknowledged, but substantial hurdles to overcome
- Alternative fuels alone not sufficient to contain growth in GHG emissions in the foreseeable future
- ICAO needs to reconsider other measures to meet climate protection goals