Feasibility of a biojet fuel supply chain in Canada

A project under Canada’s Clean Transportation Initiative (CTI)

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Presentation Outline

- Biojet for reducing aviation GHG emissions
  - Technology
  - Initiatives
  - Sustainability

- Project under Transport Canada’s ‘Clean Transportation Initiative’ Aviation Sector

- Observations
Select Information and Observations on Biojet
Biojet basics, briefly

- Biojet – considered a drop-in fuel
- Existence of technical specification allowing up to 50% biojet fuel content
  - ASTM D67566 (biojet spec) into ASTM D1655 (Jet A spec)
Upstream/Downstream Logistics

3. Options for transport to the airport:
   - Pipeline connection
   - Trucking
   - Rail tank car
   - Shipping

2. Physical blending & Recertification to jet A(A1) (ASTM D1655)

1. Certification of biojet fuel (ASTM D7566)

4. Options for into plane logistics:
   - With Bowser trucks
   - Using the airport’s fuel hydrant system (unique)
   - Trials expected at Schipol and Valencia airports

Multiple Feedstocks
### Overview of conversion pathways

<table>
<thead>
<tr>
<th>Pathway</th>
<th>ASTM certified</th>
<th>Description</th>
<th>Target feedstock</th>
<th>1st commercial facility expected to be available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fischer-Tropsch (FT)</td>
<td>✔️</td>
<td>Converts any carbon-rich material (e.g. biomass) into sugars which is then catalytically converted to jet</td>
<td>All biomass &amp; MSW</td>
<td>Unclear. Large uncertainties</td>
</tr>
<tr>
<td>Hydrotreated Esters and Fatty Acids (HEFA)</td>
<td>✔️</td>
<td>Converts oil to jet via deoxygenation with hydrogen and cracking</td>
<td>Oils and fats</td>
<td>2010</td>
</tr>
<tr>
<td>Alcohol to Jet (ATJ)</td>
<td>2014***</td>
<td>Uses alcohols derived from sugars and starches and converts them to jet via dehydration, oligomerization and hydrogenation</td>
<td>All alcohols (based on biomass, MSW and waste gases)</td>
<td>2017</td>
</tr>
<tr>
<td>Direct Sugars to Hydro Carbons (DSHC)*</td>
<td>2014***</td>
<td>Ferments plant sugars and starches to hydrocarbons which are subsequently thermo-chemically upgraded to jet fuel</td>
<td>Sugars (incl. C6 cellulosic sugars)</td>
<td>2017</td>
</tr>
<tr>
<td>Hydrotreated Depolymerized Cellulosic Jet (HDCJ)**</td>
<td>2015***</td>
<td>Converts any carbon-rich material into a bio-crude oil via thermochemical depolymerization which can then be upgraded to jet</td>
<td>All biomass &amp; MSW</td>
<td>2018</td>
</tr>
</tbody>
</table>

*This includes Direct Sugars to Hydrocarbons (DSHC)
**This includes, amongst others, pyrolysis and Hydro Thermal Upgrading (HTU)
*** Expected year of certification
The biojet fuel market for aviation is growing; shift from single flights towards supply chain development initiatives.
‘Sustainable’ biomass feedstock is the key to ‘sustainable’ biofuels
Project Introduction
Project Overview

Project Team

External Advisors

Funding

Pierre Poitras et Associés

Transport Canada + Partners
**Project Objectives**

- Characterize Canadian regional capacities for biojet production and supply chain development
- Assess the potential performance of biojet supply chains across sustainability metrics
- Structure a partnership model for a pre-commercial biojet supply chain
- Determine enabling conditions for biojet supply chain, take into account issues of competitiveness with other jurisdictions, feedstock availability, market access, risk, etc.
- Relate applicability of the aviation sector research to other Transport Canada priority sectors (rail, marine)

**Timeline**

- **Phase 1**
  - Determine the main components of a regional biojet fuel supply chain
- **Phase 2**
  - Identify the supply chain partners
  - Complete techno-economic and sustainability analysis
  - Inform the business case for renewable jet fuel production in Canada
- **Phase 3**
  - Commercial agreements
  - Feedstock development
  - Project development
- **Phase 4**
Value Proposition

- Multidisciplinary team with technical and commercial understanding of conventional fuels, biofuels, and aviation sector

- Experience earned through ‘1G’ renewable diesel sector and ‘2G’ drop-in sector in Canada

- Research team based at University of British Columbia

- Knowledge of sustainability via its assessment methodologies (standards e.g. ISO, ISCC, RSB), its practical application in policy (Canada, US, EU) and its relevance to project success

- Canadian aviation industry engagement with IATA and Air Canada participation as external advisors

- Commercial purpose
This project will seek to build on the results of completed studies and initiatives.
Observations:

- Overcoming sustainability concerns may be harder than overcoming technical barriers
- High expectations on biojet

Aspirations:

**IATA:** ‘Meet sustainability criteria such as lifecycle carbon reductions, limited fresh water requirements, no competition with food production and no deforestation’

**ATAG:** The aviation industry is seeking biofuels made from crops that:
- are fast growing, non-food plants that don’t take up productive arable land which would otherwise be used for food production;
- do not require excessive supplies of pesticides, fertiliser or irrigation and do not threaten biodiversity;
- do not require excessive amounts of fresh water to grow;
- provide socio-economic value to crop-growing local communities;
- result in a lower carbon footprint on a total carbon lifecycle basis and provide an equal or higher energy

**Outside perspective:** operating under (very) aspirational voluntary targets on biofuels may be preferable to regulatory requirements
Challenges

- Market access
  - Complex area with overlapping initiatives, suitability of existing policy designs (ETS, RFS, LCFS)
  - Life Cycle Assessment (LCA) – multiple models, multiple jurisdictions
  - Indirect Effects (e.g. iLUC) and coverage of concept on any commoditized biomass
  - Integration with existing energy infrastructure – Bowser vs. Hydrant
  - Technical certification process for new pathways

- Competitive fiscal environment
  - Capital availability: high volume, low margin
  - Limited production capacity
  - Build vs. buy (e.g. domestic production or imports to CDA)
  - Perpetual Drive to Reduce risk: commercially available, viable technology and feedstock

- …but notwithstanding, biojet a large and important opportunity
Thank You!

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(on behalf of the CTI project team)

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