Road to Tokyo 2020 and Beyond
Japan’s Initiatives
Presentation for IATA Alternative Fuel Symposium
16-17 November 2017

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Euglena Co., Ltd.
Global Goals-ICAO Resolution & IATA⇒ CNG 2020
IATA⇒Reduction of CO2 50% by 2050

11th largest emitter in international aviation

3 biofuel-powered flights operated by the Japanese airlines to date

CO2 emission reduction effort by Japanese Airlines in “Tech, Ops, Infra” → Fuel Efficiency Project

(Source: ICAO)
# The Road to Tokyo 2020 Olympic & Paralympic Games

## Beyond (chronological table)

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Virgin Atlantic’s first biofuel flight</td>
</tr>
<tr>
<td>2008</td>
<td>ANA, JAL joined SAFUG as founding member</td>
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<tr>
<td>2009</td>
<td>JAL biofuel Test flight</td>
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<tr>
<td>2012</td>
<td>ANA biofuel ferry flight / NCA biofuel ferry flight</td>
</tr>
<tr>
<td>2012</td>
<td>Japan Association for Microalgae Fuels (JMAF) formed to tackle challenges – All Japan collaboration (active)</td>
</tr>
<tr>
<td>2020</td>
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</tr>
<tr>
<td>2020</td>
<td>Celebrate the first biofuel commercial flights in summer 2020 during the Olympic and Paralympic Games</td>
</tr>
<tr>
<td>After 2020</td>
<td>Large scale commercialization commences towards 2030</td>
</tr>
<tr>
<td>2030</td>
<td></td>
</tr>
</tbody>
</table>
Initiatives for Next Generation Aviation Fuels (INAF)
May 2014 – April 2015
Report issued in July 2015

- **Background**
  - Global Environmental Issues - promotion of measures to counter global warming and ensure energy security
  - Industry commitments and collaborations - Carbon Neutral Growth (CNG2020) by ICAO and IATA and a 50% decrease in carbon emissions by 2050 ⇒ a international pledge by the aviation industry
  - Emergence of Sustainable Aviation Fuel Users Group (SAFUG) – ANA, JAL, interested airlines’ pledge to work on the development and use of sustainable biofuels
  - Global movement – Inclusion of Bio-SPK in the ASTM D7566 as Annex 2 paved the way for the use of biofuels
  - Insufficient Pace ?– development in production and fuel certification
Initiatives for Next Generation Aviation Fuels (INAF)

- **Objectives**

  - **Introduction of Next-Generation Aviation Fuels**
    Energy security, reduction of GHG emission in aviation sector

  - **Establishing supply chain by 2020 – 6 feedstock categories:**
    Municipal waste; Microalgae; Natural oils; Waste food oil; Non-edible biomass; Woody biomass

  - **Entire supply chain - from the procurement of raw materials, production of next-generation aviation fuels, blending with conventional jet fuel to refueling of aircraft**

  - **Formulating a Roadmap for commercialization – utilization by 2020 Tokyo Olympics & Paralympics**
Roadmap for Establishing a Supply Chain for Next-Generation Aviation Fuels

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Production of next-generation aviation fuels</th>
<th>Municipal waste</th>
<th>Micro algae</th>
<th>Natural oils</th>
<th>Used food oil</th>
<th>Non-edible biomass</th>
<th>Woody biomass</th>
<th>Handling in mixture, transport, airports, aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Formulate business plan (demonstration project)</td>
<td>FT-SPK (ATJ *)</td>
<td>HEFA-SPK</td>
<td>HEFA-SPK</td>
<td>HEFA-SPK</td>
<td>(ATJ *)</td>
<td>FT-SPK</td>
<td>Develop methods for handling next-generation aviation fuels and alternative aviation fuels</td>
</tr>
<tr>
<td>2016</td>
<td>Design, construct and have trial operation of demonstration plant for producing next-generation aviation fuels (demonstration project)</td>
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<td></td>
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<tr>
<td>2017</td>
<td>Prepare basic design and detailed design</td>
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<td></td>
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<tr>
<td>2018</td>
<td>Produce next-generation aviation fuels (demonstration project)</td>
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<tr>
<td>2019</td>
<td>Reflect results of analysis of demonstration project in commercial project</td>
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<tr>
<td>2020</td>
<td>Expand scale of production (commercial project)</td>
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<tr>
<td>2021 ~</td>
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</tbody>
</table>

Notes:
- The size of the plant project increases in order from small to large beginning with lab, bench, demonstration and commercial. Here, an assumption that the size will increase beginning in FY 2021 has been taken into account, and the projects have been arranged so that a demonstration project is implemented by FY 2020 and a commercial project in FY 2021 or thereafter.
- The roadmap for each raw material is based on the results of reviews conducted by each subcommittee (see appendix (only Japanese version) pp. 76, 105, 135 and 136).
- Provisions for the ASTM standard ATJ have not been prescribed in D7566 Annex as of May 2015, but enactment of such provisions is anticipated in 2015 or 2016.
From “INAF” Roadmap to the Next Stage
“Committee for the Introduction of BJF for the 2020 Olympic and Paralympic Games in Tokyo” (Committee)
Government –led Committee formed in 2015~

Challenges in Introducing BJF
(Source: Based on the diagram prepared by METI and MLIT and presented to the Committee in 2015, translated and modified by N.H. Terasaki)
R&D activities by METI and NEDO in Japan

Strategic Development of Next-generation Bioenergy Utilization Technology (FY2010-2016) by NEDO

- Element technology for bio jet fuel and so on

Project to develop bio-jet fuel production system (FY2017-2020) by NEDO

- Once through production process
- Industrialization

Commercialization in 2030
Predicted price of jet fuel
EIA 1 $/L = 120 ¥/L (reference)

Fuel blending / Certification facility establishment (FY2018-2019) by METI

FY2010 FY2015 FY2017 FY2020 FY2030

(Source: NEDO – Presented at ICEF2017 Biofuels Session on October 5, 2017)
R&D Activities for Bio Jet Fuel in Japan
In Japan there are various technologies concerning Annex of ASTM D7566.

<table>
<thead>
<tr>
<th>Japanese major challenges</th>
<th>Method</th>
<th>Annex of ASTM D7566</th>
<th>Feedstock</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTL derived from Lignocellulosic biomass (MHPS)</td>
<td>Gasification, FT synthesis (+ upgrading)</td>
<td>Annex1 (FT SPK)</td>
<td>Organic</td>
</tr>
<tr>
<td>Cultivation, Extraction, Of Microalgae (IHI)</td>
<td>Cultivation, Extraction, Hydrotreating (+ upgrading)</td>
<td>Under confirmation with Annex2 (HEFA SPK)</td>
<td>Algal Oil</td>
</tr>
<tr>
<td>Hydrothermal Cleanup, Catalytic Hydrothermolysis, Hydrotreating (Euglena)</td>
<td>Biofuels ISOCONVERSION process</td>
<td>Applying for new Annex</td>
<td>Used cooking oil, Algal oil, Waste oil, etc</td>
</tr>
<tr>
<td>Isobutanol production technology using Genetically modified Corynebacterium (RITE)</td>
<td>Fermentation, Dehydration, Oligomerization (+ upgrading)</td>
<td>Annex5 (ATJ)</td>
<td>Sugar</td>
</tr>
</tbody>
</table>
Country Roadmap and Challenges

Government (METI and NEDO) aims at:

By 2020 (Phase 1) Strategic development of next-generation bioenergy utilization technology~2016//2017~2020 Development and establishment of BJF manufacturing technology & system (BTL and microalgal-derived) R&D projects - Funding provided by NEDO

BJF flights during 2020 Tokyo Olympic and Paralympic Games - Milestone

By 2030 (Phase 2) – Development of large-scale manufacturing process technology → commercial biofuel production 2030

Large-scale intensive biofuel production - Overseas locations for cost reduction

Standard Specification for BJF – ASTM Annexes/DEF STAN Amendments → JIG → JIS - many requirements to meet and fulfill

Integration of BJF into conventional jetfuel infrastructure at airports – key for efficient and lower cost supply chain

Integrated BJF Logistics - key for more efficiency and lower cost supply chain

Further collaboration among airlines, BJF producers and everyone in the supply chain
a venture company originating from the Faculty of Agriculture of the University of Tokyo,
world’s first company succeeding in the outdoor mass cultivation of the microalgae “Euglena” in December 2005
Received Prime Minister’s Award in the 1st Japan Venture Awards program
In January 2015

**Mid-term business goals**

Achieve the following goals by **FY 9/2020**.

1. **JPY30billion Sales (Consolidated)**

2. **Produce and supply bio jet/diesel fuels**

   **Made-in-Japan Biofuels Project**
   - Complete construction of biofuels demonstration plant and start supply of biofuels
   - Commercial flight using bio-jet fuel
   - Public road transportation using bio-diesel fuel
Introduction of “Made-in-Japan Biofuels Project”

We announced “Made-in-Japan Biofuels Project” by partnership with a city and 4 companies on Dec. 1, 2015

We aim to achieve commercial flight by biojet fuel and public road transportation by biodiesel fuel
Overview of “Made-in-Japan Biofuels Project”

Produce renewable jet/diesel fuels from **domestically-produced/-procured feed stocks**, and supply the products for practical use by 2020.

Start operation of demonstration plant in 1H 2019

- Feedstock:Produced or procured domestically
- Plant location:In Japan (in Tsurumi, Yokohama)
- ASTM-compliant renewable jet fuel
- Next-generation renewable diesel fuel

Commercial flights
Achieve practical use leading up to 2020
Public road transportation
Roadmap for commercialization of biofuels

Aim for commercialization by establishing the supply from Euglena mass production to biofuels production.

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020 and thereafter</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study &amp; preparation</td>
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<tr>
<td>Construction</td>
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<tr>
<td>Completion</td>
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<tr>
<td>In operation</td>
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<tr>
<td>Operation</td>
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<tr>
<td>Study &amp; preparation</td>
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<td></td>
</tr>
<tr>
<td>Construction &amp; Operation</td>
<td></td>
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</tbody>
</table>

- **Euglena cultivation research**
  - Central Research Center (Research on algae breeding and cultivation method)
  - Microalga Culture Center (Utilization of sewage)
  - Microalga Energy Research Center (Utilization of exhaust gas)

- **Euglena mass production**
  - Study & preparation
  - Construction
  - Completion

- **Biofuels demonstration plant**
  - Realization of revenue flight and public road transportation by 2020

- **Commercial plant**
  - Aim for mass production/supply by commercial plant
    - (several hundred times larger than the pilot refinery plant)
**Euglena cultivation research**

Cultivating microalgae by **utilizing treated sewage, CO2, industrial waste water and heat**

Microalgae Cultivation Center (Saga City Waterworks and Sewerage Bureau.)

Microalgal Energy Research Center (Industrial zone in Taki crystal town)

**Cooperation with the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)**

**Cooperation with the Ministry of Economy, Trade and Industry (METI)**

Aim to establish the cultivating technique for commercialization of microalgae
Euglena cultivation research – larger scale culture pool

Completed the construction of the world-first larger scale pool applied from construction technology of paddy field with Kobashi Industries

Operation starts on July, 2017

Microalgal Energy Research Center(Taki crystal town, Mie)

Aim to reduce the production costs of microalgae for biofuel
## Overview of Biofuels demonstration plant

The construction began in June 2017, and it is planned to be **completed in October 2018**

<table>
<thead>
<tr>
<th>Construction site</th>
<th>The KEIHIN plant of Asahi Glass Company, Limited (Yokohama, Japan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site area</td>
<td>7,787.6m²</td>
</tr>
<tr>
<td>Production capacity</td>
<td>5 barrels per day</td>
</tr>
<tr>
<td>Production volume</td>
<td>125 kiloliters per year</td>
</tr>
<tr>
<td>Product</td>
<td>Bio-kerosene (aviation biofuel), biodiesel, bio-naphtha</td>
</tr>
<tr>
<td>Adopted technology</td>
<td>Biofuels ISOCONVERSION Process (Licensed by Chevron Lummus Global / ARA)</td>
</tr>
</tbody>
</table>
| Schedule          | Start of construction – June 1, 2017  
Completion of construction – October 31, 2018  
Start of operation – 1H 2019 |

Aim to accumulate manufacturing know-how and establish the optimal process
Latest appearance image of the demonstration plant

(1) Administrative building  (2) Reactor device building  (3) Utility plant

(4) Storage area  (5) Loading area
Overview of “Made-in-Japan Biofuels Project” partnership

we aim to establish the supply chain working with our partners and related associations.

Microalgae "Euglena" + Other microalgae + Inedible plant oil ..etc

Produce microalgae "Euglena"

Government, industry, consortium

Cooperation for subsidy program, deregulation and standardization

Support for construction and operation

Support for construction and operation

ASTM-compliant renewable jet fuel

Land leasing

Commercial flights

Supply to domestic users

Public road transportation

Investment in and operation of the Japan’s first pilot refinery plant for biofuels

Next-generation renewable diesel fuel

Licensing

Evaluation and utilization of next-generation renewable diesel fuel

Supply of biofuel feedstock other than “Euglena”

Research on supply demand and distribution of products

Engineering, procurement and construction

Note: Our roles are written in orange, and partners of Made-in-Japan biofuels project are boxed in blue.
## Company Overview

<table>
<thead>
<tr>
<th>Foundation</th>
<th>9 August 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headquarters</td>
<td>5-33-1 Shiba, Minato-ku, Tokyo, Japan</td>
</tr>
<tr>
<td>Shareholder’s equity</td>
<td>15,276 million yen (US$137 million)</td>
</tr>
<tr>
<td>Sales</td>
<td>11,103 million yen (US$100 million)</td>
</tr>
<tr>
<td>Head-count</td>
<td>252 staff (consolidated)</td>
</tr>
<tr>
<td>Subsidiaries</td>
<td>8 fully-owned subsidiaries in Japan and 2 overseas joint ventures in Shanghai and Dhaka</td>
</tr>
<tr>
<td>Corporate philosophy</td>
<td>Make People and the Earth Healthy</td>
</tr>
<tr>
<td>Corporate vision</td>
<td>Make yesterday’s impossible into today’s possible through biotechnology</td>
</tr>
<tr>
<td>Listing</td>
<td>The 1st section of the Tokyo Stock Exchange</td>
</tr>
<tr>
<td>Ticker</td>
<td>2931</td>
</tr>
<tr>
<td>Number of shareholders</td>
<td>88,183</td>
</tr>
<tr>
<td>Market cap.</td>
<td>99 billion yen (US$896 million)</td>
</tr>
</tbody>
</table>

Note: Figures converted to US$ at the exchange rate of US$1=JPY111, TTS rate as of July 31, 2017