VELOCYS

From forest floor to first flight
Proving SAF from woody biomass

Client

Toyo Engineering Corporation (TOYO), in collaboration with Mitsubishi Heavy Industries, JERA, JAXA, and supported by NEDO (New Energy and Industrial Technology Development Organization, Japan).

Woody biomass-to-SAF demo plant in Nagoya, Japan. Source: TOYO.

Challenge

Demonstrate and validate an end-to-end sustainable aviation fuel (SAF) production process using woody biomass via gasification and Fischer-Tropsch (FT) synthesis. Key goals included:

- Verifying long-term stable operation of a biomass-to-SAF pathway
- Producing SAF that meets ASTM D7566 Annex-1 standards
- Reducing SAF production costs and supporting domestic fuel security
- Achieving flight-ready SAF for commercial aviation

Solution

After previous experience with Velocys FT synthesis technology in a gas-to-liquids (GTL) demonstration in the Americas, TOYO selected Velocys to partner with them in executing a fully integrated SAF demonstration plant in Japan.

The demonstration converted woody biomass into syngas using Mitsubishi Heavy Industries' gasification technology. The high-quality syngas was then synthesized into sustainable crude using Velocys FT technology. Leveraging microchannel reactor advantages and Oxford-engineered high-activity catalyst, the FT unit enabled TOYO to significantly downsize and modularize plant design.

After FT synthesis, the produced blend of hydrocarbons was further upgraded via hydrocracking onsite before being transported offsite and refined into neat SAF fully compliant with aviation specifications.

Outcomes and achievements

Flight-ready SAF from woody biomass

The demonstration achieved full compliance with ASTM D7566 Annex-1 for FT synthetic paraffinic kerosene.

Reliable long-duration performance

- 1,543 hours of integrated plant operation
- 30 consecutive days of uninterrupted FT crude production with more than 90% uptime
- Successful regeneration of catalyst to test the process (not required for the short demo production run)
- 2,366 liters of on-spec SAF successfully produced and certified

Proven FT technology performance

Velocys FT technology demonstrated high reliability and continuous output in a biomass-integrated setting.

The unit showed no degradation and was deemed suitable for immediate use after catalyst discharge.

Catalyst and process validation

Consistently clean syngas delivery and FT operation confirmed system stability and catalyst performance.

By the numbers

1st integrated FT SAF
demonstration in Japan using woody biomass

2,366 liters
of flight-certified SAF produced

1,543 total hours
of plant operation

30 days
of uninterrupted performance

Key learnings for future deployment

- **Modular FT technology is a game-changer**
  Compact, scalable systems enable flexible plant deployment in regions with localized feedstocks.

- **Full-chain integration is critical**
  Synchronizing gasification, syngas cleaning, FT synthesis, and refining ensures product consistency and system reliability.

- **Regulatory readiness drives momentum**
  Producing ASTM-compliant SAF enabled downstream validation, including fueling a commercial flight in Japan.

Project completion

The project culminated in the successful fueling of a domestic commercial flight using ASTM-compliant FT SAF, validating both the technical and regulatory viability of the biomass-to-jet pathway.

Fuelling JAL flight with SAF at Tokyo Haneda Airport. Photo courtesy of NEDO.

Legacy

This project marked the first demonstration of Velocys FT technology operating successfully with woody biomass feedstock in Japan. It proved that sustainable aviation fuel:

- Can be produced reliably at small-to-medium scale
- Meets rigorous aviation standards
- Supports national and global decarbonization efforts

The demonstration set the stage for commercial-scale deployment and affirmed the ongoing collaboration between Velocys and TOYO in the synthetic fuels space.

Learn more about licensing proven, cost-cutting FT technology at **Velocys.com**.

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