SUSTAINABLE AVIATION
BUSINESS OVERVIEW

Honeywell
**DECARBONIZING AVIATION: SAF AND HYDROGEN**

**Commercial Demonstration - 2008**
First SAF powered flight occurred.

**Gov’t & Policy Milestones - 2023**
Policies incenting SAF production coupled with volumetric requirements.

**Projected 5% Adoption Rate - 2030**
Timeframe for SAF with majority supplied from new processes.

**Projected 20% Adoption Rate - 2035**
Assuming hydrogen fueled aircraft enter into service in 2035 & narrow body H₂ planes are delivered in 2050.

**Projected 20% Adoption Rate - 2060**
~2075 timeframe assuming entry into service timelines are met.

**Gov’t & Policy Milestones - 2023**
C.I. and emissions reductions targets set for industry.

**Underlying Infrastructure - 2023**
New feedstock (biomass and ethanol) going commercial.

**Underlying Infrastructure - 2030**
Projected global electrolyzer capacity ~90 GWs by 2030; only enough for 25% of aviation fuel need.

**Commercial Demonstration - 2035**
ZEROe initiative from Airbus targeting 2035 for announcement of zero emission plane.

**Projected 5% Adoption Rate - 2050**
Assuming hydrogen fueled aircraft enter into service in 2035 & narrow body H₂ planes are delivered in 2050.

**2000 - 2020**
**2020-2025**
**2025-2030**
**2030-2040**
**2040-2060**

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*Fit for S5 and ReFuelEU*  
Aviation Airbus ZEROe  
IEA Renewable Energy Capacity
Honeywell UOP Technology Produces first Commercial Aviation Biofuel

Sources: Gulf Stream News
Most Experienced Licensor producing Sustainable Aviation Fuel

ECOFINING UNITS PRODUCING
SUSTAINABLE AVIATION FUEL (SAF)

- 150,000 MTA Feed (3,000 BPD)
- First refinery retrofit to UOP SAF at Paramount, California
- Produces SAF
- Expansion to 1,000,000 MTA (20,000 BPD)

World Energy operating since 2016

In Jan 2023, Honeywell AERO will receive its first monthly delivery of 8,000 gallons of SAF to be used in engine and APU testing.

The blend is 70% Jet A and 30% SAF, produced by World Energy using our IP technology. Every APU/Engine will run with SAF before being certified and shipped to customers.
bp selects Honeywell’s Ecofining™ Technology for the new Diesel and Sustainable Aviation Fuels Project in Kwinana, Australia.

JGC and Cosmo Oil to build first Sustainable Aviation Fuel Project in Japan using Honeywell Technology.

Oriental Energy licenses Honeywell technology to build Million-ton SAF Production Facility.

World Energy Secures Permits; will completely convert its Southern California refinery to create North America’s largest, world’s most advanced Sustainable Aviation Fuel Hub

- The world’s first SAF producer assembles Air Products, Honeywell, and leading energy transition innovators to team up to pioneer the frontier of low-carbon aviation in Southern Calif. for replication globally.

199,000 BPD of Ecofining SAF capacity under design & construction globally.
NEW TECHNOLOGY

BENEFITS OF ETJ

- High jet yield output
- Lower CAPEX & OPEX
- Reduced GHG emissions
- Higher profit margins
Reduced GHG emissions is based on UOP analysis derived from a 3rd party LCA for 1G low carbon ethanol production with locally sourced feedstock used in comparison to fossil fuels.
Leveraging over a decade of Ecofining™ experience
Ethanol to Jet Fuel Charts A More Efficient Path To Profits
THREE WAYS TO PRODUCE GREEN FUELS
CUSTOM SOLUTIONS FOR YOUR OBJECTIVES

Stand-Alone
Greenfield Ecofining Unit

- Maximum unit flexibility
- Produce 100% green fuel
- Targeted product slate
- Highest capital expense, but the best economy of scale

Refinery Revamp of
Existing Hydrotreater

- Repurpose underutilized assets
- Faster time to production
- Limited capacity and feed flexibility
- Moderate capital expense and economy of scale

Co-Processing Green
Feed with Petroleum Feed

- Fast implementation
- Produce blended fuel
- Minimal capital expense
- Limited capacity and feed flexibility
ECOFINING™ UNIT
UOP RENEWABLE TECHNOLOGY SOLUTIONS
Proven Technologies for Feedstock Flexible Drop-In Fuels

- Vegetable Oils
- Animal Fats
- Greases
- Algal Oil
- Petroleum
- Biomass
- Ethanol
- CO₂

**Ecofining™ & UOP Renewable Jet Fuel Processes**
- Renewable Naphtha
- Sustainable Aviation Fuel (SAF)
- Renewable Diesel (RD)
- Partial Sustainable Aviation Fuel
- Partial Renewable Diesel

**UOP Distillate Unionfining™ Process**

**RTP® (Pyrolysis)**
- Partial Renewable LPG
- Partial Renewable Gasoline
- Partial Renewable Diesel
- RFO for Heating/Power

**UOP Ethanol to Jet Process**
- Sustainable Aviation Fuel

**UOP CO₂ to Jet**
- Sustainable Aviation Fuel

**Inedible FOGs**

Partial Renewable Diesel
DROP-IN RENEWABLE FUELS FROM HONEYWELL UOP

Proven Licensor in Renewable Fuels

- Leading renewable fuels experience; 35 licenses and 7 operating plants +30 years combined operating data
- Flexibility to process a wide range of sustainable oil and fat feedstocks
- Delivering 3-4x typical industry profit margins for refining customers

Two-Stage Ecofining Unit

Ecofining can also be designed to produce renewable H₂ and LPG as byproducts, or 100% renewable naphtha

REDUCING DIESEL AND JET GHG EMISSIONS >80% COMPARED TO PETROLEUM FUELS
UOP ECOFINING WITH HPS CONTROLS
HOW DOES IT WORK?

Startup Your Facility Sooner
Proven world-class UOP process technology, pre-engineered automation solutions and innovative execution to reduce project schedule and risk

Reach Target Production Faster
Processes and equipment embedded with Honeywell UOP’s expertise, deep process knowledge and best practices to optimize startup and operator experience

Operate at Peak Performance
Honeywell process-specific software solutions to enhance safety, productivity and reliability

Earlier production & higher unit margin

Experion Pre-Integration
for UOP critical control system packages

Operational Knowledge
Interaction requirements-based operator displays and console workspaces, embedded operating procedures

Alarm Knowledge
Operator Alarm Help

Safety Knowledge
Cause and effect logic, startup / maintenance bypasses and shutdown logic displays

Control Knowledge
Basic and complex loops, automated sequences

Migrate, Optimize, Support
HOW WE DELIVER IT

TRADITIONAL

Basic Engineering Design → Schedule A Release → Design Review → Check-Out → Process Guarantees

Contractor FEED & Selection → Detail Design & Construction → Commission & Start-Up

Automation FEED → Automation Design → FAT → SAT

THE HONEYWELL ADVANTAGE

Basic Engineering Design → Schedule A Release → Design Review → Check-Out → Process Guarantees

Contractor FEED & Selection → Detail Design & Construction → Commission & Start-Up

Automation FEED → Automation Design → Training Simulators → FAT → SAT

Pre-engineered solutions with UOP Knowledge embedded into ICSS and APC

Detailed operating procedures, scenarios, exercises, & workbooks developed on OTS using UOP proprietary models

Cloud based validation of configuration and embedded procedures with UOP experts

UOP process know-how embedded in APC strategies can be implemented up to 4 months earlier

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UOP’S APPROACH
ETHANOL CONVERSION TO JET

Key Features

- High yields to jet and diesel from UOP’s ETJ process
- Compatible with hydrous or ASTM D4806 anhydrous ethanol
- Advanced heat integration for lower carbon intensity route
- Simplified oligomerization, leading to a lower CAPEX and OPEX than competing technologies
- Based on commercially demonstrated technologies – enabling fast scale-up and quicker time to commercialization
SUMMARY: UOP + HPS INTEGRATED VALUE

Embedded UOP Process knowledge
- Unique insights into start-up, shut down and operational cases
- Unmatched insights throughout all phases of the project including design, construction, building, commission, and long-term operations

Integrated Control & Safety System (ICSS)
- Preconfigured cause / effect matrix based on UOP expertise
- Preconfigured operator screens for key process areas to save errors
- Decrease complexity and schedule

Multi-purpose dynamic simulator (MPDS/OTS)
- Savings on re-engineering of equipment design based on dynamic studies
- Reduced start-up time due to pre-identified bottlenecks
- Control checkout of complete loops, saving time in the field
- Operational technology implementation miss-configuration identified early

Advanced Process Control (APC)
- Analysis and tuning of individual loop and services
- Pre-configured seed model to reduce testing and field implementation complexity
- Tested and verified in the MPDS, advancing the schedule forward

UOP’s technical expertise is integrated into solution suite