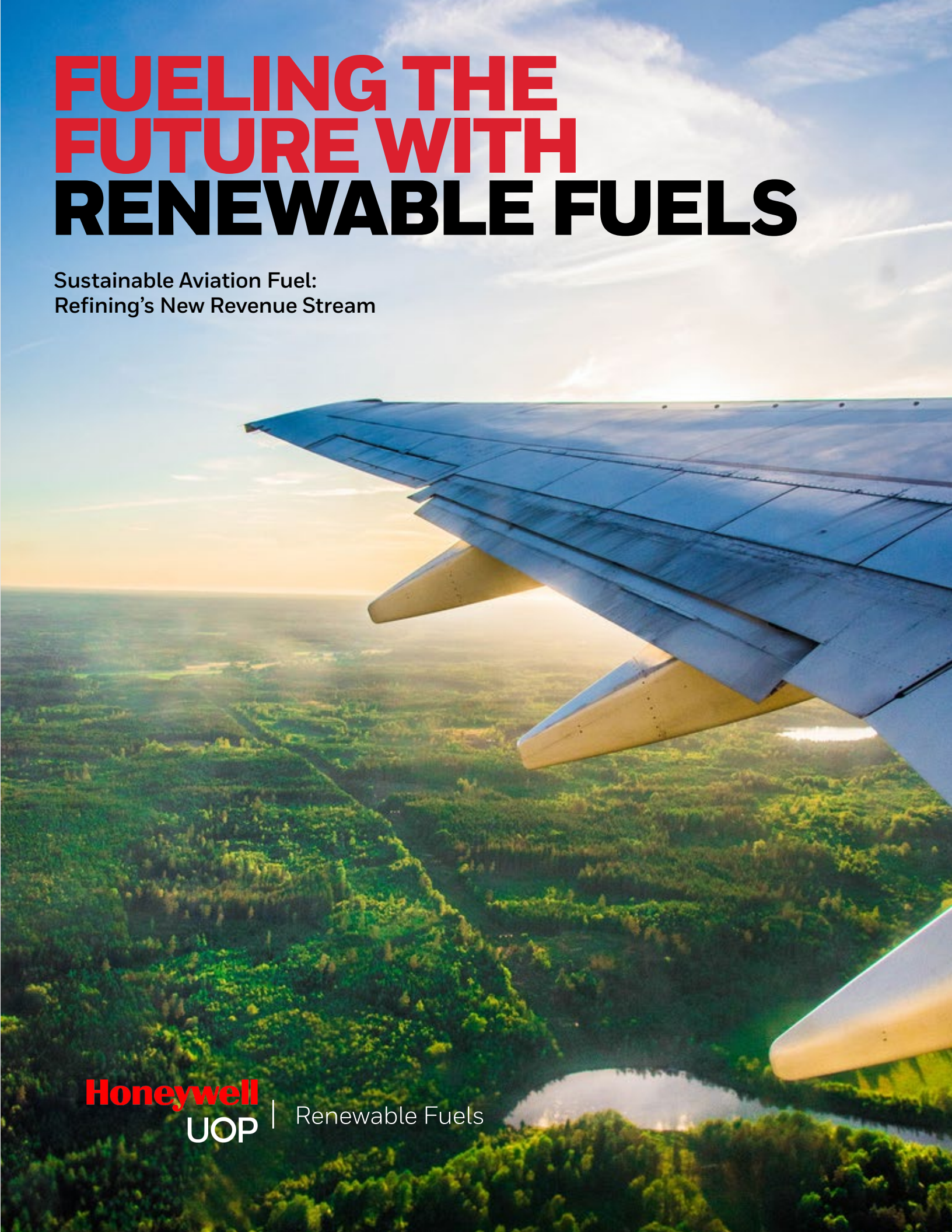
FUELING THE FUTURE WITH RENEWABLE FUELS

Sustainable Aviation Fuel:
Refining's New Revenue Stream



Honeywell UOP | Renewable Fuels

HELPING YOUR BUSINESS TAKE OFF

The world is in the process of reimagining how we fuel our lives while preserving our planet.

The pace and magnitude of this change could have disruptive implications for the refining industry. The massive projected growth of electric vehicles and battery-driven electric storage will be powerful catalysts for dramatic shifts in the future of our fossil fuel industry. Sustainability is creating new markets and the need for new products that support our transition to a carbon-neutral world. Sustainability, meet opportunity.

Sustainable aviation fuels represent a new revenue stream for traditional refiners, as well as alternative fuel producers who are focused on the future and what it could be. At Honeywell, we've developed a portfolio of technology solutions to develop sustainable aviation fuel from a wide range of feedstocks and production processes.

With carriers and producers committed to reaching sustainability goals, whether by choice or by mandate, sustainable aviation fuel in the form of diverse biofuels, or more specifically ethanol to jet fuel, holds real promise as an answer to our environmental challenges and is expected to represent a large percentage of aviation fuel growth. The good news is we have readily available feedstocks and proven refining and conversion technologies to help make this a reality while improving production efficiencies and profitability for refiners in the process. Our innovative portfolio of diversified technologies enables producers to economically repurpose underutilized assets or dedicate new ones to producing highly sustainable and highly profitable renewable fuels.

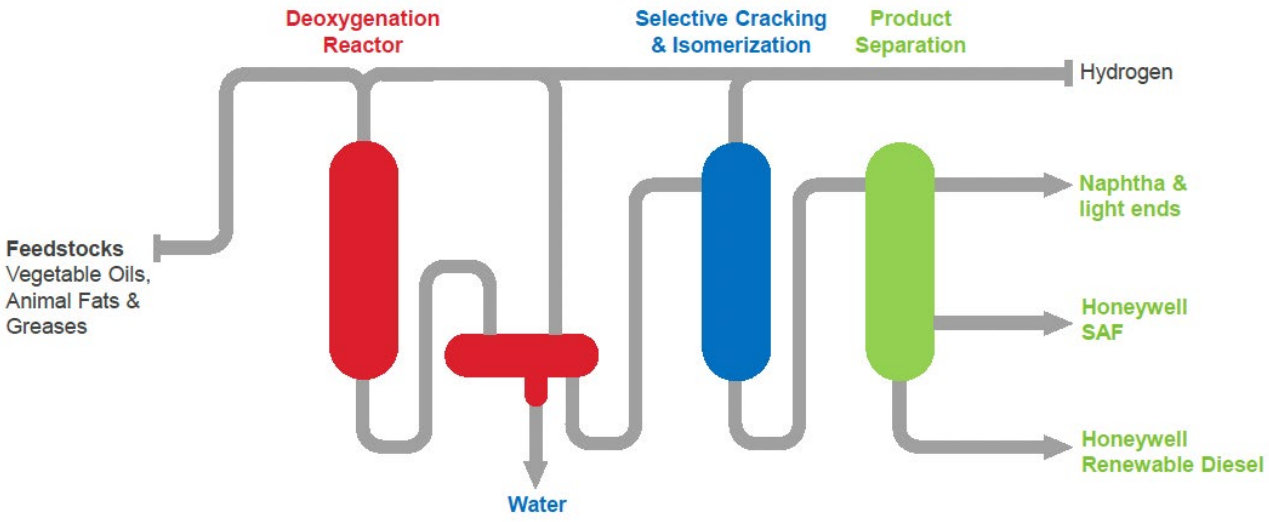
PROOF OF PRINCIPLE

Honeywell UOP was the first licensor to commercialize the production of SAF with the start-up of the Alt-Air (now World Energy) facility in Los Angeles, California, in 2016. This project was a complete refinery revamp to the processing of 100% bio-feed into renewable jet fuel. Today, it remains the only commercial 100% SAF production facility delivered by a technology licensor. Honeywell SAF meets the ASTM D7566 specification for Aviation Fuel under Annex A2 for HEFA-SPK. The product qualities all meet or exceed the qualities of petroleum aviation fuel and deliver overall clean performance.

REENERGIZE YOUR BUSINESS BY REPURPOSING YOUR ASSETS WITH ECOFINING™

An increase in social consciousness regarding the future of our planet, combined with an increasingly prescriptive regulatory environment, will have significant ramifications for the petrochemicals industry. At Honeywell, we have well-established technology solutions to develop sustainable aviation fuel from a wide range of feedstocks and production processes. One example is our proven Ecofining™ technology, which was born out of this alchemy of necessity and responsibility to support our customers and our planet.

With our time-tested Ecofining technology, traditional refiners can reenergize their business by repurposing their assets. Ecofining's adaptable, compatible, drop-in capability gives fossil fuel refiners access to a proven, single-stage technology that can help them generate higher yields of higher-margin renewable fuels. It's a fast-to-market, low-capital cost solution that allows fossil fuel refiners to economically repurpose underutilized assets or dedicate new ones to generating highly sustainable and profitable biofuels while satisfying their environmental and economic goals. The Ecofining process produces high-quality, renewable jet fuel that performs similarly to petroleum fuels. Made from vegetable oils, animal fats and non-food-based, second-generation feedstocks such as camelina, jatropha and algae, sustainable aviation fuels made by the Ecofining process meet or exceed critical specifications for flight. When used up to a 50 percent blend, it can be a drop-in replacement, requiring no changes to fleet technology or the fuel storage and delivery infrastructure.



The Ecofining Process

The Ecofining process for renewable jet fuel is based on traditional refining hydroprocessing technology. It works by adding hydrogen to remove the oxygen from the feedstock and then further refining this product to meet the required specifications. The process produces bio-synthetic paraffinic kerosene (bio-SPK) or Renewable Diesel that is then blended with standard jet fuel for use in flight. The resulting fuel meets all the jet fuel specifications set by qualifying agencies. The Ecofining process successfully converts many inedible feedstocks and a variety of others to produce on-spec, renewable jet fuel. This flexibility gives fuel producers the option to choose the bio feedstock that best suits their location and operating goals.

NEW TECHNOLOGY CREATES NEW OPPORTUNITIES FOR ETHANOL

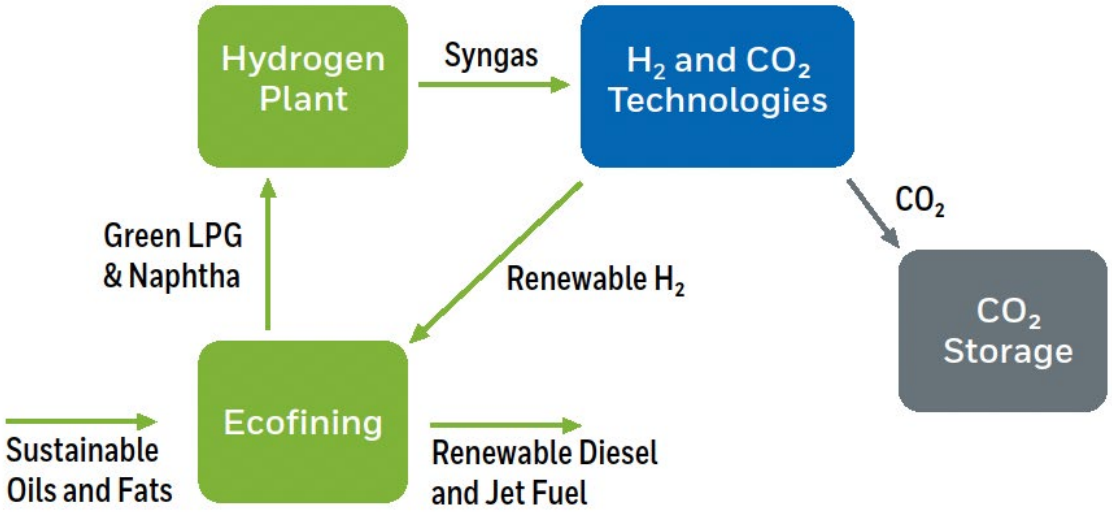
The impending transition to a carbon-neutral world is creating the need for new fuel sources, such as ethanol, to support new applications. In response, we're expanding our Sustainable Aviation Fuel portfolio to include new ethanol to jet fuel technology. Ethanol to jet fuel charts a more efficient path to profits and represents a new revenue stream for ethanol producers looking for diversification to satisfy the needs of the large and growing aviation market.

Our revolutionary solution is a low carbon intensity, low capex, low technology risk option that helps producers take advantage of existing supply chains, proven conversion technologies and feedstocks to create new revenue streams for ethanol in the aviation sector, allowing them to grow beyond the automotive sector. It is highly scalable, reliable, profitable and creates a more efficient route for converting renewable and waste-derived ethanol into useful platform chemicals to produce jet fuel.

Adopting this technology also helps producers meet oncoming regulations and take advantage of the financial incentives that come along with them. Our world is evolving, and at Honeywell, we're focused on helping the refining industry evolve along with it. For us, this means making renewable fuels, like ethanol to jet, more accessible while helping to make refining more sustainable and profitable, and our planet more livable. We call that fueling the future.

RENEWABLE HYDROGEN SUPPLY

For sustainable aviation fuels, all opportunities to reduce fuel carbon intensity should be captured. Using the secondary products from the Ecofining process, integrated hydrogen production is made available. By using the LPG and naptha by-products for the generation of renewable hydrogen, a significant reduction between 4-8gCO2/MJ in fuel carbon intensity compared to fossil fuel hydrogen production can be achieved.



Comprehensive hydrogen solution to produce low-carbon fuels.

SAF Product Quality

Honeywell SAF meets the ASTM D7566 specification for Aviation Fuel under Annex A2 for HEFA-SPK. The product qualities all meet or exceed the qualities of petroleum aviation fuel and deliver overall clean performance. The UOP Ecofining process successfully converts many inedible feedstocks and many others to produce on-spec, renewable jet fuel. This flexibility gives fuel producers the option to choose the biofeedstock that best suits their location and operation goals.

SAF PROPERTIES

PROPERTIES	JET A-1 SPECIFICATIONS	HONEYWELL SAF BIO-SYNTHETIC ARAFFINIC KEROSENE (BIO-SPK) MADE FROM CAMELINA	50/50 BLEND OF CAMELINA BIO-SPK & JET A-1	ETJ
Flash Point, °C	Min 38	45	46	38
Freeze Point, °C	Max -47	-57	-57	-60
Net head of combustion, MJ/kg	Min 42.8	43.9	43.6	43.6
THERMAL STABILITY (JFTOT) **• Filter pressure differential, mm Hg** **• Tube deposit rating (visual)**	 Max 25 Max 3	 0.0 1	 0.0 1	 <1 1
Aromatics, % volume	Max 22	<0.3	8.5	<0.1
Sulfur, % mass	Max 0.3	<0.001	0.05	<0.001

REIMAGINING OUR FUTURE WITH RENEWABLE FUELS

Together, these sustainable aviation fuel solutions help alternative fuel producers reduce their reliance on fossil fuels while helping them meet regulatory requirements and generate new revenue streams in the process. Renewable fuels are vital to reinventing our energy infrastructure and restoring the earth's ecosystems. At Honeywell, we're proud to play a role in helping to create brand new industries and new futures for existing industries, all while helping to protect the future of our planet. That's what we call fueling the future. We've applied our rich history in sustainable innovation to the development of our diversified technology portfolio for sustainable aviation fuels. Whether applied to more traditional biofuels, or those that are strictly ethanol based, we believe these conversion technologies hold real promise when it comes to next-generation aviation fuels. Our world is evolving, and at Honeywell, we're focused on helping the refining industry evolve along with it. For us, this means making renewable fuels more accessible while helping to make refining more sustainable and our planet more livable. We're reimagining our future with renewable fuels.

A RECORD OF SUCCESS

2009 - 2011

Honeywell UOP led the committee for approval of HEFA SPK as aviation turbine fuel under ASTM D7566 Annex 2.

2012 - 2015

AltAir Fuels installed the first commercial renewable jet fuel (HEFA SPK) production unit using UOP technology with offtake by United Airlines.

2016

United Airlines became the first commercial airline in the US to use renewable jet fuel on regularly scheduled flights from LAX.

2019

Gulfstream corporate aircraft flies more than 1M nautical miles on SAF produced by UOP renewable jet fuel process at World Energy (AltAir).

2021

First commercial passenger flight on 100% SAF with United Airlines using fuel produced at World Energy (AltAir) using UOP renewable jet fuel process.

2022

World Energy partnership for expansion of SAF facility in Houston..

For more information

For more information, please contact your UOP representative or visit us online at uop.honeywell.com

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THE FUTURE IS WHAT WE MAKE IT

Honeywell