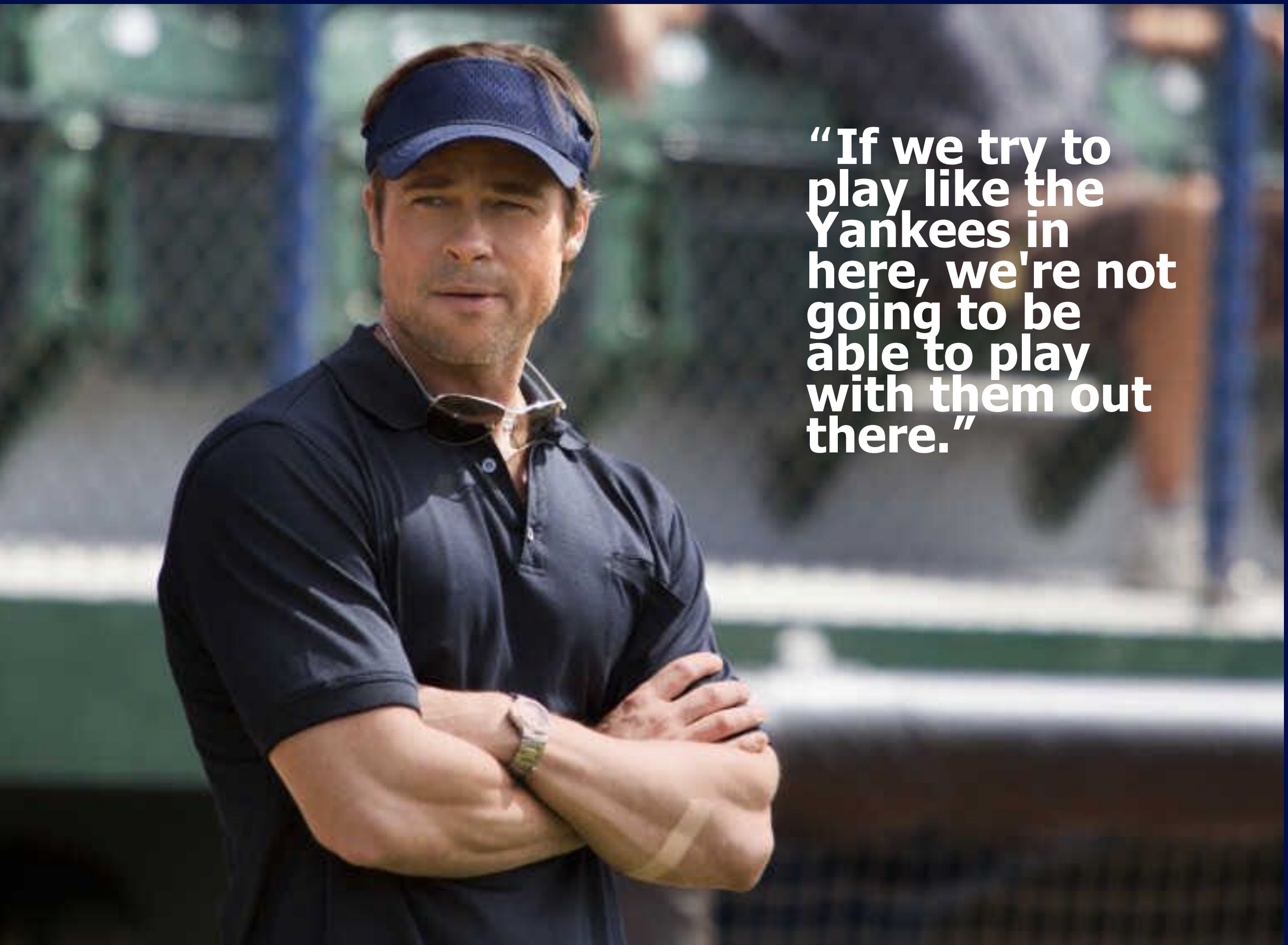
THE STATE OF SAF The Year of Thinking Differently

ABLCCONNECT

Jim Lane, The Digest

SUSTAINABLE AVIATION FUELS ★★ ABLCCONNECT

LESSON FROM MONEYBALL



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LESSON FROM APPLE: THINK DIFFERENT

Scale-up
Conventional takes too long, skip-a-step too risky, think different.

Policy
conventional favors incumbents, tax credits are unproven and unreliable; think different.

Financing
conventional's too costly, loan guarantees too slow, think different.

Feedstock
Plant oils are scarce, ethanol's expensive, think different.

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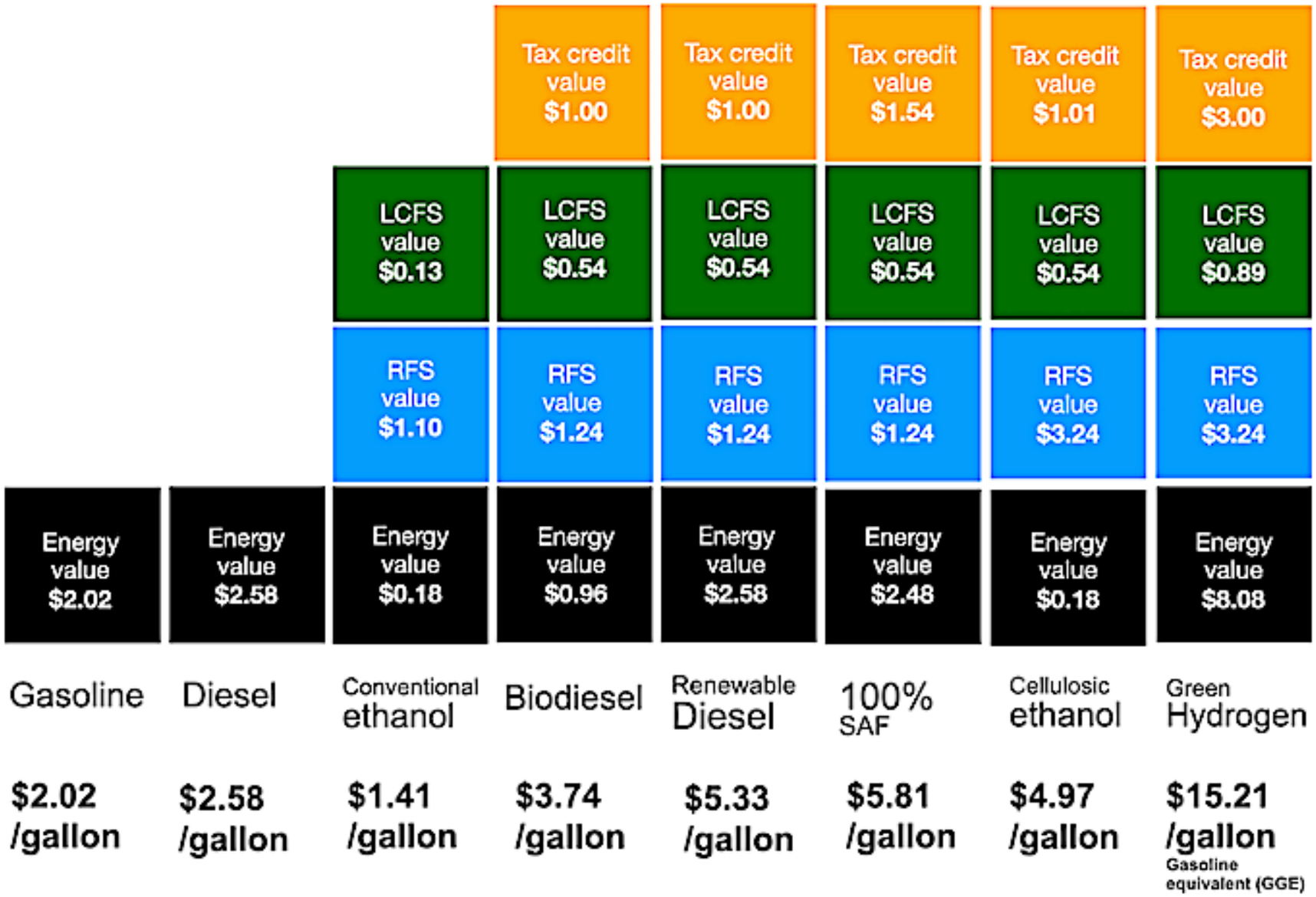
PRICES: THE VALUE STACK



Data updated 01/09/24.

Notes. These values are for delivery into a US market with a clean fuels standard. Since ethanol and biodiesel are traded commodities and those commodity prices include the assumed value of federal credits/RINs.For the others, quoted energy prices are for the equivalent fossil molecule, so we've added in all the available carbon prices for a full comparison. Also note that conventional ethanol is modeled at a Carbon Intensity of 70, RD, SAF and CellEth at a CI of 20. Individual companies/processes may have better or worse CI scores that are used to calculate LCFS credits. **Sources**. We use quoted prices at CBOT for ethanol, USDA's weekly report for B100 biodiesel, and the EIA's daily energy prices for gasoline, diesel, IATA for jet fuel prices. LCFS credit prices are from the California Air Resources Board. Tax credits are as provide by the US Congress. RIN prices are as provided by the US Environmental Protection Agency.

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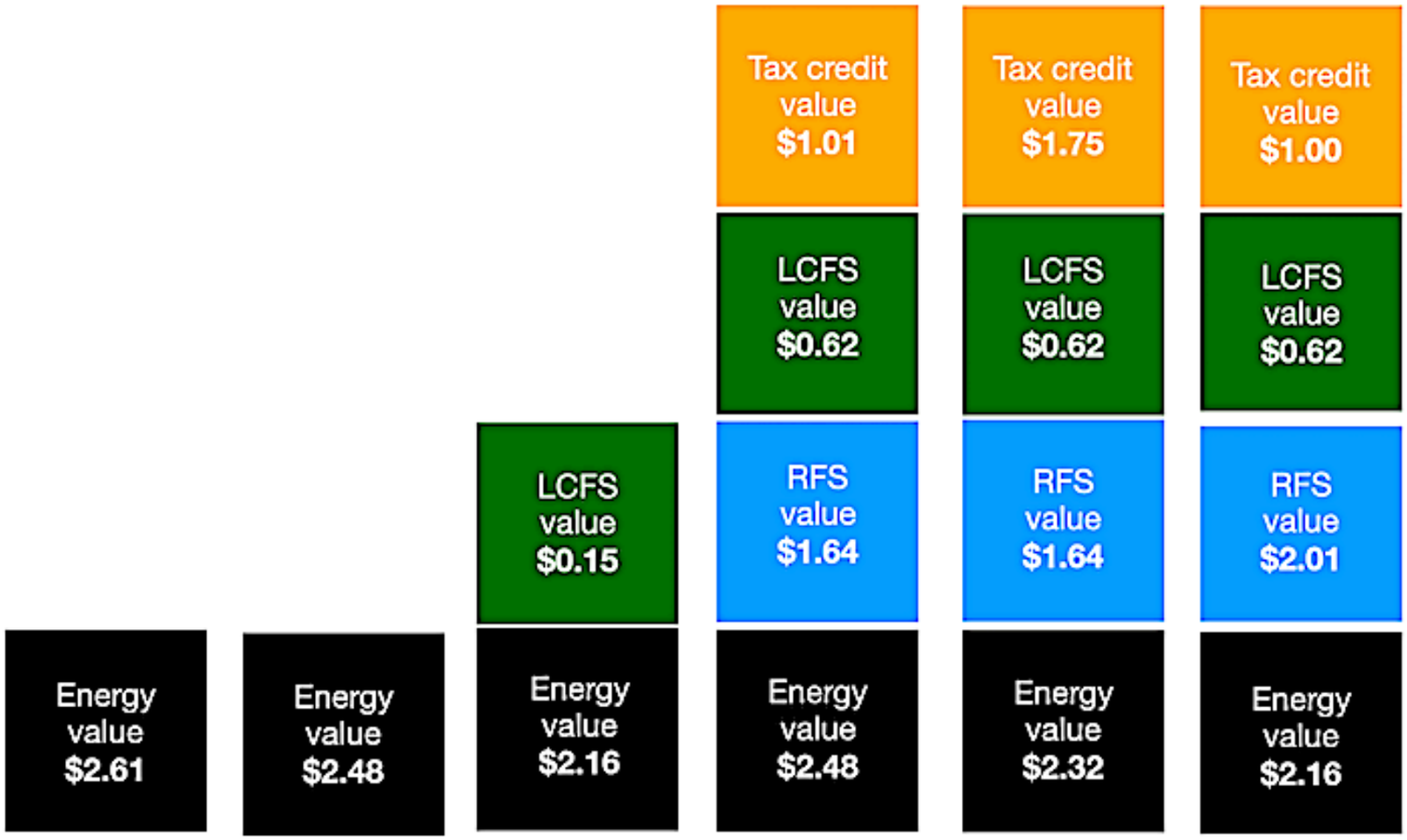
PRICES: THE VALUE STACK (June 2023)



	Gasoline	Diesel	Conventional ethanol	Renewable Diesel	100% SAF	Cellulosic ethanol
	$2.61 /gallon	$2.48 /gallon	$2.31 /gallon	$5.75 /gallon	$6.33 /gallon	$5.79 /gallon
Change since 06/23	-23%	+4%	-39%	-8%	-8%	-14%

Notes. These values are for delivery into a US market with a clean fuels standard. Since ethanol and biodiesel are traded commodities and those commodity prices include the assumed value of federal credits/RINs.For the others, quoted energy prices are for the equivalent fossil molecule, so we've added in all the available carbon prices for a full comparison. Also note that conventional ethanol is modeled at a Carbon Intensity of 70, RD, SAF and CellEth at a CI of 20. Individual companies/processes may have better or worse CI scores that are used to calculate LCFS credits. **Sources**. We use quoted prices at CBOT for ethanol, USDA's weekly report for B100 biodiesel, and the EIA's daily energy prices for gasoline, diesel, IATA for jet fuel prices. LCFS credit prices are from the California Air Resources Board. Tax credits are as provide by the US Congress. RIN prices are as provided by the US Environmental Protection Agency.

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RD/ SAF PLANNED CAPACITY

Project	US	ROW
A Coruna	90.0	3.1
Acelen Brazil		264.0
Aemetis	90.0	0.0
Acenel Brazil		260.0
AGRA ENERGY	2.0	
Alder	150.0	0.0
Alfanar		300.0
Atmosfuel		26.4
Azure Renewable Fuels		378.0
Bangchak		96.0
Bayernoil		30.0
BBF' Manaus Brazil		143.0
Bio-D Colombia		50.0
BioTJet		33.0
Bolivia	0.0	120.0
BP (Cherry Point, Kwinana	109.0	153.0
Brasil BioFuels		150.0
Braya Renewable Fuels		214.0
Chevron El Segundo	153.3	
Chevron REG	340.0	0.0
Cielo	0.0	50.0
Covenant	0.0	100.0
CVR Coffeyville, Wynnewood	200.0	0.0
DG Fuels	302.0	
Diamond Green Diesel	1200.0	0.0
Dimeta rDME		90.0
EDL		15.0
Emerald	100.0	0.0
Energy Absolute Thailand		14.2
ENG	200.0	100.0
ENI Gela		222.0
ENI Venice		105.0
ENI Livorno		150.0
ENI Taranto		9.0
Future Energy Australia	0.0	4.6
FutureFuels ANZ	0.0	3.0
Galp Sines		81.0
Geo Biogas Brazil	0.0	0.5
Gevo	65.0	0.0
Global Bioenergies		10.0
Global Clean Energy	230.0	0.0
Grön Fuels	996.0	
Guvnor		150.0
Haike Chemicals		210.0
Heartwell	75.0	0.0
HH2E		60.0
HIF Global	168.6	
HOBO	120.0	0.0
HollyFrontier	200.0	0.0
HySKies		27.0
Imperial		264.0
Indaba	100.0	0.0
Indian Oil Haryana	0.0	300.0
Infinium eFuels	7.2	
JetZero		26.4
JSRE		90.0
Kosan Gas		0.5
LanzaJet	10.0	0.0
LanzaTech (Dragon)		26.4
Mangalore		38.0
Marathon Dickinson	184.0	0.0
Marathon Martinez	760.0	
Marquis Energy	120.0	0.0
MOL Group		20.0
Montana RF	150.0	0.0
MyRechemial		35.0
Nacero Texas	1073.0	0.0
Nansei Sekiyu		58.2
Neste	0.0	2040.0
New Rise Renewables	44.0	0.0
Next	766.5	
Nova Pangae Speedbird		27.0
NWABF	64.0	0.0
Oberon Maverick	1.5	
Oceania		90.0
Omega Green	0.0	300.0
OMV Petron	300.0	0.0
Oriental Energy		300.0
P2X Europe		12.0
Pan Oleo India		0.5
Parkland		100.0
PBF	305.0	0.0
Petrobras Repar		34.0
Petrobras Presidente Bernardes		260.0
PKN Orlen		90.0
Preem	0.0	317.0
Prince George	0.0	37.0
Raven SR	60.0	0.0
Rapsol	0.0	0.6
RETI Calgary		100.0
Seaboard	85.0	0.0
Saffire	0.3	0.0
Santa Maria Renewables	46.0	
SG Preston	0.0	2600.0
Shell	300.0	245.0
Sherdar	0.0	150.0
Sinclair	115.0	0.0
SkyNRG	27.0	15.0
SPIC		3.0
Strategic Biofuels	100.0	0.0
Swedish Biofuels/COWI	0.0	120.0
Texas Renewable Fuels	100.0	0.0
Total Gonfreville	0.0	12.0
Total LaMede		150.0
Total Antwerp		45.0
Tupras		150.0
Twelve	0.1	0.0
UPM		194.0
Vandelay Malaysia	0.0	75.0
Velocys	20.0	20.0
Vertex	200.0	0.0
Viking	43.0	0.0
Willis Sustainnable Fuels		5.0
World Energy	1000.0	0.0
	10772.5	11972.4
Conventional BD	2300.0	5800.0
TOTAL Heavy-duty	13072.5	20772.4

Total Global RD/SAF/DME: 22.744B

Total Global Heavy-Duty Fuels: 33.844B

January 2023

Total Global RD/SAF/DME: 19.456B +16.9%

Total Global Heavy-Duty Fuels: 30.556B

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INITIATIVES AROUND THE WORLD

Multi-region initiatives

Global Biofuels Alliance
BioFuture Platform
Bold Goals Action Group

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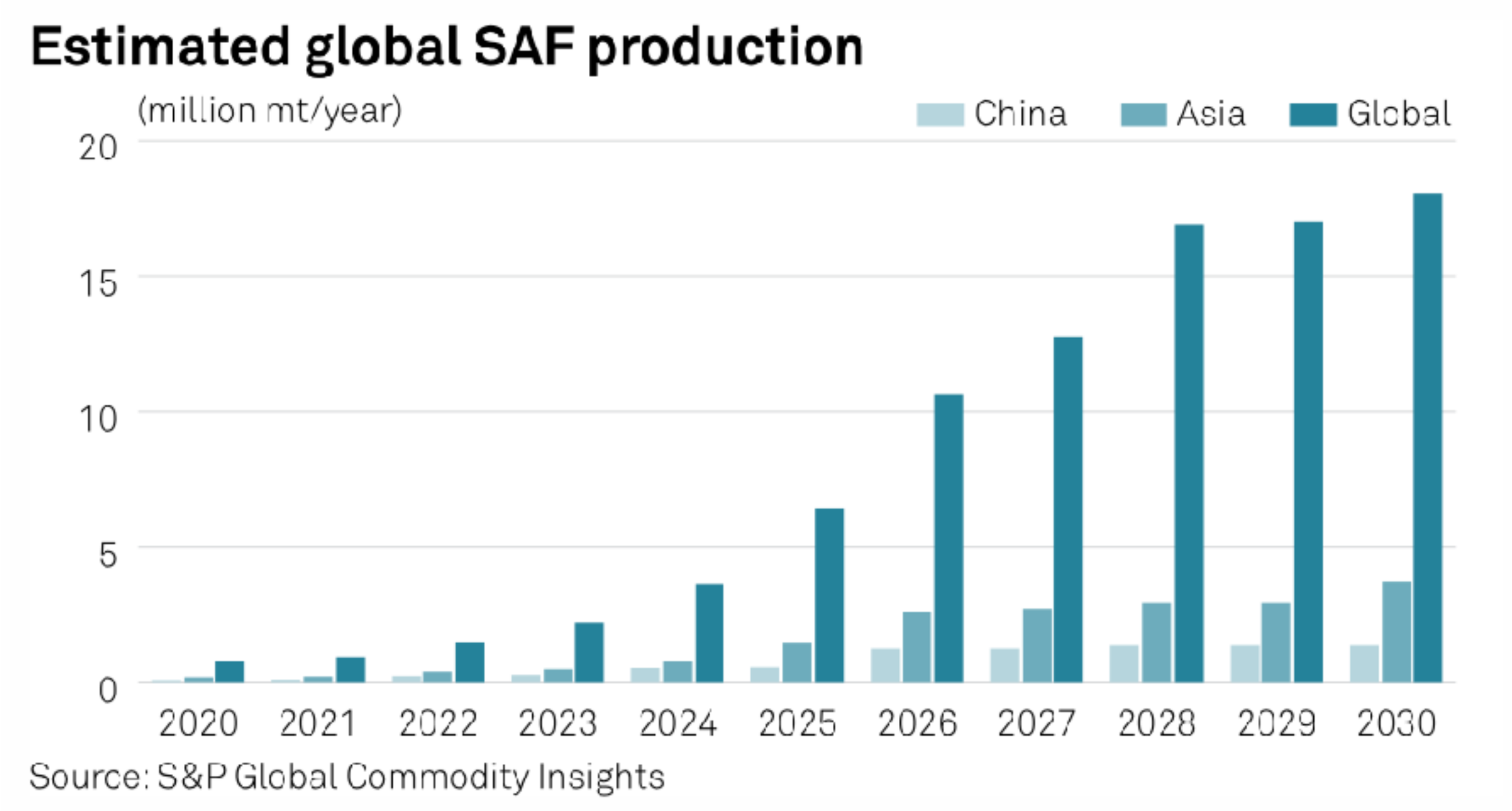
GLOBAL SAF DEMAND TO 2030



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US DEMAND: RFS RVOs 2020-2025

Final Volume Requirements for 2020-2022 (billion gallons)

	2020	2021	2022
Cellulosic Biofuel	0.51	0.56	0.63
Biomass-Based Diesel	2.43**	2.43**	2.76
Advanced Biofuel	4.63	5.05	5.63
Total Renewable Fuel	17.13	18.84	20.63
Supplemental Standard	n/a	n/a	0.25

Volume Targets (billion RINs)[a]

	2023	2024	2025
Cellulosic biofuel	0.84	1.09	1.38
Biomass-based diesel[b]	2.82	3.04	3.35
Advanced biofuel	5.94	6.54	7.33
Renewable fuel	20.94	21.54	22.33
Supplemental standard	0.25	n/a	n/a

UPSTREAM: FEEDSTOCK CONUNDRUM

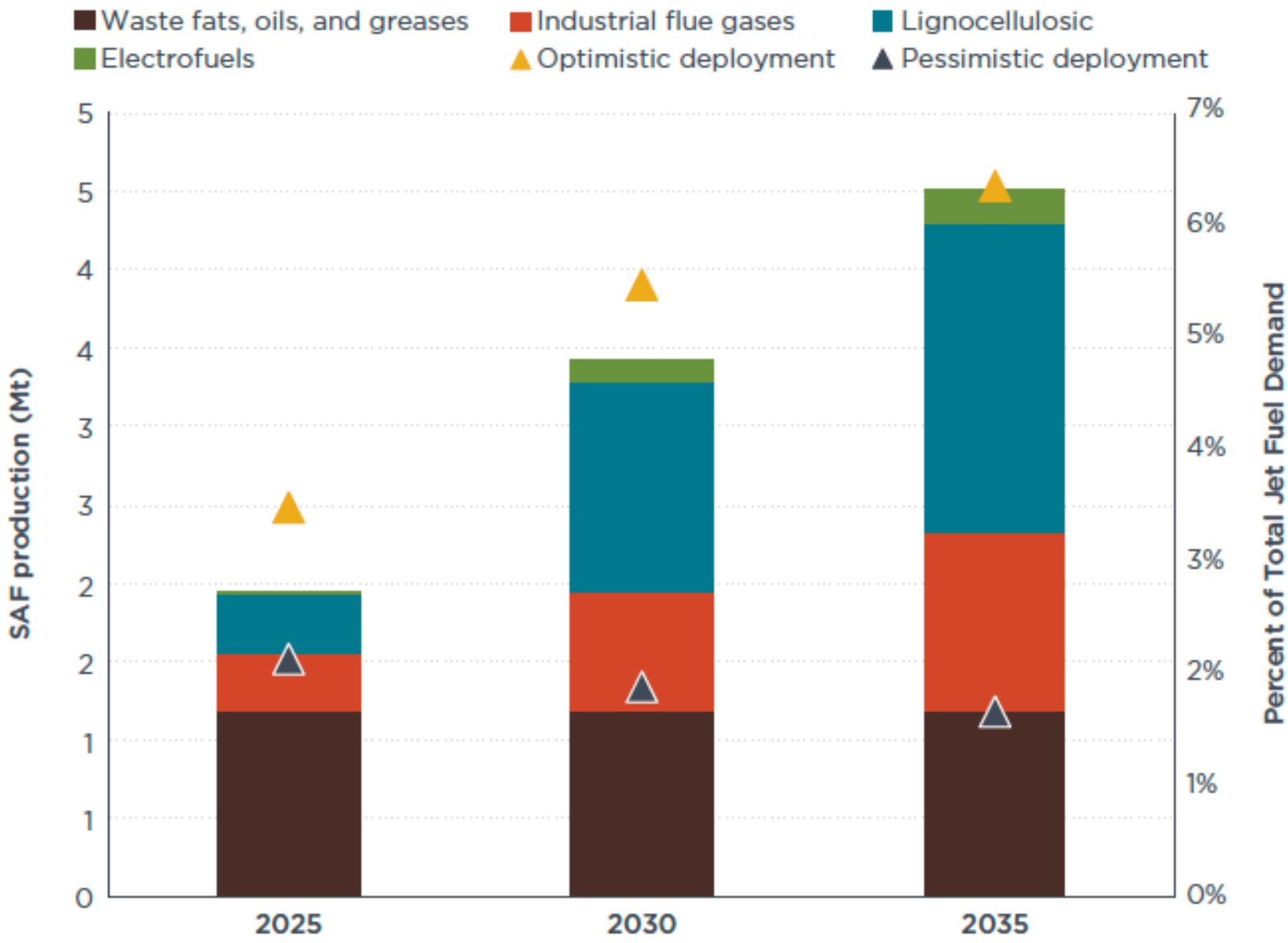

Figure 2: Estimated annual advanced SAF production (Mt) (left axis) and percent of total jet fuel demand that could be displaced, depending on facility deployment success (right axis)

Source: ICCT

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MIDSTREAM: MOVEMENT, STANDARDS, STORAGE

Clean Tyne Shipping Corridor Project to support net zero carbon fuels methanol, hydrogen, and ammonia

September 27, 2023 | Meghan Sapp

Post Share Mail Share

In the UK, the Port of Tyne, working with Connected Places Catapult and partners Arup, Lloyds Register, EDF R&D UK, Newcastle University and the North East LEP, has published the results of a feasibility study looking at the decarbonization of the maritime industry through the creation of green shipping corridors, and the adoption of scalable zero-emission energy sources.

The Clean Tyne Shipping Corridor Project – funded by the Department for Transport and delivered in partnership with Innovate UK as part of the Clean Maritime Demonstration Competition Round 2 (CMDC2) – sets out the opportunities and economic and environmental benefits of creating a new, green shipping corridor from North-East England that links the region with the European Green Corridors Network

The study also explores the current use of alternative fuels in the shipping industry, and some of the challenges the sector faces in transitioning from conventional fuels to net zero carbon fuels like methanol, hydrogen, and ammonia.

For the first time, SAF delivered to NY using existing petroleum pipelines

June 15, 2022 | Helena Tavares Kennedy

Tweet Share Mail Share

In New York, sustainable aviation fuel has been safely delivered to New York's LaGuardia Airport through the Colonial and Buckeye pipeline systems – two essential pieces of American energy infrastructure and existing petroleum pipelines.

The low-emission jet fuel will power a Delta Air Lines flight, marking a seminal moment in the ongoing development and distribution of SAF in the U.S.

This partnership between Delta, Neste, Colonial Pipeline and Buckeye Partners demonstrates the long-term viability of SAF and the airline industry's journey towards net zero. Importantly, it shows that SAF can go anywhere there is an existing pipeline currently carrying fossil jet fuel.

The milestone delivery and flight is supported by the Port Authority of New York and New Jersey, the first U.S. transportation agency to embrace the Paris Climate Agreement and a champion for accelerating the use of sustainable fuels.

CoSAFA publish SAF book and claim guidance

May 17, 2023 | Juan Pedro Tomas

Tweet Share Mail Share

In Washington D.C., the Council on Sustainable Aviation Fuel (CoSAFA) introduced its "Methodology for SAF Environmental Attribute Transactions."

The entity said this is a first step in establishing universally recognized procedures for SAF accounting and auditing to support global book and claim systems. The guidance details the information and procedures necessary for individual book and claim systems to transparently and credibly transact SAF's associated environmental benefits.

Claude Hurley, Director, Environment and Flight Operations at the International Business Aviation Council (IBAC), said: "The transition to sustainable aviation fuels will be the greatest contributor to business aviation achieving NetZero carbon emissions by 2050. Book and claim systems are required for wider SAF uptake, especially in areas where it's not yet readily available. We applaud CoSAFA's efforts to develop this transparent, credible B&C accounting and auditing methodology."

DOWNSTREAM: PATHWAYS TO SAF

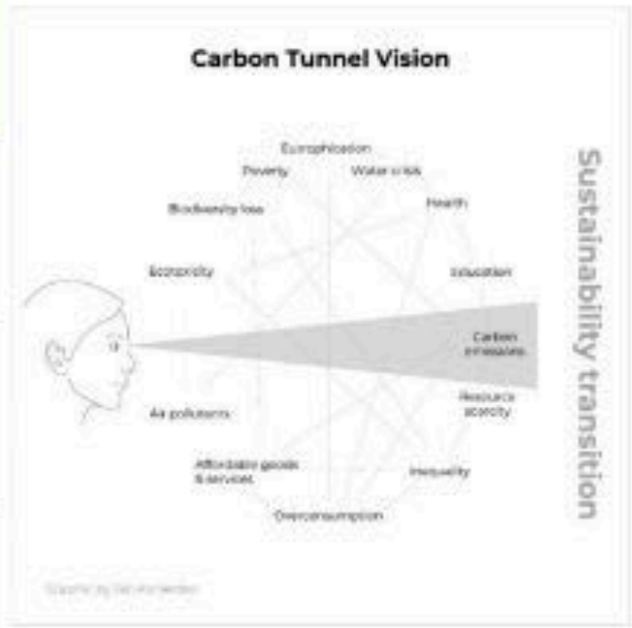
Table 3. ASTM Pathways

ASTM Reference	Conversion Process (Abbreviation)	Possible Feedstocks	Blending Ratio by Volume	Year of ASTM Approval	Commercialization Proposals/Projects
ASTM D7566 Annex A1	Fischer-Tropsch hydroprocessed synthesized paraffinic kerosene (FT)	Coal, natural gas, biomass	50%	2009	Fulcrum Bioenergy, Red Rock Biofuels, SG Preston, Kaidi, Sasol, Shell, Syntroleum
ASTM D7566 Annex A2	Synthesized paraffinic kerosene from hydroprocessed esters and fatty acids (HEFA)	Bio-oils, animal fat, recycled oils	50%	2011	World Energy, Honeywell UOP, Neste Oil, Dynamic Fuels, EERC
ASTM D7566 Annex A3	Synthesized iso-paraffins from hydroprocessed fermented sugars (SIP)	Biomass used for sugar production	10%	2014	Amyris, Total
ASTM D7566 Annex A4	Synthesized kerosene with aromatics derived by alkylation of light aromatics from non-petroleum sources (FT-SKA)	Coal, natural gas, biomass	50%	2015	Sasol
ASTM D7566 Annex A5	Alcohol-to-jet synthetic paraffinic kerosene (ATJ-SPK)	Biomass from ethanol or isobutanol production	50%	2016 (isobutanol); 2018 (ethanol)	Gevo, Cobalt, Honeywell UOP, LanzaTech, Swedish Biofuels, Byogy
ASTM D7566 Annex A6	Catalytic hydrothermolysis jet fuel (CHJ)	Triglycerides such as soybean oil, jatropha oil, camelina oil, carinata oil, and tung oil	50%	2020	Applied Research Associates (ARA)
ASTM D7566 Annex A7	Synthesized paraffinic kerosene from hydrocarbon-hydroprocessed esters and fatty acids (HC-HEFA-SPK)	Algae	10%	2020	IHI Corporation
ASTM D1655 Annex A1	Co-hydroprocessing of esters and fatty acids in a conventional petroleum refinery (Coprocessed HEFA)	FOG coprocessed with petroleum	5%	2018	
ASTM D1655 Annex A1	Co-hydroprocessing of Fischer-Tropsch hydrocarbons in a conventional petroleum refinery (Coprocessed FT)	Fischer-Tropsch hydrocarbons coprocessed with petroleum	5%	2020	Fulcrum

SUSTAINABILITY CRITERIA ARE COVERED BUT MOSTLY FOCUSING ON GHG SAVINGS AND FEEDSTOCK SELECTION

CO_2

Minimum GHG savings	Bio-Jet : **min. 65%** e-Jet : **min. 70%**	D4&D5 RIN : **min. 50%** IRA : **min 50%**	**10%**
Fossil Fuel Comparator	94 gCO_2eq/MJ	**RFS2**: 93.1 (gasoline) and 91.9 (diesel) gCO_2eq/MJ. **IRA**: 89 gCO_2eq/MJ	89 gCO_2eq/MJ
LCA GHG calculation model for SAF	- **Bio-jet**: RED II Annex V - **E-jet**: RED II, Art. 28(5)	**RFS2:** GREET **IRA**: CORSIA methodology	CORSIA methodology
Feedstocks and ILUC	No feed or food crops, only waste	No palm oil in IRA. Indirect feed selection with GHG criteria	No biomass from land converted after 1 January 2008 that was primary forest, wetlands



Although SAF combustion is counted as zero-carbon, there are still some non-CO2 emissions that have a significant climate impacts
In EU, regulators start focusing on non-CO2 effects.

EMERGING DOWNSTREAM PLAYERS

RAVEN

SG Preston

Chevron

Vertimass
Low-cost, defossilized fuels. Now!

twelve

ALDER FUELS

IndianOil

eni

MARATHON

Global Bioenergies

nacero

VISOLIS

NEW RISE RENEWABLES - RENO

UPM

AEMETIS

bp

FIDELIS NEW ENERGY
CLIMATE POSITIVE CARBON NEGATIVE

DG FUELS

INDABA
RENEWABLE FUELS
DECARBONIZING THE WORLD

MARQUIS ENERGY

INFINIUM

MONTANA RENEWABLES

Global clean energy

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THE SAF GRAND CHALLENGE

Workstreams Supporting Near-Term SAF Production Impactful to 2030 Goals

- **Build and support stakeholder coalitions through outreach, extension, and education** (Workstream SC.1) to set the stage for SAF supply chains to develop and sustain themselves and replicate with continuous improvement.
- **Maximize sustainable lipid supply for 2030** (Workstream FI.2) through a coordinated approach to lipid feedstock RDD&D to support rapid buildout of lipid pathway production.
- **Decarbonize, diversify, and scale current fermentation-based fuel industry** (Workstream CT.1) to address barriers to expansion of SAF supply via alcohol pathways.
- **Invest in SAF infrastructure** to support industry deployment (Workstream SC.4) and to allow industry to attract investment into production capacity.
- **Develop improved environmental models and data for SAF** (Workstream PA.1) to support optimization of existing policies and implementation of new policies that could be enacted.
- **Inform SAF policy development** (Workstream PA.3) with analysis of gaps and impacts of policies under consideration.
- **Stakeholder outreach and engagement on sustainability** (Workstream CP.1) to exchange data and information about best practices to reduce life cycle GHG emissions from agricultural and forest-derived feedstocks and optimize other environmental and social impacts.
- **Enable use of drop-in unblended SAF and SAF blends up to 100%** (Workstream EU.2) to simplify blending requirements, reduce cost of logistics, and facilitate supply.
- **Integrate SAF into fuel distribution infrastructure** (Workstream EU.4), including conducting infrastructure analysis to identify and address barriers to SAF supply to airports.

HOT PROJECTS

JM and bp chosen by EDL to support production of SAF at HyKero plant in Germany

October 26, 2023 | Juan Pedro Tomas

Post Share Mail Share

In the UK, Johnson Matthey (JM) and bp announced that EDL Anlagenbau Gesellschaft mbH (EDL) has selected their co-developed Fischer Tropsch (FT) CANS technology for EDL's HyKero plant located in Böhlen-Lippendorf, south of Leipzig, Germany.

The HyKero plant is planned to produce 50,000 metric tons of sustainable aviation fuel per year when fully operational, including eSAF from a power-to-liquids (PtL) route, and would be the first plant of its kind at commercial scale in Germany. The PtL route is the conversion of renewable electricity and carbon dioxide into sustainable liquid fuels, the companies said.

When fully operational, the HyKero plant is also planned to produce 14,000 metric tons of sustainable naphtha, and approximately 1,000 metric tons of green hydrogen per year.

Strategically located to serve Leipzig-Halle international airport, this first phase of the plant is planned to be online by 2027, the firms added.

Agra Energy selects KP Engineering for SAF plants

October 11, 2023 | Juan Pedro Tomas

Post Share Mail Share

In the UK, Hydrocarbon Engineering reported that KP Engineering has been selected as the engineering, procurement, fabrication and construction management (EPFCm) partner for Agra Energy's series of sustainable aviation fuel plants. These gas-to-liquids (GTL) units will produce SAF produced entirely from effluent waste from dairy farms.

"We are honored to be a trusted partner for another project that converts waste to value, and to be working alongside a revolutionary developer like Agra," said William Preston, CEO, KPE. "Their technology will fundamentally improve the operational sustainability of dairy farmers in America and abroad."

Tony Long, CEO, Agra Energy, said: "Working with KP Engineering has been instrumental in our operational know-how, start up and commissioning. Now that the first unit is producing, we look forward to partnering with KPE to further optimize for the second, third and many units to come as we scale. This will offer benefits to farms and communities in building a better world."

Twelve starts construction of its SAF plant in Washington

July 12, 2023 | Juan Pedro Tomas

Post Share Mail Share

In Washington, Twelve broke ground on its commercial-scale E-Jet fuel production facility in Moses Lake, Washington.

The firm said that E-Jet fuel is SAF produced using Twelve's carbon transformation technology, which uses only renewable energy and water to transform CO2 into critical chemicals, materials and fuels conventionally made from fossil fuels, and in partnership with Emerging Fuels Technology.

The facility is expected to begin E-Jet fuel production in mid-2024 at a capacity of approximately 40,000 gallons per year.

Alaska Airlines, Microsoft, and Shopify will be the first customers to receive products from the Moses Lake plant under existing

Kraftstock, Feedstock, Comstock: the unleashing of kraft lignin as an abundant, affordable feedstock for drop-in renewable fuels

January 2, 2024 | Jim Lane

Nine days ago, in the story "Molecules for Christmas," Dr. Brian Westlake opined that "the answers to all your questions are in the forest" and further evidence of his prescience arrives this week from Virginia City, Nevada, where **Comstock** Fuels unveiled a remarkable partnership, investment and pathway to drop-in renewable fuels focused in this announce on Europe, that we reported on (here is the Digest brief and here's the full release).

What are the consequences, the "if so, then what" of this series of announces?

First, let's recap the highlights. First, Comstock has made an investment in **RenFuel** technology, the focus is to assure that RenFuel has the resources to complete some additional R&D that will broaden the applications of the technology they have already brought to commercial readiness. Second, Comstock has secured the North American rights to the technology and now has options elsewhere around the world, including an option to acquire the entire RenFuel subsidiary — a JV with **Preem** — that owns the worldwide technology rights. Third, there's a sizable refinery that is expected to be developed and ready by the end of 2025, in Sweden.

HOT PROJECTS

SkyNRG to invest in SAF plant in Washington state

May 24, 2023 | Juan Pedro Tomas

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In Washington, The Seattle Times reported that Dutch company SkyNRG has chosen Washington state to locate a new biogas facility that will produce sustainable aviation fuel.

The firm's CEO Philippe Lacamp said he expects the plant to be operational by 2028 or 2029. Its construction will provide about 600 jobs, according to the report.

Lacamp said new state legislation signed this month by Governor Jay Inslee that provides sustainable aviation fuel subsidies and speeds permits for plant construction positions the state for investments in the SAF field. The legislation "positions Washington state as the most attractive, most supportive state for SAF," he said.

The project to produce about 90,000 metric tons of SAF per year will require an investment of between $600 million and $800 million, he added.

Indian Oil Corporation plans to build SAF plant in Haryana

May 10, 2023 | Juan Pedro Tomas

Post Share Mail Share

In India, Swarajya reported that state-run oil firm Indian Oil Corporation (IOC) is planning to build a $122 million sustainable aviation fuel plant at Panipat in Haryana to meet the growing demand for the green fuel. "This is going to be a booming business. The reason for us to conceive such a big plant is that unless the capacity is higher, you won't get the economies of scale," said SSV Ramakumar, director for research and development at IOC. Apart from IOC, Mangalore Refinery and Petrochemicals is also planning to build a bio-ATF pilot plant at Mangalore using CSIR-Indian Institute of Petroleum's technology using non edible oils and used cooking oil as feedstock, the report stated.

Mubadala Capital to invest $2.5 billion to build SAF plant in Brazil

April 19, 2023 | Juan Pedro Tomas

Post Share Mail Share

In Jordan, MENAFN reported that Mubadala Capital, a state-owned investment firm in the United Arab Emirates (UAE), has signed a deal to invest $2.5 billion in Brazil over the next 10 years to build a sustainable aviation fuel and kerosene plant. The plant will be located in the northeastern state of Bahia and will be built through Acelen, Mubadala's arm in Brazil, with production set to begin in 2026. According to the report, the project will produce 1 billion liters of hydrotreated vegetable oil per year. Acelen anticipates that all of its renewable fuel production will be exported.

CAAS and partners complete SAF pilot in Singapore

November 8, 2023 | Juan Pedro Tomas

Post Share Mail Share

In Singapore, The Civil Aviation Authority of Singapore (CAAS), GenZero, and Singapore Airlines (SIA) have completed a 20-month SAF pilot, which commenced in February 2022, in partnership with Temasek.

CAAS said that the SAF pilot supports one of the key recommendations of the International Advisory Panel (IAP) on Sustainable Air Hub to create a long-term secured SAF supply ecosystem for Singapore.

The pilot found that while Singapore is operationally ready to supply SAF, more is needed to support adoption. CAAS will incorporate the lessons learnt in the development of the Singapore Sustainable Air Hub Blueprint.

The pilot validated the end-to-end process needed to bring SAF into Changi Airport, including procurement, blending of neat SAF with conventional jet fuel in Singapore facilities, safety certification and delivery of the blended SAF to Changi Airport. The pilot affirmed

HOT PROJECTS

MRPL gets ready to produce SAF in India

December 20, 2023 | Juan Pedro Tomas

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In India, The Hindu Business Line reported that Mangalore Refinery and Petrochemicals Ltd (MRPL) is gearing up to produce sustainable aviation fuel in two years to support the government's SAF target. According to the report, MRPL is setting up 20-kiloliter-per-day plant to demonstrate indigenously-developed technology. The MRPL management is in the process of taking necessary board approvals for the construction of the SAF plant, said Sanjay Varma, managing director at MRPL. MRPL has also undertaken a survey with subject matter experts to identify sources for the required quantities of feed for target SAF production, the report added.

Bangchak signs construction agreement for UCO SAF project

June 29, 2023 | Meghan Sapp

Post Share Mail Share

In Thailand, the signing ceremony for the construction marked the launch of Thailand's first and only Sustainable Aviation Fuel (SAF) production unit from used cooking oil between BSGF Company Limited – a joint venture between Bangchak Corporation Public Company Limited, BBGI Public Company Limited, and Thanachok Oil Light Company Limited, and TTCL Public Company Limited, an esteemed engineering and construction company from Japan, with more than 20 years of business experience with Bangchak.

The construction of the Sustainable Aviation Fuel (SAF) production unit from used cooking oil is a joint effort to support the aviation industry in reducing carbon dioxide emissions into the atmosphere according to the plans of the International Civil Aviation Organization (ICAO). SAF has garnered global attention as a key fuel in achieving targets for carbon dioxide emission reduction. Notably, the United States passed the Inflation Reduction Act of 2022 (IRA) last year, which provides incentives to producers through a tax credit of USD 1.75 per gallon of SAF. Similarly, Europe has adopted a mandate requiring a minimum portion of SAF in the overall fuel supply, with targets set at 2% by 2025, 5% by 2030, and 70% by 2050. Japan has also established a goal for international flights passing through Japanese airports, stipulating a SAF blending ratio of 10% by 2030.

Mitsui and Taiyo team up on SAF and renewable diesel project with LanzaJet tech

July 28, 2023 | Meghan Sapp

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In Japan, Mitsui & Co., Ltd. and Taiyo Oil Co., Ltd. have agreed to conduct a joint study concerning the production of ethanol-based sustainable aviation fuel (SAF) and renewable diesel.

The purpose of this project is to build a reliable supply chain for high-quality SAF and RD in anticipation of future growth in demand for these fuels. The project will combine the Alcohol-to-Jet (ATJ) technology of the American company LanzaJet, Inc.,the plant operating expertise developed by Taiyo Oil and its subsidiary Nansei Sekiyu K.K. ("Nansei Sekiyu") through their oil refining business, with Mitsui's procurement capabilities of ethanol feedstock. The project aims to commence production in fiscal 2028 at a site owned by Nansei Sekiyu, with a maximum yearly output of 220,000 kiloliters of Japanese-made SAF/RD. SAF can be used as an aviation fuel, while RD is suitable for buses, trucks, and other means of transportation that use light diesel oil as their fuel.

In April 2023, this study was selected by the Okinawa General Bureau of the Cabinet Office as part of the FY2023 Okinawa Clean Energy Introduction Promotion Research Program.

HOT PROJECTS

Imperial Oil begins construction on Strathcona Renewable Diesel project

August 1, 2023 | Meghan Sapp

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In Canada, Imperial Oil announced it had begun facility construction of the Strathcona Renewable Diesel project, with key contractors mobilizing to site. The project is designed to produce more than one billion litres of renewable diesel annually, primarily from locally sourced feedstocks, and could help reduce greenhouse gas emissions by about 3 million metric tons per year, as determined in accordance with Canada's Clean Fuel Regulations. Renewable diesel production expected to start in early 2025.

Axens to provide Vegan Technology to Haike Chemicals for its SAF project in China

August 9, 2023 | Juan Pedro Tomas

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In France, Axens said that Shandong Haike Chemical Co., a Chinese refining and petrochemical company, has selected Axens' Vegan technology to produce sustainabe aviation fuel (SAF) by retrofitting its existng assets.

Vegan technology is a second-generation hydrotreated vegetable oil (HVO) solution which processes up to 100% of any kind of lipid, including wastes from agriculture and food industry to produce renewable fuels that are able to reduce greenhouse gas emissions by up to 80% compared with a conventional jet fuel production scheme, Axens said.

This new contract with Haike Chemicals is Axens' first reference for its Vegan technology in Asia.

SAF will play a key role for the aviation industry as we transition to a low carbon world, but it requires immediate action to scale up production in cost competitive quantities and reduce dependence on fossil fuels. Our new contract with Haike Chemicals allows us to take our Vegan® technology to the next level, paving the way for industrial development of the latest generation of SAF, not only in China but also in the rest of the world," said Jacques Rault, Axens Technology and Technical Support Executive VP.

LanzaTech launches pre-application consultation for Project Dragon

August 24, 2023 | Meghan Sapp

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In the UK, LanzaTech UK Ltd announced the next stage of consultation on its proposed industrial facility to turn ethanol into sustainable aviation fuel. The Pre-Application Consultation (PAC) follows a period of early consultation on the plans which was held in May and June of this year.

The consultation will run until September 13 and provides the opportunity to comment directly to LanzaTech on the proposals prior to the submission of a planning application to Neath Port Talbot Council. Draft copies of the proposed application, plans, and other supporting documents can be viewed online at www.lanzadragon.wales.

If approved the facility, which would be located at Crown Wharf in Port Talbot, would produce about 100 million litres of sustainable aviation fuel per year, around 10% of the sustainable aviation fuel that the UK plans to use by 2030. When compared with conventional jet fuel, sustainable aviation fuel reduces the production of greenhouse gases by more than 70%. This is expected to create over 150 full-time jobs, including 85 jobs on-site alongside further employment in the supply chain.

HOT PROJECTS

Petrobras signs MOU with Mubadala to explore Bahia biorefinery project

September 4, 2023 | Meghan Sapp

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In Brazil, Petrobras has signed a memorandum of understanding with MIC Capital Partners (Brazil Strategic Opportunities) Fundo de Investimento em Participações, Mubadala Capital Group's Multi-strategy Investment Abroad, to develop studies covering future businesses in the downstream segment, with emphasis on

evaluating Petrobras' participation in a biorefining project.

The Mubadala Capital Group is in the process of developing an integrated biorefinery project in Bahia, focusing on the production of renewable diesel and sustainable aviation kerosene. This project reinforces Brazil's role as a strategic supplier of renewable fuels, capitalizing the abundant natural resources present in the country.

Mitsui to invest in Galp's HVO and SAF project at Sines Refinery

September 25, 2023 | Meghan Sapp

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In Portugal, Mitsui & Co. has agreed to invest in a renewable diesel (hydrotreated vegetable oil/HVO) and sustainable aviation fuel (SAF) production business operated by Galp SGPS, S.A., Portugal's biggest energy company. A joint venture company will be established once necessary authorities' clearances are obtained. Galp will own 75% of its shares and Mitsui 25%.

As the only oil refiner in Portugal, Galp has been operating the Sines Refinery since 1978. The Lisbon-based company has been stepping up its investment in the energy transition field and pursuing fuel conversion initiatives. This project will involve the construction of facilities within the Sines Refinery, which are capable of being switched between HVO and SAF production modes. With the first HVO production in the end of 2025, the commercial operation date of the project is expected in 2026, and it is anticipated that the facilities will also be used to produce SAF, demand for which is expected to increase over the long period of time. In addition to its investment in the production business, Mitsui will also take responsibility for the overall value chain, including the procurement of feedstocks, primarily from Asia, and the sales of the products.

DHL and Sasol join HH2E on SAF project

September 27, 2023 | Juan Pedro Tomas

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In Germany, Reuters reported that German logistics company DHL is partnering with energy firm HH2E and South African petrochemicals firm Sasol on the expansion of sustainable aviation fuel production in Germany.

The report stated that the companies have signed an agreement to set up a joint initiative to build potential production capacities for SAFs based on green hydrogen, or eSAFs, somewhere in eastern Germany.

The partners aim to produce at least 200,000 tons per year, with the potential to scale up to 500,000 tons per year.

Also, aircraft manufacturer Airbus also intends to join the consortium to use the jet fuel, according to the report.

HOT PROJECTS

NEXTCHEM awarded new project in the UAE for the transformation of solid waste into SAF

December 27, 2023 | Juan Pedro Tomas

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In Italy, local firm Maire Tecnimont announced that NEXTCHEM, through its subsidiary MyRechemical, has been awarded a feasibility study for the integration of its proprietary Waste-to-Syngas technology in a large-scale conversion plant that would transform solid municipal waste into sustainable aviation fuel. This is the first major project in the United Arab Emirates (UAE) aimed at producing up to 120,000 tons per year of SAF. MyRechemical will provide the gasification unit to transform solid waste streams into synthesis gas (syngas). This syngas will be converted into low carbon ethanol and then to SAF. "We are happy to participate in the first waste-to-chemicals initiative in the UAE" said Giacomo Rispoli, CEO of MyRechemical. "This achievement further confirms our commitment in valorizing alternative feedstocks contributing concretely to the reduction of the carbon footprint in the aviation sector. This happens in a country like UAE where we boast a long-standing presence in the transformation of natural resources, and which is now open to sustainable innovation".

Project Speedbird wins $11.2 million government funding

November 21, 2023 | Juan Pedro Tomas

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In Illinois, Project Speedbird – a joint partnership between LanzaJet, British Airways (BA), and Nova Pangaea Technologies (NPT) – said it has secured new funding totaling $11.2 million from the UK Government's Advanced Fuels Fund (AFF) competition.

LanzaJet, and NPT, a UK-based cleantech company developing advanced biofuels used to produce SAF, will receive the funding to increase global SAF production and decarbonize the aviation industry.

The SAF will be developed using a combination of NPT's innovative technology, which converts agricultural waste and wood residue feedstocks into second-generation biofuels such as ethanol, and LanzaJet's proprietary technology that converts ethanol into SAF. The NPT ethanol will be initially processed into SAF through LanzaJet's Alcohol-to-Jet (ATJ) plant in Soperton, Georgia prior to Project Speedbird's own larger ATJ facility, planned to be built in the UK by 2027. British Airways is intending to purchase all the SAF produced through Project Speedbird to help power some of its flights.

Project Speedbird will produce 27 million gallons of SAF per year and will produce SAF at full capacity by 2028.

Santa Maria Renewable Resources taps Topsoe, Chemex for East Texas SAF, RD project

November 30, 2023 | Jim Lane

Post Share Mail Share

In Texas, Santa Maria Renewable Resources has selected Topsoe, as its technology provider, and has executed License and Engineering Agreements with the leader in the renewable fuels market. These licenses encompass the state-of-the-art Hydroflex and H2bridge technologies. Topsoe's HydroFlex process layout combined with the H2bridge concept offers unprecedented greenhouse gas emission savings and lower carbon intensity of renewable fuels. The process and concept are both pivotal components for a biofuels and sustainable agriculture project currently in development by SMRR in East Texas.

The facility will provide 600 to 700 construction jobs and 300-plus permanent operating employment positions. A daily output of up to 3,000 barrels per stream per day is expected, encompassing both renewable diesel (RD) and sustainable aviation fuel (SAF). The demand for RD and SAF is significantly on the rise as the aviation industry makes strides to reach net zero carbon emissions by 2050. SMRR's project is a central step towards supporting the aviation industry in their green initiatives.

Additionally, SMRR has partnered with Chemex Global, a wholly-owned subsidiary of The Shaw Group, to commence the front-end engineering design for the facility in East Texas.

HOT PROJECTS

Infinium gets $75 million equity commitment from Breakthrough Energy Catalyst for investment in Project Roadrunner

December 6, 2023 | Juan Pedro Tomas

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In Texas, Infinium and Breakthrough Energy Catalyst announced a $75 million project equity investment commitment to support Infinium's Project Roadrunner, subject to the satisfaction of certain closing conditions. Project Roadrunner will convert waste carbon dioxide (CO2) and renewable power into sustainable aviation fuel and other low-carbon fuels. Project Roadrunner, located in West Texas, will convert an existing brownfield gas-to-liquids project into a fully integrated eFuels facility that will deliver products into both U.S. and international markets. It will primarily produce Infinium eSAF. Project Roadrunner will also produce Infinium eNaphtha for use in plastics manufacturing and Infinium eDiesel for use in hard-to-electrify transportation methods, such as long-haul trucking and maritime applications. In tandem with Catalyst's investment in Infinium, American Airlines and Infinium have entered into an offtake agreement for Infinium eSAF. American joined Breakthrough Energy Catalyst as an anchor partner to accelerate the development of next-generation clean energy technologies, including SAF.

Alfanar taps Air Liquide for UK Lighthouse Green Fuels project

December 3, 2023 | Jim Lane

Post Share Mail Share

In the UK, Air Liquide Engineering & Construction has been awarded an engineering package by Alfanar to support the development of the Lighthouse Green Fuels project located in Teesside, UK. The Lighthouse Green Fuels project is one of the first projects underway in the UK aiming to convert biogenic and non-biogenic solid wastes and residues into sustainable aviation fuels (SAF) on a large scale.As part of the agreement, Air Liquide Engineering & Construction will provide the license, basic engineering and FEED for the new plant with its innovative and well-referenced syngas cleaning, hydrogen purification and carboncapture(RECTISOLTM)technologies,whichwillprocessaroundonemillliontonnesofwastesand residues into SAF each year.The plant is expected to enter commercial operation in 2028 and to fuel the equivalent of more than 25,000 short-haul or 2,500 long-haul flights a year.

SAFFiRE picks Conestoga's Arkalon Energy for cellulosic SAF pilot project

November 20, 2023 | Jim Kendrick

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In Kansas, PRNewswire reported Conestoga Energy and SAFFiRE Renewables agreement for Conestoga to host SAFFiRE's cellulosic ethanol pilot plant at Conestoga's Arkalon Energy ethanol facility in Liberal, Kansas. The SAFFiRE pilot project aims to validate and demonstrate the commercialization of SAFFiRE's corn-stover-to-ethanol technology in a fully integrated pilot facility that processes 10 tons of corn stover per day. Both Conestoga and SAFFiRE are focused on producing ultra-low carbon intensity (CI) ethanol for use in renewable fuels, making this a synergistic relationship.

The cellulosic ethanol from the SAFFiRE pilot project and potential future commercial facilities is planned to be upgraded to ultra-low CI sustainable aviation fuel (SAF) in support of the aviation industry's decarbonization efforts. SAF is fuel produced from non-fossil fuel sources that can result in lower greenhouse gas (GHG) emissions than conventional jet fuel on a lifecycle basis. SAF is a drop-in fuel when blended with conventional jet fuel and is crucial to decarbonizing aviation.

SAF's lower carbon intensity makes it an important part of reducing aviation GHG emissions, which make up 9%–12% of U.S. transportation GHG emissions, according to the U.S. Environmental Protection Agency.

HOT PROJECTS

Chevron Lummus successfully starts up ISOTERRA at Chevron's El Segundo renewable fuel conversion project

November 7, 2023 | Meghan Sapp

Post Share Mail Share

In California, Chevron Lummus Global LLC announced the completion and successful startup of an ISOTERRA unit as part of Chevron's renewable fuel conversion project at their El Segundo Refinery in Southern California.

The ISOTERRA unit leverages both the refinery's existing assets and Chevron Lummus Global's proprietary catalyst and reactor internals technology to achieve exceptional diesel yields. The conversion from a diesel hydrotreater (DHT) allowed for a quick turnaround of the existing unit, establishing El Segundo as Chevron's first petroleum refinery with the flexibility to supply diesel fuel derived entirely from renewable or traditional feedstocks.

Willis Lease Finance Corporation announces Teesworks as site for its new SAF project

October 11, 2023 | Juan Pedro Tomas

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In Florida, Willis Lease Finance Corporation (WLFC), a lessor of commercial aircraft engines and global provider of aviation services, together with its subsidiary Willis Sustainable Fuels Limited, announced the selection of Teesworks in Tees Valley, England, as the intended location for a sustainable aviation fuel plant.

This plant will be the first of its kind in the region focused on developing and producing power-to-liquid (PtL) SAF. Teesworks is the United Kingdom's largest industrial zone, and an international hub for diverse, sustainable, and low-carbon activity.

WLFC's planned SAF refinery will be designed to convert feedstocks, sourced from industrial-waste carbon dioxide and green hydrogen into SAF.

"Our pioneering SAF project at Teesworks will directly support the global aviation industry's ambitious goal of net-zero emissions by 2050," said Austin Willis, CEO of WLFC. "We are proud to be continuing our legacy as a leader and innovator in aviation, being the first aviation leasing company to launch a SAF initiative of this type."

Technip Energies awarded EPsCm contracts for Galp's advanced biofuel project

October 5, 2023 | Meghan Sapp

Post Share Mail Share

In France, Technip Energies has bees awarded Engineering, Procurement Services and Construcion Management (EPsCm) contracts by Galp for an advanced biofuels unit and a green hydrogen unit for its Sines refinery in Portugal. Both projects are part of Galp's program to reduce the carbon footprint of the refinery and its products.

The Advanced Biofuels Unit, promoted by the joint verture of Galp (75%) and Mitsui (25%), will have a 270 ktpa capacity and will produce renewable diesel and sustainable aviation fuel (SAF) from bio-feedstock and waste residues and will allow Galp to avoid c. 800 ktpa of greenhouse gas emissions. For this unit, Technip Energies will work in consortium with Technoedif Engenharia, a large engineering firm in Portugal, to complete the EPsCm project.

The Green Hydrogen Unit, composed of a 100 MW electrolysis plant, will produce up to 15 ktpa of rerewable hydrogen, using proton exchange membrane (PEM) electrolyzers which will be supplied by Plug Power. This unit will allow the replacement of c. 20% of the existing grey hydrogen consumption of Sines refinery and will lead to greenhouse gas emissions reduction of c. 110 ktpa.

Both units represent a gross investment estimated at €650 million and will transform the Sines refinery into one of the most important low-carbon platforms in Portugal.

Because the problem is up there.

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