

JET FUEL INTELLIGENCE®

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SUSTAINABLE FUELS

SAF Producers Stress Urgency to Scale Up for Net-Zero Target

Three leading producers of sustainable aviation fuel (SAF) emphasized the urgent need to speed up SAF commercialization if the aviation sector has any hope of meeting its net-zero goal by 2050. During a webinar sponsored by SAF Fuel Futures this week, LanzaJet CEO Jimmy Samartzis referred to his company's adage that "some day is now." World Energy CEO Gene Gebolys underscored the importance of demonstrating proof of concept in the near term to derisk the technology and attract private capital to build new plants. SkyNRG's head of growth and investment Darrin Morgan pointed out that convergence of scalable technologies and government support through the US Inflation Reduction Act had put the financial community on notice — with everyone now focused on SAF.

Three technologies for producing SAF via the Hefa, alcohol-to-jet (ATJ) and Fischer Tropsch pathways have already been derisked. World Energy is spending \$2 billion to expand capacity at its Los Angeles plant by 700% to produce 340 million gallons of SAF per year. The firm is partnering with hydrogen producer Air Products and Honeywell to build what it says is "the most technologically advanced products and distribution hub ever constructed."

LanzaJet Doubles US SAF Output

LanzaJet is building its first ATJ plant in Freedom Pines, Georgia, that will double SAF production in the US when it starts up next year, with capacity to produce 9 million gallons of SAF and 1 million gallons of renewable diesel per year. Other projects are in the planning stages in North America, Europe and Asia that will boost its global SAF capacity to more than 1 billion gallons/yr. Samartzis pointed out that it would take 50 plants of 60 million gallons/yr each for aviation to reach its net-zero target.

SkyNRG is working on the Synkero facility in the Port of Amsterdam to produce e-Fuels for aviation from CO2 and hydrogen. It is due on line in 2027 with the capacity to produce 16 million gallons (50,000 tons) annually and a direct pipeline link to Schiphol airport. Its Delfzijl plant currently under construction will add 33 million gallons (100,000 tons) to its annual capacity. In the Pacific Northwest SkyNRG is collaborating with Boeing on a project to produce 30 million gallons (90,000 tons) of SAF from renewable natural gas and green hydrogen. "The money is there" and the timing is right, Morgan said. He equated the emerging SAF sector with the wind power industry 20 years ago, when broad-based financial support enabled wind projects to take off and costs to come down.

In discussing the high prices for SAF, which can cost from two to five times the price of fossil jet fuel, the three executives echoed each other's comments about the need to factor in the cost of carbon. Gebolys said that Bill Gates' book on climate change — *How to Avoid a Climate Disaster* — was probably the best one ever written on the

subject. But Gates made one mistake by oversimplifying higher costs for renewable fuels as the "green premium." Gebolys stressed that "lower-carbon fuels cost more because they are better." He pointed out that price parity between SAF and fossil jet will only be attained when all externalities (such as emissions) for the incumbent product (jet fuel) are fully accounted for. He insisted that "it's the price of carbon that matters," since SAF achieves emissions reductions of up to 80% versus fossil jet fuel.

The three panelists emphasized the importance of Book & Claim accounting so that more parties can achieve carbon savings from usage of SAF. World Energy used the Book & Claim system to enable the UAE's Etihad Airways to operate a net-zero flight carrying delegates from Dulles airport near Washington, DC, to the COP27 meeting. The flight was meant to showcase the logistical challenges of using SAF until supplies become more widely available around the world.

As Gebolys summed up the predicament for SAF producers, "It took 120 years to develop the current energy system. We can't build a new one overnight. But every day that we do nothing just maintains the status quo."

Cristina Haus, New York

CHINA China's Slow Reopening Weighs Down Aviation Recovery

China is still mired in the pandemic, with Beijing's "zero-Covid" policy curbing international air travel and suppressing economic activity. From the engine for global jet fuel demand gains prior to the pandemic, China has become a deadweight on the pace of recovery. Despite lower fatalities than in Europe or the US, Asian countries are laggards with a far more cautious approach than in the West to reopening their borders. "Even with econom-ic and geopolitical uncertainties, the demand for air transport continues to recover ground. The outlier is still China with its pursuit of a zero-Covid strategy keeping borders largely closed and creating a demand roller-coaster ride for its domestic market," the International Air Transportation Association reported earlier this month.

China's GDP growth for the first three quarters of this year averaged 3%, well below an initial 2022 target of 5.5%. The economy is struggling in the fourth quarter as China braces for its largest Covid-19 outbreak in at least six months. Its case numbers surpassed 24,000 a day this week — levels last seen during the Shanghai lockdown in April-May. Cases are more widespread this time with outbreaks in the southern city of Ghangzhou, Chonqjing and to a lesser extent in Beijing.

On Nov. 10 the government introduced new measures to fine-tune its zero Covid policy. They effectively reduce the length of quarantine for close contacts and inbound travelers to avoid mass testing and full-city lockdowns. Local and provincial officials have leeway to apply the domestic measures with more or less stringency. But as Covid variants spread and testing becomes less widespread, citizens may opt to stay home which would further reduce mobility and suppress economic growth.

After accounting for the stringency of measures in each individual city under lockdown, Nomura Securities estimates that by Nov. 14, the total weighted sum of those areas comprised nearly 16% of China's total GDP, up from 12% the week before.

Sagging Domestic Demand

At a time when jet demand is on the mend in most of the world, China's apparent consumption of 451,000 barrels per day in the first three quarters is 42% lower than in 2021 and 47% below the same period in 2019 before the pandemic, Energy Intelligence calculates. Air passenger volumes fell 42% to 204 million in the first nine months, according to the Civil Aviation Administration of China. Domestic passengers comprised 203 million, down 42% from the same period a year ago. International travelers totaled just 1 million due to border closures and quarantine restrictions.

But international traffic has picked up gradually over the past few months. The government now recognizes the need to reopen for business travel at least, in order to reinvigorate economic growth. In September 212,000 passengers flew in or out of China, up 72% from September 2021 and 12% higher than September 2020.

Earlier this month China opened the Covid–19 door by a crack. Beijing reduced the quarantine for inbound travelers to five days from seven since June. Prior to that travelers faced quarantines of up to four weeks in a hotel or government facility, followed by three days of confinement at home. Domestic quarantine restrictions for close contacts were also cut.

China is doubling the number of international flights for the winter period from November to March to 840 one-way flights. That's still well below the 3,000 a week average before Covid-19. Penalties for airlines bringing in infected travelers were also scrapped, which should unleash a large increase in flight activity into and out of China.

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When Will It End?

Once all Covid-19 restrictions are scrapped, pent-up demand for air travel at home and abroad after three years should trigger a surge in jet demand. The initial phase of reopening is likely to start in earnest only after President Xi Jinping's new government is in place after the March parliamentary sessions. A large-scale vaccination campaign will also be needed to provide boosters for a significant proportion of China's elderly. Asian neighbors reopened slowly this year and China is expected to follow a similarly progressive path. All told, this could mean air travel will start picking up in the second quarter of next year and rise gradually thereafter.

The long-term outlook for China's aviation remains bright. At the country's largest air show this month, domestic and international aircraft manufacturers said that China will need 9,284 new planes over the next 20 years to meet demand. Boeing projects that China's domestic traffic will triple between 2019 and 2041 to 2.5 billion passenger trips — the largest flow worldwide. Travel within China was the third-largest market in 2019. Boeing's bull-ish forecast is predicated on China's economic gains averaging 4.3% over the next 20 years. But that growth rate is far from certain in the wake of the pandemic.

Maryelle Demongeot, Singapore

SPOT CARGO MARKETS Worries About Jet Supply Mount Despite Oil Demand Warnings

Oil prices fell below the bottom of their recent range as fears of demand contagion spread well beyond China's current Covid-19 lockdowns. The International Energy Agency has warned current high diesel prices are almost certain to trigger demand destruction. It now sees global diesel/gasoil demand shrinking next year, even with gas-to-oil fuel switching. Europe will be forced to bid up the market in order to draw more US, Mideast and Asian fuel away from their traditional buyers to replace Russian supplies. Dwindling US manufacturing activity is also threatening to taking a bite out of distillate buying.

ICE Brent futures have hovered in a \$90-\$100 per barrel range since the early October decision by the Opec-plus coalition to cut output by 1 million barrels per day from November. They fell to \$89.78/bbl at Thursday's close, down \$3.89/bbl on the week and their lowest since early October. US domestic price-pin West Texas Intermediate shed \$4.83/bbl to finish the week at \$81.64/bbl.

The market is surprisingly nonplussed by the imminent EU ban on crude imports from Russia, which starts on Dec. 5, and a





EUROPEAN QUARTERLY JET FUEL SWAPS QUOTES

(Bid/Offer Range in \$/ton, c.i.f. NWE)							
Q	Chg.	Nov 1	18	Nov 11			
Q1'23	-52.25	964.50 -	965.50	1,016.75 - 1,017.75			
Q2'23	-38.75	917.25 -	918.25	956.00 - 957.00			
Q3'23	-29.75	893.25 -	894.25	923.00 - 924.00			
Q4'23	-24.25	872.00 -	873.00	896.25 - 897.25			
Prices are live for midday. Source: FCStone							

product import ban from Feb. 5. "The market cannot interpret yet what the bans mean," says a trader. He added that crude oil from Russia is likely to flow in high volumes and the biggest impact will come from the product embargo. Crude markets are already finding ways to replace Urals. Angola, Guyana, Norway, Brazil, Iraq, Saudi Arabia and the US are all stepping up crude sales to Europe.

European jet fuel prices fell twice as hard as Brent crude with traders seemingly confident that longer-haul suppliers in Asia can make up for missing Mideast barrels during the soccer World Cup being held in Qatar this month and next. Total East of Suez arrivals are pegged at 2.5 million metric tons this month, roughly the same as October, but traders say volumes are already committed and tanks are still low.

Unease is growing about the impact of February's ban on Russian diesel imports on already-volatile jet markets. Local refiners are certain to maximize diesel production and leave Europe more reliant on jet imports, at a time when most overseas suppliers are also focusing on road fuels. Kuwait Petroleum Corp.'s new Al-Zour



export refinery is one of the market's few silver linings. But more fuel moving longer distances will induce a sharp run-up in longrange tanker rates.

Northwest European jet cargoes were pegged at a \$100.50 per metric ton premium to softening December ICE low-sulfur gasoil (LSGO) futures at Thursday's close, down from a \$119.75/ton premium a week ago. Flat jet prices slumped 8% on the week compared to a 4% dip in crude. The week saw two jet cargo deals. Shell sold twice to rival regional major BP in Thursday's pricing window. BP first paid a \$33/ton premium to the floating Platts' c.i.f. cargo mean (CCM), then CCM plus \$27/ton for two parcels into Le Havre Dec. 8-12. Shell also offered fuel on board the STI Jermyn coming from China into Rotterdam. China is ramping up overseas jet fuel sales more than ultra-low-sulfur diesel under Beijing's recent relaxation of export quotas. Jet tanks in Amsterdam-Rotterdam-Antwerp fell to a seven-week low of just 816,000 tons on Nov. 17, according to Insights Global. Staff at BP's 400,000 b/d Rotterdam refinery began working-to-rule on Monday amid a pay dispute which could result in walkouts.

In the US, jet fuel spreads lost more ground than basis diesel futures, which settled at \$3.53 per gallon on Thursday for a loss of just 2¢ versus last week. A massive price divide separates the East Coast from the Gulf and West coasts. New York Harbor jet is the most expensive in the country, trading at a 22.5¢/gallon premium to the Nymex December contract, down from a 32¢ peak on Nov. 10. Gulf Coast differentials firmed slightly to 37¢ below diesel futures, while spreads in Los Angeles weakened further to a massive 50¢ below the print.

Fundamentals reflect the market disparities. The East Coast market is as tight as a drum, with tanks falling by 800,000 barrels to 8.1 million bbl or some 8% below year-ago levels when demand was much lower. West Coast stocks jumped by 600,000 bbl to 9.8 million bbl amid a flurry of incoming cargoes. Overall US imports topped 200,000 b/d in the week ended Nov. 11, according to government data. Jet demand climbed by 100,000 b/d to 1.65 million b/d and is poised for huge gains next week during the Thanksgiving holiday period. Airlines are gearing for an especially hectic travel period following three years of limited traffic due to Covid-19 restrictions and concerns.

Asian jet markets lost their verve even as overall air traffic inched up in the four largest regional aviation markets East of Suez. The benchmark Singapore spot price differential tumbled by 57¢/bbl to a premium of \$2.24/bbl to Singapore quotes on Nov. 17. The drop wiped out almost all of last week's increase. Higher airline capacity in Southeast Asia, South Asia and the Middle East outweighed a decline in Northeast Asia to lift prompt jet demand, according to data from OAG.

Kerry Preston, London, Cristina Haus, New York, Freddie Yap, Singapore

IN BRIEF

Wizz Air Buys SAF From OMV

Hungary-based budget airline Wizz Air has signed a memorandum of understanding with Austrian jet fuel supplier OMV for up to 185,000 metric tons of sustainable aviation fuel between next year and 2030. Europe's fastest-growing airline aims to cut its CO2 emissions by 25% by 2050 en route to net zero by 2050 "with the use of SAF playing a significant role in that commitment," said Wizz Air's Development Officer Owain Jones in a Nov. 15 statement. "Supporting the production and research of SAF technologies is one of our priorities," he added. The airline already claims to be Europe's greenest thanks to its new, fuel-efficient fleet.

OMV aims to become a leading European SAF producer by the end of the decade, targeting production of 700,000 tons/yr by 2030. "Cooperation between OMV and Wizz Air will help us achieve our respective strategic sustainability goals. With Wizz Air we were able to gain a strong international partner," said OMV Vice President Aviation, Fuel Distribution & Public Sector Nina Marczell. OMV already has SAF supply deals with Austrian Airlines, Lufthansa and Ryanair and supplies SAF to all carriers at Vienna Airport.

Germany Funds New Methanol-to-SAF Pathway

The German government has committed €3.1 million (\$3.2 million) in funding for a new drop-in methanol-to-sustainable aviation fuel (SAF) pathway being developed by a consortium that includes Austrian jet fuel supplier OMV. "The starting point of the process is sustainably produced methanol from CO2 and green hydrogen," OMV said in a Nov. 16 statement. "This production process should generate only minimal additional CO2 emissions and be easy to integrate into existing production plants," the oil company added. Similar to power-to-liquids SAF, green methanol transforms green hydrogen into an easy to handle liquid fuel. However, it was recently rejected by the shipping industry as a low-carbon fuel because it's too expensive.

Four other companies have signed up to the methanol to SAF (M2SAF) consortium: refinery catalyst supplier BASF, engineering firm Thyssenkrupp, synthetic fuels developer DLR and testing lab ASG. "We are pleased to see the bundled know-how and the initiative of the renowned industrial companies in the M2SAF consortium," said State Secretary for Germany's Federal Ministry of Digital and Transport Olivier Luksic at the Nov. 16 launch in Frankfurt. "The fact that the development project plans to use existing industrial facilities promises a quick realization of the M2SAF project along with scalability of production to industrial levels. These are crucial factors in providing the best support in our transformation to net-zero carbon," he added. The project covers catalyst and process development, plant integration and the design of a demo plant, as well as support for the certification and analysis of the new jet fuels.

GLOBAL JET FUEL DEMAND ('000 b/d)



GLOBAL DEMAND SNAPSHOT Summer Travel Restores Normal Patterns

Jet fuel demand reached a post-pandemic high of 3.3 million b/d in August as peak summer traffic restored more normal seasonal patterns to consumption trends. Jet usage in a group of industrialized countries topped 2.8 million b/d — a 22% gain from levels that were reduced by Covid-19 restrictions in the previous year. Demand in the four largest European markets jumped by nearly 60% versus 2021, with a doubling in the UK driving most of the gain. Australia's move to scrap travel restrictions doubled its jet usage to 130,000 b/d as international flights resumed.

The changes in consumption trends were less dramatic among key developing countries. Their overall demand climbed by nearly 25% versus last year, with South Korea showing the highest 38% jump. Indian usage stabilized at around 150,000 b/d as ongoing Covid-19 cases reduced demand for air travel.

					Aug	'22 vs.		Q1 '22
Country	Aug ^p	Jul ^r	Jun ^r	May ^r	Jul '22	Aug '21	Q1 '22	vs. Q1 '21
US	1,650	1,599	1,707	1,574	+3.2%	+5.5%	1,451	+29.1%
Japan*	158	154	143	146	+2.7	+23.2	146	+15.5
Europe 4	747	697	652	626	+7.2	+58.7	444	+77.2
UK	243	245	229	231	-0.9	+101.1	144	+126.0
Germany	222	221	207	191	+0.4	+41.4	153	+70.4
France	179	137	117	117	+31.0	+52.5	92	+25.1
Italy	103	94	98	86	+9.7	+36.3	55	+134.3
Canada	163	173	158	113	-5.3	+48.6	98	+72.0
Australia/N.Z.	130	130	128	122	-0.4	+105.5	94	+33.1
Total	2,848	2,752	2,789	2,582	+3.5%	+22.0%	2,233	+37.1%
Key Developing Countries								
Brazil	94	97	97	99	-3.2%	+22.8%	99	+40.2%
S. Korea*	121	113	110	104	+7.5	+37.6	107	+16.1
India	148	144	152	153	+2.4	+13.7	146	+0.9
Mexico	90	89	88	87	+0.8	+31.3	84	+82.0
Total	453	443	448	443	+2.2	+24.7	435	+23.3
Grand Total	3,302	3,196	3,236	3,025	+3.3%	+22.3%	2,669	+34.7%
Key Kerosene Consumers								
Japan	81	70	74	97	+16.6%	-8.2%	432	-1.6%
India	107	104	110	111	+2.4	+13.7	105	+0.9
S. Korea	27	11	13	17	+140.7	+44.3	77	+2.6
Total	215	185	197	225	+16.1%	+6.9%	615	-0.6%

p=Preliminary. r=Revised. *Includes domestic and bonded sales.

US SUPPLY, DEMAND AND STOCK TRENDS AT A GLANCE

US JET KEROSENE STOCKS



REGIONAL STOCK LEVELS, NOV 11



JET KEROSENE STOCKS		2022			2021		Latest Levels vs.		
(million bbl)	Nov 11	Nov 4	Oct 28	Oct (p)	Sep (p)	Nov 12	Oct	Nov 4 '22	Nov 12 '21
East Coast (Padd 1)	8.1	8.9	8.5	8.7	8.5	8.8	10.3	-8.3%	-7.7%
West Coast (Padd 5)	9.8	9.2	8.3	8.7	8.5	10.1	9.8	+6.8	-2.3
Central (Padd 2-4)	19.3	18.9	19.5	19.3	19.2	19.1	20.2	+2.2	+1.1
Total Stocks	37.3	37.0	36.4	36.6	36.2	38.0	40.4	+0.8%	-1.9%

		202	22		20	021	Latest Wkly.	Oct '22 vs.	Sep '22 vs.
('000 b/d)	Nov 11	4 Wk. Avg.	Oct ^p	Sep ^p	Oct	Sep	Change	Oct '21	Sep '21
Jet Refinery Output	1,618	1,550	1,519	1,564	1,321	1,356	-1.3%	+15.0%	+15.3%
% Jet Yield	9.7	9.5	9.4	9.5	7.5	7.6	-2.2	+25.9	+24.9
% Utilization	92.9	91.1	90.0	91.7	86.1	87.2	+0.9	+4.5	+5.2
Imports	201	191	143	75	218	222	+73.3	-34.3	-66.3
Sales	1,649	1,547	1,488	1,520	1,467	1,485	+6.6%	+1.4%	+2.3%

p=Preliminary. Source: US Department of Energy. Data has not been updated due to delays at the Dept. of Energy.

JET FUEL INTELLIGENCE DATA

PRICES IN SPOT CARGO AND FUTURES MARKETS

	ICE Prompt Futures (\$/ton)	European Spot	t Jet Fuel (\$/ton)*	Asian Spot Jet Fuel Markets (\$/bbl)†			
	Gasoil 0.1% Sulfur	NW Europe	Mediterranean	Mideast	Singapore	Japan c.i.f.	
Weekly Trend	-59.26	-9.95	-82.93	-2.12	-2.70	-2.03	
This Week	982.44	1,020.75	1,003.53	124.35	124.05	129.45	
Previous Week ^r	1041.70	1,030.70	1,086.46	126.47	126.75	131.48	
Oct 31-Nov 4	1084.85	1,076.55	1,025.76	121.14	122.90	127.54	
Oct 24-Oct 28	1100.75	1,099.65	1,018.12	121.74	123.75	126.56	
		I)					

Nymex Prompt Futures (\$/gal)		US Spot Jet Fu		
NY Harbor ULSD	New York [†]	US Gulf [†]	Chicago*	Los Angeles [†]
-0.09	+2.86	-8.02	-78.77	-8.45
3.58	387.72	318.78	378.08	313.09
3.67	384.86	326.80	456.85	321.55
3.85	376.18	360.98	434.92	328.98
4.18	419.64	399.54	361.66	331.11
	Nymex Prompt Futures (\$/ga) NY Harbor ULSD -0.09 3.58 3.67 3.85 4.18	Nymex Prompt Futures (\$/gai) NY Harbor ULSD New York* -0.09 +2.86 3.58 387.72 3.67 384.86 3.85 376.18 4.18 419.64	Nymex Prompt Futures (\$/gal) OS Spot Jet Futures NY Harbor ULSD New York [†] US Gulf [†] -0.09 +2.86 -8.02 3.58 387.72 318.78 3.67 384.86 326.80 3.85 376.18 360.98 4.18 419.64 399.54	NY Harbor ULSD New York [†] US Gulf [†] Chicago* -0.09 +2.86 -8.02 -78.77 3.58 387.72 318.78 378.08 3.67 384.86 326.80 456.85 3.85 376.18 360.98 434.92 4.18 419.64 399.54 361.66

<code>r=Revised.</code> Source: *OPIS Worldwide Jet Fuel Report, [†]Refinitiv .

DISTILLATE CRACK SPREADS - ICE vs Nymex



GLOBAL CARBON PRICES

(€/ton)	Nov 15	Nov 8	Chg.
EUA Dec '22	76.65	76.06	+0.59
US (\$/ton)			
CCA (Calif.) Dec '22 RGGI (NE) Dec '22*	27.68 13.30	28.20 13.38	-0.52 -0.08
New Zealand (NZ\$/ton)			
NZU (spot)	88.25	88.20	+0.05
Asia (\$/ton)	Nov 11	Nov 4	Chg.
China (National) South Korea	8.16 14.58	8.08 14.25	0.09 0.33

Benchmark months. *Short tons; all others metric tons. Based on given week's exchange rates. Source: $\mathsf{ICE},\mathsf{OMF}$

US (\$/gallon)	Nov 11	Nov 4	Chg.
Futures			
CBOT Ethanol	2.71	2.64	+0.08
RBOB Gasoline	2.60	2.71	-0.10
Spot market			
Ethanol Midcont.	2.70	2.79	-0.09
Ethanol NY Harbor	2.71	2.80	-0.09
Ethanol US Gulf	2.77	2.86	-0.09
Europe (\$/ton)	Nov 11	Nov 4	Chg.
Futures			
ICE Gasoil	1,041.70	1,084.85	-43.15
Spot market			
Gasoline	944.36	992.50	-48.14
Diesel	1,025.85	1,099.55	-73.70

KEY BIOFUEL PRICES

Source: Refinitiv, Exchanges

EU CARBON FUTURES PRICES



ECX front-month futures. Source: ICE

EU CARBON FORWARD CURVE



ECX EUA forward curve. Source: ICE

DATA: JFI's biofuel and carbon data are sourced from EI New Energy, Energy Intelligence's publication on renewables, carbon and transportation. For more data and information, see www.energyintel.com/newenergy.