Required Report: Required - Public Distribution **Date:** October 19, 2023

Report Number: CH2023-0109

Report Name: Biofuels Annual

Country: China - People's Republic of

Post: Beijing

Report Category: Biofuels

Prepared By: Erin Covert and FAS China Staff

Approved By: Adam Branson

Report Highlights:

CORRECTION: China’s biofuels policies continue to wane as a priority for the People’s Republic of China (PRC). Post forecasts PRC fuel ethanol production and consumption at 3.9 billion liters. Production will keep the blend rate slightly lower than 2022 levels as there will be less blending in some areas, high feedstock prices, and limited imports constrained by high tariffs. PRC 2023 fuel ethanol production is forecast to increase 96 million liters from the previous year due to a period of profitability early in the year. Biomass-based diesel (BBD) imports in 2023 are up 40 percent from 2022 - more than 90 percent are palm oil biodiesel from Indonesia and Malaysia. PRC exports again surged due to EU demand as the country replaced Argentina as the primary exporter of FAME to the EU in the fourth quarter of 2022. NOTE: Corrections include amending the conversion ratio for SAF and removing an unintentional, mistaken reference to a private firm and allegations of mislabeled product trade in the region.

I. Executive Summary

The PRC's biofuels policy has been primarily used as a corn stocks management program while air quality and environmental or climate change goals have been secondary. In 2023, high corn prices mean domestic corn-based ethanol producers continue to struggle with profitability even after the PRC's strict "Zero Covid" policies and related lockdowns and travel bans ended. Gasoline prices returned to 2021 levels, down from 2022. Demand for fuel ethanol is sluggish, and the PRC's high tariffs make ethanol imports unviable. At the same time, enforcement of the PRC's E10 blending mandate remains weak, further dampening any incentive to import. The PRC did not enact any significant policies or supports over the past year to assist or develop the ethanol industry, another indication government priorities have shifted away from biofuels development. There has never been a nationwide blend mandate for biodiesel.

In late 2020, President Xi made an international commitment to peak carbon dioxide emissions by 2030, but biofuels were noticeably absent as a directive or tool to meet these targets. The policy-driven directives made by the PRC also allowed the country's biofuels sector to be partially isolated from the global market and less responsive to market forces. It is rumored that the PRC may move unofficially to an E5 mandate in the coming years, but the government insists E10 remains in force. While E10 remains the official policy, actual blend rates vary and are often significantly lower even in locations with an E10 provincial program. Moreover, several provinces have yet to establish a program and are unlikely to ever establish one without surplus grain feedstock to support a local industry. The PRC declared in 2017 that it would establish a nationwide E10 mandate by 2020. The goal was unofficially suspended in late 2020 and ethanol blend rates in pilot areas have since declined. High corn prices pushed up the cost of fuel ethanol production while ethanol price gains were held in check using a formula tied to gasoline prices, forcing the provinces and cities which had announced E10 expansion plans in 2019 to scale back implementation. The PRC has reportedly delegated E10 blending goals and decision-making authority to provincial governments while requiring existing E10 pilot areas to continue to blend at E10.

Fuel ethanol consumption in 2023 is estimated at 3.9 billion liters, slightly up from 2022 as demand has not been recovering as strongly after the end of the PRC's "Zero Covid" as some analysts expected. China's 2023 fuel ethanol production is forecast to increase to 3.9 billion liters, up 96 million liters from the previous year due to a period of profitability early in the year. With international fuel ethanol prices high early in the year, China will rely on domestic production to meet market demand in 2023.

The export of used cooking oil (UCO)-based biodiesel and hydrogenation-derived renewable diesel (HDRD) continued increasing momentum in the first half of 2023 as robust demand from the European Union (EU) spurred biodiesel producers to increase production[1]. Fatty acid methyl esters (FAME) biodiesel producers have relatively stable production capacity at 3.7 billion liters per year. Export-oriented HDRD plants saw notable expansion in the last two years, with an expected combined capacity of 3 billion liters by the end of 2023 and an additional 1.2 billion

1 Due to uncertainty in HS codes used for HDRD, it is possible some product traded under the biodiesel code in Chapter 38 could be HDRD that should be reported in Chapter 27. Exact trade figures for biodiesel vs HDRD remain uncertain ever since China began producing HDRD (mainly for export) beginning in 2017.

liters per year capacity planned. BBD production in 2023 is forecast at 3.3 billion liters, up by over 36 percent from 2022 due to a surge in exports almost entirely to the EU. From January to May 2023, China's BBD exports rose 70 percent year-on-year. The vast majority is shipped to the Netherlands and Belgium. With no national or provincial biodiesel blend mandates, demand for domestic biodiesel use and imports is discretionary (except for Shanghai's city mandate) and thus hinges on the price spread between palm oil (feedstock used to make the generally lowest cost biodiesel from Indonesia and Malaysia) and diesel. HDRD remains almost entirely export-oriented due to high production costs and no policy to support domestic use. Lacking any significant support, plants remain small with localized and limited sales. Post estimates a 0.2 percent biodiesel blend rate in 2023, similar to the previous two years. There have been no appreciable changes since biodiesel emerged in China two decades ago.

II. Policy and Programs

Past government policies state biofuels are part of the PRC's long-term strategic plan to protect the environment, conserve resources, and reduce dependence on imported energy. However, no new biofuel policies were announced in the last half of 2022 or the first half of 2023. Ethanol is the only biofuel that has received any attention from policy makers with ambitious emissions targets. The PRC's ethanol programs also support national initiatives to manage air pollution. Support for biodiesel (mandates, producer subsidies, and pricing policy) which lowers air toxins compared to fossil diesel, remains noticeably absent and is left out of policy conversations. Sustainable aviation fuel (SAF) is still in its infancy and there have yet to be serious conversations around support policies. For more details, see GAIN reports CH19047 and CH2020-0105.

Renewable Energy and Greenhouse Gas (GHG) Emissions

Carbon Peak before 2030
At the Climate Ambition Summit in December 2020, President Xi committed the PRC to lower its carbon dioxide emissions per unit of GDP by over 65 percent from its 2005 level and to increase the share of non-fossil fuels in primary energy consumption to 25 percent by 2030 to meet the goal of peak carbon dioxide emissions by 2030.

The PRC launched an emissions trading system (ETS) on July 16, 2021. Carbon emissions by companies covered in the first batch of trading are estimated to exceed 4 billion tons per year, or roughly 12 percent of global CO2 emissions, making it the world's largest market in terms of the amount of greenhouse gas emissions due to heavy use of coal. The first compliance period of the national ETS was completed on December 31, 2021. It spanned 114 trading days, with a cumulative trading volume of 179 million tons of carbon allowances and a cumulative turnover of $1.1 billion (RMB 7.7 billion). Ethanol could stand to benefit from the carbon trade system as a carbon emission reducer if the China Certified Emission Reductions (CCER) approves biofuel ethanol for carbon trade. Ethanol would then hold additional value on the carbon market. This would support ethanol producers and make the use of ethanol-blended gasoline more economical than pure gasoline.

For information on the PRC's CO2 and energy intensity reduction goals as well as the Energy Development Strategy Action Plan published in November 2015, the Blue Sky Protection Plan issued in July 2018, and China's Vehicle Emissions Standards, please see the 2021 and 2020 Annual Biofuels Reports.

China's biofuels policy has never, nor does it today, set minimum environmental sustainability performance criteria for biofuels related to water, soil, or air. Most importantly, regarding biofuels' role as a climate change mitigation tool, there are no maximum boundaries set on biofuel GHG emissions (gCO2/MJ) nor any certification requirements. China does not even permit foreign authorities' on-site access to certify biofuels shipped to them. Lacking such policy and requirements, China also fails to deliver policy that incentivizes GHG emission reductions of existing commercialized fuels over time as does U.S. West Coast states, Brazil, some European countries and now Canada. All biofuel production can be incentivized to lower biofuel emissions and failing in this task is to forgo the full potential biofuels can deliver in helping reduce climate change impacts.

Fuel Ethanol Policy Framework and Mandates

PRC law restricts fuel ethanol processing to licensed facilities that produce and supply fuel ethanol to national refiners and fuel marketing companies. Provincial Development and Reform Commissions (DRCs) are responsible for the distribution of licenses for fuel production, refining, and marketing. (See Section III. Ethanol Production).

In February 2022, the State Council released its annual policy guidelines on agriculture and rural development known as the "Number 1 Document" which instructed officials to "strictly control the corn-based fuel ethanol processing industry." (See also GAIN Report CH2023-0026 and CH2022-0029.) This likely indicates that corn-based ethanol production will remain at current capacity for the foreseeable future. Ethanol was not mentioned in the 2023 Number 1 Document, an omission which again seems to indicate that it is no longer a priority issue.

On May 10, 2022, NDRC and MOFCOM jointly released the 2022 Catalogue of Encouraged Foreign Investment in Industries, which includes fuel ethanol development and production. However, the catalogue specifically discourages foreign investment in grain-based ethanol production. This is a further signal that investments in expanding China's corn (or other grain) based ethanol production capacity in the short to near-term is unlikely.

In May 2022, the NDRC issued the "14th Five-Year Plan for Bioeconomic Development" establishing a national biotechnology framework to boost the bio-economy during the next five years. The Plan call to action encourages stakeholders to:

- Actively develop bioenergy, promote the development of biofuels and support the integrated development of the biochemical industry
- Establish biomass combustion and blending standards
- Speed up the key technology development and equipment manufacturing with regard to bio-natural gas, cellulosic ethanol and algae-based biofuels
- Actively promote the replacement, promotion and usage of advanced biofuels in municipal operation, transportation and other important areas
- Promote the transformation of fossil energy to green, low-carbon and renewable energy

- Carry out demonstrations of cellulosic ethanol, biodiesel, and biogas industries pilots in urban and rural areas where organic waste is concentrated
- Open up important links such as biomass raw material collection, organic fertilizer production and use, and increase the scale of biofuel production
- Carry out pilot projects for the promotion of biodiesel in areas where conditions permit and promote the demonstration and application of bio jet fuel.

In May 2022, the NDRC led nine ministries to publish the "14th Five-Year-Plan for Renewable Energy" (See GAIN Report CH2022-0065). The Plan calls for the development of non-grain biofuel ethanol such as cellulosic biofuel (a long-standing announced goal that has led to no large-scale commercial industry), and encourages demonstration pilots of alcohol, electricity, gas, and fertilizer production. The Plan also encourages promotion of clean liquid fuels such as fuel ethanol and biodiesel (a rather empty statement and nothing new). The Plan also called to support research and development and promote the use of advanced technology and equipment in biodiesel and jet fuel. In addition, the Plan continues to promote the use of clean liquid fuels such as fuel ethanol and biodiesel.

However, no detailed implementing measures or policies were announced following the release of the two Plans.

In 2017, PRC government messaging called for the moderate development of grain-based fuel ethanol and an E10 mandate which shifted in 2020 to the "strict control of the expansion of fuel ethanol processing capacity." This is reminiscent of earlier period of reduced surpluses and high corn prices in 2008, following a corn ethanol expansion phase, when China restricted construction of new ethanol facilities. In 2022, the messaging was repeated, "to strictly control the corn-based fuel ethanol processing industry." This shift from 2017 to 2020 and reinforced in 2022 illustrates the gradual transition away from the original first-ever push for E10 nationwide. That said, the PRC will maintain E10 mandates in provinces and municipalities that have fully or partially adopted E10, while quietly postponing (and likely eventually dropping altogether) any expansions of nationwide E10. Meanwhile, as China's gasoline pool (including bioethanol, biomethanol, and ETBE) has recovered and now surpasses the 2019 pre-pandemic level of 197 billion liters; the estimated national average blend rate of 2.2 percent that year has fallen to a current estimate of 1.8 percent.

E10 is Unachievable in the Short Team and Even More So Long Term
Post forecasts the PRC to produce 3.9 billion liters of fuel ethanol and (with no trade) consume the same amount in 2023, slightly higher than 2022 production and consumption levels. Domestic production will keep the blend rate even lower than 2022 levels as there will be less blending in some areas, high feedstock prices, and essentially no trade which are constrained by high import tariffs.

If China were to fully implement a national E10 blending program, based on the International Energy Agency (IEA) and China's National Energy Administration (NEA) figures, the PRC would need to consume about 21 billion liters of fuel ethanol in 2023, or five and a half times greater than actual consumption. Even if all existing approved fuel ethanol projects begin operation in 2023, the total output would only allow an E4 blend rate. However, this assumes

China's corn stocks could support the expansion which they cannot, and that expansion would have to grow further with China's growing fuel pool to maintain E10. Climate change impacts such as water scarcity and extreme weather including widespread floods and heat waves creates even further challenges. It seems equally unlikely in the current political climate and considering President Xi's frequent emphasis on the importance of agricultural self-sufficiency that the PRC would commit to a long-term corn import program. The assumption here is that cellulosic ethanol will never achieve cost breakthroughs needed to realize large-scale commercial production that would make a meaningful and growing contribution to overall supply.

Phased Adoption and Actual Implementation of E10 Varies by City and Province
Beginning in 2006 and until recent years, China expanded in a piecemeal fashion the number of cities and provinces adopting E10 blending mandates. Actual rates of fuel ethanol blended into gasoline vary over time and by city and province, and usually fall below local mandates due to varying levels of enforcement. The level of implementation often reflects the volume of ethanol produced regionally which fluctuates based on corn and gasoline prices and feedstock availability.

For more historical information on blend mandates, please see the 2020 Biofuels Report.

Government Financial Support for Ethanol Production

Past PRC government subsidies for fuel ethanol production supported both feedstocks and production inputs to make the industry viable. Starting in 2009, central government production subsidies for grain-based conventional ethanol were as high as $0.25/liter but were eliminated in 2016. From 2016 to 2018, provinces in Northeast China offered corn processors and ethanol facilities generous subsidies. Provincial authorities have not renewed processing subsidies since 2019 as government commitment to supporting the biofuels industry has waned with corn stocks depleted. The advanced cellulosic ethanol production subsidy was set at $0.07 per liter (600 RMB per ton) in 2018 and there have been no additional announcements or updates to the original subsidy program. Such a low subsidy remains ineffective at incentivizing the building of an industry. Support for corn is unlikely to be reintroduced unless concerns over feedstock supply reverse at some future date.

Import Tariffs

Tariffs on ethanol remain unchanged in 2023.

Denatured Ethanol (HS 220720) (ethanol used as fuel falls under this code in PRC import stats)
On January 1, 2017, the tentative tariff rate for denatured ethanol (HS 22072000) rose from 5 percent to the World Trade Organization (WTO) Most-Favored Nation (MFN) bound rate of 30 percent. Subsequently, on April 2, 2018, China levied an additional 15-percent retaliatory tariff on U.S.-origin denatured ethanol in response to the U.S. 232 Action, raising the tariff from 30 percent to 45 percent. Later, on July 6, 2018, China imposed an additional 25-percent retaliatory tariff on imports of U.S. denatured ethanol in response to the U.S. 301 Action, raising the effective tariff to 70 percent.

Undenatured Ethanol (HS 220710)

MFN tariff rates on undenatured ethanol were raised to 40 percent on January 1, 2017. On August 3, 2018, MOFCOM announced a retaliatory tariff on U.S.-origin undenatured ethanol, raising the tariff by 25 percent from 40 to 65 percent.

Table 1. China: Import Tariffs on Ethanol

HS Code		MFN	232 Retaliation	301 Retaliation
22072000	Ethyl Alcohol & Other Spirits, Denatured of Any Strength	30%	15%	25%
22071000	Undenatured Ethyl Alcohol, Of Alcohol V. ≥80%	40%	-	25%

Source: PRC Ministry of Finance

On February 18, 2020, China announced a new round of tariff exclusions for U.S. agricultural commodities impacted by the retaliatory Section 301-tariffs. Denatured ethanol (HS Code: 22072000) is included in the list with the announcement effectively lowering the duty on U.S. fuel ethanol from 70 percent back to 45 percent for those importers who apply for the exclusion. Tariff exclusions are approved for individual importers and will not automatically extend to all importers. Undenatured ethanol (HS Code: 22071000) is not on the list, but eligible importers can also apply for an exclusion on the Section 301 retaliatory tariffs for this product. The application process through China's Ministry of Finance (MOF) website opened on March 2, 2020. See Post's February 26, 2020 report "China Announces a New Round of Tariff Exclusions" for more information.

Biodiesel (HS382600) and Petroleum Oils Containing Biodiesel (HS27102000)
On August 23, 2018, China imposed an additional 25 percent tariff on U.S.-origin petroleum oils containing 1 to 30 percent biodiesel (HS27102000, Petroleum oils containing up to 30 percent biodiesel by volume) by volume, which effectively raised the tariff from 6 to 31 percent. At the same time, the duty for U.S.-origin biodiesel-blended petroleum containing more than 30 and up 99 percent biodiesel by volume as well as pure (B100) biodiesel was raised from 6.5 to 31.5 percent (HS38260000). See GAIN report CH18034. Regardless of the duty rates on U.S. biodiesel, China has never imported U.S. biodiesel even when rates were low because palm-oil based biodiesel from Southeast Asia is priced consistently lower.

For more historical information on China's biofuel policies, please see the 2021 Biofuels Annual and 2022 Biofuels Annual Reports.

III. Ethanol

Overview
The PRC is the world's fifth largest fuel ethanol producer after the United States, Brazil, India, and the EU, but its fuel ethanol market has remained insular throughout its 20-year history with the exception of brief periods (2015-16, 2018, 2021) when it allowed imports, nearly all from the

United States. Imports were effectively banned even though duties were held well below MFN rates prior to 2015, and China has never produced an exportable surplus. Since additional duties on U.S.-origin imports were implemented in early 2018, China's fuel ethanol market retreated from the global marketplace.

China produces a broad variety of ethanol products at a commercial scale covering potable alcohol, medical grade, and other industrial chemicals, in addition to fuel ethanol. Unlike other major ethanol producing countries, China's major end use market is non-fuel industrial chemicals.

Fuel Ethanol Consumption

In 2023, fuel ethanol consumption is estimated at 3.9 billion liters, up slightly from 2022. China's national average fuel ethanol blend rate is estimated at 1.8 percent, almost unchanged from the previous two years, while significantly lower than the 2.8 percent peak blend rate achieved in 2009. Demand has not recovered much since the pandemic began in 2020 and most recently since the "Zero Covid" policy ended. The 2023 half year economic data also shows that recovery has been very sluggish. Fuel ethanol demand is expected to increase in the second half of 2023 in line with the recovery of gasoline. Although the NDRC has reportedly increased attention on localities with existing E10 pilots to meet their full blend mandate, there is a common understanding that E10 expansion has been halted.

Stagnant policy and high feedstock prices with limited surplus grain stocks continue to limit fuel ethanol consumption and as such the average blend rate is slipping lower since 2020. The State Council called for controlling the expansion of fuel ethanol processing capacity in 2020, while the NEA in early 2021 urged local governments and companies to support the development of liquid biofuels, work to regulate ethanol gasoline promotion, and urged gasoline companies to sell liquid biofuel in line with existing regulations. These guidelines from both the State Council and the NEA had little effect on biofuel consumption.

Table 2. China: Ethanol Production, Supply, and Distribution

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023f**
Beginning Stocks		0	0	0	0	0	0	0	0	0
Fuel Begin Stocks		0	0	0	0	0	0	0	0	0
Production	6,921	7,868	8,071	9,211	9,770	10,740	10,830	10,580	11,850	12,087
Fuel Production	2,951	2,914	2,534	3,041	2,914	4,300	3,801	3,421	3,804	3,900
>of which fossil-based synthetic	0	0	0	0	0	0	30	30	40	100
>of which biobased	2,951	2,914	2,534	3,041	2,914	4,339	3,771	3,391	3,764	3,800
>of which biobased cellulosic	25	38	40	30	20	0	0	0	0	0
Imports	27	687	890	24	1,035	104	69	824	0	0
Fuel Imports	26	477	871	8	759	42	63	550	0	0
Exports	33	25	34	135	79	21	367	13	10	20
Fuel Exports	2	0	1	3	35	7	21	4	3	2
Consumption	6,915	8,530	8,927	9,100	10,726	10,823	10,532	11,391	11,840	12,067
Fuel Consumption	2,975	3,391	3,404	3,046	3,638	4,335	3,843	3,967	3,801	3,898
Ending Stocks										
Fuel Ending Stocks										
Refineries Producing First Generation, Bio-based Fuel Ethanol (Million Liters) 1/										
Number of Refineries	7	7	10	11	12	14	20	22	22	22
Nameplate Capacity	3,200	3,200	3,600	4,200	5,000	5,257	6,578	7,720	7,720	7,720
Capacity Use (%)	91%	90%	69%	72%	58%	83%	57%	44%	49%	49%
Refineries Producing Cellulosic Fuel Ethanol (Million Liters) 2/										
Number of Refineries	3	3	1	1	1	1	1	1	1	1
Nameplate Capacity	129	129	65	65	65	65	65	65	65	65
Capacity Use (%)	19%	29%	62%	46%	31%	0%	0%	0%	0%	0%
Co-product Production (1,000 MT)										
DDGs	1,661	1,640	1,427	1,719	1,536	2,290	1,848	1,378	1,499	1,893
Feedstock Use for Fuel Ethanol (1,000 MT)										
Corn Kernels	5,308	5,241	4,558	5,105	4,542	6,763	5,426	4,229	4,694	5,468
Rice	0	0	0	0	364	2,170	2,357	3,052	3,199	2,280
Cassava (dried chips)	2,215	2,188	1,902	2,283	2,188	1,303	1,132	1,018	1,469	1,141
Wheat	0	0	0	387	371	552	480	173	96	580
Celluloic Biomass	na	na	na	na	na	na	na	na	na	na
Waste Flue Gases/Other	na	na	na	na	na	na	na	na	na	na
Market Penetration (Million Liters)										
Fuel Ethanol Use	2,975	3,391	3,404	3,046	3,638	4,335	3,843	3,967	3,801	3,898
Gasoline/Ethanol Pool 1/	135,837	157,490	164,502	170,477	189,899	197,745	184,773	204,395	196,240	213,576
Blend Rate (%)	2.2%	2.2%	2.1%	1.8%	1.9%	2.2%	2.1%	1.9%	1.9%	1.8%

Note 1: Gasoline/ethanol pool overs gasoline and all biocomponents (ethanol, some methanol) and MTBE. China does not produce ethanol derived ETBE in commercial volumes. Fuel blends incorporating ETBE require additional processing and have not been adopted in China. Fossil fuel derived MTBE is the alternative oxygenate used across much of China along with methanol in certain areas. Both are included in the gasoline/ethanol fuel pool series.

Note 2: f = forecast
Feedstock-to-ethanol yield rates (liters/MT) used:
Corn kernels: 1 MT = 402 (before 2014) to 417 liters (after 2014)
Rice: 1 MT = 400 liters
Wheat kernels: 1 MT = 393 liters
Sorghum (Sweet) 1 MT = 430 (used in 2014 Baseline)
Cassava (fresh root): 1 MT = 143 to 150 liters (25 to 35% starch content)
Cassava (dried chips): 1 MT = 333 to 400 liters (15 to 65% starch content)
Sources: Post estimates and industry sources

Fuel Ethanol Production

China's 2023 fuel ethanol production is forecast to increase to 3.9 billion liters, up a mere 96 million liters from the previous year. Fuel ethanol prices are fixed at 91.1 percent of the retail gasoline price, which is set by the NDRC according to a basket of global benchmark crude prices. The Brent crude oil prices rebounded to an average of $71/barrel in 2021, then soared to peaks near $130/barrel in 2022 and slumped to $81/barrel on average in the first half of 2023. Chinese fuel ethanol prices have been fluctuating with gasoline with no change in the pricing mechanism, while corn prices stayed at high levels similar to 2022 in the first half of 2023. Profitability increased to U.S. $28 (RMB 200) per ton in the first half of 2023 from negative U.S. $11 (RMB 80) per ton during the same period in 2022. Fuel ethanol plants continued to use old stock paddy rice as feedstock to protect margins. The fuel ethanol plant operational rate is estimated to remain at 49 percent in 2023, 5 percent higher compared to 2021.

Industry sources report no new facilities began production in 2023, unchanged from the past two years. The total production capacity is forecast to remain at 7.7 billion liters, also unchanged since 2021. Industry sources report that China's fuel ethanol production was over 80 percent grain-based (i.e., corn, wheat, and rice) in 2023 and 10 percent cassava or sugarcane-based. Corn ethanol is mostly in Northeast, cassava ethanol is mostly in East and molasses ethanol is mostly in South. From 2018 to 2021, essentially all fuel ethanol expansion was attributed to higher production from China's 8 major grain-based ethanol production facilities. Ethanol was transported to consumption areas via truck (87 percent), barge (8 percent) and rail (5 percent).

Table 3. China: Production Capacity of China's Fuel Ethanol Licensed producers (2022 estimates)

	Producers	Production Capacity	Feedstock
1	SDIC Jilin Alcohol	887 million liters	Corn
2	Henan Tianguan	887 million liters	Wheat, Corn, Cassava
3	COFCO Biochemical (Anhui)	798 million liters	Corn, Cassava
4	COFCO Bioenergy (Zhaodong)	507 million liters	Corn, Cellulosic
5	SDIC (Zhanjiang)	190 million liters	Cassava
6	Shandong Longlive	65 million liters	Cellulosic
7	COFCO Bioenergy (Guangxi)	253 million liters	Cassava
8	Zonergy (Inner Mongolia)	38 million liters	Sweet Sorghum

9	SDIC (Tieling)	380 million liters	Corn
10	Liaoyuan Jufeng Biochemical	380 million liters	Corn
11	Jilin Boda Biochemistry	507 million liters	Corn
12	Jiangsu Lianhai Biotechnology	152 million liters	Corn
13	Shandong Fu'en Biochemical	152 million liters	Cassava
14	Jiangxi Yufan	127 million liters	Cassava
15	Shougang Lanza Tech	58 million liters	Coal, Waste Residues, Industrial Flue Gases
16	SDIC (Hailun)	380 million liters	Corn
17	Wanli Runda (Baoqing)	380 million liters	Corn
18	Hongzhan (Nehe)	380 million liters	Corn
19	Hongzhan (Huanan)	380 million liters	Corn
20	Ningxia Shougang Lanza Jiyuan	57 million liters	Coal, Waste Residues, Industrial Flue Gases
21	Hongzhan (Bayan)	380 million liters	Corn
22	SDIC (Jidong)	380 million liters	Corn
	TOTAL	**7,720 million liters**	
Source: Post Industry Sources			

Industry sources report that sugar- and molasses-based ethanol producers continue to struggle with low margins due to limited supplies of sugarcane and high molasses prices. China mainly imports cassava from Thailand for feedstock use. Thailand's cassava supply and prices are projected to remain stable in 2023.

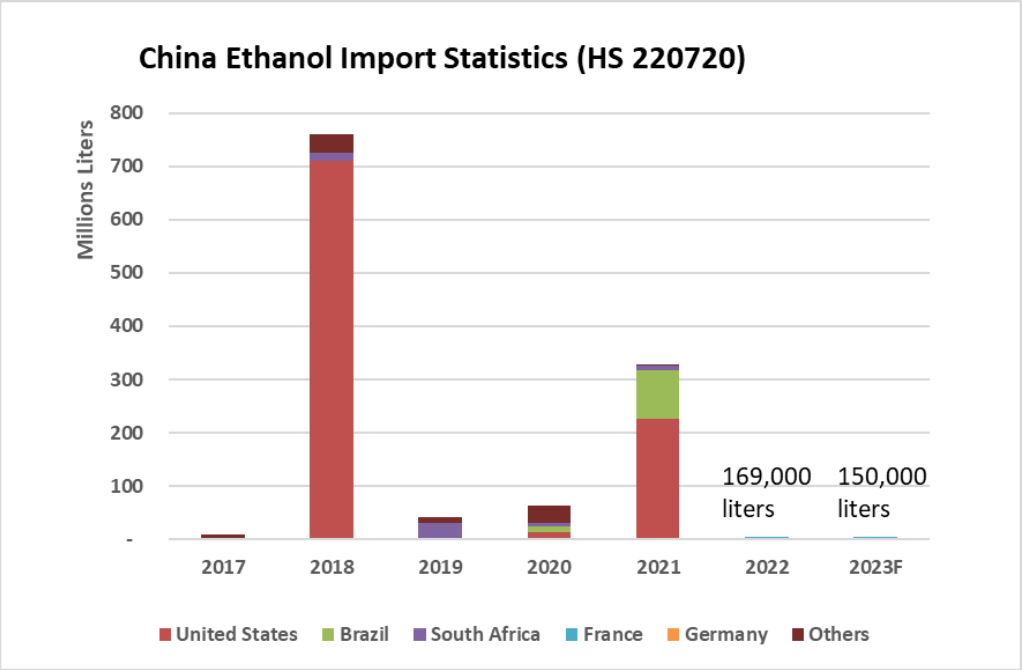
Synthetic ethanol production will be up slightly in 2023. In early 2023, the first syngas-based fuel ethanol plant project in Guizhou reportedly started producing. Once fully operational, the plant is expected to produce 76 million liters (60,000 tons) of fuel ethanol per year. In September 2022, the "world's largest" coal-based 633 million liters (500,000 tons) ethanol project reportedly started producing in Shaanxi's Yulin City. Once operational, the plant is expected to produce 76 million liters (60,000 tons) of fuel ethanol per year but has not yet come to fruition. While the PRC press and industry contacts still report that China's Syngas ethanol production capacity is expected to reach 2.5 billion liters by the end of 2022, Post does not expect this to be achievable within this timeframe.

Trade

Exports are expected to remain well under half a million liters, similar to last year. Nearly all imports originating from the United States since 2016 were used as fuel ethanol. China first allowed some test shipments of U.S. fuel-quality ethanol in 2015 which turned into commercial trade in 2016 at the tariff rate of 5 percent. Starting January 1, 2017, China increased tariffs on all fuel (denatured) ethanol to the WTO MFN bound rate of 30 percent and trade was shut off from January to October 2017. Trade resumed in November 2017 as U.S. ethanol prices reached a 12-year low and continued thru March 2018. Retaliatory tariffs on U.S. fuel ethanol were imposed in April 2018 which raised the duty to 45 percent and choked off all trade. Three months later, duties on U.S. products were raised further to 70 percent. In the second half of 2018, media reports chronicled how Malaysia and Indonesia shipped large volumes of ethanol to

China, taking advantage of duty-free market access for ASEAN members. After two years, Chinese fuel ethanol imports from the United States picked up in late 2020 when U.S. ethanol prices fell. The purchases were all price-based on sporadic openings in the arbitrage window. Post analysis and industry sources suggest the PRC's political will and endorsement is necessary to see significant purchases of U.S. ethanol, regardless of tariff level. The PRC reportedly waived import tariffs for an unknown volume of U.S. ethanol in 2021. Industry members believe the tariff waiver was a limited action and not a significant development or endorsement for greater imports of U.S. ethanol. Imports expected for the remainder of 2023 are minimal.

Chart 1. China: Ethanol Import Statistics



Sources: Trade Data Monitor, General Administration of China Customs, and Post estimates
Note: News reports indicate that shipments from Indonesia and Malaysia in 2018 were US-origin product.

IV. Biodiesel / Renewable Diesel (HDRD)

Overview

The PRC has been setting targets for carbon peak emissions and encouraging expanded biodiesel (Fatty acid methyl esters or FAME) and renewable diesel (the only type commercialized is Hydrogenation-Derived Renewable Diesel or HDRD) use and production, but in fact there is no nationwide change despite these pronouncements. China's biodiesel/HDRD limited consumption has for years remained within a narrow range, depending on the price of fossil diesel, due to a lack of support at the national level. It therefore remains limited to discretionary demand rising when oil prices rise and falling when oil prices fall. This will not change unless blending mandates are created and enforced and effective tax policy exist to reward lower GHG emission fuels or other supports such funding for supply chain buildout arise. Additionally, a nationwide

UCO feedstock-to-biodiesel/HDRD supply chain is lacking to move large volumes of the only feedstock in plentiful supply.

There has never been the will to mandate or provide support other than attempts to ban the reuse of cooking oil in food preparation which has never been enforced on a wide scale. Based on the size of the diesel pool in 2022, a modest B5 nationwide mandate for on-road use alone would have required 6.8 billion liters of B100 (see Table 4 below). Beyond on-road use, the potential for biodiesel (and renewable diesel) is greater still, as China's off-road diesel applications include inland fisheries, construction, mining, agriculture and even limited stationary power.

The story for renewable diesel is different. Production began and started growing in 2017. The renewable diesel industry is almost entirely export-oriented thanks to policy incentives and product demand in Europe. The same lack of policy and program support to build domestic demand for biodiesel applies to HDRD, a biobased renewable fuel which (unlike biodiesel) is fully fungible with fossil diesel without modification with far fewer tailpipe emissions than fossil diesel and even biodiesel.

Table 4. China: Biodiesel Production, Supply, and Distribution

Biodiesel (FAME) & Renewable Diesel (HDRD), Million Liters										
Calendar Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023f**
Beginning Stocks		-	-	-	-	-	-	-	-	-
Production	1,133	787	909	1,043	834	939	1,455	1,835	2,430	3,300
>HDRD Production	0	0	0	42	146	332	300	620	940	1,400
Imports	1,028	33	8	18	853	953	102	204	358	500
Exports	43	27	76	194	357	752	1,035	1,475	2,054	2,950
>HDRD Exports	0	0	0	42	146	332	300	600	900	1,320
Consumption	2,118	793	841	867	1,330	1,140	522	564	734	850
>HDRD Consumption	0	0	0	0	0	0	0	20	40	80
Ending Stocks	0	0	0	0	0	0	0	0	0	0
Production Capacity, Biodiesel (Million Liters)										
Number of Biorefineries	53	53	48	46	44	40	42	44	46	48
Nameplate Capacity	4,000	4,000	2,680	2,680	2,680	2,680	2,726	3,300	3,500	3,700
Capacity Use (%)	28%	20%	34%	39%	31%	35%	42%	37%	43%	51%
Production Capacity, Renewable Diesel (HDRD) (Million Liters)										
Number of Biorefineries	0	0	0	na	na	na	2	9	11	12
Nameplate Capacity	0	0	0	na	na	na	500	1,000	2,000	3,000
Capacity Use (%)	-	-	-	na	na	na	60%	62%	47%	47%
Feedstock Use for Biodiesel (1,000 MT)										
Used Cooking Oil (UCO)	1,080	750	870	955	655	580	1,100	1,160	1,420	1,815
Feedstock Use for Renewable Diesel (HDRD) (1,000 MT)										

Used Cooking Oil (UCO)	0	0	0	37	136	310	280	580	880	1,310
Market Penetration, Biodiesel (Million Liters)										
Biodiesel+ HDRD, on-road	340	236	273	313	410	430	250	260	284	315
Diesel Pool , on-road use 1/	133,365	134,375	130,564	130,538	139,622	122,447	118,238	132,433	136,579	141,277
Blend rate, on-road (%)	0.3%	0.2%	0.2%	0.2%	0.3%	0.4%	0.2%	0.2%	0.2%	0.2%
Diesel Pool, Total 1/ 2/	205,179	206,816	200,418	199,951	206,041	186,509	177,679	188,671	194,184	209,488
Jet Fuel/Other Kerosene 3/	29,488	33,625	37,508	42,002	48,962	52,710	44,321	45,794	32,645	52,346

Note: 1/Diesel pool covers diesel and all biocomponents
2/ Covers all on/off-road uses plus rail & heavy marine diesels and stationary power. Source: IEA.
3/ Covers all private-commercial-military kerosene-type jet fuels (fossil and bio-based, both Jet A-1 and naphtha-kerosene blend Jet B) + other fuel applications (eg, cooking). Source: IEA.
f = forecast; All PSD data are B100 or B100-equivalent (see statistical info section of Reporting Instructions).
Used cooking oil (UCO): 1 MT = 1,043 liters of UCOME (UCO methyl ester, i.e. UCO-based biodiesel)
Source: Post and Industry sources

Consumption

Biodiesel

China's 2023 biodiesel consumption is estimated at 770 million liters, 11 percent higher than 2022, approaching its peak level from 2018 and 2019. Biodiesel consumption is closely positively correlated to imports of palm-oil based biodiesel from Indonesia and Malaysia. China's discretionary demand for biodiesel triggers when the palm oil to fossil diesel (PO-GO) price spread falls below minus $70-80/metric ton. From July 2022 to April 2023, China's biodiesel imports soared by 56 percent. During the same period, domestic biodiesel prices declined from $1,790 (RMB 12,500) to $1,064 (RMB 7,450). In contrast to most other countries, biodiesel in China is mainly used for environmentally friendly plasticizer, electric power generation, fishing vessels, and farm equipment. Post contacts report that on-road transport accounts for over one-third of total biodiesel demand. UCO is the main feedstock for China's biodiesel production. In 2010, NDRC launched a UCO reutilization and disposal pilot program and over 100 pilot cities were identified. However, delivery supply chains to collect, process, and deliver UCO are lacking.

Shanghai remains the only local authority with a biodiesel program. In 2021, Shanghai revised the *Administrative Measures on Promoting and Using Gutter Oil to Produce Biodiesel* which took effect March 1 and lasts for two years. In early 2023, Shanghai issued Implementing Plan to Coordinatively Reduce Pollution and Lower Carbon, calling for feasibility study to use UCO-produced B10 biodiesel and encourage use of B10 biodiesel in inland river ships.

Shanghai is still the only municipality or province supporting a biodiesel market. The Shanghai government subsidizes biodiesel blenders based on the amount of biodiesel sold to gasoline stations. The government also subsidizes producers when diesel prices drop below $902 (RMB 6,000) per ton. The city published the industry Standard of *B10 Diesel produced by UCO* in

2021. In January 2021, Hainan provincial officials proposed resuming the B5 mandate the province adopted 10 years ago but officials have yet to take action.

In October 2017, Sinopec Shanghai began offering B5 diesel at a $0.05 per liter (RMB 0.3) discount to regular diesel as part of a pilot program. The Shanghai program aims to buck a historical precedent where previous efforts to adopt local and provincial biodiesel blending mandates failed. Shanghai produces about 40,000 tons of UCO each year. There are 18 designated companies collecting UCO daily. Shanghai currently has three blending centers with annual distribution capacity of B5 diesel of over 600,000 tons (equivalent to 30,000 tons or 34 million liters of B100 biodiesel) to over 300 gas stations, which accounts for half of Sinopec Shanghai's total gas stations in the city.

Renewable Diesel (HDRD)

China's 2023 HDRD consumption is estimated at 80 million liters, double the volume consumed in 2022 which itself was double the volume in 2012 when post understands consumption began. Lacking domestic incentives, the industry remains nearly entirely export focused.

Production

Biodiesel and Renewable Diesel (HDRD)

China's 2023 biodiesel production is forecast at 1.9 billion liters, up 28 percent from 2022 due to higher exports and domestic consumption. In the first half of 2023, China produced and exported higher volumes at very competitive prices. However, this booming trend may slow in the second half of 2023 after arbitrage from Europe has closed in mid-2023. Importers are also likely to be more reluctant to take Chinese product following the ISCC (International Sustainability and Carbon Certification)'s withdrawal or temporary suspension of seven certificates from Chinese companies over concerns about potentially fraudulent behavior regarding unusual trade volumes" (See ISCC Press Release 27 July 2023). The same issue likely affects HDRD shipments to Europe which directly supports most HDRD production. HDRD production continues to reach new records every year with the expansion of exports. HDRD production is estimated at 1.4 billion liters in 2023, nearly 50 percent higher than the previous year.

Beginning in 2020, China's biodiesel production capacity grew to 3.7 billion liters. These facilities are located mainly in Hebei, Guangdong, Fujian, and Zhejiang. HDRD plants have a combined annual capacity of 3 billion liters with an additional 1.2 billion liters capacity planned. Nearly all plants are export-oriented to take advantage of EU tax policies. HDRD production capacity is estimated to have grown 1 billion liters every year starting in 2021, and the same is expected in 2023 with an estimated 3 billion liters this year.

China's BBD (biodiesel plus HDRD) production capacity expanded rapidly over the past year due to strong export demand. Contacts report that since 2021, biodiesel production profits averaged $122 (RMB 880) per ton, up 75 percent. Zhuoyue New Energy is the leading FAME biodiesel producer, with a new 114 million liters per year production line that started production in October 2022. The company plans to expand capacity to 925 million liters (including more than 130 million liters of HDRD capacity) from the current 570 million liters in 3 to 5 years.

Zhejiang Jia'ao also plans to expand capacity to 1,534 million liters from current capacity of 570 million liters. Another emerging giant, Shangao Huanneng, also plans to build 1,480 million liters of biodiesel production capacity (including 1,026 million liters of HDRD and 454 million liters of FAME) on top of their existing UCO business. Availability of UCO may at some point limit biodiesel production as China's UCO export rebate policies incentivize UCO exports. Industry contacts estimate that China generates over 11.4 billion liters of UCO annually. If correct, this means an estimated 27 percent will be used this year to produce BBD and assuming only UCO is being used which seems unlikely. The potential for UCO collection and for further expansion of biodiesel production capacity is enormous.

Table 5. China: Major Biodiesel and HDRD Producers

	Producer	**Production Capacity**	**Status**
Biodiesel/FAME (Fatty Acid Methyl Esters)	Zhuoyue New Energy	570 million liters	
	Hebei Jingu Group	284 million liters	
	Bimei New Energy	341 million liters	
	Tangshan Jinhai Biodiesel	180 million liters	
	Hebei Longhai Biofuel	68 million liters	
	Shandong Fenghui	68 million liters	
	Zhejiang Jia'ao Environment Protection (Dongjiang)	570 million liters	
	Jingzhou Dadi Biotechnology	57 million liters	
	Shanghai Zhongqi Environment Protection	125 million liters	
	Shangao Environmental	454 million liters	Announced
HDRD (Hydrogenation-derived Renewable Diesel)	Jiangsu's Yangzhou Jianyuan Biotechnology	130 million liters	
	Shijiangzhuang Changyou Bioenergy	256 million liters	Operation suspended
	Jiangsu's Zhangjiagang Eco Biochemical Technology	385 million liters	
	Henan Junheng	385 million liters	
	Haixin Energy Technology (Sanju)	513 million liters	
	Hainan Huanyu	130 million liters	
	Fujian Longyan Zhuoyue	130 million liters	Operation may start in June 2023
	Shandong Tianyuan New Energy	214 million liters	Operation started in November 2022
	Jiangxi Zunchuangxin New Energy	224 million liters	Operation started at end of 2022
	Zhongdiyou New Energy	513 million liters	Operation suspended
	Henan's Hebi Huashi	130 million liters	Operation suspended

	Zhuoyue New Energy	130 million liters	Under construction
	Shangao Huanneng	1,026 million liters	Announced

Source: Post Industry Contacts. 1 MT Biodiesel= 1,136 liters of Biodiesel; 1 MT HDRD = 1,282 liters of Biodiesel

Trade

Biodiesel and Renewable Diesel (HDRD)

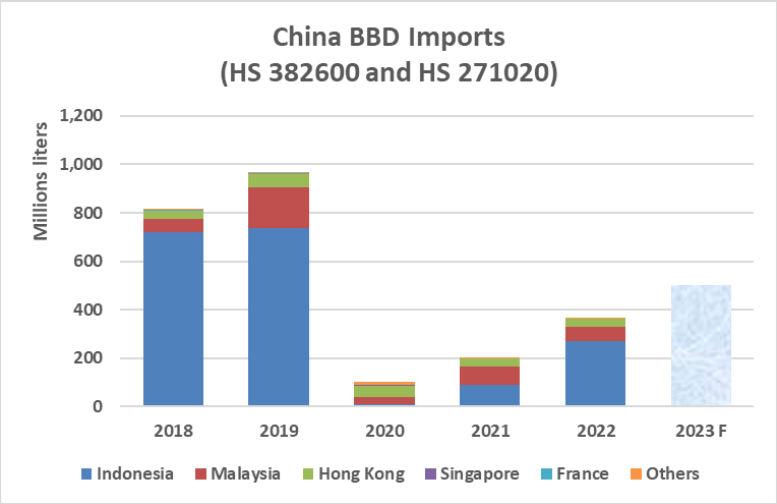
BBD imports in 2023 are estimated at 500 million liters, 40 percent higher than 2022. From January to May 2023, China's BBD imports rose 208 percent year-on-year. More than 90 percent of imports are palm oil-based biodiesel from Indonesia and Malaysia. The PO-GO price spread shows the import window for China was mostly closed for all of 2020 and 2021 but opened in the second half of 2022. From July 2022 to April 2023, China's BBD imports soared by 56 percent. From January 2022 to April 2023, China's biodiesel and HDRD imports soared by 274 percent. However, the PO-GO spread increased from close to negative $300/MT in mid-2022 to over $100/MT in May 2023. If (as assumed) diesel prices continue dropping in 2023, imports will not remain as robust in the second half of 2023.

China replaced Argentina as the primary export supplier of biodiesel to the EU in the fourth quarter of 2022. Biodiesel and HDRD exports are projected to continue surging in 2023, due to the EU and its double-counting provisions for UCO-based biofuels (both biodiesel and HDRD) of the EU's Renewable Energy Directive (REDII) and support by China's 70 percent VAT rebate. Hainan and Fujian provinces top the export list. Average biodiesel prices for exports continued to be strong at $1,500 (RMB 10,500) per ton in early 2023, up over 30 percent from 2021, with even higher prices for HDRD. Current biodiesel prices are no longer affordable on the domestic market, but exports remain competitive to Europe. From January to May 2023, China's BBD exports rose 70 percent year-on-year. The vast majority was shipped to the Netherlands and Belgium. But the record high exports may be disrupted as European importers are reportedly more reluctant to import product from the PRC following the May 5 ISCC regulatory action.

In response to a request by a competent authority of a Member State, the European Commission reportedly launched an investigation into biodiesel exports from China to Europe. A Euractiv article reported that the European Biodiesel Board also "submitted a formal request for investigation to DG TRADE in July, arguing that alleged fraudulent imports [purportedly routed through China and the UK to circumvent countervailing duties on Indonesian biodiesel] were harming the integrity of the EU biodiesel market."

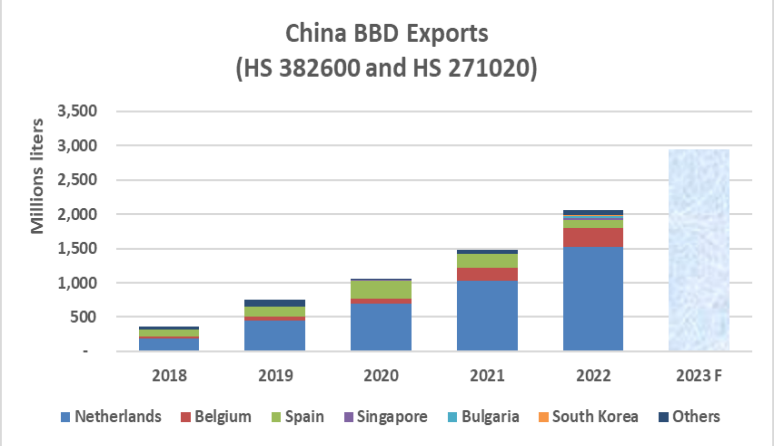
Note: These estimates are based on trade reported under the Chapter 38 Chapter code, though it is unclear if some or all of China's HDRD exports to Europe fall under the designated Chapter 38 code for biodiesel or if they fall under Chapter 27 (2710.19). Some of this product, when misclassified, could be HDRD since sales of HDRD to Europe have been documented by market analysts. HDRD cannot be accurately tracked at this time due to tariff code uncertainties which will be investigated further.

Chart 2. China: BBD Imports



Sources: Trade Data Monitoring and General Administration of China Customs

Chart 3. China: BBD Exports



Sources: Trade Data Monitoring and General Administration of China Customs

Note: All product trade under HS 3826.00 is assumed to be pure B100 biodiesel; All product under HS 271020 as petroleum oil, containing biodiesel up to 30 percent, is assumed to contain on average 10 percent biodiesel by volume, converted and reported as B100 equivalent.
Due to uncertainty in trade codes used for HDRD, it is possible some of the product traded under the biodiesel code in chapter 38 could be HDRD that should be reported under Chapter 27 (according to NesteOil) or Chapter 15. The accurate tracking of HDRD will be investigated in future publications.

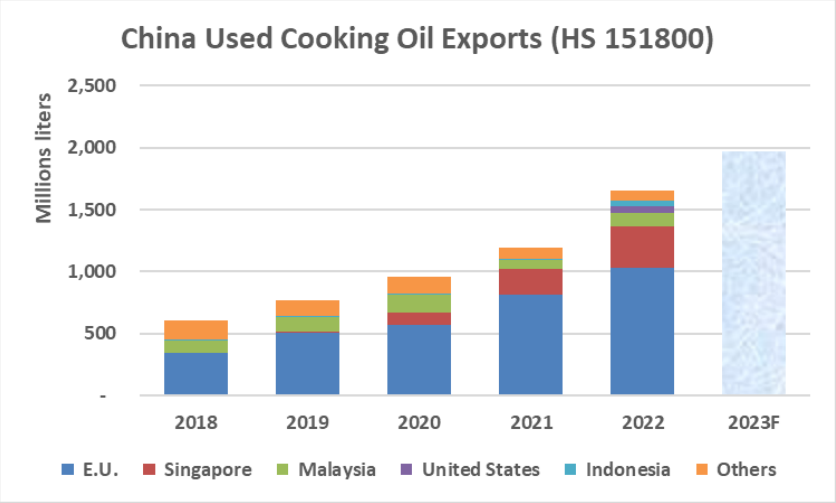
Used Cooking Oil (UCO) Exports

China is the largest known exporter of UCO and sales in recent years have grown exponentially. Shipments destined for Europe account for the highest percentage of sales by far and most of the growth. Shipments to the Neste Singapore HDRD plant, which recently finished a major expansion and now includes SAF production capacity, account for most of the remaining growth. UCO shipments to the U.S. market, negligible in past years, are sharply higher this year with considerable growth potential given U.S. industry expansion plans for HDRD and SAF.

China's BBD producers are disappointed at the amount of domestic UCO being exported rather than available for use as feedstock. UCO is used as the feedstock for biodiesel in China, but UCO enjoys a 100 percent refund of its 13 percent export tax, and the PRC no longer has a tax refund for biodiesel exports. Leading BBD producers reported they will "join hands" to complain to supervising government authorities that the tax policy on biodiesel exports is unreasonable. In addition to strong BBD exports, Post expects China will also export close to 2 billion liters (1.9 MMT) of UCO in 2023.

China's UCO exports to all destinations for the first five months of 2023 were up 15 percent year-on-year. The United States replaced Singapore as the top destination in this period, followed by Singapore and the EU (mainly to Spain, the Netherlands and Germany). Chinese UCO is considered a stable resource, and its exports are projected to be steady, assuming the question of feedstock fraud can be settled.

Chart 4. China: Used Cooking Oil (UCO) Exports (HS 151800)



Sources: Trade Data Monitoring and General Administration of China Customs
Note: Used cooking oil (UCO): 1 MT = 1,043 liters of UCOME (UCO methyl ester)

V. Advanced Biofuels

Sustainable Aviation Fuel (SAF)

China's SAF industry development was initiated by China Petroleum & Chemical Corporation (Sinopec) but the company has yet to build a commercial-scale plant. The three smaller initiatives, listed below, are considered pre-commercial scale. Based on the table below, it appears the earliest that true commercial scale SAF production could begin might be in 2025-26.

Sinopec started SAF technology research in 2009. The first test flight using SAF was successfully completed in Shanghai in 2013. The first passenger flight was Hainan Airline's HU7604 using SAF in a Boeing 737-800, which successfully completed a 2.5-hour flight from Shanghai to Beijing in 2015. The first international passenger flight, Hainan Airline's HU497 using SAF on a Boeing 787, successfully landed in Chicago in 2017. Sinopec Zhenhai Refinery established China's first SAF production facilities in 2020. The company's HEFA

(Hydroprocessed Esters and Fatty Acids) products passed Roundtable on Sustainable Biomaterials (RSB)'s certification in 2022. On June 28, 2022, Sinopec Zhenhai Refinery produced the first test batch of SAF products.

Table 7. China: SAF Production Capacity (2023 estimates)		
Producers	**Production Capacity**	**Status**
Jiangsu's Zhangjiagang Eco Biochemical Technology	63 million liters	Under construction
Sinopec Zhenhai Refinery	100 million liters	Operational
Guangdong's Donghua Energy	1,250 million liters	Trial I planned to operate in 2023
Henan Haixin Nengke	19 million liters	Planned to operate in 2023
Zhejiang Jia'ao Environment Protection	1,250 million liters	Trial I planned to operate in 2024
Sichuan's Jinshang	375 million liters	Project announced in May 2023
Guangxi Hongkun	N/A	Announced

Source: Post Industry Contacts
1 MT SAF, HEFA-type = 1,250 liters of Biodiesel

Synthetic Fuel Ethanol
China's efforts to reduce air particulate matter and other fossil fuel toxins include projects to convert coal and industrial waste gas into synthetic ethanol. At the same time, China's adoption of more stringent environmental standards at industrial plants further constrains expansion of existing coal-to-syngas-to-ethanol processing facilities.

In 2019, several non-fuel, industrial chemical ethanol producers in Jiangsu province that use coal and synthetic gasification technology ceased operations in the wake of weakening demand for industrial chemicals and the implementation new environmental and safety requirements. Currently, one 58-million-liter-per year fuel ethanol facility in Hebei is operational and another 57-million-liter-per-year production line, the Ningxia Shougang Lanza Jiyuan, started production in May 2021. In September 2020, the first syngas-based fuel ethanol plant project in Guizhou held a signing ceremony. Once operational, the plant will produce 76 million liters (60,000 tons) of fuel ethanol per year. The project reportedly has started producing in early 2023. In September 2022, the "world's largest" coal-based 633 million liters (500,000 tons) ethanol project reportedly has started producing in Shaanxi's Yulin city. While the PRC press and industry contacts still report that China's Syngas ethanol production capacity was expected to reach 2.5 billion liters by the end of 2022, this was clearly not attained and future progress remains uncertain.

VI. Notes on Statistical Data

Ethanol

Production capacity, production and consumption figures are based on statistics of industry and FAS posts. Ethanol import figure are based on Trade Data Monitor, LLC (TDM) data, which are sourced from General Administration of Customs of the People's Republic of China (GACC). Feed stock and co-product figures represent FAS posts estimates and are based on the conversion and yield rates listed in the Appendix.

Biomass-based Diesel

Production capacity, production and consumption figures are based on statistics of industry and FAS posts. Ethanol import figure are based on TDM data, which are sourced from General Administration of China Customs. Feed stock and co-product figures represent FAS posts estimates and are based on the conversion and yield rates listed in the Appendix.

Trade estimates are based on trade reported under the Chapter 38 Chapter code, though it is unclear if some or all of China's HDRD exports to Europe fall under the designated Chapter 38 code for biodiesel or if they fall under Chapter 27 (2710.19). Some of this product, when misclassified, could be HDRD since sales of HDRD to Europe have been documented by market analysts. HDRD cannot be accurately tracked at this time due to code uncertainties which will be investigated further.

All product trade under HS 3826.00 is assumed to be pure B100 biodiesel; All product under HS 271020 as petroleum oil, containing biodiesel up to 30 percent, is assumed to contain on average 10 percent biodiesel by volume, converted and reported as B100 equivalent. Due to uncertainty in trade codes used for HDRD, it is possible some of the product traded under the biodiesel code in chapter 38 could be HDRD that should be reported under Chapter 27 (according to NesteOil) or Chapter 15. The accurate tracking of HDRD will be investigated in future publications.

Appendix A: Energy Content and Conversion Rates
1 MT Gasoline = 1,256 Liters
1 MT Ethanol = 1,267 Liters
1 MT Biodiesel = 1,136 Liters
1 MT of HDRD = 1,282 Liters
1 MT of SAF, HEFA-type = 1,250 Liters

Yields Ethanol

Corn kernels: 1 MT = 402 (before 2014) to 417 liters (after 2014)
Wheat kernels: 1 MT = 393 liters
Molasses: 1 MT = 246 liters
Cassava (dried chips): 1 MT = 333 to 400 liters (15 to 65% starch content)
Rice: 1 MT = 400 liters
Sorghum (Sweet) 1 MT = 430 (used in 2014 Baseline)

Yields Biomass-based Diesel
Used cooking oil (UCO): 1 MT = 1,043 liters of UCOME (UCO methyl ester)

Ethanol Feedstock-to-Co-product Yield Rates
Corn kernels: 1 MT = 313 kg of DDGs + up to 29 kg of corn oil
Other grain kernels: 1 MT = 313 kg of DDGs (negligible vegetable oil)

Appendix B: China's Biofuels Program: Development of Production/Use Targets & Feedstock Priorities

Over two decades old, China's biofuels program remains in essence a surplus corn disposal program. Changes over many years to support the introduction of biofuels have focused almost entirely on ethanol, neglected use of renewables in the diesel pool (except for one city program), and SAF has only recently received attention. Despite years of stated intent, the program has failed to commercialize cellulosic and or any other advanced ethanol industry based on a technology platform other than the fermentation of starch or sugars with the minor exception of coal-to-ethanol.

There has never been a sustained effort or realistic plan to build the average national blend rate for ethanol in gasoline above roughly two percent (E2) despite continually setting higher goals. This is because to do so with existing production technologies and feedstock would have required significant imports for feedstock or fuel-grade ethanol. No effective carbon tax scheme or environmental sustainability criteria for biofuels were ever established to help drive the carbon intensity of all existing biofuels lower. All this means that biofuels' potential to drive climate change mitigation and reduce the health costs of a fossil fuel driven economy remains mostly undeveloped in China. It is understandable that China has failed to commercialize large-scale production of cellulosic biofuels including ethanol even though there is considerable domestic supply of waste agricultural and forest products. Despite large investments and significantly more program support in the United States, Europe and Brazil, cellulosic fuels have mostly failed to achieve widespread commercialization. China looks toward other means to achieve these nationwide GHG emission reduction goals focused on renewable electricity and increasingly hydrogen.

10th Five-Year Plan for Economic and Social Development (FYP) (2001-2005) – Corn Surplus Period

China implemented a fuel ethanol program, one of the world's earliest, starting in the early 2000's to create additional demand for then abundant grain supplies. In MY1998/99, USDA ending stocks estimates for China reached record highs at 123.8 million tons. During these early years, the vast majority of domestic ethanol production relied on existing corn surpluses and was in essence a con disposal program. Beginning in 2005, as global grain prices soared, China began its initial promotion of nongrain, conventional fuel ethanol production known as Generation 1.5 ethanol.

11th Five-Year Plan (2006-2010) – Corn Surplus Moderated

China's 11th Five-Year Plan (2006-2011) was the first targeting the production of biofuel from non-grain materials, including sweet sorghum, potatoes, and cassava root for ethanol, and jatropha trees for biodiesel.

Beginning in 2006, 11 provinces (Heilongjiang, Henan, Jilin, Liaoning, Anhui, Guangxi, Hebei, Shandong, Jiangsu, Inner Mongolia and Hubei) were selected as pilot zones for fuel ethanol production and 'mandatory' E10 blend use. Many fuel retailers argued in courts and protested against state-owned petroleum giants that China's implementation of biofuels blending targets restrict their ability to respond to market prices, undercutting their profitability and the long-term

sustainability of their businesses. As a result of these concerns, some provinces with blending requirements do not fully enforce province wide E10 blending. Many provinces remain with no blend mandate and use MTBE instead (then and today) since they have no major corn growing areas and thus little economic interest in an ethanol program.

In August 2007, NDRC published a "Mid- to Long-term Renewable Energy Development Plan" that targets annual fuel ethanol use to exceed 12.670 billion liters by 2020, effectively expanding production by five-fold from 2017 to 2020.

During a period of high corn prices in 2008, China restricted construction of new ethanol facilities. Starting in 2010, phase out of PRC government subsidies for conventional ethanol plants began, falling from $0.03 per Liter (RMB 2,000 per ton) in 2009 to zero in 2016. Ethanol production subsidies using non-food grain feedstocks to produce conventional ethanol were also phased out by 2018. Afterwards, China limited the growth of corn use for fuel ethanol when rising domestic grain prices triggered food price concerns. During this same period, China became a net corn importer.

12th Five-Year Plan (2011-2015) – Corn Surplus Period
In 2010, the government set ambitious targets for ethanol and biodiesel in its 12th FYP, including a goal of producing 5.068 billion liters of fuel ethanol and 1.136 billion liters of biodiesel by 2015.

Despite significant investments in research and development, government efforts to expand production of non-grain conventional fuel ethanol never materialized into commercial-scale projects.

The 12th FYP goal for biodiesel was met early in 2014. However, both biofuel production targets fell short in 2015. In 2015, fuel ethanol production reached just 2.9 billion liters, or less than two-thirds of the original 5.1-billion-liter 12th FYP goal.

13th Five-Year Plan (2016-2020) – Corn Stocks Drawdown
On October 24, 2016, China's State Council announced its 13th FYP goal to produce 5.1 billion liters of ethanol and 2.3 billion liters of biodiesel by 2020. While the goal requires ethanol production to rise four-fold from 2016 levels, underlying economic fundamentals and the lack of national or provincial government support undermined large-scale efforts to expand production.

Government policies introduced in 2016 paved the way for a fuel ethanol industry revival through the elimination of the temporary reserve policy for corn; reinstatement of the VAT refund on ethanol products added further support. Industry sources reported at the time that China's provincial corn processing subsidies and a nationwide effort to expand E10 effectively supported margins for ethanol producers.

On September 13, 2017, NDRC, NEA, Ministry of Finance (MOF) and 12 other ministries jointly announced a plan to expand ethanol production and promotion for transportation fuel. This included a nationwide target of 10-percent ethanol blending into gasoline fuel by 2020, and a proposed shift to commercial-scale cellulosic ethanol by 2025. To date, the PRC has not

proposed an updated volumetric target for commercial-scale cellulosic ethanol production. On August 22, 2018, Chinese Premier Li Keqiang addressed China's State Council, and reiterated the central government's commitment to expand ethanol use nationwide.

In December 2019, media reported that China will suspend the expansion of its E10 mandate, essentially confining it to regions where it had already been introduced as corn stocks were too low and ethanol production capacity too small to implement E10 properly nationwide. The expressed use of imports as a vehicle to advance the E10 goal remained off the table.

Biodiesel remains unsupported for the most part in the domestic market and grows to become and more export oriented; no significant change in production capacity but capacity use rises. HDRD production emerges as a new fuel but almost entirely export market oriented with not programs in incentivized domestic use.

14th Five-Year Plan (2021-2025) – Corn Stocks Remain Lower

The outline of the 14th FYP (2021-2025), published in March 2021, sets an 18 percent reduction target for "CO2 intensity" and 13.5 percent reduction target for "energy intensity" from 2021 to 2025. Biofuels are not expected to realistically contribute to progress on these goals if existing policy does not radically change.

In May 2022, the NDRC issued the "14th Five-Year Plan for Bioeconomic Development" establishing a national biotechnology framework to boost the bio-economy during the next five years.

In June 2022, the NDRC led nine ministries to publish the "14th Five-Year-Plan for Renewable Energy." The Plan calls for the development of non-grain biofuel ethanol and encourages promotion of clean liquid fuels such as fuel ethanol and biodiesel (a rather empty statement and nothing new). The Plan also called to support research and development and promote the use of advanced technology and equipment in biodiesel and jet fuel. In addition, the Plan continues to promote the use of clean liquid fuels such as fuel ethanol and biodiesel. However, no detailed implementing measures or policies were announced following the release of the two Plans.

China's 2021-2023 national average fuel ethanol blend rates are estimated at around 1.9 percent, significantly lower than the 2.8 percent peak blend rate achieved in 2009. Demand has not recovered since the pandemic began in 2020 nor as expected since the "Zero Covid" policy ended. The first half of 2023 economic data also shows that recovery has been very sluggish. Many pilots and plans are reportedly either scaled down or currently stalled. For example, by 2019, seven provinces and cities had announced full implementation of mandatory E10 fuel ethanol blending. Another five provinces partially implemented E10 at varying levels. Another three provinces launched pilot programs in a few select cities. All of these programs have lost momentum.

Biodiesel and HDRD remain unsupported for the most part in the domestic market and remain export oriented. China's BBD production capacity expanded rapidly over the past three years due to strong export demand.

Appendix C: Commonly Used Acronyms

BBD	Biomass-based Diesel (biodiesel plus renewable diesel (aka HDRD))
CAS	Chinese Academy of Sciences
CEF	Carbon Emission Footprint
ETS	Carbon Emissions Trading System
CAAM	China Association of Automobile Manufacturers
COFCO	China National Cereals, Oils and Foodstuffs Corporation
CNOOC	China National Offshore Oil Company
CNPC	China National Petroleum Corp
PetroChina	China National Petroleum Corp, publicly listed arm
Chinaoil	China National United Oil Corp, CNPC Trading arm
Sinopec	China Petroleum and Chemical Corporation
Unipec	China Petroleum and Chemical Corporation, Trading arm
CPPCC	Chinese People's Political Consultative Conference
DDGs	Dried Distiller's Grains with Solubles
EV	Electric Vehicle
ETBE	Ethyl Tert-Butyl Ether
FYP	Five-Year Plan
GACC	General Administration of Customs of the People's Republic of China
GHG	Greenhouse Gas
HDRD	Hydrogenation-derived Renewable Diesel (world's only renewable diesel commercialized at scale)
MTBE	Methyl tert-butyl ether
MEE	Ministry of Ecology and Environment
MEP	Ministry of Environmental Protection
MOF	Ministry of Finance
MPS	Ministry of Public Security
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NPC	National People's Congress
NEV	New Energy Vehicles
PM	Particulate Matter
RMB	Renminbi
SCTC	State Council Tariff Committee
SAF	Sustainable Aviation Fuel
UCO	Used Cooking Oil

Attachments:

No Attachments