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Report Highlights:

The introduction of E5 gasoline in July 2023 restarted Indonesia's bioethanol consumption after years of inactivity, albeit to a modest start of an estimated 2 million liters for 2023 due to E5's price premium in a price sensitive market. Meanwhile, Indonesia's new B35 biodiesel blending mandate reached nationwide coverage in August 2023 and is expected to raise biodiesel consumption 25 percent to 13 billion liters. The government of Indonesia (GOI) continues to carry out tests for renewable diesel (HDRD) and sustainable aviation fuel (SAF).

Section I. Executive Summary

In July 2023, E5 gasoline was introduced to select gas stations in Indonesia as the culmination of the government's sugar self-sufficiency goals, increasing renewable energy shares, and low carbon emission targets. Without any subsidy, Pertamina's E5 rollout is expected to cover Java Island in a year, penetrating a niche market for high-octane gasolines but only expecting to reach about 2 million liters in sales for 2023 due to limited production capacity, distribution infrastructure as well as market price sensitivity. Given the extremely limited scope of the initial roll out and existing high duties of imports, it is clear that the program exclusively targets the use of domestically produced ethanol. As such, any climate and health benefits associated with adding ethanol to the gasoline pool will progress slower than otherwise possible.

Meanwhile, with the biodiesel mandate program, Indonesia set a nationwide 35 percent blending mandate in August 2023, without a change in allocated volume. As post-pandemic economic activity continues to grow modestly, Post estimates that biodiesel consumption will reach 13 billion liters for 2023, an annual increase of 25 percent, mostly on a higher blending rate and growth in diesel consumption.

The Government of Indonesia (GOI) officially stated it plans to raise the blending rate beyond 35 percent in the near future. Following the accomplishment of road tests for trucks and passenger cars in late December 2022, the GOI began carrying out a test specifically designed for heavy machinery in the mining sector in May 2023. The road test used two blending types of bio component: fuel with 40 percent Fatty Acid Methyl Ester (FAME) and fuel with 30 percent FAME with 10 percent hydrogenation derived renewable diesel (HDRD). Higher compositions of HDRD were used in heavy machinery testing.

In related developments, after finishing a flight test for military aircraft in 2022, state-owned company Pertamina conducted another test of Sustainable Aviation Fuel (SAF) in July 2023 for commercial aircraft jet engines.

The GOI continues to show firm support for the biodiesel blending mandate program by maintaining the effective financial support mechanism put in place since 2015. The mechanism allows funds collected from its palm oil exports levy, managed by the Crude Palm Oil (CPO) fund agency, to subsidize the price difference between biodiesel and fossil diesel. In 2022, funds collected from the export levy reached $2.3 billion, on par with funds expended for the biodiesel subsidy. The levy collected in 2022 was 33 percent lower than in 2021 on cheaper global palm oil prices and adjustments of the export levy structure.

As part of its commitment to reduce greenhouse gas (GHG) emissions, Indonesia started a carbon trading scheme in February 2023 for its power generation sub-sector. The GOI is expected to widen the carbon trading scheme to other sectors and subsectors, but without any clear timeline.

Other than boosting blending higher in recent years, a significant accomplishment in itself and important to recognize, Indonesia has thus far failed to set or enforce minimum GHG emission requirements for biodiesel or any other renewable fuel potentially used in land (or eventually air) transport, and widespread concern remains focused on the actual practice (including disposal of palm oil mill effluent) of oil mills supplying palm oil (and derivatives) to renewable fuel biorefineries that can negatively impact the carbon intensity of biofuels delivered to the market using life-cycle assessment and including land use change. As yet, there remain no mandatory

certification requirements for palm oil mills and biodiesel plants although that may change in the medium term, but there is no move to set minimum emission standards to qualify for mandate participation.

The situation pertaining to the introduction of renewable fuel in the gasoline market has remained concerning as well with program reversal due to financial support failure and unwillingness to import just over a decade ago followed by stagnation. Consequently, there remains no use of ethanol as a climate change mitigation tool for transport emissions. The gasoline pool has since grown rapidly from 24 billion liters in 2010 to 37 billion liters today. The effectiveness of the 2023 restart of the fuel ethanol program is noted, but its future success and capacity to progress remain uncertain given the supply, pricing, and financial support factors at play, and especially if imports remain at high duties. If the use of domestic arable land under cultivation increases (direct or indirect land use change) to grow more feedstock, there will be immediate and urgent concern over the carbon intensity of Indonesian ethanol.

Section II. Policy and Programs

Indonesia began adopting national-level biofuels policies in 2006 with the issuance of Government Regulation No. 1 concerning the procurement and usage of biofuels. In support of Regulation No. 1, Presidential Decree No. 10/2006 established a National Biofuels Development Team, responsible for supervising the implementation of biofuel programs and creating a blueprint for biofuels development. According to the blueprint, biofuels development aims to (1) alleviate poverty and unemployment, (2) drive economic activities through biofuel procurement and (3) reduce domestic fossil fuel consumption. This regulation was followed by Indonesia's House of Representatives (DPR) also passing the Energy Law (UU 30/2007) to strengthen regulations prioritizing the use of renewable energy. Additional background information can be found here.

The National Energy Policy (KEN) established through Government Regulation (GR) No. 79/2014 is now the most important policy basis for the biofuels program. KEN targets 23 percent renewable energy use economy-wide by 2025 and 31 percent by 2050. The contribution of biofuels towards meeting these goals, shown in Presidential Regulation (PR) No. 22/2017, roughly translates to 13.9 billion liters and 52.3 billion liters of biofuel use, respectively. Table 1 provides the plan for biofuel's contribution to the transportation sector's energy consumption.

Table 1. Plan of Biofuel Provision for Transportation, 2016-2050

		2016	2025	2050
Biodiesel	Blend rate (%)	20	30	30
	Volume (Bn liter)	2.5	6.9	17.1
Bioethanol	Blend rate (%)	5	20	20
	Volume (Bn liter)	0.1	2.6	11.4
SAF ("Bioavtur")	Blend rate (%)	2	5	10
	Volume (Bn liter)	0.0	0.1	2.7

Source: PR No. 22/2017

Indonesia's biodiesel mandate program is a nationwide directive to blend palm-based Fatty Acid Methyl Ester (FAME) with diesel to reduce fuel imports, generate domestic demand for palm oil, and reduce emissions. The mandatory distribution is carried out by state-owned energy company Pertamina as well as smaller, private companies.

The biodiesel program was unstable until a more reliable support mechanism was established following Indonesia's switch from providing subsidies through the national state budget (APBN) to subsidies via the CPO fund, which was established in 2015 to collect a levy on palm oil product exports. Since 2015, Indonesia has aggressively expanded the blending program from its initial application covering only Public Sector Obligation (PSO) industries to a nationwide B20 program in 2018 and then to the B30 program in January 2020. In February 2023, Indonesia increased its biodiesel blending rate to 35 percent for several regions and expanded it to nationwide coverage by August 2023.

The GOI is preparing to increase its blending beyond 35 percent. A road test completed in 2022 sought performance for two types of diesel fuels with different rates of bio components: (1) 40 percent of FAME and (2) 30 percent of FAME + 10 percent of renewable diesel. Despite an unclear implementation schedule, in May 2023 the GOI announced another test for 50 percent renewable diesel for heavy machinery specifically used in the mining industry.

In response to the increasing blending rate, the auto-industry association expressed concerns about impacts that could ultimately lead to increasing maintenance costs. According to the association,[1] the water content present at B30 could potentially damage diesel engines and cause a suboptimal combustion process. The association also raised other concerns about shorter periods between fuel filter replacements in vehicles using biodiesel and increased fuel consumption of 5 percent.

In July 2023, the GOI issued guidance for the handling and storage of biofuel and its blending rate of at maximum 40 percent for diesel engines. The guidance was issued prior to the nationwide B35 implementation in August 2023.

After a long dormant period for the bioethanol program due to inadequate support (see previous report ID2022-0017), the GOI issued PR No. 40/2023 in June 2023 addressing bioethanol procurement based on the acceleration of sugar self-sufficiency goals. PR No. 40/2023 sets forth Indonesia's target of achieving self-sufficiency in sugar production for human consumption by 2028 and producing 1.2 billion liters of sugarcane ethanol by 2030.

In mid-July 2023, the Ministry of Energy and Mineral Resource (ESDM) issued Decree No. 252/2023 on specifications for 95 RON gasoline with 5 percent ethanol blending. This fuel specification decree is a reference for retailers in domestic market sales.

Renewable Energy and GHG Emission Reductions

Indonesia's latest nationally determined contribution (NDC) document submitted to the United Nations' Framework Convention on Climate Change (UNFCC) in September 2022 shows higher greenhouse gas (GHG) reduction targets of 31.89 percent (unconditional) and 43.2 percent (conditional) by 2030 from 29 percent and 41 percent respectively. The unconditional NDC target represents Indonesia's commitment to emissions reduction goals without any international assistance.

Within the energy sector, the business as usual (BAU) emission scenario below shows emissions without consideration for climate change mitigation policy. The Counter Measure 1 (CM1) emission scenario, with mitigation, considers sector targets without international support. The CM 2 emission scenario considers sector targets with international support. Emission reductions for the energy sector assume biodiesel use, specifically B30, within the transportation sector covering 90 percent of the total diesel fuel pool under CM1 and 100 percent under CM2. Without certification of the actual carbon intensity of biofuels marketed, these values of future goals met will remain questionable.

[1] See more the auto industry association comment here

Table 2. Projected BAU and Emission Reduction for the Energy Sector

GHG Emission Level 2010	GHG Emission Level 2030			GHG Emission Reduction			
MTonne CO_2e	*MTonne CO_2e*			*MTonne CO_2e*		*Percent of BAU*	
	BAU	CM1	CM2	CM1	CM2	CM1	CM2
453.2	1,669	1,311	1,223	358	446	12.5	15.5

Source: Indonesia Enhanced NDC 2022

Indonesia's long-term strategy for low carbon (LTS-LCCR 2050) puts forward biofuels as Indonesia's main source of energy in the transportation sector by 2050 (see Table 3), gradually replacing gasoline with bioethanol and palm oil-based gasoline and diesel with palm biodiesel and renewable diesel.

Table 3. Indonesia Transport Energy Source 2050

Energy Source	Contribution
Biofuels	46 percent
Oil Fuels	20 percent
Electricity	30 percent
Natural Gas	4 percent

Source: Indonesia LTS-LCCR

Power Plants Using Renewable Sources

Aiming to increase the use of renewable energy sources, the GOI issued PR No. 112/2022 which lays out a tariff reference for power plants using renewable sources, including biofuels, biogas from Palm oil methyl ester (POME), and biomass like solid waste from palm oil mills. The regulation provides a legal basis for the state-owned company PLN to buy electricity from power plants utilizing renewable energy sources. Updated annually, the tariff reference is formulated by type of renewable energy source and is staging-based.

PR No. 112/2022 provides updated formulas defining financial incentives to manage liquid and solid waste from palm processing while at the same time reducing GHG emissions. In 2021, installed capacity of Indonesia biogas power plants (PLTBg) reached 117 mega-watts (MW) consisting of 55 plants using POME, while biomass power plant (PLTBM) installed capacity was at 1658 MW. To achieve 23 percent of renewable energy mix in 2025, Indonesia must develop a total of 5.5 Gigawatt (GW) of installed capacity from bioenergy sources.

Indonesia is expected to produce between 115 million metric tons (MMT) to 155 MMT of POME, based on 46 MMT of CPO output in 2022[2]. However, only a small amount of POME is

[2] Assuming each ton of CPO produced will generate 2.5 to 3.37 ton of POME (source: Chin, May Ji, et al. (2013)

utilized to generate electricity with methane capture. Without any methane capture facilities, POME is usually processed in an open ponding system. Another recent use of POME is processing into compressed biomethane (bio-CNG). At least three commercial projects are under construction and expected to be commissioned in late 2023 with potential GHG reduction of up to 3.7 MMT of $CO2e$[3].

Carbon Trade and Taxes

In order to achieve its NDC target, the GOI issued Law No. 7/2021 establishing a carbon tax and PR No. 98/2021 laying out carbon pricing mechanisms, including (1) carbon trade, (2) result-based payment, (3) carbon tax, and (4) other mechanisms based on the development of science and technology. The detailed provisions for carbon pricing are stipulated in Ministry of Environment and Forestry Regulation No. (KLHK) No. 21/2022. The regulation addresses procedures, including monitoring, reporting, and verification. The KLHK No. 21/2022 also defines sectors and sub-sectors for the implementation of carbon pricing, aligning with NDC working areas such as energy, waste, industrial processing, agriculture, and forestry.

In February 2023, the carbon trade scheme officially launched for the power-generation sub-sector.[4] There are 99 coal-generated power plants, each with the capacity of more than 100 Megawatts (MW) currently participating in the scheme. In two years, all types of power plants are scheduled to join the scheme. The GOI expects carbon trading in this sector to reduce $CO2e$ by 36 MMT by 2030.

The non-trade mechanism covers carbon tax and result-based payment (RBP). The carbon tax is expected to apply with a minimum tariff of IDR 30 ($0.002) per kg $CO2e$, based on carbon content and carbon emitting activities while the RBP allows payment based on emission reduction results. The GOI plans to expand the carbon pricing mechanism to other sectors and sub-sectors, including transportation without any certain timeline. However, the implementation of the carbon tax is expected to be postponed while the carbon exchange is set to be launched in September 2023.

Mandate and Pricing

Indonesia's biofuel blending mandate was created in 2008 and is currently regulated through ESDM No. 12/2015, released in March 2015. The ESDM No. 12/2015 established biofuel-blending targets for the transportation, industrial, and power generation sectors[5]. Table 4 shows the GOI plans to increase biodiesel and bioethanol blending rates through 2025. While biodiesel targets for on-road transportation have been achieved, no progress has been made in fulfilling the bioethanol mandate.

[3] A standing buyer ready to utilize bio-CNG produced from POME plant, replacing diesel fuel. Read more here.

[4] ESDM 16/2022 provides guidance on carbon trade for power-generation sub-sector. Power plant who emitting above the cap is allowable to buy carbon from the power plant emitting below the cap.

[5] Read historic policy background in earlier report here.

Table 4. Indonesia Biofuels Mandate Targets

Sector	Biodiesel			Bioethanol		
	2016	2020	2025	2016	2020	2025
Transportation, Public Service Obligation (PSO)	20%	30%	30%	2%	5%	20%
Transportation, Non-PSO	20%	30%	30%	5%	10%	20%
Industry	20%	30%	30%	5%	10%	20%
Electricity	30%	30%	30%			

Source: ESDM 12/2015

Accompanying the mandate program, the GOI sets market index prices for both bioethanol and biodiesel on a monthly basis. Since 2016, domestic molasses prices published by state-owned agricultural trade company KPB are used as the basis for bioethanol prices. Prior to 2016, an Argus-based price was utilized. For biodiesel prices, the GOI uses CPO prices published by the same state-owned company as a reference.

Table 5. Biofuels Market Index Price (HIP) Formula

HIP Formula (IDR/liter)	
Biodiesel	= (CPO Price IDR/kg + 85 $/ton) x 870 kg/$m^3$ + transportation cost
Bioethanol	= (Molasses price IDR/kg x 4.125 kg/liter) + 0.25 $/liter

Source: ESDM

The HIP biodiesel formula has been adjusted several times in recent years. In 2015, the biodiesel conversion was set at $125 per metric ton (MT). In 2017, the GOI lowered the value to $100 per MT before reducing it further to $80 per MT in May 2020. Most recently, the GOI adjusted the conversion upwards to $85 per MT in September 2020. The biodiesel conversion value bridges producers' margin and amount of subsidy from CPO fund, with lower values reducing subsidy expenditures and lowering producers' margins.

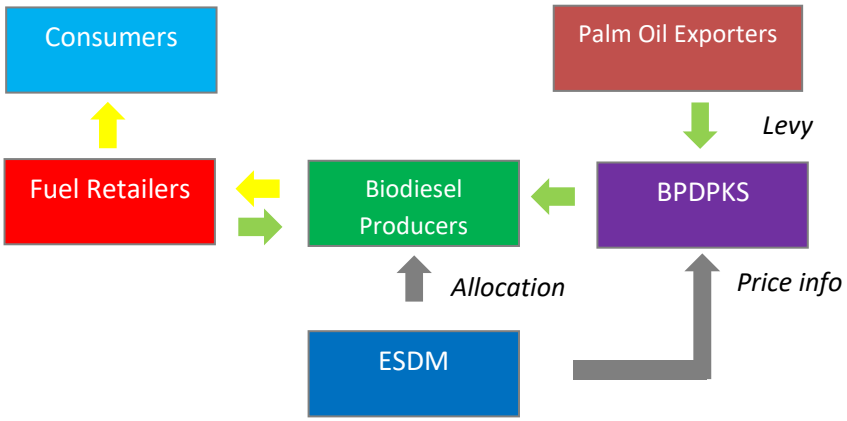
Financial Support for Biodiesel Mandate Program

In 2015, the financial support mechanism for domestic biodiesel consumption was completely overhauled. The new scheme, with modifications as needed, has proven effective and durable thus far. Managed by the Oil Palm Plantation Fund Management Agency (BPDPKS), funds are collected from a palm oil export levy to offset the price gap between biodiesel and fossil diesel. The agency also uses the funds for research and development, replanting, and palm promotion activities.

The GOI has been setting domestic biodiesel supply allocations on an annual basis since 2019. The MEMR establishes volumes for fuel retailers consisting of private and state-owned companies and assigns production allocations to biodiesel producers, who in turn supply palm oil-based biodiesel, also referred to as palm oil fatty acid methyl ester (PME) for blending. BPDPKS continues to disburse funds based on the spread between the diesel market index price (HIP Diesel) published by Directorate General of Oil and Gas (DG Migas) and biodiesel index

market price (HIP Biodiesel) published by the Directorate General of New and Renewable Energy (DG EBTKE). Both offices are parts of ESDM.

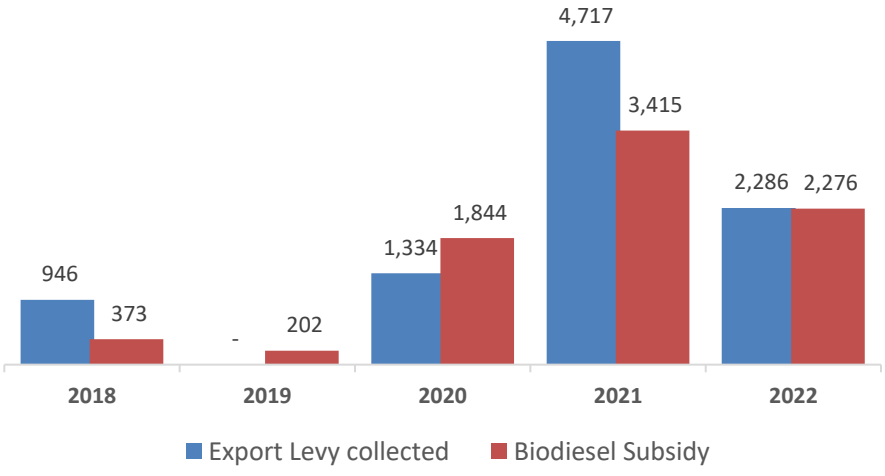
Figure 1. Indonesia Biodiesel Support Mechanism



Source: ESDM

Over the past few years, the GOI has frequently adjusted its export levy scheme to maintain the solvency of its CPO fund amidst palm oil price fluctuations. In December 2018, the export levy formulation changed from a flat-rate structure to a progressive price-based structure in response to declining CPO prices. As the price decline continued into 2019, the GOI halted CPO levy collection altogether, leading to no new revenues being collected by the CPO fund for the entirety of 2019. In 2022, The GOI also added new leviable categories of palm products, including Used Cooking Oil (UCO) and POME, which are both used for biodiesel feedstock.

Figure 2. Exports Levy and Biodiesel Subsidy in 2018-2022 ($ million)



Source: BPDPKS Annual Reports

Flex Fuel Vehicle Incentive

The GOI provides lower sales taxes on flex-fuel vehicles (FFVs) to incentivize the adoption of low carbon emission vehicles along with other low carbon emission vehicles such as electric cars and hybrids. Government Regulation No. 79/2019, which was amended by GR No. 74/2021, fixed lower sales taxes based on carbon emissions, engine capacity and alternative technology including flex-fuel vehicles. However, this incentive was likely largely unused in 2023, due to the limited availability of bioethanol gas stations and more lucrative tax cuts for electric vehicles. A glimpse of a response from the auto industry surfaced in August 2023 as a local auto manufacturer exhibited a passenger vehicle with a flex-fuel engine capable of running on 100 percent bioethanol.[6]

Import Policy, Import Duties, and Export Taxes

The importation of biofuels requires import recommendations from the ESDM, as stated by the Ministry of Trade (MOT) Regulation No. 25/2022. The MOT will issue import licenses based on either a biofuel's commodity balance or on other available market data. An import license for a biofuel is valid for one year in accordance with Indonesia's commodity balance policy.

Table 6. MFN Import Duties on Ethanol, Biodiesel, Gasoline and Fuel additives

HS code	Description	Duty Rate (percent)
2207.10 2207.20	Undenatured ethanol Denatured ethanol	30
2710.12.21 2710.12.24 2710.12.27	Unblended gasoline	0
2710.12.22 2710.12.25 2710.12.28	Gasoline pre-blended with ethanol	0
2710.20	Petroleum oils containing up to 30 percent biodiesel	0
2902.20 2902.30 2902.44	Benzene Toluene Xylene	0
2909.19	Methyl Ter-Butyl Ether (MTBE)	5
3826.001 3826.002	Biodiesel, with coconut methyl ester content more than 70 percent Biodiesel, with methyl ester content more than 96.5 percent	5

Source: INSW, Ministry of Finance (MOF)

Indonesia is bound by several trade agreements providing duties below MFN rates on ethanol imports. The Preferential Trade Agreement (PTA) between Indonesia and Pakistan has allowed ethanol imports between the two countries at zero percent since 2019. The trade agreement signed between Indonesia and EFTA countries (Iceland, Liechtenstein, Norway, and Switzerland) also reduced the duty on ethanol imports from those countries to 27.6 percent beginning in 2022[7].

[6] The flex-fuel passenger SUV is showcased in the Indonesia largest auto show, August 2023. Read more here.

[7] See ID2022-0017 for details trade agreements providing lower ethanol import duties.

Table 7. Export Levy on Biodiesel and other Palm Products

HS code	Description	Export Levy ($/MT)
2306.90.90 2306.69.90	Palm Oil Mill Effluent (POME)	5
1518	Used Cooking Oil (UCO)	35
1511.10.00 1511.90.41 1511.90.42 1513.21.10 1513.29.11	Crude Palm Oil (CPO), Crude Palm Kernel Oil (CPKO), Crude Palm Olein, Crude Palm Stearin, Crude Palm Kernel Olein, Crude Palm Kernel Stearin	55-240
3823.19.20 3823.19.30	Palm Fatty Acid Distillate (PFAD), Palm Kernel Fatty Acid Distillate (PKFAD)	45-214
1511.90.20	Refined Bleached Deodorized Palm Oil (RBDPO)	38-207
3826	Palm-based Biodiesel (with Methyl Ester more than 96.5%)	25-194

Source: MOF No. 154/2022

Indonesia's export levy for palm oil products was revised in November 2022, lowering the price threshold from $750 per MT to $680 per MT. The revised levy also maintains a progressive tariff structure.

Environment Sustainability and Certification

The GOI mandates all palm oil companies and smallholders operating in Indonesia to be ISPO-certified before 2025 as stipulated in PR No. 44/2020. The ISPO standard covers a range of criteria, including GHG emissions, land use, biodiversity, and labor. The ISPO certification process is carried out by a certifying company agent that must be recognized by the National Accreditation Committee (KAN). Since 2021, at least 15 certifying agents have already been recognized by KAN. In 2022, there were 918 ISPO certificates issued, of 97 percent of which were for companies and 3 percent were for smallholders, covering 3.6 million hectares or about 22 percent of total palm plantations.

In addition to the mandatory ISPO requirements, there are several voluntary sustainability certification schemes in place to support palm oil product exports, such as the RSPO (Roundtable on Sustainable Palm Oil).

Voluntary certification scheme for POME and UCO

Voluntary certifications are also available for POME methane capture facilities in Indonesia. Third parties carry out the certification process for selected facilities and operators in accordance with the selected standards, and the certificate is typically valid for certain periods of time. Based on the International Sustainability and Carbon Certification (ISCC) database, more than 800 certificates issued for POME had UCO as the raw material, between 2016 and 2023. The ISCC certification includes trader and storage facilities.

EU biofuel-related measures

The European Union (EU)'s focus on biofuel sustainability criteria weighs heavily on the Indonesian biofuels sector and is a constant source of strife among GOI officials and their EU

counterparts. The EU outlines its sustainability criteria in its Renewable Energy Directive (RED) and RED II which officially entered into force in December 2018 and EU member states transposed its provisions into national law in June 2021.

In March 2019, the EU Commission adopted the delegated act which set criteria both for (1) determining the high ILUC (indirect land-use change) risk feedstock for which there is a significant expansion of the production area into land containing high carbon stocks and (2) certifying low ILUC-risk biofuels. The report, published along with the delegated act, concluded that palm oil is a high ILUC-risk feedstock and therefore the consumption of imported biodiesel (PME) or renewable diesel and PME or renewable diesel made within the EU with imported palm oil must be capped then gradually decreased after 2023 to zero by 2030. Several EU member states have already begun an earlier phase-out, including France, Austria, Belgium, and Germany. However, the report also notes that some PME or palm oil-based renewable diesel production, under certain conditions (by smallholders), may be considered in the low ILUC risk category. This phaseout pertains only to palm oil-based biofuels, not palm oil products for other uses such as food.

The GOI continues to challenge this policy, initially requesting a WTO consultation in December 2019. A dispute panel was established in July 2020 at the request of Indonesia. In February 2023, the Chair of the panel announced the panel is expecting to issue its final report before the third quarter of 2023. Read more on the summary here.

The EU deforestation regulation (EUDR) that entered into force in June 2023 is expected to affect several palm oil and derivative products exports, including palm oil waste used for biofuel feedstocks such PFAD and Palm Acid Oil (PAO). Companies exporting targeted products to the EU market must collect information ensuring that the product was not produced on land deforested after December 31, 2020. The EUDR also requires importers to carry out mandatory due diligence and mitigation measures such as using satellite monitoring tools to verify information.

Studies on Life Cycle Assessment (LCA) Approach for Indonesia Biodiesel Production

Studies on LCA biodiesel in Indonesia have been carried out with varying results. In the scope from land preparation to biodiesel combustion, several LCA studies identified stages that critically contribute to the value of Global Warming Potential (GWP). The studies found that the best scenario to minimize negative environmental impact for biodiesel production is achieved by selecting non-burning techniques for land clearing and choosing non-forest and non-peat land. U.S., European, and Canadian experts in applying LCA to biofuels would unquestionably add methane capture to the list of critical management tools. Another study highlighted additional key factors such as farm fertilizer and soil management technique as well as disposal methods of POME and presence of methane capture.[8]

Another study pointed out that total GWP for a metric ton of biodiesel production is 2,762 kg CO2e, 90 percent of which is caused by the planting stage, 1.1 percent from the CPO production stage, and 8.6 percent from biodiesel production stage[9].

[8] See K Siregar et al, 2021

[9] See Paminto AK et all, 2022

Section III. Ethanol

Consumption

Following the early collapse of the initial ethanol program in 2009, Indonesia's second attempt was launched this year as state-owned company Pertamina introduced E5 gasoline to select gas stations in July 2023, branded as Pertamax Green, with 95 RON. According to the ESDM data, the sales share of 95 RON gasoline is about 1 percent of yearly gasoline consumption, far below sales of 90 RON gasoline which made up 83 percent of sales in 2022. In addition, Pertamina sells E5 at IDR 13,500 ($0.89), 90 RON at IDR 10,000 ($0.66), and 92 RON at IDR 12,400 ($0.82).[10] Pertamina plans to market E5 gasoline across the entire island of Java within the next 12 months, expanding from currently only marketing it in Jakarta and Surabaya. Post forecasts fuel ethanol consumption at only 2 million liters for 2023, based on expected limited sales of E5 due to most consumers' preference for cheaper fuel and limited roll out.

Non-Fuel Grade Ethanol (Non-FGE) consumption is forecast at 160 million liters in 2023 as demand for antiseptic products continues to decline following the easing of pandemic-related restrictions. In addition to the antiseptic industry, non-FGE uses include pharmaceuticals, cosmetics, and chemical solvents.

Production

Post forecasts Indonesia fuel ethanol production at 4 million liters in 2023, mainly for use in the new E5 gasoline in certain Pertamina gas stations on Java Island. Indonesia ethanol production relies on molasses feedstock supplied by state-owned sugarcane companies in East Java.

Indonesia's sugar production is expected to reach 2.6 MMT in 2023,[11] providing about 1.7 MMT of molasses. However, competition for the valuable feedstock continues to pose challenges for local ethanol producers as molasses is also used in food processing, the production of monosodium glutamate, and for export. Indonesia's cumulative total ethanol installed capacity is roughly 350 million liters per year across eight active ethanol producers. One recently reactivated distiller in Lampung is utilizing domestic corn as its main feedstock.

Trade

Indonesia's ethanol exports (non-FGE) are forecast at 60 million liters in 2023, down from 77 million liters in 2022 on reduced demand from major markets in the South-East Asian region due to limited price competitiveness. Post expects the Philippines to remain the main market for Indonesian ethanol exports in 2023, followed by Thailand and Vietnam. In 2022, Indonesia shipped 99 percent of its ethanol exports to the Southeast Asia region, mainly the Philippines (94 percent), Thailand (4 percent), and Vietnam (1 percent). Ethanol imports for 2023 are expected to drop to 10 million liters from 32 million liters in 2022 on improved domestic supplies and contracted demand for sanitizer products.

Table 8: Ethanol Supplies, Trade and Use in Indonesia

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	2014	2015	2016	2017	2018	2019	2020	2021	2022r	2023f
Beginning Stocks	39	14	16	15	14	14	5	5	10	7

[10] Price as of early August 2023 per liter, for Jakarta region. Exchange Rate (IDR/$): 15,189.

[11] See Indonesia Sugar Annual 2023 (ID2023-0011)

Fuel Begin Stocks	0	0	0	0	0	0	0	0	0	0
Production	202	205	205	195	200	200	193	200	205	215
Fuel Production	18	1	0	0	0	0	1	0	0	4
Imports	2	0	2	5	96	1	29	54	32	10
Fuel Imports	0	0	0	0	0	0	0	0	0	0
Exports	94	67	71	64	158	70	47	82	77	60
Fuel Exports	18	1	0	0	0	0	1	0	0	0
Consumption	135	136	137	137	138	139	175	167	163	162
Fuel Consumption	0	0	0	0	0	0	0	0	0	3
Ending Stocks	14	16	15	14	14	5	5	10	7	10
Fuel Ending Stocks	0	0	0	0	0	0	0	0	0	1
Refineries Producing Fuel Ethanol (Million liters)										
Number of Refineries	3	3	3	3	3	3	3	3	3	3
Nameplate Capacity	100	100	100	100	100	100	100	100	100	100
Capacity Use (%)	18%	1%	0%	0%	0%	0%	1%	0%	0%	4%
Feedstock Use for Fuel (1,000 MT)										
Molasses	72	4	0	0	0	0	5	0	0	16
Market Penetration (Million Liters)										
Fuel Ethanol	0	0	0	0	0	0	0	0	0	3
Gasoline Pool 1/	30,925	31,528	31,986	33,548	34,490	35,677	31,194	32,953	35,796	36,691
Blend Rate (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Note: r: revised, f: forecast

1/ Gasoline pool includes all additives (like MTBE) and any biocomponents (like ethanol) when used.

Source: ESDM, Trade Data Monitor, LLC, Post calculation

Section IV. Biodiesel/Renewable Diesel

Consumption

The biodiesel mandate program finally supported by the levy on palm oil products exports and fuel growth has driven Indonesia's biodiesel consumption since 2015. Post forecasts biodiesel consumption for 2023 will reach 13 billion liters on higher blending rates and expected rising diesel consumption.

After a decrease in 2020 caused by the pandemic, the diesel pool rose in 2021 and 2022 to 35 billion liters and 38 billion liters, respectively. As economic growth modestly continued in the first half of 2023, diesel use is expected to rise to 39.2 billion liters.

Since the biodiesel mandate program defines FAME as the bio component to blend with diesel and HDRD production capacity is very limited, there is no significant HDRD consumption in 2023. The GOI is expected to publish technical specifications and a price reference formula for HDRD blending if there is clarity on the inclusion of HDRD to come.

In regard to biodiesel allocations for 2023, the GOI appointed 22 fuel retailers who in turn blend FAME biodiesel with their conventional fossil diesel and sell the product through their distribution channels. Pertamina alone receives around 80 percent of the total biodiesel allocation volume. A total allocation of 13.15 billion liters of FAME was initially set based on a 30 percent blending rate. However, without any change to the total allocated volume, the GOI increased the blending rate to 35 percent beginning in February 2023 with a nationwide rollout by August 2023.

The biodiesel mandate program relies on subsidies funded by Indonesia's CPO export levy to cover the price spread between biodiesel and fossil diesel. In 2022, the subsidy reached $2.3 billion, almost at par with the funds collected from the export levy. This amount of subsidy is 33 percent lower than the subsidy provided in 2021 of $ 3.4 billion due to a narrowed spread as the palm oil price dropped significantly in the second half of 2022.

Production

The GOI appointed 22 biodiesel producers to supply FAME for the 2023 mandatory B35 program. Post expects Indonesia biodiesel production to reach 13.57 billion liters in 2023, an increase of 25 percent from 10.87 billion liters in 2022. Biodiesel production nameplate capacity is projected at 16.6 billion liters in 2023.

On renewable diesel, production is estimated at 80 million liters, produced at Pertamina biorefineries in Cilacap and Dumai. Pertamina produced renewable diesel utilizing RBD palm oil and plans to use used cooking oil. However, since the majority of UCO supplies are exported, Pertamina will have difficulties competing with export markets for supplies.

Feedstock for both biodiesel and renewable diesel in 2023 is expected to remain palm oil, as other feedstocks are more expensive and less abundant. In addition, procuring palm oil for biodiesel production is easier than collecting UCO across the country from dispersed consumer groups and requires a new supply chain. Currently, UCO use has been at a micro-small scale and is expected to remain small as there is no available incentive to utilize UCO at a commercial volume or to serve the biodiesel mandate program.

A study in 2022 estimated potential collectable UCO in Indonesia at 715,000 MT a year, based on sources from urban restaurants, urban households, and food processing facilities. This estimate excludes illicit "gutter oil" as that particular data is not available.

Trade

Indonesia biodiesel exports in 2023 are forecast at 630 million liters on accelerated demand due to a narrowed spread between palm oil and diesel prices. This is well below record sales of years past, but a considerable increase over 2020 and 2021. China is expected to remain as the main destination, followed by the Netherlands, Peru, and the Philippines. In 2022, 53 percent of Indonesia's biodiesel exports went to China, followed by Netherlands (22 percent) and Peru (10 percent). Post expects China to remain the main destination for biodiesel exports in 2023 as shipments in the first half of 2023 already reached 153,000 MT, equal to 63 percent of total projected 2023 biodiesel exports.

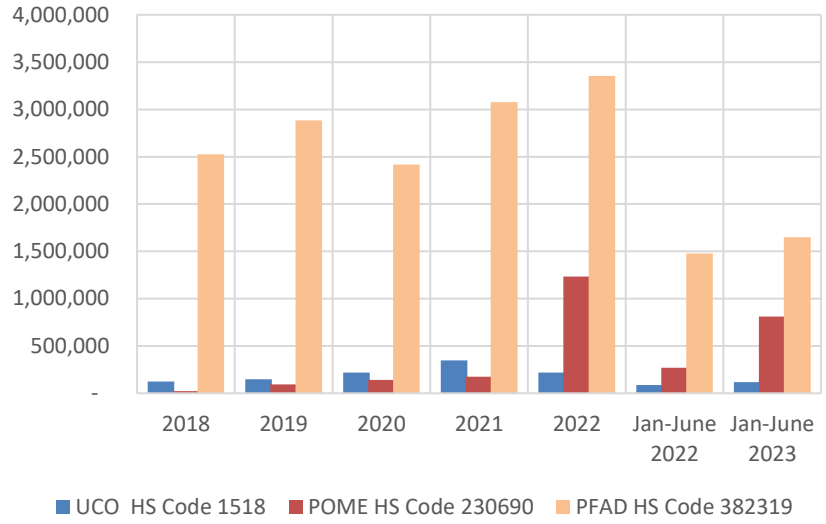
At far smaller volumes, exports of HDRD are projected at 76 million liters in 2023, on expected rising demand from the EU. Future sales of HDRD to Europe have little potential unless operating plants switch to and certify use of EU RED-permitted waste stream fats and oils.

The narrowed spread between palm oil and gasoil/diesel prices (POGO) began in July 2022 following a sharp drop in palm oil prices by nearly 30 percent. In the first half of 2023, the POGO spread is estimated at less than $50 on average compared $330 in 2021 and $150 in 2022. The spread is likely to increase for the rest of 2023, due to palm oil price volatility related to El-Nino weather events. However, other factors also might come into play, such as crude oil prices and prices of other vegetable oils such as soybean oil.

Indonesia palm biodiesel exports to the United States remains limited due to high countervailing and anti-dumping duties. A commercial sales market in the United State does not exist because Indonesia palm biodiesel is not eligible for Renewable Identification Numbers (RINs) which have market value and because this biodiesel does not meet the 20 percent minimum GHG saving threshold and thus obligated parties cannot use the product to meet Renewable Fuel Standard (RFS) volumetric obligations. The EU also imposed 8-18 percent countervailing duties on Indonesia biodiesel since December 2019 and has begun its shift away from the use of palm oil biodiesel.

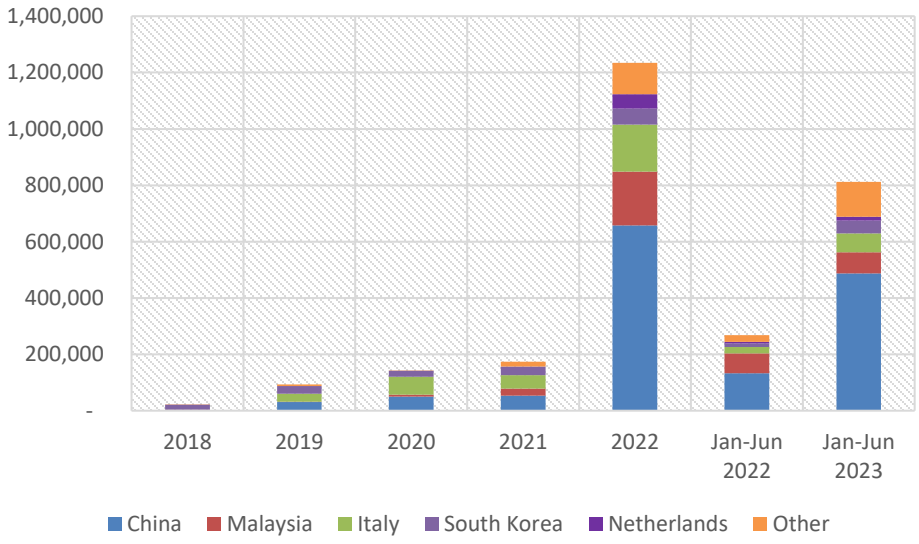
Indonesia UCO exports show growth, peaking in 2021 at 346,000 MT before being levied at $35 per MT in 2022. In the last five-years, Indonesia shipped around 87 percent of its UCO exports to EU countries, Malaysia, China, and Singapore. On increased demands for renewable diesel feedstocks, Post estimates UCO exports to rise to 250,000 MT in 2023. Indonesia's POME exports also showed a spike in 2022 and is expected to go up to 1.7 MMT in 2023, mostly for China-bound destinations. The POME export levied at $5 per MT began in March 2022. In April 2023, a report on spiking palm-waste exports to China raised concerns about "alleged mislabeling practices."

Figure 3. Indonesia UCO, POME, PFAD Exports 2018-2023 (MT)



Source: Trade Data Monitor, LLC

Figure 4. Indonesia POME Shipments to China Surged in 2022-23 (MT)



Source: Trade Data Monitor, LLC

Table 9. Biodiesel/Renewable Supplies, Trade and Use in Indonesia

Biodiesel (FAME) & Renewable Diesel (HDRD), Million Liters										
Calendar Year	2014	2015	2016	2017	2018	2019	2020	2021r	2022r	2023f
Beginning Stocks	11	97	94	110	152	258	294	329	390	390
Production	3,500	1,200	3,500	2,800	5,600	7,700	8,500	9,550	10,900	13,650
>HDRD Production	0	0	0	0	0	0	0	6	21	80
Imports	0	0	0	0	28	0	0	0	0	0
Exports	1,569	343	476	187	1,772	1,271	39	193	516	630
>HDRD Exports	0	0	0	0	0	0	0	6	19	76
Consumption	1,845	860	3,008	2,572	3,750	6,393	8,426	9,296	10,384	13,000
>HDRD Consumption	0	0	0	0	0	0	0	0	0	0
Ending Stocks	97	94	110	152	258	294	329	390	390	410
Production Capacity, Biodiesel (Million Liters)										
Number of Biorefineries	26	27	30	32	31	31	31	32	33	33
Nameplate Capacity	5,670	6,887	10,898	11,547	11,357	11,357	11,357	14,415	16,656	16,565
Capacity Use (%)	61.7%	17.4%	32.1%	24.2%	49.3%	67.8%	74.8%	66.2%	65.3%	81.9%
Production Capacity, Renewable Diesel (HDRD) (Million Liters)										
Number of Biorefineries								1	2	2
Nameplate Capacity								41	165	165
Capacity Use (%)								14.6%	12.7%	48.5%
Feedstock Use for Biodiesel (1,000 MT)										
Palm Oil	3,220	1,104	3,220	2,576	5,152	7,084	7,820	8,791	10,047	12,630
Used Cooking Oil (UCO)										
Feedstock Use for Renewable Diesel (HDRD) (1,000 MT)										
Palm Oil								5	16	62
Used Cooking Oil (UCO)										
Market Penetration, Biodiesel (Million Liters)										
Biodiesel, on-road	1,292	583	2,263	1,963	2,982	5,238	7,341	7,945	10,017	11,228
Diesel Pool, on-road use 1/	23,257	21,931	21,567	23,877	24,984	30,610	28,859	31,653	34,027	34,708
Blend rate (%)	5.6%	2.7%	10.5%	8.2%	11.9%	17.1%	25.4%	25.1%	29.4%	32.34%
Diesel Pool, Total 1/	34,651	30,912	30,039	31,441	33,268	33,169	31,230	34,728	35,770	36,664
Jet Fuel/Kerosene Pool	5,201	5,106	5,474	5,985	6,317	5,596	3,300	2,555	3,824	3,920

Note: R: Revised, F: forecast
1/ Covers diesel and all biocomponents (biodiesel and renewable diesel).
Source: Aprobi, ESDM, Trade Data Monitor, LLC

Section V. Advanced Biofuels

The GOI agencies and state-owned companies are collaborating to conduct research and various tests for developing advanced biofuels. If a domestic market for HDRD and SAF was to develop, given its higher production cost over biodiesel, fossil diesel, jet fuel, and given experience in

Europe and the United States, Indonesia will have to mandate and likely provide financial supports or otherwise incentivize fuel switching through tax policies, including an effective carbon tax policy. No such mandating or other support has yet to occur.

Sustainable Aviation Fuel (SAF)
In 2022, Pertamina successfully conducted a flight test using Sustainable Aviation Fuel (SAF) on a military aircraft. In July 2023, Pertamina completed a static test on CFM56-7B jet engines used as commercial aircraft and is preparing to conduct other tests: ground round tests and flight tests. The test for commercial aircraft took place at a state-owned airline company facility owned by GMF Aeroasia, a subsidiary of state-owned airline company Garuda Indonesia. Pertamina produces SAF utilizing co-processing technology and uses feedstock of Refined Bleached Deodorized Palm Oil (RBDPO) at Cilacap Refinery facility in Central Java.

Renewable Gasoline
MEMR plans to expand its research to include palm-based renewable gasoline at a pilot plant in South Sumatera with a production capacity of 238.5 kiloliters per day (87,053 liters/year). This project converts palm oil to renewable gasoline using a cracking process utilizing a zeolite-based catalyst produced by Bandung Institute of Technology (ITB).

Section VI. Notes on Statistical Data

Fossil Fuel Consumption
Fuel consumption figures, both for gasoline and diesel, are based on the ESDM publication issued 2023: Handbook of Energy & Economic Statistics of Indonesia. Historical figures from previous publications have been updated with the latest figures.

Biofuel Production, Nameplate Capacity and Consumption
Post estimates for ethanol production and consumption, based on most recently available data from ESDM and the ethanol producers association.

Biodiesel consumption figures sourced from Aprobi (Indonesia biofuel producer association) using distribution number. Biodiesel production figures are Post estimates (the "residual" is based on other supply/demand elements) based on Pertamina's fuel stock average of 19 days, trade, and consumption.

Nameplate capacity figure is gathered from ESDM and Aprobi.

Trade Data
All trade data sourced from Trade Data Monitor, LLC with the following HS codes: 3826 (Biodiesel/FAME), 2207 (ethanol), 1518 (UCO), 230690 (POME) and 382319 for PFAD.

Renewable diesel export volume in 2022 is estimated based on Pertamina official numbers and 2023 figures.

Price
Information on palm oil prices and gasoil (diesel) prices to estimate POGO spread gathered from World Bank Pink Sheet, August 2023.

Conversion Rates
1 MT Biodiesel = 1,136 Liters

1 MT Ethanol = 1,267 Liters

Feedstocks-to-Biofuels conversion rate
1 MT Molasses = 246 Liters of ethanol

1 MT Crude Palm Oil (CPO) = 1,087 liters of PME (Palm Methyl Ester)

General Terms & Abbreviations

Bpd	barrel per day
EU	European Union
FAME	Fatty Acid Methyl Ester
GHG	Greenhouse Gas
HDRD	hydrogenation derived renewable diesel (also known as hydrotreated vegetable oil)
ISPO	Indonesian Sustainable Palm Oil
MEMR	Ministry of Energy and Mineral Resources or ESDM
MOT	Ministry of Trade
MOEF	Ministry of Environment and Forestry or KLHK
MW	Mega Watt
GW	Giga Watt
NDC	Nationally Determined Contribution
PFAD	Palm Fatty Acid Distillate
POME	Palm oil methyl ester
PKFAD	Palm Kernel Fatty Acid Distillate
PTA	Preferential Trade Agreement
RBDPO	Refined Bleached Deodorized Palm Oil
RON	Research Octane Number
RSPO	Roundtable Sustainable Palm Oil
UCO	Used Cooking Oil

Attachments:

No Attachments