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Abbreviation List

APKASINDO	Asosiasi Petani Kelapa Sawit Indonesia
APROBI	Asosiasi Produsen Biofuel Indonesia
APTRINDO	Asosiasi Pengusaha Truk Indonesia
ASPEKPIR	Asosiasi Petani Sawit Pola Inti Rakyat
B20	Government program that requires mixing 20% Biodiesel with 80% diesel fuel type
B30	Government program that requires mixing 30% Biodiesel with 70% diesel fuel type
B40	Government program that requires mixing 40% Biodiesel with 60% diesel fuel type
B50	Government program that requires mixing 50% Biodiesel with 50% diesel fuel type
B100	Green diesel
Balitbang	Indonesian Research and Development
BBM	Bahan Bakar Minyak, fuel
bioavtur	Alternative fuel for airplane turbine engines made from crude palm oil
biodiesel	Diesel fuel derived from plants or animals and consisting of long-chain fatty acid esters
biogasoline	Alternative fuel from biomass, either vegetal or animal, or from wastes of both
bopd	barrels of oil per day
BPDPKS	Badan Pengelola Dana Perkebunan Kelapa Sawit
BPPT	Badan Pengkajian dan Penerapan Teknologi
CCT	Clean and Coal Technologies
CIFOR	Center for International Forestry Research
CPO	Crude Palm Oil
E100	Bioethanol
EBT	Energi Baru dan Terbarukan
EBTKE	Directorate General of New, Renewable Energy, and Energy Conservation
ESDM	Energi dan Sumber Daya Mineral Republik Indonesia, Ministry of Energy and Mineral Resources
ESG	Environmental, Social, and Governance
EV	Electric Vehicle
FAME	Fatty Acid Mehthyl Ester
GAIKINDO	Gabungan Industri Kendaraa Bermotor Indonesia
GAPKI	Gabungan Pengusaha Kelapa Sawit Indonesia
GDP	Gross Domestic Product
GSEN	Grand Strategy for National Energy
HEFA	Hydroprocessed Esters and Fatty Acids
HVO	Hydrotreated Vegetable Oil
IKABI	Ikalan Ahli-ahli Bioenergi Indonesia
ITB	Institut Teknologi Bandung
ISCC	International Sustainability and Carbon Certification
Kementan	Indonesian Ministry of Agricultural
KEN	Kebijakan Energi Nasional, National Enery Policy
kL	Kilo litres
km	Kilometer

LEMIGAS	the research centre for oil and gas technology development under the Ministry of Energy and Mineral Resources
NDC	Nationally Determined Contributions
OPEC	Organisation of the Petroleum Exporting Countries
Pertamina	Indonesian state-owned oil and natural gas corporation
PFAD	Palm Fatty Acid Distillate
POJK	Peraturan Otoritas Jasa Keuangan
POME	Palm Oil Mill Effluent
Pusri	Indonesian state-owned fertiliser company
RBDPKO	Refined, Bleached, and Deodorised Palm Kernel Oil
R&D	Research & Development
RPJMN	Rencana Pembangunan Jangka Menengah Nasional
RSPO	Roundtable on Sustainable Palm Oil
RON	Research Octane Number
SAMADE	Sawit Masa Depan
SKK Migas	Satuan Kerja Khusus Pelaksana Kegiatan Usaha Minyak dan Gas, Special Task Force for Upstream Oil and Gas Business Activities

Foreword

Indonesia's commitment to take action on the issue of climate change has begun with the Paris Agreement with a target of reducing greenhouse gas emissions by 2030 to 29% with its own efforts and to 41% with international support. This commitment has resulted in an agreed National Determined Contribution (NDC) with the development of green fuels or biofuels projected to play a key role in achieving its 2030 target. This target was affirmed by the Government of Indonesia during the 26th United Nation Climate Change Conference (COP26) in early November 2021. Another plan is to step by step reduce coal use by 60% in 2050 and move forward to net emission conditions in 2070 by implementing Carbon Captured Storage/Carbon Capture Unitization Storage (CCS/CCUS) and applying renewable energy and bioenergy. This commitment and plans were appreciated by COP26 President Designate, Alok Aharma, who mentioned Indonesia as a superpower country in mitigating climate change.

In support of the Government of Indonesia on their efforts to maintain this momentum, we developed a thought leadership paper on the topic of biofuel to see Indonesia's journey in positioning biofuels as a key step towards leading the energy sector and achieving sustainability. In this issue, we discuss the challenges and opportunities that will be faced by stakeholders in the development of biodiesel to achieve the B100 target and other biofuels such as bio gasoline and bio avtur in order to provide insightful reference for the industry to see a bigger picture of the issue.

We would like to express our gratitude to Andriah Feby Misna, ST., MT, the Director of Bioenergy, Directorate General of Energy Renewal and Conservation, Ministry of Energy and Mineral Resources, Ir. Dedi Djunaedi, M.Sc, Director of Processing and Marketing of Plantation Products, Ministry of Agriculture, Ir. Gulat Manurung, MP.,C.APO, Head of APKASINDO, Yohanes Nangoi, Head of GAIKINDO, Sugi Purnoto, Expert Council of APTRINDO, and Tonton Eko, Product Development General Manager of PT Isuzu Astra Indonesia who took the time and energy to accept our invitation for an interview. Also, our highest appreciation goes to Dadi Sugiana, Joseph Tundang, energy experts, Christ de Lavigne and Rahul Kar, our Southeast Asia Partner and Director, who have reviewed the earlier draft of the paper and provided their feedbacks.

I hope this thought leadership paper on biofuels will be of use to industry stakeholders to help them understand the challenging situations at hand and see the industry's future bright spots.

Maria Christi Pratiwi
Consumer Industry Leader

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Advancing Indonesia's biofuel agenda

Given its substantial size as the largest economy in Southeast Asia, Indonesia recognises that it has a significant role to play in accelerating our collective journey towards sustainability. Under the Paris Agreement, Indonesia has committed to a greenhouse gas emissions reduction target of 29% by 2030[1]. These commitments, including those for the agreed Nationally Determined Contributions (NDC), are broadly consistent with the Nine Priority Agenda (Nawa Cita) framework implemented by President Joko Widodo outlining the nation's transition towards a low-carbon and climate-resilient future[2].

But even before the Paris Agreement came into being, Indonesia had already begun to embark on its transition towards green and sustainable energy sources. In particular, the national energy policy *Kebijakan Energi Nasional (*KEN) – formed in response to Government Regulation No. 79 of 2014 – had set a national energy mix target for Indonesia comprising the following: no more than 25% petroleum, more than 22% natural gas, more than 30% coal, and more than 23% renewable energy[3]. In its National Energy Policy Strategy, the government also set out its plan for Indonesia to develop the capacity to produce a targeted 400 gigawatts of green and renewable energy[4], and is currently planning for the upcoming implementation of a carbon tax that is intended to ensure that energy costs reflect the cost of pollution generated from coal in steam power plants[5].

At this juncture, however, it must be acknowledged that while the national government recognises the immense potential of renewable energy, fossil fuels continue to play an important role in Indonesia's energy sector and overall economy. To drive change, national-level policies alone will not be sufficient: companies and local governments must first realise that there is an urgent need to end Indonesia's dependency on fossil fuels, and recognise the opportunities presented by renewable energy – particularly, in Indonesia's case, palm-oil based biofuels – in not only advancing sustainability goals, but also driving economic growth.

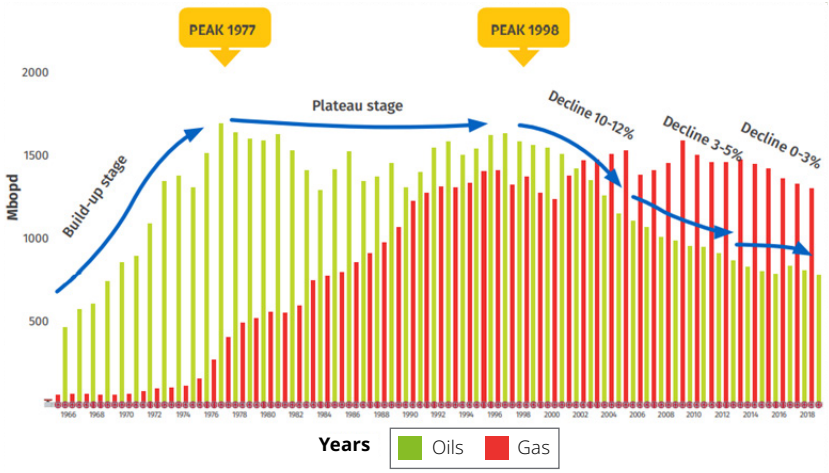
The urgent need to end Indonesia's dependency on fossil fuels

Once the world's 11th largest oil producer with an output of up to 1.65 million barrels per day (bpod) in 1977[6], Indonesia has since terminated its Organisation of the Petroleum Exporting Countries (OPEC) membership and become a net oil importer. This was a result of both a steadily increasing demand for oil and a reduction in its supply since at least 1996 (see Figure 1).

Data published by the Special Task Force for Upstream Oil and Gas Business Activities (SKK Migas) revealed the consistently declining annual oil production levels in Indonesia: in 2018, it was 772,100 bpod; by 2019, it had reduced to 745,100 bpod; and by 2020, it had dropped further to 706,000 bpod[7]. With Indonesia's known oil reserves expected to be depleted within the next 9.5 years[8], closing this gap will require not only efforts to slow demand growth but also new, game-changing sources of fuel.

[1] "Strategi Implementasi NDC (Nationally Determined Contribution)". Direktorat Jenderal Pengendalian Perubahan Iklim, Kementerian Lingkungan Hidup dan Kehutanan. October 2017.
[2] "First Nationally Determined Contribution: Republic of Indonesia". United Nations Framework Convention on Climate Change. November 2016.
[3] "Kajian Skema Dana Energi Terbarukan Sebagai Insentif Perceptan Pemanfaatan Energi Terbarukan", Badan Kebijakan Fiskal, Kementerian Keuangan, 2019
[4] Press Release of the Ministry of Energy and Mineral Resources Number 284.Pers/04/SJI/2020, 23 September 2020
[5] "Aturan Pajak Karbon Dinilai Bisa Dorong Pengembangan EBT", CNBC Indonesia, 14 September 2020
[6] "Indonesia Dahulu Produsen Minyak Bumi, Kini Importir, Kenapa?, Kompas.com, 3 October 2017
[7] SKK Migas Laporan Tahunan 2019: Meningkatkan Investasi Menuju Produksi 1 Juta BPOD
[8] Warning! Cadangan Minyak Bumi RI Tinggal 9,5 Tahun (cnbcindonesia.com)

Figure 1: Indonesia's oil and gas production levels (1966-2020)



Source: SKK Migas Annual Report 2019

A phased transition is required

Given that the need to reduce Indonesia's oil import dependence is a key theme in Indonesia's energy security policy, a phased transition into more sustainable energy sources – particularly from fossil fuels to biofuels – has been built in as a main cornerstone in its national energy policies, including the Grand Strategy for National Energy (GSEN), which outlines Indonesia's energy transition roadmap from 2020 to 2040[9].

Of particular importance is the need for a phased and gradual transition. A clean-break scenario – one that does not take into account existing energy infrastructure, natural and factor endowments, the economics of renewable energy, supply chain issues, and commercial viability – will in all likelihood only be unsustainable and untenable. Recognising this, the GSEN, while encouraging the development of renewable energy sources and markets, has placed a greater emphasis on an initial pivot from crude oil to more abundant but less pollutive sources of fossil fuels, such as natural gas and clean coal technologies (CCT).

Looking further ahead, however, Indonesia will also need to consider the factor endowments that it has to completely wean itself off fossil fuels. One such important factor endowment is likely to be its large and thriving palm oil sector – which will be able to provide much-needed feedstock for biofuels that could first supplement and then gradually replace natural gas and CCT.

[9] First NDC Indonesia_submitted to UNFCCC Set_November 2016.pdf

Palm oil as a critical biofuel feedstock

Indonesia's biofuel program relies heavily on its palm oil sector for feedstock. In this section, we will take a look at an overview of the palm oil sector, and discuss its role in driving economic development and facilitating the green energy transition in Indonesia.

Overview of Indonesia's palm oil sector

The palm oil sector is an important component of Indonesia's economy, contributing to about 3.5% of overall Gross Domestic Product (GDP)[10]. According to the Indonesian palm oil association *Gabungan Pengusaha Kelapa Sawit Indonesia* (GAPKI), Indonesia produced some 47 million metric tonnes of CPO in 2020, making it one of the largest producers and exporters of palm oil in the world.

Palm oil plantations also account for a significant amount of Indonesia's land area: at a total of around 11.9 million hectares, this is nearly triple their size of 4 million hectares in 2000[11]. Broadly, there are two different types of palm oil plantations: large-scale private plantations, usually owned by conglomerates and accounting for more than half of total production; and smallholder plantations that tend to be more affected by market and price volatilities given their lack of access to bank loans and cash reserves.

Typically, palm oil players belong to at least one trade association or industry group. The two formal palm oil farmers' associations in Indonesia are the *Asosiasi Petani Kelapa Sawit Indonesia* (APKASINDO), the association for independent palm oil farmers who are not part of private or state-owned enterprises; and *Asosiasi Petani Sawit Pola Inti Rakyat* (ASPEKPIR), the association for farmers who are partners of private or state-owned enterprises. Other informal groups also exist, with some, such as the *Sawit Masa Depan* (SAMADE), garnering a significant following on social media channels[12].

In the last few decades, growing global demand for CPO and higher yields have seen both large-scale and smallholder plantations – the latter numbering about 2.4 million in total[13] – embarking on significant capacity operations. Historically, the majority of Indonesia's CPO production were bound for export shipments to destinations such as China, India, Malaysia, Netherlands, and Pakistan. However, in more recent years, the growing demand for biofuel and other use cases within Indonesia have contributed to an increasing pivot towards domestic shipments, particularly given the volatility of international oil prices and international trade dynamics[14].

Overall, despite the imposition of trade restrictions on Indonesian exports of CPO in several overseas markets on the back of deforestation concerns, the palm oil sector remains a priority growth engine for Indonesia. Apart from efforts to promote the positive use cases of palm oil, the government has also increased national production targets from 40 million in 2020 to 52 million metric tonnes in 2021[15].

[10] "Industri Sawit Topang Pertumbuhan Ekonomi". Portal Informasi Indonesia. 21 September 2021.
[11] "Produksi dan Ekspor Minyak Kelapa Sawit di Indonesia", www. Indonesia-investment.com
[12] Interview with Chairman of APKASINDO, Ir. Gulat Manurung, MP., C.APO, 2020
[13] Pengembangan Bioenergi di Indonesia, Peluang dan tantangan kebijakan industri biodiesel, Working Paper 242, Dharmawan, AH, Nuva, Sudaryanti DA, Prameswari AA, et.al, Pusat Penelitian Kehutanan Internasional (CIFOR), 2018
[14] Idem
[15] Idem

Palm oil as an economic driver

Following President Joko Widodo's issuance of the Presidential Instruction Number 6 of 2019 on National Action Plan of Indonesian Sustainable Palm Oil 2019-2024, the government plans to increase palm oil plantation capacity and land settlement, promote CPO as a source of biofuel feedstock, accelerate the progress towards sustainable palm oil, and enhance diplomacy efforts to promote sustainable palm oil at international forums.

From an economic perspective, Indonesia's national biodiesel program provides an important import-substitution policy to wean domestic dependence off crude oil fuels, while buffering the economy against international price volatilities and high export dependency. In particular, estimates by APKASINDO reveal that the B30 program has resulted in a significant reduction in export dependency: since its implementation on 1 January 2020, the domestic share of CPO sales has increased from 22% in 2019 to 33% in 2020[16].

Based on the annual biodiesel allocation of 9,547,506 kL as set out under the Minister of Energy and Mineral Resources Decree No. 199K/20/MEM/2019, Indonesia can also expect to benefit from foreign exchange savings of around IDR 63 billion (USD 4.4 billion)[17]. Due to recent logistical hurdles and economic turbulence caused by the pandemic – which also resulted in a reduction in CPO exports from neighbouring Malaysia – CPO prices have witnessed significant spikes in prices: in a one-year span from April 2019 to April 2020, prices rose from IDR 1,020 to about IDR 1,750[18].

Palm oil as a part of Indonesia's green energy roadmap

Under the biodiesel development strategic plan, a comprehensive series of programs have been put in place by the government to integrate the national biodiesel program with its green energy roadmap and energy security strategy (see Figure 2). Broadly, the national biodiesel program is overseen by the Ministry of Energy and Mineral Resources, implemented by the state-owned enterprise PT Pertamina, and supported by transport industry associations.

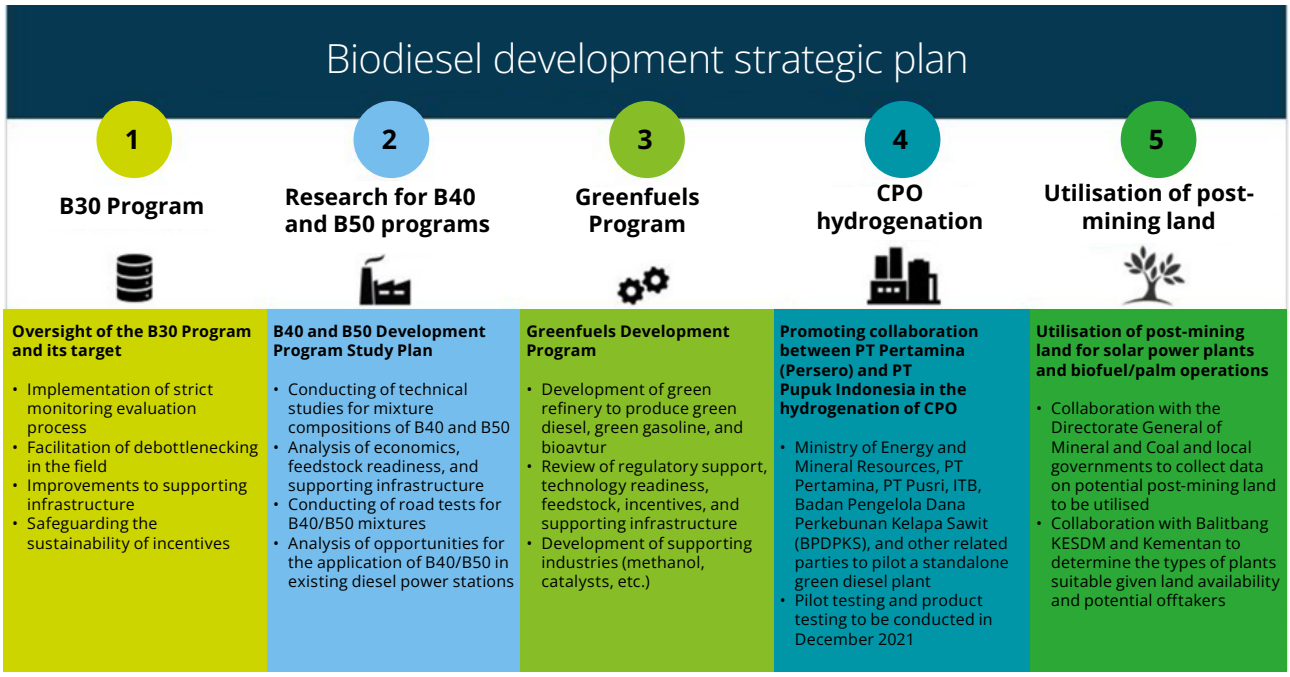
Given that Indonesia's biofuel program relies heavily on its palm oil sector for feedstock, the increasing demand for biodiesel – production levels for domestic energy needs are expected to increase from 8.5 million kL in 2020 to 9.2 million kL in 2021[19] – is likely to translate into an expansion in the total land area of palm oil plantations.

While there are some lingering concerns that this will translate into greater deforestation and therefore higher emissions levels, it must be noted that under Indonesia's NDC, the forestry and agriculture sector is expected to contribute to 17.2% of the overall unconditional 29% reduction in national emissions. With growing land sizes, the palm oil sector will therefore be expected to play a greater role in emissions reduction, whether this is achieved through its use as a renewable energy source in biomass power plants, or potential use cases for plantation waste – also known as palm oil mill effluent (POME) – as another source of bioenergy[20].

To ensure the sustainability of the palm oil and biofuel sectors, the Presidential Regulation Number 44 year 2020 on Certification System of Indonesia Sustainable Palm Oil was also recently enacted to pave the transition away from fossil fuels to greener biofuels by promoting greater global acceptance of Indonesian CPO and increasing its competitiveness in the international market[21].

[16] Interview with Chairman of APKASINDO, Ir. Gulat Manurung, MP., C.APO, 2020
[17] "Pemerintah Serius Capai Target Pemanfaatan Biofuel Dampaknya Luar Biasa", ebtke.esdm.go.id, 6 February 2020
[18] Interview with Chairman of APKASINDO, Ir. Gulat Manurung, MP., C.APO, 2020
[19] "Tok! Biodiesel Domestik Dipatok 9,2 Juta KL di 2021", www.cnbcindonesia.com, 25 December 2020
[20] "Bisakah minyak kelapa sawit masuk ekonomi sirkular?". CIFOR Forests News.
[21] Interview with Directorate General of Plantation, Ministry of Agriculture July 2020

Figure 2: Biodiesel development strategic plan



Source: Directorate General of New, Renewable Energy, and Energy Conservation (EBTKE)

Translation for above graph for graphic designer

Development of biofuels in Indonesia

To promote the greater use of biofuels, Indonesia is investing in efforts to advance the efficacy and uptake of its current B30 biodiesel variant. Looking ahead, however, it is also exploring the usage and production of several other biofuels, including aviation biofuel and biogasoline.

Overview of Indonesia's biodiesel program

On 23 December 2019, President Joko Widodo launched the B30 biodiesel program to reduce Indonesia's dependence on fossil fuels – a central tenet of its energy security policy – with the third amendment to the Minister of Energy and Mineral Resources Regulation no. 32/2008 concerning the provision, utilisation, and biofuel commercial system constituting other types of fuel.

This latest B30 biodiesel program represents a culmination of nearly 14 years' worth of efforts by the government and industry to advance the use of biodiesel in Indonesia. In 2006, the state-owned enterprise PT Pertamina launched a biofuel with a 2.5% biocontent of fatty acid methyl ester (FAME)[22]. Over the years, PT Pertamina worked to increase the component of FAME in its biofuel and promote its usage. By 2017, the biofuel – by now known as the B20 biodiesel with a composition of 20% FAME and 90% diesel – was utilised to fulfil Public Service Obligations (PSO) to the tune of 9.24 million kL per year[23]. The move to a B30 program for biodiesel with a 30% FAME content is therefore the next logical step in this sequence of events.

Overall, the B30 biodiesel program sets out to achieve six main objectives. First and foremost, the program aims to strengthen Indonesia's energy security. Second, by reducing import dependency, it aims to improve Indonesia's trade and foreign exchange balances. Third, it aims to reduce greenhouse gas emissions and enhance the quality of the environment. Fourth, it aims to stabilise CPO prices; and fifth, add economic value to downstream CPO. Last but not least, it also aims to create more jobs and improve the welfare of plantation farmers[24].

By committing to reduce fossil fuel consumption and broad the use of renewable energy sources, Indonesia also hopes that the B30 biodiesel program would contribute to its national sustainability goals as set out in the Paris Agreement's NDC. While there remain several concerns around the use of deforestation techniques in palm oil plantations, biodiesel as an agricultural product in its own right is widely considered to be more environmentally friendly option than fossil fuels[25].

Furthermore, by increasing the domestic demand for CPO and therefore reducing international CPO supply through lower exports, the B30 biodiesel program is expected to have a positive impact on boosting CPO prices and reviving the palm oil sector in Indonesia. In addition, economic activity spurred by agricultural development is also expected to generate an uplift for the economy on a national and local level by expanding the number of employment opportunities for the millions of plantation farmers and workers, as well as those engaged in downstream or upstream activities.

[22] "Peran Pertamina dalam Pengembangan Bisnis Biodiesel dan Bioetanol di Indonesia". Pertamina. 21 November 2006.
[23] "Pengembangan Bioenergi di Indonesia, Peluang dan tantangan kebijakan industri biodiesel". Pusat Penelitian Kehutanan Internasional (CIFOR). 2018.
[24] "Interview with Director of Biodiesel, Directorate General of New Renewable Energy and Energy Conservation". Ministry of Energy and Mineral Resources. 2020.
[25] "Pengembangan Bioenergi di Indonesia, Peluang dan tantangan kebijakan industri biodiesel". Pusat Penelitian Kehutanan Internasional (CIFOR). 2018.

Technical performance of the B30 biodiesel

To prepare for the launch of the latest iteration of the B30 biodiesel, the Ministry of Energy and Mineral Resources, in partnership with other stakeholders – including PT Pertamina, *Badan Pengelola Dana Perkebunan Kelapa Sawit* (BPDPKS), Badan Pengkajian dan Penerapan Teknologi (BPPT), and transport associations such as *Asosiasi Produsen Biofuel Indonesia* (APROBI), Gabungan Industri Kendaraan Bermotor Indonesia (GAIKINDO), and *Ikatan Ahli-ahli Bioenergi Indonesia* (IKABI) – conducted a series of road tests in May and November 2019 for vehicles weighing less than 3.5 tonnes and more than 3.5 tonnes respectively[26] to gain a better understanding of the fuel's performance (see Figure 3).

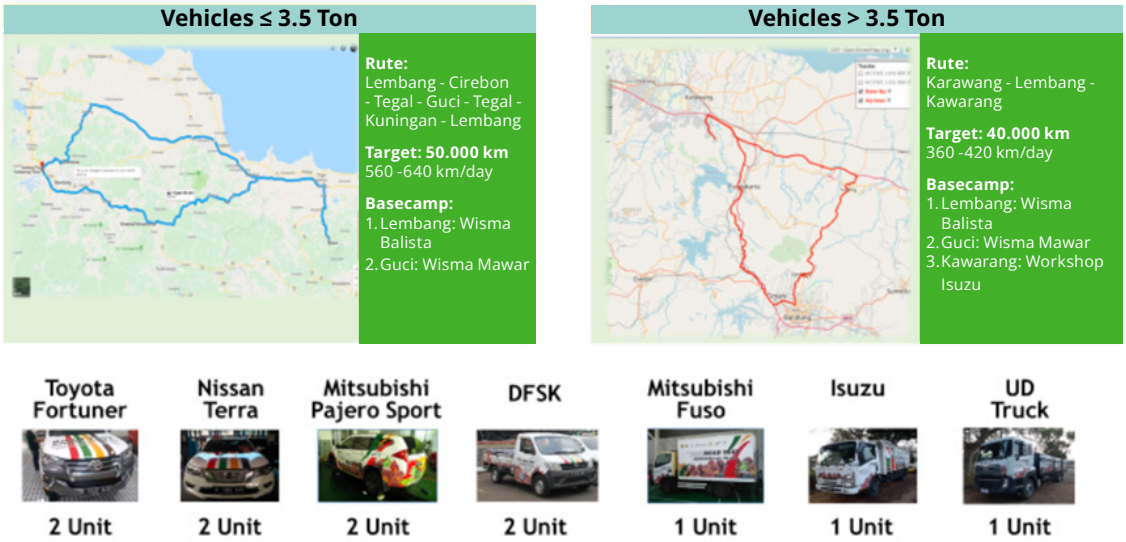
In particular, the road tests had been designed to find out if the B30 biodiesel had been able to overcome some of the shortcomings presented by the previous B20 iteration, which transport players claimed had resulted in a lack of power in engines and shorter service lifetimes of their vehicles. Overall, the results of the road tests were found to be successful: the B30 biodiesel was not only able to increase engine power without exerting a significant detrimental impact on engines, but also generated reduced levels of emissions as compared to the B20 iteration.

The road tests also generated several recommendations for the future development of the biodiesel around its mixing, retention, and distribution processes to maintain quality, as well as issues relating to the frequency of fuel filter changes. In particular, vehicle users may be required to change their fuel filters more regularly when using biodiesel as some of the palm oil-derived components within it can lead to more frequent clogging. To overcome these challenges, transport players also suggested the use of a double fuel filter[27,28], which when coupled with more frequent fuel filter changes can also help to prolong engine life.

Another point raised by industry players relates to the high level of water content in the biodiesel[29], which has the potential to cause damage to engines in the long haul. Specifically, when stored in tanks at gas stations, the water component of the B30 biodiesel – which is hydroscopic in nature due to its 30% FAME content – tends to sediment. This causes water content to increase, and prolonged usage of such fuel in vehicles may result in damage to the fuel filter, and subsequently the engine.

While newer vehicles that are capable of complying with higher emissions standards tend to cope better with this issue, the older vehicles that are still commonly found across Indonesia may run the risk of engine corrosion. This, in turn, may lead to higher costs for trucking businesses, as they would need to replace fuel filters and injection pumps more frequently[30]. To mitigate these risks, transport associations recommend that gas station operations drain water from the biodiesel storage tanks on a more frequent basis, and vehicle owners check their fuel filters more regularly.

Routes and vehicles for the B30 road test



Source: Directorate General of New, Renewable Energy, and Energy Conservation (EBTKE)

[26] "Road Test B30 Menunjukkan Hasil Memuaskan". Badan Pengelola Dana Perkebunan Sawit. 9 September 2020.
[27] "Efek BBM B30 Masih Dikeluhkan". Ini Trik Isuzu.
[28] Interview with Isuzu Astra Motor. January 2021.
[29] Interview with Yohannes Nangoi, Chairman of GAIKINDO. 22 September 2020.
[30] Interview with Sugi Purnoto, Expert at APTRINDO. 29 September 2020.

Looking ahead, Indonesia also plans to continue developing the next B40, and eventually B50 biodiesel iterations (see Figure XX). Other biofuel alternatives leveraging the use of palm and waste oils as feedstock – including hydrotreated vegetable oil (HVO) biodiesel derived from palm fatty acid distillate (PFAD) – are also being considered as alternatives.

HVO, in particular, is considered to be a promising area of development: it can be used not only in biodiesel, but also in the aviation and maritime sectors[31]. Currently, PT Pertamina has already begun exporting HVOs; however, the lack of a mandatory International Sustainability and Carbon Certification (ISCC) remains a key hurdle that it will need to overcome in order to gain access to potential buyers.

Figure 3: Indonesia's biodiesel program roadmap

Short term	• Continuation of B30 program • Adjustments in allocation of B30 based on diesel demand • Provision of additional government funding through BPDPKS • Imposition of export levels that vary with CPO prices
Mid term	• Progress to B40 program • Provision of investment incentives for the development of B40 biodiesel • Issuance of green certificates • Implementation of a carbon tax
Long term	• Development of a green refinery • Provision of investment incentives for the green refinery

Source: CNBC Indonesia[32]

Other biofuels under development

Indonesia's biofuel ambition does not stop with biodiesel. In this section, we will examine two other types of biofuels that are currently under development: aviation biofuel (bioavtur), and biogasoline.

1. Bioavtur

As the global aviation sector looks towards decarbonisation, there has been much interest in the use of bioavtur – including those derived from palm oil, copra, and sugar cane. Of the different variants, palm oil is likely to be the most viable for Indonesia, given its enormous CPO production capacity and ban on the export of copra[33].

In Indonesia, the interest in bioavtur can be traced to at least 2015, when the government held several discussions with aviation industry players on its possible use. However, the narrative at the time did not manifest into concrete action[34]. Later in 2020, when several energy players – including PT Pertamina, Balitbang ESDM, *Badan Pengelola Dana Perkebunan Kelapa Sawit* (BPDPKS), PT Pupuk Indonesia, and Bandung Institute of Technology (ITB) – came together to collaborate on the construction of a biofuel plant in the Pupuk Sriwijaya area of Palembang, South Sumatra[35], greater hopes of avtur developments were spurred amongst industry observers, even though the biofuel plant was not intended for the exclusive production of bioavtur.

To date, the domestic avtur industry continues to struggle to meet the mandatory targets set out in Regulation No. 12/2015 on Biofuel Supply, Utilisation, and Trading as an Alternative Fuel issued by the Ministry of Energy and Mineral Resources, which requires avtur producers to blend at least 3% of biofuels into their avtur mix by 2020, and 5% by 2025 (see Figure 4).

There has, however, been some optimistic recent developments. In December 2020, PT Pertamina's Refinery Unit IV Cilacap conducted a trial on bioavtur derived from refined, bleached, and deodorised palm kernel oil (RBDPKO)[36]. The bioavtur, which has since undergone several trials – including one at the Garuda Maintenance Facility – is expected to come onstream in December 2022[37].

Figure 4: Mandatory composition of biofuels in avtur mix

Transport	2015	2016	2020	2025
Land - Biodiesel (B100)	15%	20%	30%	30%
Land - Bioethanol (E100)	2%	5%	10%	20%
Sea	10%	20%	20%	20%
Air	-	2%	3%	5%

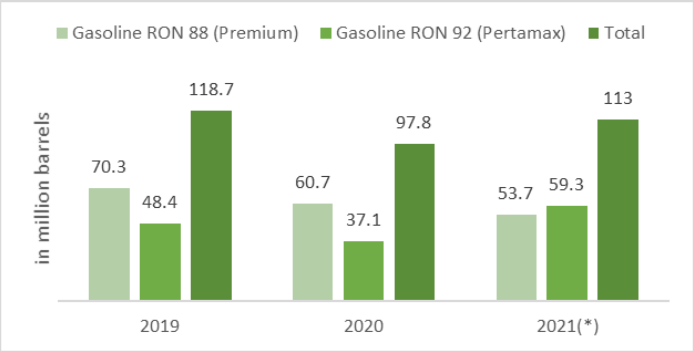
Source: Ministry of Energy and Mineral Resources, 2015.

[31] "HVO/HEFA Overview", www.etipbioenergy.eu
[32] Idem
[33] "Menilik Komoditas Kopra hingga Kemiri Sunan yang Diolah jadi Bioavtur". Katadata. 15 January 2020.
[34] "Pemanfaatan Sawit: Uji Coba Bioavtur pada Pesawat Masih Sulit Dilakukan". Bisnis.com. 9 September 2019.
[35] "Pertamina Dorong Pembangunan Pabrik Contoh Biorefinery". Republika. 5 March 2020.
[36] "Kilang Pertamina Cilacap Uji Coba Produksi Green Diesel & Green Avtur". Pertamina. 15 January 2021.
[37] "Pertamina Optimalkan Green Refinery di Kilang Cilacap". Kementerian Badan Usaha Milik Negara. 4 March 2021.

2. Biogasoline

Energy consumption in Indonesia's transportation sector continues to grow: by 2050, the sector is expected to account for about 38% of Indonesia's energy consumption[38]. According to BPPT, 90% of energy used by the sector is currently sourced from fossil fuels[39], and efforts to phase out the imports of gasoline are still in their infancy. In 2021, for instance, it has been estimated that Indonesia will likely need to import 113 million barrels of gasoline in order to fulfil demand[40] (see Figure 5).

Figure 5: Indonesia's gasoline imports in million barrels (2019-2021)



Source: Pertamina, 2021; Tempo, 2021.

(*) forecast

To reduce Indonesia's import dependence on fossil fuels, a significant shift towards biogasoline alternatives is therefore required. In this regard, one possible solution is the use of methanol-ethanol fuel blends[41]. Earlier in 2020, PT Pertamina – in collaboration with LEMIGAS, the research centre for oil and gas technology development under the Ministry of Energy and Mineral Resources – embarked on a trial to incorporate a mixture of 15% methanol and 5% ethanol into gasoline[42].

Other biogasoline trials conducted by PT Pertamina also include a series based on the use of RBDPO palm oil that was recently conducted in Refinery Unit III Plaju and Refinery Unit IV Cilacap from April 2020[43]. Looking ahead, PT Pertamina has also revealed upcoming plans to build a standalone refinery for the production of biogasoline.

As a sign of its commitment to biogasoline, the government announced in early 2021 the inauguration of PT Katalis Sinergi Indonesia, a chemical company that is more commonly referred to as Katalis Merah Putih. Formed under a strategic collaboration between PT Pertamina Lubricants, PT Pupuk Kujang, and PT Rekacipta Inovasi ITB, the company will serve as a producer of a specific chemical catalyst that is required in the production of biofuel products.

Prior to the establishment of Katalis Merah Putih, Indonesia had to import nearly 100% of its catalyst needs, which totalled to some USD 500 million per year[44]. By producing this catalyst domestically, Katalis Merah Putih is expected to bring palm kernel processing plants closer to plantations[45], spur more inclusive participation from plantation farmers, and generate a multiplier effect in the ecosystem that would benefit not only larger players, but also small-scale farmers.

As compared to the biodiesel market, the biogasoline market is less mature and saturated, and therefore may present more entry opportunities for new domestic players. Biogasoline products may also be more enticing to transportation end-users than biodiesel as they do not require the modification of car engines.

However, as battery-powered cars are a direct substitute to gasoline-powered cars, the extent to which biogasoline will take off in Indonesia is likely to depend not only on Indonesia's national energy policies, but also its electric vehicle (EV) adoption policies. Currently, Indonesia has set a target of reaching more than 2 million EVs by 2025[46], and the government has also demonstrated its commitment to EVs with the issuance of several legislation, such as the Presidential Regulation No. 55 of 2019 on Acceleration of Battery Electric Vehicles Program for Road Transportation.

Looking ahead, a more integrated national policy – one that accounts for the relationship and interdependencies between EVs and biogasoline – is therefore likely to be essential to strike a balance between biogasoline and alternative fuel sources in Indonesia.

[38] "BPPT: Pengembangan BBN ditingkatkan untuk subtitusi BBM", www.antaranews.com, 7 January 2021
[39] "BPPT Pengembangan BBN Ditingkatkan untuk Substitutsi BBM". ANTARA. 7 January 2021.
[40] "Impor BBM Pertamina Bakal Naik 13.5 Persen Jadi 113 Juta Barel Tahun Ini," www.bisnis.tempo.co, 9 February 2021
[41] "2020 Anjlok, Impor Bensin 2021 Diperkirakan Melonjak 54%," www.cnbcindonesia.com, 19 January 2021
[42] "Pertamina Fokus Pengembangan 4 Pilar Energi Terbarukan (EBT)". Kontan. 15 September 2020.
[43] "Pertamina Optimalkan Green Refinery di Kilang Cilacap". Kementerian Badan Usaha Milik Negara. 4 March 2021.
[44] "Masyarakat Biohidrokarbon Kembangkan Katalis Merah Putih ITB". Republika. 26 October 2020.
[45] "Katalis Merah Putih! Solar, Bensin hingga Avtur dari Kelapa Sawit Berkelanjutan". Gabungan Pengusaha Kelapa Sawit Indonesia (GAPKI).
[46] "Target Produksi Mobil dan Motor Listrik 2 Juta Unit pada 2025". CNN Indonesia. 23 February 2021.

The future of biofuel in Indonesia

From a demand and supply perspective, Indonesia's biofuel market possesses much potential for growth. However, sustainability concerns relating to the use palm oil remain a key stumbling block. To overcome these issues, more concerted efforts from financial institutions, government, and biofuel producers will be required.

Demand and supply of biofuels

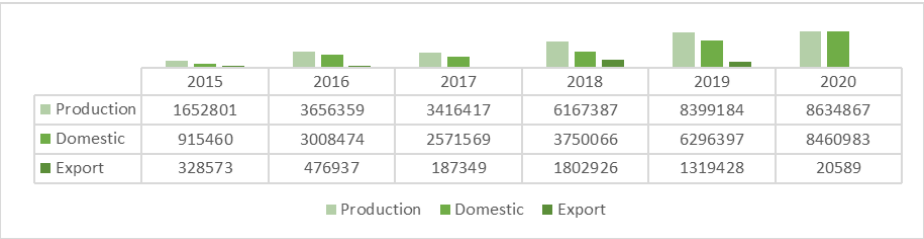
Indonesia's demand for biofuels is driven predominantly by domestic demand, rather than imports. With a growing population and increasing urbanisation, annual national energy consumption has increased by an average of 3% since 2013[47]. This increasing demand for energy – coupled with the government's efforts to shift the economy towards alternative sources of fuels – has resulted in a growing demand for renewable energy: according to BPPT, renewable energy sources contributed to about 11% of Indonesia's primary energy supply in 2018[48].

Given the efforts by the government and industry to increase the utilisation of biofuels in the transport sector under the national biodiesel program, this figure is likely to continue to rise. In the one-year period from 2018 to 2019, biodiesel consumption in Indonesia increased by nearly 40% to reach 3.7 million tonnes[49]. Palm oil-based biofuel, in particular, is expected to account for a significant proportion of energy demand: by 2025, estimates suggest that it will contribute 24% or 24.5 million kL to Indonesia's total fuel needs[50].

The good news is that Indonesia is the largest oil palm producer in the world, and therefore likely to have ample CPO supply to meet these growing demands. At the same time, biodiesel production capacity is also rapidly expanding. Over the last 10 years, Indonesia's overall biodiesel production level has increased more than 35-fold: in 2010, production level was 243,000 kL; by 2020, it had reached 8,634,867 kL (see Figure 6)[51].

In terms of production capacities for the other biofuels under development, PT Pertamina has announced plans to commence the full operations of its Refinery Unit IV Cilacap in December 2021, which is expected to possess the capacity to produce about 6,000 barrels of bioavtur per day[52]. Plans are also in place to increase production capacity to enable Indonesia to reach its annual target of producing 320,000 kL of bioavtur for the domestic market by 2025[53] (see Figure XX).

Figure 6: Biodiesel production, consumption, and export levels (2015-2020)



	2015	2016	2017	2018	2019	2020
Production	1652801	3656359	3416417	6167387	8399184	8634867
Domestic	915460	3008474	2571569	3750066	6296397	8460983
Export	328573	476937	187349	1802926	1319428	20589

[47] "Perkembangan Biodiesel di Indonesia dan Terbesar di Asia," www.gapki.id, 2018
[48] "BPPT Siap Wujudkan Cita-cita Energi Hijau Bagi Pembangunan Nasional," www.bppt.go.id/ 15 September 2020
[49] "Konsumsi Biodiesel Dalam Negeri Mencapai 3.8 Juta Ton di tahun 2018, Kompas.com, 6 February 2019
[50] Masyarakat Biohidrokarbon Indonesia, 2019 obtained from BPDP Please cite source in consistent format
[51] "BPDPKS Siap Melaksanakan Program Green Fuel Sesuai RPJMN 2020-2024,"BPDPKS Press Release, 3 February 2020
[52] "Pertamina Bidik Produksi Kilang Green Avtur di Cilacap Dimulai Akhir 2021". 6 March 2021.
[53] "Indonesian Aviation Biofuel and Renewable Energy Initiatives, Presentation ICAO Seminar on Alternative Fuels, 2017.

Figure 7: PT Pertamina's bioavtur production targets (2017-2024)

Source: ICAO Seminar on Alternative Fuels, 2017.

While fewer concrete plans have been announced for biogasoline to date, some indications of an upcoming push towards biogasoline can already be seen: for example, the Ministry of Energy and Mineral Resources had earlier revealed plans to promote the development of gasoline products immediately after the B30 and B40 biodisesel products have been launched[54].

Addressing sustainability issues in the palm oil sector

While the palm oil sector is the main provider of feedstock required to drive the growth of biofuels in Indonesia, its poor sustainability track record – including deforestation practices, unsustainable land use, and contribution to food insecurity – remains its main stumbling block. The sector's sustainability reputation, in particular, has resulted in a number of significant negative impacts on export sales and capital inflows, as customers and investors alike seek to distance themselves from associations with palm oil. In October 2018, for example, Nestlé announced that it will cease its partnership with Indofood Agri Resources on the back of sustainability concerns[55].

Sustainability concerns have also driven several important European markets to place restrictions on the import of palm oil, with others requiring that all palm oil imports must obtain the Roundtable on Sustainable Palm Oil (RSPO) certification. Under changes to the Renewable Energy Directive announced by the European Parliament in January 2018, the use of palm oil-derived biofuels will also be banned in European Union countries after 2021.

When compounded, these developments would exacerbate the capital issues faced by the palm oil sector – and in turn affect their ability to conduct research & development (R&D) activities or invest in innovation to improve yields and the overall sustainability of the palm oil ecosystem. There are, however, several ways in which these sustainability challenges can be turned into valuable financing and investment opportunities for the sector:

- **Sustainable finance and green bonds**
  Many financial institutions hold significant agriculture portfolios and are therefore in a unique position to drive the adoption of sustainable practices in the sector. By integrating environmental, social, and governance (ESG) considerations into their investment considerations, financial institutions can innovate to create new financial products – for example, those with investment criteria requiring biofuel producers to ensure traceability across their entire supply chain – that would incentivise industry action against deforestation and other sustainability issues.

  On the flip side, biofuel producers also stand to benefit from the use of these sustainable products. By adopting sustainability strategies, they could gain access to new forms of financial products, such as green bonds, that would provide them with the capital to expand their production and development capacity. By improving their overall sustainability track record, they would also be able to position themselves to gain greater access to overseas export markets.

  Some traction in sustainable financing schemes can already be seen in Indonesia. Under Indonesia's Regulation on the Issuance and the Terms of Green Bond POJK 60, biofuel producers are now permitted to issue green bonds for biofuel development if they can fulfil several requirements relating to climate change mitigation.

[54] "Habis B20 dan E100, Ini Bensin Hijau yang Dikembangkan RI," www.cnbcindonesia.com, 26 October 2018
[55] "Nestle dan Indofood Sepakat Akhiri Usaha Patungan, Begini Gambarannya," www.kontan.co.id, 3 October 2018

- **Government incentives for biofuel producers**
  Currently, the palm oil plantation fund management agency BPDPKS provides biodiesel companies with a number of incentives through a system of levies to buffer them against fluctuating CPO prices, and maintain their price competitiveness against subsidised conventional diesel.

  In addition, the BPDPKS also disburses funding for priority plantation activities, including those relating to capacity building, R&D, promotion, replanting, and construction of facilities and infrastructure. From 2015 to 2018, about 70% of the total IDR 47 trillion disbursed in palm oil levies have been channelled towards the national biodiesel program[56]. To promote a more concerted industry shift towards sustainability initiatives, government incentives – particularly in the form financing support that is tied to green outcomes – will therefore be crucial.

Next steps for biofuel producers

As an urgent next step, biofuel producers must now turn their attention towards addressing the sustainability aspects of the palm oil sector. This would entail three broad steps. Firstly, biofuel producers must develop an integrated sustainability roadmap with ESG criteria to guide their corporate strategy, and ensure that all decisions that are being made are in lie with these considerations.

Secondly, they must achieve transparency and traceability of the entire supply chain, down to individual plantations. This will not only ensure visibility over the sustainability efforts of all supply chain players, but may also provide opportunities for biofuel producers to identify and mitigate potential supply chain risks.

Finally, biofuel producers will need to shift towards a more integrated reporting process. As sustainability reporting is increasingly viewed by investors and businesses to be equally important as financial reporting, biofuel producers can also benefit from a better reporting of their progress in sustainability initiatives as that would enable them to gain access to more markets and greater capital.

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[56] "Indonesia Environment Fund: Bridging the Financing Gap in Environmental Programs," Climate Policy Initiative, April 2020

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