Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis
P-ISSN: 2460-4321, E-ISSN: 2579-8340
Volume 10, Nomor 2, Juli 2024: 3622-3630

The Impact of Indonesian Crude Oil Demand Prices on the Indonesian Biodiesel Industry

Dampak Harga Permintaan Minyak Mentah Indonesia Terhadap Masyarakat Indonesia Industri Biodiesel

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(Diterima 04-07-2024; Disetujui 27-07-2024)

ABSTRACT

Biodiesel is one of Indonesia's potential export commodities as there is a production surplus that occurs every year from 2006 to 2020. The study used the 2SLS method with a validation and simultaneous equation model. Data processing using SAS/ETS version 9.4. The purpose of this study is to analyze the impact of Indonesia's crude oil demand price on Indonesia's biodiesel industry. The findings indicate that the demand for Indonesian biodiesel is positively impacted by a rise in the global real price of crude oil by 0.11%. This increase is due to both the biodiesel industry's and the local market's need for Indonesian palm oil. The local price of Indonesian biodiesel would rise by 0.49% due to the increase in demand for the fuel. The amount of biodiesel produced in Indonesia will increase by 0.87%, this increase in production is due to increasing domestic demand for Indonesian palm oil, and the volume of biodiesel exported to destination countries will increase by 0.01%. Exports of palm oil may be more impacted by the policy of raising the actual world price of crude oil. This implies that the program may potentially result in a rise in raw material exports. On the other hand, the biodiesel industry and other industries also see a spike in palm oil as a result of the strategy of raising the real world price of crude oil.

Keywords: Biodiesel, crude oil, demand, fossil

ABSTRAK

Biodiesel merupakan salah satu komoditas ekspor Indonesia yang potensial karena terdapat surplus produksi yang terjadi setiap tahunnya pada tahun 2006 hingga tahun 2020. Penelitian menggunakan metode 2SLS dengan model validasi dan persamaan simultan. Pengolahan data menggunakan SAS/ETS versi 9.4. Tujuan dari penelitian ini adalah untuk menganalisis dampak harga permintaan minyak mentah Indonesia terhadap industri biodiesel Indonesia. Temuan menunjukkan bahwa permintaan biodiesel Indonesia dipengaruhi secara positif oleh kenaikan harga riil minyak mentah dunia sebesar 0,11%. Peningkatan ini disebabkan oleh kebutuhan industri biodiesel dan pasar lokal terhadap minyak sawit Indonesia. Harga biodiesel Indonesia akan naik sebesar 0,49% karena peningkatan permintaan bahan bakar. Jumlah biodiesel yang diproduksi di Indonesia akan meningkat sebesar 0,87%, peningkatan produksi ini disebabkan oleh meningkatnya permintaan minyak sawit Indonesia dalam negeri, dan volume biodiesel yang diekspor ke negara tujuan akan meningkat sebesar 0,01%. Ekspor minyak sawit mungkin lebih terkena dampak kebijakan kenaikan harga minyak mentah dunia. Hal tersebut menunjukkan bahwa program ini berpotensi meningkatkan ekspor bahan mentah. Di sisi lain, industri biodiesel dan industri lainnya juga mengalami lonjakan harga minyak sawit sebagai dampak dari strategi kenaikan harga minyak mentah dunia.

Kata Kunci: Biodiesel, minyak mentah, permintaan, fosil

INTRODUCTION

Energy sources are one of the determining factors of a country's economic growth. Energy is essential to the industrialization process, an important determinant of production and as part of the export structure (Stern, 2011). Energy has a positive impact on economic growth (Gozgor et al., 2018), making energy demand a fundamental aspect. The Ministry of Energy and Mineral

Resources (ESDM) (2021) reports that Indonesia's crude oil production decreased by 3.37% from 745.14 thousand barrels of oil per day (BOPD) in 2019 to 719.99 BOPD in 2020. The economic rebound in 2021 raised crude oil prices to about USD 70 per barrel from about USD 20 per barrel in mid-2020, following a shock demand and supply due to Covid-19 since 2020 (International Energy Agency, 2022). Indonesia's trade balance is impacted by the rise in oil prices worldwide because these nations are now importers of oil due to a lack of substantial increases in investment and production capacity in the oil industry. In the oil and gas industry, Indonesia's imports increased by 27.14% between January 2017 and September 2018, leaving a USD 9.4 billion trade imbalance (Sahara et al., 2022).

The impact of climate change and the issue of petroleum scarcity necessitate the supply of environmentally friendly energy sources. One of the alternative energy sources is biofuels derived from various raw materials from biomass processed through the utilization of conversion technology (Hoekman et al., 2012). The development of such energy arises to deal with the limitations of fossil energy in meeting public demand (Zah & Ruddy, 2009). The demand for this type of energy is predicted to continue to increase along with the growth of the world's population and the development of industrial activities. The production growth of both biofuels in the global market shows a positive trend as shown in Figure 1.

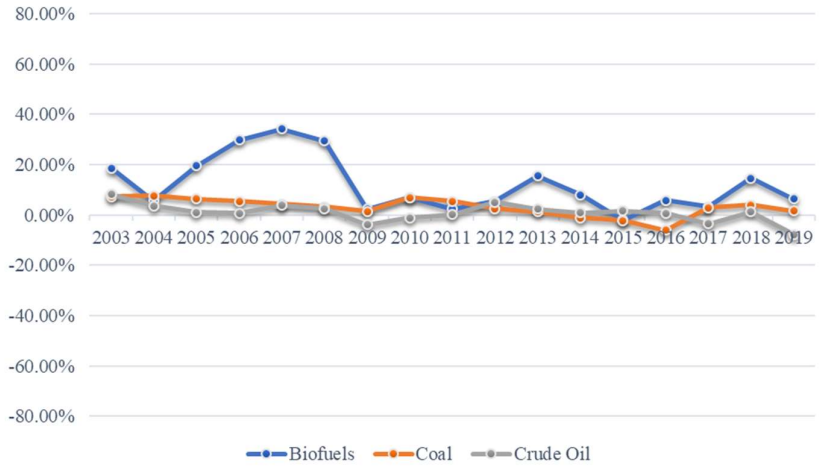

Figure 1. Production Growth of Energy Sources in the World
Source: (EIA, 2020); (JODY, 2020)

Figure 1 shows that the growth of biofuel production has dramatically increased compared to the two fossil fuel sources (crude oil and coal). The growth rate has outperformed both fossil fuels over the period 2003 to 2019. The production side of biofuels shows that there is potential for these fuels in the future. However, the growth of biofuel production has tended to decline since 2010 although it still outperformed fossil fuel use during the observation period. In addition to the supply side, the consumption uptake of biofuels is also considered to see the overall potential.

Biodiesel can be made from biomass raw materials, such as palm oil, and is a renewable energy source whose availability is more guaranteed because the resource can be renewed. Biodiesel is very important in Indonesia because it can be used directly as a substitute fuel or as a mixture of diesel oil for diesel vehicles without undergoing a modification process.

Basically, the economics of energy resources is not only determined by the price of the energy source itself, but also by the price of similar energy sources that will be competed. The higher the price of crude oil, the higher the price of refinery products such as diesel oil (ADO), premium and fuel oil, so that the increase will result in a smaller difference between the price of biodiesel and fuel, making biodiesel economically attractive to be used as an alternative energy source (Santoso, 2014).

Indonesia is the world's biggest producer of palm oil, accounting for around half of the total supply. Undoubtedly, there are certain obstacles associated with palm oil. These include the growing scarcity of fossil fuels, fluctuations in the pricing of fossil fuels, and the widening trade deficit

P-ISSN: 2460-4321, E-ISSN: 2579-8340
Volume 10, Nomor 2, Juli 2024: 3622-3630

within the oil industry. In order to raise the added value of palm oil, stabilize domestic production of crude palm oil, and boost farmer incomes, the Indonesian government has implemented a biodiesel development policy. Implementation of the B30 mandate faces several challenges, one of which is the increase in the price of crude palm oil (CPO), especially in 2023 which highlights the sustainability of raw materials for the biodiesel program because it will be more profitable to export crude palm oil than to fulfill the biodiesel program. Funding for this program requires large government subsidies.

Indonesia's current energy policy is the mandatory use of palm oil-based biodiesel B-15, B-20 and B-30 developed by the current Indonesian government. In 2020, the mandatory B-30 policy was implemented in order to increase domestic biodiesel consumption. This aims to improve the country's crude oil-dependent trade balance. The legal basis for the implementation of the mandatory biofuel program is the Mandatory Biofuel Program through Minister of Energy and Mineral Resources Regulation No. 32/2008 on the Provision, Utilization, and Commerce of Biofuel as Other Fuel as last amended by Minister of Energy and Mineral Resources Regulation No. 12/2015.

Increasing fuel consumption and declining domestic crude oil production have made Indonesia highly dependent on fuel imports. Another problem is the uncertainty of fuel prices that fluctuate with world crude oil prices and the low purchasing power of the public, causing the government to subsidize prices so that people can access fuel at affordable prices (Saputra et al., 2021) (Winardi et al., 2017). Therefore, the author conducted a study with the aim of analyzing the impact of Indonesia's crude oil demand price on Indonesia's biodiesel industry. The research will use validation and historical policy scenario simulations with (1) Indonesian DMO (Domestic Market Obligation) scenarios; (2) Changes in the world price of crude oil; (3) Increase in domestic palm oil supply.

RESEARCH METHODS

This research employs 48 observations of monthly time series secondary data from January 2018 to December 2021. The secondary data collected are data on CPO production, CPO exports, CPO domestic real price, biodiesel domestic real price, cooking oil domestic real price, CPO world real price, rubber world real price, biodiesel production and biodiesel exports. The data is sourced from various agencies, namely the Central Statistics Agency (BPS), the Directorate General of New Renewable Energy and Energy Conservation of the Ministry of Energy and Mineral Resources, The World Bank, Databoks, UN Comtrade, the National Strategic Food Price Information Center (PIHPS), and so on. The research uses the 2SLS method with a simultaneous equation model to determine the relationship between exogenous variables and endogenous variables in a simultaneous relationship. The 2SLS method is a method used to estimate the parameters of the equation model simultaneously. This method is used to replace the OLS method which is caused by correlation between the endogenous independent variable and error The Statistical Analysis System / Econometric Time Series Software (SAS/ETS) version 9.4 and Microsoft Office Excel are used for data processing. In his study, which is a component of the investigation into the supply and demand of CPO and its derivative products (Novindra et al., 2019). The specification of the research model is given via dynamic simultaneous equations. The 2SLS (two-stage least squares) approach was used to estimate the model's structural equation parameter.

Model validation aims to find out whether the model is valid to use to simulate alternative impacts of changes in palm oil and biodiesel policies. Model validation is comparing the predicted value and actual value of each endogenous variable. The statistical criterion used for validation is Theil's Inequality Coefficient (U-Theil). The impact analysis aims to analyze the impact of Indonesia's crude oil demand price on Indonesia's biodiesel industry which is carried out by simulating historical policy scenarios. Historical simulations were carried out on several upstream to downstream sectors in the form of domestic policies and policies that support trade, and mandatory Indonesian palm oil biodiesel. Domestic policies and trade policies with efforts to increase upstream and downstream productivity through government policies regarding palm oil rejuvenation programs, increasing world prices for crude oil and domestic quota policies in the form of increasing the supply of Indonesian palm oil. Domestic policy simulation instruments and policies that support trade and productivity of Indonesian palm oil are presented in Table 1 below.

Simulation

Impact analysis was conducted by simulating historical policy scenarios.

Table 1. Simulation scenarios of domestic policies and biodiesel mandatories

Simulation	Change	Basic consideration
S1: DMO Domestik Market Obligation) Indonesia	The demand for palm oil by the biodiesel industry will increase by 10% in 2021.	Ministry of Energy and Mineral Resources policy for 2020 that in 2021 the target of biodiesel blending is 30% (B-30) and biodiesel exports increase by 451,288.4 tonnes in 2021.
S2: Changes in the world price of crude oil	World price of crude oil up 50%	The world price of crude oil in 2021 is US$ 74.10/barrel. The average world price of crude oil during the simulation period was US$ 23.15/barrel
S3: Increase in domestic palm oil supply	Indonesian palm oil supply will increase by 10% in 2020-2021.	There is a government policy that requires every palm oil entrepreneur to supply palm oil for the needs of the domestic downstream palm oil industry.

RESULTS AND DISCUSSION

Validation of the Indonesian palm oil and biodiesel trade model in the period January 2018 to December 2021 shows that endogenous variables with a U-Theil value of less than 0.3 are 78.57 percent. This shows that during the historical simulation period January 2018 to December 2021 the predicted values of the endogenous variables are quite close to their actual values. The U-Theil indicator value shows a good criteria model for simulating the impact of policies on several endogenous variables. Therefore, this model is good to use to simulate the impact analysis of Indonesian palm oil and biodiesel trade policies.

Based on Figure 2. shows that the highest world crude oil export destinations are in Germany by 24%, Netherlands by 15%, Belgium 13%, Slovakia 8% and so on. The development of Indonesia's crude oil prices in the international market is one of the factors that has a significant effect on changes in the state budget both in terms of state revenue and state expenditure. On the state revenue side, changes in crude oil prices affect oil and gas SDA revenues and oil and gas income tax and others derived from the sale of DMO (Domestic Market Obligation) crude oil. On the state expenditure side, changes in crude oil prices affect the amount of fuel and electricity subsidies and revenue sharing funds. Fuel subsidies are highly affected by changes in the price of Indonesian crude oil because most of the fuel production costs of fuel subsidy operators are the costs of procuring crude oil.

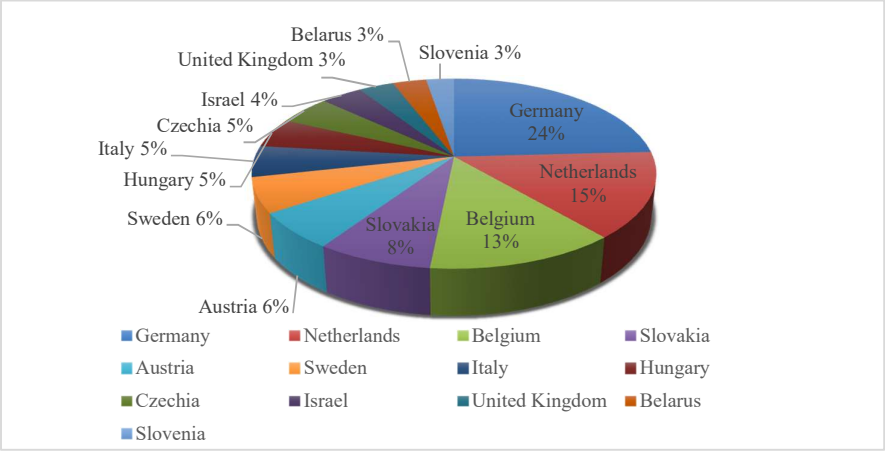

Figure 2. World Crude Oil Export Destinations 2012 to 2021

Developments in the price of Indonesian crude oil on the international market are one of the factors that have a significant influence on changes in the state budget, both in terms of state revenue and state spending. On the state revenue side, changes in crude oil prices affect oil and gas natural

P-ISSN: 2460-4321, E-ISSN: 2579-8340
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resources revenues and oil and gas PPh as well as others from the sale of DMO (Domestic Market Obligation) crude oil. On the state spending side, changes in crude oil prices affect the amount of fuel subsidies and electricity subsidies as well as revenue-sharing funds. Fuel subsidies are highly affected by changes in Indonesian crude oil prices because most of the fuel production costs from fuel subsidy operators are costs for crude oil procurement.

The growth of Indonesia's biodiesel exports to the world market in aggregate tended to fluctuate from 2012 to 2019. Meanwhile, when grouped based on export destination countries as shown in Table 2, most destination countries have negative export growth. There are two export destination countries that have positive export growth, namely Belgium and South Korea. The development of Indonesia's biodiesel exports was due to an increase in domestic consumption along with the implementation of the mandatory B-20 policy in 2016, B-30 in 2020 and B-35 in 2023 as an implication of the government's policy to utilize crude palm oil. When compared to other competing countries, Indonesia has relatively fewer export destinations. This is because competing countries, one of which is Malaysia, have focused on exporting downstream products. Indonesia has actually established a downstream roadmap for palm oil derivative products including biodiesel as a step to control global crude palm oil prices. However, there are still several obstacles, especially in terms of infrastructure, misalignment between other industrial growth, various issues in international trade, foreign private sector investment, technological problems, innovation costs, cost inefficiencies and supply chain problems in the palm oil industry (Azahari, 2019).

Table 2. Indonesian Biodiesel Exports to Destination Countries (In Thousands of USD)

Country of Destination	Export (HS 382600 and HS 271020)		Growth (%)
	2018	2019	
Belgium	20430	39906	95.33
China	425980	360059	-15.48
India	5028	617	-87.73
Italy	28429	13980	-50.82
Netherlands	121308	57532	-50.82
South Korea	892	3252	264.59
Singapore	1155	0.031	-100
Spanish	362337	192813	-46.79
Malaysia	24063	0.024	-100

Source: UN Comtrade (2022)

An increase in the real world price of crude oil has an impact on increasing Indonesia's biodiesel demand by 0.11% (Siregar, 2023). Crude oil is a substitute commodity for palm oil as a raw material for producing biodiesel and other industries in the world vegetable oil market. The simulation results show that with the increase in demand for Indonesian biodiesel, the domestic price of Indonesian biodiesel will increase by 0.49%. The biodiesel industry's demand for palm oil increased by 0.01%, this occurred in response to the real increase in global crude oil prices, while local demand for Indonesian palm oil increased by 0.04%. Increasing domestic demand for Indonesian palm oil will cause Indonesian biodiesel production to increase by 0.87%, while increasing biodiesel production in Indonesia will cause the volume of biodiesel exports to be exported to destination countries to increase by 0.01%.

Exports are sales of domestically produced goods to foreign markets with the involvement of four actors: exporters, importers, transportation providers and governments (Christian & MBT, 2019). (Murti, 2017) the simulation results show that the rise of 18,80 percent in the world crude oil led the real price of Indonesia's CPO exports to be increased by 11.860 percent. The increase in the real price of CPO exports due to the increasing number of CPO used is going to produce biodiesel as a commodity crude oil substitute. Whether it is the government or individual companies that will conduct export activities, the biggest challenge in selecting export destination markets is to utilize a country's capital resources to increase the value of exports in the right and attractive export destination markets. Therefore, focusing on resource allocation to support the right export markets is an effort that needs to be made on the downstream side of palm oil derivative products, namely Indonesian biodiesel. Increased exports of Indonesian biodiesel will result in an increase in domestic biodiesel supply, which will affect state revenue. This is in line with the research of (Gaur, 2016), changes in crude oil prices affect the CPI (Consumer Price Index) and GDP in India. (Purba et al., 2018) reducing Indonesian exports will reduce world exports so that the world price

of palm oil will increase. In the domestic market, the supply of palm oil increased and caused domestic prices to continue to decline. This decline in prices has led to an increase in demand for palm oil by the cooking oil industry, biodiesel industry and other industries. The increase in demand for palm oil by the biodiesel industry has opened up opportunities to implement a mandatory biodiesel program which has been responded to by increasing production followed by increased exports and supply of Indonesian biodiesel.

Research (Purba et al., 2018) examined the impact of trade policy on the development of Indonesia's biodiesel industry. The analysis used is an econometric model with a simultaneous equation system with 27 structural equations and 9 identity equations through Two Stage Least Squares (2SLS) estimation during the 1990-2015 period. The result is that there is a positive impact of increasing Indonesia's palm oil export tax and the EU import ban on the development of Indonesia's biodiesel industry, but a negative impact on Indonesia's foreign exchange earnings although this can be overcome by the replanting policy. Therefore, Domestic Market Obligation (DMO) and replanting policies are recommended to deal with the palm oil import ban. (Pradana et al., 2021)discussed the analysis of factors affecting Indonesia's biodiesel exports in the European Union using multiple linear regression analysis. The result is that European biodiesel production and consumption also affect the increase in biodiesel exports. While other external factors such as the rupiah exchange rate, Indonesian biodiesel consumption, anti-dumping duty policy dummy, international biodiesel prices and diesel consumption have a negative influence on biodiesel exports in the European Union.

Table 3 . The Impact of The World Crude Oil Price Policy on The Indonesian Biodiesel Industry

Variable	Variable Name	Unit	Base Value	Change (%)
				S1
LAMSM	Total area of producing Indonesian palm oil	000 ha	17321.2	0.004
YSI	Indonesian palm oil productivity	tons/ha	2.4274	0 .003
QCPO	Indonesian palm oil production	Million tons	38224.3	0.097
SCPOI	Indonesian CPO domestic supply	000 tons	33264.9	0.089
RDCPO	The real domestic price of palm oil	IDR/kg	8353.0	-0.010
RPXCPO	The real export price of CPO	US$/ton	684.8	-0.015
XCPO	CPO export	000 tons	5256.7	0.160
QDCPOBI	Demand for CPO by the biodiesel industry	000 tons	951.0	0.010
QDCPOIL	CPO demand by other industries	000 tons	4596.5	0.002
QDCPOI	Domestic demand for Indonesian CPO	000 tons	5348.3	0.041
QPBI	Indonesian biodiesel production	000 tons	7254.7	0.872
XBII	Indonesian biodiesel export	000 tons	19334.2	0.018
SBII	Indonesian biodiesel domestic supply	000 tons	6478.2	3.895
QBII	Indonesian biodiesel demand	000 tons	7517.8	0.118
RPDBI	Domestic price of biodiesel	Rp/ton	8275.2	0.499

Source: (Processed Data, 2023)

Indonesia's exports of palm oil increased by 0.16% as a result of the rise in the actual price of crude oil. The increase in palm oil exports was due to an increase in palm oil production by 0.09%, so that the area and productivity increased by 0.004% and 0.003%. With the increase in palm oil exports, the real price of palm oil exports will decrease by 0.01%. The increase in the real world price of crude oil has an impact on downstream energy and food and is estimated to be greatest for Indonesian palm oil exports. The increasing demand for palm oil by the biodiesel industry will increase Indonesia's biodiesel production by 0.05% so that it will have an impact on biodiesel exports which will increase by 0.02%. The results of this research are in line with the research of (Hartoyo et al., 2011), stated that the increase in world prices of crude oil during the 2003-2007 period encouraged an increase in the use of alternative fuels (biodiesel). If the world price of crude oil increases by 30% every year, then the total export value will increase by 1%. The increase in world prices for crude oil has had a positive impact on the trading performance of palm oil, rapeseed oil and the Indonesian biodiesel industry.

Biodiesel is one of Indonesia's potential export commodities as there is a production surplus that occurs every year from 2006 to 2020. In addition, Indonesia in average exports from 2012 to 2020 is also included in the top ten global biodiesel exporters. The increase in global energy consumption is signaled to continue to rise, along with the growth of the world's population and the increase in production in terms of GDP. At the same time, environmental issues due to the

continuous use of fossil fuels, as well as limited reserves of petroleum and coal as the main ingredients for fossil fuels also support the existence of emerging biofuel products including Biodiesel. By purchasing and selling a specific quantity of crude oil at a fixed price at a specific future date, investors can reduce the risk associated with changes in the price of crude oil by engaging in crude oil futures trading. West Texas Light and Low Sulfur Crude Oil Futures (WTI) and North Sea Brent Crude Oil Futures (Brent) have emerged as the standard for international oil prices as a result of the expanding global oil trade and the ongoing development of the futures market.

Numerous problems pertaining to crude oil and the downstream palm oil sector in Indonesia, where the price of palm oil decreased 31% YoY in March 2015. ((Lestari & Oktavilia, 2020) (Johari et al., 2015) (Irawan et al., 2021)) said that there was a fall in demand and an excess supply of palm oil, which was the cause of the price decline. But according to (Nugraheni, M.Sc. & Inayah, 2022) ; (Priyati & Tyers, 2016), changes in the price of crude oil are what drive changes in the price of palm oil. Simultaneously, one of the downstream products of palm oil, the biodiesel business, is on the edge of bankruptcy. The decline in crude oil prices and the imposition of anti-dumping duties by the European Union on Indonesian biodiesel (Zuhdi et al., 2021) have stopped biodiesel exports. The decline in demand for biodiesel made the utilization of the biodiesel industry below 30 percent in 2015. Biodiesel production was only 1.65 million kilo liters of the total installed capacity of 7.5 million kilo liters.

CONCLUSION

Price enhancement the actual oil world's raw impact on price enhancement Indonesia's demand for biodiesel will rise, and this will result in an improvement in the price of Indonesia's domestic biodiesel. Improvement of the price of raw oil in the real world was met by a rise in demand for domestic Indonesian palm oil and requests for oil palm by the biodiesel industry. Indonesia is producing more biodiesel as a result of rising domestic demand for Indonesian palm oil. An increase in the overall volume of biodiesel exports to the destination country will arise from Indonesia's improved biodiesel production.

The development of the biodiesel industry really needs to be carried out through increasing technological innovation in the future which is expected to be able to support the downstream palm oil strategy, one of which is downstream energy through accelerating replanting activities because it can increase palm oil productivity and domestic prices as well as increase foreign exchange for exports of palm oil and biodiesel. Indonesia should develop an integrated and sustainable downstream palm oil industry. This will enable regional and national economic growth and create more jobs.

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P-ISSN: 2460-4321, E-ISSN: 2579-8340
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