FFTC Agricultural Policy Platform (FFTC-AP)
Available online at: http://ap.fftc.agnet.org/index.php

Perspective of B-100 Biofuel Policy and Programs in Indonesia

Iqbal Rafani
Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS)
Email: iqbalrafani@gmail.com

ABSTRACT

Energy still has an important role and is a strategic sector in the national economy of Indonesia. Due to limited availability of fossil energy, it is necessary to find other alternative energy sources. Biofuel is viewed as a renewable energy that can be developed as a counterbalance or even a substitute for fossil energy. One of the renewable energy types is B-100 biofuel. The perspective of B-100 biofuel is quite promising. The most readily available raw material, especially in terms of quantity, to produce biofuel is crude palm oil due to Indonesia's rapid jump in palm oil production in the past year. It is expected to realize mandatory B-100 biofuel in the future. In view of this perspective, the government of Indonesia has provided price incentive to encourage the national biofuel industry. Above all, some regulations have been issued addressing the implementation program of biofuel in the country.

Keywords: biofuel, B-100, perspective, policy, program, implementation, Indonesia

INTRODUCTION

It is believed that energy is one of basic needs to sustain human life globally. In the case of Indonesia, energy still has an important role and is a strategic sector in national economy. It is not only as a main source of state revenue, but also supplies energy requirements, provides industrial raw materials, creates employment, attracts investments, and encourages economic growth.

As the world's population increases, there will also be hard competition over access to resources consequently. Due to limited availability of fossil energy, it is necessary to find other alternative energy sources. Bioenergy is expected to be able to replace the significant function of fossil energy.

Recently, bioenergy has become an actual topic in Indonesia (Dharmawan *et al*, 2018 and Agustian, 2015). First, bioenergy is viewed as one of solutions to overcome the problem of energy security. Second, bioenergy is a motivation driven to respond to the adverse effects of greenhouse emissions of using fossil energy. Third, bioenergy development can be used as an instrument to control commodity price, including agricultural commodities. *Fourth*, bioenergy is one of solutions triggering economy through agricultural development.

The development policy supporting the implementation of bioenergy is necessary. One of the essential bioenergy criteria is B-100 biofuel. This article presents the perspective of B-100 biofuel development in Indonesia. It discusses non-renewable and renewable energies comprising of fossil fuel, biofuel, and B-100 biofuel viewpoints.

NON-RENEWABLE AND RENEWABLE ENERGIES

Based on the process and the availability of its sources, energy can be divided into two criteria, namely non-renewable energy and renewable energy. The former is energy which cannot be recovered or requires a very long process such as fossil fuels. The latter is simply collected from renewable resources which are naturally replenished. Biofuel is viewed as a renewable energy source that can be developed as a counterbalance or even a substitute for fossil energy (Sulaiman *et al*, 2019).

Fossil fuel

According to Kopp (2019), fossil fuel is any of a class of hydrocarbon-containing materials of biological origin occurring within the Earth's crust that can be used as a source of energy. Among other things, it includes coal, petroleum, natural gas, tar sands, and heavy oils.

The process of forming fossil energy actually takes place continuously. However, since the transformation process is very long, the rate of increase in fossil energy resource reserves is faster than its use, so the volume of reserves tends to or cannot recover as much as the initial stock. Therefore, fossil energy is classified as non-renewable energy.

Hubbert (Anonymous, 2019) mentioned that a fossil fuel production first increasing following discovery of new resources and improved extraction methods, peaking, and then ultimately declining as resources became depleted. In other words, fossil fuels (coal, oil and gas) are finite – consume them for long enough and global resources will eventually run out.

In the case of Indonesia, the national energy still relies on fossil fuels, gas, and coal up to present. It is primarily consumed by households (33%), followed by transportation (29.31%), and industry (22.19%). The extent of household consumption tends to increase due to dietary changes in line with population growth and community welfare improvement, while the transportation is such influenced by the number of vehicles, and industry is determined by the development of economic activities.

One of fossil fuels is petroleum (oil fuel). The national production of petroleum reached its highest level in 2000s, but it is expected to decrease until 2025. This situation indicates a threat to the national resilience energy. To overcome this threat, Indonesia carries out petroleum imports which was getting higher starting in 2007 and would expect to continually increase until 2025 (Dharmawan *et al*, 2018). Moreover, government revenues from upstream oil and gas have rapidly declined in Indonesia, namely from 35% of the total (7% of Growth National Product/GDP) in 2001 to just 6% (<1% of GDP) in 2016. In the future, the decline in government revenues from fossil fuels is going to continue (IISD, 2019). It is particularly because there is a long-standing downward trend in oil fuel exports in Indonesia, as a result of decline in production and increase in domestic consumption (Figure 1). Hence, an alternative energy in the form of bioenergy as a new renewable energy is one of the solutions to reduce import pressures and to overcome energy security threats.

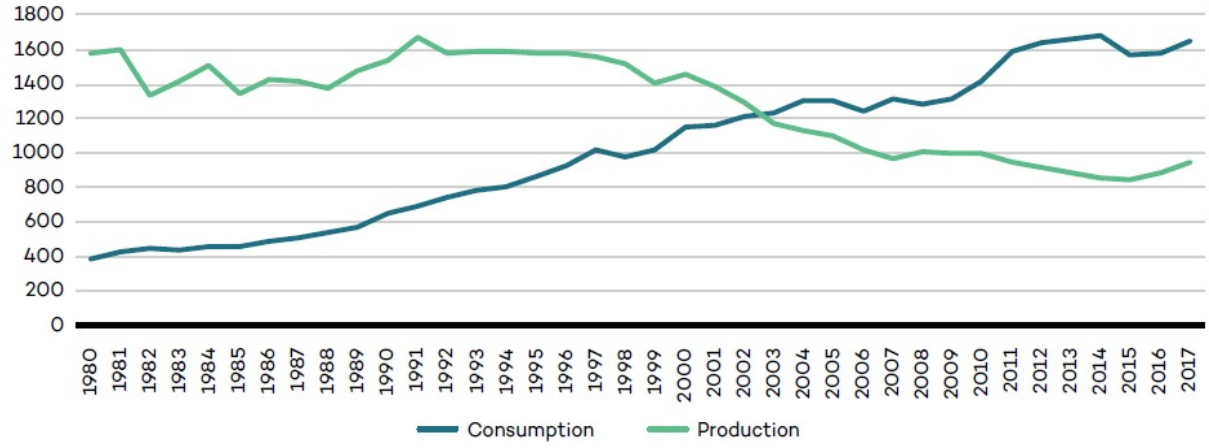

Figure 1. Production vs. consumption of petroleum oil fuels in Indonesia, 1980-2017 (000 barrels/day) (Source: IISD, 2019)

Biofuel

Biofuel is one of bioenergy types obtained from biological organisms or organic materials. In other words, biofuel is simply energy made from living matter, usually plants. Biodiesel, bioethanol, and biogas are among other types of biofuel. Biofuels are considered renewable energy, emit less than fossil fuel, and have received increasing attention in the transition to a low-carbon economy. As a result, it is expected that biofuels are able to replace the important role of non-renewable energy sources namely fossil fuels.

First, biofuels have some advantages comparing to other energy sources. Those are: (1) Being able to substitute fossil fuels that dominate the current energy mix; (2) Being renewable (more readily available and sustainable); (3) Provides economic benefits (competitiveness); (3) Poses less risk to human health and safety (biodegradable); and (4) Reduces harmful emissions-lowering impact on the environment (environmentally friendly).

Second, biofuels are technically the best substitution for fossil fuels for several reasons. They are: (1) Chemical molecules of fossil fuels and biofuels are both hydrocarbon base because those come from organic matters; (2) Physical form of fossil fuels and biofuels are comparable, which can be in the form of solid, liquid (oil), and gas; and (3) Technological advances have enabled various types of biofuels that are commensurate with fossil fuels both in terms of chemical and physical possessions.

Third, biofuels are more environmentally friendly than fossil fuels. As an example, a comprehensive review of the United States Environment Protection Agency (US-EPA) shows that biodiesel (part of biofuel) is far more environmentally friendly than petrodiesel. The indicator of environmentally friendly on the impact of fossil fuel is more specifically referred to carbon dioxide (CO_2). However, the effect on CO_2 emission is highly dependent on production methods and the type of feedstock used.

Considering the emissions from fossil fuel and biofuel use, it typically focuses on major pollutants such as hydrocarbons. Total hydrocarbon emissions of biodiesel are 67% lower than those of petrodiesel. Moreover, carbon monoxide emissions of biodiesel are 48% lower than petrodiesel. Ozone biodiesel emissions are also relatively small which reach 50% comparing to petrodiesel (Table 1).

Table 1. Average Level of Biodiesel Emissions relative to Petrodiesel (%)

Emission element	Biodiesel (B100)	Petrodiesel (B20)
Total unburned hydrocarbons	-67	-20
Carbon monoxide	-48	-12
Particulate matter	-47	-12
Nitrogen oxide	+10	+2 to -2
Sulfates	-100	-20[*]
Polycyclic Aromatic Hydrocarbon (PAH)[**]	-80	-13
Nitrated PAH (nPAH)[**]	-90	-50[***]
Ozone potential of speciated hydrocarbons	-50	-10

Note: [*] Estimated from B100 result
[**] Average reduction across all compounds measured
[***] 2-nitroflorine results where within test method variability
Source: US-EPA (2001)

Many countries have legalized the production and commercial use of biofuels with certain provisions and standards. Currently, the common practice is through blending system. The use of biofuels is carried out as a mixture of fossil fuels starting from low level namely 5% (B-5), then increase to 10% (B-10) and 20% (B-20), and so on. Indonesia has implemented B-20 as a mandatory policy since 2018. This confirms that Indonesia decides to make biofuels as a major energy source for the future, including B-100 biofuel.

B-100 Biofuel

During the period of 2016-2050, it is predicted that the average growth rate of GDP of Indonesia is about 6.04 percent per year with population growth of 0.71% yearly, resulting final energy demand growth of 5.30% annually. It is estimated to require energy of 4,569 barrel of oil equivalent (BOE) in 2050 (Figure 2). The largest proportion still dominated by oil fuels, namely about 40.1%. However, the proportion of biofuels tends to increase. It is also challenging, particularly in line with the use of B-100 biofuel.

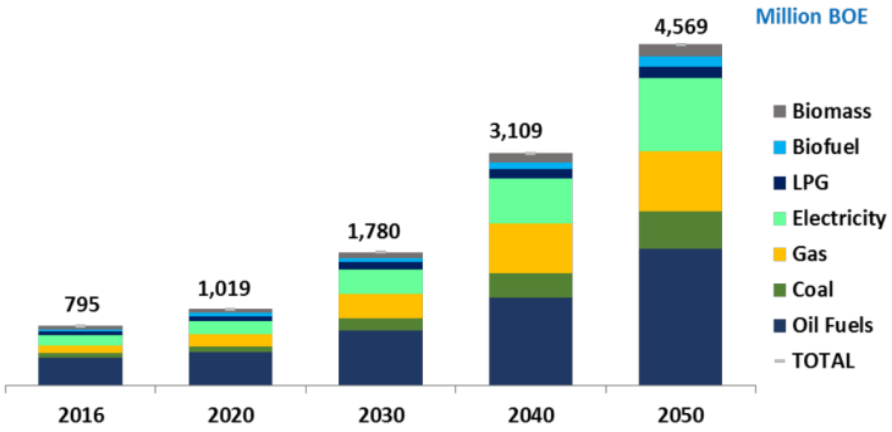

Figure 2. Final energy requirements per type (Source: BPPT, 2018 in Sulaiman *et al*, 2019)

B-100 biofuel (pure biodiesel) is typically used as a blend stock to produce lower blends of fuel. B-100 biofuel has a solvent effect, and it can clean a vehicle's fuel system and release deposits accumulated from petroleum diesel use. The most readily available raw material, especially in terms of quantity, to produce biofuel is Crude Palm Oil (CPO). It was noted that Indonesia's rapid jump in palm oil production in the past year. Consequently, increasing biofuel production is strategically implemented to encourage the B-20 and B-30 in short-term programs and B-100 for the long-term program. However, B-100 biofuel still faces the problems in terms of incentive and price affecting the consequences.

A problem that frequently arises related to the implementation of mandatory biofuel is price disparity between market price indexes of oil fuels and biofuels. It is required to recognize economic analysis of biofuels particularly with regard to its production cost and market price index. Table 2 shows that to produce biofuel-based CPO requires cost of Rp 8,471.5 per liter. The largest component cost was CPO raw material, namely Rp 6,124.6 or about 72.3% of total production cost. It was followed by methanol (14.7%).

Table 2. Production cost of B-100 biofuel, February 2019 (Rp/liter)

Component	Volume	Price (Rp/unit)	Cost (Rp/liter)
Operational Cost:			
CPO*)	1.13 liters	5,420 ($US 0.39)/ liter	6,124.60 ($US 0.44)
KOH	16.95 grams	200,000 ($US 14.29)/kg	197.00($US 0.01)
Methanol	124.3 milliliters	10,000 ($US 0.71)/liter	1,243.00 ($US 0.09)
Water	169.5 milliliters	17,500 ($US 1.24)/$m^3$	2.97 ($US 0.00)
Labor**)	1 person	200 ($US 0.01)/liter	200,00 ($US 0.01)
Electricity	0.076 kwh	605 ($US 0.04)/kwh	45.98 ($US 0.00)
ALB testing, filtering	1 liter biofuel	90,000 ($US 6.43)/1,000 liter	90.00 ($US 0.01)
Fixed Cost			568.00 ($US 0.04)
	Total Cost		8,471.55 ($US 0.61)

Note: *]rendement (87%)
**] work performance base-daily labor wage of Rp 100,000 ($US 7.14) (500 liter/person/day)
Source: ICECRD (2019) in Sulaiman *et al* (2019)

It was realized that the above production cost calculation was still at research level. The production cost of biofuel (Rp 8,471 ($US 0.61)/liter) was relatively higher comparing to its market price index in aggregate (Rp 7,470 ($US 0.53)/liter).

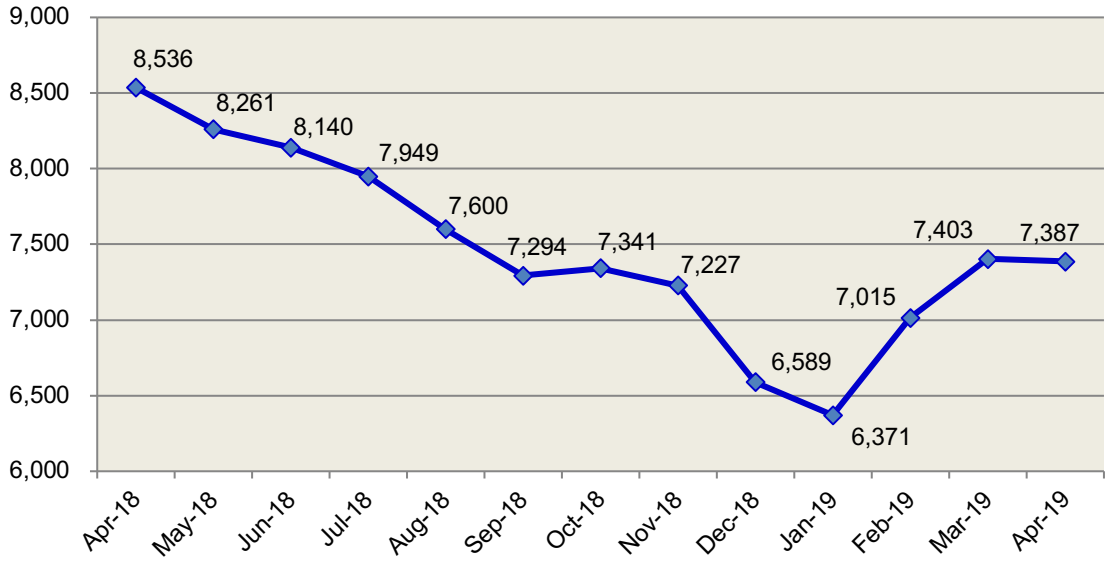

Figure 3. Market price index of biofuels, April 2018 to April 2019 (Rp/liter)
(Source: ESDM, 2019 in Sulaiman *et al*, 2019)

In order to encourage national biofuel industry, the government of Indonesia has provided price incentive based on Ministerial Decree of Energy and Mineral Resources (Sulaiman *et al*, 2019). The market price index of biofuel was formulated based on the average price of CPO + USD 100/ton x 870 kg/m^3 + transportation cost.

Biofuel Development Challenges

The development of biofuel using 100% bioethanol as a substitute for fossil fuel has certain challenges particularly in line with environment conservation and mechanical principle. The former is related to the feedstock supply, while the latter is associated with the utilization of biofuel.

Environment conservation

Using extracted material of palm oil offers great potential as a cost-effective feedstock for biofuel. However, the conflict in oil palm plantation in Indonesia has been hotly debated from various sides. Facing the international pressure with negative issues is a challenge to biofuel development in the country.

The government of Indonesia (GoI) has certain policies in response to the sustainable indicators such as conservation, sustainability, and/or biodiversity. The emission reduction target is part of overall commitment in reducing greenhouse gas emissions of 29% in 2030 and up to 41% with international assistance.

The GoI has also issued the Presidential Instruction Number 8/2018 concerning moratorium on new palm oil development and ordered a review of existing plantations as well as boost the productivity of oil palm plantations. The moratorium will be within three years which simultaneously aims at improving the management of sustainable palm oil plantations. It also provides legal certainty and protects the environment.

Besides oil palm, the GoI has an alternative plan to provide feedstock supply for biofuel from sub-optimal lands such as ex-mining and reservoir buffer lands. One of prospective plants is *sunan* candlenut (*Aleurites trisperma blanco*). The reclamation of ex-mining land and the utilization of reservoir buffer land with certain appropriate feedstock plants will not only meet future energy needs but also maintain and improve the quality of biodiversity and environment sustainability.

Mechanical principle

Prior to use, biofuel must be analyzed to ensure it meets the requirements of existing quality standards. The determination of biodiesel standards from one country to another is different because it is adjusted to the availability of raw materials, the type of engine used, as well as emissions regulations, and fuel standards in each country. In case of Indonesia, it is decided to refer the ASTM D6751 standard implemented in the United States.

It is challenged that the quality of biofuel used must be monitored continuously towards the applicable of the Indonesian National Standard (*Standar Nasional Indonesia/SNI*). The static engine test was carried out for agricultural machinery such has tractor. The results concluded that B-100 Biofuel can be efficiently and effectively used as an alternative fuel for diesel engines. Nevertheless, the continuous further testing is still required to ensure that B-100 Biofuel is categorically appropriate for use.

CONCLUSION

The development of biofuels has been carried out since 2006 based on Presidential Regulation Number 1/2006 concerning the supply and utilization of biofuels. It involves 13 ministries as well as provincial and district/city government units. It was stated that the duties of the Ministry of Agriculture were particularly: (1) Encouraging supply of raw material plants for biofuel, including seed/seedling provisions; (2) Carrying out extension activities concerning raw material plants for biofuels; (3) Facilitating seed/seedling of raw material plants for biofuels; and (4) Integrating development of cultivation and postharvest activities of raw material plants.

In line with Government Regulation Number 79/2014 and Presidential Regulation Number 22/2017 respectively governs National Energy Policy and National Energy Plan, the Ministry of Agriculture has several tasks. Those are: (1) Promoting the cultivation of non-food biomass plants: (2) Prioritizing the use of raw material plants for biofuels from new sources outside of priority food crops; (3) Preparing the road map of priority plant types for biofuel raw materials; and (4) Assuring the availability of CPO to meet the needs of domestic biofuel industries.

In 2019, the government of Indonesia decides the expansion of mandatory biofuel at least 20 percent pure biofuel (B-20) for all sector users. It also plans to enhance the mandatory policy of biofuel blends at least 30 percent (B-30) by 2025. President of the Republic of Indonesia, Joko Widodo, expresses his intention and hopes to realize the mandatory B-100 biofuel in the country. Thus, in order to meet the target of supplying energy sources from renewable materials, the use of biofuels is initiated to be implemented in various sectors.

Overall, the consistency of long-term policy in the development of biofuels becomes very important. It is reasonable since investing in biofuel production requires a very large cost and involves many stakeholders including research.

REFERENCES

Agustian, A. 2015. *Pengembangan Bioenergi di Sektor Pertanian: Potensi dan Kendala Pengembangan Bioenergi Berbahan Baku Ubikayu* (Bioenergy Development in the Agricultural Sector: Potential and Constraints of Cassava Bioenergy Development). Agricultural Policy Analysis Journal, Vol. 13 (1), June 2015: 19-38. Indonesian Center for Agricultural Socio Economic and Policy Studies. Bogor, Indonesia.

Anonymous. 2019. Hubbert's Peak Theory. Retrieved from http://www.globalization101.org/c-hubberts-peak-theory/ (14 September 2019)

Bappenas. 2015. *Kajian Pengembangan Bahan Bakar Nabati* (Assessment of Biofuel Development). National Development Planning Agency. Jakarta, Indonesia.

Dharmawan AH, Nuva, Sudaryanti DA, Prameswari AA, Amalia R, and Dermawan A. 2018. *Pengembangan Bioenergi di Indonesia: Peluang dan Tantangan Kebijakan Industri Biodiesel* (Energy Development in Indonesia: Biodiesel Energy Policy Opportunity and Challenges). Working Paper 242. Center for International Forestry Research (CIFOR). Bogor, Indonesia.

GoI. 2017. Government Regulation Number 22/2017 on *Rencana Umum Energi Nasional/RUEN* (General Plan of National Energy). Government of Indonesia, Jakarta, Indonesia.

IISD. 2019 Beyond Fossil Fuels: Indonesia's Fiscal Transition. International Institute for Sustainable Development. Canada.

Sulaiman, AA, K. Subagyono, F. Djufry, P. Simatupang, D. Soetopo, M. Syukur, D. Pranowo, M. Herman, A. Aunillah, and B. Prastowo. 2019. *Biofuel B 100: Energi Masa Depan Dunia* (Biofuel B-100 Biofuel: World's Future Energy). IAARD Press. Jakarta, Indonesia.

US-EPA. 2001. Biodiesel Emissions. United States Environmental Agency. Retrieved from https://www.biodieselsustainability.com/better-for-the-environment/biodiesel-emissions/ (24 October 2019)

Date submitted: October 3, 2019
Reviewed, edited and uploaded: November 8, 2019