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Analysis Bioavtur for Energy Security

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Abstract

In 2014, Avtur commodities in Indonesia, recorded a deficit of 0.9 million kiloliters. This situation are not profitable, both economically and energy security. This aim of research is exposing clearly about the condition of national energy resources, the development of biofuels (especially bioavtur) and policies that support the production and use of bioavtur. This study used a qualitative approach with descriptive analysis. Data sources obtained from in-depth interviews with the institutions related to the energy field, air transport, the biofuels industry (bioavtur) and farmer groups/associations of oil palm plantations. The results is there are a variety of biological sources in Indonesia that can be used bioavtur such as algae, pecans, coconut, and palm oil. Opportunities and prospects bioavtur market in Indonesia is promising. Future studies are necessary to improve the economics of the plant-based oil bioavtur because Indonesia has large oil supply source.

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Pada tahun 2014, avtur komoditas di Indonesia, mencatat defisit sebesar 0,9 juta kiloliter. Situasi ini tidak menguntungkan, baik secara ekonomi dan keamanan energi. Tujuan penelitian ini adalah mengungkap dengan jelas tentang kondisi sumber daya energi nasional, pengembangan biofuel (terutama bioavtur) dan kebijakan yang mendukung produksi dan penggunaan bioavtur. Penelitian ini menggunakan pendekatan kualitatif dengan analisis deskriptif. sumber data yang diperoleh dari wawancara mendalam dengan lembaga-lembaga yang terkait dengan bidang

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energi, transportasi udara, industri biofuel (bioavtur) dan kelompok tani / asosiasi perkebunan kelapa sawit. Hasil ini ada berbagai sumber hayati di Indonesia yang dapat digunakan bioavtur seperti ganggang, kemiri, kelapa, dan minyak sawit. Peluang dan prospek pasar bioavtur di Indonesia cukup menjanjikan. Studi masa depan diperlukan untuk meningkatkan ekonomi dari bioavtur minyak nabati karena Indonesia memiliki sumber pasokan minyak besar.

Introduction

Fuel shortages certain types such as diesel oil and Avtur oil (Jet Fuel), imported from the China country, Japan, Singapore, and the European Union. One of the refined products are imported kerosene used for cooking and aircraft fuel. Avtur is a kind of kerosene with special specifications, especially the boiling point and freezing. Kerosene production by domestic refineries are not able to suffice the country need so that the government must comply through the import Avtur from abroad.

Indonesia avtur consumption in 2014 totaled 4.2 million kiloliters (KL) while production from domestic refineries only reached 3.3 million KL, so the balance Avtur commodities recorded a deficit of 0.9 million KL. This situation are not profitable for the country, both economically and energy security. One of those opportunities to overcome deficit Avtur commodities are used bioavtur.

Bioavtur generated by hydrogenesis technology, ie splitting vegetable oils component with hydrogen. Unsaturated triglycerides (vegetable oil component) hydrogenated into saturated fatty acids and propane (C3H8). Saturated fatty acids are redecarboxylation and hydrogenated to hydrocarbons.

Compared with Avtur produced from petroleum refineries, bioavtur has advantages more environmentally friendly, as well as lubrication and cleaning machine properties (thus affecting the performance of the machine). However, although it does not require modifications to the engine fuel

vehicles, bioavtur have a tendency to freeze faster, and specific consumption (usage amount for the same performance) greater 4.5% to 6.0%.

It has been proven by Eller, Varga, & Hancsók (2016) who study the production of jet fuel from natural triglycerides (technical grade coconut oil) with special hydrocracking (hydrogenation of olefinic double bonds, propane split, hydrodeoxygenation, decarbonylation and decarboxylation) with lower chemical and energy costs, less harmful material emission and better economy. This means significant chemical and operation cost decreasing, less energy consumption, moreover less harmful material emission.

In abroad, many efforts have been made bioavtur of some types of vegetable oils, such as castor oil, camelina oil, and oil microalgae. Increasing avtur prices is one reason why the airline will begin to look bioavtur as an alternative fuel. The combination of these factors led to the development of processes for the conversion of animal fats, vegetable oils and biomass into paraffinic hydrocarbons that could make use of existing pyrolysis, hydrotreatment and cracking technologies that already exist in petroleum refineries (ÉcoRessources Consultants, 2012).

The first test performed on aircraft flying from São José dos Campos to Brasília using pure biokerosene (no added minerals traditional kerosene) called cent. Seames and Aulich (2008) with the synthesis process technology bioavtur using raw materials soybean oil and canola oil. While, McCall et al. (2009) using the raw material for refined soybean oil (Refined bleached deodorised / RBD) and Bradin (2011) with the raw material crude soybean oil, pure soybean oil, corn oil, Rapseed oil, and cottonseed oil.

Companies biofuel from Brazil in cooperation with NASA and Boeing in 2006 to develop aircraft fuel in the form of biokerosene called jet biofuel using transesterification reaction. The successful development of plant-based fuel technology is followed by several success other airlines. The aviation

industry is actively searching for replacements for conventional jet fuel through the use of biofuels. Air New Zealand and Continental Airlines have recently performed two successful test flights (Air New Zealand, 2008; ATW, 2009). Furthermore, Virgin Atlantic (2008) reports successful test flights using biofuel. For the moment biofuels is more of a problem for the aviation industry due to the issue with FAME. Production of bio-jet fuels has so far only been for research purposes and far from on an industrial scale.

In Indonesia, the source of raw materials bioavtur diverse enough, but based on availability, palm kernel oil and coconut meat is a potential candidate. Currently, Indonesia is the largest palm oil producing countries in the world; Crude Palm Oil (CPO) of national palm oil production in 2014, reaching 29.5 million tons and is expected to reach 61.06 million tons in 2030. Location bioavtur production of CPO is the islands which is central to the production of palm oil plants, ie Sumatra and Kalimantan. Meanwhile oil also has the potential to be used as raw materials bioavtur. Coconut oil advantages compared CPO is 98% of the area is people's plantation. But the consumption of fresh coconut and variations of oil production inside the country a very high so that production for Crude Coconut Oil (CCO) only 700-800 tons / year.

Research has been carried out by various institutions such as Pertamina, Agency for Assessment and Application of Technology (Indonesia: Badan Pengkajian dan Penerapan Teknologi (BPPT)), Institute of Oil and Gas (Indonesia: Lembaga Minyak dan Gas Bumi (Lemigas)), and universities to study the manufacture and utilization bioavtur as a substitute or Avtur mixture for aircraft fuel. The Ministry of Transportation is targeting bioavtur consumption by 2% of all aviation fuel supply can be realized at 2016 to reduce dependence on fossil fuels. Bioavtur program for the aircraft also has been a priority of the Director General of New and Renewable Energy and Energy Conservation (Indonesia: Energi Baru dan Terbarukan dan Konservasi Energi (EBT-KE)). Bioavtur user penetration is done in stages and is expected to reduce fuel consumption (energy

diversification), increasing national energy security and reduce greenhouse gas emissions as energy security factors

Jet Fuel (Avtur)

Avtur or Jet Fuel or ATF (Aviation Turbine Fuel) is an aircraft fuel with gas turbine engines. The most common avtur type used for commercial airlines are Jet A and Jet-A1. Another type jet fuel is Jet-B is used for cold weather. Avtur is a mixture of light hydrocarbons with the amount chain destillate carbon constrained by the products requirements such as the freezing point or smoke point. Kerosene type Avtur (including Jet A and Jet-A1) has a the amount chains of carbon atoms between 8 and 16 (carbon atoms per molecule); while naphtha type Avtur (including Jet-B), has a the amount chains of carbon atoms between 5 and 15.

The dominant fuel is jet fuel originating from crude oil as it is used in all large aircraft. Jet fuel is almost exclusively extracted from the kerosene fraction of crude oil, which distills between the gasoline fraction and the diesel fraction. The IEA has estimated that the world's total refinery production in 2006 at 3861 million tonnes (Mt). The aviation fuel part was 6.3%, implying an annual aviation fuel production of 243 Mt (corresponding to about 5 Mb/d), including both jet fuel and aviation gasoline (IEA, 2008).

Bioavtur Economical

Almost all jet fuel of today is manufactured from crude oil (Liu, Yan, & Chen, 2013). A relatively small percentage is made from three unconventional sources of petroleum—Canadian oil sands, Venezuelan VHOs, and oil shale (Liu, Yan, & Chen, 2013; Long, et. al., 2007; Jiang, et al., 2008; Al-Otoom, et. al., 2009; Kok and Pamir, 2000). Alternative fuels are the future of the aviation industry today (Blakey, Rye, & Wilson, 2011).

The aviation industry can expect alternative fuel potential environmental interests of the reduction of greenhouse gas emissions and useful economic life cycle with an increase in the availability of fuel and fuel costs are lower (Bailis and Bake,

2010). Bioavtur economical studies conducted abroad with various kinds of raw materials to produce figures presented on the table below::

Table 1. Economical Bioavtur from Various Raw Materials Production

	Pongamia	Sugarcane	Algae
Total Capital Investment ($M)	$506	$259	$3,451
Annual Operating Cost ($M)	$303	$253	$984
Facility--dependent Costs[1,2]	31.93%	18.84%	84.17%
Raw Materials[1]	57.86%	70.89%	10.11%
Utilities[1]	5.56%	8.13%	4.43%
Labor Cost[1]	4.53%	2.14%	1.25%
Consumables[1]	0.12%	0.01%	0.04%
The minimum sale price ($/bbl)	$373.68	$301.35	$1,343.18

[1] As percentage of annual operating cost
[2] Facility-dependent costs include depreciation, maintenance,insurance and overhead

Sugarcane raw material showed the cost per barrel lower than Pongamia and algae. Starting in 2016 every liter of Avtur should be mixed with 2% of biofuels or bioavtur. However, with bioavtur aircraft fuel price more expensive than Avtur.

In Indonesia, cost calculation bioavtur of oil crops still are approximate. According to Heru Setiawan (Vice President of Corporate Strategic Planning of Pertamina Company), these process about 70-80% of CPO price. Most of the petroleum products that can be based on renewable biofuel as oil was more expensive than conventional. With a biofuel mix only 2% not burdensome for airlines and passengers as end user. Currently, avtur price engaged in the average rate of USD 12,000 / liter to Rp 15,000 / liter, while CPO price more expensive than fuel price, then bioavtur price more than Rp 15,000 per liter. It certainly would be burden on airlines. With airline operating costs 30%-40% for fuel, the price is more expensive bioavtur 20%-30% than regular jet fuel prices.

Bioavtur for Environment

Boeing estimates that biofuels could reduce greenhouse gas emissions by 60 to 80 percent. Began in 2016, Indonesian government imposed mandatory rules to mix 2% biofuel-based oil into Avtur. According to Garuda Indonesia Airlines Company, use bioavtur only helps reduce exhaust gas and save on fuel usage. According Novianto,

Operations Director of Garuda Indonesia Airlines Company, although there is no cost savings, but the exhaust emissions of CO2 and sulfur is reduced more by nearly 50%. All aircraft types using fuel types bioavtur generally specification better than Avtur.

Energy Policy

In accordance with Presidential Decree No. 5 of 2006, the National Energy Policy, known as "Scenario National Energy Mix", it was determined in 2025 the energy use from biofuels expected to reach 5%, equivalent to 4.7 million kiloliters. These rates are equivalent to 22.26 million kiloliters of biofuel, which will supply biodiesel amounted to 10.22 million kiloliters.

National Energy Policy is formulated are periodically (within 10 years), began in 1981, 1987, 1991, 2003, and next. Currently, National energy policy has contained in the Decree of the Minister of Energy and Mineral Resources as Chairman of the National Energy Coordinating Agency about National Energy Management 2005-2015.

The government has establish policies on the use of biofuels (biodiesel, bioethanol, pure vegetable oil, bioavtur) for substitution of fuel oil. However, there has been no policy governing bioavtur. While biodiesel Regulation can be seen on the table 2. Directorate General of New Energy, Renewable and Energy Conservation forming Aviation Biofuel and Renewable Energy Task Force (ABRETF), consisting from various airlines, universities, and research centers. ABRETF program can be seen on figure 2.

Table 2. Biodiesel Policy in Indonesia

Level of Policy	Policy
Constitution	• Act No. 39/2014 • Act No. 30/2007
Regulation of Government and Presidential	• Government Regulation No. 24/2015 • Government Regulation No. 79/2014 • Presidential Regulation No. 61/2015
Ministerial Regulation	**Ministry of Finance** • Ministerial Regulation No..133/2015 • Ministerial Regulation No. 113/2015 • Ministerial Regulation No. 136/2015

Level of Policy	Policy
Directorate General	**Ministry of Trade** • Ministerial Regulation No. 748/2015 • Ministerial Regulation No. 54/2015 • Ministerial Regulation No. 748/2015 • Ministerial Regulation No. 74/2015 **Ministry of Energy and Mineral Resources** • Ministerial Regulation No. 12/2015 • Ministerial Regulation No. 29/2015 • Ministerial Regulation No. 3239/2015 • Decision Directorate General of New Energy, Renewable and Energy Conservation No. 723K/10/DJE/2013

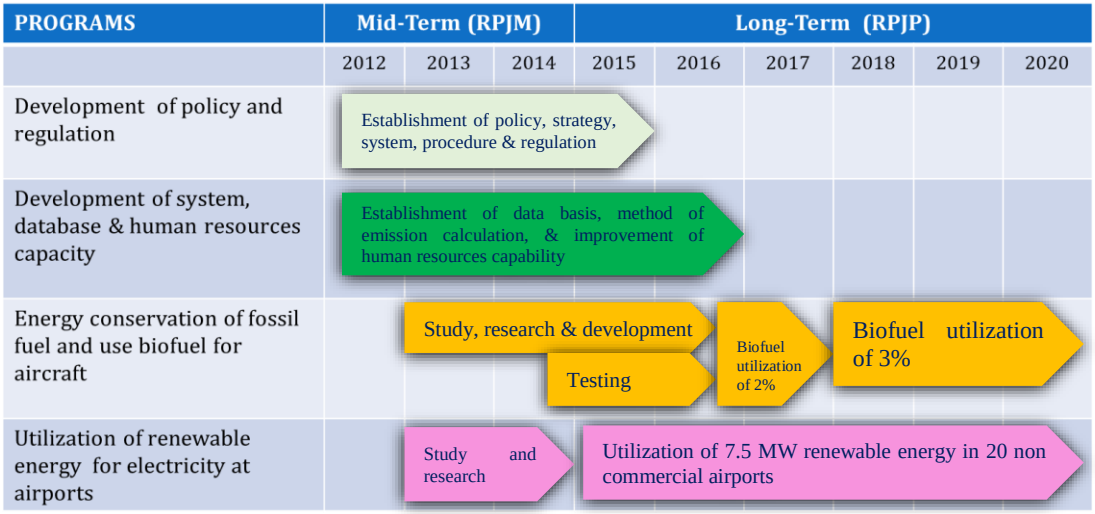

Figure 2. Plan of Biofuel Utilization and Renewable Energy to airplane

Research Method

This study used a qualitative approach. Qualitative research is an approach to understanding and deepen the meaning of individual or group social issues and human problems. In addition, qualitative research started by using assumptions and interpretive framework or theory that can shape or influence the studies that are being studied (Creswell, 2014).

This research method using descriptive analysis, with the intention of exposing clearly about the condition of national energy resources, the development of biofuels (especially bioavtur) and policies that support the production and use of bioavtur, as well as analysis of the use of bioavtur as fuel on the aircraft, and its prospects in

the future, and its relation to resistance national energy.

Data sources obtained from in-depth interviews with the institutions related to the energy field, air transport, the biofuels industry (bioavtur) and farmer groups or associations of oil palm plantations. Data collected through interviews, documentary studies, focus group discussions, and observations.

Result and Discussion

The Potential Bioavtur Calculation

The calculation of bioavtur supply potential in this study based on sources bioavtur kernel oil palm fruit; Palm plantation area in Indonesia by 2013 are 7.9 million hectares; Acquisition of fresh fruit bunches (Indonesia: Tandan Buah Segar (TBS)) on palm oil plantations in Indonesia was 13.2 tons hectare per year; Obtaining kernel is 5.5% by TBS weight; Obtaining kernel oil is 80% by weight of the kernel; Bioavtur acquisition is 80% by weight of kernel oil; and bioavtur density is 0.8 kg per liter

From data above, each hectare of oil palm are bioavtur acquisition of 13.2 x 5.5% x 80% x 80% tons, or 467 kg, or 584 liters per year. With a land area of oil palm plantations in Indonesia 7.9 million hectares per 2013, bioavtur supply potential are 3.7 million tons, or 4.6 million kiloliters. Meanwhile, Indonesian aviation fuel supply balance showed a deficit of 0.9 million kiloliters, namely the production and consumption of 3.3 liters of 4.2 million kiloliters.

Implementation bioavtur as fuel for air transport carried through a blending policy. Scenario blending portion will provide aviation fuel at the balance sheet impact: 10%, required bioavtur many as 0.37 million liters of aviation fuel so that the deficit will be reduced to 0.53 million kiloliters per year; 20%, required bioavtur much as 0.82 million kiloliters aviation fuel so that the deficit was reduced to 0.075 million kiloliters; and 25%, required bioavtur 1.1 million kiloliters, which will provide national account surplus aviation fuel supply. From resource availability bioavtur aspect, the policy is implemented eligible for potential supply of 4.6 million kiloliters bioavtur far above the need for blending.

Economies Calculation of Bioavtur

To obtain raw materials, namely palm kernel oil, bioavtur have to compete with other users that is fine-cosmetics industry who bid a high price. With kernel oil price assumption for CPO reference price as stipulated in the Minister of Trade No. 68 Year 2015 regarding Stipulation export benchmark price of US $ 529.51 per metric ton, the specific weight of 0.8 kg / liter and Rp.14,000-exchange rate per US $, then obtained a palm kernel oil price of Rp. 5927 per liter. By using biodiesel manufacturing cost of Rp. 1300 per liter, the production cost are bioavtur Rp.7.227 per liter. Plus 10% PPN and other costs, the selling price bioavtur can reach Rp 8,000 per liter. Meanwhile, Pertamina sells Jet-A1 fuel at Sukarno Hatta airport for Rp.7.508 per liter, so that the issue price will be the main obstacle in the utilization bioavtur to enter the aviation fuel market

Utilization Policy Bioavtur Analysis

Project feasibility is determined by external variables that costs and prices are volatile and dynamic, so the decision on whether a project "go or no go" depends on the perception of the economic situation in the future at the time of the project. While energy security is defined as the availability of a regular supply of energy at an affordable price (Chang, 2001).

Strategic projects and public interest generally requires long-term preparation, both to prepare systems, infrastructure, and human resources. Need to be taken into account also the influence of the "learning curve" cost reduction, which will increase the competitiveness of aviation fuel bioavtur. Whereas, Energy security seeks to ensure access to affordable, clean, and secure sources of energy to underpin sustainable global economic growth and to protect our environment. Energy security is defined as the availability of a reliable, affordable, and clean supply of energy (Commission of the European Communities, 2007).

Currently, bioavtur may still not be able to compete with alternative uses for other palm kernel oil (fine cosmetics and exports) that have a higher opportunity costs. If the development bioavtur allowed

stagnant, and at a later time where palm kernel oil use to bioavtur had the opportunity cost is higher than at any other use, then the country will have the opportunity losses due to the loss of an opportunity to get more added value for the system bioavtur in the country is not ready for production.

Bioavtur industry is positioned for supporting the national energy security (diversification of energy sources, more environmentally friendly, and improve its sustainability by renewable). Even compared kernel oil exports, to use bioavtur will provide a greater multiplier effect for the economy. Thus it is reasonable if the Government provides incentives for industrial development bioavtur.

A variety of incentives could be given by the Government to support the industrial development bioavtur, namely: First, DMO palm kernel oil; DMO (dometic market obligation) for palm kernel oil producers to set aside part of its production to the domestic market consumption. The amount is determined regulator (government), for example by 10%. In exchange, producers receive a payment production cost of palm kernel oil. Bioavtur industry will be assured raw material supply at a price below the export price, which would increase fuel bioavtur competitiveness, Second, Investment Tax Credit; Be given to reducing the tax burden so that it will lower the selling price bioavtur.

Third, exemption or PPN payment by the Government; As an infant industry, bioavtur need to be given protection by the PPN exemption. These incentives are so helpful to lower the selling price bioavtur; Fourthly, Liability blending with bioavtur aviation fuel; In terms of product off-taking, liability in aviation fuel blending bioavtur provide marketing collateral bioavtur. With this assurance MARR (Minimum Attractive Rate of Return) bioavtur company to be low, and will lower the selling price bioavtur.

Additional measures such as the subsidies provision , soft loans, and so forth can be done even when unpopular. Direct subsidies could be given to bioavtur used by military aircraft, because the subsidy will impact on the budget for military

aircraft operation. Keep in mind that the provision of this protection is only temporary, as an instrument to help the growth of industries that face barriers cost of learning and economies of scale.

Socialization Use Bioavtur

From interviews with the stakeholders during the team conducted a survey in East Java, found that not many people who know and be aware of issues bioavtur. Thus socialization bioavtur business opportunity needs to be encouraged in order to support the growth of the industry bioavtur strengthened and the Government should be more active in formulating policies

Conclusion

First, there are a variety of biological sources in Indonesia that can be used bioavtur such as algae, pecans, coconut, and palm oil. With the availability of abundant, palm kernel oil from the plant is a source of reliable bioavtur. Bioavtur potential that can be produced per 2013 were 3.7 million tonnes, or 4.6 million kiloliters.

Second, in terms of demand, opportunities and prospects bioavtur market in Indonesia is promising, as indicated by the jet fuel deficit amounted to 0.9 million tons in 2014, and will continue to grow in the future with more intense activities of the aviation industry. Nevertheless, the main obstacle are raw materials price. Palm kernel oil is currently used as ingredients in fine cosmetics which are highly valued domestic and export kernel oil gets too high prices.

Third, if Government would be made decision about increased the independence level of energy sector with bioavtur palm kernel oil, necessary to intervene in the market in an effort to encourage the use bioavtur and ***Fourth***, readiness all stakeholders to use bioavtur are limited, and the Government should be more active in formulating policies.

Recommendation

Future studies are necessary to improve the economics of the plant-based oil bioavtur because Indonesia has large oil supply source. Bioavtur based microalgae research abroad is being carried with massive, for that Indonesia should also enhance

research-based bioavtur oil as its comparative advantage.

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