Pre-Feasibility Study Of Bioavtur Production With HEFA Process In Indonesia

Tri Yuni Hendrawati, Agung Siswahyu, Anwar Ilmar Ramadhan

Abstract: To 2005-2011 in Indonesia, Indonesian aviation fuel consumption is almost always greater than the production that should be met through import. Production of aviation fuel using vegetable oil (Bioavtur) as CPO is expected to be one of the strategic solutions, as Indonesia is the largest palm oil producer in the world. The use of this Bioavtur will also support the Presidential Regulation No. 61 Year 2011 on the National Action Plan for Greenhouse Gas Emission Reduction (RAN-GRK) and the Ministry of Transportation Decree No. KP 201 in 2013 on RAN-GRK Transportation sector from 2010 to 2020, especially in the field of air transport through Indonesia Green Aviation Initiatives for Sustainable Development, The purpose of this study to conduct a prefeasibility production Bioavtur with HEFA process in Indonesia. The methodology used secondary and primary data collection to get a prefeasibility. To generate and achievement of objectives in this activity, would require data. The data used in this study are primary and secondary data. Pre-feasibility results for the environment, technology, the availability of the world are worthy of where Indonesian CPO producers. The simulation results prefeasibility economics are preliminary results which indicate that the economics of the fastest in the year 2029 prices Bioavtur with technology HEFA will be eligible for sale in the market, so if we want to use Bioavtur as much as 2% in the year 2016 to 2018 and 3% in the year 2019-2020 the use of this technology for the production of Bioavtur if done commercially unprofitable. With the use of CPO Rp.6.200 price per kg this would make Bioavtur price will be lower than the price Avtur.

Index Terms: bioavtur, transportation, prefeasibility, CPO, emissions

1 INTRODUCTION

Jet fuel (Aviation Turbine) is the fuel for some types of commercial aircraft with a main component in the form of paraffin hydrocarbons (C10-C14), aviation fuel derived from crude oil hydrocracking process is then followed by a gradual separation of the hydrocarbon fraction. Several types of Aviation Fuel used on commercial aircraft such as Jet A, Jet A-1, Jet B, JP-4, JP-5, JP-7 or JP-8. Bioavtur has an important role in the development of world energy security because most of the needs of aviation fuel has not completely dapatdipenuhi of fossil energy production. Bioavtur development itself is still hampered by the fulfillment of technical qualification of aviation fuel is very tight [1-4]. In Indonesia from 2005-2011 year, Indonesian aviation fuel consumption is almost always greater than the production that should be met through impor.Produksi aviation fuel using vegetable oil (Bioavtur) as CPO is expected to be one of the strategic solutions, as Indonesia is the largest palm oil producer in the world. The use of this Bioavtur will also support the Presidential Regulation No. 61 Year 2011 on the National Action Plan for Greenhouse Gas Emission Reduction (RAN-GRK) and the Ministry of Transportation Decree No. KP 201 in 2013 on RAN-GRK Transportation sector from 2010 to 2020, especially in the field of air transport through Indonesia Green Aviation Initiatives for Sustainable Development [5-6]. The global aviation industry has a target to reduce emissions of carbon dioxide (CO2) emissions by 50% compared to the level (CO2) emissions in 2005 at 2050 [7-11].

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To achieve this, the International Air Transport Association (IATA) has outlined "four pillars" approach that includes: (i) technology, (ii) operation, (iii) infrastructure and (iv) economic. Of the four pillars, the technology is seen as the most promising option for reducing emissions and included improved engine technology, aircraft design, new composite lightweight materials, and the use of biofuels which has the effect of lower greenhouse (GHG) emissions than conventional fuels [12-17]. American Society for Testing Materials (ASTM) specifications established two criteria that became the standard aircraft fuel is Jet A and Jet A-1. Jet A is the specification of fuel used in the United States, while Jet A-1 is an aircraft fuel specifications are set for areas outside of North America. Both specifications have the same criteria for density, dot heating (energy content), but Jet-A1 has a slightly lower freezing point of Jet-A [18]. Aviation fuel is produced must meet the standards refer to ASTM D1655 - 09 of Standard Specification for Aviation Turbine Fuels [19]. The parameters that must be fulfilled by the Aviation Fuel produced from any process must meet the parameters as listed in Table 1.

Table 1. *Specification of Avtur*

Typical chemical composition of petroleum jet fuel	
Component of jet fuel	Composition, %
Linear and isoparaffins	55
Monocycloparaffins	17
Dicycloparaffins	8
Tricycloparaffins	0.6
Alkyl benzenes	13
Indans and tetralins	5
Naphthalene	<0.2
Substituted naphthalenes	1.3

Typical physical properties for Jet A and Jet A-1		
Physical properties	Jet A-1	Jet A
Flash point, °C	42	51.1
Auto-ignition temperature, °C	210	
Freezing point, °C	-47	-40
Open air burning temperatures, °C	260-315	
Density at 15°C, kg/L	0.804	0.820
Specific energy, MJ/kg	43.15	43.02
Energy density, MJ/kg	34.7	35.3

Table 2. Specifications of any type Avtur

Selected Specification Properties of Jet Fuels

Fuel	Jet A	Jet A-1	TS-1	Jet B
Specification	ASTM D 1655	DEF STAN 91-91	GOST 10227	CGSB-3.22
Acidity, mg KOH/g	0.10	0.015	0.7 (mg KOH/100ml)	0.10
Aromatics, % vol, max	25	25.0	22 (% mass)	25.0
Sulfur, mass%	0.30	0.30	0.25	0.40
Sulfur, mercaptan, mass%	0.003	0.003	0.005	0.003
Distillation, °C:				
Initial boiling point	—	Report	150	Report
10% recovered, max	205	205	165	Report
50% recovered, max	Report	Report	195	min 125; max 190
90% recovered, max	Report	Report	230	Report
End point	300	300	250	270
Vapor pressure, kPa, max	—	—	—	21
Flash point, °C, min	38	38	28	—
Density, 15°C, kg/m^3	775–840	775–840	min 774@20°C	750–801
Freezing Point, °C, max	–40	–47.0	–50 (Chilling point)	–51
Viscosity, –20°C, mm^2/sec, max	8	8.0	8.0 @ –40°C	—
Net Heat of combustion, MJ/kg, min	42.8	42.8	42.9	42.8
Smoke point, mm, min	18	19.0	25	20
Naphthalenes, vol%, max	3.0	3.00	—	3.0
Copper corrosion, 2 hr @ 100°C, max rating	No. 1	No. 1	Pass (3 hr @ 100°C)	No. 1
Thermal stability				
Filter pressure drop, mm Hg, max	25	25	—	25
Visual tube rating, max	<3	<3	—	<3
Static test 4 hr @ 150°C, mg/100 ml, max	—	—	18	—
Existent gum, mg/100 ml, max	7	7	5	—

Table 2. explains that for sales Avtur types of Jet A-1, TS-1 and Jet B also has a strict standard which is equivalent to ASTM standards, and this also applies to all Avtur derived from petroleum. Bioavtur produced apart from crude oil must also meet ASTM standards, including those made using the Hydro-processed Esters and Fatty Acids (HEFA) or commonly called the Hydro-treated Renewable Jet fuel and Biomass-to-liquid (BTL) through Fischer -Tropsch (FT) [20-22]. Both of these processes in addition to producing Bioavtur as the main products also produce Biodiesel. In the process of biomass and coal BTL evaporated then converted into synthetic oil via the FT process. Bioavtur resulting from HEFA and FT processes have been certified by ASTM D7566 on Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons in September 2009. In this standard Bioavtur can be used as fuel for jet turbine engines Aviation Fuel blended with up to 50% without changing the mix turbine engine aircraft used and mixed Avtur, Bioavtur and is already used for commercial flights by OR Tambo International Airport in Johannesburg [23-24]. The purpose of this study to conduct a prefeasibility production bioavtur with HEFA process in Indonesia.

2 Research Method

The methodology used secondary and primary data collection to get a prefeasibility. To generate and achievement of objectives in this activity, would require data. The data used in this study are primary and secondary data. Stages of data collection / survey in this study include the collection of data both qualitative and quantitative measures to aspects related to prefeasibility. Data collection will be conducted in this survey include secondary data (institutional) and primary (interviews and questionnaires, the data patent, publication references, technical data prefeasibility.

3 Results and Discussion

3.1. Environmental aspects of the prefeasibility

The use Bioavtur cycle gas recycle CO2, reduction of emissions can be generated not only from the physical properties and the production process alone either using a process HEFA, ATJ and FT, which Bioavtur not contain sulfur but the CO2 produced from burning can also be absorbed by the plants that produce raw materials for Bioavtur. So that emissions generated by the use of very small Bioavtur as shown in Figure 1 where to produce Bioavtur emissions produced would be smaller between 16-29 g CO2ekv / MJ when compared with the production of jet fuel that produces emissions of 84 g CO2ekv / MJ.

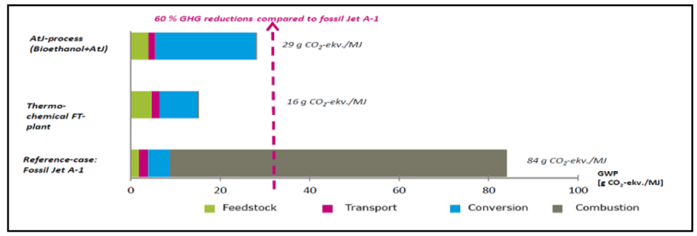

Figure 1. *Comparison of Exhaust Emissions in Bioavtur Production and Avtur [26]*

Besides Indonesia, the global airline industry also has a target to reduce emissions of carbon dioxide (CO2) emissions by 50% compared to the level (CO2) emissions in 2005 at 2050 (IATA, 2009). Therefore, to achieve its goal IATA implement several strategies among which to reduce emissions from the source is on the air turbine engines where enhanced fuel efficiency and fuel are also reduced exhaust emissions. One way to reduce exhaust emissions from aircraft engines is to use Scenario Bioavtur can be seen in Figure 2.

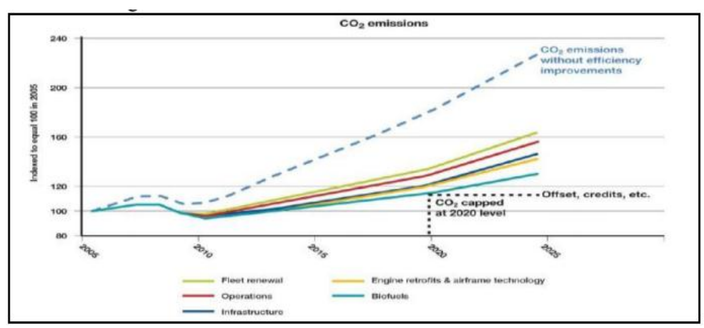

Figure 2. *Exhaust Emission Reduction Strategies Aviation Industry [25]*

3.2. Availability Pre-feasibility aspect Raw Materials

One of the challenges in the development of this bioavtur is the raw material. Particularly if they use technology HEFA, this is because the vegetable oil raw materials available in large quantities are also used as raw material for the food industry. As shown in Figure 3, it was shown that the price of Avtur always below the price of vegetable oil feedstock.

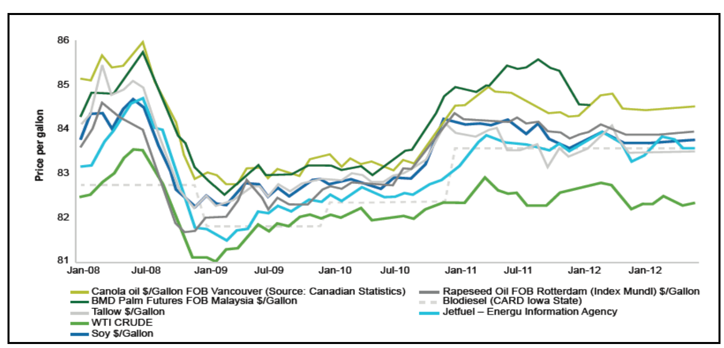

Figure 3. *Comparison of Raw Material Price Bioavtur with Avtur [25]*

To be able to make the selling price to compete with aviation fuel bioavtur is to seek another source of raw materials that do not intersect or competition with the food sector or commonly called the Non Edible Raw Material. A raw material that may be used is biomass-based raw materials or non-edible Oil, as shown in Figure 4.

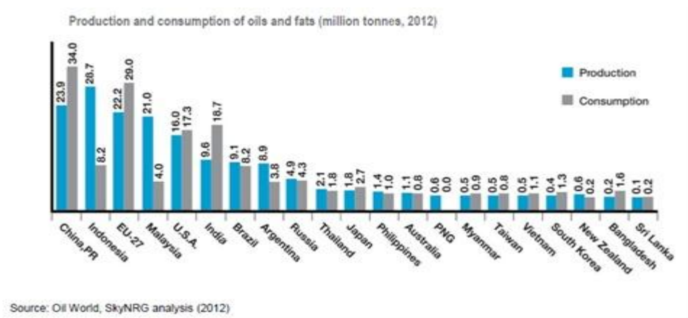

Figure 4. *Supply and Demand Oils and Fats [25]*

Opportunities for Indonesia at a time when other countries difficult to find raw materials Bioavtur because Indonesia is a country where oil production of vegetables much more than on consumption. These opportunities can be used to grow the downstream industry vegetable oil into enormous energy industry that can foster supporting industries. Moreover, it can also create new jobs and increase the income per capita of population. Indonesia had a surplus of vegetable oil amounted to 20.5 million tons per year of which this amount if converted into Bioavtur can meet the needs of the country and the world.

3.3. Technology Aspects of the prefeasibility

Aspects prefeasibility process technology Bioavtur is a chemical process that has multiple paths including paths Hydro-processed Esters and Fatty Acid (Hefa), Advance Fermentation Jet Fuel (AFJ), Sugar Derived Renewable Jet Fuel (SRJ), Alcohol to Jet Fuel (ATJ), pyrolysis Reneweable Jet Fuel (PRJ) and FT Jet Fuel (FTJ). Of all the processes that currently exist Bioavtur new production process using HEFA and FT are the products have been standardized and used on turbine engines for commercial airlines, can be seen in Figure 5.

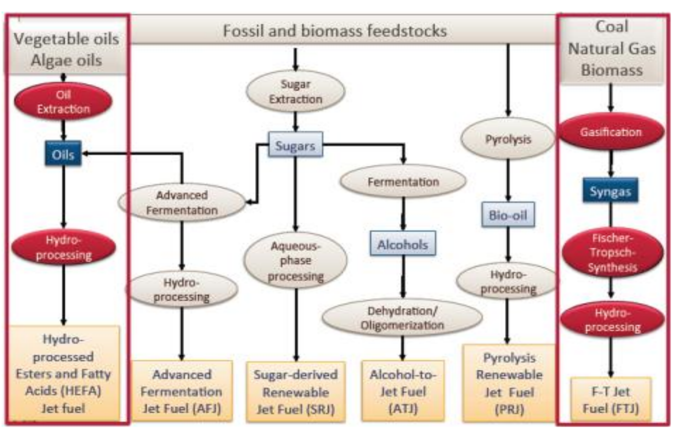

Figure 5. *Production Line Bioavtur [25]*

Bioavtur of production lines that already exist in Figure 7 then develops several production lines Bioavtur with various raw materials to currently still a research developed by several companies as presented in Table 3 and Table 4.

Table 3. *Production Line Bioavtur [26]*

Technology	Process	Fuel Produced	Companies
Lipids (fats, oils, and greases)			
	Transesterification	Biodiesel	Imperium Renewables, Renewable Energy Group, ADM, Amerigreen Energy, Inc., Cargill Inc., Direct Fuels, etc.
	Transesterification of microalgae	Biodiesel	Cellana, Solix, Seambiotic, LiveFuels
	Hydroprocessing	Diesel, Jet Fuel	Neste Oil, Dynamic Fuels LLC, Diamond Green Diesel LLC, UOP, AltAir, Emerald Biofuels LLC, etc.
	Hydroprocessing of microalgae	Diesel, Jet Fuel	Sapphare, Solazyme
Lignocellulosic Biomass/Sugars from Cellulose			
Biochemical	Conversion of cellulose via carboxylic acid	Diesel, Jet Fuel	Terrabon
	Synthetic Biology	Diesel, Jet Fuel	Amyris, LS9, Joule
Thermochemical	Gasification/Fischer Tropsch	Diesel, Jet Fuel	Choren, Flambeau River Biofuels, ClearFuels/ Rentech, TRI, Syntroleum
Hybrid Biochemical/ Thermochemical	Syngas fermentation	Diesel, Jet Fuel	Coskata, Lanztech, INEOS Bio
	Acetic acid production and lignin gasification	Diesel, Jet Fuel	ZeaChem
Depolymerization	Catalytic depolymerization of cellulose	Diesel, Jet Fuel	Covanta, Green Power
	Pyrolysis	Diesel, Jet Fuel	Envergent (UOP/Ensyn), Dynamotive, KiOR, RTI, GTI
	Thermal depolymerization	Diesel, Jet Fuel	Changing World Technologies Inc.
Other	Catalytic reforming of sugars from cellulose	Diesel, Jet Fuel	Virent
	Alchohol-to-jet fuel	Jet Fuel	Gevo, Cobalt

Note: The list of companies in the table is shown as an example and it is not meant to be complete. Some of the listed companies (such as Terrabon and Choren) were inactive at the time of writing. However, these companies are associated with either pioneering or further developing a process, and thus, they are included in this summary for illustrative purposes.

Tabel 4. *Milestone Production Technology Bioavtur [26]*

Technology Process	Advantages	Challenges
Alcohol to Jet (ATJ)	Feedstock flexibility and availability in Midwest	Still at developmental stage Need to go through costly ASTM approval process
Catalytic Conversion of Oil to Jet (CCOTJ)	Low capex Commercial unit to make biodeisel	Best suited to produce products other than jet fuel Needs to be further processed to make jet fuel
Catalytic Conversion of Sugar to Jet (CCSTJ)	Feedstock availability	Still being developed Need to go through costly ASTM approval process
Catalytic Hydrothermolysis, Hydroprocessing to Jet (CH-HRJ)	Potential for no blending requirement	Early stage of development Need to go through costly ASTM approval process
Direct Fermentation of Sugar to Jet (DFSTJ)	Good feedstock supply potential	Low yield → high cost Concern of product properties for jet fuel application
Fischer-Tropsch synthesized paraffinic kerosene (FT-SPK)	ASTM approved	High capex requirements
Hydrotreated Depolymerized Cellulosic Jet (HDCJ)	Feedstock flexibility Attractive cost structure	Early stage of development Need to go through costly ASTM approval process
Hydroprocessed Esters & Fatty Acids (HEFA)	ASTM approved Commercialized technology	Limited feedstock availability (non-food) and high cost of feedstock Renewable diesel has better yield/return

From Table 4 we can see Milestone Bioavtur production technology in which we already have the technology with various advantages and disadvantages as well as a wide selection of raw materials that can be used until the technology has reached the level of commercial operations.

3.4. Feasibility aspect Availability Bioavtur

Availability Bioavtur will be related to how much needs to be Bioavtur and production units are available, according to the [26] for flights in Europe alone required a 2 million ton / year Bioavtur with details as listed in Table 5.

Table 5. *Bioavtur Provider in Europe [27]*

Project-Location	Technology Type	Planned Total Production Capacity, t/a	Planned Aviation Biofuel Production Capacity, t/a	Start-up Date
Neste Oil-Netherlands	HEFA	800,000	*	2011
Neste Oil-Singapore	HEFA	800,000	*	2010
Neste Oil-Finland 1	HEFA	190,000	0	2007
Neste Oil-Finland 2	HEFA	190,000	15,000	2009
UOP-Italy	HEFA		0	
UOP-Spain	HEFA		0	
BTG-Netherlands	PO	1,000,000	50-100,000 t/a HPO	
Evergent Techn.	HPO		0	
Neste/Stora Enso-Finland	FT		0	
ForestBTL Ajos - Finland	FT	140,000	0	2017
Solena-UK	FT	120,000	50,000	2015
UPM/Carbona - France	FT	100,000	0	2017
CEA - France	FT	22,000	15,000	2018

* = Possibility exists to dedicate tens of thousands of tons capacity to renewable aviation fuel production, if a demand exists

Besides in Europe in America there are also some companies setting up manufacturing units Bioavtur among others:

1. Dynamic Fuels, a joint venture between Tyson Foods and Syntroleum Corporation located Geismar, Louisiana. Production capacity by 75 million gallons per year and will operate November 2010. Raw materials used are animal fats and vegetable oils. In 2011, Syntroleum announced Dynamic Fuels achieve Bioavtur and byproduct production up to 87% of its production capacity (Syntroleum 2011).
2. KiOR's, located in Columbus, Mississippi operations in early 2013. The use of wood biomass as a raw material, and its production capacity by 13 million gallon per year (KiOR 2013).
3. Diamond Green Diesel, a joint venture between a subsidiary of Valero, Diamond Alternative Energy LLC and Darling International Inc. located in Norco, Louisiana. Production capacity by 137 Million Gallons per year and akanberoperasi year 2013. The raw materials used are animal fats and vegetable oils former.

3.5. Pre-feasibility Economic Aspects

Economics is a challenge of development Bioavtur at this point where Bioavtur price is still higher than the Avtur. Component costs in the form of raw material prices, production costs and variable costs make Bioavtur price above the price of aviation fuel as shown in Figure 6.

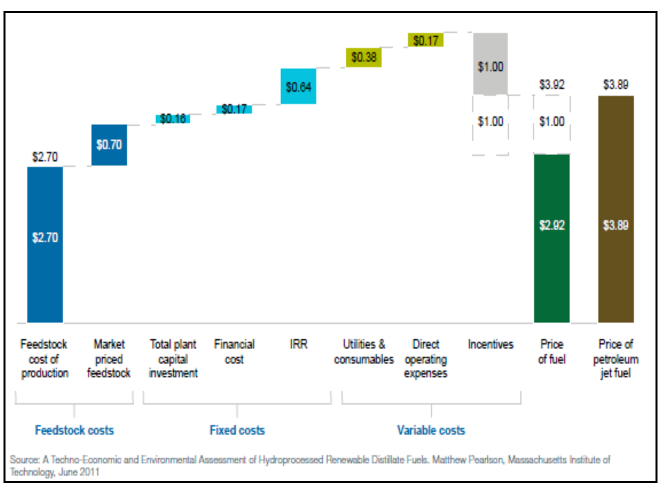

Figure 6. *Comparison Bioavtur with Avtur [27]*

Circumstances where Bioavtur still more expensive when compared to Avtur also delivered in various journals, among others, as presented in Table 6.

Table 6. *Comparison of Production Costs Bioavtur*

Technology	Raw Materials	Production Cost ($/gal)	Reff
HEFA	soybean oil	$3.82 to $4.39	Pearlson et al. (2012)
FT synthesis	corn stover	$4.50	Anex et al. (2010)
FT synthesis	corn stover	$6.45	(NETL 2009)
FT synthesis	corn stover	$3.9	Agusdinata et al. (2011)
FT synthesis	switchgrass	$4.95	
FT synthesis	woody crops	$5.22	
FT synthesis	Algae	$15.3	

The production cost of the technologist HEFA that use raw materials of vegetable oils price difference Bioavtur generated nearly matching the price of aviation fuel to the need for incentives to keep the price Bioavtur can compete with the price of aviation fuel, or should be sought raw materials to other vegetable oils, which are cheaper than soybean oil, such as Palm oil. Besides the use of algae as the raw material through the FT process has the highest production costs among other raw materials so that it looks not competitive when compared with the use of biomass raw materials. From the price comparison existing Bioavtur with aviation fuel at this time with consideration of raw materials, crude oil prices, the demand for aviation fuel is very visible that the price Bioavtur still higher than in aviation but if oil prices rise and demand for aviation fuel increases with the number of people who use air transport and aviation industry as well as an increase in production cost efficiency of the production line Bioavtur not very unlikely that prices can equal Bioavtur jet fuel prices or even cheaper than the price of aviation fuel, as predicted by some authors in the journal shown in Figure 7.

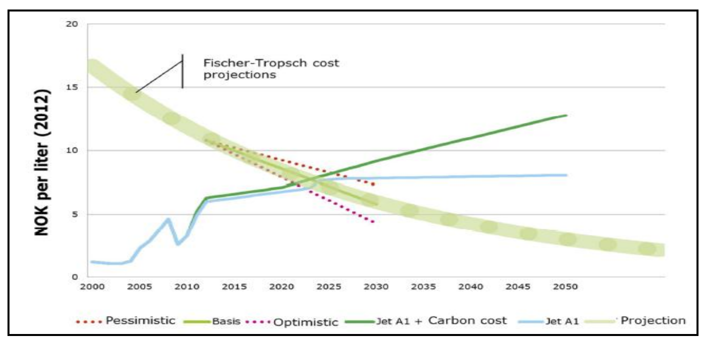

Figure 7. *Predicted Production Costs Bioavtur*

Figure 7 shows a prediction model which Bioavtur production costs in 2022 will be equal to the production cost of aviation fuel so Bioavtur price will be equal to the price of jet fuel even in the next year Bioavtur price be less than the price of aviation fuel. Assuming that the technology used is FT with raw materials of biomass and the production of these byproducts Biodiesel and Naphtha and sold at a price of 9 and 3 Norwegian Krone (NOK) per liter and the price of Bioavtur sold for 7 NOK per liter and raw materials biomass 1 NOK per kg dry period. Making can be done by using raw materials of vegetable and animal oils; this process is often referred to HEFA (Hydro treated Esters and Fatty Acids). This process involves the removal of oxygen, sulfur and nitrogen in oils and fats through the process of hydrogenation catalysts to produce straight chains with paraffin-rich composition (nC15-nC22) similar to aviation fuel. In this process beneficial to the economy in terms of the amount of raw materials that can be used and can produce with higher purity and is very similar in composition to the aviation fuel as well as when compared with the investment using the FT-SPK process cheaper Hefa. However, due to the price of the raw material for this process is more expensive if compare with FT-SPK process so that the higher cost of the process. The production process of fats and oils into jet fuel has 2 s products, the first maximum distillate products where the product is produced with the composition, among others:

1. Water: 8.47%-weight
2. CO2: 5.36%-weight
3. Propane: 4.09%-weight
4. LPG: 1.56%-weight
5. Naftha: 1.75%-weight
6. Aviation fuel: 12.46%-weight
7. Biodiesel: 66.31%-weight

If seen from the composition that the main product of these products are Biodiesel. Yield 66.31% by-weight of the amount of raw material. Both of these products maximum Avtur which produced the product composition, among others:

1. Water: 8.37%
2. CO2: 5.19%
3. Propane: 4.04%
4. LPG: 5.77%
5. Naftha: 6.73%
6. Avtur: 47.50%
7. Biodiesel: 22.40%

For this simulation we chose the route of products with aviation fuel into its main product is the maximum product of aviation fuel, but the selection of these products is a consequence of higher production costs when compared to the Maximum distillate products. For the analysis of the potential in the economy to take some of the parameters associated with the system and the amount of economic processes that have, among others:

1. The capacity used for these simulations is 300,000 KL Biofuel / Year
2. Operational costs derived from a mathematical function y = -0,0055x + 103.55, where Y is the operational costs do not include the main raw material with units Cent / Gallon, and x is the capacity of the plant in a Barrel per day. This equation is obtained from data processing to a study in which the study was made operational on a cost comparison of different capacities. Operational costs decreased along with increasing the amount of capacity.
3. CPO prices based on the spot price taken from the Joint Marketing Office (KPB) PTPN Rp. 8000, - per Kg
4. The increase in raw material and operating costs 3% / year
5. The exchange rate $ 1 = 15.000, -
6. Conversions volume 1 Gallon = 3.78 liters
7. Converting a volume of 1 barrel = 159 liters.

Of the entire amount that has been described above, this data will be used as input in this simulation. The magnitude of these quantities presented in Table 7.

Table 7. *Parameter Input CPO*

Cost	Price (Rp)	Unit
Price of CPO	8.000	Rp/Kg
Operating Costs exc BB at capacity 300,000 KL	2.736	Rp/Liter Avtur
Conversion of CPO:Avtur	1.9 : 1	Kg CPO/Liter Avtur

From the simulation results conducted on biofuel production capacity of 300,000 KL / year will be presented in Table 8.

Table 8. *Simulation Results*

Parameter	Value	Unit
Capacity	300.000	KL Biofuel/Year
Demand of CPO	271.710	Ton/Year of CPO on Year of 2015
Product of Avtur	142.500	KL/Year
Product of Biodiesel	72.000	KL/Year
Product of Naftha	66.000	KL/Year
Product of Propane	12.115	KL/Year
Product of LPG	17.308	KL/Year
HPP Avtur, exc. By product in the year 2015	5,3 / 21.041	$/Gallon / Rp/Liter
HPP Bioavtur EQ Avtur	2029 -2030	Year

HPP calculations done for 15 years of the life of the plant, this is done to determine in which year the HPP has the same value as the price of aviation fuel. The result of the calculation HPP Avtur for 15 years without and with considering the production of byproducts will be presented in Table 9.

Table 9. *Calculation Results HPP Avtur*

Year	HPP	
	Product Without Side ($/Gallon)	Product Without Side (Rp/Liter)
2015	5.30	21.015
2016	5.45	21.645
2017	5.62	22.295
2018	5.79	22.964
2019	5.96	23.652
2020	6.14	24.362
2021	6.32	25.093
2022	6.51	25.846
2023	6.71	26.621
2024	6.91	27.420
2025	7.12	28.242
2026	7.33	29.089
2027	7.55	29.962
2028	7.78	30.861
2029	8.01	31.787
2030	8.25	32.740
2031	8.50	33.723
2032	8.75	34.734
2033	9.02	35.776
2034	9.29	36.850
2035	9.56	37.955

Aviation fuel price projections made by using three price scenarios that scenario High Price (Optimistic), Middle Price (Moderate) and Low Price (Pessimistic). Modeling to create mathematical equations that represent the three scenarios is performed using linear regression. All the highest price every year collected then made trend line and generate the equation y = 0.3059x - 612.71 is used to represent a model High Price (Optimistic). Similarly, for scenario Low Price (Pessimistic) all the lowest price in each year are collected and then made trend line and generate the equation y = 0.2941x - 589.15. For the manufacture of mathematical equations with the scenario Middle Price (Moderate) all the data either the highest price or the lowest prices each year trend line created simultaneously and generate the equation y = 0.2845x - 569.76. When do Plotting calculation HPP with Predicted rise in jet fuel prices by 3 scenario, we will find that the 2029 HPP Bioavtur will be equal to the price of aviation fuel in the scenario High Price (Optimistic), whereas if we use scenario Middle Price (Moderate) and Low Price (pessimistic) Bioavtur HPP will happen after 2035, can be seen Figure 8.

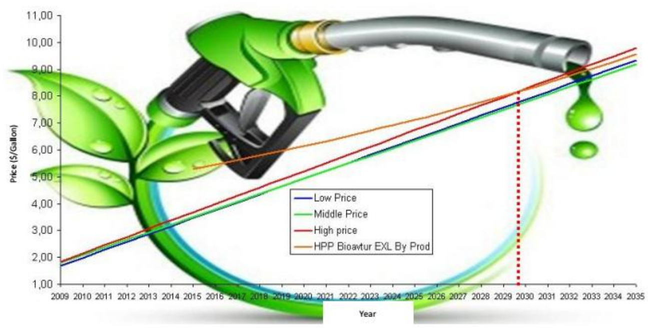

Figure 9. *Results Plotting HPP with Estimated Price Avtur with HEFA Technology*

The simulation results are preliminary results which indicate that the economics of the fastest in the year 2029 prices Bioavtur with technology HEFA will be eligible for sale in the market, so if we want to use Bioavtur as much as 2% in the year 2016 to 2018 and 3% in the year 2019-2020 the use of this technology for the production Bioavtur if done commercially unprofitable. With the use of CPO prices Rp.6.200, - per kg this would make Bioavtur price will be lower than the price Avtur.

4 Conclusion

From this research can be summarized as follows:

1. Pre-feasibility results for the environment, technology, the availability of the world are worthy of where Indonesian CPO producers
2. Pre-feasibility economic simulation results are preliminary results which showed that the fastest economies in the year 2029 with a price Bioavtur Hefa technology will be eligible for sale in the market, so if we want to use Bioavtur as much as 2% in the year 2016 to 2018 and 3% in the year 2019-2020 of use The technology for the production of Bioavtur if done commercially unprofitable.
3. with the use of CPO prices Rp.6.200, - per kg this would make Bioavtur price will be lower than the price Avtur.

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