BIODIESEL AND BIOETHANOL, FUEL FOR TRANSPORTATION

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ABSTRACT

This paper describes the importance of substituting the fossil fuel for transportation, the existing production of bioethanol and the national target to substitute gasoline until 2025. Specific energy density of biofuel, the properties of jatropha curcas oil and petro-diesel oil are shown to give a sense to compare their energy content. International standard and national standard are also given.
The advantage of using biodiesel blend and bioethanol blend for human health and for the environment are described. SVO usage for diesel cars and the conversion equipment needed is described. The use of SVO instead of biodiesel should be considered based on technological and economical point of view to weight the risk. Vision of shifting to biofuel infrastructure the research needed are described. In order to achieve the national target, the tax incentives for fuel efficient cars are given as an example to be considered.

ABSTRAK

Makalah menguraikan pentingnya substitusi bahan bakar fosil disektor transportasi, produksi etanol saat ini dan target nasional untuk substitusi premium sampai tahun 2025. Kerapatan energi spesifik dari biofuel, parameter minyak jarak dibandingkan dengan minyak petro-diesel diberikan untuk membandingkan kandungan energinya. Standard internasional dan standard nasional juga ditampilkan. Keuntungan memanfaatkan campuran biodiesel dan campuran bioetanol dengan petro-diesel terhadap kesehatan manusia dan lingkungan juga diuraikan. Pemanfaatan SVO untuk mobil diesel dan unit konversi yang dibutuhkan juga diuraikan. Pemanfaatan SVO menggantikan biodiesel haruslah mempertimbangkan teknologi dan nilai keekonomiannya untuk menimbang risikonya. Wawasan perubahan ke infrastruktur biofuel dan kebutuhan riset masa depan diuraikan.
Untuk merealisasikan target nasional insentif pajak bagi mobil yang memanfaatkan bahan bakar dengan efficient diberikan sebagai contoh untuk dipertimbangkan.

1. BACKGROUND OF THE IMPORTANCE.

In 2004, total domestic consumption of petroleum based fuel (gasoline, diesel, kerosene) were 59.4 million kL (kilo liter) and the need of Pertamax and Pertamax Plus in total was 0.66 million kL. In 2005 the total consumption reached 65.7 million kL. On the other hand, the total production of the existing refineries is limited to only 44.9 million kL in 2005, leaving the deficit to be purchased from international market.
In 2005, the need for diesel fuel is 26.3 million kL and for gasoline/premium is 15.2 million kL. This demand reflects a large potency of biodiesel as blending component for petroleum based diesel fuel and bioethanol as blending component for gasoline.

Assuming the growth rate is 7% per year, the diesel fuel demand in 2006 will be 28.1 million kL and in 2007 will be 30 million kL **[1].** The use of biodiesel as blending

component for conventional diesel fuel up to 5% will require 1.5 millions kL in 2007. Popular code of this mixture is B5. If this requirement will be substituted with a non-edible curcas oil, and if 3 ton seed can be harvested per hectare per year that give 1 ton curcas oil per hectare per year, this means 1.5 million hectare plantation of Jatropha Curcas will be needed. It is only 8 % of the total critical land in Indonesia which is about 19,663,343 hectare **[2].** Other alternative that is more developed is palm oil. Indonesian is still in the learning process on how to growth Jatropha Curcas that can give high yield while large scale biodiesel industries to process curcas oil to be biodiesel is waiting investor tough.

Gasoline demand in 2007 will be 17.5 million kL. The use of bioethanol as blending component for gasoline up to 5% v/v will require 900 thousands kL in 2007. Popular code of this mixture is E5. Current production capacity of bioethanol in Indonesia is less than 20% of this demand. Target for substituting gasoline until 2025 is given in **Table 1**.
There is a huge gap which must be filled

Table 1 Target to substitute gasoline until the year 2025.
Consumption rate is predicted 7% per year **[3]**

	Unit	2005	2006	2007	2008	2009	2010	2025
Predictied gasoline consumption	thousand KL	16 050	17 170	19 370	19 660	21 036	22 500	62 110
Percentage of gasoline subtitution	%		1	4	7	10	10	50
Volume of bioethanol needed	thousand KL		172	735	1 376	2 100	2 261	30 000
Raw Material (Cassava) needed	thousand tones		1 200	4 800	8 900	13 650	14 600	

It is easy to plant cassava, sugarcane, corn, potatoes, sweet potatoes and palm tree (the raw material to derive ethanol) especially for a country where majority are farmer. Indonesia is the 5th biggest sugarcane producer in the world, the 5th biggest cassava producer and the 2nd biggest palm oil producer, but the growth of ethanol industry in Indonesia is slow **[4].** The existing ethanol factories produce 200 thousands kL industrial grade ethanol per year.

2. BIODIESEL BLEND FOR DIESEL CAR.

Historically, transesterified vegetable oils has been in use since the mid-1800's. It was originally used to distill out the glycerin used for making soap. The "by-products" of this process are methyl and ethyl esters. Biodiesel is composed of these esters. In 1898, when Rudolph Diesel first demonstrated his compression ignition engine at the World's Exhibition in Paris, he used transesterified peanut oil. Diesel believed this fuel to be viable alternative to the steam engine that consumes natural resources inefficiently. Vegetable oils were used in diesel engines until the 1920's, a time when an alteration was made to the diesel engine to be compatible to use a residue of petroleum as it has specific energy density greater than transesterified vegetable oils, see **Table 2**. The residue of petroleum is written in the text as petro-diesel.
The word “biodiesel” might confuse people as they might think it is “a blending of plant oil with petrol-diesel”. Biodiesel is pure plant oil that has been processed and transesterified to

be "neat" biodiesel or pure-biodiesel or B100. Biodiesel blend is written as Bxx, the xx indicates the amount of biodiesel in the blended mixture with petro-diesel. Biodiesel can be stored and transported anywhere as petro-diesel with little damage, biodegradable and non-toxic. Various biofuels that are derived from biomass (plant oils or crop wastes or wood) are given in **Table 2**.

Table 2. Specific and Volumetric Energy Density of Biofuel [5]

Fuel Type	Specific Energy Density (MJ/kg)	Volumetric Energy Density (MJ/l)
Solid Fuels		
Wood fuel	16 – 21	
Bagasse	9.6	
Liquid Fuels		
Methanol	19.9 – 22.7	15.9
Ethanol	**23.4 – 26.8**	23.4
Butanol	36.0	29.2
Biodiesel	**37.8**	33.3 – 35.7
Gaseous Fuels		
Methane	55 – 55.7	Compression Dependent
Hydrogen	120 – 142	Compression Dependent
Fossil Fuels (as comparison)		
Coal	29.3 – 33.5	
Gasoline	**45 – 48.3**	32 – 34.8
Diesel	**48.1**	40.3
Natural Gas	38 – 50	Compression Dependent

Biodiesel has been in the spotlight lately because of rising petro-diesel prices. It also has a great potential to become a substitute for petro-diesel that produces a lot of soot and carbons, especially in buses. Smoothness and mobility of biodiesel blend is important for diesel engines that use rotary and distributor type fuel injection pump. This fuel well-lubricates moving parts include unit injectors as it moves through the pump and greatly increase the efficiency of the machines. Nowadays, in Europe, there is an option for biodiesel blend in many gas stations. Over 1000 stations in Germany alone offer biodiesel blend for their customers. Over 5% of France's energy uses are provided by biodiesel. All French diesel fuel now contains 2-5% biodiesel. Partly reason is to make up the lack of lubricity in low-sulphur diesel fuel. European and Japanese diesel cars can use it safely **[6].** In the UK, current estimation suggests that the UK can provide around 2% of its diesel requirements from rapeseed methyl ester. With the Government-backed incentives, this number could grow to 10%. This mean a saving of about 1.7 million tonnes of fossil hydrocarbon diesel each year, see: www.biodiesel.co.uk .

The parameters of jatropha curcas oils and petro–diesel, as to compare, is given in **Table 3** Jatropha curcas oils is similar to canola oil made of rapeseed that widely used as blending in Germany, France and Austria. Olive oil is used as blending in Spain. Current US biodiesel is primarily made of soybeans oil or recycled restaurant cooking oil **[7].** In Japan and Hawai made of waste cooking oil. In Mali and South Africa made of jatropha curcas oil. In Filipina made of coconut oil. In Malaysia and Indonesia made of palm oil.

Table 3 Properties comparison of pure Jatropha Curcas oil and of Petro-Diesel oil [8]

Standard specification	Jatropha Curcas oil	Diesel #2
Flash point (°C)	110	50
Solidfying Point (°C)	2.0	0.14
Distillation (°C)	284 - 295	350
Kinematics Viscosity (cs)	50.73	2.7 - up
Calorific value (kcal/kg)	9470	10170
Pour point (°C)	8	10
Colour	4.0	4 or less
Viscosity of "Fatty acid" at 30^{o}C (cp)	52.6	3.60
Specific gravity 15 °C and 4 °C	0.917 and 0.923	0.841 and 0.85
Refractive Index at 30°C	1.47	--
Cetane Value at 38°C	51.0	47.8 - 59
Sulfur (%)	0.13 - 0.16	<1.2
Carbon residue (%)	0.64	< 0.15
Saponification Value	188 - 198	--
Iodine Value	90.8 -112.5	--
Acid Value	1.0 - 38.2	--
Palmitic acid (%)	4.2	--
Stearic acid (%)	6.9	--
Oleic acid (%)	43.1	--
Linoleic acid (%)	34.3	--
Other acids (%)	1.4	--

Flash point indicate the lowest temperature at which the substance above this temperature can easily vaporized. Pour point indicate the lowest temperature at which a substance flows under specified condition. High viscocity will humble the fluid movement, not properly atomized when the fuel injectors spray it into the combustion chamber make it not combust properly. Cetane value indicate the rate of easiness to ignite. Combustible substance can be ignited in air. High iodine value is not good for diesel engines, iodine can polymerized to form tough epoxy deposits. Acid and water cause corrosion in the injector pump. A higher cloud-point makes the fuel gel easily. Pure biodiesel gel faster than biodiesel blend.

2.1. International and national standard of biodiesel.

Clean Air Act 1992 in USA was amended, it included more stringent restrictions on vehicle emissions. The amendment introduced provisions of increased oxygen content in gasoline to reduce carbon monoxide emissions and lower sulfur content in diesel fuels.

Energy Policy Act 1992 was aimed to increase the use of alternative fuel by the US government transportation fleets in order to reduce dependency on foreign oil.
Energy Policy Act 1998 amendment included the use of biodiesel fuel for US government diesel vehicles and an acceptable alternative to purchase the alternative fuel vehicles **[5; 7].**
To be sold commercially and legally, biodiesel must meet the specifications as 'fuel grade' by the American Standards Testing of Materials (ASTM) D6751.
Fuel grade biodiesel must be registered as a fuel and fuel additive with the Environmental Protection Agency (EPA) and meets clean diesel standards established by the California Air Resources Board **[9].** Raw vegetable oil cannot meet biodiesel fuel specifications as it is not registered with the EPA, therefore it is not a legal motor fuel.

German have Pure Plant Oils (PPO) fuel standard, which excludes waste vegetable oil (WVO). It covers a "Quality Standard for Rapeseed Oil as a Fuel".
The International World Wide Fuel Charter dated December 2002 agreed on 5% biodiesel blend or B5**.** Tax incentives for fuel efficient cars and bio fuel has been press released in The Hague, Netherland, see **Annex 1**. This insentive might be considered and adopted to raise the local achivement.

Indonesia has national policy for diesel oil that has been published by Directorate General for Oil and Gas at the Ministry Office of Energy and Mining. It is allowed for diesel oil to have fatty acids methyl ester (FAME) until 10% volume **[10].** This means any B10 that match to the national standard and registered legally is a legal fuel for trading in Indonesia**.**
The proposed standard is given in **Table 4.** Today, the government of Indonesia exerted consecutive campaigns for alternative energy in order to change local paradigm on alternative energy and to courage businesses in this energy alternative.

2.2. The advantage of using biodiesel blend.

Many owners of diesel cars have been using biodiesel blend (<B20) to naturally lubricate their car's engine to make them run smoother. Like petro-diesel, biodiesel blend ignites when compressed causing air in the engine cylinders to expand. This is the energy that pushes the engine pistons into motion. A diesel engine runs with this biodiesel blend will performs almost identically to conventional diesel fuel **[11; 12]:**

- Biodiesel blend fuel lubricates the diesel engine far better than petro-diesel fuel. According the national biodiesel board in UK: "lubricity tests that compare biodiesel fuel and petroleum diesel indicate that there is a marked improvement in performance after biodiesel is added to conventional diesel fuel. Even biodiesel levels as low as 1% can provide up to a 65% increase in lubricity in petro-diesel fuels".
- The esters in biodiesel have superior scuffing and adhesive wear resistance that exceeds conventional diesel fuels.
- Biodiesel blend fuel perform very similar to low sulfur diesel fuel in terms of power, torque, haulage and fuel consumption without a major modification of engines. The

national biodiesel board in UK claims that there is only 1.73% difference in economy, torque and horsepower between B20 and Diesel # 2.

The biggest impact of the use of biodiesel blend instead of just plain petro-diesel is on the human health and the environment.

1. Unburned hydrocarbons and unburned nitrogen oxides in petro-diesel account for most of the particulates in air pollution. Tests that have been conducted according to EPA regulations have shown that hydrocarbon exhaust emission from biodiesel is half of that measured from petro-diesel. So, someone use biodiesel blend product that right fit to her/his diesel car engine, they contribute a substantial *reduction of unburned hydrocarbons and smog*.
2. The overall lifecycle emissions of carbon dioxide from biodiesel are 78% lower than the overall carbon dioxide emissions from petro-diesel. Biodiesel contributes to reducing the effects of global warming.
3. The overall lifecycle emissions of sulfur oxides (major components of acid rain) from biodiesel are 8% lower than overall sulfur oxides emissions from regular petro-diesel.
4. Additionally biodiesel make less soot. Soot is the heavy black smoke portion of the petro-diesel exhaust that consists of 100% carbon. Studies have shown that biodiesel reduces the total amount of particulate matter soot in bus tailpipe exhaust by 83.6%.
5. The use of biodiesel reduces the emission of particulate matter that cause asthma and other lung disorders by about 47 %.
6. Scientific research confirms that biodiesel exhaust has less *polycyclic aromatic hydrocarbons* compounds, the cancer causing compounds, therefore it is less harmful to humans then petro-diesel exhaust.

Burning just 2% biodiesel blend in the on-road vehicle that usually takes petro-diesel will reduce all kinds of harmful emissions **[13]**. Annually, this one action has a potential to**:**

- to reduce poisonous carbon monoxide emissions by more than 35 million pounds,
- to reduce ozone forming hydrocarbon emissions by almost 4 million pounds,
- to reduce hazardous diesel particulate emissions by almost 3 million pounds and
- to reduce acid rain-causing sulfur dioxide emissions by more than 3 million pounds.

That is a big difference and everybody can contribute to make a big difference.

2.3. Points need to be considered.

Many European-made diesel engines of the 1980s and 1990s, including most Volkswagen Group engines, were able to run on biodiesel. Actually biodiesel blends are as good as the petro-diesel if it is used in the right engine where fuel hoses, sealant, gaskets and fuel caps use material that compatible with the biodiesel blend. However, modern high-tech fuel injection technology, such as pump-duse injection, high-pressure direct injection or piezo-electric injection, is not compatible with neat-biodiesel. As the complex engines is specifically tuned for conventional fuels. Stanley P.Miller of the Alternate Fuel Project Center in the US warning that: “It all comes down to lubrication, corrosiveness and

viscosity. You can get problems if you have not replaced parts of your vehicle that are not compatible with the new fuel you are putting in your car". Considering these,

- Most manufacturers recommend that natural or butyl rubbers are not allowed to come in contact with neat-biodiesel.
- The long term tests of biodiesel blend above 20 % nearly always result in engine maintenance problems. See: http://www.uidaho.edu/bae/biodiesel/rawoils.html.
  Therefore, almost all diesel car manufacturers do not recommend putting a blend of biodiesel fuel higher than B20 in an engine.
- The manufacturers warrant their engines to run on a blend of up to 5% to match the International World Wide Fuel Charter dated December 2002 that allows for diesel oil to have fatty acids methyl ester (FAME) only 5% volume. However, some diesel car manufacturers would discourage using biodiesel blend more than 2 % or B2 **[14].**

3. STRAIGHT VEGETABLE OIL (SVO) or PURE PLANT OIL (PPO).

SVO can be extracted with a simple expeller in small capacity. Its direct usage to diesel cars give a possibility to eliminates some process chain, save methanol that means save funding. However, the car owners have to install the conversion equipment in their cars if wanting to use SVO. The use of SVO instead of biodiesel should be consideration based on many aspect such as technology and economical point of view to weighing the risk.
The risk of using SVO to any diesel engine is described below**:**

- SVO is much more viscous than petro-diesel fuel (11 to 17 times thicker) therefore SVO is rarely used in any diesel car, truck or engine.
- If the fuel is too thick it is not properly atomized when the fuel injectors spray it into the combustion chamber and it does not combust properly. The injectors get coked up leads to poor performance, higher exhaust emissions and reduced engine life.
- SVO has very different chemical properties and combustion characteristics from those of petro-diesel fuel..
- SVO has a higher cloud-points, therefore they start to gel earlier than biodiesel blend made of the same oil.
- Never pour SVO into the diesel engine without checking whether the fuel fit to the engine. Undiluted biodiesel can destroy certain types of gasket, hose, and seal compounds like natural rubber, Buna-N, and nitrile and will cause fuel system leaks. Create scald (an injury to material similar to a burn sign resulting from heat) and engine clog up because of the existing extraneous matter that hinder piston motion. Unfortunately these materials are what most fuel hoses and fuel pump seals are made of.
- Studies indicated carbon buildup on injectors **[15]**. This sloppy dirt will need removal by an automotive professional. Engine tests showed that carbon deposits in the engine were reduced if the oil was heated prior to combustion. It was found that carbon deposit levels differ for different oils with similar viscosities. This indicates that oil composition was also an important factor."

- In cold weather SVO crystallizes, forming solid wax crystals that can quickly block the fuel filters. This happen at temperature approximately 2-10 Fahrenheit **[16].** Below this range, gelling happen in fuel pumps and hoses.
- One of the few truly scientific studies available found that SVO must be heated to 150 Celcius to achieve the same viscosity and performance as petro-diesel. Atomisation tests showed that at 150 C the performance of the rapeseed oil is comparable with that of the diesel oil **[17].**
- In winter usually the vehicle is store in a heated garage so that the fuel in the diesel engine does not have a chance to gel. The use of additives such as regular anti-freeze should be cross checked to the manufacturer.

3.1. SVO Engine.

Many people mistaken the diesel car engine with a SVO engine. To convert the diesel car engine to a SVO engine needs a conversion kit that will replace **[18; 19]:**

- Injector nozzles. Injector pressure is increased by 5 - 10 bar depending on the engine.
- The spray pattern and angle is optimised for SVO.
- Glow-plugs is replaced with the stronger one that hotter and stay hot longer.
- Electric fuel filter will have heater and *coolant-powered heat exchanger*.
- Dual parallel fuel filters.
- Oil temperature sensor and control.
- Relays for glow-plugs and filter heater.

This conversion system will operate as a portable processor that will heat and process SVO into useable fuel inside the car engine. It can be installed by a professional mechanic in a couple of hours. New virgin SVO (not waste) is the best oil to use.

The first three-cylinder SVO diesel motor was designed in 1979 by Ludwig Elsbett. It is a multifuel engine and the forerunner of all direct injection diesel engines made today **[18].**
The single-tank SVO system conversion kit from Elsbett Technologie is sold for about $1200. Seem expensive but if someone considers how high oil prices might be in the future, it is becomes a new vision and wisdom to invest in this conversion.
The Folkecenter for Renewable Energy in Denmark holds regular workshops for installation Elsbett SVO engine and VW Passat single-tank SVO systems.
See: http://www.folkecenter.dk/plant-oil/converted_cars_examples.htm
A single-tank SVO system kit from Elsbett Technologie was installed in 1990 Toyota TownAce (1.9-litre 4-cyl turbo-diesel 4x4 van). A team of pioneers drove it from Hong Kong to Southern Africa, producing their own biodiesel along the way and teaching the peoples they met on how to make their own biofuel for use in their heaters, tractors, buses, automobiles and other machines they might have **[19]**.

The German company who converted VW Touran 2.0 Pump Düse Injection, 4 valves / cylinder, with a single-tank SVO system claims that they have tabulated the emission approval for all their converted cars. This car meets EURO IV standard, see Annex 1.

The tests prove very convincing for both the starting stage and driving.
See: http://www.folkecenter.dk/plant-oil/converted_cars_examples.htm
Another SVO engine manufacturers are in the USA and Japan.
Long experiments on SVO conversion note that, see: http://biocar.de/info/warnung1.htm :

- Mechanical injection is better match to SVO conversion than computerized injection.
- Inline injection pumps such as most Bosch models are most suitable for SVO conversion.
- Lucas/CAV injection pumps show high failure rates if it is running on SVO conversion.
- Rotary pumps should not be used with SVO conversion systems.

3.2. SVO quality for SVO engine.

SVO with a low Free Fatty Acid (FFA) content is good for SVO engine, therefore need to check oil quality.

- Oil quality is best checked with a titration test **[19; 20]** used in making biodiesel to determine the Free Fatty Acid content of the oil.
- The lower the titration result the better the quality. A titration at *2.5 ml of NaOH solution* is considered good to show a good oil quality.
- It is generally said that oil titrating at more than *3.5 ml 0.1% NaOH solution* should be processed into biodiesel rather than to be used in a SVO system.
- More than *3.5 ml 0.1% NaOH solution* the oil will be too acidic and probably contain water.
- If oil titrating at *8.5 ml of NaOH solution*, this means the oil too acidic to be used in Elsbett single-tank SVO system. It also means high water content. Water and acid cause corrosion in the injector pump.

Other points need to be considered.

- Raw oil straight from the oilseed press has to be de-gummed and de-acidified before use in SVO engine. Most research with raw vegetable oils have shown reduced engine life due to polymerization in the ring belt area and reduced bearing life.
  See: http://www.uidaho.edu/bae/biodiesel/rawoils.html
- Avoid SVO with a high iodine value (i.e. linseed oil) since iodine can polymerized to form tough epoxy deposits that is not good for the SVO engines.
- Copper will catalyze SVO, so the manufacturer avoid to use copper in SVO engine systems. See: http://journeytoforever.org/biodiesel_svo.html#copper
- Good quality waste vegetable oil (WVO) which can be used in SVO engine must be free of water and acid, therefore de-acidification is recommended for WVO.
- The impurities in WVO can cause coking and further corrosion. Therefore, WVO must be pre-filtered to the original specifications for the injection pump, usually 10 microns. Some pro-biodiesel proponents use filter of 5 microns or less. Need to check fuel filters often, especially in cold weather when waxes can clog up the fuel system **[19].**

Table 4 Biodiesel standard in European, in the USA and Indonesian standards (tentative) proposed by Forum Biodiesel Indonesia.

Parameters and their units	Europe EN 14214	USA ASTM D6751	Indonesia FBI-S01-03
Density at 15^{o}C, mg/ml	0.860 – 0.900	-	-
Density at 40^{o}C, mg/ml	-	-	0,850 – 0,890
Kinematics Viscosity at 40^{o}C, mm^{2}/ s (cSt)	3.50 – 5.00	1.9 – 6.,0	2.3 – 6.0
Cetane Number	min. 51	min. 47	min. 48
Flash Point ^{o} C	min. 120	min. 130	min. 100
Cold Filter Plugging Point, ^{o}C	max 5^{o}C	-	-
Cloud Point,^{o} C	-	reported	max. 18
Copper strip corrosion (3 hours at 50^{o}C)	Class 1	max. no. 3	max. no 3
Carbon Residue (%-b),			
- original sample		max.0.05	max. 0.05
- 10% of distillation residue	max. 0.3	-	max.0.3
Water and sediment, %-vol.	-	max. 0.05	max. 0.05
Water, ppm-b (mg/kg)	max. 0,05	-	-
Total contamination,ppm-b, mg/kg	max. 24	-	-
Distillation temperature 90%,C	-	max. 360	max. 360
Sulfated Ash, %-b	max. 0.02	max. 0.02	max.0.02
Sulfur, ppm-b (mg/kg)	max. 10	max. 500	max. 80
Phosphorous content,ppm-b,mg/kg	max. 10	max. 10	max. 10
Acid Number, mg-KOH/g	max. 0.5	max. 0.8	max.0.8
Free glycerol, %-b	max. 0.02	max. 0.02	max. 0.02
Total glycerol, %-b	max 0.25	max. 0.24	max. 0.25
Ester content, %-b	min. 96.5	-	min. 96.5
Iodine Number, %-b (g-I2/100 g)	max. 120	-	max. 115
Halphen test	-	-	negative
Oxidation stability at 110^{o}C, hours	min. 6	-	-
Linolenic acid methyl ester content, %-b	max. 12	-	-
Polyunsaturated methyl ester content ≥ 4, %-b	max. 1	-	-
Free methanol content, %-b	max. 0.20	-	-
Content of Na & K),ppm-b, mg/kg	max. 5.0	-	-
Content of Ca and Mg	max.5.0	-	-
Monoglyceride content %-b	max. 0.80	-	-
Diglyceride content, %-b	max. 0.20	-	-
Triglyceride content, %-b	max. 0.20	-	-

4. BIOETHANOL FOR GASOLINE CAR.

One single plant that produce biodiesel and bioethanol was hemp that had been grown as a major product in America. George Washington and Thomas Jefferson gave both governmental and popular support. Hemp provided the biomass that Henry Ford needed for his production of ethanol. Ford found that 30% hemp seed oil is usable as a high-grade diesel fuel and could be used as a machine lubricant and as engine oil.
Henry Ford designed his automobiles, beginning with the 1908 Model T that use ethanol. Ford was so convinced that renewable resources were the key to the success of his automobiles. He built a plant to make ethanol in the Midwest and formed a partnership with Standard Oil to sell it in their distributing stations. During the 1920's, this biofuel was 25% of Standard Oil's sales in that area. Ford continued to promote the use of ethanol through the 1930's. Competition of hemp derived ethanol / biodiesel with petroleum based oil raise an issue to discredit hemp that was then named as "mariyuana". By 1937, fossil fuel industrialists were able to parlay the fear they created into the Marijuana Tax Act. This law was the precursor to the demise of the hemp industry in the United States. By 1940, Ford ethanol plant was closed due to the low prices of petroleum based gasoline **[6].**

In 1973 and in 1978, American hit by oil crises. OPEC is controlling the oil in the world, adjust supplies and prices. Automobile purchasers began consider seriously to purchase a diesel car and bioethanol as an option to gasoline car. The potential of biodiesel and bioethanol reentered the public consciousness. People began making their own fuel.
Frustrated with pumping gasoline that costs well over $3 a gallon, some U.S. drivers are turning to E85 (a mixture of 85% corn-based ethanol and 15 % gasoline). It is 30 cents cheaper than regular gasoline. Some users of E85 in USA state the use of this fuel in their cars show no problems at all. A quick switch to E85, specifically, an older car may suffer from worn-out gaskets, or lasting damage to a gasoline tank or a vehicle's overall fuel system. On this point, Dan Kahn a road-test editor at online automotive resource Edmunds.com said **[21]:** *"Other potentially harmful for a car's engine is the sediment that naturally builds up in a gasoline tank. This is especially true of an older vehicle. If you have a Ford pickup truck with about 50,000 miles on the clock, it have some "stuff" forming inside the tank. If the owner start using ethanol-based fuel, the solvent properties in the fuel can dissolve that "stuff" and if the stuff get sucked into fuel lines will cause problem. This is why important to keep changing the fuel filters whenever it is recommended…E85 can corrode "soft" parts inside the car's engine, such as gaskets, seals and fuel injectors quicker than gasoline. Alcohol is not a lubricant and so these engine parts will need to be replaced more often than usual".*

Dr. Timothy Maxwell, a professor of mechanical engineering at Texas University said: "*Another potentially more destructive consequence of using ethanol-based fuel is permanent damage to a car's gasoline tank. Water is attracted to alcohol, and so with a metal fuel tank, especially one that's made of steel, the ethanol in the fuel absorbs water from the atmosphere and then form water droplets, that can lead to rust and corrosion in*

the tank, and pin holes can form. Older and non-flexible fuel cars must be converted to run on E85 fuel. Without this adjustment, a car's engine will have a poorer performance rate and a dirty exhaust." **[21].**
For this reason, auto manufacturers of non flexible cars only give warranty up to 10 percent blend of ethanol (E10). However, vehicles that are designed for a blend of 85 % ethanol will not have this problem. E85 burns in an extremely clean and complete manner **[22].** Octane value of gasoline is 87, while bioethanol blend is less than 110. This makes bioethanol blend resists better to knocking resulting from faulty combustion than gasoline.

Ford and Saab have unveiled bioethanol vehicles available for the UK market, which can run on gasoline, or any mixture of gasoline and bioethanol up to 85%. The Saab Biopower is more powerful than its petrol equivalent type. "A higher octane level of E85 adds 30bhp to the 150bhp turbocharged engine. A 15% gain in fuel efficiency can be achieved at high speeds. Turbocharged engines are particularly well suited to the benefits of ethanol" said Kjell ac Bergstrom, chief executive of Saab Automobile Powertrain.

According to the UK Government Agency Central Science Laboratory, bioethanol made from grain produces 65% fewer greenhouse gases than gasoline. Saab Great Britain explained that this is largely because the amount of carbon dioxide emitted during consumption of ethanol and the ethanol production is "almost equal" to carbon dioxide removed from the atmosphere when crops are being grown. Green Spirit Fuels said: "One hectare of wheat produces about 29,000 miles of motoring, enough to take a car around the equator and still have 4,000 miles of fuel left" **[23].**
UK Government announced its Renewable Transport Fuel Obligation last autumn, which states that 5% of all motorcar fuel must come from renewable sources by 2010. Some practices are set to pick up pace after this announcement.
Somerset county councilor Paul Buchanan is exerted a biofuel experiment that seeking environmentally friendly fuel and a wider plantation of locally grown grains campaign. The local police will drive 40 Ford Focus cars powered by E85. From March 2006, supermarket in Taunton, Bridgwater, Bristol and Shepton Mallett are preparing to supply E85 made from locally grown grains under the Somerset Biofuel Project.

Nowadays, E85 is already running on millions of so-called *E85 flexible cars* in the U.S. These cars, primarily used in corporate and government fleets, are manufactured by DaimlerChrysler, Ford, GM (passenger vehicles) and Mercedes Benz (E Class). Most of the E85 flexible cars are wagons and pick-ups. USA has nearly 170,000 gasoline stations; approximately 600 offer ethanol. The biggest one is in Midwestern agricultural states **[21].** Hankinson, North Dakota will have the largest ethanol plant of 100 million gallon ethanol a year starting this spring 2006. It will need about 37 million bushels of corn to produce 320 thousand tones of distiller grains. The investment needed is about $145 million **[24].**

5. CONCLUDING REMARKS.

The International Price of Crude Petroleum (ICP) raise continuously and reach the highest prices ever. Its golden age is only about a hundred years started in the year 1920. The fossil fuel deserted faster than that predicted caused by human greediness. This shows a tendency that the era of fossil fuel is declining. The era of biofuel (1890-1920) will return.

Developing bioethanol and biodiesel production plant need to be accelerated to contribute a solution to overcome the fast growing need of fuel for transportation, to reduce dependency to fossil fuel and to reduce greenhouse gases. However a shift to biofuel infrastructure would require a major shift in our collective political will. This potential shift raises serious concerns about land use, genetically modified energy crops, as well as difficult economic questions about the net costs of using land for food production versus energy production.
Need to improving yields from crops, or otherwise bioethanol / biodiesel remaining a more expensive option than petro-diesel due to the cost of technology and the cost of feed stock. The business in this field can provide a new income for farmers and rural communities.

Biodiesel is chemically altered plant oil. The process to chemically change the structure of Pure Plant Oil (PPO) is a costly operation and requires a lot of energy. Need to tabulate various processes to do it and to investigate its economical consideration. Research institutes could contribute in this point. The biodiesel and bioethanol industries have a chance to get a support from the government, as politicians look to diversify fuel supply in order to improve fuel security.

In order to reach national target as described in the first section, cars must go through a relatively cheap conversion such as replacing rubber seals and aluminium parts with materials that are not eroded by bioethanol to make the cars compatible to the new fuel. Until workshops for doing this conversions is widely available in the local car dealers, the alternative fuel market will not widespread to the general public. This is a huge potential business. Build more ethanol filling in the local gas stations.
Simultaneously, people as the user need to be convinced about the advantage of the use of biodiesel blend and bioethanol blend. Therefore, Indonesian Renewable Energy Society made a campaign on 12 November 2006 to promote the use of B5 and E5 in Jakarta and Bandung. There is a chance for the rich to demonstrate their action to support a change.
Other possibilities to promote biofuel could be done through *moving classes*. A team of pioneers is traveling around the country and on the way do teaching the people of the villages how to make their own biofuel for use in their heaters, tractors, buses, automobiles, and other machines they might have, especially in the energy-tree plantation areas.
Finally, one way that gives the best results is the one that fits the local circumstances best.

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ANNEX 1
Tax incentives for fuel efficient cars and bio fuel

Press release, PERS-2005-111a, The Hague, Netherland, 20 September 2005

The tax plan 2006 includes proposals to improve air quality and reduce CO_2 emissions by traffic. They involve encouraging the use of low-energy cars via car and motorcycle tax (BPM), and continuing to promote lorries and buses that meet the Euro IV/V standard via the environmental investment tax credit. To encourage the use of bio fuels, excise duty on them will be lowered temporarily.

In 2006, car and motorcycle tax (BPM) will be made partially dependent on fuel consumption. The existing system of energy labels will be used for this purpose. For relatively fuel efficient cars (labels A and B) which run on conventional fuels such as petrol and diesel, BPM will be reduced by up to €1,000. Cars that are not very economical (labels D, E, F and G) will have to pay a supplement of up to €540. This system will have no consequences for cars in class C. These measures will take effect on 1 July 2006. In addition, the current BPM regime for hybrid cars will be extended. These are cars equipped with both a combustion engine and an electric engine. At present, these energy-efficient cars (class A) are still entirely exempt from BPM, while those in class B are subject to the full amount. To encourage further growth of these technologies, a bonus will be introduced in the two most fuel-economical classes until 1 July 2008: €6,000 in class A and €3,000 in class B. The €3,000 reduction will take effect as early as the beginning of next year. The

BPM proposals are budget neutral. In terms of environmental impact, they are expected to yield a 100 to 200 kiloton reduction in CO_2 emissions by 2011.

Overview of BPM reductions/supplements (per car) per fuel-economy class

		A	**B**	**C**	**D**	**E**	**F**	**G**
Current situation	Hybrid	€ 9.000						
	Non-hybrid							
From 1-1-2006 to 30-6-2006	Hybrid	€ 9.000	€ 3.000					
	Non-hybrid							
From 1-7-2006	Hybrid	€ 6.000	€ 3.000		€ 135	€ 270	€ 405	€ 540
	Non-hybrid	€ 1.000	€ 500		€ 135	€ 270	€ 405	€ 540

To reduce greenhouse gas emissions from traffic, tax incentives will be introduced in 2006 to encourage the mixing of 2% of bio fuel with fossil fuels at the pump, without the need to raise prices. This measure is worth €70 million. Efforts to use the environmental investment tax credit to encourage the introduction of cleaner lorries and buses (Euro IV/V standards) will be continued in the period 2006-2009.

Furthermore the following measures are proposed:

- The excise duty exemption for mineral oils used for generating electricity will be extended to include plants with an output of at least 1 MW.
- The tax on lubricants will not be introduced. Such a tax would significantly increase the administrative burden on businesses and would require a considerable inspection effort by the Tax and Customs Administration. Moreover, it would only make a limited contribution to replacing fossil lubricants with eco-friendly ones.
- Due to the rise in fuel prices, excise duty on petrol and diesel and on domestic aviation fuels will not be indexed in 2006. This measure is worth €57 million.
- To prevent the economic damage and extra traffic jams that would result from major roadworks, employers may issue temporary public transport passes to their employees and others without any tax consequences.
- The groundwater tax for irrigation and watering purposes will be scrapped.
- The credit term for excise stamps affixed to packets of cigarettes and tobacco will be reduced by a month. The present term for cigars will be maintained. This measure will yield a one-off sum of €160 million.

Note from the author :
Petrol in Annex 1 means gasoline. Popular gasoline name in Indonesia is premium.