Socio-economic and Feasibility Study of Utilising Palm Oil Derived Biofuel in Malaysia

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ABSTRACT

In May 2006, the Malaysian government introduced the National Biofuel Policy to reduce the nation's dependence on non-renewable fossil fuels. This study was carried out to determine the feasibility of using palm oil derived biofuel (Envodiesel) *in Malaysia in term of socio-economic impact to both, the government and consumer. Among the parameters studied were the amounts of excess crude palm oil available for palm biofuel blending without affecting local and international consumption of palm oil and financial costing or government savings in term of subsidy from the use of palm biofuel blends (B5, B10, B15, B20, B25) in Malaysia. It is concluded that the supply of local palm oil is enough to cater biofuel usage up to B15 without disturbing supply for other used of palm oil. Furthermore, Malaysian government needed to subsidise nearly RM 4 billion annually in order to keep the price of biofuel remains at competitive level.*

INTRODUCTION

The petroleum products (petrol, diesel and LPG) subsidy is becoming a major headache to the policy makers in Malaysia. A whopping RM 13.4 billion was set aside as subsidy in 2005, and slightly lower at RM 10.11 billion and RM 12.15 billion in 2006 and 2007 respectively (Thillainathan, 2008). The petroleum subsidies had significantly trimmed the government coffers and reducing the budget for national development. Other than that, heavily relying on fossil fuel proves to be unsustainable due to the fact that petroleum fuel is non-renewable and additionally its emission is polluting our environment.

Realising this factor, the government had introduce the National Biofuel Policy in 2006 with the primary objective to reduce the nation's dependence on fossil fuels and reducing emissions (Lunjew, 2007). One of the proposals was the introduction of B5 (contains 5% of processed palm oil and 95% of petroleum diesel) to replace the 100% petroleum diesel fuel that is currently available in the market. As a result, on 21 March 2006, the then Prime Minister of Malaysia, Datuk Seri Abdullah Ahmad Badawi had launched Malaysia's first biofuel named *Envodiesel* (Basiron, 2006). The *Envodiesel* consists of 5% processed palm oil and 95% petroleum diesel (B5).

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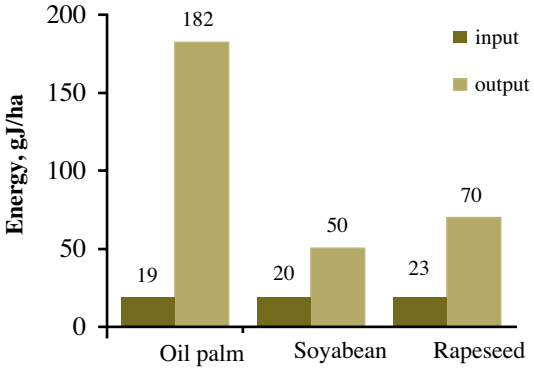
The usage of palm oil and its product as a source of fuel was started in January 2001, when palm oil price declined to below RM 900/t. Malaysian Palm Oil Board (MPOB) initiated a programme on the burning of palm oil in power station targeting to reduce the palm oil stock level in the country (May, 2006). This programme successfully made the price of palm oil rebound. Thus, it can be seen that the palm biofuel can act as a price stabilization mechanism for palm oil.

One of the main advantages of palm oil as biofuel as compared to other vegetables oil is its annual oil yield per hectare. *Table 1* shows four different vegetable oils that are normally used as biodiesel and their respective annual oil yield per hectare. It can be seen that the oil palm yielded the most oil compared to rapeseed, sunflower and soyabean. It implies that with less cultivated area, oil palm can produce much oil thus can save much arable land to be used to cultivate other crops.

Besides that, in terms of energy, oil palm is an energy efficient crop. It requires less energy input to release output more than three times higher compared to soyabean and rapeseed oils as shown in *Figure 1*.

Moreover, the usage palm biofuel is regarded as carbon neutral since it does not increase the level of carbon dioxide (CO_2) in the atmosphere as the oil palm absorbs CO_2 in the atmosphere through photosynthesis and releases oxygen (O_2) back to the surroundings. It is worth to mention that due to the fact oil palm is a perennial crop as compared with other annual crops such as soyabean and rapeseed, cultivation of oil palm contributed hugely to a reduction in global warming (Basiron, 2007).



Source: Fairhurst and Mutert (1999).

Figure 1. Energy balance of major oil balance.

The objective of this study is to determine the feasibility in terms of the availability of palm oil and the economic impacts of using B5 and another blend (B10, B15, B20 and B25) as a commercial diesel fuel in Malaysia.

METHODOLOGY

Availability of Excess Palm Oil as Biofuel in Malaysia

The refined, bleached and deodorised palm olein (RBDPO) is an edible oil that is used as cooking oil and biofuel. Any supply shortage and sudden price increase will be a chaotic nationwide. Thus, it is necessary to ensure the introduction of biofuel will not really affect the supply and price of the RBDPO.

Before pursuing further, the production and stock of crude palm oil (CPO) which is the 'raw' material to produce RBDPO and the RBDPO itself was thoroughly studied for the past four years. It is shown in *Table 2* that about 3% of RBDPO is kept as stock while for CPO is 6%. To minimise the impact of the introduction of biofuel, it is suggested that these stocks are used as biofuel.

Petroleum Diesel Consumption

The introduction of biofuel is mainly for the transportation purposes as enshrined in National Biofuel Policy. Therefore, the supply of diesel that is used in transportation sector was mainly obtained from the petrol pump station. The annual sale of petroleum diesel from 2004 until 2008 is shown in *Table 3* together with the estimated and projected sale from 2009 until 2014.

Since the data were available until 2008, it is necessary to estimate the sale from 2009 until 2014. The average growth rate from 2004 until 2008 was 2.41%, thus it can be used as a guide to estimate for 2009 and onwards as shown in *Table 3*.

Based on 2010 estimated diesel consumption, the amount of RBDPO needed to blend with

TABLE 1. THE AVERAGE OIL YIELD OF MAJOR VEGETABLE OILS

Crops	Average oil yield (t/ha/yr)	Total area (million ha)
Oil palm	3.68	9.86
Rapeseed	0.59	27.29
Sunflower	0.42	22.95
Soyabean	0.36	92.63

Source: *Oil World Annual* (2006).

TABLE 2. THE PRODUCTION AND STOCK OF CRUDE PALM OIL (CPO) AND REFINED, BLEACHED AND DEODORISED PALM OLEIN (RBDPO)

	2007		2008		2009		2010	
	RBDPO	CPO	RBDPO	CPO	RBDPO	CPO	RBDPO	CPO
Production (million tonnes)	9.292	15.824	9.895	17.734	9.938	17.565	10.328	16.994
Stock (million tonnes)	0.207	0.725	0.244	1.064	0.225	0.868	0.260	0.857
Percent (%)	2.2	4.6	2.5	6.0	2.3	4.9	2.5	5.0

Source: MPOB.

TABLE 3. ANNUAL DIESEL SALE AT PETROL PUMP STATION

Year	Annual diesel sale (billion litres)	Growth rate
2004	5.56	NA*
2005	5.62	1.08
2006	5.46	-2.85
2007	5.03	-7.88
2008	6.00	19.28
2009**	6.14	2.41
2010**	6.29	2.41
2011**	6.44	2.41
2012**	6.60	2.41
2013**	6.76	2.41
2014**	6.92	2.41

Note: *not applicable.
**Estimate.
Source: KPDNKK (2010).

TABLE 4. AMOUNT OF REFINED, BLEACHED AND DEODORISED (RBD) PALM OLEIN AND PETROLEUM DIESEL IN SPECIFIED PALM BIOFUEL

Biofuel blends	RBD palm olein (billion litres)	Petroleum diesel (billion litres)
B5	0.31	5.98
B10	0.63	5.66
B15	0.94	5.35
B20	1.26	5.03
B25	1.57	4.72

petroleum diesel is shown in *Table 4*.

Furthermore, if 90% of the CPO's stock is further processed as RBDPO and combined with 50% from available RBDPO stock then a total of 995 million litres of RBDPO are available for biofuel up until B15 without any disruption in local supply of cooking oil provided that there is minimal increase in demand for RBDPO.

Price Forecasting of Biofuel Blends

The palm biofuel is produced through volumetric blending of palm olein with petroleum diesel. This means that in order to produce biofuel of blend B5, 1 litre of palm olein is blended with 19 litres of petroleum diesel. Therefore, to calculate the price of producing biofuel, the equation below is formulated:

$$B_{xx} = \frac{(0.xx) \times A}{\frac{1000}{\rho\alpha}} + (1 - 0.xx) \times (c)$$

where:

B_{xx} = price of biofuel for the respective blending number XX (for example B5, B10, B15, B20 and B25).
A = price of RBD palm olein (RM/t).
$\rho\alpha$ = density of RBD palm olein = 0.9055 kg/litre.
C = price of unsubsidised petroleum diesel (RM/litre).

This equation can be simplified to become;

$$B_{xx} = \frac{(0.xx) \times A}{1104.3622} + (1 - 0.xx) \times (c)$$

Based on statistics obtained from MPOB, the average local price of RBD palm olein in August 2010 was RM 2848.50/t. On the other hand, the price for unsubsidised petroleum diesel is not disclosed by the government and the oil company but according to the recent announcement by the government

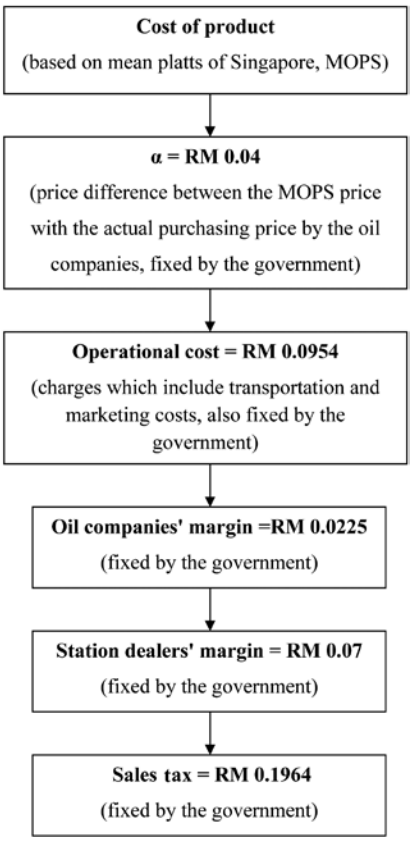


Figure 2. The cost breakdown of unsubsidised petroleum diesel in Malaysia.

as reported by (Ahmad, 2009), the cost breakdown of unsubsidised diesel price in Malaysia is shown in *Figure 2*.

TABLE 5. PRICES OF BIOFUEL BLENDS AND PRICE DIFFERENCES COMPARED TO PETROLEUM DIESEL (August 2010)

Palm biofuel blend	Price per litre (RM)	Price difference[1] (RM)	Price difference[2] (RM)
Petroleum diesel (PD)	2.3300	0	0.48
B5	2.3425	0.0125	0.4925
B10	2.3549	0.0249	0.5049
B15	2.3674	0.0374	0.5174
B20	2.3799	0.0499	0.5299
B25	2.3923	0.0623	0.5423

Note: 1 = price of blend – price of unsubsidised PD (RM 2.33).
2 = price of blend – price of subsidised PD (RM 1.85).

RESULT AND DISCUSSION

As shown in *Figure 2*, the only cost that is not controlled by the government is the cost of diesel which is determined by the market price. From the latest price in MOPS, the petroleum diesel price was about USD 94.82 per barrel (August 2010) and considering 1 USD = RM 3.20 (August 2010), the price of unsubsidised petroleum diesel was RM 2.33 per litre. Thus, using these two parameters, the estimation of the price differences between palm biofuel blends and petroleum diesel are presented in *Table 5*.

Based on the price differences of the biofuel blends and petroleum diesel, an estimate of the potential savings or additional budget of the government in the near future can be projected according to the estimated growth of annual consumption of petroleum diesel as previously shown in *Table 2*. The result (assuming that the diesel consumption pattern does not change) is shown in *Table 6*.

In *Table 6*, it is shown that the Malaysian government needs to fork out additional budget as subsidy if the implementation of palm biofuel is imminent. The amount keep increasing year

TABLE 6. ADDITIONAL GOVERNMENT SUBSIDY FROM INTRODUCTION OF PALM BIOFUEL AS SUBSTITUTION FOR PETROLEUM DIESEL

Biofuel blend	2010 (RM billion)		2011 (RM billion)		2012 (RM billion)		2013 (RM billion)		2014 (RM billion)	
	Price$^{\alpha}$	Price$^{\beta}$	Price$^{\alpha}$	Price$^{\beta}$	Price$^{\alpha}$	Price$^{\beta}$	Price$^{\alpha}$	Price$^{\beta}$	Price$^{\alpha}$	Price$^{\beta}$
B5	0.078	3.097	0.080	3.171	0.082	3.250	0.084	3.329	0.086	3.407
B10	0.157	3.176	0.161	3.252	0.165	3.333	0.169	3.413	0.172	3.494
B15	0.235	3.254	0.241	3.332	0.247	3.415	0.253	3.498	0.259	3.580
B20	0.314	3.333	0.321	3.412	0.329	3.497	0.337	3.582	0.345	3.667
B25	0.392	3.411	0.401	3.492	0.411	3.579	0.421	3.666	0.431	3.753

Note: α = additional amount needed to match the price of unsubsidised diesel fuel.
β = additional amount needed to maintain the price of subsidised diesel fuel.

by year due to the increasing diesel consumption. Moreover, additional quantity demanded of palm olein will push up the price of palm biofuel because of high price of palm olein in the market currently. This will further increase the government commitment in order to stabilise fuel prices.

Even so, since Malaysia is the largest exporter of palm oil product in the world, the increase in palm oil prices in the market will definitely benefit the government directly in term of tax. Moreover, the introduction of biofuel will reduce country dependent on imported fuel thus bring additional saving through foreign exchange. Furthermore, a lot of countries such as Germany, United States and Brazil provide subsidies to their biodiesel to keep their prices at competitive level.

CONCLUSION

The introduction of palm biofuel using the blends of petroleum diesel and RBDPO had minimal impact on Malaysian socio economy since there is enough supply of RBDPO to blend up until B15. Additional cost from the government in term of subsidy is needed to ensure the price of biofuel remain at competitive level.

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REFERENCES

AHMAD, I (2009). Setting the retail price for petrol and diesel. *The New Straits Times*. Kuala Lumpur.

BASIRON, Y (2006). Pushing the case for envodiesel. *New Straits Times*. Kuala Lumpur.

BASIRON, Y (2007). The palm oil advantage in biofuel. *New Straits Times*. Kuala Lumpur.

FAIRHURST, T H and MUTERT, E (1999). Introduction to oil palm production. *Better Crops International (BCI)* (Armstrong, D L ed.). Saskatchewan, Potash & Phosphate Institute of Canada (PPIC).

KEMENTERIAN PERDAGANGAN DALAM NEGERI KOPERASI DAN KEPENGGUNAAN (KPDNKK) (2010). *Jualan Bahan Petroleum di Stesen Minyak bagi Tahun 2004-2008*. Putrajaya.

LUNJEW, D D M D (2007). *Fourth Biomass-Asia Workshop: Policy and Legislation on Biofuel Utilisation*. Shah Alam.

MAY, C Y (2006). Development of palm biofuels in Malaysia. *MIMA Bulletin*. Kuala Lumpur, Maritime Institute of Malaysia (MIMA).

OIL WORLD (2008). The revised oil world 2020. Available online at http://www.oilworld.biz/S, accessed in November, 2006.

MPOB (2010). Economics and Industry Development Division. Available online at <http://econ.mpob.gov.my/economy/EID_web.htm, accessed in September 2010.