BIOFUELS - AT WHAT COST ?

Government support for biodiesel in Malaysia

One of a series of reports addressing subsidies for biofuels in selected developing countries

September 2008

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Prepared for :
The Global Subsidies Initiative (GSI)
The International Institute for Sustainable Development (IISD)

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Geneva, Switzerland

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Abbreviations and acronyms

B5	A blend of 5 per cent biodiesel and 95 per cent diesel by volume
B20	A blend of 20 per cent biodiesel and 80 per cent diesel by volume
cc	Cubic centimetres
CPKO	Crude palm kernel oil
CPO	Crude palm oil
DoE	Department of Environment
EIA	Environmental Impact Assessment
EPF	Employees Provident Fund
EPU	Economic Planning Unit
EU	European Union
FDI	Foreign Direct Investment
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land and Development Authority
FFB	Fresh Fruit Bunches
GHG	Greenhouse gases
Ha	Hectares
ICA	Industrial Coordination Act 1975
IISD	International Institute for Sustainable Development
IOI	IOI Corporation Berhad
MBA	Malaysian Biodiesel Association
MDTCA	Ministry of Domestic Trade and Consumer Affairs
MEWC	Ministry of Energy, Water & Communication
MIDA	Malaysian Industrial Development Authority
MoF	Ministry of Finance
MPIC	Ministry of Plantation Industries and Commodities
MPOA	Malaysian Palm Oil Association
MPOB	Malaysian Palm Oil Board
NASH	National Association of Smallholders
NEAC	National Economic Action Council
NEP	New Economic Policy
PELITA	Land Custody and Development Authority of Sarawak
PETRONAS	Petroliam Nasional Berhad (Malaysia's national oil and gas company)
PIA	Promotions of Investment Act 1987
PKO	Palm Kernel Oil
PME	Palm Methyl Esters
PNB	Permodalan Nasional Berhad (National Equity Corporation)
PORAM	Palm Oil Refiners' Association of Malaysia
PORIM	Palm Oil Research Institute of Malaysia

PPO	Processed Palm Oil
PTM	Pusat Tenaga Malaysia (Malaysian Energy Centre)
R&D	Research and Development
RBD	Refined Bleached Deodorised
RISDA	Rubber Industry Smallholders' Development Authority
RLPO	Refined Liquid Palm Oil
RM	Ringgit Malaysia
RSPO	Roundtable for Sustainable Palm Oil
SALCRA	Sarawak Land Consolidation and Rehabilitation Authority
SIRIM	Standards and Industrial Research Institute of Malaysia
U.S.	United States of America

Currency conversion note

Where values in Malaysian Ringgit (RM) have been converted into US dollar values (US$), the average weekly spot exchange rate[1] was used for each year. The data source is the Central Bank of Malaysia (Bank Negara Malaysia). Malaysia instituted a fixed exchange rate regime on 1 September 1998, setting it at RM 3.80 to US$ 1.00. The Ringgit moved to a managed float on 21 July 2005. Since then, the Malaysian Ringgit has been vacillating between RM 3.53 to RM 3.78 to the US dollar in 2006 and RM 3.31 to RM 3.52 in 2007. In 2008, it was between RM 3.13 to RM 3.31. The average for 2006 was RM 3.68 to US$ 1.00. For 2007 it was RM 3.45 to US$ 1.00 and, up until June 2008, it was RM 3.25 to US$ 1.00.

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1 Bank Negara Malaysia (Central Bank of Malaysia), http://www.bnm.gov.my/index.php?ch=12&pg=629

Executive summary

In a few short years, Malaysia has seen its vision of sustainable development through biofuel production turn into a mirage. The Malaysian Federal Government ("the government") developed ambitious biofuel policies in 2005 when it appeared that the country's key agricultural product, palm oil, could be profitably transformed into biodiesel.[2] The policies aimed to expand the market for palm oil, improve energy security and create a new export industry. Malaysia subsidizes the end-user prices of petroleum transport fuels so, by replacing a proportion of petroleum diesel with biodiesel, the government hoped to reduce its subsidy burden. Environmental considerations were a minor motivating factor, with the government seeking to improve ambient air quality and reduce emissions of greenhouse gases through increased biofuel use.

However, the very striving of governments worldwide to encourage the production and use of biofuels undermined the economic viability of the industry. In 2007, global production was approximately 70 million litres of biofuels, converting millions of tonnes of vegetable oils, tallow, grains and sugar cane to biofuels. A sizeable portion of this production occurred in OECD countries, supported by government incentives that are estimated to have totalled over US$ 15 billion in 2007 alone. The result was a major surge in demand for agricultural commodities over the past two years, causing dramatic rises in prices, including for palm oil. High feedstock prices put biofuels beyond the reach of any but the wealthiest nations that can afford to maintain subsidies.

Malaysian biofuel producers were not able to draw on significant domestic government support to maintain their operations. To date, government support for the Malaysian biodiesel industry has been limited to RM 60 million (US$ 16 million) in low-interest loans in 2004, and RM 12 million (US$ 3.3 million) in federal grants for demonstration projects in 2006. Plans to mandate the replacement of five per cent of domestic diesel consumption with palm-based biofuel (B5) were never implemented.

Hoped-for jobs from the biofuels industry did not materialize and, instead, many biofuel facilities suspended operations in 2008, stranding public and private investments. While 92 biodiesel projects had been approved in Malaysia during 2006 and 2007, a survey of plants in September 2008 revealed that there were 14 functional biodiesel plants, only eight of which had produced biodiesel in 2008 (approximately 130 000 tonnes—less than ten percent of their potential production capacity). The remainder had suspended operations due to high feedstock prices, and a further four had closed. Eight new biodiesel plants were under construction. Assuming no further closures or cancellations, total production capacity is expected to reach approximately 2.7 million tonnes in 2009.

Biodiesel is estimated to cost around RM 0.67 (US$ 0.20) per litre more to produce than petroleum diesel when palm oil is RM 3 000 per tonne and Malaysian Tapis crude petroleum oil is US$ 115 per barrel. Replacing petroleum diesel with biodiesel would therefore worsen the government's subsidy burden, rather than improve it. The Malaysian Government's consumption subsidies for petroleum fuel have been estimated to total around RM 25 billion (US$ 7.8 billion) in 2008 alone. Replacing five per cent of

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[2] Two types of biofuel were promoted: palm methyl esters (PME) biodiesel (similar to the conventional biodiesel produced internationally) and "Envodiesel" (a direct blend of palm oil and petroleum diesel). Fuel-grade ethanol is not currently produced in Malaysia.

petroleum diesel with biodiesel would add RM 395 million (US$ 122 million) per year to this subsidy bill, at the above mentioned prices.

A B5 mandate would lock Malaysia into consuming around 500 000 tonnes (approximately 560 million litres) of biodiesel per year, regardless of its cost relative to petroleum diesel. The implications could be expensive. For example, if petroleum oil prices fell to US$ 75 per barrel while palm oil rose to RM 5 000 per tonne (only RM 500 higher than prices in March 2008), the subsidy cost of supplying five per cent of Malaysia's diesel from biodiesel would be around RM 2.2 billion (US$ 675 million) per year.

A biofuel mandate would be a retrograde step for the Malaysian Government, which introduced measures in June 2008 to restructure the price subsidy for petroleum fuels. Fuel subsidies increase consumption, discourage more efficient use of resources and absorb national budgets that could be spent on social services (such as health and education). By moving fuel prices closer towards the international market price, the government generated subsidy savings in the transport fuel and electricity sectors of RM 14 billion (US$ 4.2 billion) in 2008 alone.

If palm oil is cheap relative to petroleum oil, replacing five per cent of Malaysia's petroleum diesel with biodiesel could generate subsidy savings. For example, if the palm oil price were to fall to pre-2006 prices of around RM 1 500 per tonne while petroleum oil prices shot up to US$ 175 per barrel, a B5 mandate would *reduce* government subsidies by around RM 1 400 billion (US$ 430 million). Were such circumstances to arise, however, production and blending of biodiesel would be profitable, eliminating the need for government intervention.

The profitability of Malaysian biodiesel production is precarious, depending on volatile palm oil and petroleum prices, and decisions of policymakers both in Malaysia and overseas. The vast majority Malaysia's current biodiesel production is exported, mostly to the EU and United States where domestic subsidies support biodiesel use (including imports). Malaysian biodiesel is likely to be benefiting from a loophole in U.S. legislation that allows fuel blenders to claim a US$ 1 per gallon (US$ 0.26 per litre) subsidy for blending biodiesel (including imports), even if the product is then re-exported (usually to the EU, where the biodiesel can access additional consumption subsidies). Pressure from the EU to close this loophole could prevent Malaysian (and other) biodiesel exporters from accessing the U.S. subsidies. In the longer term, sustainability standards could limit access into the EU of all but certified biofuels and feedstocks.

Despite biodiesel being uneconomic, many countries have supported the development of a domestic biodiesel industry for social and environmental reasons. There is no evidence to suggest a strong social or environmental rationale for promoting biofuels in Malaysia. While high commodity prices have delivered benefits to some, these have been more than offset economy-wide by rising food prices, which have hit the poor hardest. Oxfam (2008) estimated that high food prices attributed to global biofuel production have caused 30 to 75 million people to fall into poverty and to jeopardize the livelihoods of 100 to 220 million people.

The presumed environmental benefits of biodiesel—most notably in terms of reducing greenhouse gas emissions—have evaporated with improved understanding of the full lifecycle impacts of biofuel production. Biodiesel is commonly considered to be "carbon neutral" because carbon released in burning the fuel is off-set by growing the feedstock. However, the conversion of forest to oil-palm plantations has been has been found to cause greenhouse gas releases that far outweigh any carbon emission reductions arising from the use of biofuels sourced from that land.

The expansion of the palm oil industry in Malaysia has been associated with deforestation, release of carbon from vegetation and soil, forest fires, soil erosion, water pollution and biodiversity loss. Current *domestic* production of biodiesel in Malaysia is unlikely to be driving deforestation, due to low production levels. However, the growing global demand for palm oil—largely due to increased demand for vegetable oils for biodiesel production—has contributed to a plantation expansion boom in Borneo, with associated deforestation and social conflicts.

The Government has said that no more forest reserves will be converted to oil-palm. However, it is allowing land previously zoned for agriculture to be cleared, including rainforest. Should the Malaysian Government institute its B5 mandate, 570 000 tonnes of palm oil would be required.[3] This equates to approximately 130 000 hectares of land,[4] or three per cent of the current 4.2 million hectares currently under cultivation. The majority of new Malaysian oil-palm developments are in the states of Sarawak and Sabah. These state governments have a great deal of autonomy and it appears that, in some areas at least, environmental impact assessments are not being performed rigorously. Many Malaysian firms are also operating in the Indonesian provinces of Kalimantan and Riau, which have high rates of conversion of forest to oil-palm, and less exacting governance structures.

These fundamental elements of biodiesel production are unlikely to change in the near term. In the meantime, measures to address sustainability issues will become increasingly important in order to supply environmentally-conscious markets. Such measures might improve the environmental credentials of palm oil destined for OECD markets, but are likely to do little to avoid expansion of uncertified oil-palm and consequent deforestation.

As for the international export opportunities, prospects have diminished since the early euphoria. European Union and U.S. subsidy policies may currently be improving the viability of Malaysian biodiesel exports, but policy changes in the future may limit access for Malaysian biodiesel to U.S. and EU subsidies.

In light of the limited economic, social and environmental benefits of promoting biodiesel in Malaysia, this report recommends that the government refrain from intervening in the market for biofuels, through such measures as offering direct price support or imposing mandatory blending. The biofuel industry should be allowed to function in response to market signals—consistent with environmental and social standards—so that the industry establishes itself on a sustainable rather than a government-dependent basis.

The government's current plan to move domestic retail fuel prices towards the world price is commendable, particularly as steps are also being envisaged to ensure that adequate safeguards are provided for the poor. The government has correctly surmised that biodiesel can only, at most, complement other energy sources. It cannot significantly augment the nation's energy supplies. A B5 mandate would only lock in a new form of fuel subsidy that is delinked from market forces, thus creating new inefficiencies in the economy that would likely require painful reform in future years.

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3 A B5 mandate is estimated to require 500 000 tons of biodiesel. One ton of biodiesel production requires 1.14 tons of CPO.

4 Assuming that the average oil-palm plantation can produce 4.3 tons of CPO per hectare.

1 Introduction

This report examines the history and status of the biofuel industry in Malaysia, focusing on government support policies. It forms part of a multi-country effort by the Global Subsidies Initiative (GSI) to characterize and quantify (to the extent possible) government subsidies and other support for biofuel production, distribution and consumption, including support provided for the production of key inputs. The environmental and social impacts of biofuel production are also reviewed.

1.1 Biofuels in Malaysia

Biofuel production in Malaysia is synonymous with palm oil, a major established agricultural product in Malaysia. There are two methods of producing biofuel from vegetable oils (Box 1.1). The conventional method is through transesterification, which produces methyl esters ("biodiesel") that can be used in compression ignition engines (diesel engines) without any modification. Malaysia produces palm methyl esters (PME) primarily for the export market, although consideration is being given to increasing its use domestically.

The second method is direct blending of straight vegetable oil (SVO) with petroleum diesel. In Malaysia, an SVO blend of 5 per cent refined palm oil and 95 per cent petroleum diesel is marketed under the name "Envodiesel." Envodiesel is facing resistance from automobile manufacturers, who are hesitant to extend engine warranties when palm oil rather than methyl ester is used in blending.

Ethanol is not currently produced in Malaysia.[5] There are initiatives to develop biofuel from other agricultural crop sources such as *Jathropa curcas*[6] (to produce oil that can be processed into biodiesel or used directly as SVO) and oil-palm biomass (trunks, fronds, empty fruit bunches, shells, roots and fibre—to produce cellulosic ethanol or generate electricity from biomass).

The Malaysian Federal Government ("the government") launched its National Biofuels Policy in 2005 with the aim of positioning Malaysia as a major global biodiesel producer. The primary goals of the policy were to expand and diversify the market for crude palm oil (CPO), increase foreign exchange income through exports of biodiesel and biofuel feedstocks, help alleviate rural poverty as well as to help address long-term domestic

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5 The sole planned ethanol-producing venture in Malaysia was terminated in 2007 (Lunjew, 2007). It was to be the first refinery to produce ethanol commercially from the nipah palm, a plant indigenous to south-east Asia with sugary sap that can be used for ethanol production. The reasons for the cancellation of this project are not known to the authors.

6 *Jatropha curcas* is a hardy perennial plant native to South America. Its nuts have a high oil content, which has potential as a biofuel feedstock. Jatropha can be grown in dry, poor soils and is therefore less likely to compete with food production for arable land. The Malaysian Palm Oil Board (MPOB) is currently undertaking a pilot project to evaluate the feasibility of jatropha plantations (*Bernama*, 24 September 2007). Although the Jatropha genus contains many species, this report will use the conventional name of jatropha to refer to the species *J. curcas*.

energy needs. Malaysia subsidizes petroleum transport fuel so, by reducing the use of petroleum diesel, the government also hoped to reduce its subsidy burden.[7]

By the end of September 2007, the Government of Malaysia had approved 92 licenses for individual biodiesel projects.[8] These projects had a potential production capacity of 10.2 million tonnes (11.5 billion litres)[9] a year in total. MPOB statistics show that in 2006, 47 990 tonnes of biodiesel were exported with revenues totalling RM 121 million (US$ 33 million). This increased in 2007 to 95 010 tonnes and revenues of RM 253 million (US$ 73 million).[10]

However, high feedstock prices since 2006 have severely affected the development of the Malaysian biodiesel industry. A phone survey in September 2008 revealed that only eight of Malaysia's 14 biodiesel facilities were in operation, with the remainder having temporarily suspended production and a further four having permanently ceased operations. Eight plants were under construction, but many more new facilities had been delayed or cancelled (Tan, 2007; *ICIS News*, 27 September 2007).

The vast majority of Malaysia's current biodiesel production is exported, mostly to the EU and U.S. where domestic subsidies support biodiesel use (including imports). The profitability of Malaysian biodiesel production is therefore precarious, depending on volatile palm oil and petroleum prices, and decisions of policymakers both in Malaysia and overseas.

1.2 Outline of the report

The second section of this report provides a history of the palm oil industry's development in Malaysia, highlighting its importance to the Malaysian economy and biofuel industry. Government policies and legislation supporting biofuel production and consumption are outlined in section three, as are industry milestones and major recent announcements.

Section four provides an overview of Malaysia's biofuel industry, together with estimates of production costs for PME biodiesel at varying palm oil costs. Biodiesel production cost estimates are compared with production costs for petroleum diesel at varying crude oil prices, to show when biodiesel is likely to become economically competitive with petroleum diesel. This introductory section provides the reader with the basic information needed to understand the business of producing biofuels in Malaysia as well as a basis for understanding government support figures listed in other sections of this report.

Current forms of government support to the biofuel production chain are discussed in section five, including support for intermediate inputs (such as feedstocks), output-linked

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7 The official version of the National Biofuels Policy in Bahasa Malaysia, titled "Dasar Biofuel Negara", is available at http://www.kppk.gov.my/index.php?option=com_content&task=view&id=200&Itemid=148 . The English version is available at: http://www.mpoc.org.my/download/mktstat/Biofuel%20Policy.pdf

8 Malaysian Parliament Hansard, DR. 30 October 2007

9 One ton palm diesel has a volume of 1 123 litres.

10 http://econ.mpob.gov.my/economy/performance%202007.htm

support, value-adding factors and research and development. The potential subsidy costs of mandatory consumption requirements are also assessed.

Social and environmental implications for Malaysia of domestic and international biofuel production are addressed in section six. Section seven provides conclusions and recommendations.

1.3 Framework of the analysis

Figure 1 illustrates the framework used in the report to assess the scale of subsidies provided at different points of the supply chain for biofuels in Malaysia, from the production of feedstock crops through to the final consumption of the product. The framework of analysis is that developed by the Global Subsidies Initiative (first published in Koplow, 2006) and adapted to suit the conditions found in Malaysia. In this analysis, the report has focused on subsidies and taxes that affect production components—those components which have a significant effect on the cost structure of biofuel, including subsidies to producers of intermediate inputs to biofuel production, namely palm oil plantations. Support to production and consumption may be provided at different points in the supply chain. For the purpose of this report, the dividing line between production and consumption is taken as the point at which the biofuel leaves the manufacturing plant.

Description and data on subsidies and taxes, where available, have been obtained from official sources such as the Ministry of Plantation Industries and Commodities (MPIC), the Ministry of Domestic Trade and Consumer Affairs (MDTCA) and the Ministry of Finance (MoF) as well as government agencies such as the Malaysian Palm Oil Board (MPOB) and Pusat Tenaga Malaysia (PTM). Data on production costs were sourced from the MPOB and the PTM. Other data sources utilized in this research were publicly available research and media reports on the biofuel industry in Malaysia. A production-cost formula using basic financial techniques was developed to create scenarios of price levels and the support required to make biodiesel production economically viable in Malaysia.

Box 1.1 Biodiesel and ethanol production processes

Liquid transport biofuels are most commonly produced as either biodiesel or ethanol.

In Malaysia, all biofuels are produced from palm oil, by one of two routes:

Route 1 (Transesterification): palm oil + methanol = methyl esters (palm oil methyl ester—PME) + glycerol. This process is currently being used solely for export product. This method is the conventionally accepted way of producing fuel generally referred to as "biodiesel."

Route 2 (Direct blending): processed palm oil (a "straight vegetable oil"—SVO) + petroleum diesel = SVO biofuel. In Malaysia, an SVO blend of 5 per cent processed palm oil + 95 per cent petroleum diesel is marketed as "Envodiesel". Envodiesel was developed by the Malaysia Palm Oil Board for consumption in the domestic market. It has yet to gain widespread acceptance.

Biodiesel can be produced from vegetable oil or animal fat. In a process known as transesterification, the fat or oil is reacted with an alcohol (usually methanol synthesized from natural gas) in the presence of a catalyst to yield mono-alkyl esters (biodiesel) and glycerine. Other by-products can include fatty acids, fertilizer and oilseed meal. Many of these by-products have a value, particularly the glycerine and oilseed meal (e.g. soybean meal used for human and animal food). Palm oil for biodiesel production is squeezed from the fruit of the plant and its by-product is mesocarp fibre, which is usually burnt as fuel ,with any excess possibly used as mulch.

Biodiesel is used to replace fossil diesel. It can be used pure or in a blend (commonly B5 or B20, which contains 5 per cent or 20 per cent respectively biodiesel mixed with fossil diesel). The energy content of biodiesel varies between 88 per cent and 99 per cent of the energy content of diesel, depending on the feedstock and esterification process used (Love and Cuevas-Cubria, 2007).

Over 50 plant species produce extractable oils. All have potential for use as fuel, but most are prohibitively expensive. The main oils used for fuel are derived from soybeans, oil-palm fruit, rapeseed (canola), sunflower seed, and physic nut (*Jatropha curcas*). Another possible source of lipids is oil-rich microalgal feedstocks. Producing biodiesel from algae is still at the research and demonstration phase.

For **palm biodiesel** production, palm oil is heated in the presence of excess methanol and an alkaline catalyst. It then passes through a set of multi-stage continuous reactors to maximize the amount of transesterification. Glycerol is removed after each reaction. The removal of glycerol is important to achieve a higher conversion to methyl esters as part of the reaction. After the reaction is complete, excess methanol is recovered and can be reused. The crude biodiesel is washed using hot water and separated by centrifugal action. It is then dried in a vacuum to ensure the final product has a low moisture content prior to it being sent to storage tanks. The glycerol is treated to recover the methanol and then sent to storage tanks as crude glycerol.

Several alternative technologies are vying to replace transesterification. The costs of these technologies are highly sensitive to rises in the prices of oils and fats. One new process uses existing equipment normally found in oil refineries to create a diesel substitute (called “renewable diesel”) using animal fats or vegetable oils. Longer term, diesel substitutes may be synthesized from almost any type of low-moisture biomass using the Fischer-Tropsch (F-T) process. Although the F-T process is well developed and has been used to make liquid fuels from fossil-fuel feedstocks such as coal, production from biomass is still at the research and demonstration stage.

Ethanol is a clear alcohol that can be used as a fuel in spark-ignition engines, either neat or blended with gasoline. The energy content of fuel ethanol is around two-thirds that of gasoline (regardless of the feedstock used), but it has a significantly higher octane rating. This method is not currently used in Malaysia.

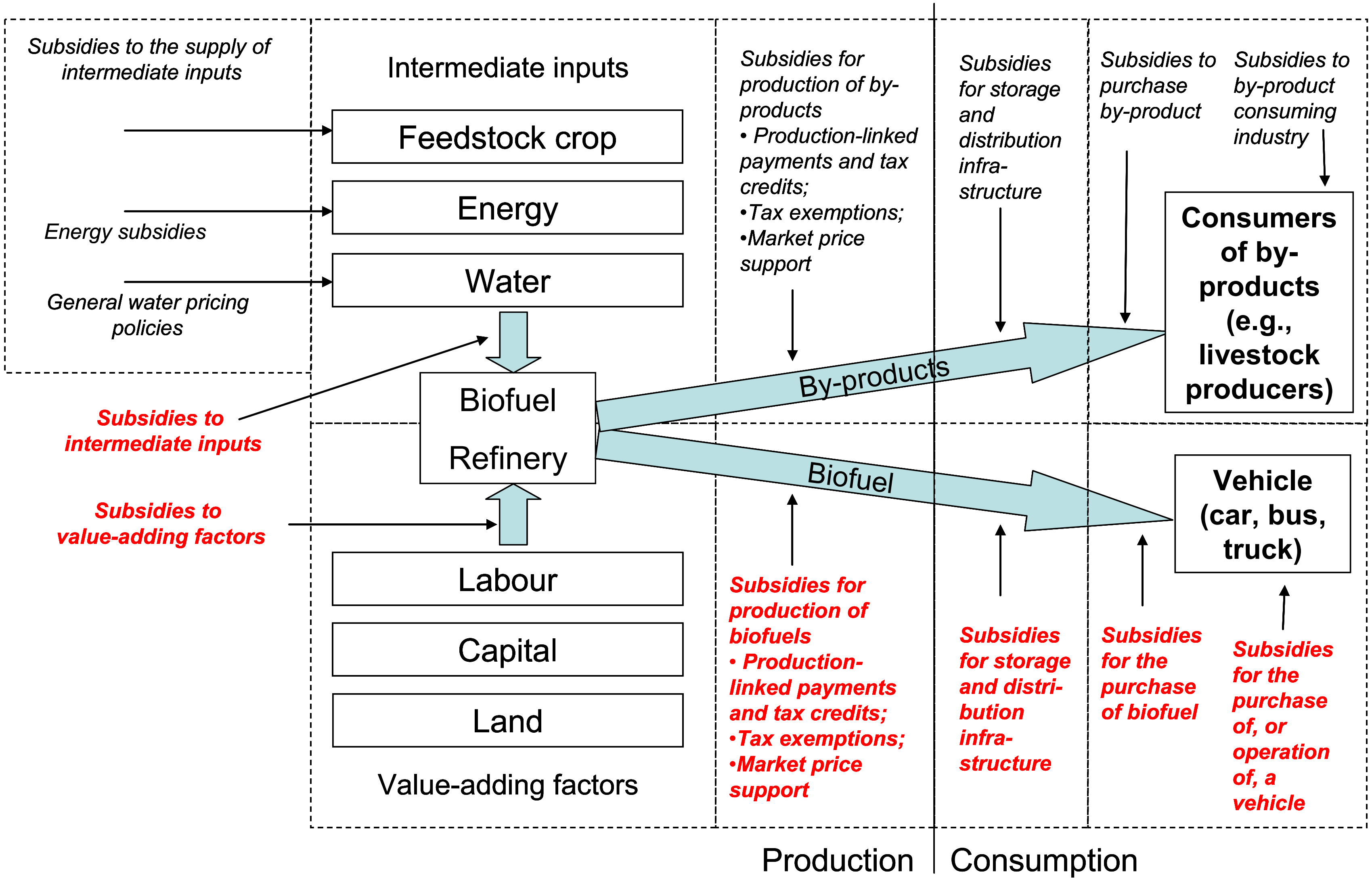
Fuel ethanol can be either hydrous (also called “hydrated”) or anhydrous. Hydrous ethanol typically has a purity of about 95 per cent and has been used in Brazil since the late 1970s as a fuel in modified motor vehicles. Further processing to remove any residual water produces a high-purity anhydrous ethanol that is more typically blended with petrol.

More than 95 per cent of the world’s ethanol is produced by fermented plant-derived matter, mainly sugars and starches. The rest is produced synthetically from petroleum or coal. Less than 25 per cent of total ethanol produced is used for beverage or industrial purposes.

Production from sugar and starch is referred to as a *first-generation* technology. *Second-generation* technologies are under development to commercialize production of ethanol from cellulosic material, such as crop waste, wood and grasses. In second-generation ethanol manufacturing plants, the cellulose and hemi-cellulose constituents of the biomass are converted into simple sugars either biologically, using enzymes, or chemically, using acids and high temperatures, prior to fermentation.

Sources: Love and Cuevas-Cubria (2007); Steenblik (2007); Ministry of Plantation Industries and Commodities (2007); Lipochem (M) Sdn. Bhd. (personal communication).

Figure 1.1 Subsidies provided at different points in the biofuel supply chain



2 Palm oil in Malaysia

The palm oil industry is a key component of the domestic economy, and an influential player in the global edible oils market. Within the agricultural sector, palm oil is the biggest contributor to the Malaysian economy. Approximately 13 per cent of Malaysia's land mass and 60 per cent of its agricultural land is being used to grow oil-palm (Economic Planning Unit, 2006a). In 2007, the industry's assets were valued at approximately RM 85 billion (US$ 25 billion) and around 860 000 people were directly or indirectly employed in the industry (Ministry of Plantation Industries and Commodities, 2007). Export earnings for all oil-palm products (including palm oil, palm oil cake and oleocemicals) were a record RM 45.1 billion (US$ 13 billion) in 2007.[11] Palm oil can be extracted from the fruit of the palm or its seeds (Box 2.1). About 80 per cent of palm oil is used for food and the rest in non-food applications (Table 2.1). The majority of Malaysian palm oil is exported as processed palm oil products for use in the chemical and food sectors. Increasing the value-added of the Malaysian palm oil industry requires widening end-uses for palm oil products, including biodiesel production.

This section describes the policies that have supported the establishment, management and growth of the industry: the foundations of Malaysia's biofuels industry.

Box 2.1 Types of palm oil

Crude palm oil (CPO) is obtained from the flesh of the fruit (mesocarp) of the oil-palm species *Elaeis Guineensis* by cooking, mashing and pressing. Palm oil is semi-solid at room temperature.

Processed Palm Oil (PPO) is a generic term used for a range of refined products produced from CPO.

Palm olien and palm stearin are produced from fractioning CPO. The triglycerides found in the oil have different melting points. At room temperature (~25^{o}C), the higher melting triglycerides would be solid and the lower melting tryglycerides liquid, giving the oil a solid (stearin) and liquid (olein) fractions. The fraction can be separated by filtration. The liquid olein is the premium product. The stearin has less value.

Palm kernel oil (PKO) is from the seed of the fruit. A shell separates the mesocarp from the fruit.

Palm kernel olein is the liquid fraction obtained by fractionation of palm kernel oil after crystallization at low temperature. Palm kernel olein is approximately 80 per cent saturated, while palm olein is around 50 per cent saturated.

Palm kernel stearin is the more solid fraction of palm kernel oil obtained from fractionation. It is a co-product of palm kernel oil.

Refined Bleached Deodorised (RBD) palm oil is light yellow and semi-solid at room temperature, melting to a clear yellow liquid on slight heating. It is also known as Partially Processed Palm Oil.

Refined Bleached Deodorised (RBD) palm olein is refined palm olein—a clear yellow liquid at room temperature.

Refined Bleached Deodorised (RBD) palm stearin is refined palm stearin—a white solid at room temperature, melting to a clear yellow liquid on heating.

Red Palm Olein is palm olein refined at a lower temperature to retain much of the rich content of carotenoids in palm oil.

Sources: MPOB (2000, 5th Edition) Pocketbook of Palm Oil Uses. MPOB & Kuala Lumpur Kepong Berhad website.

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[11] Malaysian Palm Oil Board, http://econ.mpob.gov.my/economy/overview07.htm

Table 2.1 Food and non-food uses of palm oil

Palm oil component	Products
Food applications	
Palm oil and palm kernel oil	Ingredients for production of specialty fats (widely used for production of chocolate confectioneries)
Refined, bleached and deodorised (RBD) palm oil	Margarine, shortenings, *vanapasti* (vegetable ghee), frying fats & ice-cream
RBD olein	Cooking and frying oils, shortening and margarine
RBD stearin	Shortenings and margarine
Red palm olein	Natural carotenes (precursors of Vitamin A) used as food colouring, a source of antioxidants in bakery products, margarine, pasta and mayonnaise
Non-food uses	
Without transesterification	Straight vegetable oil fuel
	Drilling lubricant, soaps, epoxidised palm oil product, polyols, polyurethanes & polyacrylates
With transesterification	Fatty acids, esters (including PME biodiesel), alcohols, nitrogen compound & glycerol

Source: Teoh (2002)

2.1 History

The palm oil tree (*Elaeis Guineensis*) is native to West Africa. It was introduced to the British colony of Malaya in the early 1870s. In 1917, the first commercial planting took place at the Tennamaran Estate in Selangor with seeds sourced from Indonesia. This initial plantation laid the foundation for subsequent oil-palm plantations and the later development of a palm oil industry in Malaysia.

The development of the palm oil industry in Malaysia can be divided into several phases (Table 2.2), beginning with the experimental phase from the late 1800s until 1916 (Rasiah, 2004). The colonial private estates and plantation phase commenced in 1917 and lasted until 1960 (three years after Malaya became an independent nation in 1957). The third phase started in the 1960s in response to the Government of Malaysia's diversification policy to reduce the national economy's dependence on rubber. Following a recommendation of a World Bank mission in 1955, the Government started promoting the planting of oil-palm.

From the late 1970s, producers began to integrate palm oil refineries with plantations, further to government decisions to penalize the export of crude palm oil (CPO) with high export taxes, forcing its price downwards to improve the profitability of the refining sector. The government continued to promote increased processing of palm oil for different end uses and export diversification as production of CPO increased. The emphasis since the late 1980s has been characterized by an effort to diversify into the production of higher value-added products. The government had introduced various incentives and disincentives to achieve these objectives.

Table 2.2 Evolution of palm oil industry in Malaya/Malaysia

Phase	Period	Description
First	1870 – 1917	Ornamental planting and experiments with palm oil
Second	1917 – 1960	Private individual estates (Colonial)
Third	1960 – 1979	Aggressive commercial cultivation & export
Fourth	1979 – 1986	Expansion of the estate area in Peninsular Malaysia (FELDA projects) and Sabah commences. Integration of palm oil processing
Fifth	1986 – 1996	Continued expansion of the estate area in Peninsular Malaysia and Sabah. Export market expansion; establishment of oleo-chemical industry and product diversification
Sixth	1996 – present	Expansion of the plantation estate area in Eastern Malaysia and Indonesia Product diversification and value-adding

Source: Adapted from Rasiah (2004).

2.1.1 Oil-palm development strategies

The government's first intervention in the Malaysian palm oil industry was in the 1960s through the Federal Land Development Authority (FELDA), established in 1956 to develop plantation land for the rural and landless poor (Box 2.2). Beginning in the late 1970s, state-owned enterprises began to take over many of the private colonial plantation houses such as Guthrie, Sime Darby and Harrisons & Crossfield.[12]

The next intervention was the establishment of the Palm Oil Registration and Licensing Authority in 1974 and the Kuala Lumpur Commodity Exchange in 1980. The establishment of the Commodity Exchange shifted the price setting and hedging from London to Kuala Lumpur.

Research and development (R&D) in palm oil breeding and production began when the Malaysian Government established an exchange program under the Department of Agriculture with Western African nations and four private palm oil plantations (Rasiah, 2004). Together these entities formed the Oil-palm Genetics Laboratory. The government also established the Kolej Serdang, which later expanded into Universiti Pertanian Malaysia (Agriculture University of Malaysia). The Agriculture University of Malaysia specialized in training graduates to work and undertake research in the agricultural sector. The government set-up and financed the Palm Oil Research Institute of Malaysia (PORIM) in 1979.

The government introduced an export tax in 1976 to stimulate the processing of CPO into processed palm oil (PPO). Excess capacity was prevented by capping the number of licenses. Financial incentives designed to stimulate palm oil refining were provided under the Pioneer Industry Ordinance 1958 and later under the Investment Incentives Act,

[12] Rasiah (2004) notes that a comprehensive study of the palm oil refining industry is provided in Dr. Jaya Gopal's PhD thesis (2001) titled "The Development of Malaysia's Palm Oil Refining Industry: Obstacles, Policy and Performance," at Imperial College, London.

1968. These incentives were extended to most kinds of palm oil processing—including neutralization, bleaching or deodorization—to stimulate the production of PPO. The incentives were removed by the early 1980s as the industry matured.

The government provided incentives for processed palm oil through the Investment Incentives Act 1968, which included according it "pioneer status,"[13] and investment tax credits. Tax holidays were granted to manufacturing firms on the basis of export orientation and the New Economic Policy[14] criteria established through the Industrial Coordination Act 1975. The Export Credit Refinancing Scheme offered loans with preferential interest rates to export-oriented firms.

Box 2.2 Federal Land Development Authority (FELDA)

The Federal Land Development Authority (FELDA) was established on 1 July 1956 under the Land Development Act 1956 with the purpose of implementing government policies designed to raise the living standards of rural poor and landless communities. Originally, FELDA functioned as a board to manage and channel federal financial aid to state governments for carrying out and coordinating land-development schemes in their respective states. Later, the government expanded FELDA's function, and from 1961 FELDA was entrusted to carry out its own development and settlement schemes throughout the country. To date, FELDA has developed over 853 000 hectares of plantation and settlement areas, involving around 113 000 direct recipients (not including their families and employees).

FELDA operates a settlement scheme whereby settlers (low income and landless rural people) are allocated cooperative land ownership rights with an equal and uniform share of profits derived from working the allocated areas. Each settler is allocated a housing plot and a plot of land to cultivate. Ownership is eventually transferred to the settler when they have paid for the development costs of their units. Settlers' incomes are derived from plantation production, other farming activities and non-farm income, which may include investments in FELDA itself. FELDA also provides settlers with a Guaranteed Minimum Income. The Guaranteed Minimum Income for 1985 to 1988 was RM 350 (US$ 92) per month and from 1989 to 2006 it was RM 600 (US$ 158) per month.

FELDA estimated that, as at the end of 2005, approximately RM 9.7 billion (US$ 2.55 billion) had been spent to finance land development schemes and the building of settlers' housing (FELDA, 2005). FELDA receives government support for infrastructure under each Malaysia Plan (five-year economic development plans by the government). FELDA spends an average of RM 51 240 (US$ 13 500) to place a settler family in the scheme. Forty-two per cent of this cost is borne by the government while each settler is expected to repay the remaining 58 per cent of the cost, amounting on average to RM 29 260 (US$ 7 700), over a period of 15–20 years (Tarmizi, 2007).

Source: www.felda.net.my, Tarmizi (2005)

Two other key policies that assisted downstream actors in the palm oil industry were the Industrial Masterplan, introduced in 1986, and the Industrial Masterplan II, introduced in 1995. Under the First Industrial Masterplan, palm oil refineries were provided with tax reductions proportionate to their export earnings. The Export Credit Refinancing Scheme was continued under the Industrial Master Plan. Other measures included incentives to stimulate R&D activities and training.

13 A company which is granted "pioneer status" obtains favorable fiscal treatment in respect of income derived from "promoted activities" or "promoted products." Promoted activities and products are defined by the Ministry of Finance and published in the Government Gazette.

14 The New Economic Policy was introduced as an affirmative action for the poor.

The Industrial Masterplan II aimed to establish Malaysia as the international centre for the production of edible oils and fats, by continuing to encourage diversification of the industry. It encouraged the domestic production of machinery and equipment that had previously been imported. The Industrial Master Plan II called for the expansion of value-adding activities in Sabah and Sarawak. For example, Palm Oil Industrial Cluster (POIC) Sabah, fully owned by the state government of Sabah, is embarking on a 15 year Masterplan (2006-2021) to develop 4 000 hectares of land in Lahad Datu to process palm oil. The aim of the project is to promote Lahad Datu as a regional hub and export gateway for palm oil and other vegetable-oil-based products.

2.1.2 Palm oil marketing strategies

During the period 1960 to 1980, Western Europe was the only major market for CPO and consequently the main destination for Malaysian exports (Basiron, 2006). Much of the palm oil was re-exported from Europe to secondary markets in the form of finished products. The main strategy pursued by Malaysia during this period was to wrest the marketing of palm oil away from the control of traders based in London. At the same time, refineries were built by Malaysian companies in Indonesia to enable to the importation of larger quantities of palm oil. The overall effect was for Malaysian producers and refiners to enjoy increased revenue derived from both higher prices and larger sales of palm oil.

From 1980 to 2000, oilseed producers in other countries began to see palm oil as a threat to their markets. The American Soybean Association (ASA) launched a campaign to cast doubt on the health implications of palm oil consumption. Malaysian producers, with the support of the government (through the Malaysian Palm Oil Board), have attempted to find new markets for palm oil while at the same time establishing scientific evidence to refute its critics.[15]

2.2 Plantation area and ownership

Oil-palm is the most widely planted agricultural crop in Malaysia. Over the past decades, the area under oil-palm cultivation has increased in contrast to a decline in most other crops planted. With the exception of paddy (rice), whose land conversion to other uses is strictly regulated,[16] all other commodities in Malaysia (e.g. rubber, cocoa, coconut, pepper, pineapple, tobacco, coffee, tea and sugarcane) are experiencing a decline in their areas cultivated.

Between 1990 and 2005, the area under oil-palm doubled from two million hectares to four million hectares. Over half of this land was in Peninsular Malaysia, while the remainder was located in East Malaysia where Sabah alone accounts for nearly 30 per cent or 1.27 million hectares. Sarawak recorded the highest increase in area converted from forest for production: more than 950 per cent since 1990 compared with 342 per

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15 See the Malaysian Palm Oil Council website, http://www.mpoc.org.my.

16 Most paddy farmers are Malays, a politically important group in Malaysia. The government has gone to great lengths to support this constituency, justifying the support by reference to poverty eradication, rural development and food security. In 2004 alone, approximately RM 400 million (US$ 126 million) was provided in direct support to approximately 350 000 people in this sector (World Trade Organization, 2006).

cent for Sabah and 37 per cent for Peninsular Malaysia. Another interesting factor is the long term decline of area under palm oil cultivation in Peninsular Malaysia in comparison to Sabah and Sarawak.

The planted area under oil-palm in 2007 was 4.23 million hectares, an increase of around 2.7 per cent from the previous year (Table 2.3). The expansion occurred mainly in Sabah and Sarawak with a combined growth of 6.1 per cent compared to 1.4 per cent in Peninsular Malaysia (Ministry of Plantation Industries and Commodities, 2007).

Table 2.3 Area under oil-palm (millions of hectares)

Year	Peninsula Malaysia	%	Sabah	%	Sarawak	%	Total
1990	1.698	84	0.276	14	0.055	3	2.029
1995	1.903	75	0.518	20	0.119	5	2.540
2000	2.046	61	1.001	30	0.330	10	3.376
2005	2.268	57	1.180	30	0.515	13	3.963
2006	2.334	56	1.239	29.8	0.581	14	4.127
2007	2.368	55.9	1,254	29.6	0.614	14.5	4.238

Source: Ministry of Plantation Industries and Commodities (2007).

The private sector (palm oil corporations) is the largest producer group, controlling approximately 60 per cent of the land under palm cultivation. Another 30 per cent is under government ownership or management and 10 per cent belongs to independent smallholders. FELDA is the single largest entity in terms of land management or ownership, with approximately 16 per cent of total cultivated oil-palm land.

The Malaysian government is involved in the industry via government investment funds (EPF); pension and pilgrim and other funds (e.g. TH, Boustead, Genting Group); state government parastatals; and intermediate investment vehicles (such as smallholder settlement schemes).

The government has indirect control of Malaysia's largest plantation companies—i.e. Sime Darby, Guthrie and Golden Hope (now merged into Sime Darby)—through its investment arm, Permodalan Nasional Berhad (National Equity Limited). The Malaysian Army Pension Foundation is a major shareholder in some companies such as Boustead via Lembaga Tabung Angkatan Tentara (LTAT, the Armed Forces Fund Board). LTAT was founded in 1973 through a Parliamentary Act and is the main shareholder (67 per cent) in Boustead Holding. In addition, the Malaysian government playes a key role in Lembaga Tabung Haji (Tabung Haji Foundation—which manages Malaysian Muslims savings for pilgrimages to Makkah), the owners of TH Plantations.

Consequently the government has significant control over, and interest in, production in the oil-palm sector, both through regulatory and market mechanisms. The role of government in the industry can seem unclear, as it is regulator, land owner, shareholder, policy-maker, monitor and law enforcer. Table 2.4 provides the distribution of palm oil plantations by type of ownership.

Table 2.4 Distribution of palm oil planted area by ownership type (June 2006) (millions of hectares)

State	Sector						Total
	Small-holder (licensed)	FELDA	FELCRA	RISDA	State schemes[1]	Private estates, including parastatals	
Peninsular Malaysia	0.331	0.540	0.126	0.082	0.140	1.107	**2.324**
Sabah	0.091	0.117	0.015	-	0.97	0.902	**1.22**
Sarawak	0.020	0.007	0.019	-	0.076	0.458	**0.581**
Total	**0.442**	**0.664**	**0.151**	**0.081**	**0.313**	**2.468**	**4.127**

Note: (1) Examples of state government schemes are SALCRA (Sarawak Land Consolidation and Rehabilitation Authority) and PELITA (Land Custody and Development Authority, Sarawak)

Source: Ministry of Plantation Industries and Commodities (2007).

2.3 Production, prices and contribution to the economy

In 1990, total palm oil production was approximately six million tonnes. By 2007, production had risen to approximately 15.8 million tonnes, which is expected to grow to 16.2 million tonnes in 2008. [17]

The market price of CPO has been volatile during the past two decades. During 1990, prices reached as low as US$ 267 per tonne. Prices then increased, peaking at over US$ 700 per tonne in 1994 and 1998. In May 2001, however, prices collapsed again to a low of US$ 295 per tonne. Since 2001, the price for CPO has been on an upward trend. The average price of all oil-palm products rose sharply in 2007. In March 2008, the price of CPO reached a record high of RM 4 350 per tonne (US$ 1 338), before stabilizing at around RM 3 500 per tonne (US$ 1 077) in May 2008.[18]

Export earnings for Malaysia have risen by 124 per cent since 2001 on the back of high palm oil prices and increased production levels. In 2007 alone, total export earnings for the industry as a whole were RM 45.1 billion (US$ 13.85 billion) (for all oil-palm products), an increase of 42 per cent compared with 2006. The industry was the second-largest contributor to external trade after the electrical and electronics sectors, on a par with crude petroleum products and greater than refined petroleum products, liquefied natural gas timber and timber-based products.

The quantity of palm oil exported from Malaysia declined by 4.8 per cent to 13.7 million tonnes between 2006 and 2007, but the value increased from RM 23 billion to RM 33 billion (US$ 6.7–9.56 billion).[19] China was the leading export destination, followed by the EU, Pakistan, the U.S., Japan and India.

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17 Malaysian Palm Oil Board, http://econ.mpob.gov.my/economy/overview07.htm

18 U.N. Food and Agriculture Organisation, http://www.fao.org/es/esc/prices

19 Malaysian Palm Oil Board, http://econ.mpob.gov.my/economy/performance%202007.htm

Palm oil corporations have fared well on the Bursa Malaysia (Malaysian Stock Exchange) because of soaring palm oil prices resulting in record profits for palm oil corporations.

2.4 Global context

Since 2006, Indonesia has surpassed Malaysia as the leading producer of palm oil. Malaysia remains the largest exporter of palm oil. Together, Malaysia and Indonesia account for 86 per cent of global palm oil production.

Malaysian palm oil corporations have made significant investments in Indonesia. Malaysian holdings accounted for some 890 000 hectares of land in Indonesia in 2005.[20] Production in Indonesia is dominated by a few large plantation operators, an estimated 30 per cent of which are currently controlled by Malaysian interests (*Asia Times*, 8 February 2007). According to Wakker (personal communication), there are, as of March 2008, about 35 Malaysian company groups with a plantation land bank in Indonesia covering a total of 1.93 million hectares.

Due to its lower price, consistent supply and wide use (both for food and non-food purposes), palm oil is currently the largest single component (28 per cent) of the global production of oils and fats. Palm oil and palm kernel oil together account for 56 per cent of oils and fats entering international trade. Soybean oil is the other significantly produced oil, accounting for 24 per cent of total world oil consumption.

2.5 Regulations and statutory charges

A large number of legislative acts and regulations govern the Malaysian palm oil industry. The table below lists the key regulations with respect to property rights, environmental and labour standards, occupational safety and health standards (Table 2.5).

Table 2.5 Regulatory framework (Peninsular Malaysia)

Legislation	Area
Land Acquisition Act 1960	Property rights
Land Conservation Act 1960, revised in 1989	Environment
Protection of Wildlife Act 1972	Environment
Environmental Quality Act 1974 (Environmental Quality) (Prescribed Premises) (Crude Palm Oil) Regulation 1977	Environment
Environmental Quality (Clean Air) Regulation 1978	Environment
Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987	Environment
Factories and Machinery (Noise Exposure) Regulations 1989	Occupational Safety & Health
Pesticides Act 1974 (Pesticides Registration) Rules 1976	Occupational Safety & Health
Pesticides (Licensing for Sale & Storage) Rules 1976	Occupational Safety & Health
Pesticides (Labelling) Regulations 1984	Occupational Safety & Health
Workers' Minimum Standard of Housing and Amenities act 1990	Labour standards

20 Menteri Perusahaan Perladang dan Komoditi (MPPK). Senarai Syarikat Malaysia Yang Melabur Dalam Sektor Perladangan Kelapa Sawit di Indonesia, 19 December 2005.

Legislation	Area
Occupational Safety and Health Act 1977	Occupational Safety & Health
Malaysian Labour Law	Labour standards
Occupational Safety & Health Act 1977	Occupational Safety & Health
Use and Standards of Exposure of Chemicals Hazardous to Health Regulations 2000	Occupational Safety & Health

Source: Chandran (2004).

The palm oil industry is also taxed through various instruments. Table 2.6 outlines the main statutory charges Malaysian palm oil planters are required to pay. On 1 July 2008, the government introduced a new windfall tax on palm oil exports. The levy imposed will be 3 per cent of the profit for every one metric tonne of FFB in plantations in Peninsular Malaysia and 1.5 per cent for plantations in Sabah and Sarawak. Smallholders owning 40 hectares and below are exempted from this tax (*Bernama,* 15 July 2008).

Table 2.6 Statutory charges on palm oil plantations

Charges	Rate	Remarks
Corporate tax	25% per annum	Budget 2008 (tax rate on profits)
MPOB Cess Order 2002[1]	RM 11/per tonne	Not entitled for R&D Double Tax Deduction
Palm oil price stabilization fund	RM 4/per tonne	Cess Order 2001[1]
State Sales Tax Order		
In Sabah:	RM 50 & above	5% for CPO RM 1 000/tonne and above
In Sarawak: based on equity taxation	RM 25 – RM37.50	2.5% for RM 1 000/t to RM 1500/tonne
	RM 75 & above	5% for above RM 1 500/tonne
Export tax on CPO	10% to 30%	Threshold at RM 650/tonne
Import duties and sales tax	5% to 25%	
Other fees: Capitation and Contribution		
Infrastructure	…	
Department of Environment	…	E.g. license fees and levy
Local Council Quit Rent	…	
Inspector of Machinery fees	…	
Foreign workers		
Recruitment fee	RM 600 – RM 1200	per worker
Foreign worker levy	RM 360	per annum
Worker compensation	RM 98	per annum
FOMEMA	RM 180	Medical certification per annum
Security Bond deposit	RM 250	
Visa + processing fee	RM 25 – RM 70	(RM 15 to RM 60) + RM 10

Source: Chandran (2004)

Notes: (1) "Cess" is a tax-like levy.

2.6 Stakeholders and institutional framework

Table 2.7 describes the key stakeholders in the palm oil production chain.

Table 2.7 Major actors in the palm oil industry

Stakeholders	Economic activity
Upstream producers	Mainly involved in the cultivation of oil-palm, producing fresh fruit bunches (FFB) and processing them into crude palm oil and palm kernel oil.
Downstream producers	Palm oil refiners, palm kernel crushers, manufacturing of palm-based edible products and speciality oils and fats.
Exporters and Importers	Import and export of CPO or CPKO.
Customers	International buyers, retail customers and investors.
Associations	Industry organizations representing the upstream and downstream producers.
Government	Government agencies and departments associated with the palm oil industry, particularly with respect to research and development and regulatory functions.
Others	Other actors such as non-governmental environment organizations (ENGO), trade unions of plantation workers, etc.

Source: Teoh (2002).

The Ministry of Plantation Industry and Commodities oversees the development of the plantation and commodity sectors in areas involving R&D, production, processing and marketing, with respect to palm oil, rubber, wood and wood-based products, cocoa, pepper and tobacco.

Three other organizations are heavily involved in the palm oil industry, namely the Malaysian Palm Oil Association (MPOA), the Malaysian Palm Oil Board (MPOB) and the Malaysian Palm Oil Council (MPOC). These are parastatal agencies. MPOB derives its funding mainly through a government-imposed cess on the industry for every tonne of palm oil produced.[21] In addition, MPOB receives budget allocations from the government to fund development projects, and for approved research projects under the Intensification of Research in Priority Areas (IRPA) program. As for the MPOC, according to the MPOC Annual Report 2006, 98 per cent of its budget for that year came from MPOB.

Table 2.8 shows private-sector and parastatal interests in the palm oil industry.

[21] The cess is a form of taxation. MPOC is a company limited by guarantee, but it works with tax-free funds.

Table 2.8 Private-sector and parastatal organizations in Malaysia's palm oil industry

Upstream
The Malaysian Palm Oil Association
The East Malaysian Planters' Association
The Incorporated Society of Planters
Downstream
The Malaysian Oil Manufacturers' Association
The Malaysian Oleochemical Manufacturers Group
The Malaysian Palm Oil Council

Source: Teoh (2002)

The Malaysian Palm Oil Association represents the single largest voice in this sector (Chandran, 2004). Launched in 1999, it was created through a merger of the four major plantation associations, namely the Rubber Growers' Association, the United Planting Association of Malaysia, the Malaysian Oil Palm Growers' Council and the Malaysian Estate Owners' Association. MPOA members manage 1.6 million hectares or 40 per cent of the total area planted with oil-palms in Malaysia. Its members also jointly control 60 per cent of the country's palm oil milling capacity. The membership of the MPOA is organized according to the amount of planted area managed by the company or organization (Table 2.9).

Table 2.9 Malaysian Palm Oil Association membership classifications (2004)

Member category	Category I				Category II
Class	Class I	Class II	Class III	Class IV	FELDA plantations
Hectare	> 40 000	5000 – 40 000	500 – 5 000	40 – 500	
Member/s	11	24	51	18	1
Total area	865 923	332 164	87 036	4 944	349 028
Fee/ hectare[1]	RM 1.25	RM 1.52	RM 1.33	RM 1.32	RM 0.45

Note: (1) 1 RM = US$ 3.8 in 2004.

Source: Chandran, 2004.

Through fees and cess charged by the government, Malaysian Palm Oil Association members have generated substantial revenue, which has been directed to further developing the industry. This measure has also allowed the palm oil industry to become independent of 'direct' government support, in contrast to many other agricultural industries in Malaysia that continue to rely on government funding. In the year 2004, for example, a total of RM 1.86 million (US$ 0.49 million) was collected for the MPOA from its 103 members. [22]

The Malaysian Palm Oil Board was incorporated by an act of parliament (Act 582) and established on 1 May 2000, taking over, through a merger, the functions of the Palm Oil Research Institute of Malaysia (PORIM) and the Palm Oil Registration and Licensing Authority (PORLA). The Malaysian Palm Oil Board is an agency under the jurisdiction of the Ministry of Plantation Industries and Commodities.

Under the Ninth Malaysia Plan, the government will meet the developmental cost of the MPOB (e.g. building of new research laboratories) (Dosim, 2007). However, all operational costs, including research, will be financed by the industry itself. In 2006, the MPOB's total funding was RM 282 million (US$ 81 million). Around 95 per cent (RM 268 million, US$ 78 million) was derived from cess (10 per cent of which was allocated to MPOC in 2006), while RM 13.58 million (US$ 3.9 million) was derived from grants, and RM 620 000 (US$ 180 000) from royalties.[23] Federal grants for research and development are available for producers under the Intensification of Research in Priority Areas (IRPA) program.[24]

The MPOB has recently been aiming to promote the Malaysian palm oil industry internationally. Its activities are concentrated on promoting the health benefits of palm oil (e.g. conducting nutritional trials), addressing non-tariff barriers (e.g. countering environmental and consumer perceptions), promoting different uses of the product (e.g. development of palm biodiesel, palm polyurethane, etc) and improving palm oil's brand image.

The Malaysian Palm Oil Council was incorporated in 1990. Its primary objective is to promote and market Malaysian palm oil and its products. The MPOC works to improve the image of Malaysian palm oil in key international markets, through increasing awareness of palm oil's health effects and Malaysia's oil-palm management practices, particularly with respect to environmental sustainability. [25] The Director-General of MPOB is a member of the MPOC board. A number of palm oil industry captains are also MPOC directors (Eric Wakker, personal communication).

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22 The current cess (per ton of CPO or PKO) payment structure ranges from RM 7 to RM 11 (US$ 2.15 to US$ 3.38). If at RM 11, RM 9 would go to MPOB and RM 2 to MPOC. There is also RM 4 for the Palm Oil Price Stabilisation Fund effective February 2001.

23 Author's interview with MPOB officers. The sources of these grants are not known.

24 The IRPA fund in total amounts to RM 1 (US$ 3.25) billion. It is available for critical R&D areas.

25 www.mpoc.org.my

3 Energy and biofuel policies

3.1 Energy policies

Since the energy crisis of 1973–74, the government has introduced various policies to improve national energy security while ensuring economic growth (Table 3.1). These measures sought to manage Malaysia's limited oil reserves more effectively and guard against over-exploitation. Later policies sought to diversify energy from oil to other sources, including renewable energy.

Table 3.1 Major developments in Malaysia's energy policies, 1974 to 2000

Policy	Broad objectives
Petroleum Development Act, 1974	The Act established Petroliam Nasional Berhad (Petronas) as a corporatized company, wholly owned by the Government of Malaysia, vested with ownership and control of petroleum resources in Malaysia.
National Petroleum Policy, 1975	Introduced to ensure optimal use of petroleum resources; regulation of ownership and management of the industry; and economic, social and environmental safeguards in the exploitation of this resource.
National Energy Policy, 1979	Formulated to achieve a range of supply, utilization and environmental objectives.
National Depletion Policy, 1980	Introduced to guard against over-exploitation of national oil and gas reserves.
Four Fuel Diversification Policy, 1981	Emphasis given to fuel diversification. Designed to reduce dependence on oil and to place increased emphasis on gas, hydro-electricity and coal as energy sources.
Five Fuel Diversification Strategy, 2000	Adds renewable energy to the Four Fuel Diversification policy. Introduced in recognition of the potential of biomass, biogas and other renewable energy resources.

Source: UNDP Malaysia (2007)

Pusat Tenaga Malaysia (PTM: Malaysia Energy Centre) predicts that Malaysia's energy consumption will grow at an annual rate of 4.8 per cent for the period 2000 to 2030. Energy for transport is projected to be the fastest growing sector during the next 25 years, expanding at an annual rate of 5.3 per cent. Malaysia's final energy requirements are expected to triple by the year 2030 from current consumption levels (Pusat Tenaga Malaysia, 2005).

Petroleum products comprise 60 per cent of Malaysia's end usage for energy. Natural gas and electricity comprise approximately 18 per cent each, while coal and coke make up around 4 per cent. The biggest components of petroleum products are automotive gasoline and diesel, largely used in the transportation sector. According to Petronas (Malaysia's national oil company), Malaysia's crude oil reserves of 5.25 billion barrels will last another 20 years at current rates of extraction if no new oil fields are discovered.

Petroleum fuels have been heavily subsidized in Malaysia. While there are no clear indications of when fuel was first subsidized in Malaysia, it is believed to have begun in 1982 when the Mahathir administration expanded existing subsidies to include fuel products, a policy that has had serious budgetary implications, which will be exacerbated once Malaysia becomes a net oil importer (Thillainathan, 2008).

The mechanism for setting retail prices for petroleum products has been in effect since 1983 (Thillainathan 2008). The product price is determined after taking into consideration prevailing international prices, as well as operating costs linked to distribution, marketing, and sales tax. The subsidy is determined every month using the average oil price for the particular month (the oil price used is Mean of Platts Singapore[26]). The subsidy is paid every two months to distributors of petroleum products, mainly the oil companies (Yazid, 2007). Retail prices are a function of the wholesale petroleum product prices plus operating costs, the margin for distributors of petroleum products, the commission for owners of petrol (gasoline) retail stations and sales tax. Deducted from the sum of these factors are any sales tax exemptions and the government's direct subsidies. Frequent price rises for fossil oil since 2000 have repeatedly required the government to raise the subsidized price of fuel for domestic consumers, including most recently on 5 June 2008 (Table 3.2) (Prime Minister's Department, 2006).

Table 3.2 Changes in fuel prices in Malaysia (1993 to 2008)

Year of fuel price setting	Petrol (RM/litre)		Diesel (RM/litre)	LPG (RM/kg)
	RON 97	RON 92		
1993	1.13	1.09	0.65	1.18
2000	1.20	1.16	0.70	1.28
2002	1.33	1.38	0.74	1.31
2004	1.42	1.38	0.83	1.40
2005	1.62	n.a.	1.28	1.45
2006	1.92	1.88	1.58	1.75
2008	2.70	2.62	2.58	1.75

Note: RON – Research octane number – is a measure of resistance to self-ignition (knocking) of a gasoline when mixed with air in an engine cylinder, determined when vehicles are operated at low speed or under city driving conditions. The higher the octane number, the higher the anti-knock quality of the gasoline.

Source: National Economic Action Council/Prime Minister's Office (2004, 2005 & 2006), *International Herald Tribune*, 19 January 2008.

Until 2008, the Government subsidized gasoline and diesel at different rates for different sectors, based on a set formula. These sectors were gasoline stations (retail), operators of fishing vessels, public road transport and public river transport. The government sets the prices for a fixed period. In February 2006, the prices for diesel were:

Petrol stations	1.581 RM/litre
Fishermen	1.00 RM/litre
Public transport (roads)	1.431 RM/litre
Public transport (rivers)	1.20 RM/litre

[26] Mean of Platts Singapore (MOPS) is the mean of the high and low components of a Platts assessment for oil cargoes loading from Singapore. It is often used as a component in floating prices. http://www.platts.com/Oil/Resources/Glossaries/#MOPS

On 5 June 2008, the government revised fuel subsidies, due to the untenable and rising costs to budget, and standardized the subsidy rates.[27] The gasoline price was increased to RM 2.70 (US$ 0.83) per litre for RON 97, and to RM 2.62 (US$ 0.80) per litre for RON 92. The price of diesel was increased to RM 2.58 (US$ 0.79) per litre (*The Edge*, 6 June 2008). Transport fuel prices would henceforth be adjusted monthly but would remain RM 0.30 (US$ 0.09) below the international market price. The Malaysian government has not released details about how the subsidized price will be calculated (i.e. whether it will take into account distribution and retailer costs).

For specific target groups, additional subsidies were provided: For example:

- Vehicles with engine capacities of up to 2000cc, and trucks and jeeps with capacities up to 2500cc, will receive a cash rebate of RM 625 (US$ 192) per year. Motorcycles up to 250cc will receive a cash rebate of RM 150 (US$ 46) per year.
- Vehicles with engine capacities above 2000cc will receive a road tax rebate of RM 200. Motorcycles exceeding 250cc will receive a road tax rebate of RM 50 (US$ 15) per year.
- Registered fishermen and vessel operators will receive RM 200 (US$ 62) per month.
- Vessel operators will receive 10 cent per kilogram of fish catch landed.

The total cost of diesel subsidies has varied over recent years, reflecting the international price for fuel. Fuel subsidies rose from RM 4.2 billion (US$ 1.1 billion) in 2002 to RM 14.7 billion (US$ 4.3 billion) in 2006, before further price reforms were introduced. In 2007, subsidies rose to RM 16.2 billion (US$ 4.7 billion). Finally, in 2008, with the international oil price averaging over US$ 130 per barrel during the first half of the year, the estimated total cost to the federal budget was RM 25 (US$ 5.5) billion (Thillainathan, 2008) (Table 3.3).

[27] See Economic Planning Unit document, "Explanation on the Restructuring of Petroleum Product Subsidies and Reduction in Gas Discounts To The Electric and Industry Sector" http://www.epu.jpm.my/buku_penstrukturan.pdf

Table 3.3 Expenditure on petroleum fuel subsidies and foregone sales tax (2001 to 2008)

	2001	2002	2003	2004	2005	2006	2007	2008[1]
Fuel subsidies (RM billion)	7.5	4.2	6.6	12.0	16.0	14.7	16.2	25
Direct subsidy	2.4	0.9	1.8	4.8	8.2	7.3	8.8	18
Revenue lost[2]	5.1	3.3	4.8	7.2	7.8	7.4	7.4	7
% of operating expenditure[3]	3.8	1.3	2.4	5.2	8.4	6.8	7.1	-
% of GDP[3]	0.7	0.2	0.4	1.0	1.6	1.3	1.4	-

Notes: (1) Estimated.

(2) Revenue lost is foregone sales tax. The general rates of sales tax in Malaysia are 5, 10 or 20 per cent. Sales tax on petroleum fuels is a specific rate of RM 0.005862 per litre for gasoline and RM 0.001964 per litre for diesel. These rates are considerably lower than 5, 10 or 20 per cent of even the subsidized price of RM 2.62 per litre for RON 92, RM 2.70 per litre for RON 97 and RM 2.58 per litre for diesel.

(3) Calculated from direct subsidy.

Sources: Table adapted from *The Edge* (6 June 2008) and expanded using information from Kastam Diraja Malaysia [Royal Malaysian Customs) (2008) and Thillainathan (2008).

3.2 National Biofuel Policy

Encouraging a domestic biodiesel industry based on the existing palm oil sector appeared to an ideal means to improve energy security, reduce petroleum subsidies, add value in the palm oil sector, as a poverty alleviation strategy and develop a new export product. Environmental motivations, such as urban air quality and lower greenhouse gas emissions, have not been primary drivers behind Malaysia's promotion of biofuels.

The key biofuel policies were developed when palm oil prices were relatively low and the possibility of replacing some petroleum use with biofuel appeared feasible. In August 2005, the Malaysian Government launched the National Biofuel Policy (NBP) under its Five Fuel Diversification Strategy (see Table 3.1) with a view to developing the biofuels industry. The policy provides the overarching framework to develop biofuels as one of the five main energy sources for Malaysia.

The NBP aims to supplement the depleting supply of fossil fuels with renewable resources; mobilize local resources for biofuel production; exploit local technology to generate energy for the transportation and industrial sectors; pave the way for export of biofuels; and benefit from the spin-off effects of more stable prices for palm oil. It also aims to be consistent with the United Nations Framework Convention on Climate Change (UNFCCC), but only on the assumption that biofuels help reduce greenhouse gases by definition. There are no specific criteria to ensure this is actually the case.

Five strategic objectives underpin the NBP (Table 3.3). The first two objectives refer to the institution of a five per cent biofuel mandate, using palm oil as the feedstock. The NBP does not specify whether the "processed palm oil" to be used in the blend would be palm olien ("Envodiesel") or palm methyl ester (PME). In this perspective, as noted in the table below, "B5" should be considered a general term for a five per cent blend palm-based biofuel, not necessarily a direct blend of palm oil.[28] The policy notes that a B5 mandate would create new demand for 500 000 tonnes of palm oil (assuming national consumption of 10 million tonnes of diesel per year).

Table 3.4 National Biofuel Policy: strategic objectives

Objective 1: Biofuel for transport	Diesel for land and sea transport will be a blend of 5% processed palm oil[1] and 95% petroleum diesel. This 'B5' would be made available throughout the country.
Objective 2: Biofuel for industry	Supply B5 diesel to the industrial sector, to be used as fuel in industrial boilers, construction machinery and diesel-powered generators.
Objective 3: Biofuel technologies	Promote research, development and commercialization of biofuel technologies.
Objective 4: Biofuel for export	Encourage and facilitate the establishment of plants for producing biofuel for export.
Objective 5: Biofuel for a cleaner environment	Enhance the quality of the ambient air, reduce the use of fossil fuels and minimize emissions of greenhouse gases (mainly carbon dioxide), carbon monoxide, sulphur dioxide and particulates through increased use of biofuels.

Note: The NBP does not specify whether the "processed palm oil" would be palm methyl esters or direct blending of palm olien. In this context, "B5" can be considered a generic term referring to a 5 per cent blend of a palm-based biofuel.

Source: Adapted from the National Biofuel Policy

The NBP outlines more specific milestones for the development and use of palm methyl ester (PME), the form of biodiesel most commonly used internationally (Table 3.5). By the end of 2007, 28 months after the launching of the NBP, the government had completed trials in which a five per cent blend of PME and 95 per cent petroleum diesel (PME B5) was used by selected government department fleets as well as by selected users in industry. The Malaysian Standard specifications for PME B5 were set, and some commercial biodiesel plants established. The policy has yet to meet its medium and long-term goals, however.

Following the development of the National Biofuel Policy, the government introduced legislation to regulate the biofuel industry and assist its continued development. The Lower House of Parliament passed the Biofuel Industries Act in April 2007 but, as of August 2008, it had yet to be gazetted into law.

The Act provides for the mandatory use of biofuels and the licensing of biofuel-related activities. The Act also allows the licensing authority to revoke or suspend any license if the licensee has ceased to produce, operate or carry out any activity for which the license was issued.

[28] The National Biofuel Policy is available at http://www.mpoc.org.my/download/mktstat/Biofuel%20Policy.pdf

Table 3.5 National Biofuel Policy implementation milestones for the development of palm methyl ester (PME) biodiesel

Short-term	Medium-term	Long-term
The Malaysian Standard specifications for palm methyl ester biodiesel (PME B5) will be established.	The Malaysian Standard specifications for PME biofuel for domestic use and export will be established.	The proportion of processed palm oil added to the diesel blend will be gradually increased.
Selected government departments having fleets of diesel vehicles will participate in trials using PME B5.	Efforts will be made to encourage engine manufacturers to extend their warranties to the use of PME B5 diesel. Extensive PME B5 diesel testing will be carried out to facilitate the granting of such engine warranties.	
PME B5 diesel pumps for the public will be installed at selected stations.	Legislation to mandate the use of PME B5 diesel will be passed and enforced.	Greater uptake of biofuel technology by Malaysian and foreign companies.
Voluntary trials on PME B5 will be run by the MPOB for selected users in the industrial sector.	To meet strategic thrust for exporting biofuel, establishment of commercial methyl esters plants will be encouraged. In this regard, the MPOB will act as a catalyst by pioneering the establishment of palm biodiesel plants in Malaysia in collaboration with the private sector.	

Source: Adapted from the National Biofuel Policy.

3.3 Institutional framework

The federal government's Economic Planning Unit (an influential agency within the Prime Minister's Department) is responsible for the formulation of national energy planning and policy development at the macroeconomic level.

The Ministry of Plantation Industry and Commodities regulates the biofuel industry. The Malaysian Industrial Development Authority (MIDA) currently issues licences for biofuel processing, which is classified as a manufacturing activity. However, with the implementation of the Biofuel Industry Act 2006, the Malaysian Palm Oil Board (MPOB) would become the implementation agency and take over the licensing responsibility. Normally, the Ministry of Water, Energy and Telecommunication (MWEC) is responsible for inter-ministry coordination and implementation of issues concerning the energy sector. It is unclear why this Ministry (MWEC) is not responsible for the National Biofuel Policy.

In June 2006, the Cabinet Committee on the Competitiveness of the Palm Oil Industry decided temporarily to stop issuing manufacturing licenses for biodiesel projects due to a concern there was insufficient CPO available for other related industries. The temporary ban appears to have been subsequently lifted as the total number of licenses at the end of September 2007 was 92, compared with 32 in June 2006. Further decisions on issuing licences were to be taken after the completion of a comprehensive review of the downstream palm-based sectors, including the biodiesel sector (*Business Times*, 30 June 2006). As of August 2008, the review had not yet been released.

3.4 Allocation of dedicated biofuel feedstock

In July 2006, the governments of Malaysia and Indonesia announced that they would each allocate six million tonnes of their crude palm oil output to biofuel production (Abdullah, 2006). This commitment was estimated to be about 40 per cent of each country's CPO production at the time. The aim of this announcement was to assure biodiesel investors there would be a sufficient supply of feedstock to the industry. However, the Minister of Plantation Industries and Commodities clarified that the announced target of six million tonnes of CPO was a pledge between the two governments, but that there was no legal obligation for either country to meet the quota should biodiesel usage of CPO exceed or fall short of this level. The commitment would leave around 10 million tonnes of CPO for other palm oil users in Malaysia. According to an officer from the MPIC, the respective food industries' use of CPO had not exceeded 10 million tonnes, and this was the basis of the allocation (Majid, 2007).

3.5 Biofuel standards

The European Standard for Biodiesel (EN 14214) and the American Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels (ASTM 6751-02) are the two major international biodiesel standards relevant to PME. Testing conducted by the MPOB on Malaysian PME certified that it met international biodiesel standards. However, there are still some challenges that must be overcome in order to use PME in cold weather. These relate to the "low pour point" of PME, which means that it solidifies in cold temperatures.[29] Malaysia is considering setting its own national biodiesel standard for PME. The standard is likely to follow closely the EU and U.S. standards.

The MPOB is also keen to develop a standard for its direct blend of 5 per cent palm olein and 95 per cent diesel, "Envodiesel." Envodiesel is facing resistance from automobile manufacturers, who are hesitant to extend engine warranties when palm olein rather than methyl esters are used in blending. Other relevant bodies within the government are also sceptical of the merits of promoting Envodiesel, and there is little support for it.[30]

3.6 Export opportunities

In May 2003, the European Commission issued a directive promoting the use of biofuels. It proposed a plan eventually to replace 5.75 per cent of petroleum fuel in the transport sector with biofuels by 2010. This move is expected to create a total demand of 10.2 million tonnes of biodiesel per year by 2010 (Joint Research Center, 2004), approximately 4.5 million tonnes above current production levels.[31] Table 3.6 provides the projections for gasoline and diesel consumption in the transport sector in the EU for the period 2005 to 2010.

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29 For a discussion of these issues refer to Choo Yen May *et al.* (2004)

30 The 'Envodiesel' is promoted mainly by the former Director General of MPOB and current CEO of the MPOC, Tan Sri Yusof Basiron.

31 The European Biodiesel Board cites 2007 EU production as 5.713 million tons, www.ebb-eu.org.

Table 3.6 EU 25: Demand and market potential (million tonnes oil equivalent)

Fuel	2005	2006	2007	2008	2009	2010
Fossil Gasoline	133	134	135	137	138	139
Fossil Diesel	160	163	167	170	174	178
Total	293	298	302	307	312	317
Biofuel (%)	2	2.75	3.5	4.25	5	5.75
Ethanol	2.7	3.7	4.7	5.8	6.9	8.0
Biodiesel	3.2	4.5	5.8	7.2	8.7	10.2
Total	5.9	8.2	10.6	13.0	15.6	18.2

Source: European Commission, 2004

Although progress towards the achievement of the 5.75 per cent target has been slow (on average, only around two per cent of fuel demand in the transport sector was met by biofuels in 2007; Kutas *et al.*, 2007), the European Commission is considering a 10 per cent target by 2020. Domestic production is unlikely to be able to meet this level of biofuel blending and the European Commission forecasts that by 2020, 27 per cent of biodiesel will be produced from imported vegetable oils: approximately 5.5 billion litres of vegetable oil per year (Joint Research Centre, 2007). The figure is expected to be much higher when substitution effects are taken into account, as imported oils would replace domestically-produced rapeseed and soy oil in the food market. Assuming that second-generation biofuels are not commercially viable at that time, 80 per cent of EU biodiesel production would, in effect, be met by imports (Joint Research Centre, 2007). A large proportion of this is expected to be met by imported palm oil (Joint Research Centre, 2007; Oxfam, 2008). This presents a major opportunity for Malaysia, as the world's top palm oil exporter.

Currently, 80 per cent of the EU's biodiesel is produced from rapeseed. However, palm-biodiesel is a cheaper feedstock, with higher oil yields per hectare (Table 3.7). Unlike ethanol, the tariff rates for biodiesel are generally low, at around five per cent in most OECD countries (Steenblik, 2007), permitting market access for palm methyl ester. The use of palm biodiesel is currently constrained in cooler countries as it solidifies in low temperature. However, this deficiency can be partially overcome by adding additives and "winterizing" the fuel to lower its melting point.

Other potential markets are primarily developed countries that are net oil importers, including the United States, Japan, South Korea and Australia.

Table 3.7 Oil production by major vegetable oil crops

Oil crop	Oil production (million tonnes)	% of total production	Average oil yield (tonnes/ hectare/year)	Crop area (million hectares)	% of total area
Soybean	33.6	32	0.36	92.1	42
Sunflower	9.7	9	0.42	22.9	11
Rapeseed	16.2	15	0.59	27.3	13
Oil-palm	33.7	32	3.68	9.17	4
Total*	106	-	-	218	-

*Only for seven major oil crops (soybean, oil-palm, sunflower, rapeseed, cottonseed, groundnuts and coconut)

Source: Basiron (2007).

4 Status of the biodiesel industry

Malaysia's palm biofuel program began in 1982, funded by a research and development levy on the palm oil industry, with the government providing policy support for the program. Over a period of 20 years, the Malaysian government supported the development and commercialization of industry technology to bring palm biofuels to domestic and international markets (Table 4.1).

Table 4.1 Chronology of the development of palm biofuels in Malaysia

Year	Milestone
1982	Laboratory research commenced on palm oil methyl esters (PME) biodiesel
1983	Formation of Palm Diesel Steering Committee by the Minister of Primary Industries.
1984	Commencement of PME biodiesel pilot plant construction.
1984–1985	Preliminary field trials in taxis.
1985	Launch of the PME biodiesel pilot plant.
1986–1989	Field trials phase I—31 commercial vehicles and stationary engines.
1990	Field trials phase II—bench test by Mercedes Benz in Germany.
1990-1994	Field trials phase III—commercial buses.
1995	Transfer of PME production technology to industry to produce oleochemicals, carotenes (pro-Vitamin A) and Vitamin E.
2001	Use of a CPO and fuel oil blend for power generation initiated.
2001	Research on low pour point palm biodiesel initiated.
2002	Commencement of field trials using processed liquid palm oil and petroleum diesel blends (B2, B5, B10) in MPOB vehicles (i.e. an SVO biofuel blend).
2004	Trials of refined, bleached and deodorized (BD) palm oil and petroleum diesel blends (B5) using MPOB vehicles (i.e. an SVO biofuel blend).
2005	Transfer of technology from MPOB to Lipochem (M) Sdn. Bhd. and Carotino Sdn. Bhd. to build PME biodiesel plants.
2005	Design of commercial low pour point PME biodiesel plant.

Source: Malaysian Palm Oil Board, 2005.

4.1 Current production levels and planned capacity

Malaysia's first commercial-scale biodiesel plant commenced operations in August 2006 (Malaysian Palm Oil Board, 2008). From August to December of that year, a total of 55 000 tonnes of biodiesel were produced in Malaysia. This increased to 130 000 tonnes in 2007.[32] The main feedstock used was RBD palm oil, accounting for 94 per cent of the total palm oil processed by biodiesel plants.

[32] Malaysian Palm Oil Board, http://econ.mpob.gov.my/economy/Production%20with%20table.pdf

At the end of 2007, 92 biodiesel projects—57 located in Peninsular Malaysia and 35 in East Malaysia—had been approved, with a combined production capacity of 10.4 million tonnes (11.7 billion litres) per year. However, at that time only five plants were in operation with a combined capacity of 400 000 tonnes per year. A further seven plants with a capacity of 615 000 tonnes had been constructed but were yet to commence operations.

Since late 2007, the dramatic increase in the price of CPO has caused many biodiesel producers to suspend operations. As of September 2008, there were 14 functional biodiesel plants in Malaysia, eight of which were in production. The remainder had suspended operations given high feedstock prices. A further three had closed or cancelled plans, and one had shifted its operations to Indonesia (Table 4.2). Eight plants were under construction.

Based on information provided by companies regarding their production in 2008, we estimate that total production from January to September 2008 was around 130 000 tonnes. Official production figures for 2008 were not available but the Malaysian Palm Oil Board reports PME biodiesel exports of 100 000 tonnes between January and August 2008. Since most PME biodiesel is exported, this is also likely to reflect the level of total production during that period. The year-to-date production estimates presented here (i.e. 130 000 tonnes) include the month of September, when several plants recommenced operations This might explain why the estimates are higher than the MPOB export figures, which are only through to August.

Regarding the remaining 92 licenses, informal discussions between the authors and industry representatives revealed a belief that few were likely to materialize into new projects in the short term. A 2007 Reuters survey of biodiesel projects in the region showed that 14 projects with a combined capacity of more than two million tonnes had either been shelved or delayed (Tan, 2007). The Malaysian government has indicated that it may revoke permits issued to companies that were planning to set up biodiesel plants if license holders failed to start operations within a stipulated time frame (*Thompson Financial News*, 12 November 2007).

4.2 Exports

In 2007, Malaysia exported 95 000 tonnes of PME biodiesel (around 75 per cent of total biodiesel production) with a value of RM 253 (US$ 73) million. The main export markets were the United States (mainly for re-export to Europe), the EU, Singapore and Australia.[33] As noted above, exports have risen to 100 000 tonnes in the first eight months of 2008.

[33] Malaysian Palm Oil Board, http://econ.mpob.gov.my/economy/EID_web.htm

Table 4.2 Palm oil biofuel facilities in Malaysia (tonnes per year)

Company	Capacity				Actual production	Notes
	2006	2007	2008	2009[e]	2008[1]	
In production						
Carotech	30 000	90 000	150 000	150 000	60 000[e]	
FIMA-MPOB		60 000	60 000	60 000	7 000[e]	
Greenbiofuels			100 000	100 000	17 000[e]	
Loreno			60 000	60 000	7 000[e]	
Mission Biofuel			100 000	100 000	18 000	
PGEO Bioproducts				100 000	n/a	
Vance Bioenergy	30 000	70 000	100 000	100 000	25 000[e]	
Weschem Technologies			120 000	120 000	n/a	
Suspended production						
Carotino-MPOB	60 000	120 000	120 000	120 000	n/a	Current status unknown
DXN Biofuels				n/a	0	
Sawit Biodiesel			200 000	200 000		
Sime Darby (merged with Golden Hope)	30 000	60 000	150 000	150 000	0	Possibly more than one plant
SPC Biodiesel		100 000	100 000	100 000	0	
Zurex Corp			200 000	200 000		
Closed or cancelled[2]						
PPB Group		100 000	0		0	Shifted to Indonesia
Zoop Sdn Bhd			[100 000]		0	Closed
QL Resources			[175 000]		0	Cancelled
IJM Plantations			[90 000]		0	Cancelled
Under construction						
Biodiesel LD				350 000		Commencing October 2008
Global Bioenergy				200 000		Commencing end 2009
Kulim/CremerOleo (joint venture, Nexol)				100 000		Commencing October 2008
Malaysia Vegetable Oil Refinery				n/a		Commencing December 2009
Mission Biofuels (expansion)				250 000		Commencing end 2008
Plant Biofuels Corporation				n/a		Commencing end 2008
Success Nexus				100 000		Commencing September 2009
YPJ Palm International				120 000		Commencing in early 2009
Total[2]	**150 000**	**600 000**	**1 460 000**	**2 680 000**	**134 000**[1]	

Notes: e = GSI estimate based on media reporting or information provided by companies; n/a = not available

[1] To end September 2008.

[2] The capacities of closed or cancelled plants were not included in the total capacity numbers.

Sources: GSI telephone interviews and emails with companies in mid-2008, plus company websites.

4.3 Industry structure

Biofuel producers are either vertically integrated producers such as Golden Hope/Sime Darby or independent producers such as Carotino Sdn. Bhd. Integrated producers are those who have ownership of the various subsidiaries throughout the supply chain—i.e. plantations, mills and refineries. Kulim, for example, launched a joint venture with the Peter Cremer Gruppe of Germany to construct and operate two biodiesel plants in Malaysia and Singapore (with a joint venture name of Nexol). Integrated producers are also able to decide the best options for their CPO, directing it to food or non-food sectors (including biodiesel production) as relative prices shift.

Currently, only Carotech has production facilities that can produce products different from CPO. Their production facilities can commercially extract Vitamin E, carotene and phytosterols from CPO, while simultaneously producing biodiesel and glycerine. This has enabled them to focus on their micronutrient processing since biodiesel became too expensive to produce.[34] Other producers have not had this capability.

There has been significant consolidation of corporations in the Malaysian agriculture sector, as well as expansion in terms of land banks and diversification towards other areas of the trade chain. Most of the large Malaysian agri-business corporations have thus considered investing in the biofuel industry. This is reflected in the consolidation of three major plantations—Sime Darby, Kumpulan Guthrie and Golden Hope Plantations—to form the largest listed company on the Bursa Malaysia (Malaysian stock exchange) with a market capitalization of RM 50 (US$ 14) billion. This diversified multinational will also be one of the world's leading oil-palm plantation groups, with approximately 543 000 hectares of land managed as plantations.

The Malaysian Biodiesel Association (MBA) is a newly formed association of biodiesel producers. It currently has approximately four to five members and is led by the Executive Director of Carotino Sdn. Bhd., Mr. Unni Krishnan Unnithan. MBA has undertaken efforts to lobby the government to provide subsidies aimed at stabilizing feedstock prices for biofuel production.

4.4 Cost structure of biodiesel production in Malaysia

The operational cost for the production of PME biodiesel comprises the price of the feedstock and the chemicals involved in the conversion process. The main input, CPO, accounts for the major component of the production cost of biodiesel in Malaysia.

Several studies examining biodiesel production costs in Malaysia have been developed in recent years. According to the MPOB, palm oil production costs are divided into two major categories: Fresh Fruit Bunch (FFB) production and FFB processing. The major costs in FFB production are joint estate costs (28 per cent), fertilizer and its application (22 per cent), transportation (19 per cent) and harvesting and collection (19 per cent) (Noor *et al.,* 2003). The cost of processing FFB comprises separating the fresh fruits and kernals from the empty fruit bunches and then extracting the oils (Pleanjai *et al.,* 2004), as well as sales, management, maintenance and depreciation costs (Noor *et al.,* 2003).

[34] See Carotech's company websites: http://www.carodiesel.com/index/news/64.html and http://www.carotech.net/index/news/163.html

In 2006, NIRAS Consultants (a Danish firm) undertook a comprehensive research project with the MPOB for the Government of Malaysia (NIRAS, 2006a). The study considered three elements of the cost function for biodiesel: the price of feedstocks (crude palm oil and methanol), processing costs and the price of the final products (PME and glycerol).

The equation below, taken from the report, shows that the viability of biodiesel production improves with lower feedstock costs and higher by-product revenue (primarily from sales of glycerol):

$$P_{CPO} + 0.112P_M + P_C = 0.96P_{PD} + 0.1P_G$$

(where P_{CPO}, P_M, and P_G are the market prices of crude palm oil, methanol and glycerol respectively; P_C the conversion cost and P_{PD} the outcome price of the palm diesel).[35]

The analysis did not include capital costs.

Based on this model, the NIRAS study found that, when palm oil (the main input cost) was RM 1 400 (US$ 380) per tonne, biodiesel in Malaysia could be produced for RM 1 658 (US$ 450) per tonne (RM 1.48 or US$ 0.40 per litre). This assumed prices for methanol and glycerine of RM 1 070 and RM 2 280 respectively:

$$P_{PD} = (P_{CPO} + 0.112P_M + P_C - 0.1P_G)/0.96$$
$$P_{PD} = (1\,400 + 0.112 * 1\,070 + 300 - 0.1 * 2\,280)/0.96 = \underline{1\,658 RM/tonne}$$

The NIRAS study also noted that one tonne of biodiesel has a volume of 1 124 litres, and that biodiesel contains approximately 10 per cent less energy per litre than petroleum diesel fuel.[36] It follows that the production cost of biodiesel would be RM 1.64 (US$ 0.44) per litre of petroleum diesel equivalent at this CPO price:[37]

Applying the NIRAS cost function for biodiesel production and CPO costing RM 2 500 (US$ 670) per tonne, biodiesel could be produced at a variable cost[38] of RM 2 804 (US$ 790) per tonne or RM 2.77 (US$ 0.77) per litre of petroleum diesel equivalent.[39] When CPO costs 3 500 (US$ 950) per tonne, biodiesel could be produced for around RM 3.80 (US$ 1.03) per litre of petroleum diesel equivalent.

Other organizations have estimated similar variable production costs. Lipochem (M) Sdn. Bhd., a Malaysian biodiesel firm, reported production costs of RM 2.66 (US$ 0.76) per litre of diesel equivalent (with the price of CPO at RM 2 500 per tonne or US$ 670).

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35 The equation assumes that one ton of CPO yields 0.96 tons of biodiesel, plus 0.1 tons of glycerine. Pleanjai (2004) found that one ton of biodiesel is produced from 1.14 tons of CPO (therefore 1 ton CPO yields 0.86 tons of biodiesel).

36 The NIRAS study noted that biodiesel contains ten per cent less energy than petroleum diesel and therefore one ton of biodiesel (1 123.6 litres) is equivalent to 1 011 litres of petroleum diesel (i.e. minus ten per cent). The price per litre used in this study refers to diesel-equivalent.

37 RM 1 658/1 011= RM 1.64/litre.

38 Variable cost does not include capital investment (e.g. such as plant and machinery).

39 RM 2 804/1 011= RM 2.77.

A study conducted by MPOB researchers estimated biofuel production costs at RM 3.31 (US$ 0.70) per litre, with palm olein at RM 2 500 (US$ 740) per tonne (Nasir *et al.*, 2004).

Taking into account total costs (variable and fixed), the Malaysian Biodiesel Association calculated in 2007 a break-even price of RM 3 150 (US$ 913) per tonne of biodiesel (RM 3.12 or US$ 0.90 per litre of petroleum diesel equivalent), when palm oil was purchased at RM 2 500 (US$ 725) per tonne (Table 4.3). When only operating costs were taken into account, PME could be produced for RM 2 960 (US$ 858) per tonne (RM 2.93 or US$ 0.85 per litre of petroleum diesel equivalent).

Table 4.3 Breakeven analysis for palm methyl ester biodiesel—Malaysian Biofuel Association study (2007)

Item	RM per tonne	US$ per tonne
Crude palm oil price	2500	725
Variable cost of production (excluding palm oil)		
Refining cost adjusted for PFAD & yield loss in refining	90	26
Methanol @ 0.115/MT of Biodiesel, 0.115 MT of methanol per MT of biodiesel & RM1 400/MT of methanol (average 2006 price)	161	46
Catalyst cost @ 2% sodium methoxide @ US$ 900/MT	63	18
Utilities	32	9
Other chemicals	37	9
Yield loss @ 2%	52	15
Labour, consumables and other direct overheads	25	7.2
Total variable cost (TVC)	460	133
Fixed Costs		
Financing Costs @ 7% for RM 90 million investment for a 100 000 mt/yr plant	63	18
Total overheads @ RM12 million/annum	120	35
Depreciation on RM 70 million @ 6.7% (over 15 years)	47	13
Working capital cost, 2 months	30	8.70
Total fixed costs (TFC)	260	75
Total production cost (TC = TVC + TFC)	**720**	**210**
Glycerine credit @ crude glycerine price of US$ 200/MT & 10% yield on biodiesel.	(70)	(20)
Breakeven cost for biodiesel production over crude palm oil price	**650**	**188**

Notes: All cost of production figures assume a plant capacity of 100 000 tonnes per year; the average exchange rate in 2007 was US$ 1 = RM 3.45.

Source: MPOB

Table 4.4 provides various production cost scenarios based on different CPO prices. When CPO prices are at mid-2008 levels of around RM 3 500 (US$ 1 076) per tonne, biofuel production costs (covering variable costs only) in Malaysia range from RM 3.65 to RM 4.50 (US$ 1.12 to US$ 1.38) per litre of petroleum diesel equivalent. The variation in production costs may be attributed to the different sample prices used in each estimate.

The NIRAS, MBA (TVC), Lipochem and Nasir *et al.* studies only include variable costs. Based on the Malaysian Biofuel Association study (Table 4.3), fixed costs are likely to add around ten per cent to the price. Once distribution costs and a profit margin are taken into account, the pump price of biodiesel would be higher still.

Table 4.4 Estimated variable cost of production of biodiesel at different CPO prices

	Unit	Price							
CPO price[1]									
	RM/tonne	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**	**4500**	**5000**
	US$/tonne[2]	460	615	770	925	1075	1230	1385	1540
	RM/litre[3]	1.39	1.86	2.32	2.79	3.25	3.72	4.18	4.65
Biodiesel variable cost of production[4]									
NIRAS	RM/litre diesel eqiv.[5]	1.75	2.25	2.75	3.30	3.80	4.30	4.85	5.35
MBA (TVC)	RM/litre diesel eqiv.	1.95	2.45	2.95	3.40	3.90	4.40	4.90	5.40
Lipochem	RM/litre diesel eqiv.	1.60	2.15	2.65	3.15	3.65	4.15	4.65	5.15
Nasir *et al.*	RM/litre diesel eqiv.	2.10	2.70	3.30	3.90	4.50	5.10	5.70	6.25
Average	***RM/litre diesel eqiv.***	***1.85***	***2.40***	***2.90***	***3.45***	***4.00***	***4.50***	***5.00***	***5.55***
	US$/litre diesel eqiv.	*0.57*	*0.74*	*0.89*	*1.06*	*1.23*	*1.38*	*1.54*	*1.71*

[1] CPO was the only variable in this scenario. Other input prices and by-products (such as glycerine) were not adjusted from the original sources.

[2] The average exchange rate from January to July 2008 was 1 RM = US$ 3.25.

[3] CPO has a specific gravity of 0.924 at 15.6°C. Therefore 1 tonne CPO = 1 082 litres.

[4] Estimates do not include fixed costs, profit margin or transport costs.

[5] Biodiesel provides ten per cent less energy than petroleum diesel.

Source: Authors' estimates using the cited methodologies.

The price estimates in Table 4.4 match closely those cited by the government. The Ministry for Plantation Industries and Commodities, for example, has noted that the average price of CPO between January and March 2008 was RM 3 433 (US$ 1 046) per tonne (*Bernama*, 14 May 2008). According to Table 4.4, this CPO price would correspond to a cost of production for biodiesel of between RM 3.65 and RM 4.50 (US$ 1.12 and US$ 1.38) per litre (or RM 4 100 to RM 5 050 per tonne; US$ 1 262 to US$ 1 554 per tonne), depending on the methodology used for calculation. The Ministry estimated that, in March 2008, the cost of producing biodiesel was RM 4 330 (US$ 1 332) per tonne (RM 3.86 per litre; US$ 1.19 per litre). This compared unfavourably with a market price of RM 3 632 (US$ 1 135) (RM 3.23 per litre; US$ 1 per litre) for the biofuel.

4.5 Profitability of biodiesel relative to petroleum diesel

Assuming an absence of subsidies, biodiesel becomes economically competitive when feedstock prices are low and petroleum prices are high. During the period from June 2005 to July 2008, the price of crude oil rose from around US$ 56 to over US$ 150 per barrel, and at the end of August 2008, it stood at around US$ 120 per barrel.[40]

Table 4.5 shows the estimated cost of production for petroleum diesel in Malaysia. Given the absence of ex-factory prices for diesel (due to the commercially confidential nature of the information), a cost of production price was estimated by applying a U.S. refining margin for diesel to Malaysian Tapis crude oil.[41] The average margins were 23 per cent in 2005, 21 per cent in 2006, 20 per cent in 2007 and 18 per cent in 2008. A similar refining margin (20 per cent) was derived when comparing the price of Malaysia Tapis crude oil spot prices with diesel spot prices trade in Singapore, using data from Platts cited by the International Energy Administration (2008).

In July 2008, for example, the Malaysian Tapis price was US$ 147 (RM 478) per barrel, yielding an estimated cost of production for diesel of RM 3.55 (US$ 1.09) per litre. The U.S. average spot price for diesel (pre-tax) in the same month was RM 3.65 (US$ 1.12) per litre, lending support to the estimates shown in this report.[42] Table 4.5 provides hypothetical costs of production prices for diesel, at varying crude oil prices.

Table 4.5 Cost of producing petroleum-diesel at varying crude oil prices

Crude oil price (Malaysian Tapis)									
US$/barrel	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**	**225**
US$/litre	0.16	0.31	0.47	0.63	0.79	0.94	1.10	1.26	1.42
RM/litre	0.51	1.02	1.53	2.04	2.56	3.07	3.58	4.09	4.60
Diesel estimated cost of production (Malaysian Tapis crude + refining margin)[1]									
US$/barrel	30	59	89	118	148	177	207	236	266
US$/litre	0.19	0.37	0.56	0.74	0.93	1.11	1.30	1.49	1.67
RM/litre	**0.60**	**1.21**	**1.81**	**2.42**	**3.02**	**3.62**	**4.23**	**4.83**	**5.43**

[1]The average margin for refining crude oil to diesel was estimated to be 18 per cent in 2008 (year-to-date).

Sources: **Crude oil price**: U.S. Energy Information Administration, http://tonto.eia.doe.gov/dnav/pet/hist/wepctapisw.htm; **Refining margin**: calculated using data and methodology from the Energy Information Administration regarding estimated refinery and refinery profit margins in the United States, http://tonto.eia.doe.gov/dnav/pet/pet_pri_spt_s1_d.htm

40 Malaysia Tapis Crude, sourced from the U.S. Energy Information Administration http://tonto.eia.doe.gov/dnav/pet/hist/wepctapisw.htm.

41 Average refining costs and profits were calculated for each year using U.S. Energy Information Administration (EIA) methodology and data. The margin was calculated as the difference between the annual average spot price of diesel fuel (used as a proxy for the value of diesel fuel as it exits the refinery) and the average price of crude oil purchased by refiners (the crude oil component). The data relates to U.S. refineries, in the absence of information on ex-refinery prices in Malaysia.

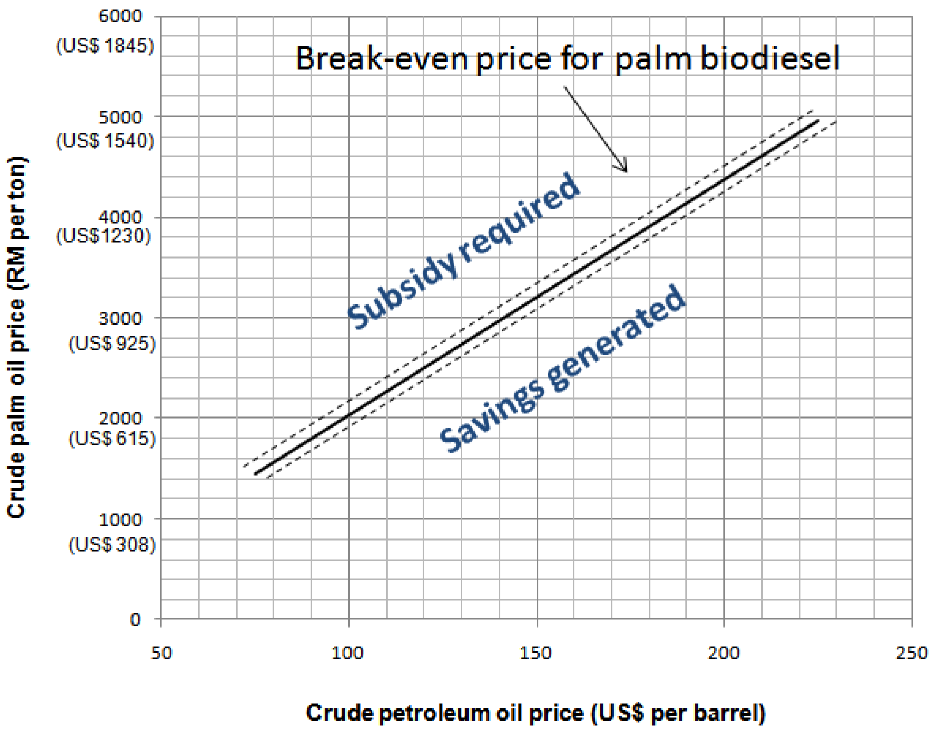
42 U.S. Energy Information Administration.

Drawing on the cost of production estimates from Table 4.4, for PME biodiesel, and from Table 4.5 for petroleum diesel, biodiesel is likely to be competitive with petroleum diesel when the price of CPO is below RM 1 500 (US$ 460) and the crude oil prices are around US$ 75 (RM 245) per barrel or higher. At these prices, both fuels can be produced for around RM 1.80 (US$ 0.55) per litre of diesel-equivalent (biodiesel contains ten per cent less energy than petroleum diesel).

When CPO is RM 3 500 (US$ 1 080) per tonne (the average price for July 2008),[43] biodiesel would cost around RM 4 (US$ 1.25) per litre diesel-equivalent to produce. This would only be competitive with petroleum diesel if crude oil prices were US $165 (RM 536) per barrel or higher.

Figure 4.1 provides estimated break-even prices for biodiesel at varying CPO and crude oil prices. If crude oil was US$ 150 (RM 485) per barrel, for example, biodiesel would be competitive at a CPO price of RM 3 200 (US$ 985) per tonne. Were CPO prices to rise, a subsidy would be needed to keep biodiesel viable. Were CPO prices to fall, a saving would be generated from using biodiesel rather than petroleum diesel, at a crude oil price of US$ 150 per barrel.

Figure 4.1 Break-even price for palm biodiesel production at varying petroleum oil and crude palm oil prices



Note: The dashed lines around the break-even price indicate variation in the cost of production. They are a schematic representation only and not a statistical calculation.

Source: **Cost of production for palm biodiesel** was estimated from an average refining margin calculated according to the methodologies presented in this chapter; **petroleum diesel cost of production** was calculated using U.S. Energy Information Administration methodology and data (for Malaysian Tapis crude oil).

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[43] Malaysian Palm Oil Board, http://econ.mpob.gov.my/economy/EID_web.htm

The estimates shown in Figure 4.1 are similar to the break-even prices quoted by government and industry sources in Malaysia. NIRAS (2006b) found that biodiesel would be at break-even when crude petroleum oil was US$ 90 per barrel and CPO was RM 2 000. An MPIC presentation notes that biodiesel in Malaysia would be viable when the CPO price was below RM 1 422 (US$ 438) per tonne against a crude petroleum price of US$ 80 per barrel (Nagarajan, 2008). Figure 4.1 predicts that PME biodiesel will be competitive when crude petroleum oil is US$ 80 per barrel and CPO is around RM 1 500 per tonne. The difference in the two break-even prices could be explained by different methodologies used to calculate the cost of biodiesel refining. As can be seen from Table 4.4, there is significant variation in the estimated costs of production.

The break-even curve presented here assumes that there are no subsidies for either fuel. In Malaysia, however, the government subsidizes petroleum fuels. In June 2008, the retail price for petroleum diesel was set at RM 2.58 (US$ 0.80) per litre.[44] This is significantly lower than the estimated cost of production for biodiesel of RM 3.45 (US$ 1.05) per litre at a CPO price of around RM 3 000 per tonne. CPO prices would need to be below RM 2 500 per tonne for biodiesel to be competitive with a diesel price of RM 2.58 per litre (without biodiesel subsidies).

The breakeven price is likely to be lower if Envodiesel (palm olien directly blended with petroleum diesel) is used instead of PME biodiesel. Less processing (i.e. transesterification) is required to produce the biofuel-component of Envodiesel, namely refined palm olien. NIRAS (2006b) added a ten per cent refining margin for converting CPO to olien. However, olien has ten per cent lower energy content than diesel. These two factors cancel each other out, so the diesel-equivalent price of olien is equal to the CPO costs presented in Table 4.4.

In August 2008, the Deputy Minister for Plantation Industries and Commodities, A. Kohilan Pillay, said that Envodiesel would be competitive with subsidized petroleum diesel if CPO remained below 3 000 per tonne (*Bernama*, 19 August 2008). CPO at RM 3 000 per tonne is RM 2.79 per litre (Table 4.4)—higher than the RM 2.58 subsidized price for diesel. However, the Minister also indicated that Envodiesel would be subsidized like petroleum diesel. At a price of RM 2.79, palm olien would cost the same as unsubsidized diesel when crude oil is US$ 115 per barrel (yielding an estimated ex-refinery diesel price of RM 2.78). The oil price was, in fact, US$ 115 per barrel at the time the Minister made his announcement on 19 August 2008.

As highlighted above, the key condition for PME biodiesel to be competitive with petroleum diesel is a low CPO price coupled with a high crude oil price. However, a significant price differential between the two products might be unlikely to arise for any length of time, as in recent years the price of vegetable oils (including CPO) appears to have been following the same trajectory as crude petroleum oil (Figure 4.1).

It may be too much to infer that a linkage in prices between the two commodities has arisen due to world biodiesel production. Nevertheless, it seems logical that palm biodiesel or Envodiesel production should increase when CPO is cheap relative to fossil

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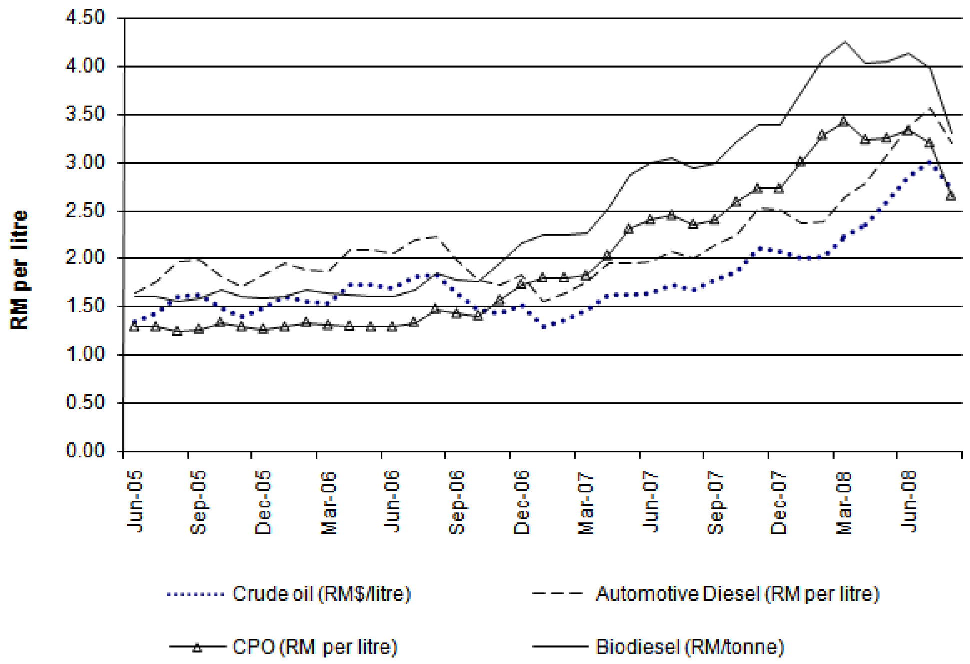
44 Our calculations indicated that automotive diesel could be produced for RM 2.58 if Malaysian Tapis crude was US$ 107 per barrel. However, that figure represents the cost of fuel leaving the refinery. An additional margin would need to be included for distribution and sales costs.

diesel. This would raise demand for CPO and push up its price, making production of biofuels from CPO uneconomic once again. So long as biodiesel is made from vegetable oils (as opposed to biodiesel made from less-valuable biomass feedstock), CPO prices are likely to remain linked to petroleum oil prices, thereby decreasing the likelihood that a sufficient price gap will open-up to make PME biodiesel competitive for any length of time.

Figure 4.2 Prices of crude petroleum, crude palm oil and estimated costs of production of their diesel fuel products, 2005 to 2008



Note: The automotive diesel and biodiesel prices were calculated by adding refining margins to the crude oil and CPO prices respectively. They will, therefore, follow the same trajectory as their parent data.

Sources: Crude palm oil: MPOB http://mpob.gov.my; Malaysian Tapis Crude; U.S. Energy Information Administration http://tonto.eia.doe.gov/dnav/pet/hist/wepctapisw.htm; automotive diesel and biodiesel costs of production, GSI estimates.

Figure 4.2 shows that in 2005 and 2006, CPO was worth less than crude petroleum oil, and that PME biodiesel could be produced more cheaply than petroleum diesel. This was the time when the Malaysian government developed its ambitious biofuel policies and there was substantial interest from investors. However, in late 2006, a switch took place, with CPO becoming more expensive than crude petroleum oil, and even more expensive than diesel. It therefore made little economic sense to convert CPO to biodiesel when it was worth more in its unprocessed state. Since June 2008, prices of both commodities have fallen, with CPO falling further and now being valued at a similar price to crude petroleum oil. This has corresponded with renewed interest in palm-based biofuels in Malaysia.

5 Government support

The Biofuel Industries Act 2006—passed by Parliament in 2007 but yet to be enacted into law—would allow the Ministry of Plantation Industries and Commodities (MPIC) to grant subsidies to the industry. The domestic biofuel industry, spearheaded by the Malaysian Biofuel Association (MBA), is currently lobbying for government support. The MPIC is deliberating as to whether it should extend support to the biofuel industry.

Using the Global Subsidies Initiative's framework, an analysis of current government support in the production of biofuel in Malaysia is provided below.

5.1 Assistance to intermediate inputs

Inputs for biofuel production can be classified into two categories: (i) the raw material (CPO) and (ii) chemicals including mainly methanol as well as catalysts, citric acid, hydrochloric acid, sodium hydroxide and water (steam).

In the past, the government intervened heavily in the establishment of the palm oil industry, including through allocation of public land to private smallholders and plantation companies; funding and undertaking R&D; tax exemption for export-oriented industries; training incentives and preferential interest rates (see Section 2.1.1).

Various taxes implemented by the government encourage producers to add value to CPO and export high-value products derived from palm oil. The prices of fresh fruit bunches are monitored by the MPOB to ensure fair rates, especially for smallholders.

During a market slump in 2000–01, when the average price of CPO fell to a low of RM 700 (US$ 185) per tonne, the government provided a subsidy of RM 1 000 (US$ 260) per hectare as an incentive to encourage replanting in plantations having palms that were older than 25 years (*New Straits Times,* 8 April 2001). This initiative resulted in 198 000 hectares being replanted, which temporarily reduced annual output by 540 000 tonnes (Rasiah, 2006).

In the context of land development for palm oil plantations, FELDA spent an average of RM 51 200 (US$ 13 500) per settler family placed in its scheme. Of this, 42 per cent was borne by the government. Since its inception, FELDA has resettled 105 000 settler families. Of these 71 000 are involved in the production of oil-palm. Therefore, we can estimate that approximately RM 1.5 billion (US$ 0.39 billion) has been extended to the palm oil sector through subsidizing oil-palm production. However, it is difficult to quantify how much of this assistance has benefited the Malaysian biodiesel industry.

No direct subsidies or tax exemptions are currently provided for palm oil production, which is, on the contrary, taxed.

5.2 Labour

The palm oil industry indirectly benefits more from lower labour costs than many other sectors in Malaysia, due to its ability contract foreign workers both legally and illegally. While there is no national minimum wage, a non-binding industry level agreement sets a wage of RM 360 (US$ 110) per month (below the poverty line). This is achieved through sector-specific arrangements that allow wages to be depressed even below indicative Malaysian poverty lines. This forms a major incentive for plantation companies to employ lower-cost foreign workers, particularly from Indonesia, to keep production costs low. One estimate indicated that there were more than 800 000 illegal workers in Malaysia before a crackdown in 2003. Some plantation estates in Sabah were found to employ solely Indonesian workers (Wakker, 2005).

Government labour policies that allow for low-wage foreign labour in the plantation sector do not provide these workers with the same rights as Malaysian citizens. Furthermore, the influx of illegal immigrants working in the plantation sector, coupled with weak or non-existent trade unions, also contributes to keeping wages low. As palm oil production is a labour-intensive industry, low wages contribute to low production costs. However, labour costs in Malaysia are still higher than in neighbouring countries, such as Indonesia or Papua New Guinea, due in part to continued high economic growth rates and a relatively tight labour market.[45]

As Indonesian wages have improved, the incentive for workers to migrate to Malaysia has diminished. As a result, workers are increasingly being brought in from Myanmar and Bangladesh (Wakker, personal communication).

5.3 Assistance to outputs

During 2006 and 2007, the government did not provide any market-price support for the biodiesel industry. Although there is support for renewable energy under the Five Fuels Diversification Strategy, it is broad-based and not targeted specifically at the biodiesel industry.

Furthermore, there are also no import tariffs on biodiesel or palm oil.

If implemented, the mandatory five per cent biodiesel consumption requirement would provide significant price support for the industry. Approximately 500 000 tonnes of biodiesel would be needed to meet the mandated requirement, with consumers required to pay higher prices for biodiesel than for the cheaper petroleum equivalent. How much more would depend on the relative prices of petroleum and CPO. See Section 5.7 for further discussion.

5.4 Assistance to value-adding factors

Biofuels are included in the list of activities and products that are encouraged under the Promotion of Investment Act 1986.[46] Biodiesel projects are eligible to be considered for "Pioneer Status" or Investment Tax Allowance (ITA) as stipulated by the National Biofuel Policy and the Promotion of Investment Acts 1986. Pioneer Status grants eligible companies a tax exemption of 100 per cent of statutory income for a period of ten years. The ITA provides a tax credit of 100 per cent on qualifying capital expenditure incurred within a period of five years from the commencement of operations.

These tax breaks have potential to confer substantial benefits to producers. For example, a company can build and operate its plant and not pay any income tax. Similarly, it can write off all of its investment against income tax.

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[45] Average unemployment has been below four per cent since the early 1990s.

[46] List of Promoted Activities and Products – General. http://www.mida.gov.my/beta/view.php?cat=3&scat=6&pg=976

Eligibility for Pioneer Status or ITA is based on certain government priorities for the palm oil industry, including the levels of value added,[47] the technology used and links to other industries. Such eligible priorities are termed as "promoted activities" or "promoted products". These include oleochemical products (such as biodiesel), food products, nutraceuticals, products produced from palm oil by-products (such as palm cake and mill effluent) and products from palm biomass.

Projects located in the "promoted areas" of Sabah, Sarawak and the Eastern Corridor of Peninsular Malaysia are eligible for Pioneer Status or ITA.

"Reinvestment Incentives for Resource-Based Industries" provide Malaysian companies (i.e. at least 51 per cent Malaysian owned) that have export potential in the rubber, palm oil and wood-based industries, with Pioneer Status or ITA for any reinvestment made for the purposes of expansion.

Biodiesel projects that meet certain criteria will also be eligible for incentives under the "Incentives for High Technology Companies" or "Incentives for Commercialisation of Research and Development Findings of the Public Sector in Resource Based Industries." To encourage commercialization of resource-based R&D by public research institutes, a Malaysian company that invests in a subsidiary company engaged in the commercialization of the R&D findings may be given a tax deduction equivalent to the amount of investment made in the subsidiary company. The subsidiary company that undertakes the commercialization of the R&D findings may be granted Pioneer Status.

The granting of a licence to produce biofuel does not automatically mean the companies receive these benefits. Only four firms produced biodiesel in Malaysia during 2006 and, according to the Managing Director of the Carotech Bhd (one of the four), none of them benefited from the above incentives financially or otherwise.

The biofuel industry may, however, have benefited from investment incentives offered under the Promotion of Investment Act 1986. At the end of November 2007, 92 biofuel projects had been approved by the Malaysian Industrial Development Authority (MIDA). The amount of investment incentives provided to foreign investors in the biodiesel sector in not known.[48] Major sources of Foreign Direct Investment (FDI) were Australia, Singapore, U.S., India, Italy and Japan (United States Commercial Service, 2006).

The MPOB has provided soft loans totalling approximately RM 60 million (US$ 17 million) to three corporations to build three biodiesel plants (*Bernama*, 26 September 2005). The three companies were Golden Hope Plantations' wholly owned subsidiary, Rubiatec Sdn.[49] Bhd., Kumpulan Fima Bhd. and the JC Chang's Group's Caratino Sdn.

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[47] Value added refers to the additional value of a product over the cost of the inputs used to produce it from the previous stage of production (the value of bread compared with the value of the flour and other ingredients).

[48] There are two problems in estimating investment incentives in Malaysia. First, MIDA reports investments approved and not investments realized. Second, investment incentives such as tax exemption, credit facilities, subsidized utilities and land are difficult to assess. It is often done *ex-post* and relates to the issue of production and profits.

[49] The Rubiatec plant is estimated at RM 89 (US$ 26) million. www.sspsb.com.my/Brochure/09_INDUSTRIAL%20PLANTS/SSP_IND_ID14_MPOB%20BIODIESEL%20PLANT.pdf

Bhd. (Abdullah, 2006). The total cost of a 60 000 capacity biodiesel plant is estimated to be around RM 40 (US$ 5.2) million. Interviews with MPOB officers and the General Manager of Golden Hope's Biodiesel Division revealed that the MPOB provided loans of approximately RM 20 million (US$ 5.80 million) per corporation.

The above three biofuel corporations also used MPOB technology for biofuel production. Intellectual Property Rights do not allow the corporations to commercialize or replicate this technology. It is unclear whether there was any payment to the MPOB for the licensing of the technology. The three firms' repayments on their respective facilities leases should be approximately RM 1 to RM 1.25 million (US$ 290 000 to US$ 360 000) per annum, running from the first year for a period of thirty years.[50]

5.5 Assistance for research and development

Research and development in the palm oil industry is conducted at company-level, and by dedicated government agencies, such as the MPOB, and universities. The MPOB relies mainly on funds generated through compulsory government taxes on the industry as well as government grants. Biodiesel production, R&D and the commercialization of new technology, has been undertaken by the MPOB together with Petronas. In 2004, Petronas contributed RM 12 million (US$ 3.8 million) to build a pilot plant for biodiesel production (Ong Soon Hock, 2004).

In 2006, the MPOB received R&D grants from the government totalling RM 13.58 million (US$ 3.69 million). However, it is unclear what proportion of the grants was utilized for biodiesel initiatives. Three firms producing biodiesel are using technology developed by the MPOB.

5.6 Aggregate levels of support

Aggregate levels of support for the biodiesel industry comprised RM 60 million (US$ 15.80 million) in low-interest loans in 2004 and RM 12 million (US$ 3.26 million) in federal grants for demonstration projects in 2006.

In addition, the Malaysian Government provided an estimated RM 1.5 billion (US$ 395 million) for land development under FELDA. However, only a small proportion of this funding could be argued to have supported current biodiesel production. The FELDA program, although focusing on poverty eradication, has created the largest oil-palm plantation corporation in the world. This has created economies of scale, thereby reducing production costs for the industry and downstream industries. Furthermore, FELDA itself is venturing into biodiesel production and may benefit from its scale of operations.

5.7 Potential subsidy costs

While the Malaysian government is not, at this stage, providing direct subsidies for production or consumption of biodiesel, or for the production of palm oil, the possible introduction of a mandatory blending requirement would generate significant support for

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[50] Author's interview with MPOB officers and tele-conversation with Mr. Zazili, General Manager of Golden Hope's biodiesel plant.

the industry. It could also impose a major financial burden on taxpayers or consumers, given that biodiesel currently costs more to procure than fossil diesel.

The National Biofuels Policy estimates that mandatory five per cent blending of biofuel in petroleum diesel would require 500 000 tonnes of diesel per year, based on current demand of 10 million tonnes of diesel per year. At crude petroleum oil and CPO prices of US$ 115 per barrel and RM 3 000 per tonne, respectively, the cost of production of petroleum diesel is estimated to be around RM 2.80 per litre, while biodiesel is RM 3.45 per litre. The higher cost of biodiesel (RM 0.67 per litre) would need to be borne by the government (through subsidies) or consumers (through higher fuel prices).

At these CPO and crude oil prices, replacing 500 000 tonnes of petroleum diesel with biodiesel would cost the Malaysian government around RM 395 million (US$ 122 million) more in fuel subsidies per year than supplying the same quantity of petroleum diesel (Table 5.1). This assumes that the government would subsidize biodiesel in the same way as fossil diesel.

Table 5.1 Estimated saving or subsidy cost of replacing 500 000 tonnes of petroleum diesel with PME biodiesel at varying CPO and crude petroleum oil prices (million RM)

CPO price	Crude petroleum oil price (US$/barrel)					
RM/tonne	US$ 75	US$ 100	US$ 115	US$ 125	US$ 150	US$ 175
1 500	-25	330	545	690	1,045	1,400
2 000	-345	9,125	220	365	720	1,075
2 500	-640	-285	-70	70	425	780
3 000	-965	-610	-395	-250	100	460
3 500	-1,285	-932	-720	-575	-220	135
4 000	-1,580	-1,225	-1,015	-870	-515	-160
4 500	-1,875	-1,520	-1,310	-1,165	-810	-455
5 000	-2,200	-1,845	-1,630	-1,490	-1,135	-780

Source: Authors' estimates.

The estimated subsidy cost rises dramatically with higher CPO prices. If CPO were to reach the record prices of RM 4 500 per tonne prevailing in March 2008 with petroleum oil prices remaining constant at US $115 per barrel, a B5 mandate would cost an additional RM 1.3 billion (US$ 400 million) in fuel subsidies. If the CPO price were to fall to pre-2006 prices of around RM 1 500 per tonne, a B5 mandate would *save* the government around RM 545 million (US$ 170 million) in fuel subsidies.

Looked at in another way, if CPO price remained constant at RM 3 000 per tonne (the average price in mid-2008), petroleum oil would need to reach around US$ 150 per barrel for a B5 mandate to be more cost-effective than subsidizing an equivalent quantity of petroleum diesel. Were petroleum oil prices to fall to US$ 100 per barrel, the B5 mandate would cost the government around RM 610 million (US$ 185 million) in additional subsidies.

The prevailing prices for crude petroleum oil and CPO are not expected to change significantly over the short to medium term. The U.S. Energy Information Administration forecasts that crude oil prices will average US$ 119 in 2008 and US$ 124 in 2009 (Energy Information Administration, 2008). The OECD-FAO 2008–2017 Agricultural Outlook forecasts that vegetable oil prices [51] will average US$ 985 (RM 3 200) per tonne in 2008–09, then increase over several years to around US$ 1 050 (RM 3 410) per tonne, where they will remain until at the least the end of forecast period. On any given day, of course, market prices for both commodities will fluctuate around the mean.

At these prices (US$ 125 for crude petroleum oil and RM 3 500 (US$ 1 077) per tonne for CPO), a B5 mandate would cost the government approximately RM 575 million (US$ 175 million) more in fuel subsidies than supplying petroleum diesel, assuming a retail price of RM 2.58 (US$ 0.79) per litre for diesel. This is in addition to the direct subsidies and foregone sales tax revenue, which is assumed to apply equally to both biodiesel and petroleum diesel.

By way of alternative, the Government could impose a B5 mandate without subsidizing biodiesel at the same rate as petroleum diesel. In this scenario, the additional costs or savings of a B5 mandate would—in theory—be passed on to consumers through higher or lower fuel prices.

To summarize, a B5 mandate would guarantee a fixed level of domestic demand for biodiesel, regardless of the price of CPO. Without such a mandate, biodiesel would only be blended by fuel suppliers when it was profitable to do so, specifically when biodiesel can be purchased at a similar or cheaper price than petroleum diesel. A mandate would require that fuel suppliers blend and sell biodiesel even when the price is far more expensive than petroleum diesel. These costs would be passed on to the consumer or, if subsidies were provided, to the government (and therefore to taxpayers). In either case, there would be a transfer of wealth from motorists or taxpayers to biodiesel producers, who would have the enviable advantage of guaranteed sales regardless of the price of their product.

5.8 Fuel subsidies and opportunity cost of subsidies

Without including biofuel subsidies, it has been estimated that Malaysian government consumption subsidies for petroleum fuels are likely to total around RM 25 billion (US$ 7.8 billion) in 2008 alone (Thillainathan, 2008). This includes around RM 18 billion in direct subsidies and around RM 7 billion of foregone tax revenue for transport fuels (assuming an oil price of US$ 100–120 per barrel). A further RM 20 billion is expected to be spent on natural gas used for electricity generation, leading to total fuel subsidies of RM 45 billion (US$ 13.85) in 2008—higher than the record RM 40 billion (US$ 12.30 billion) allocated for development for 2008 under the 9th Malaysia Plan.

Biofuel subsidies would create a new expense for government, diverting taxpayer funds to private interests and encouraging production of an economically unviable product. In

[51] Comprising a group of vegetable oils, including palm oil.

March 2008, the Malaysian Palm Oil Board noted that cost of producing palm oil-based biodiesel was RM 4 330 (US$ 1 330) per tonne compared with a market price of RM 3 630 (US$ 1 115) per tonne for the fuel.[52] Bridging this gap with taxpayer's funds makes no economic sense and squanders the finite resources of government.

5.9 Accessing subsidies from other countries

While the Malaysian domestic retail price for biodiesel is constrained by the RM 2.58 (US$ 0.79) per litre subsidized rate of petroleum diesel, higher prices can be commanded in other countries. In August 2008, spot prices for rape methyl ester biodiesel in Europe averaged US$ 1 500 (RM 4 940) per tonne: US$ 1.35 or RM 4.40 per litre. Palm methyl esters commanded a lower price of around US$ 1200 (RM 4 060) per tonne or RM 3.60 (US$ 1.10) per litre of biodiesel.

This would imply slim margins for Malaysian biodiesel producers. The cost of production for biodiesel at August 2008 CPO prices (RM 3 000 per tonne) was estimated to be around RM 3 500 per tonne (variable costs only). Incorporating capital costs would add an extra ten per cent to this ex-refinery price (bringing the cost of production up to RM 3 850), plus any transport and marketing costs as well as a profit margin.

However, Malaysian biodiesel exporters are likely to be benefiting from subsidy policies in the U.S. and the EU. The United States provides a tax credit for biodiesel blended with fossil diesel fuel, which is applied to blends exported to other countries as well as to fuel consumed in the United States. The credit provides one cent for every per cent of biodiesel blended, hence a 99.9 per cent blend would get almost US$ 1.00 per gallon in tax credits (*Biodiesel Magazine*, October 2007).

The scheme was originally intended to benefit U.S. biodiesel producers, but owing to a loophole in the law, biodiesel can be imported and blended with 0.1 per cent fossil diesel then re-exported, with the blender claiming the full tax credit. Once the "splash" of fossil-diesel has been added, the fuel is then "dashed" to Europe where it can benefit from fuel-tax exemptions that effectively raise the price that fuel blenders are willing to pay for biodiesel.

The majority of biodiesel involved in "splash and dash" is expected to come from Southeast Asia (Malaysia and Indonesia) and Latin America (Brazil and Argentina). Hence, despite uneconomic international prices for biodiesel, some producers can sell biodiesel to more profitable markets thanks to U.S. and EU subsidies. EU producers have protested against the U.S. scheme, claiming that the subsidized imports undercut their biodiesel sales. The EU Trade Commissioner has requested an investigation and is threatening a retaliatory tariff. However, resolution of the issue is not expected for at least another year.

[52] Malaysian Palm Oil Board, see http://econ.mpob.gov.my/economy/biodiesel/NEWS1.pdf

6 Social and environmental issues

Biofuels have received considerable support from some developed and developing country governments on the assumption that they would generate multiple social and environmental benefits. In developing its biofuel policies, the Malaysian Government was primarily motivated by the potential for a domestic biofuels industry to increase employment, raise incomes, boost export earnings and enhance energy security. Environmental concerns were less of a driver, although the government's biofuels policy does assume that biofuels are beneficial for reducing greenhouse gas emissions and localized pollutants.

The ability of biofuels to deliver against these objectives is uncertain. Evidence is mounting of unintended negative consequences of pro-biofuel policies that can undermine governments' policy objectives. On the social and economic front, these include higher food prices, detrimental effects on other businesses (such as food-processors and feedlots) and the opportunity cost of government expenditure. Environmental concerns include the energy and resource use required in biofuel production, the expansion of agricultural land into natural ecosystems, increased intensity of farming (higher use of water, pesticides and fertilizers) and pollution.

Before the advent of biofuels, similar concerns were raised in the context of Malaysian palm oil production. Oil-palm has been a powerful instrument for economic and social development in Southeast Asia, but it has also been associated with dispossession of land from indigenous communities, exploitation of labour, deforestation and pollution (Greenpeace, 2007; Oxfam, 2008; Wakker, 2005). The emergence of palm biodiesel has been particularly controversial therefore.

As seen in the previous section, demand for biodiesel depends substantially on government policies and subsidies, because biodiesel is currently more expensive to produce than petroleum diesel. Biofuel support polices influence outcomes in Malaysia both directly, by causing production of biofuels or feedstocks, and indirectly through flow-on effects to agricultural commodity markets.

If governments around the world were to cease providing support, the vast majority of current biodiesel production would close down. A discussion on the social and environmental impacts of biodiesel production is, therefore, highly relevant to this paper, given the volatility of fuel and CPO markets, as well as possible changes in biofuel support policies in Malaysia and in potential export markets.

The Malaysian biofuel industry is currently small. No fuel ethanol is being produced and the biodiesel industry is operating well below capacity. The direct social and environmental impacts—positive or negative—are therefore likely to be limited at this stage, especially when compared with palm oil exports more broadly. Exports of biodiesel were around 95 000 tonnes in 2007, or less than 0.7 per cent of the 13.75 million tonnes of CPO exported. However, this could change in the future as biofuel mandates expand in the EU and U.S., potentially increasing the demand for imported biofuels or feedstock. However, full implementation of the government's biofuel policies (should feedstock prices or fossil oil prices rise), could have significant social and environmental implications.

Should the Malaysian Government implement a B5 mandate, an additional 570 000 tonnes of palm oil would be required (assuming that current uses are not disrupted).[53] This equates to approximately 135 000 hectares of land,[54] or three per cent of the 4.2 million hectares currently under cultivation and around three-quarters of the increase in oil-palm area from 2005 to 2006 (164 000 hectares). This would be in addition to the ongoing expansion of the industry to serve other end users, and could result in further conversion of forest.

6.1 Social impacts

6.1.1 Employment

Exact figures on employment in the biodiesel sector are not available. However, the 21 plants existing or under construction in Malaysia have the potential to directly employ around 420 people if operating at full capacity (based on the assumption that the average biofuel plant usually employs approximately 20 people). Actual employment is likely to be much lower at present, given that most facilities are producing well below capacity, or have suspended production. Data on wage rates in biodiesel plants are not available.

For the past 100 years, palm oil has played an important role in the Malaysian economy and with respect to employment, particularly in rural areas (see Chapter 2 and Box 7.1). Many people have been lifted out of poverty through the successful development of the industry, with consequential improvements to health, education and standards of living.

Today, the palm industry directly employs over 860 000 people in Malaysia. However, pay and conditions of plantation labour remain contentious issues. Palm plantation workers are among the poorest in Malaysia. In addition, there are concerns about infringements by the industry on land rights, use of illegal workers and poor occupational health and safety (Wakker, 2005).

A collective agreement was reached in 2001 that stipulated that plantation workers would receive a guaranteed monthly wage of RM 325 (US$ 92 at the time) (*Asia Times Online,* 3 May 2003). This has been criticized as being below the poverty line index of RM 691 (US$ 218), including food, or RM 415 (US$ 130) covering non–food items only (clothing, housing, transport and other items), introduced in 2005.

6.1.2 Biofuels and food prices

While the direct effects of Malaysia's biofuel production appear to be minimal at this stage, the indirect effects of global production on Malaysia have been profound. Biofuel policies in other countries, particularly the EU and the U.S., have diverted vast quantities of agricultural commodities previously consumed in other markets. These include primarily the food but also the industrial sectors, with the overall effect of pushing up prices and spurring agricultural production.

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53 According to the Malaysian Government's National Biofuel Policy, a B5 mandate would require 500 000 tons of biodiesel. One ton of biodiesel production requires 1.14 tons of CPO (Pleanjai *et al.,* 2004).

54 Assuming the average oil-palm plantation can produce 4.3 tons of CPO per hectare (USDA, 2005).

The amount of food converted to fuel in Malaysia has been limited due to the current low levels of domestic biofuel production. Global biofuel production, however, has been largely responsible for recent dramatic rises in the price of many agricultural commodities. Higher prices have not been limited to biofuel feedstocks, but have extended to substitutable commodities.

Since 2006, agricultural commodity prices have risen sharply, with prices of major food staples such as grains and oil seeds doubling in the past year. The FAO's food price index rose, on average, eight per cent in 2006 compared with 2005, and 24 per cent in 2007 compared with the previous year. In the first three months of 2008, prices rose 53 per cent compared with the final quarter of 2007 (FAO, 2008a).

A confluence of factors contributed to the rise in food prices, but many analysts consider that the single most important factor was the production of biofuels in the U.S. and EU. The IMF (2008) estimated that biofuels accounted for almost half of the increased demand for major food crops in 2007, while the OECD (2008) estimated that around 60 per cent of the increase in consumption of cereals and vegetable oils was due to biofuels. In 2008, World Bank senior economist, Donald Mitchell, concluded that the most important factor causing food price rises between 2002 and 2008 was the large increase in biofuel production from grains and oilseeds in the U.S. and EU. Without these increases, global wheat and maize stocks would not have declined appreciably and price increases due to other factors (such as increased demand in some developing countries, higher fertilizer costs, poor crop yields in some counties, decline of the U.S. dollar and market speculation) would have been moderate (Mitchell, 2008).

Pro-biofuel OECD governments have not reacted flexibly to higher feedstock prices. As commodity prices have risen, many governments have persisted with, and even increased, mandates and subsidized biofuel production. This exacerbated the market situation, driving commodity prices higher still, with flow-on effects around the world.

In the United States, for example, subsidies for corn ethanol production were found to encourage farmers to increase the area planted for corn in 2007, mainly at the expense of soy and wheat (FAO, 2008b). The supply of soy and wheat contracted, leading to higher prices for these commodities. Higher wheat prices also had flow-on effects on rice prices, as consumers switched from wheat to rice as a staple food, thereby increasing demand for rice and pushing up prices (Mitchell, 2008). Thus, biofuel support policies have been found to influence the availability and price of even non-biofuel feedstock commodities.

Conversion of vegetable oils to produce the world's nine billion litres of biodiesel last year (Steenblik, 2007) has contributed to the dramatic rise in palm oil demand and prices. The largest biodiesel consumer is the EU, where the biodiesel sector absorbed around 60 per cent of Member States' 2007 rapeseed oil output (around 25 per cent of total world production). This was driven by over US$ 4.5 billion (RM 15 billion) in subsidies and market price support in 2006 alone (Kutas *et al.*, 2007). Largely as a result of the diversion of rapeseed oil to fuel, EU imports of palm oil more than doubled between 2000 and 2006 (Thoenes, 2006). The increased demand and associated market speculation drove vegetable oil prices to record highs.

Between early 2006 and early 2008, palm oil prices surged by around 165 per cent—the price in January 2006 was RM 1 412 (US$ 384) and the price in March reached RM 4 350 (US$ 1 182). According to Oil World, a forecasting service in Germany, biofuels accounted for almost half the increase in worldwide demand for vegetable oils in 2007, and represented seven per cent of total consumption of the oils (cited in *International*

Herald Tribune, 19 January 2008). Palm oil yields per hectare remained steady, providing no additional supply from exiting plantations.

The situation is likely to have benefited farmers (albeit only in the short term if they do not own their land), plantation owners and exporters, who can all command higher prices. Wiggins *et al.* (2008) found oil-palm production by smallholders in Indonesia to be a profitable business, with net present value returns of more than US$ 9 000 (RM 29 250) per hectare. This value was at 2006 prices. When 2007 average prices were used in the calculations, returns increased by around 65 per cent, and palm oil prices were higher still in 2008. Profits are likely to be lower in Malaysia, where wages are higher, but record-high prices will undoubtedly more than compensate for this, and make a profitable activity even more lucrative.

Palm oil is a staple ingredient of food in Southeast Asia. It is used for cooking and in food processing. For the poor, cooking oil is an important source of calories. It can also be a major food expense for households that grow their own food but must buy oil with which to cook it. In Malaysia, the effects of rising prices are being felt both by the poor and as a general inflationary effect.

Meanwhile, higher food prices have undermined the purchasing power of many of the world's poorest people (World Bank, 2008). For poor households that may spend up to 75 per cent of their income on food, it has meant sacrificing education or medical care in order to afford basic foods. The least fortunate have been unable even to afford sufficient food (Ivanic and Martin, 2008). Higher food prices affect urban and rural poor alike, as most rural households are net consumers rather than producers of food (Ivanic and Martin, 2008).

Oxfam (2008) estimates that the livelihoods of at least 290 million people around the world are immediately threatened by the food crisis. The World Bank estimates that 100 million people have already fallen into poverty because of the food crisis (Ivanic and Martin, 2008). Depending on the estimate used regarding the role of biofuels in creating the food crisis (OECD, IMF or World Bank research), biofuels can be said to have caused 30 to 75 million people to fall into poverty and to jeopardize the livelihoods of 100 to 220 million people.

The inflationary pressures of higher food prices are constrained to some extent in Malaysia, as the prices of many essential food items are controlled. However, the cumulative effect of increased food and fuel prices transmitted across the economy is leading to food shortages and a large federal government subsidy bill. Smugglers have been bidding up prices as they move the oil (both fossil fuel and vegetable oil) from Malaysia to less subsidized markets, like Singapore.

Full implementation of Malaysia's biofuel targets would put further pressure on food prices, particularly vegetable oils, lifting the cost to taxpayers for both biofuel subsidies and food provision programs.

6.1.3 Potential for land grabs

Further expansion of oil-palm plantations is likely to occur in the states of Sabah and Sarawak, where land development schemes are still possible because there is natural forest, as well as Native Customary Rights land that can be converted to oil-palm.

Sabah and Sarawak state government policies on poverty alleviation programs involving palm oil or biodiesel have not been clearly articulated, nor have they been convincingly demonstrated to benefit the poor. In Sarawak, the state government introduced a land-lease scheme, called in the 1990s New Concept (Vermeulen and Goad, 2006) or New Model (Cooke, 2005), as a strategy for rural development on land under Native Customary Rights (NCR). The New Concept arrangement involves the setting up of a three-way joint venture. It has been estimated that 80 per cent of the agricultural land in Sabah is under palm oil (Yii Tan, personal communication).

Under the arrangement, a private plantation company, selected by the state, holds 60 per cent ownership. The plantation company does not buy the land. Rather, it provides financial capital for landowners to develop the land for palm oil production. The local community that holds the NCR to the land is awarded a 30 per cent share of this investment. A Land Bank mechanism allows farmers to register their land in the bank as an asset. This enables the private company to use the land as a deposit to borrow money locally or abroad. Finally, the government—acting through a parastatal agency—acts as trustee and power of attorney, holding the remaining 10 per cent. Land titles are issued to the joint venture for 60 years. On expiry, the NCR landowners can apply to the Superintendent of the Land and Survey Department to renew the lease or opt out of the scheme.

Parastatal agencies implementing the program guarantee the venture and facilitate interactions between private companies and landowners. The landowners do not essentially have any say in day-to-day decisions in the joint venture as they are required to sign a power of attorney handing over all rights to the land to the guarantor when the project begins.

Vermeulen and Goad (2006) note that many NCR landowners in Sarawak are opposed to the New Concept idea, due to a number of concerns such as:

- *Lack of real choice.* Communities have been told to participate or risk having their land developed anyway under the provisions of the Sarawak Land Code, which allows the government to designate any piece of land for development.

- *Lack of information.* Landowners often feel they have had little control over the negotiating process and have received inadequate explanation of the terms of the joint venture.

- *Cultural differences in attitudes to land.* There is an understanding among indigenous peoples that land is inherited, communal and inalienable. They are therefore often wary of handing over land to a management company, which shifts their status from landowners to workers and minor shareholders in plantation companies. Smallholding status, by contrast, allows them to retain some measure of control over their livelihoods.

- *Concern about loss of land.* Methods used by the Land and Survey Department to determine NCR land boundaries are questionable as they delete existing boundaries and result in the amalgamation of NCR land into large blocks of 5 000 hectares with a single land title. Landowners are also concerned about whether the land will be returned, and how it will be re-divided, once the 60-year lease is finished.

- *Issues of political patronage.* Some stakeholders are concerned that governments awarding leases to plantation companies and parastatal agencies monitoring plantation activities can be disproportionately influenced by powerful and wealthy stakeholders. Bureaucratic and political corruption may also influence outcomes of land use decisions.

Box 6.1 Poverty reduction and palm oil settlement schemes

In the past, palm oil production has been a significant driver of poverty reduction in Malaysia. Agricultural land development schemes, which allocated land rights to the landless poor, were introduced in the 1950s in Peninsular Malaysia to address rural poverty. These lands were allocated for the production of specific commodities such as rubber, palm oil, coconut, coffee, cocoa, tobacco, sugarcane or rice, as well as for aquaculture and livestock. (See Box 2.2 for a description of the first and largest of these authorities, the Federal Land Development Authority—FELDA.)

The intensification of palm oil since the late 1950s helped to diversify the economic base away from rubber, which experienced falling prices after the invention of synthetic substitutes. Furthermore, the relatively high prices for palm oil on average led new land development authorities to focus on oil-palm. As of June 2006, federal and state government land-development programs under palm oil constituted 30 per cent of the total palm oil area, or 1.2 million hectares, with FELDA having the largest holding with 0.66 million hectares.

As of 1 January 1990, FELDA stopped accepting new settlers for its program and ceased opening up new land for development. The federal government has abandoned earlier plans to create new land schemes similar to FELDA.

FELDA's major recent activities have been the rehabilitation of the older palm oil and rubber schemes, through the Federal Land Consolidation and Rehabilitation Authority (FELCRA) and the Rubber Industry Smallholders Development Authority (RISDA). Similarly, it has been active in the conversion of Native Customary Rights (NCR) land to plantation development. There are also private cooperative schemes such as the National Land Finance Cooperative Society (NLFCS), which operates roughly 25 000 hectares under oil-palm, rubber and coconut, as well as subsidiary companies owning mills and refineries. Subscribing farmers share ownership of the plantations and receive dividends. The cooperative gives loans to members for education, housing, small business development and medical treatment.

In terms of poverty reduction, FELDA has been a qualified success. Overall, poverty in the agricultural sector declined from 68 per cent in 1970 to 21 per cent in 1990, when FELDA's expansion program was terminated. Poverty among oil-palm smallholders dropped from 30 per cent in 1970 to 8 per cent in 1980, when data for this sub-group ceased to be collected (Simeh and Ariff, 2001).

Aspects of the settler schemes have been questioned. Productivity among settlers is low compared with industry standards and the schemes have been plagued by absentee landlords, "illegal land sales," social problems, out-migration and poverty among youths of the second generation of FELDA settlers. Furthermore, in Peninsular Malaysia, expansion of FELDA-type land redistribution schemes is not possible due to the scarcity of land (unless land is bought from private companies).

6.2 Environmental issues

The environmental effects of biofuels are politically sensitive, given that many biofuel policies, including those of Malaysia, are based on the assumption that biofuels are, by definition, an environmentally-friendly alternative to fossil fuels. In particular, they are reputed to bring about lower emissions of several pollutants, including greenhouse gases (GHGs), than their fossil equivalents. The GHG performance of biofuels varies widely, however, depending on their feedstock and methods of production. The expansion of the oil-palm industry in Malaysia, in part driven by demand for biofuels, has been associated with deforestation, release of carbon from the vegetation and soil, forest fires, soil erosion, water pollution, biodiversity loss, pesticide residues and further pressure on endangered species (Wakker, 2005). Malaysian palm oil companies have also been expanding into Indonesia, where more land is available for conversion to palm oil plantations, and where restricting regulations are less strictly enforced (Eric Wakker, personal communication).

6.2.1 Legislation to protect the environment

Under the Constitution of the Federation of Malaysia, most land matters are delegated to the states. The states of Sabah and Sarawak manage their own environmental regulations. The federal government retains some powers, particularly in relation to protected areas. Forests and marine parks gazetted as protected areas come under legislation as national or state parks, reserves and sanctuaries (Table 6.1). Permanent reserve forests are protected under the National Forestry Act 1984 (amended 1993). Approximately 44 per cent of Malaysia is under some form of reserve forest. However, differentiating "production" from "protected" forest reveals that 22 per cent is protected while the balance (78 per cent) is production forest. Protected areas managed by the Department of Wildlife and National Parks, a federal agency, tend to have better protection than permanent reserve forests, which are managed under state jurisdiction.

Table 6.1 Total gazetted protected area in Malaysia (2003)

Region	National park and state parks		Reserves and sanctuary		Total protected area	
	Million hectares	% of total	Million hectares	% of total	Million hectares	% of total
Peninsular Malaysia	0.58	54	0.31	47	0.89	51
Sabah	0.25	23	0.16	24	0.41	24
Sarawak	0.25	23	0.19	29	0.44	25
Total Malaysia	1.28	100	0.66	100	1.74	100

Source: Laplante *et al*. (2007)

The wide diversity of regulations relevant to biodiesel producers creates a major coordination challenge for Malaysia's federal and state governments, as well as complexity for investors in the sector. In addition to protected area legislation there are numerous Acts to protect the environment at the federal and state levels (Annex 1). Those most relevant to the biofuel and oil-palm industries are the Land Conversion Act 1960, Environmental Quality Act 1974, Pesticides Act 1974 and Environmental Quality Act 1986 (American Palm Oil Council, 2008).

At the federal level, the Ministry of Plantation Industries and Commodities has primary responsibility for regulating the plantation industry and biofuel refineries. However, it has limited influence in areas beyond its jurisdiction, such as labour, land and the environment. The Ministry of Human Resources regulates employer-employee relations such as wages, health and safety standards, including those applicable to migrant workers. The Ministry of Home Affairs is responsible for work permits and issues related to illegal migrant workers. The Ministry of Natural Resources and Environment regulates issues relating to environment.

A federal environmental impact assessment (EIA) is required for a range of "prescribed activities," including the clearing of 500 hectares or more of land, which requires permission from the federal Department of Environment (American Palm Oil Council, 2008). Federal legislation requiring EIAs was first implemented in 1987. The relevant act, the Environmental Quality Act 1974, requires anyone who intends to undertake a prescribed activity to first conduct a study to assess the environmental impacts that are likely to occur from that activity and the mitigating measures that need to be undertaken, as set out in the *Handbook of Environmental Impact Assessment Guidelines.*[55]

Sarawak and Sabah have independent EIA procedures for natural resource management (Memon, 2003). Sabah enacted its own law on the environment—the Conservation of Environment Enactment 1996 and developed specific guidelines with respect to EIAs for developing plantations (State Environmental Conservation Department, Sabah, Malaysia, 2001).

In Sarawak, both the federal and state environmental laws apply in respect to EIAs. The relevant state law is the Natural Resources and Environment Ordinance 1993 (Emang, 2006). Sarawak has asserted its autonomy in recent years and has taken responsibility for EIA assessment procedures for resource-based development projects (Memon, 2003). Unlike the EIA requirements in Peninsular Malaysia, Sarawak excludes public participation in the EIA process, unless the project proponent elects for public consultation (Mohamed Idris, 2007). The process has drawn criticism for being non-transparent and contrary to good governance, as there is no provision for public feedback prior to the EIA approval.

The quality of the EIAs has also been questioned in relation to the accuracy and rigour of both assessment and mitigation measures. In one case in Sarawak, an EIA found no permanent inhabitation by indigenous people in a proposed 156 000 hectare forestry and oil-palm development. Other investigators had, however, previously documented at least five indigenous settlements in the vicinity, whose existence could be verified by official records of the local region and previous EIAs, as well as anthropological studies dating back to 1955 (Mohamed Idris, 2007).

The key problem with regard to enforcement in Malaysia relates to lack of independent, transparent and accountable institutions. This in turn generates systemic corruption. There have been several influential reports that highlight these problems and indicate the continued deterioration of governance (e.g. Tenaganita, 2007a; Tenaganita, 2007b; Human Rights Commission of Malaysia, 2008; Suara Rakyat Malaysia, 2002; Human Rights Watch, 2007; *Mongabay.com*, 2008b).

Transparency International (TI) notes that Malaysia's ranking in the Corruption Perception Index fell from a high of 33 in 2002 to 44 in 2006, and increased only marginally in 2007 to 43.[56] Several other reports such as the Asia Pacific Development Report 2007 and the International Country Risk Guide suggest that corruption is worsening in Malaysia. Recent high-profile exposures in Malaysia on alleged links between high political offices, business and institutions responsible for implementing and enforcing regulations demonstrate the seriousness of the problem.

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55 Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 under the Federal Environmental Quality Act.

56 The TI Corruption Perception Index score relates to perceptions of the degree of corruption as seen by business people and country analysts. Countries ranked first have the lowest-perceived level of corruption.

Other challenges for enforcement of environmental and social laws in Malaysia include difficulties in intergovernmental coordination, poor infrastructure (particularly in East Malaysia) and limited resources for policing wide expanses of forest and coastline.

6.2.2 Deforestation and land-use change

The potential for conversion of Malaysia's rainforests to palm oil plantations as a result of biofuel policies has generated understandable concern among policy makers and the public. Such an outcome would undermine the environmental credentials of biofuels as well as cause ecological damage, with consequential economic and social effects. While the impacts of converting forest to oil-palm have received considerable attention in recent years, the incremental role that biofuel production has played in deforestation is less well understood.

The conversion of natural ecosystems due to biofuel production is not limited to the establishment of new feedstock farms or plantations. Because of the relationship between food and feedstocks, higher commodity prices due to global biofuel production (see Section 6.1.1) can cause increased clearing for non-feedstock commodities. Elevated prices send a strong market signal to increase production, leading to increased agricultural intensity or the bringing of new areas into production (with consequential conversion of forest or other land).

Another way to consider this chain reaction is in terms of displacement effects. Arable land around the world that once produced food is now being used to grow biofuel crops. Assuming that people will continue to consume the same amount of food, new land is needed for food crop production. This leads to increased land use intensity (e.g. cropping of fallow land or pasture) or conversion of natural ecosystems to farms or plantations (Searchinger S*et al*., 2008).

A recent report commissioned by the United Kingdom Government found that displacement of existing agricultural production as a result of biofuel demand is accelerating land-use change and, if left unchecked, will reduce biodiversity and may even cause increases rather than reductions in GHG emissions (Gallagher *et al.,* 2008). The 2007–08 *Human Development Report* of the United Nations Development Program (UNDP) concluded that EU demand for biofuels is coming at a high social and environmental cost in Asia.

Malaysia's total landmass is approximately 33 million hectares, 64 per cent (21 million) of which is under forest (MPOC, 2007). The extent of Malaysia's primary forests ("virgin" forest that has never been logged) has remained unchanged at 3.8 million hectares since 1990, but the rate of loss of the country's secondary (previously logged) forests increased from 0.3 per cent per year during the period 1990–2000 to 0.8 per cent per year from 2000 to 2005 (Koh and Wilcove, 2007). These forests are among the most biologically diverse in the world (Box 6.1) and secondary forests have been found to support up to 80 per cent of the species found in primary forest (Koh and Wilcove, 2008).

Box 6.1 Malaysia's forests and biodiversity

Over 15 000 flowering plant species (nine per cent of the world's total) and 185 000 animal species (16 per cent of the world's total) are found in Malaysia (Malaysian Ministry of Information, 2008). A total of 286 species of mammals, 736 species of birds, 406 species of amphibians and reptiles and more than 100 000 species of insects have been recorded in the country. Parts of Malaysia and Indonesia are located within biodiversity hotspots that contain high concentrations of endemic species. For example, 89 species (44.5 per cent) of amphibians in Malaysia and 17 500 species (60 per cent) of vascular plants in Indonesia do not occur anywhere else in the world

Lowland tropical forests (the land type most commonly converted to palm plantations) support the highest biodiversity of any terrestrial ecosystem, with those of equatorial Southeast Asia among the richest. The loss of forest cover has had an impact on biodiversity and threatened rare species, including rhinoceros, Sumatran tiger, honey bear, gibbons, tapir and orangutans. One quarter (47 species) of Malaysia's amphibians are listed as threatened on the IUCN Red List. Because almost all these species are unique to the region, their loss would mean global extinction.

Source: Koh and Wilcove, 2007; Ministry of Information, 2008; Nelleman, 2007.

Oil-palm plantations are generally located in previously logged areas, or converted from rubber, coconut or cocoa plantations (Table 6.2). "Previously logged" land may include land that has re-grown into mature natural forest, once again species-rich and providing valuable ecosystem services such as water catchment and carbon storage. An analysis of FAO data found that, during the period 1990 to 2005, more than half of oil-palm expansion in Malaysia occurred at the expense of forests (Koh and Wilcove, 2008). While secondary forests can support up to 80 per cent of the species found in virgin forest, oil-palm plantations can support no more than 20 per cent of the species of mammals, reptiles and birds found in primary forest (Wakker, 2005).

Table 6.2 Summary of conversion of tree crops and logged-over forests into oil-palm (million hectares)

Period	Oil-palm—beginning	Rubber	Cocoa	Coconut	Logged over forest	Converted to oil-palm	Oil-palm—ending
1990–1994	2.029	0.099	0.122	0.023	0.139	0.383	2.412
1994–2000	2.412	0.307	0.195	0.132	0.331	0.965	3.377
2000–2004	3.377	0.149	0.031	0.013	0.304	0.497	3.874
Total	**-**	**0.555**	**0.348**	**0.168**	**0.774**	**1.845**	**-**

Source: Chai (2007)

Palm oil plantations have been expanding faster than the Malaysian Government had planned. The National Agricultural Plan III (NAP III) projected that industrial crops[57] would expand from 4.4 million hectares in 1995 to 5.0 million hectares in 2010. The target for oil-palm was 3.6 million hectares by 2010 (Table 6.3). This target was surpassed

57 Industrial crops in the NAP III are palm oil, rubber, cocoa and saw logs.

in 2006, when oil-palm plantations reached 4.17 million hectares, well over the 2010 target. The planted area under oil-palm in 2007 was 4.23 million hectares.

Table 6.3 Areas under industrial crops (million hectares)

Year	Palm oil	Rubber	Cocoa	Total
1995	2.540	1.690	0.190	4.420
2010 (NAP III projection)	3.600	1.200	*	5.000
2006 (actual)	4.170	1.212	0.032	5.414

*NAP III did not provide any projection for cocoa plantation area.

Source: NAP III & MPOC

Malaysia's Prime Minister, Datuk Seri Abdullah Ahmad Badawi, said in June 2008 that no new forested areas would be cleared for oil-palms. This was because more effective plantation management and technological development could increase production by 30 per cent, negating the need for further palm plantation development (*New Straits Times Online*, 2008a). The Minister for Plantation Industries and Commodities, Datuk Chin Fah Kui, appeared to qualify the statement by saying that no *permanent forest reserves* would be cleared, but land already zoned for agriculture could still be converted for cultivation of palm oil. This implies that large land banks of forest that were earmarked for agricultural purposes can still be cleared of forest for the purposes of expanding palm plantations (*Mongabay.com*, 2008a).

The Chief Minister of Sarawak, Tan Sri Abdul Taib Mahmud, is reported to have said that the Prime Minister's directive did not apply to Sarawak and that the state would continue to open up forest land for oil-palm plantations. This would include land allocated to agriculture since the 1950s and would *not* include permanent forest reserves (*New Straits Times Online*, 2008b).

6.2.3 Greenhouse gas emissions

Comprehensive assessment of GHG emissions resulting from the production of biofuels requires analysis of all direct and indirect effects of producing the feedstock, as well as the burning of the fuel. It is commonly thought that the CO_2 sequestered during growth of the feedstock is equivalent to the CO_2 emitted when burning the fuel, leading to a "carbon neutral" net balance. However, production of the feedstock and conversion into a biofuel also requires energy (such as fuel for tractors and for powering the biofuel refinery) as well as chemical inputs (such as fertilizers and reagents). When taking these factors into account, Beer *et al.* (2007) found that palm biodiesel resulted in a saving in GHG emissions of 80 per cent when compared with fossil diesel fuel.

These calculations were based on the assumption that the palm oil was sourced from a plantation that had been established before 1990, and therefore no emissions associated with land clearing could be attributed to the biodiesel. When emissions associated with forest conversion were taken into account for palm biodiesel, the GHG emissions for palm oil sourced from cleared rainforest were found to be 8 to 21 times higher than those of fossil diesel (where the effects of clearing were annualized over 50 years) (Beer *et al.,* 2007).

If the GHG emissions from forest conversion are considered as a one-off "debt" that can be repaid over time (given the emissions profile of biodiesel compared with fossil diesel), then converting tropical rainforest in Malaysia to palm biodiesel would result in a "carbon debt" that would take around 86 years to repay (Farigone *et al.,* 2008). Up until that time, burning fossil diesel would have caused less total GHG emissions. Converting peatland forest (with a peat depth of less than three metres) to palm production would result in significantly higher GHG emissions, due to the effects of draining and subsequent oxidation of the peat. The biofuel carbon debt under this scenario was estimated to require approximately 420 years to repay. If the peat layer was thicker (three metres or more), it would emit carbon for around 120 years, resulting in a biofuel carbon debt that would take 840 years to repay (Farigone *et al.,* 2008). Burning of the peat would accelerate the release of carbon emissions (Beer *et al.*, 2007; Hooijer *et al.*, 2006).

An estimated 27 per cent of new concessions for palm oil plantations in Malaysia and Indonesia are on peatland rainforests (Farigone *et al.,* 2008). Deforestation data for Sarawak showed that around 50 per cent of forest land cleared from 1999 to June 2006 was located on peatlands, many of which were converted to palm plantations (Hooijer *et al.*, 2006).

Oxfam (2008) estimated that, by 2020, emissions associated with Indonesian and Malaysian palm oil production stimulated by EU biofuel policies (both for biodiesel use and replacing diverted domestic edible oils) would total around 4.6 billion tonnes of CO_2. The main impacts are associated with forest clearance and peatland conversion in Indonesia (given that scope to expand oil-palm plantations is limited in Malaysia, and many Malaysian firms are now active in Indonesia). This level of total emissions is 68 times the savings the EU hopes to generate by 2020 from using biofuels.

In response to demands from civil society and also from within the EU, such as the Cramer Report,[58] the government of Malaysia is undertaking its own research to identify the GHG emissions from oil-palm production and processing, and conducting its own life-cycle analyses. It is also currently studying the GHG emissions from biodiesel plants.

Box 6.2 Palm oil and forest fires

The cheapest and most efficient means for clearing land of vegetation prior to establishing an oil-palm plantation is through burning. However, the technique pollutes the atmosphere.

The Malaysian Government banned clearing of vegetation by burning in 1997 and strict law enforcement coupled with heavy penalties has led to high compliance (Wakker, 2005). "Zero-burning" techniques, while more expensive than burning, have been widely adopted in Malaysia, but open burning is still observed from time to time (Eric Wakker, personal communication). The problem has been more intractable in Indonesia, where many Malaysian firms are also operating. The Association of South East Asian Nations (ASEAN) developed an Agreement on Trans-boundary Haze Pollution, signed in 2002, to bring haze pollution under control in Southeast Asia. The serious regional health impacts of haze have caused Malaysia, Singapore and Thailand in particular to place pressure on Indonesia to control its forest fires (many of which are directly related to planting oil-palm).

Source: ASEAN Secretariat (2008); Wakker (2005)

[58] Project Group Sustainable Production of Biomass (2006): C*riteria for sustainable biomass production.* The Netherlands. See Chapter 6 for further discussion.

6.2.4 Pollution associated with processing

Biofuel refineries can pollute air, water and drinking water, as well as produce construction wastes. For example, biodiesel and ethanol fuel production in Iowa over the past six years led to 394 instances in which the plants fouled the air, water or land, or violated regulations intended to protect health or the environment (*The Bioenergy Blog*, 3 June 2007). Most incidents involved biodiesel refineries failing to meet sewage pollution limits or safeguards to prevent wastes from spilling into waterways. Refineries also exceeded limits for hazardous air pollutants and illegally burnt or dumped waste. One biodiesel plant was cited for a fish kill caused by the improper spreading of liquid wastes.

Oil-palm plantations can cause air pollution (by forest and peat fires), heavy sediment loads in rivers and streams (as a consequence of land clearing), agro-chemical loads in the environment, and palm oil mill effluent discharge. The mill effluent is a mixture of water and waste palm oil biomass (Wakker, 2005).

The Malaysian government has promoted best practices to reduce pollution related to oil-palm. These include the terracing of slopes to reduce long-term erosion and leaving slopes greater than 25 degrees to native vegetation; the recycling of mill effluent as an organic fertilizer; the improvement of effluent treatment techniques; zero-burning practices for replanting; and integrated pest management (introduction of owls to reduce rodents, rather than the use of poison) (American Palm Oil Council, 2008).

6.3 *Jatropha curcas* and conversion of "marginal land"

Non-food biofuel crops, such as *Jatropha curcas* ("jatropha"), may not necessarily resolve the conflict between biofuels, food production and the environment.

Jatropha is widely believed to be capable of growing on poor, degraded lands that would not otherwise have the capacity to produce food crops or support healthy natural ecosystems. However, studies have shown that jatropha nut yields from low-grade, un-irrigated lands can be poor. [59] Like other crops, jatropha's yield is a function of factors such as water, nutrients, heat and plant age. Seed production ranges from about two tonnes per hectare per year (un-irrigated) to over 12.5 tonnes per hectare per year, after five years of growth. Hence jatropha may yet compete with food crops for arable land, water or fertilizers, if it is to be profitable.

The long-term sustainability implications of large-scale jatropha plantations are not yet well understood, due to its recent emergence as a bioenergy crop. Achten *et al.* (2007) found in a qualitative study, which focused on environmental impacts and some socio-economic issues, that jatropha plantations could have overall favourable benefits for sustainable development, subject to the proviso that only wastelands or degraded lands were used. Conversion of natural forest would have severe net negative environmental implications, including for GHG emissions. Depending on local circumstances there could also be impacts on soil, water and biodiversity.

59 http://www.jatrophabiodiesel.org/jatrophaPlantation.php

Jatropha used for wasteland reclamation and biodiesel production could be useful drivers of rural development. Local circumstances would need to be considered carefully in each case to ensure such developments are appropriate.

6.4 Sustainability standards and certification

Most negative social and environmental impacts from existing biofuel facilities and oil-palm plantations could be avoided through good management practices. As a high-yielding and profitable crop, palm oil is both an important source of food and a driver of rural development. One hectare of oil-palm yields as much oil as eight hectares of soybeans or three hectares of oilseed rape. Among major crops, only sugar cane comes close to oil- palm in calorific energy per unit land area (*International Herald Tribune*, 19 January 2008). The use of palm biodiesel rather than petroleum diesel can result in lower GHG emissions, so long as no land-use changes are caused by its production or consumption (Beer *et al.,* 2007).

Certification schemes are being developed to enable consumers to choose palm oil derived from sustainable sources. The leading scheme is administered by the Roundtable on Sustainable Palm Oil (RSPO). This was established in 2004 to bring producers together with conservation organizations, civil society groups, governments and other stakeholders in order to promote the production, procurement and use of sustainable palm oil. The RSPO aims to provide a platform where stakeholders can discuss and develop a definition of sustainable palm oil. It has developed a set of voluntary principles and criteria, leading to a voluntary certification scheme.[60] In July 2007, the RSPO released its first draft guidelines for producers. A list of accredited certification bodies are due to be announced. The fifth meeting of the RSPO in November 2007 agreed on a procedure for tracing palm oil from producer through to the final product.

Enthusiasm for the scheme is not universal, however. Greenpeace, for example, alleged in 2007 that "the RSPO and its members have taken few meaningful steps to end the devastation and injustice linked to the [palm oil] industry and its expansion."

Compulsory certification schemes are under development in Europe, which aim to ensure that biofuels and their feedstocks are produced sustainably. Switzerland passed legislation in 2007 that requires all biofuels to demonstrate sustainability by 1 July 2008 in order to qualify for tax advantages. Most challenging for biofuel exporters are the implications raised by the Cramer Report.[61] Several EU countries have proposed guidelines to ensure that biofuels are sourced from "Sustainable Producers", and some Member States specify stringent social obligations. The EU Commission's current legislative outlook is essentially that:

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[60] www.rspo.org

[61] The project report 'Criteria for sustainable biomass production,' produced in 2006 in the Netherlands, is popularly known as the Cramer Report, named after the chair of the project group (and, subsequently, Minister for the Environment and Spatial Planning), Professor Jacqueline Cramer. The project group consisted of representatives from government, private business and non-governmental organizations as well as academics. It discussed the risks associated with large-scale biomass production and established criteria for the sustainable production of biomass. The Cramer Report has been influential in developing standards for EU policies on biomass sustainability. It has been criticized for not consulting producers of biomass in developing countries, and for the use of environment standards to discriminate amongst like products.

> Biofuels used to fulfil the requirements of the legislation should not emit more greenhouse gases in production than they save by avoiding the use of petrol or diesel—or (to give a safety margin) should achieve at least a given amount of greenhouse gas savings (for example 10%). (Cramer, NL Carbon Intensity Tool)

The European Commission has drafted a scheme that would fulfil the sustainability criteria as well as promote reduction of GHGs. The EU Commission laid out three criteria:

a. Achieving a minimum level of GHG savings;

b. Avoiding major reduction in carbon stocks through land use change; and

c. Avoiding major biodiversity loss from land-use change.

The Commission claims its scheme will ensure that biomass, failing to meet one of the criteria, will neither count towards meeting Member States' obligations nor be eligible for any incentives (e.g. fuel-tax deductions or other financial support). The Member States would be responsible for ensuring the criteria are respected, and legislation would be put in place to define the requisite procedural requirements (e.g. reporting, verification and monitoring).

At this stage, the proposed EU and Swiss certification schemes do not take into consideration the indirect, or displacement, effects of diverting plant oils to biofuel production. Certification of palm biodiesel is potentially meaningless if palm oil imported for food or other industrial purposes does not need to be certified. For example, certified EU-sourced rapeseed oil might be diverted from food purposes to make certified biodiesel, only to be replaced in the edible oils market by uncertified palm oil that has been grown unsustainably on former tropical forest.

A recent report commissioned by the United Kingdom government concluded that biofuel feedstock production should avoid agricultural land that would otherwise be used for food production:

> During the period to 2011–12, comprehensive, mandatory sustainability criteria within the EU Renewable Energy Directive should be implemented for biofuels and bio-energy, including requiring feedstock that avoids indirect land-use change. (Gallagher *et al.,* 2008)

The report recommended that biofuel use should be slowed until controls are put in place that demonstrably address displacement effects. Such controls are likely to be difficult to define, let alone meet.

Although these initiatives could be considered non-trade barriers, it is clear that environmental issues are high on the agenda of foreign importers of Malaysian biodiesel. To maintain these markets, the Malaysian government and producers will need to meet environmental and social criteria. Other major markets, such as China and India, may be less discerning on environmental or social grounds. The net result is likely to be that developed-country markets will be furnished with "sustainably produced" biofuels and palm oil while other markets will take the less-sustainably produced products. Hence demand from the EU and other OECD countries could simply displace unsustainable practices to other markets.

Even if all palm oil produced in Malaysia were certified, uncertified production could expand into Indonesian Borneo, where Malaysian companies currently hold around 30 per cent of oil-palm investments. Hence the net effect of OECD biodiesel subsidies is likely to be an increase in demand for vegetable oils, leading to an expansion of oil-palm—certified and uncertified—with consequential environmental and social impacts.

6.5 Sustainability summary

In a few short years, Malaysia has seen its vision of sustainable development through biofuel production turn into a mirage. The very striving of governments worldwide to encourage the production and use of biofuels has undermined the economic viability of the industry, by pushing up feedstock prices beyond the reach of any but the wealthiest nations that can afford to maintain subsidies. Hoped-for jobs have not materialized and, instead many biofuel facilities have suspended operations, stranding public and private investments, and plans for new facilities have been put on hold. High commodity prices have delivered benefits to a select few but these have been more than offset economy-wide by rising food prices, which have hit the poor the hardest.

The presumed environmental benefits of biodiesel—most notably in terms of reducing GHG emissions—have evaporated with improved understanding of the full lifecycle impacts of biofuel production. While current *domestic* production of biodiesel in Malaysia is unlikely to be driving deforestation, the growing demand for CPO—largely due to global biodiesel production—has contributed to a plantation expansion boom in both Malaysian Borneo, with associated deforestation and social conflicts. The Sarawak and Sabah state governments have a great deal of autonomy and it appears that, in some areas at least, environmental impact assessments are not being performed rigorously. Many Malaysian firms are also operating in the Indonesian provinces of Kalimantan and Riau, which have high rates of conversion of forest to oil-palm, and less rigorous governance structures.

These fundamental elements of biodiesel production are unlikely to change in the near term. In the meantime, measures to address sustainability issues will become increasingly important in order to supply environmentally-conscious markets. Such measures might improve the environmental credential of palm oil destined for the EU market, but are likely to do little to avoid displacement effects and consequent deforestation.

7 Conclusions and Recommendations

Rising palm oil prices since 2006 put a firm break on the implementation of Malaysia's biofuel policies. While 92 licenses for new plants were issued in 2006 and 2007, there were only 14 completed facilities in Malaysia in September 2008, six of which had suspended operations. Those plants operating in 2008 were functioning well below capacity. A further four had closed permanently. Eight were under construction but plans for many more new plants have been cancelled. Inactive licenses could be revoked under the Biofuel Industries Act.

A B5 mandate was originally planned for implementation in January 2008, which would have generated an additional 500 000 tonnes per year in biodiesel consumption (five per cent of Malaysia's 10 million tonnes of annual diesel use) but the blending requirement has—so far—not been implemented. The government's intention to allocate 6 million tonnes of crude palm oil (CPO) to biofuel has also been overtaken by events, with less than one tenth of this amount currently converted to biodiesel.

Hopes that domestically produced biodiesel could reduce the burden of subsidizing petroleum fuels quickly faded as palm oil prices rose rapidly in 2006, making biodiesel more expensive to procure than fossil-diesel, even though the price of petroleum was also rising over the same period. In June 2008, the government raised gasoline prices by 40 per cent to RM 2.70 (US$ 0.83) per litre and diesel prices by 63 per cent to RM 2.58 (US$0.79) per litre. Electricity prices were also restructured and subsidy savings from the transport fuel and electricity sectors were expected to save the government RM 13.7 billion (US$ 4.22 billion) in 2008. Prime Minister Abdullah Ahmad Badawi pledged that the savings would be channelled towards increasing food security, including subsidizing imported commodities and food products.

At the D8 Summit in July 2008, Mr Abdullah Ahmad Badawi joined with other leaders (including the Indonesian Prime Minister Susilo Bambang Yudhoyono) in calling for developed counties to stop allowing the use of arable land for biofuel production, which they said was contributing to global food scarcity (*Financial Times,* 8 July 2008). However, neither Mr Abdullah nor other leaders committed to removing their own biofuel support policies, which rely on food crops for feedstocks.

Instead, the Malaysian government still appears to be keeping its options open regarding support for a domestic biofuel industry. Sabri Ahmad, chairman of the Malaysian Palm Oil Board, told a biofuels summit in January 2008 that Malaysia was considering the gradual introduction of a two per cent blend in 2008 (*Energy Current*, 16 January 2008). In August 2008, Plantation Industries and Commodities Minister, Peter Chin, said that use of Envodiesel (palm oil directly blended with petroleum diesel) could be initiated if the CPO price remained below RM 3 000 per tonne (*Bernama*, 19 August 2008). He indicated that the aim would be to use around 500 000 tonnes of CPO from growing stockpiles in order to boost prices (equivalent to a B5 mandate). As of September 2008, however no mandatory biofuel blending had been put in place.

To date, the Malaysian government has been pragmatic in its support for the biofuels industry. The Malaysian biodiesel industry receives minimal support compared with the assistance provided to producers in some OECD countries (Steenblik, 2007). Support has been confined to soft loans totalling RM 60 million (US$ 17 million), technology transfers to kick-start the industry, assistance for pilot plants of RM 12 million (US$ 3.8 million), as well as an undisclosed amount of tax incentives to motivate firms to invest in the industry.

Nevertheless, the situation could change quickly in the future. The government's intention to introduce a five per cent mandatory blending requirement would constitute significant price support for the industry. At petroleum oil and CPO prices of US$ 115 per barrel and RM 3 000 per tonne, respectively, the cost of production of petroleum diesel is estimated to be around RM 2.78 per litre, while biodiesel is RM 3.45 per litre. The higher cost of biodiesel (RM 0.67 per litre) would need to be borne by the government (through subsidies) or consumers (through higher fuel prices).

Should the mandated level come into force, it would impose a cost of approximately RM 395 million (US$ 122 million) more in fuel subsidies per year than supplying the same quantity of petroleum diesel.[62] This would be in addition to direct subsidies and forgone tax revenue applied to retail diesel, which are assumed to apply equally to both biodiesel and petroleum diesel. Legislating a B5 mandate would also lock the government into purchasing around 500 000 tonnes of biodiesel per year, regardless of its price or that of crude petroleum oil. The outcome could be very expensive. For example, if the price of crude petroleum oil were to fall to US$ 75 per barrel and the price of CPO rose to RM 5 000 per tonne (only RM 500 higher than prices in March 2008), the subsidy cost of a B5 mandate would be around RM 2 200 billion (US$ 675 million).

Biodiesel would be competitive without subsidies when CPO prices are below RM 3 000 per tonne and crude petroleum oil prices above US$ 140 per barrel (or if a similar divergence existed between the two commodities). However, such a divergence in the prices is unlikely to be sustained for long, given that vegetable oil prices now appear to be following petroleum oil prices.

If all current plants and those under construction in Malaysia started operating at full capacity, they would produce over 2.7 million tonnes per year, using over 3 million tonnes of palm oil in the process. This is equivalent to around 18 per cent of Malaysia's entire annual palm oil production. An increase in demand of this magnitude would likely push up palm oil prices, potentially to levels beyond the reach of biodiesel producers.

Most of Malaysia's current biodiesel production is destined for the export market, mainly the EU and U.S., and subsidies in these countries will therefore improve profitability of Malaysian biodiesel imports. In fact, exports could be "double dipping" into both EU and U.S. subsidies, if accessing a loophole that allows U.S. biofuel blenders to claim the US$ 1 per gallon (US$ 0.26 per litre) subsidies for blending imported biodiesel and re-exporting it, generally to the EU ("splash and dash"). Pressure from EU biodiesel producers to remove this loophole could prevent Malaysian (and other) biodiesel producers from accessing these double-subsidies. In the longer-term, EU sustainability standards could limit access to all but certified biofuels and feedstocks.

The profitability of Malaysian biodiesel production is therefore precarious, depending on volatile palm oil and petroleum prices, and decisions of policymakers both in Malaysian and oversees.

This report recommends that the government should refrain from intervening in the market for biofuels through mechanisms such as direct price support or mandatory blending. The biofuel industry should be allowed to function purely in response to

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62 This assumes a CPO price of RM 3 000 per ton and crude petroleum oil of US$ 115 per barrel.

market signals (consistent with environmental and social standards) so that the industry establishes itself on a sustainable, and not a government-dependent basis.

The government's current plan to move domestic retail fuel prices towards the world price is commendable, particularly as steps are also being envisaged to ensure that adequate safeguards are provided for the poor. The government has correctly surmised that biodiesel can only, at most, complement other energy sources. It cannot significantly augment the nation's energy supplies. Rather than promote biodiesel to address fuel demand in the transportation sector, efforts should be directed towards improving the overall energy efficiency at the national level including improving the public transportation system and infrastructure.

Annex I

Table I. 1 Legislation relevant to protection of the environment

Federal	Description
Environmental Quality Act 1974	Act relating to the prevention, abatement, control of pollution and enhancement of the environment.
Pesticides Act 1974	Act to control pesticides (through the control of importation and manufacture of pesticides, manufacture, sale and storage of pesticides, presence of pesticides in food, death and injury caused by pesticides and the enforcement.
Fisheries Act 1985	Governs conservation, management and development of maritime, river and estuarine fisheries.
Peninsular Malaysia	
Waters Enactment 1920	Provides guidelines to all states in Malaysia regarding control of rivers.
Taman Negara (Kelantan) Enactment 1938	Empowers the Department of Wildlife and National Parks (DWNP) to manage Taman Negara, which straddles three states.
Taman Negara (Pahang) Enactment 1939	Empowers the DWNP to manage Taman Negara, which straddles three states.
Taman Negara (Terengganu) Enactment 1939	Empowers the DWNP to manage Taman Negara, which straddles three states.
Aboriginal Peoples Act 1954	An Act to provide for the protection, well being and advancement of the aboriginal peoples of Peninsular Malaysia.
Land Conservation Act 1960	An Act to consolidate the law relating to the conservation of hill land and protection of the soil from erosion.
National Land Code 1965	An Act to amend and consolidate the laws relating to land and land tenure, the registration of title to land and of dealings therewith and the collection of revenue from the states in Peninsular Malaysia.
Protection of Wildlife Act 1972	Act to consolidate the laws relating to, and to further provide for protection of, wildlife.
National Parks Act 1980	Act that governs the creation and maintenance of national parks in Peninsular Malaysia.
National Forestry Act 1984	Act defining a general framework for the management of forestry in Peninsular Malaysia. It can only come into force on adoption by the state legislature as forestry is a state matter.
Sabah	
Fauna Conservation Ordinance 1963	An Ordinance to consolidate and amend the law for the protection and conservation of certain species of wild animals and birds and for purposes connected therewith and incidental thereto.
Forest Enactment 1968	An Enactment to repeal and re-enact the law relating to the provisions and control of national parks and national reserves in Sabah and to provide for matters incidental thereto and connected therewith so as to make better provisions respecting the constitution, administration, procedure, functions and finance of Parks.
Parks Enactment 1984	An Enactment to repeal and re-enact the law relating to the provisions and control of national parks and national reserves in Sabah and to provide for matters incidental thereto and connected therewith so as to make better provisions respecting the constitution, administration, procedure, functions and finance of Parks.

Sarawak	
Natural Resources Ordinance 1949	An Ordinance which allows the State to exercise control over and to regulate environmental protection in regards to the utiliszation, management and protection of natural resources. This Ordinance has since been reconstituted as the Natural Resources and Environment (Amendment) Ordinance, 1993 and 1997.
National Parks Ordinance 1956	An Ordinance established to provide for the constitution, maintenance and control of national parks.
Wildlife Protection Ordinance 1958	An Ordinance to provide better provisions for the protection of wildlife, the establishment and management of wildlife sanctuaries and all matters relating to them.
Forest Ordinance 1958	An Ordinance to provide for the protection and management of the forests of Sarawak, and to regulate the taking of forest products.
Public Parks and Greens Ordinance 1993	An Ordinance enacted to make provisions for the control and management of any land declared to be a special area to enhance the environment of that area and to provide for the regulation of proper planning in the State for preservation and protection of such areas.
Water Ordinance 1994	An Ordinance giving the State Water Authority general control and supervision of all water supply authorities and the management of all water resources and water catchment areas in the state.

Source: Food and Agriculture Organisation (2006): Legal Office database—Faolex.

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The Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD)

The International Institute for Sustainable Development's Global Subsidies Initiative shines a spotlight on subsidies – transfers of public money to private interests – and the ways in which they can undermine efforts to put the world on a path toward sustainable development.

Subsidies have profound and long-lasting effects on economies, the distribution of income in society, and the environment, both at home and abroad. Subsidies have shaped the pattern and methods of agricultural production, even in countries that now provide few or no farm subsidies. They have encouraged fishing fleets to search farther and deeper than ever before, aggravating the problem of over-fishing. They have fueled unsustainable energy production and wasteful consumption patterns.

While subsidies can play a legitimate role in securing public goods that would otherwise remain beyond reach, they can also be easily subverted. Special interest lobbies and electoral ambitions can hijack public policy. When subsidies result in a fundamentally unfair trading system, and lie at the root of serious environmental degradation, the question has to be asked: Is this how taxpayers want their money spent?

The GSI starts from the premise that full transparency and public accountability for the stated aims of public expenditure must be the cornerstones of any subsidy program. In cooperation with a growing international network of research and media partners, the GSI is endeavouring to lay bare just what good or harm public subsidies are doing; to encourage public debate and awareness of the options that are available; and to help provide policy-makers with the tools they need to secure sustainable outcomes for our societies and our planet.

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