Chapter 8

Trade and Market Dynamics of Biodiesel

Benchmarking of Biodiesel Fuel Standardization in East Asia Working Group

July 2010

This chapter should be cited as
Benchmarking of Biodiesel Fuel Standardization in East Asia Working Group (2010), 'Trade and Market Dynamics of Biodiesel' in Goto, S., M. Oguma, and N. Chollacoop, *EAS-ERIA Biodiesel Fuel Trade Handbook: 2010*, Jakarta: ERIA, pp.170-183.

8. TRADE AND MARKET DYNAMICS OF BIODIESEL

8.1 Global Biodiesel Market

Over the past decade, global biodiesel market has been growing around the world [44] and the market growth is being driven mainly through three key factors:

(1) reduction of petroleum dependence;

(2) mandated biodiesel blends; and

(3) fiscal incentive.

The substantial growth of biodiesel production, also considered as biodiesel consumption, from 1999 to 2007 is shown in Figure 66.

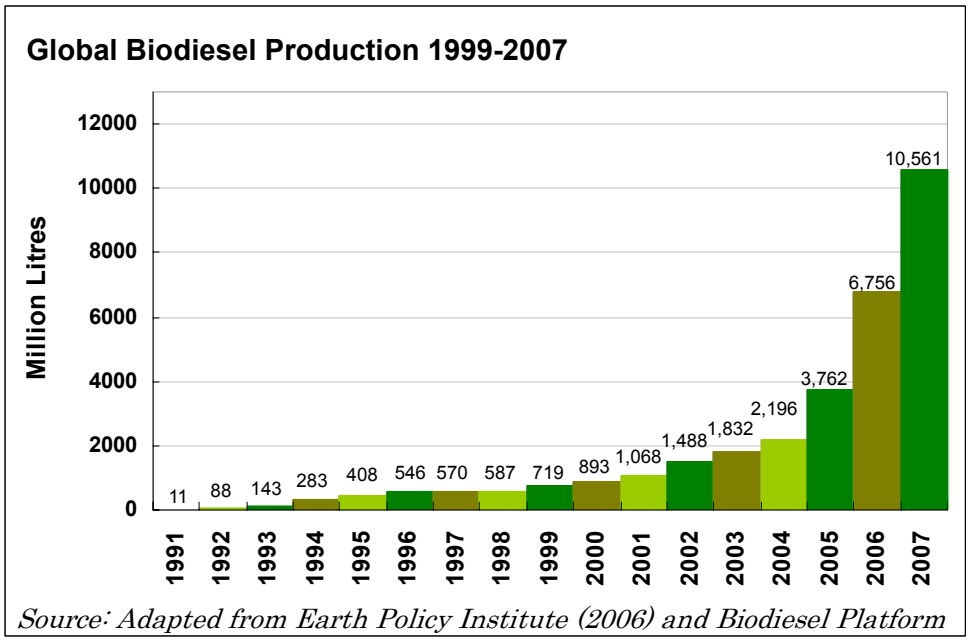


Figure 66 World Biodiesel Production

An average world growth rate from 2002-2006 is estimated to be around 40% per annum. In 2005, global biodiesel production reached around 3,762 million litres with 85% of this production in Europe, 7% in the USA and 8% in the rest of the world (predominantly Brazil and China) [45], [46]. This resulted from specific biofuel support policies as well as the fact that diesel-fuelled vehicles are more widely used in Europe, Asia and Brazil than in the USA [45]. For the year 2007, a total world biodiesel production was 10,561 million litres, with 61% processed in Europe, 16% in the USA and 23% in the rest of the world, i.e. Indonesia, Brazil, China and Malaysia. Although, Europe is currently the biggest producer and consumer of biodiesel in the world, the

United State is accelerating its biodiesel production capabilities. In addition, Brazil is expected to surpass European and the United States production by 2015 [47]. More detailed information on biodiesel production and consumption in EU, USA, Asia and Brazil is provided below.

8.1.1 The European Union (EU)

The biodiesel production capacity has increased in the EU as a result mainly from the biodiesel blending target set by the EU of 2% in 2005, 5.75% in 2010 and 8% in 2015. Based on the total diesel fuel consumption and these blending targets of biodiesel, the estimates of biodiesel consumption from 2005 to 2010 is shown in Table 51. Although the EU could achieve their first target of 2% in 2005, achieving their next target (5.75% by 2010 and 8% by 2015) will depend mainly on feedstock availability, government commitment and market economics [48]. Figure 67 shows the biodiesel production and production capacity of the EU from 2002 to 2008[49]. In 2007, the biodiesel production in the EU was over 5.7 million tonnes with an increase of 16.8% from the production in 2006. For the most of the EU countries, the production capacity is two to three times higher than the actual production and this is mainly caused by the availability of feedstocks. According to Frost & Sullivan, Europe's terrestrial biodiesel feedstock availability will not be able to meet the 5.75% EU blending target in 2010 [50].

Table 51 Biodiesel Action Plan of the EU and demand according to the plan

Estimate	2005	2010	2015
Quantity target (%)	2%	5.75%	8%
Diesel fuel consumption (million tons)	158.6	165	165
Diesel fuel consumption (million litres)	188,810	196,429	196,429
Biodiesel demand (million tons)	3.69	11	16.7
Biodiesel demand (million litres)	4,155	12,387	18,806

(Source data: Adapted from [51])

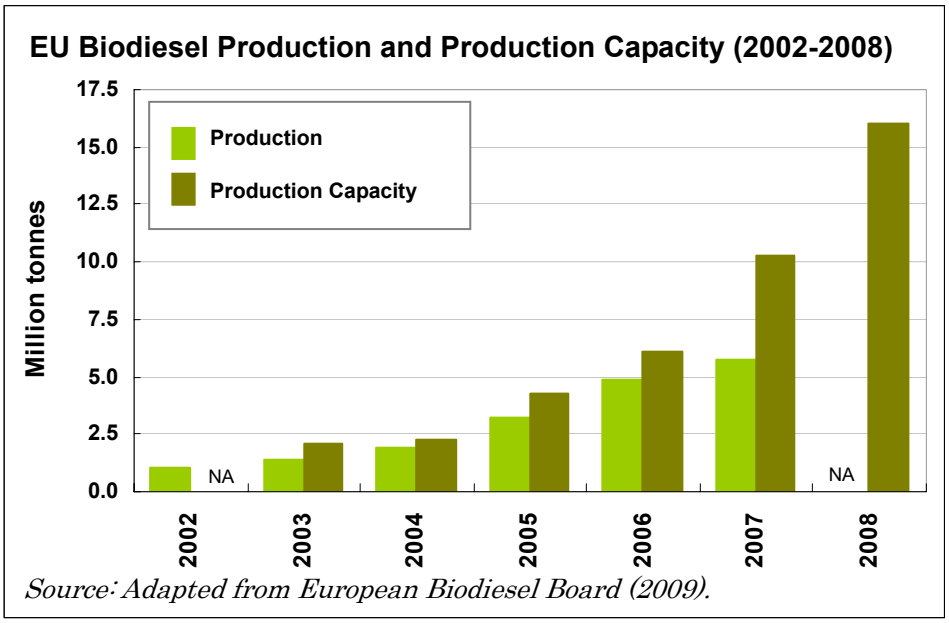


Figure 67 Biodiesel production and installed capacity of the European Unions

Figure 68 shows a breakdown of biodiesel production in the European Union for 2006 and 2007. Germany is the world's leader in producing biodiesel in terms of capacity as well as plant technologies [51]. Germany will be the first member state fulfilling the EU-promotion directive in the diesel market.

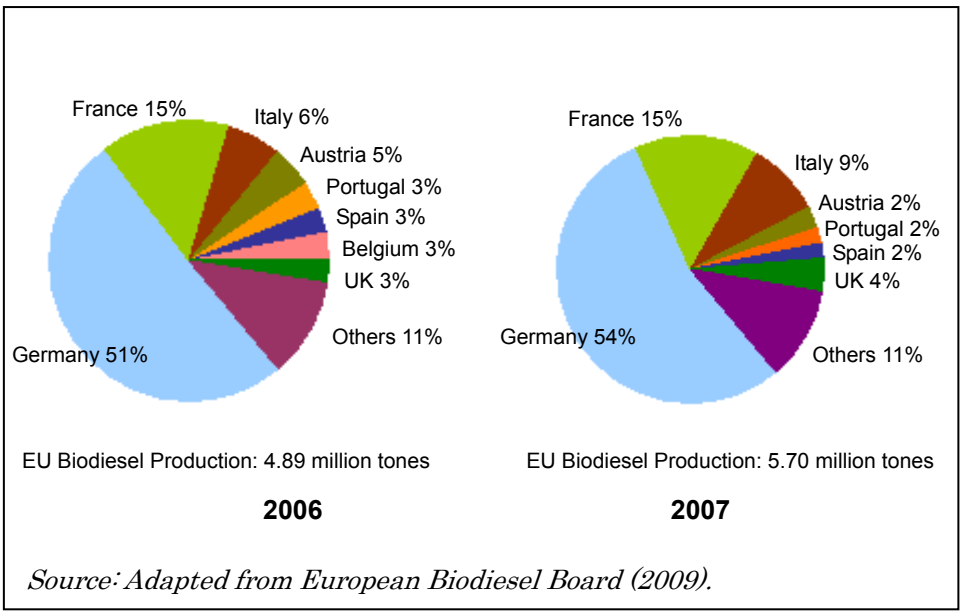


Figure 68 A breakdown of biodiesel production in the European Union

In 2008 the biodiesel capacity stood at 15.1 million tons/year, a 30% increase from the capacity of 11.6 million tons at the end of 2007, with new plants coming online in Spain, Italy and France. Despite this increase most capacity remained idle in 2008 due to lack of consumption and increase in imports [52].

In 2008 German biodiesel consumption fell by 14% to 2.8 million tons from 3.3 million tons in 2007. This was mainly a result of the sharp drop in B100 (pure biodiesel) consumption from 1.8 million tons to 1.2 million tons in 2008. The biodiesel share in low blends actually increased in 2008 compared to 2007 from 4.9 wt% in 2007 to 5.5 wt% in 2008. [53].

EU Renewable Energy Directive and amended Fuel Quality Directive - April, 2009

The recently announced Renewable energy Directive (RED) and the amended Fuel Quality Directive signal a move away from the drivers of the Biofuels Directive – agricultural support, fuel security and environmental protection – and directly targets climate change and GHG reductions. The RED calls for a 20% share of renewable energy in the EU's total energy consumption by 2020 – 10% share of energy from renewable sources in each member state's transport energy consumption. The 10% target aims ensures consistency in transport fuel specifications and availability. The directive also establishes:

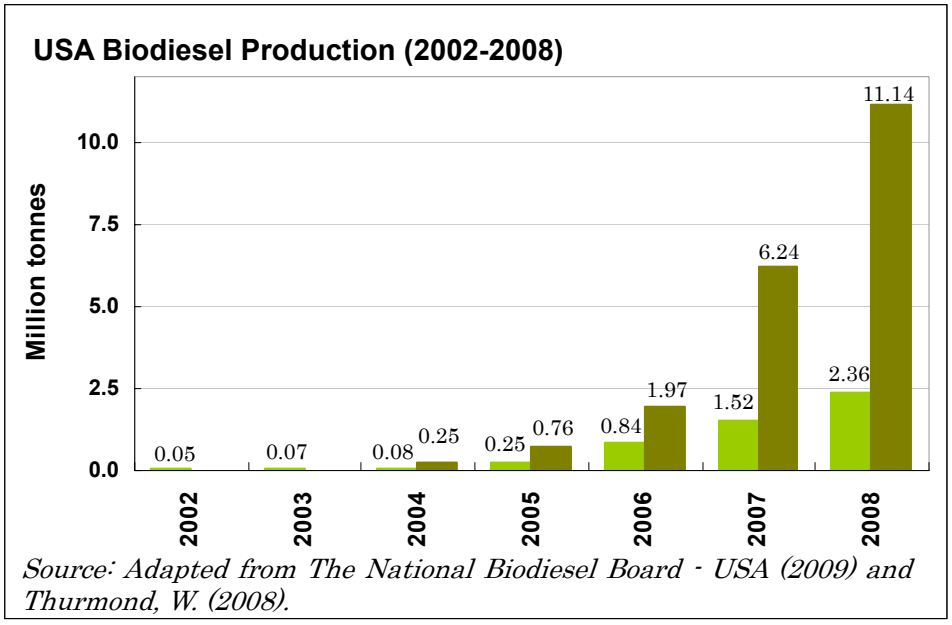
- Sustainability criteria – biodiversity, protection of rare, threatened or endangered species and ecosystems, and greenhouse gas savings;
- CO_2 standards for new passenger cars (2012); and
- New environmental quality standards for fuels and biofuels.

The standards for fuels facilitate more widespread blending of biofuels into petrol and diesel and, avoid negative consequences, sets ambitious sustainability criteria for biofuels. For the first time a GHG target for fuels will be in place requiring a 6% decrease over entire life-cycle of product by 2020. This can be reached by mixing biofuels, as well as improving production technology in refineries. The directive allows for 7 vol% FAME content in diesel or more if marked at the pump [52], [54].

8.1.2 The United States

In the USA, interest in biodiesel is stimulated by the Clean Air Act of 1990 combined with regulations requiring reduced sulphur content in diesel fuel and reduced diesel exhaust emissions. In the USA, biodiesel industry efforts are mostly concentrated in four markets and these are urban transit, government/regulated fleets, marine and underground mining. Biodiesel is used in three primary applications to address three different market segments: B100 (neat Biodiesel); B20 (20% Biodiesel/80% fossil

diesel); and B2 (2%Biodiesel). The largest market is probably within Energy Policy Act-affected fleets, which requires covered fleets to use alternative fuels. Figure 69 shows the US biodiesel production in 2002 to 2008 [55], [56]. The nascent US market for biodiesel is growing at a staggering rate from 0.25 million tonnes in 2005 to 0.84 million tonnes in 2006. The amount of biodiesel produced grew more than threefold over the course of that period. Biodiesel production was estimated to reach 1.52 million tonnes by the end of 2007 and to reach 2.36 million tonnes by the end of 2008. As of 2008, a total production capacity was around 8.81 tonnes [56]. The USA is considered as the second largest biodiesel producer and/or consumer in the world after Germany.



Source: Adapted from The National Biodiesel Board - USA (2009) and Thurmond, W. (2008).

Figure 69 Biodiesel production and installed capacity in the USA

Proposed Renewable Fuel Standard (RFS2)

In May 2009 the US Government announced the release of a Notice of Proposed Rule Making (NPRM) on the expansion of the Renewable fuel Standard (RFS2) program. The NPRM proposes regulatory requirements for increasing the RFS under the Energy Independence and Security Act of 2007, which mandates that the country's motor fuel supply use 36 billion gallons (136 billion litres) of renewable fuel per year by 2022. The 2009 renewable fuels volume requirement is 1.10 billion gallons (4 billion litres), of which 0.500 billion gallons (1.9 billion litres) is to come from biomass-based diesel fuel and 0.100 billion gallons (0.38 billion litres) from non-cellulosic advanced biofuel. Lifecycle greenhouse gas reductions relative to lifecycle emissions from

gasoline and diesel fuel (baseline fuels) have been proposed for renewable fuel, advanced biofuels, biomass-based diesel and cellulosic biofuel. 'Biomass-based diesel' - includes biodiesel, non-ester renewable diesel and any other diesel fuel made from renewable biomass as long as it is not 'co-processed' with petroleum. It must achieve a lifecycle GHG emission displacement of 50% compared to the gasoline or diesel fuel it replaces [57].

The California Air Resources Board (CARB) released a proposal for a Low Carbon Fuel Standard (LCFS) in March 2009. This policy aims to reduce California's transportation fuels by 10% by 2020, and proposes lifecycle GHG emissions targets including measurement of the carbon intensity of fuels and signals a push to advanced low carbon fuels (non-crop based).

The US EPA has proposed that atmospheric concentrations of GHGs endanger public health and welfare within the meaning of the Clean Air Act and propose that the emissions of a mix of some GHGs from new motor vehicles and new motor vehicle engines are contributing to air pollution, which is endangering public health and welfare. Comprehensive climate change legislation is being considered in Congress in late April 09 that includes a provision to require a low carbon fuels standard (LCFS) nationwide.

8.1.3 Asia

Most Asian countries are significant agricultural producers and have excess production of commodities that could be used for biodiesel production (such as palm and coconut). The largest palm oil producers in the world are located in Malaysia and Indonesia creating huge potential for biodiesel production. In addition the Philippines is the world's largest coconut producer and exporter. Furthermore, Thailand and Vietnam are agricultural-based countries that are able to grow various kinds of crops as feedstock to meet national and global biofuels demand. Countries such as Japan, Singapore and South Korea would most likely depend on biodiesel and/or feedstock imports because of a lack of sufficient land to produce domestic feedstock for biodiesel. In the Asia-Pacific region the existing total annual capacity (see Table 52) for biodiesel production is 12.5 billion litres (3.3 billion gallons) (2008) with a further 38.5 billion litres (10.2 billion gallons) per year capacity planned [58].

Table 52 Biodiesel production capacity in Asia Pacific by Country (million liters per year)

Country	Existing	Under Construction
China	3,526	3,358
Indonesia	3,488	909.09
Japan	4.72	-
Malaysia	3,120	2,205
New Zealand	33.61	95
Philippines	447.14	34.09
Singapore	986.36	-
South Korea	653.64	-
Thailand	1,770	406.82
Vietnam		11
Total :		

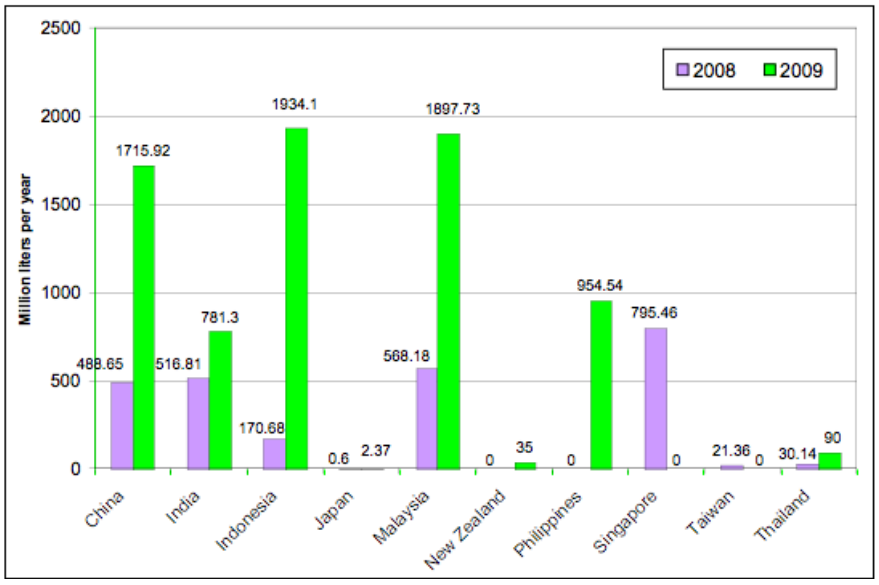
(Adapted from [58])

Million liters

Country	Present Capacity	Sale/Production		
		2007	2008	2009
Australia[a]	273			
China				
Indonesia	3,488	40	125	398
Japan	7			
Malaysia	3,120	108	207	258
New Zealand				
Philippines	396	49	65	131
Singapore	1,136			
South Korea	1,120	109	196	292
Thailand	1,770	392	460	607
Vietnam[*]		-	6	6
Total :				

[a]Department of Resources, Energy and Tourism.
[*]MINH TU company and Vietnam Institute of Industrial Chemistry (VIIC)

In 2008 the Asian biodiesel industry saw a capacity increase of 2.59 billion litres (648.2 million gallons) coming mainly from Singapore, Malaysia, India and China, with a further 7.41 billion litres (1.96 billion gallons) of new capacity expected to start operations in 2009 in several Asian countries. Figure 70 shows new and expanded biodiesel capacity in 2008 and outlook for 2009 in the Asia Pacific, which clearly shows China, Indonesia and Malaysia as the major growth areas in new biodiesel capacity in the region [58].



(Source data from [58])

Figure 70 New and Expanded Biodiesel Capacity in 2008 and Outlook for 2009 in Asia Pacific

China is one of the biggest diesel oil consumers in the world. About 60-70 million tons of diesel oil are used annually with approximately one third of it being imported to balance the market. China's government emphasized its support of biofuels sometime ago, but it seems that ethanol development is much faster than biodiesel. The potential markets are expected to grow rapidly: the vehicle ownership rate in China is 8.5 vehicles/1,000 persons and the number is projected to grow six fold by 2020 (52 vehicles/1,000 persons). Corresponding to these figures, transportation energy demand in China is projected to grow by 6.4%/year from 1999 to 2020, increasing its share of world energy use for transportation from 4.1% in 1999 to 9.1% in 2020. This indicates that China will become the world's second largest consumer of transportation fuels [59]. Although China has a target to replace from 5% to 20% of total petrodiesel consumption with biodiesel, there is no clear implementation plan of mandate of biodiesel blend. However, biodiesel production is expected to expand rapidly as China now consumes twice as much diesel as gasoline.

There is currently no national policy to use biodiesel in China. Local plants are only supplying captive fleets with biodiesel produced from waste cooking oil, which is limited in supply. Many plants have been proposed and a number of them are based on jatropha as China moves away from food-based feedstocks [58].

In countries such as Indonesia, Malaysia, Thailand and India, the aim of respective Government policy is for domestic biodiesel production to substitute diesel imports and be a support mechanism for the agricultural sector.

Mandates in the region include B1 mandates in Taiwan and Indonesia and B2 mandates in Thailand (2008), the Philippines (Feb 2009) and South Korea (2010). In Malaysia a B5 mandate was set in February 2009, for B2 use in Government agencies own depots. In June 2009 the mandate extends to industrial sectors and the to the transport sector in January 2010.

In Thailand, the production capacity is about 365 million litres (0.32 million tonnes) in 2007. The target of the Government is to mandate B2 by 2008 and to increase to 4.5 ML/D by 2022. In 2008, no new plants were known to come online in Australia, New Zealand or the Philippines. High tallow prices had a negative impact on the Australian and New Zealand markets. The repeal of the Biofuel Bill at the end of December 2006 in New Zealand has meant that biodiesel plants expected to come online in 2009 would most likely wait until financial support from the government is granted [58]. ExxonMobil announced a B5 trial in April 2009, becoming the first company to market biodiesel in the country. The biodiesel will be produced from tallow and the B5 product will be available in a trial marketing test in the Bay of Plenty.

In Australia a number of Government reviews relating to biofuels policy, including taxation treatment of fuels and broader energy policy, as well as the development of an emissions trading scheme, once completed, will have an impact on the biodiesel industry. A B2 mandate was announced by the NSW Government in December 2008 and is expected to be in place by January 2010. The current consumption of diesel transport fuel in NSW is 4,000ML p.a. and a B2 mandate would equate to 80ML of biodiesel. This is approximately equal to the current production volume nationwide. The NSW Government has indicated an increase to 5% (B5) in 2012 or as supply is available. At this stage it is planned that there will be sustainability criteria provisions linked to this mandate.

Public transportation and captive fleets are being supplied with biodiesel in India. Also, a number of producers have been exporting to the EU and the US. The industry is expected to grow in the next year, although not as rapidly as Malaysia and Indonesia, in the absence of a biodiesel blending requirements and maturity of large-scale jatropha plantations at this stage [58].

Despite high palm oil prices in early 2008 170 million liters (44.91 million gallons) of biodiesel capacity came online in Indonesia. With a subsequent drop in palm oil prices a number of producers are expected to start operating during 2009 to help meet the demand for the B1 blending requirement, which was expanded nationwide in January 2009 [58].

In the Philippines the Biofuels Act came into effect in May 2007 requiring a

minimum biodiesel blend of 1 vol% increasing to 2 vol% in February 2009.

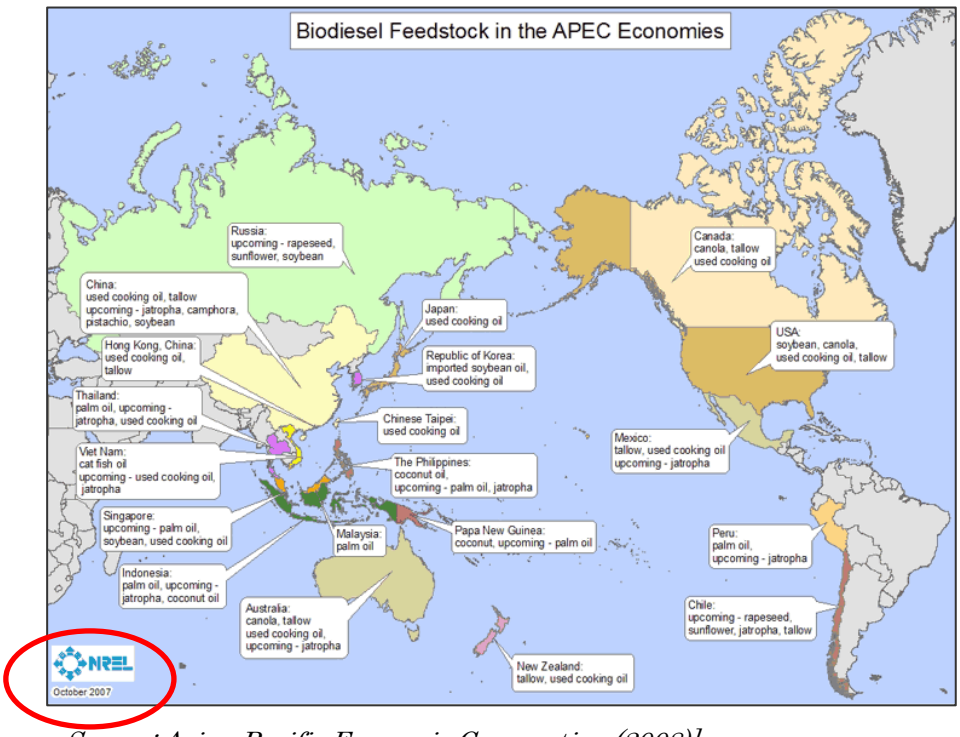
8.1.4 Brazil

Brazil has been a leader in biofuel production for many years starting with its production of ethanol after the fuel crisis in the 1970s. Brazil's biodiesel law developed in 2004 created the National Biodiesel Production and Use Program, which established a mandate of a minimum blend of 2% biodiesel blend from January to June 2008. Production capacity was estimated at five times that needed to meet the demand established by the blending mandate. Hence, in 2008, the mandatory blend was increased to 3% in order to offset the excess production capacity. Brazil has 56 biodiesel plants authorized by the government to produce biodiesel, with new projects awaiting approval. 80% of the feedstock used for biodiesel is soybean oil and 15% is animal fats. Current capacity is approximately 1.1 billion gallons (3.8 million tonnes). Production in 2007 was estimated to be 106.2 million gallons (0.36 million tonnes) while 2008 production is estimated at 290.6 million gallons (0.97 million tonnes). Unlike other countries in the region, it appears that Brazil could meet their minimum blending requirements for 2008 [60].

8.2 Biodiesel Price vs Diesel Price

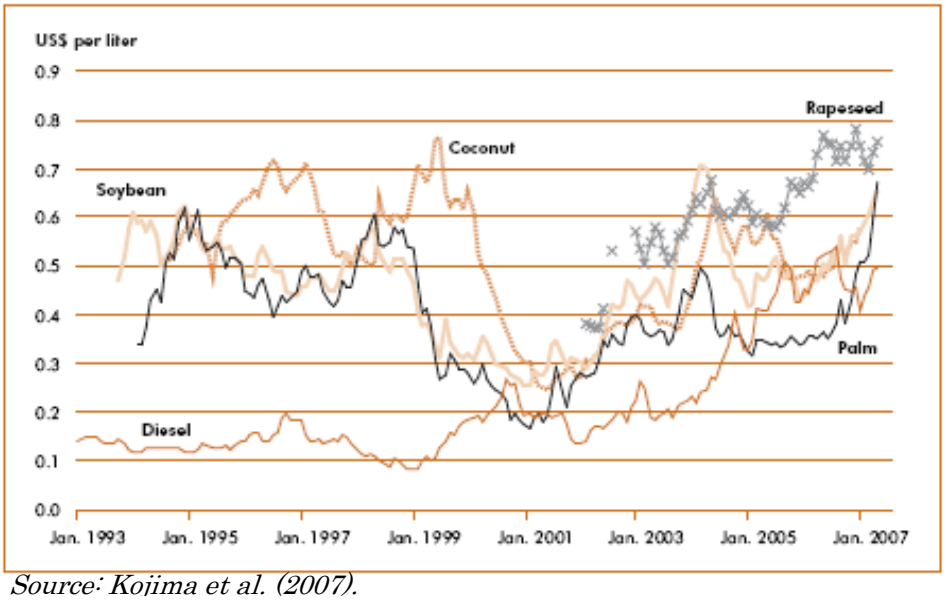
It is evident that the feedstock is the single largest component of biodiesel production cost [61] and it can account for up to 70% of the production cost. The feedstock cost can vary significantly from region to region due to types and availability of the feedstock. Figure 71 shows the biodiesel feedstocks used in the APEC region and these include palm oil, canola oil, rapeseed oil, Jatropha oil, used cooking oil and tallow. As for the EU countries, the biodiesel feedstock is focused on rapeseed and canola oil.

Figure 72 shows historical prices of coconut, soybean, palm and rapeseeds oil versus diesel and it shows that biodiesel has remained relatively expensive: biodiesel feedstock costs have generally been higher than petroleum diesel prices [62]. Since the feedstock is the most costly part of biodiesel production and the feedstock cost has risen very much in the last few years with the result that many biodiesel plants are being under-used or not used at all, awaiting a cheaper feedstock. The graph below also provides an indication of the production costs of biodiesel from various feedstocks, illustrating the cost advantage fossil diesel has over biodiesel. It also demonstrates that palm oil-based biodiesel is less expensive than rapeseed-oil based biodiesel, produced domestically in the EU countries [63].



Source: Asian Pacific Economic Cooperation (2008)].

Figure 71 Biodiesel Feedstock around the world



Source: Kojima et al. (2007).

Figure 72 Historical prices of coconut, soybean, palm and rapeseeds Oil versus diesel

8.2.1 The United States

For the USA, the biodiesel price also varies from area to area with a national B100 average price of US$ 4.64 per gallon or US$1.22 per litre in October 2008 while a national average petrol diesel price was US$ 3.65 per gallon or US$ 0.96 per gallon. Figure 73 shows the historical price of diesel versus biodiesel in the USA from 2005 to 2008 [64]-[66]. From September 2005 through July 2008, petroleum diesel has typically been less expensive than biodiesel. The greater amount of biodiesel in the biodiesel blend, the higher the cost, with B100 being the most expensive. However, the price gap has been narrowing between 2007 and 2008. This was probably due to the rising price of petroleum oil during that period. It should be noted that there are tax incentives for blenders of US$ 1.00/gallon (27 cents/litre) for biodiesel and US$ 0.51/gallon (13.5 cents/litre) for ethanol according to The Energy Policy Act of 2005. According to the information reported by Asian Pacific Economic Cooperation (2008) provided by EarthFirst Americas Incorporated (EFA), the palm oil-based biodiesel was imported twice from Ecuador at the end of 2005 and early 2006. The second shipment totals 3 million litres, a substantial increase from the first shipment of 1 million litres. The announcement was received with a negative reaction be the American Soybean Association (ASA) and called on the Congress to establish protectionist measures to block imported biodiesel from competing with the domestic soy-based product. The US biofuels market will unlikely grow substantially in the next few years given the increased domestic production. In fact, some analysts predict that the US biofuels market could become independent of imports in the next 1 to 2 years [67].

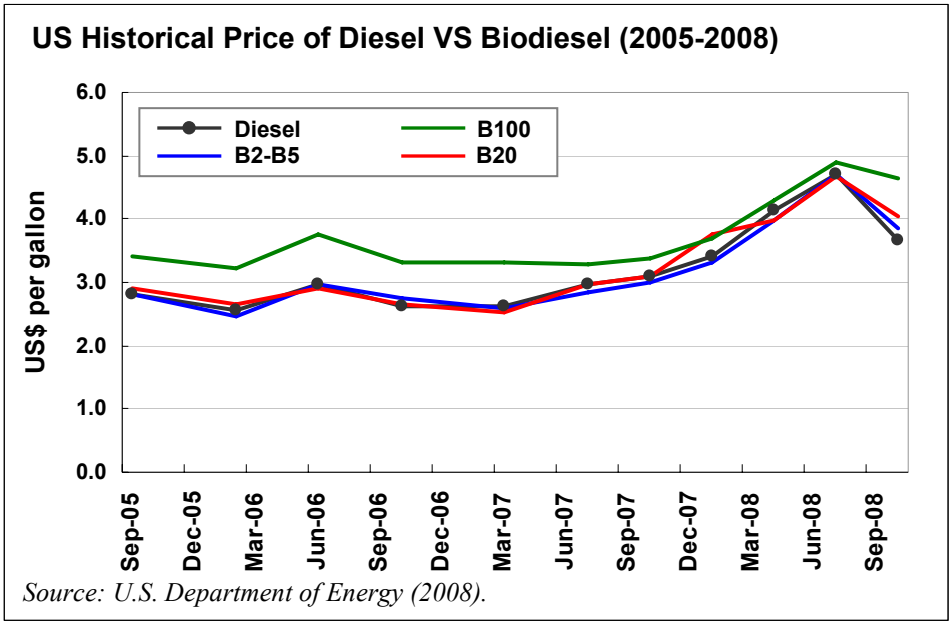
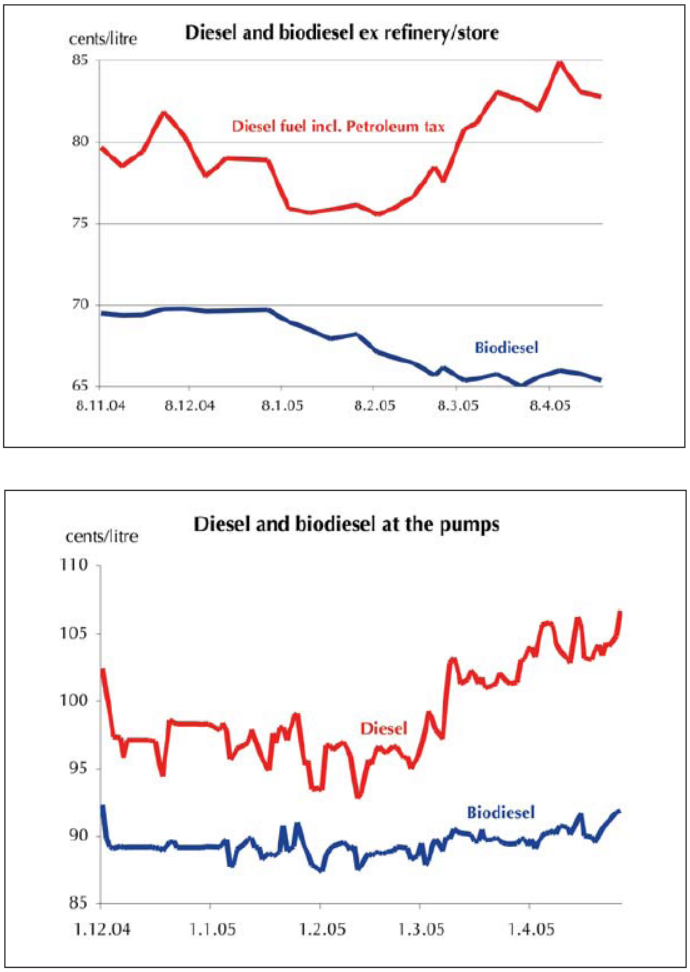


Figure 73 US historical price of diesel versus biodiesel from 2005 to 2008

8.2.2 The EU

Although the rapeseed oil is the most commonly used feedstock in EU countries, the *net production cost* of biodiesel still varies slightly from 0.8 Euro per litre in one region to 1.25 Euros per litre in another [47]. Figure 74 shows historical prices of biodiesel versus diesel during 2004 to 2005 in Germany, the largest biodiesel producer and consumer. Over the mentioned period, the price differences between diesel and biodiesel at the petrol stations were around 11 euro cents per litre with a price of diesel on gas-station of around 1.11 Euro (1.44 USD) per litre inclusive petroleum tax, compared with 1 Euro (1.3 USD)/litre for biodiesel [68]. The biodiesel production seems to be profitable for many companies. However, biodiesel can be profitable when it is subsidized, usually by a reduction in fuel tax. But subsidies can be given and subsidies can be taken away, making for uncertainty.



Source: Bockey, D (2005).

Figure 74 German historical price of diesel versus biodiesel

For example in Germany there have been significant impacts on biodiesel production and consumption with changes to taxation regimes. The German Union for the Promotion of Oil and Protein Plants (UFOP) reported that for the first two months of 2009 the price difference in Germany between biodiesel and diesel was €0.20 (US$0.27) per litre in favour of diesel, the highest negative difference for biodiesel since July 2006 following the introduction of the biodiesel tax in August 2006. This leads the association to predict that biodiesel consumption is likely to fall even further in 2009. This situation will be further aggravated if the Bundestag ratifies the proposed reduction of biofuels quotas this spring, to which UFOP is opposed [53].