

CHAPTER IV

INDUSTRY ANALYSIS

This chapter presents the information about industry analysis. One of the most commonly used approaches to evaluate the attractiveness of an industry is Porter's Five Forces. With the employment of Porter's Five Forces Analysis, five different aspects of threat of entry, intensity of rivalry between existing competitors, pressure from substitute products, bargaining power of buyers, and bargaining power of suppliers are investigated to give an overall picture and its attractiveness of the industry, in this case Thai's Biodiesel industry.

4.1 Porter's Five Forces Analysis

To formulate a competitive strategy, one of the bases is to learn and understand the nature of one's business. According to Michael E. Porter, he proposed a framework for analyzing the industry – Porter's Five Forces Analysis. From his framework, Porter suggested that in any industry, the competitive state depends on five factors of: potential entrants, buyers, suppliers, substitutes, and last but not least, rivalry among existing firms.

For the biodiesel industry, each of the five forces would be explored accordingly. In term of potential entrants or sometimes refers to as 'threat of new entrants', the set-up a new biodiesel factory would be countering some challenges such as; economies of scale, access to the feedstock, capital requirement, and governmental policy. For the buyers or refers to as 'the bargaining power of buyers' in biodiesel industry, it relies on two key factors of, firstly, the dependence on few buyers, and secondly, its ability to integrate backwardly. Moving on to suppliers or 'the bargaining powers of suppliers', in biodiesel industry, raw material plays an essential role – particularly in three aspects of differentiation of feedstock, dependence of the feedstock, and supplier concentration. For the substitutes or sometimes refers to as 'pressure from substitute products', both the present and emerging substitutes in biodiesel industry would be investigated. Last but not least when it comes to determining the biodiesel industry's intensity of competition or

'rivalry among the existing firms, two factors include the number of competitors and the pace of industry growth should be taken into the consideration.

4.1.1. Threat of new entrants

Biodiesel is a new industry in Thailand. The promotion of renewable energy has started only a few years back. Due to the oil crisis situation, Thailand has been searching for other solutions, one of which turns out to be biodiesel. Hence, to enter this industry, there are few barriers to the entry. These identified barriers include:

Economies of Scale

One of the first barriers for the new entrants is the economy of scale. To obtain economies of scale, a biodiesel production plant should be operated at a relatively large production capacity. From the feasibility study conducted by TMB Bank Public Company Limited (5) entitling, "The feasibility study for setting up a biodiesel factory at Krabi Province", the recommended production capacity of a biodiesel factory is of at least two hundred thousands liters per day in order to be financially satisfied from the financial institution point of view.

From the study, it turns out that if a biodiesel company chooses to operate with a capacity of one hundred thousands liters per day, the company would be resulted in a loss for the first two years of its operation. The company would yield the Internal Rate of Return (IRR) of 1.68% and the Net Present Value (NPV) of -139.91 million Baht. Additionally, from the sensitivity study, with the production capacity of one hundred thousands liters per day, the difference between biodiesel price and crude palm oil (CPO) price would have to be of at least 4.50 Baht in order to be financially feasible. Hence, from the financial institute's point of view, the project return was considered unattractive.

Consequently, a research team from TMB Bank Public Company Limited continued to examine a feasibility study of a biodiesel factory with two hundred

thousands liters per day capacity. The result was that if a biodiesel company chooses to operate with a capacity of two hundred thousands liters per day, the company would be gaining the net profit since its first year of operation. The company would yield the Internal Rate of Return (IRR) of 11.39% and the Net Present Value (NPV) of 133.92 million Baht. Additionally, from the sensitivity study, with the production capacity of two hundred thousands liters per day, the difference between biodiesel price and crude palm oil (CPO) price would only have to be of at least 4 Baht in order to be financially feasible.

As a result, considering the financial analysis of both one hundred thousands liters per day capacity and two hundred thousands liters per day capacity conducted by TMB Bank Public Company Limited (5), the recommended production capacity is two hundred thousands litres/day in order to obtain the economies of scale.

Capital Requirement

The capital requirement in building a biodiesel plant is huge. From TMB's feasibility study (5), to build a biodiesel plant with the recommended production level of two hundred thousands litres per day, the capital requirement for both the infrastructure and machinery concluded up to five hundred million baht. Together with the consultation and construction fees, the investment capital could reach as much as seven hundred million Baht.

However, overlooking at the investment capital and the cost of producing biodiesel of three proposed production level studied by TMB Bank Public Company Limited (5), the result turns out that with the higher the production, the investment capital to build the plant goes up. Yet, with higher investment capital, the production cost reduces. So, biodiesel could actually be produced at a lower cost when it operates at a high production level, as shown in Table 4.1.

Table 4.1: Biodiesel cost of production analysis of 50, 100, 200 and 300 tons/day

	Production capacity (tons/day)							
	50	%	100	%	200	%	300	%
Investment (million Baht)								
Infrastructure	30.50	8.1%	33.90	8.0%	40.80	8.3%	47.70	8.5%
Machinery and equipment	345.60	91.9%	392.00	92.0%	451.90	91.7%	511.50	91.5%
Total	376.10	100.0%	425.90	100.0%	492.70	100.0%	559.20	100.0%
Cost of production (Baht/litre)								
Raw material: CPO	15.19	73.4%	15.19	77.8%	15.19	80.3%	15.19	81.2%
Raw material: Additives	2.20	10.6%	2.20	11.2%	2.20	11.6%	2.20	11.7%
Direct labour	0.18	0.9%	0.09	0.5%	0.06	0.3%	0.05	0.2%
Indirect labour	1.20	5.8%	0.97	5.0%	0.85	4.5%	0.81	4.3%
Depreciation	1.91	9.3%	1.08	5.6%	0.63	3.3%	0.47	2.5%
Biodiesel cost	20.68	100.0%	19.53	100.0%	18.92	100.0%	18.71	100.0%

Source: TMB Bank Public Company Limited (5)

Government policy

For the government policy, Thai government lead by the Energy Policy and Planning Office, Ministry of Energy, has constructed the Biofuel plan of 2002 to 2011. This Biofuel plan is divided into two parts: Part I – concerning with Biofuel strategy during 2002 to 2004, and Part II – concerning with Biofuel strategy during 2005 to 2011 (5).

Part I: Biofuel Plan of 2002-2004, the Thai government compels to:

- Research on biodiesel production from various crops and used vegetable oil.

- Genetically improved the oil yield of the oil-producing crops, particularly for the palm and the coconut plants; with the objective that by 2011, the yield of these crops would increase by 1.33 times comparing to the oil yield of 2001.

Part II: Biofuel Plan of 2005-2011

- For palm oil, the excess palm oil leftover from domestic consumption would be used to produce biodiesel. From 2005 to 2007, the excess palm oil is expected to be approximately about 20% of the Thai's palm oil production; increased by 1.12 times comparing to the excess palm oil of 2003. And for 2008 to 2011, the excess palm oil is expected to increased through the governmental promotion to be about 40% of the Thai's palm oil production; increased by 1.33 times comparing to the excess palm oil of 2003.
- For coconut oil, the excess coconut oil leftover from domestic consumption would similarly be used to produce biodiesel. Expectedly in 2011, the coconut production would increased by 1.33 times comparing to 2003, causing the coconut oil to likewise increased by 2% each year.
- For the used vegetable oil, it is another source of raw material that can be used to produce biodiesel. By combining the food frying industry and the large restaurant chains, the used vegetable oil was expected to conclude up to 42,000 litres each year (with a potential to grow by 2% annually).

Not only Thai government has come up with a Biofuel plan, but also the government has come up with the Biodiesel application roadmap; as shown in Figure 4.1. Starting from 2006, Thai government was anticipating that each day about one hundred and fifty thousand litres of biodiesel would be distributed in Bangkok Metropolitan, its boundary provinces, and also in the Southern part of Thailand. By 2009, the government expects that at least five hundred thousand litres of biodiesel

would be distributed each day through the increasing numbers of biodiesel service stations. In 2012, B10 blended fuel must be made available throughout Thailand with the objective to replace diesel fuel by 8.5 million litres each day.

For both the Biofuel Plan and Biodiesel Application Roadmap to succeed, several related-governmental agencies need to be involved making both the plan and the roadmap to happen as expected.

Thailand's Biodiesel Roadmap

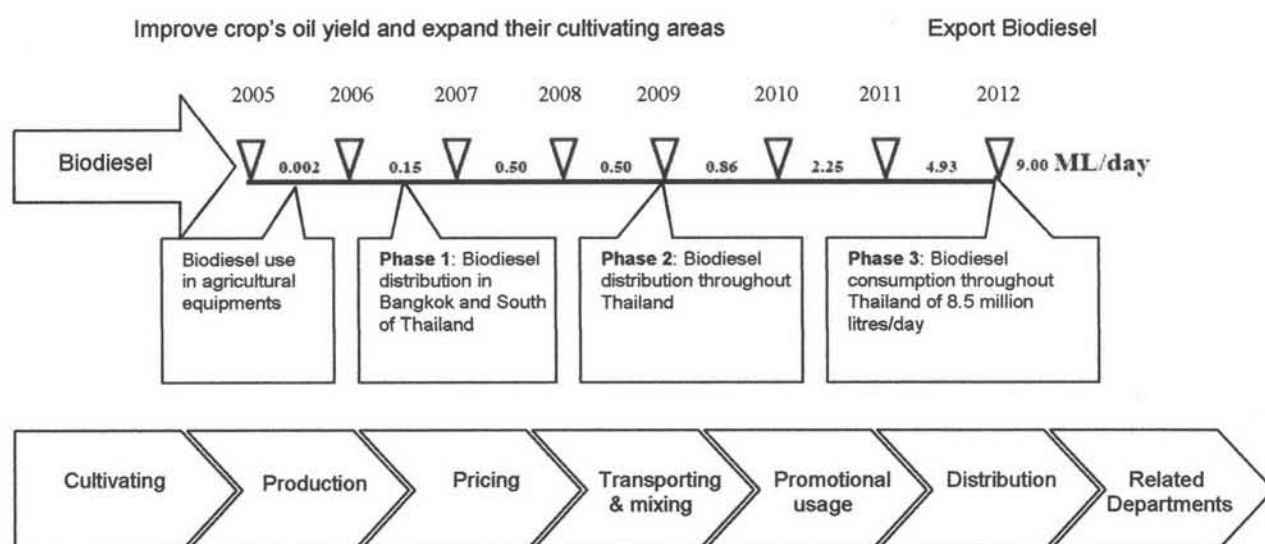


Figure 4.1: Thai's Biodiesel Application Roadmap

Source: TMB Bank Public Company Limited (5)

Accordingly, with reference to the Cabinet Resolution on Energy of 17th May 2005, Thai government has come into a conclusion of a biodiesel development and promotional plan that (5):

1. The government would approve of the biodiesel development and promotional plan by delegating related-governmental agencies to help making it happen as:

- For the Ministry of Agriculture and Cooperatives, they are responsible for:
 - i. the zoning of palm plantation expansion to be completed within 6 months by assigning the South and the East of Thailand as a palm plantation base;
 - ii. research and development in planting palm trees in the North and the North-East of Thailand;
 - iii. handling out of the palm seedlings and promoting of palm cultivation;
 - iv. conducting a study to determine the effects of palm plantation replacement;
 - v. and coordinating with the neighboring countries to promote palm cultivation in their countries through 'Contract Farming'

- For Ministry of Finance, they are responsible for setting up of Special Purpose Vehicle (SPV) – in cooperation with Ministry of Agriculture and Cooperatives, Ministry of Industry and Ministry of Commerce, to promote the palm plantation expansion, other oil-producing crops plantation expansion and biodiesel production. As well, Ministry of Finance is responsible as a collateral security helping SPV to ask for a credit from the Bank for Agriculture and Agricultural Cooperatives to run their palm businesses in compliance with Section 10 (17) of Bank for Agriculture and Agricultural Cooperatives Act.

- Ministry of Industry and Ministry of Energy, they are responsible for:
 - i. promoting both the biodiesel production and the biodiesel application to conform with the Biodiesel Application Roadmap;

- ii. specifying the policy for the construction of a biodiesel production plant;
 - iii. monitoring the size and number of biodiesel production plant to be in accordance with the expansion of palm plantations;
 - iv. and, specifying the location of a biodiesel depot in order to reduce the transportation cost to blend diesel and biodiesel.
2. And additionally, the government has also approved of a promotional budget that intent for use to promote the expansion of palm plantation. Upon agreeing with the Thai's Bureau of the Budget, an approval budget of 1,300 million Baht would be used in two themes of extension services and project management; with the assigned amount of 800 million Baht and 500 million Baht respectively.

Access to the feedstock

As biodiesel grows to be more and more popular in Thailand, accessing to the feedstock becomes one of the entry barriers. In term of both the sky-rocketing price of biodiesel raw material and the amount of raw material available for biodiesel production, these are the factors that might resist the entry into the Thai biodiesel industry.

To acquire palm oil for biodiesel production, the price of the raw material plays a significant role. With reference to Table 4.1 illustrating a cost structure of biodiesel production, biodiesel raw material (the crude palm oil, CPO) accounts up to 70 to 80 % of a total biodiesel production depending on the production capacity – pointing out the importance of the price of biodiesel raw material in biodiesel production. By looking at the price of fresh fruit palm, this would as well determine the price of crude palm oil. From Figure 4.2 illustrating an average price of fresh fruit palm over a period of 13 months (34), the price of one kilogram of fresh fruit palm significantly increased up to 116.5% over a year.

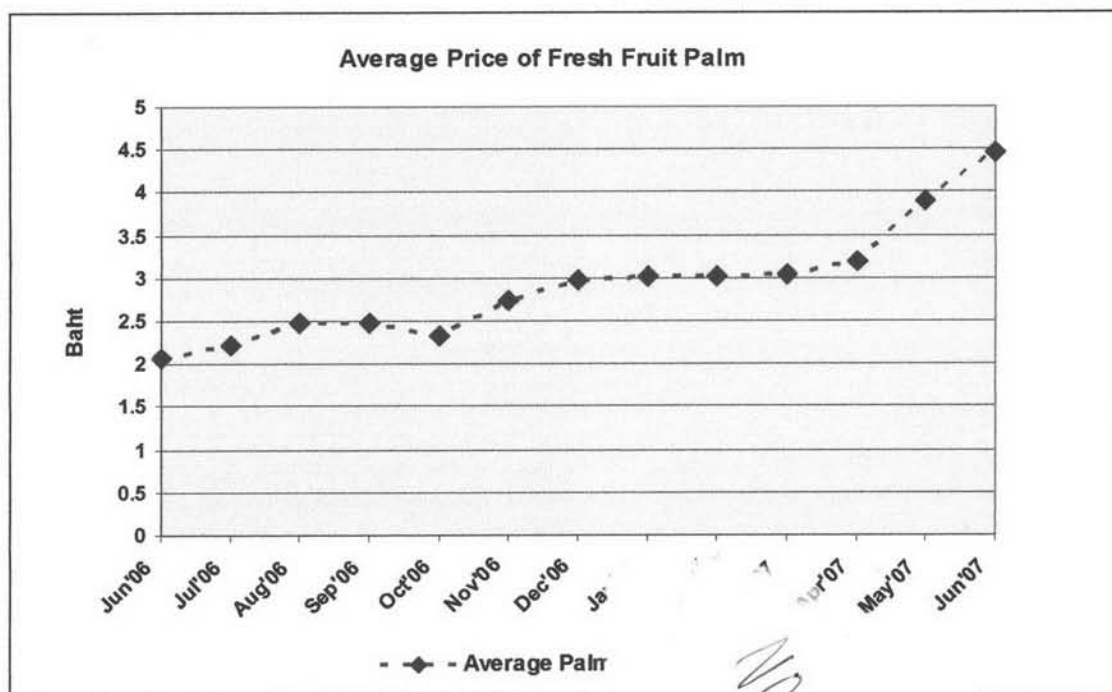


Figure 4.2: Average Price of Fresh Fruit Palm

3 months

Source: Office of Agricultural Economics, 2007

As the price of the crude palm oil depends largely on the price of fresh fruit palm, it resulted in the increased in price of crude palm oil correspondingly. This significantly affects a crude palm oil price, causing it the biodiesel production cost to rise enormously. Hence, the price of fresh fruit palm greatly affects the price of crude palm oil, and consequently, affects the production cost structure of biodiesel.

For the biodiesel raw material availability, it should be further discussed in the topic of Bargaining Power of Suppliers in the subtopic of '*Dependence of one feedstock*'.

4.1.2. Bargaining Power of Buyers

It is unquestionable that buyers play an important role in any industry. For Thai biodiesel industry, the bargaining power of buyers would be analyzed in term of the dependence on buyers and the backward integration ability with the buyers.

Dependence on Few Buyers

When it comes to the buyers, the similar characteristics of biodiesel industry and the diesel industry are evident. One of the most observable characteristics is that both industries depend on few buyers. Particularly for biodiesel industry, the key buyers of biodiesel are Petroleum Authority of Thailand (PTT) and Bangchak Petroleum Public Company Limited.

With reference to Preechajarn, S. of Thailand Oilseeds and Products Annual 2006 (33), the unblended biodiesel of about 5,000 liters per day produced by four to five biodiesel producers is supplied to Petroleum Authority of Thailand (PTT) and Bangchak Petroleum PLC. Moreover, according to Thailand Oilseeds and Products Annual 2006 report, each month both Petroleum Authority of Thailand (PTT) and Bangchak Petroleum PLC are distributing 2.85 million litres of the B5 blended fuel countrywide throughout their 35 service stations.

Ability of a Backward Integration

Petroleum Authority of Thailand (PTT) Public Company Limited, one of the large two biodiesel retailers, has set off in the backward integration. According to the Ministry of Energy (23), with the initial demand of five hundred thousand litres per day of B100 biodiesel, PTT Public Company Limited has endorsed the Memorandum of Understanding (MOU) with two large palm oil producing companies namely; Thaksin Palm (2521) Company Limited and Bioenergy Plus Company Limited, on the 3rd August 2006.

With reference to PTT Public Company Limited Performance Review of 2006 (35), this Memorandum of Understanding (MOU) signed with Thaksin Palm (2521) Company Limited and Bioenergy Plus Company Limited has the two key objectives of, firstly, to jointly investigate the production of biodiesel using crude palm oil as the main raw material, and secondly, to build biodiesel production facilities at Suratthani

and Ayutthaya provinces in order to acquire B100 biodiesel representing PTT's commercial expansion of biodiesel production.

At Suratthani province, under a supervision of Thaksin Palm (2521) Company Limited, a biodiesel production using crude palm oil as a raw material with a production capacity of 300,000 litres per day would be produced to supply to PTT Public Company Limited (35). Additionally at Ayutthaya province, under a supervision of Bioenergy Plus Company Limited, a biodiesel production using palm stearin or palm wax as raw material with a production capacity of 200,000 litres per day would similarly be produced to supply to PTT Public Company Limited. As a result, PTT Public Company Limited would be obtaining altogether 500,000 litres of B100 biodiesel each day.

Moreover, together with its subsidiary company – Thai Oleo Chemical Company, with a plan to build a 600,000 litres per day biodiesel factory by the 3rd quarter of 2007, PTT Public Company Limited would be acquiring a total of 1.1 million litres of B100 biodiesel per day (23).

4.1.3. Bargaining Power of Suppliers

As important as the buyers, suppliers play an important aspect. Particularly for biodiesel industry, it could be said that suppliers is the critical composition of the industry. While the market for biodiesel is relatively vast, its supplier is, on contrary, limited. For the Thai biodiesel industry, three key features of suppliers would be investigated in term of differentiation of feedstock and supplier concentration as followed:

Differentiation of feedstock

In Thailand, altogether about 10 oil-producing crops have been studied as the biodiesel raw material (5). These crops include palm, sunflower, coconut, soybean, peanut, castor bean, rapeseed, sesame, and cotton. Overlooking at these ten identified

crops, it is obvious that the oil yield from palm trees is outstanding (as shown in Figure 4.3). As a result, Ministry of Energy has chosen palm trees to be the main feedstock to produce biodiesel.

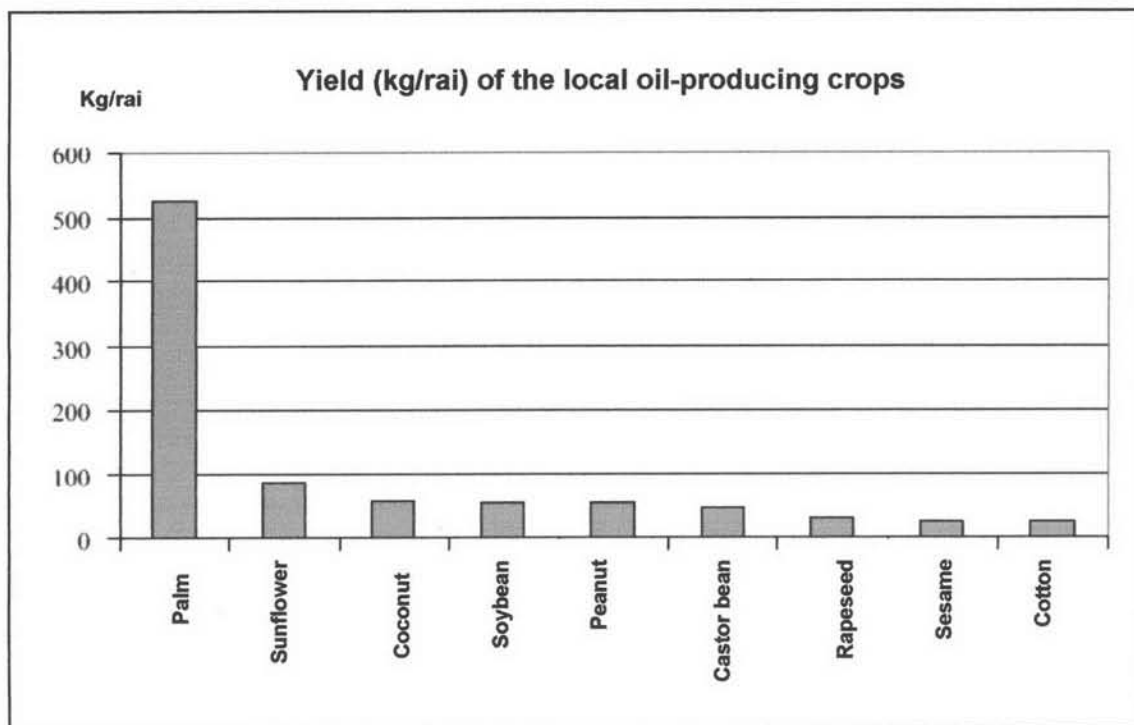


Figure 4.3: Yield (kg/rai) of the local oil-producing crops

Source: TMB Bank Public Company Limited (5)

Apart from palm trees, *Jatropha curcus* plant is another identified crop. It is a drought-resistant crop with the ability to grow in a poor soil. As an easy and fast growing crop with a life span of fifty years, *Jatropha* is another preferred crop for biodiesel production. Yet, at the moment, the study of *Jatropha* plant is still an on-going basis. As further research and development is required on this crop, the only feedstock that would be focused in this research would be solely on palm trees.

Dependence of one feedstock

In Thailand, the total harvested area of palm oil is 2,026,000 rai (0.32 million hectares), yielding a total palm oil production of 5,003,000 tons each year. Together with an outstanding yield of palm oil in comparison with other oil-producing crops as shown in Figure 4.4, palm oil has been chosen as a biodiesel raw material in Thailand.

As shown in Table 4.2, with reference to TMB Bank Public Company Limited; Feasibility study for setting up a biodiesel factory with a production capacity of 100,000 liters per day (5), it shows the Thai's palm oil accounts from 1995 to 2005. From the data presents, the leftover stock from domestic consumption of the total palm oil production is not much. Despite a continual expansion of palm plantation, the domestic consumption has also increased over the years.

Table 4.2: Thailand's palm oil account of 1995 to 2005

Thailand's palm oil account of 1995 to 2005							Unit: Ton(s)
Year	Previous stock	Yield	Import	Total	Export	Local consumption	End-year stock
1995	47,646	402,649	19,968	470,263	4,232	419,008	47,023
1996	47,023	479,605	33,026	559,654	23	479,504	80,127
1997	80,127	449,796	23,172	553,095	49,941	432,973	70,181
1998	70,181	352,118	11,373	433,672	23,483	384,490	25,699
1999	25,699	707,951	0	733,650	16,967	536,106	180,577
2000	180,577	579,557	0	760,134	20,234	582,512	157,388
2001	157,388	780,389	0	937,777	160,810	668,083	108,884
2002	108,884	641,608	0	750,492	49,744	640,753	59,995
2003	59,995	863,835	0	923,830	76,667	732,210	114,953
2004	114,953	820,841	0	935,794	3,036	781,636	151,122
2005 (estimation)	151,122	890,706	0	1,041,828	10,000	834,398	197,430

Source: TMB Bank Public Company Limited (5)

As a result, this left with a limited amount of the palm oil stock each year. However, since 2003 the palm oil stock apart from the domestic consumption seemed to increase gradually. In 2005, Thai's palm oil has left with 197,430 tons. With this amount, it could potentially produce biodiesel of about 676,130 litres each day. Taken from the TMB Bank Public Company Limited feasibility study (5), it presents in Figure 4.4 the crude palm oil stock that could be used to produce biodiesel from 1995 to 2005.

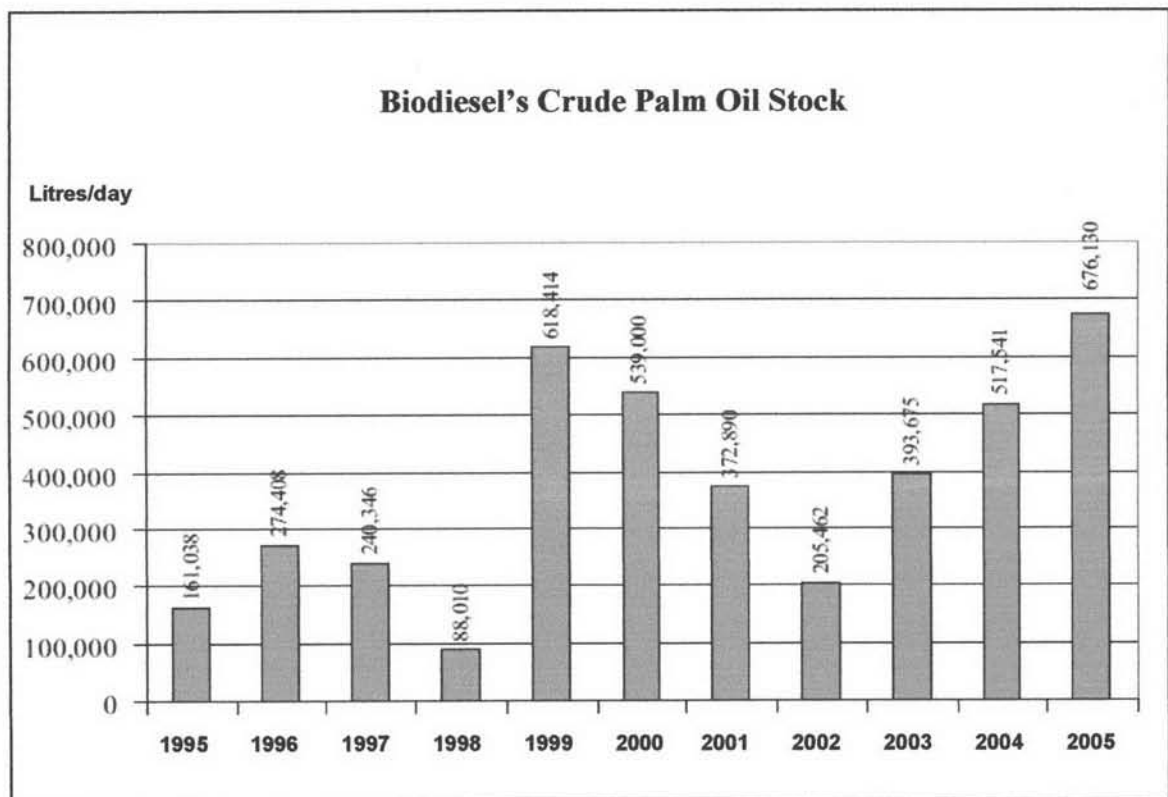


Figure 4.4: Biodiesel's Crude Palm Oil Stock

Source: TMB Bank Public Company Limited (5)

In 2006, with the government support in term of both the set-up of biodiesel factory and palm plantation expansion, Thailand's palm production is anticipated to rise considerably by 30% to 900,000 tons (33). Out of 900,000 tons, 280,000 tons was used for industrial consumption, probably for biodiesel production. Yet, the palm oil stock excluding the food-used domestic consumption is still inadequate to support

with the Biodiesel Roadmap proposed by the government. Hence, the attempt of Thai government to expand more palm plantation must be continuously fulfilled; in order to increase the palm oil production, and consequently, increase the raw material for biodiesel production.

Supplier concentration

With reference to TMB's feasibility study (5), Thailand has a palm plantation coverage of 2.19 million rai (0.35 million hectares), and it continuously increases over the years as the demand of palm oil constantly increasing. For the past ten years from 1995 to 2004, palm plantation has increased over 1.05 million rai (0.17 million hectares) as palm oil demand climbs up. At the moment, Thai's palm agriculture is carried out only in 2 regions; the Central and the South of Thailand. Over 93% of palm plantation is located in the Southern part of Thailand. Additionally, considering the palm plantation expansion rate, most palm plantation expansion is from the South – more than 0.9 million rai (0.14 million hectares) has been expanded since 1995 in the South of Thailand alone.

From the data obtained from the Office of Agricultural Economics (36), in 2005, the highest harvested area of palm oil is at Krabi province. With suitable growing climate and fertile land, Krabi has altogether the harvested area of palm oil of 629,146 rai (0.1 million hectares). It accounts up to 31% of the whole harvested area of palm oil in Thailand. For a second place, it goes to Suratthani province with the palm oil harvested area of 554,478 rai (0.09 million hectares) accounting for 27% of Thailand's total harvested area. For a third place, still within a South of Thailand, it is Chumporn province with the harvested area of 384,199 rai (0.06 million hectares) accounting for 19 % of the total harvested area.

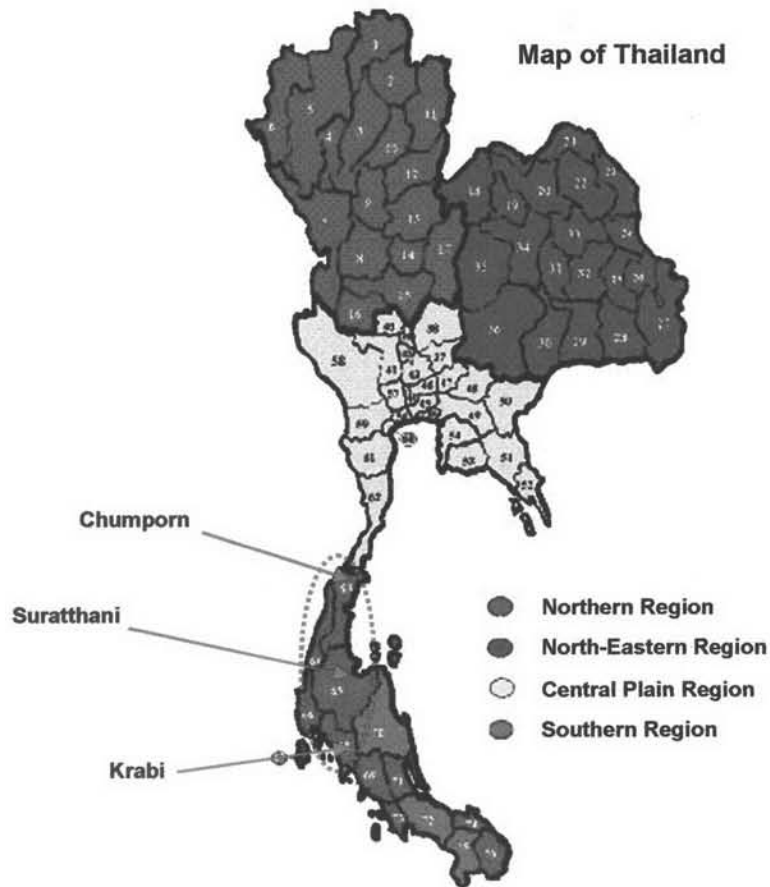


Figure 4.5: Map of Thailand showing the top 3 provinces of palm harvested area

Source: Office of Agricultural Economics, Thailand (36)

From the top three of Thai's palm planting area – Krabi, Suratthani and Chumporn as shown in Figure 4.5, it accounts up to 77% of the total palm plantation in Thailand. As a result, for the supplier concentration for biodiesel, it could be concluded that the raw material of biodiesel is located in the Southern region of Thailand.

4.1.4. Intensity of competition within the industry

Number of Competitors

Up to August 2007, according to the Department of Energy Business, Ministry of Energy (37), there are altogether 8 biodiesel producers that are qualified by the Department of Energy Business (DOEB) Notification to produce B100. All the 8 biodiesel producers are currently producing biodiesel at a rate of 1,500,000 litres per day. These biodiesel producers are as shown in Table 4.3:

Table 4.3: A list of Biodiesel Producers with their production capacities

Biodiesel Producers	Production Capacity (litres/day)
Pathum Vegetable Oil	300,000
Bangchak Petroleum	50,000
BioEnergy Plus	100,000
I A Energy	250,000
Bangkok Alternative Energy	200,000
Veerasuwan	200,000
Suntech Palm Oil	200,000
Green Power Corporation	200,000

Source: Department of Energy Business, Ministry of Energy (37)

Pace of Industry Growth

According to the Department of Alternative Energy Development and Efficiency website (25), by 2006 there are only three biodiesel producers – BioEnergy

Plus, Pathum Vegetable Oil, and I A Energy. These three B100 biodiesel producers generated altogether 615,000 litres of biodiesel per day.

In 2007, according to the Department of Energy Business, Ministry of Energy (37), there are in total 8 biodiesel producers generating altogether of 1,500,000 litres of biodiesel per day. With the newcomers, they are adding another 885,000 litres of biodiesel per day to the industry – increasing the supply of biodiesel into the industry by another 144%; showing a swift growth of the biodiesel industry.

2006		2007
1. BioEnergy Plus 35,000 litres/day		1. BioEnergy Plus 100,000 litres/day
2. Pathum Vegetable Oil 80,000 litres/day		2. Pathum Vegetable Oil 300,000 litres/day
3. I A Energy 500,000 litres/day		3. I A Energy 250,000 litres/day
		4. Bangchak Petroleum 50,000 litres/day
		5. Bangkok Alternative Energy 200,000 litres/day
		6. Veerasuwan 200,000 litres/day
		7. Suntech Palm Oil 200,000 litres/day
		8. Green Power Corporation 200,000 litres/day
Total biodiesel generated per day:		Total biodiesel generated per day:
615,000 litres		1,500,000 litres


Increase by 144% 

Figure 4.6: List of B100 Thai biodiesel producers of 2006 and 2007

Source: Department of Alternative Energy Development and Efficiency (25) and Department of Energy Business (37)

4.1.5. Pressure from substitute products

Present Possible Substitutes

One of the key biodiesel substitutes is, of course, diesel fuel. In fact, biodiesel is a diesel's substitute product. With a constant escalation of diesel price and the intention to reduce the oil import by the Thai government, biodiesel is gaining its popularity in Thailand.

Another biodiesel's substitute product is purified palm diesel. With reference to Petroleum Authority of Thailand (PTT) Public Company Limited website (38), Petroleum Authority of Thailand (PTT) Public Company Limited is the only initiator for selling purified palm diesel. To attract its usage, the price of purified palm diesel has been structured to be 0.5 Baht lower than the diesel price. Currently, Petroleum Authority of Thailand (PTT) Public Company Limited is distributing palm diesel in 4 service stations. As a result, one of the main rivals of biodiesel would be purified palm diesel.

Emerging Substitutes

In the near future, most cars would be equipped with either the NGV technology or the hybrid technology. With such technologies, the traveling cost per kilometer would be minimized. At the moment, NGV per kilogram is at around 8.50 Baht. This reduces the traveling cost by almost 300%, when comparing to the regular petrol. Thus, with a much cheaper cost of traveling, the usage of those technologies would increase rapidly. Also, it would reduce the dependency of both the oil and the biodiesel.



Figure 4.7: NGV service station

Source: PTT Public Company Limited (38)

For the longer term, hydrogen technology would be the coming technology. Being a clean and renewable energy, hydrogen is now being researched and developed extensively. At the moment, hydrogen energy is already used some of the industrialized countries, like USA and Germany. Unless the fuel cell technology is further developed and becomes economical, until then Thailand would still be waiting for the technology.

4.2 Porter's Five Forces Conclusion

From the Porter's five forces analysis (the summary of Porter's five forces analysis is shown in Figure 4.8), we learn that biodiesel industry is a new and emerging industry. The industry is growing in term of both the demand for biodiesel and the numbers of biodiesel manufacturing factories. However, at the moment, the demand for biodiesel is much exceeding the supplies. One of the causes this is due to the palm oil limitation and insufficient of palm cultivation area. Hence, it increases the bargaining power of suppliers and also the barrier to the new entrants. Additionally, with high set-up investment required, it again becomes the hurdle for the new biodiesel company to leap over in the entrance of the Thai's biodiesel industry. For these reasons, the attractiveness of this industry is still questionable.

Thus, for biodiesel industry to expand progressively, Thailand must try to increase the input of the industry and seek for a solution to assist the new entrants financially in order to raise the attractiveness of the Thai's biodiesel industry. As this

industry matures, it would support the growing demand of greener and cleaner alternative energy for Thailand.

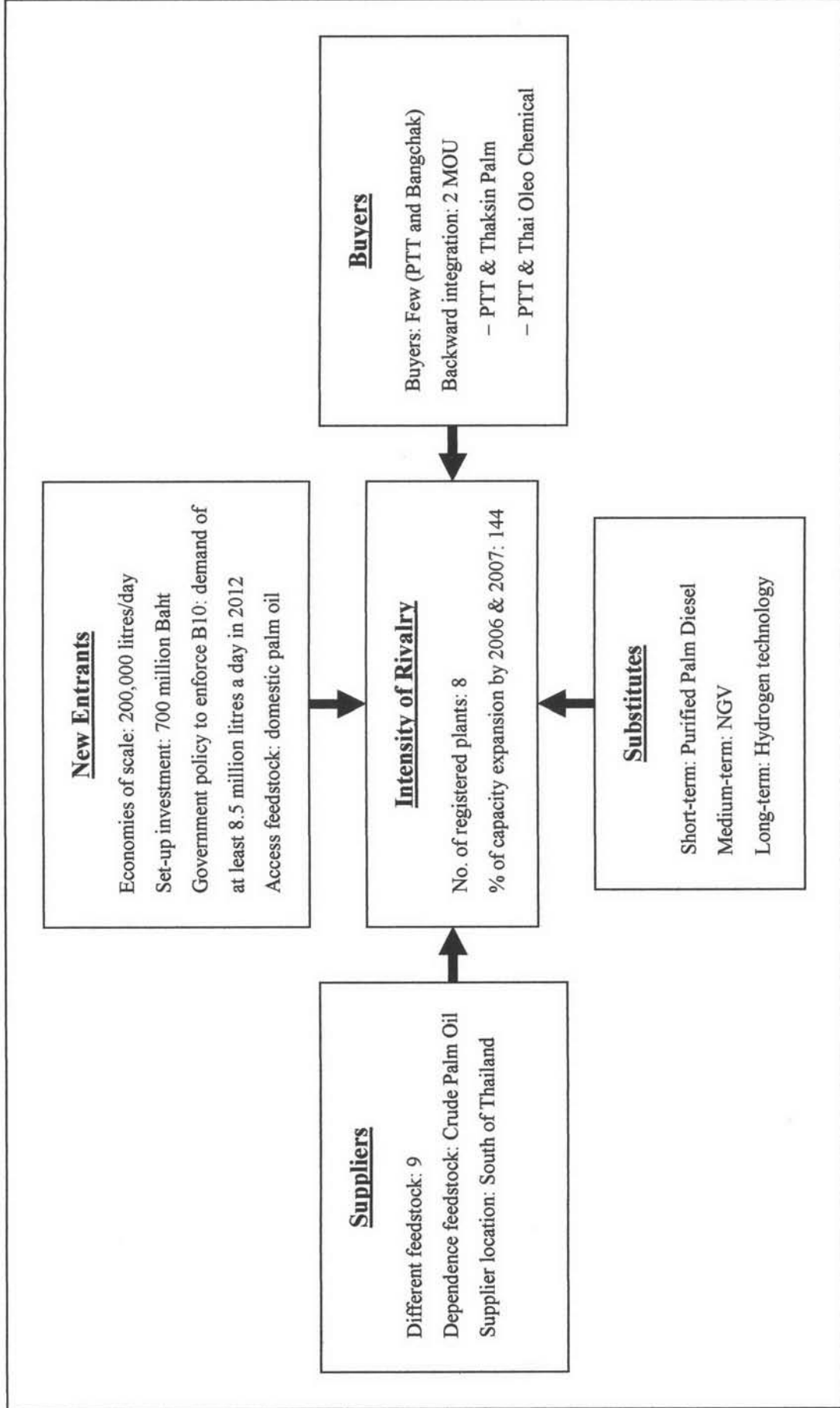


Figure 4.8: Thai's biodiesel industry analysis using Porter's Five Forces