2011 PETROCHEMICALS DEVELOPMENT OUTLOOK IN SOUTH EAST ASIA

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A project report submitted in partial fulfilment of the requirements for the award of the degree of Bachelor (Hons.) of Chemical Engineering

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

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2011 PETROCHEMICALS DEVELOPMENT OUTLOOK IN SOUTH EAST ASIA

ABSTRACT

Petrochemical industry is a very important chemical industry. Petrochemical are chemical products derived from naphtha or natural gas by using distillation or cracking process. These primary products are processed in petrochemical plants into more useful products. Polyethylene is the product of polymerization of ethylene and it can be processed in downstream industries to produce daily life products such as synthetic fibers, plastic and many more. This research was conducted to understand the current situation of petrochemical activities in Southeast Asia region. The ethylene and propylene plant capacity from 2000 to 2015 had been presented in graph to understand the trends of development of ethylene and propylene production in six Southeast Asia countries, which are Malaysia, Thailand, Singapore, Indonesia, Philippines and Vietnam. The location and capacity of existing and planned olefins plants were listed in a table. The total production capacity of polyethylene and polypropylene for 2011 will provide information on current development of polyethylene and polypropylene. The location and capacity of existing polyethylene and polypropylene plants were listed. Other than that, the supply and demand of plastic from 2000 to 2015 for the six Southeast Asia countries had been presented in graph. The graphs help to understand the trends of plastic supply and demand. From the graph, the export situation of each Southeast Asia country could be understood as well. Southeast Asia map with plant location and capacity had been drawn to understand the location and capacity of olefins and polyolefins plants in the region.

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LIST OF SYMBOLS / ABBREVIATIONS

kTA	kilo tonne per annum
LLDPE	liner low density polyethylene
LDPE	low density polyethylene
HDPE	high density polyethylene
PS	polystyrene
PVC	polyvinyl chloride
PCS	Petrochemical Corporation of Singapore
PETRONAS	Malaysian Government and Petroliam National Berhad
BP	British Petroleum
LPG	liquefied petroleum gas
AFTA	ASEAN Free Trade Agreement
WTO	World Trade Organisation

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CHAPTER 1

INTRODUCTION

1.1 Overview

Petrochemicals are chemical products derived from petroleum or natural gas by using distillation or cracking processes. Petrochemicals are made up of hydrocarbon molecules. There are two classes of primary petrochemicals, include: olefins (ethylene, propylene and butadiene) and aromatics (benzene, toluene and xylene isomers) and methanol. Olefins are produced by steam cracking of natural gas liquids in chemical plants, while aromatics are produced by catalytic reforming of naphtha. The main sources of petrochemical are crude oil and natural gas because they are cheapest and can be easily processed into petrochemicals.

These primary petrochemicals are processed in petrochemical plants into more useful products, for examples, the polymerization of ethylene to polyethylene. Polyethylene can be processed in downstream industries to produce daily life product such as plastic bags and containers. Petrochemical industry is one of the most important chemical industries in the modern world. Petrochemical products are very useful for the production of a diverse set of products, such as synthetic fibres and rubbers, plastics and resins, solvents and many more.

In Southeast Asia region, Malaysia, Thailand, Singapore, Indonesia, Philippines and Vietnam are the producers of petrochemicals products. Petrochemical industry is one of the leading industries in Malaysia. Malaysia is a major exporter of petrochemical products (Malaysia Industrial Development

Authority [MIDA], 2009). The development of petrochemical industry has been in great progress since the early 1990s (Malaysia Petrochemical Association [MPA], 2006). The growth of the petrochemical industry is supported by the Malaysian Government and Petroliam National Berhad (PETRONAS), the national oil and gas company. There are three existing petrochemical zones: Gebeng industrial area, Kerteh industrial and Pasir Gudang industrial area in Malaysia. Foreign investors such as Dow Chemicals, BASF, BP, Shell and others collaborate with PETRONAS to invest in the petrochemical industries (MIDA, 2009).

In Thailand, the petrochemical industry began about five decades ago at a time when the industry was fully dependent on imports (Thailand Investment Review, 2007). In the early 1980s, due to discovery of significant natural gas reserve in the Gulf of Thailand, the industry began to take shape as a regional and global force (Thailand Investment Review, 2007). For the purpose of maximizing the benefits of the economic boom following the discovery of natural gas reserves, Thailand government had launched the Eastern Seaboard Project in the early 1980s (Thailand Investment Review, 2007). Today, Thailand is one of the main petrochemicals producers within Southeast Asia region. Map Ta Phut, a region of Thailand has evolved into a premier chemical industrial cluster.

The first petrochemical complex in Singapore and in Southeast Asia was brought on-stream by the Petrochemical Corporation of Singapore (PCS) (Monetary Authority of Singapore [MAS], 2003). The complex included a naphtha cracker and four downstream plants. In 1997, the start-up of PCS's second cracker boosted the petrochemical output of Singapore (Monetary Authority of Singapore [MAS], 2003). In Singapore, most of the petrochemical plants are located at Jurong Island. Jurong Island was developed by government of Singapore to become an integrated, world class petroleum and petrochemical hub (Monetary Authority of Singapore [MAS], 2003). Same as Malaysia, there are many foreign investors such as Exxonmobil, DuPont, Mitsui Chemicals and others collaborate with the government-linked company, the Petrochemical Corporation of Singapore.

Before the late 1980s, Indonesian petrochemicals industry was dominated by fertilizer production (Embassy of the United States of America, 2006). Starting from the end of 1980s, Indonesia began producing a broader range of petrochemical (Embassy of the United States of America, 2006). Olefins have been produced by P. T. Chandra Asri from naphtha feedstocks. In Indonesia, most of the petrochemical plants are located at Merak and Anyer (Embassy of the United States of America, 2006).

The Philippines petrochemicals industry has a limited scope on account of the inability of a local upstream facility to supply the basic raw materials (Irani, 2000). Olefins are currently being imported due to the fact that there are no cracker plants in Philippines. The focus of the industry has so far been on downstream operations. These involve the manufacture of plastic resin for plastic-processing, surface coating and textile industries (Irani, 2000). The local plastic resin manufacturers produce PVC and PS resins (Irani, 2000).

Unlike other Southeast Asia countries, Vietnam has a poorly developed petrochemical industry. There are no cracker plants in Vietnam. Despite being Southeast Asia's third largest crude oil producer, Vietnam still imports most of its oil products due to the lack of refining facilities (Huynh, 2010).

1.2 Aims and Objectives

The objectives of this research are:

i. To understand the current situation of petrochemical activities in South East Asia and their future trends.
ii. To understand the demand and supply of petrochemicals in South East Asia and the impact in Malaysia.
iii. To understand the location and capacity of petrochemicals plants in South East Asia region.

1.3 Dissertation Layout

Basically, the thesis is divided into five chapters.

Chapter 1:	Presents an introduction to the study.
Chapter 2:	Presents a literature review to discuss the development of petrochemical industry of Southeast Asia.
Chapter 3:	A summary of research methodology.
Chapter 4:	Presents results and discussion of the study.
Chapter 5:	Conclusion and recommendation

CHAPTER 2

LITERATURE REVIEW

2.1 Petrochemical

The main sources for the production of petrochemicals are natural gas and crude oils. From natural gas, ethane and liquefied petroleum gas (LPG) are recovered as a source for the production of olefins. On the other hand, different crude oil processing schemes, the refinery gases are important source for olefins (Matar & Hatch, 2000). Crude oil distillates and residues are important feedstocks for olefins and aromatics. Table 1 show that naphtha is the most important feedstock for the production of petrochemicals. Naphtha is the major feedstock to steam cracking units for the production of olefins.

Table 2.1: World Ethylene Production by Feedstocks (MMtpd) (Source: Matar & Hatch, 2000)

Feedstock	1990	1995	2000
Ethane/refinery gas	16	18	20
LPG	6	9	12
Naphtha/condensates	30	36	40
Gas oil/others	4	5	6
Total	56	68	78

Petrochemicals are chemicals derived from petroleum and natural gas. In the petrochemical industry, there are two main sectors: olefins and aromatics. Olefins are single-chain or branched-chain unsaturated hydrocarbons. Some important olefins in petrochemical industry are ethylene, propylene and butadiene. Compared with paraffins, olefins are more reactive and easily react with inexpensive reagent such as oxygen and water to form more valuable chemicals. Olefins can be polymerised to produce important polymers such as polyethylene and polypropylene. Among three types of olefins, ethylene plays the main role in the production of petrochemicals.

Aromatics are cyclic unsaturated hydrocarbons. There are three types of aromatic compounds: benzene, toluene and *p*-xylene. Aromatics are important precursor for many commercial chemicals and polymers such as nylon, phenol and plastics (Matar & Hatch, 2000).

2.2 Global Petrochemical Industry: An Overview

2.2.1 North America

North America ethylene demand contracted in 2008 as the slowing of the domestic market override the positive influence of record derivative exports (Zinger, 2008). A robust environment for exports was caused by the favourable natural gas liquids cracking economics and the weakness in U.S dollar. Besides this, the significant capacity additions around the world started to impact ethylene derivative exports from North America resulting in a reduction in ethylene derivative trade from the region starting in 2009 (Zinger, 2008). As a large wave of delayed production capacity comes on-stream in the Middle East, coupled with an even larger capacity build in Asia, North American producers feel the full force of the downturn over the next 2 to 3 years (Dunwoodie, 2010). The name plate ethylene operating rates in North America are forecast to decline to 85-89 percent range during the period from 2010 to 2013 (Zinger, 2008). Figure 2.2 present ethylene and propylene production capacity in North America.

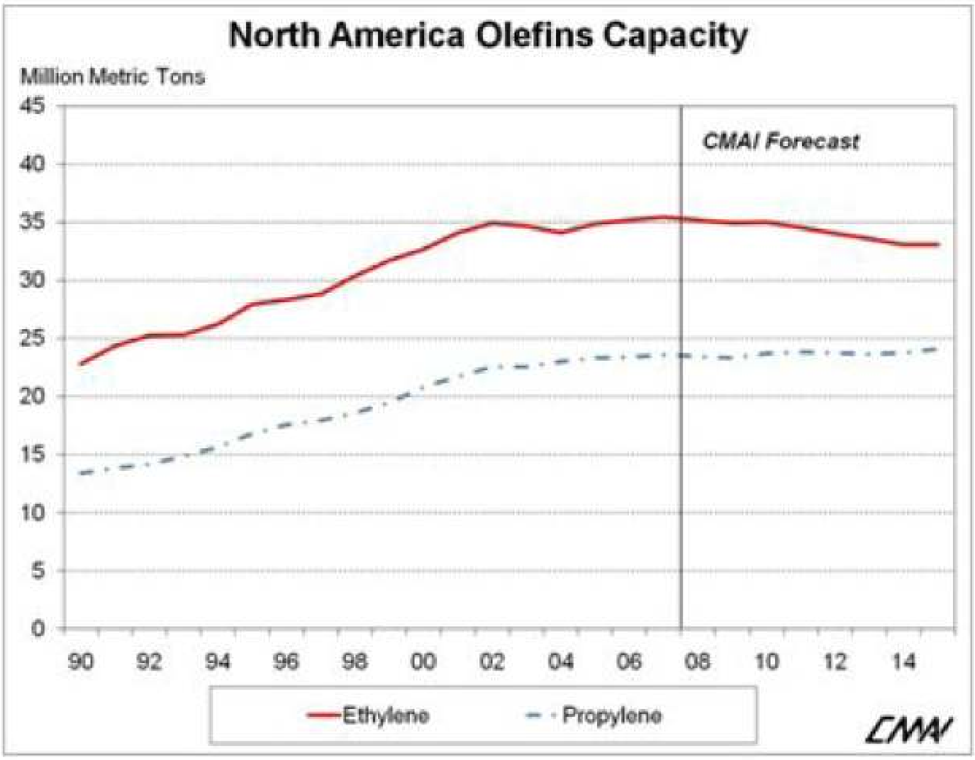


Figure 2.1: North American Olefins Capacity (Source: Zinger, 2008)

With starting-ups in the Middle East experiencing delays, low ethane prices generating a cost for North American producers and high demand in China, the ethylene exported in 2009, up to 12 % from 2008 (Dunwoodie, 2010). This strong export demand helped to offset weaker, recession-impacted domestic demand and led to a solid supply and demand balance.

The current petrochemical downturn is a challenge for North America due to the structural cost disadvantage compare to the Middle East. The Middle East producers are in the process of dramatically increasing their share of global trade in ethylene derivatives by its advantaged feedstock position and the substantial amount of capacity coming on-stream in the region. As a result, North America, which exported a record of 35 % of its net ethylene production in 2009, will likely see a gradual deterioration in its share of the global export market over the next five years (Dunwoodie, 2010).

A number of ethylene crackers in the Middle East have experienced delays and/or reduced operating rates. The delays had a beneficial impact on North American as the new capacity had been expected to displace ethylene product from higher cost regions including US. As the Middle East adds 3.5 million m.t. of new ethylene capacity (or 2.5 % of global ethylene capacity) in 2010 and the most of the projects are based on 30 % of natural gas costs in the US, Middle East will continue to gain international market share at the expense of producers in North American as shown in Figure 2.3 (Dunwoodie, 2010). Figure 2.4 shows the decline of petrochemical products in North America from 2004 to 2014.

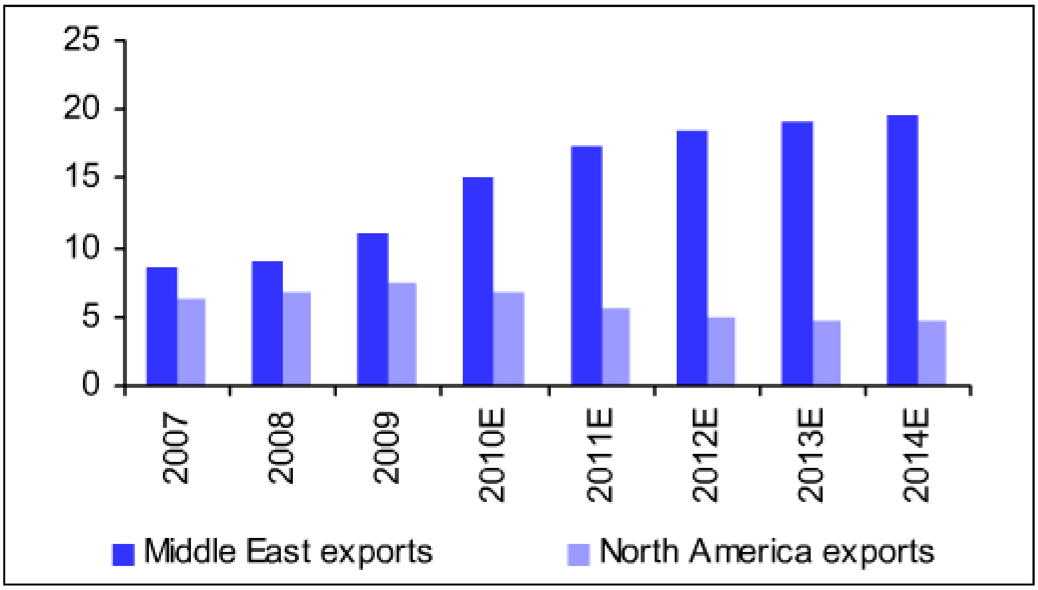


Figure 2.2: Middle East vs. North American Ethylene Equivalent Exports 2007-2014E (Source: Dunwoodie, 2010)

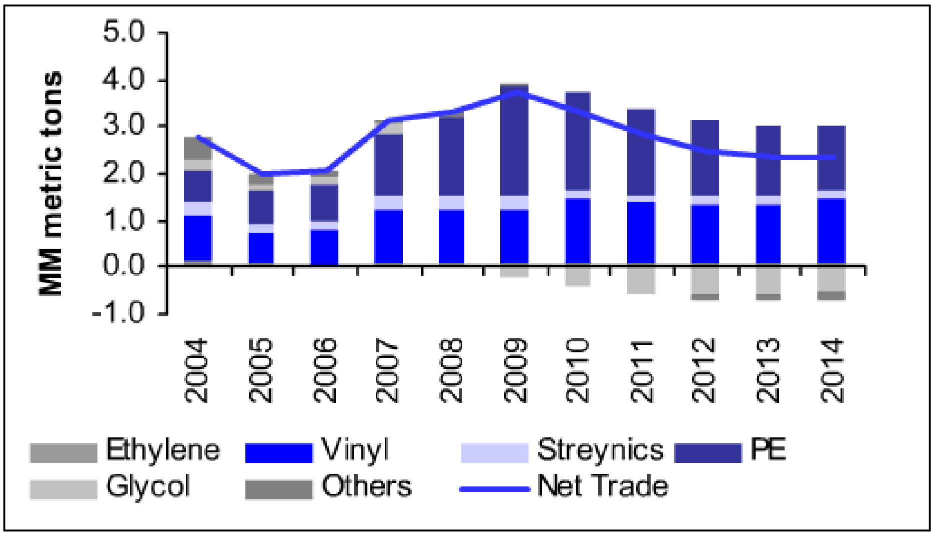


Figure 2.3: The decline in North America Petrochemical Exports (Source: Dunwoodie, 2010)

Propylene demand growth will continue to outplace ethylene demand growth on a regional and global basis. The industry emphasis remains on developing other sources of propylene beyond steam crackers. North America is expected to remain a global supplier of propylene and its derivatives for the future, although the Middle East is developing export-oriented propylene and its derivative capacity (Zinger, 2008).

2.2.2 West Europe

Production and domestic consumption of ethylene in Europe appear to have peaked in 2007. A modest decline is expected in the 2008-2010 period due to derivative import pressures (Zinger, 2008). The increase of ethylene derivative demand will be satisfied by the increase in derivative imports from the Middle East. The competitiveness of European olefins and derivative plants such as the Middle East is the main reason of no firm commitments exist for the construction of new grass roots steam cracker (Zinger, 2008). The net imports of ethylene and derivatives to Europe will increase from 750 kTA in 2009 to a peak of 3,250 kTA in 2011 as shown in Figure 2.5 (Dunwoodie, 2010).

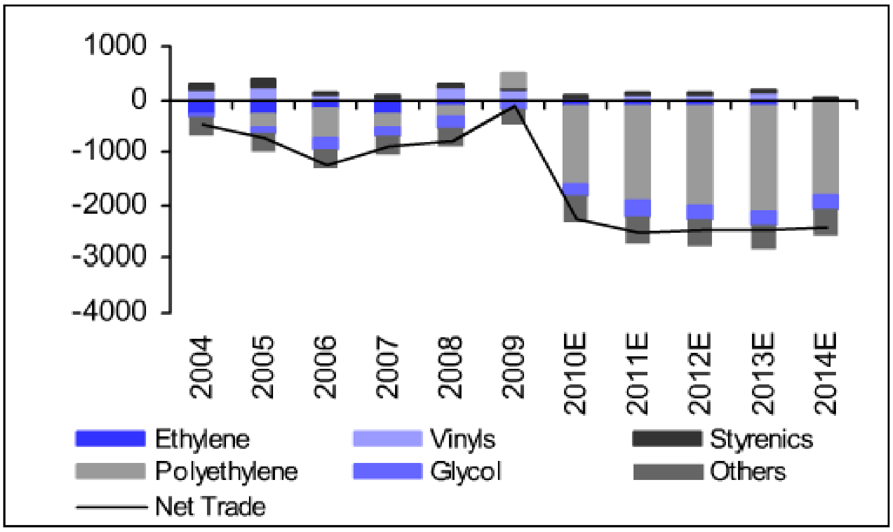


Figure 2.4: Western Europe a net important of product (Source: Dunwoodie,2010)

European ethylene producers are at disadvantages on costs of raw material and it sits higher than Middle East producers as shown in Figure 2.6. The cost per tonne for Middle Eastern producers is USD 250 whereas Western European producers structurally higher at approximately USD 700 (Dunwoodie, 2010). The wave of new cheaper Middle East capacity will have an impact on European markets with 8 % of current global capacity to come by 2015 (Dunwoodie, 2010).

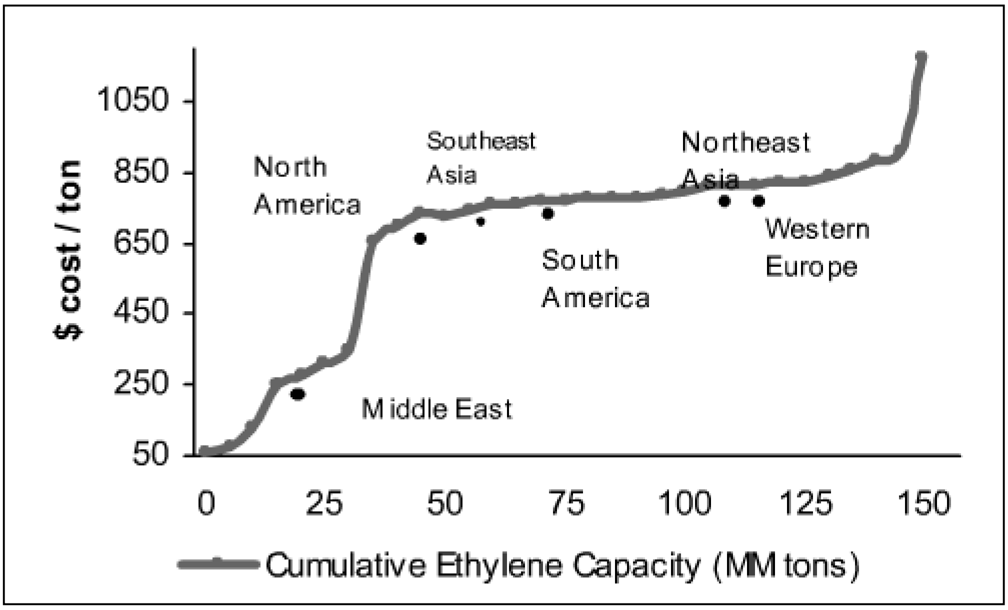


Figure 2.5: Global Ethylene Cost Curve (Source: Dunwoodie, 2010)

Other than the disadvantage of cost, there are also social issues in Europe with strong unions which will likely to prevent substantial capacity closures (Dunwoodie, 2010). The geographic dispersion of Europe's cracker, many of which are not connected to a pipeline network, often means a cracker shut down decision would be in fact a site shut down decision, which makes the decision much more difficult (Zinger, 2008).

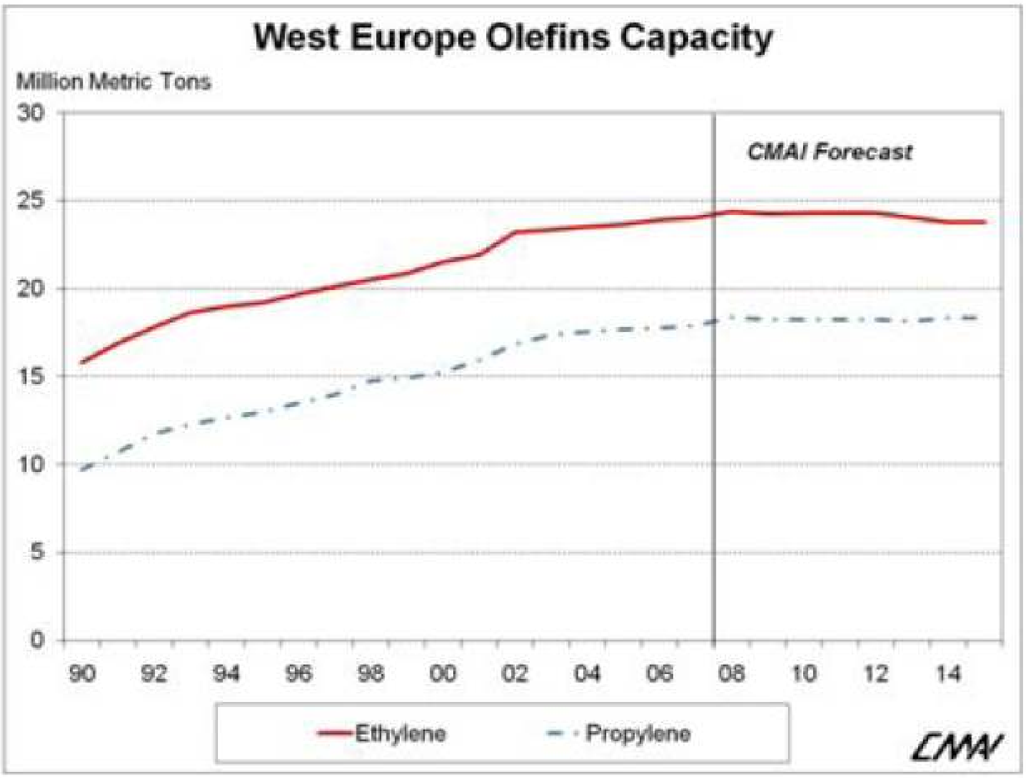


Figure 2.6: West Europe Olefins Capacity (Source: Zinger, 2008)

For the propylene industry, Middle East producers will export significant volumes of polypropylene to West Europe, displacing West Europe's current exports. As a result, domestic propylene monomer consumption growth will decline slightly over the next few years. West Europe will switch from being a net propylene derivative exporter to a net importer due to the advent of the Middle East polypropylene industry (Zinger, 2008). Figure 2.7 shows the olefins capacity of West Europe.

2.2.3 Middle East

The development of the petrochemicals industry in the Gulf regions can largely be attributed to the abundant natural gas reserves and the major part is associated gas (Dunwoodie, 2010). The fast expansion of the Middle East as a petrochemicals region has been fuelled by the development of the gas field between Qatar and Iran. It provides the cheap gas feedstock. The low cost of gas feedstock in the Middle East enable the region to experience very strong margins. Iran plans to add two ethylene crackers in 2010-2014 accounting for 4 of global ethylene capacity growth between the periods of 2010-2014 (Dunwoodie, 2010). Figure 2.8 shows the expansion of olefins and polyolefins in the Middle East.

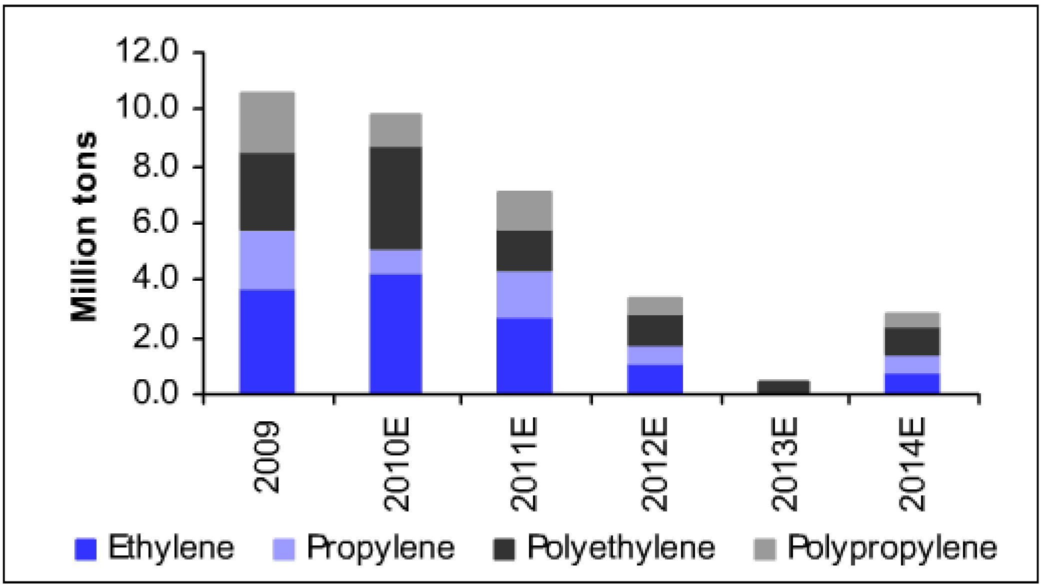


Figure 2.7: Middle East Expansion (Source: Dunwoodie, 2010)

The new capacity will be instrumental in shaping the global ethylene cycle, decreasing global operating rates between 2009-2011 to a point where cracker margins will be severely squeezed in most of the rest of the world, particularly North America, Europe and Asia (Zinger, 2008). The main causes of the delaying of the petrochemical projects in the Middle East are the shortage of engineering and construction resource, large increases in project development and execution costs (Dunwoodie, 2010). However, the projects in the Middle East region have been subjected to only minor delays. There will be insufficient delays to defer the forecast global capacity utilisation slow down (Zinger, 2008). Figure 2.9 shows the polyethylene expansions of the world and the Middle East is dominant in the production of polyethylene.

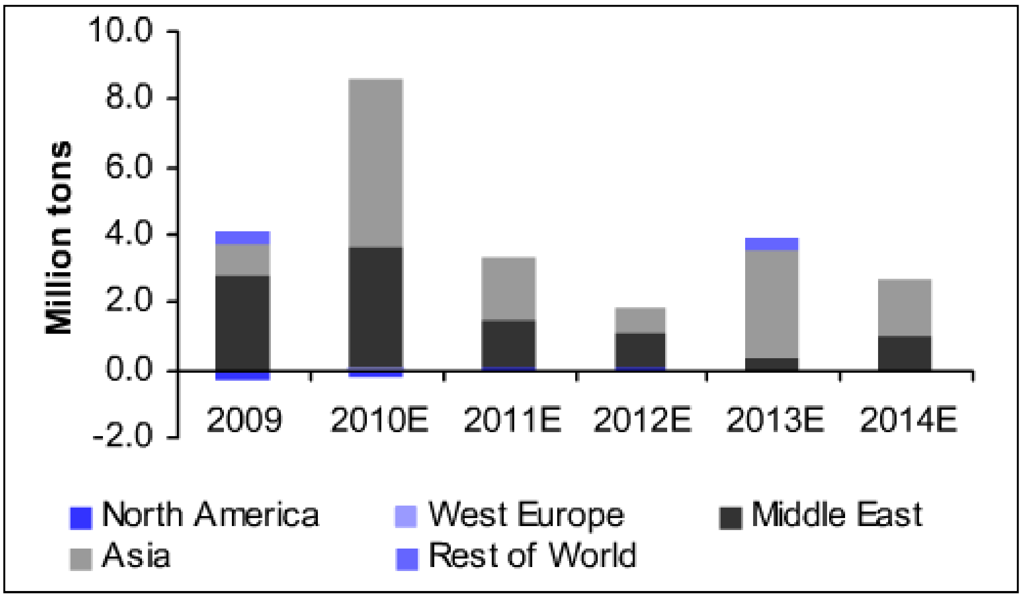


Figure 2.8: Polyethylene Expansions-Middle East is Dominant (Source: Dunwoodie, 2010)

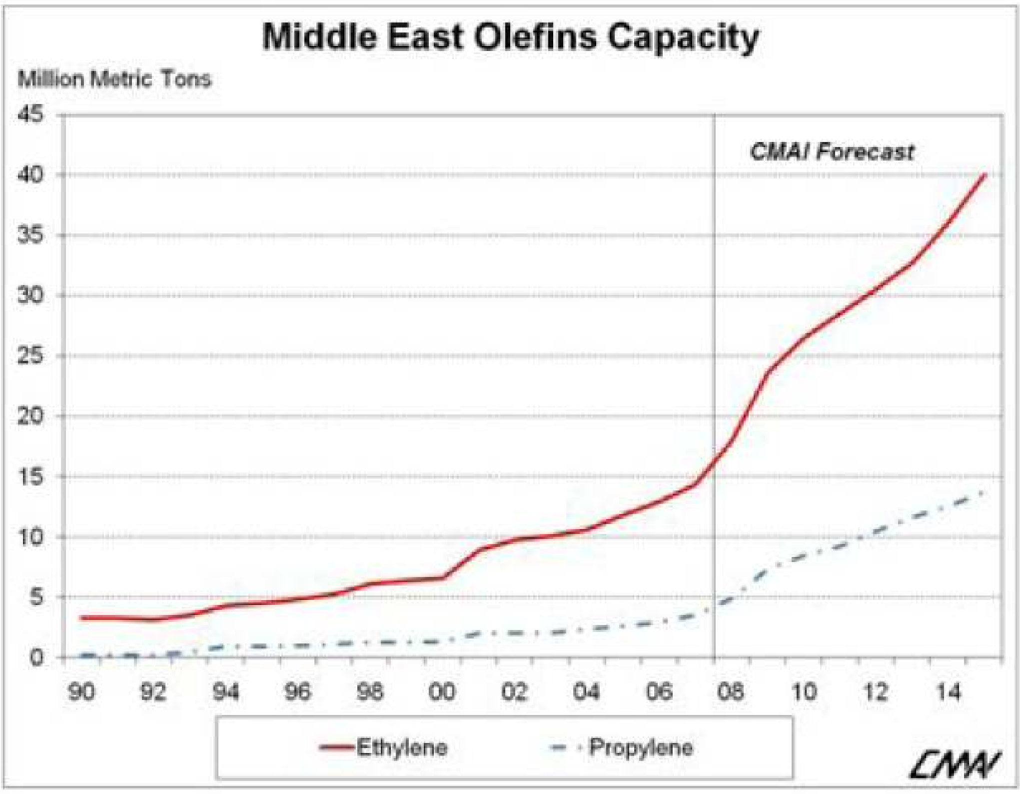


Figure 2.9: Middle East Olefins Capacity (Source: Zinger, 2008)

Figure 2.10 shows olefins capacity of the Middle East between 1990-2014. The Middle East is forecast to become a major net exporter of propylene in the form of polypropylene. Large volumes of propylene will be produced in the new Saudi mixed feed cracker and the region will also produce significant propylene from on-purpose technologies (Zinger, 2008). Other than polypropylene, the Middle East will produce more significant volumes of propylene derivatives. The incremental propylene production come from steam cracker running discounted LPG and condensate feedstock and propane dehydrogenation units using discounted propane (Zinger, 2008).

2.2.4 Asia

The flood of new capacity in China and the Middle East has implications on Korean, Japanese, and Taiwanese petrochemical producers. First of all, China will become more self-sufficient, thus growth in petrochemical imports into China is likely to stagnate. Secondly, the Middle-East producers are likely to penetrate the China import market and grab market share from other Asian producers (Dunwoodie, 2010).

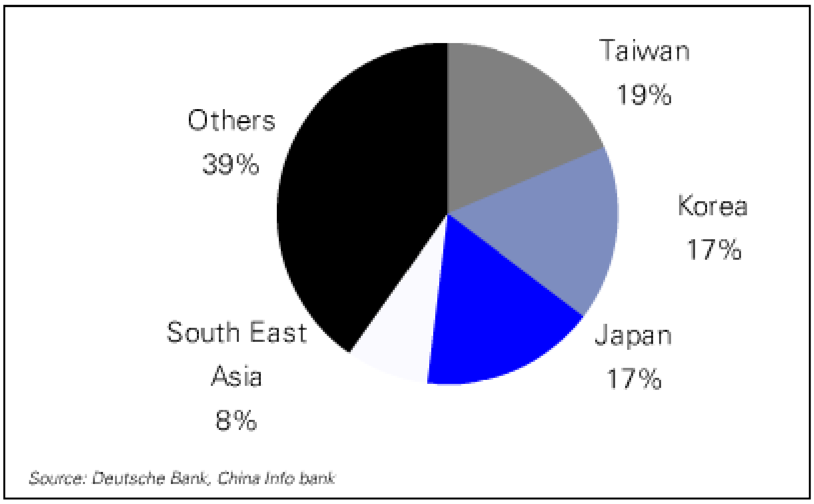


Figure 2.10: China Plastic Product Import by Origin (Source: Dunwoodie, 2010)

China demand has become crucial for its neighbourhood exporting countries, Japan, Korea and Taiwan. In Figure 2.11, Taiwanese players have had high dependency on the China market. As shown in Figure 2.12, an average over 30 % of petrochemical products from Taiwan were exported to China. In Figure 2.11 and Figure 2.13, Korean players have a certain level of dependency on China market but it is not as high as Taiwanese players.

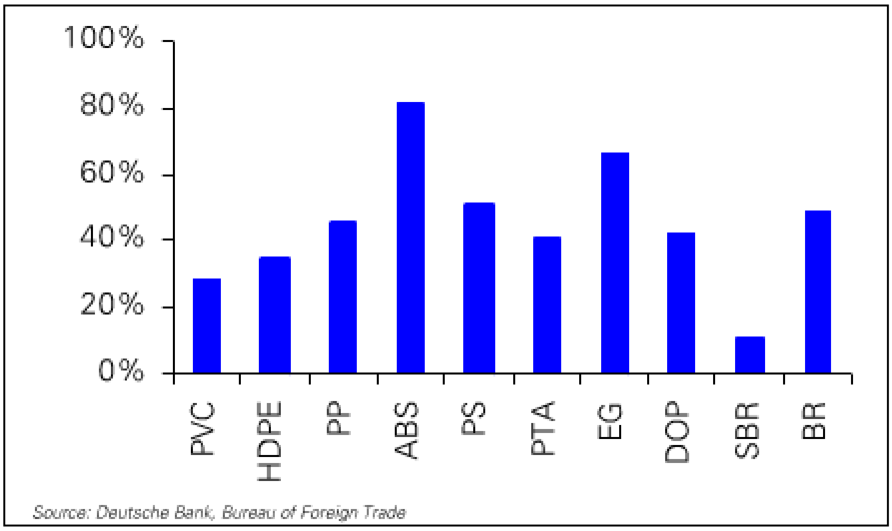


Figure 2.11: Percentage of Taiwan Petrochemical Products Export to China 2008 (Source: Dunwoodie, 2010)

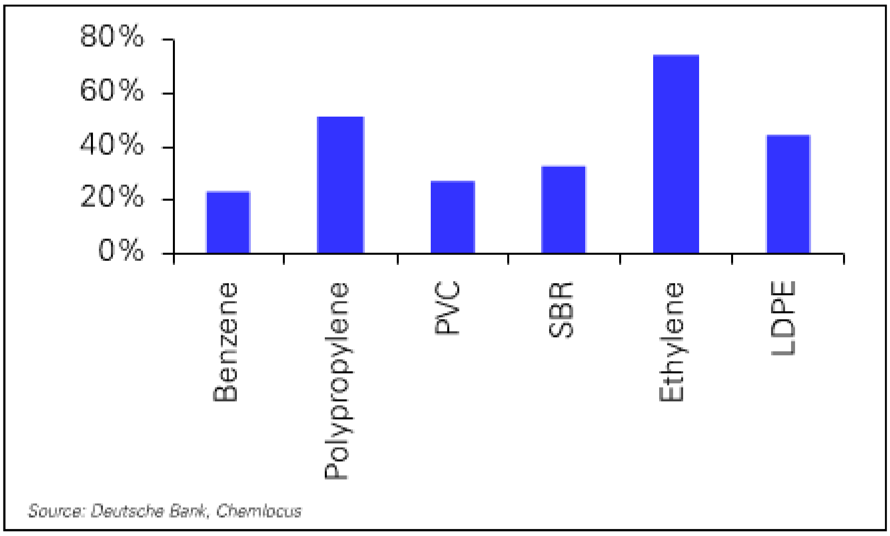


Figure 2.12: Percentage of Korea Petrochemical Products Export to China 2009 (Source: Dunwoodie, 2010)

Overall, Asian petrochemical players are likely to be affected by a flood of Middle East supply and fierce competition among themselves in the coming years (Zinger, 2008). A potentially shrinking China import market with new competition from the Middle East will be likely to accelerate the consolidation of uncompetitive players (Dunwoodie, 2010).

2.3 Overview of South East Asia Petrochemical Industry

2.3.1 Malaysia

The petrochemicals industry is one of the leading industries in Malaysia. In Malaysia, the petrochemical industry is being developed along an industrial cluster based approach (Sarmidi, 2001). Malaysia is a major exporter of petrochemical products within the ASEAN region, exporting both commodity grade polymer and petrochemical derivatives. The major foreign investors are Dow Chemical, British Petroleum, Amoco, Shell, BASF, Eastman Chemical, Toray, Mitsubishi, Idemitsu, Polyplastic, Dairen and Titan Petrochemicals Group (Malaysia Petrochemical Association [MPA], 2007)

Overall, Malaysia investments in the industry amounted to RM 34.8 billion (63 %), with PETRONAS being the major investor (MPA, 2007). Foreign investments, mainly from the USA and Germany, accounted for 36.7 % of the total investments in the industry (Market Watch, 2009). The development of the industry is mainly attributed to the availability of oil and gas as feedstock, a well-developed infrastructure, a strong base of supporting services, and the country's cost competitiveness, as well as Malaysia's strategic location within ASEAN and its close proximity to major markets in the Far East (MPA, 2007).

The production of petrochemicals has been stimulated by the availability of natural gas as feedstock for the industry. Malaysia is presently the third largest producer of LNG in the world, after Algeria and Indonesia, with a production capacity of 24 million metric tonne per annum, largely concentrated in the Bintulu complex in Sarawak (MPA, 2007). Methane, ethane, propane and butane are obtained from natural gas and used as feedstock for the petrochemicals industry. These feedstocks are produced by gas processing plants in Terengganu. The feedstocks are sent to petrochemical zones of Kertih in Terengganu and Gebeng in Pahang, as well as industrial areas in Peninsular Malaysia (Sarmidi, 2001). The table below shows the production, import, export and consumption of raw material in Malaysia.

Table 2.2: Production, Import, Export and Consumption of Raw Material in Malaysia (Source: Malaysia Petrochemical Association [MPA], 2009)

Product	Unit: kTA	2007	2008	2009	%Change +/- (2009 vs 2008)
Ethylene	Production	1,581	1,686	1,617	-4%
	Import	10	10	-	-
	Export	101	136	140	3%
	Consumption	1,498	1,536	1,477	-4%
Propylene	Production	839	870	867	0.30%
	Import	33	40	25	-38%
	Export	78	97	95	-2%
	Consumption	765	811	797	-2%

The industry also uses naphtha obtained from petroleum refining. Naphtha is available from the existing petroleum refineries in Peninsular Malaysia. A large proportion of naphtha is also imported. The naphtha cracker in Pasir Gudang-Tanjung Langsat, Johor, provides ethylene, propylene and butadiene as feedstocks for the production of polypropylene, polyethylene and aromatics. Table 2.3 show the nameplate capacity for raw material in Malaysia in 2009.

Table 2.3: Nameplate Capacity for Raw Material in Malaysia in 2009 (Source: MPA, 2009)

Product	Company	Capacity (kTA)
Ethylene	Ethylene Malaysia Sdn Bhd	400
	Optimal Olefins (M) Sdn Bhd	600
	Titan Chemicals Corp. Bhd	730
Total Ethylene		**1,730**
Propylene	Optimal Olefins (M) Sdn Bhd	95
	Titan Chemicals Corp. Bhd	520
	MTBE (M) Sdn Bhd	380
	Shell (FCC)	140
Total Propylene		**1,135**

Today, the petrochemical industry is developing rapidly in three main petrochemical zones, i.e. , Kertih in Terengganu, Gegeng in Pahang, and Pasir Gudang-Tanjung Langsat in Johor (MPA,2009).

Malaysia is a net exporter of polyolefins with export of 620 KMT compared to import of 410 KMT in 2006. Major exporting destinations were China, South East Asia and India Sub-Continent (MPA, 2007). Table 2.4, 2.5, 2.6 and 2.7 shows the supply and demand of LDPE, LLDPE, HDPE and PP respectively.

Table 2.4: Supply and Demand of LDPE in Malaysia (Source: MPA, 2009)

Product		2006	2007	2008	2009E
Supply	Production	470	480	465	458
	Import	20	11	24	20
	Export	490	491	489	478
Demand	Production	110	113	124	125
	Import	380	366	347	353
	Export	490	479	471	478

Table 2.5: Supply and Demand of LLDPE in Malaysia (Source: MPA, 2009)

Product		2006	2007	2008	2009E
Supply	Production	55	60	57	65
	Import	195	210	238	234
	Export	250	270	295	299
Demand	Production	250	270	294	296
	Import	0	0	1	296
	Export	250	270	295	299

Table 2.6: Supply and Demand of HDPE in Malaysia (Source: MPA, 2009)

Product		2006	2007	2008	2009E
Supply	Production	462	505	481	505
	Import	190	196	161	160
	Export	652	701	642	665
Demand	Production	460	480	472	480
	Import	190	221	170	180
	Export	650	701	642	660

Table 2.7: Supply and Demand of Polypropylene in Malaysia (Source: MPA, 2009)

Product		2006	2007	2008	2009E
Supply	Production	440	450	417	488
	Import	80	85	98	92
	Export	520	535	515	580
Demand	Production	315	340	343	352
	Import	200	195	172	200
	Export	515	535	515	552

2.3.2 Thailand

Petrochemical industry is one of the most important primary industries to Thailand's economic development. In 2006, the exporting values of upstream, intermediate and downstream petrochemical products are 27,694, 41,729 and 15,1486 million Baht (Ministry of Energy, 2007). Figure 2.14 shows the production of Thailand's petrochemical industry from 2003 to 2006.

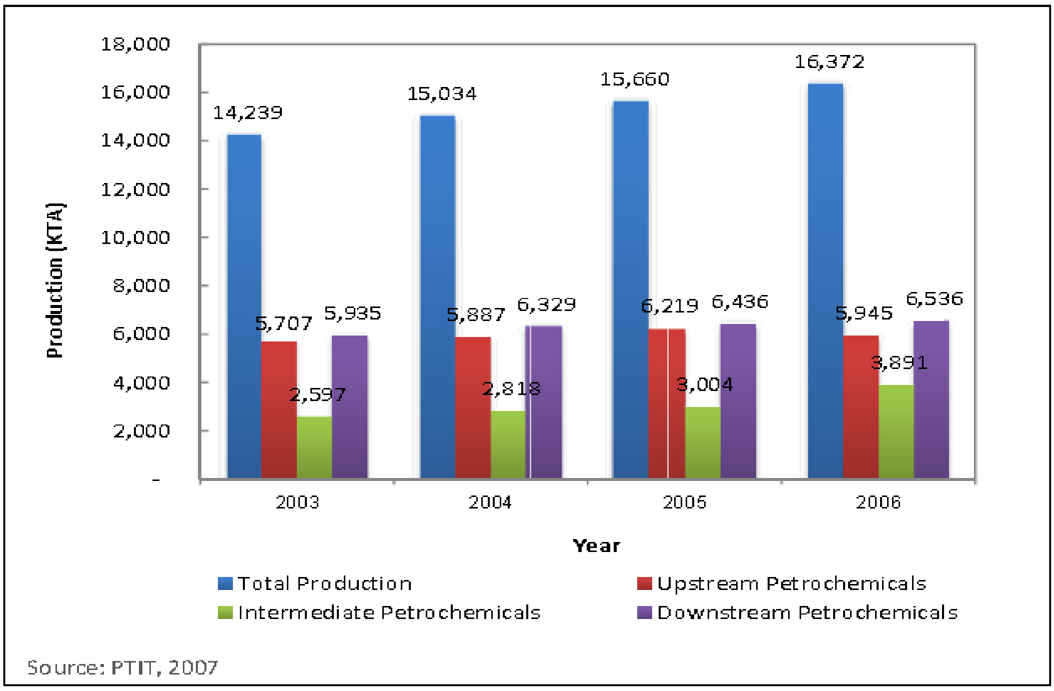


Figure 2.13: Production of Thailand's Petrochemical Industry from Year 2003 to 2006 (Source: Ministry of Energy, 2007)

Most of the petrochemical plants are located in the industrial estates in Rayong province. Rayong province is located less than 200 km from Bangkok and it is where plastic processing business is located. It is surrounded by high potential industries such as electronic and appliance. Well planned infrastructure such as utilities, waste management and transport system is another important factor for the development of petrochemical industry (Danpadungtham, 2006). Table 2.8 presents the production, consumption, import and export of five major petrochemical products from 2005 to 2008 in Thailand. Table 2.9, 2.10, 2.11 and 2.12 show the capacity of ethylene, polyethylene, propylene and polypropylene respectively of Thailand in 2008.

Table 2.8: Production/Consumption and Import/Export of Five Major Products 2005-2008 (Source: Petroleum Institute of Thailand [PTIT], 2009)

Product	Unit: kTA	2005	2006	2007	2008
Ethylene	Production	2,216	2,391	2,347	2,201
	Import	42			210
	Export	186	145	16	0
	Consumption	2,050	2,286	2,469	2,464
Propylene	Production	1,211	1,246	1,220	1,120
	Import	20	0	0	5
	Export	79	79	71	33
	Consumption	1,226	1,226	1,230	1,141
PTA	Production	1,500	2,247	2,562	2,184
	Import	77	38	2	3
	Export	535	1,291	1,487	1,207
	Consumption	1,088	1,085	1,090	980
PE	Production	1,660	1,800	1,788	1,782
	Import	233	234	273	263
	Export	840	888	929	984
	Consumption	1,072	1,105	1,120	1,094
PP	Production	1,167	1,171	1,149	1,087
	Import	142	125	156	172
	Export	487	422	347	314
	Consumption	842	865	963	945

Table 2.9: Capacity of Ethylene 2008 (Source: PTIT, 2009)

Company	Capacity
IRPC	360
ROC	800
PTTCH	1,276
Total	**2,436**

Table 2.10: Capacity of Polyethylene 2008 (Source: PTIT, 2009)

Company	Capacity				
	LDPE/ EVA	LLDPE	LLDPE/ MDPE	HDPE	Total
TPE	100		120	580	800
TPI Polene	158				158
IRPC				152	152
PTTCH				250	250
Siam Polyethylene		300			300
BPE				250	250
Total	**258**	**300**	**120**	**1,232**	**190**

Table 2.11: Capacity of Propylene 2008 (Source: PTIT, 2009)

Company	Capacity
PTTCH	437
ROC	400
SPRC	132
IRPC	312
Total	**1,281**

Table 2.12: Capacity of Polypropylene 2008 (Source: PTIT, 2009)

Company	Capacity
HMC	455
IRPC	475
TPP	320
Total	**1,250**

2.3.3 Singapore

Singapore sits at the confluence of two great rivers of oil. Flowing in are the huge volumes from the rich oil fields of the Middle East, and gushing out are the refined petrochemicals products to the world's greatest consuming nations such as China, Japan and the United States. Singapore is today among the world's top three refining centre and one of the top ten petrochemical hubs (Monetary Authority of Singapore [MAS], 1999).

At the southwestern tip of the country lies Jurong Island, which the Singapore Economic Development Board (EDB) calls the "nerve centre" of the chemicals cluster (MAS, 1999). More than 90 companies are engaged in a range of manufacturing activities, with well developed infrastructure that is protected by a multi-layered security framework, and includes a chemical logistic park which provides incentives for investors (Monetary Authority of Singapore [MAS], 2003). Table 2.13 and Table 2.14 show the production capacity of raw materials and polyolefins in Singapore respectively.

Table 2.13: Production Capacities for General Matters and Raw Materials (Source: Singapore Chemical Industry Council Limited [SCIC], 2009)

Product	Total Production Capacity (tpa)
Ethylene	18800000
Propylene	1055000
Butadiene	60000
Benzene	420000
Toulene	145000
Xylenes	495000

Table 2.14: Production Capacities for Polyolefins (Source: SCIC, 2009)

Product	Total Production Capacity (tpa)
Polyethylene	1270000
Polypropylene	370000
MTBE	238000

2.3.4 Philippines

Philippines's petrochemical industry is still well behind those of other countries in the South East Asia region. In the Philippines, there are only downstream petrochemical production such as LLDPE, HDPE, PS and PVC. There are no upstream production such as olefins and aromatics in the country (Irani, 2000). The production capacity of Philippines petrochemical industry is shown in Table 2.15.

Table 2.15: Philippines Petrochemicals-Current Production (Source: Irani, 2000)

Product	Total capacity (mtpa)	Company
LLDPE/HDPE	175	JG Summit Petrochemical
LLDPE/HDPE	250	Bataan Polyethylene
Total LLDPE/HDPE	425	
PP	225	PETROCORP
PP	180	JG Summit
Total PP	405	
Total PS	52	By five producers
Total PVC	112	By three producers

2.3.5 Indonesia

The Indonesian petrochemical industry is progressing slowly towards recovery after the late-1990s economic crisis. The Asian economic crisis damaged the petrochemical industry. Many of the remaining companies have heavy debt. Since 2005, petrochemical producers have also faced high prices for raw material as a result of soaring global crude prices. There is only an ethylene cracker, Chandra Asri Petrochemical Center in Indonesia, with annual capacity of 550,000 tons. The capacity is well below Indonesia's annual demand of over 900,000 tons (Embassy of the United States of America, 2006). As a result, almost half of ethylene demand is supplied through imports. Table 2.16 shows the capacity of petrochemical industry in Indonesia.

Table 2.16: Petrochemical Industry in Indonesia (Source: Embassy of the United States of America, 2006)

Products	Annual Capacity (1000MT)	Production			Utilization 2006
		2004	2005	2006	
Ethylene	550	485	488	490	89%
Polyethylene	750	445	461	470	63%
Polyvinyl Chloride	589	362	377	400	68%
Ethylene Glycol	220	195	202	206	94%
Propylene	513	352	365	598	117%
Polypropylene	600	508	526	536	89%
Styrene Monomer	300	283	290	303	101%
Polystyrene	130	70	73	83	64%

CHAPTER 3

METHODOLOGY

3.1 Plant Capacity and Location

Plant capacity is the ability of a petrochemical plant to produce the petrochemical products. The ability of a country to produce chemical products depends on domestic plant capacity. The size and number of crackers determines a country's likely output. Three sources were used for this research: government, petrochemical company and third-party source to state year-end capacity for ethylene, propylene, polyethylene and polypropylene. The capacities of expansion projects or new plant project were stated as well.

3.2 Demand and Supply Forecast

There are a few methods used to generate the demand and supply forecasts:

1. Underlying economic growth trends.
2. Government or industry projections
3. Third party forecasts from national or international industry trade association.

3.3 Maps

For this research, South East Asia map is drawn by using AutoCAD software and the plant capacity data and location of the petrochemical plants were added into the maps as well.

3.4 Graphs

In order to study the trends of the development of petrochemical industry, the plant capacity data were presented in graph form by using Microsoft Office-Excel.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Study of Plant Capacity and Location

4.1.1 Existing and Planning Olefin Plant

Table 4.1: Existing Olefins Plants in Southeast Asia for 2011 (Source: Chemical Market Associates Inc [CMAI], 2008; BMI, 2010a,2010b, 2010c, 2010d, 2010e, 2010f; Asia Petrochemical Industry Conference [APIC], 2010a, 2010b, 2010c, 2010d)

COMPANY	LOCATION	PRODUCT	CAPACITY (kTA)
OLEFINS PLANT			
1. Exxon Chemical Pte. Ltd.	Chawan, Singapore	Ethylene	1875
		Propylene	830
2. PTT Chemical Co.	Map Ta Phut, Thailand	Ethylene	1378
		Propylene	250
3. Petrochemical Corp. of Singapore Pte. Ltd.	Merbau, Singapore	Ethylene	1080
		Propylene	530
4. PTT Polyethylene	Map Ta Phut, Thailand	Ethylene	1000
5. Map Ta Phut Olefins Co.	Map Ta Phut, Thailand	Ethylene	900
		Propylene	450
6. Rayong Olefins	Map Ta Phut, Thailand	Ethylene	800
		Propylene	400
7. Shell Eastern Petroleum Pte.Ltd.	Bukom, Singapore	Ethylene	800
		Propylene	400
8. Titan Petrochemicals Corp.	Pasir Gudang, Malaysia	Ethylene	690
		Propylene	480
9. Optimal Olefins	Kertih, Malaysia	Ethylene	600
		Propylene	95

Table 4.1 (continued)

10. P. T. Chandra Asri	Cilegon, Indonesia	Ethylene Propylene	550 300
11. Ethylene Malaysia Sdn. Bhd.	Kertih, Malaysia	Ethylene	400
12. Integrate Refinery&Petrochemical Complex Co. (IRPC)	Rayong, Thailand	Ethylene Propylene	350 180
13. Pertamina	Balongan	Propylene	190
14. MTBE Malaysia	Gebeng, Malaysia	Propylene	80
15. Shell Refining Co.	Port Dickson, Malaysia	Propylene	80

Table 4.2: Planning Olefins Plants in Southeast Asia (Source: Yim et al., 2010)

COMPANY	LOCATION	PRODUCT	CAPACITY (kTA)	ON-STREAM
PLANT IN PLANNING STAGE				
1. JG Summit Petrochemical	Batangas, Philippines	Ethylene Propylene	600 310	2015
2. JG Summit Petrochemical	Batangas, Philippines	Ethylene Propylene	320 190	2013
3. Philippines National Oil Company	Bataan, Philippines	Ethylene Propylene	600 300	2015
4. Petrovietnam	Dung Quat, Vietnam	Ethylene Propylene	350 150	2015
5. Long Son PC. Co.	Vung Tau,Vietnam	Ethylene Propylene	1050 600	2014
6. Integrated Refinery&Petrochemical Complex Co. (IRPC)	Rayong, Thailand	Propylene	100	2013

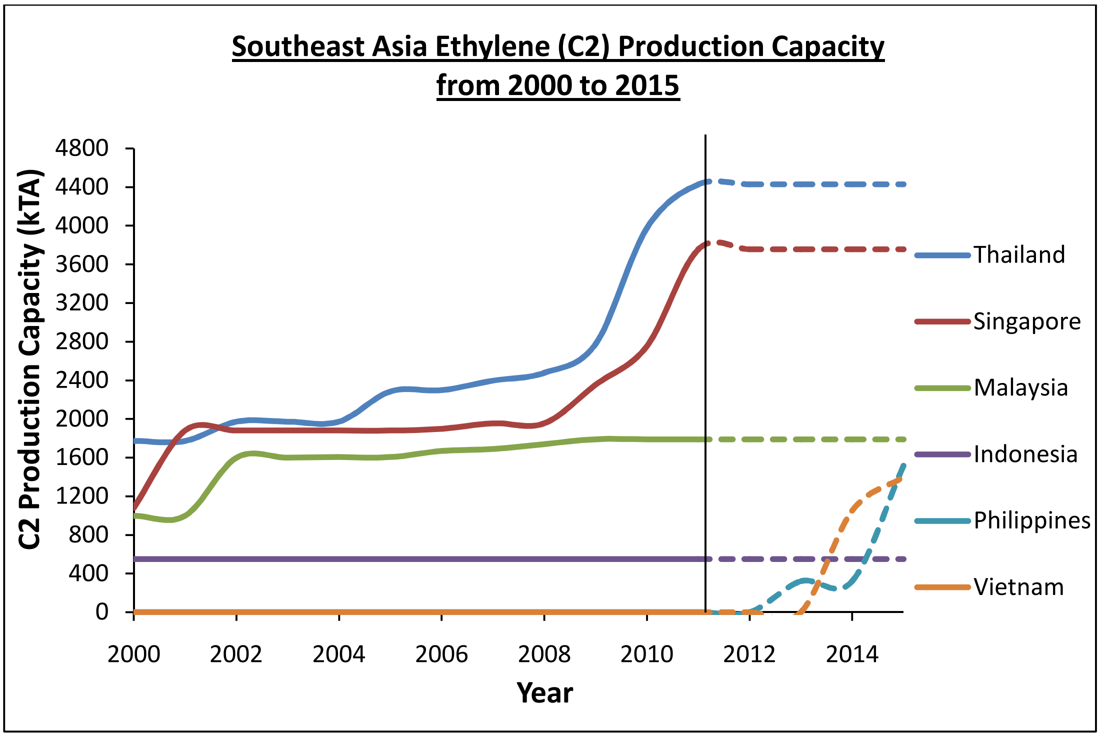


Figure 4.1: Southeast Asia Ethylene Production Capacity from 2000 to 2015 (Source: CMAI, 2008; BMI, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f; Yim et al., 2010)

Table 4.1 and 4.2 shows the existing and planning olefins plants in Southeast Asia. Figure 4.1 presents ethylene production capacity in Southeast Asia countries from 2000 to 2015. In 2011, Thailand is the leading ethylene producer in Southeast Asia region, followed by Singapore, Malaysia, and Indonesia while Philippines and Vietnam own no cracker plant at the moment.

For Thailand, there was a slight increase of 200 kTA between 2001 and 2002 due to the expansion of Rayong Olefins's cracker plant from 600 kTA to 800 kTA (Chemical Market Associates Inc [CMAI], 2008). The production capacity remained unchanged from 2002 to 2004 as there was no expansion of existing plant or start-up of new cracker plant. In 2005, there was a 300 kTA cracker plant came on-stream in Thailand and it is owned by PTT Chemical (CMAI, 2008). From 2006 to 2008, the capacity growth increased slowly. There was a dramatic increase in ethylene capacity from 2009 to 2011 as there were two new cracker plants came on-stream which are natural gas-based PTT Polyethylene's cracker with 1,000 kTA capacity and naphtha-based Map Ta Phut Olefins's cracker with 900 kTA capacity (CMAI, 2008). The production capacity will remain unchanged as there is no planning of new plant or expansion of plant has been announced (Yim et al., 2010).

The start-up of Exxon Chemical's first cracker plant increased 800 kTA of ethylene production capacity of Singapore in 2001 (CMAI, 2008). After that, the growth of capacity has increased slightly until 2009. The rapid growth after 2009 was due to the start-up of Shell Eastern Petroleum Pte. Ltd.'s first cracker plant with a capacity of 800 kTA and Exxon Chemical's second cracker with 1,000 kTA capacity in Singapore in 2010 and 2011 respectively (CMAI, 2008). For Thailand, there will be no growth of capacity until 2015 (Yim et al., 2010).

In 2001, the Optimal Olefin Sdn. Bhd. came on-stream with a capacity of 600 kTA at Kertih, Malaysia (CMAI, 2008). Following this, the growth increase gradually as there were expansions of Titan Petrochemicals's crackers and Ethylene Malaysia's cracker (CMAI, 2008). There will be no increase after 2011 until 2015 (Yim et al., 2010).

On the other hand, there is only one sole producer, P. T Chandra Asri in Indonesia. There was no expansion of cracker plant in the past 11 years (CMAI, 2008). It will remain unchanged until 2015 (Yim et al., 2010). There are new plants in planning stage and will come on-stream during 2013 to 2015 for Philippines and Vietnam. For Philippines, JG Summit Petrochemical's two new crackers with a capacity of 600 kTA and 320 kTA will start the production in 2015 and 2013 respectively (Yim et al., 2010). Another new cracker plant is owned by Philippines National Oil Company which has a capacity of 600 kTA and it will come on-stream in 2015 (Yim et al., 2010). Petrovietnam's and Long Son's planning cracker will be brought on-stream in 2015 and 2014 respectively (Yim et al., 2010).

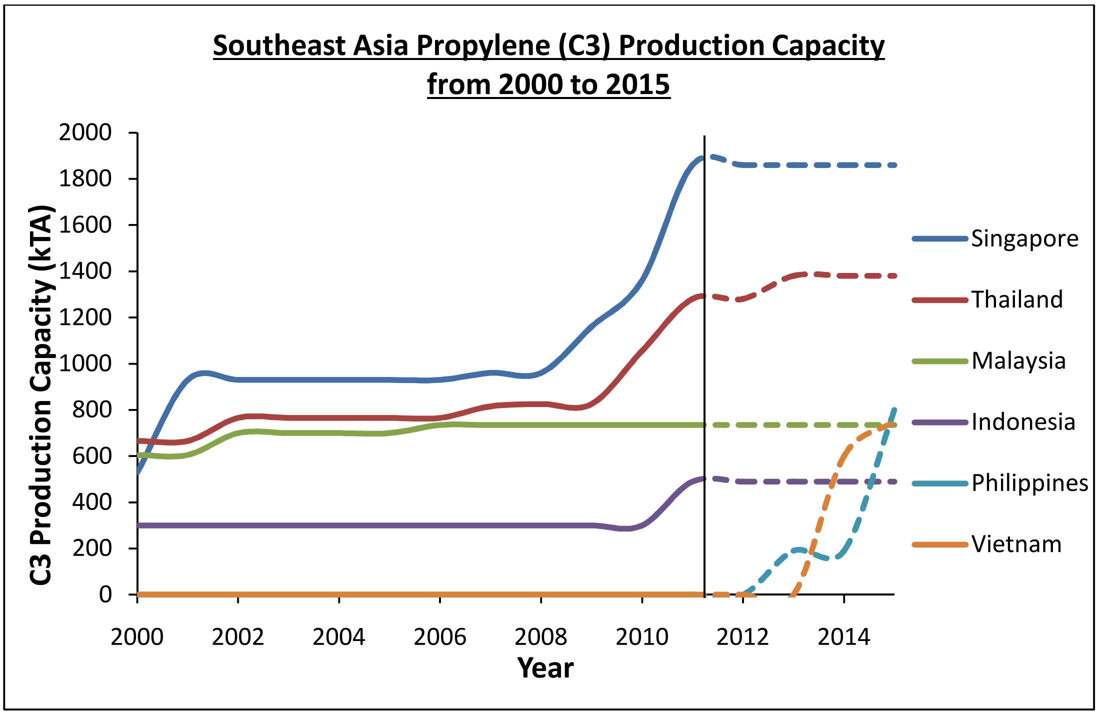


Figure 4.2: Southeast Asia Propylene Production Capacity from 2000 to 2015 (Source: CMAI, 2008; BMI, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f; Yim et al., 2010)

Figure 4.2 shows propylene production capacity in Southeast Asia countries from 2000 to 2015. In terms of production capacity of propylene, Singapore is the leading producer in Southeast Asia and this is followed by Thailand, Malaysia and Indonesia. Philippines and Vietnam do not produce propylene at the moment.

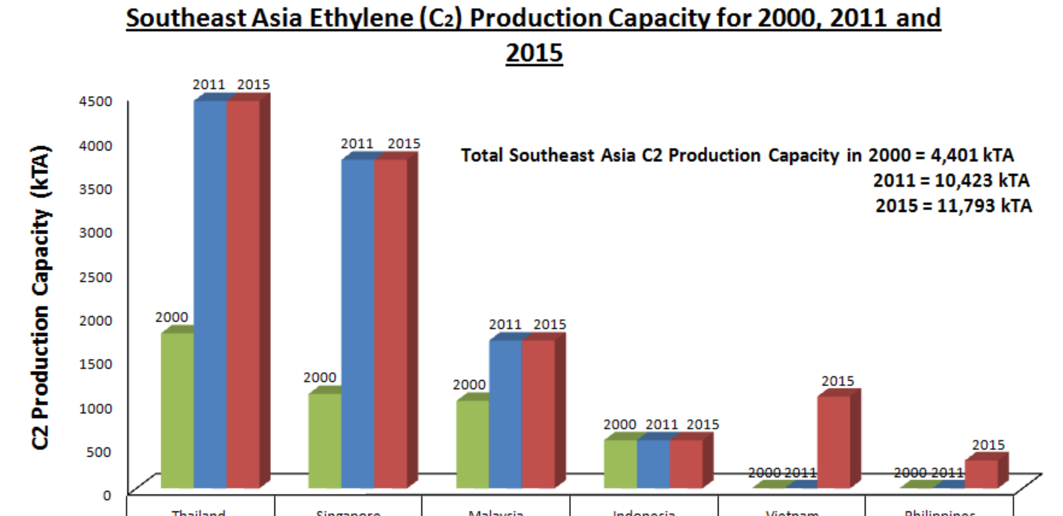
For Singapore, the start-up of Exxon Chemical's naphtha-based cracker increased the capacity by 400 kTA in 2001. From 2002 to 2009, the growth increased gradually. The start-up of Shell Eastern Petroleum Pte. Ltd.'s cracker and Exxon Chemical's second cracker increased 400 kTA and 500 kTA of propylene in 2010 and 2011 respectively.

There was a slight increase of 100 kTA between 2001 and 2002 due to the expansion of Rayong Olefins's cracker plant at Map Ta Phut, Thailand (CMAI, 2008). The production capacity remained unchanged from 2002 to 2006 as there was no expansion of existing plant or start-up of new cracker plant. There was a slight increase in propylene capacity from 2007 to 2009 as there were some plant expansions. The new naphtha-based Map Ta Phut Olefins's cracker has increased the capacity by 450 kTA in 2011 (CMAI, 2008). In 2013, the propylene capacity will be increased by another 100 kTA as there will be a new metathesis unit owned by Integrated Refinery &Petrochemical Complex Company (Yim et al., 2010).

For Malaysia, there were only addition of 95 kTA and 35 kTA in 2001 and 2006 respectively from 2000 to 2011 (CMAI, 2008). It will remain unchanged until 2015 (Yim et al.,2010).

The situation in Indonesia is the same as Malaysia's. There was no plant expansion or new plant from 2000 to 2009. Pertamina started its new metathesis plant in production which can produce 190 kTA of propylene in 2010 (Yim et al., 2010). The growth of propylene capacity remains constant until 2015 (Yim et al., 2010).

For Philippines, JG Summit Petrochemical's two new crackers with 310 kTA and 190 kTA will start the production in 2015 and 2013 respectively (Yim et al., 2010). Another new cracker plant is owned by Philippines National Oil Company which has a capacity of 300 kTA and it will come on-stream in 2015 (Yim et al., 2010). Long Son's and Petrovietnam's planning cracker with 600 kTA and 150 kTA will be brought on-stream in 2014 and 2015 respectively (Yim et al., 2010).



	Thailand	Singapore	Malaysia	Indonesia	Vietnam	Philippines
2000	1772	1080	999	550	0	0
2011	4428	3755	1690	550	0	0
2015	4428	3755	1690	550	1050	320

Figure 4.3: Southeast Asia Ethylene Production Capacity for 2000, 2011 and 2015 (Source: APIC, 2010a, 2010b, 2010c, 2010d; Yim et al., 2010)

Figure 4.3 shows Southeast Asia ethylene capacity for 2000, 2011 and 2015. As observed from Figure 4.3, the growth of ethylene capacity was rapid between 2000 and 2011 for Thailand and Singapore. The capacity increased by 2,656 kTA and 2,675 kTA for Thailand and Singapore respectively. However, there is no increase in capacity between 2011 and 2015 for both countries. From 2000 to 2011, there was only addition of 691 kTA for Malaysia and no addition of capacity from 2011 to 2015. The growth of Malaysia's petrochemical industry is not as rapid as Singapore's and Thailand's. For Indonesia, the production capacity remains unchanged in these 15 years. Although there was no cracker plant in Philippines and Vietnam until now, however, the ethylene capacity will be 1,400 kTA and 1,520 kTA for Vietnam and Philippines respectively in 2015.

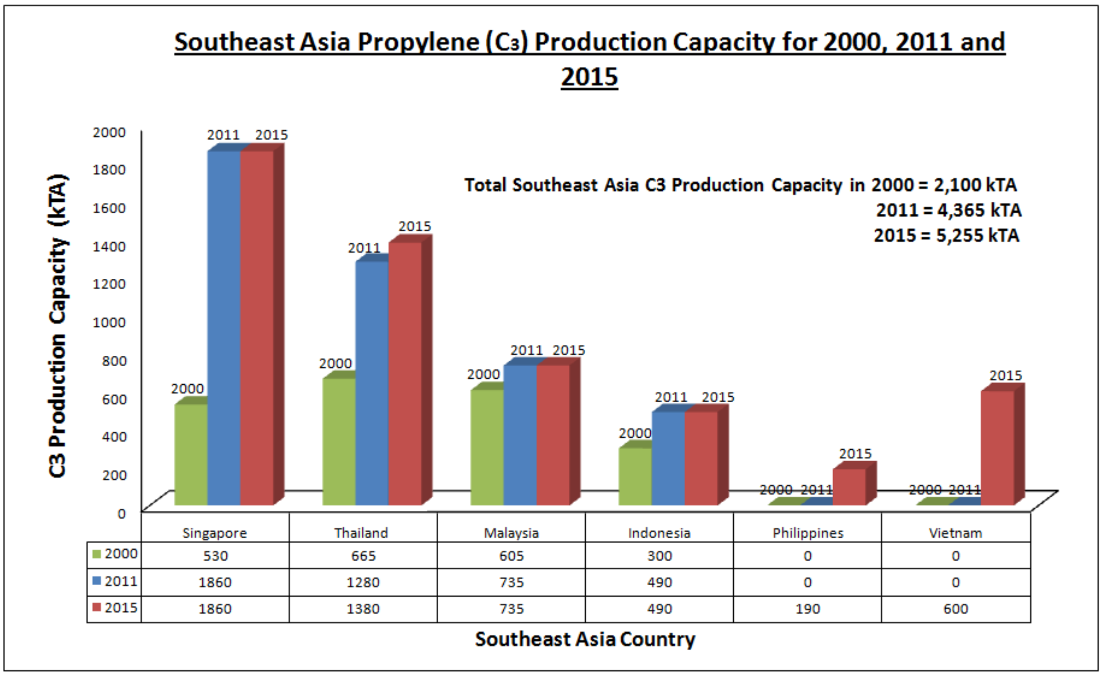


Figure 4.4: Southeast Asia Propylene Production Capacity for 2000, 2011 and 2015 (Source: APIC, 2010a, 2010b, 2010c, 2010d; Yim et al., 2010)

Figure 4.4 presents Southeast Asia propylene capacity for 2000, 2011 and 2015. The growth of propylene capacity was rapid between 2000 and 2011 for Singapore. The capacity increased by 1,330 kTA. However, there is no increase in capacity between 2011 and 2015 for Singapore. The production capacity of Thailand increased by 615 kTA from 2000 to 2011 and it is further increased by 100 kTA from 2011 to 2015. From 2000 to 2011, there was only addition of 130 kTA for Malaysia and no addition of capacity from 2011 to 2015. The growth of Malaysia's petrochemical industry is not as rapid as Singapore and Thailand. For Indonesia, the production capacity increased by 190 kTA in 2010 but remains unchanged after 2011 until 2015. Although there was no cracker plant in Philippines and Vietnam until now, however, the propylene capacity will be 800 kTA and 750 kTA for Philippines and Vietnam respectively in 2015.

4.1.2 Exisiting Polyethylene and Polypropylene Plants

Table 4.3: Existing Polyethylene (PE) Plants in Southeast Asia for 2011 (Source: BMI, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f; APIC, 2010a, 2010b, 2010c, 2010d)

COMPANY	LOCATION	PRODUCT	CAPACITY (kTA)
POLYETHYLENE (PE) PLANTS			
1. Titan Petrochemicals Corp.	Pasir Gudang, Malaysia	LLDPE	220
		LDPE	230
		HDPE	115
2. Thai Polyethylene	Map Ta Phut, Thailand	LLDPE	120
		LDPE	100
		HDPE	580
3. Integrated Refinery&Petrochemical Complex Co. (IRPC)	Rayong, Thailand	LDPE	160
		HDPE	150
4. P. T. Chandra Asri	Cilegon, Indonesia	LLDPE	200
		HDPE	100
5. Exxon Chemical Pte. Ltd.	Chawan, Singapore	LLDPE	480
6. Siam Polyethylene	Map Ta Phut, Thailand	LLDPE	300
7. Polyethylene Malaysia	Kertih, Malaysia	LLDPE	150
8. P. T. Titan	Merak, Indonesia	HDPE	450
9. Chevron Phillips Co.	Merbau, Singapore	HDPE	390
10. PTT Chemical Co.	Map Ta Phut, Thailand	HDPE	250
11. Bangkok Polyethylene	Map Ta Phut, Thailand	HDPE	250
12. The Polyolefins Co.	Merbau, Singapore	LDPE	250
13. Petlin Malaysia	Kertih, Malaysia	LDPE	120
14. Bataan Polyethylene	Bataan, Philippines	LLDPE /HDPE	250
15. JG Summit Petrochemical	Batangas, Philippines	LLDPE /HDPE	200

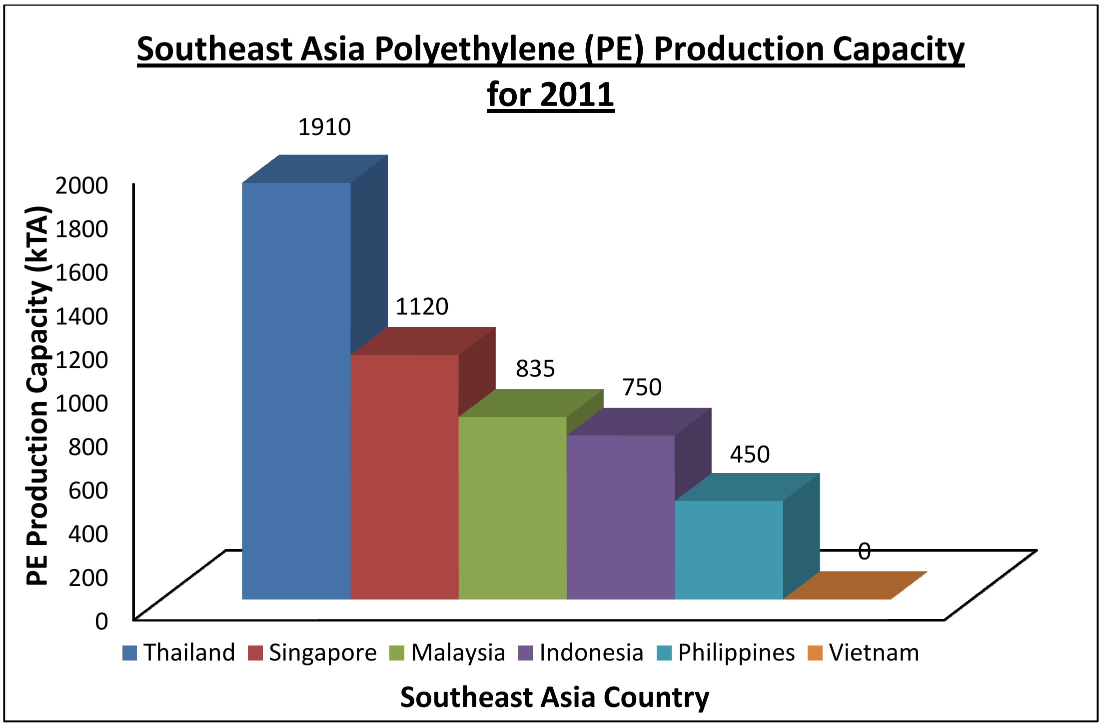


Figure 4.5: Southeast Asia Polypropylene Production Capacity for 2011 (Source: BMI, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f; APIC, 2010a, 2010b, 2010c, 2010d)

Table 4.3 presents the existing polyethylene plants in Southeast Asia and Figure 5 shows Southeast Asia polyethylene production capacity for 2011. Thailand is the lead producer of ethylene and polyethylene among the six Southeast Asia countries. It is followed by Singapore, Malaysia, Indonesia and Philippines. There is no polyethylene plant in Vietnam at the moment.

Table 4.4: Existing Polypropylene Plants in Southeast Asia for 2011(Source: BMI, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f; APIC, 2010a, 2010b)

COMPANY	LOCATION	PRODUCT	CAPACITY (kTA)
POLYPROPYLENE (PP) PLANTS			
1. The Polyolefins Co.	Merbau, Singapore	PP	560
2. Integrated Refinery&Petrochemical Complex Co. (IRPC)	Rayong, Thailand	PP	500

3. Titan Petrochemicals Corp.	Pasir Gudang, Malaysia	PP	480
4. HMC Polymers	Map Ta Phut, Thailand	PP	455
5. Exxon Chemical Pte. Ltd.	Chawan, Singapore	PP	450
6. P. T. Tripolyta Indonesia	Cilegon, Indonesia	PP	385
7. Thai Polypropylene	Map Ta Phut, Thailand	PP	320
8. P. T. Polytama Propindo	Balongan, Indonesia	PP	240
9. JG Summit	Batangas, Philippines	PP	180
10. Petrocorp	Bataan, Philippines	PP	160
11. LG International Group	Dung Quat, Vietnam	PP	100
12. Polypropylene Malaysia	Kuantan, Malaysia	PP	80
13. Pertamina	Palembang, Indonesia	PP	45

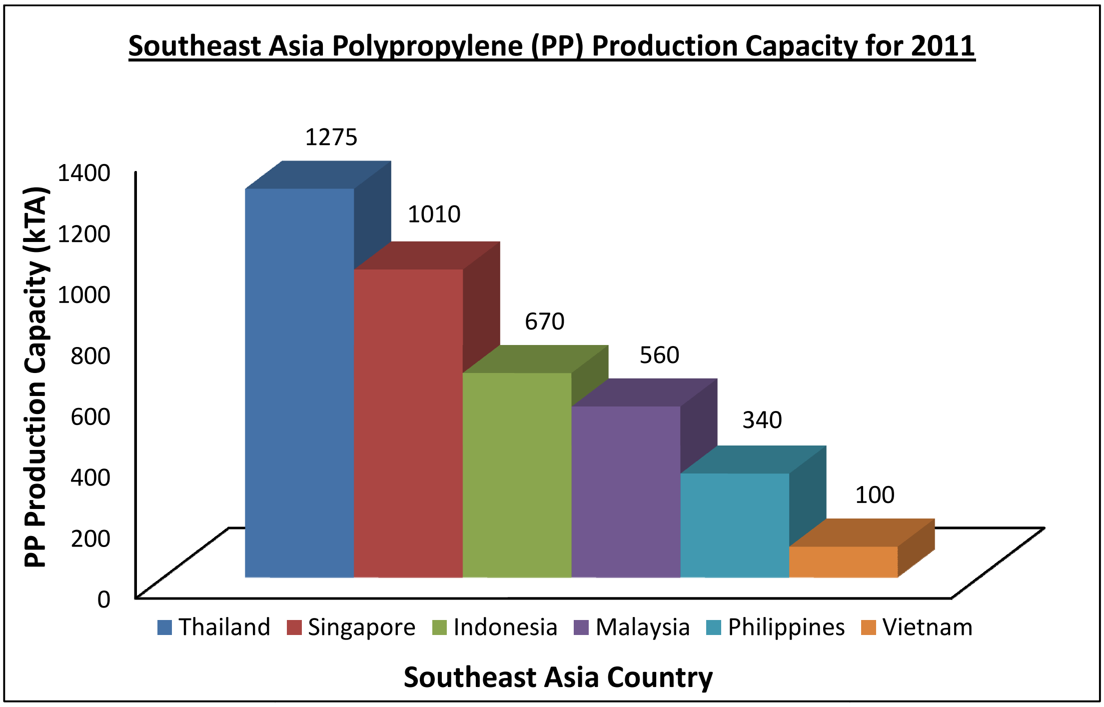
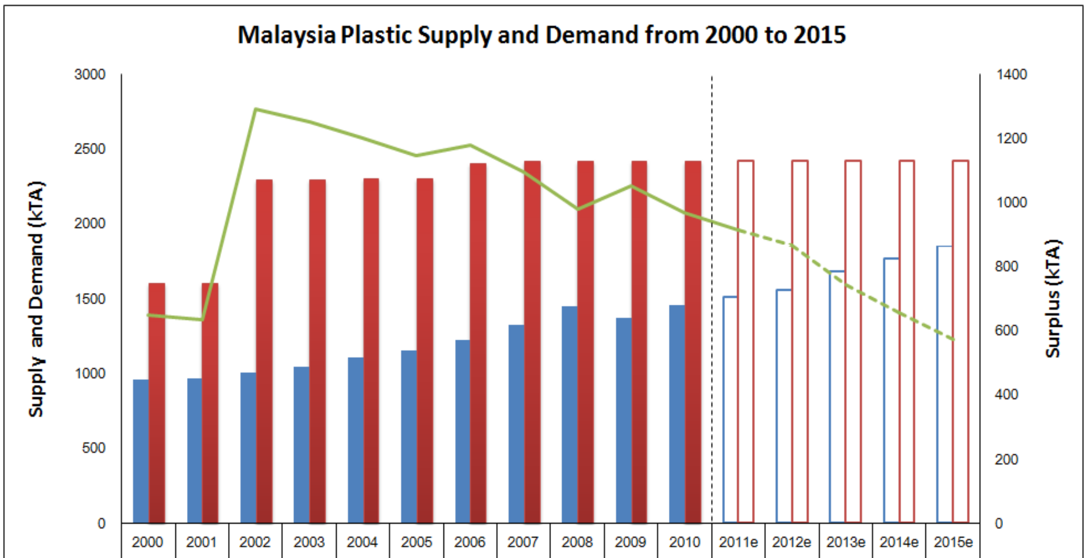


Figure 4.6: Southeast Asia Polypropylene Production Capacity for 2011 (Source: BMI, 2010a, 2010b, 2010c, 2010d, 2010e, 2010f; APIC, 2010a, 2010b, 2010c, 2010d)

On the other hand, Table 4.4 presents the existing polypropylene plants in Southeast Asia and Figure 4.6 shows Southeast Asia polypropylene production capacity for 2011. Thailand is the lead producer in the production of polypropylene. This is followed by Singapore, Indonesia, Malaysia, Philippines and Vietnam.

4.2 Study of Plastic Supply and Demand and SWOT Analysis

4.2.1 Malaysia



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011e	2012e	2013e	2014e	2015e
demand	956.3	967.7	1005.8	1047.3	1104.3	1156.9	1226.3	1328.0	1446.9	1371.3	1457.0	1510.3	1557.3	1680.8	1767.8	1850.8
supply	1604	1604	2299	2299	2305	2305	2404	2425	2425	2425	2425	2425	2425	2425	2425	2425
surplus	647.7	636.3	1293.2	1251.7	1200.7	1148.1	1177.7	1097.0	978.1	1053.7	968.0	914.7	867.7	744.2	657.2	574.2

Figure 4.7: Malaysia Plastic Supply and Demand from 2000 to 2015 (Source: Ghosh, 2007; BMI, 2010a; World Bank, 2010)

Figure 4.7 shows supply and demand of plastic in Malaysia from 2000 to 2015. It shows that the demand of plastic is increasing for 15 years; however, the supply of plastic was increasing from 2000 to 2006 and became constant from 2007 to 2010 and will remain unchanged from 2011 to 2015. As a result, the surplus is decreasing after 2006. Although Malaysia remains as an exporter of petrochemical products, but the amount of export will be decreasing in the next five years.

As one of the petrochemical producers in SEA region, Malaysia has proven ability to attract foreign investment, highly skilled workforce and rich oil and gas reserves. The investment from worldwide major petrochemical players, including Shell, BASF, BP, ExxonMobil, Titan Chemical Group, Taiwan-based Dairen Chemicals, Japan-based Idemitsu, Toray Industries, and others reflects that Malaysia is one of the top choices as investment location for petrochemical industries. The Malaysian government has set up a Third Industrial Master Plan (2006-2020) which will focus on the development of support infrastructure, dedicated utilities and supply service to the new petrochemical zones- Gurun (Kedah), Tanjung Pelepas (Johor) and Bintulu (Sarawak) (MPA, 2006). The developments of upstream and downstream industries are parts of the plan as well. Other than new petrochemical zones, the government is planning to ultilize the full potential of the three existing petrochemical zones. There are three existing and integrated petrochemical zones- Kerteh (Terengganu), Gebeng (Pahang) and Pasir Gudang (Johor). The petrochemical zones have storage services, well-planned transportation network and utilities. The development of centralized utility facilities offers a reliable supply of crucial utilities such as demineralised and cooling water, power, steam and wastewater treatments enhances the efficiency of the petrochemical zone concept (MPA, 2006). The concept helps to reduce the plant capital and operational costs. The growth of petrochemical industry is attributed to Malaysia's strategic geographical location within ASEAN and proximity to major petrochemical markets too (Market Watch, 2009).

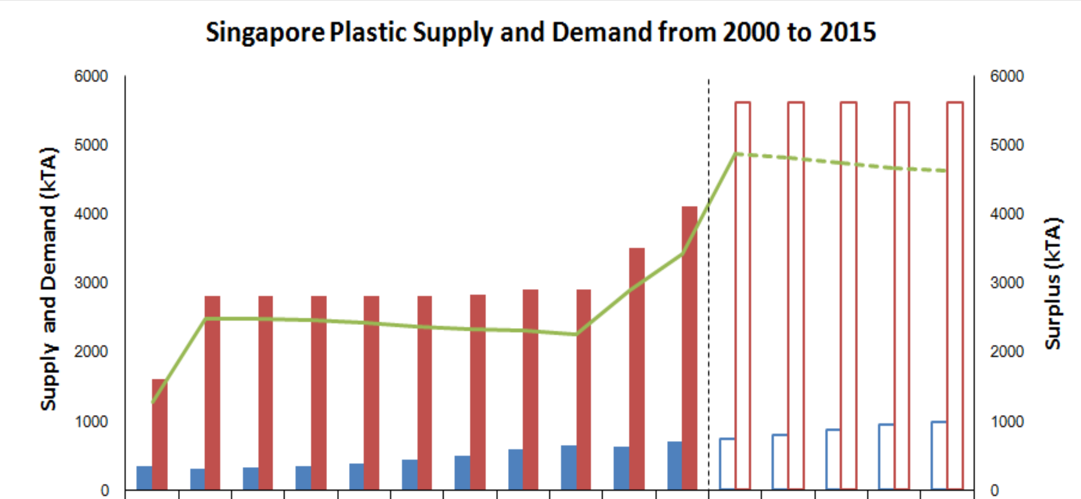
Other than these, generous tax incentives are available to petrochemical investors to encourage the investment in the petrochemical industry. There are seven types of incentives offered to petrochemical investors such as incentives for manufacturing companies, incentives for high technology companies, incentives for strategic projects, pre-packaged incentives, incentives to strengthen industrial linkages, incentives for research and development, and general incentives (Malaysia Industrial Development Authority [MIDA], 2011). The government constantly reviews these incentives to ensure petrochemical companies can maintain their competitive edge (MIDA, 2011).

Natural gas-based production performed better than naphtha-based plant due to the lower price of natural gas compared with oil. According to Williams (2011), the price of NYMEX light sweet oil is US$ 107.94/barrel and the price of NYMEX natural gas is US$ 4.362/mm BTU on 1st of April 2011. Although there are opportunities and strengths of Malaysia petrochemicals industry, but Malaysia lacks of feedstock economy advantage compared to other competitors in the SEA region such as Thailand which are rich in natural gas reserves.

Petrochemical players in Malaysia will benefit from the ASEAN Free Trade Agreement (AFTA) and from the access to a larger Asia Pacific market (Business Monitor International [BMI], 2010a). China, a very important importer of petrochemical products, entry into the World Trade Organisation (WTO) is expected to open up new business opportunities to petrochemical manufacturers in Malaysia (BMI, 2010a).

There are no new projects announced to construct and start-up until 2015 (Yim et al., 2010). Malaysia's petrochemical industry is re-assessing its competitive status within ASEAN and the threat posed by China's rapid petrochemical industrial expansion. The massive increase capacities in Asia and the Middle East cause the petrochemical industry to face tougher market conditions with downward pressure on product prices. Now, not only Malaysia, but the entire Asian petrochemical industry is facing the rising feedstock prices and the rapid increasing capacity from the Middle East.

4.2.2 Singapore



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011e	2012e	2013e	2014e	2015e
demand	338.6	319.0	327.6	341.3	391.5	440.2	501.2	599.1	652.6	621.5	699.7	745.3	797.1	880.9	947.5	980.5
supply	1610	2810	2810	2810	2810	2810	2829	2915	2915	3515	4115	5615	5615	5615	5615	5615
surplus	1271.4	2491.0	2482.4	2468.7	2418.5	2369.8	2327.8	2315.9	2262.4	2893.5	3415.3	4869.7	4817.9	4734.1	4667.5	4634.5

Figure 4.8: Singapore Plastic Supply and Demand from 2000 to 2015 (Source: Ghosh, 2007; BMI, 2010; World Bank, 2010)

Figure 4.8 shows supply and demand of plastic in Singapore from 2000 to 2015. It shows that the demand of plastic was increasing every year except for 2001; however, the supply of plastic was increasing from 1,610 kTA in 2000 to 5,615 kTA in 2015. As a result, the surplus is increasing every year. Since supply is more than demand, it means that Singaporean is an exporter of petrochemical products.

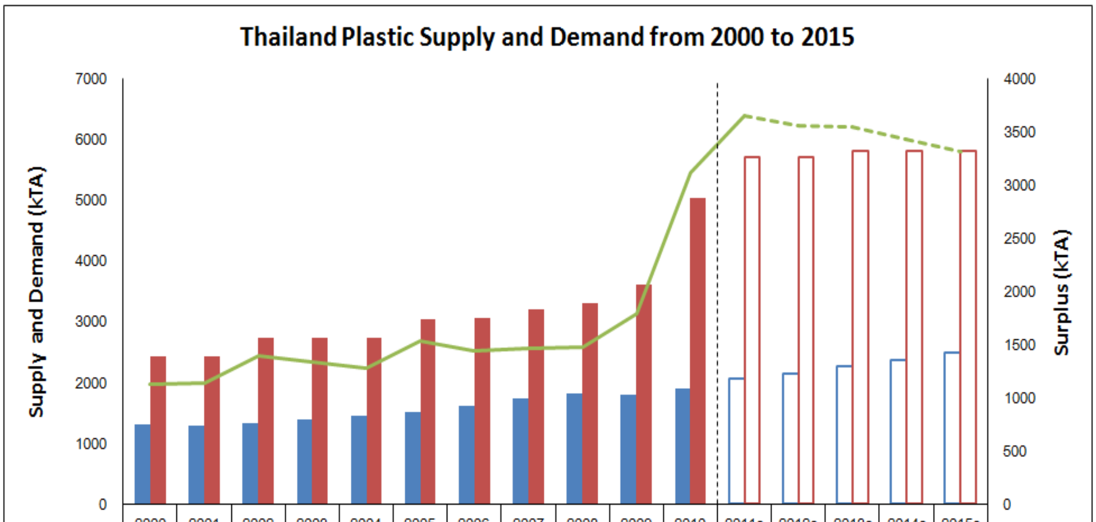
Singapore has been labeled as Asia's petrochemical hub. Jurong Island, which locates at the southwestern tip of the country and just a km off the main island, the Singapore Economic Development Board (EDB) calls it as the "nerve centre" of the chemicals clusters (MAS, 1999). Most of Singapore's oil, petrochemicals and chemicals production takes place on this island. More than 90 companies are engaged in a range of manufacturing activities, with well-developed infrastructure that is protected by a multi-layered security framework, and includes a chemical logistic park which provides incentives for investors (MAS, 1999). Companies located on Jurong Island are able to share various facilities such as power, water, natural gas suppliers, storage and logistics firms, wastewater facilities and service pipelines, enabling them to save their capital costs (Economic Development Board [EDB], 2010). Besides this, Singapore's government has been an important driver in the development of Singapore's petrochemical industry. The government is willing to support on large-scale projects and to invest in infrastructure (Iswaran, 2010). The government is working closely with petrochemical companies to ensure flexibility in the policies and providing a robust infrastructure to help the development of their projects to be executed successfully (Iswaran, 2010). Other than facilities, the growth of highly skilled talent pool in the cluster is important as well. There are institutions such as Chemical Process Technology Centre (CPTC) to ensure that there are a ready pool of worker equipped with the specialized skilled needed by the industry (BMI, 2010b).

The lack of natural gas reserves and crude oil would be a negative factor to the Singapore's petrochemical industry. Singapore has to import the basic feedstock from other countries. There are two types of feedstock maybe used – naphtha and natural gas. The high yield of natural gas makes it the cheapest feedstock. The usage of natural gas is limited due to the high transportation cost. This gives countries with natural gas reserves a distinct feedstock economy advantage.

Asia's especially China's demand for petrochemicals steadily rises. The rising demand provides very good export opportunities to the petrochemical manufacturers. According to Yim et al. (2010), there are two new cracker come on stream: Shell's new cracker with capacity of 800,000 kTA of ethylene in 2010 and Exxon Mobil's second cracker in Singapore with capacity of 1,000,000 kTA of ethylene in 2011. The increase of ethylene output helps to improve the standing of Singapore in the ethylene league table. The new crackers capacity helps to turn Singapore into one of the world's largest petrochemical production centers (Iswaran, 2010).

As other Southeast Asia petrochemical producers, Singapore is not immune to the challenges. The new capacity in China and the Middle East has implications on Singapore-based petrochemical producers. China will become more self-sufficient, thus the demand of imported petrochemical products is likely to stagnate. The Middle-East producers are likely to penetrate the China market and grab the market share from other Asian producers. The Middle-East produces have advantaged feedstock position and abundant natural gas reserves compared to Asian producers.

4.2.3 Thailand



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011e	2012e	2013e	2014e	2015e
demand	1303.3	1291.4	1336.7	1395.8	1463.3	1518.2	1619.3	1746.0	1828.1	1808.1	1910.2	2061.6	2144.7	2263.0	2376.8	2494.4
supply	2437	2437	2737	2737	2737	3050	3063	3212	3303	3603	5033	5708	5708	5808	5808	5808
surplus	1133.7	1145.6	1400.3	1341.2	1273.7	1531.8	1443.7	1466.0	1474.9	1794.9	3122.8	3646.4	3563.3	3545.0	3431.2	3313.6

Figure 4.9: Thailand Plastic Supply and Demand from 2000 to 2015 (Source: Ghosh, 2007; BMI, 2010c; World Bank, 2010)

Figure 4.9 shows supply and demand of plastic of Thailand from 2000 to 2015. It shows that the demand of plastic was increasing every year except for 2001; however, the supply of plastic was increasing from 2,437 kTA in 2000 to 5,807 kTA in 2015. Thailand and Singapore is competing to be the largest producer within SEA region.

Thailand's petrochemical industry is one of the most important primary industries that contributed to the development of Thailand's economic. The industry is well placed and considered as the strongest in the SEA region. It helps Thailand in taking the advantage of rapidly increasing China's demand for polyolefins. Import substitution, domestic market and investment incentives encourage the investments in this sector. In Thailand, the private sector is active in the investment of the petrochemical industry. The partly–privatised PTT Chemicals has invested approximately US$ 3.6 billion in Thailand's petrochemical industry (Hayes, 2010).

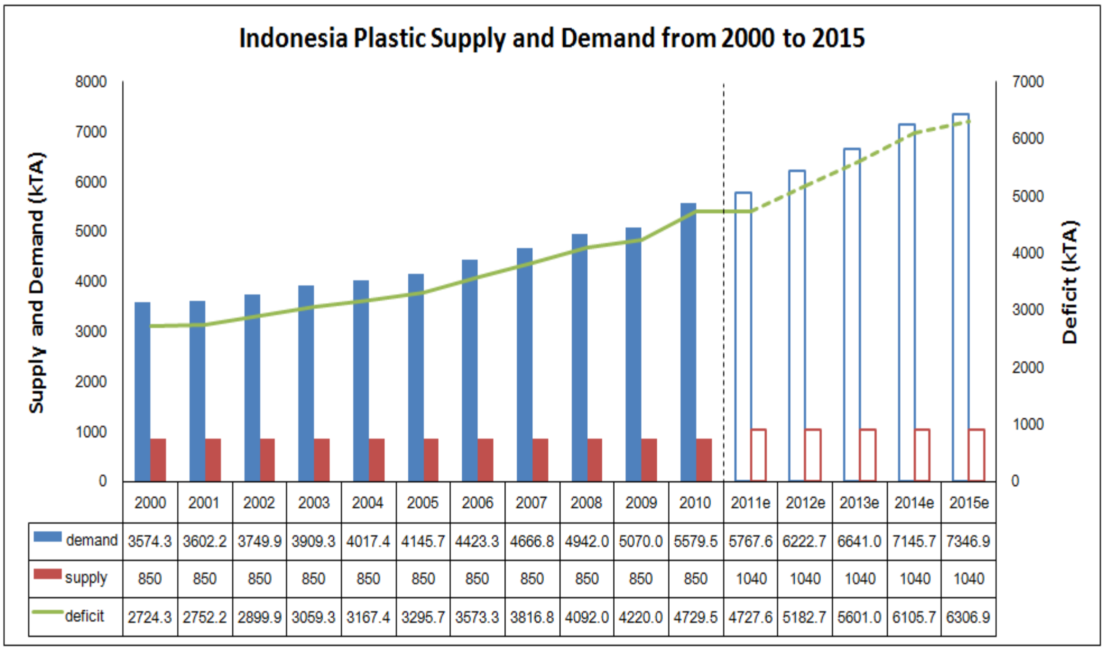
The natural gas availability in Thailand makes the low cost of feedstock becomes one of the strengths of the petrochemical industry.

Although Thailand has feedstock economy advantage compared to Singapore and Malaysia, but if compared to the Middle East players, Thailand is still considered lack of the comparative feedstock advantage. The increasing competition among SEA petrochemical producers has resulted in margin pressure on Thailand's petrochemical manufacturers. Thailand has suffered from over-capacity of petrochemical plants, which may be aggravated by expansions.

The industry is currently in the third wave of Thai government development plan for petrochemical growth (Bunsumpun, 2005). The main objectives of the development plan are to create a fully integrated manufacturing cluster around Map Ta Phut industrial estate, to establish domestic and international business alliances and to enhance the competitiveness of Thailand's petrochemical industry (Bunsumpun, 2005). The plan aims to build more major petrochemical complexes and develop this sector to make Thailand one of the petrochemical hubs in the region (Bunsumpun, 2005). Thailand's government is liberalising the petrochemical industry, reducing import tariffs and its direct participation. The sixth gas separation plant and the third pipeline installation will increase the use of natural gas in petrochemical industry and the high demand growth from automotive, electrical and electronic, and packaging have provided opportunity for the growth of the industry (Hayes,2010).

The economic slowdown in China could affect the China's demand of petrochemical products from Thailand. As other major producers, Thailand is threatened by the Middle Eastern petrochemical capacity expansion. The rising oil prices might reduce the margins of those naphtha-based cracker plants in Thailand. In 2009, new petrochemical projects require approvals from both health impact assessment (HIA) and environmental impact assessment (EIA) if the projects could be harmful to the local community (Hayes, 2010). This new environmental concerns have led to a halt in some new projects and are likely to increase costs to those new projects. In 2010, more than 20 petrochemical projects among a total of 65 projects to be suspended in Map Ta Phut industrial estate and the 65 projects that will remain suspended must comply with Article 67 of Thailand's new constitution, which is related to environmental protection (Hayes, 2010). Bangkok has seen massive political protests in this year. Although the petrochemicals industry has functioned normally despite the political risk, however, Thailand still needs to deal with this risk to maintain foreign investment in the sector. If the political instability continues, the confidence of foreign investor will decline.

4.2.4 Indonesia



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011e	2012e	2013e	2014e	2015e
demand	3574.3	3602.2	3749.9	3909.3	4017.4	4145.7	4423.3	4666.8	4942.0	5070.0	5579.5	5767.6	6222.7	6641.0	7145.7	7346.9
supply	850	850	850	850	850	850	850	850	850	850	850	1040	1040	1040	1040	1040
deficit	2724.3	2752.2	2899.9	3059.3	3167.4	3295.7	3573.3	3816.8	4092.0	4220.0	4729.5	4727.6	5182.7	5601.0	6105.7	6306.9

Figure 4.10: Indonesia Plastic Supply and Demand from 2000 to 2015 (Source: Ghosh, 2007; BMI, 2010d; World Bank, 2010)

Figure 4.10 shows supply and demand of plastic of Indonesia from 2000 to 2015. It shows that the demand of plastic was increasing every year except for 2001; however, the supply of plastic had not been increasing from 2000 to 2010. Although the supply of plastic increases in 2011 but the supply still cannot meet the demand of plastic. As a result, Indonesia is still a net importer of plastic.

The Indonesian petrochemical industry is progressing slowly towards recovery after the late-1990s economic crisis (BMI, 2010d). The Asian economic crisis damaged the petrochemical industry. Many of the remaining companies are in heavy debt. The petrochemical producers have also faced high prices for raw material as a result of soaring global crude prices.

There is only an ethylene cracker, Chandra Asri Petrochemical Center in Indonesia, with annual capacity of 550,000 tons of ethylene. Although Indonesia is an oil producing country, however, the oil industry has not been able to fully meet the domestic demand of olefins. Chandra Asri imports almost its naphtha feedstock requirement. The imported feedstock used in the production of polymer products such PE, PP, PVC and PS resin. The petrochemical industry is not fully integrated between upstream-midstream and downstream chain.

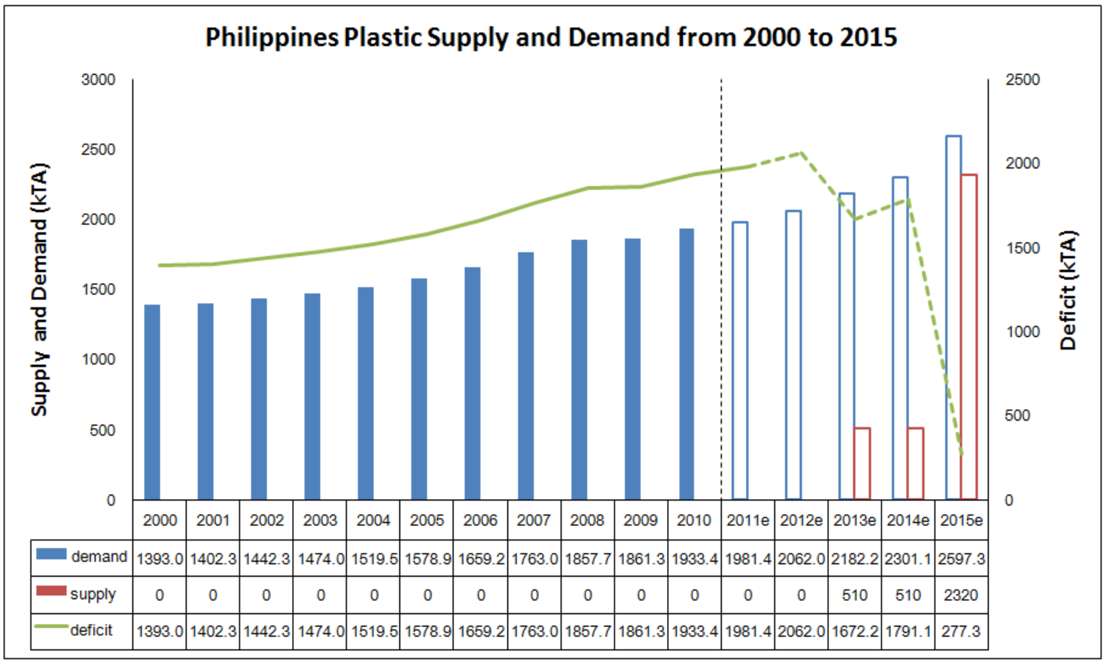
Indonesia lacks of investment in petrochemicals industry. Without investment, the production capacity could not be increased and greater amounts of raw materials have to be imported. Chandra Asri has not increase its plant capacity in the last ten years.

The gas fields in Indonesia are running out sooner than expected. It no longer dominates the market for liquefied natural gas and Qatar becomes the world's largest liquefied natural gas exporter (BMI, 2010d). The declining resource base is causing the shortage of the feedstock for the sector. The decline can be attributed to the low investment in the Indonesia's energy sector.

As to encourage the investment from foreign major players, the government is planning to set up special economic zones (SEZ) and push for oil and gas output boost to potentially bring more feedstock on stream (Kusdriana, 2010). It can help to attract investment from foreign investors.

However, the rising oil prices will adversely affect Indonesia's competitiveness among the other countries and reduce the profit margins. The insufficient supply of petrochemicals forces Indonesia to open its market to cheaper foreign imports that undercut local producers.

4.2.5 Philippines



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011e	2012e	2013e	2014e	2015e
demand	1393.0	1402.3	1442.3	1474.0	1519.5	1578.9	1659.2	1763.0	1857.7	1861.3	1933.4	1981.4	2062.0	2182.2	2301.1	2597.3
supply	0	0	0	0	0	0	0	0	0	0	0	0	0	510	510	2320
deficit	1393.0	1402.3	1442.3	1474.0	1519.5	1578.9	1659.2	1763.0	1857.7	1861.3	1933.4	1981.4	2062.0	1672.2	1791.1	277.3

Figure 4.11: Philippines Plastic Supply and Demand from 2000 to 2015 (Source: Ghosh, 2007; BMI, 2010e; World Bank, 2011)

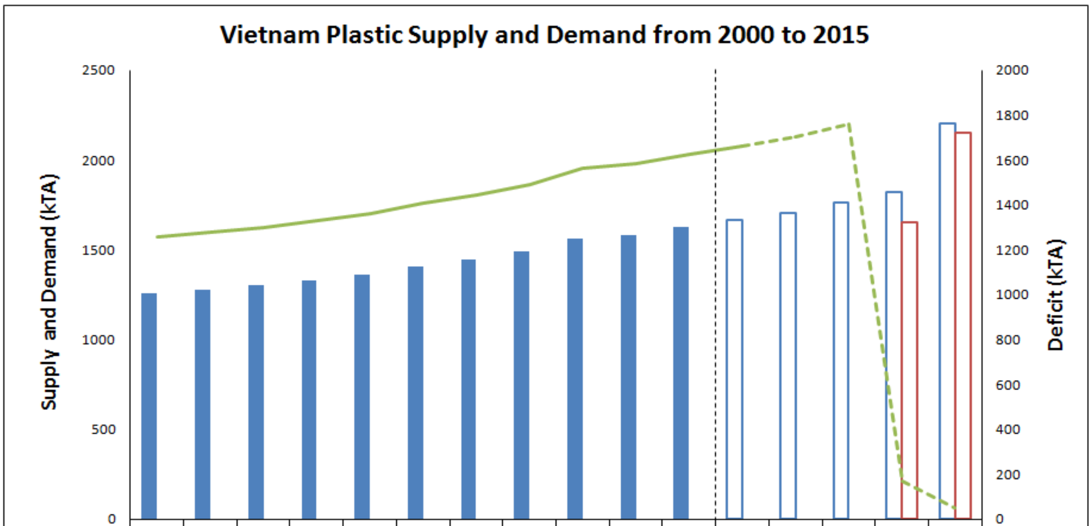
Figure 4.11 shows supply and demand of plastic of Philippines from 2000 to 2015. As other SEA countries, from 2000 until 2012, there is no cracker plant in Philippines. The deficit of plastic depends on import during this period. Although new crackers plants will be brought on stream in 2013 to 2015 but the supply of plastic is still not enough for Philippines.

The petrochemical industry of Philippines is still well behind those of other countries in the SEA region. There are only downstream petrochemical productions such as LLDPE, HDPE, PS and PVC (Irani, 2000). There are no upstream petrochemicals or cracker plant in Philippines at the moment. The Philippines petrochemical industry suffers from a lack of local supply of feedstock and a relatively small local polymers manufacturing base.

JG Summit Holdings has planned to build the first naphtha cracker plant in Philippines (Irani, 2000). The plans were shelved in 1999 as it would not be able to compete with the imported products. The main weakness of the sector is the dependence on imported olefins and aromatics. Due to the failed projects, high level of corporate debt and cheaper imports, Philippines will remain dependent on cheaper imported petrochemical products (BMI, 2010e). Without domestic ethylene cracker plant, the downstream petrochemical plants are difficult to be integrated and the production is not cost-competitive.

In Philippines, the plastic consumption per capita is still considered very low compare to other SEA countries. The low demand of plastic is caused by the insufficient domestic plastic production.

4.2.6 Vietnam



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011e	2012e	2013e	2014e	2015e
demand	1258.2	1278.3	1301.2	1330.0	1361.6	1405.4	1444.8	1490.4	1565.0	1584.7	1626.2	1663.1	1704.8	1760.6	1819.1	2200.6
supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1650	2150
deficit	1258.2	1278.3	1301.2	1330.0	1361.6	1405.4	1444.8	1490.4	1565.0	1584.7	1626.2	1663.1	1704.8	1760.6	169.1	50.6

Figure 4.12: Vietnam Plastic Supply and Demand from 2000 to 2015 (Source: Ghosh, 2007; BMI, 2010f; World Bank, 2011)

Figure 4.12 shows supply and demand of plastic of Vietnam from 2000 to 2015. The demand of plastic is growing every year but Vietnam's petrochemical industry is not well-developed. As a result, the demand of plastic cannot be balanced up although new crackers will start-up in 2014 (Yim et al., 2010).

Vietnam has the fourth-largest crude oil reserves in the SEA region (Hoanh, 2007). There is only a refinery plant located at Dung Quat (BMI, 2010f). Due to the lack of refining facilities in Vietnam, most of petrochemical products are still imported. There is only relatively small downstream industry and no cracker in Vietnam at the moment.

The global economic crisis has halted the expansion plans of Vietnam's petrochemicals industry. For example, the Long Son project has been delayed due to the unfavourable market and economic conditions (BMI, 2010f).

The oil production in Vietnam gives a feedstock advantage, which can help in the development of the petrochemicals sector. Although the economic slowdown has affected the sector, however, there is still investor interest in Vietnam.

Until now, the petrochemical product portfolio is still limited to PVC and the high input costs for production of petrochemical products are the weaknesses of the industry (BMI, 2010f).

Vietnam plans to establish refining facilities and development of intermediate and downstream petrochemicals production. The rising gas production could provide sufficient feedstock needed by the petrochemicals industry. The further lowering of tariffs in order to enter WTO, can be a deterring factor to the foreign investment in Vietnam (BMI, 2010f).

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the study of petrochemical plant capacity and supply and demand of plastic, the development of Malaysia's petrochemical industry is still far behind from Singapore and Thailand. Vietnam is developing its own petrochemical industry, and Malaysia will face increasing competition. As China has entered the WTO, Malaysia should grab this opportunity to develop its petrochemical industry rapidly to compete the China's petrochemical market. The competitiveness in the global petrochemical market depends on Malaysia's ability to cultivate and maintain competitive advantages over other competing countries.

5.2 Recommendations

In order to sustain its competitiveness within the Southeast Asia region, the following recommendations are suggested:

a) Malaysia's petrochemical producers will need to overcome the volatility of feedstock price, product price and low margins brought by competition from global and regional producers.
b) Move up the value chain and strengthen its innovation capabilities in the production of high technology and specialized plastic products to increase its competition from other competing nations.

c) Implement the construction of a world-scale methanol-to-olefins (MTO) or ethanol-to-olefins (ETO) complex. The methanol or ethanol both are the alternative petrochemical feedstock and can overcome the shortage of feedstock in the future.

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APPENDICES

APPENDIX A: Maps

1. Malaysia
2. Singapore
3. Indonesia
4. Thailand
5. Philippines
6. Vietnam
7. Southeast Asia