

An Analysis of Asia's Petroleum Refining Industry: Changes and Challenges

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Introduction

Sharp increases in Asian energy demand, reflecting the region's rapid economic growth, have attracted a great deal of attention over the past 30 years. Moreover, due to transportation sector advances in developing countries, Asia's demand for petroleum product, and in particular light petroleum product, has increased significantly as well. However, with very limited proved oil reserves, Asia's oil import volume has continued to increase, and dependency on supplies from the Middle East remains high. Meanwhile, regulations on petroleum product specifications tighten more and more.

Therefore, finding itself in a short position on petroleum product, Asia's refining industry will have to secure crude supply and simultaneously boost both the quantity and quality of petroleum product output to meet growing regional oil demand during the next decade and beyond. Vast investments are expected to be put into the refining industry.

Based on this backdrop, this paper analyses key changes in the region's petroleum product demand and supply configuration based on a projection of the world petroleum product demand and supply balance to the year 2015 and sorts out the challenges that the region's refining industry is facing.

1. The Key Changes Faced by Asia's Refining Industry

This paper's analysis references projections by IEEJ that include the demand and supply balance of the main petroleum products in Asian countries. Regarding demand, the IEEJ projection refers to the energy balance database of IEA (2005 Edition) and includes GDP, population, oil price, exchange rate, inflation rate, and power development plans into the demand model. For oil price and population inputs, please see the Annual Energy Outlook 2006 by DOE and projections by UN, respectively. For refining capacity and production, please refer to outlooks by the Oil and Gas Journal and actual construction plans of China and India, combined with projections of utilization rates for the production model. Factors such as crude type, processing cost, and trade flow have also been considered.

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1-1. Petroleum Demand expansion

Based on IEEJ projections, Asia's petroleum product demand is expected to increase from a level of 21,274 thousand b/d in 2003 to 30,955 thousand b/d in 2015, with an average annual growth rate of 3.4% during the period from 2003 to 2010 and 2.9% during the period from 2010 to 2015 (see table1-1). Developing countries such as China, India, Vietnam, Thailand, and Malaysia are expected to contribute the main share of this demand increase in Asia.

Among these countries, China has the biggest petroleum product demand with the highest growth rate. China's petroleum product demand will increase to 8,722 thousand b/d by 2010, comprising 1/3 of the total petroleum product demand of Asia, and will exceed 10,000 thousand b/d by 2015. Moreover, half of the incremental increase in Asia's petroleum product demand during the period from 2003 to 2010 will be taken by China. Therefore, China's petroleum product demand will make a large impact on the whole picture of Asia. India is also projected to become a major Asian petroleum product consuming country in the future, however, its influence isn't considered to substantially strengthen until after 2010.

Developed countries, on the other hand, will see just minor increases or even a slight decrease in petroleum product demand. For example, Japan will remain the 3rd largest petroleum consuming country in the world, however, its demand will decrease to a level of 5,034 thousand b/d in 2015 from 5,389 thousand b/d in 2003. Meanwhile, its share in Asia will drop substantially to 16.3%. Also, the demand increase of Korea will be slow, with a low average annual growth rate about 1%.

Table1-1: The Outlook of Asia's petroleum product demand (by country)

Unit: 1,000b/d

Country	Oil Demand			Change				AAGR	
	2003 (share)	2010 (share)	2015 (share)	2003	2010 (share)	2010	2015 (share)	2010/2003	2010/2015
Japan	5,389 (25.3%)	5,072 (18.9%)	5,034 (16.3%)	-316	(-5.7%)	-39	(-0.9%)	-0.9%	-0.2%
Korea	2,313 (10.9%)	2,399 (8.9%)	2,560 (8.3%)	+86	(1.5%)	+161	(3.9%)	+0.5%	+1.3%
China	5,304 (24.9%)	8,722 (32.5%)	10,791 (34.9%)	+3,418	(61.2%)	+2,069	(50.5%)	+7.4%	+4.3%
Hong Kong	279 (1.3%)	310 (1.2%)	339 (1.1%)	+31	(0.6%)	+29	(0.7%)	+1.5%	+1.8%
Taiwan	949 (4.5%)	1,237 (4.6%)	1,286 (4.2%)	+288	(5.2%)	+49	(1.2%)	+3.9%	+0.8%
Singapore	742 (3.5%)	909 (3.4%)	1,036 (3.3%)	+167	(3.0%)	+128	(3.1%)	+2.9%	+2.7%
Brunei	12 (0.1%)	14 (0.1%)	16 (0.1%)	+1	(0.0%)	+2	(0.0%)	+1.5%	+2.7%
Indonesia	1,320 (6.2%)	1,708 (6.4%)	1,973 (6.4%)	+388	(7.0%)	+264	(6.5%)	+3.8%	+2.9%
Malaysia	514 (2.4%)	740 (2.8%)	889 (2.9%)	+227	(4.1%)	+149	(3.6%)	+5.4%	+3.7%
Philippines	328 (1.5%)	378 (1.4%)	474 (1.5%)	+50	(0.9%)	+95	(2.3%)	+2.1%	+4.6%
Thailand	785 (3.7%)	1,070 (4.0%)	1,289 (4.2%)	+285	(5.1%)	+219	(5.3%)	+4.5%	+3.8%
Vietnam	222 (1.0%)	300 (1.1%)	393 (1.3%)	+78	(1.4%)	+93	(2.3%)	+4.4%	+5.5%
India	2,483 (11.7%)	3,135 (11.7%)	3,784 (12.2%)	+652	(11.7%)	+649	(15.8%)	+3.4%	+3.8%
Other Asia	635 (3.0%)	863 (3.2%)	1,092 (3.5%)	+227	(4.1%)	+229	(5.6%)	+4.5%	+4.8%
Total Asia	21,274	26,856	30,955	+5,583		+4,098		+3.4%	+2.9%

Source: IEEJ estimated (July 2007)

1-2. Increase in the share of light petroleum product

Breaking down the demand increase by product type, gasoline demand increase will continue to be high due to the advance of motorization. With an average annual growth rate of over 3%, gasoline demand will increase from 3,118 thousand b/d in 2003 to 4,665 thousand b/d in 2015. Including the needs from the power generation sector, diesel demand will increase to 9,609 thousand b/d in 2015 and will comprise the biggest share of total petroleum product demand in Asia-- about 31%. Additionally, with the development of the petrochemical industry, naphtha is seen to assume a particularly high growth rate of 6.3% through 2010, and a further increase to 4,720 thousand b/d in 2015. Demand for jet fuel and kerosene is expected to increase as well due to development of the air transportation sector.

On the other hand, although heavy oil used by the shipping sector will increase, its growth rate is expected to be the lowest among all petroleum products, as some potential growth will be displaced by natural gas and other alternative fuels.

Table1-1: The Outlook of Asia's petroleum product demand (by product type)

Unit: 1,000b/d

	2003 (share)	2010 (share)	2015 (share)	Change		AAGR	
				2003	2010(share)	2010	2015(share)
Product Total	21,274 (100.0%)	26,856 (100.0%)	30,955 (100.0%)	+5,583 (100.0%)	+4,098 (100.0%)	3.4%	2.9%
Fuel Oil Total	17,977 (84.5%)	22,347 (83.2%)	25,887 (83.6%)	+4,370 (78.3%)	+3,540 (86.4%)	3.2%	3.0%
Gasoline	3,118 (14.7%)	4,004 (14.9%)	4,665 (15.1%)	+886 (15.9%)	+662 (16.1%)	3.6%	3.1%
Naphtha	2,682 (12.6%)	4,124 (15.4%)	4,720 (15.2%)	+1,442 (25.8%)	+596 (14.5%)	6.3%	2.7%
Kerosene/Jet	2,105 (9.9%)	2,387 (8.9%)	2,765 (8.9%)	+283 (5.1%)	+377 (9.2%)	1.8%	3.0%
Diesel	6,224 (29.3%)	7,982 (29.7%)	9,609 (31.0%)	+1,758 (31.5%)	+1,627 (39.7%)	3.6%	3.8%
Heavy Fuel	3,849 (18.1%)	3,849 (14.3%)	4,205 (13.6%)	+0 (0.0%)	+356 (8.7%)	0.0%	1.8%
LPG	2,092 (9.8%)	2,476 (9.2%)	2,764 (8.9%)	+384 (6.9%)	+288 (7.0%)	2.4%	2.2%
Others	1,205 (5.7%)	2,034 (7.6%)	2,288 (7.4%)	+829 (14.8%)	+254 (6.2%)	7.8%	2.4%

Source: IEEJ estimated (July 2007)

1-3. Tightening regulation on specification

Along with the dramatic demand growth, most Asian countries in recent years have also seen tightening regulation on specification(see table1-2). In case of gasoline, specifications on sulfur, aroma, and olefin are being regulated more and more strictly. For diesel, specifications ofnsulfur, cetane number, and poly-aroma are also strengthening.

Table1-2: Sulfur Specification Regulation in Asian Countries

Unit: ppm

Region	Country		Regular gasoline			Auto Diesel		
			2005	2008	2010	2005	2008	2010
S.Asia	India	Urban Area	150	150	50	350	350	150
		Rural Area	500	500	150	500	500	250
	Pakistan		1,000	1,000	1,000	2,500	1,500	1,500
	Bangladesh		500	500	500	2,000	2,000	2,000
	Sri Lanka		1,000	1,000	1,000	2,500	2,500	500
S.E.Asia	Indonesia		2,000	2,000	2,000	300	300	300
	Thailand		500	500	500	350	350	350
	Singapore		100	50	10	500	50	50
	Malaysia		1,000	500	500	3,000	500	50
	Philippines		1,000	1,000	1,000	500	50	50
	Vietnam		1,500	1,500	1,500	500	500	100
E.Asia	Japan		50	10	10	50	10	10
	China	Beijing	150	50	50	200	50	50
		Shanghai/Guangzhou	500	150	50	200	200	50
		Others	500	150	50	200	200	200
	Taiwan		50	50	50	350	50	50
Korea		130	50	50	500	30	10	

Source: Asia-Pacific Refined Products, Energy Intelligence (2006 Edition) and others

Japan introduced sulfur-free gasoline (equal to 10ppm or less) in 2005. By 2010, Singapore will also introduce the EuroV standard and lower sulfur specification to 10ppm, while in the capital cities of China, Korea and India the sulfur specification will be lowered to 50ppm. In case of diesel, by 2008 and 2010, Japan and Korea will implement sulfur-free fuel, while Beijing, Shanghai, Guangzhou in China, Taiwan, Singapore, Malaysia, and Philippines will lower the sulfur specification for diesel to 50ppm. In other Asian countries, however, the sulfur specification regulation of gasoline and diesel are progressing slowly.

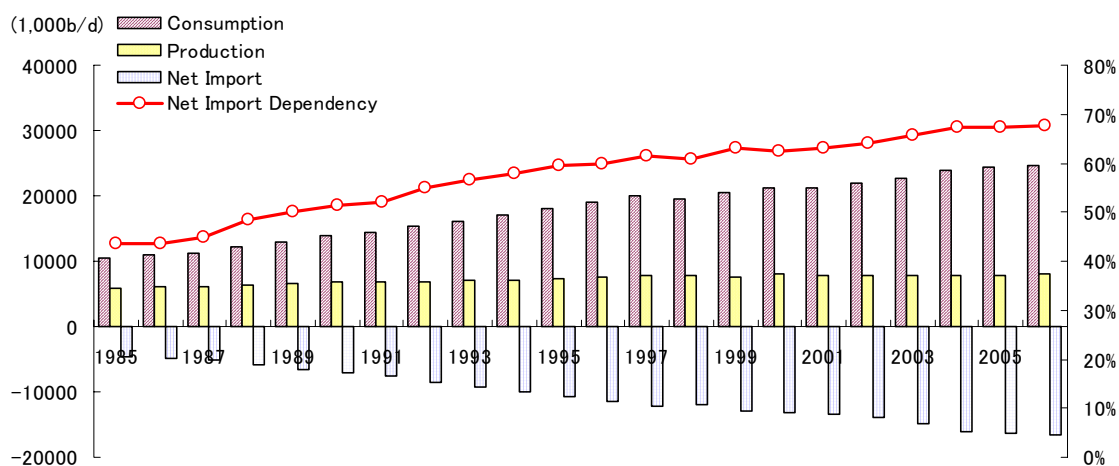
In terms of the production of high quality petroleum product, until 2010, only Japan, Taiwan, and Korea will be able to produce sulfur-free gasoline and diesel while Singapore will be able to lower sulfur specification to 50ppm to meets its standard. Also, refineries under construction in Middle East appear unable to produce sulfur-free petroleum product, though new refineries in China are designed to meet the sulfur standard of 50ppm. In the future, with the strengthening of regulation on sulfur specification, the supply-demand of high-quality gasoline and diesel will get tight. Moreover, as diesel demand is almost twice that of gasoline, its situation will be even more serious.

1-4. Increase in crude import from the Middle East

Compared to the drastic demand increase over the past 20 years, the proved oil reserves in Asia remained almost unchanged, and crude production increased only 2013 thousand

b/d(see figure1-3). Therefore, almost in parallel with the increase in oil consumption, Asia’s net oil import has increased rapidly since the mid-80s, with a volume reaching 21,064 thousand b/d in 2006 representing a dependency rate of 68%. Among Asian oil importing countries, Northeast Asian countries including Japan, China, Korea and Taiwan account for over 60% of the total import volume.

Figure1-3: The Petroleum Supply and Demand Balance of Asia



Source: BP Statistics Review 2007

As for the import source, Middle East countries supply most of Asia’s crude, with crude import volumes expanding to 13,606 thousand b/d in 2006 (see table1-4). However, the Middle East’s share of Asian crude imports has fallen while import from Africa increased drastically over the same period to 2,121 thousand b/d in 2006, an increase of more than a six-fold from 1994-- enlarging its share from 3% to 10%.

Table1-4: Asia’s crude oil import by region

Unit: 1,000b/d

	1994		2006	
	Volume	Share	Volume	Share
Middle East	7496	77%	13606	65%
Africa	323	3%	2121	10%
Asia Pacific	1648	17%	3848	18%
Others	307	3%	1490	7%
Total	9773	100%	21064	100%

Source: BP Statistics Review 2007

2. Challenges for Asia’s Refineries

Drawing from the analysis of key changes in the region’s petroleum product demand and supply configuration above, Asia’s refining industry is believed to be facing the following

challenges, and correspondent policies are to be taken necessarily.

2-1. Refinery expansion and investment

2-1-1 CDU Expansion

Asia's total refining capacity increased to 23,944 thousand b/d in 2006, an increase of 11% since 2000, while throughput reached 21,455 thousand b/d with a utilization rate of about 90%. Asia's share in world refining capacity reached 27.4% in 2006. Among those Asian countries, the refining capacity of China, Japan, Korea, Taiwan, India, and Singapore accounts over 85% of the total regional refining capacity. However, Asia is still at a short position of 3,134 thousand b/d for petroleum product, which accounts about 13% of Asia's petroleum product demand in 2006.

As the region's petroleum product demand increase is expected to continue, and the existing refineries have already achieved high levels of utilization rate at this moment, Asia's refineries will have to invest in refining capacity expansion in the future. Here, Table 2-1 shows plans in Asia to expand crude distillation units (CDUs).

Table2-1: The Refinery expansion plan

Unit: 1,000b/d

Country	CDU			Change	
	2003 (share)	2010 (share)	2015 (share)	03→10	10→15
Japan	4,703 (22.6%)	4,672 (18.5%)	4,672 (16.1%)	-31	+0
Korea	2,750 (13.2%)	2,825 (11.2%)	2,825 (9.7%)	+75	+0
China	5,619 (27.0%)	8,646 (34.3%)	10,158 (35.0%)	+3,027	+1,512
Taiwan	1,220 (5.9%)	1,220 (4.8%)	1,220 (4.2%)	+0	+0
Singapore	1,337 (6.4%)	1,337 (5.3%)	1,337 (4.6%)	-0	+0
Indonesia	993 (4.8%)	1,093 (4.3%)	1,360 (4.7%)	+100	+267
Malaysia	516 (2.5%)	545 (2.2%)	695 (2.4%)	+29	+151
Philippines	333 (1.6%)	333 (1.3%)	333 (1.1%)	+0	+0
Thailand	703 (3.4%)	761 (3.0%)	982 (3.4%)	+58	+221
Vietnam	0 (0.0%)	148 (0.6%)	242 (0.8%)	+148	+94
India	2,135 (10.3%)	3,136 (12.4%)	4,472 (15.4%)	+1,001	+1,336
Other Asia	486 (2.3%)	521 (2.1%)	753 (2.6%)	+35	+232
Total Asia	20,794	25,236	29,049	+4,442	+3,813

Source: IEEJ estimated (July 2007)

Based on outlooks prepared by IEEJ, Asian refining capacity is expected first to increase to 25,236 thousand b/d in 2010, later reaching 29,049 thousand b/d in 2015. Chinese and Indian planned refining capacity expansion, in particular, is significant. For example, China's refining capacity will increase to 10,158 thousand b/d in 2015, double that in 2003, and its

share of Asia's total capacity will enlarge to 35%. India's capacity will increase to 4,472 thousand b/d in 2015, also double that in 2003, nearly reaching the refining capacity of Japan. At the same time, the refining capacity of Indonesia, Vietnam, Thailand, and Malaysia are expected to increase as well.

2-1-2 Supply and Demand Balance

Therefore, according to the outlook on demand and the refining capacity expansion plans above, it seems that although Asia's refining industry will invest to substantially expand its refining capacity, Asia's petroleum product import will nevertheless increase to 3,770 thousand b/d and 3,426 thousand b/d in 2010 and 2015 respectively (see table 2-2). China will become the most significant importing country with an import volume of 1,649 thousand b/d, 50% of the total import volume of Asia. Japan's net import volume will decrease from over 1,000 thousand b/d to 596 thousand b/d in 2015. India, on the other hand, will become the biggest exporting country with an export capacity of over 1,000 thousand b/d.

Table2-2: The Outlook of Asia's petroleum supply and demand balance (by country)

Unit: 1,000b/d

Country	2003				2010				2015			
	Demand	Production	Net Export	Share of Demand	Demand	Production	Net Export	Share of Demand	Demand	Production	Net Export	Share of Demand
Japan	5,389	4,359	-1,029	(19.1%)	5,072	4,438	-634	(12.5%)	5,034	4,438	-596	(11.8%)
Korea	2,313	2,367	55	(2.4%)	2,399	2,598	200	(8.3%)	2,560	2,598	38	(1.5%)
China	5,304	4,859	-445	(8.4%)	8,722	7,090	-1,632	(18.7%)	10,791	9,142	-1,649	(15.3%)
Hong Kong	279	0	-279	(100.0%)	310	0	-310	(100.0%)	339	0	-339	(100.0%)
Taiwan	949	1,083	134	(14.2%)	1,237	1,159	-78	(6.3%)	1,286	1,159	-127	(9.8%)
Singapore	742	750	8	(1.0%)	909	1,270	362	(39.8%)	1,036	1,270	234	(22.6%)
Brunei	12	11	-1	(7.3%)	14	10	-3	(24.2%)	16	10	-5	(33.8%)
Indonesia	1,320	1,043	-277	(21.0%)	1,708	962	-746	(43.7%)	1,973	1,256	-717	(36.3%)
Malaysia	514	470	-43	(8.4%)	740	517	-222	(30.0%)	889	660	-229	(25.7%)
Philippines	328	255	-73	(22.1%)	378	316	-62	(16.4%)	474	316	-157	(33.3%)
Thailand	785	819	34	(4.4%)	1,070	723	-347	(32.4%)	1,289	933	-356	(27.6%)
Vietnam	222	0	-222	(100.0%)	300	141	-160	(53.3%)	393	224	-163	(41.5%)
India	2,483	2,585	102	(4.1%)	3,135	3,356	221	(7.0%)	3,784	4,785	1,001	(26.4%)
Other Asia	635	323	-313	(49.2%)	863	507	-356	(41.3%)	1,092	737	-355	(32.5%)
Total Asia	21,274	18,926	-2,348	(11.0%)	26,856	23,086	-3,770	(14.0%)	30,955	27,529	-3,426	(11.1%)

Source: IEEJ estimated (July 2007)

Among all kinds of petroleum products, gasoline's net export volume will decrease to 53 thousand b/d, while on the other hand naphtha's import dependency will be high, with import volume increasing to 1,936 thousand b/d in 2010, doubling the level of 2003(see table 2-3).

Table2-3: The Outlook of Asia's petroleum supply and demand balance (by product)

Unit: 1,000b/d

	2,003				2,010				2,015			
	Demand	Production	Net Export	Share of Demand	Demand	Production	Net Export	Share of Demand	Demand	Production	Net Export	Share of Demand
Product Total	21,274	18,926	-2,348	(11.0%)	26,856	23,086	-3,770	(14.0%)	30,955	27,529	-3,426	(11.1%)
Fuel Oil Total	17,977	16,310	-1,667	(9.3%)	22,347	19,555	-2,791	(12.5%)	25,887	23,384	-2,503	(9.7%)
Gasoline	3,118	3,230	112	(3.6%)	4,004	3,993	-11	(0.3%)	4,665	4,718	53	(1.1%)
Naphtha	2,682	1,830	-852	(31.8%)	4,124	2,529	-1,595	(38.7%)	4,720	2,784	-1,936	(41.0%)
Kerosene/Jet	2,105	2,115	11	(0.5%)	2,387	2,312	-75	(3.2%)	2,765	2,788	23	(0.8%)
Diesel	6,224	6,052	-172	(2.8%)	7,982	7,674	-308	(3.9%)	9,609	9,421	-188	(2.0%)
Heavy Fuel	3,849	3,083	-766	(19.9%)	3,849	3,048	-801	(20.8%)	4,205	3,662	-544	(12.9%)
LPG	2,092	1,349	-743	(35.5%)	2,476	1,601	-875	(35.3%)	2,764	1,705	-1,059	(38.3%)
Others	1,205	1,267	62	(5.1%)	2,034	1,931	-103	(5.1%)	2,288	2,451	163	(7.1%)

Source: IEEJ estimated (July 2007)

2-1-3 Secondary Unit Expansion

So far, most of the refining capacities expansion plans announced in Asia have been focused on CDUs. The level of capacity in Asia for hydro-cracking units, hydro-desulphurization refining units, and other secondary units, however, is low in comparison with developed countries (see table 2-4) .

Table2-4: The Secondary Unit

Unit: 1,000b/d

	Crude Distillation	Vacuum Distillation	Coker	Thermal Cracking
China (Present)	5,360	3,800 (71%)	692 (13%)	168 (3%)
(Incl.plan)	7,480	4,970 (66%)	860 (11%)	168 (2%)
Japan	4,777	1,652 (35%)	93 (2%)	0 (0%)
USA	17,273	7,635 (44%)	2,372 (14%)	22 (0%)
India	2,256	507 (22%)	170 (8%)	93 (4%)
Korea	2,577	316 (12%)	19 (1%)	0 (0%)
Saudi Arabia	2,095	448 (21%)	0 (0%)	138 (7%)
Russia	5,339	1,925 (36%)	85 (2%)	383 (7%)
	Catalytic Cracking	Catalytic Reforming	Hydro Cracking	Hydro Desulfurization
China (Present)	1,838 (34%)	615 (11%)	636 (12%)	1,380 (26%)
(Incl.plan)	1,964 (26%)	669 (9%)	1,033 (14%)	2,000 (27%)
Japan	882 (18%)	711 (15%)	175 (4%)	4,370 (91%)
USA	5,731 (33%)	3,536 (20%)	1,517 (9%)	13,508 (78%)
India	303 (13%)	42 (2%)	55 (2%)	231 (10%)
Korea	187 (7%)	236 (9%)	120 (5%)	1,068 (41%)
Saudi Arabia	104 (5%)	193 (9%)	132 (6%)	553 (26%)
Russia	331 (6%)	746 (14%)	57	2,171 (41%)

Source: Oil & Gas Journal, December 2006, China's Oil and Petroleum Chemical Industry (2006 Edition)

As mentioned in table 1-1, the growth of oil demand in the region has been mainly based on light petroleum products such as gasoline, diesel, and kerosene, and this trend is expected to continue. At the same time, Asian refineries will be required to meet increasingly stringent environmental regulations for their products, particularly for sulfur content. Additionally, in the future, as crude oil production in the Asian region is expected to diminish,

developing countries must prepare for increased volumes of crude oil from the Middle East, which is heavier and contains more sulfur content.

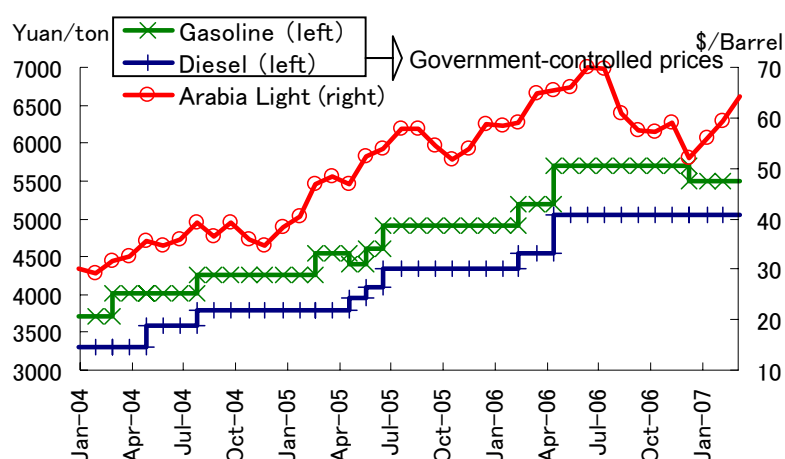
For these reasons above, in the long term, Asian refineries will be required to expand capacities of secondary units including hydro-cracking, hydro-desulphurization, and other secondary units to address this shift in demand mix and crude slate.

2-2. The process of market and price liberalization

As shown in table 2-1, the incremental expansion in refining capacity from China and India represents most of that of Asia through 2010. Therefore, the smoothness of their plans' implementations will have a serious influence on Asia's petroleum supply and demand balance. However, one factor that may have a big impact on their refining investment and, in turn, the supply and demand balance of Asia is the process of their market and price liberalization.

Although India's petroleum industry's market liberalization is progressing somewhat better than China's, government-controlled petroleum prices and the domestic product retail prices in both countries are currently lower than those of the international market. Since 2007, the Chinese government seems to be mulling a "cost-plus" price formula reform, whereby refiners would be allocated a 5% profit above a base consisting of the weighted average crude price at the Brent, Dubai and Minas markets and refining costs. However, the price adjustment frequency hasn't been clarified yet, and in reality, Chinese petroleum prices continued to be adjusted on an *ad hoc* basis.

Table2-4: The government-controlled petroleum prices in China



Source: The Refining Industry of China, Yue ZHANG (June 2007)

In India, the government had previously announced a reform plan to adjust the prices of

gasoline and diesel once every two weeks on a near-real-time basis according to international oil prices. However, as the international prices soared since 2004, the government reversed its position and decided to freeze the prices of gasoline and diesel, making further adjustments to the price on an irregular basis. Under such a condition, the refining departments of Indian national oil companies have suffered deficits during the last two years. Therefore, the government provides subsidies of billions of dollars to these companies every year to compensate part of their loss.

It is believed that if the government-controlled price could be liberalized, the economic conditions of Chinese and Indian national oil companies would improve. Moreover, with liberalization, capability of investment would be enhanced and new refinery construction and upgrading would become smoother, which of course, would contribute to the region's supply and demand balance as well. However, at this moment, there is still no sign that those two countries will resume liberalization before 2010.

Government controlled low prices causes another problem as well. That is, in order to sell refined petroleum product at a better price, national oil companies tend to export at much as they can, which can cause supply shortage on the domestic market. To combat this, the government has issued emergent policies such as imposing export taxes to limit export. The supply and demand balance therefore shows random fluctuations, which inhibits the market's ability to represent fundamental supply and demand.

2-3. Entry of alternative fuels

Under the pressure of petroleum security, environment issues, and high oil prices, most Asian countries have been introducing alternative fuels actively during the last few years. Typical pursuits include Coal to Liquid (CTL) and biomass fuels such as ethanol and bio-diesel. However, their influences on the supply and demand balance of the region are not expected to be significant by 2015.

Some Asian CTL projects have already entered the producing stage or are now under construction/experiment. For example, China is planning to reach a CTL petroleum product production of 1000 thousand b/d by 2020. However, due to vast investment requirements and the huge consumption of water and electricity during the production process, at this moment, it is unclear if the target will actually be reached. Like China, coal-abundant Indonesia is also undertaking experimental CTL projects. And India is also considering a start, however those two countries have announced no concrete target or plan yet.

As for the bio-fuels, in Asia, although the annual production of bio-diesel in Malaysia and Indonesia have both reached 15,000 thousand ton, most of the product is exported to Europe. And although the production of bio-diesel and bio-ethanol in Singapore and China

are being supplied to the domestic market, annual production is only about 1,000 thousand ton. Moreover, as issues such as raw material supply, competition with food supply, potential cultivation area, deforestation, bio-fuel standards, and technical barriers of the 2nd generation bio-fuels remain unresolved, bio-fuel are not expected to have a big influence on the region's supply and demand balance in the short term (table2-6) .

Table2-6: The Introduction of bio-fuels in Asian countries (including future plans)

Indonesia		Malaysia	Thailand		Philippine		India	China		Korea		Japan
E10	B5	B5	E10	B2	E5	B1	E5	E10	B5	E0.1	B5	E3

-E10 represents 10% of ethanol added to gasoline; -B5 represents 5% of bio-diesel added to diesel

Source: IEEJ estimated (July 2007)

Conclusions

In conclusion, the challenges mentioned above leave much uncertainty towards the realization of such investment and the optimization of Asia's refining industry.

Price liberalization is a particularly important issue to be addressed. The current low petroleum product prices in some Asian counties (for example, China and India) are seriously affecting the returns and profits of their national oil companies, which in turn, restrain their investment to enlarge and optimize the refining capability and also will have a big impact on the supply and demand balance of the region. Therefore, the government controlled price policy should be alleviated as early as possible. Yet, there is currently little evidence that China or India might institute such reforms before 2010. On the other hand, the underlying reason for government-controlled pricing stems from the very existence of national oil company-dominated monopoly markets. Thus, broader petroleum industry reform and, more generally, oil market liberalization itself is an important background which must dictate the form of such pricing liberalization.

Of course, pricing liberalization is not the sole remedy to the numerous challenges now before Asian petroleum refiners. With this must also come a host of supporting therapies, including shared information, updated supply & demand projections of the Asian market, closer linkage with the Middle East, promotion of energy conservation, and deeper mutual recognition and understanding for building further regional co-operations. With careful consideration of a broad array of treatments such as these, however, Asia's refining industry would be well equipped to face its future.

Reference:

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