

## **Coal Supply and Demand Trends in Asia – Huge Potential Demand and Related Subjects –**

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### **Introduction**

Asia has achieved outstanding economic growth and has been looked upon with admiration as the “growth center of the world.” Furthermore, this region is inhabited by more than half the world’s population, and its own population is growing rapidly. Apart from all these interwoven factors, its energy demand was until recently growing at a staggering pace as well. In July 1997, however, the hitherto burgeoning Asian economies were struck a disastrous economic blow by a currency crisis that originated in Thailand. The currency crisis devastated all but a few Asian countries, such as China and India, whose currencies were not targeted by a selling drive.

However, helped by IMF-sponsored financial aid conditional on economic liberalization, etc., the severely hit Asian economies have established various kinds of economic reform programs. They are now showing signs of incipient recovery in their economic trends. Also from the point of view of Japan’s energy security, it is important at this time to take a close look at the trends of Asia’s coal supply and demand environment. In the following, we review Asia’s coal supply and demand based on our literature and field surveys, the latter covering Thailand, Malaysia and the Philippines.

### **1. Status of Coal Supply and Demand in Asia**

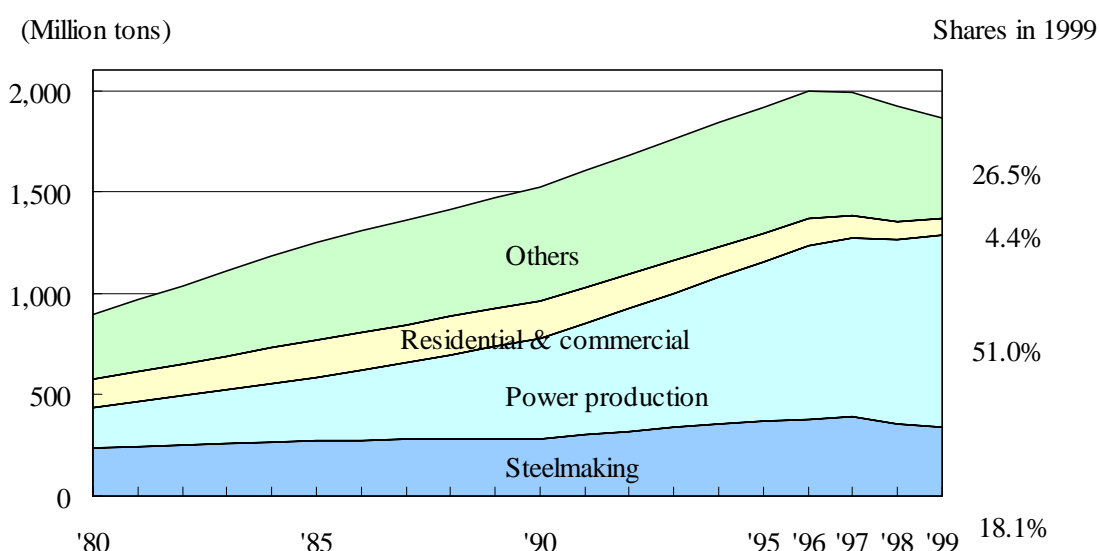
#### **1-1 Coal supply and demand in Asia**

Asia’s coal demand is outlined on the basis of “Coal Information 2001, with 2000 data” published by the IEA. Fig. 1-1 and Table 1-1 show how Asia’s coal demand has changed. Coal demand in Asia more than doubled from 894.30 million tons in 1980 to 1,861.30 million tons in 1999.

By use, the share of steelmaking, which accounted for 26.3% of total coal demand in 1980, had fallen to 18.1% by 1999. During this period, power production’s demand for coal (steaming coal) expanded rapidly from 204.10 million tons in 1980 to 312.30 million tons in 1985, which was 39.60 million tons more than the quantity consumed in steelmaking. This can be attributed to the steeply increasing number of coal-fired power plants built after the second oil crisis occurred in 1979. From 1985

onward, too, demand for steaming coal for power production continued to grow, and by 1999, it had risen to 949.60 million tons (a 51.0% share) throughout the Asian region. Residential and commercial coal demand, 137.80 million tons (15.4%) in 1980, had declined to 81.10 million tons (4.4%) by 1990. Likewise, demand from the remainder (including general industry), which amounted to 316.80 million tons and claimed the then largest share (35.4%) in 1980, began to decline after peaking in 1996 at 630.70 million tons and ended at 493.20 million tons (26.5%) in 1999.

**Fig. 1-1 Asia's Coal Demand**



Source: Prepared by IEEJ on the basis of IEA, "Coal Information 2001, with 2000 data [Part III: Non-OECD Coal Statistics.]"

While Asia's coal demand expanded by 967.00 million tons (up 3.9%/year on average) in the 19 years from 1980 to 1999, 745.50 million tons of the increment resulted from growing electricity demand (8.4%/year). In other words, electricity demand was responsible for about 77.1% of the extra coal needs. On the other hand, coal needs for steelmaking grew by only 101.80 million tons (accounting for 10.5% of the increment, up 1.9%/year on average). Residential & commercial coal demand slumped by 56.70 million tons, and the remainder (including general industry) increased its coal demand by 176.40 million tons (2.4%/year). Growing coal demand for power production is seen throughout Asia; 449.90 million tons (8.3%/year) in China, 162.40 million tons (7.4%/year) in India, 49.40 million tons (10.0%/year) in Japan, 28.90 million tons (15.8%/year) in Korea, and 24.70 million tons (13.6%/year) in Taiwan.

**Table 1-1 Asia's Coal Demand**

(Unit: Million tons)

		1980	1985	1990	1995	1996	1997	1998	1999	Ups/downs '99/'80
China	Steelmaking	127.3	139.9	134.0	232.9	236.1	243.5	215.2	200.5	73.2
	Power production	126.5	179.0	302.0	502.3	550.7	551.5	558.1	576.4	449.9
	Residential & commercial	115.7	156.2	167.0	134.8	134.1	112.5	80.7	75.3	-40.4
	Others	246.4	391.7	432.4	446.0	447.6	426.4	420.8	350.4	104.0
	Total	615.9	866.8	1,035.4	1,316.0	1,368.5	1,333.9	1,274.8	1,202.6	586.7
India	Steelmaking	30.0	44.9	56.5	49.7	50.3	53.3	49.5	47.1	17.1
	Power production	55.8	79.9	109.6	164.5	179.6	193.5	207.7	218.2	162.4
	Residential & commercial	2.9	2.2	1.2	0.3	0.3	0.0	0.0	0.2	-2.7
	Others	25.7	29.0	49.4	68.0	69.6	66.1	56.0	42.8	17.1
	Total	114.4	156.0	216.7	282.5	299.8	312.9	313.2	308.3	193.9
Japan	Steelmaking	66.0	69.3	65.4	57.7	57.0	57.5	54.8	55.8	-10.2
	Power production	9.6	23.8	31.5	47.1	50.7	53.0	55.6	59.0	49.4
	Residential & commercial	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.5
	Others	10.4	16.6	15.0	24.2	25.1	23.3	22.3	22.3	11.9
	Total	86.5	109.8	111.9	129.0	132.8	133.8	132.7	137.1	50.6
Korea	Steelmaking	4.7	7.3	11.9	14.1	15.1	15.9	15.9	15.9	11.2
	Power production	1.9	6.9	7.7	16.7	21.5	25.0	28.1	30.8	28.9
	Residential & commercial	18.0	23.1	18.8	3.0	2.0	1.4	1.2	1.1	-16.9
	Others	1.7	4.7	3.5	17.8	14.5	14.2	12.8	11.0	9.3
	Total	26.3	42.0	41.9	51.6	53.1	56.5	58.0	58.8	32.5
Taiwan	Steelmaking	1.5	2.6	4.2	4.7	4.8	6.6	6.9	6.4	4.9
	Power production	2.4	5.2	8.7	16.5	19.9	22.2	24.6	27.1	24.7
	Residential & commercial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others	3.3	4.2	6.1	7.7	6.5	7.6	5.7	7.7	4.4
	Total	7.2	12.0	19.0	28.9	31.2	36.4	37.2	41.2	34.0
Indonesia	Steelmaking	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2
	Power production	0.0	0.2	4.6	6.7	7.5	10.0	10.6	11.6	11.6
	Residential & commercial	0.0	0.0	0.0	0.0	0.0	1.3	2.6	3.7	3.7
	Others	0.2	0.7	1.8	3.7	6.7	2.2	1.4	2.5	2.3
	Total	0.2	0.9	6.4	10.4	14.2	13.6	14.7	18.0	17.8
Rest of Asia	Steelmaking	6.1	8.7	12.3	12.3	12.2	11.9	11.6	11.5	5.4
	Power production	7.9	17.3	26.1	26.4	26.4	26.0	26.3	26.5	18.6
	Residential & commercial	0.7	0.5	0.4	0.8	0.9	0.9	0.7	0.8	0.1
	Others	29.1	37.1	53.1	59.7	60.7	61.6	56.5	56.5	27.4
	Total	43.8	63.6	91.9	99.2	100.2	100.4	95.1	95.3	51.5
Asia total	Steelmaking	235.6	272.7	284.3	371.4	375.5	388.8	354.0	337.4	101.8
	Power production	204.1	312.3	490.2	780.2	856.3	881.2	911.0	949.6	745.5
	Residential & commercial	137.8	182.1	187.4	138.9	137.3	116.1	85.2	81.1	-56.7
	Others	316.8	484.0	561.3	627.1	630.7	601.4	575.5	493.2	176.4
	Total	894.3	1,251.1	1,523.2	1,917.6	1,999.8	1,987.5	1,925.7	1,861.3	967.0
World total	Steelmaking	632.8	625.5	614.9	619.0	614.9	629.8	587.3	570.1	-62.7
	Power production	1,231.9	1,465.1	1,753.9	2,079.5	2,211.3	2,253.5	2,310.7	2,327.3	1,095.4
	Residential & commercial	181.1	225.3	216.9	184.7	179.9	157.8	119.4	117.6	-63.5
	Others	760.5	927.6	972.3	826.9	781.9	776.0	733.8	642.8	-117.7
	Total	2,806.3	3,243.5	3,558.0	3,710.1	3,788.0	3,817.1	3,751.2	3,657.8	851.5

Source: Prepared by IEEJ on the basis of IEA, "Coal Information 2001, with 2000 data [Part III: Non-OECD Coal Statistics."

Table 1-2 and Fig. 1-2 show clearly how electricity demand has changed in Asia. In all the Asian economies except Japan, final energy consumption grew by an average 4.8% annually between 1971 and 1999, a little lower than the real GDP growth standing at 6.5% over the same period. However, energy consumption in the form of electricity grew by a high 8.1%, which was 3.3 points faster than the total final energy consumption. In particular, although unevenly distributed, the nine economies of East Asia (Korea, Taiwan, Hong Kong) and Southeast Asia (Singapore, Malaysia, Thailand, Indonesia, the Philippines, Vietnam), all showed remarkable economic development during these years and recorded a strong electricity demand growth of more than 9% when combined. In other words, along with their steady economic development, their energy demand also continues to grow. Above all, electricity demand is sharply on the rise, thus occupying a higher-than-ever position in energy use.

**Table 1-2 Asia's Final Energy Consumption and Other Data**

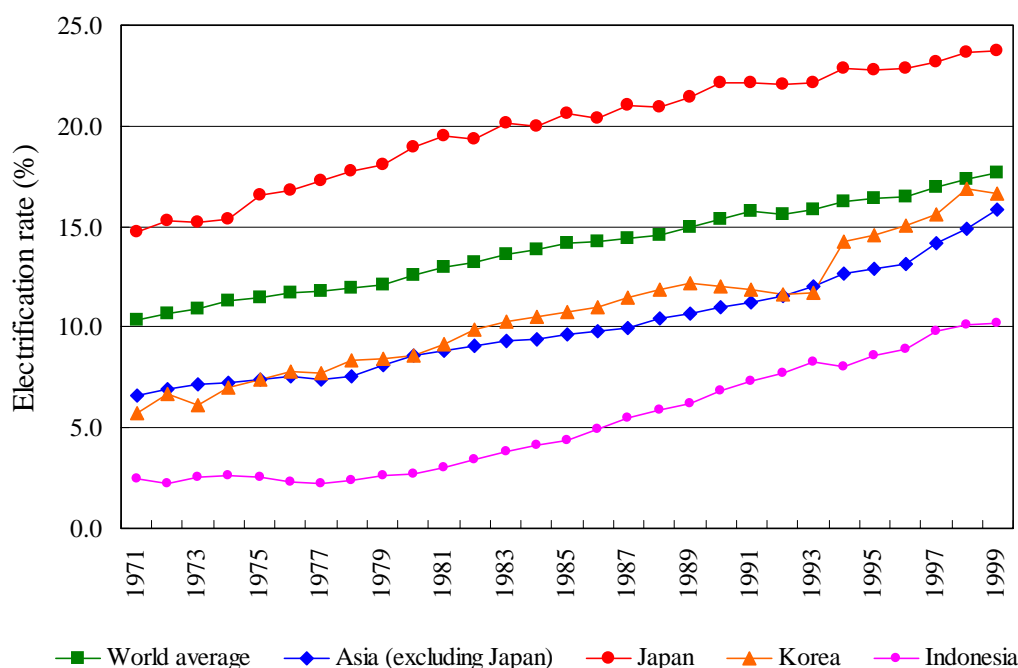
(Unit: Million tons)

	1971	1980	1985	1990	1995	1996	1997	1998	1999	Annual average growth (99/71)
Final energy consumption (million tons oil equivalent)										
Japan	199	233	246	294	329	336	340	335	342	2.0%
Asia excluding Japan	308	518	659	864	1,126	1,194	1,167	1,148	1,145	4.8%
ASEAN total	30	51	61	91	141	156	162	156	167	6.3%
OECD countries	2,580	2,963	2,951	3,130	3,359	3,472	3,490	3,478	3,553	1.1%
World total	3,630	4,672	4,903	5,399	5,705	5,856	5,840	5,834	5,900	1.7%
Final energy consumption (electricity) (million tons oil equivalent)										
Japan	29	44	51	65	75	77	79	79	81	3.7%
Asia excluding Japan	20	44	63	95	145	157	165	171	181	8.1%
ASEAN total	2	5	7	11	19	21	23	24	25	9.7%
OECD countries	278	408	465	548	620	639	652	668	683	3.3%
World total	377	586	693	829	935	966	989	1,014	1,041	3.7%
GDP in real terms (US\$ billion in 1995 price)										
Japan	2,187	3,232	3,814	4,782	5,137	5,397	5,483	5,345	5,356	3.3%
Asia excluding Japan	599	1,009	1,387	1,959	2,841	3,047	3,221	3,239	3,450	6.5%
ASEAN total	138	255	311	445	642	689	717	663	685	5.9%
OECD countries	11,871	16,052	18,212	21,651	23,744	24,505	25,272	25,765	26,417	2.9%
World total	14,029	19,503	22,124	26,246	29,141	30,164	31,187	31,767	32,607	3.1%
Electrification rate										
Japan	14.7%	18.9%	20.6%	22.1%	22.7%	22.8%	23.1%	23.6%	23.7%	-
Asia excluding Japan	6.6%	8.6%	9.6%	11.0%	12.9%	13.1%	14.2%	14.9%	15.9%	-
ASEAN total	6.2%	9.1%	10.7%	12.0%	13.3%	13.5%	14.5%	15.3%	14.9%	-
OECD countries	10.8%	13.8%	15.7%	17.5%	18.5%	18.4%	18.7%	19.2%	19.2%	-
World total	10.4%	12.5%	14.1%	15.4%	16.4%	16.5%	16.9%	17.4%	17.6%	-

Note: Electrification rate (%) = electrical energy consumption/total final energy consumption

Source: Prepared on the basis of "Energy/Economy Statistical Handbook, 2002 edition" edited by EDMC, IEEJ.

**Fig. 1-2 Changing Electrification Rates in Asia**



Source: Prepared on the basis of “Energy/Economy Statistical Handbook, 2002 edition” edited by EDMC, IEEJ.

In all the Asian economies except Japan, the electrification rate (share of electricity in total final energy consumption) rose from 6.6% in 1971 to 15.9% in 1999, which is still lower than the 19.2% for OECD members. Therefore, regarding the form of energy consumption in Asia, there is a strong likelihood that the electrification rate will rise along with economic growth and that electricity demand will continue to grow faster than total energy demand. Thus, in Asia, rising electricity demand is the prime mover of greater coal use and has been the greatest contributor to the expansion of coal demand which has been noted throughout this continent.

**1-2 Coal production and imports/exports in Asia**

Table 1-3 shows the historical trends of coal production, imports/exports and domestic consumption in the Asian economies, based on “Coal Information 2001, with 2000 data” available from the IEA. Asia’s coal production rose sharply from 816.80 million tons in 1980 to 1,834.30 million tons in 1996. Since 1997, however, production has been on the gradual decline and remained at 1,690.20 million tons in 1999. This represents 46.1% of 3,666.50 million tons produced worldwide in 1999. Of Asia’s coal production, China holds the dominant share of 73.3% by producing 1,238.30 million tons in 1999. With these figures, China also claims a share of 33.8% in worldwide coal

**Table 1-3 Asian Economies' Coal Production, Imports/Exports and Domestic Consumption**

(Unit: Million tons)

		1980	1985	1990	1995	1996	1997	1998	1999	Ups/downs '99/'80
China	Production	620.2	872.3	1,050.7	1,343.0	1,401.8	1,367.2	1,305.5	1,238.3	618.1
	Imports	2.0	2.3	2.0	1.6	3.2	2.0	1.6	1.7	-0.3
	Exports	6.3	7.8	17.3	28.6	36.5	35.3	32.3	37.4	31.1
	Domestic consumption	615.9	866.8	1,035.4	1,316.0	1,368.5	1,333.9	1,274.8	1,202.6	586.7
India	Production	113.9	154.2	211.7	270.1	285.6	295.8	297.9	291.0	177.1
	Imports	0.6	2.0	5.1	12.5	14.3	17.2	15.6	18.1	17.5
	Exports	0.1	0.2	0.1	0.1	0.1	0.1	0.3	0.8	0.7
	Domestic consumption	114.4	156.0	216.7	282.5	299.8	312.9	313.2	308.3	193.9
Japan	Production	18.0	16.4	8.3	6.3	6.5	4.3	3.7	3.9	-14.1
	Imports	68.6	93.4	103.6	122.7	126.3	129.5	129.0	133.2	64.6
	Exports	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
	Domestic consumption	86.5	109.8	111.9	129.0	132.8	133.8	132.7	137.1	50.6
Korea	Production	18.6	22.5	17.2	5.7	5.0	4.5	4.4	4.2	-14.4
	Imports	7.7	19.5	24.7	45.9	48.1	52.0	53.6	54.6	46.9
	Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Domestic consumption	26.3	42.0	41.9	51.6	53.1	56.5	58.0	58.8	32.5
Taiwan	Production	2.6	1.9	0.5	0.2	0.1	0.1	0.1	0.1	-2.5
	Imports	4.6	10.1	18.5	28.7	31.1	36.3	37.1	41.1	36.5
	Exports	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Domestic consumption	7.2	12.0	19.0	28.9	31.2	36.4	37.2	41.2	34.0
Indonesia	Production	0.3	2.0	10.5	41.1	50.2	54.9	61.2	72.0	71.7
	Imports	0.0	0.0	0.8	0.6	0.4	0.4	0.4	0.5	0.5
	Exports	0.1	1.1	4.9	31.3	36.4	41.7	46.9	54.5	54.4
	Domestic consumption	0.2	0.9	6.4	10.4	14.2	13.6	14.7	18.0	17.8
Rest of Asia	Production	43.2	53.3	77.3	83.9	85.1	86.1	81.4	80.7	37.5
	Imports	1.4	11.2	15.8	18.7	19.3	18.2	17.1	18.3	16.9
	Exports	0.8	0.9	1.2	3.4	4.2	3.9	3.4	3.7	2.9
	Domestic consumption	43.8	63.6	91.9	99.2	100.2	100.4	95.1	95.3	51.5
Asia total	Production	816.8	1,122.6	1,376.2	1,750.3	1,834.3	1,812.9	1,754.2	1,690.2	873.4
	Imports	84.9	138.5	170.5	230.7	242.7	255.6	254.4	267.5	182.6
	Exports	7.4	10.0	23.5	63.4	77.2	81.0	82.9	96.4	89.0
	Domestic consumption	894.3	1,251.1	1,523.2	1,917.6	1,999.8	1,987.5	1,925.7	1,861.3	967.0
World total	Production	2,810.0	3,242.8	3,566.4	3,715.2	3,797.1	3,820.7	3,757.9	3,666.5	856.5
	Imports	259.6	346.2	392.2	488.3	504.1	528.6	538.8	538.6	279.0
	Exports	263.3	345.5	400.6	493.4	513.2	532.2	545.5	547.3	284.0
	Domestic consumption	2,806.3	3,243.5	3,558.0	3,710.1	3,788.0	3,817.1	3,751.2	3,657.8	851.5

Source: Prepared by IEEJ on the basis of IEA, "Coal Information 2001, with 2000 data [Part III: Non-OECD Coal Statistics."

production. Following China are India and Indonesia, producing 291.00 million tons and 72.00 million tons, respectively, in 1999. On a yearly basis, production growth from 1980 to 1999 averages 3.9% across Asia, compared with 1.4% worldwide. The production growth averaged 3.7%/year in China, 5.1%/year in India and 33.4%/year in Indonesia, with Indonesia thus registering by far the strongest growth. On the other hand, domestic coal production shrank sharply in Japan and Korea.

Comparing coal output and consumption, all the Asian economies except China, India (despite having increased imports in recent years) and Indonesia depend on imports in securing their coal supplies. Coal imports of the Asian economies reached a total of 267.50 million tons in 1999, equivalent to almost half of the world's coal trade. Asia's coal imports, up an average 6.2% per annum from 84.90 million tons in 1980, are likely to keep growing faster than production. For reference, Table 1-4 shows the nine economies' coal imports estimated for 2000.

**Table 1-4 Asian Economies' Coal Imports**

(Unit: Million tons)

	2000 (estimated)			1999 actual	1998 actual	Annual average growth (00/98)
	Total	Steaming coal	Coking coal			
Japan	145.4	80.6	64.7	132.2	129.0	6.2%
Korea	64.6	42.8	18.9	54.6	53.6	9.8%
Taiwan	45.4	39.3	6.1	41.1	37.1	10.6%
India	24.5	9.1	15.4	19.5	15.6	25.3%
Philippines	7.1	7.1	-	5.4	3.7	38.5%
Hong Kong	6.1	6.1	-	6.4	7.1	-7.3%
Thailand	3.1	3.1	-	3.1	1.4	48.8%
Malaysia	3.0	3.0	-	2.7	1.1	65.1%
China	2.1	1.7	0.4	1.7	1.6	15.1%
Total	301.3	192.8	105.5	266.7	250.2	9.7%
(share in world total)	(53.0%)	(50.6%)	(54.8%)	(51.9%)	(49.2%)	
World total	568.0	381.2	192.4	513.8	508.9	5.6%

Note: In the column of 2000 (estimated), the "world total of 568.0" does not accord with the "sum-total of steaming and coking coals of 573.6," but they are put as stated in the source.

The figures for "1999 actual" differ slightly from those stated in Table 1-3, but they are put as stated in the source.

Source: Prepared by IEEJ on the basis of IEA, "Coal Information 2001, with 2000 data [Part I 4. TRADE].

China and Indonesia are the two biggest coal exporters in Asia. In 1999 China exported 37.40 million tons, or 3.0% of its coal output, while Indonesia exported 54.50 million tons, or 75.7% of its total production. With these included, coals exported by the Asian economies in 1999 totalled 96.40 million tons. This represents 17.6% of the world's coal trade, or less than one-fifth. Apparently Asia is unable to meet its regional coal import needs within Asia.

Table 1-5 shows the Asian economies' coal imports by source. It covers six Asian economies, including four major coal importers (Japan, Korea, Taiwan and Hong Kong), coal-rich India whose coal imports are expanding, and also coal-rich China which has little choice but to import coal to its southern coastal areas since these located too remotely from domestic coalfields to justify the cost of inland transportation. Four producing countries (Australia, Indonesia, China and South Africa) can be cited as the principal coal exporters to Asia. Among others, Canada and the United States are also exporting a massive amount of coal to Asia. Within the Asian region, anthracite-producing Vietnam can also be counted as a coal exporter. Table 1-5 also gives an estimate of what the Asian economies' coal trade will be in 2000.

Japan's coal imports, an estimated 145.40 million tons for 2000, have been growing by 3.4%/year on average during the last ten years. By coal rank, steaming coal amounts to 80.60 million tons, or 55.4% of the whole, and coking coal to 64.70 million tons (44.5%). Thus, steaming coal imports are larger than those of coking coal. By source, 87.50 million tons come from Australia, 14.40 million tons from Indonesia, 16.50 million tons from China and 1.90 million tons from South Africa. When combined, coals imported from these four countries alone amount to 120.40 million tons, or as much as 82.8% of Japan's total coal imports.

In Korea and Taiwan alike, coal imports have grown at an average of more than 9%/year during the past ten years. In 2000, Korea's coal imports were an estimated 61.60 million tons, and Taiwan's an estimated 45.40 million tons. Both these economies have larger steaming coal imports than of coking coal. The share of steaming coal stands at 69.5% in Korea and 86.6% in Taiwan, much higher than in Japan. From the big four (Australia, Indonesia, China and South Africa) Korea imports a total of 51.70 million tons and Taiwan a total of 39.90 million tons. These represent 84.0% and 87.8%, respectively, of their total coal imports, revealing that their dependence on the big four is heavier than Japan.

India's coal imports have surged by a high 17.0%/year from 5.10 million tons to 24.50 million tons in the last decade. Coking coal occupies a massive share of the imports, while steaming coal imports are limited. The share of coking coal is estimated



**Table 1-5 Asian Economies' Coal Trade (Trading Partners and Traded Amounts)**

(Unit: Million tons)

Exporting country	Australia			Indonesia			China			South Africa			4-exporter total			Total imports		
	1990 actual	2000 estimated	Annual average growth	1990 actual	2000 estimated	Annual average growth	1990 actual	2000 estimated	Annual average growth	1990 actual	2000 estimated	Annual average growth	1990 actual (share in total imports)	2000 estimated (share in total imports)	Annual average growth	1990 actual	2000 estimated	Annual average growth
Japan	54.1	87.5	4.9%	0.9	14.4	31.9%	4.6	16.5	13.7%	4.8	1.9	-8.7%	64.4 (62.2%)	120.4 (82.8%)	6.5%	103.6	145.4	3.4%
Steaming coal	24.5	46.8	6.7%	0.7	10.5	31.9%	3.3	13.2	15.0%	1.4	1.6	1.4%	29.8	72.2	9.2%	36.0	80.6	8.4%
Coking coal	29.6	40.7	3.2%	0.2	3.9	32.0%	1.3	3.3	9.8%	3.4	0.3	-21.8%	34.6	48.2	3.4%	67.6	64.7	-0.4%
Korea	8.6	22.7	10.2%	0.4	3.6	24.6%	1.0	23.0	36.8%	4.2	2.5	-5.0%	14.2 (57.5%)	51.7 (84.0%)	13.8%	24.7	61.6	9.6%
Steaming coal	3.5	12.0	13.1%	0.4	3.4	23.9%	1.0	20.2	35.1%	4.2	2.5	-5.0%	9.1	38.1	15.4%	11.6	42.8	14.0%
Coking coal	5.1	10.6	7.6%	0.0	0.2	—	0.0	2.8	—	0.0	0.0	—	5.1	13.6	10.3%	13.1	18.9	3.7%
Taiwan	6.5	12.4	6.6%	0.6	15.2	37.6%	0.5	9.4	33.3%	5.6	2.9	-6.5%	13.3 (72.0%)	39.9 (87.8%)	11.6%	18.5	45.4	9.4%
Steaming coal	3.8	9.9	10.0%	0.6	15.2	37.6%	0.5	9.4	33.3%	5.6	2.9	-6.5%	10.6	37.4	13.5%	14.2	39.3	10.7%
Coking coal	2.7	2.5	-1.0%	0.0	0.0	—	0.0	0.0	—	0.0	0.0	—	2.7	2.5	-1.0%	4.2	6.1	3.7%
India	4.8	13.1	10.6%	0.0	4.1	—	0.0	1.9	—	0.0	5.0	—	4.8 (93.4%)	24.1 (98.6%)	17.6%	5.1	24.5	17.0%
Steaming coal	0.1	2.5	37.8%	0.0	0.0	—	0.0	1.6	—	0.0	5.0	—	0.1	9.1	56.9%	0.1	9.1	56.9%
Coking coal	4.7	10.6	8.5%	0.0	4.1	—	0.0	0.4	—	0.0	0.0	—	4.7	15.1	12.4%	5.0	15.4	11.9%
Hong Kong	3.0	0.3	-21.2%	0.7	2.8	15.8%	1.7	2.3	3.0%	3.2	0.6	-15.9%	8.6 (96.2%)	6.0 (98.8%)	-3.5%	8.9	6.1	-3.8%
Steaming coal	3.0	0.3	-21.2%	0.7	2.8	15.8%	1.7	2.3	3.0%	3.2	0.6	-15.9%	8.6	6.0	-3.5%	8.9	6.1	-3.8%
Coking coal	0.0	0.0	—	0.0	0.0	—	0.0	0.0	—	0.0	0.0	—	0.0	0.0	—	0.0	0.0	—
China	0.6	1.2	7.0%	0.0	0.1	—							0.6 (30.0%)	1.3 (62.5%)	8.3%	2.0	2.1	0.6%
Steaming coal	0.0	1.0	—	0.0	0.1	—							0.0	1.2	—	1.1	1.7	4.5%
Coking coal	0.6	0.2	-11.6%	0.0	0.0	—							0.6	0.2	-11.6%	0.9	0.4	-7.7%
6-importer total (share in total imports)	77.7 (75.1%)	137.1 (73.4%)	5.8%	2.6 (53.2%)	40.3 (71.0%)	31.6%	7.8 (45.1%)	53.1 (96.5%)	21.2%	17.8 (35.7%)	12.9 (18.5%)	-3.2%	105.9 (60.3%)	243.5 (85.4%) (66.1%)	8.7%	162.8 (42.1%)	285.1 (49.7%)	5.8%
Steaming coal	34.9	72.5	7.6%	2.3	32.1	29.9%	6.5	46.7	21.8%	14.4	12.6	-1.3%	58.2	163.9	10.9%	72.0	179.6	9.6%
Coking coal	42.8	64.6	4.2%	0.2	8.2	42.3%	1.3	6.4	17.4%	3.4	0.3	-21.8%	47.7	79.5	5.3%	90.8	105.5	1.5%
Total exports	103.4	186.8	6.1%	4.9	56.8	27.9%	17.3	55.0	12.3%	49.9	69.9	3.4%	175.4 (45.4%)	368.5 (64.3%)	7.7%	386.3	573.6	4.0%
Steaming coal	45.3	87.1	6.8%	4.6	48.1	26.5%	13.3	48.2	13.8%	45.9	67.5	3.9%	109.0	250.9	8.7%	214.8	381.2	5.9%
Coking coal	58.1	99.6	5.5%	0.3	8.7	40.7%	4.0	6.9	5.6%	4.0	2.5	-4.7%	66.4	117.7	5.9%	171.5	192.4	1.2%

Source: Prepared by IEEJ on the basis of IEA, "Coal Information 2001, with 2000 data [Parts II &amp; III].

to have been 62.9% of all imported coals in 2000. Import dependence on the big four exporting-countries stands at 98.6%, virtually the whole of India's coal imports.

Hong Kong's coal imports are of steaming coal only, and these have shrunk during the last ten years from 8.90 million tons to 6.10 million tons. The principal coal exporters to Hong Kong were Australia and South Africa as of 1990, though they have now been replaced by Indonesia and China. China imports Australian and Indonesian coals, though as little as 2.10 million tons at present.

Of coal exports estimated for 2000 to the six Asian economies of Japan, Korea, Taiwan, Hong Kong, India and China, Australia was responsible for 137.10 million tons (73.4% of its total coal exports), Indonesia 40.30 million tons (71.0%), China 53.10 million tons (96.5%) and South Africa 12.90 million tons (18.5%). The three countries of Australia, Indonesia and China have increased their exports to Asia at an annual average growth of 5.8%, 31.6% and 21.2%, respectively, during the last ten years. On the other hand, South Africa alone saw its Asia-bound exports shrinking. Perhaps this is because South Africa has poorer price competitiveness than rival coal exporters due to the high transportation costs attributable to its distant location from Asia, particularly East Asia (Japan, Korea and Taiwan).

Coal imports by the six Asian economies of Japan, Korea, Taiwan, Hong Kong, India and China account for as much as around 50% (Japan alone accounting for about 25%) of the world's coal trade. In reverse, the exports from the four producing countries of Australia, Indonesia, China and South Africa to the above-mentioned six Asian economies account for more than half of the world's coal trade, or 64.3% (Australia alone responsible for 32.6%).

## **2. Overseas Survey Results**

### **2-1 Thailand**

Table 2-1 shows Thailand's net energy imports estimated from the data contained in "PDP2001," furnished by the National Energy Policy Office (NEPO). Net energy imports are likely to grow by 6.9%/year on average between 2000 and 2016. During this period, coal imports in particular will grow as sharply as 15.1%/year, by far outrunning the average growth of all-energy imports. Even natural gas, in which Thailand is reportedly self-sustaining, has been imported since 1998, although in limited quantities. Natural gas imports are projected to triple in 2000-2001, with growth averaging 10.2%/year in 2000-2016, which is much higher than the average growth of all-energy imports. Imports of electricity itself are expected to grow nearly tenfold in the five years from 2006 to 2011.

**Table 2-1 Net Energy Imports and Imported Energy Mix (PDP2001: Base Case)**

(Unit: 1,000 toe)

	2000	2001	2002	2003	2004	2005	2006	2011	2016	Annual average growth (16/00)
Crude oil	32,094 92.8%	33,847 89.7%	32,650 86.1%	32,355 80.1%	34,611 80.9%	35,794 76.3%	38,368 74.5%	54,990 77.6%	67,647 67.6%	4.8%
Petroleum products	-1,641 -4.7%	-3,770 -10.0%	-3,281 -8.7%	-1,364 -3.4%	-3,317 -7.8%	-2,638 -5.6%	-2,820 -5.5%	-4,619 -6.5%	-2,360 -2.4%	2.3%
Condensate	-221 -0.6%	-210 -0.6%	-214 -0.6%	-229 -0.6%	-225 -0.5%	-234 -0.5%	-255 -0.5%	-315 -0.4%	-351 -0.4%	2.9%
Natural gas	1,517 4.4%	4,574 12.1%	5,811 15.3%	6,161 15.2%	7,437 17.4%	8,322 17.7%	7,991 15.5%	7,121 10.1%	7,140 7.1%	10.2%
Coal	2,604 7.5%	3,052 8.1%	2,724 7.2%	3,270 8.1%	4,013 9.4%	5,438 11.6%	8,002 15.5%	11,298 15.9%	24,877 24.9%	15.1%
Electricity	224 0.6%	248 0.7%	229 0.6%	225 0.6%	249 0.6%	249 0.5%	245 0.5%	2,375 3.4%	3,136 3.1%	17.9%
Total	34,577	37,742	37,918	40,418	42,768	46,930	51,530	70,850	100,088	6.9%

Source: Prepared by IEEJ on the basis of NEPO, "PDP 2001."

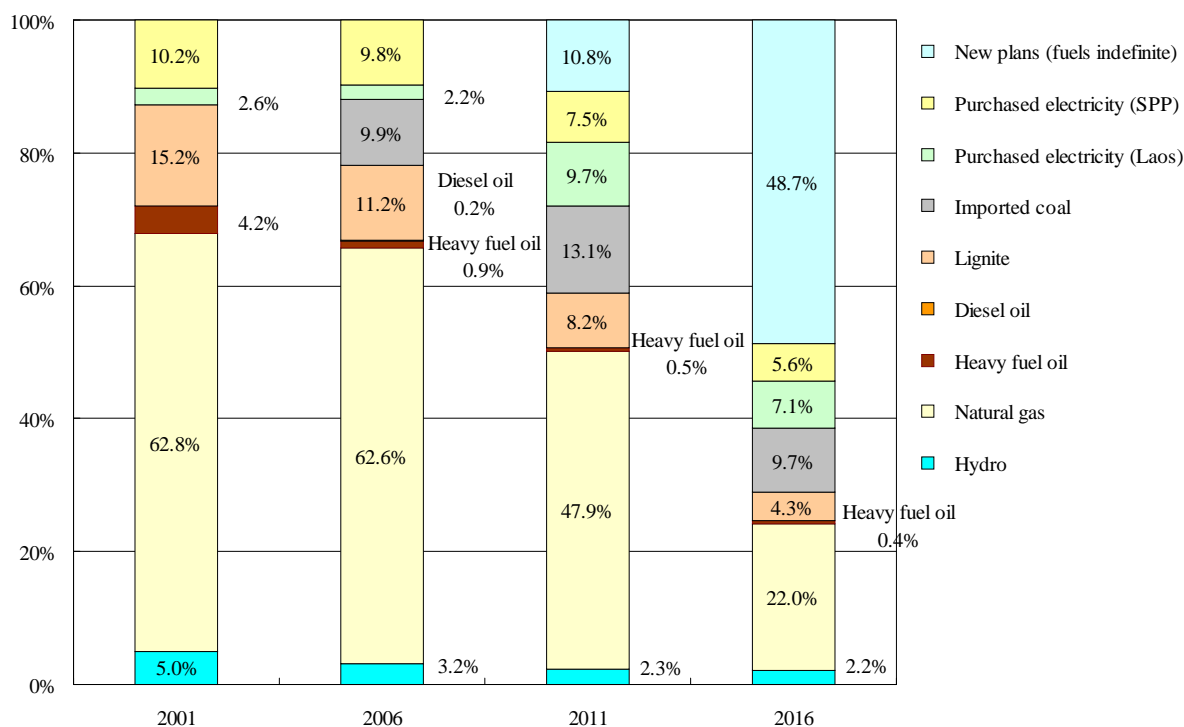
Crude oil, occupying a share of around 90% of energy imports right now, is expected to shrink and remain below 70% by 2016. Coal, on the other hand, accounting for around 8% at present, comes to occupy about 25%. As a result, dependence on imported oil declines somewhat in relative terms. Also, although at a varying share year by year, the Thai natural gas imports will be continued in an effort to cover domestic shortages.

The Electricity Generating Authority of Thailand (EGAT) states in "Power Development Plan PDP 2001," that the Thai generating fuel consumption mix will be as shown in Fig. 2-1. Lignite and natural gas are having their shares gradually undermined by imported coals. As of now, it is not clear what fuels will be employed in the newly planned power plants (2011, 2016), while such capacity additions amount to 21,583 MW by 2016.

According to a recommended plan in PDP 2001, EGAT hopes that newly built IPPs (independent power producers) will cover 18,300 MW, or about 85% of the newly planned capacities, as of 2016. Given that the country's proximity to Indonesia, Australia and South Africa enables Thailand to obtain cheaper-priced steaming coal than Japan, among others, wide use of imported coals is likely among the newly built IPPs. This assumption is supported by the greater coal imports projected for net energy

imports in Table 2-1, though to what extent imported coal consumption by the newly built IPPs is included in these data remains unknown. Thus, depending on future developments, coal demand to fuel newly built IPPs may increase further.

**Fig. 2-1 Generating Fuel Consumption Mix (Recommended Plan)**



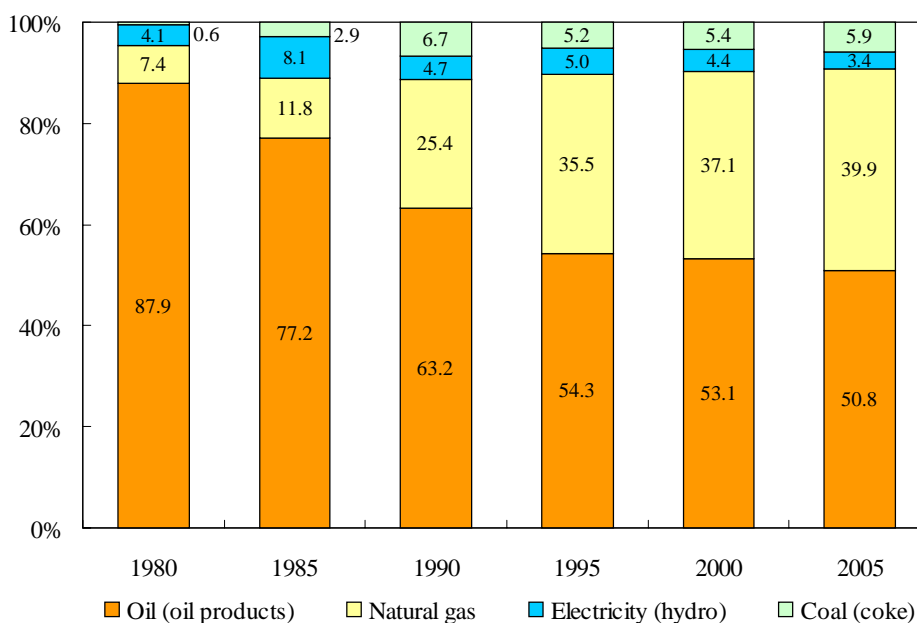
Source: Prepared by IEEJ on the basis of EGAT, "Power Development Plan PDP 2001."

## 2-2 Malaysia

Fig. 2-2 shows Malaysia's primary energy supply mix (commercial energies alone) prepared from documents of the Ministry of Energy, Communications and Multimedia, Malaysia (MECM). It is noted that the oil share will drop to around 50% by 2005, giving way to coal and natural gas.

Regarding generating fuels, TNBF (TNB Fuel Services Sdn Bhd) released a consumption forecast (Table 2-2). TNBF predicts that coal consumption will treble from 4.20 million tons in 2000 to 12.43 million tons by 2005 and will increase further to 21.89 million tons by 2010, up a high 18%/year on average in ten years. On the other hand, TNBF reveals natural gas and oil projections in reflection of the country's energy policy, which calls for lowered reliance on natural gas and oil. As of 2010, natural gas consumption is projected to be flat at its present level without any increase, while a drastic cut in oil consumption is planned.

**Fig. 2-2 Primary Energy Supply Mix (Commercial Energies Alone)**



Source: Prepared by IEEJ on the basis of MECM, “National Energy Balance, Malaysia (1980-1999).”

**Table 2-2 Generating Fuel Consumption Outlook**

	Coal		Natural gas		MFO (Fuel Oil A)	
	Million tons	2000=100	mmscf	2000=100	tons	2000=100
2000	4.20	100	389,000	100	468,000	100
2001	4.57	109	420,000	108	503,000	107
2002	4.60	110	460,000	118	507,000	108
2003	7.52	179	458,000	118	361,000	77
2004	10.17	242	467,000	120	336,000	72
2005	12.43	296	490,000	126	358,000	76
2006	17.61	419	464,000	119	251,000	54
2007	19.79	471	432,000	111	177,000	38
2008	20.93	498	431,000	111	167,000	36
2009	21.64	515	405,000	104	140,000	30
2010	21.89	521	381,000	98	83,000	18

Source: Prepared by IEEJ on the basis of the data disclosed by TNB Fuel Service Sdn Bhd on its web site.

According to “Future Coal Demand for the Malaysian Power Industry,” a presentation delivered at the 13th JAPAC International Symposium (held September 2001 in Tokyo), the Malaysian power industry currently depends on natural gas to meet

its fuel needs. However, the situation is considered to be unsound in terms of stability and reliability vital to the power supply system. Coal is expected to play a key role as a substitute for natural gas. The presentation predicts that Peninsula Malaysia's coal-fired power installed capacity will total 7,200 MW by 2007, and that this will involve coal consumption of about 19.20 million tons a year. Moreover, Peninsula Malaysia's installed capacity will increase from the present 12,000 MW to 27,000 MW by 2100, with gas-fired power accounting for 62% and coal-fired power for 33%. Given the gloomy outlook for domestic coal production, there is a strong likelihood that Malaysia will continue to depend on imports, particularly from neighboring countries, to meet its coal needs for fueling coal-fired power plants.

### **2-3 The Philippines**

Table 2-3 shows the coal supply and demand outlook released by the Department of Energy, Philippines (DOE) in its "Philippine Energy Plan" (2002-2011). This projects that coal demand will shrink once from 11.936 million tons in 2001 to 9.175 million tons in 2002, and then, after rebounding to 12.916 million tons by 2010, that it will slip a little to 12.545 million tons in 2011. The outlook predicts that coal demand will grow by more than 4%/year on average from 2002 to 2010. Coal demand is destined to be used mostly in power production, with its share exceeding 80% from 2001 to 2011. In the meantime, greater use of briquettes is planned as a replacement for the firewood and charcoal used as fuels in the residential sector and small/medium-sized firms.

Coal supply is projected to grow 12.3%/year on average from 1.343 million tons in 2001 to 4.297 million tons in 2011. Coal imports are forecast to drop from 10.593 million tons to 8.248 million tons over the same period. As a result, the share of imports in the total coal supply is expected to fall from 88.7% in 2001 to 65.7% in 2011.

Table 2-4 shows generated output and its generating fuel mix projected in the report. Generated output is expected to grow by an average 9.4%/year from 47,287 GWh in 2001 to 116,274 GWh in 2011. By fuel, coal accounts for 21.2% of generated output, natural gas 16.9%, geothermal 8.7%, oil 8.6%, hydro 6.2%, biomass 0.1% and others 38.4%. While 9,440 MW-capacity additions are necessary for producing as much electricity as the quantity projected for the category of "others" for 2011, the report gives no specifics about when or what types of power plants will be built. The question as to what power sources can be selected for the category of "others" is crucial in determining the future shape of coal consumption.

**Table 2-3 Coal Supply and Demand Outlook (Base Case: Low Growth)**

(Unit: 1,000 tons)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Demand</b>											
Electricity	10,401 87.1%	7,605 82.9%	8,919 84.8%	9,872 85.8%	10,403 86.2%	11,057 86.6%	11,075 86.4%	11,079 86.2%	11,054 85.9%	11,062 85.6%	10,652 84.9%
Cement	1,509 12.6%	1,543 16.8%	1,578 15.0%	1,612 14.0%	1,644 13.6%	1,679 13.2%	1,714 13.4%	1,751 13.6%	1,789 13.9%	1,828 14.2%	1,867 14.9%
Other manufacturing	26 0.2%	26 0.3%	26 0.2%	26 0.2%	26 0.2%	26 0.2%	26 0.2%	26 0.2%	26 0.2%	26 0.2%	26 0.2%
<b>Total</b>	<b>11,936</b>	<b>9,175</b>	<b>10,523</b>	<b>11,510</b>	<b>12,073</b>	<b>12,762</b>	<b>12,815</b>	<b>12,856</b>	<b>12,869</b>	<b>12,916</b>	<b>12,545</b>
<b>Supply</b>											
Domestic production	1,343 11.3%	1,343 14.6%	1,343 12.8%	1,532 13.3%	1,532 12.7%	2,206 17.3%	2,910 22.7%	3,810 29.6%	4,151 32.3%	4,151 32.1%	4,297 34.3%
Imports	10,593 88.7%	7,832 85.4%	9,180 87.2%	9,978 86.7%	10,541 87.3%	10,556 82.7%	9,905 77.3%	9,046 70.4%	8,718 67.7%	8,765 67.9%	8,248 65.7%
<b>Total</b>	<b>11,936</b>	<b>9,175</b>	<b>10,523</b>	<b>11,510</b>	<b>12,073</b>	<b>12,762</b>	<b>12,815</b>	<b>12,856</b>	<b>12,869</b>	<b>12,916</b>	<b>12,545</b>

Source: Prepared by IEEJ on the basis of DOE, "Philippine Energy Plan (2002-2011)."

**Table 2-4 Generated Output Outlook and Its Fuel Mix (Base Case: Low Growth)**

(Unit: GWh)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Generated output	47,287	51,559	56,051	60,483	64,779	71,121	78,313	86,035	94,633	104,108	116,274
Coal	23,924 50.6%	17,388 33.7%	20,458 36.5%	22,688 37.5%	23,928 36.9%	25,459 35.8%	25,501 32.6%	25,510 29.7%	25,451 26.9%	25,470 24.5%	24,611 21.2%
Oil	8,050 17.0%	3,212 6.2%	3,736 6.7%	5,399 8.9%	4,531 7.0%	6,669 9.4%	10,559 13.5%	11,417 13.3%	12,415 13.1%	12,934 12.4%	9,960 8.6%
Natural gas	-	15,654 30.4%	15,803 28.2%	16,763 27.7%	19,509 30.1%	19,969 28.1%	20,661 26.4%	20,634 24.0%	20,532 21.7%	20,521 19.7%	19,705 16.9%
Hydro	5,649 11.9%	6,691 13.0%	6,244 11.1%	6,126 10.1%	6,660 10.3%	6,642 9.3%	6,686 8.5%	6,817 7.9%	6,920 7.3%	7,011 6.7%	7,171 6.2%
Geothermal	9,664 20.4%	8,615 16.7%	9,810 17.5%	9,486 15.7%	10,067 15.5%	10,071 14.2%	10,077 12.9%	10,079 11.7%	10,084 10.7%	10,085 9.7%	10,085 8.7%
Biomass	-	-	-	-	6 0.0%	19 0.0%	73 0.1%	85 0.1%	99 0.1%	106 0.1%	120 0.1%
Others	-	-	0 0.0%	22 0.0%	78 0.1%	2,292 3.2%	4,756 6.1%	11,493 13.4%	19,132 20.2%	27,981 26.9%	44,622 38.4%
Baseload	-	-	-	-	-	2,018	4,036	10,090	16,144	22,198	35,651
Midrange	-	-	-	19	74	258	669	1,252	2,620	5,049	7,217
Peaking	-	-	0	3	4	16	51	151	368	734	1,754

Source: Prepared by IEEJ on the basis of DOE, "Philippine Energy Plan (2002-2011)."

A bold assumption is that, of the generated output projected for "others" for 2011 (see Table 2-4), the whole of the baseload, or 35,651 GWh, would be covered by

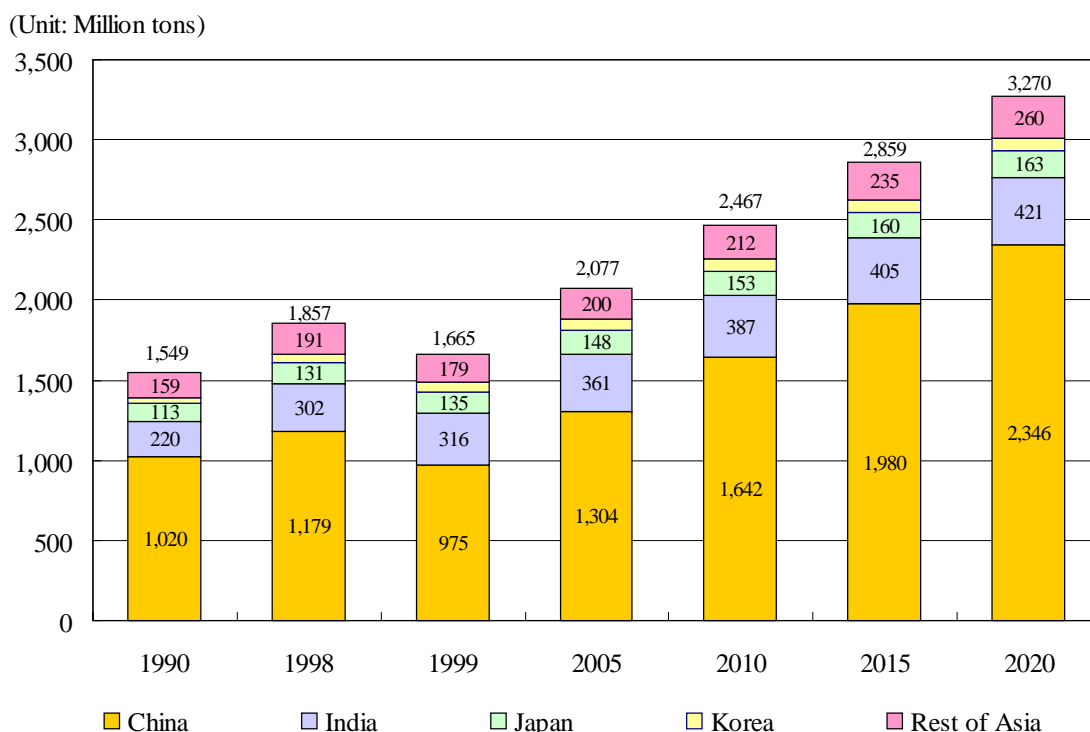
coal. In this case, coal requirements would amount to 14.00 million tons a year, if generating efficiency is put at 35% and imported coals having a calorific value of 6,200 kcal/kg are in use. This would double the coal demand in 2011 at a single stroke. If domestic coals of poorer calorific value (5,000 kcal/kg) are employed, coal requirements would total 17.50 million tons. Adding this to the 4.297 million tons of domestic coal production projected for 2011 gives 22.00 million tons. This is 16 times larger than domestic coal production in 2000, or 1.353 million tons. This figure should not be dismissed as unrealistic.

### 3. Coal Supply and Demand Outlook for Asia

#### 3-1 Coal demand outlook

The EIA in its “International Energy Outlook 2001” prepared three cases — base, high growth and low growth — assuming an annual average GDP growth (1999-2020) of 4.5%, 3.2% and 2.0%, respectively. In the base case, the world’s coal demand is predicted to grow by an average 1.5% a year from 4,300 million tons in 1999 and reach 5,845 million tons in 2020, up by 1,545 million tons in absolute terms.

**Fig. 3-1 Asia’s Coal Demand Outlook (EIA, Base Case)**



Source: Prepared by IEEJ on the basis of EIA, “International Energy Outlook 2001.”



The EIA report states that, although Southeast Asia will see its economic growth falling in the short run due to the economic recession triggered by the 1997 currency crisis, coal demand in the Asian developing areas will continue to expand. As shown in Fig. 3-1, including Japan, Asia's coal demand — 1,665 million tons in 1999 — is forecast to increase by 1,605 million tons to 3,270 million tons by 2020 (up 3.3%/year on average). Above all, China will account for about 85% of the increments, with its coal demand swelling by 1,371 million tons from 975 million tons to 2,346 million tons during the same period (up 1.4%/year on average). India is expected to record the second largest demand increase after China, up 105 million tons from 1999 to 2020, or an average 1.4% a year. In reflection of their strong economic growth expected in the years ahead, India and China are both expected to record huge industrial coal demand, particularly for power production. In reality, however, it is feared that environmental regulations and problems such as how to raise necessary funds for the huge demand will pose demand constraints.

**Table 3-1 Power Sector's Energy Consumption Outlook and Energy Mix (IEA, Base Case)**

(Unit: Million toe)

		World			Annual average growth (20/97)	Asia (excluding Japan)			Annual average growth (20/97)
		1997	2010	2020		1997	2010	2020	
Power sector's energy consumption		3,151	4,275	5,201	2.2%	728	1,321	1,937	4.3%
Share of power sector's energy consumption in primary energy use		36.0%	37.5%	37.9%		35.7%	39.1%	40.6%	
Power sector's energy consumption mix	Coal	1,374 43.6%	1,864 43.6%	2,305 44.3%	2.3%	517 71.0%	921 69.7%	1,332 68.8%	4.2%
	Oil	279 8.9%	316 7.4%	328 6.3%	0.7%	66 9.1%	94 7.1%	111 5.7%	2.3%
	Natural gas	556 17.6%	966 22.6%	1,409 27.1%	4.1%	57 7.8%	128 9.7%	238 12.3%	6.4%
	Nuclear	624 19.8%	690 16.1%	617 11.9%	0.0%	40 5.5%	86 6.5%	115 5.9%	4.7%
	Hydro	221 7.0%	287 6.7%	336 6.5%	1.8%	39 5.4%	72 5.5%	103 5.3%	4.3%
	Renewables	97 3.1%	152 3.6%	206 4.0%	3.3%	9 1.2%	20 1.5%	38 2.0%	6.5%
Primary energy consumption		8,743	11,390	13,710	2.0%	2,038	3,376	4,775	3.8%

Source: Prepared by IEEJ on the basis of IEA, "World Energy Outlook 2000."

The greatest single factor contributing to the expansion of Asia's coal demand is the power industry's mounting coal needs since the second oil crisis in 1979. In its "World Energy Outlook 2000" the IEA states that this trend will last long into the future. Table

3-1 shows the power industry’s energy consumption outlook and its energy mix in the base case of the IEA report. During the period from 1997 to 2020, the power industry’s energy consumption in Asia (excluding Japan) is projected to grow 4.3%/year on average, thus outrunning the world’s average growth of 2.2%/year over the same period. It also exceeds the expected growth of primary energy consumption at 3.8%/year for Asia (excluding Japan) over the same period. The coal share in the power source mix, staying at around 44% worldwide, is expected to decline a little but still to remain high at around 70%.

**3-2 Coal demand outlooks for individual Asian economies**

From sundry reference materials on primary energy consumption outlooks for Asia (including Japan), we extracted data relevant to coal consumption in the individual Asian economies, summaries of which are tabulated in Table 3-2 – Table 3-11. These tables are designed to clarify the coal demand outlook for Asia.

**Table 3-2 Outlook for Japan’s Coal Consumption as Primary Energy**

In line with the report released in July 2001 by the Advisory Committee for Resources and Energy (ACRE), the trend to discourage coal use is likely to be intensified. However, if little progress is made in nuclear power plant construction/operation and introduction of new energy, coal demand could be larger than projected.					
	Unit	2005	2010	2015	2020
ACRE report (2001/7) “Energy Policy from Now On”	Million kl crude oil equivalent (base case)		136		163
	Million t (base case)		184		221
	Million kl crude oil equivalent (target case)		114		
	Million t (target case)		154		
ACRE (1998/6)	Million t (base case)		145		
	Million t (case of measures taken)		124		
EIA, “International Energy Outlook 2001”	Million t (high growth case)	155	164	177	184
	Million t (base case)	148	153	160	163
	Million t (low growth case)	142	143	144	144
IEEJ (1998/12) “The 31st Energy Symposium Distributed Materials VI”	Million t (BUA case)		154		154
	Million t (structural reforms case)		143		147

**Table 3-3 Outlook for China's Coal Consumption as Primary Energy**

Despite greatly differing results, all outlooks accord in the point that coal consumption will continue to grow. At any rate, China's coal consumption is projected to expand to nearly 1.5 billion tons by 2010 and may even surpass 2 billion tons by 2020. If so, a question inherent to China — namely, whether China can meet its coal demand with domestic production alone or will it be reliant on imported coals to some extent — may have a massive impact on Asia's coal supply and demand.					
	Unit	2005	2010	2015	2020
Energy Institute of China, “A Study Report on Natural Gas”	Million toe		707		854
	Million tce		1,010		1,220
	Million t (6,200 kcal/kg)		1,140		1,377
IEA, “World Energy Outlook 2000” (Base case)	Million toe		940		1,192
	Million tce		1,343		1,703
	Million t (6,200 kcal/kg)		1,516		1,923
EIA, “International Energy Outlook 2001”	Million t (high growth case)	1,383	1,827	2,316	2,872
	Million t (base case)	1,304	1,642	1,980	2,346
	Million t (low growth case)	1,158	1,321	1,442	1,556
IEEJ, EDMC (2001/10) “Long-term Macro Economy & Energy Supply-Demand Model Based Econometric Analysis of ASEAN Four, China and Korea” (Base case)	Million toe		839		1,115
	Million tce		1,199		1,592
	Million t (6,200 kcal/kg)		1,353		1,798
IEEJ (2000/3) “Asia's Currency Crisis and Energy Supply-Demand Outlook”	Million toe		1,228		1,778
	Million tce		1,755		2,541
	Million t (6,200 kcal/kg)		1,981		2,869
IEEJ (2001/3) NEDO-sponsored FY2000 Works to Advanced Overseas Coal Development, “Advanced Coal Development in Asia/Pacific”	Million t		1,760		2,060

**Table 3-4 Outlook for Korea's Coal Consumption as Primary Energy**

Though slack, Korea's coal consumption is likely to continue rising and reach 100 million tons or so by 2020.					
	Unit	2005	2010	2015	2020
APEC "Energy Mix and Coal Demand Outlook in Republic of Korea  (The 6th APEC Coal Flow Seminar)	Million toe		53		56
	Million tce		76		80
	Million t (6,200 kcal/kg)		86		91
	Million t (bituminous coal demand)		75		82
EIA, "International Energy Outlook 2001"	Million t (high growth case)	69	79	90	94
	Million t (base case)	64	72	78	80
	Million t (low growth case)	61	65	68	67
IEEJ, EDMC (2001/10) "Long-term Macro Economy & Energy Supply-Demand Model Based Econometric Analysis of ASEAN Four, China and Korea" (Base case)	Million toe		43		57
	Million tce		61		81
	Million t (6,200 kcal/kg)		69		91
IEEJ (2000/3) "Asia's Currency Crisis and Energy Supply-Demand Outlook"	Million toe		51		98
	Million tce		73		139
	Million t (6,200 kcal/kg)		82		157

**Table 3-5 Outlook for India's Coal Consumption as Primary Energy**

India's coal consumption is likely to keep growing and reach 500 million tons or so by 2020.					
	Unit	2006	2011		
Nabhi Publications "Ninth Five Year Plan 1992-2002"	Million t	545	775		
	Unit	2005	2010	2015	2020
IEA, "World Energy Outlook 2000" (Base case)	Million toe		246		336
	Million tce		351		480
	Million t (6,200 kcal/kg)		397		542
EIA, "International Energy Outlook 2001"	Million t (high growth case)	384	430	472	513
	Million t (base case)	361	387	405	421
	Million t (low growth case)	340	348	347	345
IEEJ (2000/3) "Asia's Currency Crisis and Energy Supply-Demand Outlook"	Million toe		284		469
	Million tce		406		670
	Million t (6,200 kcal/kg)		458		757

**Table 3-6 Outlook for Indonesia's Coal Consumption as Primary Energy**

Coal consumption outlooks vary greatly, probably due to different assumptions of economic growth, coal-fired power plant construction/operation, etc. However, there is no doubt that Indonesia's coal consumption is on the increase and likely to approach 100 million tons by 2020.					
	Unit	2005	2010	2015	2020
Directorate of Mineral and Coal Enterprises, "Indonesia's Current Coal Industry Situation"	Million t	38	64	104	165
IEEJ, EDMC (2001/10) "Long-term Macro Economy & Energy Supply-Demand Model Based Econometric Analysis of ASEAN Four, China and Korea" (Base case)	Million toe		12		15
	Million tce		17		21
	Million t (6,200 kcal/kg)		19		24
IEEJ (2000/3) "Asia's Currency Crisis and Energy Supply-Demand Outlook"	Million toe		25		66
	Million tce		35		94
	Million t (6,200 kcal/kg)		40		107
IEEJ (2001/3) NEDO-sponsored FY2000 Works to Advanced Overseas Coal Development, "Advanced Coal Development in Asia/Pacific"	Million t	36	50	68	94

**Table 3-7 Outlook for Thailand's Coal Consumption as Primary Energy**

“PDP2001,” a document of NEPO, predicts that Thai net coal imports will expand greatly from 2.604 million toe in 2000 to 5.438 million toe by 2005, 11.298 million toe by 2011 and 24.877 million toe by 2016. The question that arises when considering Thailand's coal supply-demand from the Asian perspectives is to what extent indigenous lignite can meet the country's coal demand. If indigenous lignite production declines for environmental or other reasons, Thai demand for imported coals may increase further.

	Unit	2006	2011		
APEC (The 5th APEC Coal Flow Seminar, 1999) “Economic Reform and Review of Coal Demand in Thailand”	Million t	36	54		
	Million t (Indigenous lignite)	24	21		
	Million t (Imported coals)	12	33		
	Unit	2005	2010	2015	2020
IEEJ, EDMC (2001/10) “Long-term Macro Economy & Energy Supply-Demand Model Based Econometric Analysis of ASEAN Four, China and Korea” (Base case)	Million toe		10		12
	Million tce		14		17
	Million t (6,200 kcal/kg)		16		19
IEEJ (2000/3) “Asia's Currency Crisis and Energy Supply-Demand Outlook”	Million toe		20		34
	Million tce		28		48
	Million t (6,200 kcal/kg)		31		54

**Table 3-8 Outlook for Malaysia's Coal Consumption as Primary Energy**

Electricity accounted for 60.6% of Malaysia's coal consumption in 2000. While gas-to-coal shifts are under way in the electricity sector, the sector's total coal demand is projected to reach 19.20 million tons by 2007 when coal-fired IPPs will be in operation at their full capacity. Given coal demand outside the electricity sector, coal consumption may reach 30 million tons or so by 2020.

	Unit	2005	2010	2015	2020
IEEJ, EDMC (2001/10) “Long-term Macro Economy & Energy Supply-Demand Model Based Econometric Analysis of ASEAN Four, China and Korea” (Base case)	Million toe		10		16
	Million tce		14		22
	Million t (6,200 kcal/kg)		16		25
IEEJ (2000/3) “Asia's Currency Crisis and Energy Supply-Demand Outlook”	Million toe		5		8
	Million tce		6		12
	Million t (6,200 kcal/kg)		7		13

**Table 3-9 Outlook for the Philippines' Coal Consumption as Primary Energy**

“Philippine Energy Plan (2002-2011)” counts energy demand for indefinite energy sources as “others,” of which a portion specified in Table 2-4 as “others: baseload” is put at 22,198 GWh for 2010. If fully covered with imported coals featuring a calorific value of 6,200 kcal/kg, it requires 8.80 million tons a year when generating efficiency stands at 35%. With this included, coal demand in 2010 can jump from 13 million tons to over 20 million tons at a stroke.

	Unit	2005	2010	2015	2020
Department of Energy “Philippine Energy Plan 2002-2011”	Million t (base case, low growth)	12	13		
	Million t (base case, high growth)	12	13		
	Million t (highly reliant on indigenous energy)	7	12		
IEEJ, EDMC (2001/10) “Long-term Macro Economy & Energy Supply-Demand Model Based Econometric Analysis of ASEAN Four, China and Korea” (Base case)	Million toe		4		5
	Million tce		6		8
	Million t (6,200 kcal/kg)		7		9
IEEJ (2000/3) “Asia’s Currency Crisis and Energy Supply-Demand Outlook”	Million toe		6		14
	Million tce		9		20
	Million t (6,200 kcal/kg)		10		23

**Table 3-10 Outlook for Taiwan’s Coal Consumption as Primary Energy**

Taiwanese coal consumption is likely to surpass 50 million tons by 2010 and approach 70 million tons by 2020.

	Unit	2005	2010	2015	2020
Energy Commission, “Energy Plan” (2000/3)	Million kl oil equivalent		31		38
	Million toe		33		41
	Million tce		47		58
	Million t (6,200 kcal/kg)		53		66
Energy Commission, “White Paper on Energy Policy” (1998/12)	Million t	47	56	64	70
IEEJ (2000/3) “Asia’s Currency Crisis and Energy Supply-Demand Outlook”	Million toe		34		48
	Million tce		48		68
	Million t (6,200 kcal/kg)		54		77



**Table 3-11 Outlook for Vietnam's Coal Consumption as Primary Energy**

Though limited in quantities, Vietnamese coal consumption is likely to increase constantly and surpass 20 million tons by 2020.					
	Unit	2005	2010	2015	2020
NEDO, International cooperation project (2001/3) "A Study on Status Quo of Coal Use and Others within APEC, Coal Note"	Million toe	6	8	10	14
	Million tce	8	11	15	20
	Million t (6,200 kcal/kg)	9	13	17	23
IEEJ (2000/3) "Asia's Currency Crisis and Energy Supply-Demand Outlook"	Million toe		8		13
	Million tce		11		18
	Million t (6,200 kcal/kg)		12		20

**Table 3-12 Coal Demand Outlook for Ten Asian Economies**

(Unit: Million tons)

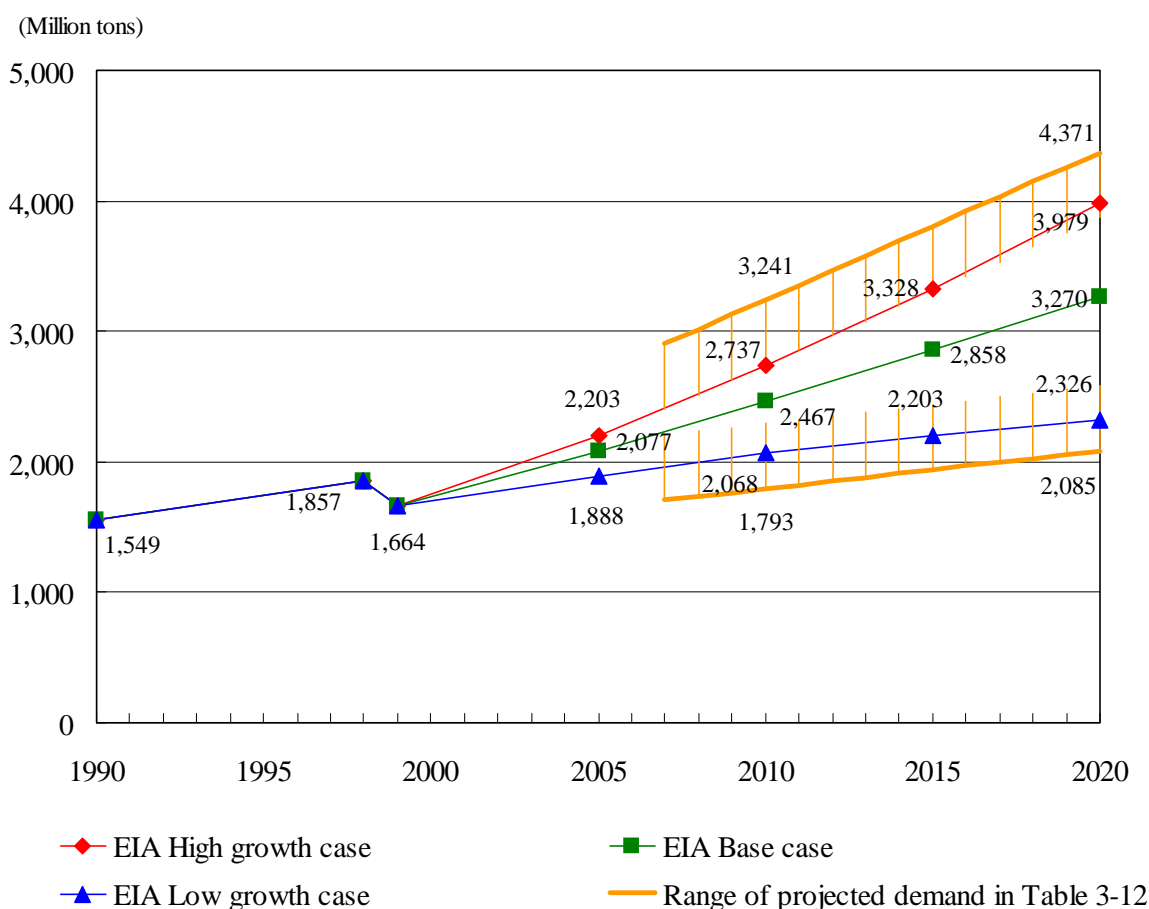
	2010 (2011)		2020		Volatile range	
	Min.	Max.	Min.	Max.	2010	2020
Japan	124	184	144	221	60	77
China	1,140	1,981	1,377	2,869	841	1,491
Korea	65	86	67	157	20	90
India	348	775	345	757	427	412
Indonesia	19	64	24	165	44	141
Thailand	16	54	19	54	38	35
Malaysia	7	16	13	25	8	12
Philippines	7	13	9	23	6	14
Taiwan	53	56	66	77	3	12
Vietnam	12	13	20	23	0	2
Total	1,793	3,241	2,085	4,371	1,448	2,286

Note: Some of the figures for 2010 include 2011 data.

When original data collected or sampled were in terms of oil or coal equivalent, they were converted into weight with a conversion factor of 6,200 kcal/kg. From the thus converted data and others originally expressed in weight, we calculated the maximum and minimum coal consumption in individual Asian economies at the primary energy

stage. By adding up the results, we forecast Asia’s total coal consumption levels for 2010 and 2020. These are shown in Table 3-12. The same results are plotted in Fig. 3-2 together with Asia’s coal demand as projected by the EIA. For both 2010 and 2020, China shows the widest gap between maximum and minimum consumption, which means that the way in which China’s coal demand expansion is calculated is crucial in assessing the future of Asia’s coal supply and demand.

**Fig. 3-2 Asia’s Coal Demand Outlooks**



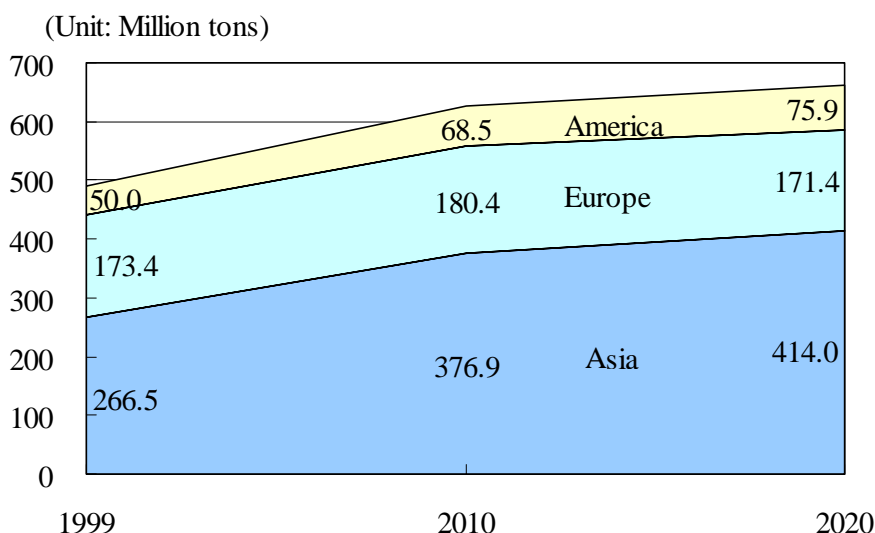
**3-3 Coal trade outlook**

Based on the EIA’s “International Energy Outlook 2001,” we discuss the relevant future factors of individual Asian economies’ coal trade in meeting their coal demand. We also report their potential demand for coal imports on the basis of domestic documents and literature of the individual economies.

“International Energy Outlook 2001” states that coal exports from the major producing countries will increase from 497.50 million tons in 1999 to 661.30 million

tons in 2020. Of the 163.80 million ton incremental exports, 144.20 million tons will be steaming coal, and coking coal is likely to show only a slight rise of 19.50 million tons (Fig. 3-3).

**Fig. 3-3 Coal Export Outlooks by Destination (EIA, Base Case)**



Source: Prepared by IEEJ based on EIA, "International Energy Outlook 2001."

The EIA report states that, centering on developing areas where sharp growth in coal demand is likely, Asia's coal import demand will increase by 147.50 million tons from 266.50 million tons to 414.00 million tons in the period from 1999 to 2020. By comparison, during the period from 1999 to 2020, Europe's demand for imported coal will increase a little to 180.40 million tons to cover declines in domestic coal output in European countries, and will then drop slightly to 171.40 million tons by 2020. In America, imported coal demand is projected to keep rising a little from 50.00 million tons in 1999 to 75.90 million tons by 2020.

As shown in Table 3-13, coal exports to Asia from the major exporting countries are forecast to grow 2.1%/year on average from 266.50 million tons in 1999 to 414.00 million tons in 2020. The share of Asia-bound coal exports in the world's coal trade will be on the rise from 53.6% in 1999 to 60.2% in 2010 and to 62.6% in 2020. Asia will thus become the largest coal market in the world.

Australia continues to be, and will remain, the largest supplier of coal to Asia. Australia's coal exports to Asia, up by an average 1.9% a year in the period from 1999 to 2020, are forecast to reach 195.60 million tons. This represents 47.2% of coals shipped to Asia by the major exporting countries, and 29.6% of coals supplied to the world

market by the major producing countries. The positions of leading coal suppliers to Asia after Australia are held by Indonesia and China, whose exports to Asia likely to grow by 2.4%/year and 3.5%/year, respectively, between 1999 and 2020.

**Table 3-13 Asia-bound Coal Export Outlook by Major Producing Country (EIA, Base Case)**

(Unit: Million tons)

Exporter	1999			2010			2020		
	Steaming coal	Coking coal	Total	Steaming coal	Coking coal	Total	Steaming coal	Coking coal	Total
Australia	69.1	63.2	132.3	110.2	74.4	184.5	117.3	78.3	195.6
USA	4.1	3.7	7.8	7.0	1.2	8.3	7.8	1.4	9.2
South Africa	17.2	0.7	17.9	26.2	5.5	31.8	34.6	6.0	40.6
Russia	4.4	2.6	7.0	2.5	0.0	2.5	3.5	0.0	3.5
Poland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canada	4.1	18.2	22.3	3.0	18.2	21.2	1.5	18.1	19.5
China	28.6	6.3	34.8	59.1	7.5	66.6	64.1	8.0	72.1
South America	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indonesia	36.6	7.8	44.4	58.5	3.6	62.2	69.9	3.7	73.6
Total	164.1	102.5	266.5	266.5	110.4	376.9	298.6	115.5	414.0

Source: Prepared by IEEJ based on EIA, "International Energy Outlook 2001."

Table 3-14 contains the coal import outlooks for 2010 prepared by individual Asian economies from sundry data and documents of their own. Points of particular note in the table are mentioned below.

#### \* Trends in Japan

According to a report entitled "Energy Policy from Now On" released in July 2001 by the Advisory Committee for Resources and Energy, as of 2010, Japan's coal demand will be larger than it is now, despite the call for curbing coal consumption in an effort to mitigate global warming. Imported coals are likely to cover the country's entire coal demand. Moreover, delays in planned nuclear power plant construction/operation, as well as in the introduction of new energy, if any, may increase coal demand further, and the extra demand would need to be met by purchasing from the international market.

**Table 3-14 Asian Economies' Coal Import Outlooks for 2010**

(Unit: 1,000 tons)

	2000	2010 (2011)	Increments	Sources of 2010 data
Japan	<i>145,369</i>	184,257	38,888	Advisory Committee for Resources and Energy (2001/7), a report, "Energy Policy from Now On," calling for meeting all needs with imported coals.
China	<i>2,120</i>	50,000	47,880	ABARE, "Supplying Coal to Southeast China: Impacts of China's Market Liberalization"
Korea	<i>61,639</i>	74,638	12,999	The 6th APEC Coal Flow Seminar, 2000, "Energy Mix and Coal Demand Outlook in Republic of Korea"
India	<i>24,497</i>	103,500	79,003	Nabhi Publications, "Ninth Five Year Plan 1997-2002," etc. (Import outlook for FY2011)
Thailand	<i>4,200</i>	18,223	14,023	NEPO's document, "PDP2001," (Import outlook for 2011)
Malaysia	<i>1,500</i>	19,200	17,700	The 13th JAPAC International Symposium, 2001, "Future Coal Demand for Malaysian Power Industry," counting imported coal consumption by coal-fired IPPs alone.
Philippines	<i>6,643</i>	8,765 (17,562)	2,122 (10,919)	NSCB, "The Philippine Statistics 2001 edition," DOE, "Philippine Energy Plan 2002-2011"
Taiwan	<i>45,424</i>	56,010	10,586	Energy Commission, "White Paper on Energy Policy" (1998)
Vietnam	<i>0</i>	1,330	1,330	NEDO, international cooperation project, "A Study on Status Quo of Coal Use and Others within APEC, Coal Note" (2001)
Total	<i>291,392</i>	515,923 (524,720)	224,531 (233,328)	

Note: The figures (in slanting letters) for coal imports in 2000 by China, Korea, India, Taiwan and Japan are based on the IEA, "Coal information 2001, with 2000 data." Those for the remaining economies are taken from the sources specified in the rightmost column.

The figures in parenthesis stated in the columns of the Philippines and total represent coal import outlooks with the Philippines' potential coal demand added.

**\* Trends in China**

The Australian Bureau of Agricultural and Resources Economics (ABARE) predicts in its study report published in November 1999 that China could become a big coal importer by 2010 if the Chinese coal industry fails to maintain its present efforts for market reform. According to the report entitled “Supplying Coal to Southeast China: Impacts of China’s Market Liberalization,” the Chinese coal industry enjoys various advantages, including (1) subsidies to debt-ridden enterprises, (2) tax exemption, (3) financial support to prioritized state mines, (4) subsidized transportation, and (5) taxation on imported coals. If these favored policies were to be discontinued, the domestic coal price would shoot up, which in turn would intensify competition between domestic and imported coals in the southern coastal areas, a big coal-consuming region having easy access to coal imports. As a result, coal imports, hovering at around 2.00 million tons a year today, could exceed 50.00 million tons by 2010.

In reality, these projections in the Australian report may be somewhat exaggerated, because they were calculated from economic elements alone and also because China is likely to introduce some protective policies to help retain its domestic self-supporting rate, aside from China’s economic capability and the availability of hard currency. And yet, given the strong likelihood that foreign capital investments will be concentrated on the southern coastal areas, which in turn will stimulate economic development and energy demand, including electricity, accelerated coal imports to the southern coastal areas are very likely.

**\* Trends in India**

According to India’s coal supply and demand outlook based on the 11th five-year plan unveiled by the national government, India will be 103.50 million tons in short supply in FY2011, the last year of the 11th five-year plan. The supply shortage of domestic coals should be met by importing coals from overseas. However, in view of delays in construction of ports capable of serving as coal terminals, it remains questionable whether India will be able to import the quantities of coals needed.

**\* Trends in the Philippines**

As already mentioned, the Philippine energy plan contains indefinite portions in regard to what energy sources are in use. If all of the indefinite portions are covered by coals, a case could be assumed in which the Philippines would double its coal imports (see 2-3 “The Philippines” and Table 3-9).

Comparing outlook for the Asia-bound coal exports (base case) of the EIA’s “International Energy Outlook” with the total specified in Table 3-14, the latter reaches 516 million tons in 2010 though it does not cover coal imports projected for all the Asian importing economies. The total is as much as 139 million tons larger than the EIA projection. Also, in terms of annual average growth in ten years, the latter is almost twice the amount of the former (Table 3-15).

If such large quantities of coals should be exported to Asia as of 2010, we need to learn about the production plans of the coal-producing countries for the years to come, based on which we will have to assess the exact amounts of coals that can be supplied to the Asian coal market.

**Table 3-15 Comparison of Asia’s Coal Import Outlooks**

(Unit: Million tons)

	1999	2000	2010	Annual average growth
EIA, Base case	267		377	3.2%
IEEJ, latest study (Potential coal demand)		291	516 (525)	5.9% (6.1%)

Note: The figures in parenthesis represent coal import outlooks with the Philippines’ potential coal demand added.

**Conclusions**

As discussed in the foregoing, the primary factor contributing to the expansion of coal demand in Asia has been the sharply growing electricity demand following the second oil crisis in 1979. With Japan included, Asia’s coal demand, which was 1,665 million tons in 1999, is projected to be 3,270 million tons in 2020. Above all China’s coal demand is expected to soar from 975 million tons to 2,346 million tons over the same period. After China, India is likely to see its coal demand grow to 421 million tons by 2020. While China and India are both projected to record massive industrial coal demand, particularly for power production, which reflects their strong economic growth expected from now on, it is feared that environmental regulations and necessary fund raising, among other things, may constrain their coal demand. When considering the

future shape of Asia's coal supply and demand, a matter of crucial importance is the manner in which China's mounting coal demand should be forecast. We have to pay attention not only to environmental aspects such as combating acid rain and global warming, but also to China's coal consumption trends.

The total of coal imports planned or projected for 2010 by individual Asian economies amounts to 516 million tons, which is much larger than the 377 million tons projected by the EIA in its "International Energy Outlook 2001." Such large quantities of coals, if exported to Asia in 2010, are certainly capable of tightening coal supply and demand. By studying the production plans held by the coal-producing countries for the present and the future, we must estimate the exact amount of coals that will be available for the Asian coal market from now on.

### **Acknowledgements**

This study report was recomposed from "Chapter 1 Reviews on Asia's Coal Supply and Demand" of "FY2001 Works to Advanced Overseas Coal Development (Coal Supply and Demand Viewed from Energy Security and Global Warming Abatement Aspects)," a study project awarded to IEEJ by the New Energy and Industrial Development Organization.

Acknowledgements are due to the NEDO for its kind permission to use this publication.

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