Impact of Changes in Indian Coal Supply/Demand Outlook on International Coal Markets ♦

By Koichi Koizumi * and Kiminori Maekawa, **
Institute of Energy Economics, Japan

Introduction

In India, which has continued remarkable economic growth, the Planning Commission issued the Integrated Energy Policy Report in August 2006 calling for annual economic growth between 8% and 10% through FY 2031 to eradicate poverty and develop human resources. The policy report also states that India will, at the very least, have to expand primary energy supply by three to four times and electricity generation capacity (electricity supply) by five to six times from FY 2003 in order to sustain an annual economic growth rate of 8% and meet the people's energy demand through FY 2031. Coal is a key fossil fuel that India can domestically produce to meet domestic demand. Given the projected expansion in energy demand, however, domestic coal output is expected to slip far below domestic demand in the near future.

This report considers how changes in India's coal supply/demand outlook and its expected expansion of coal imports would affect the international coal market, based on the Report of the Working Group on Coal & Lignite for Formulation of the 11th five-year Plan (2007-12) as released by the Ministry of Coal in November 2006.

1. Coal's Position in Primary Energy Supply

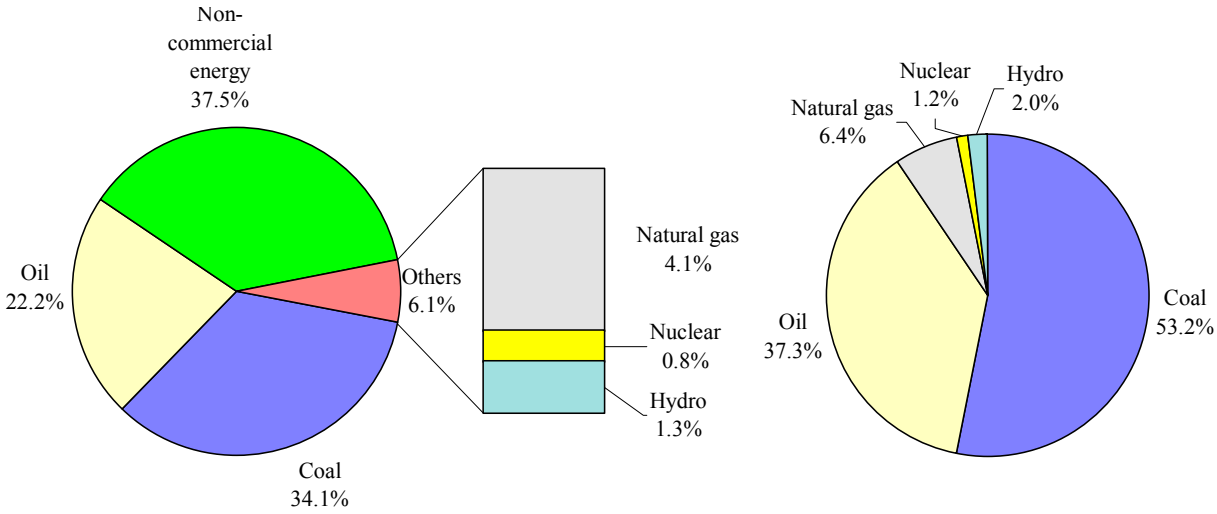
According to the International Energy Agency's "Energy Balance of Non-OECD Countries 2006, 2003-2004," primary energy supply in India in 2004 totaled 573 million tons oil equivalent, of which coal accounted for 34.1% (195.5 Mtoe), oil for 22.2% (127.3 Mtoe), natural gas for 4.1% (23.4 Mtoe), nuclear for 0.8% (4.4 Mtoe), hydro for 1.3% (7.3 Mtoe) and non-commercial energy[1] for 37.5% (214.8 Mtoe). At present, non-commercial energy captures the largest share of primary energy supply. Coal occupies the largest share of commercial energy.

♦ This report is a reedited version of the FY 2006 A Study on Advancement of Overseas Coal Development (India's Coal Development Plan and Its Impact on World Coal Markets), a study that the IEEJ conducted under a contract with the New Energy and Industrial Technology Development Organization, known as NEDO. The authors would like to thank NEDO for permitting the survey to be published

* Senior Engineer, Coal Research Group, Strategy and Industry Research Unit
** Senior Engineer, International Cooperation Group, Planning & Administration Unit

1 Non-commercial energy includes wood, agricultural wastes and animal fecal wastes that are used as household fuel in rural regions where electricity or petroleum products have yet to be available. India aims to electrify these regions to eradicate poverty. The IEA report's non-commercial energy includes 0.4 Mtoe in solar energy, wind power and other new or renewable energies.

Figure 1-1 Primary Energy Mix in 2004



Source: "Energy Balances of Non-OECD Countries 2006, 2003-2004," 2006 Edition, OECD/IEA

The Integrated Energy Policy Report indicates 11 primary energy supply scenarios through FY 2031, as shown on Table 1-1. As shown in Table 1-2, Scenario 11 features the least primary energy supply at 1,536 Mtoe including non-commercial energy in FY 2031. Scenario 1 represents the most primary energy supply at 1,887 Mtoe. The gap between the two scenarios is 350 Mtoe. Scenario 11 also includes the least coal supply at 632 Mtoe (accounting for 41.1% of primary energy supply) against the most coal supply at 1,022 Mtoe (54.2%) in Scenario 1. The gap is close to 400 Mtoe.

Table 1-1 Some Energy Supply Scenarios for 8% GDP Growth

Scenario	Details
1. Coal-dominant case	In the most economical case, coal will be dominant as fuel for electricity generation.
2. Forced nuclear	Nuclear electricity generation willl be developed for an optimum scenario.
3. Forced hydro	All potential hydro resources (for 150 million kW) will be developed by FY 2031/32
4. Forced nuclear and hydro	Maximum utilization of nuclear and hydro (2 + 3)
5. 4 + Forced gas	Natural gas will cover 16% of electricity supply.
6. 5 + DSM	Demand side management will reduce electricity demand by 15%.
7. 5 + Enhanced coal efficiency	Supercritical pressure boilers will be used for 500,000 kW generators to boost the thermal efficiency to 38-40% from the present 36%.
8. 6 + Enhanced coal efficiency	DSM will be combined with enhanced coal efficiency.
9. 8 + Increased railway share	The railway transportation share will be raised to 50% from 32%.
10. 9 + Enhanced fuel efficiency	Fuel efficiency for all automobiles will be improved by 50%.
11. 10 + Renewables	By FY 2031-32, wind power will cover 300 million kW, solar energy 10 million kW and biomass 50 million kW. Supply will total 10 million tons for biodiesel and 500 million tons for bioethanol.

Source: "Integrated Energy Policy Report of the Expert Committee," Planning Commission, August 2006

Table 1-2 Scenario Summaries for 8% GDP Growth – Fuel Mix in FY 2031

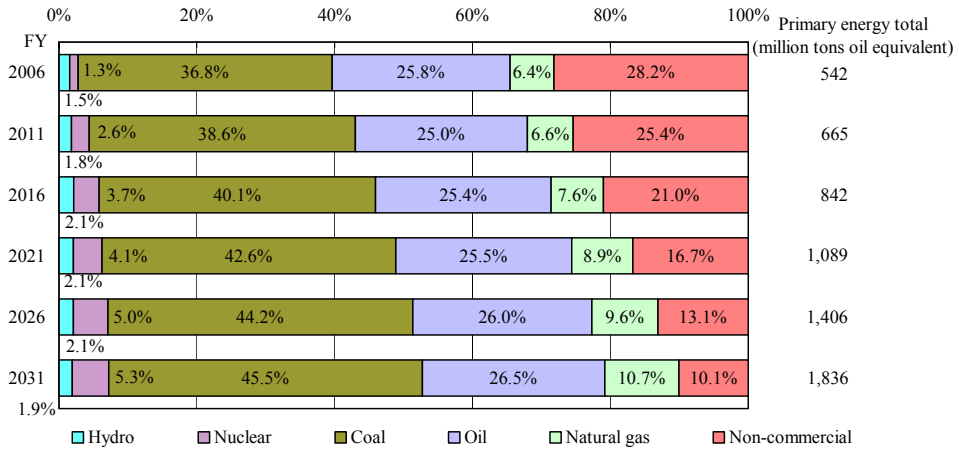
(Unit: million tons oil equivalent)

Scenario	1 Coal-dominant case	2 Forced nuclear	3 Forced hydro	4 Forced hydro and nuclear (2+3)	5 4+ Forced gas	6 5+ DSM	7 5+ Enhanced coal efficiency	8 6+ Enhanced coal efficiency	9 8+ Increased railway share	10 9+ Enhanced fuel efficiency	11 10+ Renewables
Oil	486	485	486	485	486	486	485	485	447	361	350
Natural gas	104	105	104	105	197	174	191	171	171	171	150
Coal	**1,022**	953	998	929	835	715	818	698	701	707	**632**
(In millions of tons of domestic coal)	**(2,493)**	(2,324)	(2,434)	(2,266)	(2,037)	(1,744)	(1,995)	(1,702)	(1,710)	(1,724)	**(1,541)**
Hydro	13	35	13	35	35	35	35	35	35	35	35
Nuclear	76	76	98	98	98	98	98	98	98	98	98
Renewables	2	2	2	2	2	2	2	2	2	2	87
Commercial energy total	1,702	1,655	1,700	1,654	1,652	1,510	1,628	1,488	1,454	1,373	1,351
Non-commercial energy	185	185	185	185	185	185	185	185	185	185	185
Total	1,887	1,840	1,885	1,839	1,837	1,695	1,813	1,673	1,639	1,558	1,536
Coal's share	54.2%	51.8%	52.9%	50.5%	45.5%	42.2%	45.1%	41.7%	42.8%	45.4%	41.1%

Note: One million tons in Indian coal amounts to 0.41 million tons oil equivalent.
Source: "Integrated Energy Policy Report of the Expert Committee," Planning Commission, August 2006

The Integrated Energy Policy Report indicates a primary energy supply outlook for the 11th five-year plan period (to FY 2011) under Scenario 5. As shown in Figure 1-2, coal will increase its share of primary energy supply as the non-commercial energy share falls. From FY 2006 to 2031, nuclear will post the fastest annual growth rate of 11.2%, followed by 7.2% for natural gas, 5.9% for hydro, 5.9% for coal and 5.1% for oil. All of these energies will score annual growth above 5%. The average annual growth rate for these commercial energies will come to 6.0% against only 0.8% for non-commercial energy.

Figure 1-2 Changes in Primary Energy Supply Mix for Scenario 5 (GDP growth at 8%)



Source: "Integrated Energy Policy Report of the Expert Committee," Planning Commission, August 2006

All these scenarios position coal as one of key pillars supporting India's energy demand. Coal will thus remain an important energy source in India.

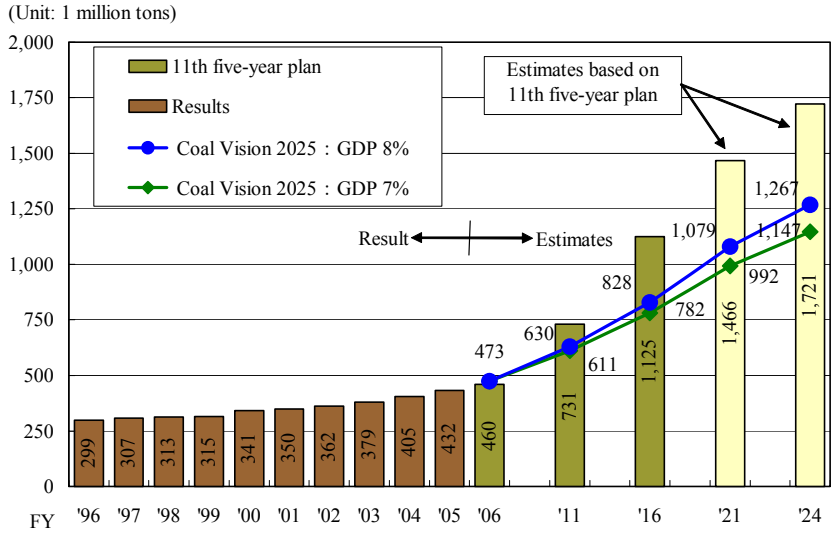
2. Coal Supply/Demand Gap

2-1 Coal consumption

According to a coal demand outlook given in "Coal Vision 2025" as compiled by the Energy and Resources Institute (TERI) at the request of the Indian government, based on the coal policy before the 11th five-year plan released in November 2006, coal demand in FY 2024 is estimated to reach 1,147 million tons under the 7% GDP growth scenario and 1,267 million tons under the 8% growth scenario. But the 11th five-year plan projects demand in FY 2011 to far exceed the estimate under the Coal Vision 2025, as shown in Figure 2-1.

Figure 2-1 indicates coal consumption through FY 2005 and demand estimates for the 11th five-year plan and Coal Vision 2025 (three five-year periods and three years between FY 2021 and 2024). The 11th five-year plan gives only estimates through FY 2016. For Figure 2-1, coal consumption estimates for FY 2021 and 2024 are based on the FY 2016 projection which is estimated using average annual consumption growth rates (5.4% for FY 2016-21 and 5.5% for FY 2021-24) under the 8% GDP growth scenario in Coal Vision 2025. The projected figures are 1,470 million tons for FY 2021 and 1,720 million tons for FY 2024.

Figure 2-1 Domestic Coal Consumption Results and Estimates

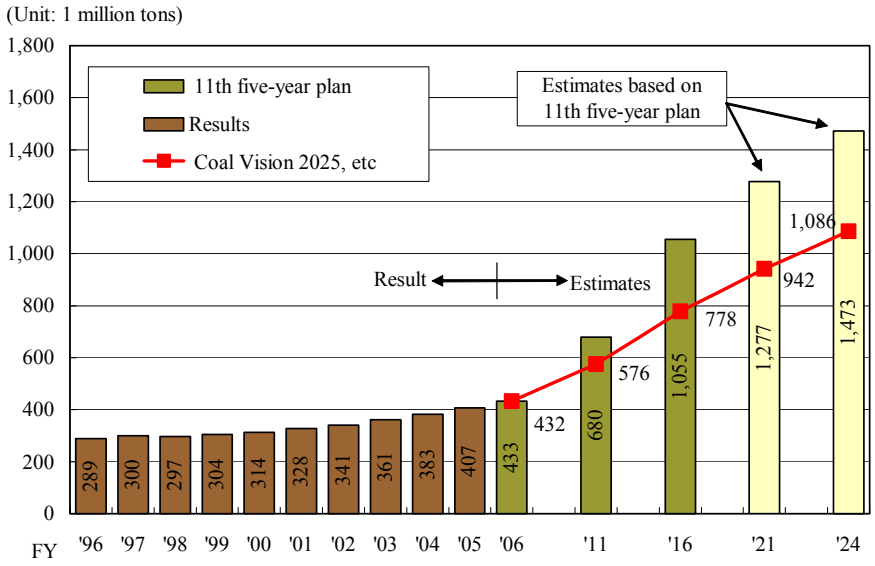


Note: The 11th five-year plan gives estimates through FY 2016. Average annual consumption growth rates under the 8% GDP growth scenario in Coal Vision 2025 are used for estimating coal consumption for FY 2021 and 2024.
Sources: Results: "Energy Statistics 2006," Ministry of Statistics and Programme Implementation
11th five-year plan: "Coal & Lignite for Formulation of 11th 5 year plan (2007-12)," November 2006
Long-term outlook: "Coal Vision 2025," TERI

2-2 Coal production

India's FY 2005 domestic coal production totaled 407 million tons (bituminous coal alone). (If 30.1 million tons in lignite output is added, the total comes to 437.1 million tons). Coal Vision 2025 and information from the Ministry of Coal indicate that coal production in FY 2024 would reach 1,086 million tons (902 million tons or 83% in open-pit production and 184 million tons or 17% in underground production). As seen in Figure 2-2, however, the 11th five-year plan projects FY 2011 output at a higher level than the estimate in Coal Vision 2025. The 11th five-year plan's projection for FY 2016 is close to the estimate for FY 2024 in Coal Vision 2025.

Figure 2-2 India's Domestic Coal Production Results and Estimates



Note: The 11th five-year plan gives estimates through FY 2016. Average annual production growth rates derived from Coal Vision 2025 and other sources are used for estimating coal consumption for FY 2021 and 2024.
Sources: Results: "Energy Statistics 2006," Ministry of Statistics and Programme Implementation
11th five-year plan: "Coal & Lignite for Formulation of 11th 5 year plan (2007-12)," November 2006
Long-term outlook: "Coal Vision 2025," TERI; MOC data; etc.

In the same case as Figure 2-1, production estimates for FY 2021 and 2024 in Figure 2-2 are based on the FY 2016 projection under the 11th five-year plan and average annual production growth rates (3.9% for FY 2016-21 and 4.9% for FY 2021-24) derived from Coal Vision 2025 and other sources. The estimates are 1,280 million tons for FY 2021 and 1,470 million tons for FY 2024. But the estimated expansion of production to such levels would be difficult due to constraints as described below.

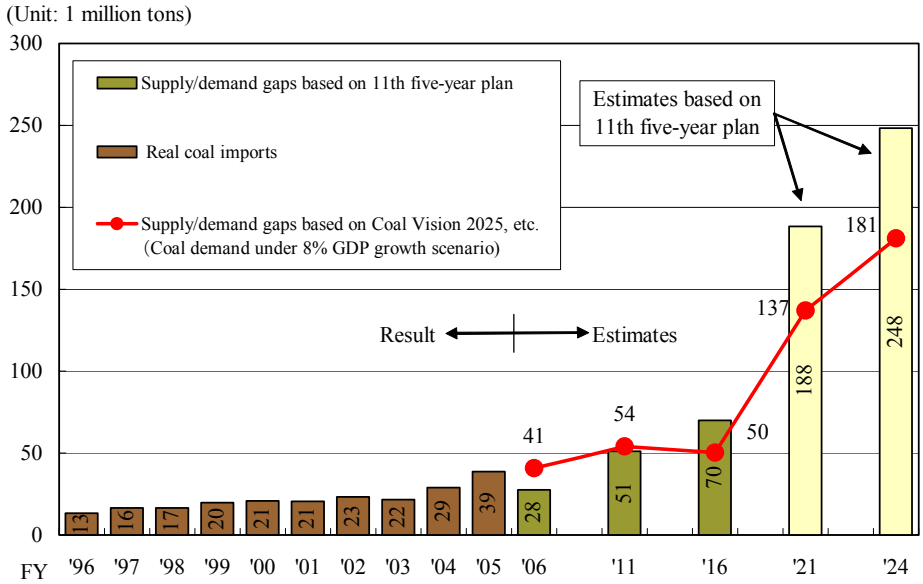
The Geological Survey of India gave India's proven coal reserves at 97.9 billion tons as of January 1, 2007. But the credibility of this estimate is doubted as the GSE has failed to subtract mined and consumed coal (estimated at 10 billion tons) for the past two centuries and to comply with the United Nations Framework Classification, an international standard for calculation coal reserves. While the Central Mine Planning and Design Institute Ltd. has estimated minable coal reserves at 52 billion tons as of January 1, 2005, the 10th five-year plan put the estimated minable reserves at 18 billion tons. Although India has domestic coal resources

for stable production, reserve assessment have yet to be fixed. Comparison between some estimates of minable reserves and projected production has prompted some people to doubt a continuous production expansion (or stable supply). If domestic production were to increase at an annual average rate of 5% as projected by the Ministry of Coal, India's coal reserves could be depleted in 30 to 40 years[2].

2-3 Coal imports

We have subtracted domestic production estimates in Figure 2-2 from consumption estimates in Figure 2-1 to determine future coal supply/demand gaps in India. Figure 2-3 indicates coal supply/demand gaps based on the 11th five-year plan and the gaps based on Coal Vision 2025 and other data (coal demand growth under the 8% GDP growth scenario). The gaps based on the 11th five-year plan is thus estimated to increase from 27.5 million tons[3] in FY 2006 to 70 milllion tons in FY 2016. Based on the Coal Vision 2025 and other data, the gap is projected to expand substantially from the second half of the 2010s to reach 181 million tons in FY 2024.

Figure 2-3 Real Coal Imports and Estimated Supply/Demand Gaps



Note: Results are real imports. Estimates are projected supply/demand gaps.
Sources: Results: "Energy Statistics 2006," Ministry of Statistics and Programme Implementation
11th five-year plan: Figures 2-1 and 2-2
Long-term outlook: Figures 2-1 and 2-2 (demand growth under the 8% GDP growth scenario)

Based on the 11th five-year plan, the coal supply/demand gap is estimated at 200 million tons in FY 2021 and nearly 250 million tons in FY 2024. As noted in Footnote 3, exports and inventories should be taken into account when imports are estimated. Inventories are expected to increase as demand expands. Based on the coal supply/demand balance for FY 2005 as indicated on Table 2-1, therefore, imports should cover the

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2 S.K. Chand, Anant Sudarshan, Pragya Jaswal, “Coal security issues in India”, “Energy Security Insights, Vol. 1, Issue 3,” TERI: New Delhi, December 2006

3 The gap is more than 10 million tons short of 38.6 million tons in real coal imports in FY 2005 because exports and inventories are not taken into account. Coal imports are estimated to have increased further in FY 2006.

supply/demand gap and more than 10 million tons in exports and inventories. All these points are taken into account for projected coal imports and import dependence ratios indicated in Table 2-2. Based on the 11th five-year plan, coal imports in FY 2024 are estimated to exceed 250 million tons with the coal import dependence ratio at 15%. Based on Coal Vision 2025 and other data (coal demand under the 8% GDP growth scenario), coal imports in FY 2024 are estimated to slip slightly below 200 million tons. With demand estimated at a lower level, the coal import dependence ratio is put at 16%.

Table 2-1 Coal Supply/Demand Balance and Dependence on Coal Imports (FY 2004-05)

(Unit: 1 million tons)

			2004-2005	2005-2006	Growth
Domestic output	Bituminous coal	Coking coal	30.224	31.511	4.3%
		Steaming coal	352.391	375.528	6.6%
		Total	382.615	407.039	6.4%
	Lignite		30.337	30.066	-0.9%
	Total		412.952	437.105	5.8%
Imports	Bituminous coal	Coking coal	16.925	16.891	-0.2%
		Steaming coal	12.025	21.695	80.4%
	Total		28.950	38.586	33.3%
Exports	Bituminous coal	Coking coal	0.240	0.046	-80.8%
		Steaming coal	1.134	1.943	71.3%
	Total		1.374	1.989	44.8%
Domestic inventories	Bituminous coal	Coking coal	0.935	1.385	48.1%
		Steaming coal	1.743	8.959	414.0%
		Total	2.678	10.344	286.3%
	Lignite		0.309	-0.017	-105.5%
	Total		2.987	10.327	245.7%
Domestic demand	Bituminous coal	Coking coal	45.974	46.971	2.2%
		Steaming coal	361.539	386.321	6.9%
		Total	407.513	433.292	6.3%
	Lignite		30.028	30.083	0.2%
	Total		437.541	463.375	5.9%
Bituminous coal supply/demand gap			24.898	26.253	5.4%
Difference between bituminous coal imports and supply/demand gap			4.052	12.333	204.4%
Import dependence ratio					
	Bituminous coal	Coking coal	36.8%	36.0%	
		Steaming coal	3.3%	5.6%	
	Total		7.1%	8.9%	

Note: Import dependence ratio = Imports ÷ Domestic demand
Source: "Coal Directory of India 2005-2006 Part-2: Coal Statistics," Coal Controller's Organization/Ministry of Coal, January 2007

Table 2-2 Coal Import and Import Dependence Outlook

(Unit: 1million tons)

	FY 2006	FY 2011	FY 2016	FY 2021	FY 2024
11th 5-year plan					
A. Coal demand estimate	460.0	731.1	1,125.0	1,465.7	1,721.1
B. Coal output estimate	432.5	680.0	1,055.0	1,277.4	1,472.7
C. Coal supply/demand gap (A-B)	27.5	51.1	70.0	188.4	248.5
D. Export estimate + inventory estimate	12.0	13.0	14.0	15.0	15.6
E. Imports（C+D)	39.5	64.1	84.0	203.4	264.1
F. Import dependence ratio（E÷A）	8.6%	8.8%	7.5%	13.9%	15.3%
Coal Vision 2025, etc.（Coal demand under 8% GDP growth scenario)					
A. Coal demand estimate	473.2	629.6	828.2	1,079.0	1,267.0
B. Coal output estimate	432.4	575.6	778.0	942.0	1,086.0
C. Coal supply/demand gap (A-B)	40.8	54.1	50.2	137.0	181.0
D. Export estimate + inventory estimate	12.0	13.0	14.0	15.0	15.6
E. Imports（C+D)	52.8	67.1	64.2	152.0	196.6
F. Import dependence ratio（E÷A）	11.2%	10.6%	7.7%	14.1%	15.5%

Note: Import dependence ratio = Imports ÷ Domestic demand
Source: "Coal Directory of India 2005-2006 Part-2: Coal Statistics," Coal Controller's Organization/Ministry of Coal, January 2007

3. Responses to Coal Supply/Demand Gap

In response to future expansion of the coal supply/demand gap, India may have to (1) curb coal demand, (2) expand coal production and utilize untapped coal resources, (3) develop coal transportation infrastructure, and (4) secure coal import sources.

3-1 Curbing coal demand

(1) Diffusion of coal washing operations

Coal produced in India is mostly sold and consumed without washing. Washed coal production in FY 2005 came to 20.94 million tons -- 8.38 million tons in coking coal and 12.56 million tons in steaming coal, accounting for only 5.1% of 407.04 million tons in total raw bituminous coal output in the year. Even simply mining method improvements and coal classification for removal of shale and other minerals can lower Indian coal's average ash content to 35% from 40%. Optimum washing can lead to an even lower ash content, transportation cost savings and greater energy efficiency. In fact, Tata Steel Ltd. has washed raw coal with an ash content of 35% produced at its captive coal mine to reduce the ash content to 13%. The company aims to achieve a lower ash content of 10% to 12% for the same level of imported coal.

(2) Clean coal technologies

India must promote research and development to utilize Clean Coal Technology (CCT) and work toward practical use of this technology in order to improve the energy conversion efficiency and curb emissions of pollutants. State-run Bharat Heavy Electricals Limited[4] has implemented programs to develop (a) coal

[4] State-run Bharart Heavy Electricals Limited (BHEL) is India's largest engineering and manufacturing company active in energy, transportation and engineering.

combustion systems to reduce emissions, (b) fluid bed combustion and circulating fluidized bed combustion (CFBC) boilers, (c) coal-washing technologies, and (d) integrated gasification combined cycle (IGCC) systems.

India has launched cooperation in CCT development and investment with Russia, Germany, Australia, the United States and South Africa. The Planning Commission has proposed that the Indian government implement projects for coal liquefaction and gasification for captive coal mines. The commission expects to get foreign investment in such projects. Particularly, South Africa's Sasol has been cited as a candidate partner for coal liquefaction.

(3) Coal alternatives in electricity generation sector

The Indian government has worked out a plan to enhance electricity generation using nuclear and renewable energy. India's nuclear electricity generation capacity is expected to increase from 3.36 million kW at the end of March 2006 to 21.18 million kW in FY 2021. The capacity is planned to rise up to 70 million kW through a three-phase program[5]. Another plan calls for hydroelectric generation capacity from 32.33 million kW at the end of March 2006 to 150 million kW in 2031 to make maximum use of hydro resources. Given the substantial increase in India's energy demand, however, nuclear and renewables are expected to play a relatively small role in generating electricity through FY 2031. Their share of commercial energy supply may be limited to less than 5%.

3-2 Coal output expansion and utilization of untapped coal resources

(1) Coal resources exploration

As discussed in "2-2 Coal production," India must utilize some international standard to reassess its domestic coal resources. In order to steadily promote development of new coal mines, India may have to scrutinize resources for expanding recoverable coal resources and conduct a reconnaissance survey for finding undiscovered resources.

(2) Restructuring coal industry

India's coal industry was nationalized in the early 1970s. Public coal companies such as Coal India Limited (CIL) and Sigareni Collieries Company Ltd. (SCCL) accounted for 94% of coal output (381 million tons of 407 million tons) in FY 2005. But a growing view in India is that the coal industry's introduction of private sector resources and funds are important for expansion of coal production. In order to develop an efficient coal industry and form a sound coal market, India must open the coal industry wider to the private sector including foreign direct investment, in addition to captive mine production (that accounted for 26 million tons or 6% of

[5] Theoretically, nuclear is an optimum energy source for India's long-term stable energy supply. With domestic uranium resources limited, India can supply nuclear fuel for up to 10 million kW in capacity for pressurized heavy water reactors. In order to exploit its huge thorium resources, India will have to convert thorium into fissionables. For these reasons, India has proposed a three-phase nuclear program. The program calls for construction of PHWRs in Phase 1, construction of fast breeder reactors in Phase 2 and construction of reactors utilizing the Uranium 233-Thorium 232 Cycle in Phase 3. India plans to successfully implement the three-phase program and take advantage of its huge thorium resources for achieving its energy self-sufficiency in and after 2050.

output in FY 2005). Before taking this measure, India should reconsider its biased allocation of coal concessions to CIL. To this end, India must amend the 1973 Coal Mines (Nationalization) Act (1) to encourage private sector companies to participate in the coal industry for other purposes than captive coal production and (2) to promote allocation of concessions to entrepreneurs in the future. It should expedite efforts to form consensus on the need for these amendments.

(3) Improving productivity of mines

Productivity at India's coal mines is extremely low. The average productivity indicator stood at 7.84 tons per man shift for open-pit production and 0.74 ton per man shift for underground production in FY 2005. In Australia, the largest coal exporter in the world, the productivity indicator came to 75.04 tons per man shift for open-pit production and 39.92 tons per man shift for underground production in 2005. One shift covers 8 hours. If India were to implement its coal output expansion at reasonable costs in future, it would have to substantially improve productivity. In this respect, India must promote mechanization and modernization of the entire coal mining systems meeting specific conditions.

(4) Cooperation with foreign countries

The Indian government is considering the following objectives regarding cooperation with advanced coal-producing countries for introduction of sophisticated technologies and improvement of skills:

(a) Introducing new technologies or know-how for efficient operational management, development of skills and training for underground and open-pit coal mining.
(b) Seeking bilateral cooperation for importing equipment made outside India.
(c) Obtaining foreign financial assistance to meet investment conditions.

With these objectives in mind, the Indian government has formed working groups on coal with France, Germany, Russia, Canada, Australia and China. It has given priority to acquisition of modern underground coal mining technologies and more productive open-pit coal mining technologies (including those for underground operations under severe geological conditions, fire control and coal mine security). The government is exploring cooperation with other countries than those cited above.

(5) Utilizing untapped coal resources

For enormous untapped coal beds where commercial coal mining is difficult, India is considering utilizing coal bed methane (CBM) and underground coal gasification (UCG) technologies to obtain coal alternatives. It is seeking to introduce these technologies from foreign countries. India plans to acquire UCG technologies from Russia and hopes to introduce such technologies from other countries as well.

3-3 Coal transportation infrastructure development

Indian seaports as the gateway for coal imports have been forced to handle nearly 60 million tons. The amount exceeds 13 major ports' coal-unloading capacity totaling 44 million tons. The gap is fulfilled by

general-purpose berths. India will have to expand port facilities and build new ports to expand coal imports.

Both imported and domestically produced coal must be transported in India. It is important to establish a cost-efficient system for smooth transportation of coal from ports and coal mines. Railways will continue to play a central role in transporting coal within India. India is expected to expand utilization of the merry-go-round system[6] to directly link coal mines and power stations. India will have to build cargo transportation railways, increase the axle load of coal-carrying railroad cars and improve railway operation systems. Both hardware and software improvements are required to enhance coal transportation capacity.

3-4 Securing coal import sources

India is considering acquiring overseas coal mining concessions in a bid to prepare for future massive coal imports including coking coal. CIL has set up an overseas operations division for consideration of coal mines subject to its acquisition of concessions in Australia, Indonesia, Mozambique and South Africa. It launched overseas operations to acquire overseas companies in the second half of 2004. Gujarat NRE Coke Limited (GNCL), India's largest independent coke producer, has already acquired a coking coal mine in Australia and has been importing coal from the mine.

4. Impact of India's Coal Import Expansion on World Coal Market

4-1 India's present coal trade

According to data on the OECD/IEA Coal Information 2006, coal consumption (excluding lignite) in Asia excluding former Soviet republics in central Asia is estimated to have expanded by an average annual rate of 5.1% from 1,863 million tons in 1995 to 3,055 million tons in 2005, as indicated in Table 4-1. This is because growth-pursuing Asian economies, including China and India, have viewed coal as cheap fuel available for stable supply for electricity generation, and increased its consumption. Meanwhile, Asian coal output in 2005 is estimated at 2,827 million tons, accounting for 56.9% of the world total. Comparison of coal consumption and output indicates that consumption exceeds output in most of Asian economies. The annual gap between consumption and output has remained in a range between 200 million and 300 million tons since 1995[7]. This is because resources-poor economies such as Japan, South Korea and Taiwan have imported massive coal. As shown in Table 4-2, coal imports in 2005 are estimated at 177.7 million tons in Japan (the largest coal importer), 76.8 million tons in South Korea (the second) and 61.4 million tons in Taiwan (the third). The year's coal imports are put at 37.1 million tons in India (the sixth) and 25.3 million tons in China (the eighth). The five major coal-importing economies' imports totaled 378.3 million tons, accounting for as much as 90% of Asia's coal imports at 418.2 million tons.

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6 The merry-go-round system, or MGR, is a closed-loop railway system linking a coal mine and a power station at the mouth of the coal mine. Railway cars in the system shuttle between mining sites and the power station for coal transportation.

7 A negative consumption-output gap may mean net exports. A positive gap may indicate net imports. But it must be noted that the gap can include inventories and statistical errors.

Table 4-1 World and Asian Coal Supply/Demand (excluding lignite)

(Unit: 1 million tons)

	1995			2005 Estimate			1995-2005 Change		
	A. Consumption	B. Output	A-B	A. Consumption	B. Output	A-B	Consumption	Output	A-B
China	1,316.9 (70.7%)	1,293.4 (78.5%)	23.5	2,179.2 (71.3%)	2,225.6 (78.7%)	-46.4	862.3	932.2	-69.9
India	277.5 (14.9%)	262.3 (15.9%)	15.2	433.4 (14.2%)	397.7 (14.1%)	35.7	155.9	135.4	20.5
Japan	133.5 (7.2%)	6.3 (0.4%)	127.2	177.7 (5.8%)	0.0 (0.0%)	177.7	44.2	-6.3	50.5
South Korea	44.4 (2.4%)	5.7 (0.3%)	38.7	84.4 (2.8%)	2.8 (0.1%)	81.5	40.0	-2.9	42.9
Taiwan	26.4 (1.4%)	0.2 (0.0%)	26.1	61.4 (2.0%)	0.0 (0.0%)	61.4	35.0	-0.2	35.2
Indonesia	10.3 (0.6%)	41.1 (2.5%)	-30.8	33.7 (1.1%)	139.7 (4.9%)	-106.1	23.3	98.6	-75.2
North Korea	24.3 (1.3%)	23.7 (1.4%)	0.6	23.7 (0.8%)	24.4 (0.9%)	-0.6	-0.6	0.7	-1.3
Vietnam	5.9 (0.3%)	8.4 (0.5%)	-2.4	15.8 (0.5%)	27.8 (1.0%)	-12.0	9.9	19.4	-9.6
Hong Kong	9.1 (0.5%)	0.0 (0.0%)	9.1	10.8 (0.4%)	0.0 (0.0%)	10.8	1.7	0.0	1.7
Malaysia	2.3 (0.1%)	0.1 (0.0%)	2.2	9.7 (0.3%)	0.8 (0.0%)	8.9	7.4	0.7	6.7
Philippines	3.1 (0.2%)	1.3 (0.1%)	1.8	8.8 (0.3%)	2.8 (0.1%)	6.1	5.7	1.5	4.2
Thailand	2.3 (0.1%)	0.0 (0.0%)	2.3	8.5 (0.3%)	0.0 (0.0%)	8.5	6.2	0.0	6.2
Pakistan	4.7 (0.3%)	3.6 (0.2%)	1.1	5.2 (0.2%)	3.0 (0.1%)	2.2	0.5	-0.6	1.1
Others	2.4 (0.1%)	1.4 (0.1%)	1.1	2.5 (0.1%)	2.6 (0.1%)	-0.2	0.0	1.3	-1.2
Asian total	1,863.2 (100%) (51.0%)	1,647.6 (100%) (45.8%)	215.7	3,054.7 (100%) (61.2%)	2,827.2 (100%) (56.9%)	227.4	1,191.4 (89.1%)	1,179.6 (85.8%)	11.8
World total	3,653.4	3,594.9	58.5	4,990.1	4,969.6	20.5	1,336.7	1,374.8	-38.0

Notes: Former Soviet republics in central Asia are excluded from Asia.
Percentages in parentheses on the right of consumption and production amounts indciate respective Asian economies' shares of the Asian total. Percentages in parentheses under Asian total amounts indicate Asia's shares of world total amounts.
Source: "Coal Information 2006," OECD/IEA

Table 4-2 World Coal Trade (10 largest exporters and imports of coal excluding lignite)

(Unit: 1 million tons)

Coal imports (excluding lignite)					Coal exports (excluding lignite)				
Importer	1995	2005 Estimate	1995-2005 Change	1995-2005 Average annual growth	Exporter	1995	2005 Estimate	1995-2005 Change	1995-2005 Average annual growth
Japan	127.3 (25.9%)	177.7 (22.8%)	50.4	3.4%	Australia	136.7 (27.6%)	231.3 (30.0%)	94.6	5.4%
South Korea	45.6 (9.3%)	76.8 (9.9%)	31.2	5.3%	Indonesia	31.3 (6.3%)	108.0 (14.0%)	76.7	13.2%
Taiwan	28.7 (5.8%)	61.4 (7.9%)	32.7	7.9%	Russia	26.3 (5.3%)	75.7 (9.8%)	49.5	11.2%
United Kingdom	15.9 (3.2%)	44.0 (5.6%)	28.1	10.7%	South Africa	59.7 (12.1%)	73.0 (9.5%)	13.3	2.0%
Germany	15.1 (3.1%)	38.2 (4.9%)	23.1	9.8%	China	28.6 (5.8%)	71.8 (9.3%)	43.2	9.6%
India	12.5 (2.5%)	37.1 (4.8%)	24.6	11.5%	Colombia	18.3 (3.7%)	55.8 (7.2%)	37.5	11.8%
United States	6.5 (1.3%)	27.6 (3.5%)	21.0	15.5%	United States	80.3 (16.2%)	45.1 (5.8%)	-35.2	-5.6%
China	1.6 (0.3%)	25.3 (3.3%)	23.7	31.5%	Canada	34.2 (6.9%)	27.7 (3.6%)	-6.6	-2.1%
Spain	13.4 (2.7%)	24.8 (3.2%)	11.3	6.3%	Poland	31.9 (6.4%)	20.8 (2.7%)	-11.0	-4.2%
Italy	18.5 (3.8%)	24.2 (3.1%)	5.7	2.7%	Kazakhstan	20.8 (4.2%)	16.9 (2.2%)	-3.8	-2.0%
Others	207.3 (42.1%)	241.4 (31.0%)	34.0	1.5%	Others	26.4 (5.3%)	45.3 (5.9%)	18.9	5.5%
World total	492.5 (100%)	778.3 (100%)	285.9	4.7%	World total	494.5 (100%)	771.5 (100%)	277.0	4.5%
Asian total	235.1 (47.7%)	418.2 (53.7%)	183.1	5.9%	Asian total	77.5 (16%)	83.9 (11%)	6.4	0.8%

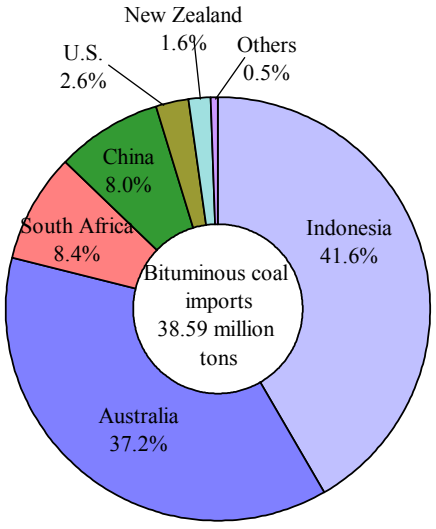
Note: Percentages in parenetheses on the right of import and export amounts indicate respective economies' shares of the world total.
Source: "Coal Information 2006," OECD/IEA

Major Asian coal exporters include Indonesia, China and Vietnam. Exports in 2005 are estimated at 108 million tons from Indonesia (the second largest coal exporter in the world), at 72 million tons from China (the fifth) and at 12 million tons from Vietnam (the 11th). Their coal exports might have gone not only to Asian

region but also to North America and Europe. This means that Asian coal imports should have exceeded the consumption-output gap as given above. The Asian coking and steaming coal market is estimated at about 410 million tons (with import and export errors taken into account). Australia provides Asian economies with 190 million tons (47% of the market size), Indonesia with 90 million tons (22%) and China with 70 million tons (17%). The three countries alone support nearly 85% of the Asian coal import market.

According to India's domestic data, its coal imports in FY 2005 came to 38.6 million tons, including 16.06 million tons (41.6% of India's toal imports) from Indonesia and 14.37 million tons (37.2%) from Australia, as shown in Figure 4-1. The two countries alone accounted for about 30 million tons or nearly 80% of India's coal imports. Until FY 2004-05, Australia had been the largest coal exporter to India. Indonesia gradually expanded its share of coal imports into India and replaced Australia as the largest coal exporter to India in FY 2005. This may be because demand for steaming coal imports has been rising in India. Indonesian coal (steaming coal) is cheaper than Australian coal in F.O.B price due to a lower carolific power, and is more eco-friendly because of less ash and sulfur contents. Demand for such Indonesian coal has grown globally. India has paid attention to Indonesian coal's price and environmental advantages. For India, Indonesian coal has another advanage over Australian coal. The distance between Indonesia's Kalimantan and India's eastern coast is some 2,000 kilometers, far less than 4,000 to 5,500 kilometers between Australia's eastern coast and India's eastern coast. The shorter maritime transportation distance means lower transportation costs.

Figure 4-1 India's Bituminous Coal Imports (FY 2005)



(Unit: 1 million tons)

Indonesia	16.058
Australia	14.365
South Africa	3.244
China	3.081
United States	1.022
New Zealand	0.606
Others	0.210
Total	38.586

Source: "Coal Directory of India 2005-2006 Part-1: Coal Statistics," Coal Controller's Organization/Ministry of Coal, January 2007

4-2 Coal supply/demand and trade outlook

Based on the OECD/IEA World Energy Outlook 2006 (hereinafter referred to as WEO 2006) published in the autumn of 2006, the world's coal demand outlook is indicated in Table 4-3 and the coal production outlook on Table 4-4. We must take note of the fact that these projections include lignite demand and production as well as steaming and coking coal.

As indicated in Table 4-3, the world's coal consumption is projected to expand at an average annual rate of 1.8% from 5,558 million tons in 2004 to 8,858 million tons in 2030. Over this period, coal is expected to maintain its share of primary energy consumption at around 25%. Coal consumption in 2015 is projected to expand by 32% from 2004; that in 2030 is estimated to increase by 59% from 2004. Asia is expected to account for 85% of a coal consumption increase between 2004 and 2030. Particularly, China is projected to capture 60% and India 18%. Their coal consumption expansion is outstanding.

The electricity generation sector (including heat supply) accounted for 68% of the world's coal consumption (in terms of oil equivalent) in 2004 and is projected to capture 73% of such consumption in 2030. This means that the electricity generation sector would account for 81% of a consumption increase during the period. A rise in coal consumption is thus interpreted as meeting an increase in electricity demand. In India, the electricity generation sector accounted for 75% of the country's total coal consumption in 2004 and is projected to capture 79% of such consumption in 2030. Coal consumption is predicted to increase slightly in most regions while decreasing in OECD countries.

Table 4-3 World Coal Demand Outlook (Reference Scenario)

(Unit: 1 million tons)

		1980	2004	2010	2015	2030	2004-2030 Average annual growth
OECD	North America (U.S., Canada, Mexico)	687	1,080	1,222	1,248	1,376	0.9%
	Asia (Japan, South Korea)	114	262	293	296	287	0.3%
	Oceania (Australia, New Zealand)	69	137	146	154	166	0.8%
	Europe	1,163	834	846	855	905	0.3%
Total		2,033	2,313	2,507	2,552	2,735	0.6%
Russia		n.a.	215	239	234	216	0.0%
China		626	1,881	2,603	3,006	3,867	2.8%
India		114	441	534	636	1,020	3.3%
Indonesia		0	36	50	63	105	4.2%
Other Asian economies		64	166	204	232	314	2.5%
Latin America		18	34	39	44	63	2.3%
Africa		93	193	196	211	248	1.0%
Middle East		2	15	18	23	31	2.8%
Others (including countries in transition)		872	264	306	327	259	-0.1%
World total		3,822	5,558	6,696	7,328	8,858	1.8%
Asian total		918	2,786	3,684	4,233	5,593	2.7%

Note: Coal demand includes lignite. The world total includes statistical errors and inventory changes.
Source: "World Energy Outlook 2006," OECD/IEA

The WEO 2006 forecasts production to meet demand with a supply/demand equilibrium achieved for coal, as indicated in Tables 4-3 and 4-4. China and India are forecast to account for 76% (including 60% for China and 16% for India) of a 3.3 billion-ton increase in coal production from 2004 to 2030. Steaming coal production is projected to substantially expand, capturing 85% of the coal production increase from 2004 to 2030.

Table 4-4 World Coal Production Outlook (Reference Scenario)

(Unit: 1 million tons)

		1980	2004	2010	2015	2030	2004-2030 Average annual growth
OECD	North America (U.S., Canada, Mexico)	793	1,085	1,230	1,250	1,361	0.9%
	Asia (Japan, South Korea)	37	3	2	0	0	-
	Oceania (Australia, New Zealand)	107	360	434	467	564	1.7%
	Europe	1,108	627	609	601	614	-0.1%
Total		2,045	2,075	2,274	2,318	2,538	0.8%
Russia		n.a.	260	304	306	301	0.6%
China		620	1,960	2,673	3,074	3,927	2.7%
India		116	413	494	586	937	3.2%
Indonesia		0	132	172	202	263	2.7%
Other Asian economies		60	90	106	118	145	1.8%
Latin America		11	67	83	94	130	2.6%
Africa		120	248	261	280	332	1.1%
Middle East		1	2	2	2	3	1.9%
Others (including countries in transition)		849	312	327	348	282	-0.4%
World total		3,822	5,559	6,696	7,328	8,858	1.8%
Asian total		833	2,598	3,447	3,980	5,272	2.8%

Note: Coal production includes lignite. The world total includes statistical errors and inventory changes.
Source: "World Energy Outlook 2006," OECD/IEA

Net inter-regional trade in coal is forecast to increase at an average annual rate of 1.8% from 619 million tons in 2004 to 975 million tons in 2030, as indicated in Table 4-5. Net inter-regional coal trade's ratio to world coal consumption excluding lignite and peat is expected to remain at around 13% after 2004. As indicated above, the coal demand increase is planned to meet a rise in consumption of steaming coal for electricity generation. Thus, steaming coal is expected to account for 85% of the incrase in net inter-regional coal trade. As a result, steaming coal's share of world coal transactions is predicted to rise from 71% in 2004 to 76% in 2030.

Table 4-5 Net Inter-regional Coal Trade Outlook (Reference Scenario)

(Unit: 1 million tons)

		1980	2004	2010	2015	2030	2004-2030 Average annual growth
OECD	North America (U.S., Canada, Mexico)	-83	-14	-4	1	16	-
	Asia (Japan, South Korea)	72	261	291	296	287	0.4%
	Oceania (Australia, New Zealand)	-43	-220	-288	-314	-397	2.3%
	Europe	73	201	237	254	292	1.4%
Total		19	228	235	237	197	-0.6%
Russia		n.a.	-50	-65	-72	-85	2.1%
China		-5	-72	-70	-67	-60	-0.7%
India		0	27	40	50	82	4.4%
Indonesia		0	-96	-122	-139	-157	1.9%
Other Asian economies		6	77	96	113	167	3.0%
Latin America		7	-33	-45	-51	-67	2.8%
Africa		-27	-57	-65	-69	-84	1.5%
Middle East		1	13	16	20	28	3.0%
World total		172	619	754	819	975	1.8%

Note: Trade does not include lignite and peat. A negative number indicates exports and a positive one means imports.
Source: "World Energy Outlook 2006," OECD/IEA

The WEO 2006 gives the following views about a steaming coal trade outlook for the Asian region: (a) In the Pacific market, India will join Japan, South Korea and Taiwan as large coal importers, as India's electricity sector coal demand rise exceeds its domestic coal production expansion. (b) Indonesia, Australia and Russia will meet the rise in steaming coal demand in the Pacific market. (c) China, though remaining a net coal exporter, will see its Pacific coal market share decline as any increase in domestic coal production must be used for the domestic market. But this prediction is uncertain. If a demand increase is faster or a production rise is slower, China may become a net coal importer[8]. As for coking coal, the four big exporters - Australia, the United States, Canada and Russia - will continue to account for most exports. Particularly, Australia's share of the coking coal export market is projected to increase from 63% in 2004 to 67% in 2030.

Figure 4.2 contrasts the WEO 2006 world coal supply/demand and trade projections with India's coal supply/demand and import projections as indicated in "2. Coal Supply/Demand Gap." As shown in the figure, the Indian government's coal demand, domestic production and import projections are far larger than indicated in the WEO 2006. This wide difference is attributable to a wide gap in projected economic growth. While the WEO 2006 assumes India's average annual GDP growth at 6.4% between 2004 and 2015, at 4.2% between 2015 and 2030 and at 5.1% between 2004 and 2030, the Indian government has adopted a scenario in which annual GDP growth would be 8% to 10%.

If India were to promote its economic development in line with its own scenario, it would be indispensable for the country to expand coal demand as envisaged in the 11th five-year plan. In such case, the WEO 2006's reference scenario indicates that the Asian coal market would have to provide India with 10 million to 30 million tons in additional coal in 2016, with 90 million to 140 million tons in 2021 and with 130 million to 200 million tons in 2024. The current Asian coal market size is a little more than 400 million tons. Even if coal production expands in the future, it would be difficult to expand the market by more than 100 million tons for the following reasons:

- ► Countries that could expand coal exports to Asia include Australia, Russia (Siberia), the United States (Alaska) and Canada. They have many problems to solve before such expansion, including underdeveloped export infrastructure. Indonesia's coal exports are expected to expand at an average annual rate ot 7.8% from 2005 to 150 million tons in 2009. Later, however, Indonesia's coal exports may be capped at 150 million tons due to a rapid increase in domestic coal demand. Around 2017, domestic onsumption may be balanced with exports. Later, exports may slip below domestic consumption, according to some forecasts[9].
- ► The supply/demand relationship for maritime transportation capacity is expected to grow tighter. China and India are expected to expand transportation of iron ore and other mineral resources, and farm products as well as coal for international trade. Although some shipping firms have announced their investment in new ships, the supply/demand relationship for dry bulk carriers is likely to grow even tighter. Even CIL has no plan to own such carriers but intends to depend on Japanese and other shipping companies for

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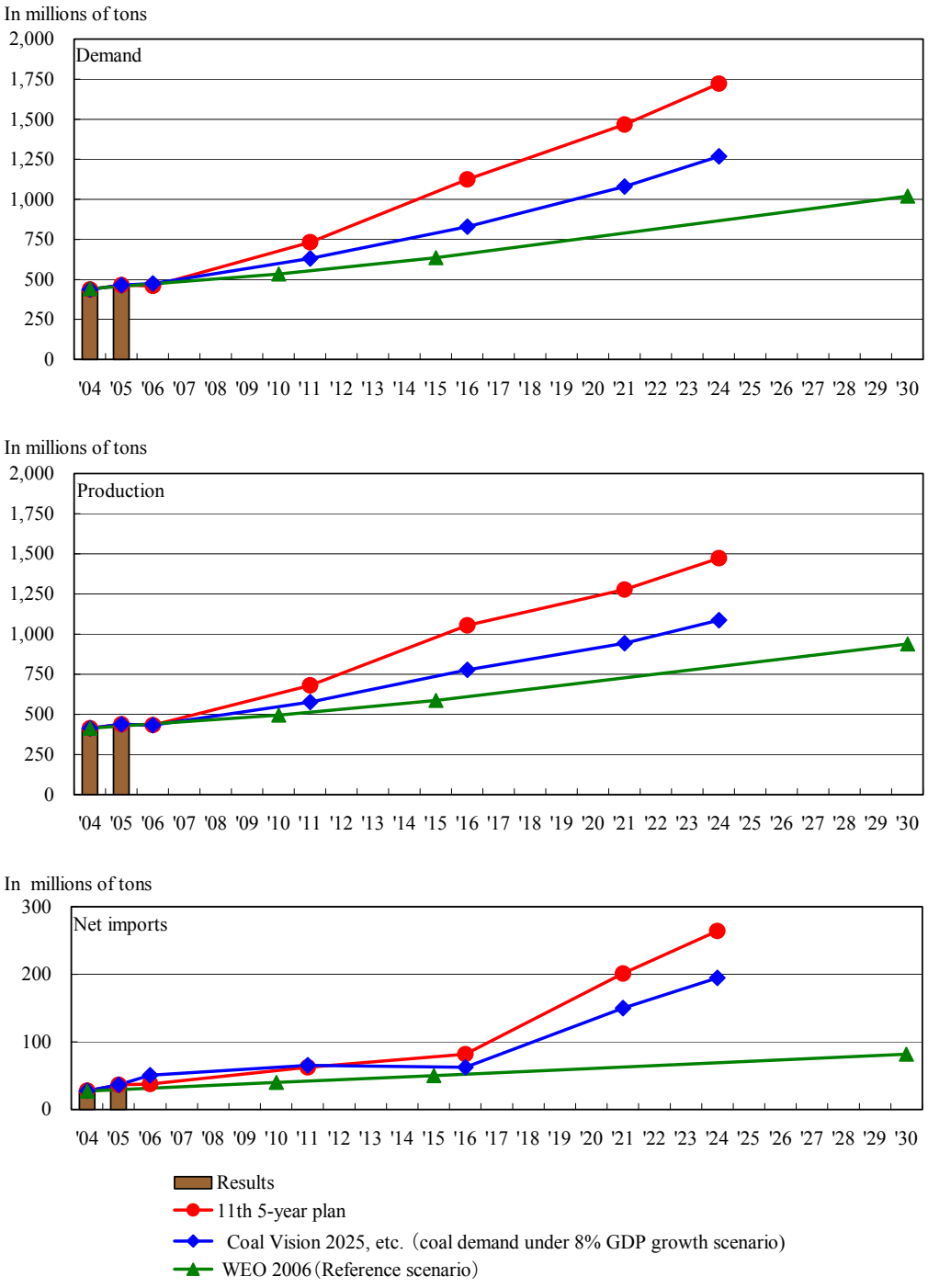
8 According to China's customs statistics, its coal imports in the first five months of 2007 totaled 22.96 million tons, exceeding 19.30 million tons in exports.

9 “Outlook of Indonesian Domestic Coal Supply and Demand toward 2025, ” Mr. Bambang Hartoyo, Ministry of Energy and Mineral Resources,, APEC CFE Technical and Policy Seminar, February 2007

transportation of coal imports. In this respect, a key point would be whether India could effciently charter dry bulk carriers for coal imports.

► Any coal consumption expansion cannot be considered without measures against global warming. Such measures could become constraints on any coal demand expansion.

Figure 4-2 Comparison of Indian Coal Supply/Demand and Import Projections



Sources: Tables 2-1, 2-2, 4-3, 4-4 and 4-5

4-3 Coal price changes

Table 4-6 shows steaming coal price projections in the WEO 2006 and our Asia/World Energy Outlook 2006 (hereinafter referred to as IEEJ 2006). The WEO 2006 forecasts coal prices to decline toward 2010 before rising back to levels for 2005. In contrast, the IEEJ 2006 predicts coal prices to remain unchanged. Both projections indicate no substantial price hikes in real terms. Supply is expected to smoothly expand in a balanced manner to meet a steaming coal demand rise.

Table 4-6 Steaming Coal Price Outlook (in 2005 prices)

(Unit: US$ dollar per ton)

	2000	2005	2010	2015	2020	2030
WEO 2006	37.51	62.45	55.00	55.80	-	60.00
IEEJ 2006	38.00	63.00	62.00	-	63.00	65.00

Note: The WEO 2006 projects steaming coal import prices in OECD countries. The IEEJ 2006 predicts steaming coal import prices in Japan.
Sources: "World Energy Outlook," OECD/IEA; "Asia/World Energy Outlook 2006," IEEJ.

As coal prices have remained high since 2004, coal-producing countries have expanded operational coal mines and developed new mines and transportation infrastructure. Therefore, coal production is well expected to expand in the future. Coal prices depend on a specific supply/demand balance. As supply is now likely to exceed demand, coal consumers expect to see lower prices. But coal demand in China and India could increase faster than predicted by research institutes. Particularly, there are wide-ranging forecasts of an increase in Indian coal imports. If India expands its coal imports in line with its own scenario, it may exert pressure on coal prices to rise substantially. Such development would be the greatest pressure on the international coal market.

Factors behind the expected substantial increase in the Indian electricity generation sector's consumption of coal (includng imported steaming coal) include ultra mega power projects. Even if prices rise on the international coal market, India may have to import a certain amount of steaming coal irrespective of prices in order to implement these ultra mega power projects. Learming lessons from the 2004 coal crisis in this sense, India apparently attemps to further promote acquisition of overseas coal concessions in a bid to take advantage of such concessions for preventing coal procurement from being destabilized by coal price hikes.

Conclusion

If India's coal imports increase to meet a supply/demand gap expanding in line with its own scenario, it may greatly affect Japan which depends on imports for almost 100% of coal supply. In order to avoid such development, Japan should positively cooperate with India in implementing measures to curb an expansion in the Indian coal supply/demand gap.

Measures to curb an expansion in India's coal supply/demand gap include "curbing coal demand" and

"coal output expansion and utilization of untapped coal resources" as indicated in "3. Responses to Coal Supply/Demand Gap." Japan is good at technological assistance for these measures. For example, Japan may help India upgrade existing coal-washing plants, construct new plants and manage coal-washing plant operations. Japan may also be able to cooperate with India in improving capacity utilization rates, fuel efficiency and electricity distribution losses at exisitng coal thermal power stations, as well as in constructing USC (ultra-super critical) coal-fired power plants and in introducing new technologies such as the IGCC (integrated gasification combined cycle) power generation system and the IGFC (integrated coal gasification fuel cell combined cycle) power generation system. Japan has also made achievements in coal exploration and coal mine productivity improvement technologies, including those for safety management and production at underground coal mines. Technological assistance should cover not only technology transfers but also diffusion of technologies through education and training of engineers and operators. Japan has so far implemented bilateral talks with coal-supplying countries. Based on the Japan-India energy talks, Japan should have regular consultations with India, as a coal-consuming country, on a wide range of coal topics such as supply/demand conditions and introduction of clean coal technologies to deepen mutual understanding and cooperation. Private sector companies should participate in such talks.

India may compete with Japan for overseas coal concessions. With Australia, the largest coal exporter to Japan, the Japanese government has held regular high-working-level energy talks. Japan has also held coal policy talks with Indonesia, China and Vietnam. Japan should discuss its assistance to coal-exporting countries at these talks and promote assistance meeting their needs to deepen mutual trust and cooperative relations and secure stable coal imports from them over a long term.

Japanese companies' overseas coal industry investment has concentrated in Australia which has developed a politically stable investment climate and features better coal development conditions than other coal-exporting countries. In a bid to diversify coal import sources in future, however, they are expected to seek to participate in coal development in other coal-rich countries such as Canada, Indonesia, Russia, Mozambique, Mongolia and the United States (Alaska). As well as India, South Korea, which is in a similar position to Japan as a coal importer, and China, which is under the pressure of fast-growing coal demand, have been seeking to acquire coal concessions in these coal-rich countries. While Japanese private-sector companies are left free to procure overseas coal or acquire overseas coal concessions, the government should support private-sector through (1) government-to-government talks on investment in developing countries with high country risks and positive involvement (through official development assistance) in development of transportation infrastructure, (2) expansion of applications of overseas investment loss provision and trade insurance systems and investment protection agreements, and (3) participation in large overseas projects from a long-term perspective.

Contact：report@tky.ieej.or.jp