FINAL TECHNICAL REPORT

Project Title: Potential for Thermal Coal and Clean Coal Technology (CCT) in the Asia-Pacific

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SECTION 1

Summary of Project Activities

The Coal Project was able to make considerable progress in understanding the evolving energy situation in Asia and the future role of coal and Clean Coal Technologies. During the past year government officials and industry representatives were contacted in nine Asian countries (Australia, China, Hong Kong, Indonesia, Japan, Korea, Philippines, Taiwan and Thailand). The findings of these visits and research at the East-West Center resulted in the attached reports, and the selection of individuals to participate in the Coal and the Environment: Asia 2010 Conference (Section 7).

The main findings of this research are contained in the attached paper (Section 2). It is clear that there will be major growth in consumption of coal in Asia over the next two decades -- we estimate an increase of 1.2 billion metric tons. Second, all governments are concerned about the environmental impacts of increased coal use, however enforcement of regulations appears to be quite variable among Asian countries. There is general caution on the part of Asian utilities with respect to the introduction of CCT's. However, there appears to be potential for introduction of CCT's in a few countries by the turn of the century. It is important to emphasize that it will be a long term effort to succeed in getting CCT's introduced to Asia.

The Coal Project recommends that the U.S. CCT program be expanded to allow the early introduction of CCT's in a number of countries (China, South Korea, Taiwan, Hong Kong, and Thailand). Japan is planning to establish a CCT center in 1992 with the objective of facilitating the transfer of CCT's to developing countries. It is recommended that attempts be made to learn about Japan's CCT plans, and determine where the two countries might cooperate in assisting developing countries gain access to CCT's.

The following sections contain the main reports produced in the Coal Project over the past year. In addition, the project has assisted DOE in answering a range of questions pertaining to Asia. Close cooperation was maintained with DOE throughout the year particularly with respect to the highly successful conference: Coal and the Environment: Asia 2010.

Listing of Activities

(1) The Coal and the Environment: Asia 2010 Conference was held at the East-West Center in July. The conference brought together 85 energy and environmental planners from government and electric utilities, plus energy research analysts, and private companies involved in both coal trade and developing advanced coal technologies to reduce pollution. Conference participants came from Australia, Canada, Hong Kong, India, Japan, South Korea, Philippines, Taiwan, Thailand, and the United States.

(2) Two special reports were prepared for the conference and the Coal Advisory series: *Environmental Legislation and U.S. Electric Power Generation: Implications for Fuel Options in Asia* by Vince Calarco, and *The Impact of New Coal Producers on the Price of Thermal Coal* by Donald Barnett (Reports submitted with the 3rd quarter 1991 progress report).

(3) The country coal forecasts have been updated for Australia, China, South Korea, Indonesia, Japan, Taiwan, Philippines, and Hong Kong. A copy of all production and consumption forecasts for each country as well as an overview forecast for all of Asia is attached and can be found in section 3 (Titled *Coal Projections for the Asia-Pacific: 1990-2010*).

(4) An outline paper on the steps needed to be taken to establish an *APEC Clean Coal Clearinghouse* was submitted to DOE/FE.

(5) A computer Database on coal statistics is being kept and continually updated. Also, work continues on a database in which environmental standards and issues are documented. The goal in keeping these databases is to respond more quickly to requests for information on coal and the environmental issues that accompany coal usage.

(6) A one week trip was made to Tokyo, Japan to meet with government officials, research institutions, and companies involved in coal and technology issues. The purposes were to: (i) better understand the energy planning process in Japan, particularly with respect to future coal use, (ii) examine the role of Clean Coal Technologies in Japan, and (iii) better understand Japan's strategy toward coal developments and coal technology transfers to Asia in the 1990's.

The trip resulted in improved estimates of thermal coal trends in Japan and Asia, information on why Japan has been successful in introducing pollution control technologies (particularly FGD), and a better understanding of the relationship between industry and planning agencies (particularly MITI) developing and implementing long term coal and technology strategies.

(7) An overview paper was completed titled *Asia's Coal Future and Strategies to reduce Environmental Impacts* which includes updated Coal Project estimates of production, consumption and trade as well as an examination of the state of Clean Coal Technologies in the major economies involved in the Asian coal trade (Section 2).

(8) At DOE/FE request, a summary report on Taiwan's coal and environmental outlook was sent along with suggestions of names of people and organizations that the DOE/FE should contact during its mission to Asia.

(9) An article was released to the press titled "Coal is here to Stay." Also Charles Johnson did an interview with Voice of America on Coal's future and the Role of Clean Coal Technologies.

(10) The trip report from the October 1990 mission to Asia was expanded into a series of country reports bound into one volume. The 71 page report: *Selected Coal and Related Environmental Issues in Australia, China, Hong Kong, Indonesia, Japan, Philippines, South Korea and Taiwan* was submitted to DOE/FE in March 1991 (Section 8).

(11) An advisory was released titled *Japan's Official Forecasts Underestimate Coal Consumption* which among other subjects treated points out that coal consumption in Japan will most likely be significantly higher than MITI estimates and that Australia will continue to account for 45 to 55 percent of Japanese exports over the next two decades (Section 4).

(12) An advisory was released titled *Coal's Share of Thailand's Total Energy to Almost Triple by 2010* which dealt with the fact that coal's share of total primary energy supply will increase from 12 percent in 1990 to 30 percent in 2010 (Section 5).

(13) The report: *Summary of Asia Pacific Coal News (July 1990 to June 1991)* was released (Section 6).

SECTION 2

ASIA'S COAL FUTURE AND STRATEGIES TO REDUCE ENVIRONMENTAL IMPACTS

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Introduction

Asia leads the world in dependence on coal with almost half of it's energy requirements (47 percent) supplied by coal compared to less than a quarter (22 percent) for the rest of the world. The outlook for Asia over the next two decades is for a 75 percent increase in coal consumption. This will have a substantial environmental impact on many areas in Asia where emissions from coal burning are already at unacceptable levels.

Throughout Asia there is a realization that coal related environmental problems must be controlled in the future, but most utilities are following cautious strategies with respect to major investments in environmental control technologies. Priority continues to be on meeting the rapidly growing demand for electricity. Control of particulate emissions is already a high priority, and reducing SO_2 emissions is occurring in most countries, but only Japan appears to be in a position to take substantial action to control CO_2 emissions in the 1990s.

Over the longer term Asia may be better able than other developing regions of the world, to address environmental problems associated with expanded coal use because of the following three factors. First all major coal consuming economies are aware of the environmental problems generated by coal consumption. Second, the major coal consuming economies have been able to sustain much higher economic growth rates than the rest of the world, therefore have greater access to loans from international lending agencies. Third, is the difficult to quantify cultural advantage. Asia contains economies at all levels of economic development,

with higher-income Asian economies likely to provide substantial technical and financial assistance to their lower-income neighbors.

The Asian Coal Outlook: 1990-2010

Coal consumption in Asia has grown at an average annual rate of about five percent over the past two decades, and is projected to moderate to about 2.8 percent per year over the 1990-2010 period. As shown in Table 1, Asian coal consumption is projected to increase from 1.6 billion metric tons (hereafter tons) in 1990 to 2.1 billion tons in 2000 and 2.8 billion tons in 2010, an increase of 1.2 billion tons. China and India dominate with over two-third's of total coal consumption during the 1990-2010 period.

Table 1
COAL CONSUMPTION IN ASIA[1], 1990-2010
(Million metric tons)

Economy	1990	2000	2010	Increase 1990-2010
China	1,064	1,335	1,565	501
India	205	360	575	370
Japan	113	148	172	59
Australia	51	67	85	34
Korea (North)	51	62	87	36
Korea (South)	43	58	69	26
Taiwan	19	35	57	38
Hong Kong[2]	10	15	20	10
Indonesia	7	23	50	43
Philippines	3	15	25	22
Thailand	<1	6	27	27
Other	13	22	34	21
Total	1,580	2,146	2,766	1,186

[1] Asia includes the SW Pacific but excludes the U.S.S.R.; excludes lignite.
[2] Hong Kong statistics are separated from China to show the significance.
EWC Coal Project projections, November 1991.

Table 2 shows that total coal production from within the Asian region is expected to roughly parallel consumption. However, as shown in Table 3, net imports to the region are projected to triple from from 37 million tons in 1990 to 111 million tons in 2010. The projections in Tables 1-3 are subject to considerable error, particularly after 2000, and may not agree with official estimates.

Table 2

COAL PRODUCTION IN ASIA[1], 1990-2010

(Million metric tons)

Economy	1990	2000	2010	Change 1990-2010
China	1,080	1,360	1,600	520
India	201	345	554	353
Australia	163	237	310	147
Korea (North)	49	58	77	28
Korea (South)	21	10	4	-17
Indonesia	11	48	70	59
Japan	8	3	1	-7
Vietnam	5	11	20	15
Other	6	15	19	14
Total	1,543	2,087	2,655	+1,112

[1] Asia includes the SW Pacific but excludes the U.S.S.R.; excludes lignite.
EWC Coal Project projections, November 1991.

Environmental Technology Trends in Asia

The environmental consequences of increased coal use are recognized in the energy and environmental planning agencies in most economies in the region. However, both the legislation and enforcement to reduce environmental impacts from burning coal vary widely among economies in the region. A survey to determine the technological choices that economies will make to control coal related pollution would probably be accurate only for the next few years. The reason is that most people involved in power

Table 3
COAL TRADE IN ASIA[1]: 1990-2010
(Million metric tons)

	1990	2000	2010	Change 1990-2010
Net Exporters				
Australia	112	170	225	+113
China & Hong Kong	6	10	15	+9
Indonesia	4	25	20	+16
Vietnam	1	3	5	+4
Net Exports	123	208	265	+142
Net Importers				
Japan	105	145	171	+66
Korea (South)	22	48	65	+43
Taiwan	19	35	57	+38
India	4	15	21	+17
Korea (North)	2	4	10	+8
Philippines	2	11	21	+19
Thailand	1	6	27	+26
Other	5	3	4	+1
Net Imports	160	267	376	+216
Net Trade	-37	-59	-111	-74

[1] Asia includes the SW Pacific but excludes the U.S.S.R.; excludes lignite.
EWC Coal Project projections, November 1991.

plant planning and environmental control do not know the viable economic choices that will be available in this decade, and are even less certain after 2000. In addition, most electric utilities in Asia are state owned and follow conservative strategies toward the introduction of new technologies, particularly with respect to major capital investments in environmental control technologies.

Given this caveat, in Table 4 an attempt has been made to group Asian economies into three broad groups based on the technology choices that are probable or possible for the electric utility industry in each economy in the 1990s. The first group includes economies that have already introduced

Table 4

ECONOMIES GROUPED ACCORDING TO THEIR EXPECTED COAL RELATED ENVIRONMENTAL CONTROL STRATEGIES IN THE 1990s

Group I: *Advanced coal technology options and stringent controls. Clean Coal Technology candidates:*	
Existing:	Japan
Possible:	Hong Kong
	South Korea
	Taiwan
Group II: *Likely to introduce FGD control systems on most new plants:*	
Existing:	Japan
Probable:	Hong Kong
	South Korea
	Taiwan
Possible:	Thailand (lignite plants)
Group III: *FGD not required, and emphasis on low sulfur coal, etc.*	
	Australia
	China
	India
	Philippines
	Thailand

flue gas desulfurization (hereafter FGD) systems to control SO_2 emissions. The second group does not presently use FGD but is likely to introduce FGD systems on most large, new coal-fired plants in the future. The third group of economies is unlikely to pass and enforce legislation that will

require widespread adoption of FGD, but are expected to rely on one or more of the following: low-sulfur fuels, high stacks, siting plants away from population centers, and switching to natural gas in some areas.

Table 4 reflects our view of trends in the 1990s, however beyond the 1990s, improvements in the economics and reliability of technologies under development, combined with more stringent environmental legislation may greatly alter these rankings.

Asian Country Coal and Environmental Issues

The following section gives a brief summary of key coal and environmental issues in the most significant coal consuming countries in the Asian region. In most Asian countries both energy and environmental policies and strategies have been under active review by their governments in recent years, and tightening of environmental legislation is highly likely in the 1990s.

Australia

Although usually grouped with the Pacific economies, it is such a key factor in energy trade in adjacent Asia that it is included in the Asian region in this paper. Australia is the world's largest coal exporter with 112 million tons of exports in 1990, up more than 100 percent from 1980. Exports are projected to increase to 170 million and 225 million tons in 2000 and 2010 respectively. These optimistic export projections are dependent on major increases in investments in new mine capacity and related infrastructure, and a continuation of Australia's open-door policy toward foreign investment.

Australian coal exports have established the basis for both quality and prices in Asian coal trade, and most coal importing utilities have designed their coal-fired power plants to burn Australian coal. It is a major exporter of both steam and coking coals, and has recoverable reserves of 30-45 billion tons.

Australia depends primarily on coal and lignite for electricity generation, and present environmental standards can be met without installation of FGD systems. Australian SO_2 regulations are less stringent than most other major industrialized coal consuming countries (Mannini et al., 1990).

Coal is Australia's largest export commodity in terms of value, and neither government or industry are expected to support international environmental controls that would seriously jeopardize their most important export commodity. As shown in Table 1, Australia is projected to continue to dominate coal trade in the Asia-Pacific region over the 1990-2010 period.

Australia has a keen interest in protecting it's export markets for coal, with a primary focus on maintaining Australia's competitive position in international coal trade by improving the economics and quality of Australian coal supplies. Australia does not focus on coal consumer technologies such as in the United States and Japan which have large Clean Coal Technology programs.

China, P.R.

China is the world's largest producer and consumer of coal with 1.1 billion tons produced and consumed in 1990 and a goal to produce 1.4 billion tons of coal in 2000. (Yunzhen, 1991). Coal accounts for a very high 75 percent of total primary energy consumption (Yunzhen, 1991). China faces formidable problems in controlling emissions from coal burning because about two-thirds of coal consumption is among millions of residential, commercial and other small users. Jia Yunzhen of the Ministry of Energy reports that coal burning results in annual emissions of 13 million tons of particulates and 15 million tons of SO_2.

The government's strategy places heavy emphasis on increasing efficiency in coal use in three broad areas: promoting co-generation in urban areas, increasing the share of heating by central heating systems, and increasing the share of electricity generation in the total energy mix. The shift of up to 200 million people from rural to urban areas over the decade of the 1990s improves the prospect for more centralized coal use and greater energy efficiency and control of particulate emissions. However urban air quality will further deteriorate without vigorous control of coal related emissions.

Over the past decade China reportedly has been able to reduce ash emissions per unit of energy from coal burning power plants by two-thirds, with a goal of an additional 40 percent reduction by 2000 (Ministry

of Energy, 1990). The ash content of coal used in the power sector averages over 25 percent.

Sulfur concentrations are controlled by stack height, sulfur content of coals and the location of plants. Major investments in FGD and other advanced emission control technologies are not a priority for the 1990s, however these technologies are expected to be introduced on a limited scale.

Hong Kong

Hong Kong switched from total dependence on oil for electricity generation in 1981 to almost total dependence on coal in 1990. This pattern will continue to change in the 1990s as two 900 MW nuclear power units begin operation across the border in China in 1992 and 1993. Economic considerations would have led to coal-fired plants, however political considerations apparently favored selection of the nuclear power plants. In addition, 1200 MW of pumped storage will be commissioned toward the end of 1992. The demand for electricity is projected to grow at 5-6 percent during the 1990s compared to about 9 percent in the 1980s (Tang, 1991). Consumption of steam coal for electricity consumption is projected to increase from approximately 10 million tons in 1990 to 14 million tons in 2000.

Hong Kong has relatively strict regulations pertaining to both the quality of coal burned and emissions of particulates, SO_2 and NOx. Power plants cannot burn coals with more than 1 percent SO_2 and 16 percent ash. In addition, environmental performance levels for the newest and largest power plant limit particulates to 125 mg/m^3, SO_2 to 2000 mg/m^3, and NOx to 2700 mg/m^3 (Tang, 1991). Over the 1981-1990 period Hong Kong's major power company, China Light and Power, reduced total SO_2 emissions by 40 percent even though electricity production increased by 220 percent (Tang, 1991).

The outlook for Hong Kong is for continued use of very low sulfur coal (average 0.6 percent sulfur). Environmental standards are likely to be tightened in the 1990s, and the installation of FGD may be required to meet future standards.

India

The demand for electricity continues to exceed supplies, and domestic targets for coal production are often not achieved. Domestic coal resources are large but are mostly below the quality standards of internationally traded coals. Major improvements are required in mining, beneficiation and transport of India's coal to meet it's optimistic supply projections. Production and consumption is presently about 200 million tons per year, and is projected to increase to about 350 million tons in 2000 and 500-600 million tons in 2010. Imports are restricted to under five million tons of coking coal, and both coking and steaming coal imports would rapidly increase if restrictions were removed.

The environmental problems associated with coal burning in this heavily populated country are serious, however major investments in emission control equipment are not a viable alternative in the foreseeable future. Fortunately, most of India's coal reserves contain less than 1.0 percent sulfur. Increased efficiency in power generation, greater beneficiation of coal at the mines to reduce impurities and improved transport systems are priority areas.

Indonesia

Indonesia's large steam coal export potential was not recognized until the 1980s. Rapid expansion in production from extensive deposits in Kalimantan are underway, and Indonesia is expected to become the lowest cost supplier of coal into the Asian market. Although Indonesia has some premium steam coal (such as Kaltim Prima), most of the coal has one or more quality deficiencies that may constrain its market potential. In general, Kalimantan coals contain low sulfur, medium energy, and medium to high moisture. Some coals have exceptionally low sulfur contents of 0.1 percent that could meet sulfur emission standards in most countries without FGD.

Indonesia's coal production is projected to jump from 11 million tons in 1990 to 48 million and 70 million tons in 2000 and 2010 respectively. Exports are projected to increase from 4 million tons in 1990 to 25 million and 20 million tons in 2000 and 2010. The projected decline after 2000 is due to the expected rapid growth in domestic consumption of coal for

electricity generation.

Indonesia has the fifth largest population in the world at 182 million in 1990 and will reach a quarter billion people within two decades. Electricity consumption has been growing at roughly 15 percent per year in recent years, with oil and gas accounting for over half of total generation. The limited size of oil and gas reserves is expected to result in a major switch to coal-fired generation in the 1990s. However, chronic delays in financing and construction of coal-fired plants could result in greater than expected expansions in oil and gas capacity.

With respect to environmental controls, there are no regulations that would prevent burning of low sulfur Indonesian coal. The installation of sulfur emission control equipment is unlikely during the 1990s, unless it becomes a requirement behind loans from international lending institutions.

Japan

Japan is the largest importer of coal in the world with imports of 105 million tons in 1990. Japan's official projections released by the Ministry of International Trade and Industry (MITI) project coal to increase from the present 113 million tons to a plateau of 142 million tons in the 2000 to 2010 period. The MITI projections assume adding about 40,000 MW of nuclear capacity over the 1990-2010 period. We expect substantial delays in nuclear power expansions, and therefore are projecting higher coal consumption of 148 million and 172 million tons in 2000 and 2010 respectively.

Steam coal is expected to increase it's share of Japan's total coal consumption from 40 percent in 1990 to 67 percent in 2010. The demand for coking coal in the steel industry will gradually decline. Japan's high cost domestic coal mining industry is projected to decline from about 8 million tons in 1990 to no more than 3 million tons in 2000 and 1 million tons in 2010.

Japan is the leader in Asia in developing and introducing emission control technologies for SO_2 and NOx. Japan embarked on a program to introduce FGD in the 1970s, and today 90 percent of Japan's coal-fired power plants have FGD -- the highest percentage among major coal consuming countries. About 70 percent of Japan's coal-fired capacity have

denitrifying systems, and all plants have high efficiency ash removal systems.

Japan is planning to take a very active role in the 1990s in developing and transferring advanced coal technologies to developing countries (Aoki, 1991). Japanese coal and related environmental assistance in Asia has the potential to become one of Japan's largest development program areas in the 1990s. A Clean Coal Technology (CCT) Center is planned for 1992 to promote CCT development and transfer to developing countries, including China, in cooperation with industry.

The size of the Japanese R & D program on new technologies is much smaller than the present R & D program in the United States. However, Japanese executives believe this apparent disadvantage is offset by: (i) their more "practical" approach to development and the introduction of new energy and emission control technologies, (ii) differences in "administration culture", (iii) a shorter period for assessments, (iv) the ability to more readily pass costs of new technologies on to electricity consumers, and (v) the willingness of Japanese companies to acquire and exchange technologies.

Korea, Republic of

The second oil shock in 1979 was the stimulus that caused the Korean government to enforce substitution away from dependence on oil (Kim, 1991). Nuclear and coal grew rapidly during the 1980s with a small amount of LNG entering the energy mix at the end of the 1980s. In 1990 Korea's electricity capacity mix was 36 percent nuclear, 23 percent oil, 18 percent coal, 12 percent LNG and 11 percent hydro (Kim, 1991).

Imported coal consumption increased from 7 million tons in 1980 to 22 million tons in 1990, and is projected to increase to 48 million and 65 million tons in 2000 and 2010 respectively (Lee, 1991).

As shown in Table 5, the present emission standards can be met with low sulfur coal, low NOx burners and electrostatic precipitators. The projected SO_2 emission regulations in 1995 could probably be met through selective purchases of low sulfur coal, however it would be extremely difficult to meet the regulations projected in 1999 and still maintain the strategic goal of diversified sources of coal. Therefore, all new power

plants are expected to have FGD systems to reduce sulfur emissions.

Table 5
LONG TERM EMISSION REGULATIONS PERTAINING TO COAL-FIRED POWER PLANTS

	1991	1995	1999
SOx (ppm)	700	500	270
NOx (ppm)	350	350	350
Particulate (mg/m^3)	250	100	50
Max. Sulfur content of compliance coal (%)	.95	.70	.30

(Kim, 1991 and KEPCO)

Emissions of SOx, NOx and CO for the power sector are estimated in Table 6 along with the power sector's estimated share of the total emissions of the country. As can be seen in Table 6, emission control plans will control SOx emissions to less than 15 percent of the total by 2000, however for both NOx and CO, emissions are expected to increase in both absolute terms and as a percent of total national emissions over the 1988-2010 period.

Philippines

The Philippines has modest amounts of geothermal energy and low quality coal that are being developed to meet a portion of the country's energy requirements. At present coal accounts for only 7 percent (405 MW) of total electricity generating capacity, but by 2000 coal is expected to jump to about 30 percent of capacity. Accelerating the development of low quality domestic coal has been a goal since the late-1970s (Bantugan, 1991). Domestic coal production is slightly over one million tons and is projected to increase to about 4 million tons in 2000. Imported coal is

projected to increase very rapidly after the mid-1990s reaching about about 10 million tons in 2000 and 20 million tons in 2010.

Table 6

PROJECTION OF EMISSIONS OF POLLUTANTS FROM THE POWER SECTOR

(Thousand metric tons)

	1988	1995	2000	2010
SOx	133	219	171	181
Percent of total	12.9	18.3	14.9	14.4
NOx	111	225	272	393
Percent of total	18.3	27.6	29.3	32.9
CO	9,155	18,966	23,567	34,508
Percent of total	15.9	22.4	23.7	27.2

(Kim, 1991)

The Philippine National Power Corporation faces serious problems in meeting increasing demand for electricity, and is not planning to install advanced emission control technologies for SO_2 because of the high capital requirements. Existing air quality standards are periodically reviewed, however passage and enforcement of standards that would require the installation of FGD systems are not anticipated in the 1990s.

Taiwan

Taiwan has very limited energy resources, and is heavily dependent on imported energy. In 1989 the energy mix was 56 percent oil, 24 percent coal, 13 percent nuclear, 4 percent hydro and 3 percent LNG. The growth in energy consumption is projected to average 4-5 percent per year for the 1990s.

Coal consumption is projected to triple by 2010, increasing from 19 million tons in 1990 to 57 million tons in 2010. As is the case in Korea,

emission limits for SO_2 are projected to tighten substantially in the 1990s. The present limit of 750 ppm SO_2 will be reduced to 500 ppm in 1993 (Chuang, 1991). At present, coal-fired power plants use low sulfur coals, but the installation of FGD systems is probable for most future plants.

Thailand

Since the 1970s Thailand has had an active program to diversify energy sources and promote development of domestic energy resources of lignite, natural gas and oil. This trend is expected to continue in the future. Oil's share of total primary energy is expected to decrease from 66 percent in 1990 to 55 percent in 2010. The share of energy from domestic lignite is expected to increase marginally from 11 percent in 1990 to 12 percent in 2010. The major change is expected to come from imported coal which is projected to jump from 1 percent in 1990 to 18 percent in 2010. Imported coal is projected to increase from less than 1 million tons in 1990 to 25-30 million tons in 2010.

Thailand faces serous environmental problems in the Bangkok metropolitan area. In the north at Mae Moh, where the country's largest mine-mouth lignite power station is located, SO_2 levels are rapidly approaching maximum allowable limits. The lignite contains an average of 3.7 percent sulfur, and on an equivalent heat basis is equal to 7-10 percent sulfur coal. It is likely that power plant expansions at the large Mae Moh mine will be accompanied by sulfur emission control equipment. In addition, coal imports for electricity generation are expected to be restricted to low sulfur coal. Of the approximately one million tons of SO_2 released annually from fossil fuel burning, lignite accounts for almost half (Intarapravich, 1991). Without FGD systems on new lignite capacity, the rapid growth in lignite consumption will increase lignite's share of total SO_2 emissions to over two-thirds by 2000.

The possibility of importing natural gas from neighboring countries has been under investigation by the Thai government, and imports are considered probable after 2000, and possibly sooner.

Other Economies

Malaysia uses about two million tons of mostly imported coal, and is

not expected to become an important user of coal over the next two decades. Significant potential for development of coal in Sarawak exists, and Malaysia could eventually export a few million tons of coal per year. The substantial reserves of oil and natural gas are expected to meet most of Malaysia's energy requirements over the next two decades. The substantial resources of natural gas are expected to meet over two-third's of Malaysia's generation mix over the medium term (Pei, 1991).

Pakistan has very limited reserves of low quality coal and presently produces about 2-3 million tons of coal and consumes about four million tons per year. Plans are underway to build a major 4000 MW power plant burning imported coal. This will push consumption to 7-10 million tons by about 2000 and 12-16 million tons by 2010.

Vietnam has substantial energy resources of anthracite coal, oil and hydropower, and the potential for major discoveries of oil and natural gas. Present production of coal is about five million tons with a slightly under one million tons exported. Production is projected to expand to 10-14 million tons in 2000 and 16-24 million tons in 2010. These projections assume substantial foreign assistance in expanding coal capacity, and are subject to considerable uncertainty. Exports of 4 to perhaps 8 million tons of anthracite may be possible by 2010 depending on levels of foreign investment. Accelerated foreign investment is being promoted by the government to increase the rate of economic growth and exports, with particular attention to expanding exploration and development of its' oil and coal resources.

Conclusions

Asia's lower-income economies have high levels of growth in electricity demand, and most depend heavily on coal in their energy mix. China and India dominate this group. The focus of attention is on meeting the rapid growth in demand for electricity and improving efficiency in energy use. Emission control includes control of particulate emissions, and burning of low sulfur coal and high stacks in areas where sulfur levels are high. Heavy investments in FGD or Clean Coal Technologies is not anticipated by Asia's low income economies.

Asia's rapid growth middle income economies, particularly Hong

Kong, South Korea and Taiwan, are moving toward much tighter emission control regulations and are expected to install SO_2 control technologies on most future coal-fired power plants. These countries are also potential candidates for Clean Coal Technologies, particularly after 2000.

Japan stands in a class by itself as it already has some of the most stringent environmental regulations in the world, and has FGD technologies installed on most of its coal-fired power plants. In the Asian region, Japan is expected to become the first user of the new generation of Clean Coal Technologies. In addition, Japan is planning major expansions in technical and financial assistance to it's Asian neighbors in obtaining advanced energy technologies, including technologies to control coal-fired plant emissions. Japan is the most likely Asian economy to undertake a major program to reduce CO_2 emissions in the 1990s.

In general, Asian countries place heavy emphasis on sustaining rapid economic growth strategies, and are unlikely to adopt environmental strategies that would substantially decrease their economic growth rates in the 1990s. Coal is expected to continue to be the dominant energy option for Asia over the 1990-2010 period. The level of investments in environmental control technologies is generally related to the income level of the various Asian economies, with most investments occurring in the higher income economies.

References

1. Yunzhen, J., 1991, *Coal Development, Use Plans and Environmental Issues in China*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

2. Tang, R.K.K., 1991, *Hong Kong Steam Coal Consumption and Environmental Regulations*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

3. Aoki, S., 1991, *Coal and the Environment Asia 2010*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

4. Korea Energy Economics Institute, 1991, *Korea Energy Review Monthly April/May, 1991.*

5. Lee, W.W., 1991, *Recent Coal Situation and Outlook in Korea*, prepared for the Coal in Asia-Pacific Workshop 1990 held in Thailand.

6. Pei, C.S., 1991, *Coal as an Energy Resource in Malaysia*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

7. Bantugan, G.A., 1991, *Coal, Energy, and the Environment: Philippine Setting*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

8. Plueksawan, W., 1991, *Coal Use in the Electricity Sector of Thailand*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

9. Intarapravich, D., 1991, *Coal and the Environment in Thailand*, presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

10. Mannini, A. et al., 1990, IEA Coal Research, *World Coal Fired Power Stations.*

11. Energy Information Administration, 1991, *Annual Prospects for World Coal Trade 1991.*

12. Kim J.G., 1991, *Coal Use Plans for Republic of Korea: 1991 - 2006,* presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

13. Chuang, S.M., *Coal and Environmental Regulation for Taiwan Area,* presented at the Coal and Environment; Asia 2010 Conference, East-West Center, Hawaii.

SECTION 3

COAL PROJECTIONS FOR THE ASIA PACIFIC: 1990-2010

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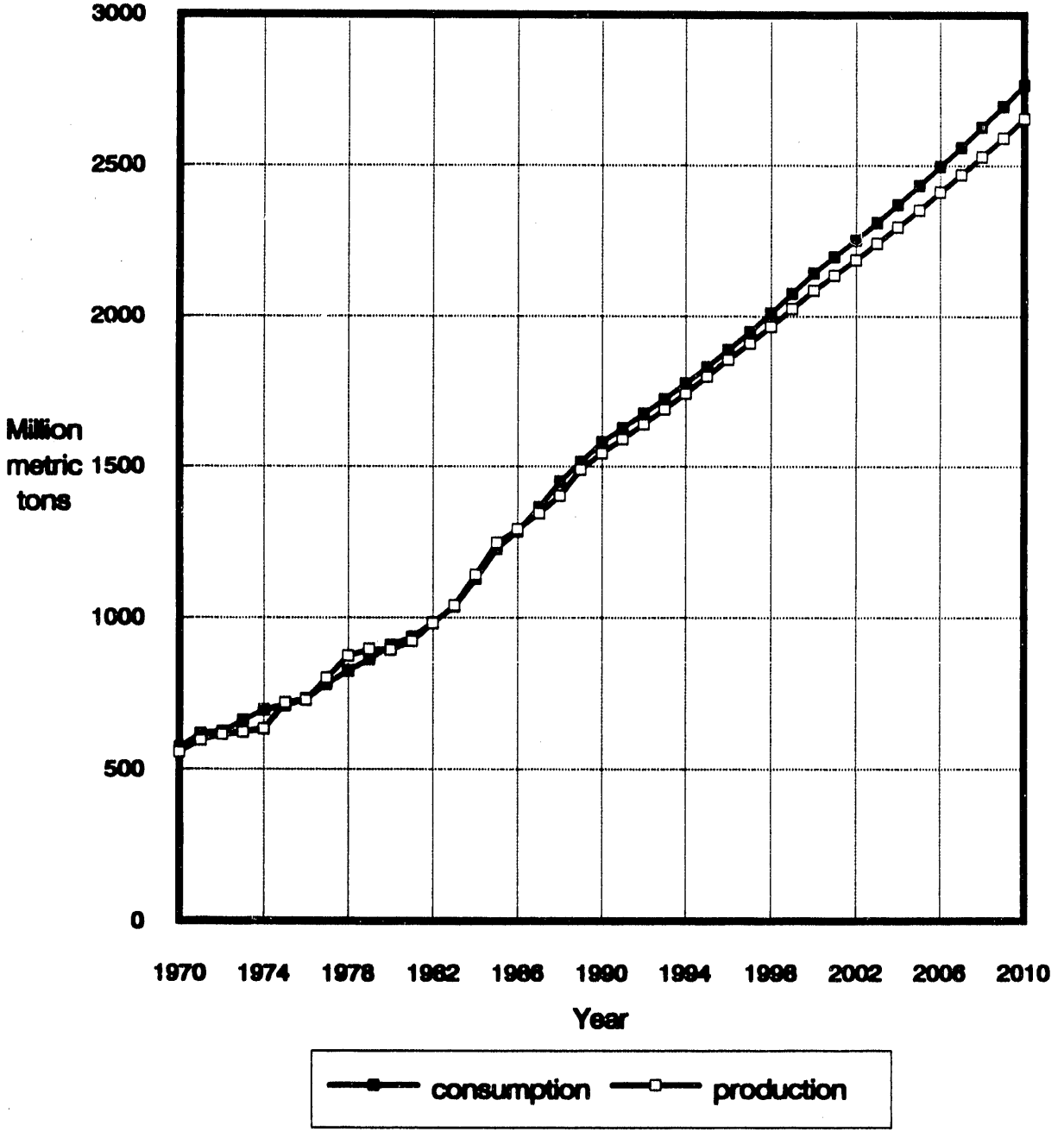
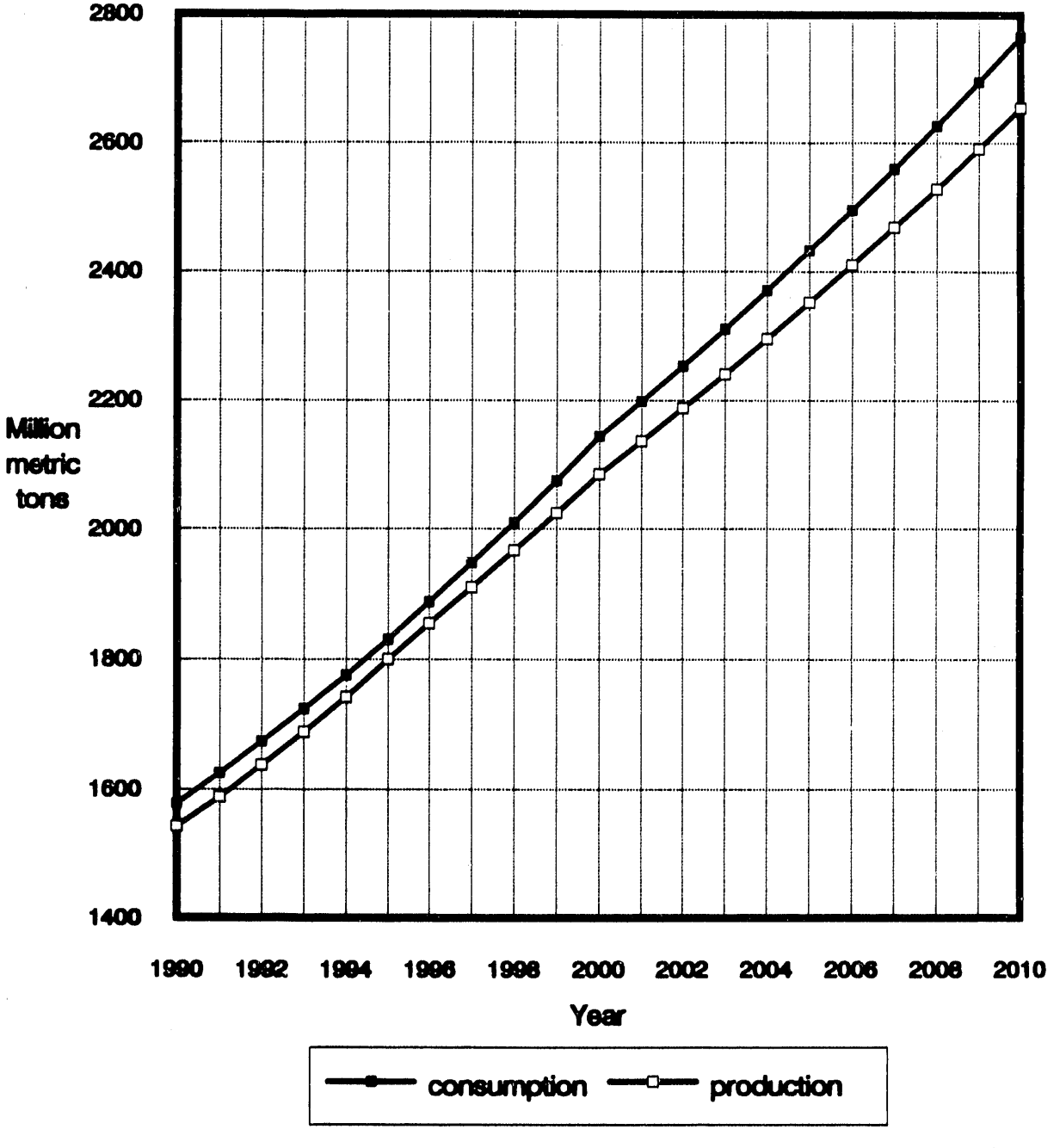
These estimates contain a substantial subjective element based on a range of technical, economic and political factors, and do not necessarily reflect projections by governments or other organizations. The Coal Project will update these projections periodically to include new information and analyses.

PRODUCTION AND CONSUMPTION OF COAL IN ASIA 1970 - 2010



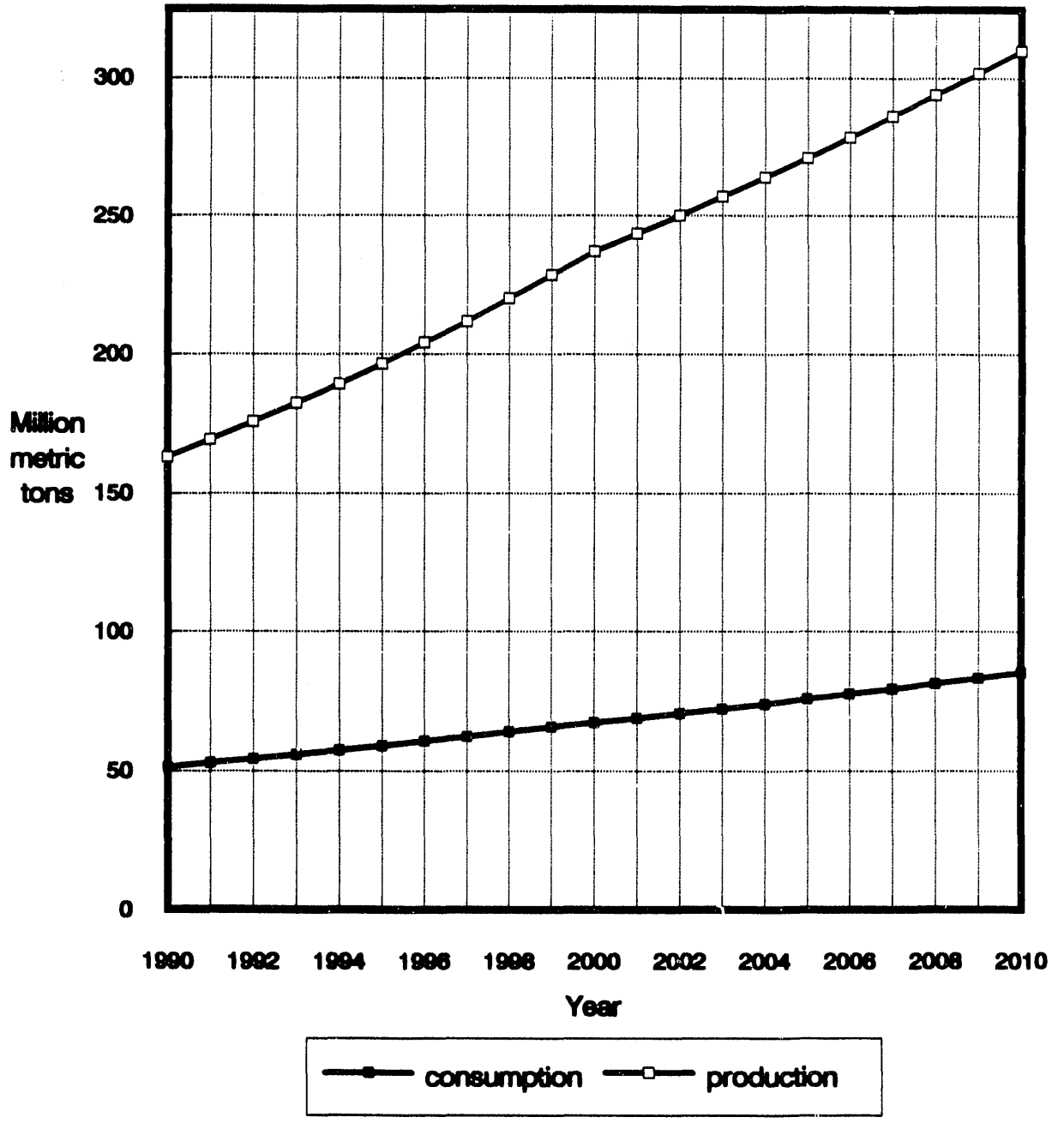
EWC Coal Project Estimates (11/19/91)

PRODUCTION AND CONSUMPTION OF COAL IN ASIA 1990 - 2010



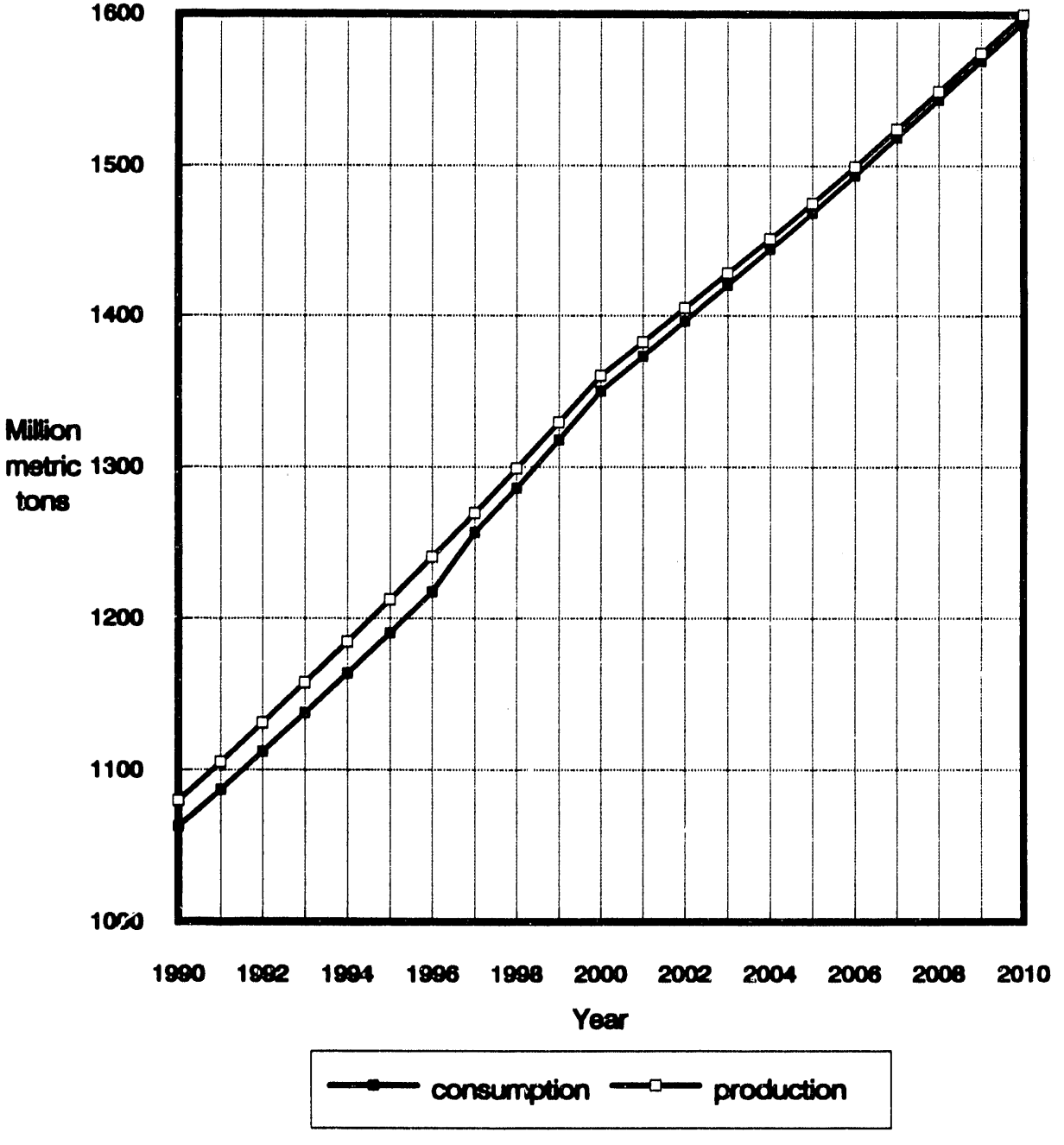
EWC Coal Project Estimates 11/19/91

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN AUSTRALIA



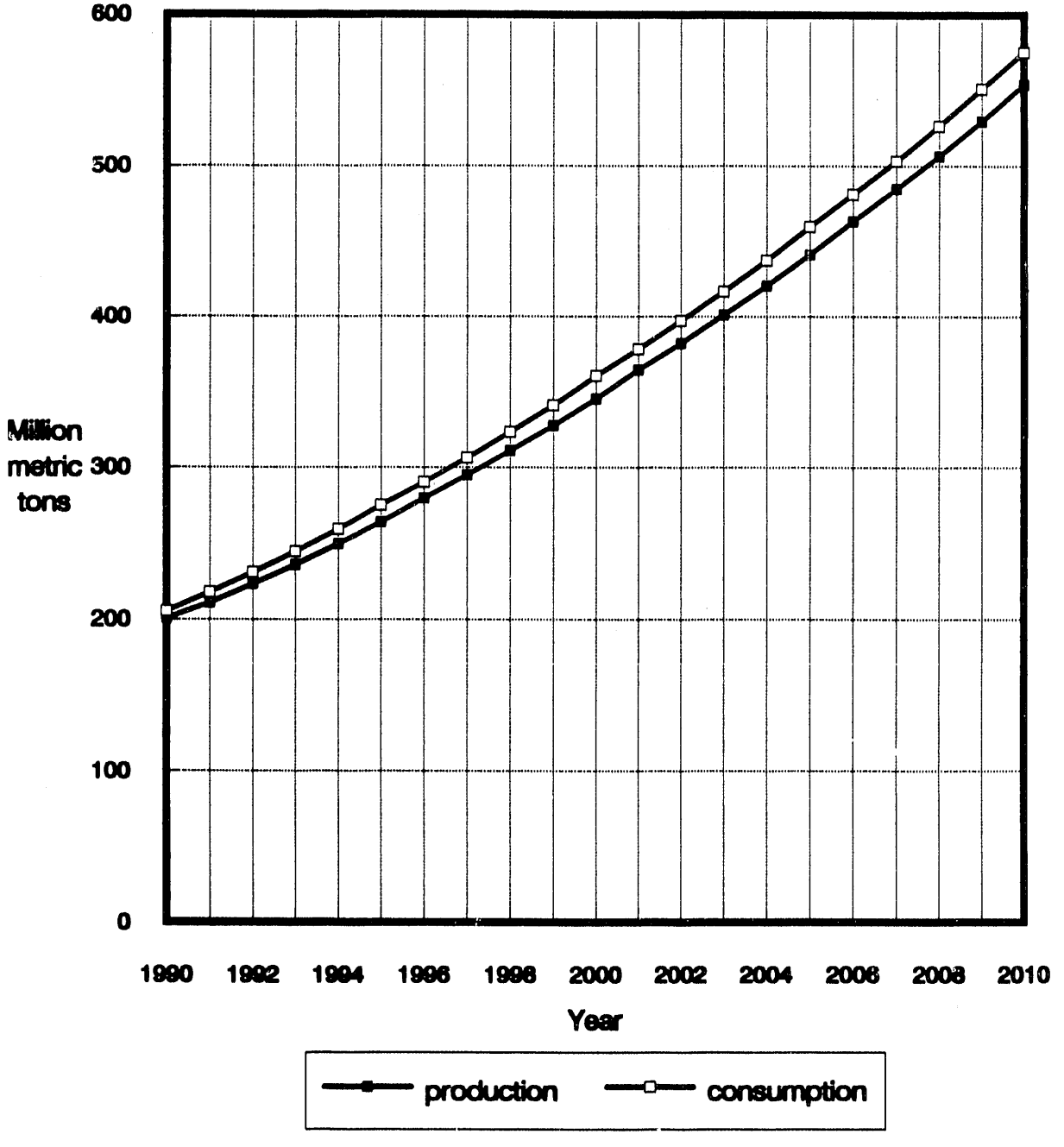
EWC Coal Project Estimates (11/19/91)

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN CHINA



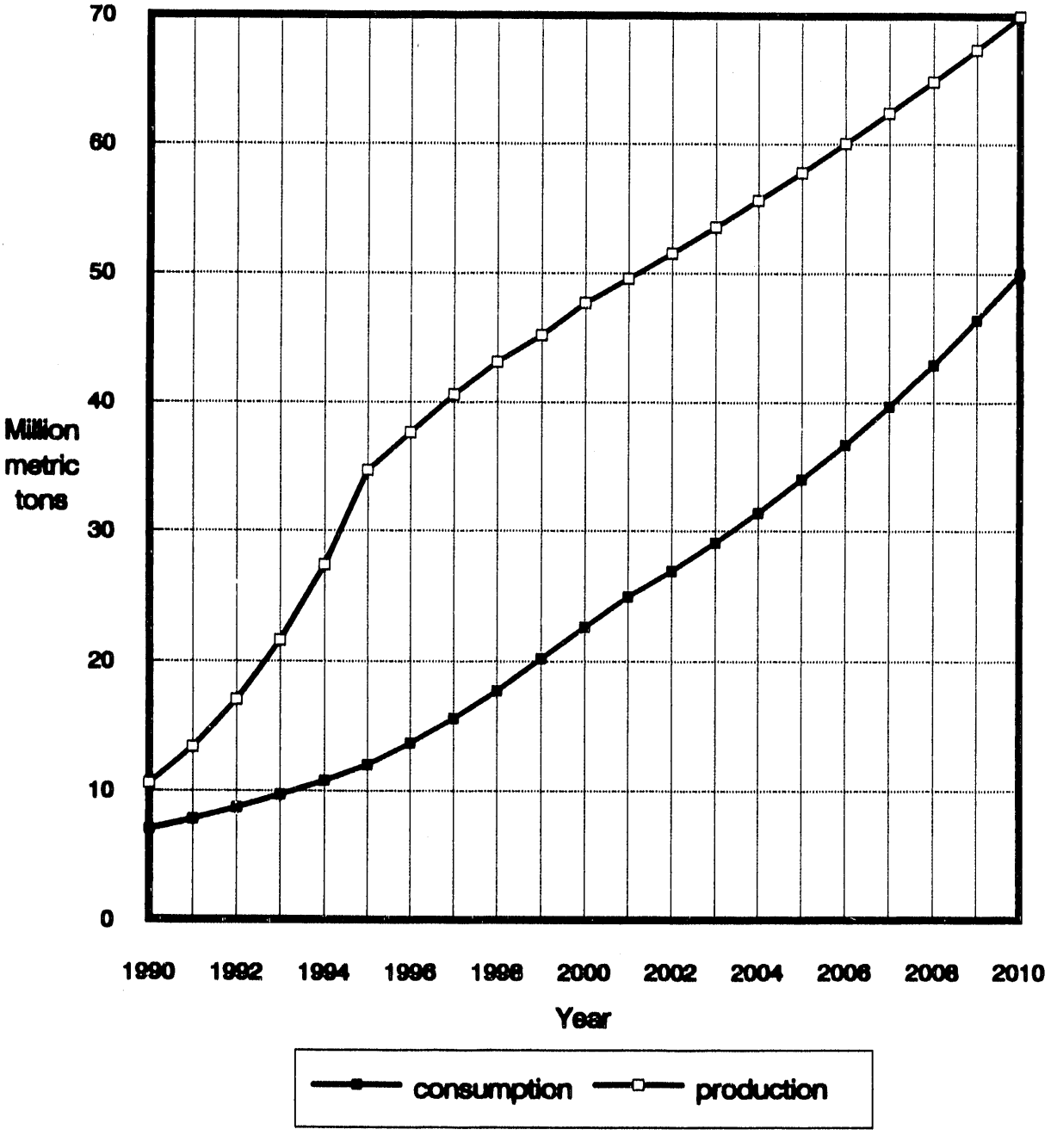
EWC Coal Project Estimates (11/19/91)

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN INDIA



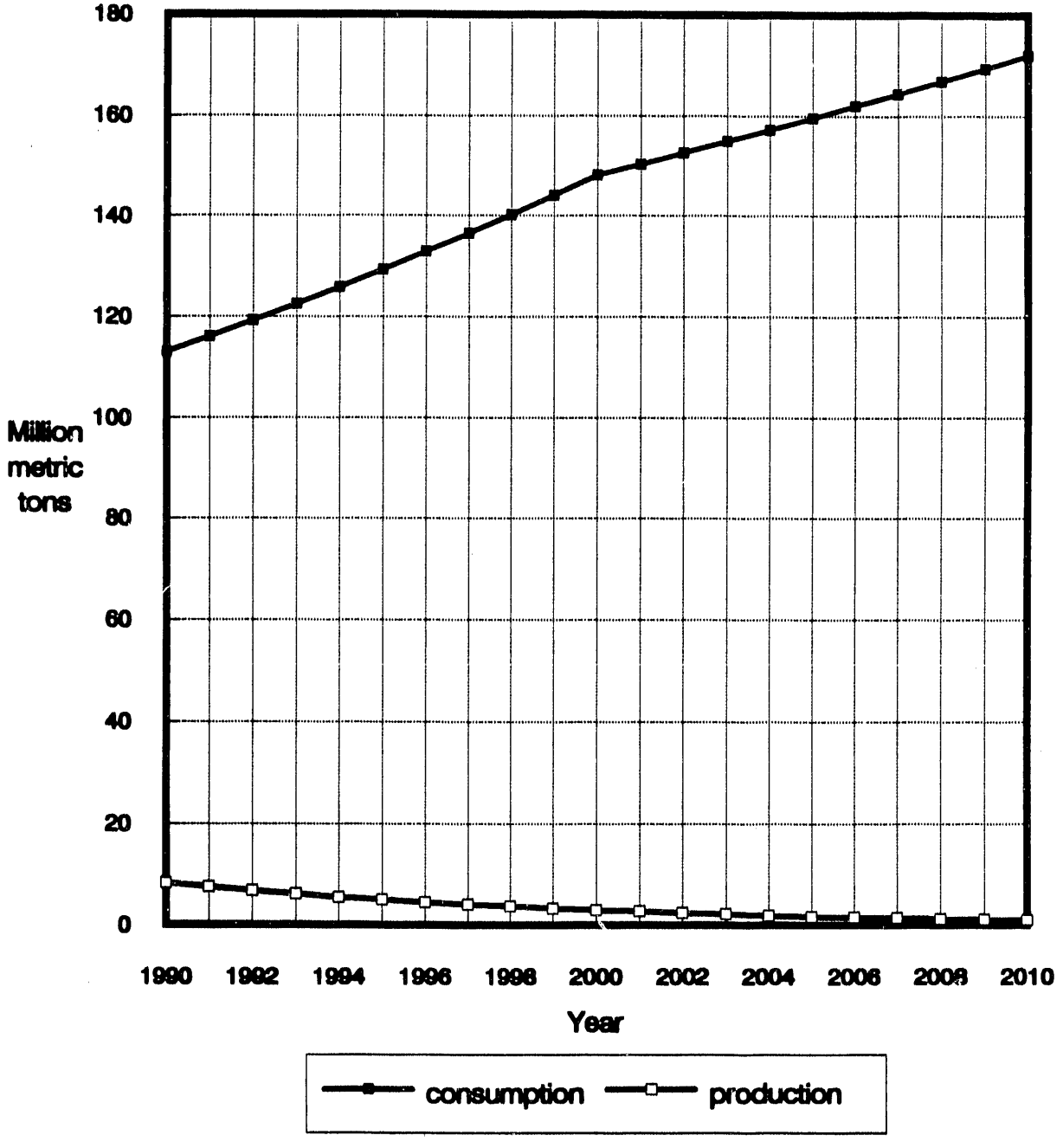
EWC Coal Project Estimates (11/19/91)

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN INDONESIA



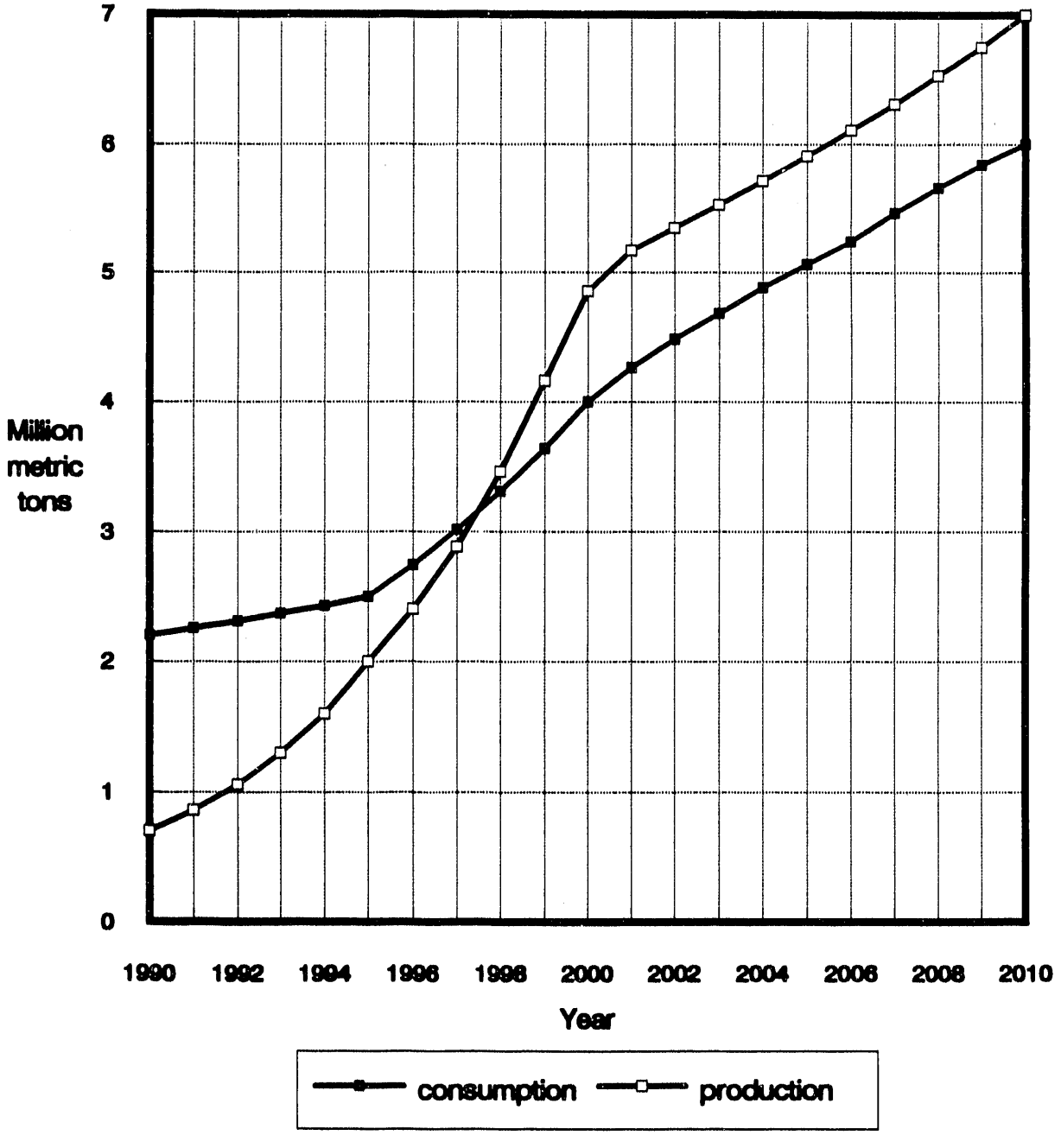
EWC Coal Project Estimates (11/19/91)

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN JAPAN



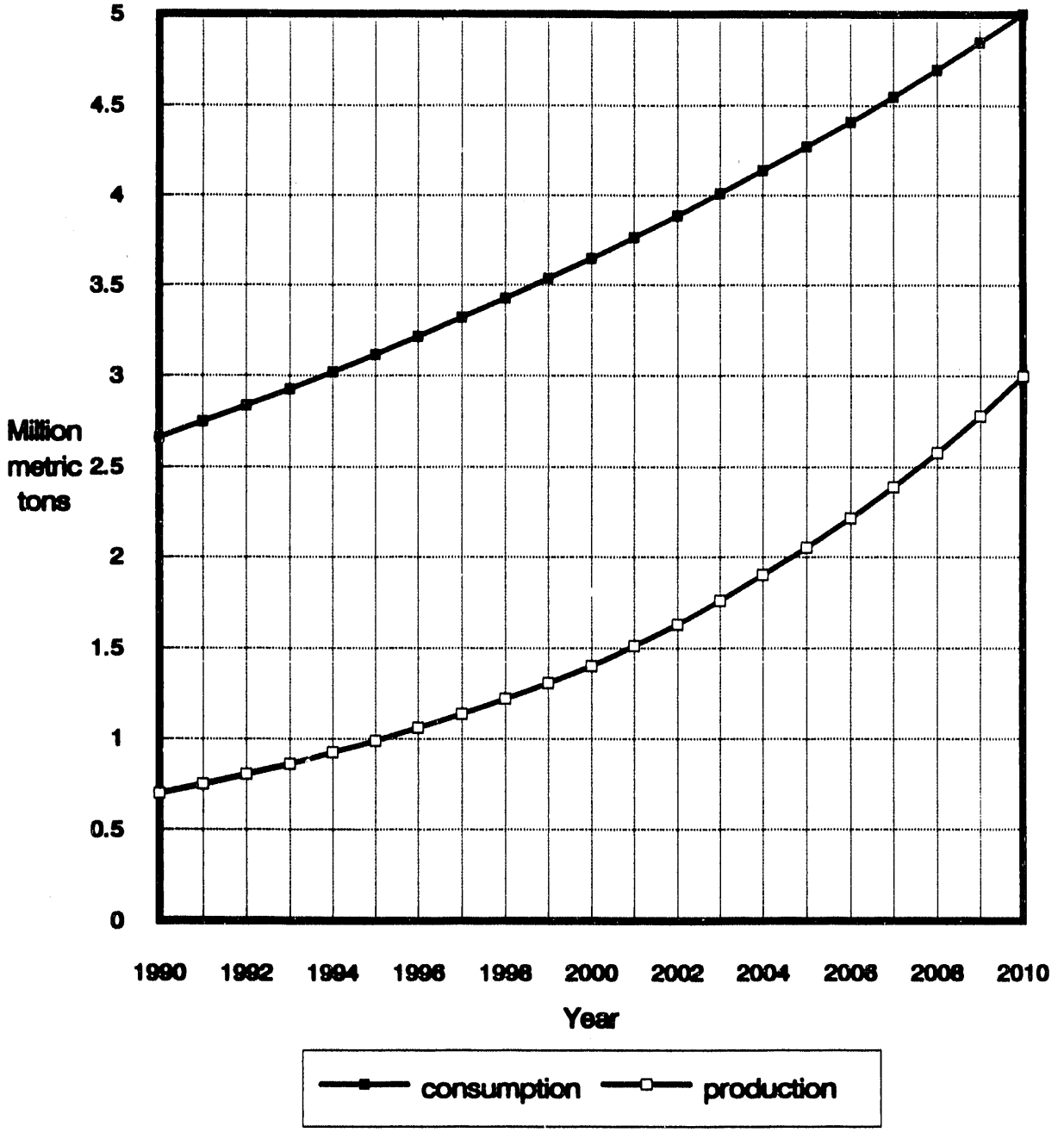
EWC Coal Project Estimates (11/19/91)

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN MALAYSIA



EWC Coal Project Estimates (11/19/91)

PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN MONGOLIA



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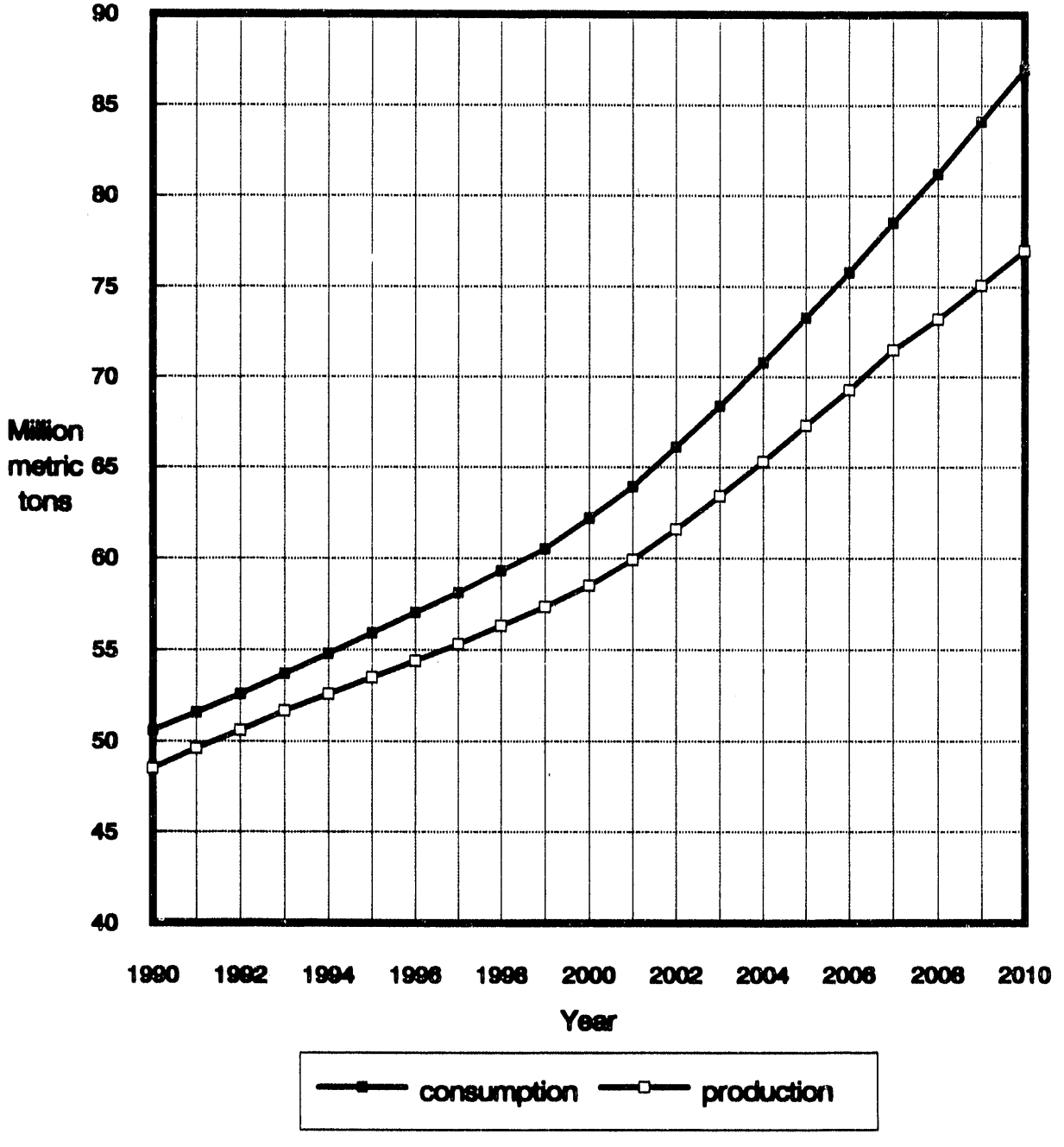
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN NORTH KOREA



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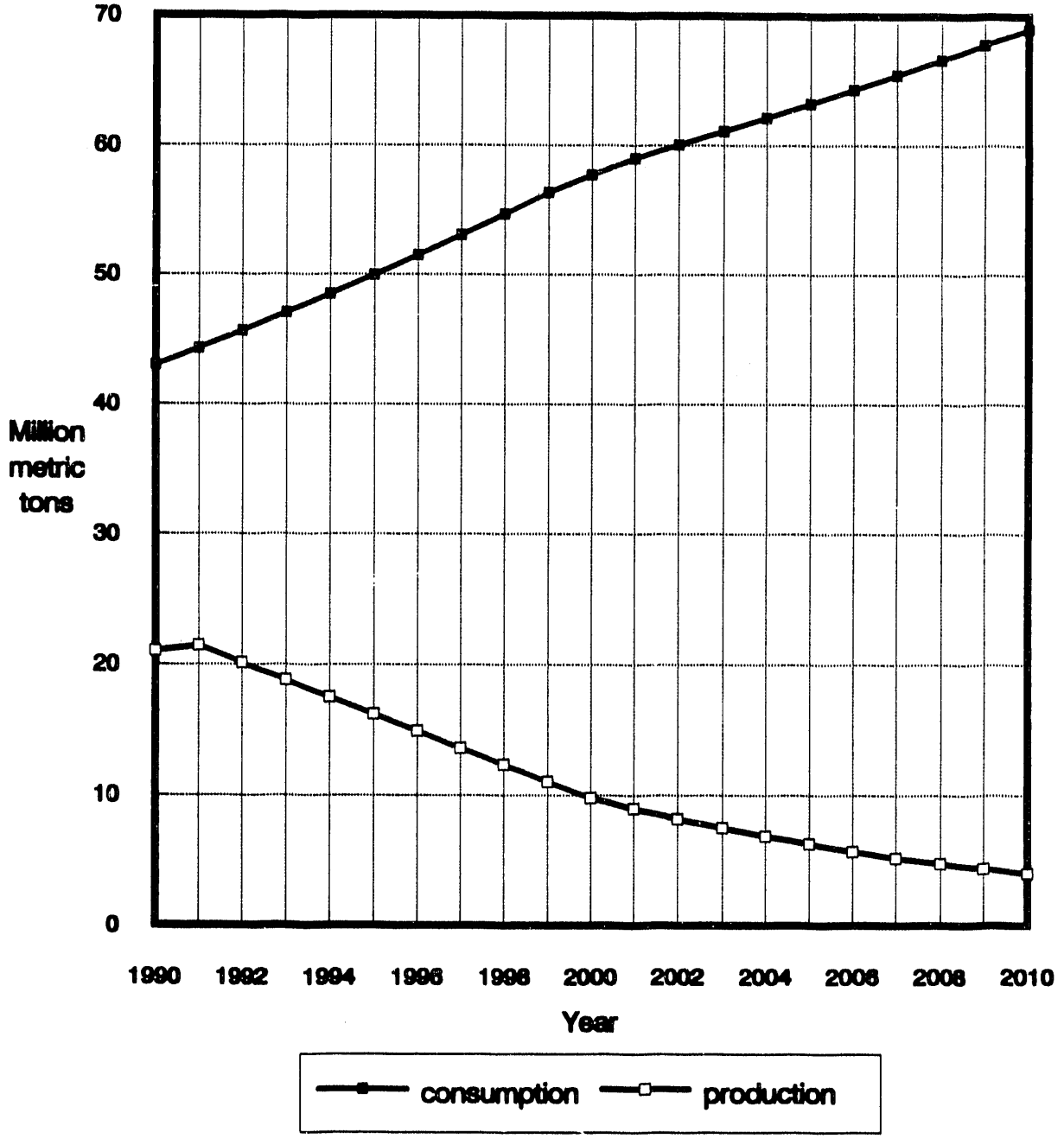
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN SOUTH KOREA



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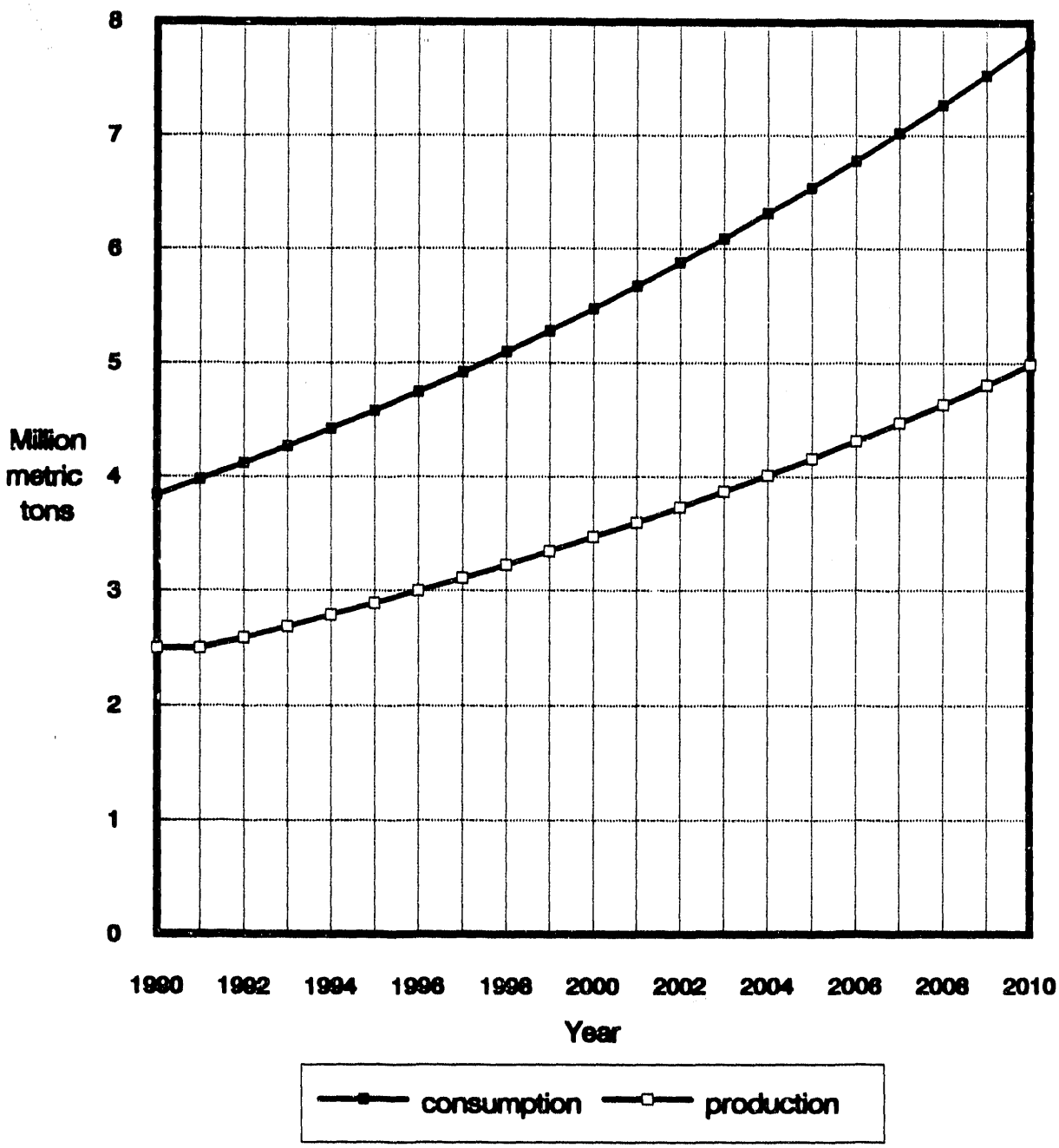
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN PAKISTAN



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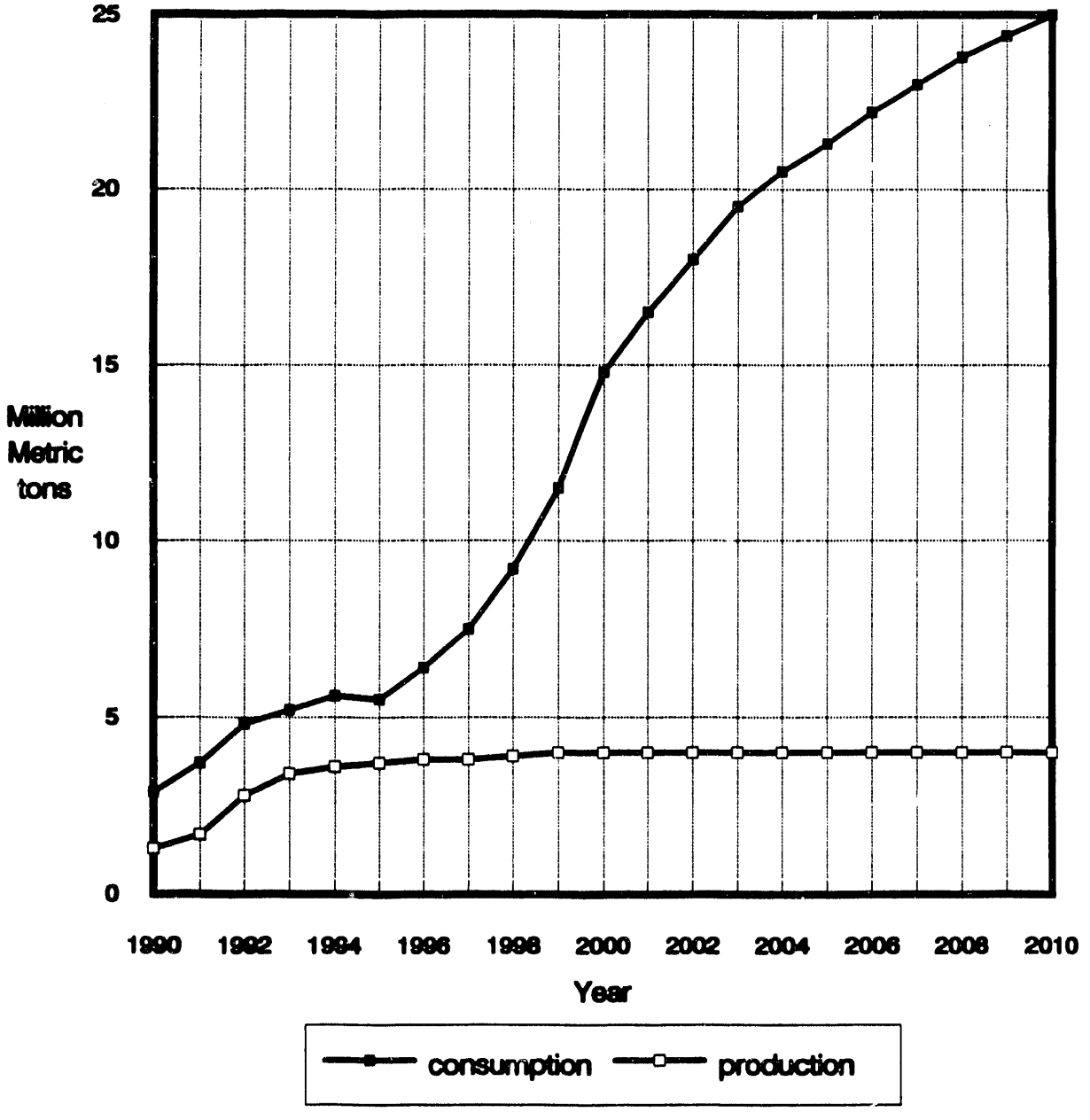
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN THE PHILIPPINES



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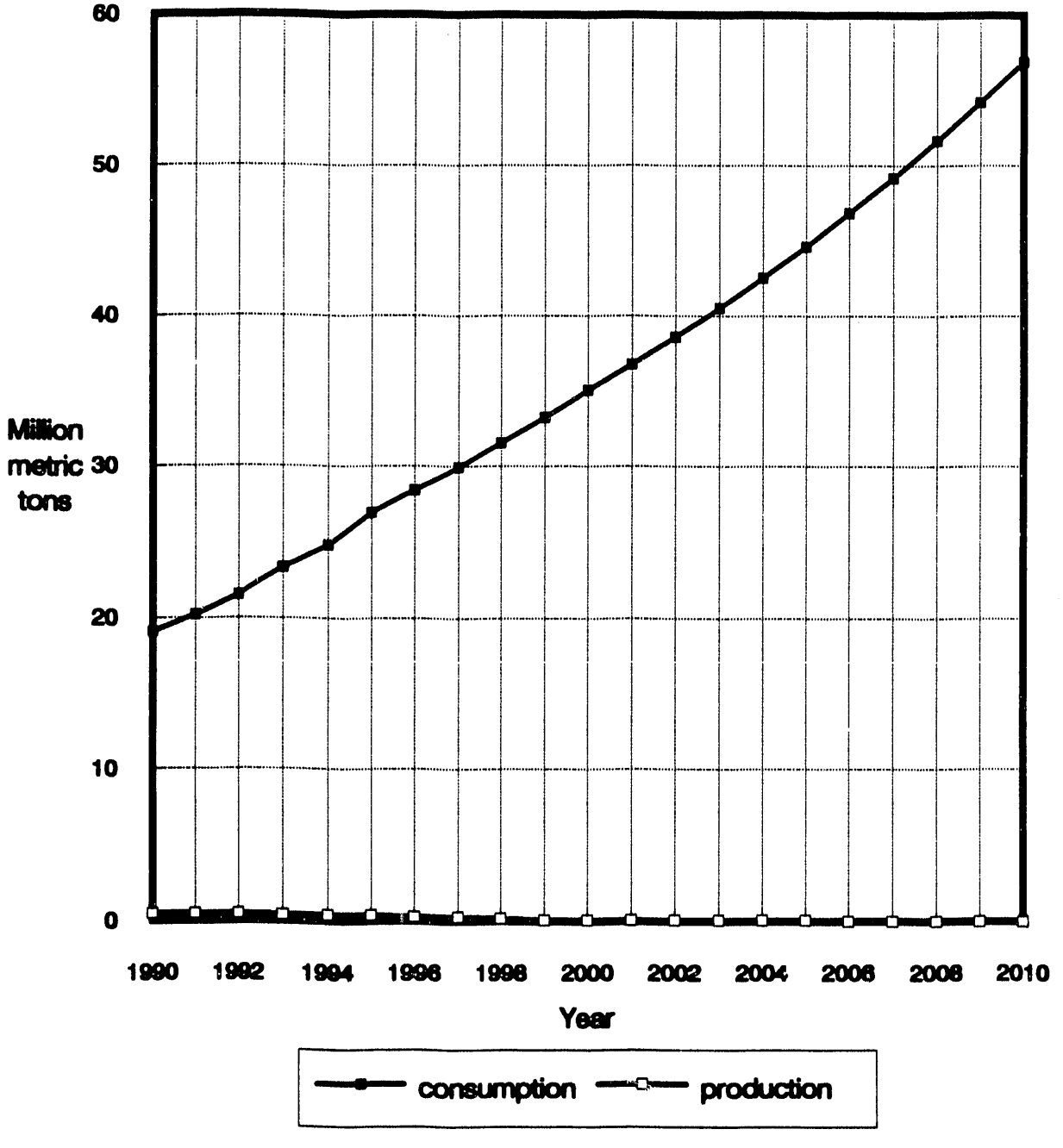
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN TAIWAN



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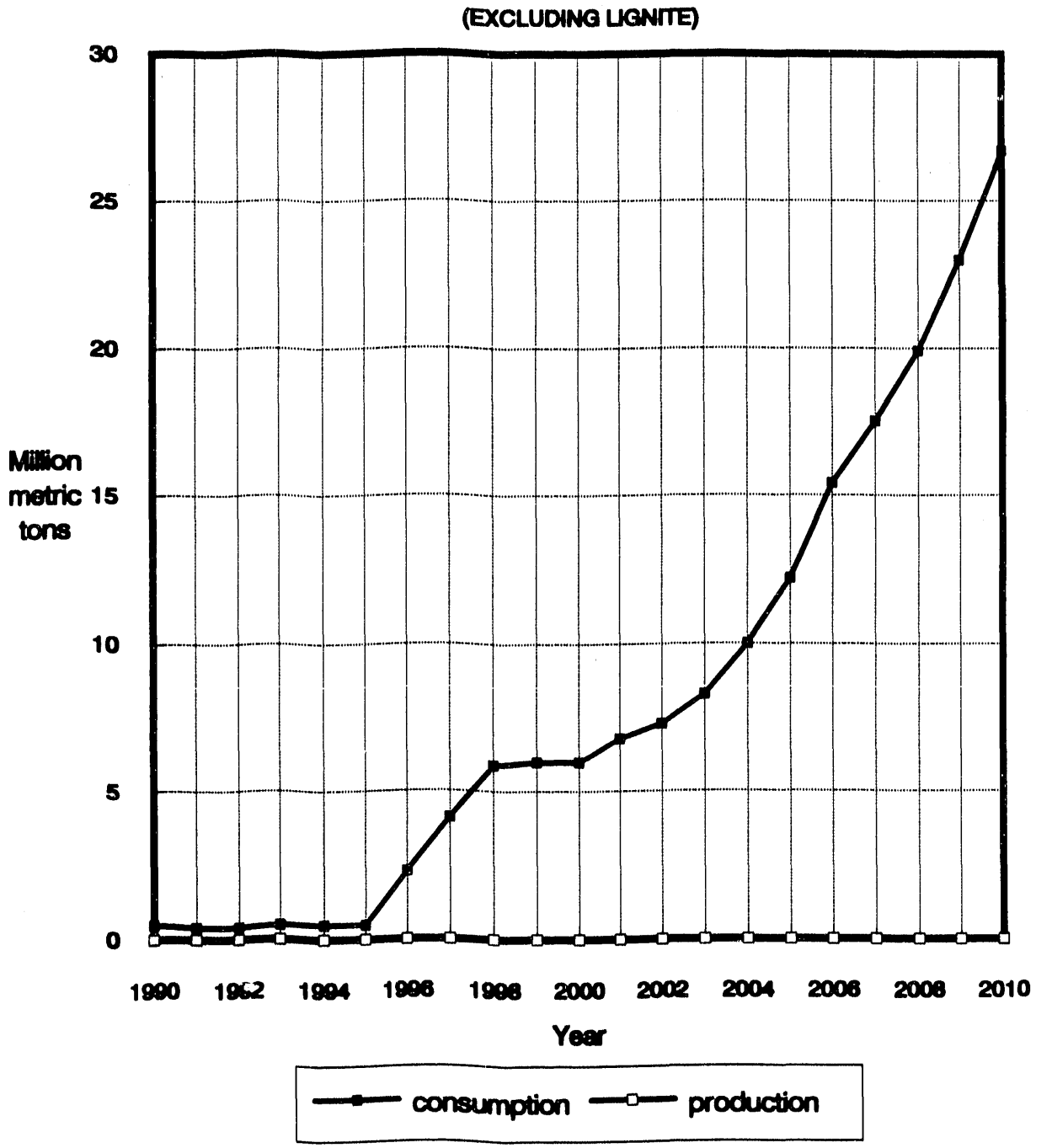
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN THAILAND



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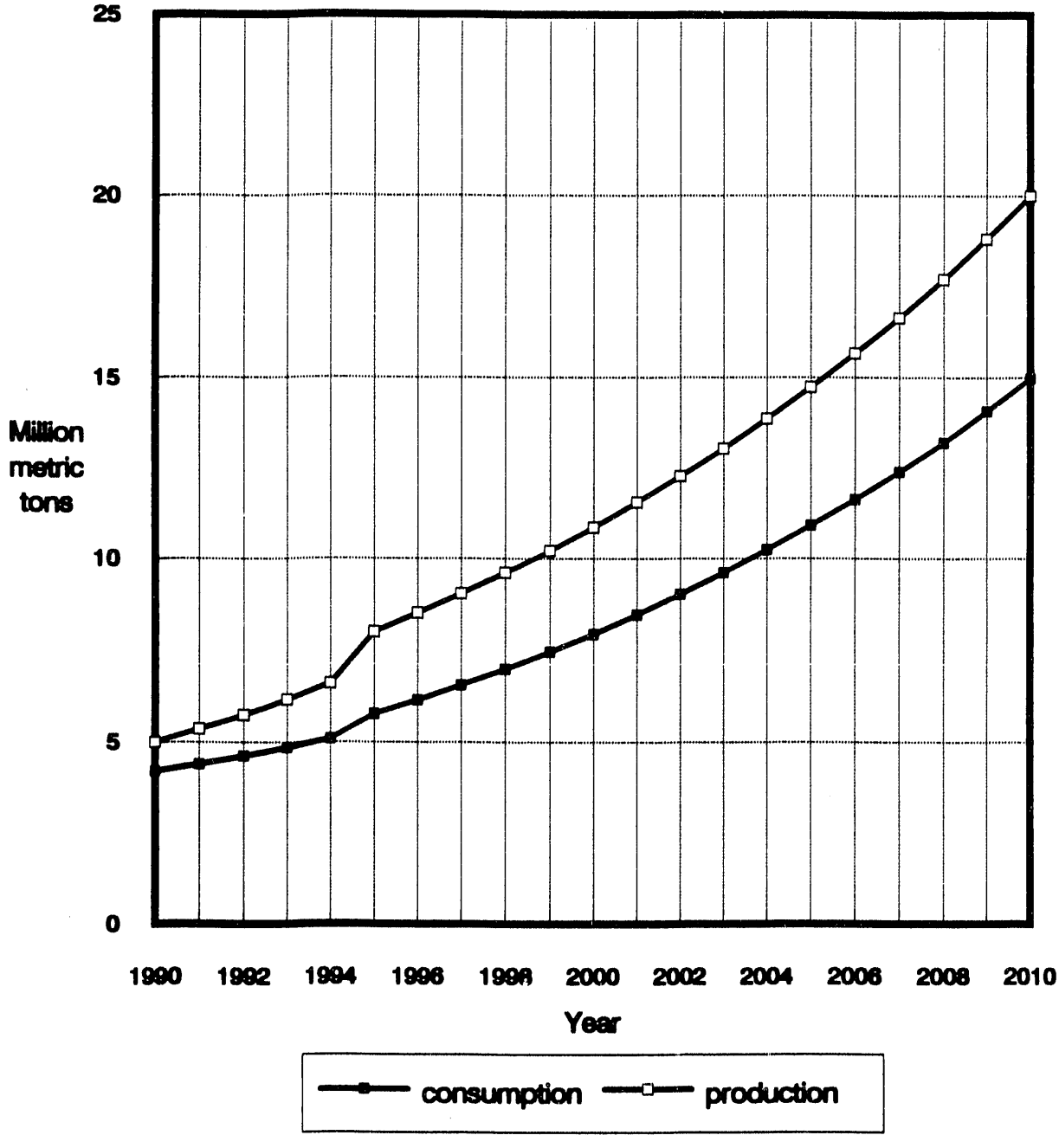
PROJECTED PRODUCTION AND CONSUMPTION OF COAL IN VIETNAM



EWC Coal Project Estimates (11/19/91)

SECTION 4

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November 6, 1991

Energy Advisory #80
Japan's Official Forecasts Underestimate Coal Consumption

1. Summary

- The Ministry of International Trade and Industry (MITI) projects total coal consumption of 142 million tons[1] in 2000 and 2010. These estimates appear to be low. Delays in nuclear power expansions are expected to result in total coal consumption of about 6 and 30 million tons above MITI estimates for 2000 and 2010 respectively.

- Japan's policy to promote diversification of sources of coal supplies and expansions in imports from Indonesia will have only modest long term impacts on the share of imports from Australia which is expected to continue to account for 45-55 percent of coal imports over the next two decades.

- Coal production from Japan's domestic high cost coal mines is projected to decline rapidly in the 1990s from 8 million tons in 1990 to no more than 3 million tons in 2000, and 1 million tons in 2010. Political and not economic considerations appear to be most important in the rate of decline of domestic coal production.

- All growth in coal consumption in Japan is for thermal coal which will increase its share of total coal consumption from 40 percent in 1990 to 64 percent in 2010.

- Increased U.S. steam coal imports in the 1990's are expected to more than offset decreases in U.S. coking coal imports.

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[1] tons = metric tons

- Japan's energy policies are shifting toward active participation in international efforts to effectively address global warming issues. This is expected to result in Japan favoring stronger international action on environmental controls, and commitments from industrialized countries to provide more financial assistance to developing countries in meeting their energy and environmental problems.

- Japan's strategy to stabilize domestic greenhouse gas emissions after 2000 relies heavily on nuclear power and energy conservation. Nuclear power expansions are projected to fall substantially below MITI goals for 2000 and 2010. Therefore, conservation (increased energy efficiency) could play a more prominent role in Japan's energy policies.

- Japan is likely to greatly increase it's share of aid to Asian countries in developing and using the energy resources of the Asian region, with coal and coal technologies receiving a larger share of energy related aid. A Clean Coal Technology Center is planned to promote the development and transfer of these technologies to developing countries, including China, in cooperation with industry.

2. Energy Sector Organization

- MITI, through its Agency for Natural Resources and Energy, is the government's main policy and planning body with respect to energy planning.

- MITI consults closely with industry in developing energy forecasts and in long term planning, and industry commonly refers to these forecasts in published papers. However, MITI forecasts are generally considered by industry as "goals" not "requirements", and individual company forecasts may vary considerably from official forecasts.

- MITI provides substantial research funds for the development and improvement of various energy technologies. Consortiums of Japanese companies are usually involved in major R & D projects on energy technologies. MITI's coal technology R & D programs are broadly split between more conventional technologies through the Electric Power Development Company (EPDC) and longer term technology developments through the New Energy Development Organization (NEDO).

- The size of the Japanese R & D program on new coal technologies is much smaller than the present R & D program in the United States. However, Japanese executives believe this apparent disadvantage is offset by: (i) their more "practical" approach to development and introduction of new energy and emission control technologies, (ii) differences in "administrative culture", (iii) a shorter period for assessments, (iv) the ability to more readily pass costs of new technologies on to electricity consumers, and (v) the willingness of Japanese companies to acquire and exchange technologies. As part of Japan's "Green Aid Program", A Clean Coal Technology Center is planned for 1992 to promote CCT development and transfer to developing countries, including China, in cooperation with industry.

3. Energy Sector

- Figure 1 shows the energy mix in Japan for 1973 and 1990. The most pronounced change has been the decline in oil's share of the energy mix from 78 percent in 1973 to 58 percent in 1990. LNG and nuclear power account for the largest growth in energy shares over the period, increasing their combined share of total energy from 2 percent in 1973 to 19 percent in 1990.

- The growth in coal consumption has averaged a modest 2.0 percent per year over the 1973-1990 period, increasing its share of total energy from 15 percent in 1973 to 17 percent in 1990. The small change in the share of energy held by coal is misleading because it is the result of divergent trends for coking and steam coal. Coking coal consumption stagnated, but steam coal consumption has grown at 7.2 percent per year since 1973.

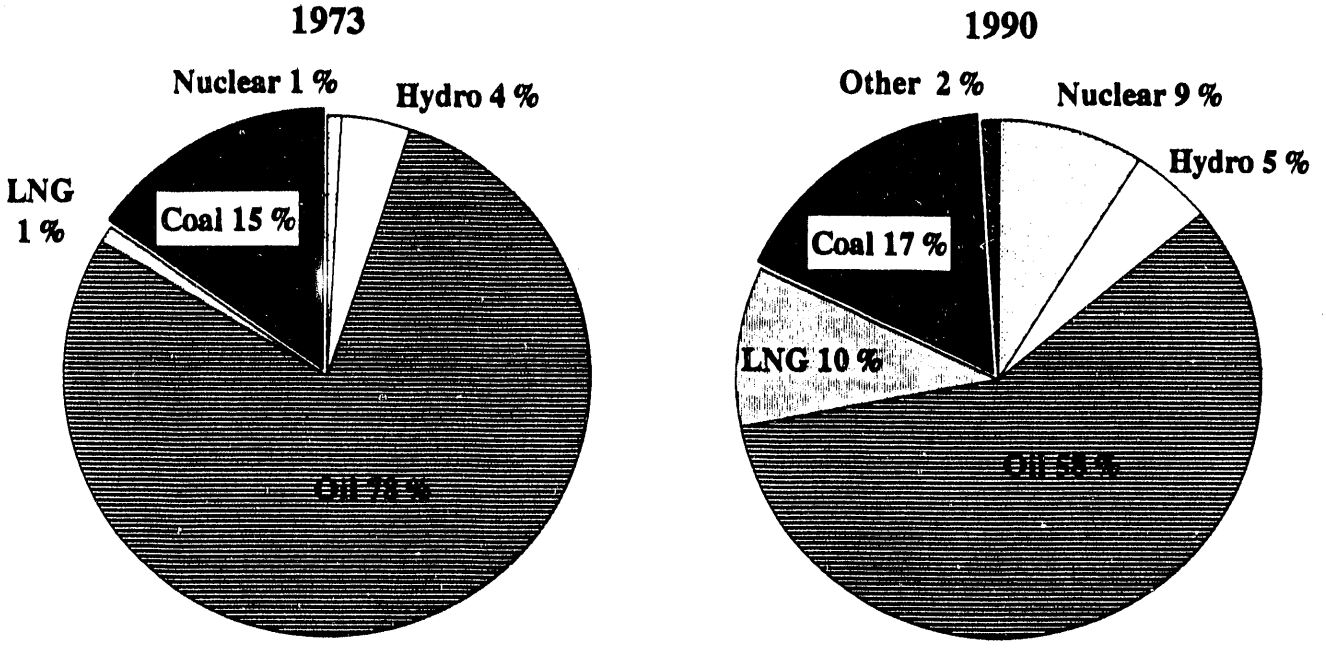

Figure 1. Japan's primary energy mix in 1973 and 1990.
Source: Energy in Japan, 1990, 1991.

- MITI studies indicate that nuclear power is the lowest cost electricity source, plus it is the lowest contributor to green house gases per kWh. However, local opposition to nuclear power plants, and high capital costs are expected to cause nuclear power expansions to fall substantially below MITI projections for 2000 and 2010. MITI projections are for an average increase of about 2000 MW of nuclear power per year between 1990 and 2010.

- LNG is the cleanest burning fossil fuel, and consumption will continue to expand during the 1990s. However, LNG growth is expected to be constrained by the following: (i) capital investments are large, (ii) the cost per unit of energy is high, (iii) there is limited scope for diversification of supplies, and (iv) significant safety risks, particularly in Japan's already congested harbors.

4. Coal Sector

- MITI projects coal consumption in Japan to increase from 113 million tons in 1990 to stabilize at 142 million tons in the 2000-2010 period. The leveling off in coal consumption after 2000 would allow Japan to meet its greenhouse gas emission goals. However, MITI's projections appear optimistic, and we believe a more likely scenario is for consumption of about 145-150 million tons in 2000 (best estimate 148 million tons) increasing to 160-180 million tons in 2010 (best estimate 172 million tons).

- The primary reason that consumption of coal is expected to be higher than projected by MITI is their optimistic forecast for nuclear power expansions. MITI projects an increase of 40,000 MW of new nuclear capacity between 1990 and 2010 or about 2,000 MW per year.

- In our projections we assume that nuclear power capacity will fall substantially below MITI projections in 2000 and 2010. We assume that increased thermal coal use will account for the majority of the nuclear capacity shortfall with the remainder split between oil and LNG. Our estimates for 2000 and 2010 are in the same range as the internal estimates of some major Japanese corporations.

- Table 1 shows steam and coking coal consumption in 1990, with our projections for 2000 and 2010. Steam coal's share of the total is expected to increase from 40 percent in 1990 to 59 and 67 percent in 2000 and 2010 respectively. It is important to emphasize that there is considerable uncertainty about the projected decline in consumption of coking coal over the 1990-2010 period.

Table 1
COAL CONSUMPTION IN JAPAN: 1990-2010
(Million tons)

	1990	2000	2010
Steam Coal			
Utility	27	62	83
Other	18	26	32
Steam Coal Total	45	88	115
Coking Coal Total	68	60	57
Total Coal	113	148	172

Johnson and Long, October, 1991.

- Japan has maintained a long term policy to promote diversification of sources of coal supplies. However, the share of coal imported from Australia gradually climbed to 52 percent in 1989 and 1990. Expansions in imports from Indonesia, China, South Africa, and The United States may reduce Australia's share to 45-50 percent in the mid -to late- 1990s. However, there is little economic basis to support arguments for Australia's share of imports to decline below 45 percent (except perhaps temporarily) during the 1990 to 2010 period.

- A recent study from Japan's Institute of Energy Economics forecasts a decline of about 50 percent in steaming coal capacity from existing mines in Australia by 2000 as known reserves are depleted. The report concludes that major investments in new capacity are necessary, however notes that investments in new capacity are small at present. The Japanese concern appears to be that insufficient investment in new capacity will lead to shortages in supplies and higher coal prices. Our view is that it does not follow that depletion of existing reserves indicates a serious erosion of Australia's long term competitive position because of their roughly 30 billion tons of recoverable coal reserves. The key issues are timely investments in new capacity, and a continuation of the trends of the 1980s to increase productivity, reduce rail transport and port handling costs, and improve labor practices.

- The expected decline of perhaps 2-4 million tons in U.S. coking coal exports to Japan in the 1990s will probably be more than offset by increases of 5-10 million tons in U.S. steam coal imports.

- A major component of Japan's strategy to promote economic development in Asia is assistance in the development and use of Asia's indigenous energy resources. Through the "Coal Flow Initiative", industry, with government financial support, is expected to greatly increase assistance to Asian governments in coal mine developments, transport and use of coal, including emission control technologies.

- Japanese coal and related environmental assistance in Asia has the potential to become one of Japan's largest development program areas in the 1990s. The Japanese government is in the process of establishing a Clean Coal Technology Center to promote development and transfer of these technologies to developing countries, with particular interest in China.

- The domestic coal industry is not competitive with imported coal and is in decline, with the rate of decline determined primarily by political and not economic considerations. Production declined from 18 to 8.3 million tons in 1980 and 1990 respectively, and is projected to decline to 3 and 1 million tons in 2000 and 2010.

- There is concern in Japan that the disappearance of a domestic coal industry will be accompanied by loss of coal mining skills, and technical innovations in coal mining. However, the decline in importance of Japan's domestic coal industry is more than offset by Japanese equity involvement in foreign coal projects.

- Considerable research has gone into developing Coal Water Mixtures (CWM) and Coal Oil Mixtures (COM) to allow greater ease in transporting coal in congested areas. This research has produced technical successes, however unless there is a substantial (unexpected) increase in conventional coal prices, both of these options will remain marginal and account for a small fraction of coal movements in Japan. China appears to be the most likely developing country to introduce CWM on a limited scale.

5. Environmental Issues

- Japan has followed an aggressive program in adopting emission control technologies since the mid-1970s. Japan embarked on a program to introduce Flue Gas Desulfurization (FGD) in the 1970s, and today 90 percent of Japan's coal-fired power plants have FGD -- the highest percentage among major coal consuming countries. About 70 percent of Japan's coal-fired capacity have denitrifying systems, and all plants have high efficiency ash removal systems.

- Japan had unacceptable SO_2 levels in the mid-1970s, and chose a "practical" approach, moving ahead with the installation of FGD and passing costs onto consumers. Japan embarked on this strategy before utilities in most other industrialized countries believed such investments were justified. The early adoption of this strategy to control sulfur emissions has made Japan the world leader in reducing sulfur emissions from its coal-fired power plants. However, the ease with which environmental costs have been passed on to consumers may have contributed to higher electricity prices in Japan than in other industrialized countries.

- In recent years, MITI planners have become active in addressing the global warming issue, and are beginning to take an active role among industrialized countries in discussions about controlling CO_2 and other greenhouse gas emissions. In order for Japan to maintain a credible position on global warming issues, it will probably increase its efforts to control domestic CO_2 emissions. This strategy is expected to result in increased efforts to improve efficiencies in electricity generation, emission control, development of new technologies and policies to encourage energy conservation, and the transfer of these technologies to developing countries.

Acknowledgments: The authors wish to thank the generous assistance of MITI officials, Japanese industry representatives and Japanese research institutions for providing energy information and views that have been used in this advisory. Any errors and omissions should be attributed to the authors.

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November 5, 1991

Energy Advisory #79
Coal's Share of Thailand's Total Energy to Almost Triple by 2010

1. Summary

- Thailand is expected to rapidly expand lignite consumption from about 13 million tons in 1991 to 33 million tons in 2000, and reach 45-50 million tons by 2010.

- Imported coal is expected to increase rapidly from under half a million tons today to 6 million tons in 2000 and about 27 million tons in 2010.

- Indonesia has a comparative advantage from both an economic and political perspective to become an early supplier of coal, but Australia is likely to become the leading supplier by abc.. 2005. Vietnam may become a modest supplier of anthracite for industrial uses.

- Long term projections of domestic lignite consumption appear to underestimate the potential constraint posed by environmental problems. The high 3.7 percent sulfur content of most of Thailand's lignite is equivalent to an exceptionally high 7-10 percent on a standard ton coal equivalent basis.

- The high level of SO_2 emissions from lignite burning is expected to result in requirements for FGD or other control measures on most future lignite fired electricity plants, and will probably increase interest in Clean Coal Technologies.

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- Even though lignite accounts for only 12 percent of Thailand's primary energy consumption, it contributes almost half of the country's sulfur oxide emissions. The rapid expansion of high sulfur lignite consumption in the 1990s is expected to increase coal's share of total sulfur emissions to more than two-thirds by 2000.

- Thailand's electricity sector has been growing at almost 15 percent per year, among the fastest in the world. Even with the expected moderation to a 7-8 percent growth rate in the 1990s, 800-1,000 MW of additional capacity will have to be added each year during the next decade.

- There is substantial potential for pipeline import of natural gas to Thailand from large reserves in Indonesia, Malaysia, Myanmar and possibly Vietnam. Imports may occur in the late-1990s, however are projected to begin in the 2000-2005 period and reach the equivalent of about 10 million tons of coal per year in the 2005-2010 period.

- The discovery and development of Thailand's lignite/subbituminous coal potential is constrained by government's policies and procedures toward private sector exploration and coal development.

2. Energy Sector Organisation

- The senior energy policy committee in government is the National Energy Policy Committee (NEPC) under the cabinet. The NEPC approves projects for the various energy agencies. Other agencies include: (i) the National Economic and Social Development Board (NESDB), under the Office of the Prime Minister, that ensures energy investment plans of state enterprises are in line with national energy policies; (ii) the National Energy Agency, under the Ministry of Science, Technology and Energy, to promote energy conservation and development of renewable resources, and (iii) the National Energy Policy Office (NEPO) to coordinate with energy organizations, and to conduct energy policy research.

- The state enterprises responsible for Thailand's electricity supplies are the Electricity Generating Authority of Thailand (EGAT), the Metropolitan Electricity Authority and the Provincial Electricity Authority. EGAT dominates the electric utility sector, generates all of Thailand's electricity, and distributes electricity throughout most of Thailand. EGAT is also Thailand's largest producer of lignite at it's Mae Moh mine in northern Thailand. EGAT has the primary responsibility for the exploration and development of lignite for electricity generation, and the National Energy Administration (NEA) is

responsible for industrial uses and contracting with private mines to develop mines.

- The Petroleum Authority of Thailand (PTT) is the primary state enterprise responsible for the purchase, transport, processing and sale of oil and natural gas.

- The Department of Mineral Resources (DMR) has the dual responsibilities of granting licenses to companies for coal exploration and mining, and in undertaking coal exploration and evaluation. There is a need to more clearly define and limit the role of DMR, and to implement exploration policies and procedures that are compatible with modern coal exploration practices of private companies.

- The primary environmental agency is the Office of the National Environmental Board (ONEB) which is responsible for environmental protection throughout the country. ONEB oversees Environmental Impact Assessments (EIAs) for all coal mines, and also establishes air and water quality standards.

3. Energy Sector

- Figure 1 compares the energy mix in Thailand in 1990 with our estimate of the mix in 2010. Over the 1990-2010 period, petroleum's share of energy is projected to decrease from 66 to 55 percent; natural gas is projected to decrease from 18 to 15 percent; and coal and lignite combined are expected to jump from 12 to 30 percent. Domestic supplies of oil, natural gas and coal presently account for about 40 percent of total energy requirements. Oil accounted for almost all of the energy imports in 1990. Domestic production of oil, gas and hydropower resources are expected to peak in the late-1990s. The growth in lignite production will slow after the year 2000 when the largest known deposit at Mae Moh reaches maximum capacity.

- We project major imports of gas by pipeline from neighboring countries after 2000. Malaysia, Indonesia and Myanmar (Burma) have large gas reserves that have been considered as future sources of imports to Thailand. In addition, Thailand and Vietnam have recently had discussions on joint exploration and development of a highly gas prone disputed offshore area in the Gulf of Thailand. Prospects appear favorable for reaching an agreement in the near future.

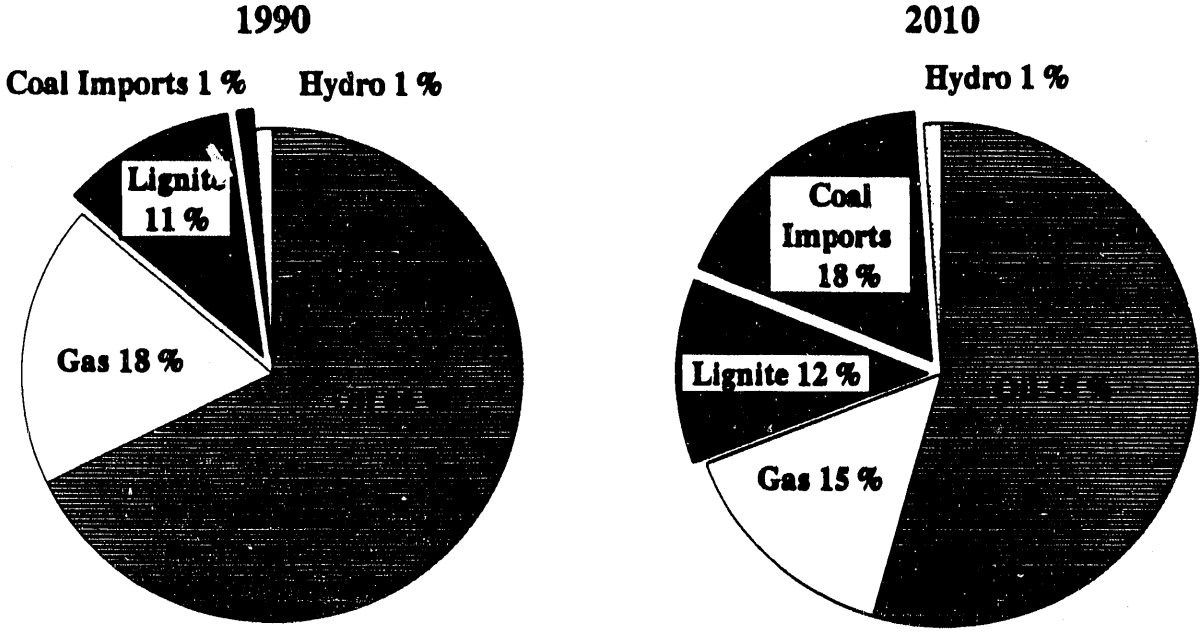

Figure 1. Thailand's primary energy mix in 1990 and projections for 2010 by the East-West Center Coal Project.

- In the EWC Coal Project projections it is assumed that imports begin at 350 million cubic feet per day (MMcf/d) in 2004, and increase to 700 MMcf/d in 2008, equivalent to about 10 million tons of coal (6600 kcal/kg). These projections are speculative but are reasonable, given the size of natural gas reserves in surrounding countries, and the expected rapid growth in demand for clean fuel imports to Thailand.

- The electricity sector has been growing at almost 15 percent per year in recent years, and even with moderation to 7-8 percent per year during the 1990s will result in more than a doubling of capacity by 2001. Table 1 shows the present and projected mix of electricity generating capacity in Thailand.

Table 1
PRESENT AND FUTURE GENERATING CAPACITY
(Megawatts)

Type	1991	2001	Increase
Lignite	1,770	5,620	3,850
Coal (Imported)	0	2,800	2,800
Gas	3,370	6,060	2,690
Oil	1,750	2,770	1,020
Hydro	2,430	4,000	1,570
Total (inc reserve)	9,320	21,250	11,930
Total Demand	7,900	17,840	9,940

Source: Wiwat Plueksawan, 1991.

4. Coal Sector

- Lignite resources are reported at many locations in Thailand, however about 86 percent of the known lignite reserves are located at EGAT's Mae Moh deposit in Lampang Province in northern Thailand. This open cut mine is destined to become one of the world's largest mines by the turn of the century when annual lignite production reaches about 30 million tons, plus overburden removal of roughly 150 million cubic meters per year. Production from Mae Moh is totally committed to electricity generation. The primary problems facing this deposit is that production is expected to peak at about 2000, the quality is low (2,400 kcal/kg or 4,320 Btu/lb), and the sulfur content is high (3.7%). When converted to a typical coal (6,600 kcal/kg), the sulfur per ton coal equivalent (tce) jumps to 10 percent for Mae Moh lignite compared to 1 percent sulfur in most internationally traded steaming coal.

- As shown in Table 2 total coal imports to Thailand for all sectors (electricity, cement and other industrial) are projected to increase from less than a half million tons at present to 6 million tons in 2000, and 27 million tons in 2010. Imported coal for electricity generation is projected by EGAT to begin at about 2 million tons in 1996, increasing to about 5 million tons in 2000. Thai government estimates of imported coal requirements after 2000 are much higher than projected by the Coal Project. The government projects imports to

increase to 41 million tons (assume 6,600 kcal/kg coal) in 2010 or 14 million tons more than our estimate of 27 million tons. We believe the combination of increased efficiency in generation and use, and large imports of gas will reduce imported coal to about two-thirds of the government projections for 2010.

Table 2
THAILAND'S LIGNITE PRODUCTION
AND COAL IMPORTS: **1990-2010**
(Million tons)

Year	Lignite Production[1]		Total	Imported
	Electricity	Other	Domestic Supplies	Coal
1990	10	2	12	<0.5
1995	13	4	17	0.5
2000	27	6	33	6
2005	35	8	43	19
2010	35	11	46	27

Johnson and Hayes, October 1991.

- Indonesia is a particularly favorable source of imported coal. Indonesia's major Kalimantan coal deposits are the closest major deposits of low sulfur, bituminous coal and are expected to be highly competitive with any other source of coal. In addition, both Indonesia and Thailand are members of ASEAN which promotes cooperation on energy among the member countries. This economic and political combination gives Indonesia an advantage in supplying Thailand's import requirements. However, the Coal Project expects Indonesia's export potential to be constrained after about 2000 due to the rapid growth in consumption in the domestic market. Australia is expected to become the largest supplier before 2010.

- There is substantial potential for discovery of additional lignite reserves in Thailand as well as modest deposits of subbituminous coal. The private sector has recently become active in exploring for lignite/coal in Thailand and lignite/coal discoveries and developments may slightly reduce the estimated imports in Table 2. There are substantial policy and administrative barriers to active private sector exploration and development of lignite/coal in Thailand. Success in expanding private sector participation in domestic coal exploration

[1] "Electricity" is generated from lignite averaging about 2500 kcal/kg and "Other" includes lignite and subbituminous coals of 3000-5000 kcal/kg.

and development is heavily dependent on changes in government policies and procedures toward private sector minerals exploration and mine developments. The two largest private coal companies in Thailand are Ban Pu Coal Company and Lanna Lignite Company that produce higher quality coals (3000-5000 kcal/kg) for the industrial sectors, excluding electricity generation.

- There is potential for imports of anthracite from Vietnam for the industrial sector. Vietnam's reserves are large and near the coast.

5. Environmental Issues

- Thailand is rapidly reaching the limits of SO_2 emissions that will be allowed at its Mae Moh mine-mouth power complex in northern Thailand. Lignite burning already accounts for about 47 percent of Thailand's total sulfur oxide emissions, and 17 percent of Thailand's carbon dioxide emissions. At present EGAT reports that annual average values of SO_2 ambient levels as well as ambient 24-hours levels fall within World Bank standards of 100 and 500 ug/m^3. However, short term concentrations in selected areas are above acceptable standards, and EGAT plans to install wet scrubbers on two units (no. 12 and 13) in the future. Two units (no. 10 and 11) will be retrofitted with sorbent injection at a future date.

- The movement toward more stringent environmental regulations with respect to SO_2 emissions is expected to result in sulfur emission technology (FGD) on most new lignite expansions, and may result in increased opportunities for Clean Coal Technologies. In addition, more stringent SO_2 emission controls improves the competitive position of importing low sulfur coals and is expected to encourage the search for lower sulfur lignite/coal in Thailand, and efforts to import natural gas from neighboring countries.

References and Acknowledgements: Various officials within the government and EGAT were helpful in providing information of Thailand's energy sector. In addition, the following papers and reports were used: Thailand: Coal Development and Utilization Study, 1989, Report of the Joint UNDP/World Bank Energy Sector Assessment Program; Energy and Environment: Choosing the Right Mix, 1990, Tienchai Chongpeerapien, et. al; "Coal Use in the Electricity Sector of Thailand", 1991, Wiwat Plueksawan; and "Coal and the Environment in Thailand", 1991, Duangjai Intarapravich; plus projections and analyses of the Coal Project. Any errors in the above advisory should be attributed to the EWC authors.

SECTION 6

Summary of Asia-Pacific Coal News

Third Quarter 1990 to Second Quarter 1991

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Notes:

1. The period covered by this coal summary is the 3rd quarter 1990 up to and including the 2nd quarter 1991 (July 1 1990 to June 31, 1991).

2. Ton = metric ton, Coal Project = East-West Center Energy Program Coal Project, Tpy = Tons per year.

AUSTRALIA

1. Production and Exports

- Coal exports totalled 106.1 million tons for 1990, a record quantity, and an increase of 7.5 percent over 1989 levels. This included 56.9 million tons of coking coal and 49.2 million tons of steaming coal. Japan was the largest market with 28.2 million tons of coking coal and 27 million tons of steaming coal. Exports for 1991 are projected to be approximately 112 million tons.

- Australian coal supplies about 40 percent of Japan's coking coal and 70 percent of Japan's steaming coal. According to Japan's IEE (Institute for Energy Economics), demand for steaming coal to Japan is expected to increase from about 27 million tons to 50 million tons by 1995. The Coal Project expects this number to be higher, perhaps around 55 million tons, due to an expected in planned nuclear capacity.

- Exports of Australian steaming coal will reach 64.8 million tons by 1994, up from the present level of 49.2 million tons, according to the Australian Bureau of Agriculture and Resource Economics (ABARE). This figure could reach 70 million tons if Japan imports a greater than forecast quantity of steaming coal due to a deficit in nuclear capacity. In comparison, steaming coal exports from South Africa are projected at 51 million tons, from the USA at 35 million tons, and from Colombia at 20 million tons.

- ABARE projects prices of steaming coal to rise by 13 percent in real terms by the year 2005, and world seaborne trade in steaming and coking coal is expected to reach about 500 million tons per annum, with Australia supplying about 144 million tons per annum.

- New South Wales (NSW) exported 42.7 million tons of coal in FY 1989, an increase of 2.4 million tons over FY 1988. Steaming coal accounted for 24.7 million tons, and coking coal for 18 million tons. Consumption in NSW was 28.7 million tons, and 70 percent of this was at coal-fired power stations.

- NSW's Hunter Valley is the sight of eight proposed coal mine developments in the next five years, with an investment of A$1.3 billion.

- Queensland's state government has invited two consortia to undertake coal exploration in the Bowen Basin in central Queensland. Queensland Coalfields Ltd., Sedgman and Associates Pty Ltd. and South Korea's Hyundai Corp comprise one consortium, and the other is headed by Magnum Resources Ltd. of NSW.

2. Country Specific Factors

2.1 Industrial Relations

- Industrial relations have substantially improved in recent years, however, further improvements are still necessary. Australia's largest coal exporting port, Newcastle, in NSW, was the center of industrial action by a waterfront labour strike protesting the planned layoff of 33 workers. The strike by loader operators prevented the loading of three ships docked at the two loaders, and delayed the loading of four more ships at a cost of A$10,000 per day in late June 1991.

- The NSW Electricity Commission (ELCOM) announced it was going to sell its 10 mines, and as a result suffered a two day strike by over 2000 miners. ELCOM was also looking to reduce its 3000 strong workforce by about 500 before putting the mines up for sale, but could not guarantee the safety of jobs after their privatisation. The miners have also launched a legal challenge to the mine sales.

- Industrial problems also occurred at the Port Kembla Coal Loader, where samplers refused to return to work as ordered by the Industrial Relations Commission. Four NSW coal companies, BHP-Utah, Kembla Coal and Coke, Austen and Butta, and Clutha Ltd. invoked legal action in the Federal court seeking up to A$2 million in compensation. This legal action was withdrawn following negotiations between the companies and union representatives. At least one sale of 20,000 tons of coal worth A$1.4 million was lost because of the stoppages.

- The Coal Industry Tribunal averted a major nationwide coal-miners strike when it ordered Kembla Coal and Coke to withdraw its threats to sue its already striking miners, and the United Mineworkers Federation consequently cancelled its one week planned walkout. Kembla's miners had been striking for three weeks in protest of the loss of 143 jobs, as well as a further 250 layoffs scheduled for March 1991 at the company's Coalcliff mine.

- MIM Holdings Ltd. threatened to close its Collinsville mine with a loss of 750 jobs unless the unions agreed to a change of work practices. Collinsville has lost A$62 million over the last three fiscal years, and has a much lower than average output per man. The unions subsequently agreed to reduce their workforce by 150 jobs. MIM has also asked for reductions in rail freight charges from the Queensland government, but the government wants any deal kept secret, on the grounds of precedence.

- BHP Steel will close its Tower and Kemira mines in NSW, with the loss of about 300 jobs.

2.2 Prices

- There is concern about the rising value of the Australian dollar against the US dollar. Every 1 cent appreciation of the Australian dollar results in a A$70-$75 million drop in the Australian coal industry's pre-tax profits. The average exchange rate in A$ per US$ over the past five years has been: 1986 = 1.49; 1987 = 1.43; 1988 = 1.28; 1989 = 1.26; 1990 = 1.28; Sept 1991 = 1.28.

- After two years of price increases which improved coal-industry profits, the industry is facing price drops or no price increases. This is due to slowing world economic growth, and a build-up of supplies. There are reportedly large stockpiles being held by some Australian producers, arising from coal importers in Japan not taking their full shipments. There are also reports of European customers not taking their full shipments.

- CRA Ltd. failed in its attempt to control Coal and Allied Industries Ltd. (C&A). CRA is Australia's second largest coal producer, producing 17 million tons in 1990. C&A is the country's third largest, producing 11 million tons in 1990. Both fall well behind the largest producer, BHP-Utah, producing 33 million tons in 1990. Two Japanese companies, Nissho Iwai Corp. and Ube Industries, with a combined total of 17.5 percent holding in C&A, would not sell to CRA. Their decision was influenced by their desire for stability in long term supplies rather than short term share profits.

- The Australian Department of Primary Industries and Energy (DPIE) blocked at least one spot transaction involving the sale of Australian coal at below-contract price to Japan. Reportedly, as a result of the inability to lower the price of Australian coal, Hong-Kong Electric cut its purchase of coal from 500,000 tons to 140,000 tons in 1990, making up the difference with coal from BHP-Utah's Kalimantan operation.

2.3 Rail Transport

- For many years the Queensland rail system and the NSW State Rail Authority (SRA) have come under criticism for their relatively high transport charges. The Queensland government was reviewing freight rates in 1990 with a view to lowering them, and was expected to make a decision by December of 1990. Rates average A$12/ton, and the coal industry and many economists have long argued that the Queensland government charges excessive rates for coal transport. Substantial reductions have been achieved in NSW in coal transport costs in recent years, consequently the competitive position of some NSW mines has been improved.

- There was an increase in Queensland's rail freight rates, ostensibly due to the increasing cost of diesel fuel for locomotives. Most Queensland coal is internally transported via electrified railroads. The increase was challenged by the Queensland Coal Association.

- Striking Queensland railroad crews stopped the supply of coal in August 1990 from the Queensland mines to Hay Point and Dalrymple coal terminals, however stockpiles were high enough to cover one month of stoppage.

2.4 Others

- The Gordonston joint venture in central Queensland will be Australia's largest underground coal mine, costing A$500 million. It will produce 4.2 million Tpy with a workforce of only 400. The coal has a 0.6 percent sulphur content, 6.5 percent ash level, and the highest fluidity of any Australian coking coal on the market. High fluidity coal allows the blending of lower quality (lower cost) coals in making coke. The first shipment is expected to be in November 1992.

- Newcastle was the busiest port in New South Wales in FY 1989, with a throughput of 30.2 million tons, according to the Joint Coal Board. Port Kembla and Sydney followed with 9.7 million tons and 2.8 million tons respectively.

- Most NSW steam coal contracts with Japan are based on 6,700 kcal/kg (12,060 BTU/lb).

CHINA

1. Production and Exports

- Coal production is expected reach 1.11 billion tons in 1991, and an export target of 20 million tons has been set for 1995, according to China's State Planning Commission.

- China exported 17.7 million tons in 1990, 1.7 million above its target of 16 million tons. This was an increase of 16 percent over 1989 levels, when China exported 15.3 million tons at a value of US$550 million (an average price of US$36 per ton). The 1990 exports totalled US$660 million (an average price of US$37.3 per ton), an increase of 19.8 percent from 1989.

- China reports coal resources of 4,490 billion tons to a depth of 2 kilometers, and 900 billion tons of reserves, although by Western standards only about 30 percent of this figure are reserves. The 17 largest coal mines produced 241 million tons in 1989, or 23 percent of total output. It is planned to increase total production by 40 million Tpy each year to 1,400 million Tpy by 2000. Some 80,000 small coal mines account for only 5 percent of China's coal output.

- Japanese steel mills accounted for 1.4 million tons of Chinese coking coal exports in 1990. In 1991, the contracted tonnage increased to 1.6 million tons, but at a US$1 per ton price reduction in line with international prices. Under the China-Japan Long Term Trade Agreement, the Japanese mills are committed to buy 1.4 to 1.8 million tons per annum until 1995.

- Steaming coal exports to Japan are expected to increase from 2.3 to 2.5 million tons, to 2.5 to 3.5 million tons under the 1991-1995 five year China-Japan Long Term Trade Agreement. Total coal exports to Japan are set at 3.9 to 5.3 million tons. In 1991 Japan is expected to buy 2.7 million tons, but at a reduced price of US$1 per ton to US$39.45, FOB, on a 6800 kcal/kg basis.

- Australian and Canadian coking coal totalling almost one million tons was destined for the steel industry in China in 1990. This is twice the tonnage imported in 1989. The price was set at about US$51 per ton FOB.

2. Country Specific Factors

2.1 Coal Quality

- There have been many complaints concerning the quality of China's export coal

from customers. Foreign matter is often found in steaming coal, while some shipments of coking coal have had high ash and moisture contents. The Japanese, among others, have imposed penalties, and threatened to cancel contracts. Japan's 1990 imports of Chinese coal were reduced because of quality problems. Chinese domestic customers complained of delivered coal containing up to 1/3 dirt.

- China's National Coal Import and Export Corp. has named four bases from which Chinese coal can be exported. Three of the bases are for coking coal - Kailaun, near Beijing; Zaozhuang, near the east coast, and Huaibei, northwest of Shanghai. The fourth base is for steaming coal - Datong, in Shanxi Province.

2.2 Mine Development

- The largest coal mine in China, the An Tai Bao mining project in Shanxi province, lost its US partner, Occidental Petroleum Corp. in a rationalisation of the company's assets. Occidental sold its 25 percent holding in the mine to the Bank of China through Island Creek China Coal. A total of US$475 million in loans owed by the mine were to be paid by the end of June. The mine, established in 1985 by three Chinese companies and Occidental, cost US$750 million. Occidental's withdrawal was primarily motivated by difficulties with operating the mine in China and unsatisfactory profits.

- The proposed Shengfu-Dongshen coal field project is potentially the largest in the world, expected to produce 60 million tons of coal per annum by the year 2000. Beyond 2000, output could rise to 100 million Tpy. The Chinese government is seeking foreign funding for the US$3.8 billion project, which will cover over 25,000 square kilometers of Inner Mongolia and Shaanxi provinces. The project will encompass an estimated 230 billion tons reserves of high-grade steaming coal, or 1/4 of China's reserves. The project, started in 1986, now has 11 major mines under construction, and is being developed in stages:

  Stage 1: Until 1992, it will produce 10 million Tpy,
  Stage 2: 1993-1995, it will produce 30 million Tpy,
  Stage 3: 1996-2000, it will produce 60 million Tpy.

- A major expansion program has begun for the Guizhou coal field, in south west China's Guizhou province. The coal field's annual output is about 10 million Tpy, but this is expected to rise to over 50 million Tpy by the year 2000. A synthetic ammonia plant of 80,000 Tpy and a urea plant of 130,000 Tpy are planned.

2.3 Terminal Construction

- China will add 5 new berths and increase its Yingkou New Port capacity from 2 million Tpy to 10 million Tpy, at a cost of US$58 million. The port currently consists of a 30,000 ton coal wharf, two container terminals and six berths.

- A contract worth US$81.3 million has been awarded to Japan's Mitsubishi Heavy Industries Ltd. by the China National Technical Import and Export Corp. for a 15 million Tpy coal handling facility at Quingdao, in Shantung Province on the Yellow Sea. It should be completed by the end of 1993.

2.4 Others

- Marubeni Corp. of Japan has been awaiting the results of a feasibility study of coal-water mixture production before building a 500,000 Tpy plant at the port of Qinhuangdao, in conjunction with China's Huaneng Fine Coal Corp. The coal, supplied by Huaneng from the Shenmu coalfields in northeastern China, would be a mixture of 70 percent coal with 30 percent water. It is reported that Marubeni Corp. has invested US$18.5 million in the plant. There is some confusion as to where the actual plant will be sited - one report puts the site on the east coast of China at the port mentioned above, while another report puts the plant in Shaanxi province, within the country's major coal producing area (Shaanxi, Inner Mongolia and Shanxi). Shanxi province is estimated to contain 28 percent of China's coal reserves, followed by Inner Mongolia with 22 percent, and Shaanxi with 17.5 percent.

- China has drilled its first submarine coal mine in Longkon Bay in the Bohai Sea area.

HONG KONG

1. Consumption and Imports

- Hong Kong's steam coal demand in 1990 was 9.9 million tons, the major suppliers being South Africa (38 percent), Australia (32 percent), China (19 percent), and minor suppliers were Indonesia, Colombia and USA.

- Hong Kong has two electric utilities, China Light and Power (CLP), with a coal fired capacity of 4108 MW, and the much smaller Hong Kong Electric Co. (HKEC), with a coal fired capacity of 1,450 MW.

- China Light and Power's (CLP) subsidiary, Kowloon Electricity Supply Corp. (KESCO), has contracted with the US company Coastal Coal Corp. for 500,000 to 600,000 short tons of western steam coal from July 1990 to 1992. The coal will probably be mined from Coastal's Sufco mine in Utah, containing about 11,400 BTU/lb and 0.5 percent sulphur, and will be used in Hong Kong's Castle Peak station. The sale is significant in that it marks the first import of US coal to Hong Kong since 1983, after pressure from Exxon's members on KESCO's board of directors to buy coal from the US. The station burns about 7 million Tpy.

- CLP has contracted with Australia's BHP-Utah for the supply of 450,000 Tpy of steaming coal for the Castle Peak station for three years. Coal specifications: 6,400 kcal/kg, priced at US$37.10/t, with a reported 5.5 percent annual escalation. CLP also renewed an existing contract with BHP-Utah for delivery of 200,000 Tpy of Queensland coal for three years; coal specifications: 6,700 kcal/kg, priced at less than US$40.85/t FOB.

- Indonesia also entered the market as a coal supplier to Hong Kong in 1990 when Hong Kong Electric Co. (HKEC) bought 90,000 tons of Indonesian coal for its Lamma station, which burns about 2.5 million Tpy of Indonesian, South African and Chinese coal. Coal specifications: 6,300 kcal/kg, at a price of US$30/t, FOB. HKEC has also contracted for another 300,000 tons of 6,300 kcal/kg coal from BHP-Utah's Arutmin mine in Indonesia, for the Lamma station in 1991.

- Both HKEC and CLP have signed contracts with Indonesia's Tanito Harum Ltd., with a total of 500,000 Tpy to the two utilities.

INDIA

1. Production, Consumption and Imports

- Indian coal production is expected to reach 218 million tons in 1991. Rail problems, labour unrest, power shortages and rain contributed to a poor year for coal production in 1990. The agency controlling most of India's coal mines, Coal India Ltd. (CIL), expects 203 million tons to be produced in FY 1991, and 256 million tons by FY 1994. In FY 1990, 189 million tons were produced.

- The state of Orissa is expected to increase coal production from its present level of 13.6 million Tpy to 47 million Tpy by the year 2000. Orissa contains about 20 billion tons of reserves in two main coalfields: Talcher and IB Valley. Orissa produced only 5.6 percent of India's coal but has 23 percent of India's coal reserves. Orissa's goal is to produce 8.1 percent of India's coal by 1995.

- India's coking coal imports for FY 1990 were 4.8 million tons, estimated to rise to 5.5 million tons for FY 1991. The Steel Authority of India (SAIL) will account for around 4.5 million tons in FY 1991. India's domestic production of coking coal was 9 million tons for FY 1990, and is projected to increase to around 13.5 million tons for FY 1994. China has shown interest in equity participation, and Australia is already assisting with the 6.5 million Tpy Piparwar opencast mine and the Pootki-Bullihaari underground mine. The biggest users of coking coal are SAIL and Tata Iron and Steel Co.

- Huge reserves of 17 percent ash coking coal have been found in the Chanch Victoria area near the border of Bihar and West Bengal. The estimated tonnage was not mentioned.

2. Country Specific Factors

2.1 Coal Shortages

- The Coal Project projects higher levels of coking coal imports to India than official projections. It is also possible that substantial steaming coal imports may eventually occur when the government removes restrictions.

- Coal shortages from CIL have forced the shutdown of at least one steel plant, the Rourkela Steel Plant in Orissa, and threaten the operations of SAIL's Bhilai plant, and the Burnpur plant of Indian Iron and Steel Co., as well as paper, sugar, textile and chemical industries. Apparently heavy rains and a power crisis have affected coal production.

- SAIL has been trying to increase coking coal imports to make up for the shortfall in local coal. SAIL imports coal from Australia on annual contracts.

- The Tamil Nadu Electricity Board has also been plagued by coal shortages. The situation has deteriorated to such an extent that a 30 percent power cut on certain industries has been imposed.

- The Gujurat State Electricity Board temporarily shut down three power stations because of the shortage in steaming coal. Power was reduced to major customers by 40 percent in the state.

2.2 Joint Projects

- Four coalfield development projects, two in the Western Coalfields and two in the Eastern Coalfields, will be assisted by France. The projects, all subsidiaries of CIL, will have a total capacity of about 4.7 million Tpy.

- Meanwhile, Canada is increasing its assistance to India following a review of the Rajmahal mine project in West Bengal being developed by India with financial support from Canada of US$145 million. Rajmahal has a planned capacity of 10.5 million Tpy, expected to be reached by 1995.

- The Australian government is jointly constructing a coal mine and beneficiation plant with Central Coalfields Ltd. at Piparwar in India, on a turnkey basis. The coal mine will supply the Dadri and Jamunanager power plants.

2.3 Terminal Construction

- A US$3.6 million coal handling system will be installed at Jawahar Dock II by the Madras Port Trust, increasing the total throughput to 3.5 million tons.

- The Port of Haldia, in Calcutta, will have its iron ore berth modified to increase its coal-handling capacity from 1.5 million Tpy to 2 million Tpy. Steaming coal traffic at Haldia is expected to reach 4 million tons for FY 1991, and 5.5 million tons for FY 1994. Coking coal traffic is expected to be 1.8 million tons for FY 1991.

INDONESIA

1. Consumption, Production and Exports

- The state electricity corporation, PLN, currently has 1,730 MW of coal-fired capacity and plans to add an additional 3500 MW of capacity during the 1990s.

- Indonesian coal production in 1990 was 10.6 million tons, and exports reached 4.9 million tons. Exports are projected by the Coal Project to increase to at least 15 million tons in 1993, increasing to around 25 million tons by the year 2000. The average annual growth rate in coal exports is projected to be about 13 percent between 1991 and 2000.

- Indonesian targets of 6 million tons of coal exports by 1993 are achievable according to Australian analysts. The Coal Project estimates that coal exports in 1993 will be much higher than this figure, however, probably around 14 to 15 million tons, and around 25 million tons by the year 2000. This is an average annual growth rate of 13.2 percent from 1991 to 2000.

- The Coal Project also estimates aggregate coal production to reach 30 million tons in 1994, and 48 million tons by 2000, with production from the large coal contractors in Kalimantan to account for around 20 million tons in 1994.

- Indonesian coal appears to have a price advantage over Australian coal, and has a definite geographical advantage. This poses a significant threat during the 1990s to South Africa and Australia, but is expected to decrease after the turn of the century due to decreased availability of higher quality export coals. The primary constraint will be the rapid growth in Indonesian consumption of coal.

- Indonesia imported about 1.3 million tons of coal in 1989. The 1989 figure is up 25 percent from the 1988 figure. Most imported coal is burnt at the Suralaya power station.

- The two state-owned coal companies, PT Tambang Batubara Bukit Asam and Perum Tambang Batubara (PTB), merged to increase their efficiency and facilitate expansion plans. The new company is also known as PTB. In 1990, both state companies produced 5.6 million tons of coal, most of which went to the Suralaya power station in west Java.

- PT Adaro Indonesia has 1.1 billion tons of in-situ "envirocoal" of 0.06 percent sulphur and 0.8 percent ash. It is expected that 5 million Tpy will be exported by 1994, and 10 million Tpy by 1996, establishing Indonesia as a supplier of the world's best coal.

- Japan's Electric Power Development Co. has contracted for 300,000 tons of Kalimantan coal in 1992.

- PT Kaltim Prima Coal Co., which is 50 percent owned by CRA of Australia, has signed two contracts with Japanese steel-makers Nippon Steel and NKK for delivery of 2.75 million tons between FY 1991 and FY 1995. Kaltim Prima is the largest steam coal project in Indonesia, with a planned capacity of 7 million Tpy, costing roughly US$580 million. PT Kaltim Prima Coal Co. favours CIF shipments and has about two thirds of production for the first three years under contract. Although no mention has been made about production above 7 million Tpy, the Coal Project projects expansion above 7 million Tpy in the latter half of the 1990's.

2. Country Specific Factors

2.1 Terminal Construction

- A major coal port project is under construction by PT Indonesia Bulk Terminal at Pulau Laut, Kalimantan. The port project is an Indonesian/Australian joint venture, to be built in two phases of 8 million tons capacity each. The first phase should be completed in August 1992, and the second in early 1994. The site will contain four coal stockpiles of up to 150,000 tons each. The project cost is about US$150 million, including the first phase cost of US$126 million.

- Arutmin Indonesia, which is a subsidiary of BHP-Utah, will construct a second coal terminal on Pulau Laut, at Kota Baru, off Kalimantan. The terminal is expected to be in operation by 1992. The Arutmin controlled mines project production of 6.5 million Tpy in 1993.

- Another Indonesian company, Multi Harapan Utama Ltd., plans to construct a coal export terminal near Balikpapan, East Kalimantan. The terminal is expected to be completed by the end of 1992, will be able to load at a rate of 2000 tons per hour, and will include four 50,000 ton stockpiles. The first phase will have a capacity of 2.5 million Tpy.

2.2 Others

- Substantial coal deposits have been found in four basins in west Sumatra: the Ombilin Basin with 162 million tons, the Jujuhan Sinamar Basin with 109 million tons, the Painau Basin and part of the Kampar Kanan Basin.

- Mobil Petroleum Co., a subsidiary of Mobil Oil Corp., agreed to sell its 60 percent share of PT Berau Coal to PT United Tractors for US$9.8 million. Nissho Iwai Corp. holds the remaining 40 percent of the company.

JAPAN

1. Consumption and Imports

- In 1990 (Jan to Dec), Japan imported 107.4 million tons, an increase of 2.3 percent over 1989 figures, according to the Ministry of Finance. The average CIF value was US$57.54, (up 3.8 percent from 1989's US$52.86); 74.1 million tons of coking coal at CIF US$60.64 per ton and 31.4 million tons of steaming coal at US$50.55 per ton were imported. Japan also imported 2 million tons of anthracite.

- Major suppliers were Australia (21.8 million tons), China (3 million tons), the USSR (2.7 million tons), South Africa (1.4 million tons), Canada (1.4 million tons), USA (780,000 tons), and Indonesia (290,000 tons). Japan imported 29.4 million tons of steaming coal in 1989, with Australia supplying 20.3 million tons.

- Also in 1990, utilities in Japan consumed 26.78 million tons of steaming coal, according to MITI. This is 11.3 percent higher than last year. The Electric Power Development Co. (EPDC) was the leading consumer, consuming 10.1 million tons, up 2.8 million tons from 1989.

- The Hokkaido Colliery and Steamship Co. Ltd. of Japan expects to increase imports of steaming coal over the next three years because of increasing demand and a decline in domestic production. The company produced about 800,000 tons in 1990, and plans to increase coal imports from the 1990 level of 200,000 tons to 500,000 tons by FY 1993. Australia and Indonesia are expected to supply the bulk of the additional tonnage.

- Domestic coal production fell to 9.6 million tons in FY 1989, less than 10 percent of consumption, according to MITI. Since 1986, the number of larger coal mines has fallen from 11 to 6, and the price of domestic coal is 2.5 times the international market price. The decline is projected by the Coal Project to continue, reaching about three million tons in the year 2000.

- The Nippon Oil Co. of Japan will start buying steaming coal from the USA in 1991, and will also begin overseas coal sales. Nippon expects to trade around 2 million tons in 1991-92, almost double the 1990-91 tonnage of 1.1 million tons. Much of this will come from Australia and the USA for resale to Asian countries.

1.1 US Coal

- Seven Japanese utilities used western US coal in FY 1990, with a total contracted tonnage of about 1.4 million tons.

- Western US coal producers Cyprus Coal Co. and Coastal Coal have set a benchmark price for steaming coal for 1990 with Japanese utilities which is competitive with Australian prices. Cyprus steam coal is priced at US$39.50 per ton, FOB West Coast.

- Japans' Electric Power Development Co. (EPDC) agreed to purchase 340,000 tons of steaming coal from five different western producers, including Coastal Coal, Andalex Resources, Arco Coal, Meridian Minerals and Nerco Coal. EPDC is the largest steaming coal consumer in Japan, using 8 million Tpy. EPDC will also import 300,000 tons from Indonesia in FY 1992 primarily from Kaltim Prima.

- The price of coal shipped from the western US to Japan in FY 1991 will be 75 cents per ton lower than for FY 1990. A major brand of western US coal was priced at US$38.75 per ton (in FY 1991) FOBT on a 12,060 BTU/lb basis, which is US$1.10 lower than Australian coal, however the freight difference will equalise the delivered cost for both coals. In FY 1990, western US coal was priced at US$39.50 per ton.

- Japanese steel mills have settled contracts with four US companies for coking coal shipments in FY 1991. Pittston Coal Export will supply 2.7 million long tons at US$51.50 per long ton, a decrease of US$4.15 per long ton or 7.5 percent over last year. Three other US companies suffered smaller price cuts. Westmoreland Coal will supply 600,000 long tons (a decrease from the 950,000 long tons last year), at US$49.45 per long ton, down US$1 per long ton. Mapco Coal will supply 200,000 long tons (from 300,000 long tons last year) at US$51.50 per long ton, a reduction of US$3.29 per long ton, as well as tightening up on moisture and sulphur specs. Consolidation Coal took a price cut of US$1.62 per long ton, supplying between 500,000 and 550,000 long tons at US$46.80 per long ton, as well as revised ash specifications.

- The first coal exports to Japan by the US company Pacific Coast Coal Co. will have begun by February 1991, in a partnership with Mitsubishi Materials Co., called Dia Coal. Between 150,000 and 200,000 tons will be shipped to Japan over 1991. This will decrease to 100,000 tons after 1992 because of a new cement plant opening in Seattle, Washington.

1.2 Chinese Coal

- China supplied about one million tons of Datong steaming coal to Japan in FY 1990, about the same tonnage as the previous year. In total, Japan imported about 2.5 million tons of steaming coal and 1.4 million tons of coking coal from China in FY 1990.

- Chubu Electric Power Co. of Japan is negotiating with the Chinese for 400,000 Tpy of Datong coal on a multi year contract, to be delivered to the new 700 MW Hekinan station in 1991. A second unit is expected to come on line in June 1992, and a third in June 1993. Each unit will burn about 1.5 million Tpy. Australian coal is already contracted to supply part of the demand, but the utility is also considering US, Canadian and Indonesian coals.

- A renewed 5 year coal contract with China calls for 1.4 to 1.8 million Tpy of coking coal, an increase from the present 1.4 to 1.6 million Tpy, and 2.5 to 3.5 million Tpy of steaming coal, an increase from the present 2.4 to 2.6 million Tpy. This includes 2.5 million tons of Datong coal.

- Japanese utilities are testing samples of Chinese Shenmu and Pingshuo brands of coal.

1.3 Vietnamese Coal

- Godo Coal Co. of Japan will have imported about 40,000 tons of Vietnamese anthracite in the second half of 1990, at a 20 percent reduction in price over the first half of 1990 price levels.

- For the first half of 1991, price agreements were reached for two brands of Hongay anthracite between Japanese traders and Vietnam's Coalimex. A 10 percent price cut was negotiated, leaving the price for No. 5 at US$74.18 per ton FOB (US$101.09 per ton CIF), and for No. 4 at US$76.78 per ton FOB (or US$103.72 per ton CIF). Freight is US$27 per ton.

- Sumitomo Metal Industries expects to import 100,000 tons of Hongay No. 8 anthracite in FY 1991, double the tonnage of FY 1990. The price has not yet been set.

- Other Japanese companies are importing test samples of Vietnamese Hongay coal, and Marubeni Corp. wants to open an office in Hanoi and in Ho Chi Minh City.

- In 1991 Vietnam has reportedly encountered substantial difficulty finding markets for its increased tonnage of anthracite. It is hopeful that improved relations with China will result in substantial exports to southern China.

1.4 Canadian Coal

- The price of coal from the Gregg River mine (a joint venture between Canada's Manalta Coal Co. and Japan's Kobe Steel and Nippon Kokan) has been settled after legal action between the parties. A price of C$80.66 (about US$70.14) per long ton was agreed, effective April 1, 1990. The contract calls for supply of 2.1 million long tons per annum, but the Japanese have exercised their 10 percent option and reduced the tonnage in recent years.

- Canadian exports to Japan for FY 1991 include Luscar, with 2 million tons of coking coal on a long-term contract, Westar Mining with 2.45 million tons, Fording Coal with 1.4 million tons, and Smoky River with around 720,000 tons. Prices are down US$1 per ton to US$51.80 per ton.

- Showa Shell Sekiyu of Japan will start importing Canadian coal in 1992, with a goal of 1 million Tpy in the longer term. A subsidiary, Showa Coal Co. Ltd., will purchase a share in the Telkwa mine in British Columbia, Canada, from Shell Canada Ltd. Production at the mine is expected to begin in 1992 and climb to a maximum level of 1.5 million Tpy.

1.5 Soviet Coal

- The USSR has been forced to cancel some of its steaming coal contracts with Japan due to production problems, including strikes. However, coking coal has not been affected. About 700,000 tons were thought to be involved, but this should not pose a major problem for the Japanese, who can make up the difference from other suppliers.

- Prices reductions have been reached for FY 1991 between Japan and the USSR's V/O Dalintorg, ranging from US$3.40 to US$2.10. Dalintorg ships about 1.5 million Tpy of steaming coal to Japan.

- Another Soviet agency, V/O Sojuzpromexport, has agreed to ship 5.5 million tons of coking coal to Japanese steel mills for FY 1991, at US$1 per ton lower than FY 1990.

- V/O Sojuzpromexport will also ship 40,000 tons of Tugnui steaming coal to Japan's EPDC.

- In April 1991, Moscow suspended all coking coal exports to Japan in the wake of the seventh week of the coalminer's strike, which spread to over 1/3 of Soviet mines. This affected 450,000 tons in April. The strike caused at least five Ukrainian steel mills to close their blast furnaces. At one stage, the strikes affected 93 mines in the USSR, and ultimately included 300,000 miners.

- Six days after the declaration by Moscow of the suspension, V/O Sojuzpromexport announced that shipments of coking coal would resume in May.

- Marubeni Corp. and Nissho Iwai Corp. will open trading offices in Vladivostok.

1.6 Australian Coal

- Japanese steel mills have agreed with their Australian suppliers on tonnage and prices for six brands of coking coal for FY 1991. Five brands are from Queensland and one is from NSW. Prices are generally US$1 per ton lower than last year. However, Clutha Ltd. had a US$2.25 price cut in a sale of 450,000 tons of coking coal to Japan in FY 1991, and, reportedly, a change in classification.

- A base price for steaming coal for FY 1991 has been reached between the Japanese utilities and Australian suppliers of US$39.85 per ton for 6,700 kcal/kg FOB coal, down US$1 per ton from last year, and US$1.10 higher than the price for western US coal.

- Soft coking coal contracts have been settled between Japanese steel mills and Australian suppliers for FY 1991. The mills will be supplied with 1.9 million tons, the same as FY 1990, but at a previously established price reduction of US$1 per ton. The coal is from NSW and will be shipped through the port of Newcastle. The mills also agreed to take 250,000 tons of semi-hard coking coal (with an option of another 100,000 tons), and 250,000 tons of semi-soft coking coal.

- Details have also been released for prices and tonnage in contracts with BHP-Utah of Australia, and Canada's Fording Coal Ltd. for coking coal shipments. BHP-Utah's tonnage will drop from last year's 8.9 million tons to 8.7 million tons in FY 1991. The contract prices were reportedly decreased by US$1 per ton.

- The Hokuriku Electric Power Co. has signed contracts for 420,000 Tpy for five years (with an option for another five years) from two Australian companies. Esso Australia Resources will supply 180,000 Tpy from the Hunter Valley in NSW, and C&A will supply 240,000 Tpy. The coal will be used for a new 500 MW power station on Honshu, with up to three more units to be built in the future.

1.7 Indonesian Coal

- The first long-term contract (spot sales have been common) between a Japanese utility and an Indonesian supplier was signed, with a tonnage of 420,000 Tpy to be supplied by PT Kaltim Prima Coal to Hokuriku Electric Power Co. for 10 years.

- EPDC announced it would buy 300,000 tons of coal from Indonesia in FY 1992.

- Other Japanese firms have also been importing trial shipments of Indonesian coal, with a view to contracting for larger quantities in the near future. Coal tested includes coal from Arutmin Indonesia Ltd. and Multi Harapan Utama Ltd.

1.8 South African Coal

- A 50,000 ton cargo of South African steaming coal will be shipped to Hokkaido Coal and Shipping Co., a Japanese utility, during FY 1991. Future purchases appear likely with 100,000 tons in 1992 and 200,000 tons in 1993.

- MITI lifted restrictions on the imports of South African coal into Japan.

2. Other

- Marubeni Corp. of Japan was awaiting the results of a feasibility study of coal-water mixture (CWM) production before building a 500,000 Tpy plant at the port of Qinhuangdao, in conjunction with China's Huaneng Fine Coal Corp. The coal, supplied by Huaneng from the Shenmu coalfields in northeastern China, would be a mixture of 70 percent coal and 30 percent water. It is reported that Marubeni Corp. invested US$18.5 million in the plant. One report puts the site of the plant at Shaanxi province, while another puts it at the above named port. Studies of the potential for CWM in Japan indicate that the economics are marginal for most sites within Japan at present energy prices.

KOREA

1. Consumption and Imports

- Pohang Iron and Steel Co. of South Korea purchased 12.2 million tons of coal in 1990, and is expected to purchase 18 million in 1991, and 21 million by 1992/93. Included in this tonnage will be 2 million tons of PCI coal in 1993. At the same time, the company will reduce its purchases of low volatility coal to about 3 percent of total tonnage.

- The Korea Electric Power Co. (KEPCO) of South Korea purchased 1.15 million tons of steaming coal from Shell Canada Ltd. in 1990. KEPCO also purchased 250,000 tons from Canada's Westar Mining, a 30,000 ton increase over the previous year.

- KEPCO finalised its 1991 supply of 4 million tons of steaming coal from seven Australian producers, six from NSW and one from Queensland. Prices are said to be based on the Japanese agreements of US$39.85 per ton for 6,700 kcal/kg, which is US$1 per ton less than 1990 prices.

- North Korea is reported to have produced 85 million tons of coal in 1989, including anthracite output. This figure is substantially above previous estimates, and should be used with caution.

- South Korea's Pohang Iron and Steel Co. will complete the expansion of its steel plant in 1992, which could amount to one million Tpy of Australian coking coal. Additional coal-fired stations in South Korea are potential customers for another 2.5 to 3 million tons of steaming coal by 1993/94.

2. Country Specific Factors

- The Hyundai Group of South Korea has contracted to develop coal mines, mineral products and transport natural gas from the Soviet Republic of Yakut to South Korea. Details have not yet been negotiated, but a joint venture company will be set up to manage the projects.

- The first direct trade between South and North Korea was approved and will consist of 5,000 tons of South Korean rice being traded for 30,000 tons of North Korean coal (anthracite), and 11,000 tons of cement. The Coal Project estimates that there is substantial potential for increased coal trade in the future.

- There is a report that a large discovery of brown coal has been made in North Korea between Sukchon and Mundok, near the western coast of North Korea.

MALAYSIA

1. Consumption and Imports

- The National Electricity board (NEB) of Malaysia plans to purchase 60,000 tons of steaming coal from PT Arutmin in Indonesia. Apparently this is NEB's first purchase from Arutmin.

- The NEB have contracted with Australian suppliers for 800,000 tons of steaming coal to be used at the Port Kelang station in 1991. The price is the same as paid by Japanese utility companies, US$40.85 per ton FOB for 6,700 kcal/kg coal.

- Sarawak exported coal worth US$6 million in 1989 to Taiwan, South Korea and Japan. Sarawak accounts for 75 percent of Malaysia's modest coal production.

2. Country Specific Factor

- BHP Minerals of Australia has discovered high quality coal deposits in Sabah. It is reported that up to 100 million tons could be produced. The reserves are in the Maliau Basin, about 150 km southeast of Kota Kinabalu. According to BHP, a mine could have a life expectancy of 25 years and up to US$3.6 billion of coal could be exported. The government of Malaysia is undertaking an environmental impact study for the proposed mine which would be located in an environmentally sensitive area.

NEW ZEALAND

1. Production and Exports

- The first trial shipment of coking coal from the West Coast Stockton mine was sent to China. The 30,000 tons of coal from Coal Corp. was to be used at a coking plant associated with the Baoshan steel mill in Yunnan Province.

- A barter deal was struck between the USSR and New Zealand's Sovenz for US$23.1 million of Soviet Kuznetsk coking coal in return for butter from the NZ Dairy Board. New Zealand Steel is the likely consumer of the coal. New Zealand is a small producer, with annual coal production around 2.2 million tons. Imports of a significant quantity of foreign coal mark a turnaround from the usual small scale exports.

- A large steaming coal project is proposed for Rapahoe, near Greymouth in the South Island. Partners in the managing company, Greymouth Coal Ltd., are Coal Corp with 33 percent, Todd Petroleum Mining with 18 percent, and three Japanese firms with 49 percent. The deposit contains between 200 and 250 million tons, with a proposed mine life of about 25 years. Coal transportation and mining methods are the main issues still to be settled. Transportation options being considered are by rail to Christchurch on the east coast and shipment overseas through the port of Lyttleton, or a coal slurry pipeline to a coastal site near the mine on the West Coast. A coal preparation plant capable of handling 2.1 million Tpy will be included in the project. Most of the production will be exported.

2. Country Specific Factors

- Coal Corp. of New Zealand Ltd., a state-owned enterprise with 130 million tons of reserves of bituminous and sub bituminous coal, is a candidate for privatisation by the New Zealand government. However, the proposed sale is complicated by claims over native land rights by the Maoris.

- A lignite deposit of about seven billion tons has been discovered in Southland, in the south of the South Island of New Zealand. It is estimated that 1.6 billion tons lie at depths of less than 200 meters. One possible use of the lignite is in liquid fuels production.

PHILIPPINES

1. Consumption and Imports

- The Philippines imported a total of 883,955 tons of steaming coal in 1989, which was down 30 percent from their 1.26 million tons imported in 1988. Almost all of the coal came from three countries, China supplied 453,000 tons, Indonesia supplied 234,000 tons, and Australia supplied 196,000 tons. Australia's FOB cost (US$25.65) was the lowest, but its CIF cost (US$57.80) was the highest.

- Domestic coal production is projected to expand from the present 1.5 million Tpy in 1990 to 4.0 million Tpy in 2000, and remain constant thereafter. Coal consumption is expected to increase far more rapidly: from 2.9 million Tpy in 1990, to 14.8 million Tpy by the year 2000, and 26 million Tpy by the year 2010. Due to continued uncertainty in the Philippine economy, long-term projections are considered particularly uncertain.

- The Coal Project projects increases in imports from 1.4 million tons in 1990, to 10.8 million tons in 2000, and 22 million tons in 2010.

- The National Power Corporation (NPC) of the Philippines has contracted with Australia's Ulan-Mitsubishi for 360,000 tons of coal for the Calaca I power station. The delivered cost is US$37.32 per ton with an ocean freight cost of US$8.92 per ton, and FOBT cost of US$28.40 per ton.

2. Country Specific Factor

- Domestically produced coal is mostly low grade and marginally competitive with imported coal. Only about 30 percent of domestic coal can be used without blending. The bulk of the local coal has to be blended with higher quality imported coal.

TAIWAN

1. Consumption and Imports

- Most of Taiwan's coal imports originate from Indonesia, China, Canada, South Africa, the USA and Australia. Imports in 1989 amounted to 16.8 million tons. Domestic production in 1989 was 784,000 tons, and for 1990 was expected to be below 500,000 tons.

- Price and tonnage has been settled between the Taiwan Power Co. and six Australian coal exporters for FY 1990. The price was the same as agreed with Japanese utilities, US$40.85 per ton FOB for 6,700 kcal/kg coal. The tonnage was reported to be about 2.5 million tons.

- Anglo-American Coal Corp. of South Africa has contracted to supply 600,000 tons of 5,900 kcal/kg steaming coal to the Taiwan Power Co. in 1991, at between US$0.50 and US$1.00 (FOB) higher than 1990.

- Taiwan Cement has purchased 300,000 tons of Australian steaming coal from two NSW companies for delivery in 1991.

2. Country Specific Factor

- A 40 year policy banning purchases from China by Taiwanese state-owned companies has been lifted with the Taiwan Power Co. receiving permission from the Economics Ministry to purchase spot market coal from China if there is a shortage in the utility's regular supplies. The move is expected to result in lower coal costs due, in part, to lower freight charges. Purchases must be handled through a third party. The plan must still be approved through the government's Mainland Affairs Council.

VIETNAM

1. Production and Exports

- In 1990 Vietnam exported about 750,000 tons and produced about 4 million tons of coal. According to Vietnamese officials, production in 1991 is expected to be about four million tons, increasing to five million tons by 1995. Of the 600,000 tons of exports in 1989, 300,000 tons went to South Korea, 200,000 tons went to Japan, and the remaining 100,000 tons went elsewhere in South East Asia. Hongay port handled 100,000 tons, while the port of Campha handled 500,000 tons.

- Vietnam's Coalimex has reduced its price on three brands of Hongay anthracite destined for Japan in the first half of 1991. On an FOB basis the price was reduced by 8 to 9 percent, but only by 4.5 to 5.5 percent on a CIF basis because the ocean freight was unchanged.

- Vietnam's reserves of anthracite near ports are very large, however, expansion is hampered by poor infrastructure, poor management, poor quality control and inadequate marketing.

2. Country Specific Factors

- The Cam Pha Mining Co. is working with an unnamed Australian company to modernise coal production facilities in north-eastern Quang Ninh Province.

- A coal loading terminal at the Port of Cua Ong is being upgraded from its present capacity to handle 30,000 ton ships, to a higher capacity of 40,000 to 50,000 ton ships.

- BHP-Utah is conducting feasibility studies on anthracite deposits at Khe Cham and Halam, to be completed by mid 1991. BHP-Utah is presently the best-placed foreign company to expand Vietnam's exports of anthracite in the 1990s.

ACKNOWLEDGEMENTS

Information for this publication has been collected from various unpublished sources, as well as International Bulk Journal, King's Coal Trade International, Mining Magazine, Mining Journal, "Energy in China" Ministry of Energy, People's Republic of China, 1990, and the East-West Center's Coal Project. Note: there are variations in reports from different industry sources, and in many cases it was not possible to validate these reports.

SECTION 7

COAL AND THE ENVIRONMENT: ASIA 2010

JULY 11-12, 1991
EAST-WEST CENTER
HONOLULU, HAWAII

The Energy Program of the East-West Center and the Fossil Energy Office of the U.S. Department of Energy are jointly sponsoring an international conference to address options for reducing environmental pollution associated with increased use of thermal coal in electricity generation in Asia (includes western Pacific countries). The ***Coal and the Environment: Asia 2010 Conference*** will be held July 11-12, 1991 at the East-West Center in Honolulu, Hawaii.

Coal and the Environmental Challenge in Asia

Coal is the most widely distributed energy resource in Asia, plus there is vigorous international competition in low sulfur steam coal trade in Asia. Coal is increasingly the economic and strategic choice for base-load electricity generation in Asia, plus plays an important role in other industrial sectors. Coal increased its share of total electricity generation in Asia from a low in 1975 of 28 percent to about 40 percent in 1990, and is expected to account for about 50 percent of electricity generation in the year 2000.

However, the growth rate in coal consumption in Asia will be constrained if coal fails to meet increasingly strict environmental regulations over the next two decades. During the 1990s policy makers and utility executives must plan for the twin goals of meeting rapid growth rates in electricity consumption and reduced pollution associated with expanded consumption of steam coal in electricity generating plants, and in other industrial uses.

Conference Goals and Outline

The Conference will bring together senior Asian energy and environmental planners from governments and electric utilities, and government and private industry people involved in both coal trade and in developing advanced coal technologies to reduce pollution. Conference papers and discussions will cover:

- **Fuel and technology plans for meeting the rapid growth in electricity consumption in key Asian countries;**
- **Present and planned environmental legislation and guidelines that will influence fuel and technology choices;**
- **Options for financing coal use technologies and pollution equipment;**
- **The status and economics of Clean Coal Technology options for increasing efficiency and reducing pollution.**

The Conference will provide energy planners with current technical and economic information and analyses that are essential in developing environmentally sound coal use policies and strategies in the 1990s. Second, the Conference will provide both suppliers of low-sulfur steam coal and pollution control technologies with insights into the evolving business opportunities in Asia in the 1990s.

An important element of the Conference will be to provide adequate opportunities for small group discussions between energy and environmental planners and coal technology developers and users.

The Conference includes participants from Australia, Canada, China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, Philippines, Taiwan, Thailand and United States.

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COAL AND THE ENVIRONMENT: ASIA 2010 CONFERENCE

Co-Sponsored by the U. S. Department of Energy
and the East-West Center

Jefferson Hall, East-West Center
1777 East-West Road, Honolulu, Hawaii 96848

THURSDAY, JULY 11, 1991

7:45 Bus departs from Ala Moana to the East-West Center.

8:15 - 9:00 **REGISTRATION**
Keoni Auditorium, Jefferson Hall (Coffee and Pastries)

9:00 - 9:55 **OPENING REMARKS**

Denise Swink	— Director, Office of Planning and Environment, U.S. Department of Energy
Fereidun Fesharaki	— Director, Resources Programs, East-West Center's Energy Program
Charles Johnson	— Head, Coal Project, East-West Center

9:55 - 10:20 **CHANGING ENERGY MIX IN THE ASIA-PACIFIC REGION**
Overview of oil, gas, coal, nuclear and hydroelectric power: 1970-2010

M. Richard Smith, Vice President,
Manager of Pacific International Offices, Bechtel Group, Inc.

10:20 - 10:40 **COFFEE BREAK**

10:40 - 12:00 **COAL AND ENVIRONMENTAL REGULATIONS**

Chairperson: Charles J. Johnson, Head Coal Project, East-West Center

Japan	— Shinya Aoki, Director of the Coal Industry Division, Natural Resources and Energy, MITI
China	— Jia Yunzhen, Deputy Director, International Cooperation, Ministry of Energy,
Hong Kong	— Ronald Tang, Fuel Supply Engineer, China Light & Power
Taiwan	— Shih-Ming Chuang, Sector Chief, Energy Commission

12:00 - 12:10 **GROUP PHOTO**

THURSDAY, JULY 11, 1991 (continued)

12:10 - 1:40 **LUNCH**
Speaker - Denise Swink for Linda Stuntz, Acting Assistant Secretary for Fossil Energy, Department of Energy.

1:40 - 3:30 **COAL AND ENVIRONMENTAL REGULATIONS**

Chairperson: Hossein Razavi, Principal Energy Economist, Asian Region, World Bank

Korea	— Jung-Gon Kim, Director, Power Supply and Demand Ministry of Energy and Resources
Philippines	— Gonzalo Bantugan, Vice President, Corporate Specialist, Environmental Sciences/Management, National Power Corporation
Indonesia	— Achmad Prijono, Coal Consultant, Indonesian Mining Association
Malaysia	— Shick Pei Chen, Director, Geological Survey of Malaysia
Thailand	— Wiwat Plueksawan, Chief of Atomic Power, Electricity Generating Authority of Thailand
	— Duangjai Intarapravich, Research Fellow, Thailand Development Research Institute

3:30 - 3:50 **COFFEE BREAK**

3:50 - 5:20 **GROUP DISCUSSIONS**

Chairpersons: Constance Holmes, Senior Vice President, Policy, National Coal Association

William Nock, Market Manager - Energy
Union Pacific Railroad

Thomas Cutler, Foreign Affairs Officer,
Office of International Affairs, U.S. Department of Energy

5:20-5:40 **Group Reports and Recommendations**

Chairperson: Gonzalo Bantugan, Vice President-Corporate Specialist, Environmental Science/Management, National Power Corporation

6:00 - 7:30 **RECEPTION** East-West Center, Jefferson Hall Lanai
(Bus returns to Ala Moana at 7:35).

FRIDAY, JULY 12, 1991

7:45 Bus from Ala Moana to the East-West Center.

8:00 - 8:30 Coffee and pastries.

8:30 - 9:30 **U. S. TRADE OPPORTUNITIES**

Chairperson: Donald Nelson, Special Assistant to Assistant Secretary, Fossil Energy

George Helland, Deputy Assistant Secretary
Export Assistance
U.S. Department of Energy
Christina Bolton, Deputy Assistant Secretary
Capital Goods and International Construction
U.S. Department of Commerce
Constance Holmes, Senior Vice President, Policy
National Coal Association

9:30 - 10:50 **AVAILABLE CLEAN COAL TECHNOLOGY OPTIONS**

Chairperson: C. Lowell Miller, Associate Deputy Assistant Secretary,
Office of Coal Technology, U.S. Department of Energy

Utility and Industrial Opportunities
Garrett Morrison, President & Chief Executive Officer
Passamaquoddy Technology, L.P.
Eugene Zeltman, Manager, Trade & Industry Associations
General Electric Power Systems
Efficiencies in Electricity Generation and Pollution Control
Allen Womack, Vice President, Research & Development Division,
Babcock & Wilcox
Economics of Alternative Systems
Irving Leibson, Executive Consultant, Bechtel Group, Inc.

10:50 - 11:05 **COFFEE BREAK**

11:05 - 11:45 **STATUS OF CLEAN COAL TECHNOLOGY DEMONSTRATION PROGRAM**

C. Lowell Miller, Associate Deputy Assistant Secretary,
Office of Coal Technology, U.S. Department of Energy

FRIDAY, JULY 12, 1991 (continued)

11:45 - 1:00 **LUNCH**
Speaker: Ben Yamagata, Executive Director,
Clean Coal Technology Coalition

1:00 - 2:30 **FINANCING ENERGY PROJECTS**

Chairperson: Peter Cover, Program Manager, Coal & Technology Exports, Office of Planning & Environment, U.S. Department of Energy

Daniel Roling, First Vice President, Merrill Lynch Capital Markets
Paul Boswell, Engineer, Export-Import Bank of the U.S.
Nancy Frame, Deputy Director, U.S. Trade & Development Program
Hossein Razavi, Principal Energy Economist, Asian Region, World Bank
James Sullivan, Director, Office of Energy,
U.S. Agency for International Development

2:30 - 2:45 **COFFEE BREAK**

2:45 - 4:00 **GROUP DISCUSSIONS**

Chairpersons: Paul Boswell, Engineer, Export-Import Bank of the U.S.

James Sullivan, Director, Office of Energy,
U.S. Agency for International Development

Nancy Frame, Deputy Director, U.S. Trade and Development Program

4:00 - 4:20 **GROUP REPORTS AND RECOMMENDATIONS**

Chairperson: Steve Torok, Economic Affairs Officer,
Energy Resources Section, United Nations, ESCAP

4:20 - 4:40 **SUMMARY AND CONCLUDING REMARKS**
Fereidun Fesharaki, East-West Center
Denise Swink, U.S. Department of Energy

4:45 Bus departs from East-West Center to Ala Moana.
6:00 Bus departs from Ala Moana to Kahala Hilton.

7:00 - 9:30 **BANQUET** (KAHALA HILTON)
(Bus returns to Ala Moana at 9:30).

SATURDAY, JULY 13, 1991

7:15 - 11:30 **Field visit to AES Barbers Point Cogeneration Facility.**
Two circulating fluidized bed (CFB) boilers are under construction.

Bus pickup times: Ala Moana 7:15, Quality Inn 7:30, Lincoln Hall 7:50, to arrive at 9:00. The bus will return at about 11:30 a.m.
Sign up at registration desk. (Limited to 48 participants).

COAL AND THE ENVIRONMENT:ASIA 2010

July 11-12, 1991

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SECTION 8

SELECTED COAL AND RELATED ENVIRONMENTAL ISSUES

IN

AUSTRALIA, CHINA, HONG KONG INDONESIA, JAPAN, PHILIPPINES SOUTH KOREA AND TAIWAN

TRIP REPORT

By

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March 6, 1991

This is part of a U.S. Department of Energy, Office of Fossil Energy project titled: Potential for Thermal Coal Technology (CCT) Export in the Asia-Pacific (Grant Number: DE-FG03-89FE61811)

CONTENTS

INTRODUCTION

The following trip report is based on visits to eight countries in the Asia-Pacific Region in October 1990. The purposes of the trip were to meet key people involved in coal use planning and in environmental areas that will influence future coal use.

During the 1990s, Asia is expected to continue to have both the highest economic growth rate and the highest growth rate in electricity consumption of any major region in the world. Coal imports and use in electricity generation is expected to continue to grow rapidly during the 1990s. Steaming coal imports are expected to increase from about 80 million tonnes in 1990 to 150-180 million tonnes in 2000.

Most consumers indicated that Australia and Indonesia are likely to capture most of the growth in steaming coal trade in the region in the 1990s. However, South Korea and Taiwan emphasised that strategic considerations ensure that a portion of steaming coal imports will come from the United States.

Environmental regulations vary widely in the region from Japan's stringent regulations to the liberal regulations in China. Hong Kong, South Korea and Taiwan are moving toward much stricter environmental regulations that will result in either installation of FGD on new plants or use of very low sulfur coal. Australia, China, Indonesia and the Philippines are unlikely to implement regulations that force the installation of FGD or the equivalent in the 1990s.

The prospects for the introduction of Clean Coal Technologies are best in Japan, South Korea and Taiwan. Hong Kong is a possibility after the technologies are proven in large scale power plants. China is interested in cooperating in a Clean Coal Technology project providing the U.S. puts up all of the foreign currency requirements.

AUSTRALIA

Summary

Australia is the largest exporter of coal to both Asia and the world, and therefore the main focus of government and industry is on promoting Australian coal exports. Discussions about environmental trends and clean coal technologies revolved mostly around their implications to the development and export of Australian coal.

At present the Australian industry appears to have only limited interest in clean coal technologies, and would be unlikely to invest substantial R & D into this area. Within government the commitment to clean coal technology R & D appears to be much lower than in the United States. Both utility and coal mining people did not believe that there would be an early introduction of clean coal technologies in Australia. However, the Australian government, and to a lesser extent private industry, may be interested in cooperating with the US Clean Coal Technology program because this would provide early access to technology developments at much lower costs. This should be investigated. One person expressed concern that the US Clean Coal Technology program might develop technologies suitable for US coals and not Australian coals -- therefore take markets away from Australia.

Australia's largest export earner is coal, and it is the price setter for coal sales in Asia. Exports in FY1989-90 were 105 million tonnes with over half going to Japan. During the 1980's Australia made substantial progress in removing restrictive labor practices, consequently it is better positioned to maintain a competitive advantage in coal trade in Asia in the 1990s. The present cost structure and trends in the Australian coal industry is such that the steaming coal exports from the United States are

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Note: Exchange rate (1990): A$1.00 ≈ US$0.77

only marginally competitive in the Asian Market at present coal prices. According to Australian producers the modest purchases of US steaming coal by Asian consumers appear to be heavily influenced by strategic considerations (diversified sources of supply).

Australian steaming coal exports are mostly low sulfur (0.3-0.9% S) and medium to high ash (8-17%). Export coals are commonly washed to lower the ash content. Australian companies can lower the ash content of export coals to meet tighter specification in the future, but this will increase costs (requires higher prices to justify).

Almost all production for exports is within 200 km of deepwater ports in Queensland and New South Wales. Reserves are large and depletion is not a significant issue, but most coal executives believe that new greenfield coal developments cannot be justified at present coal prices. In addition, the best reserves are all held by companies, and newcomers cannot acquire reserves at low cost. The action of Australia's two largest coal companies (BHP and CRA) to develop new steaming coal projects in Indonesia appears to be because comparable low cost reserves are not available to these companies in Australia.

Energy Plans

Australia will continue to rely primarily on abundant domestic coal and lignite supplies for its electricity generation needs. Both state and central governments appear sensitive to the need to adjust policies over time to ensure that Australia maintains its competitive position in international coal trade. Australia's coal development projects are increasingly attracting equity investments from Asia with Japan leading the trend. The potential negative impacts on open market trade in coal needs to be investigated.

Coal Supplies

Production and Exports:

Australian coal production is forecast to increase marginally to 163

million tonnes in FY1990-91 (July 1989 - June 1990) with two-thirds (108 million tonnes) going to the export market. In FY1990-91 stagnant coking coal exports are estimated at 59 million tonnes with steaming coal exports rising by about 3.5 million tonnes to 49 million tonnes.

During the first half of the 1990's the tonnage of steaming coal exports is expected to overtake coking coal. The Australian Bureau of Agricultural and Resource Economics (ABARE) forecasts exports in FY1995-96 of 67 million tonnes steaming coal and 61 million tonnes coking coal. Half of the expansion in coal exports is expected to come from expansions at existing mines.

Exports from Australia's main competitor, South Africa, could increase from about 52 million tonnes to 70 million tonnes in 2000. There was a general belief among executives that large investments in South African port facilities will be required to expand above roughly 70 million tonnes. Most industry executives believed the lowest cost reserves have been developed in South Africa and export prices will have to increase appreciably before new mines will be developed.

Agreements and Specifications:

Typically power plants are designed to use coals up to 15 percent ash. There is a gradual trend toward higher quality, lower ash coals in the export market.

Steaming coal sales contracts are favorable to the buyer and provide little incentive to produce coals above the specifications in contracts. Sellers are penalized for deliveries that fall below specifications and, except for adjustments for heat content, usually do not receive a premium for supplying higher quality coals.

One coal exporter indicated the worst part of coal agreements is that they have five year contracts yet have to negotiate the price each year. One executive suggested that Japanese buyers negotiate with the most vulnerable coal exporter first to establish a low price. This price becomes the bases for subsequent negotiations (this hypothesis should be investigated).

Contracts for New South Wales' power plants allow much higher ash contents than export specifications (i.e. 18-22% ash for the Bayswater Power station). This is ideal for Australian coal producers that can sell the higher ash coals to local power plants (at lower prices), and export the higher quality coal fraction.

One executive said that the Japanese are looking for lower sulfur coals, and there are adjustment clauses in some contracts of about US$.55 for each 0.1% S above contract specifications.

A number of coal industry executives were asked if they could produce a much higher quality coal if a significant premium was paid. The answer was yes. Some companies could produce steaming coals down to at least 0.3 percent sulfur and ash contents substantially below 8 percent. It was not possible to determine the quantities of very low sulfur, low ash coal that could be produced.

Industry Economics and Strategies:

Most coal mining companies make unsatisfactory profits. At present coal prices, there will be only modest increases in exports from Australia. However, with higher prices Australia could increase production by 50 million tonnes.

Capital costs: Estimates vary widely. My rough estimate from the few estimates given to me were that a low cost, open pit mine adjacent to an operating mine by the same company could be developed for A$60-90 per annual tonne. A new mine for deeper coal in more remote areas would cost A$180-200 per annual tonne.

Operating costs: One company executive gave the following underground mining costs for New South Wales. Longwall mining under favorable conditions could produce coal for about A$18 per tonne compared to a continuous miner with costs of about A$31 per tonne.

Shipping costs: The cost differential between shipping to Europe and Asia is US$5-6 per tonne. Cape sized ships are now moving coal from Australia to Europe for about US$11 per tonne, and freight rates could decline in 1991.

Coal washery costs: Cash costs are in the range of US$2.00-3.00 per tonne washed. Need to add about A$3 per tonne capital costs. Typical coal recoveries are about 80 percent for steaming coal and 70 percent for coking coal. For each 1 percent loss in washing there is a loss of about A$0.50 per tonne in sales revenue, therefore coal is washed only to the point where it meets market specifications.

Table 1 shows estimates of the relationship between ash content, washability and coal yield for one mine in New South Wales.

Table 1
EXAMPLE OF COAL WASHABILITY VERSUS YIELD FOR DIFFERENT ASH COALS
(Percent)

Raw Coal Ash	Washed Coal Ash	Coal Yield
22.0	14.0	75
17.0	8.5	70
14.5	8.5	75

Rail rates: For Hunter Valley coal (New South Wales) rail rates dropped by about A$3 tonne between 1986 and 1989. Queensland has higher total freight costs than New South Wales. A flat rate in Queensland of A$12.50 per tonne was given but has not been confirmed. Some projects, such as Blair Athol coal, are known to have rates below A$10 per tonne.

Port fees: The port of New Castle is expected to reduce it's port fees from A$4.75 per tonne in 1990 to A$4.25 in 1991 after restructuring.

Coal prices: At present (October 1990) steaming coal averages about US$40 tonne FOB, pulverized coal injection (PCI) quality coal averages about US$43 and coking coal averages US$48 per tonne.

Sales commissions: Japanese trading companies charge consumers about US$1.00 per tonne for purchasing coal.

Labor Practices and Productivity:

Comments apply primarily to New South Wales. There has been a major increase in the number of effective days of production at some mines. Before 1988 one executive reported his mines operated an average of 220 days per year, and today can operate for over 360 days per year.

Environmental Issues

Most environmental issues pertaining to emissions from power plants are addressed at the state level. None of the major states have emission limits for SO_2 because of the low sulfur content of coals. The national guideline of the Australian Environmental Council/National Health & Medical Research Council on SO_x emission is 200 mg/Nm^3. There are regulations or guidelines for particulate and NO_x emissions in most states. Australian regulations on emissions from coal-fired power plants are less stringent than in Japan and the United States.

Environmental issues have periodically become major political issues in Australia. The debate over the CO_2 problem could bring increased attention to coal burning in Australia in the 1990s, and tighter controls on power plant emissions. However, most industry executives did not expect a major tightening of emissions standards in the next few years.

Clean Coal Technologies

Power plants have efficient ash recovery systems, however there are no plans to install FGD systems for sulfur recovery. At present Clean Coal Technologies are not under serious consideration for commercial power plants. The long term importance of coal to Australia's economy, both for domestic consumption and exports, suggests that the Australian government might consider modest cooperation with the US Clean Coal Technology program.

One person believed that the US Clean Coal Technology program was a threat to the long term competitive position of Australian coal. He suggested that the CCTs would be designed for US and not Australian coals. This appears to be a minority view.

Electric Utilities

Comments refer to ELCOM plants in New South Wales.

Particulates: Emission limit is 250 mg/m^3. Electrostatic precipitators give emissions of about 250 mg/m^3 for the high ash coals they burn (25 percent ash). ELCOM has recently switched to fabric filters that reduce emissions to 10-50 mg/m^3. Fabric filters have higher capital and operating costs than electrostatic precipitators.

Sulfur oxides: Vary the stack height and sometimes the sulfur content to reduce SO_x emissions.

NO_x: Installing low NO_x burners on newer power plants.

CO_2: No action taken to date. Doubtful that Australia would agree to any strong international restrictions on coal burning to reduce CO_2.

ELCOM studies show that it is cheaper for them to burn high ash coals at mine-mouth plants and recover the ash from the stack gases. There are only modest costs to ELCOM from burning high ash coals, including added ash disposal costs and increased wear of power plant equipment. They apply a penalty when the ash is significantly above 25 percent. Most New South Wales coals are soft with an HGI of about 45 or greater (coal hardness varies inversely to the HGI number).

Conference Participation

A number of industry executives indicated a general interest in the Coal Conference, particularly with respect to discussions about changes in the qualities of steaming coals that might be imported to Asia. Participants could report on the outlook for steaming coal exports to Asia and their views of trends in coal specifications. There would probably be interest from the Australian Department of Primary Industries and Energy. Dr.

Donald Barnett, a coal economics expert at MacQuarie University expressed particular interest in the conference.

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PEOPLE'S REPUBLIC OF CHINA

Summary

China is the dominant coal producer and consumer in the world, and probably produces the largest amount of coal related atmospheric pollution. The Chinese are aware of their pollution problems, but are heavily constrained by the lack of financial resources to introduce pollution control equipment, plus weak environmental legislation and enforcement procedures. With respect to coal and environmental issues, the priorities are (1) increasing efficiency in coal use, (2) reducing ash emissions, and (3) ground level sulfur concentrations in urban areas. The CO_2 (Global Warming) problem does not appear to be a priority with respect to power plant and fuel choices.

There is some research underway in China on clean coal technologies (fluidized bed combustion). However, commercial scale introduction of clean coal technologies is not envisioned for the electric utility industry in the foreseeable future. There would probably be an interest in cooperating on pilot testing of clean coal technologies providing the Chinese side does not have to put up any hard currency.

Energy Sector Organization

In 1988 the Ministry of Energy (MOE) was established by the State Council through the merger of the Ministries of Petroleum, Coal, Power, Nuclear and the electric power part of the original Ministry of Water Resources and Electric Power. Its main functions are: (1) to implement energy development policies and strategies, including technical and investment policies and production and consumption policies; (2) to coordinate energy planning; and (3) to supervise the implementation of policies and plans. It is also responsible for cooperative energy projects with foreign governments. MOE does not have responsibility for the

direct management of energy sector industries.

With respect to coal production, state controlled mines account for 44 percent of coal production, with 56 percent produced by the rapidly growing "local mines" sector that includes, collectively owned town and village mines, and privately owned mines (allowed since 1983).

Interestingly, state controlled mines produce higher quality coal that is sold at lower prices than local mines. The reason that inferior coal produced by local mines can sell at a premium is because: (1) state mines are unable to meet demand, and (2) state produced coal is at fixed low prices. Local coal production is generally not subject to price controls to the same degree. The need for price reform in coal pricing has long been recognized by Chinese economists, but implementation continues to be delayed.

Energy Plans and Strategies

China's energy development strategies up to the year 2000 can be summarized broadly into six areas:

(1) Give equal emphasis to both exploitation and conservation of energy
(2) Improve the structure and distribution of energy
(3) Encourage energy conservation
(4) Develop industries based on coal-fired electricity, and also continue to develop other energy sources
(5) Introduce technologies to increase the efficiency of energy production and utilization
(6) Reduce environmental coal generated pollution in urban areas.

Specific quantitative goals are provided in China's five-year development plans. However in a number of energy areas, actual results

have deviated substantially from the plan. Coal's share of total primary energy production in the country has gradually declined over time, but still represents almost three-quarters of total production. Therefore, emphasis will continue to be heavily on coal in the 1990s.

Coal Reserves and Supplies

Various estimates of China's huge coal resources and reserves have been published. Resources are on the order of about 4,000 billion tonnes with about a quarter designated as reserves (860 billion tonnes). Reserves are divided approximately as follows: 50% steaming coal, 20% coking coal, 15% anthracite and 15% lignite.

About 80 percent of China's coal is located in north and north-west China. The leading coal producing province is Shanxi which produced 260 million tonnes of coal in 1989 --about a quarter of China's total production. Only about 7 percent of China's coal is reportedly suitable for open cut mining. The low percentage of coal that is washed (17.5%) is of concern to MOE, and MOE recognizes that raising the percentage of washed coal will increase fuel use efficiency and reduce pollution from burning coal.

In 1989, China produced 1.15 billion tonnes of raw coal. Coal supplies presently do not meet domestic demand, and this situation is unlikely to be reversed during the 1990s. The level of coal exports is likely to be determined by requirements for foreign exchange -- particularly to repay loans for coal mine developments. Coal exports (steaming and coking coal) increased from 7.6 million tonnes in 1985 to 15.3 million tonnes in 1989 -- falling far below official projections of 30 million tonnes by 1990. The two largest constraints on coal exports are transportation infrastructure (rail and port), and domestic demand which exceeds domestic supplies. Exports of about 25 million tonnes in the mid-1990s are projected by the Chinese. For forecasting purposes, I am working on the assumption of <u>net</u> coal exports of 20-30 million tonnes per

year during the last half of the 1990s. Imports of coal have averaged about 1-2 million tonnes per year and are likely to increase substantially during the 1990s's.

Coal Consumption

China is the largest producer and consumer of coal in the world, and will readily maintain the lead if its ambitious coal production goals are achieved. During the first ten years (1978-1988) of China's open door policies, coal consumption increased at an average rate of 5.7 percent per year.

China's coal consumption pattern is the reverse of the industrial nations. In China roughly one-third of the coal consumed is by electric utilities and the steel industry. The majority of coal consumed is by millions of primarily small consumers that are very difficult to control with respect to efficient coal burning and environmental pollution.

Between 1989 and 2000 the plan is to increase steam coal consumption for electricity generation by 200 million tonnes (50% of the growth in production). About 250 million tonnes of coal were consumed for electricity generation in 1988.

Environmental Issues

There are three basic levels of air quality standards in China, based on ground level concentrations. These are:

(1) Tourist and special preservation areas
(2) Urban areas
(3) Industrial areas

Environmental standards in China appear to be *guidelines* rather than *legislated* requirements -- a fundamental difference from the approach used in western countries.

Increasing the efficiency of coal use is of major importance, and can be divided into three broad areas:

(1) Promoting co-generation in urban areas
(2) Increasing the share of heating by central heating systems
(3) Increasing the share of electricity generation in the total energy mix.

Coal related air pollution in China is among the highest in the world, particularly in many of China's large cities. MOE emphasized that the immediate concern is to reduce particulate and SO_2 emissions, and not CO_2. As previously stated, the primary goal is to raise the efficiency of coal use -- in electricity generation. The goal is to reduce the national average coal consumption by about 20 percent per Kwh generated by the year 2000. At present national average estimates vary from about 0.4 to 0.43 kg coal/kWh.

Ash: A second major problem is to reduce ash emissions from coal that averages 28 percent ash in the power sector. Note: MOE's published statistics for 1988 give an average ash content of *saleable* coal of 18.8 percent (includes all coals -- steaming and coking).

The figures given for ash emissions per kilowatt hour in 1989 (52 kg/kw/year) were about one-third of those in 1979 (160 kg/kw/year respectively). By 2000 the goal is to further reduce ash emissions per kilowatt hour by about 40 percent from the 1989 level. The figures given for ash removal in power plants were as follows:

30% ESP with 98% efficiency
30% have venturi scrubbers with 95% efficiency
40% have less efficient controls.

There was no way of knowing whether these figures are realistic. My guess is that the efficiencies of ash recovery are probably substantially below those given above.

Sulfur Oxides: In general these are not controlled in China. Present regulations apply to ground concentrations, and the easiest option is to increase stack heights and/or use lower sulfur coal. Sulfur removal

systems were seen as too expensive, and MOE does not expect significant use of FGD sulfur removal systems in China.

Typical Chinese coal is relatively low sulfur as half of the coal produced has a sulfur content of less than 1 percent, and only 10 percent has a sulfur content above 2 percent. High sulfur coals are more of a problem in southern China.

-- With respect to the substitution of low sulfur coals for high sulfur coals, the following strategy is followed:

(1) In cities good quality coals are used -- means lower ash and sulfur. Steaming coal used in major cities averages less than 1% sulfur.
(2) Low quality coals are usually not shipped long distances.

Clean Coal Technologies

Chinese officials are quite aware of the environmental problems associated with coal use. However, in practice, the willingness and ability of the government to take effective action to reduce pollution is limited, given the pressures to increase energy production to meet the rapid growth in energy consumption, and economic growth targets. Greater washing of coal, and supply of higher quality coal products (briquettes, etc.) to the non-utility market is planned in the 1990s.

MOE emphasized that their primary focus is ***how to best use existing technologies to reduce pollution and increase efficiency.*** MOE stated that the key problem that constrains plans to increase the efficiency of coal use and reduce pollution is the lack of funds.

MOE officials specifically said that they are not looking at frontier technologies (clean coal technologies) to solve their pollution problems. However, if DOE wanted to set up a pilot clean coal technology plant in China, they would be pleased to cooperate. DOE would be responsible for the hard currency portion of the funding.

Conference Participation

MOE is quite interested in participating in the July Coal Conference in Hawaii. The issue of funding was not discussed, but from past experience it is known that they are unable to pay their own travel and per diem costs. Mr. Jia Yunzhen speaks good English and has attended many international conferences. He would probably be the person to participate in the conference. However Mr. Zhu Chengzhang and Madam Shu HuiFen are the experts, but do not speak significant English. If one of these people were also able to attend the conference there may be greater potential for follow-up cooperation on the Chinese side.

Key People Interviewed

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(2) Mr. Zhu Chengzhang (No English, reviewed China's coal situation)
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(3) Madam Shu HuiFen (No English; reviewed environmental issues)
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(5) Dr. Virginia E. Palmer
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(6) Mr. Xie Shaoxiong (Did not meet on trip but have met before)
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HONG KONG

Summary

Electricity consumption grew at 8.9 percent per year during the 1978-1988 period. In 1979 all of Hong Kong's electricity was generated by oil, however a rapid shift to coal occurred during the 1980's, and by 1988 coal accounted for 98 percent of all fuel consumed for electricity generation. Coal's share will decrease substantially with the start-up of a nuclear power plant in 1992. Hong Kong presently exports about 350 MW of power to China.

Environmental regulations are quite strict in Hong Kong, and FGD equipment is probable on all new coal-fired power plants.

Energy Sector Organization

There is limited government intervention in the energy sector except in the environmental area, establishing tariffs and allowable returns to the utilities. The Economic Services Branch of the Secretariat deals with energy policy issues.

Two private power companies, China Light & Power and Hong Kong Electric, supply all electricity for Hong Kong. China Light & Power accounts for about 70 percent of the electricity market. It should be noted that China Light and Power is both efficient and quite profitable in contrast to many of the state utilities in Asia. Hong Kong's Environmental Protection Department is in the process of considering regulations on sulfur emissions from coal-fired power plants that will effectively force all new plants to install desulfurization equipment.

Energy Plans

Steam coal consumption for electricity generation is projected to increase from about 10 million tonnes in 1990 to about 15 million tonnes in 2000. The increases in coal consumption in the 1990's are moderate due to the impact of

two nuclear power units that will begin operation in 1992 and 1993. The decision to install two nuclear power units was not based strictly on commercial considerations as coal is believed to be the lowest cost alternative for electricity in Hong Kong. China apparently wanted Hong Kong to build a nuclear power plant and the British government apparently supported, and may have provided incentives to Hong Kong to construct the Guangdong Nuclear Power Station.

Coal Supplies

Australian coal: No particular problem except with Ulan coal which causes problems with precipitators.

Chinese coal: Acceptable except for substantial amounts of foreign matter (i.e. blasting caps). Through a barter arrangement 500,000 tonnes of coal were shipped to China Light and Power in 1989 in exchange for electricity. The remainder of shipments from China are for cash. The Chinese are also selling some coal to Europe (transported in Chinese ships).

Colombian coal: Only competitive when the Colombian's can obtain exceptionally good shipping rates. In addition, it is more difficult to conclude an acceptable agreement with the Colombians.

Indonesian coal: Kaltim Prima coal from Kalimantan is low ash but has high moisture. China Light and Power recently closed down a coal-fired unit as a result of an unexpected slagging problem that occurred when they blended coals from the United States and Indonesia.

South African coal: difficult to precipitate ash.

Sources of coal: In 1987, the sources of the 8 million tonnes of steaming coal imports were as follows: 37 percent Australia, 32 percent South Africa, 25 percent China and 6 percent others.

Environmental Issues

The Secretary for Planning, Environment and Lands (SPEL) has overall responsibility for policy on environmental issues. The Environmental Protection Department advises SPEL and also is responsible for implementation

and enforcement of environmental legislation.

China Light and Power presently burns high quality coal with an average of 0.6% sulfur and 12 percent ash. The modern power plants have efficient electrostatic precipitators, and the next coal-fired plant planned for 1996 will have FGD and low NO_x burners. There are plans to retrofit one unit with low NO_x burners that will result in emissions of about 300 ppm NO_x. In the future they may have to install SCR technology to reduce NO_x to the 100 ppm range.

Government regulations are likely to require both (1) 90 percent removal of sulfur and (2) a limit of 1 percent sulfur in all coal. If these regulations are implemented, as expected, they will eliminate the option of using low sulfur coal to meet environmental regulations. This was confirmed by both the China Light and Power and the Environmental Protection Office. Another result will be that the legislation will remove the incentive to use coals with sulfur contents below the upper limit of 1 percent.

The present limit on particulate emissions is 115-125 mg/m^3, and actual emissions from the power plants are in the range of 25 mg/m^3. New plants will probably have to meet emission limits of 85 mg/m^3 (My notes are not clear on limits for new plants).

Ash disposal costs about US$10 per tonne (about US$1.2 per tonne of coal burned).

Clean Coal Technologies

China Light and Power is unlikely to install Clean Coal Technologies until they have been commercially proven or there are substantial incentives from the supplier of the technologies.

Note: In the near term Hong Kong may be a better place to test clean coal technologies than China for two reasons: (1) Hong Kong has the technical skills and (2) efficient management experience that is essential in testing clean coal technologies. Hong Kong will become a province of China after 1997, and perhaps could become a showcase and window for the introduction of new clean coal technologies to China.

Conference Participation

An ideal participant is Keith Stott, an articulate, very knowledgeable executive of China Light and Power Company. There are a number of suitable alternatives within China Light and Power if Keith Stott is not available. In the government sector, Franklin Chung knows the evolving situation on the environmental side.

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INDONESIA

SUMMARY

Indonesia has the fasted growth rate in electricity consumption in Asia averaging about 15 percent per year over the past decade. Forecasts for the 1990's range from 9 to 14 percent per year. Estimates of domestic coal consumption vary widely from 18 to 39 million tonnes in 2000. Domestic coal production is forecast to increase from about 8 million tonnes in 1989 to about 50 million tonnes in 2000. Forecasts of coal exports vary widely from 11 to 32 million tonnes per year, depending on assumptions about the size of the domestic market in 2000.

It is assumed in the EWC Coal Project that total production in 2000 will be in the 40-50 million tonne range and domestic consumption will be in the 20-30 million tonne range. Assuming the average of these estimates gives: 45 million tonnes production, 25 million tonnes consumption and 20 million tonnes available for the export market in 2000.

Some of the coal from Kalimantan is among the lowest cost coal in the world for the Asian market. In addition, some of the coal has sulfur contents down to 0.1 percent sulfur and could meet most sulfur emission standards without FGD equipment. However, most of the coals have some quality deficiencies including one or more of the following: low energy content, high moisture, unacceptable grindability (too hard), low fusion temperatures. Wide acceptance in the electric utility market will require considerable testing among utilities and careful quality control by producers, a potential problem for small producers.

Energy Sector Organization

The Ministry of Mines and Energy has overall responsibility for the energy sector. Under the Ministry are Pertamina (the state oil and gas corporation), Perusahaan Listrik Negara (PLN) (the state electricity authority), and the State coal mining companies: PT Tambang Batugara

Bukit Asam and Tamban Batubara Omblin.

Coal Companies, Qualities and Reserves

Figure 1 shows the location of the contract areas in Kalimantan, and Table 1 shows the coal qualities for the contract areas. Reserves can readily support planned production levels in most contract areas. However, the low quality and unfavorable locations of some deposits are likely to result in some delays and slower rates of development than indicated below. The following is a brief description of the coal contractors in Indonesia in mid-1990.

PT Kaltim Prima: This is the premium coal project in both quality and probably competitive position in Indonesia. A joint venture between CRA (Australia) and BP (Britain). The project has a planned capacity of 7.0 million tonnes per year, an average stripping ratio of 6/1. Coal will be transported 13 km by conveyor belt to ships up to 180,000 DWT. Capital investment is estimated at about US$500 million (US$71-79/annual tonne capacity), and direct operating costs will probably fall in the US$12-15 per tonne range. This project can supply steaming coal to Asia at very competitive prices, and is likely to be competitive in the European market, and perhaps in the coastal areas of eastern United States.

The project is expected to produce about 800 thousand tonnes in 1990 with transport to the port by truck. Commercial production using the preparation plant and conveyor system is expected in late-1991 with a gradual build up to 7.0 million tonnes in 1996 with about 6 million tonnes going to the export market. The build up to 7 million tonnes could occur well before 1996. The capacity constraint of 7 million tonnes is primarily due to the capacity of the conveyor belt system.

PT Arutmin: A Utah International Project (United States) a fully owned subsidiary of BHP (Australia). The project is about 15 kilometers from barge loading facilities that can directly serve markets or can transfer coal to ships for regional markets. This project has a stripping ratio of about 6:1 and staged development is planned from the present production of

about 1 million tonnes to 5.5 million tonnes in 1993. Substantial production will probably go to Indonesian power plants.

PT Allied Indo Coal: This is an 80 percent Australian joint venture (Allied Queensland Coalfields) on Sumatra in the Ombilun area. Capacity is about 500 thousand tonnes mainly for the export market.

PT Tanito Harum: This is the only 100 percent Indonesian coal contractor. Production in 1990 estimated at 700-900 thousand tonnes per year from a deposit along the Makakam River in Kalimantan. Outlook is for a gradual build up to perhaps 2 million tonnes in the late 1990s.

PT Multi Harapan Utama: This is a 50 percent Indonesian joint venture with Hope of Australia. Production in 1990 is estimated at about 1.2 million tonnes and 1.5 million tonnes 1991-1995. The deposit is located along the Makakam River in Kalimantan. About half the production is available for export.

PT Kideco Jaya Agung: A Korean project under development to produce about 2 million tonnes per year in 1994. The deposit is located in Kalimantan, and coal will be transported about 40 kilometers by truck to a coal terminal. The low quality of the coal and the limited ship size (less than about 70,000 DWT) indicate that all production will be used within the Asian region.

PT Chung Hua OMD: This Taiwan group is exploring and evaluating a deposit in Kalimantan.

PT Adaro Indonesia: This project in Kalimantan is 70 kilometers from the Barito River where barges will carry the coal to a common user terminal on Pulau Laut. The coal has very low ash but high moisture and sulfur. Production of about 250 thousand tonnes is planned for 1991 and expansions to 5 million tonnes in 1994 have been suggested. However, given the nature of this deposit relative to others on Kalimantan, the start-up date and build up to 5 million tonnes in 1994 appear optimistic.

PT Berau Coal: This project on Kalimantan is located 10 kilometers from the Berau River, where small 3500 DWT barges will carry the coal to a

transshipment point. Production starting at 0.5 million tonnes in 1994 jumping to 2 million tonnes in 1995 have been suggested. Due to coal quality considerations and transportation constraints, the rate of development of this project could be slower than indicated.

PT Tambang Batugara Bukit Asam: A state corporation operating the Bukit Asam mine on Sumatra. Estimated production for 1990 is 5 - 5.5 million tonnes for the domestic market. In the late-1990's the mine will probably be expanded to the 11 million tonnes per year range.

PT Tamban Batubara Ombilin: A state corporation operating the Ombilin mine on Sumatra. Production in 1990 is estimated at about 600 thousand tonnes, and will approximately double by the mid-1990's.

Coal Supply and Consumption

The demand for electricity in Indonesia is likely to grow faster than new capacity is added. Domestic requirements can be readily met from domestic supplies. There is uncertainty about the timing of new coal fired generation capacity, therefore estimating the amount of coal that will be available for the export market is subject to considerable uncertainty.

Clean Coal Technologies

I did not talk to energy planners during my visit to Indonesia, however Indonesia is an unlikely candidate for the early introduction of Clean Coal Technologies for the following reasons: (1) It has ample reserves of low sulfur coal, plus substantial reserves of low sulfur natural gas and petroleum; (2) power plant expansions cannot keep up with the growth in consumption, and the focus of capital expenditures will be on new generating capacity with control of ash but not sulfur emissions.

Conference Participants

A possible participant is Mr. A. Andoyo, director of Electric Power Planning and Development, Directorate General of Electric Power and New Energy, Ministry of Mines and Energy. Mr. Andoyo presented a

paper at the 1989 "Asia-Pacific Technology Conference". In addition, Mr. E. Yamin, President and Director of the PLN (the state electricity authority) would be a good participant.

Key People Interviewed

A visit was made to the PT Kaltim Prima coal project, the most important coal mine development in Indonesia with respect to the export market. At the mine I met the key people responsible for the development of the project. During my visit to Melbourne I met the head office executives responsible for this project. There names are listed under Australia.

(1) Doug Fishburn
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TABLE 1
COAL QUALITIES AND RESERVES/RESOURCES
IN EASTERN KALIMANTAN

CONTRACTOR	DEPOSIT	ENERGY BTU/lb[1]	SULFUR %	MOISTURE % (T.M.)	ASH %	HGI[2]
ARUTMIN	Senakin	10,700	0.7	9	15	37
	Satui	11,800	0.8	10	8	n.a.
UTAH INDO.	Petanggis	11,300	0.8	10	12	35
KALTIM PRIMA	Prima	12,100	0.5	9.5	4	50
	Pinang	10,800	0.4	13.5	7	45
KIDECO J. A.		8,200-9,900	0.1	21-30	2	50-55
ADARO INDO.		10,000	0.1	20	1	31-45
BERAU COAL	Lati	9,800	0.9	19	3	52
ALLIED INDO		11,600	0.5	12	7	25-43
CHUNG HUA		9,400-11,700	0.3-0.9	10.5	9	29-39
MULTI HARAPAN		10,600	0.8	14-16	5	46
TANITO HARUM		10,900	0.6	14-16	6	46-48

[1]Gross As Received. [2]Hardgrove grindability index: most utilities require an HGI of 40 or greater)
Note: there are substantial variations in coal quality within some deposits.

JAPAN

Summary

Japan is the largest importer of coal in the world with estimated total imports of about 107 million tonnes in 1990. In addition, Japan's environmental regulations are among the strictest in the world. The result is that Japan has the highest share of coal-fired generation capacity with desulfurization equipment in the world. According to the Ministry of International Trade and Industry (M.I.T.I.) their plans for the next twenty years include stabilization of CO_2 emissions by 2000. M.I.T.I. projections indicate coal consumption will stabilize at 142 million tonnes after 2000. Industry estimates indicate slow growth in coal consumption after 2000. Nuclear power is expected to play an increasing role in the power sector over the next 20 years. Japan has an active clean coal technology development program which seems tailored to specific problems in the Japanese market -- particularly relating to transportation constraints. Therefore, substantial research is going into the development of coal-oil and coal-water mixtures that can be moved by pipe.

Energy Sector Planning

There are numerous organizations involved in energy planning. M.I.T.I. energy and environmental planners were interviewed as they are the most powerful agency involved in long term energy and environmental planning. There appeared to be substantial differences between the views of M.I.T.I. and industry on the future of coal use in the electric utility industry. The main difference is that M.I.T.I. gives greater weight to global warming issues and believes that the favored option, nuclear power, can be expanded more rapidly than industry anticipates. The widely quoted M.I.T.I. forecasts appear to be "policy guidelines" and not absolute requirements for industry.

Energy Plans and Strategies

There are various statements of energy policies, goals and strategies. The following are extracted from M.I.T.I.'s June 1990 "Advisory Committee for Energy -- Summary Report":

Basic Facts and Assumptions:

(1) The increasing standard of living in Japan will result in continued increases in energy consumption.

(2) World oil supplies are not expected to keep up with the growth in demand, particularly after the mid-1990's, and therefore prices for oil will increase substantially.

(3) The global warming problem, particularly with respect to increases in CO_2, is sufficiently serious to justify action now to reduce the growth in CO_2 emissions.

(4) Japan is both the fourth largest consumer of energy and fourth largest producer of CO_2 in the world. Therefore, Japan plays an extremely important role in international energy affairs.

Basic Philosophy of Energy Policies:

"Achieve energy supply with a minimum increase in energy demand, lower dependency on oil, and increase dependency on nonfossil energy sources, while at the same time, actively promote international cooperation in the energy field."

Goals:

(1) The most important goal is to ensure stable energy supplies (i.e. energy security);

(2) respond to global warming problems at both the national and international level, while maintaining stable economic development.

Energy Strategies:

(1) Intensified energy conservation through: (a) utilization of waste heat, (b) increased efficiency of energy use in buildings, (c) recycling energy intensive natural resources, (d) improved efficiency of appliances, automobiles and power generation plants.

(2) Reduced dependence on fossil fuels through: (a) development of nuclear power to the maximum extent possible, (b) introduction of unconventional energy sources, (c) expansion of hydo and geothermal sources of energy, (d) (my interpretation) industry will be encouraged to reduce the rate of growth in coal consumption because coal is the largest CO2 contributor per unit of energy (also will promote commercial development of combined cycle power generation), (e) simultaneous reduction in dependency on oil and increased efforts to secure stable supplies, and (f) encourage improvement in the electricity load curve.

Coal Supplies, Qualities and Prices

Japan's economic coal reserves are quite small, and production is declining over time. Therefore, Japan's steaming coal industry is almost totally dependent on coal imports. The following summary is largely based on research at the Institute of Energy Economics (October 1990):

(1) Australia: In 1989 Australia accounted for 69 percent (20.3 million tonnes) of total steaming coal imports. This share is forecast to range from 63-70 percent in 2000 and 60-70 percent in 2010 -- depending on how actively Japanese companies diversify away from Australian coal.

(2) United States: Imports of 1.3 million tonnes in 1989 are forecast to expand to 5.5-10.5 million tonnes in 2000 and 10-20 million tonnes in 2010. There is concern about the use of subbituminous coal which makes operating plants more difficult.

(3) Soviet Union: Imports of 2.5 million tonnes in 1989 increasing to 4.5 million tonnes in 2000 and 5.0 million tonnes in 2010. The coal is low sulfur, but some utilities have encountered slagging problems.

(4) South Africa: Imports of 1.6 million tonnes in 1989 increasing to 3 million tonnes in 2000 and 5 million tonnes in 2010.

(5) China: Imports of 2.4 million tonnes in 1989 increasing to 3 million tonnes in 2000 and 4 million tonnes in 2010.

(6) Indonesia: Trial imports of about 30,000 tonnes in 1989 increasing to

1.5 million tonnes in 2000 and 3 million tonnes in 2010.

(7) Colombia and other: Nil imports in 1989 increasing to 1 million tonnes in 2000 and 2010.

The above estimates appear to be conservative with respect to increased supplies outside of Australia and the United States. For example, these estimates appear to underestimate the expansion potential of Indonesian coal -- some of which is very low cost, and has both very low sulfur and ash contents.

Anthracite: A shrinking market. Can be used in fluidized bed boilers. Contracted for 825,000 tonnes in 1990. Is used as a substitute for coal breeze in sinter. Personal note: modernization of anthracite mines in Vietnam (which has large reserves near the coast) could result in substantial increases in exports at competitive prices. The largest Australian mining company, BHP, is involved in a modest sized commercial anthracite project in Vietnam.

Coal Prices: Forecasts are based on assumptions about trends in Australian coal -- the price setter in the Pacific. The general view was that coal prices will be firm in the 1990s with less excess capacity than in the 1980's. The trend in coal prices has been averaging 5 percent per year compared to the average Australian inflation rate of 7 percent per year. Therefore, the Institute of Energy Economics assumes the trend in coal prices will fall within the range of 5-7 percent per year. This forecast assumes a continuation of the conditions that existed in the 1980's (a contradiction to suggestions that prices will be firmer in the 1990's).

Japanese Equity in Foreign Coal Mines: Japanese equity participation in foreign coal mines has been increasing as indicated in the following statistics prepared by the Coal Department of M.I.T.I.. An estimated 43

Number of projects:	with Japanese equity	Japanese equity above 30%
1980	14	3
1989	49	20

percent of coal imported to Japan is from mines with Japanese equity. The growing role of Japanese equity in coal mines increases the difficulty of modelling future import patterns based only on the economics of coal supplies as substantial sales may not be arms-length (open-market).

Coal Consumption Forecasts (There are numerous forecasts for Japan):

Both the Institute of Energy Economics and Idemitsu Kosan Co. have forecast increases in steam coal consumption of 35-38 million tonnes over the 1988-2000 period. M.I.T.I. forecasts an increase in total consumption (steaming and coking) of 27 million tonnes over the same period. Part of the difference is the assumption that coal consumption in the steel industry will decrease over this period.

(1) M.I.T.I. nuclear power forecast:

Nuclear power -- expands from the current 30,000 Mw to 50,000 Mw in 2000 and 72,000 Mw in 2010 (will require construction of 40 nuclear power plants).

(2) M.I.T.I. coal forecasts (date of forecast):

Latest forecast (June 1990):

1988 (actual)	114.6 million tonnes
2000	142.0 million tonnes
2010	142.0 million tonnes

(October 1987):

2000	136 million tonnes

(November 1983):

2000	160-170 million tonnes

(3) Institute of Energy Economics Forecast:

Coal consumption to increase by about 35 million tonnes to 2000, assuming a 4% annual growth rate in the economy. Table 1 (appendix) contains the Institute of Energy Economics forecast of coal consumption by

sectors in Japan. The greatest uncertainty in these forecasts is not the demand for steaming coal but the demand for metallurgical coal used in the steel industry.

(4) Idemitsu Kosan Co. Forecast:

Table 2 (appendix) shows total steam consumption growing from about 43 million tonnes in 1988 to 81 million tonnes in 2000. Table 3 (appendix) gives details of annual coal-fired power plant additions to 2000.

(5) Major Utilities Forecast: Table 4 (appendix) shows the forecast of steam coal consumption and its share of total electricity for the nine major electric utilities:

Electric Utility Industry

There are nine major power companies in Japan. They believe that nuclear power is the best alternative for three reasons: (1) nuclear is the lowest cost source of electricity, (2) nuclear is more environmentally acceptable than fossil fuels, and (3) nuclear best meets security of supply considerations. Note: there appeared to be a firm belief among those interviewed that Japan has the technical expertise and experience to avoid significant risk from nuclear plant accidents associated with expanded use of nuclear power.

Coal prices are acceptable, but environmental costs are high. In addition, ash disposal is a serious problem in some areas where ash must be trucked through towns, and it is exceedingly difficult to obtain approvals to transport additional ash by road.

There are no plans to build new oil-fired power plants in the future.

Plans are to add 40 nuclear plants between 1990 and 2010 or an average of two per year. However, industry sources indicated that this M.I.T.I. projection is optimistic. There is a "nuclear power acceptance" program in Japan to get people to accept nuclear power. Under this program, utilities

construct recreational and other facilities in the area of nuclear power plants, and provide subsidies to attract industry.

Power Plant Economics

Table 5 shows M.I.T.I.'s June 1990 estimates of the capital and operating costs of electricity for a plant start-up in 1989. The exchange rate was not given so the average for 1989 was assumed (137.96 Yen = US$1.00). In the M.I.T.I. table nuclear power is the lowest cost alternative for electricity.

Table 5
COMPARISON OF COSTS OF ELECTRICITY
FROM ALTERNATIVE PLANT TYPES

Power Plant Type	Capital Cost (US$/kw)	Total Costs (US Cents/kwh)
Nuclear	2247	6.5
Coal-fired	1667	7.2
LNG-fired	1450	7.2
Oil-fired	1377	8.0
Hydroelectric	4639	9.4

M.I.T.I. Report by the Advisory Committee for Energy, June 1990

Environmental Policies and Regulations

Environmental policies appear to originate from both M.I.T.I. and the Environmental Protection Agency. There are two basic organizational levels where environmental controls originate. The central government establishes minimum environmental requirements, and the local prefectures (local governments) establish stricter regulations -- particularly for SOx and NOx. Regulations specify both the level of emissions and the quality of fuels that can be burned.

The present regulations on SOx and NOx emissions in Japan are among the most stringent in the world. In 1989, the estimated percent of plants with SOx control equipment (Flue Gas Desulfurization) and NOx controls are shown in Table 6.

Table 6
PERCENT OF ELECTRICITY GENERATION CAPACITY HAVING SOx AND NOx EQUIPMENT IN SELECTED COUNTRIES

Country	SOx (FGD)	NOx Reduction
Japan	90	63
United States	20 (approx.)	n.a.
West Germany	85	20 (approx.)

IEA Coal Information, etc.

At present there are no CO_2 regulations. However, according to M.I.T.I., they are developing policies to control CO_2 emissions in the future. Plans are for slow growth in CO_2 emissions during the 1988-2000 period, and no increases after 2000. M.I.T.I. plans also assume no growth in coal consumption after 2000.

Clean Coal Technologies

There are a range of technology research programs underway including fluidized bed combustion, coal gasification combined cycle, and coal-liquid mixtures. Substantial emphasis is being placed on coal preparation to allow ease in transportation.

The three coal products being investigated are: the coal cartridge system (CCS), coal-water mixture (CWM) and coal-oil mixture (COM). The CCS is a system of pulverizing coal and transport by truck for use in small to medium boilers. For large users, CWM and COM are being developed. Tokyo

Electric Power Company has been actively involved in using COM and CWM on a trial basis at electric utility plants.

Interest in CWM and COM appears to be primarily because of the difficulty in transporting coal to the various power plants in Japan. It should be noted that many of these power plant sites were selected when oil was the fuel of choice, and pipe transportation assumed.

Changes in the technologies and methods of making steel are likely to result in increased substitution of steaming coal for high priced coking coal.

My impression of the Japanese clean coal technology program from my limited discussions in Japan, and review of selected documents, is that it is more narrow in scope, and perhaps, less innovative then the US program. However, is has had considerable commercial success with FGD on its plants -- I was told that sulfur recoveries up to 98 percent have been achieved.

Among industrialized countries Japan appears to be the most likely to take action to control pollution in Asia. The reasons are because Asian countries have a higher long term priority to Japan, and Japan's concern that pollution in Asia can impact on Japan's environment. Consequently, Japan may be more aggressive in introducing pollution control technologies in other Asian countries, and perhaps, provide more flexible financing terms. There is a need to examine and compare the two clean coal programs more closely to determine if these very preliminary observations is correct.

Conference Participation

Participants from M.I.T.I., Tokyo Electric Power Company (Japan's largest utility) or the Institute of Energy Economics would be suitable for the Coal Conference. An impressive speaker pertaining to long term environmental issues, and the likely changes in power plant choices, is Mr. Hiroshi Watanabe of M.I.T.I.. He would be a strong speaker, and is well aware of longer term energy and environmental issues in Japan

Key People Interviewed

(1) Mr. Tadashi Abe — Tel: (03) 213-4148
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Coal Supply — (knows major supply issues)
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(2) Mr. Akira Chimura — Tel: (03) 501-7866
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APPENDIX

Table 1
FORECAST OF TOTAL COAL CONSUMPTION
IN JAPAN, 1988, 2000 AND 2010
(Million tonnes)

Sector	1988 (Actual)	2000	2010
Steam coal:			
Electricity	24.1	60.2	80.7
Manufacturing	18.7	17.0	19.6
Steel	0	0.7	5.5 - 16.2
Steam Coal:	42.8	77.9	105.3 - 116.5
Metallurgical	72.0	39.0 - 58.7	36.5 - 34.7
Total Coal:	114.8	116.9 - 136.6	141.8 - 151.2

Institute of Energy Economics, 1990, "Outlook for Japan's Supply-Demand and Prices for the Year 2000 and 2010", October.

Table 2
FORECAST OF STEAM COAL CONSUMPTION

Year	Million Tonnes	Increase From 1988
1988	43.3	--
2000	80.9	37.6
2010	86.8	43.5

Idemitsu Kosan (August 22, 1990)

Table 3

FORECAST OF ADDITIONS TO COAL-FIRED CAPACITY AND STEAM COAL CONSUMPTION

Year	MW Added	Increased Coal Consumption (million tonnes)
1989	700	1.54
1990	1,000	2.20
1991	1,200	2.64
1992	1,050	2.31
1993	1,956	4.30
1994	1,156	2.54
1995	2,650	5.83
1996	1,600	3.52
1997	4,800	10.56
1998+	10,500	23.10

Idemitsu Kosan (August 22, 1990)

Table 4

FORECAST OF STEAMING COAL CONSUMPTION
BY THE NINE MAJOR UTILITIES

Year	Steaming coal (million tonnes)	Percent of total electricity
1989 (actual)	24.2	9
1990	25.1	10
1994	31.1	11
1999	48.2	15

Tokyo Electric Power, 1990

PHILIPPINES

Summary

The economic growth rate in the Philippines of 4.3 percent per year over the past four years is expected to continue in the early part of the 1990's. Electricity consumption has been increasing at 1.2 times the growth rate of the gross domestic product. The policy of developing the domestic low quality coal resources for electricity generation has been accompanied by considerable problems in supplying uniform quality coal to power plants. During the 1990's high quality imported coals will account for the largest share of the growth in coal consumption. Demand is forecast to reach about 14 million tonnes in 2000 with domestic supplies leveling off at about 4 million tonnes. Due to the continued unstable state of the Philippines economy forecasts must be used with considerable caution.

Effective environmental constraints are modest, and there are no plans to add FGD equipment to coal-fired plants in the 1990's. The introduction of clean coal technologies on a commercial scale in the 1990s is considered a distant possibility.

Energy Sector Organization

The National Power Corporation is a state corporation responsible for the national electricity generation and distribution system. The Office of Energy Affairs is under the Office of the President. It is the main policy, planning and regulatory agency for the energy sector. There is also a National Coal Authority to promote development of the domestic coal industry, and the Philippine National Oil Company with responsibility for petroleum industry exploration and development.

Energy Plans

Table 1 shows the energy supply mix in 1989 with projections to

2000. Coal-fired plants are expected to account for the largest share of expansion in the 1990's with the majority of the coal coming from imports. Coal consumption for electricity generation is forecast to increase from 1.1 million tonnes in 1990 to 7.7 million tonnes in 2000.

Table 1
PRESENT AND FORECAST ELECTRIC
ENERGY MIX IN THE PHILIPPINES
(Percent)

Year	Coal	Geothermal	Hydro	Oil
1989	9	22	27	42
2000	32	30	20	18

National Power Corporation, 1990 Power Development Program (1990-2005).

Coal Reserves, Supplies and Consumption

Coal reserves and quality: Reserves of coal are reported at 250 million tonnes with about 75 percent located in Luzon. The two largest deposits are Semirara (93 million tonnes with average mined coal of about 8,600 Btu/lb) and Cagayan Valley (88 million tonnes averaging about 4,700 Btu/lb). There are only about 20 million tonnes of relatively high quality (greater than about 11,000 Btu/lb) coal reserves reported in the Philippines. Coal development is hindered by five basic problems:

(1) Low energy content (subbituminous to lignites)
(2) Reserves tend to be small deposits in thin seams
(3) Seams tend to be steeply dipping and disturbed
(4) Coal quality is quite variable

(5) Poor quality control in mining coal and no beneficiation

Coal supplied to the National Power Corporation often fails to meet contract specifications due to (4) and (5). The best deposit with respect to the size of reserves is on Semirara Island. Coal from the Semirara mine often does not meet the specifications in contracts with the National Power Corporation. The problem is difficult to solve because of government involvement in both the supply and consumption of coal, and a lack of political will to enforce contracts in the same manner that occurs with imported coal.

Those contacted in the National Power Corporation expressed interest in learning more about (1) terms in long term coal contracts, and (2) technical and economic aspects of coal beneficiation.

Coal production: Domestic production is forecast to increase from 1.4 million tonnes in 1989 to about 4 million tonnes in 2000, far below projected total coal requirements of about 14 million tonnes in 2000. Table 2 shows present and projected coal consumption.

Imported coal: Because of the low quality and limited quantities of domestic coal, it is blended with high quality imported coal to produce a higher quality coal for electricity generation. The National Power Corporation designs its coal-fired plants to handle variable quality coals which probably adds to the total costs of electricity generation. In 1989 970,000 tonnes of coal was imported and consumed in the following industries: electric power (420,000 tonnes), cement industry (420,000 tonnes) and the mining industry (130,000 tonnes).

With respect to reliable sources of coal supplies, Indonesia was suggested as one of the most reliable foreign sources of supply because both the Philippines and Indonesia are members of ASEAN.

Environmental Issues

Particulate emissions: All plants have electrostatic precipitators.

Sulfur oxides: The total SOx emission limit for their power plants is 250

mg/m^3. However, when the SOx limit cannot be met, control will be by increasing the stack height to produce a ground level concentration of 360 ug/m^3 over 24 hours. At present the coal-fired plants cannot meet emission standards but can meet ground level concentration limits.

The Department of Environment and National Resources has the responsibility for reviewing environmental assessments required for all new power plants.

Clean Coal Technologies

There are no plans to install FGD equipment on power plants because of the high capital and operating costs of such systems. The Philippines does not appear to be a good candidate for clean coal technologies during the 1990s.

Conference Participation

Coal Conference information should be sent to Mr.Ernesto Aboitz, President of the National Power Corporation, and Mr. Wemcesnao R. Dela Paz, Office of Energy Affairs. Both Dr. Gonzalo A. Bantugan and Mr. Rufino B. Bomasang expressed interest in attending the workshop.

Table 2
PRESENT AND FORECAST COAL CONSUMPTION
IN THE PHILIPPINES
(Million tonnes)

Sector and Source	1989	1995	2000
Electricity Generation (total)	1.1	3.4	10.8
Domestic coal	0.6	2.1	3.0
Imported coal	0.4	1.3	7.8
Cement (total)	0.8	1.1	1.4
Domestic coal	0.5	0.6	0.7
Imported coal	0.4	0.5	0.7
Mining & other (total)	0.4	1.5	1.5
Domestic coal	0.3	1.1	0.4
Imported coal	0.1	0.4	1.0
Total coal consumption	2.3	6.0	13.7
Total domestic	1.4	3.8	4.2
Total imported	0.9	2.2	9.5

Note: totals vary slightly due to rounding
NEDO, June, 1990

Key People Interviewed

(1) Mr. Josue D. Polintan — Fax: 921-3526
Senior VP — (chaired meeting, knowledgeable)
National Power Corporation
BIR Road East Triangle
Diliman, Quezon City

(2) Dr. Gonzalo A. Bantugan — (expressed strong interest in conference)
VP Corporate Specialist
Environmental Science/Management
National Power Corporation
BIR Road East Triangle
Diliman, Quezon City

(3) Mr Marcio E. Mano — (negotiates coal contracts)
VP Operations
National Power Corporation
BIR Road East Triangle
Diliman, Quezon City

(4) Mr. Roberto C. Agustin
Manager Thermal Design Div.
National Power Corporation
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(5) Mr. Rufino B. Bomasang — Fax: 817 8603
Deputy Executive Director — (10 years in coal industry)
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Office of the President
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KOREA

Summary

Growth in electricity generation averaged slightly over 10 percent per year during the 1979-1989 period with higher growth rates during the late 1980s. Korea rapidly expanded its nuclear capacity from 6 percent in 1980 to approximately its long term goal of 36 percent in 1989. Coal's share of total capacity declined during most of the 1970's, and increased during the 1980's. Coal will continue to increase its share of total capacity from about 18 percent in 1989 to 31 percent in 2000. Total steam coal consumption (excluding anthracite) for all uses is forecast to increase from about 9 million tonnes in 1989 to 29 million tonnes in 2000.

Environmental regulations are expected to tighten substantially after the mid-1990s, resulting in the addition of desulfurization equipment on new coal-fired plants. The cornerstone of Korea' energy strategy is security of fuel supplies. With respect to coal supplies, the strategy is to diversify sources of supply and increase Korean participation, through joint ventures, to about 30 percent of total supplies.

Energy Sector Organization

The key agency for energy planning is the Ministry of Energy and Resources (MOER). With respect to environmental issues the Ministry of Environment has recently been elevated to Cabinet level. The Korean Electric Power Corporation (KEPCO) is a government enterprise responsible for electricity supplies throughout Korea. The Korean Energy Economics Institute (KEEI) is an academic energy research institute that examines energy and environmental policy issues within an economic framework.

Energy Policies and Plans

The following four fundamental considerations guide government

energy policies:

(1) Security of supply
(2) Economics and economic development
(3) Environment (increasing emphasis)
(4) Safety (increasing emphasis)

Security of supply is the most important consideration. It includes a strategy to diversify sources of supply and to increase equity participation to 30 percent of total supplies.

Table 1 shows the present mix of power generation capacity in Korea and MOER's forecast for 2000. As shown in Table 1 nuclear power will remain at the current level of 36 percent. During the 1990's coal-fired capacity will increase from about 18 percent to 32 percent of total capacity. Oil's share will decline by about 50 percent from about 23 percent to 11 percent over the 1989-2000 period, and LNG and hydro will decrease slightly.

It is important to note that the share of total electricity generation varies considerably from installed capacity, because nuclear power with the lowest operating costs, is operated at the highest percent of plant capacity. Nuclear power, with 36 percent of capacity, generated 50 percent of total electricity in 1989, and is expected to maintain this share throughout the 1990's. Coal generated about 17 percent of electricity in 1989, and is forecast to generate 35 percent of electricity in 2000. LNG's share of electricity generation is expected to decline from 9.7 percent in 1989 to only 2.4 percent in 2000.

Table 2 gives present and forecast consumption of coal in Korea from 1989 to 2000. Total coal consumption is forecast to increase from 44 million tonnes in 1989 to 77 million tonnes in 2010. The growth of steaming coal is forecast to increase from about 9 million tonnes in 1989 to about 50 million tonnes in 2010 with an average growth rate of 16.6

percent per year. As shown in Table 3 steaming coal used in electricity generation is projected to increase from about 5 million in

Table 1
EXISTING AND PROJECTED
POWER GENERATION CAPACITY IN KOREA
(Percent)

Year	Nuclear	Coal	Oil	LNG	Hydro
1989	36.3	17.7	22.8	12.1	11.1
2000	36.1	31.4	11.3	10.7	10.5

Ministry of Energy and Resources, 1990, Major Statistics of Energy and Resources.

Table 2
FORECAST OF COAL CONSUMPTION IN KOREA
(Million tonnes)

Year	Steaming coal	Coking coal	Anthracite	Total
1989	9.2	11.1	23.3	43.6
1995	21.5	14.6	15.9	52.0
2000	28.9	18.7	12.5	60.1
2010	49.6	21.9	5.6	77.1

Won-Woo Lee, 1990 "Recent Coal Situation and Outlook in Korea", Korea Energy Economics Institute.

1990 to 19 million tonnes in 2000 with an average growth rate of 13.6 percent per year.

Table 3
FORECAST OF STEAMING COAL CONSUMPTION
FOR ELECTRICITY GENERATION

Year	Million tonnes
1990	5.3
1995	13.2
2000	19.0

Ministry of Energy and Resources, 1990

Coal Reserves, Supplies, Qualities and Prices

Domestic reserves and supplies: Korea has relatively high cost reserves of anthracite that have been used primarily in the residential and commercial sectors in the form of briquettes. Until 1988 the Korean government's energy policy was to expand domestic production (at the expense of lower cost imports). In 1988 a decision was made by government to rationalize the domestic coal industry and in 1989 130 small mines were closed. Production in the late 1980's stagnated around 24 million tonnes and is expected to decline throughout the 1990's.

Import sources: The sources of imported steaming coal in 1990 were: Australia (51%), Canada (25%), United States (12%), and Asia (12%). The following observations were made with respect to various steaming coals: Australia coal is very good; a tendency for coal from western Canada and western United States not to meet specs (some problems with ash type); Soviet coals tend to have problems associated with iron impurities; no problems with Chinese coals to date; problems with high moisture and fusion temperatures with trial shipments of coal from Kalimantan.

Import prices: The average CIF prices per tonne of imports in 1989

were as follows: Australia ($49.48), Canada ($50.74), United States ($54.93), Asia ($47.63) giving an average of ($50.20).

Coal specifications for power plants:

Gross heating value:	Min. 6,000 Kcal/kg
Total moisture:	Max. 10%
Volatile matter:	22-26%
Ash:	Max. 17%
Sulfur:	Max. 1%
Fusion (initial):	1,250° C
Hardgrove (HGI):	Min. 45

Coal Import Strategy

With respect to steaming coal for utilities the goal is to achieve the following mix of contractual arrangements:

60% long term contracts
30% joint ventures (Korean participation)
10% spot market

Coal supplies from Korean joint venture mines increased from only 1.5 percent in 1982 to 10.6 percent of coal in 1988. (Won-Woo Lee, 1990).

Environmental Issues

Table 4 gives present pollution regulations pertaining to emissions from coal-fired power plants. Low sulfur coal meets present SO_2 emission regulations. With respect to particulate emissions, KEPCO's coal-fired plants have electrostatic precipitators and have average emissions of 100-150 mg/m^3. At present there are no CO_2 regulations.

Table 5 shows present and anticipated sulfur emission regulations pertaining to coal-fired plants, and sulfur content of coals required to meet these regulations. The general view of KEPCO is that there will be

Table 4
POLLUTION REGULATIONS AND CONTROL METHODS
FOR COAL-FIRED PLANT

Pollutant	Present regulations	Control method
SO_2	700 ppm	low sulfur coal
NOx	350 ppm	low NOx burner, two stage combustion
Particulates	250 mg/m^3	electrostatic precipitator

KEPCO, 1990

Table 5
PRESENT AND ANTICIPATED SO_2 REGULATIONS
AND SULFUR CONTENT COAL OF COMPLIANCE COAL

Year	SO_2 limit (ppm)	Sulfur content of compliance coal (percent)
1990	700	0.95
1996	500[e]	0.70
2000	250[e]	0.30

Estimates provided by KEPCO, 1990

insufficient low sulfur compliance coal available (below 0.7%), therefore desulfurization systems are (tentatively) planned for new coal-fired plants that will be commissioned after 1995.

Clean Coal Technologies

There was general interest in clean coal technologies and their commercial status. Both KEPCO and KEEI asked for additional materials on clean coal technologies. Korea is clearly a prime country that has the technical capability to introduce and operate clean coal technologies.

Conference Participation

Interest in participation in the Coal Conference was expressed by the three different organizations: Korea Electric Power Corporation, Korean Energy Economics Institute and the Ministry of Energy and Resources. potential speakers from each organization are: Mr. Ho-Chul Kim (MOER), Won-Woo Lee (KEEI), and Eui Du Kim (KEPCO).

Key People Interviewed

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(2) Mr. Ho-Chul Kim
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(3) Mr. In Block Lee
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TAIWAN

Summary

Taiwan's rapid economic growth is expected to continue during the 1990's at an average GNP growth rate of 6.5 percent per year. Energy consumption is forecast to average 4.6 percent per year, with electricity consumption growing at about 5.4 percent during the 1990's. Total coal consumption is forecast to double from about 19 million tonnes in 1988 to 37 million tonnes in 2000. Steaming coal consumption is forecast to increase from about 13 million tonnes in 1988 to 29 million tonnes in 2000.

Environmental regulations on SO_x emissions are projected to tighten in 1993, consequently FGD equipment will probably be installed on all new coal-fired power plants. Taipower is a conservative company and will be cautious about introducing clean coal technologies before they are proven.

However, Taiwan is a possible candidate for the introduction of clean coal technologies for the following reasons: (1) rapidly growing public sensitivity to environmental issues, (2) government concerns that Taiwan not be labeled a major polluter by their main export market (United States), and (3) Taiwan's growing technical capability. The key appears to be to get the Taiwan government to agree to test clean coal technologies, then the appropriate implementing agency will follow.

Taiwan's technical sophistication is reflected in their active nuclear power development program. In 1990 nuclear power is estimated to account for 40 percent of the total electricity generation in Taiwan. However, nuclear plant expansions are now on hold due to public opposition.

Energy Sector Organization

Taiwan Power Corporation (Taipower) is a state electric utility responsible for developing and supplying electricity throughout the country.

Taipower is under the general supervision of the Ministry of Economic Affairs.

Under the Ministry of Economic Affairs is the Energy Commission which is responsible for "the general affairs related to energy management to assure the stability of energy supply, accelerate the rationalization of energy pricing, prevent energy related environmental pollution and enhance energy research and development."

Energy Plans

The shift away from oil that began after the second oil price shock in 1979 is projected to continue through the 1990's. Between 1989 and 2000 the shares of total energy supply are forecast to change as follows: oil declines from 53 to 43 percent, coal increases from 26 to 29 percent, natural gas increases from 3 to 10 percent, nuclear power and hydro power remain approximately constant at about 15 and 2 percent respectively, and new energy sources increase from 1 to 2 percent.

With respect to electricity generation, in 1990 the shares of total electricity generated by various sources are estimated to be: 40 percent nuclear, 27 percent coal, 24 percent oil, and 9 percent hydro. The next planned nuclear plant is on hold due to local resistance, and most growth in the 1990s is expected to be from coal and LNG. Planners in the Energy Commission favored rapid increases in LNG consumption in the 1990's.

Coal Reserves, Supplies and Consumption

(1) Reserves. Domestic reserves are limited and high cost, and contributed only 0.8 million tonnes in 1989 -- about 5 percent of total coal consumption. Domestic production will continue to decrease in the 1990's.

(2) Foreign suppliers: The big three suppliers of steam coal in 1989 are expected to remain among the top three during the 1990's. These are Australia, South Africa and the United States. Coal imports from each of these suppliers is expected to remain in the 20-40 percent range in the 1990's. However, it does not appear that Taipower has fully taken into account the the

potential for low cost Indonesian coal. With respect to US coal the general view was that it would remain among the highest cost coals, particularly eastern US coal. Coal from the US will continue to be imported for strategic reasons.

(3) Coal specifications: It was suggested that new coal-fired units would be designed to accommodate a wider range of coal qualities. The range of coal specifications for coal-fired power plants in Taiwan are shown in Table 1.

Table 1
COAL SPECIFICATIONS FOR TAIPOWER'S
COAL-FIRED PLANTS

Heat content:	6300-6600 kcal/kg (11,300-11,900 Btu/lb)
Sulfur:	0.5-1.5% (mostly <1.25%)
Moisture (I.M.):	<5%

The specifications for ash limits were not given, however handling and disposal of ash is relatively expensive, costing about US$8 per tonne.

(4) Coal Consumption: In 1989 coal consumption was divided among user groups approximately as follows: 50 percent for power generation, 25 percent for industry (cement, etc.) and 25 percent for the steel industry.

Table 2 (Appendix) shows coal consumption in 1988 with a forecast of consumption in 1995 and 2000.

Environmental Issues

The powerful Environmental Protection Agency is above Ministry level, and reports to the Executive Wuan.

Coal-fired plants are equipped with electrostatic precipitators, and all new coal-fired plants will probably have FGD equipment for recovery of sulfur. Taipower's view is that FGD will be needed because very low sulfur coal will

not be available in sufficient quantities from diversified sources. About 1800 Mw of coal-fired capacity will continue to operate without FGD equipment.

Table 3 shows present and expected emission limits for coal-fired power plants. The expected tightening of emission limits for SO_x in 1993 will

Table 3
PRESENT AND PLANNED EMISSION
LIMITS FOR COAL-FIRED POWER PLANTS

Pollutant	1990	1993	Comments
SO_x (ppm)	750	500	1993 equivalent to <0.6% coal
NO_x (ppm)	- -	500	low NO_x burners (300 ppm)
CO_2	none		

Taipower, 1990

probably result in the installation of FGD on all new coal-fired power plants.

Clean Coal Technologies

With respect to the prospects for installation of clean coal technologies at Taipower, they pointed out that electric utilities stick to proven technologies, and therefore are not going to spend substantial funds on the development of clean coal technologies. Taipower officials stated that equipment manufactures, etc. should first develop and prove the technologies before expecting electric utilities to install these technologies.

However, it became clear during discussions that Taiwan is sensitive to its international environmental image, and does not want to be seen as a big polluter. One official expressed concern that if Taiwan produces a lot of pollution associated with its manufacturing of export products, then importing nations might eventually place restrictions on imports from Taiwan. Perhaps this sensitivity to its environmental image internationally, might positively

influence a decision to become involved in clean coal technology development.

There is a small technology development program in Taiwan, and a cooperative agreement to do test work on clean coal technologies is a possibility. As previously noted Taipower is unlikely to undertake any clean coal test work without a decision from higher levels in government.

Conference Participation

There are a number of potential speakers from Taipower, and invitations should be sent to the President. Both Mr. Richard C. T, Hsu and Mr. Ching-Chi Lin are good candidates. The Energy Commission is also probably interested in receiving an invitation to the conference.

Table 2

PRESENT AND FORECAST COAL CONSUMPTION IN TAIWAN

(Million tonnes)

Coal Type and Sector	1988	1995	2000
Steaming coal (total)	12.6	19.8	28.7
Electricity	8.2	13.9	21.9
Cement	2.3	3.2	3.7
Other	2.2	2.7	3.1
Coking coal (total)	4.3	4.8	6.4
Steel	4.2	4.7	6.3
Other	0.1	0.1	0.1
Total coal	18.7	25.6	36.6

Key People Interviewed

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