retrofitted oil-fired boilers. EPRI in the United States has for a number of years been implementing a step-by-step preparatory program. The East European countries have followed the EPRI program closely. A key issue all through the program has been what derating to expect in converted boilers. Today, the consensus is that derating can be kept at acceptable levels -- perhaps less than 20% if clean CWMs are used. Fuel cost will also, of course, be of extreme importance in this application.

Municipal heating is another important market segment. CWMs here offers quite new possibilities compared to conventional coal use because the fuel can be brought to and stored at plants located in urban areas as easily and unnoticeably as fuel oil.

One of the still open promising options to extend the use of coal from "Kovin" is by CWM pipeline network which would supply fuel for seven co-generating power plants in the county of Vojvodina. They would be used to generate electricity and heat for seven towns located in the area 200 km from "Kovin."

In some East European countries all market segments are of equal interest. In most, if not all countries, at least one market segment should be of interest.

Looking at the future market in Eastern Europe, it is obvious that there is no such thing as a CWM suitable for all purposes. Some applications call for particular handling characteristics, other applications for low sulfur and/or low ash characteristics. Other applications again require that the fuel be made from a particular coal. The customer will be willing to pay the premium prices only for those performance characteristics that he requests. This will eventually lead to there being several, probably standardized CWMs in the market, and to large production facilities, handling several coals and having several production lines. Coal will cease to be regarded as a fuel in itself, and will instead be looked upon as a new material to make "coal fuels" from. CWMs will then be just one type of these "coal fuels."

Looking a bit into the future, it seems probable that there will be several companies selling more, or less similar products.

The equipment makers in all probability will be the ones we are familiar with today. It is more difficult to foresee who the CWMs producers will be. Oil companies and operators of coal terminals seem to have the best starting position. The question is whether they have realized it.

There is no doubt that a substantial market will appear in Eastern Europe. Some preliminary assessments show that the market could eventually be equal to more than half the present fuel oil market. Even a fraction of this market is enough to make the CWMs industry a major growth sector in the East European economy.

Conclusions

Coal can provide the principal part of the additional energy needs of the next two decades. In filling this role it will act both as a bridge to the energy systems of the future and as a foundation for the continued part that coal will play in the next century. A recognition of the urgent need for coal, and determined action to make it available in time, will insure that Eastern Europe will obtain the energy it requires for its economic growth and development.

The main obstacle to greater coal consumption are related to the protection of the environment. Whereas in the 70-ies and 80-ies energy security and purely economic issues represented the propelling force which encouraged energy savings, a new imperative shows up today: concern about environment. The present pollution of the atmosphere and consequent changes in the climate, including the rise in global temperature and the so-called greenhouse effect could be a strong motive for increasing efficiency in energy production and a better understanding of how to protect our environment. Environmental sensibility has already gained prominence on the political agendas of most East European countries. Efficiency of production and the market economy of the West have definitely dispelled the illusions of the socialist countries about planned economies. This means, however, that from now on every new technology will be measured by much more severe criteria.

The technological development of the East European countries cannot be reduced to a recapitulation of the history of the highly developed countries with a blind repetition of all their mistakes. With the opening of the East European countries, an immense market has been opened, but even more important is the surge of great human potential with a strong will to assert itself. In these new movements, energy and coal will certainly play a very important part.

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"CANADIAN COAL EXPORT FUTURE"

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ABSTRACT

The world coal market has become an increasingly competitive and challenging place and like other coal producing countries, Canada must adapt to changes in the market-place. In international steam coal markets where major growth is occurring, Canadian producers must meet the challenge of their competitors whose coal deposits are closer to tide-water ports. This paper discusses Canada's coal industry and its export prospects.

INTRODUCTION

Although coal resources are widely distributed around the world, and are substantial in magnitude in many regions, coal quality and resource economics make it necessary to trade coal internationally. Trade occurs even between countries that have their own domestic coal resources. However, unlike the trade for coking coal, international trade in steam coal is a relatively recent development, only taking off after the 1973 oil crisis. Within a span of little more than a decade, international trade in steam coal has tripled and surpassed that of coking coal. World Coal Trade is shown in Table 1, and as can be seen, seaborne steam coal passed that for coking coal in 1988, and continues to be the major growth market. Coking coal markets on the other hand, have flattened out and remain on a plateau of around 145 million tonnes per year.

TABLE 1

WORLD COAL TRADE 1973 - 1988 (Million Tonnes)

Year	TOTAL WORLD COAL TRADE	COKING COAL		STEAM COAL	
		Total	Seaborne	Total	Seaborne
1973	177.1	117.7	87.0	59.4	19.0
-	-	-	-	-	-
1979	232.5	127.8	104.0	104.7	53.0
1980	256.2	138.7	114.0	117.5	74.0
1981	271.3	144.9	122.0	126.4	86.0
1982	269.2	139.6	120.0	129.6	89.0
1983	266.0	135.3	112.0	130.7	87.6
1984	304.7	155.8	131.6	148.9	103.6
1985	335.8	165.0	140.7	170.8	133.1
1986	336.1	161.0	137.3	175.1	138.2
1987	340.9	164.4	141.9	175.5	141.1
1988	345.3	165.9	144.6	179.4	147.0

Note: "Seaborne" trade excludes overland, barge and lake deliveries.
Source: Chase Manhattan Bank

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"Coal by wire", is a phrase coined to identify the link between coal and electricity in order to publicize coal's role in electricity markets. As a marketing slogan it is appropriate, because electricity is the world's largest energy market. Electricity demand has trebled over the last twenty years in the Western World, and continues to increase faster than both total energy use and overall economic growth. It is no coincidence therefore to find that today's largest market for coal, is that for power generation. This market represents the best prospects for coal's export future.

CANADA'S RESOURCE BASE

Canada is richly blessed with abundant energy resources and its coal deposits are huge by any measure. We possess world class mining and transportation capabilities and must find ways to utilize these facilities to our economic and social advantage. The economic importance of coal to Canada, is reflected in its significant contribution to supplying primary energy, employment, and revenue from its export to the rapidly expanding markets in the Pacific Rim region. However, at the present time, while Canada is a major supplier of metallurgical coal in the international market, its role in international steam coal trade is very minor.

Principal coal deposits and the principal Canadian coal mines are shown in Figures 1 and 2 respectively. Coal is the most abundant energy resource in Canada and vast reserves lie in the Province of Alberta. That Province's enormous energy resources include coal, bitumen and synthetic crude, natural gas, and conventional oil. Coal is Alberta's most abundant energy resource accounting for over 70% of the developable reserves. However, in terms of percentage of reserves consumed on an annual basis, coal is the most under-utilized energy resource. At current rates of consumption, Alberta's coal reserves will last some 900 years, as opposed to 9 years for conventional oil, 20 years for natural gas, and 200 years for heavy oil and bitumen. This situation is largely responsible for the lack of urgency in Canada, to pursue the adoption of new energy options, and new technologies. Seemingly it is believed by the country's energy planners that Canada has no immediate need for the use of many of today's advanced coal technologies.

As will be seen from Figure 1, sub-bituminous coal comprises the bulk of our reserves, and Figure 2 illustrates how the Canadian coal industry is centred around Western Canada. The bituminous coals found in Alberta and British Columbia are largely metallurgical coals which are mined for export out of the two main West Coast coal ports; Roberts Bank and Prince Rupert. However, some 98% of the coal resource in Alberta is of the sub-bituminous rank. This coal can be recovered using inexpensive surface mining methods; but unfortunately its relatively low heat value limits the distance over which it can be transported and remain an economically viable energy source. These sub-bituminous coals constitute a large energy pool which at present can only be economically utilized within a limited geographical area. In effect, their utilization is confined to mine mouth generation of electricity. While Canada is not among the top ten coal

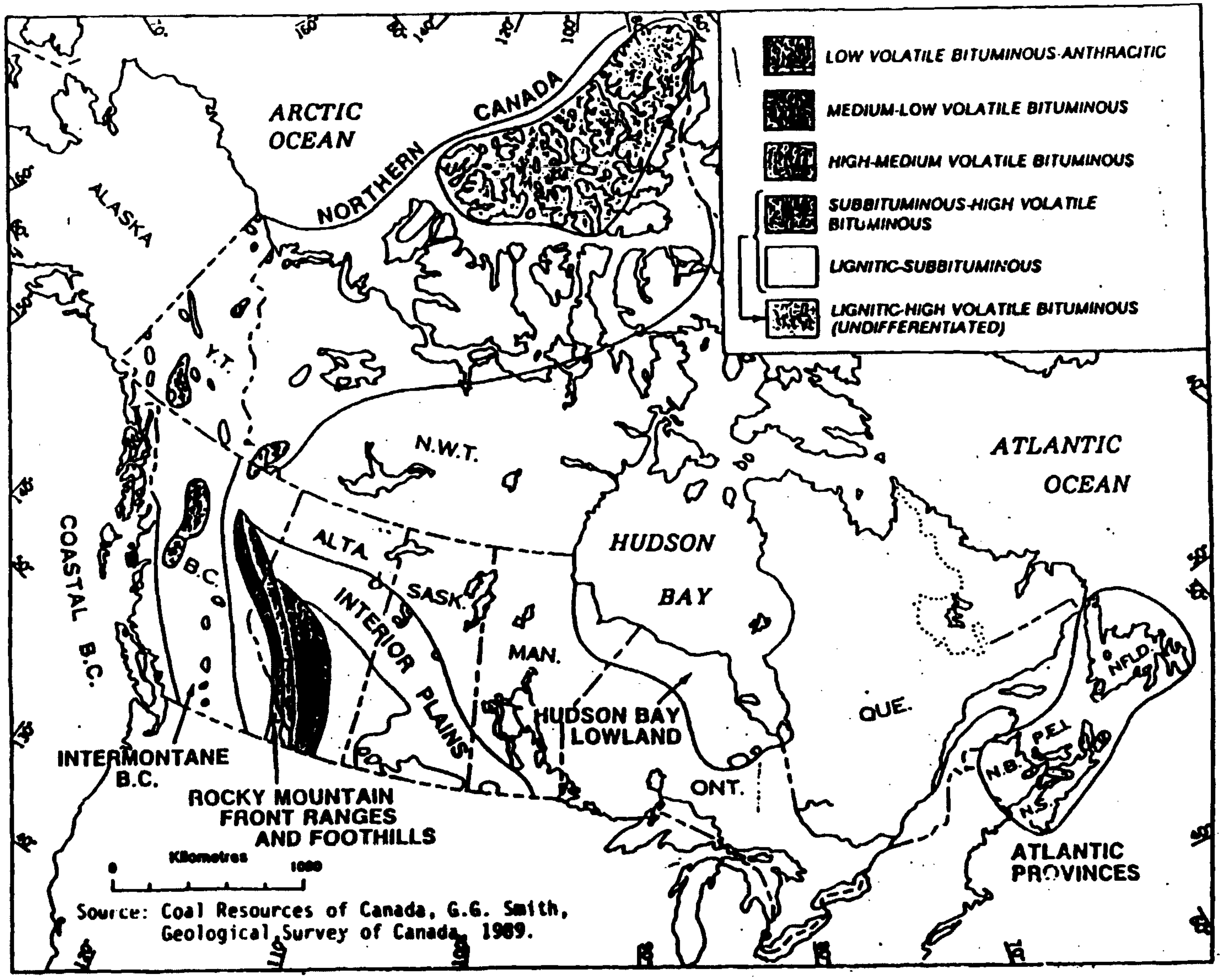
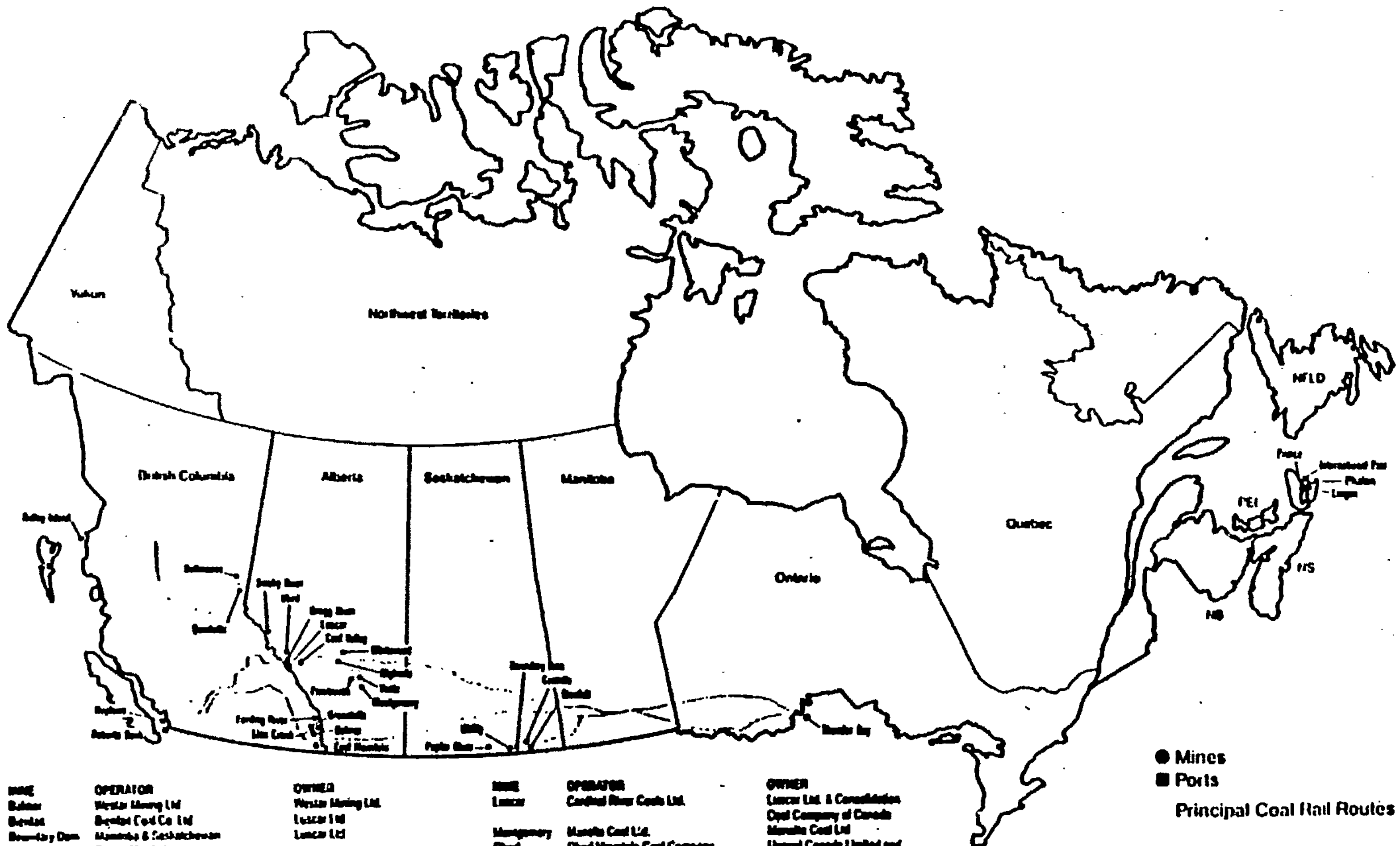


FIGURE 1 - DISTRIBUTION OF COAL IN CANADA.



MINE	OPERATOR	OWNER
Balmer	Westar Mining Ltd	Westar Mining Ltd.
Bienfait	Bienfait Coal Co. Ltd	Luscar Ltd
Boundary Dam	Manitoba & Saskatchewan Coal (1984) Ltd	Luscar Ltd
Bullmoose	Bullmoose Operating Corporation	Teck Bullmoose Coal Inc (51%)
Coal Mountain	Byron Creek Collieries	Esso Resources Canada Limited
Coal Valley	Luscar Sterco (1977) Ltd	Luscar Ltd (75%)
Costello	Prairie Coal Ltd	Manalta Coal Ltd.
Fording River	Fording Coal Limited	Fording Coal Limited
Greenhills	Westar Mining Ltd	Westar Mining Ltd.
Gregg River	Gregg River Resources Ltd	Manalta Coal Ltd.
Highvale	Manalta Coal Ltd	TransAlta Utilities Corporation
Line Creek	Crows Nest Resources Limited	Crows' Nest Resources Limited
Lingan	Cape Breton Development Corporation	Cape Breton Development Corporation

MINE	OPERATOR	OWNER
Luscar	Cardinal River Coals Ltd.	Luscar Ltd. & Consolidation Coal Company of Canada
Montgomery	Manalta Coal Ltd.	Manalta Coal Ltd
Obed	Obed Mountain Coal Company Limited	Union Canada Limited and Norcen Energy Company Limited
Paintearth	Forestburg Collieries (1984) Ltd.	Luscar Ltd.
Phalen	Cape Breton Development Corporation	Cape Breton Development Corporation
Poplar River	Prairie Coal Ltd.	Manalta Coal Ltd.
Prince	Cape Breton Development Corporation	Cape Breton Development Corporation
Quintette	Quintette Coal Ltd.	Denison Mines Limited (50%)
Smoky River	Smoky River Coal Limited	Smoky River Holdings Ltd.
Utility	Prairie Coal Ltd.	Saskatchewan Power Corporation
Vesta	Manalta Coal Ltd.	Alberta Power Limited
Whitewood	Fording Coal Limited	TransAlta Utilities Corporation

FIGURE 2 - PRINCIPAL CANADIAN COAL MINES

producing countries, it does figure in the top ten coal exporting and coal importing countries. Table 2 shows these main coal indicators.

TABLE 2

1987 MAIN COAL INDICATORS (Million Tonnes)

Production		Exports		Imports	
China	925.0	Australia	102.0	Japan	92.5
US	831.6	US	71.1	S. Korea	21.8
USSR	758.4	S. Africa	42.6	Italy	19.7
Poland	193.0	Poland	31.0	France	14.6
W. Germany	191.2	USSR	27.1	Canada	14.3
India	187.2	Canada	26.7	Taiwan	13.4
S. Africa	176.5	China	13.1	Netherlands	12.6
Australia	152.1	Columbia	9.6	Denmark	12.0
UK	104.4	W. Germany	6.4	Belg/Lux	9.8
Yugoslavia	72.3	UK	2.3	UK	9.8

Source: International Coal Report (1988)

The anomaly of Canada having significant levels of both coal exports and imports is due to transportation economics which favour utilization of Eastern U.S. coals in Central Canada; over Western Canadian coals. The long distances involved between the mines in Western Canada and industrial users in Central Canada make transportation costs, prohibitive.

Canada's export coal trade is essentially low/medium volatile bituminous coal, serving metallurgical markets in the Pacific Rim region. Canada's imports on the other hand comprises high volatile bituminous coal for the power station market in Ontario.

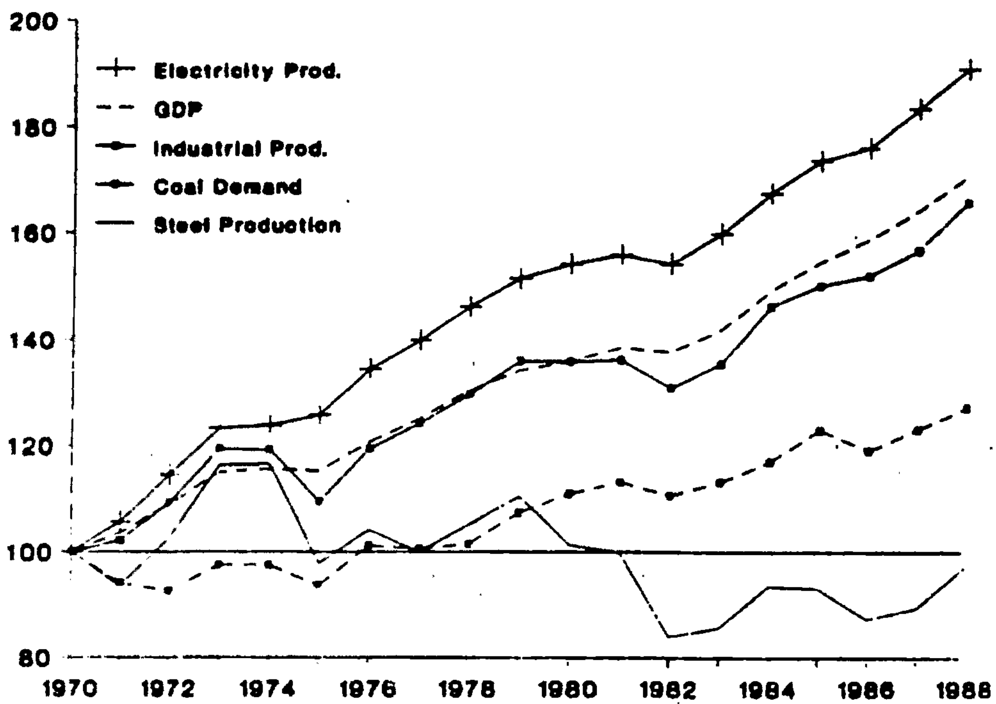
Canada's coal industry, centered primarily in Western Canada, is based on supplying mine mouth power stations in Alberta and Saskatchewan, and exporting large quantities of coking coal into international markets. There is a small struggling trade in international thermal coal which, as presently organized, seems unlikely to grow despite the fact that world demand for thermal coals is growing rapidly. Canadian thermal coals are hampered by high transportation costs, and mediocre quality which makes them marginally competitive with other sources around the world. It is worth remembering that in the late 1960's the Japanese steel industry initiated the Canadian coking coal trade by offering major supply contracts which led to the development of a number of large surface mines, port developments, and most importantly the introduction of large efficient unit trains to reduce transportation costs. In a similar way the future of Canada's thermal coal exports will need the same radical approach to improving competitiveness in a world filled with many good quality coal reserves, located much nearer to tide water than Western Canada's reserves.

HISTORICAL MARKET PERSPECTIVE

In the late 1960's there was a prevailing perception that thermal coal had passed its heyday as an industrial fuel and as a fuel for large electricity generating stations. Ready availability of cheap oil provided the base fuel in most of these applications, and many existing coal-fired plants were converted to oil. There was very little seaborne trade for thermal coal; local production essentially met all thermal coal demand. Utilities were contemplating nuclear power with great anticipation in the belief it offered the prospect of cheap electricity. In any event a number of factors combined to constrain the growth of nuclear power, indeed many jurisdictions prevented the installation of nuclear power stations totally. Oil prices kept going up, and oil users believed the price escalation would never be halted. By the late 1970's the eyes of all industrialists turned tc coal and a coal boom started which has not only continued to this day, but is predicted will continue into the next century. This is the general background to the growth in international trade for thermal coal in the 1980's. The "new" aspect of this surge in coal's fortunes has been the demand for imported, mostly seaborne coal.

OECD coal demand and economic activity between 1970 and 1988 is illustrated in Figure 3. A continuance of this scenario is the basis for the future outlook.

Figure 3. OECD Coal Demand and Economic Activity, 1970-1988
(1970 = 100)



Source: *OECD Main Economic Indicators*, OECD Steel Committee and *IEA/OECD Energy Balance*

FUTURE COAL EXPORT PROSPECTS

Canada can expect to maintain its present level of international trade in metallurgical coal. For many reasons, there is unlikely to be any significant increase in metallurgical coal demand for steel production purposes. Statistics show that world demand has now levelled off and continues to remain fairly static. In contrast with this, thermal coal demand is projected to grow rapidly. Figure 4 illustrates world seaborne coal trade to the year 2005. As can be seen, steam coal trade is expected to double its present level. According to the IEA "1989 Coal Information", growth in free world thermal coal imports is expected to be approximately 6% per annum. The main regions where major growth is forecast to occur, is Western Europe, and Japan/Far East

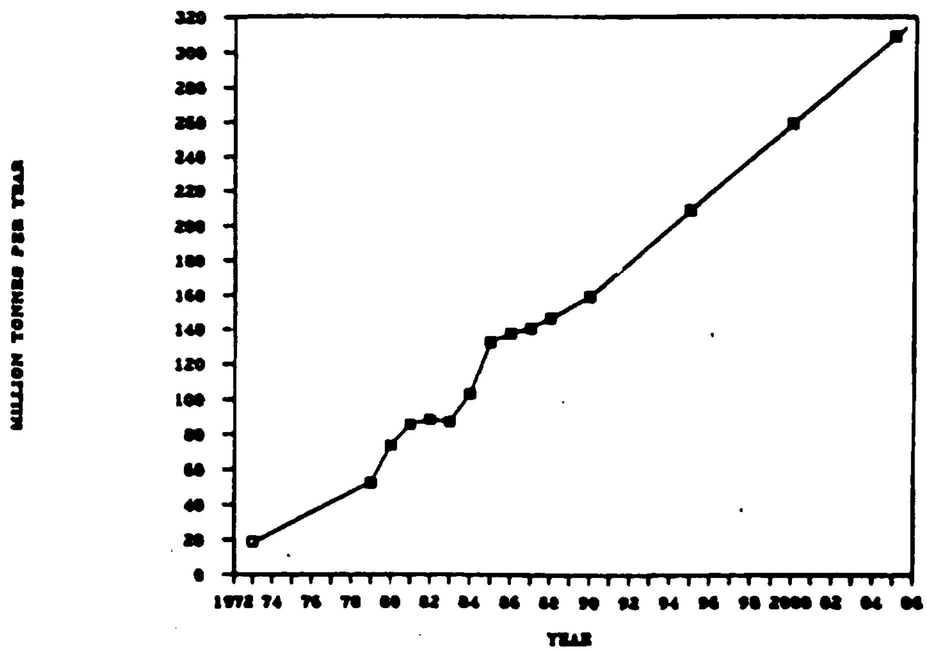


FIGURE 4 - WORLD SEABORNE STEAM COAL IMPORTS

SOURCE: CHASE MANHATTON BANK

The international market for thermal coal has developed very quickly with demand for coal arising almost overnight. Based on this rapidly rising demand, confidence in future forecasts has been promoted as a result of the current construction prog-am for new electricity power generating plants. This energy sector represents a comparatively stable demand for coal in the long term, and given the lead times for new plants, and the sizeable capital commitments they represent, the utilities will probably place coal supply contracts in advance of their actual needs. This should be a stabilizing factor for new mine developments as well.

In Canada, the situation has been less than dynamic in terms of the domestic market. Thermal coal exports have been relatively insignificant when set against world coal movements. The reason for this can be found in Canada's slow acceptance of advanced coal technologies that allow sub-bituminous coals to be upgraded and made economically attractive. This aspect is discussed in the next section. To emphasize the importance of this subject however, it is worth noting that Canada like other resource rich countries such as Australia, and the USA, is falling behind in the industrial application of many of today's advanced coal technologies. Canada's future coal export prospects in international thermal trade, will depend in large measure on how quickly this situation can be rectified.

Uncertainties surrounding economic and political factors will also affect the export prospects for thermal coal in international markets. For instance, the relative movement of national currencies, particularly those of producing countries, namely Australia, South Africa and Canada affect trade. Exchange rates in terms of the US dollar, which is the currency most often used to value coal in the market place, have a major impact on competitiveness.

Political acts such as government to government deals (e.g. Japan and China) can have an effect in international markets. Significant tonnages of coal can preferentially enter the market under these circumstances. Another key factor that has to be borne in mind, is the spectre of crude oil prices falling through the floor. If this were to happen, thermal coal markets would again become vulnerable to competition from heavy fuel oil priced at say ten dollars per barrel. However, widespread use of fuel oil for future utility and industrial purposes is inconsistent with the reality of long term hydrocarbon supplies and therefore it is not a sustainable proposition.

Temporary oversupply situations should not be construed as a long-term problem. Such circumstances do and will occur, but they are a short term problem only. If new mines are developed in a timely way around the world, and if the most economical mines are to come on-stream first, new Canadian coal mines should be developed in the 1990's. This should ensure that Canadian thermal coal exports grow, and allow Canada to play a bigger role in the Pacific Rim and other world markets. In today's environmentally sensitive climate, Canada's abundant low sulphur, low cost coal has the potential to compete economically, while being in compliance with the new strict emission control standards. From Canada's perspective; based on resource base and mining expertise, we should be able to gain a fair share of the expanding world trade in thermal coal. Major consumers will continue to place some reliance on diversified supply, and with their good record of reliability, Canada's coal producers can look forward with some confidence that they will participate in this new trade. Figure 4 illustrates the growth trend that is forecast for World Seaborne Imports.

Although Canada is a major exporter of coking coal, it does not play any significant role in international steam coal markets. Unfortunately, Canada's coking coal is low/medium volatile, and unlike high volatile coking coal it is not readily accepted in thermal markets. Because of this situation, Canada's future thermal coal exports will be based on exploiting its vast reserves of sub-bituminous coal. To that end, current state-of-the-art upgrading techniques will have to be employed to improve their economic merits. In terms of their technical merits, they have considerable advantages over many bituminous coals. From a utilization point of view, they ignite easily, burn fast and because they are highly reactive, good combustion efficiencies are achieved with maximum carbon burn-out.

NEW TECHNOLOGIES

During the 1970's, two phenomena had profound effects on the technology of coal utilization. The more sudden event was the OPEC initiated international oil crisis which brought about coal's rebirth as a primary source of energy. For the first time, serious efforts were made to exploit the enormous reserves of low rank coal which had until then been restricted to local use. Because of sudden increases in oil prices and concern over its availability, it became urgent to achieve new and better ways to use this abundant low-rank coal. More or less concurrently with these abrupt changes in the price and supply position of oil, came the gradually increasing momentum of the environmental movement. As a result of both these forces, it became important to find methods for burning and using coal more cleanly.

Most of the world's present thermal coal trade is for bituminous coal, and three basic approaches have been taken to allow this to be burned cleanly. They include clean coal technology, advanced combustion techniques, and flue gas desulphurization.

Clean coal technology is coal preparation related, and can range from simple washing to deep cleaning. These coal preparation techniques employ beneficiation processes to remove or reduce impurities such as ash and sulphur in the "as-mined" coal. This current state-of-the-art clean coal technology is now well established. When coupled with new advanced drying methods, these new technologies allow sub-bituminous coals to be upgraded. Thus the high moisture levels and attendant low heating values of these low-rank coals need no longer be an economic barrier to their off-site use. These new technologies must be adopted by the Canadian coal industry if Canada is to be successful in its quest to gain a share of the expanding international coal trade.

Advanced combustion techniques have been developed to minimize the formation of free sulphur dioxide and adjust combustion conditions to avoid or at least reduce the formation of oxides of nitrogen; a major precursor of acid rain. The application of clean coal technology makes an important contribution in effecting improved combustion. Having pioneered several advanced combustion techniques, Canada has considerable experience in this aspect of coal utilization. The industrial application of these new techniques in Canada should promote confidence in the minds of coal buyers, that environmental considerations are an integral part of quality control by Canadian coal producers.

An increasing concern worldwide for the environment has drawn attention in particular to the problem of acid rain. Increasing public concern and the need to meet either current or more stringent future emission regulations has prompted the development of various emission reducing technologies. The technology currently available to reduce sulphur and nitrous oxides from coal burning power plants, is "scrubbers". Having to incorporate this flue gas desulpurization technology, greatly adds to the cost of producing power, and there are many research programs underway which are investigating various alternatives. One of the more encouraging developments in this field, is the LNS Burner which promises to reduce both nitrous oxides and sulphur dioxide created from the combustion of coal, to near zero. As previously mentioned, clean coal technology makes an important contribution in minimizing emission problems.

Various new coal utilization technologies currently being employed by importing countries in the international thermal coal market place, include; coal-water-fuels, micronized coal, fluid-bed combustors, and slagging combustors. In the light of these developments it is essential that coal producers be aware that the successful utilization of thermal coal is dependant on two closely inter-related factors; the physico-chemical properties of the coal, and the operational characteristics of the combustion system in which the coal is to be burned. It is therefore necessary for Canadian coal producers to be well informed on current technologies in order to match each coal with its utilization needs. This is of particular importance where a new mine is being developed, or; where a market is being targeted for substituting coals in an existing combustion system.

CONCLUSIONS

The rapid growth of international trade in thermal coal, offers Canada an opportunity to increase its coal exports. However, if Canada is to be successful in its efforts to gain a share of this expanding market, it will need to adopt the same radical approach that was employed to initiate its entry into the international trade in metallurgical coal. This could be achieved by the economic exploitation of Alberta's vast resources of sub-bituminous coal which will require adopting new advanced technologies that are now available for upgrading these low rank coals.

"THE FUTURE OF COAL IN SOUTHEAST ASIA"

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THE FUTURE OF COAL IN SOUTHEAST ASIA

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ABSTRACT

The economic growth of the Pacific region has led to increased energy consumption which is mostly dependent on oil resources. As these resources are limited, it is considered necessary to take steps to reduce dependence on oil. One of the energy resources to be developed in accordance with the energy diversification is coal, of which Indonesia has extensive deposits.

ASEAN coal resources amount to 36.8 billion tons, 86.9% (31.9 billion tons) of which are in Indonesia, 6.3% in Thailand, 5.4% in the Philippines and 1.4% in Malaysia. Mostly the type of coal consists of lignite, subbituminous coal and the rest is small amounts of (semi)-anthracitic coal. Coal is utilized in large quantities in the ASEAN countries for power generation, then for the cement industry, and small industries.

The potential demand for coal in ASEAN, excluding Singapore, will be 97.51 million tons in the year 2000, a large increase from 21.99 million tons in 1990. The coal production in ASEAN is 20.34 million tons in 1989, this is expected to rise to 91.35 million tons in 2000, excluding Malaysia, whose production figures for 2000 are unavailable. Similarly, the coal demand of East Asian countries (NICs and Japan), which amounts to 184.6 million tons in 1990, is expected to rise to 250.6 million tons in 2000.

Coal exports from the Pacific countries comprising USA, Canada, Australia, and the People's Republic of China in 1990 amount to 220.7 million tons, which is sufficient to meet the total demands of East Asia and ASEAN in 1990, amounting to 206.59 million tons. The export capacity will be 253.3 million tons in 1995 and 296.0 million tons in 2000. This quantity will presumably be insufficient to cover the demands of the East Asian and ASEAN countries amounting to 264.75 million tons and 348.11 million tons.

Coal constitutes an alternative energy resource to petroleum, and can act as a bridge to future nonconventional energy use. However, the use of coal as a solid fuel on a large scale will increase pressure for environmental carrying capacity, so it will be necessary to develop "clean coal" technology such as carbonization, gasification and liquefaction, not only for industrial fuel or as oil and gas synthetic fuel but also to decrease the environmental impact and to facilitate handling.

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PREFACE

It gives me great pleasure to present a paper on "The Future of Coal in Southeast Asia" at this distinguished Symposium on the Opportunities in the SynFuels Industry on 27-29 August 1990.

It is our belief that the Asia-Pacific region will be the centre of the future development of industry, trade, and modern technology. This belief is based on the abundant natural resources, as well as the industriousness and dynamism of the people of this region. Indeed, in the last decade, the Asia-Pacific region has achieved a remarkable economic growth. The energy sector is also one of the important prime movers for this development. In this regard the topic of this timely Symposium is indeed well grounded.

In my presentation I will try to describe the coal development in the Asia-Pacific region in Southeast Asia in particular; the past, the present, and prospects for the future.

I hope that this brief resume will be beneficial to the symposium.

Bandung, 15 August 1990

INTRODUCTION

The Pacific region covers developed countries such as the United States of America, Canada, Japan, and the New Industrialized Countries (NICs) such as South Korea, Taiwan, Hong Kong, and Singapore, as well as developing countries like ASEAN countries and the People's Republic of China. It has achieved a phenomenal economic growth, although several of the regions are at present in various economic difficulties due to recent world developments, such as the political changes in Eastern Europe, and the strained situation in the Middle East, which harbor the largest oil reserves in the world.

The economic growth of the Pacific region has brought about a perceptable increase in energy demand which, at the moment, is mostly met by oil resources. However, oil reserves can not guarantee a continuous, adequate energy supply. It is considered necessary to take steps to reduce dependence on oil as a source of energy.

Coal, having been in use for a very long time, is one of the obvious alternatives to reduce dependence on oil. The technology for utilizing coal is well established. In addition, the large quantity of coal resources in the Asia-Pacific region comprises 51% of the world's coal reserves (NEDO, 1989).

COAL RESOURCES

ASEAN coal reserves have been estimated at 36.8 billion tons, of which Indonesia possesses 31.9 billion tons (86.9%), Malaysia 1.4%, Thailand 6.3%, and the Philippines 5.4%. Mostly, the type of coal consists of lignite. subbituminous coal, and the rest is a small quantity of (semi)-anthracitic coal. Coal utilization in ASEAN countries is mainly for electric power generation, then for the cement industry, and small industries.

Indonesia

The total coal resources of Indonesia amount to 31.9 billion tons, of which 22.9 billion tons or 62.35% of the total resources are found in Sumatera, succeeded by Kalimantan with an estimated 8.8 billion tons. The location of coal deposits is shown in Figure 2.1, while the quantity of the resources can be seen in Table 2.1. However, the figures in Table 2.1 are tentative and subject to change as the resources are still being explored.

From the known coal resources, the proven reserve is 4.2 billion tons, while the indicated and inferred reserves are 13.27 billion tons. The quality of Indonesian coal varies from lignite, subbituminous to anthracite (Table 2.2). Thus, if the coal reserves of Indonesia are to be compared with the reserves of other ASEAN countries, the Indonesian coal reserves are the largest.

Thailand

The coal resource of Thailand is considered to be of relatively lower quality and catagorized as lignite. The resources amount to 2.3 billion tons from which approximately 70% are deposited in the Mae Moh Basin in the northern part of the country, exploited by the Electricity Generating Authority of Thailand (EGAT). The economic reserves are estimated to amount to between 800 and 950 million tons of which 614 million tons are deposited in Mae Moh.

Philippines

The coal resources of the Phillippines are spread widely in all of the islands. At the end of 1989, the coal resource potentials were estimated to amount to 1.98 billion tons of which the proven reserves were 291 million tons. The mineable deposits are situated in Mindoro and Panay, of which 30% is in Cagayan Valley in the northern part of Luzon, and 11% is in the eastern part of Mindanao. The remaining 15% is spread through Cebu, Samar, Mindoro, Negros, Polillo, Batan, and Catanduanes. The quality of coal is classified as lignite, subbituminous, and bituminous coal (Table 2.2).

Malaysia

The coal resources of Malaysia are known from the Malaysia Gulf, Sarawak and Sabah. Among those three areas, Sarawak contains the biggest resources, then followed by Sabah. The Malaysia Gulf only contains Batu Arang deposits located about 46 km north of Kuala Lumpur with 32 million tons, of which 16 million tons are to be mined. The quality of Malaysian coal reserves varies from lignite to anthracite while the proven reserves are presumably 27,8 million tons, and the estimated reserves are 494.9 million tons about 522.7 million tons in total. The coal quality is from lignitic to bi:uminous coal (Table 2.2).

COAL UTILIZATION

Indonesia

Coal in Indonesia has been used mainly for steam power electricity generating plants, then cement industries, small-scale industries, smelting and chemical industries. The coal production in 1989 reached 8.7 million tons, of which 5.66 million tons were consumed by the steam power electricity generating plants, the cement industries, smelting industries and other industries.

The coal utilization in the future is expected to rise in quantity in line with the national policy of energy diversification. For example, in 1989 the electricity power generating plants in Indonesia consumed 3.86 million tons of coal. In the year 2000 it is projected that they will be using between 15.40 million tons (lower projection) and 28.90 million tons (higher projection). The cement industry's 1989 production capacity was 17.41 million tons, which will be increased to reach 25.89 million tons in 2000, when these industries will be utilizing 3.23 million tons of coal. In addition to the large quantities of coal used by the steam power electricity generating plants and the cement industries, the oil industry is also expected to be consuming coal for the exploitation (secondary recovery) of Duri-Riau oil reserve. Besides, based on surveys carried out in cooperation between the Mineral Technology Development Centre and Japan International Cooperation Agency, the prospect of coal for small-scale industries and rural households in Indonesia will be bright. This is indicated by the possible substitution of noncoal fuels by coal. According to the survey, the energy used by small-scale industries amounted to 5.47 million TCE in 1985, of which 4.7 million TCE could be substituted by coal (86%). The energy needed by these industries will increase to 8.15 million TCE in the year 2000 and 86% of this might be obtained from coal. Meanwhile, for rural households the energy demand in 1985 was 21.42 million TCE and in 2000 this will rise to 22.75 million TCE, which might also be obtained from coal. Another coal use, which is at present in process, is to fuel the petrochemical industries.

Thailand

Coal in this country has mainly been used for electricity power generating plants, cement industries, boiler using industries (pulp and paper, food processing, etc.). Domestic coal consumption is expected to increase from 7.6 million tons in 1988 to approximately 24 million tons in 1995 and then to reach 38 million tons by the year 2000. Most of this will be used for the electricity power generating plants.

Philippines

Coal in the Philippines is mostly utilized for electricity power generating plants and cement industries. In 1989 the power plants consumed 62% of the total coal consumption amounting to 2.3 million tons increase 14.8 million tons in 2000, while the cement industries used 36% and the rest was distributed to other industries, including an alcohol distillery in Negros Island, a fertilizer plant in Leyte and a copper smelter in Leyte.

Malaysia

Malaysia is presently at a starting position for developing coal resources. In order to advance in the development of coal resources, the urgent issues which must be addressed are as follows:

- The position of developing coal domestically and the establishment of a policy for advancing coal development according to the four energy strategies,
- The positive utilization of domestically produced coal in domestic coal-demanding industries (i.e., cement and electric power) and the search for a new demand for coal,
- The opening up of the coal market in neighboring countries including the ASEAN member countries,
- Improvement of the parts of the infrastructure (i.e., roads, harbors, etc.) which are related to coal development.

ASEAN

The production and domestic demand for coal of ASEAN countries is shown in Tables 3.1 and 3.2. Indonesia has bright prospects for coal export either to ASEAN countries or to other countries.

From Table 3.3, based on the population of the countries mentioned above, the per capita coal consumption in Indonesia is estimated to lie at the lowest rank (0.03 tons), while that in Thailand is at the first rank (0.14 tons).

Of the ASEAN countries, Indonesia possesses the largest population, the largest quantity of coal deposits, but the lowest per capita coal consumption. Clearly, therefore, it is possible for Indonesia to develop her coal utilization for domestic consumption. Therefore, coal can become an alternative fuel for small-scale industries and rural households but should be accompanied by clean technology.

In addition, Indonesia is able to become the second largest coal supplier after Australia to the other ASEAN countries.

POLICIES, STRATEGIES, AND PROGRAMS

Since the oil crisis in 1973, a number of countries have experienced economic fluctuations, caused by their heavy dependence on petroleum. Since then, ideas have emerged on energy stability and the need for diversification of energy resources. One of the energy resources to be developed in accordance with the energy diversification policy is coal, which is present in great quantities.

Indonesia

Indonesia as an oil exporting country is certainly not affected by the oil crisis. Yet, a long-term program for the future is being considered because her rapidly growing population will need adequate amounts of energy. This is obvious from the relationship between the increase of GDP and the increase of energy utilization. Due to the enhancement of domestic energy demands, in which petroleum is a dominant energy supplier, there is great concern that the income from petroleum exports may decrease as a result.

Petroleum, being a nonrenewable fossil fuel, will surely run out if it is highly exploited continuously. However, energy supply must be kept stable for the purpose of generating effective economic development. Therefore, this kind of problem should be taken into the national energy policies as early as possible. In this regard, the targets of the national policies of Indonesia are as follows:

The management of petroleum resources with focus mainly on the export demand. Domestic energy requirements will be met by developing alternative nonpetroleum resources.

The policy on domestic energy consumption needs to be directed towards the utilization of existing nonoil energy resources such as natural gas, geothermal power, hydropower and coal, with attention paid to distribution.

Considering the important role of energy in national development, the energy supply should be guaranteed for continuity, adequate quantity, quality, and affordability. In an effort to reach those goals, it is necessary to impose policies which can be classified as follows:

- Intensification
- Diversification
- Conservation
- Indexation

Intensification of inventorizing is necessary based on balanced investment pattern to increase the amount of measured reserves which can provide energy, particularly those areas with high potential for the present and future markets, such as natural oil and gas, coal, geothermal, and other renewable energy resources.

Conservation is, in terms of efficient and rational energy resource utilization, based on a cross-generation schedule.

Diversification is needed to prevent the national income and energy utilization depending on only a few energy commodities, and to satisfy the demand for energy cross-sectorally as well as cross-regionally.

Indexation is optimization of available local energy utilization based on economic efficiency and effectiveness criteria.

The government program to develop backward industries concerned with coal is concerned mainly with steam electricity generating plants and the cement industry. The State-owned electricity company has a plan to develop power generating plants for the long term as shown in Figure 4.1. In Java, by the year 2000 it will reach 16,235 MW, of which about 11,100 MW will be coal steam electricity generating plants. Outside Java, it will reach 6,180 MW of which 827 MW will use coal as fuel.

In fiscal year 1989 the installed generating capacity of Indonesia was about 9,008 MW, of which 1,730 MW, or 19.0%, was from coal steam electricity generating plants. This is dramatically changing because of government policy to push up coal utilization in the power plants from 19.0% to 45.93% or from 1,730 MW (the year 1990) to 11,927 MW (installed capacity in the year 2000).

In the cement industry in the year 1989, the estimated coal consumption was about 1.78 million tons. By the year 2000 this will be about 3.23 million tons (as shown in Figure 4.2). Efforts are also underway to replace noncoal energy resources by coal in small industries.

Malaysia

First of all, the energy policies of Malaysia set on petroleum as the main point. The policy on petroleum started in full scale in July 1974 when the Petroleum Development Act (PDA) was imposed. This energy is the main exported commodity in the world, followed by natural gas. Nevertheless, Malaysia has started using coal for its steam power electricity generating plants and the Malaysian Government has made a decision that all cement industries should be fueled by coal.

The major thrust of the policy was energy diversification based on the four-fuel strategy, namely oil, hydro, gas, and coal, and aimed at ensuring reliability and security of supplies while reducing the dependence on oil in energy consumption. The objectives were:

- Supply objective: to provide the nation with adequate and secure energy supplies by reducing dependence on oil and by developing and utilizing alternative sources of energy (Ministry of Energy, 1982). A four-fuel energy strategy based on oil, hydro, gas, and coal has been formulated towards diversifying their energy base as well as guaranteeing assured energy supplies for continued growth.

- Utilization measures aimed at efficient utilization of energy.

- Environment: the achievement of the above two objectives was not to be at the expense of the environment.

Further, the National Depletion Policy, introduced on June 1, 1980, restricted the production of crude oil to 1.75 percent of oil initially in place for major fields. Energy conservation is mainly directed at oil. Electricity tariff rates were structured to reduce wastage. Also, the government decided to impose heavier—road tax for cars exceeding 1500 cc. Fiscal measures such as expenditure incurred on plant and accelerated depreciation allowance. Effective from 1982, firms were permitted to generate power for their own use from industrial wastes.

Thailand

After the second energy crisis in 1979, the Thai Government decided to reduce its big dependence on imported energy through developing domestic energy resources such as hydropower, natural gas, and crude oil. These efforts succeeded by decreasing the dependence on imported energy from 90% in 1979 to approximately 55% in 1987.

As a result of the energy policies, the domestic coal production increased from 1.5 million tons in 1980 to 7 million tons in 1988; the stable growth rate of 34% per year during the last five years was considered spectacular. The first stage to increase coal production was to rapidly increase domestic coal consumption in the electric power sector. The total consumption in this sector showed an increase from 0.9 million tons in 1980 to 3.8 million tons in 1985 and 6.4 million tons in 1988.

Programs which will be carried out are to make projections of coal demand and coal production. Domestic coal is used in the power sector, cement industry, boiler-using industries and the tobacco-curing industry.

The power sector was the earliest large-scale user of domestic coal and presently accounts for 83% of total consumption. Of about 7,000 MW total production capacity of the Electricity Generating Authority of Thailand (EGAT), 865 MW is generated using domestic coal, accounting for nearly 20% of total electricity generation.

To meet the rapidly growing electricity demand (13.5% in 1987, 15.6% in 1988, and a forecast of 12% per annum for 1987-1991, 9% per annum for 1992-1996, and 7% per annum for 1997-2000), EGAT is planning to expand its generating capacity to 17,400 MW by the year 2000. Of the approximately 10,400 MW of additional capacity it intends to develop, 6,300 MW should be coal fired.

The cement industry comprises three large companies: Siam Cement Co., Siam City Cement Co., and Jalaprathan Cement Co. Following the surge in cement production, the energy requirements of the cement industry have grown at a rate of more than 20% per annum during the last two years and are projected to grow at an average rate of 7% per annum until 1995 and 6% per annum thereafter. Along with this rapid growth, cement companies are adding the technical capability to use domestic coal for up to 95% of the energy needs of their major plants. As a result, Siam City Cement's plant is already using 95% domestic coal and Siam Cement Company is increasing the capability of using domestic coal in its Saraburi plants from 44% in 1988 to 95% in 1990. With these conversions and the projected growth in cement production, the industry's demand for domestic coal is expected to increase to 1.9 mtpa by 1990, 2.8 mtpa by 1995 and about 3.4 mtpa by 2000.

Industrial boilers offer a significant potential for coal use but only certain sizes, types, and locations. There are currently some 4,000 industrial boilers in Thailand, most of them using heavy oil. Coal use totals some 200,000 tons per annum mainly in the food processing and pulp paper industries. To forecast future coal demand, growth in energy use in each region was assumed to correspond to the weighted average growth rates of four selected industries: food, textiles, pulp and paper, and chemical, and 25% market penetration of domestic coal. This resulted in an estimate of some 800,000 tons of coal consumption by industrial boilers in the year 2000.

Tobacco curing barns have been encouraged to substitute coal for wood in the curing process. Coal demand is expected to taper off and will probably not exceed 100,000 tons per year by the year 2000. As a result from the projection as above, consumption of domestic coal from all sectors is expected to increase from an estimated 7.6 million tons in 1988 to about 24 million tons in 1995 and to 38 million tons by the year 2000, with power generating continuing to dominate.

Philippines

The Office of Energy Affairs (OEA) has prepared the Philippines medium term energy plan (1988-1992), the plan has three main objectives as follows:

- To guarantee the energy preparation in the domestic market with profitable prices.
- To promote the wise and efficient consumption of energy resources.
- To implement both objectives above by keeping the environmental impact at a minimum.

To achieve those three objectives, the OEA has had direction for running the policies:

- Promotion of energy self-reliance.
- Rationalization of energy prices to reflect true cost of production and distribution.
- Encouragement of energy conservation measures to promote efficiency.
- Participation of private sector in energy projects.
- Maintenance of environmental and safety measures for energy projects.

Consistent with the overall objective of promoting energy self-reliance, the following are the future thrusts of the Philippine Coal Development Program (PCDP) for the short and medium term (up to 1992):

- to maximize the production of coal of such quality that can be used by existing users (i.e., Cebu, Batan, Lalat, etc.)
- to promote the use of low-rank coals by blending with high-quality imported coal or upgrading by washing or other coal preparation techniques.

For the long term (beyond 1992), the thrusts are:

- To maximize the use of low-rank coals by ensuring that new coal-fired facilities are designed to use low-rank coals, development of sub-bituminous coals that can be viably transported to shore-based coal-fired facilities in Luzon (i.e., Isabela, Cagayan, Surigao, etc.).
- To firm further long-term market for Philippines coal by further expansion of coal-fired facilities even if initial coal requirements are to be imported.

Philippines coal production is projected to increase from 1.3 million tons in 1989 to 2.6 million tons in 1994. In the same period, however, coal demand is projected to increase from 2.3 million tons in 1989 to 14.8 million tons in 2000. Thus, for the foreseeable future, the Philippines will remain a net coal importer.

PROBLEMS AND POSSIBLE SOLUTIONS

Indonesia

Several problems of Indonesian coal are as follows:

- Coal as an energy alternative needs to be ranked as a strategic project due to its numerous constraints.
- In line with the general policy in the energy sector, an energy diversification which is mainly supported by coal, could have an invertable surplus impact, which can be advantageous to national economic growth.
- Developing transportation facilities in Indonesia is a particular problem because it is necessary to build an extensive network of infrastructures to connect the nation's numerous islands, many of which are still relatively isolated.
- In the program of coal exports, a national mineral trader, who has a function to trade and keep on track with the international mineral trade, should be established.
- In the case of regional economic development, the simulation of coal commodity distribution will depict the geographical path which the same cost or price of coal in order to of minimize economic discrepancies to determine the price of coal.

For Indonesia, coal has been acknowledged at the national level so that it is given full attention by the government both for development and utilization. However, for both development and utilization, many problems have been found in the field, for example, problems caused by inadequate infrastructure. These include the limited capacity of train transportation and loading ports. One of the solutions is to apply the slurry technology. And the People's Republic of China is currently building the technology called "coal-water slurry pipeline" for a distance of 602 km, which is expected to be accomplished by 1993. The slurry technology is considered more effective and is one of the modern transportation methods. This also requires less investment and is quicker than building railways, so it should be considered for application in Indonesia.

Because Indonesian coal varies in quality, it is necessary to have coal blending centres, in order to supply those industries which require a constant quality of coal.

It is expected that Indonesia might produce sufficient coal to exceed domestic demands and thus help overcome the shortage of ASEAN coal supply.

Thailand

Thailand's coal problems include the following:

- The economy of Thailand had a rapid growth from 4.5% GDP in 1986 to 8.4% in 1987 and 11% in 1988. which has resulted in an average growth of 13% per year on the energy demand and 18% per year in coal consumption. Meanwhile, the international price and the shipping costs of exported coal have increased more than 80% during the period 1987-1988 so that hopes of stable coal prices have faded.

- In industrial sectors, particularly in the cement industries, a guarantee was given for a long-term supply, which doubled 1985's figure of 0.6 million tons to become 1.3 million tons in 1988. So the industrial sectors had both the desire and capacity to consume more coal until the domestic coal resources cannot fulfill the demand. The gap between the demand and the domestic supply will grow fast to reach 600,000 tons per year in 1990 and 1 million tons per year in 1992.

Malaysia

This country has enough energy resource potentials including coal. It has been decided that the development of new cement industries as well as steam power electricity generating plants should be on the basis of coal utilization. This year Malaysia is to import coal from Indonesia for the needs of the Electricity Power Authority Malaysia. Thus, the coal potentials of Malaysia have not yet been developed properly for its domestic consumption.

Philippines

The need for energy will be expected to increase while coal resources are scattered throughout the archipelago with quality only good for steaming purposes and has not been developed well all over the country. It is necessary to provide various economic incentives to a company who would go into coal development and/or convert their oil-burning facilities to coal to support the diversification of energy resources. In addition to that, the coal from other countries is needed to fulfill the excess demand of coal.

FUTURE PROSPECT

The potential demand for coal in ASEAN, excluding Singapore as shown in Table 3.2, will be 97.51 million tons in the year 2000, a large increase from 21.99 million tons in 1990. The coal production in ASEAN is 20.34 million tons in 1989, this is expected to rise to 91.35 million tons in the year 2000, excluding Malaysia whose production figure for 2000 are unavailable (Table 3.1). Similarly, the coal demand of East Asian countries (NICs and Japan), which amount to 184.6 million tons in 1990, is expected to rise to 250.6 million tons in 2000.

From these two tables (Table 3.1 and 3.2) it can be seen that the ASEAN countries will be self-sufficient in coal until 1995, and that the surplus is to be exported in particular to neighboring NICs and Japan, to the amount of approximately 2 million tons per year. The quantity is incommensurate with the huge potential demand.

In 2000 the coal demand of ASEAN countries will be 97.51 million tons, which is greater than the total production capacity of 91.35 million tons. Therefore, there will be a surplus demand in the ASEAN countries for about 6 million tons per year. In addition, there will also be an increasing coal demand from the East Asian countries for 250.6 million tons.

Coal exports from the Pacific countries comprising USA, Canada, Australia, and the People's Republic of China in 1990 amount to 220.7 million tons (Table 6.1), which is sufficient to meet the total demands of East Asia and ASEAN in 1990 amounting to 206.59 million tons. While the estimated future export capacity will be 253.3 million tons in 1995 and 296.0 million in 2000, this quantity will be insufficient to meet the demands of the East Asian countries and the ASEAN countries, amounting to 264.75 million tons and 348.11 million tons.

The future configuration of coal flow in the Asia-Pacific region indicates that Indonesia will have opportunities to export her coal surplus to supply the market in Japan and NICs countries due to the shortage of coal in the Pacific region (Figure 6.1), while the estimated future regional coal flow in the year 2000 as shown in Table 6.2 and Figure 6.2.

However, the utilization of coal as a bridge between current conventional energy sources and future nonconventional energy sources must as soon as possible be in the form of synfuel because of the environmental protection requirement, if coal is to be an acceptable substitute for petroleum. In the era of nonconventional energy coal utilization will decrease and be replaced by the use of new energy sources, i.e., wind, solar, nuclear, etc. (see Figures 6.3 and 6.4). The environmental aspect will be addressed by the use of a "built-in" system which incorporates the environmental input factor into energy planning and decision-making; where the environmental cost is covered by earmarked funds out of the flexible funds as part of the total (surplus) funds.

Moreover, the potential ASEAN coal utilization in the future, as a source of energy as well as nonenergy, could be based on the concept of national cross-sectorals, regionals, and across-regional development to gain its benefits as an accelerator to support global economic growth. The application of this fundamental concept requires supporting systems as innovators, such as information systems, clean coal technology and manpower development in line with firm policies in the energy and industrial sectors (see Figure 6.5). This concept is in line with the process of transforming any natural resource into a source of economic potential and finally into a form of social capital which can improve people's lives (see Figure 6.6).

CONCLUDING REMARKS

The Asia-Pacific region indicates a good economic growth, although several countries are in various states of economic fluctuation due to recent world developments, such as the political changes in East Europe and the increased tension in the Middle East. This situation has affected energy supply, especially oil. The majority of Asia-Pacific countries are dependent on oil resources.

Coal resources which occur in the Asia-Pacific region are large, about 51% of the world's coal resources (NEDO, 1989). These coal resources could constitute an alternative energy to reduce the dependence on petroleum. Moreover, the technology for coal utilization has been known since long ago. The main use of coal as an energy source in this region is for electric power generation.

The ASEAN countries will be self-sufficient in coal until the year 1995. The coal demand in the Newly Industrialized Countries (NICs) and Japan constitutes a great market opportunity for coal producers in ASEAN countries. The ASEAN countries' geographic location is more favorable compared to the other Pacific countries like the United States, Canada, and Australia (except China which also has a great market opportunity, though the domestic demand in this country is large). The Indonesian interest is to have the opportunity to utilize her coal optimally, both to help ASEAN become self-sufficient as well as to share in the coal market in the Pacific Region, particularly in ASEAN countries, NICs, and Japan.

To fulfill the coal demand that increases continuously, integrated handling systems are needed among the countries of the Asia-Pacific region, such as a coal flow system to guarantee continuity of supply to meet the coal demand in that region.

Coal constitutes alternative energy to petroleum, and can act as a bridge to future nonconventional energy use. However, the use of coal as a solid fuel on a large scale will increase pressure for environmental carrying capacity, so that it is essential to develop "clean coal" technology such as carbonization, gasification and liquefaction, not only for industrial fuels or as oil and gas synthetic fuels, but also to decrease the environmental impact and to facilitate handling.

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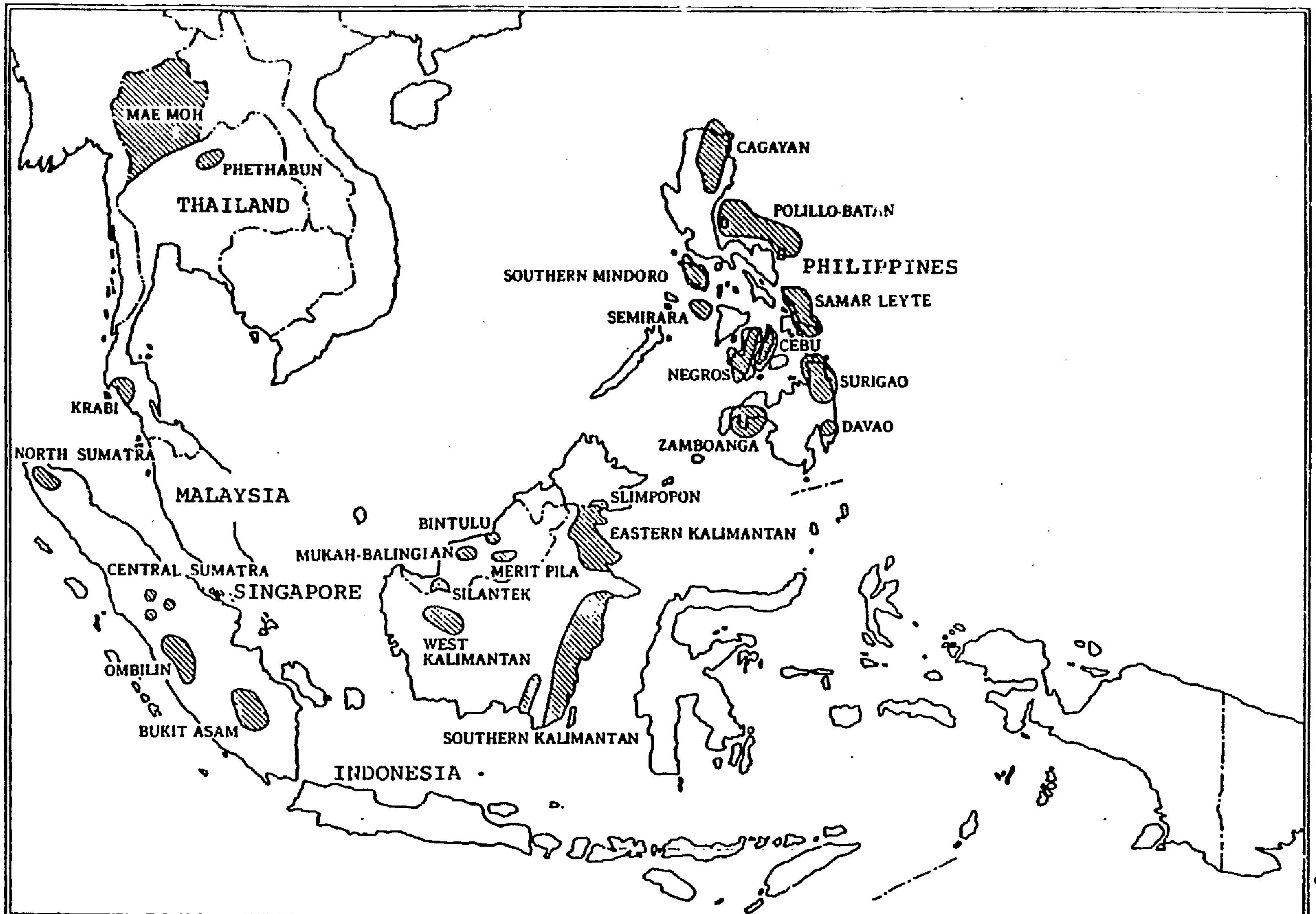
FIGURE 2.1

COAL BASINS IN ASEAN REGION



Source : NEDO, IEE JAPAN

TABLE 2.1

RESERVES AND RESOURCES OF COAL IN SOUTHEAST ASIA

COUNTRY	LOCATION	MEASURED	INFERRED & INDICATED	HYPOTETHIC	TOTAL
INDONESIA	1. NORTH SUMATERA	-	1,272,000	428,000	1,700,000
	2. CENTRAL SUMATERA	550,918	1,261,340	700,000	2,482,258
	3. SOUTH SUMATERA	1,763,294	3,800,270	13,162,000	18,725,564
	4. BENGKULU	2,334	40,079	-	42,413
	SUMATERA	2,286,546	6,373,689	14,290,000	22,950,235
	1. EAST KALIMANTAN	1,058,523	3,924,814	-	4,983,337
	2. SOUTH KALIMANTAN	932,618	2,623,186	-	3,555,804
	3. WEST KALIMANTAN	-	-	102,900	102,900
	4. CENTRAL KALIMANTAN	-	240,000	-	240,000
	KALIMANTAN	1,991,141	6,788,000	102,900	8,882,041
	1. WEST JAWA	4,376	15,390	19,054	38,820
	2. EAST JAWA	-	7,455	755	8,210
	J A W A	4,376	22,845	19,809	47,030
	SULAWESI	-	89,062	-	89,062
	IRIAN JAYA	-	4,000	-	4,000
	T O T A L	4,282,063	13,277,596	14,412,709	31,972,368
PHILIPPINES	1. SEMIRARA	129,300	29,760	550,000	709,060
	2. CAGAYAN VALLEY	88,340	53,180	336,000	477,520
	3. MINDARO	2,400	1,400	100,000	103,800
	4. POLILLO - BATAN - CATAN DUANES	5,670	4,440	17,000	27,110
	5. QUEZON	50	-	2,000	2,050
	6. NEGROS	1,050	1,060	4,500	6,610
	7. NOTHERN CEBU	1,040	370	75,000	76,410
	8. SOUTHERN CEBU	3,320	2,380	50,000	55,700
	9. CENTRAL CEBU	1,420	150	40,000	41,570
	10. BOHOL	530	740	-	1,270
	11. DAVAO	130	-	100,000	100,130
	12. SURIGAO	31,080	23,380	209,000	263,460
	13. ZAMBOANGA	20,310	7,400	45,000	72,710
	14. SAMAR	6,350	4,450	27,000	37,800
	15. MASBATE	170	-	2,500	2,670
	T O T A L	291,160	128,710	1,588,000	1,977,870
THAILAND	1. MAE MOH	614,000	-	1,491,500	2,105,500
	2. SIN PUN	23,000	-	65,170	88,170
	3. KRABI	20,000	-	120,70	140,700
	T O T A L	657,000	-	1,677,370	2,334,370
MALAYSIA	SELANGOR				
	1. BATU ARANG	16,000	-	33,000	49,000
	SERAWAK				
	2. SILANTEK	7,000	-	50,000	57,000
	3. MERIT PILA	-	-	250,000	250,000
	4. BALINGAN	-	-	120,000	120,000
	5. BINTULU	-	-	20,000	20,000
	SABAH				
	6. LABUAN	-	-	8,900	8,900
	7. SILIMPOPON	4,000	-	13,000	17,000
	T O T A L	27,800	-	494,900	522,700
	A S E A N	5,258,023	13,406,306	18,142,979	36,807,308

SOURCE : - DEPT. OF MINES AND ENERGY, INDONESIA, APRIL 1990.
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TABLE 2.2

CHEMICAL ANALYSIS OF COAL IN SOUTHEAST ASIA
(PROXIMATE ANALYSIS)

COUNTRY	PROXIMATE ANALYSIS						REMARK
	MOISTURE (%)	A S H (%)	VOLATILE MATTER (%)	FIXED CARBON (%)	SULPHUR (%)	HEAT VALUE (K. Cal/Kg)	
INDONESIA							
- Lignite	8.00-14.75	1.20-28.2	33.70-49.90	34.80-52.00	0.10-5.37	4900-7125	North Sumatera, Central Sumatera, South Sumatera, East Kalimantan
- Sub bituminous	8.00-14.75	3.00-25.6	25.30-45.25	30.20-60.00	0.49-3.00	5336-6800	Sulawesi, South Sumatera
- Bituminous	6.00-14.75	1.05-28.20	28.34-49.90	30.90-52.00	0.10-5.37	4484-7125	West Sumatera, South Sumatera, East Kalimantan, South Kalimantan
- Anthracite	8.00-13.31	4.15-8.05	39.70-45.25	40.84-51.00	0.49-6.80	5800-6800	South Sumatera
MALAYSIA							
- Lignite	10.30-48.90	2.40-13.80	36.70-53.00	30.70-53.00	0.11-2.53	5140-7110	Merit Pila, Balingan
- Sub bituminous	2.00-8.80	4.50-9.20	42.00-45.80	43.10-44.70	1.40-2.50	6000-8500	Labuan, Silimpapan
- Bituminous	3.30-4.80	2.20-6.70	39.20-43.30	48.80-54.60	1.30-2.90	7110-7540	Bintulu
- Bituminous - Anthracite	1.60-5.20	6.40-15.20	5.30-25.00	61.60-80.20	0.20-0.70	6950-7700	Silantek
PHILIPPINES							
- Lignite - Sub bituminous	4.00-18.00	2.00-35.00	20.00-55.00	25.00-45.00	0.50-3.20	3780-6110	Cagayan, Darao, Masbate, Semimara
- Sub bituminous	6.00-19.00	2.00-13.00	32.00-53.00	34.00-47.00	1.50-4.40	4170-6280	Batan, Samar, Negros, Sungai Mindaro
- Sub bituminous - bituminous	3.00-14.00	1.00-13.00	30.00-48.00	36.00-48.00	0.30-1.30	5060-7170	Polillo, Cebu
- Bituminous	2.00-14.00	5.00-22.00	22.00-40.00	20.00-67.00	0.40-38.00	5720-7280	Cataduanes, Suriaggo, Zambanga
THAILAND/. UANGTHAI							
- Lignite	4.60-30.00	6.20-21.00	20.30-32.00	37.60-40.50	1.50-9.70	1527-5022	Mae Tit, Jaokon, Li, Krabi
- Lignite - Sub bituminous	30.00-35.00	10.00-28.00	20.00	13.00-26.00	0.80-15.00	2500-3000	Maemoh
- Bituminous - Anthracite	7.75	1.06	39.50	51.70	0.71	82.75	Mae Tuen

SOURCE : - DEPT. OF MINES AND ENERGY, INDONESIA, APRIL 1990
- UNDP/WORLD BANK, THAILAND : COAL DEVELOPMENT AND UTILIZATION STUDY, OCTOBER 1989.
- NEDO, COAL IN ASIA - PACIFIC, VOL. 2 No. 1, QUARTERLY REPORT, JANUARY 1990.
- DEPT. OF MINES AND ENERGY, THE COAL RESOURCES OF INDONESIA AND SOUTHEAST ASIA, INDONESIA, 1984.

TABLE 3.1

COAL PRODUCTION IN ASEAN COUNTRIES

(Million tons)

COUNTRY	1989	1990	1995	2000
Philippines	1.34	1.68	2.60	3.28
Malaysia	1.79	2.02	3.04	N/A
Thailad	8.51	9.83	24.06	38.07
Indonesia	8.70	10.65	24.00	50.00
Total	20.34	24.18	53.70	91.35

N/A : DATA NOT AVAILABLE

SOURCE : ESCAP SERIES ON COAL VOLUME 3, UNITED NATIONS.

TABLE 3.2

COAL DEMAND POTENTIAL IN JAPAN, NICs & ASEAN

(Million tons)

COUNTRY	1990	1995	2000
ASEAN			
Philippines	2.97	6.79	14.82
Malaysia	1.94	2.80	5.30
Thailand	10.47	24.11	38.36
Indonesia	6.61	17.79	39.03
Sub total	21.99	51.45	97.51
NICs			
South Korea	37.00	41.50	52.00
Taiwan	20.10	24.20	27.40
Hongkong	9.50	15.10	20.70
Singapore	–	2.50	4.50
Sub total	66.60	83.30	104.60
Japan	118.00	130.00	146.00
Total	206.59	264.75	348.11

SOURCE : ESCAP SERIES ON COAL VOLUME 3, UNITED NATIONS.

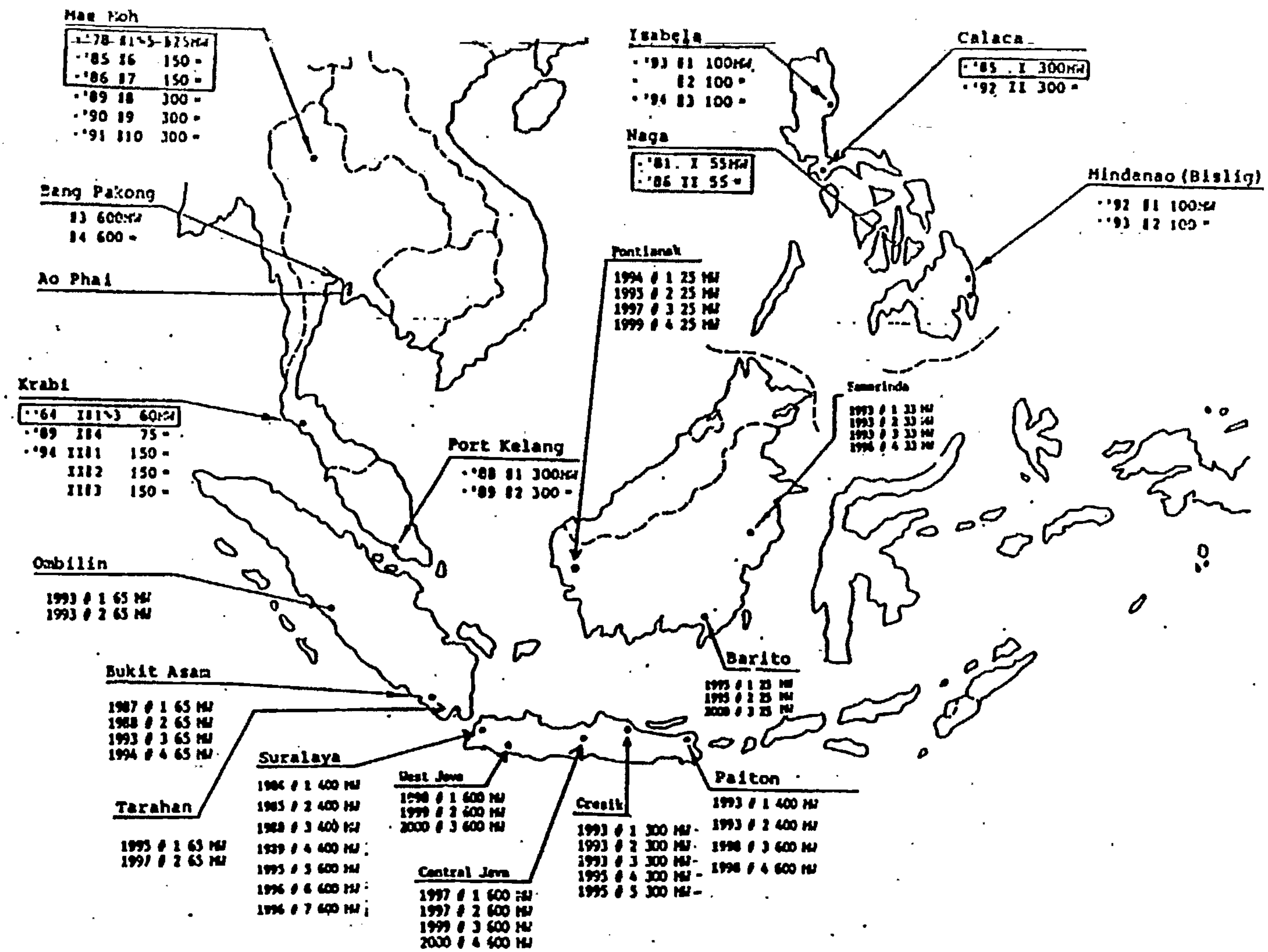
TABEL 3.3

PER CAPITA CONSUMPTION OF COAL

COUNTRIES	COAL CONSUMPTION (MILLION TONS)	POPULATION (MILLION)	PER CAPITA CONSUMPTION (TONS)
CHINA (1985)	806.00	1,041.00	0.77
USA (1985)	685.00	238.80	2.87
USSR (1985)	551.00	227.60	2.42
JAPAN (1985)	110.00	120.60	0.91
U.K (1985)	102.00	56.50	1.80
AUSTRALIA (1985)	39.00	15.80	2.47
INDONESIA (1985	1.50	162.00	0.01
(1987)	3.00	170.00	0.02
(1989)	5.66	179.10	0.03
THAILAND (1987)	7.29	53.60	0.14
MALAYSIA (1986)	-	16.11	-
(1987)	-	16.57	-
PHILIPPINES (1986	-	56.00	-
(1987	-	57.36	-
(1988	2.30	-	-

SOURCE : - JAPAN 1986 AN INTERNATIONAL COMPARISON, KEIZAI KOHO CENTER, (JAPAN INSTITUTE FOR SOCIAL AND ECONOMIC AFFAIR), 1986.
- NEDO, COAL IN ASIA - PACIFIC VOL. 2 No.1, QUARTERLY REPORT, JANUARY 1990.
- SOELISTIJO, U.W, PRAWOTO HENDRO, "APO - RSI SEMINAR ON ENERGY SECTOR AND ECONOMIC DEV'T" LAPORAN PERJALANAN DINAS, MINISTRY OF MINES & ENERGY, 1987.
- KNI-WEC, HASIL LOKAKARYA ENERGI, JAKARTA, 9 - 10 AGUSTUS 1988.

FIGURE 4.1 COAL-FIRED POWER PLANTS IN ASEAN REGION UP TO 2000



Source : - NEDO, IEE, JAPAN
- Dept. of Mines & Energy, Indonesia

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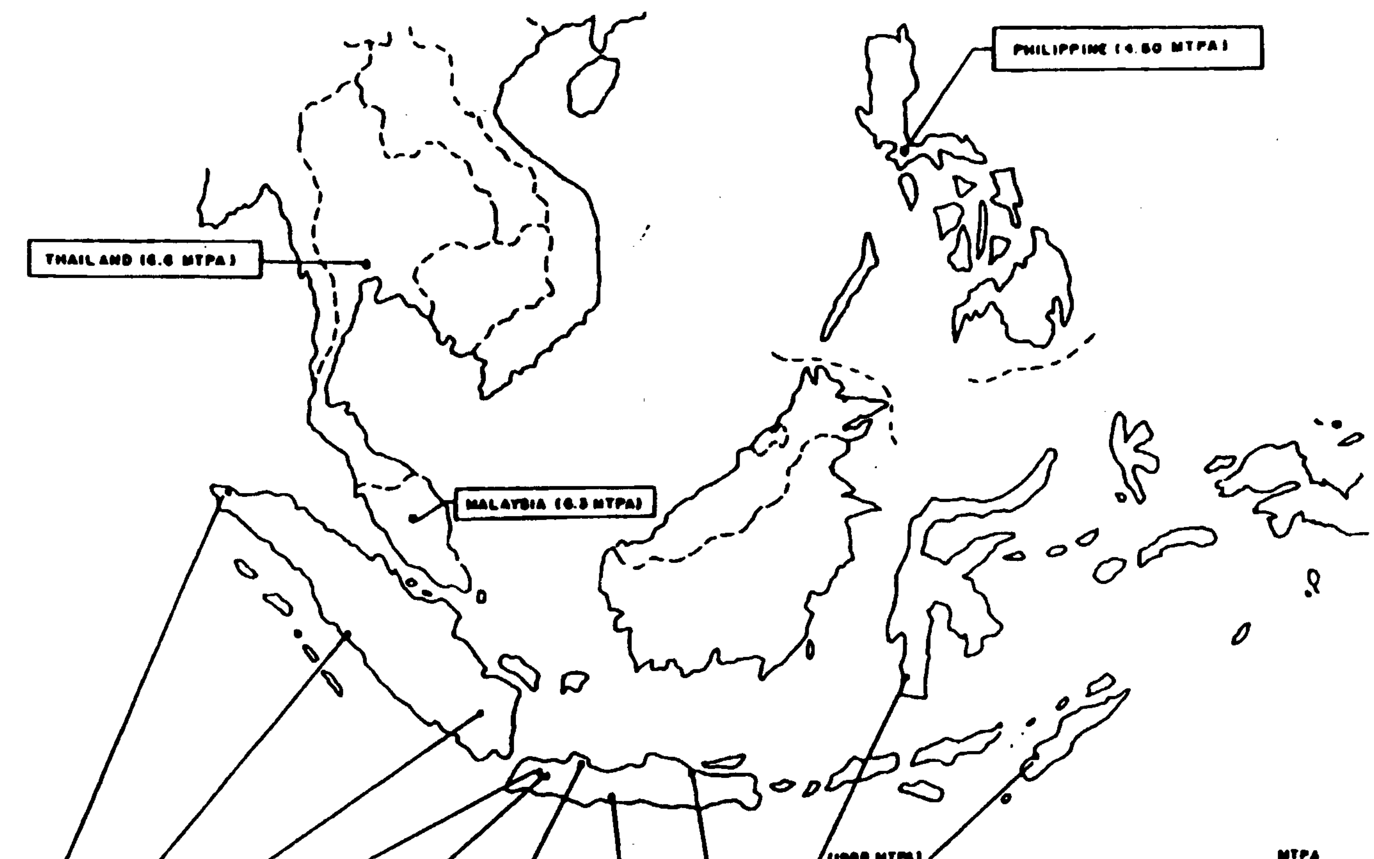
FIGURE 4.2 CEMENT PLANT IN ASEAN REGION



(1988 MTPA)

ANDALAS	PADANG	BATURAJA	INDOCEMENT	CIBINONG	CIREBON	NUSANTARA	GRESIK	TONASA	KUPANG
1.00	2.15	0.50	7.50	1.50	1.20	0.75	1.50	1.2[illegible]	0.12

MTPA

TOTAL INDONESIA
17.41 → Year 1988
25.09 → 2000

TABLE 6.1

POTENTIAL OF COAL EXPORT FROM THE PACIFIC REGION

(Million tons)

COUNTRY	1990	1995	2000
Australia	155.00	176.00	210.00
China	20.70	27.30	36.00
West USA	5.00	10.00	10.00
Canada	40.00	40.00	40.00
T o t a l	220.70	253.30	296.00

SOURCE : ESCAP SERIES ON COAL VOLUME 3, UNITED NATIONS.

TABLE 6.2

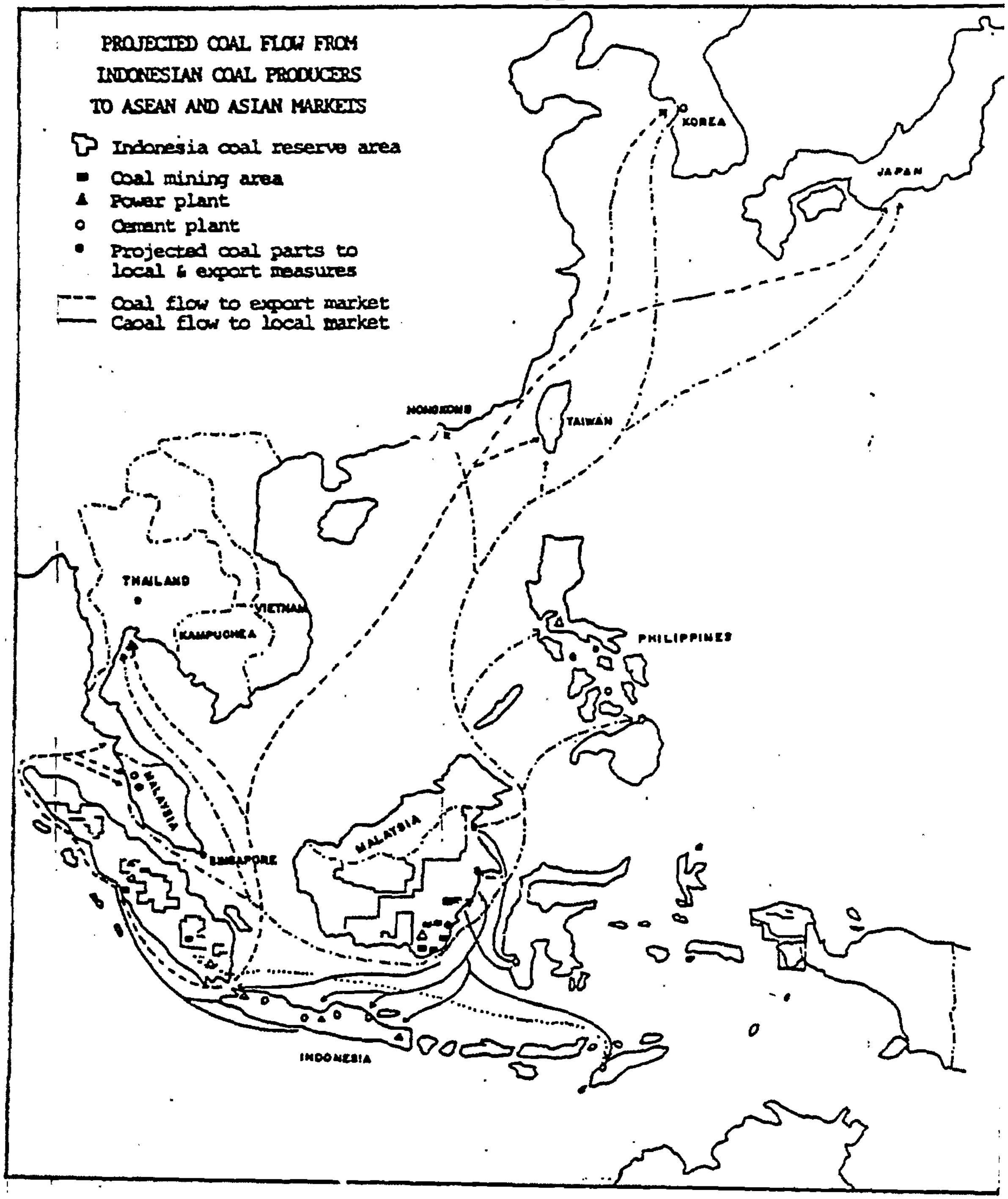
PACIFIC COAL FLOW IN 2000

(In Million Tons)

USER / SUPPLIER		ASEAN				NICs				JAPAN	TOTAL
		INDONESIA	PHILIPPINES	MALAYSIA	THAILAND	SINGAPORE	HONG KONG	KOREA	TAIWAN		
AUSTRALIA	LOW	-	0.2	2.0	0.5	-	2.5	12.0	8.5	47.4	73.1
	HIGH	-	1.5	3.0	5.0	1.5	10.0	11.0	8.7	67.4	108.1
CANADA	LOW	-	-	-	-	-	-	4.0	4.5	16.0	24.5
	HIGH	-	-	-	-	-	-	6.5	4.5	20.0	31.0
U S A	LOW	-	-	-	-	-	-	-	1.0	16.0	17.0
	HIGH	-	1.0	-	-	-	-	4.0	2.5	20.0	27.5
C H I N A	LOW	-	-	-	0.4	-	5.5	4.0	-	14.2	24.1
	HIGH		-		3.0	-	6.0	6.0		15.7	30.7
OTHERS	LOW	-		3.5	-	0.2	2.5	11.0	9.7	21.9	48.8
	HIGH	-		7.5	5.0	3.5	7.0	11.0	11.3	19.[illegible]	65.[illegible]
T O T A L	LOW		0.2	5.5	0.9	0.2	10.5	31.0	23.7	115.5	187.5
	HIGH		2.5	10.5	13.0	5.0	23.0	33.5	27.0	143.0	202.5

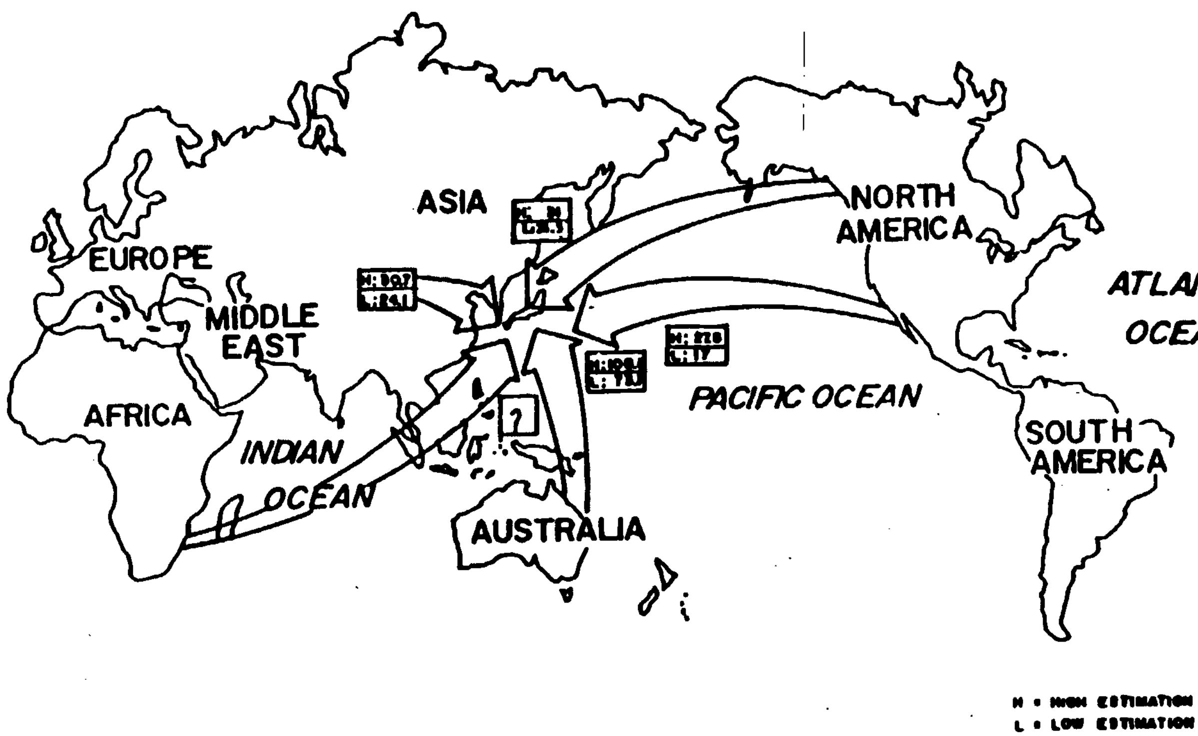
SOURCE : ESCAP Series On Coal, Volume 3, UNITED NATIONS.

FIGURE 6.1



Source : Departement of Mines and Energy, Indonesia

FIGURE 6.2 **PACIFIC BASIN COAL TRADE IN 2000**
(MILLION TONS)



Source : ESCAP Series on coal, Volume 3, United Nations

FIGURE 6.3

TRANSITION PERIOD OF PRIMARY ENERGY COMMODITY UTILIZATION

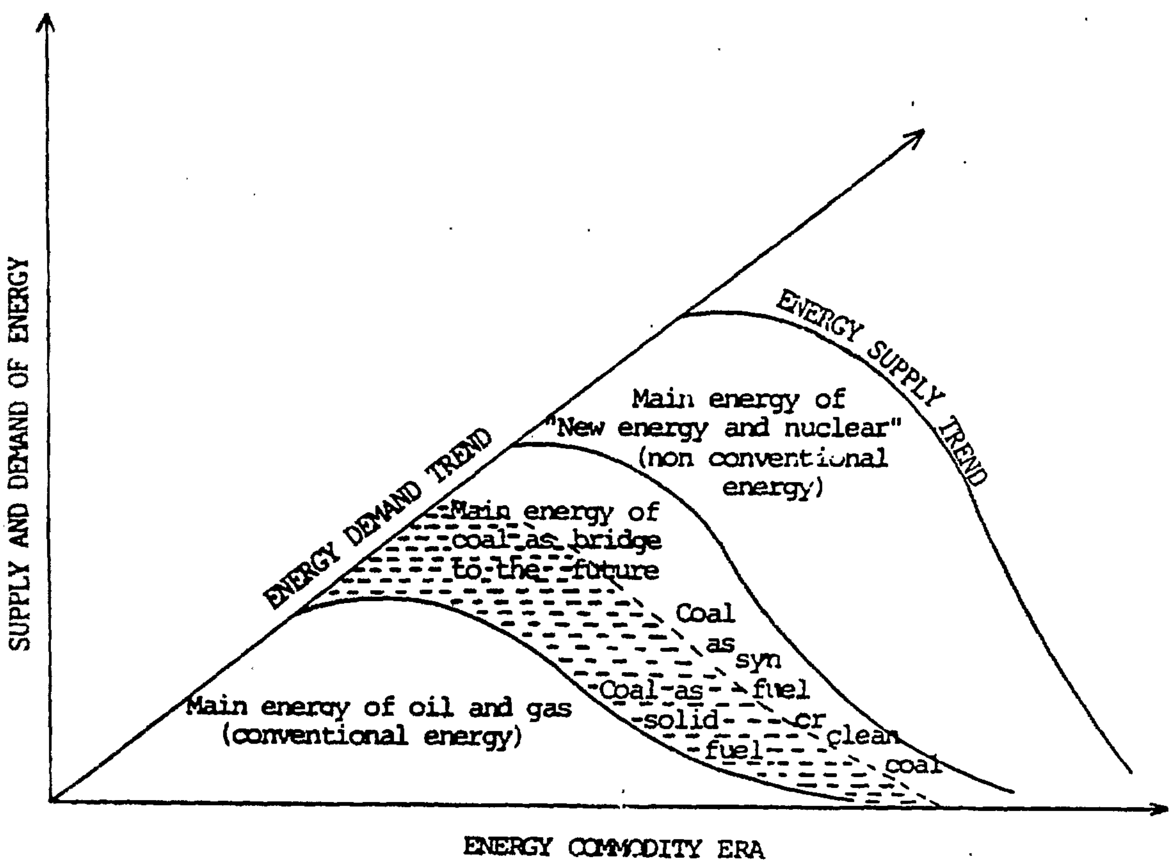
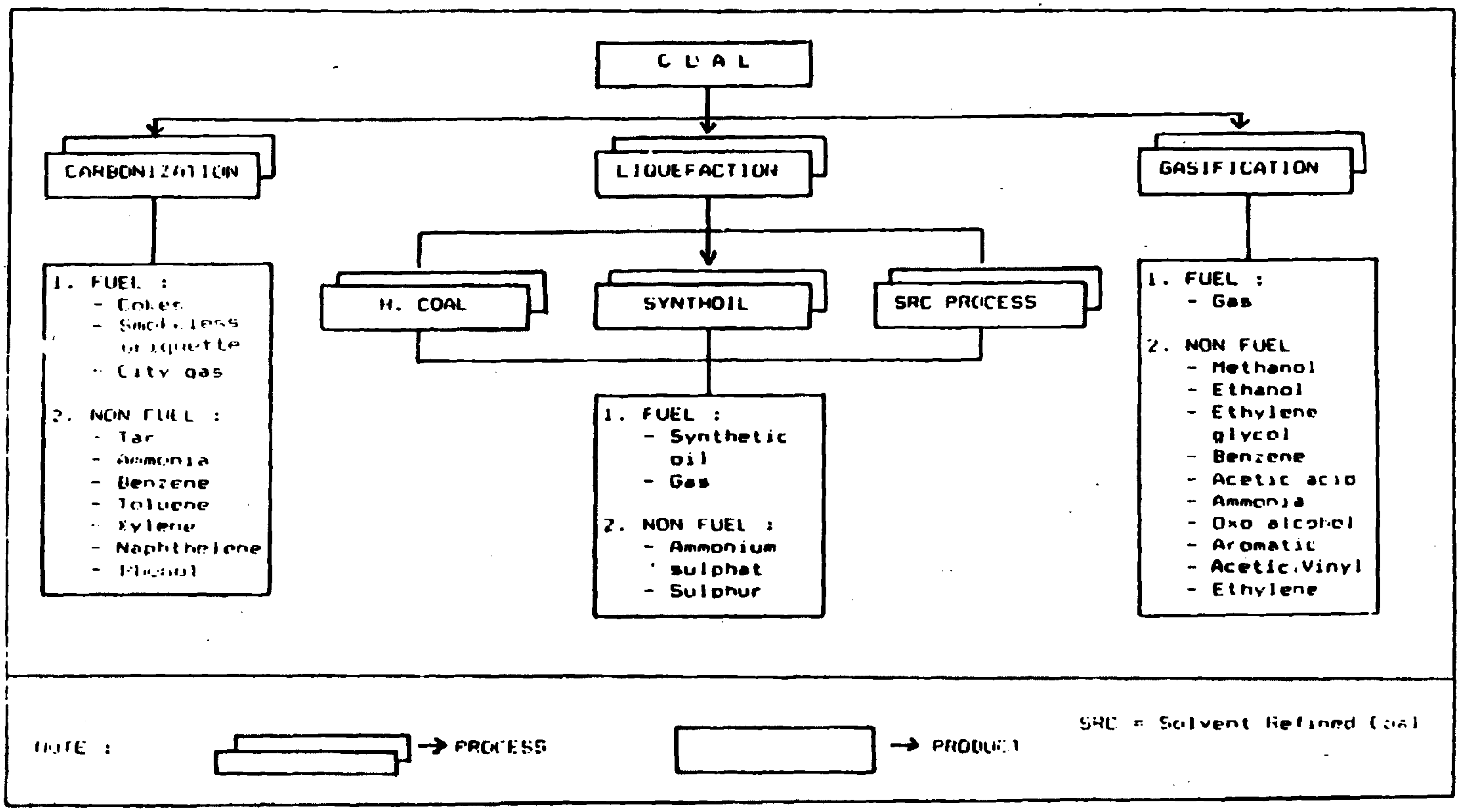


FIGURE 6.4

COAL UTILIZATION TECHNOLOGY FOR PETRO CHEMICAL INDUSTRY



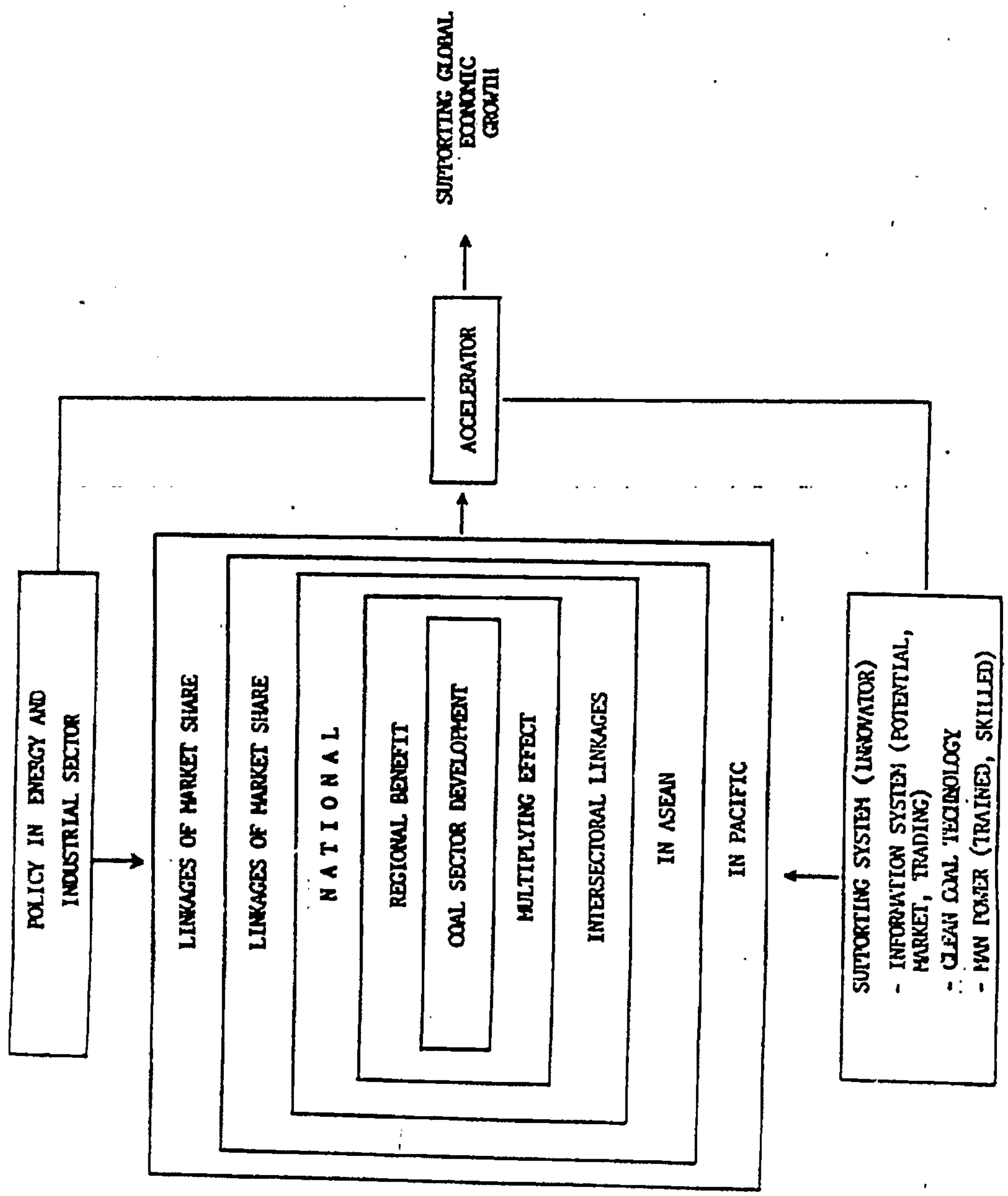
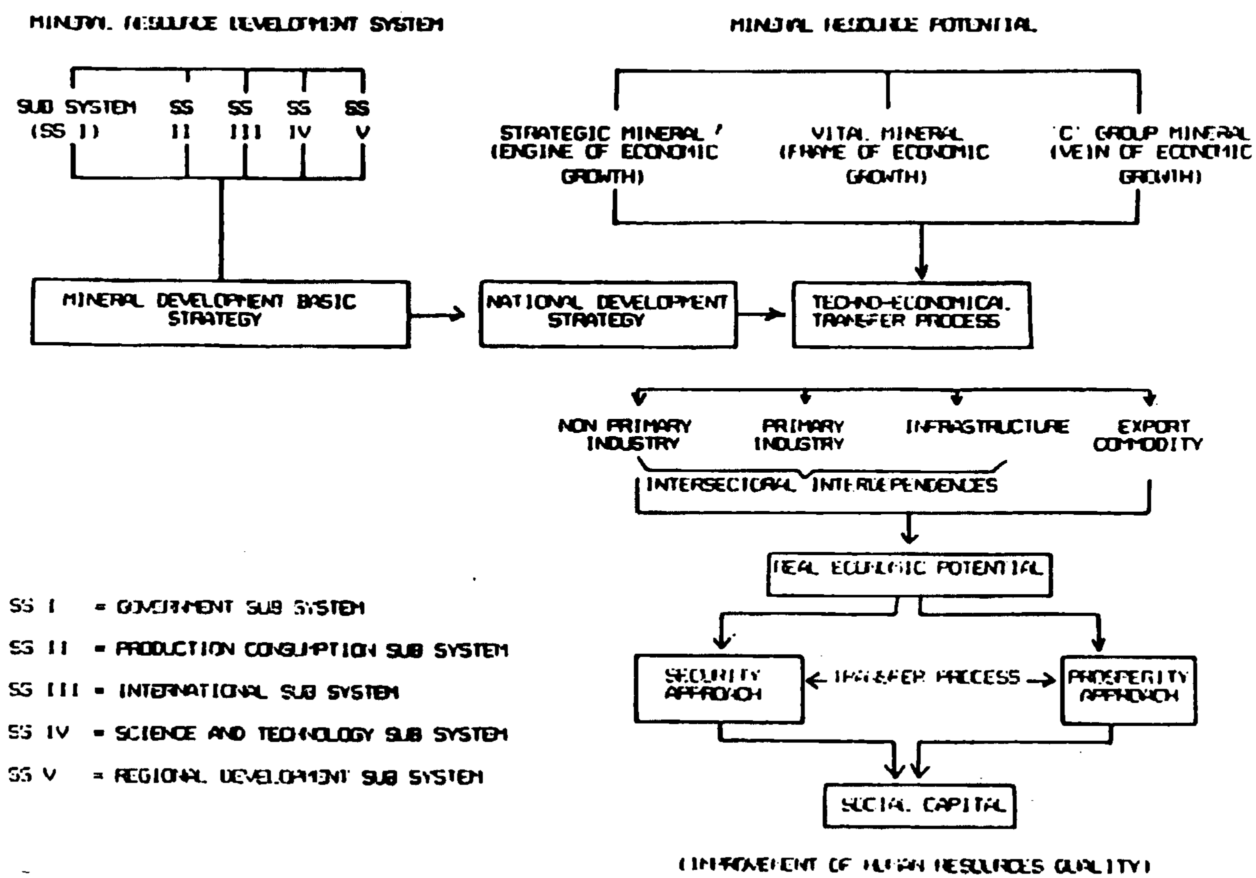


FIGURE 6.5 MOTIVATION OF ASEAN COAL UTILIZATION

FIGURE 6.6 LINKAGES BETWEEN MINERAL RESOURCE DEVELOPMENT SYSTEM AND TRANSFER PROCESS OF MINERAL RESOURCES



"AUSTRALIAN COALS IN THE DOMESTIC AND INTERNATIONAL ENERGY SCENES, THE PRESENT AND FUTURE -- AN OVERVIEW"

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AUSTRALIAN COALS IN THE DOMESTIC AND INTERNATIONAL ENERGY SCENES, THE PRESENT AND FUTURE - AN OVERVIEW

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ABSTRACT

The paper briefly reviews the Australian coal scene and examines the reasons wny Australia has become the leading seaborne exporters of both metallurgical and steam coals. Matters addressed include the resource base, its location and nature, production, domestic usage, exports, ports and destinations as well as the technology base and the nature of the R & D support for the mining, preparation industry and coal uses.

Brown coals do not feature directly in the export scene but are important in the Australian energy scene. These coals are addressed separately as appropriate and investigations of these as potential preferred feedstock for conversion to liquid fuels receives brief comment.

Projections of the future world demand for imported coal and of Australia's share in supplying this are presented and discussed. Despite the concerns for the contributions coal use makes to the input of greenhouse gases to the atmosphere the projections for future growth in coal demand, especially steam coal, are optimistic. The implications of the greenhouse issue to the coal industry and the challenges and opportunities these present are briefly addressed in concluding the paper.

INTRODUCTION

Australia, since 1984, has been the leading seaborne exporter of coal to the world markets, displacing the USA. Coal is now one of Australia's major export commodities in terms of dollar value. In recognition of this prominent role of Australian coal in the world coal scene and in the Australian economy the organizers of this conference have invited me to prepare and present a paper which provides an overview of the current

Australian coal scene and addresses the future market prospects for Australian coals. In doing this I include the brown (lignites) as well as the black (bituminous and sub-bituminous) coals since the former coals are of prime concern to North Dakota.

In the limited space allocated the following aspects are addressed briefly in the Australian context - the coal resource base, coal production, domestic coal use, coal exports, the role of technology in the coal industry and coal related research and development. Against this background the paper concludes with a discussion of projections and comments on future markets for Australian coals, with particular regard to the future demands for energy and the implications of growing concerns for the impact of fossil fuel use on the environment and of new technology.

COAL RESOURCES

Distribution, Quantities and Rank

The distribution of Australia's black and brown coal resources are shown in Fig. 1 and current estimates of the amounts of the black (Department of Primary Industry and Energy 1989) and brown coal (Stanley, 1986) resources are summarized in Tables 1 and 2 respectively.

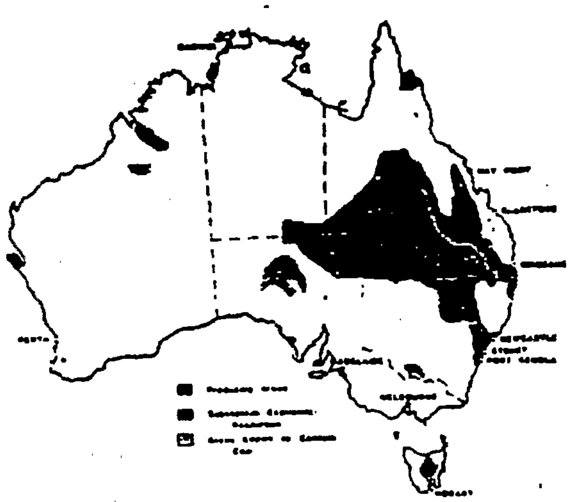

FIGURE 1 - AUSTRALIAN BLACK COAL RESOURCES

Table 1 includes only coals in New South Wales and Queensland. Black coals also occur in Western Australia (864 Mt), South Australia (3410 Mt) and Tasmania (530 Mt) (Joint Coal Board, 1986) but these resources do not feature in the export trade although some are used locally.

Black Coal

The main black coal producing areas are situated along the eastern (Pacific) seaboard. The total resources here (Table 1) are estimated to be 69,489 Mt with 48% in New South Wales and 52% in Queensland. Overall 41% of these resources are considered to be potentially accessible by surface

TABLE 1

AUSTRALIAN BLACK COAL RESOURCES*
(million tonnes)

	Open Cut	Underground	Total
New South Wales	13,929	19,507	33,436 (48%)
Queensland	14,375	21,678	36,053 (52%)
Total	28,304 (~41%)	41,185 (59%)	69,489 (100%) (100%)

*Measured plus indicated, i.e. based on bore cores at 1 km and 2 km intervals respectively.

mining techniques since they occur within 200 m of the surface in seams greater than 0.3 m thick and at an overburden to coal ratio no greater than 10:1. The resources considered amenable to underground mining include only coals with less than 35% ash yield in seams at least 1.5 m thick within 600 m of the surface.

These black coal resources cover a wide range of ranks and petrographic type encompassing low to medium volatile through to high volatile thermal and coking coals in both New South Wales and Queensland as well as some sub-bituminous coals and semi-anthracites. The coals are predominantly Permian in age with the sub-bituminous coals being Triassic or Jurassic (Mesozoic).

Recent information (World Energy Conference, 1989) indicates that, with respect to recoverable black coal resources, those of Australia represent 4% of the world total and correspond to 25% of the USA total.

Brown Coal

Australia's brown coal resources occur in Victoria, South Australia and Western Australia with those of Victoria dominating. The total in-situ reserves in Victoria which occur within 300 m of the surface (Table 2) are estimated to be 207,973 M tonnes of which 158,026 M tonnes (75%) occur in the Latrobe Valley Depression to the east of Melbourne. (Available information indicates that the total resources in all the other States amount to about 6000 M tonnes with none being currently mined). The total measured plus indicated reserves in Victoria, i.e. those yielding no more than 10% ash (dry basis) in seams not less than 3 m thick within 300 m of the surface and having an overburden to coal ratio no higher than 2:1, are estimated to be 96,300 M tonnes of which 86,200 M tonnes (89%) occur in the Latrobe Valley where coal seams average 137 m (450 feet) in thickness over an area of 4635 hectares (179 square miles), under very shallow overburden cover.

It is interesting to compare, on an equivalent basis, the brown coal resources of the Gippsland Basin in Victoria with those of the Fort Union Basin in the USA which underlies portions of Montana, North Dakota and South

Dakota. The latter is considered to be the largest coal basin in the world (US Dept. of Interior, 1980). The total identified coal resources in the Fort Union Basin, down to 300 m in seams exceeding 2.5 feet (0.76 m) in thickness is 465,000 M tonnes. This is far greater than the equipment for the Gippsland Basin down to 300 m which is 134,874 M tonnes. With regard to the reserves regarded as "strippable", however, those of the Gippsland Basin (96,300 M tonnes) exceed considerably those of the Fort Union Basin (26,300 M tonnes). The World Energy Conference (1989) figures for proved recoverable reserves of lignites (brown coals) indicate that the Australian brown coals represent 11% of the world's total whereas those of North America (Canada plus USA) amount to 6%.

TABLE 2

VICTORIAN BROWN COAL RESOURCES
(million tonnes)

		Resources	(%)	Reserves*
Gippsland Basin - Latrobe Valley	(90)	158,026		
- Other		14,848		
	(100)	172,874	(83)	96,300
Murray Basin		19,599		
Otway Basin		15,500		
Total		207,973	(100)	

*Includes only coal with 10% ash yield maximum in seams not less than 3 m thick with less than 300 m of overburden, and an overburden to coal ratio no more than 2:1.

The Latrobe Valley brown coals are of low rank having high moisture contents in the range 60 to 66% in situ. The ash yields, however, are very low being typically less than 3.5% (dry basis) and frequently less than 1% in some locations.

COAL PRODUCTION

Black Coal

The raw black coal production in Australia (Table 3) increased from 52.3 M tonnes in 1970 to 93.6 M tonnes in 1980 to 158 M tonnes in 1985 and 171 M tonnes in 1988. The corresponding saleable coal production was 45.2, 76.5, 129.4 and 141 M tonnes respectively for 1970, 1980, 1985 and 1988 as a consequence of the washing of all the metallurgical coal production and virtually of all the coal destined for export. (Joint Coal Board, 1989; Queensland Coal Board, 1989).

In 1988 almost 69% of the saleable black coal production was from open cut mines (Table 4). In Queensland, however, the corresponding figure was

94.3%. Queensland's sealeable production exceeded that of NSW for the first time in 1988, i.e. 68.6 compared with 65.7 M tonnes.

TABLE 3

RAW AND SALEABLE BLACK COAL PRODUCTION 1970 TO 1988
(million tonnes)

	1970	1980	1985	1988
Raw Coal - NSW	35.9	50.7	75.0	78.3
- Queensland	13.2	37.8	76.7	86.2
- Other*	3.2	5.1	6.3	6.8
- Total	52.3	93.6	158.0	171
Saleable Coal - NSW	31.7	42.7	62.3	65.7
- Queensland	10.5	28.8	61.0	68.6
- Other*	3.0	5.0	6.1	6.7
- Total	45.2	76.5	129.4	141.0
	(86.4)**	(81.7)	(81.9)	(82.4)

*South Australia, Tasmania and Western Australia
**Saleable coal production as percentage of raw coal production

TABLE 4

SALEABLE BLACK COAL PRODUCTION IN 1988 - BY STATE AND MINING TECHNIQUE
(million tonnes)

	Open Cut	Underground	Total
N.S.W.	26.7	39.1	65.8
Queensland	64.7	3.9	68.6
Other	5.5	-	6.6
Total Australian	96.9	43.0	141.0

The coal produced in 1988 was obtained from 68 mines in New South Wales, 51 underground and 17 open cut, and 37 mines in Queensland, 11 underground and 26 open cut. This represents an overall reduction from 89 mines in NSW and 52 in Queensland in 1985 reflecting the closure of 17 underground 4 open cut mines in NSW and of 12 underground and 3 open cut mines in Queensland. These closures all involved old low capacity, high cost mines. The 25 largest mines have annual raw coal production capacities in the range 1.7 to 6.6 M tonnes per year, with all but two at the lower capacity being open cut mines. These 25 mines, 9 in NSW, 14 in Queensland, 1 in South Australia, and 1 in Western Australia, together, accounted for 75% of the total production in 1986.

Brown Coal

Brown coal production mainly from three large open cut mines in the Latrobe Valley, Victoria increased from 21 M tonnes in 1970 to 31 M tonnes in 1980, then to 37 M tonnes in 1985 and 42 M tonnes in 1988 (State Electricity Commission of Victoria, 1988).

CONSUMPTION

Black Coal

The consumption of black coal in Australia (Table 5) increased from 25.1 M tonnes in 1970 to 36.4 M tonnes in 1980, 41.9 M tonnes in 1985 and 48.3 M tonnes in 1988. This represented 55%, 47%, 32% and 34% respectively of the total saleable coal production (Table 3) with the balance being exported.

TABLE 5

CONSUMPTION OF BLACK COAL IN AUSTRALIA, 1980 TO 1988
(million tonnes)

	1970	1980	1985	1988
Electricity generation	12.8	24.6	30.7	35.6
Iron and steel	7.9	8.2	6.3	7.6
Foundry coke	0.54	0.84	0.36	0.50
Cement industry	0.85	0.90	1.0	0.75
Alumina refining		1.2	1.5	1.8
Other	3.0	1.2	1.9	2.1
Total	25.1	36.4	41.9	48.3
(%)*	(56)	(47.6)	(32.4)	(34.2)

*percentage of saleable production

Electricity generation provides the major domestic market for black coal with the iron and steel industry being the second largest user. These two activities accounted for 67% and 22% respectively of the domestic consumption in 1980 and 74% and 16% respectively in 1988, i.e. 90% of the domestic consumption. Most of the steady annual increase in domestic demand is accounted for by the electricity industry.

Brown Coal

In Victoria 95% of the brown coal produced in 1988 was used to generate 84% of the electricity used in the State (Higgins, 1989). Most of the remainder was used to produce binderless briquettes (813,000 M tonnes). The latter are used as fuel in industry and homes (73%), as feedstock for lump char production (18%) and the remainder (9%) is exported.

EXPORTS

Black Coal

The export of Australian black coals (Table 6), exclusively from New South Wales and Queensland, increased from 18.3 M tonnes in 1970 to 99.6 M tonnes in 1988. In 1970 metallurgical (coking) coals accounted for 92% of the coal exported and 45% of the total saleable production. By 1988 metallurgical coal exports, although showing a 70% increase over those in 1970, accounted for only 56% of the exports due to a rapid increase in the exports of steam coals from a low figure of 1.4 million tonnes in 1970 to 43.6 million tonnes in 1988.

TABLE 6

AUSTRALIAN BLACK COAL EXPORTS, 1970 TO 1988
(million tonnes)

State	Type	1970	1980	1985	1988
NSW	Metallurgical	10.0	14.7	16.8	16.9
	Steam	1.3	8.2	23.9	25.0
Queensland	Metallurgical	6.9	19.2	32.9	39.1
	Steam	0.1	0.7	14.2	18.6
Australia	Metallurgical	16.9	33.9	49.7	56.0
	Steam	1.4	8.9	38.1	43.6
	Total	18.3	42.8	87.9	99.6
	(%)*	(40.5)	(55.9)	(67.9)	70.6)

*Percentage of saleable production

The rapid increase in the export demand for steam coal which commenced in the late 1970's has been a consequence of the OPEC oil embargoes and the associated marked increases in oil prices in 1973 and 1979 which led to a renewed interest in coal as an energy source.

Other interesting facts on the Australian coal scene are indicated by Table 6 and a comparison with Table 5. Firstly, coal exports have exceeded domestic coal consumption since 1976 and currently account for about 70% of the saleable coal production. This shows that the major proportion of installed coal production capacity is dedicated to serving the export market. This places Australia in a unique position relative to other coal exporting countries where coal exports represent a minor part of the annual production, i.e. seaborne coal exports (Table 7) represent 7.9%, 24.0%, 16.5% and 53.8% for the USA, South Africa, Poland and Canada respectively in 1988.

TABLE 7

COMPARISON OF BLACK COAL PRODUCTION AND SEABORNE EXPORTS FOR MAJOR COAL EXPORTING COUNTRIES IN 1988
(million tonnes)

Country (a)	Production	Exports		
		Metallurgical	Steam	Total (%)
Australia	141.0	56.0	43.6	99.6 (70.6)
USA*	863	49.0	19.0	68.0 (7.9)
S. Africa (b)	177.6	1.5	41.1	42.6 (24.0)
Poland**	193	11.0	21.1	32.1 (16.5)
Canada*	58.5	27.4	4.1	31.5 (53.8)
China	975	<2	<14	15.0

*Seaborne exports only - USA also exported 16.3 M tonnes of coal to Canada in 1988 (6.3 M tonnes metallurgical and 10.0 M tonnes steam). This effectively reduces Canada's coal exports relative to black coal availability to 42.1%.
** Total exports including seaborne - about 50% to Western World

Source (a) Depart of Primary Industry and Energy (Australia), 1989
(b) South African Coal Report, Issue 1.2, April 1990

Secondly, metallurgical coal exports still represent 56% of the total black coal export but Queensland has displaced NSW as the major supplier of metallurgical coal (since 1972) supplying 66% of the exports in 1988. Steam coal exports have increased dramatically (since 1974) with New South Wales supplying 63% of the total.

Internationally, Australia now leads in the seaborne exports of both metallurgical and steam coals (Table 7). In 1988 Australia supplied 34.8% of the World seaborne trade in metallurgical coal which was 161 M tonnes compared with 30.4% for the USA. For steam coal Australia supplied 30% of the total World seaborne trade of 145 million tonnes compared with 28.3% for South Africa and 13.1% for the USA (DPIE, 1989).

Ports

As mentioned above Australia's major black coal resources, and hence the coal mines are situated along the eastern seaboard, in New South Wales and Queensland. The coal is presently transported to a nearby port by rail over distances that range from 20 km to 320 km. NSW is serviced by 3 coal ports and Queensland by 4. The current total annual port capacity is 148.5 M tonnes, 62.5 M tonnes in NSW and 86 M tonnes in Queensland. At NSW ports the maximum size of vessels that can be handled ranges from 60,000 DWT to 180,000 DWT. At Queensland ports the maximum size varies from 65,000 to 220,000 DWT.

Destinations

Any consideration of Australia's coal exports is incomplete without mention of the destination. In 1988 NSW and Queensland exported coal to 20 and 28 countries respectively in Asia, Europe and elsewhere, Japan is, by far, the leading customer for both metallurgical and steam coals accounting for 43% and 51% respectively of the total Australian exports (Table 8), supplying 69% and 41% respectively of Japan's imports.

TABLE 8

DESTINATIONS OF AUSTRALIA'S COAL EXPORTS 1988
(million tonnes)

Region	Metallurgical	Steam	Total
Japan	27.9	22.9	50.8
Other SE Asia[a]	7.3	10.5	17.8
Other Asia[b]	5.0	2.6	7.6
Europe[c]	11.7	6.6	18.3
Other Countries[d]	4.1	1.0	5.1
Total	56.0	43.6	99.6

(a) Hong Kong, Indonesia, S. Korea, Malaysia, Philippines, Taiwan, Vietnam
(b) India, Israel, Pakistan, Turkey
(c) 10 countries
(d) Brazil, New Caledonia, United States

Brown Coal

Brown coals because of their high moisture content as mined, virtually two thirds, and high propensity to heating leading to spontaneous combustion during drying and when dry, are not amenable to transport over even relatively short distances. However, as briquettes, Latrobe Valley (Yallourn seam) brown coal has been successfully exported on a modest scale i.e. 75,000 tonnes in 1987/88 mainly for use as a domestic fuel in the importing countries.

REASONS FOR AUSTRALIA'S PROMINENCE AS A BLACK COAL EXPORTER

A number of factors have contributed to Australia featuring prominently as an exporter of both metallurgical and thermal coals from the early 1960's eventually displacing the USA as the leading exporter of seaborne coal in 1984. These are:

1) The extensive coal resource base close to ports, in thick seams close to the surface which includes a wide range of coal types suitable for use as metallurgical and thermal coals.

2) The application of the latest coal mining technology to the mechanisation of existing underground mines and in new underground and open cut mines established to service the export market.

3) The proximity of Australia to its initial and largest customer, Japan.

4) The policy of using the latest coal preparation technology to wash all metallurgical coal and virtually all export thermal coal. This aided by product blending affects both close quality control and quality assurance to enable all shipments against a contract to meet the required specification. About 75% of the coal produced in NSW is washed. The corresponding figure for Queensland is 90%.

5) The low sulphur content and the high ash fusion temperatures of most Australian black coals.

6) The perceived political and economic stability of Australia.

A key factor that stimulated the early interest of the Japanese Steel Mills, at a time when Japan as a nation decided on a complete modernization of their iron and steel industry, using the then best available technology worldwide (a decision that laid the basis for the current economic dominance of modern Japan), was the existence of an extensive and growing knowledge base on the chemical and physical characteristics of Australian coals. This was initiated in 1947 by CSIRO (then CSIR) and the CSIRO reports were studied in detail by the Japanese and some were even translated from cover to cover into Japanese.

With the renewed interest in coal as an energy source that resulted from the OPEC initiatives relating to oil prices and supply in 1973 and 1979 Australia was well poised to supply thermal coal into overseas markets as well as metallurgical coals.

It has not all been easy for the Australian coal industry, however, and in recent years much of the industry has operated at a loss while at the same time the exports of metallurgical and thermal coals continued to expand. The factors that have contributed to this have been, on the one hand, the fall in oil prices as OPEC has struggled to increase its share of the world oil market which provides a marker for setting the price of coal as a fuel and, on the other hand increases in the FOB costs of coal beyond the direct control of the coal industry. The latter have included:- unrealistic front end government charges in the form of royalties and levies, and for the provision of infrastructure services (rail transport, and port); the high cost of capital and the effect on capital requirements of the prolonged delays involved in processing through many government bodies environmental impact studies etc to obtain permission to start a new mine; restrictive work practices, together with a multitude of unions and consequent demarcation problems, which resulted in expensive items of equipment lying idle for much of each week; unrealistic wage bonus and penalty, and employment demands by the unions, with stoppages to win these demands, many of which were stimulated by the moves of mine owners to introduce new technology to increase productivity and efficiency hence to reduce costs. It has taken the downturn in the profitability of the industry and the closing of a number of high cost mines (36 since 1986 - see above) for unions, government and coal industry management to recognize the need to work together if Australia is to maintain and improve its competitive position as an international supplier of high quality coal. Over the past year significant changes in work practices etc have been negotiated which have helped increase productivity and reduce costs. This trend together with increases in the prices being received for metallurgical and steam coals is helping the industry to begin to move into profitability.

RESEARCH AND DEVELOPMENT AND NEW TECHNOLOGY FOR THE COAL INDUSTRY

The Australian coal industry has been progressive in applying, adapting to local conditions as required, coal mining and coal preparation technology developed overseas. In addition the industry has been backed by wide ranging coal related research and development (R&D) activities essentially commencing with the establishment by CSIRO (then CSIR) in 1947 the Coal Research Section (which has now become, after many changes, the present Division of Coal and Energy Technology) to undertake a systematic study of the physical and chemical characteristics of both Australia's black and brown coal resources. The subsequent development of coal R&D in Australia with regard to the establishment of industry government and academic laboratories, and to the topics addressed and the circumstances influencing changes in emphasis from time to time makes an interesting story in itself, but not for now.

Interest in coal and hence support for coal research reached a low ebb in the late 1960's as elsewhere when oil supplies were abundant and cheap and with oil being a more convenient fuel to transport, store and use. This all changed in the mid to late 1970's due to the OPEC initiatives which focussed the attention of the Western World on their heavy dependence on oil as an energy source and on oil from OPEC members in the politically unstable Middle East. This renewed interest in coal as an energy source both directly where it can be so used and as a feedstock for the production of gaseous and liquid fuels. Australia was no exception here. Although fortunate in having the electricity industry firmly based on coal (61% of the coal produced used to generate over 80% of the electricity needed the major energy demand sector (51% of total energy needs in 1973) was for oil with over half of the latter being fuel for transport. At the time Australia was about 65% self sufficient with respect to crude oil but indigenous oil reserves represented, in energy terms, less than 1% of Australia's fossil fuel energy resources (excluding oil shale) whereas coal represented over 97%.

In recognition of the significant existing dependence on imported oil, and the prospect that in the absence of any significant new oil discoveries self sufficiency is projected to be down to ~36% by 2000 (ABARE 1989), the Federal Government in 1977 implemented a levy of 5 cents/tonne on all saleable coal produced in the country to establish a Coal R&D Trust Fund and created the National Energy Research, Development and Demonstration Council (NERDDC). The latter was charged with the responsibility of funding R&D relevant to the realization of the Government's energy policy which was to maintain and increase Australia's self sufficiency in all forms of energy. The initiatives taken were directed to replacing oil by coal directly whenever practical, increasing the efficiency of energy use in all forms, the production of liquid and gaseous fuels from coals and other feedstocks and increasing the use of renewable energy sources, all in a manner that was environmentally responsible. NERDDC was charged with the responsibility of allocating funds derived from the Coal Research Trust Fund Levy together with energy research funds provided by the Government.

The initial emphasis was on Australia's energy needs but later research to help the export of Australian coals was included on the basis that overseas revenue earned in the export of energy as coal could offset the cost of importing energy as oil. In the coal area NERDDC has supported research in coal mining and preparation technology, and coal utilization including an extensive program related to the production of oil from coal, as well as research directed to improving the knowledge of the nature of coals as an important national resource. The ready availability of crude oil at relatively low cost in recent years, however, has lulled the sense of urgency and, as elsewhere, interest in coal conversion has waned, at least for the time being.

Although the NERDD program has made a significant contribution to advancing the science and technology of Australian coals the Federal Government, as part of its policy to replace the present government research funding organizations by industry based R & D Boards, is in the process of replacing the NERDD Council by an Energy R & D Corporation and a Coal R & D Corporation. There are, however, some problems relating to the latter than remain to be resolved with the coal industry.

Brown Coal

With regard to the theme and venue of the present conference and the differences between black and brown coals the latter require special comments on technology transfer and R & D in Australia. Firstly, it is of interest to recall that in 1956 the Gas and Fuel Corporation successfully commissioned and operated a brown coal gasification plant based on Lurgi high pressure steam-oxygen gasifiers to supply town gas to Melbourne. The brown coal was supplied to the gasifiers as briquettes (180,000 tonnes per year). Further expansion was planned but the discovery of natural gas resulted in the gasification plant being closed down in 1969 (Higgins, Allardice and Perry, 1988).

A more recent activity has been the Japanese financed Brown Coal Liquefaction (Victoria) Pty Ltd (BCLV) project. This project involved the construction and operation of a pilot plant at Morwell, Victoria for converting 50 tonnes per day (dry basis) of brown coal in a two stage process to naphthene and middle distillate (Higgins, Allardice and Perry, 1988). The project which has involved an expenditure in excess of A$700 million (US$540 million) including over A$500 million (US$390 million) in capital coals is scheduled to conclude in September 1990. The decision to construct this plant was based on the previously proven reactivity of Victorian brown coals, their low ash yield, and the extent of the resource. The technical feasibility has been established by the current oil supply and economic considerations do not justify a move to a commercial plant at this stage.

The extensive brown coal resources of Victoria are seen by the State Government as providing major opportunities to contribute to the economic development of the State. To this end the Coal Corporation of Victoria was established in 1985 to initiate, facilitate and co-ordinate brown coal based developments, other than for electricity generation. It is recognized by the Coal Corporation that these opportunities depend primarily on the production of value-added products using new and improved technologies. Thus considerable importance is being placed on R & D in the Corporations own Laboratories, in tertiary institutions and in CSIRO, with current emphasis on activated carbons, ion exchange materials, humic acids and agricultural applications. However, the opportunity for enhancement of the value of brown coals as a fuel is not being overlooked (Higgins, Allardice and Perry, 1988).

Before leaving the subject of technology and R & D in the Australian coal industry the advanced technology involved in the mining of very thick brown coal seams under low overburdens, the reverse of the German situation, as well as for the efficient combustion in power station boilers of a fuel which contains over 60% water needs brief mention. The State Electricity Commission of Victoria have 4960 Mwe installed generating capacity involving the use of brown coal fired boilers up to 500 Mw in size. These operations and the future development of brown coal based electric power generation in the State are backed by their own Herman Research Laboratories.

FUTURE MARKETS FOR AUSTRALIAN COALS

It remains to consider the future prospects for Australian coals. In doing this the black and brown coals need to be considered separately in the context of the domestic and export markets.

Black Coal

The first point to be made is that the coal resource base is of such a size and quality as to pose no constraint on a significant increase in production over the foreseeable future.

Recent forecasts (DPIE, 1990) suggest a continued strong growth in black coal demand in the domestic market from 48.3 M tonnes in 1988 to 60.8 M tonnes in 1995 with steam coals representing 90% of the projected 26% increase, i.e. predominantly for the electricity sector (Table 9).

Three recent forecasts of the demand for imported coals by the major coal importing countries out to 1995 and 2000 are summarized in Table 10 (DPIE, 1989; IEA 1989; and ABARE 1990). The DPIE forecast is for a 33% increase over 1988 in the World demand for imported coal to 403 M tonnes in 1995. Australia's exports are forecast to increase by 48% over the same period to 148 M tonnes in 1995 which would represent a further gain in Australia's share of the market from 33% in 1988 to 36% in 1995. Steam coals represents the major portion of the forecast increase in both the world coal exports and Australia's exports, Japan's share of Australia's coal exports is forecast to increase to almost 62% in 1995 compared with 51% in 1988.

TABLE 9

FORECAST DOMESTIC CONSUMPTION OF AUSTRALIAN BLACK COALS 1995
(million tonnes)

	1988	1995
Metallurgical	5.0	9.2
Steam	40.3	51.6
	48.3	60.8
Total Exports	99.6	137.0
Total Production	147.9	197.8

DPIE, 1989

TABLE 10

FORECASTS OF WORLD IMPORTS OF BLACK COAL AND AUSTRALIAN EXPORTS
(million tonnes)

SOURCES:*	DPIE (1989) 1988	DPIE (1989) 1995	IEA (1989) 1995	IEA (1989) 2000	ABARE (1990) 1995	ABARE (1990) 2000
Australian Exports:						
Metallurgical	56.0	64.0	69	68	73	75
Steam	43.6	83.9	57	78	68	97
Total	94.6	147.9	126	146	141	172
World Imports:						
Metallurgical	162.4	172.4	165	169	171	181
Steam	140.8	230.4	210	285	236	345
	303.2	402.8	375	454	407	526

*DPIE - Department of Primary Industries and Energy (Australia)
IEA - International Energy Agency
ABARE - Australian Bureau of Agricultural and Resource Economics

The IEA forecasts are more conservative out to 1995 for the world coal import requirements but a figure of 454 M tonnes is forecast for year 2000 with Australia's contribution at 146 M tonnes remaining at 33%. This spread reflects differences in the basis of the forecasts but either way significant increases in the demand for Australian black coals are anticipated.

ABARE have made an estimate of the impact of the progressive removal of the heavy coal producer subsidies paid in European countries and Japan (e.g. US$91 in the German Federal Republic, US$96 in Belgium and US$93 in Japan in 1987) on the local coal industry and hence the world demand for imported coal and Australia's share as an exporter. Using the IEA 1989 forecasts as base the world import requirements was predicted to increase by 199 M tonnes to 526 M tonnes in 2000 and Australia's exports by 31 M tonnes to 172 M tonnes or 33% of the total.

Brown Coals

There are no readily available forecasts for brown coal markets, since these do not feature significantly in the export trade. Expansion in demand and hence production will largely be tied to increases in demand for electricity. However, as current research initiatives mature it can be anticipated that increasing amounts of brown coal will be processed into value added products such as activated carbons, ion exchange materials, soil conditioners and fertilizers and to assist in the immobilization of undesirable components on gaseous and liquid effluents.

There are no immediate prospects for the commercial production of gaseous or liquid fuels from brown coals in Australia. However, as the availability for non OPEC oil declines, as it surely will, and oil prices increase significantly it should become economically feasible and strategically necessary to establish a significant synfuel industry in Australia. On the basis of the extensive work done to date on the conversion of Australian coals it seems likely that the initial focus will be on Victorian brown coals.

Environmental Implications

The above forecasts on future markets have been made in the presence of the present emotive concerns about the impact of fossil fuel use on the environment, particularly with regard to carbon dioxide input into the environment and its predicted contribution to global warming and climate changes. Also amongst the fossil fuels coal is seen to be a higher contributor of CO_2 to the atmosphere per unit of energy produced than oil or natural gas.

Although the actual impact of a continuing increase of CO_2 in the atmosphere remains a subject of debate the public and media attention to the matter increases the risk that governments could prematurely move to legislate economic penalties on energy use that could cause economic chaos with little or no impact on the global scene. It is therefore prudent that the coal industry addresses the problem and be seen to be concerned, despite the uncertainties. It makes both environmental and economic sense to undertake R & D to improve the efficiency of coal use to maximize useable energy production while minimizing CO_2 emission. Synfuel production could well have an important role here. Coal is well placed relative to other fossil fuels with respect to the potential for affecting significant control of CO_2 emission because most of it is used in large amounts at central plants rather than being distributed to a multitude of users.

CONCLUDING COMMENTS

Australia has become the major seaborne exporter of both metallurgical and steam coal. The import demand for coal is expected to continue to increase into the foreseeable future with the emphasis on steam coals and it is anticipated that Australia will retain a dominant position as exporter.

Coal is a significant contributor to Australia's own energy requirements being the major fuel for electricity generation. This situation is expected to continue as the demand for electricity increases. However, Australia is unique amongst the major coal exporters since most of the coal production capacity has been established to service export markets.

R & D has contributed significantly to the technological advancement in coal mining, preparation and use in Australia and elsewhere. There remains much scope for further advances to decrease production costs, enhance quality and to increase efficiency in use as well as developing new uses. This applies to both black and brown coals.

The coal industry worldwide operates in a continuing environment of challenge and opportunity. Through the 1980's the world energy scene has been focussed on the limited and rapidly declining reserves of oil and gas and the urgent need to maximize the use of coal because of its relatively high abudance and wide distribution. At the same time the need to protect the environment from sulphur and nitrogen oxides emissions was recognized. this stimulated worldwide interest in the production of clean solid, liquid and gaseous fuels from coals to either produce a clean fuel for use in electricity generation from high sulphur coals (as in the USA) or to supplement indigeneous gas or liquid fuel supplies (as in Australia and the USA).

A combination of the delayed economic impact of the OPEC actions in the 1970's and the effect of initiatives taken as a result of these actions created a situation where the availability of oil and its cost was such as to allay concern for the need for conservation of liquid and gaseous fuels and interest in synfuels from coals (and other feedstocks) declined. However, this situation can only be transient.

Now another challenge arises - that relating to an enhanced greenhouse effect due to build up of carbon dioxide in the atmosphere. In the rush to address this issue the need for conservation of liquid and gaseous fuels has been lost as oil and gas are being promoted as preferential fuels to coal in relation to greenhouse gas emissions as CO_2. As mentioned in the previous section however coal offers its own advantages which the industry should be quick to promote.

ACKNOWLEDGEMENTS

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"PROSPECTS AND CONSTRAINTS IN THE USE OF COAL IN ITALY"

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PROSPECTS AND CONSTRAINTS IN THE USE OF COAL IN ITALY

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ABSTRACT

Italy is heavily dependent on energy imports (80% of energy consumption) and on oil in particular.

To better balance our energy mix, we plan to double in ten years our coal imports and consumption.

An analysis is given on the reasons of our past scarce coal use and on the actions to be taken in the future to reach our goal.

HYDROCARBONS DEPENDENCE

The chronic and unusual, among industrialized countries, Italian dependence on hydrocarbons characterizes our energy scene.

As shown in tab. 1, in spite of two serious energy crises, our reliance on hydrocarbons has remained substantially stable. In addition, the most part of energy (80%) is imported; in particular we import 100% of coal and 90% of oil.

This fact is underlined by the Italian energy trade balance (17500 billion lire) which, even in a period of low prices, is comparatively high.

This situation points out the vulnerability of our energy supply and calls for a more balanced energy mix.

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SCARCE COAL USE

The various sources contribute differently to the deficit. Coal, while representing 10% of the energy imports, accounts for only 7% of the trade deficit.

Given this situation, coal should expand its role, at least where its use is more suitable.

This target has been clear for a long time, by now, but it is difficult to pursue.

In fact, coal utilization increase has not been up to expectations. Tab. 2 shows the coal consumption in 1989. The increase is mainly due to the thermoelectric sector and to the cement industry, and it is linked, to a large extent, to existing power stations and industrial plants designed for, or easily retrofitted to, coal. Little, if any, have contributed new power stations or industrial boilers specifically designed for coal usage. As shown in fig. 1, only 20% of electricity produced from fuels is produced from coal, another 20% from NG, the remaining from fuel oil.

Nevertheless Italy, as indicated by the New Energy Plan, is still committed to increase its coal use. By the year 2000 Italy should double present coal consumption and increase coal share from 10 to 16% (fig. 2).

We aim at that target, but in order to achieve it, we have, first, to understand why the coal use grew so slowly in the last 15 years and how we can overcome past difficulties.

In tab. 3 there are some possible answers to the first question.

Slow turnover

A slow turnover of the power stations and of the industrial boilers was certainly a factor, but probably not the most significant.

As a matter of fact industry has put off construction of new thermal plants (fig. 3) as a consequence of the industrial restructuring and/or of energy saving programs.

Logistic problems

They regard coal ports and, more generally, coal distribution.
Tab. 4 shows the handling capability of our coal ports, along with the maximum tonnage allowed for the carriers.

The present situation is inadequate both from the point of view of the transportation cost, decreasing with the size of the carriers, and from the point of view of the unloading and stockpiling capability.

Moreover, the ability to distribute coal in the mainland is quite modest. Especially the railways are unable to transport large quantities of coal; consequently the present logistics are able to supply only those users who are close to the coal ports.

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Environmental problems

The public opinion regards coal use as having an environmental impact higher than other sources, although, for some aspects, coal is intrinsically less pollutant than high sulphur fuel oil.

Public acceptance

In Italy a coal tradition does not exist. Our lack of familiarity with coal use is one of the main reasons for the strong public opposition.

Lack of demonstration projects

For this reason was not possible to prove that coal can comply with the environmental standards to a level equal or better than competing fuels. In Italy only one medium size power station is equipped with a spray scrubber, which is not the most efficient technology to abate SO_2 emissions; no power station is fitted with a denitrification system.

The insufficient demonstration of clean coal technologies, compounded with the unfamiliarity of the public opinion with coal, adds fuel to hostility towards new plants.

This vicious circle has to be broken.

ACTIONS TO BE TAKEN

With this background, in order to increase coal acceptance and actually develop coal utilization, the following steps should be carried out:

- demonstration of technologies which comply with strict environmental limits;
- debottlenecking of the logistic system, by relying on technologies able to handle coal easily and in a manner similar to liquid fuels;
- development of technologies suitable to retrofit existing, oil designed plants;
- issuing of regulations able to promote coal use in new plants or, at least, calling for a design compatible with future coal use (multifuel power stations and boiler).

Only if we succeed in implementing a consistent and integrated action plan, along these lines, we will be able to effectively tackle the problem of energy diversification, and coal use, in our country.

On all these topics there are some activities; in particular we mention the more advanced projects.

Sulcis coal exploitation

In the near future will start the exploitation of the Sulcis coal in Sardinia.

This coal, due to high sulphur content (roughly 7%), needs an environmentally suitable technology.

For this reason ENEL will install a desulphurization plant on Sulcis 720 MWe power plant and will probably built an IGCC plant.

New technologies

ENI's companies and ENEL are actively involved in R&D on new technologies.

In particular Snamprogetti (ENI group) built a 256 km coal-water pipeline in USSR and retrofitted a 670 t steam/h boiler at the arrival power station in Novosibirsk; still Snamprogetti is building a 500.000 t/y BCWF (beneficiated coal water fuel) plant in Sardinia.

ENEL (still considering CWF uneconomic in the present Italian situation) tested 4000 t of CWF in a power plant and successfully studied a new dual burner to very shortly switch from fuel oil to CWF and vice versa.

Finally, ENEL is building a 150 MWe CFBC plant and Snamprogetti will build an air-cooled PFBC 3.5 MWe pilot plant.

Environment

On this topic, in addition to the before-mentioned activities, we point out the Eniricerche beneficiation process, the Snamprogetti-Topsoe process to remove NOx and SOx from combustion gases, and the ENEL activities on sorbent direct injection and on denitrification and desulphurization of gases.

TABLE 1

ITALY'S PRIMARY ENERGY CONSUMPTION ('89)

	SOLID FUELS	OIL	NATURAL GAS	ELECTRICITY	TOTAL
MTOE	14.6	93.7	37.0	16.0	161.3
%	9.1	58.1	22.9	9.9	100.0

TABLE 2

ITALY'S COAL CONSUMPTION ('89)

	STEELMAKING	ELECTRICITY	INDUSTRY	TOTAL
MTOE	6.7	6.1	0.7	13.5
%	49.6	45.2	5.2	100.0

TABLE 3

CONSTRAINTS TO COAL EXPANSION

- SLOW TURNOVER OF THE POWER STATIONS AND OF THE INDUSTRIAL BOILERS
- LOGISTIC PROBLEMS IN THE COAL PORTS AND MORE GENERALLY IN COAL DISTRIBUTION
- ENVIRONMENTAL PROBLEMS
- PUBLIC ACCEPTANCE
- LACK OF DEMONSTRATION PROJECTS FOR NEW TECHNOLOGIES

TABLE 4

MAIN STEAM COAL PORTS IN ITALY

PORT	DWT	DRAFT m	UNLOADING RATE t/h
BRINDISI	60000	13	1500
GENOVA	50000	12	300
GIOIA TAURO	80000	14	4500
FUSINA	25000	9	2000
LA SPEZIA	65000	12.5	1100
MARGHERA	40000	10.5	250
MONFALCONE	10000	8	800
PORTO VESME	15000	8.5	450
SAVONA	40000	9.7	1500
TRIESTE	150000	17.5	1800
VADO LIGURE	50000	12.5	800

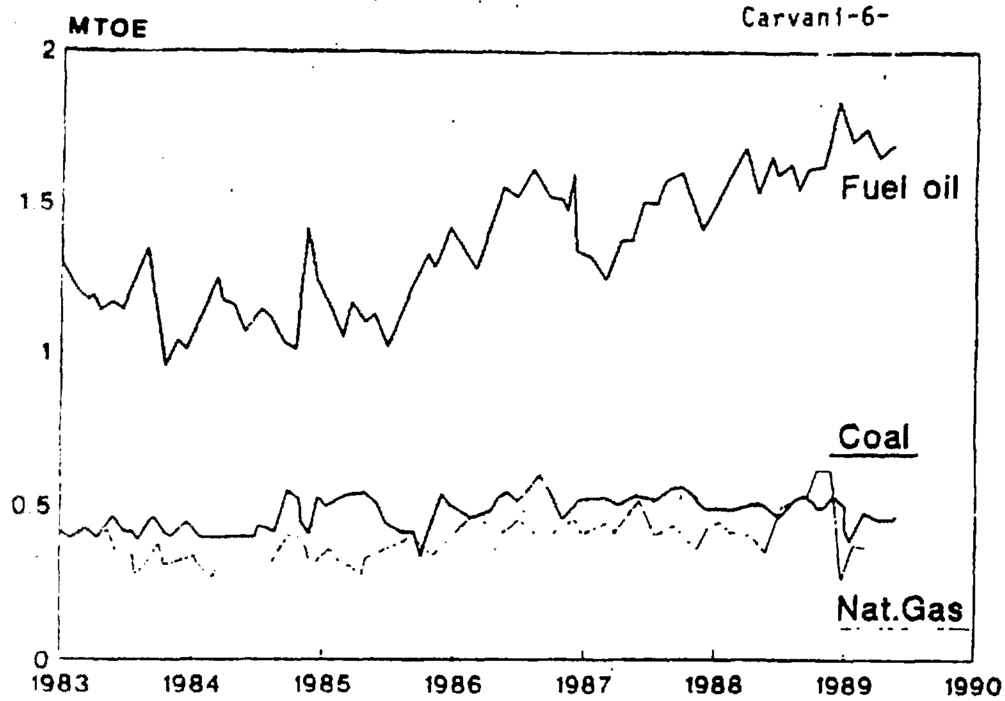

FIGURE 1: FUEL DEMAND DISTRIBUTION FOR THERMOELECTRIC PRODUCTION (MONTHLY BASIS)

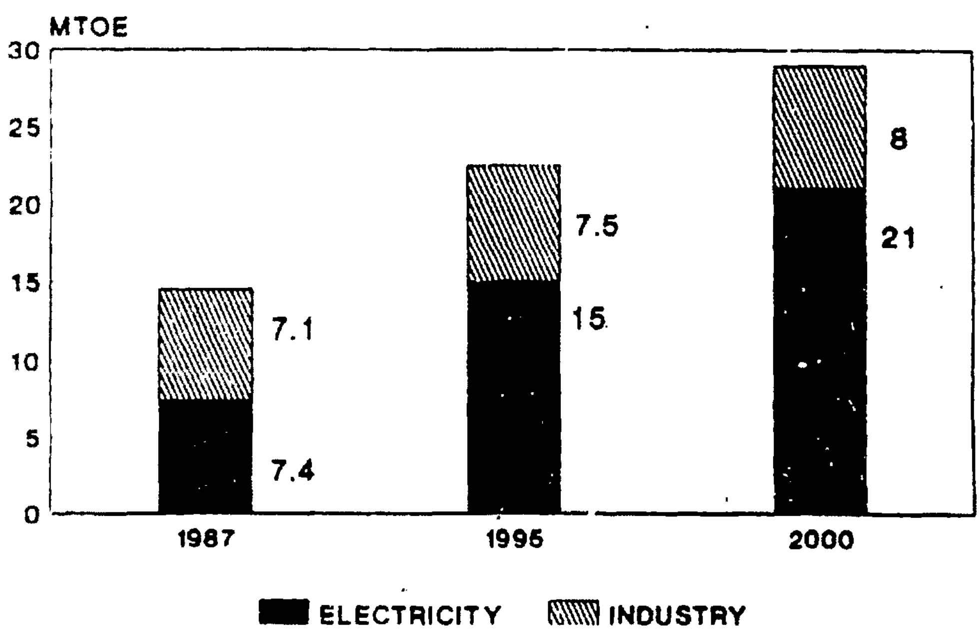

FIGURE 2: FUTURE COAL CONSUMPTION AS INDICATED BY NATIONAL ENERGY PLAN

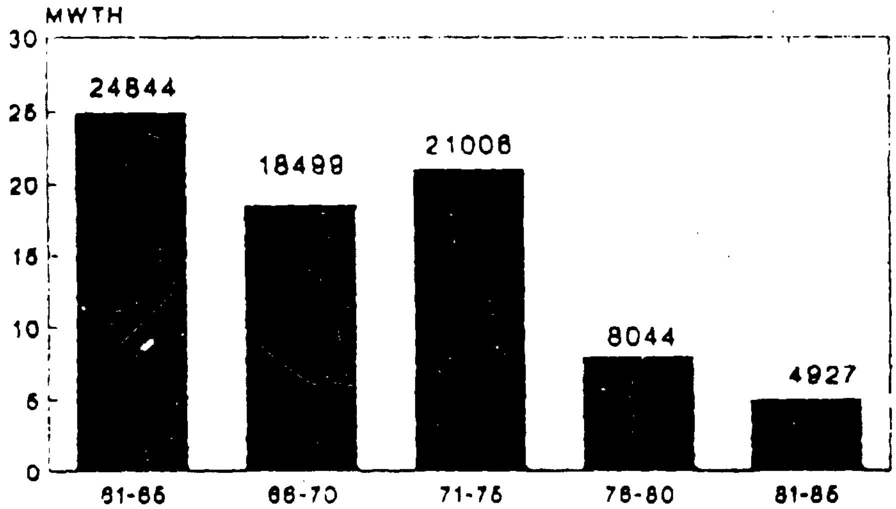

FIGURE 3: NEW THERMAL PLANTS

"U.S. COAL EXPORT OPPORTUNITIES"

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U.S. COAL EXPORT OPPORTUNITIES

Good afternoon ladies and gentlemen. It is indeed an honor for me to speak at the SynOps '90 Conference on behalf of Mobil Mining and Minerals Company, a division of Mobil Oil Corporation. I have been asked to talk to you today about the export opportunities for U.S. coal.

As you know, ever since U.S. steam coal exports surged and then suddenly collapsed in the early 1980S, U.S. suppliers have been looking forward to a major and long lasting rebound in the steam coal export market. Strong growth opportunities always seem to be just around the corner, but for one reason or another expectations haven't been realized. Is the United States now on the verge of significantly expanding its export market share or are we destined to remain a swing supplier that simply fills the gap when supplies from lower cost export sources are tight?

Realistically, one cannot address this question without first examining the outlook for internationally traded steam coals. I have opted to focus my discussion on steam coal trade and omit the metallurgical coal arena since most industry analysts believe that steam coal will represent most, if not all, of the growth in international coal trade. Met coal demand is not expected to change materially in the future - despite a projected increase in crude steel production - due to advances in steel making technology which will lower the consumption of coke needed per unit of steel production.

Exhibit 1 shows three published forecasts for world seaborne trade in steam coal which are considered representative of the prevailing industry outlook. One forecast is by the U.S. Energy Information Administration (EIA), an independent agency within the Department of Energy. A second is by Wharton Econometric Forecasting Associates (WEFA), a U.S. and U.K. based consulting firm involved in energy forecasting. The third is by the Australian Bureau of Agricultural and Resource Economics (ABARE), a research organization associated with the government. As you can see, all the forecasts are quite bullish about the prospects for growth in international

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steam coal trade. The EIA is at the top end of the range of projections forecasting that seaborne steam coal trade will more than double from 160 million tons in 1989 to almost 330 million tons in 2000. ABARE is on the lower end with a forecast of roughly 285 million tons in 2000, while WEFA is in the mid-stream of these industry projections. Mobil's outlook for international steam coal trade generally tracks WEFA'S.

As noted in Exhibit 2, all of these published forecasts are projecting that growth in steam coal trade will be strong in both the European/Mediterranean region and Asia, with these two markets accounting for essentially all of the rise in trade between 1989 and 2000. To put the growth projections in perspective, actual 1989 imports to the two areas are shown on the right side of the exhibit. For presentation purposes, the small volume of imports to the Americas and various miscellaneous destinations has been included in the European/Mediterranean figures.

While both European and Asian steam coal imports are expected to increase substantially, the underlying factors driving the growth are different in each region. In Western Europe, most of the expansion in coal imports is expected to result from declining domestic production as countries such as West Germany, the United Kingdom, Spain and Poland close high cost, inefficient mines in response to the phase out of government subsidies and support programs. A contributing factor in some of the mine closures, such as those in Spain, will be environmental compliance programs to meet tightening European Community targets on power plant emissions of sulfur dioxide and particulates. Only a small fraction of the projected growth in European steam coal imports relates to building new coal-fired capacity. This is because most of the European countries, except for a few in the southern tier, don't anticipate a need for major new baseload generation capacity until after 2000 due to current large reserve margins and modest rates of growth in electricity demand.

In contrast to Europe, growth in Asian steam coal trade is being driven principally by market fundamentals. The key factor is strong electricity demand which is spurring the addition of substantial new coal-fired generation capacity. However, growth of new coal-fired capacity also is being aided by slowing nuclear programs in Japan, South Korea and Taiwan, where there is rising public opposition to new nuclear capacity. The net result is that Japanese utilities, which are projecting load growth of about 3% per year, plan to add 15 gigawatts (GW) of new coal-fired capacity over the remainder of the decade. South Korea, with forecast electricity growth of approximately 7% annually expects to build 9 GW of new coal-fired capacity. And Taiwan, which also is projecting electricity demand growth of almost 7% per annum is planning to install 8 GW of additional coal-fired capacity. Since, most of the Asian countries, particularly the developed ones, have small coal reserves and declining domestic production, essentially all of the growth in utility coal demand will translate to increased steam coal imports.

It is obvious from Exhibit 2 that each of the forecasters has a somewhat different perception of regional growth prospects. The EIA is the most bullish on steam coal imports to Europe, while WEFA has the most optimistic view of Asian growth potential. In our opinion, a projection of strong import growth for Asia is on much firmer ground than that for Europe. Much of the Asian demand growth is predicated on new coal-fired capacity which is already under construction, principally in Japan, South Korea, Taiwan and Hong Kong. In contrast, import growth prospects in Europe are highly uncertain because they are dependent on the pace at which domestic coal industries are allowed to down size and the extent to which coal imports, rather than natural gas, replace domestic production. While the U.K. government's plan to privatize the British coal industry has been at its own initiative, pressure to dismantle the West German coal support system emanates from the European Community. The prevailing view is that the Germans will eventually comply, but the process of removing the subsidies is likely to be highly contested and take much longer than anyone anticipates. Keep in mind that West Germany employs 90,000 people in underground mines, many of which are non-competitive without subsidies. As a result, the government has a major political and social issue with which to deal.

Beyond the question of how quickly the domestic coal industries are allowed to scale down, there is the issue of the degree to which steam coal imports are substituted for domestic production. Given the availability of natural gas supplies from the North Sea, the Netherlands, the Soviet Union and Algeria, coupled with the high level of environmental concern in Europe regarding sulfur dioxide emissions and global climate change, it remains questionable whether steam coal imports will actually penetrate Europe to the levels anticipated by the various forecasters. Political changes in Eastern Europe and the Soviet Union may also have a significant effect on international steam coal trade, but it's really too early to assess the implications. One recent development that potentially could lead to a sizable expansion of coal use is the unstable situation that has manifested itself in the Middle East. It's too soon to tell, but this episode may spur the developed countries of Europe, Asia and North America to renew and reinforce efforts to further reduce reliance on imported oil. Should this occur, coal could again be a big winner as it was in the 1970s.

With this perspective on the outlook for and factors affecting steam coal trade, I'd now like to address the subject of my presentation - U.S. coal export opportunities. Exhibit 3 shows the same regional growth projections we just looked at, but superimposes on them each forecasters' outlook for growth in U.S. steam coal exports. The upper portion of each bar represents the anticipated U.S. market share. All the forecasts project a lefty increase in U.S. steam coal exports to the European/Mediterranean region over the 1989-2000 period, ranging from 20-45 million tons. However, in Asia, only a minimal rise in U.S. exports is projected from current levels. The scenario which creates the favorable prospects for U.S. coal in the European/Mediterranean market is depicted in Exhibit 4.

- First, growth in South African, Colombian and Venezuelan exports, the most competitive coals available to Europe, is limited by various infrastructure constraints or higher net back prospects in other markets (e.g. South African coal to Asia).

- Second, growth in Australian exports to Europe peak out by the mid 1990s as forecasted increases in marine transportation rates favor maximizing shipments to Asia.
- And lastly, Polish steam coal exports decrease over time due to the elimination of government subsidies.

Based on this scenario, the United States, although a higher cost supplier, becomes the chief beneficiary because it can provide the necessary production and has the needed infrastructure to satisfy Europe's shortfall. This scenario demonstrates the underlying vulnerability of U.S. steam coal exports to Europe. Unfortunately, according to the EIA and other sources, the U.S. is expected to remain the high cost supplier to Europe. As such, to the extent the assumed supply/transportation constraints for competing suppliers don't materialize or import needs don't grow as rapidly as anticipated, U.S. steam coal exports may well be lower than these three forecasters are projecting. On the other hand, United States domestic producers may find it attractive to sell surplus production into the export market on an incremental basis since, unlike other exporters, the U.S. doesn't have an export-dedicated industry. One other factor that could negatively affect U.S. exports to the European/Mediterranean region is the imminent passage of a tougher Clean Air Act, which is expected to substantially increase the demand for eastern low sulfur coals in U.S. power plants. The overall impact of the new legislation could be to limit the U.S. role in the steam coal export market unless international prices firm markedly.

Now let's turn to the Asian steam coal import scenario which generally assumes a continuation of current supply trends. As shown in Exhibit 5, Australia is expected to remain the dominant supplier, while other low cost suppliers such as South Africa, China and an emerging exporter, Indonesia, capture the bulk of the remaining market. U.S. coal supplies, mainly from the Rockies and Central Appalachia, are forecast to continue playing a minimal role in this market due to the mines' long distance from tidewater and their higher FOB mine costs.

In our view, we believe there is significant upside potential in U.S. steam coal export volumes to Asia, particularly after 1995. This potential lies in the use of subbituminous coals from the Powder River Basin (PRB) by Asian electric utilities. As many of you know, a few trial shipments of PRB coal already have been purchased by Asian utilities. In 1988, Taiwan Power successfully tested 60,000 tons of coal bought from Mobil's Caballo Rojo Mine. More recently, two Japanese electric utilities evaluated PRB coal purchased from one of our competitors and, we understand, arrangements are being made for another test shipment.

From our standpoint, PRB coals can be competitive today with Australian coals in the Japanese, Korean and Taiwanese markets on a delivered, heating value basis. Asian utilities recognize this cost competitiveness but have been reluctant to use the coal principally because of its lower heating value which could potentially derate their boilers. We, at Mobil, are convinced that this reluctance will be overcome during the next several years as Pacific Rim power companies increasingly observe more and more Eastern U.S. utilities successfully using blends of PRB and bituminous coals in boilers designed for bituminous coals.

Once PRB coals are considered acceptable by Asian utilities, we expect to see them being moved into the Asian utility market on a regular basis. Initially, the market will be restricted to blend applications of perhaps a few million tons per year. Longer term, however, new and larger opportunities for PRB coals are expected to materialize as Asian utilities begin to build more advanced boilers that can handle a wider range of coal qualities, including subbituminous.

Despite the views of many cynics, we believe subbituminous Powder River Basin coals will eventually play a role in the Asian steam coal market. The basin's huge surface minable reserves, enormous supply capability, very low production costs and non-union work force, coupled with the coal's very low sulfur and ash makes the Powder River Basin coal attractive to many utilities, including those in Asia and perhaps parts of Europe as well. As some of you may know, the Spanish state electricity company, ENDESA, is currently testing Powder River Basin coal in boilers designed for domestic lignite. Use of Powder River Basin coal is being considered as a way to extend the life span of Spain's high sulfur lignite mines, as well as to comply with tightening European Community regulations on sulfur dioxide emissions from power plants. If the ENDESA test is successful, a long-term market of several million tons per year could materialize.

Ultimately, the extent of the PRB's penetration of overseas coal markets will be dependent on the railroads' willingness to price their services competitively. Their current demonstrated aggressiveness in seeking new coal business in Asia and Europe would suggest they have strategic interests in participating with PRB producers in this growing market.

Well, I hope my presentation has raised some thought-provoking issues and enlightened you somewhat on the challenges and opportunities facing U.S. producers in moving our coal overseas. We, at Mobil, are prepared to accept the challenge because we are convinced Asia will become a significant market for Western U.S. coal exports.

This concludes my remarks. Thank you very much.

Exhibit 1

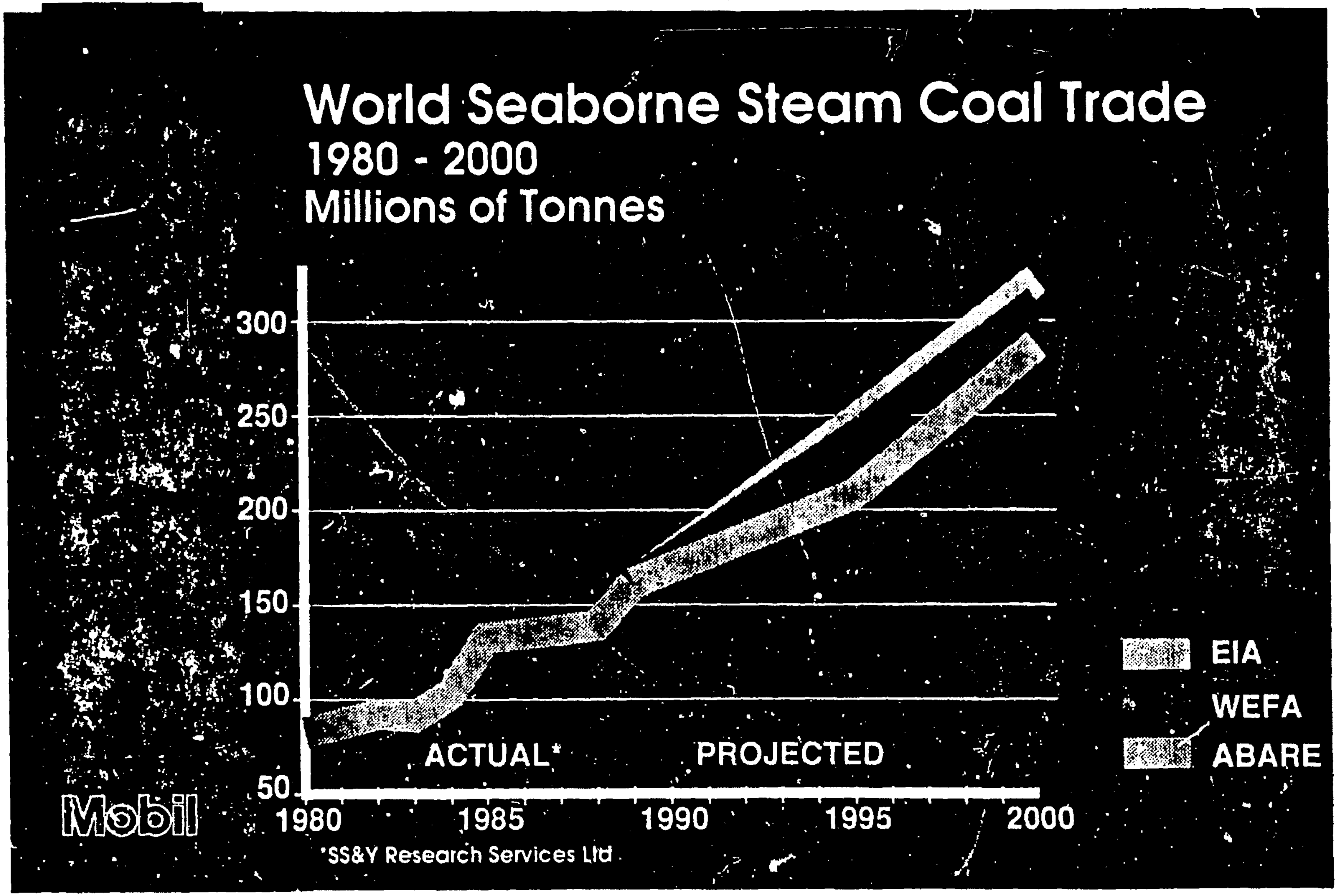

World Seaborne Steam Coal Trade
1980 - 2000
Millions of Tonnes
300
250
200
150
100
50
1980
1985
1990
1995
2000
ACTUAL*
PROJECTED
EIA
WEFA
ABARE
Mobil
*SS&Y Research Services Ltd

Exhibit 2

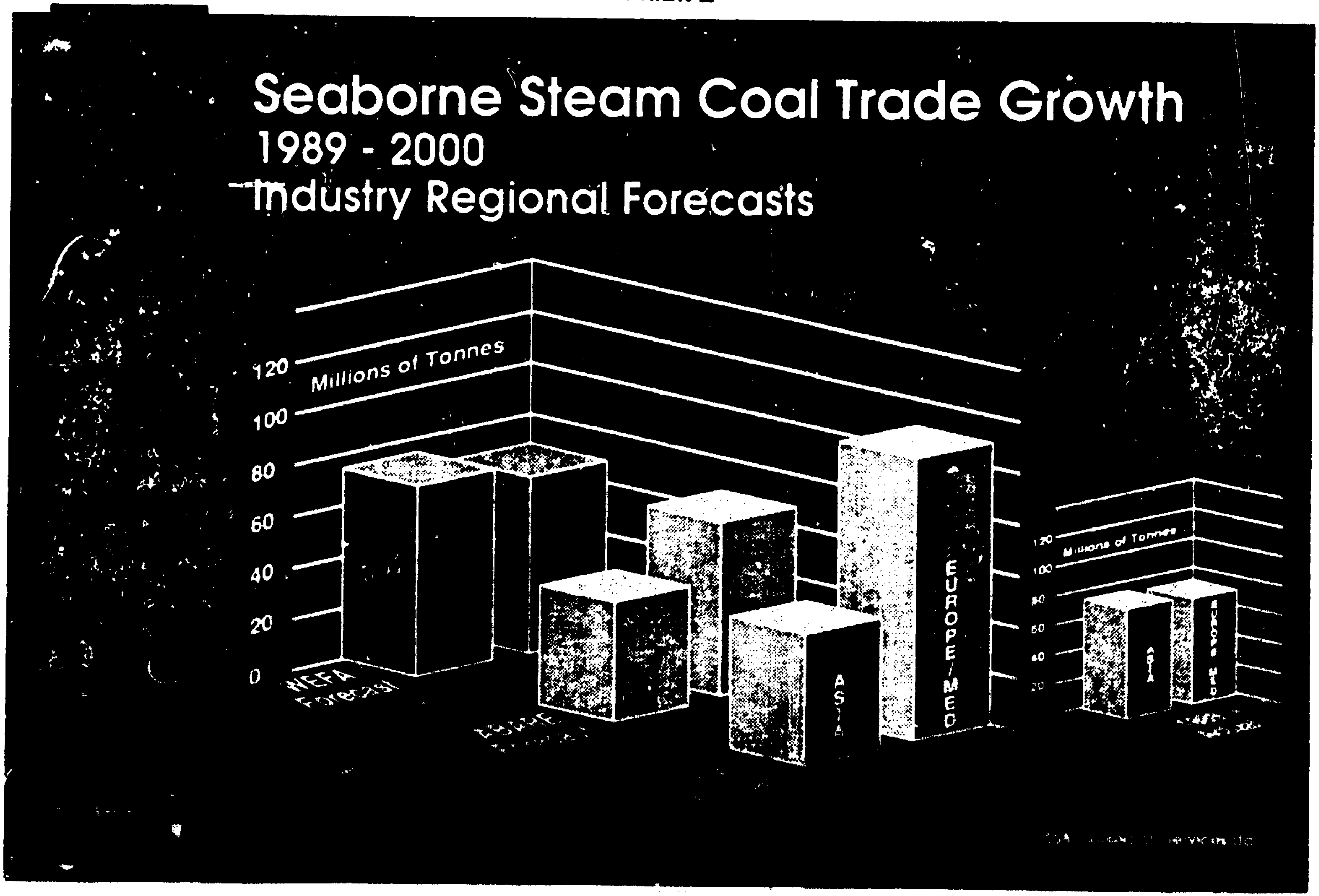

Seaborne Steam Coal Trade Growth
1989 - 2000
Industry Regional Forecasts
Millions of Tonnes
120
100
80
60
40
20
0
NEFA Forecast
ASIA
EUROPE/MED
Millions of Tonnes
ASIA

Exhibit 3

Seaborne Steam Coal Trade Growth
1989 - 2000
U.S. Market Share
Millions of Tonnes
120
100
80
60
40
20
0
WEFA Forecast
ABARE Forecast
EIA Forecast
ASIA
EUROPE/MED
Millions of Tonnes
1989 Actual
*SS&Y Research Services Ltd
Mobil

Exhibit 4

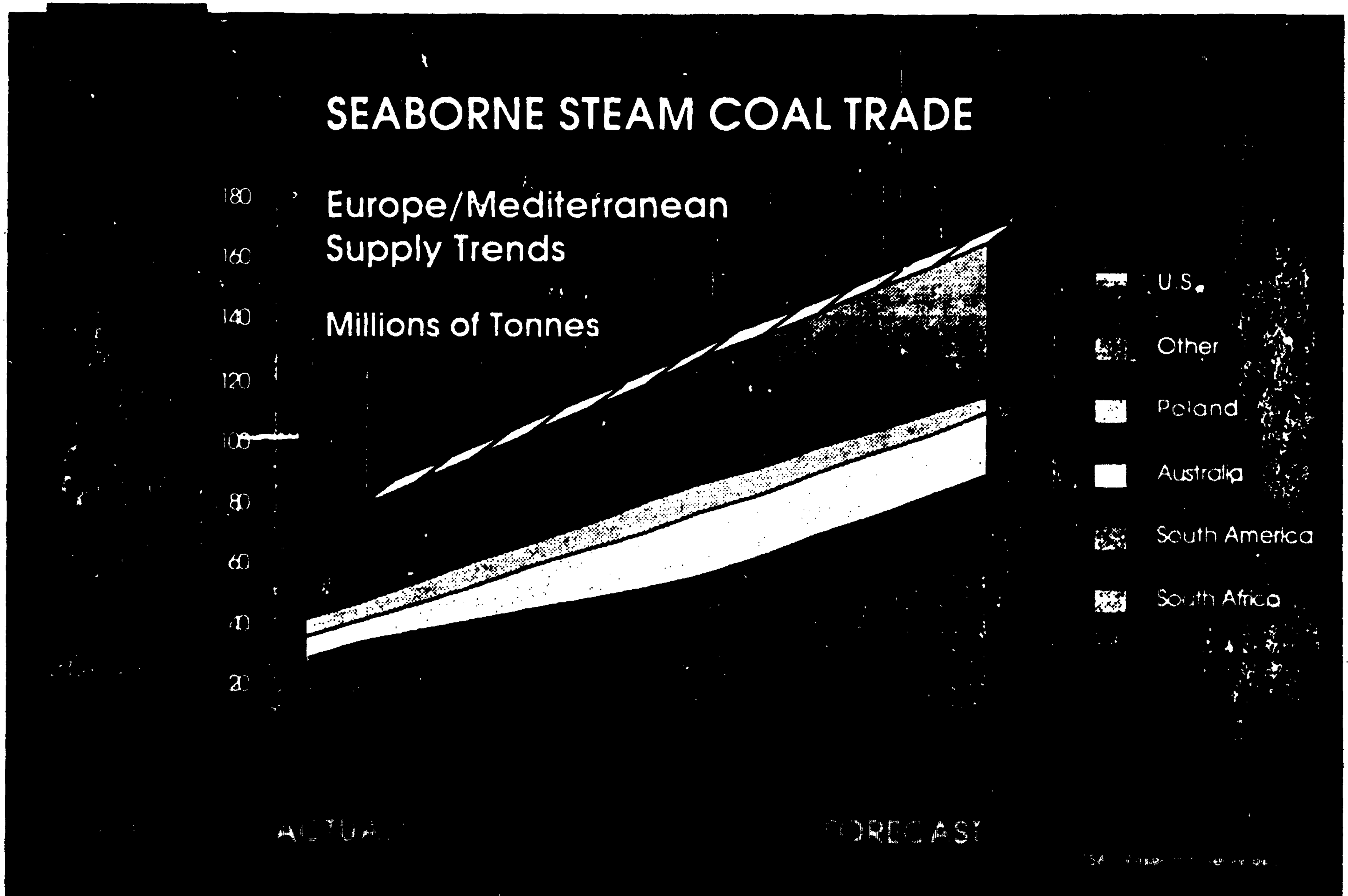
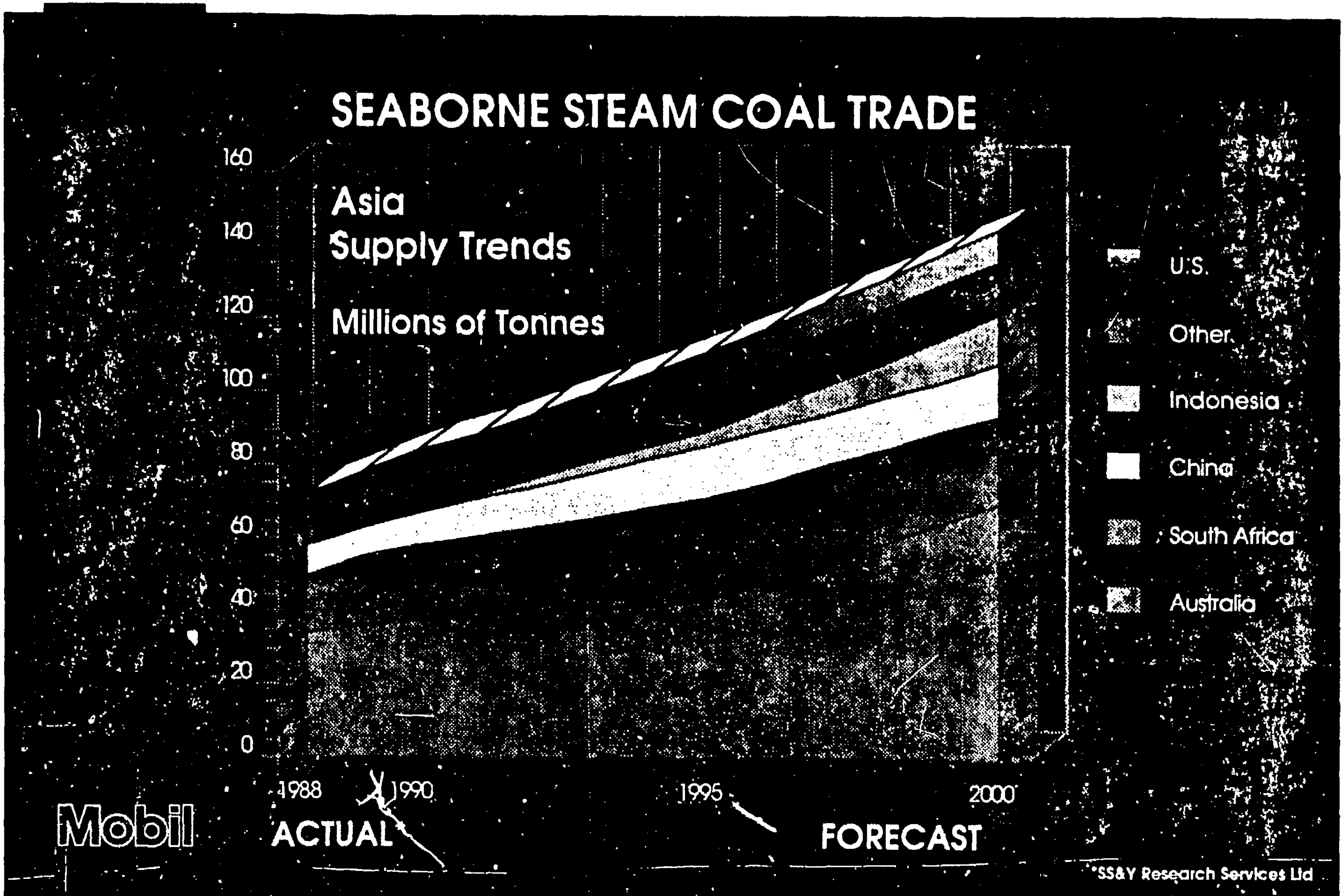

SEABORNE STEAM COAL TRADE
Europe/Mediterranean
Supply Trends
Millions of Tonnes
180
160
140
120
100
80
60
40
20
U.S.
Other
Poland
Australia
South America
South Africa

Exhibit 5


SEABORNE STEAM COAL TRADE
Asia
Supply Trends
Millions of Tonnes
160
140
120
100
80
60
40
20
0
1988
1990
1995
2000
ACTUAL
FORECAST
U.S.
Other
Indonesia
China
South Africa
Australia
Mobil
SS&Y Research Services Ltd