Coal Development Potential and Prospects in the Developing Countries

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CURRENCY

All currency figures are expressed in US$.

WEIGHTS AND MEASURES

1 metric ton	=	1.102 short tons
1 metric ton	=	1,000 kg
1 metric ton	=	2,205 lbs
1 short ton	=	2,000 lbs
1 tce	=	1 metric ton of coal with a calorific value of 7,000 kcal/kg

ABBREVIATIONS

b/d	=	barrels per day
boe/d	=	barrels of oil equivalent per day
BTU	=	British thermal unit
CIF	=	cost, insurance, freight
EC	=	European Community
FOB	=	free on board
GNP	=	Gross National Product
IEA	=	International Energy Agency
kg	=	kilogram
kcal/kg	=	kilo calories per kilogram
kwh	=	kilowatt-hour
OECD	=	Organization for Economic Cooperation and Development
OPEC	=	Organization of Petroleum Exporting Countries
p.a.	=	per annum
t	=	metric ton
tce	=	metric ton of coal equivalent
toe	=	metric ton of oil equivalent
tpy	=	metric ton per year
USBM	=	US Bureau of Mines
WEC	=	World Energy Conference

GEOGRAPHIC REGIONS

DCs	=	Developed market economies, including OECD Countries (except Turkey) and South Africa
LDCs	=	Less developed market economies, including all Central and South American, Caribbean, Africa (except South Africa), Asia (except Japan and centrally planned economies) Yugoslavia
CPEs	=	Centrally planned economies, except Yugoslavia, Cuba, Cambodia, Laos, and Viet Nam.

COAL DEVELOPMENT POTENTIAL AND PROSPECTS IN THE DEVELOPING COUNTRIES

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COAL DEVELOPMENT POTENTIAL AND PROSPECTS IN THE DEVELOPING COUNTRIES

SUMMARY

i. World prospects for coal production have recently improved considerably. During the past three decades, until the oil price increases of 1973/74, there was an apparently irreversible tendency for oil to replace coal in many uses. Coal's contribution to meeting the world's primary energy requirements fell from about 49% in 1960 to 29% in 1973.

ii. Coal constitutes a very important energy potential. World coal reserves which are exploitable with present technologies and at current prices are nearly five times larger than known oil reserves. Geological coal resources are many times more extensive. While coal is found in many places, 97% of presently known coal deposits are concentrated in developed and centrally planned economies. But there has been little coal exploration in developing countries and their basic geological data is inadequate. Comprehensive geological surveys and coal exploration programs in LDCs may well increase their known coal reserves substantially.

iii. In 1977, world coal production in terms of heat value equivalent reached about 60% of oil production. Coal output in developing countries represented 6.3% of total world coal production in that year. Some 50 developing countries have known coal resources and about 30 of these produce coal; India accounts for more than half and Yugoslavia, the Republic of Korea and Turkey for much of the rest. The lack of coal mining experience in other developing countries that have coal reserves will make it difficult to increase their output rapidly. World coal production is expected to increase at an average annual rate of about 4.2% through the 1980s, a considerable increase over growth in the previous two decades. Coal output in developing countries is expected to increase at more than 7% annually, and LDCs' share in world coal production will become more important, rising from the 6.3% in 1977 to about 9% in 1990.

iv. Coal prices have risen substantially since 1973/74, although much less than oil prices. In terms of heat value, coal is considerably cheaper than oil. But coal is difficult and expensive to distribute, particularly to small users, and the need to burn it in an environmentally acceptable manner makes it less convenient to use. Nevertheless, the prospects of a resurgence in coal use have been further enhanced by the increasing cost of other sources of energy, the delays in nuclear power programs and the anticipated depletion of oil and natural gas supplies.

v. However, coal production in LDCs is not responsive to changes in relative energy prices in the short term. Many coal bodies need additional drilling and feasibility work before investment decisions can be made. Most

developing countries also lack the infrastructure to utilize coal deposits that would be exploitable in industrial nations. The risks and high capital expenditures involved in coal mine development and uncertainties of marketing opportunities mean that few coal deposits in developing countries have appeared attractive to investors. Nevertheless, the various constraints that presently retard accelerated coal production growth in developing countries can be overcome by a more systematic approach to longer-term coal development and overall energy planning in LDCs.

vi. A strategy aimed at a more rapid coal development in LDCs must be designed to increase production while ensuring that coal demand rises in line with coal supply. Most developing countries have at this time neither the human and financial resources nor the technical know-how to launch major coal development programs. Thus international, regional and bilateral agencies as well as private mining companies have a major role to play in helping developing countries survey their coal potential, analyze the part coal may play in the energy supply balance of each country and provide financial and technical support for the implementation of coal projects.

vii. If the projected LDC coal output growth is to come about, the Bank must play an active role in (i) building up new institutions and technically and financially viable companies needed for all stages of coal development, and (ii) mobilizing capital for coal development at appropriate terms. Under its present lending program, the Bank should be able, particularly if joined in this effort by other regional and bilateral lending institutions, to assist in a substantial number of developments that might not otherwise take place. Assuming that during the 1980s the Bank will, as foreseen for the FY79-83 period, make loans for coal development totalling US$100-200 million per year in real terms, the Bank would be associated with coal projects totalling US$3.3 - 6.6 billion, or some 17-35% of expected investments in coal mining and associated transport projects in developing countries through 1990.

viii. The attempt to accelerate coal production in developing countries cannot succeed in isolation and will depend to a considerable degree on policy decisions made by developed countries. An increased emphasis on use of coal as an energy source in industrialized nations could (i) increase demand for LDC coal, particularly in countries which are short of low-cost coal, (i.e., Western Europe and Japan), and (ii) stimulate more research in industrialized nations on technologies for coal exploration, mining, processing, handling and transport, all of which could assist LDCs in the development of their coal potential.

SECTION I. INTRODUCTION

1. World prospects for coal production have recently improved considerably. For nearly 25 years until the oil price increases of 1973/74, there was an apparently irreversible tendency for oil to replace coal in many uses, especially in rail transport, residential heating and power generation. Coal's contribution to meeting the world's primary energy requirements fell from 49% in 1960 to 29% in 1973. Oil was cheaper,cleaner, easier to handle and polluted less, and Governments, consumers and producers acted as if it were to remain in unlimited supply and at low prices. The increase in price of primary energy since the 1973/74 events has stimulated serious consideration of how to increase the use of coal.

2. The drastically changed world energy picture has created a flood of information on world energy supply prospects, including coal. However, this information focuses primarily on OPEC, OECD countries and Centrally Planned Economies (CPEs), while addressing only peripherally the likely future energy demand/supply patterns of developing countries.

3. Realizing the growing importance of fuel minerals for the economic development of developing countries, the Bank's Executive Directors approved in 1977, plans for expansion of Bank Group lending and technical assistance for fuel and nonfuel mineral development. A further report A Program to Accelerate Petroleum Production in Developing Countries (dated January 1979) presented the experience gained since the start of the expanded program in mid-1977, and proposed a broadening of the Bank's role in exploration for fuel minerals. While concentrating on oil and natural gas, the January report acknowledged the contribution coal could make to solving the energy problem of the developing countries. An IBRD/IDA lending program was proposed which included 2-4 coal/lignite projects a year during FY79-83, of which 1-2 were engineering loans covering final exploration, feasibility and engineering work for promising coal/lignite prospects. It was agreed that a separate report on the prospects for accelerated coal production in developing countries would be prepared as soon as ongoing studies had been completed.

4. In September 1978, the Bank commissioned a study of the expected world coal supply until 1990 with a qualitative analysis of likely trends thereafter. Particular emphasis was to be given to (i) a country by country review of the coal reserves as well as production prospects and constraints in developing countries, (ii) the likely trend of coal trade in the world, and (iii) an assessment of the possible impact of changes in the oil price on coal output in developing countries.

5. The present paper has two major objectives. First it summarizes the essential data on coal reserves, recent patterns of coal production, and consumption and trade. These data are largely consistent with studies carried out by the World Energy Conference (WEC) in

1977 and the International Energy Agency (IEA) in 1978. Second, it discusses the major constraints in developing countries to a rapid increase in their coal production.

SECTION II. PRESENT STRUCTURE OF THE COAL INDUSTRY

Definition of Coal

6. Coal, like wood and peat, contains carbon, hydrogen, oxygen, nitrogen, sulphur and a number of other constituents in proportions which differ greatly in various deposits and grades. Quality differences among different grades of coal are more pronounced than those found for other fuel minerals, such as oil, and make the classification of coal reserves and output difficult.

7. The two most widely used classifications of coal are by calorific value and ultimate economic use. In the first classification, distinctions are made between hard coal (with a heating value of generally more than 5,700 kcal/kg of coal) and brown coal (less than 5,700 kcal/kg.). The second classification distinguishes between thermal coal for electric power generation, industrial use and residential/commercial heating purposes, and metallurgical or coking coals, used primarily as a reductant in steel-making. To allow (statistical) comparison of these various types of coal, different coal grades are normally converted into so-called "tons of coal equivalent" (tce), which corresponds to the calorific value of 1 metric ton of hard coal with 7,000 kcal/kg. Annex 1 contains additional data on the classification of different coals and their conversion factors into tce. This report focuses only on thermal coal as an alternative energy source and does not analyze LDC potential for coking coal development.

World Coal Resources and Reserves

8. The most recent comprehensive assessment of world coal resources was undertaken by the World Energy Conference (WEC) in 1977 and shows world geological resources of coal of 10,125 billion tce and technically and economically-recoverable coal reserves of 636 billion tce or about 6% of estimated coal resources. Technically and economically-recoverable reserves are defined as reserves which can be exploited under presently foreseen conditions, while geological resources include all known coal occurrences that may acquire an economic value in the future. Annex 1 contains the detailed definition of geological resources and recoverable reserves used for evaluation purposes. The recoverable coal reserves of 636 billion tce compare to presently known oil reserves of about 135 billion tce and constitute a significant energy potential.

9. Coal resources and reserves are geographically widely distributed with more than 80 countries reporting coal occurrences. Coal resource and

reserve estimates by individual countries and type of coal (i.e. hard coal/ brown coal) are provided in Annex 2, Tables 2-1 and 2-2 and summarized by region below.

Table 1: World Coal Resources and Reserves by Type of Coal and Regions

	Hard Coal		Brown Coal		Total	
	billion tce	%	billion tce	%	billion tce	%
A. Geological Resources						
Developed Countries	1,968	25.5	1,467	61.0	3,434	33.9
CPEs	5,554	71.9	906	38.0	6,461	63.8
LDCs	203	2.6	27	1.0	230	2.3
Total	7,725	100.0	2,400	100.0	10,125	100.0
B. Technically and Economically Recoverable Reserves						
Developed Countries	239	48.6	86	59.5	325	51.0
CPEs	205	41.6	41	28.7	246	38.7
LDCs	48	9.8	17	11.8	65	10.3
Total	492	100.0	144	100.0	636	100.0

Global Distribution of Coal Occurrences

10. Despite the widespread occurrence of coal, presently known coal deposits are highly concentrated in developed and centrally planned economies. Three countries (the U.S., U.S.S.R. and China) account for nearly 88% of the world's geological coal resources and 60% of recoverable reserves. Developing countries account for only about 2% of geological coal resources and about 10% of recoverable coal reserves. Nevertheless, in absolute terms, the coal resource base of the developing countries of 230 billion tce of geological resources and 65 billion tce of recoverable reserves is substantial.

11. As illustrated in Annex 2, Tables 2-1 and 2-2, coal resources in LDCs are widespread. About 50 developing countries have geological coal resources and 19 have technically and economically-recoverable coal reserves. Nevertheless, the apparent resource distribution is as concentrated in developing as it is in the developed economies. India alone accounts for 25% of LDC geological coal resources and 52% of recoverable coal reserves. India, together with Swaziland, Botswana, Indonesia and Brazil, combine in their territories as much as 77% of geological resources and 62% of technically and economically-recoverable reserves presently known in LDCs.

12. However, there has been little exploration for coal in the developing countries and there is a scarcity of basic geological data. In the past, most developing countries concentrated on exploring for base metals (such as copper and iron ore) because of the low unit value and relatively high cost of thermal coal as compared to oil. International mining companies, on the other hand, limited coal exploration in developing countries to metallurgical coal since most developed countries were amply endowed with domestic thermal coal relative to demand.

13. Following the oil price rise of 1973, developed and developing countries alike increased their coal resource base by reclassification of available data but very little effort was made to start new exploration programs. As illustrated in the following table, the absolute amount of recoverable coal reserves has increased by about 35% since then and there has been a steady shift of coal estimates from the category of geological resources to that of technically and economically recoverable reserves.

Table 2: World Coal Resource Endowment by Degree of Probability, 1973-77
(billion tce)

Year	Geological Resources		Technically & Economically Recoverable Reserves		Reserves as % of Resources		Coal Availability a/ (Years)	
	World	LDCs	World	LDCs	World	LDCs	World	LDCs
1974	8,603	n.a.	473	n.a.	5.5	n.a.	158	n.a.
1976	9,045	n.a.	560	n.a.	6.2	n.a	187	n.a.
1977	10,125	230	636	65	6.3	2.8	212	n.a.

a/ Based on present annual world coal consumption of about 3.0 billion tce and estimate of recoverable reserves.

n.a. not available

Source: World Energy Conference, 1977.

Since the degree of coal exploration in LDCs has so far been negligible, it cannot be excluded that comprehensive geological surveys and coal exploration programs in these countries may lead to a larger and more widespread geological resource base and increase the technically and economically-recoverable coal reserves. However, a systematic geological survey and exploration effort will be required over a 10 - 20 year period to ascertain the coal resource base of LDCs.

Characteristics of Coal Production

Coal Output Development

14. World coal production in 1977 was 2,774 million tce or the equivalent of some 36 million barrels of oil per day (compared to oil output of about 62 million barrels per day), of which some 176 million tce or about 6% were mined in developing countries. More than half of the LDC output (100 million tce) was mined in India. Six countries (the U.S., U.S.S.R., China, Poland, the U.K. and F.R. of Germany, in that order) produced 1,957 million tce in 1977, or 71% of that year's world output (see Annex 2, Tables 2-3 and 2-4). Three other important coal producers (Yugoslavia, the Republic of Korea and Turkey) produced a total of 44.5 million tce (35%), and seven minor producers (Pakistan, Taiwan, Viet Nam, Brazil, Chile, Colombia and Mexico) produced 1 to 6 million tce p.a. each. These 11 countries are responsible for 96% of the present coal output in the LDCs. There are substantial differences in coal quality and use among the major LDC coal-producing countries. While India extracts about 96% hard coal, including about one-fifth coking coal for the domestic iron and steel industry, the Republic of Korea mines primarily anthracite (a coal of high heat value and high carbon) for commercial/residential heating, while Yugoslavia and Turkey produce predominantly brown coal for electricity generation.

15. World coal production increased at an annual average rate of about 3% during the 1973-77 period, compared to 0.7% during the 1960-73 period. Table 3 summarizes the increase in world coal production by region during 1973-77.

Table 3: World Coal Production by Region, 1973-77

	Developed Countries		CPEs		LDCs		Total	
	mill tce	%	mill tce	%	mill tce	%	mill tce	%
1973	1,018	41.2	1,313	53.1	140	5.7	2,471	100
1974	1,037	41.4	1,334	53.3	132	5.3	2,503	100
1975	1,103	41.9	1,384	52.6	146	5.5	2,633	100
1976	1,126	41.7	1,424	52.7	151	5.6	2,701	100
1977	1,135	40.9	1,463	52.7	176	6.3	2,774	100
Average Annual Growth Rate (%)		2.9		2.9		6.0		3.0

16. Table 3 indicates that the shares in coal output of developed countries, the centrally planned economies and the developing countries have remained constant at about 41%, 53% and 5-6% respectively. However, major shifts have occurred within the first two groups. Coal production continued to fall in Japan and stagnated in Western Europe mainly due to high production

costs and environmental restrictions. Australia and South Africa,on the other hand, emerged as important new coal-producing countries, owing to relatively low production and transportation costs and good quality and easily accessible resources. In centrally planned economies, the output of China and the Democratic Republic of Korea grew at 4% and 12.8% p.a. respectively, compared to 2.9% p.a. for the CPEs, as a whole.

17. Coal production in LDCs during the 1973-77 period grew by 6.0% p.a., appreciably faster than the 2.9% p.a. growth in developed market economies. The rapid average growth reflects the low starting base; it was brought about nearly entirely by expansions in the four largest coal-producing countries (India, Yugoslavia, Republic of Korea and Viet Nam) and moderate increases in Mexico, Turkey, Colombia and Brazil. None of the other coal-producing countries emerged as an important new coal producer during this period for reasons discussed in Chapter III.

Coal Mining Costs

18. Coal production costs vary widely depending, inter alia, on the type of mine (underground or surface) and mining technology used, the geographic and topographic conditions, the consistency of the coal, the number and thickness of the coal-bearing seams, labor cost, productivity and management efficiency. As illustrated in Annex 2, Table 2-5, mine-head coal production costs worldwide in 1978 averaged about US$10-15 per ton for surface mines and US$20-30 per ton for underground mines excluding the subsidized underground mines in countries of the European Community (EC) with reported production cost in the US$45-95/ton range. The lowest mining costs for underground workings are achieved in South Africa at less than US$10 per ton due to extremely low labor cost and favorable geological conditions. Highly mechanized, large-scale strip mines such as in Canada, the U.S. or Australia, or lignite operations in the F.R. and D.R. of Germany or Poland, allow mining costs as low as US$6-10/ton. For thermal coal, however, the mining cost per energy unit is more significant than the the cost per ton of coal mined. Thus, in terms of heat value, the open-cast mining costs in the U.S. of US$0.5-0.85/million BTU compare with US$1.0-1.5/million BTU for the German lignite mines.

19. During the past decade, real production costs in the coal industry have increased by less than 1% per annum. 1/ The rising costs of capital, energy and labor, more stringent mine safety, health and environmental regulations, accelerated depletion and the deepening of coal mines, particularly in

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1/ This figure does not yet reflect a recent development, whereby coal companies lower cut-off grades, depth limit and other mining criteria of existing mines, thus increasing production cost substantially. This approach is a response to increased coal prices; coal companies attempt to maintain stable profit margins, without necessarily maximizing profits.

some developed countries, have been largely offset by (i) productivity gains in a number of countries through the introduction of more efficient mining techniques, such as continuous mining and longwall equipment for underground mines and larger draglines, bucketwheel excavators and shovels/trucks for open-pit mines, and (ii) the opening of new larger, more productive underground and open-pit mines. This trend of only slowly increasing real coal-mining costs is expected to continue since, unlike base metals, the resource base of coal worldwide is still largely unused and gradual depletion of low-cost reserves and a shift to less productive marginal mines is not expected in the near to medium term.

20. Although more efficient mining technology is likely to help hold down worldwide mining costs, major increases in the delivered cost of coal are still to be expected due to increases in transport cost. The cost of delivering domestic coal to power stations presently averages US$6-18/ton in the developed countries. However, the railroads, ports and handling facilities required to transport coal from new, large-scale surface mines in the Western U.S., Canada, Siberia, and Australia, and in developing countries such as Colombia, Indonesia, Swaziland, Chile or Brazil will increase coal transport costs substantially in the near future.

Patterns of World Coal Consumption and Trade

Characteristics of Coal Consumption

21. As shown in the following table, consumption has traditionally been dominated by the use of coal for energy generation and to a lesser extent as a reductant in steel-making.

Table 4: OECD Consumption of Coal by Sector

	1960		1976	
	mill tce	%	mill tce	%
Electricity Generation	325.8	34.0	608.5	60.2
Industry				
Iron and Steel	152.9	15.9	164.0	16.2
Others	164.2	17.1	96.5	9.6
Sub Total	317.1	33.0	260.5	25.8
Transportation	38.2	4.0	1.4	0.1
Residential/Commercial	184.9	19.3	70.4	7.0
Gas Manufacture	27.5	2.9	6.6	0.7
Energy Uses & Losses	65.8	6.8	62.6	6.2
Total	959.3	100.0	1,010.0	100.0

Source: Steam Coal Prospects to 2000, IEA, 1978.

While coal consumption for power generation in the OECD countries almost doubled (from 325.8 million tce to 608.5 million tce) between 1960 and 1976, overall coal consumption increased by only 5%. All other sectors showed declines in consumption over the period except for coking coal in the iron and steel industry, which increased slightly. Coal for power generation nearly doubled and in 1976 accounted for about 60% of coal consumption in OECD countries. OECD thermal coal trade -- excluding intra-EC trade -- increased from 26.8 million tce in 1973 to 39.7 million tce in 1976. The rapid growth of thermal coal trade and power sector consumption reflects the conversion of existing dual-fired power generating capacities from oil to coal in EC countries and readily available thermal coal supply from Poland, Australia and South Africa.

Coal Trade

22. Total world coal trade reached about 216 million tce in 1976, i.e., less than 8% of world production in that year. Thermal coal accounts for less than 25% of 1976 world coal trade with the rest in coking coal for industrial use and in anthracite.

23. The largest coal exporters, which together account for nearly 84% of total coal trade in 1976, are the U.S. (25.7%), Poland (19.7%), Australia (14.5%), the U.S.S.R. (14.2%) and the F.R. of Germany (9.1%). Coal exports from developing countries, are negligible, amounting to less than 1% of world coal exports (Annex 2, Tables 2-6 and 2-7).

Table 5: World Coal Export/Import Trade by Regions for 1961 and 1976
(million tce)

	1961			1976		
	Exports	Imports	Export Surplus (Deficit)	Exports	Imports	Export Surplus (Deficit)
Developed Countries	84.8	99.6	(14.8)	131.8	162.4	(30.6)
CPEs	48.1	27.7	20.4	83.2	41.5	41.7
LDCs	3.8	9.4	(5.6)	1.6	12.7	(11.1)
Total	136.7	136.7	-	216.6 1/	216.6 1/	-

1/ Of this total 176 million tce were coking coal and 40 million tce thermal coal.

24. Of the developing countries, only three - Brazil, Egypt and Korea - are important coal importers. All three import coking coal for their expanding steel industries and, to a lesser extent, Korea imports anthracite for commercial/residential use. Developing countries as a group are marginal net importers of coal to the extent of less than 10% of their own production.

25. International trade in coking coal, which has been stagnant over the past several years, is expected to expand again in the eighties as Japanese and European steel industries recover and demand for coking coal imports increases. A significant international market has still to develop for thermal coal trade and will largely depend on the demand generated by new coal-fired power stations in Japan and EC countries. IEA estimates that by 1990 a demand for thermal coal imports of about 140 million tce p.a. may develop (compared to some 40 million tce at present) and could be satisfied by South African and Australian exports and to a lesser degree by CPE, U.S. and LDC supplies. LDCs have the resource potential to capture a 10-25% share of this emerging market if known good quality reserves can be exploited and delivered at competitive costs and prices.

Thermal Coal Pricing

26. Since the oil price hike in 1973/74, coal prices have risen substantially, though considerably less than oil prices on a heat content basis. Between 1973 and early 1979, average oil prices increased in real terms by 270% while average coal prices rose by only 42% (Annex 2, Table 2-9). During the same period, thermal coal prices for long-term supply contracts from South Africa or Australia grew by only 15-20% in real terms. 1/ Spot market prices for thermal coal have remained 10-20% below long-term contract prices (depending on coal quality) during the past three years, indicating a coal oversupply situation. Competition in the international coal market is expected to remain strong in the foreseeable future and is unlikely to change until substantial coal demand increases are brought about by energy policies in the industrialized countries which encourage new investments in coal-fired power generation facilities.

27. There are widely divergent views about future trends in coal pricing. Theoretically, the cost of coal per BTU to users (including all costs related to disadvantages of coal such as pollution, transport, etc.) should be equal to the cost of alternative fuels competing in the relevant end-use market. Some observers believe this long-term equilibrium will be reached rapidly, i.e., the present gap between coal and oil prices will

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1/ Among thermal coals, not only the heat value but other characteristics such as moisture, ash and sulphur content as well as volatiles determine the price. According to a recent IEA study, pricing differentials in the order of US$14 to US$15.5 per tce (in 1976 terms) will be required to equalize the costs of pollution control equipment needed to use high sulphur rather than low sulphur coal in power generation. These costs are reflected in prices for different qualities of coal.

narrow as (i) demand for coal exceeds supply and (ii) coal suppliers realize the additional profit arising from their competitive position vis-a-vis oil. Others argue, and we agree in principle, that the gap between coal and oil will most likely widen because competition in the international coal markets will remain strong due to the widespread nature and abundance of reserves, lack of ownership concentration and relatively few institutional constraints to setting up coal production (with the possible exception of access to capital). This view of a widening price gap is supported by the forecast of the International Energy Agency which projects only a 1% p.a. real-term growth in world coal prices after 1985 compared to a 2.5% growth in oil prices at that time.

Substitution and Competitiveness of Thermal Coal

28. Despite the fact that in terms of heat value alone coal costs are about half as much as oil, coal's competitive position relative to other energy sources remains ambiguous. The attractiveness of coal compared to other fuels depends not only on relative prices and calorific values but also on availability and reliability of supply, government energy policies, the satisfactory solution of technical and environmental problems that presently limit coal use and last, but not least, coal handling properties. Coal is difficult and expensive to distribute, particularly to small users, and the need to control dust, dispose of ash and to provide adequate storage--as well as to burn it in an environmentally acceptable manner--makes it inconvenient to use.

29. Nevertheless, the prospects of coal development have been further enhanced by the increasing cost, perceived risks, and delays in nuclear power programs and the prospect that limited oil and natural gas supplies will result in higher energy prices in the future. The following paragraphs explore briefly the probable future competitive position of coal vis-a-vis alternative fuel supplies and the near and medium-term possibilities for coal substitution in each of the principal energy-consuming sectors.

30. The increased reliance on oil which developed in the 1960's and early 1970's is not likely to be reversed easily since reconversion from oil to coal poses ecological and financial problems. First, a sizeable and speedy reconversion to coal as fuel for energy generation in residential/commercial use and in the transport sector is not feasible since substantial investments in boilers, heating installations and railway locomotives would be needed to switch back to coal. Second, in power generation and industry the change from coal-fired equipment to oil and gas 10-20 years ago offered industry a high degree of flexibility and supply security; the reverse process requires major capital outlays for new materials-handling, storage and pollution-control equipment as well as an exchange of basic equipment, such as boilers, heat exchangers and refractory surfaces. In summary, the cost and inconvenience of reconverting existing facilities to coal will largely limit coal demand increases to new installations and replacement investment when the latter are due over a 30-year period.

31. The International Energy Agency recently published a study comparing the relative competitiveness of coal, oil and nuclear fuel for electricity generation. 1/ The study concluded that depending on operating rates and sulphur content of the coal, thermal coal is more economical to use than oil when coal prices are below US$65-86/tce (in 1978 terms). Further, coal appeared at the time to be more economical than nuclear power in the case where coal prices are less than US$24-32/tce. The calculations are based on OECD-wide cost assumptions and are therefore not directly applicable to any specific country. Nevertheless, the analysis underscores two pronounced trends. First, even if oil prices in real terms were to remain stable from 1978 to 1985 and thereafter were to increase by only 2.5% p.a. while coal prices increased by 1% p.a., and provisions were made for suitable pollution control equipment, average production cost of electricity from coal over the next 20 years would likely be almost 35% less than that from an oil-fired plant over the same period. This competitive advantage has been widened further by the latest (June 1979) oil price increase. Second, the competitive position of coal-fired electricity generation vis-a-vis nuclear power is less definitely in favor of coal than the choice between coal and oil. As noted above, the break-even price of coal in competition with nuclear power generation has to be considerably less than in competition with oil (on average only about two-fifths). On the other hand, nuclear power costs are particularly sensitive to capital costs and the impact on production costs of safety and environmental regulations has not yet been adequately assessed.

32. Further, technological development can alleviate some of coal's disadvantages such as air pollution, transport difficulties or limited versatility of coal utilization. The new technologies include inter alia:

(a) improvement of coal quality for direct utilization through (i) coal cleaning for sulphur removal; (ii) fluidized bed combustion, reducing sulphur and nitrogen oxide emission from plants and allowing utilization of a wider range of coals, and (iii) environmental control technologies such as flue-gas desulphurization, and

(b) coal conversion into (i) low-BTU gas or substitute natural gas (high-BTU gas); and (ii) liquid fuels as a direct oil substitute or for use in fuel cells.

Most of the environmental control technologies are by now sufficiently advanced to allow commercial application. Although they increase the cost of direct coal utilization in power generation and industrial fuel burner use, their introduction does not threaten the relative economic advantage of coal vs. oil in these applications. Extensive commercial use of coal in the conversion processes, on the other hand, is not expected before 1985-90 because of remaining technical problems and relatively high cost. At that time, according to IEA, substitute natural gas (high-BTU gas) derived from

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1/ Steam Coal Prospects to 2000, IEA, 1978.

coal and low-caloric gas for burning at the site of conversion are expected to be competitive with oil, while liquid fuels production from coal may still remain 10-20% more expensive than the currently projected oil price. 1/

SECTION III. COAL DEVELOPMENT AND CONSTRAINTS IN LDCs

Coal Development Plans in Developing Countries

33. Current energy prices and prospects make the development of comprehensive energy policy a matter of urgency. Any coal development plan would have to be an integral part of such national energy policy; coal use must be evaluated as part of a strategy to maximize the use of the most efficient energy sources, to make more effective use of existing domestic resources, to promote conservation, to increase knowledge of the country's resource potential and to develop or adopt techniques for using traditional fuels more effectively.

34. The formulation of energy objectives and Government policies for future energy development poses immense problems for developing countries. Projecting energy demands even 10 to 15 years ahead may give questionable results as (i) the range of values within which plausible assumptions about economic growth can be made is wide and leads to rapidly diverging forecasts, and (ii) on the supply side, unknowns with respect to the reliability of supply and the price of oil and gas, availability of local resources, and the cost and lead time for their development are great enough to impart a wide margin of error. Nevertheless, it is generally recognized that the development of indigenous coal deposits for power generation offers potentially important benefits for many developing countries. In addition to employment benefits, the major impact will be felt on the balance of payments. Coal development in LDCs for domestic use reduces oil consumption, thus saving foreign exchange for net oil-importing countries, or releasing additional oil for exports in the case of oil-exporting LDCs.

35. Most developing country governments have up to now ignored the use of coal as an alternative energy source. Only a few LDCs are in the process of assessing their coal resources and considering various coal development strategy options, taking into account the competitive cost advantage of coal as fuel for power generation and other uses, the degree of supply reliability, as well as the foreign exchange and employment generation effects of coal output expansions. The following strategies are emerging:

1/ The IEA study assumes that marker crude oil expressed in 1977 US$ is expected to remain constant in real terms at US$12.7 to 1985 and increase thereafter by 2.5% p.a. in real terms.

(a) Domestic Coal Production as Substitute for Imported Oil.

To substitute for oil in power generation, oil import-dependent LDCs look to the development of local coal resources to the extent that coal production costs prove to be below the opportunity cost of importing oil. This strategy represents a lower-cost energy alternative which should contribute to significant foreign exchange savings. India, Yugoslavia, Turkey and Viet Nam have for years used local coal as a substitute for imported oil and similar approaches are being adopted by Thailand, the Philippines, Brazil and Colombia. For countries with low-grade thermal coal reserves, which are unsuitable for export, inter alia, because of low heat value or decomposition and combustion in transport, domestic coal use represents the only economic coal use alternative. Thus, Yugoslavia is considering a large scale mine-mouth power plant to burn low-grade lignite at the source for export of electricity to neighboring countries.

(b) Domestic Coal Production by Oil-Exporting LDCs to Free Oil for Export.

The relative economic advantages of oil vs. coal exports are twofold: first, transport of oil per heat unit value is about one-third cheaper than coal transport; second, while diverse markets and marketing networks exist for oil and metallurgical coal, a significant trading volume and generally accepted marketing conditions for thermal coal have still to be developed, thus creating an element of uncertainty for potential thermal coal exporters and users. Net oil-exporting countries with known coal reserves such as Indonesia, Mexico, and Venezuela are in the process of developing local coal production for use in power generation to free oil for export. Only two oil-producing developing countries with large coal resources, Algeria and Iran, have no significant plans to develop them. Iran intends to expand production of coking coal only moderately for its domestic steel industry. In contrast, Algeria's large reserves are located in the south of the country, far away from any consuming centers and the high cost of the necessary transportation infrastructure is the main impediment to economical exploitation.

(c) Coal Production for Export.

Coal development for export is being considered by a number of countries where (i) coal resource potential exceeds domestic demand for thermal or metallurgical coal as in Swaziland, Botswana or Mozambique; (ii) foreign capital

is being attracted to develop local coal production for export, as in Indonesia and Colombia, or (iii) the need for foreign exchange earnings is given high priority.

(d) Coal Imports to Replace Oil Imports.

Substitution of oil imports by coal imports does not alleviate the foreign exchange drain associated with fuel imports but can provide a cheaper fuel energy alternative. However, as the international thermal coal trade is still limited to 40-60 million tpy and coal handling facilities are not readily available, LDCs hesitate to rely on coal imports for much of their energy needs. As a first step, a number of Asian countries (R. of Korea, Taiwan) with ready access to coal imports from South Africa and Australia have announced power development plans based on imported coal.

Most LDCs are likely to follow a combination of approaches, depending on the quality, size and location of coal resources, availability of capital and alternative cheaper energy supply, such as hydropower. Thus, Indonesia plans, in addition to hydropower plants, to develop the relatively low-grade brown coal fields in South Sumatra to supply nearby base-load power plants in Java, freeing oil for export. At the same time, Indonesia, in collaboration with foreign partners, is exploring for possible exports high-grade coal deposits in Kalimantan, where basic transport infrastructure still has to be developed.

Prospects of LDC Coal Production by 1990

36. Forecasts of future coal supply are difficult. Future coal production depends, inter alia, on the growth of overall and specific coal-related energy demand, the marginal cost relationship between coal and other forms of energy, the ability of individual countries to implement major increases in their coal production capacity and government policy in those countries. The first two variables are generally the more important in the medium and longer term, particularly in developed market and CPE countries. In LDCs, however, where the coal production base is low, shortage of capital, particularly for infrastructure development, and limited technical and managerial ability to develop a new mining sector are likely to play a more important role.

37. The projections of coal production presented in Annex 2, Table 2-11 are based on announced mine development and government plans as well as the consultant's and Bank staff assessment of prospects for coal demand and supply in individual developing countries. The production forecasts up to 1985 are relatively reliable, since the long lead time required for coal mining investments to become operational makes it unlikely that presently unknown major projects will add any significant output by that time. Additional projects could be initiated in the next two or three years and enter production between 1985 and 1990. The 1990 forecast assumes that LDCs with major known coal potential will pursue a determined coal development

policy and that this coal output is sufficiently cost competitive to capture an export market share of between 20 and 30 million tce p.a., equivalent to some 5-7% of LDC coal production at that time. These are feasible, but optimistic, assumptions and the forecasts must thus be considered on the high side.

38. Coal production in developing countries is expected to grow at 7.1% p.a. during 1977-85, compared to 3.3% and 4.6% p.a., respectively, in the developed and the centrally planned economies, and to continue at a slightly higher rate in 1985-90.

Table 6: Forecast of Coal Production by Region, 1977 to 1990
(million tce)

	1977 (actual)	1980	1985	1990	Annual Growth Rates (%) 1977-85	1985-90
Developed Countries	1,134.4	1,265	1,476	1,752	3.3	3.5
CPEs	1,463.3	1,662	2,089	2,610	4.6	4.5
LDCs	176.0	233	304	440	7.1	7.6
Total	2,773.7	3,160	3,869	4,802	4.2	4.4

In absolute terms, LDC coal production will rise from 176 million tce in 1977 to 440 million tce in 1990, thereby increasing its share of world coal production from 6.3% in 1977 to 9.2% in 1990.

39. Increased production of coal in LDCs during the early eighties is expected to come almost entirely from present coal-producing countries. Increased production in India, Turkey, the Republic of Korea, Viet Nam and Yugoslavia is estimated to account for 70% of the expanded LDC coal output of 128 million tce by 1985; three other developing countries (Brazil, Colombia and Venezuela) are likely to emerge as significant new coal producers by that time. By 1990, several other countries, presently minor coal producers such as Botswana, Swaziland, Taiwan, Thailand, Argentina, Chile, Indonesia, Rhodesia and Mexico, may be expected to reach production levels of more than 5.0 million tce. Few of the 30 other LDCs with known coal resources, but which are not now producers, will be able to develop any significant coal output by 1985; four of these countries (Angola, Malaysia, Madagascar and Bangladesh) are, however, likely to start coal production on a significant scale by 1990. The reasons are discussed on pages 17-22.

40. The coal output forecast for LDCs in this paper is about 70% higher than those projected in both the IEA and WEC reports and about 10% higher than the forecast in the January 1979 Bank paper A Program to Accelerate

Petroleum Production in the Developing Countries. The near-term estimates here have been developed project by project and thereafter country by country, whereas the other reports based their estimates on an assumed growth trend. The 1985 supply forecasts in this paper are likely to be more realistic; those for 1990 are optimistic but feasible, provided that a determined policy emphasis is given to coal development and coal-fired power/industrial plants in developing countries.

41. Increased reliance on coal will undoubtedly improve the energy balance and foreign exchange situation of a number of countries. However, as illustrated in the following table, only minor shifts of coal production to the low-income group LDCs are expected.

Table 7: Coal Production Trends by Income Group

Income Group GNP/Capita (US$/Capita-1977 base)	Recoverable Reserves		Production			
			1977		1990	
	bill tce	%	mill tce	%	mill tce	%
Less than 200	39.5	6.2	107	3.9	221	4.6
200 - 499 1/	103.9	16.3	501	16.8	1,298	27.0
500 - 1,999 2/	23.9	3.8	113	4.1	288	6.0

Sources: 1978 World Bank Atlas, WEC, Skelly & Loy.

1/ Includes the People's Republic of China.
2/ Excludes South Africa.

42. Further, increased coal production worldwide is not expected to drastically change the portion of energy consumption met by coal. As shown in Table 8 below, from 1976-90 the contribution of world coal production to total energy consumption is expected to remain at around 29%, while the same relationship in LDCs will increase significantly from 14.4% in 1976 to 17.9% in 1990.

Table 8: Growth of Coal Production Relative to Energy Consumption
(million tce)

	1976	1985	1990
World Energy Consumption	9,257	13,102	16,317
World Coal Production	2,702	3,866	4,794
Production/Consumption (%)	29.2	29.5	29.4
LDC Energy Consumption	1,049	1,718	2,462
LDC Coal Production	151	301	440
Production/Consumption (%)	14.4	17.5	17.9

Sources: Skelly & Loy, UN- World Energy Supplies 1972-76, and Bank staff estimates.

Capital Requirements

43. Capital costs for new coal mines or mine expansions vary substantially, ranging from US$30 - 85/ton (1978 dollars) of annual capacity installed for underground mines to US$15 - 60/ton of annual capacity in open-pit mines, (see Annex 2, Table 2-5). Infrastructure costs depend on the location of the mine in relation to the market and also vary widely. For example, the expected capital costs of rail and port facilities for a 15 million tpy coal project in Colombia have been estimated at US$850 million compared to US$11 million for a 1 million tpy coal expansion project in Viet Nam.

44. An estimated US$20 billion (in 1978 dollars) will be needed by LDCs to provide mining and transport facilities for the additional 264 million tce output (from the 1977 level of 176 million tce) that they would be capable of achieving by 1990 (see Table 6). Mobilization of the needed US$20 billion (in 1978 US$) will pose major problems for developing countries. Internally-generated cash from the existing coal industry cannot support such a massive expansion. As coal production will be primarily for domestic consumption and only about 10% of the additional output by 1990 is estimated to be for export, funding of a substantial portion of overall LDC capital requirements for coal by foreign equity investment cannot be expected. LDCs will thus look to bilateral and international agencies as well as commercial banks to supplement budgetary allocations. To ensure that LDCs reach an annual coal output of 440 million tce by 1990, external financing sources may have to provide as much as 60-70% of the US$20 billion needed.

Constraints to Coal Development in Developing Countries

45. The obstacles to coal development differ widely between the developed and developing countries. Most experts agree that the principal impediments to rapid short and medium-term growth in coal development in developed

countries are demand related. Partly because of the substantial materials-handling, transport and environmental problems, and partly because of uncertainties about future oil supply, prices and government energy policies, private and public investors have been hesitant to invest in coal utilization facilities and thereby generate the demand which would justify a massive increase in coal output and trade. This general reluctance to embark on coal sector development is also found in LDCs. However, the demand constraint is only one of several obstacles. The major impediments to rapid coal output growth in developing countries are largely - though by no means entirely - supply related.

46. These constraints, which are discussed briefly below, include a lack of geological data, feasibility studies and adequately prepared coal projects, high infrastructure cost, low economic/financial viability of known deposits, and inadequate technical knowledge.

Lack of Geological Data and Preinvestment Work

47. The relative unattractiveness of coal compared to oil during the period of low oil prices and the ready availability of coal in developed countries meant that few international mining companies explored for thermal coal in developing countries. LDCs themselves have often relegated the delineation of coal deposits to a lower priority than finding the most likely areas for base metals. Even in countries where some coal exploration had been undertaken and the existence of recoverable reserves had been established, the economics of coal exploitation did not encourage companies or governments to follow up with detailed exploration, coal quality testing, or the feasibility or preliminary engineering work needed to establish the economic/financial and technical viability of such known deposits. As a result, long lead times are now required before additional coal production can be realized. Developing countries with coal prospects can be divided into three broad categories:

(a) countries which are virtually unexplored, although their geological potential for coal is promising, are likely to require 10-15 years before sizeable coal output can be achieved from new discoveries. Zaire, Angola, and some areas of Brazil are representative of this group;

(b) countries with known coal reserves, the extent and quality of which have not yet been fully explored and which require additional exploration and feasibility work before proceeding to the investment/development stage may, on the average, need 5-8 years before bringing new mines into production. The majority of LDCs with minor coal production are in this category; and

(c) countries with well-established coal industries such as India, Yugoslavia, Turkey, the Republic of Korea and

Viet Nam are in a position to increase output within a short time span, averaging 3-5 years, through expansion of existing mines and the reliance on accumulated past project preparation work.

Of course, the length of time required to remedy the lack of sufficient geological data and preinvestment work for coal in developing countries depends on the specific country, the size, location and quality of a deposit, the market prospects and the technical difficulties associated with a given coal body. At present, the lack of basic geological data and the lack of a pipeline of coal projects ready for implementation represent the main impediments to a rapid short and medium-term coal production expansion in developing countries. Widespread coal resource endowments appear to exist in LDCs, however, and in the long run this important supply constraint could be overcome if LDC Governments and international mining companies are prepared to accelerate investment in coal exploration and feasibility work.

Lack of Economically Viable Projects

48. Once oil is discovered, the economic returns on exploitation investment are about 40% on average and may be as high as 50-100%. Coal projects in LDCs, however, may be fortunate to yield (at projected opportunity costs of importing oil or exporting coal) around 10-15%. The reasons for this disparity range from the large capital investments needed for mine development, bulk handling and transport to location and difficult technical/geological characteristics and/or poor quality of known coal reserves.

49. In developed countries, a well-established rail and shipping network provides a basis for coal output expansion. On average, only 10-30% of the present delivered cost of coal to consumers is accounted for by transport cost. However, in the majority of developing countries, a substantial increase in newly installed mine capacity will require corresponding investments in rail/port infrastructure. Even India, with a coal industry well over one hundred years old and one of the most extensive railroad systems in the world, finds that its coal expansion plans are constrained by transport problems in getting the coal to domestic consumers and by the lack of adequate rail and port handling capacities for export. The lead time for basic transport development tends to be one to three years longer than the time required for the development of the associated mine. While transport requirements vary widely among different coal projects, it has been estimated that in LDCs transport cost during the eighties will average 40-60% of delivered coal cost. The Amazon Region of Brazil, the south of Algeria and southern Chile are examples of areas containing relatively low-grade deposits located far from potential customers and which--at present oil and coal prices--cannot carry the infrastructure cost associated with their development.

50. Other technical and economic factors limiting project viability at present are the geology and the quality of specific coal deposits. For example, in Peru and the Republic of Korea, many coal deposits are badly faulted. The coal is therefore expensive to recover and involves the

additional health and safety hazards of deep underground workings. In Bangladesh, there is good quality coal located 3,000 to 4,000 feet beneath an alluvial overburden that requires expensive and sophisticated mining techniques. Much of the coal in Afghanistan and Zaire on the other hand, is low-quality, high-ash, high-volatile powder coal, posing materials-handling problems. Indonesia's South Sumatra coal has a high moisture content, adding additional transport costs and safety hazards because of combustion problems. These coal quality characteristics restrict not only exportation of such coals but complicate domestic storage and handling.

51. Although coal quality characteristics are important and may increase the cost of coal, beneficiating techniques and blending possibilities have been developed and allow the production of an acceptable mixture for most direct coal utilization alternatives. Furthermore, it is sometimes possible, by redesign of equipment (such as furnaces and dryers) or by amendments to processes, to use coal which is not suitable for "standard" equipment or will not work in "normal" process conditions. Recent advances in the production of so-called "formcoke" which results from the blending of metallurgical coal with other coals previously not considered cokeable, is an example of the attempt to broaden the utility of given coal properties and stretch reserves of metallurgical coal which are the more limited. The detailed and sophisticated laboratory work and pilot plant testing needed to establish the usability of a particular coal must form part of preinvestment testing to ensure the most economical use of LDC coal resources.

52. Another problem relates to the fact that coal mining at low levels of productivity and on a small scale is a common feature of the coal industry in many developing countries. In India, a major world producer with a total output of about 100 million tce per year, most of the mines, until nationalization in 1974, were small and worked with manual labor, using little mechanization. About three-fourths of India's coal production comes from underground mines using conventional room and pillar techniques, by tubs with rope haulages, and only a small number of mines use conveyor belts and mine cars. Although labor costs in developing countries are relatively low, the methods employed limit the scale of output expansion and present difficult working conditions, health and safety problems.

53. The above discussion relates primarily to large coal mines and the use of coal for large-volume and concentrated consumption. There are a number of developing countries which have only small and scattered coal deposits and their exploitation could possibly be economically attractive when made into coal briquettes and smokeless or semi-smokeless fuels for domestic and light industrial use. This could help to alleviate the shortage of firewood and thus counteract the deforestation that is occurring in some parts of the world. This potential use of coal and the related establishment of small and medium-sized mines, have not been given enough attention, with a few exceptions such as in China, Turkey and Korea.

Capital Constraints

54. A coal mine and associated infrastructure can require anywhere from US$20-150/ton of annual output (in 1978 dollars) depending on the location and scope of the project, the cost of associated beneficiation units, transport infrastructure, thermal power plants or transmission links. Problems of arranging the financing for such relatively "lumpy" projects for LDCs are, therefore, similar to those of large-scale industrial and power projects.

55. Prior to 1973, coal development projects had been typically financed by domestic resources, bilateral credits and, to a small extent, by loans from international financial institutions. Since LDCs generally did not provide a particularly inexpensive supply of metallurgical coal and international trade in thermal coal was virtually non-existent, international mining companies and commercial banks showed no interest in developing LDC coal resources. 1/

56. Since the oil crisis in 1973/74, a few exploration and development contracts have been signed or are being negotiated, in particular by Exxon and others in Colombia, by British, U.S., Japanese and South Korean interests in Indonesia and by Anglo-American and Shell in Botswana and Swaziland. The Japanese Government has a program to subsidize general coal development research projects abroad, to finance overseas coal exploration projects and to guarantee private loans for coal development in foreign countries. All these efforts are directly linked to coal development for exports whereby foreign sponsors provide equity financing or loans secured by long-term sales contracts. Foreign investors have not yet shown interest in equity participations in LDC companies producing solely coal for domestic consumption. This possibility cannot be excluded, but considering the relatively low financial return which coal companies are likely to achieve in such countries and that as a rule, coal, transport and utility tariffs are controlled, coupled with the uncertain climate for foreign investment in a number of LDCs, coal production for local consumption is unlikely to attract a substantial flow of foreign capital.

Demand Constraints

57. Even where relatively accessible deposits of good quality coal are known, the lack of a domestic market may hinder development. There are

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1/ The question has been raised whether the lack of coal exploration activity in LDCs is the result of lack of exploration funds. At present, it appears that not the lack of funds but the low priority given by LDCs to coal exploration and feasibility work is responsible for the delays in coal project preparation. Bilateral exploration grants and UNDP funds for coal development are often not used expeditiously and the UN Revolving Fund for Natural Resources Exploration has not made any loans for a coal survey or exploration due to lack of demand.

potentially attractive coal deposits in several East African countries, including Botswana and Swaziland, but the domestic markets are too small to justify any large-scale expansions.

58. As for export markets, developing countries and developed countries alike will be competing for the expanding thermal and metallurgical coal market in Europe and Japan. LDCs will compete particularly with the U.S., Australia, South Africa and Eastern European countries and can expect to break into the thermal coal trade only if they are able to supply good quality coal at competitive prices and can convince customers of the reliability of long-term supply. Since, as outlined in **pages 48-52, the financial and** economic returns on LDC coal projects are kept down by a number of factors (high infrastructure cost, inefficient operations and to a lesser extent, extensive and thus costly preinvestment work), most of the potential LDC coal output, which is economically attractive for domestic use based on the opportunity cost of importing alternative fuels, will be less attractive at the expected world market price of coal unless an equilibrium is reached. Uncertainty regarding the political stability of a country or region and the resulting risk of supply interruptions may further discourage potential customers to arrange for long-term export contracts for coal from specific developing countries.

Limited Engineering and Managerial Expertise

59. Even where the geology of a coal deposit is well known, where feasibility studies have been prepared, where markets are established and capital is available, the ability of LDCs--in terms of managerial skills and technical know-how-- to implement coal mining or integrated coal/transport/power projects is limited in the medium term. Inadequate supplies of skilled and experienced manpower and staff are pervasive constraints in all sectors of developing economies. In addition, as the lead time for coal projects in LDCs may be 7-10 years or more at present, scarce technical and managerial skills may be tied up on projects from which benefits will flow only in the longer term.

60. Only a few developing countries have made or are now initiating efforts to increase coal-related skills by emphasizing training, technical assistance and technology transfer in the coal mining sector. India, has made use of Russian, Polish, U.K. and French expertise and technical assistance, building up impressive coal mining capabilities over the years. LDCs with more recent coal development, such as Colombia and Indonesia, are still evaluating and experimenting with available bilateral coal assistance, training and project execution schemes.

SECTION IV. MEASURES TO ACCELERATE COAL DEVELOPMENT IN LDCs

61. A strategy aimed at a more rapid coal development in LDCs must alleviate the major supply constraints outlined above while ensuring that

coal demand develops in line with coal supply prospects. Most developing countries have at this time neither the human and financial resources nor the technical know-how to launch major coal development programs and integrate them in an overall planning effort. Thus, various agencies (international, bilateral and regional) as well as private companies have a major role to play in helping developing countries survey their coal potential, analyze the role of coal in their energy supply/demand balance and provide financial and technical support for the implementation of coal projects.

62. Decisions made now regarding coal resource delineation and the use of coal in electricity generation or other economic applications will only show a significant impact on LDCs' energy and foreign exchange balances in the latter part of the 1980s and in the 1990s. To ensure adequate coal supply by then, a decision is needed by LDC Governments to (i) accelerate coal exploration and preinvestment work in order to ascertain the extent and viability of their coal resources, (ii) encourage coal utilization in power generation and other applications whenever coal proves to be the most economic fuel, and (iii) encourage the implementation of coal mining projects (even on a small scale) and associated infrastructure for domestic coal consumption or export whenever economically viable.

63. Assuming a willingness on the part of LDCs to look into their coal resource potential systematically (and such willingness is a prerequisite of any meaningful coal development), the specific measures which should be promoted by developed countries and international agencies are:

(a) provision of funds and technical assistance for geological surveys, exploration and engineering work to determine the technical/financial/economic viability of projects. As noted, the lack of preinvestment data is at present the major obstacle to accelerated coal development in LDCs. As long as the viability of specific coal deposits is not established, LDCs cannot be expected to make educated decisions regarding various energy alternatives. For additional funds to be used effectively, they have to be coupled with a substantial technical assistance effort, not only in coal exploration and exploitation but also in building up the necessary institutions/operating companies and integrating coal use in an overall energy program;

(b) technical assistance to help LDC Governments and national utility companies to familiarize themselves with the technologies and economics of coal mining, handling and utilization;

(c) technical assistance and training to enable LDC agencies and companies to supervise, or undertake themselves, the project management and operation of coal mining projects and associated infrastructure and coal-use facilities;

(d) encouragement of multinational companies to provide funds, management or technical assistance for LDC coal projects from the initial exploration to the operational stage; and

(e) provision of financing for economically viable components of coal-related projects from the development of coal mines, coal-handling and transport facilities to coal-using installations such as coal-fired power plants, industrial burners, and coal gasification units, etc.

64. The Bank can play an important role in coal development. First, the Bank can assist developing countries to build up institutions dealing with energy issues and establish financially and technically viable companies for coal mining ventures, either as separate entities or integrated with coal transport and utilization projects. Second, Bank assistance will be needed to help mobilize the immense capital required as outlined in para. 3.12. Bilateral agencies, the Asian, African and Inter-American Development Banks are providing limited funds for coal development in LDCs. However, the interest of multinationals is focused solely on coal development for exports in the few LDCs that offer such prospects, while commercial bank financing is either not available because of risk or mostly available on terms incompatible with project needs. Present indications are that the Bank will have to make greater efforts to stimulate private and public investment in coal. Although the Bank could play a catalytic role in attracting co-financing for coal projects at appropriate terms, the Bank should be prepared, at least in the early years, to finance 30-50% of project cost to ensure that viable coal projects are developed without delay.

65. As mentioned previously, the Bank's lending program for fuel minerals includes 2-4 coal/lignite projects a year starting in FY80 with a Bank contribution of US$100-200 million annually. For the immediate future, the program envisages 1-2 exploration/engineering projects a year to help overcome the lack of preinvestment work for potential coal projects. One coal exploration/engineering loan has already been made to Indonesia in FY78 and for FY80 four coal loans (including two exploration/engineering loans), totalling US$118 million, have been prepared. For FY81 and 82, three coal loans a year totalling an estimated US$460 million have been programmed. Finally, the International Finance Corporation is also seeking to finance coal projects and has presently two investments in this sector under consideration.

66. In an attempt to further accelerate coal lending in the future, the Bank expects to make additional engineering loans requested by governments or identified in the course of coal sector surveys scheduled in 2-3 countries a year and through the Bank's general energy surveys. Apart from project identification, these missions offer a good opportunity to enter into discussions with Governments regarding their energy development policies and to speed up the gathering of essential data on which to base decisions about energy alternatives. The Bank has also started the systematic updating of country coal data on a periodic basis to assist energy planners worldwide.

67. Thus, the Bank will be able - particularly if joined in this effort by other regional and bilateral lending institutions - to assist in bringing about a substantial expansion of investment in coal. Assuming that the Bank maintains a coal lending program of US$100-200 million per year (in 1978 dollars) during the eighties and finances on the average 30% of project cost, the Bank would be associated with coal projects in LDCs totalling US$3.3-6.6 billion or 17-35% of expected investments in coal mining and associated transport projects between now and 1990. A much larger program of coal lending should be possible after 1982 if LDCs focus on their coal development potential. Since the Bank's effort to increase its lending in the coal sector has started only recently, the scale of the lending program, and particularly the share of project financing, will be reviewed as soon as sufficient experience has been gained.

68. The attempt to accelerate coal production in developing countries, however, cannot succeed in isolation. Developed countries, both market economies and CPEs, need to foster the greater use of coal. To do so will require policy decisions since market forces themselves appear to react rather slowly to the changing energy supply situation and prospects. Greater emphasis on coal as an energy source would stimulate the demand for LDC coal in industrial countries, particularly in Western Europe and Japan, which are short of low-cost energy resources. While increased coal imports will not decrease fuel-import dependence, coal would diversify the sources of supply and allow oil to be employed for other uses in which it will continue to have an overriding advantage.

69. More research is needed in industrialized countries on the further development of coal mining and processing technologies to reduce coal production costs. This would also help the development of lower-grade LDC coal deposits that are closer to markets, both domestic and abroad, and thus reduce the heavy burden of infrastructure investment which at present is holding back a number of higher-grade, but more distant, coal prospects in these countries. Research has also to be intensified into more efficient coal-handling and bulk transportation systems, and into measures to reduce adverse ecological effects from the greater utilization of coal. Also needed is more research to broaden the areas in which coal could be used economically and work must be accelerated on various forms of coal conversion (such as into gas, liquid fuels or as direct oil substitutes) to make emerging conversion technologies not only commercially proven but economically attractive.

70. Finally, the speed with which additional coal production in the developing countries will be forthcoming will, to a large extent, depend on domestic energy-pricing policies and the restrictions which may be imposed on energy imports, especially oil. Governments thereby can have a major influence on the utilization of domestic resources, including coal, and thus make their countries less dependent, to a degree, on the availability and price behavior of imported energy sources.

COAL CLASSIFICATION AND CONVERSION FACTORS

Delineation of Coal Occurrences

1. As detailed in Annex 2, Tables 2-1 and 2-2 coal occurrences are divided into two basic categories: (i) geological resources and (ii) economically and technically-recoverable reserves. In this report, World Energy Conference definitions of these categories are used. Geological resources are defined as coal occurrences which may acquire some economic value for mankind in the future. Coal reserves, on the other hand, are defined as coal occurrences which are exploitable subject to current economic and technical conditions. In order to provide a common base for a worldwide comparison of resources and reserves, the most recent WEC survey adopted the following technical limits:

Technical Limits Between Resources and Reserves
(meters)

	Geological Resources		Recoverable Reserves	
Coal Type	Depth Limit	Minimum Seam Thickness	Depth Limit	Minimum Seam Thickness
Hard Coal	2,000	0.5 - 5.0	1,500	0.6
Brown Coal	1,500	2.0 - 100.0	600	2.0

Source: WEC, 1977.

In its evaluation criteria, WEC refrained from defining a minimum seam thickness for resources but instead, provided a breakdown in several classes of seam thickness, which explains the wide range shown in the table above. An overall minimum seam thickness was cited for reserves.

Coal Quality Ranking

2. In terms of calorific content, coal is classified as hard coal or brown coal. Hard coal includes anthracite and bituminous coal with a calorific value greater than 5,700 kcal/kg, while brown coal includes subbituminous coal and lignite with a calorific value lower than 5,700 kcal/kg.

3. Coal quality varies considerably and the different ranges are greater than those of oil, making classification difficult on a worldwide

scale. The key elements influencing coal quality are: (i) moisture; (ii) sulphur; (iii) ash; (iv) volatile matter and (v) fixed carbon. Moisture, sulphur and ash are among the undesirable elements in coal and their presence in large proportions may entail considerable processing before the coal can be used. Fixed carbon and volatile matter, however, play an important role in the production of energy when coal is burned.

4. In ascending order of quality, coal is classified as lignite, sub-bituminous, bituminous and anthracite. Coal rank increases with the presence of greater amounts of fixed carbon and lesser amounts of moisture and volatile matter, as illustrated by the following sample analysis of anthracite, the highest grade, and lignite, the lowest grade:

Sample Ranking of Lignite and Anthracite
(%)

	Lignite	Anthracite
Fixed Carbon	33	92
Volatile Matter	26	5
Moisture	41	3
	100	100

5. Anthracite tends to have a slightly higher carbon content and lower volatile content than bituminous coal although they both have similar calorific values. Sub-bituminous coal and lignite, generally have a high moisture content which accounts for their lower heating value relative to anthracite and bituminous coal. Higher-rank coals (anthracite and bituminous) are generally classified according to fixed carbon content although some bituminous coals are classified by calorific value. Lower-rank coals, (sub-bituminous and lignite) are classified by calorific value. Bituminous coal is further classified by volatile content as low-volatile, with 14-22% volatile matter; medium-volatile, with 22 to 31% volatile matter; and high-volatile with over 31% volatile matter.

6. The term "coking coal" is used to designate certain bituminous coals which, when heated at high temperatures in the absence of air (carbonization), soften and then solidify into a hard mass known as coke, used mainly in the production of iron and steel. Little is known about the specific properties of coals that allow for the formation of coke; however, only bituminous coals possess such properties, and in varying degrees.

7. Coking coals used for metallurgical coke production must have relatively small amounts of ash (less than 8.0%) and sulphur (less than 1.0%) because most of these impurities remain in the coke that is formed and can contaminate metals when used in metallurgical furnaces. Both ash and sulphur must be removed by a costly process which reduces the ratio of steel output to coal consumed.

8. There are no established specifications for coking coals because virtually all coals carbonized in modern coking ovens are blends of various types. In the U.S., for example, high-volatile coking coal serves as the base coal, to which smaller portions of low-volatile coking coal are added. The volatile content of coal is important in the coking process. High-volatile coals, when carbonized alone, give a low yield and produce relatively weak coke while the addition of low-volatile coals increases the yield and strength of the coke. However, low-volatile coals, when added in excess, are highly expanding and can damage oven walls. Medium-volatile coals may be carbonized alone but it is general practice to use a combination of high and medium-volatile coal, high and low-volatile coal, or all three types.

9. Coal briquettes include briquettes, ovoids, and similar secondary solid fuels manufactured from hard coal by agglomeration of coal particles with pitch, including solid, smokeless, patent fuels. Brown coal and peat briquettes are secondary solid fuels manufactured from brown coal and peat, respectively, by a process in which either substance is partly dried, warmed to expel excess moisture and then pressed into briquettes, generally without the use of a binding substance.

Conversion Factors

10. For the purpose of qualitative comparison, raw coal tonnages may be converted into tons of coal equivalent (tce), corresponding to the calorific value of one metric ton of hard coal, at 7,000 kcal/kg. The following are coefficients commonly used to convert various types of coal to tce:

Typical Conversion Factors for Various Types of Coal

Coal Type	Conversion factor
Anthracite	1.0
Bituminous	1.0
Sub-bituminous	0.7 - 0.84
Lignite	0.3 - 0.6
Coal briquettes	1.0
Cokes of anthracite or bituminous coal	0.9
Cokes of brown coal or lignite	0.67
Lignite briquettes	0.67

Source: UN- World Energy Supplies, 1972-76

11. In addition, certain types of coal vary from country to country in terms of their tce value and the following is a listing of the various coefficients used for conversion of raw coal tonnages:

Country-Specific Coal Conversion Factors

Hard Coal (Low Grade)	Conversion factor
New Zealand	0.84
Pakistan	0.70
USSR	0.81
Brown Coal and Lignite	
Czechoslovakia, France, Democratic Republic of Korea	0.60
Chile	0.59
USA	0.57
Canada	0.57
Albania, Austria, Bulgaria, New Zealand, Portugal, Spain, USSR, Yugoslavia	0.50
Hungary	0.40
Italy	0.36
Australia, Denmark, Greece, India, Japan, Mongolia, Republic of Korea, Romania, Thailand, Turkey	0.33
Federal Republic of Germany, German Democratic Republic, and Poland	0.30

Source: UN- World Energy Supplies, 1972-76

12. Coal may also be compared with oil in terms of energy value and the following table contains some conversion factors that are useful in such a comparison.

Standard Energy Conversions for Coal and Oil

From/To	tce	toe	boe	bdoe
tce	1.00	0.65	4.80	0.013
toe	1.50	1.00	7.40	0.200
boe	0.21	0.13	1.00	.003
bdoe	76.00	50.00	365.00	1.000

tce = tons of coal equivalent
toe = tons of oil equivalent
boe = barrels of oil equivalent
bdoe = barrels per day of oil equivalent

Source: Energy: Global Prospects 1985 to 2000, Workshop on Alternative Energy Strategies (WAES), 1977

Industrial Projects Department
August, 1979

Table 2-1

WORLD COAL RESERVES AND RESOURCES BY COUNTRY

	Geological Resources		Technically and Economically Recoverable Reserves		Degree of Exploration
	Million tce	%	Million tce	%	
DEVELOPED MARKET ECONOMIES					
Australia	262,134	2.59	27,353	4.30	H
Belgium	253	..	127	0.02	M
Canada	115,352	1.14	9,381	1.47	M
France	2,367	0.02	438	0.07	M
Germany, FR	246,800	2.44	34,419	5.41	H
Greece	895	0.01	400	0.06	H
Japan	8,641	0.09	1,006	0.16	H
Netherlands	2,900	0.03	1,430	0.22	M
New Zealand	790	..	144	0.02	M
Spain	2,298	0.02	537	0.08	H
South Africa	57,566	0.57	26,903	4.23	M
United Kingdom	163,576	1.62	45,000	7.07	M-H
U.S.A.	2,570,398	25.39	177,588	27.91	H
Others	439	..	115	0.02	-
TOTAL:	3,434,409	33.92	324,841	51.04	
CENTRALLY PLANNED ECONOMIES					
Bulgaria	2,633	0.03	2,203	0.35	L-M
China, PR	1,438,045	14.20	98,883	15.54	M
Czechoslovakia	17,487	0.17	4,815	0.76	M-H
Germany, DR	9,400	0.09	7,660	1.20	H
Hungary	3,553	0.03	950	0.15	M
Korea, DPR	2,000	0.02	480	0.08	M
Poland	125,500	1.24	21,000	3.30	H
Romania	1,877	0.02	413	0.06	L
USSR	4,860,000	48.00	109,900	17.27	M-H
TOTAL:	6,460,495	63.80	246,304	38.71	
DEVELOPING COUNTRIES					
Africa					
Botswana	100,000	0.99	3,500	0.55	L-M
Mozambique	400	..	80	0.01	M
Nigeria	180	..	90	0.01	M
Rhodesia	7,130	0.07	755	0.12	M
Swaziland	5,000	0.05	1,820	0.29	M
Zambia	228	..	5	..	L-M
Algeria	20	..	n.a	n.a	L
Angola	500	..	n.a	n.a	L
Benin	n.a	n.a	n.a	n.a	L
Burundi	n.a	n.a	n.a	n.a	L
Cameroon	500	..	n.a	n.a	M
Egypt	80	..	n.a	n.a	M
Ethiopia	n.a	n.a	n.a	n.a	L
Madagascar	92	..	n.a	n.a	M
Malawi	14	..	n.a	n.a	M
Niger	n.a	n.a.	n.a	n.a	L
Morocco	96	..	n.a	n.a	M
Sierra Leone	n.a	n.a	n.a	n.a	L
Somali	n.a	n.a	n.a	n.a	L
Tanzania	360	..	n.a	n.a	M
Tunisia	n.a	n.a	n.a	n.a	L
Zaire	73	..	n.a	n.a	L
Total Africa	115,338	1.14	7,220	1.13	
Asia					
Bangladesh	1,649	0.02	519	0.08	
India	56,799	0.56	33,700	5.30	M-H
Indonesia	3,723	0.04	1,430	0.22	L
Iran	385	..	193	0.03	M
Korea, R.	921	0.01	386	0.06	M
Turkey	3,268	0.03	793	0.12	M
Afghanistan	85	..	n.a	n.a	L
Burma	286	..	n.a	n.a	M
Brunei	1	..	n.a	n.a	L
Cambodia	n.a	n.a.	n.a	n.a	L
Pakistan	1,375	..	n.a	n.a	M
Philippines	87	..	n.a	n.a	L-M
Taiwan	680	..	n.a	n.a	M
Thailand	78	..	n.a	n.a	M
Viet-Nam	3,000	0.03	n.a	n.a	M
Total Asia	72,466	0.72	38,583	6.06	
Latin America					
Argentina	384	..	290	0.05	L
Brazil	10,082	0.10	8,098	1.27	L-M
Chile	4,585	0.05	162	0.03	M
Colombia	8,318	0.08	443	0.07	L
Mexico	5,448	0.05	875	0.14	M
Peru	1,122	0.01	105	0.02	M
Venezuela	1,630	0.02	978	0.15	M
Bolivia	n.a	n.a	n.a.	n.a	M
Costa Rica	n.a	n.a	n.a	n.a	L
Ecuador	22	..	n.a	n.a	M
Guatemala	n.a	n.a	n.a	n.a	L
Honduras	n.a	n.a	n.a	n.a	L
Panama	n.a	n.a	n.a	n.a	L
Total Latin America	31,692	0.31	10,951	1.73	
Europe					
Yugoslavia	10,927	0.11	8,465	1.33	H
TOTAL DEVELOPING COUNTRIES:	230,360	2.28	65,219	10.25	
GRAND TOTAL	10,125,264	100.00	636,364	100.00	

.. negligible, less than 0.01%
n.a. = not available
Degree of Exploration: H = well established reserve estimates, well-defined geology within each coal-bearing region, adequate coal-bearing data
M = some exploration programs have been documented
L = few exploratory programs with very little specific resultant data

Sources: World Energy Conference, 1977; Skelly and Loy.

Table 2-2

WORLD COAL RESERVES AND RESOURCES BY COUNTRY AND COAL TYPE

	Geological Resources				Technically and Economically Recoverable Reserves			
	Hard Coal		Brown Coal		Hard Coal		Brown Coal	
	Million tce	%	Million tce	%	Million tce	%	Million tce	%
DEVELOPED MARKET ECONOMIES								
Australia	213,760	2.77	48,374	2.01	18,128	3.68	9,225	6.41
Belgium	253	..	-	-	127	0.03	-	-
Canada	96,225	1.25	19,127	0.80	8,708	1.77	673	0.47
France	2,325	0.03	42	..	427	0.09	11	0.01
Germany, FR	230,300	2.98	16,500	0.69	23,919	4.86	10,500	7.30
Greece	-	-	895	0.04	-	-	400	0.28
Japan	8,583	0.11	58	..	1,000	0.20	6	..
Netherlands	2,900	0.04	-	-	1,430	0.29	-	-
New Zealand	130	..	660	0.03	36	0.01	108	0.07
South Africa	57,566	0.75	-	-	26,903	5.46	-	-
Spain	1,786	0.02	512	0.02	322	0.07	215	0.15
United Kingdom	163,576	2.12	-	-	45,000	9.14	-	-
USA	1,190,000	15.40	1,380,398	57.51	113,230	23.00	64,358	44.73
Others	309	..	130	..	58	0.01	57	0.04
TOTAL	1,967,713	25.47	1,466,696	61.10	239,288	48.60	85,553	59.46
CENTRALLY PLANNED ECONOMIES								
Bulgaria	34	..	2,599	0.11	24	..	2,179	1.52
China, PR	1,424,680	18.44	13,365	0.56	98,883	20.08	n.a.	n.a.
Czechoslovakia	11,573	0.15	5,914	0.24	2,493	0.51	2,322	1.61
Germany, DR	200	..	9,200	0.38	100	0.02	7,560	5.25
Hungary	714	0.01	2,839	0.12	225	0.05	725	0.50
Korea, DPR	2,000	0.03	-	-	300	0.06	180	0.13
Poland	121,000	1.57	4,500	0.19	20,000	4.06	1,000	0.70
Romania	590	0.01	1,287	0.05	50	0.01	363	0.25
USSR	3,993,000	51.69	867,000	36.12	82,900	16.83	27,000	18.76
TOTAL	5,553,791	71.90	906,704	37.77	204,975	41.62	41,329	28.72
DEVELOPING COUNTRIES								
Africa								
Botswana	100,000	1.30	-	-	3,500	0.71	-	-
Mozambique	400	..	-	-	80	0.02	-	-
Nigeria	-	-	180	0.01	-	-	90	0.06
Rhodesia	7,130	0.09	-	-	755	0.15	-	-
Swaziland	5,000	0.07	-	-	1,820	0.37	-	-
Zambia	228	..	-	-	5	..	-	-
Others	2,390	0.03	10	..	970	0.20	-	-
Total Africa	115,148	1.49	190	0.01	7,130	1.45	90	0.06
Asia								
Bangladesh	1,649	0.02	n.a.	n.a.	517	0.10	2	..
India	55,575	0.72	1,224	0.05	33,345	6.77	355	0.25
Indonesia	573	0.01	3,150	0.13	80	0.02	1,350	0.94
Iran	385	..	-	-	193	0.04	-	-
Korea, R.	921	0.01	-	-	386	0.08	-	-
Turkey	1,291	0.02	1,977	0.08	134	0.03	659	0.46
Others	5,368	0.07	353	0.02	1,488	0.30	74	0.05
Total Asia	65,762	0.85	6,704	0.28	36,143	7.34	2,440	1.70
Latin America								
Argentina	-	-	384	0.02	-	-	290	0.20
Brazil	4,040	0.05	6,042	0.25	2,510	0.51	5,588	3.88
Chile	2,438	0.03	2,147	0.09	36	0.01	126	0.09
Colombia	7,633	0.10	685	0.03	397	0.08	46	0.03
Mexico	5,448	0.07	-	-	875	0.18	-	-
Peru	1,072	0.01	50	..	105	0.02	-	-
Venezuela	1,630	0.02	-	-	978	0.20	-	-
Others	55	..	5	..	-	-	-	-
Total Latin America	22,316	0.29	9,313	0.39	4,901	1.00	6,050	4.20
Europe								
Yugoslavia	104	..	10,823	0.45	35	..	8,430	5.86
TOTAL DEVELOPING COUNTRIES	203,330	2.63	27,030	1.13	48,209	9.78	17,010	11.82
GRAND TOTAL:	7,724,834	100.00	2,400,430	100.00	492,472	100.00	143,892	100.00

.. negligible, less than 0.01%.

Sources: World Energy Conference, 1977; Skelly and Loy.

Table 2-3

WORLD PRODUCTION OF RAW COAL BY COUNTRY (1950-1977)

	1950		1960		1970		1973		1977		Annual Growth Rate (%)		
	000 tons	%	000 tons	%	000 tons	%	000 tons	%	000 tons	%	1950-1960	1960-1973	1973-1977
DEVELOPED MARKET ECONOMIES													
Australia	24,277	1.28	38,164	1.37	69,524	2.32	80,160	2.63	104,000	3.03	4.63	5.87	6.73
Belgium	33,[illegible]6	1.74	30,483	1.10	11,362	0.38	8,842	0.29	7,430	0.22	-0.81	-9.08	-4.26
Canada	17,375	0.92	9,996	0.36	15,063	0.50	20,472	0.67	29,300	0.85	-5.38	5.67	9.38
France	60,341	3.18	70,707	2.54	40,623	1.36	29,114	0.96	25,930	0.74	1.60	-6.60	-3.42
Germany, FR	202,312	10.67	239,556	8.63	219,880	7.35	216,257	7.10	207,490	6.05	1.70	-0.78	-1.03
Greece	164	0.01	2,494	0.09	7,683	0.26	13,118	0.43	23,810	0.69	31.28	13.62	16.07
Japan	40,462	2.13	60,316	2.17	49,891	1.33	22,500	0.74	18,175	0.53	4.07	7.30	-5.20
Netherlands	12,451	0.66	16,506	0.59	4,33[illegible]	0.14	1,722	0.06	-	-	2.86	-15.96	-
New Zealand	939	0.05	3,065	0.11	2,365	0.08	2,486	0.08	2,475	0.07	12.56	-1.60	-0.11
South Africa	26,491	1.40	38,843	1.40	54,[illegible]	1.83	62,352	2.05	80,794	2.36	3.90	3.70	6.69
Spain	13,949	0.74	18,071	0.65	13,[illegible]	0.45	12,994	0.43	16,700	0.49	2.62	2.51	6.47
United Kingdom	224,579	11.84	200,[illegible]	7.22	147,[illegible]	4.92	132,039	4.34	123,700	3.61	-1.13	-3.16	-1.60
USA	508,722	26.81	394,[illegible]	14.20	555,[illegible]	18.57	527,398	17.31	634,925	18.51	-2.52	2.26	4.75
Others	8,702	0.46	11,[illegible]	0.42	12,[illegible]	0.41	11,989	0.39	[illegible]	0.30	2.92	0.25	-3.45
Total	1,173,824	61.89	1,134,[illegible]	40.85	1,194,[illegible]	39.90	1,141,[illegible]	37.48	1,[illegible]	37.45	-0.34	0.05	3.00
CENTRALLY PLANNED ECONOMIES													
Albania	50	..	291	0.01	606	0.02	760	0.02	1,000	0.03	19.26	7.66	7.10
Bulgaria	5,714	0.30	17,320	0.62	29,251	0.98	26,810	0.88	25,135	0.73	11.73	3.42	-1.58
China, PR	39,023	2.06	440,102	15.85	360,000	12.03	400,000	13.13	500,000	14.58	27.42	-0.73	5.74
Czechoslovakia	46,018	2.43	84,675	3.05	109,[illegible]	3.67	109,608	3.60	121,492	3.54	6.29	2.01	2.61
Germany, DR	141,440	7.46	228,590	8.23	261,631	8.74	246,998	8.11	254,055	7.41	4.92	0.60	0.71
Hungary	13,346	0.70	26,541	0.96	27,830	0.93	26,781	0.88	25,454	0.74	7.12	0.07	-1.26
Mongolia	-	-	619	0.02	2,000	0.07	2,324	0.08	3,318	0.10	-	10.71	9.31
Korea, DPR	2,044	0.11	17,437	0.63	27,[illegible]	0.92	34,000	1.12	54,000	1.57	23.91	5.27	12.26
Poland	82,[illegible]	4.37	113,842	4.10	172,[illegible]	5.78	195,845	6.43	223,793	6.52	3.22	4.26	3.39
Romania	[illegible]	0.02	8,185	0.29	[illegible]	0.69	24,943	0.82	26,780	0.78	37.78	8.95	1.79
USSR	326,[illegible]	17.20	592,081	21.32	[illegible]	21.20	673,[illegible]	22.10	[illegible]	20.59	6.14	0.99	1.20
Total	657,[illegible]	34.65	1,529,683	55.08	1,[illegible]	55.03	1,741,[illegible]	57.17	1,[illegible]	56.59	8.82	1.00	2.75
DEVELOPING COUNTRIES													
Africa													
Algeria	258	0.01	119	..	18	..	15	0.00	-	-	-7.45	-14.73	-
Botswana	-	-	-	-	-	-	78	0.00	200	0.01	-	-	26.54
Burundi	-	-	-	-	-	-	5	0.00	11	0.00	-	--	21.79
Madagascar	2	..	-	-	-	-	-	-	-	-	-	-	-
Morocco	369	0.02	413	0.02	433	0.01	565	0.03	640	0.02	1.13	2.44	3.17
Mozambique	57	..	271	0.01	351	0.01	394	0.01	390	0.01	16.85	2.92	-0.25
Nigeria	594	0.03	571	0.02	59	..	327	0.01	290	0.01	-0.39	-4.20	-2.96
Rhodesia	2,130	0.12	3,561	0.13	3,171	0.11	3,060	0.10	2,500	0.08	5.27	-1.16	-4.93
Swaziland	-	-	12	..	123	..	140	0.00	129	0.00	-	20.80	-2.02
Tanzania	-	-	-	-	[illegible]	..	3	0.00	1	0.00	-	-	-24.02
Tunisia	41	..	2	..	-	-	-	-	-	-	-26.07	-	-
Zaire	160	0.01	163	0.01	102	..	[illegible]	0.00	110	0.00	0.19	-2.65	-1.11
Zambia	-	-	-	-	624	0.02	[illegible]	0.04	[illegible]	0.02	-	-	-3.95
Total Africa	3,611	0.19	5,112	0.19	4,[illegible]	0.16	5,[illegible]	0.19	5,[illegible]	0.15	3.54	0.77	-2.65
Asia													
Afghanistan	9	..	46	..	164	0.01	150	0.00	200	0.01	17.72	9.52	7.46
Burma	-	-	1	..	11	..	15	0.00	15	0.00	-	23.16	0.00
India	32,848	1.73	52,677	1.90	77,243	2.58	80,555	2.65	102,370	2.99	4.84	3.32	6.17
Indonesia	805	0.04	658	0.02	172	0.01	149	0.00	200	0.01	-2.00	-10.80	7.64
Iran	146	0.01	231	0.01	530	0.02	1,050	0.03	850	0.02	4.69	12.35	-5.15
Malaysia	423	0.02	7	..	-	-	-	-	-	-	-33.64	-	-
Pakistan	444	0.02	832	0.03	1,315	0.04	1,161	0.04	1,380	0.04	6.48	2.60	4.41
Philippines	159	0.01	148	0.01	42	..	39	0.00	275	0.01	-0.71	-9.75	62.95
Korea, R.	598	0.03	5,334	0.19	12,394	0.41	13,571	0.45	17,270	0.50	24.51	7.42	6.21
Taiwan	1,407	0.07	3,964	0.14	4,476	0.15	3,[illegible]	0.11	2,900	0.08	10.91	-1.33	-3.40
Thailand	-	-	149	0.01	400	0.01	[illegible]	0.01	575	0.02	-	7.04	12.34
Turkey	5,579	0.30	9,725	0.35	9,010	0.30	10,[illegible]	0.33	13,100	0.38	5.71	0.29	6.74
Viet Nam	495	0.03	2,625	0.09	--	0.10	2,[illegible]	0.09	5,[illegible]	0.17	18.16	0.22	22.09
Total Asia	42,913	2.26	76,417	2.75	1[illegible]	3.63	113,[illegible]	3.72	143,135	4.23	5.80	3.07	6.42
Latin America													
Argentina	27	..	281	0.01	616	0.02	451	0.01	530	0.02	26.40	3.71	4.12
Brazil	1,960	0.11	2,331	0.08	2,361	0.08	2,316	0.08	3,500	0.10	1.75	-0.05	10.87
Chile	2,[illegible]	0.12	1,472	0.05	1,[illegible]	0.05	1,443	0.05	1,255	0.04	-4.02	-0.15	-3.43
Colombia	1,[illegible]	0.05	2,602	0.09	2,[illegible]	0.08	3,000	0.10	3,700	0.11	9.91	1.10	5.38
Mexico	[illegible]	0.05	1,777	0.07	2,[illegible]	0.10	4,220	0.14	6,000	0.17	6.89	6.90	9.13
Peru	[illegible]	0.01	193	0.01	[illegible]	0.01	85	0.00	-	-	-1.70	-6.11	-
Venezuela	[illegible]	..	[illegible]	..	[illegible]	..	50	0.00	110	0.00	3.02	2.78	21.79
Total Latin America	6,[illegible]	0.34	8,[illegible]	0.31	10,[illegible]	0.34	11,575	0.38	[illegible]	0.44	3.13	2.23	6.81
Yugoslavia	12,828	0.68	22,729	0.82	28,422	0.95	32,450	1.06	39,010	1.14	5.89	2.78	4.71
Total Developing Countries	65,737	3.47	112,949	4.07	152,14[illegible]	5.08	[illegible]	5.35	204,311	5.96	5.56	2.85	5.83
GRAND TOTAL	[illegible]		[illegible]		[illegible]		3,049,522	100.00	3,429,996	100.00	3.89	0.71	3.02

.. negligible, less than .01%

Sources: UN - World Energy Supplies (various issues); US Bureau of Mines; Skelly & Loy.

Table 2-4

	1960 Hard Coal Prod				1973 Hard Coal Prod		Hard Coal Import		1973 Hard Coal Prod		Brown Coal Prod				Coal	
DEVELOPED MARKET ECONOMIES																
Australia	23,946	1.07	15,218	2.41	45,821	2.12	54,203	2.83	55,484	2.55	24,577	2.80	71,100	2.57	43,000	3.45
Belgium	11,983	0.54	-	-	11,367	.53	-	-	8,064	0.41	-	-	3,430	0.39	-	-
Canada	3,025	0.13	1,971	0.31	11,548	.54	6,015	0.31	16,418	0.75	3,654	0.41	27,500	0.95	5,800	0.61
France	93,426	4.19	2,282	0.36	57,938	1.77	2,785	0.13	56,500	1.22	2,764	0.31	22,430	0.91	2,900	0.30
Germany, FR	143,452	6.43	96,304	15.1	171,443	5.1	108,037	12.66	97,594	4.51	119,956	13.47	84,560	3.42	122,930	12.87
Greece	-	-	2,494	0.39	-	-	2,953	0.40	-	-	13,118	1.49	-	-	23,810	2.49
Japan	58,607	2.63	1,414	0.22	59,094	1.86	147	.02	33,614	1.54	86	0.01	18,115	0.73	60	0.01
Netherlands	10,302	.47	-	-	1,334	.04	-	-	1,122	0.08	-	-	-	-	-	-
New Zealand	2,003	0.14	164	0.03	450	.02	1,916	0.21	422	0.02	2,046	0.23	2,300	0.09	175	0.02
South Africa	48,453	1.81	-	-	54,753	1.56	-	-	6,355	2.68	-	-	80,744	3.26	-	-
Spain	36,308	0.16	1,763	0.28	10,171	.30	3,511	0.43	1,991	0.06	3,403	.34	11,200	0.45	5,500	0.58
United Kingdom	200,501	9.06	-		147,114	4.93	-	-	132,014	24.17	-	-	126,793	5.00	-	-
USA	491,791	18.29	2,493	0.39	535,365	15.1	3,409	0.43	525,105	9.03	4,243	0.49	607,925	24.57	27,000	2.83
Others	[illegible]	0.11	-	1.29	[illegible]	.06	-	1.40	703	-	11,034	1.25	-	-	0.03	1.-
TOTAL	1	46.73	-	21.31	1,126,266	46.02	-	14.01	557,840	44.25	183,313	20.80	-	-	42.58	-
PLANNED ECONOMIES																
Bulgaria	731	.03	36,984	5.7	192	0.12	38,654	3.37	351	0.12	28,458	3.1	287	0.01	24,868	2.61
China, PR	440,000	19.51	-	-	460,000	16.84	-	-	400,000	18.48	-	-	500,000	20.20	-	-
Czechoslovakia	26,232	.12	95,443	9.21	28,794	1.1	82,763	6.55	27,774	1.28	81,829	9.29	28,256	1.14	92,236	9.76
Germany, DR	2,972	0.14	225,018	35.06	2,040	0.08	600,386	46.43	774	0.03	240,245	27.44	349	0.01	253,706	25.57
Hungary	3,428	0.14	23,996	.74	4,151	.14	21,674	2.26	3,413	0.16	23,471	2.65	2,925	0.12	22,529	2.36
Mongolia	614	0.03	-	-	55	.0	1,915	0.22	124	.4	2,206	0.25	240	0.01	3,078	0.32
Korea, DPR	1,467	0.61	-	-	21,850	1.72	5,703	0.67	20,950	1.25	7,650	0.89	42,000	1.74	11,000	1.15
Poland	134,509	6.49	6,933	1.7	143,131	6.06	32,767	4.83	156,651	7.24	26,459	3.45	159,112	7.52	37,681	3.95
Romania	4,300	0.21	3,685	0.58	5,402	0.13	14,129	1.62	5,172	0.33	17,771	2.02	7,375	0.30	19,410	2.03
USSR	-	21.16	-	21.81	-	-	-	-	461,323	-	211,941	24.06	500,000	20.00	-	21.57
TOTAL	1,-	49.17	-	75.04	-	-	-	-	1,054,389	-	656,847	74.54	1,268,539	51.25	-	70.43
[illegible]																
Algeria	119	0.01	-	-	1	.	-	-	17	.	-	-	-	-	-	-
Botswana	-	-	-	-	-	-	-	-	56		-	-	200	.01	-	-
Burundi	-	-	-	-	-	-	-	-	3	..	-	-	-	-	11	/a
Madagascar	-	-	-	-	-	-	-	-	-	..	-	-	-	-	-	-
Morocco	113	0.02	-	-	133	0.0	-	-	63	0.0	-	-	624	0.03	-	-
Mozambique	24	0.01	-	-	131	0.0	-	-	106	0.0	-	-	390	0.02	-	-
Nigeria	371	0.02	-	-	50	.	-	-	3,000	.14	-	-	290	0.01	-	-
Rhodesia	33,561	0.16	-	-	3,173	0.13	-	-	14	.01	-	-	2,500	0.10	-	-
Swaziland	13	-	-	-	1,3	.0	-	-	-	.	-	-	124	..	-	-
Tanzania	2	-	-	-	-	.	-	-	-	-	-	-	1	.	-	-
Tunisia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zaire	163	0.01	-	-	102	.	-	-	113	..	-	-	110	..	-	-
Zambia	-	-	-	-	-	0.1	-	-	600	0.06	-	-	800	0.03	-	-
TOTAL AFRICA	5,115	0.24	-	-	-	-	-	-	[illegible]	0.26	-	-	5,060	0.20	11	-
ASIA																
Afghanistan	6	0.0	-	-	164	0.01	-	-	140	0.0	-	-	240	0.01	-	-
Burma	1	.	-	-	1		-	-	15	..	-	-	15	-	-	-
India	22,629	2.42	46	0.1	5,935	3.0	5,565	1.41	77,251	3.58	5,935	1.37	96,455	3.98	3,913	0.41
Indonesia	658	0.03	-	-	172	0.01	-	-	148	0.01	-	-	200	0.01	-	-
Iran	231	0.01	-	-	330	0.1	-	-	1,051	0.05	-	-	850	0.03	-	-
Malaysia	7				-	.	-	-	-	-	-	-	-	-	-	-
Pakistan	842	0.04	-	-	1,3[illegible]	0.0	-	-	1,161	0.05	-	-	1,300	0.06	-	-
Philippines	148	0.1	-	-	52		-	-	34	.	-	-	275	0.01	-	-
Korea, R.	3,354	0.24	-	-	13,114	0.56	-	-	13,571	0.63	-	-	16,270	0.70	-	-
Taiwan	2,964	0.15	-	-	4,57	0.21	-	-	2,330	0.15	-	-	2,900	0.12	-	-
Thailand	-	-	1,9	0.02	-	-	490	0.13	-	-	361	0.04	-	-	535	0.06
Turkey	6,811	0.3	3,413	0.34	2,574	0.1	4,436	1.72	4,043	0.21	5,450	1.02	4,600	0.18	8,500	0.89
Vietnam	2,923	0.12	-	-	-		3,14	-	3,700	0.15	-	-	5,000	-	-	-
TOTAL ASIA	72,800	3.41	3,611	0.37	-	-	13,631	.98	104,098	4.41	5,118	1.22	132,155	-	12,945	1.36
LATIN AMERICA																
Argentina	281	0.01	-	-	316	0.0	-	-	1	0.02	-	-	300	0.02	-	-
Brazil	2,331	0.11	-	-	2,361	0.11	-	-	2,016	0.11	-	-	3,500	0.13	-	-
Chile	3,472	0.17	-	-	1,377	0.06	76	0.01	1,443	0.0	75	0.01	1,[illegible]	0.05	25	..
Colombia	2,602	0.12	-	-	2,730	0.12	-	-	3,000	0.14	-	-	3,700	0.15	-	-
Mexico	1,757	0.08	-	-	2,886	0.14	-	-	4,[illegible]	0.23	-	-	6,000	0.24	-	-
Peru	194	0.01	-	-	196	0.01	-	-	85	.	-	-	-	-	-	-
Venezuela	-	-	-	-	43		-	-	-	-	-	-	110	..	-	-
TOTAL LATIN AMERICA	-	3.41	-	-	10,009	0.5	76	0.01	-	0.53	75	0.01	15,170	0.61	25	..
Europe																
Yugoslavia	1,284	0.06	1,445	0.23	943	0.04	27,230	3.4	776	0.03	21,879	3.02	520	0.02	38,500	4.03
TOTAL OTHER	27,594	4.13	25,136	1.65	111,11	5.23	40,231	4.3	121,851	5.0	48,06	4.96	152,785	6.17	51,526	5.39
GRAND TOTAL	2,402,422	100.00	634,703	100.00	2,116,095	100.00	854,368	100.00	2,164,[illegible]7	100.00	881,241	100.00	2,475,087	100.00	945,979	100.00

(...) Negligible, less than 0.01.

Sources IEA - World Energy Supplies (various issues), US Bureau of Mines, Sweden Bo Lov

Table 2-4a

WORLD COAL [illegible] BY [illegible] AND [illegible] TYPE ([illegible] 77)
(mill[illegible] to [illegible]al eq[illegible]tent [illegible])

	1960				1970				1973				1977			
	Hard Coal	Brown Coal	Total	%	Hard Coal	Brown Coal	Total	%	Hard Coal	[illegible]	Total	%	Hard Coal	Brown Coal	Total	%
DEVELOPED MARKET ECONOMIES																
Australia	22.	5.022	[illegible]	1.20	45. [illegible]	7.987	[illegible]	2.23	55.[illegible]	8.143	63.626	2.57	71.000	10.890	81. [illegible]	2.95
Belgium	30.	-	[illegible]	1.31	11. [illegible]	-	[illegible]	.48	8.[illegible]	-	8.842	.36	7.270	-	7. [illegible]	.26
Canada	8.	[illegible]	[illegible]	37	11. [illegible]	1.143	[illegible]	.53	16. [illegible]	1.900	18.718	.76	22.500	3.016	25. [illegible]	.92
France	68.[illegible]	1.[illegible]	[illegible]	3.0	37.[illegible]	1.671	[illegible]	1.63	26. [illegible]	1.658	27.808	1.13	22.040	1.740	23.	.86
Germany, FR	143.	31. [illegible]	[illegible]	7.52	11. [illegible]	32.799	[illegible]	6.04	97. [illegible]	35.597	133.196	5.39	84.560	36.879	121. [illegible]	4.38
Greece	-	[illegible]		.04	-	2.534	[illegible]	.11	-	4.477	[illegible].477	.18	-	7.857	7.	.28
Japan	[illegible]	[illegible]	[illegible]	2.55	[illegible]	.065	[illegible]	1.67	22.[illegible]	.029	.443	.91	18.115	.020	18.[illegible]	.65
Netherlands	[illegible]	[illegible]	[illegible]	.71	[illegible]	-	[illegible]	.18	1.	-	.722	.07	-	-	-	-
New Zealand	[illegible]	[illegible]	[illegible]	.13	[illegible]	1.284	[illegible]	.07	[illegible]	1.371	.793	.07	[illegible]	.087	2.019	.07
South Africa	[illegible]	-	[illegible]	1.67	[illegible]	-	[illegible]	2.29	62.	-	.352	2.52	80.794	-	80.794	2.92
Spain	[illegible]	.882	[illegible]	.74	[illegible]	1.415	[illegible]	.51	9.[illegible]	1.502	[illegible].478	.46	11.120	2.750	13.870	.50
United Kingdom	[illegible]	-	[illegible]	8.61	[illegible]	-	[illegible]	6.05	131. [illegible]	-	[illegible].478	5.32	123.313	-	123.313	4.45
USA	[illegible]	.823	[illegible]	16.88	[illegible]	[illegible]	[illegible]	22.77	523.[illegible]	[illegible]	.522	21.23	607.925	15. [illegible]	623.315	22.47
Others	[illegible]	3.049	[illegible]	.23	[illegible]	[illegible]	[illegible]	.26	[illegible]	[illegible]	.685	.23	.719	4.[illegible]	[illegible].235	.19
TOTAL	1,[illegible]	44.941	1,[illegible]	44.96	1,[illegible]	[illegible]	1,[illegible]	44.82	957.[illegible]	[illegible]	1,[illegible].140	41.20	1,051.283	83.[illegible]	1,134.433	40.93
CENTRALLY PLANNED ECONOMIES																
Albania	-	.096	[illegible]	--	-	.303	[illegible]	.01	-	[illegible]	[illegible]	.02	-	.500	[illegible]	.07
Bulgaria	[illegible]	8.295	9.[illegible]	[illegible]	[illegible]	14.427	14.	.62	[illegible]	13. [illegible]	13. [illegible]	.55	[illegible]	12.434	[illegible]	.46
China, PR	440.[illegible]	-	440.[illegible]	[illegible]	354.[illegible]	-	354.[illegible]	15.27	[illegible]	-	430.[illegible]	17.40	500.[illegible]	-	[illegible]	18.00
Czechoslovakia	26. [illegible]	35.066	61.[illegible]	[illegible]	28.[illegible]	[illegible]	77.[illegible]	3.23		49.[illegible]	76. [illegible]	3.11	28.[illegible]	55.	[illegible]	3.00
Germany, DR	2.[illegible]	74.454	77.	[illegible]	1.[illegible]	[illegible]	79.	3.32		73.	74.[illegible]	3.02	[illegible]	76. [illegible]	[illegible]	2.76
Hungary	2.	11.846	14.[illegible]	[illegible]	4.[illegible]	[illegible]	15. [illegible]	.67	[illegible]	11.[illegible]	14. [illegible]	.60	2. [illegible]	9.[illegible]	[illegible]	.42
Korea, DPR	17. [illegible]	-	17. [illegible]		24. [illegible]	[illegible]	27.[illegible]	1.14	[illegible]	4.	31.	1.26	43.[illegible]	6. [illegible]	[illegible]	1.79
Mongolia	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.03	[illegible]	[illegible]	[illegible]	.03	[illegible]	1. [illegible]	[illegible]	.05
Poland	104. [illegible]	3.080	107.[illegible]	[illegible]	[illegible]	[illegible]	149.[illegible]	6.28	[illegible]	[illegible]	[illegible]	6.81	[illegible]	11. [illegible]	[illegible]	7.12
Romania	4. [illegible]	1.216	5. [illegible]		[illegible]	[illegible]	11. [illegible]	.46	[illegible]	[illegible]	[illegible]	.53	[illegible]	6.	[illegible]	.49
USSR	378 [illegible]	69.178	447. [illegible]	[illegible]	[illegible]	[illegible]	450.[illegible]	18.83	-	[illegible]	[illegible]	19.79	[illegible]	96.	[illegible]	18.60
TOTAL	978 [illegible]	203.231	1,181.	[illegible]	[illegible]	[illegible]	1,191.[illegible]	49.89	1,[illegible]	[illegible]	1,[illegible]	53.12	1,[illegible]	276.[illegible]	1,[illegible]	52.70
DEVELOPING COUNTRIES																
Africa																
Algeria	.119	-	.119	.01	.015	-	.015	..	.015		.015	..	-	-	-	-
Botswana	--	-	--	-	-	-	-	-	.078	-	.078	..	.200	-	.200	.01
Burundi	--	-	--		-	-	-	-	-	.002	.002	..	-	.005	.005	..
Madagascar	--	-	--	-	-	-	-	-	-	-	-	-	-	-	-	-
Morocco	.413	-	.413	.02	[illegible]	-	[illegible]	.02	[illegible]	-	.565	.02	[illegible]	-	[illegible]	.02
Mozambique	.271	-	.271	.01	[illegible]	-	[illegible]	.01	[illegible]	-	.394	.02	[illegible]	-	[illegible]	.01
Nigeria	.571	-	.571	.02	[illegible]	-	[illegible]		[illegible]	-	.326	.01	[illegible]	-	[illegible]	.01
Rhodesia	3.561	-	3.561	.15	3.[illegible]	-	3.[illegible]	.13	3.[illegible]	-	3.060	.12	2. [illegible]	-	2. [illegible]	.09
Swaziland	.012	-	.012	..	[illegible]	-	[illegible]	..	[illegible]	-	.140	.01	[illegible]	-	[illegible]	..
Tanzania	.002	-	.002	..	[illegible]	-	[illegible]	..	[illegible]	-	.002	..	[illegible]	-	[illegible]	..
Tunisia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zaire	.163	-	.163	.01	[illegible]	-	.102	..	.115	-	[illegible]	..	[illegible]	-	.110	..
Zambia	-	-	-	-	[illegible]	-	.623	.03	.940	-	[illegible]	.04	[illegible]	-	.800	.03
TOTAL AFRICA	5.112	-	5.112	.22	4.[illegible]	-	4.685	.19	5.635	.002	5.[illegible]	.22	5.[illegible]	.005	5.065	.19
Asia																
Afghanistan	[illegible]	-	[illegible]	.01	.140	-	[illegible]	.01	[illegible]	-	[illegible]	.01	[illegible]	-	[illegible]	.01
Burma	[illegible]	-	[illegible]	..	.012	-	[illegible]	..	[illegible]	-	[illegible]	..	[illegible]	-	[illegible]	..
India	52.[illegible]	.048	52.[illegible]	2.26	73.124	1.170	74. [illegible]	3.12	77. [illegible]	1.091	78.[illegible]	3.20	98.	1.292	99. [illegible]	3.60
Indonesia	[illegible]	-	[illegible]	.03	.170	-	[illegible]	.01	[illegible]	-	[illegible]	.01	[illegible]	-	[illegible]	.01
Iran	[illegible]	-	[illegible]	.01	.323	-	[illegible]	.01	1.[illegible]	-	1.[illegible]	.04	[illegible]	-	[illegible]	.03
Korea, R	5. [illegible]	-	5.[illegible]	.23	12.394	-	12. [illegible]	.52	13. [illegible]	-	13.	.55	17. [illegible]	-	17. [illegible]	.62
Malaysia	[illegible]	-	[illegible]	..	--	-	-	-	[illegible]	-	[illegible]	..	-	-	-	-
Pakistan	[illegible]	-	[illegible]	.04	.875	-	.875	.04	[illegible]	-	[illegible]	.03	.966	-	[illegible]	.03
Philippines	[illegible]	-	[illegible]	.01	.048	-	.048	..	[illegible]	-	[illegible]	..	.275	-		.01
Taiwan	3.[illegible]	-	3.[illegible]	.17	-	-	-	-	3.[illegible]	-	3. [illegible]	.13	2.900	-	2 [illegible]	.10
Thailand	-	.049	[illegible]	..	-	.132	.132	.01	-	.119	[illegible]	..	-	.120	[illegible]	.01
Turkey	6.311	1.127	7.[illegible]	.32	4.573	1.498	6.071	.25	[illegible]	1.799	5.[illegible]	.26	4.600	2.805	7 [illegible]	.27
Vietnam	2.625	-	2.[illegible]	.11	3.300	-	3.300	.14	[illegible]	-	2.[illegible]	.11	6.000	-	6 [illegible]	.22
TOTAL ASIA	72.806	1.224	74.[illegible]	3.18	94.959	2.800	97.759	4.10	[illegible]	3.009	106.[illegible]	4.33	131.731	-	136.[illegible]	4.91
Latin America																
Argentina	[illegible]	-	[illegible]	.01	[illegible]	-	[illegible]	.03	[illegible]	-	[illegible]	.02	[illegible]	-	.530	.02
Brazil	2.[illegible]	-	2.[illegible]	.10	2.[illegible]	-	2.[illegible]	.10	2.[illegible]	-	2. [illegible]	.09	3. [illegible]	-	3.500	.13
Chile	1.[illegible]	-	1.[illegible]	.06	1.[illegible]	-	1.[illegible]	.06	1.[illegible]	.023	1. [illegible]	.06	1.	.015	1.245	.04
Colombia	2.[illegible]	-	2.[illegible]	.11	3. [illegible]	-	3.	.13	3. [illegible]	-	3.[illegible]	.12	3.	-	3.700	.13
Mexico	1.	-	1.	.08	1.	-	1. [illegible]	.06	4.	-	4. [illegible]	.17	6.	-	6.[illegible]	.22
Peru	[illegible]	-	[illegible]	.01	[illegible]	-	[illegible]	.01	[illegible]	-	[illegible]	..	-	-	-	-
Venezuela	[illegible]	-	[illegible]	..	[illegible]	-	[illegible]	..	[illegible]	-	[illegible]	..	.110	-	1.[illegible]	..
TOTAL LATIN AMERICA	8. [illegible]	[illegible]	8.[illegible]	.37	9. [illegible]	-	9. [illegible]	.39	11. [illegible]	.023	11.	.46	15.070	.015	[illegible]	.54
Europe																
Yugoslavia	1.284	10.723	12.007	.52	.643	13.889	14.532	.61	.576	15.937	16.513	.67	.510	19.250	19.760	.71
TOTAL DEVELOPING COUNTRIES	87.393	11.947	99.840	4.29	109.491	16.689	126.180	5.29	121.473	18.971	140.444	5.68	152.371	23.557	175.928	6.34
GRAND TOTAL	2,067.286	260.119	2,327.405	100.00	2,[illegible].899	334.576	2,387.475	100.00	2,123.478	347.919	2,471.397	100.00	2,390.904	382.807	2,773.711	100.00

.. Negligible, less than .01%.

Sources: World Energy Supplies (various issues); US Bureau of Mines; Skelly and Loy

Table 2-5

COAL PRODUCTION AND MINE INVESTMENT COSTS IN SELECTED COAL PRODUCING COUNTRIES

	Mining Technology	Coal Type	Minehead Production Cost Existing Mine US$/ton-1978	Minehead Production Cost New Mine US$/ton-1978	Incremental Mine Investment Cost US$/ton-1978
DEVELOPED MARKETS					
Australia	S	B,C,L	12-15	8-15	30-40
Canada	U	B,C	20-45	n.a	40-50
	S	S,B,L	6-15	n.a	20-30
France	U	B	80-95	80-90	n.a.
		L	35-45	n.a.	
Germany, FR	U	B,C		70-100	70-85
		L	10-25		
South Africa	U	B,C	10-12	n.a	30-35
	S	B,C	8-10	n.a	n.a
United Kingdom	U	B,C	45-75	n.a	70-80
U.S.A	U	B,C	20-30	n.a	40-55
	S	B,L	8-15	n.a	10-35
CENTRALLY PLANNED ECONOMIES					
China, PR	U	B,C	12-20	n.a	25-35
	S	B,L	6-12	n.a	5-10
Czechoslovakia	U	B,C	30-40	n.a	60-70
Germany, DR	S	L	8-12	n.a	15-25
Poland	U	B,C	18-25	n.a	50-60
	S	L	5-10	n.a	15-20
U.S.S.R.	U	B	18-25	n.a	30-40
	S	L	5-10	n.a	15-20
DEVELOPING COUNTRIES					
Argentina	U	B	40-45	n.a.	50-60
Brazil	U/S	B	15-25	12-18	25-50
Colombia	U	B,C	5-22	n.a	n.a
	S	B	n.a	25-30	50-60-
India	U	B,C	12-25	n.a	30-35
	S	B,L	20-22	n.a	n.a
Indonesia	U	B	35-40	n.a	n.a
	S	B	18-20	30-35	50-60
Korea, R.	U	A	20-25	n.a	35-40
Mexico	U	B,C	15-20	n.a	45-55
Pakistan	U	B	20-30	n.a	n.a
Philippines	U	B	8-21	18-20	30-70
Thailand	S	L	n.a	7-12	30-35
Venezuela	S	B	n.a	20-25	50-55
Yugoslavia	U	S,B,L	20-25	n.a	25-30
	S	S,B,L	11-16	n.a	10-20

LEGEND:

Mining Technology	Coal Type
U = underground mine	A = anthracite
S = surface mine	B = bituminous
	C = coking coal
n.a. = not available	S = sub-bituminous
	L - lignite

Sources: Skelly and Loy, and IBRD data.

Table 2-6

WORLD COAL EXPORT TRADE (1961-76)

	1961	1973	1976	
	000 tce	000 tce	000 tce	%
Developed Market Economies				
Australia	2,986	28,582	31,352	14.5
Belgium	3,488	846	673	0.3
Canada	944	11,237	11,917	5.5
France	1,437	1,847	1,524	0.7
Germany, FR	28,464	23,859	19,760	9.1
Japan	64	532	541	0.2
Netherlands	5,178	2,388	1,059	0.5
South Africa	1,063	2,049	6,096	2.8
United Kingdom	7,101	3,320	2,173	1.0
U.S.A.	33,506	49,820	55,528	25.7
Others	596	1,088	1,147	0.5
Total	84,827	125,568	131,770	60.8
Centrally Planned Economies				
China, PRC	696	608	1,100	0.5
Czechoslovakia	4,590	6,547	6,618	3.1
Germany, DR	4,237	1,899	1,981	0.9
Korea, DPR	6	46	70	0.0
Poland	20,592	39,553	42,668	19.7
USSR	17,831	28,953	30,714	14.2
Others	110	135	74	0.0
Total	48,062	77,741	83,225	38.4
Developing Countries				
Africa				
Morocco	203	31	31	..
Mozambique	61	51	51	..
Nigeria	52	26	18	..
Rhodesia	1,443	149	159	..
Others	-	33	-	0.1
Total Africa	1,754	290	259	0.1
Asia				
India	943	544	507	0.2
Korea, R.	241	219	10	..
Vietnam	735	220	600	0.3
Others	9	22	19	..
Total Asia	1,928	1,005	1,136	0.6
Latin America				
Total Latin America	10	40	25	..
Europe				
Yugoslavia	106	259	229	0.1
Total Developing Countries	3,809	1,594	1,649	0.8
GRAND TOTAL	136,684	204,883	216,644	100.0

.. negligible

Source: UN - World Energy Supplies 1961-70 and 1972-77.

Table 2-7

WORLD COAL IMPORT TRADE (1961-76)

	1961 000 tce	1973 000 tce	1976 000 tce	1976 %	Coal Consumption per Capita (1976 kg/cap)
Developed Market Economies					
Austria	4,537	4,303	3,970	1.83	729
Belgium	8,302	7,182	7,849	3.62	1,454
Canada	11,409	15,267	14,856	6.86	1,115
Denmark	4,979	2,325	4,336	2.00	845
Finland	3,021	3,716	3,611	1.67	1,010
France	15,074	16,027	21,436	9.90	868
Germany, FR	10,312	10,012	8,981	4.15	1,975
Italy	10,231	11,650	12,604	5.82	221
Japan	11,325	56,906	60,821	28.07	700
Netherlands	7,840	4,487	5,187	2.39	325
Spain	473	3,542	4,878	2.25	487
USA	259	993	2,160	1.00	2,530
Others	11,816	15,610	12,097	5.41	
Total	99,578	152,020	162,786	74.97	
Centrally Planned Economies					
Bulgaria	812	6,122	6,480	2.99	2,178
Czechoslovakia	3,932	5,682	5,534	2.55	5,433
Germany, DR	12,281	12,277	9,630	4.45	4,962
Hungary	3,024	2,835	2,954	1.36	1,445
Poland	1,373	1,165	1,080	0.50	4,345
Romania	873	4,024	5,157	2.38	860
USSR	5,316	10,713	10,269	4.74	1,890
Others	85	411	411	0.19	
Total	27,696	43,229	41,515	19.16	
Developing Countries					
Africa					
Algeria	210	294	305	0.14	18
Egypt	301	426	1,028	0.46	27
Kenya	37	71	64	0.03	5
Madagascar	5	12	18	0.01	2
Malawi	64	62	65	0.03	13
Morocco	92	36	34	0.02	40
Mozambique	305	243	200	0.09	55
Tunisia	51	104	99	0.05	19
Zaire	326	143	151	0.07	10
Zambia	1,083	55	36	0.02	160
Others	174	35	24	0.01	
Total Africa	2,648	1,481	2,024	0,93	
Asia					
Bangladesh	-	474	329	0.15	4
Burma	264	66	202	0.09	7
Indonesia	26	4	22	0.01	2
Korea, R.	288	645	1,576	0.74	474
Malaysia	46	48	52	0.02	5
Nepal	-	11	8	0.00	1
Pakistan	1,073	53	74	0.03	14
Philippines	7	9	19	0.01	4
Thailand	2	17	34	0.02	6
Turkey	-	39	267	0.12	190
Others 1/	690	195	126	0.06	
Total Asia	2,396	1,561	2,709	1.25	
Latin America					
Argentina	1,256	786	808	0.37	55
Brazil	959	1,894	3,372	1.58	61
Chile	156	401	140	0.06	132
Cuba	182	98	118	0.05	13
Mexico	55	356	174	0.08	93
Peru	17	239	184	0.08	11
Surinam		35	26	0.01	60
Uruguay	57	21	26	0.01	8
Venezuela	12	324	240	0.11	27
Others 2/	20	41	13	0.01	
Total Latin America	2,714	4.195	5,101	2.35	
Europe					
Yugoslavia	1,652	2,397	2,854	1.32	990
Total Developing Countries	9,410	9,634	12,690	5,86	
GRAND TOTAL	136,684	204,883	216,644	100.00	

1/ Including Middle Eastern Developing Countries and Oceania.

2/ Including Greenland.

Source: UN - World Energy Supplies 1961-70 and 1972-77.

Table 2-8

HISTORICAL COAL TRADE VALUES FROM SELECTED COUNTRIES TO WESTERN EUROPE AND JAPAN (1972-76)

(US$/metric ton)

Year	---Australia--- W. Europe fob	W. Europe cif	Japan cif	---Belgium--- W. Europe fob	W. Europe cif	Japan cif	---Canada--- W. Europe fob	W. Europe cif	Japan cif
1972	6-9	20	18	-	24	-	-	13	21
1973	7-9	18-22	20	-	22	-	13	-	22
1974	16-17	26	30	-	40	-	-	14	31
1975	16-26	40	39	-	26-52	-	18-32	36	48
1976	14-31	45-48	51	-	56-58	-	20-33	-	58
	--F.R. of Germany--			---Mozambique---			---Netherlands---		
1972	23-37	31-55	-	-	-	17	-	22	-
1973	24-39	36-37	-	-	-	-	-	23	-
1974	44-50	42-44	-	-	-	37	-	25	-
1975	59-64	54-65	84	-	-	47	-	31	-
1976	72	44-70	-	-	-	43	-	42	-
	--United Kingdom--			----USSR----			----USA----		
1972	-	12-35	-	-	14-18	21	21	23-30	29
1973	-	12-29	-	-	14-17	21	23	24-29	30
1974	-	37-44	-	-	19-32	33	48	42-53	63
1975	29-41	40-56	-	-	30-58	50	59	50-73	73
1976	32-46	44-53	-	-	32-48	52	58	48-59	68
	--Czechoslovakia--			---France---			---Poland---		
1972	-	25-26	-	-	26-37	-	-	22-24	24
1973	-	28-29	-	-	25-56	-	-	22-25	24
1974	-	39-41	-	-	37-58	-	-	32-39	39
1975	-	35-54	-	-	43-61	-	-	42-57	57
1976	-	37-51	-	-	48	-	-	36-59	59
	--South Africa--								
1972	-	7	19						
1973	-	24	18						
1974	-	30-40	34						
1975	15	28-50	43						
1976	21	30-32	41						

Notes: (1) All values have been calculated on a tonnage basis without consideration of quality differences.
(2) fob = free on board value at the port of export, based on the transaction price including packing, inland freight, dock delivery, loading charges and other expenses up to the point where the merchandise is deposited on board the exporting vessel.
(3) cif = cash, insurance and freight delivered at the port of entry, values for Japan include only bituminous exports (mostly coking coal), while those for Western Europe include both bituminous coal and anthracite.

Sources: World Coal Trade, 1973-75; International Coal (formerly World Coal Trade), 1976-77; Commodity Trade and Price Trends, IBRD, 1978.

Table 2-9

U.S. TRADE VALUE TREND FOR BITUMINOUS COAL 1/

Years	Current Terms US$	Current Terms Annual Change %	Constant 1977 Terms US$	Constant 1977 Terms Annual Change %
1950	8.94	-	29.8	-
1951	9.63	7.7	27.0	-9.4
1952	9.72	0.9	26.6	-1.5
1953	9.25	-4.8	26.4	-0.8
1954	8.97	-3.0	26.2	-0.8
1955	9.38	4.6	27.0	3.1
1956	10.59	12.9	29.4	8.9
1957	11.03	4.2	29.6	0.7
1958	10.74	-2.6	28.7	-2.4
1959	10.34	-3.7	27.6	-3.8
1960	10.00	-3.3	26.1	-5.4
1961	10.06	0.6	26.1	0.0
1962	10.08	0.2	26.4	1.1
1963	10.06	-0.2	26.2	-0.8
1964	10.14	0.8	26.0	-0.8
1965	10.22	0.8	25.4	-2.3
1966	10.24	0.2	25.3	-0.4
1967	10.57	3.2	25.7	1.6
1968	10.80	2.2	28.0	8.9
1969	11.48	6.3	29.4	5.0
1970	14.77	28.7	34.1	16.0
1971	17.35	17.5	37.0	8.5
1972	19.16	10.4	36.9	-0.3
1973	20.90	9.1	33.4	-9.5
1974	44.52	113.0	56.9	70.4
1975	54.27	21.9	60.1	5.6
1976	53.56	-1.3	58.7	-2.3
1977	54.27	1.3	54.3	-7.5
1978	55.74	2.7	48.5	-10.7
1979 (Jan-Apr.)	59.85	7.4	52.0	7.2

1/ Export unit value, F.O.B. U.S. ports. Price trends for bituminous coal reflect primarily the price of coking coal, i.e., fluctuations in the iron and steel industry.

Source: Commodity Trade and Price Trends, IBRD, 1978.

Table 2-10

SPOT STEAM COAL PRICE TRENDS FOR SELECTED COUNTRIES[/1]

SUPPLY

Country/Port	Specifications BTU/lb	Sulphur (%)	Ash (%)	FOB Value (US$/metric ton) July 1977	July 1978	April 1979
U.S.						
Ashtabula/Conneaut	12,500	2.00	12.0	25.50	34.30	33.30
Hampton Roads/Norfolk	12,000	<1.00	12.0	30.90	39.90	32.30
Baltimore	12,500	<1.00	12.0	24.50	33.30	37.70
Duluth	9,500	0.60	27.0*	18.10	27.40	26.90
POLAND						
Gdansk/Swinoujscie	11,800	1.00	15.0	21.60	26.50	26.50
S. AFRICA						
Richards Bay	11,300	1.00	15.0	21.60	20.10	20.10
INDIA						
Hadia/Pradip	11,200	<0.60	16.0	19.60	21.10	21.10
AUSTRALIA						
Newcastle/Port Kembla	12,000	<1.00	13.0	24.50	29.90	29.90

DEMAND

Country/Port	Specifications BTU/lb	Sulphur (%)	Ash (%)	CIF Value (US$/metric ton) July 1977	July 1978	April 1979
ARA/FRANCE[/2]						
	11,000	1.00	12.0	30.40	30.40	20.40
	12,000	<1.00	12.5	37.20	35.80	47.00
SPAIN	11,200	< 1.50	11.0	29.90	30.90	30.90
	11,700	1.00	23.5	30.90	31.90	31.90
UK	10,800	1.00	17.0	30.90**	30.90**	30.90**
GERMANY, FR	11,300	1.30	12.5	32.30	33.30	34.30
	12,200	1.20	13.0	38.20	34.30	42.10
TAIWAN	11,500	1.00	16.0	35.80	35.80	35.80
	11,300	<1.00	13.0	33.80	33.80	33.80

* Moisture included.
** Contract quote.
FOB = Value at the port of exportation based on the transaction price which includes packing, inland freight, dock delivery, loading charges and all other expenses up to the point where the merchandise is deposited on board the exporting vessel.
CIF = Cash, insurance and freight, delivered at the port of entry.

/1 Price quotes are for spot sales, defined as single shipments or volumes to be delivered within one year.
/2 Amsterdam, Rotterdam, Antwerp, France.

Source: Coal Week , July 1977, July 1978, April 1979.

Table 2-11

COAL PRODUCTION PROSPECTS OF DEVELOPING COUNTRIES

	Recoverable Reserves 1/ Million tce	Production Million tce 1977	1980	1985	1990	Annual Growth Rate (%) 1977-85	1985-90
DEVELOPED MARKET ECONOMIES	324,841	1,134.4	1,265	1,476	1,752	3.3	3.5
CENTRALLY PLANNED ECONOMIES	246,304	1,463.4	1,662	2,089	2,610	4.6	4.5
DEVELOPING COUNTRIES							
Africa							
Botswana	3,500	0.2	0.2	0.3	5.0	5.2	75.5
Morocco	(96)	0.6	0.9	1.0	1.1	6.6	1.9
Mozambique	80	0.4	1.0	2.0	3.0	22.3	8.5
Nigeria	90	0.3	0.3	1.0	3.0	16.2	24.6
Rhodesia	755	2.5	4.0	4.6	5.2	7.9	2.5
Swaziland	1,820	0.1	0.5	1.5	5.0	28.6	27.2
Zaire	(73)	0.1	0.1	0.1	0.1	0.0	0.0
Zambia	5	0.8	1.3	1.9	2.5	11.4	5.6
Tanzania	(360)	2/	2/	2.0	3.0	-	8.5
Burundi	n.a.	2/	2/	2/	2/	-	-
Algeria	(20)	2/	2/	2/	2/	-	-
Angola	(500)	-	-	-	2.0	-	-
Cameroon	(500)	-	-	-	-	-	-
Benin	n.a.	-	-	-	-	-	-
Egypt	(80)	-	-	-	-	-	-
Ethiopia	n.a.	-	-	-	-	-	-
Madagascar	(92)	-	-	1.0	2.0	-	-
Malawi	(14)	-	-	-	-	-	-
Niger	n.a.	-	-	-	-	-	-
Sierra Leone	n.a.	-	-	-	-	-	-
Somali	n.a.	-	-	-	-	-	-
Tunisia	n.a.	-	-	-	-	-	-
Total Africa	7,220	5.0	8.3	15.4	31.9	14.8	17.1
Asia							
Afghanistan	(85)	0.2	0.2	0.6	1.0	14.7	20.1
India	33,700	99.7	125.0	145.0	190.0	4.8	5.6
Indonesia	1,430	0.2	0.2	3.5	12.0	42.2	27.4
Iran	193	0.9	1.0	1.5	1.5	6.6	0.0
Pakistan	(1,375)	1.0	1.5	2.0	3.0	9.1	8.5
Philippines	(87)	0.3	0.3	1.6	4.0	23.3	20.1
Korea	386	17.3	19.0	22.0	25.0	3.1	2.6
Taiwan	(680)	2.9	4.0	5.0	6.0	5.7	3.7
Turkey	793	7.4	9.8	13.0	16.2	7.3	4.5
Viet Nam	(3,000)	6.0	10.0	15.0	20.0	12.1	5.9
Thailand	(78)	0.2	0.5	2.0	6.0	33.4	24.6
Burma	(280)	2/	2/	2/	2/		-
Bangladesh	519	-	-	-	2.0	-	-
Brunei	(1)	-	-	-	-	-	-
Malaysia	(75)	-	-	-	2.0	-	-
Laos	n.a.	-	-	-	-	-	-
Total Asia	38,583	136.1	171.5	211.2	288.7	5.7	6.3
Latin America							
Argentina	290	0.5	2.3	3.5	7.5	27.5	16.5
Brazil	8,098	3.5	6.4	10.0	20.0	13.9	14.9
Chile	162	1.2	2.0	2.5	7.5	9.6	24.6
Colombia	443	3.7	5.0	10.0	20.0	13.2	14.9
Mexico	875	6.0	6.7	8.0	9.3	3.7	3.1
Peru	105	2/	0.2	0.3	0.4	*	5.9
Venezuela	978	0.1	1.2	5.0	8.8	*	12.0
Bolivia	n.a.	-	-	-	-	-	-
Haiti	(7)	-	-	-	0.3	-	-
Ecuador	(22)	-	-	-	-	-	-
Guatemala	n.a.	-	-	-	-	-	-
Honduras	(0.2)	-	-	-	-	-	-
Panama	n.a.	-	-	-	-	-	-
Total Latin America	10,951	15.0	23.8	39.3	73.8	12.6	13.4
Europe							
Yugoslavia	8,465	19.8	29.5	38.2	46.0	9.3	3.8
TOTAL DEVELOPING COUNTRIES	65,219	175.9	233.1	304.1	440.4	7.1	7.6
GRAND TOTAL	636,364	2,773.7	3,160.1	3,869.1	4,802.4	4.2	4.4

* Annual growth rate in excess of 50% due to very low 1977 production base; n.a. - not available.
1/ Figures in parenthesis represent "geological resources," since no "reserve" data available.
2/ Output below 0.1 million tce in 1977.
Sources: Reserves: World Energy Conference, 1977 Skelly and Loy; 1977 Production: US Bureau of Mines; UN- World Energy Supplies 1972-77; Supply Forecasts: Skelly and Loy; World Bank projections.

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