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# The World Market in Coal – Requirements for the Year 2000

by Dietmar Petersen, Essen\*

**Shrinking reserves of oil and natural gas at a time of increasing global energy requirements can mean a new future for coal, large reserves of which exist, half of them in the Western sphere of influence. The “renaissance of coal”, however, is not a natural law which operates on its own. The sooner the necessary decisions are taken on a world-wide basis, the more effectively will coal be able to play its new role in the international energy industry and the less will be the frictional losses along the road to a new energy future.**

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A new future for that old source of energy, coal, is assured by the basic data of the world energy market. Of the total reserves of classical fossil fuels 20 % are accounted for by oil and natural gas, the remaining 80 % are coal. At present, however, two thirds of the world's energy requirements are met by oil and natural gas, and only one third by coal. This imbalance between reserves and consumption gives rise to the necessity of a restructuring of the world energy market. This is inescapably demanded not only by the shrinking reserves of oil and natural gas but also by the fact that global energy requirements will continue to increase in the future (cf. Table 1).

A restructuring of the international energy market demands two things: first, the replacement of both oil – insofar as this is technically possible and economically feasible – and increasingly also of natural gas, and secondly, over and above this, the satisfaction of the increase in energy requirements by energy sources other than oil.

The main part in this will have to be played by coal and nuclear energy. Nuclear energy is, in the main, applicable only for the generation of electricity. It is also needed to provide the processing heat for coal liquefaction and gasification. This requires the successful development of the high temperature reactor. The principal markets for coal will be electricity generation and generation of heat (substituting for oil and natural gas). However, the coking coal requirements of the world steel industry will also expand, as will the raw material market for coal itself.

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As far as reserves are concerned, coal is capable of playing the part envisaged for it as a bridge to a new future energy age (cf. Table 2). Resources – i.e. geological deposits of a maximum depth of 2,000 m and seams of more than 30 cm thickness – are estimated by the World Energy Conference at approximately 10,000 btce. Reserves – i.e. deposits which can be economically extracted given the present state of technology – are estimated at approximately 690 btce. If world coal extraction were kept constant at its present level of approximately 2.8 billion t, the reserves alone would be sufficient for just under 250 years.

Apart from the supply situation coal – from the point of view of the Western industrialised countries – has a second advantage: its favourable international distribution. Three quarters of the reserves are situated in industrialised countries, half of them in the Western sphere of influence. There is therefore a real opportunity to develop coal once more as an energy basis for the Western industrialised countries of equal importance to that of oil. And the Western coal countries can travel that road. They possess a comparative wealth of capital both for increasing coal extraction and for constructing facilities for its utilisation. They have highly developed mining technologies, even though technological progress is not yet exhausted. Moreover, they have qualified miners and engineers or else are able to train these within a relatively short time. Optimal expansion of coal extraction offers the West the chance of effectively withdrawing from the risks of the international oil market, especially as the competitiveness of coal will continue to improve in view of the projected price trend for oil.

**Table 1**  
**World Demand for Energy in the Year 2000**

Source of Energy	Institutes <sup>1</sup>	WEC <sup>2</sup>	IIASA <sup>3</sup>	Exxon <sup>4</sup>	BP <sup>5</sup>
	in btce (in %)				
Oil	6.1 ( 34)	5.0 ( 27)	5.1 ( 35)	4.7 ( 33)	4.7 ( 28)
Coal	5.0 ( 28)	5.3 ( 28)	4.2 ( 29)	4.5 ( 30)	5.9 ( 35)
Natural Gas	3.0 ( 17)	4.0 ( 22)	2.7 ( 18)	2.9 ( 19)	3.4 ( 20)
Nuclear Energy		1.7 ( 9)	1.4 ( 10)	1.5 ( 10)	
Hydro-electricity	2.7 ( 15)	1.2 ( 6)	0.9 ( 6)	0.9 ( 6)	1.7 ( 10)
Others	1.1 ( 6)	1.4 ( 8)	0.3 ( 2)	0.3 ( 2)	1.3 ( 7)
Total	17.9 (100)	18.6 (100)	14.6 (100)	15 (100)	17 (100)

<sup>1</sup> DIW, EWI, RWI: Die künftige Entwicklung der Energienachfrage in der Bundesrepublik Deutschland und deren Deckung, Perspektiven bis zum Jahr 2000 (The future development of energy demand and supply in the FR Germany, Perspectives up to the Year 2000), Essen 1978.

<sup>2</sup> 11th World Energy Conference, Conservation Commission, Munich 1980.

<sup>3</sup> Wolf H ä f e l e : Energy in a Finite World, A Global Energy Systems Analysis, Report by the Energy System Program Group of the IIASA, Cambridge, USA, 1981 – Low Scenario –.

<sup>4</sup> Exxon Corporation, World energy outlook, New York, December 1980.

<sup>5</sup> Deutsche BP AG, Energieperspektiven 1950 – 1980 – 2010 (Energy perspectives 1950 – 1980 – 2010), Hamburg 1980.

Finally, no insuperable obstacles to an increased use of coal are likely to arise from environmental demands as the new technologies of coal utilisation have a high standard of environmental protection.

A number of studies have been carried out on the quantitative and qualitative dimensions of the contribution to be made by coal to the restructuring of the international energy market. In May 1980, the Wocol study was published under the programmatic title "Coal – Bridge to the Future"<sup>1</sup>. This comprehensive analysis of the development potential of the world's coal industry and of the international coal market was made by experts from 16 coal-producing and coal-consuming countries representing three quarters of the world's energy consumption and 60 % of the international coal market. The essential findings of the Wocol study are these:

□ World coal production must be stepped up to 7 btce by the year 2000, which means a doubling of the present level (cf. Table 3), to provide the necessary energy for even modest economic growth.

□ Within the OECD region, coal will by then have to meet up to half the additional energy requirements.

□ The coal requirements of the OECD countries may increase to up to 3 btce by the year 2000 – almost three times the present consumption figure. Coal consumption would then exceed the entire oil consumption of the OECD region. All markets for coal will share in this growth. Sectors with high rates of

growth are electricity generation, the heating market and coal liquefaction and gasification.

□ Satisfaction of this demand presupposes that international trade in coal will grow to an order of magnitude of up to 1 btce per annum, which means an expansion by a factor of 3.5 over its present volume (cf. Table 4). The growth dynamics are provided here by the international trade in steam coal<sup>2</sup>.

From our present point of view this Wocol scenario of a huge increase in the consumption of coal might seem

<sup>2</sup> A recent study by the Chase Manhattan Bank arrived at similar orders of magnitude. Even before the World Coal Study, the International Energy Agency and the World Energy Conference in 1977 discussed the prospects of the world coal market. Cf. Chase Manhattan Bank: World Coal Outlook to the Year 2000: Opportunities and Uncertainties, October 1981; International Energy Agency: Steam Coal – Prospects to 2000, OECD, Paris 1978; The World Energy Conference 1978: World Energy: Looking Ahead to 2020, World Energy Conference 1978.

**Table 2**  
**World Coal Reserves, 1980**

Region	btce
USA	190.9
USSR	165.5
PR China	99.0
Western Europe	90.5
Eastern Europe	46.4
Australia	36.5
South Africa	25.3
Far East	16.0
Africa excl. South Africa	7.4
Canada	4.4
South America	3.0
Central America	1.5
Japan	1.1
Total	687.5

<sup>1</sup> Carroll L. Wilson: Coal – Bridge to the Future, Report of the World Coal Study (Wocol), Cambridge, Mass., 1980.

excessive considering the necessary and realisable increase in international coal extraction as well as with a view to the international trade in coal. But even a reduced scenario highlights the fundamental problem of the future world coal industry: any appreciable expansion of the international trade in coal presupposes the ability and readiness of the principal coal countries to step up their extraction correspondingly and to make these quantities available for export.

The East Bloc countries, while envisaging a marked increase in their coal production, also envisage one in their coal consumption. The Wocol study therefore, just as the World Energy Conference and the Chase Manhattan Bank, proceeds from the assumption that the contribution made by the USSR and the People's Republic of China – who are numbered among the most important coal producers in the world after the USA today, and will still be so in the year 2000 – to the international coal market will continue to be modest. This means that the key role in the future development of the international coal market will be played by the USA. However, major importance will attach also to the coal policy of Australia, Canada and the Republic of South Africa, since these countries have a great export potential: potential coal extraction exceeds anticipated domestic consumption in these countries (cf. Table 5).

The central question of the future world market in coal – and hence also the question as to the extent to which oil can be replaced by coal – is whether the Western coal

**Table 3**  
**World Coal Production –**  
**Present State and Estimates**

Region	1981 <sup>1</sup>	WEC 1977 <sup>2</sup>	2000	
			WOCOL <sup>3</sup>	Chase <sup>4</sup>
(in mtce)				
USA	685	1,340	1,883	1,260
Canada	28	115	159	80
North America	713	1,455	2,042	1,340
OECD-Europe	297	380	426	390
Japan	18	20	18	20
Australia	80	300	326	265
South Africa	107	233	228	340
USSR	505	1,100	1,100	
PR China	410	1,200	1,450	2,400
Poland	170	300	313	
Rest of the World	385	792	877	565
World total	2,685	5,780	6,780	5,320

<sup>1</sup> Own Calculations.

<sup>2</sup> World Energy: looking ahead to 2020, Report by the Conservation Commission of the World Energy Conference (WEC), London 1978.

<sup>3</sup> Coal – Bridge to the Future. Report of the World Coal Study 1980. Case B assuming a heavy increase in coal consumption.

<sup>4</sup> Chase Manhattan Bank: World Coal Outlook to the Year 2000: Opportunities and Uncertainties, October 1981. Scenario: Best estimate. Own conversion into ce.

**Table 4**  
**The World Coal Market**

Supplying Country	1973	1979	1980	1981 <sup>1</sup>
	(in mtce)			
USA	50	61	86	100
Poland	40	44	33	15
Australia	27	40	42	51
USSR	31	29	28	23
FR Germany	27	30	23	20
South Africa	2	23	29	31
Canada	11	14	15	17
Others	24	25	26	30
Total	212	266	282	287

<sup>1</sup> Preliminary.

**Table 5**  
**Export Potentials of the USA, Australia,**  
**South Africa and Canada in the Year 2000**

	WEC	IEA 1978 <sup>1</sup>	WOCOL 1980 <sup>2</sup>	Chase <sup>3</sup>
	(in mtce)			
USA	90	129	350	160
Australia	180	195	200	110
South Africa	55	90	100	100
Canada	40	14 <sup>4</sup>	67	50
Total	365	428	717	420

<sup>1</sup> International Energy Agency: Steam Coal Prospects to 2000, Paris 1978.

<sup>2</sup> Case B assuming heavy increase in coal consumption.

<sup>3</sup> Net exports.

<sup>4</sup> Scenario: best estimate.

countries, above all the USA, will be prepared to expand their coal extraction more rapidly than required by the growth of domestic demand. The necessary resources – capital, labour, technologies – are potentially available. The Wocol experts in their study described as the central problem the fact that the necessary decisions would have to be taken without delay if the targets for a growing contribution by coal to world energy supplies are to be realised. In the meantime, the International Energy Agency (IEA) has also begun to monitor critically the coal policy of its member states at regular intervals regarding progress made in oil substitution.

The call for the necessary decisions and requisite measures is addressed not only to energy policy-makers but also to mining enterprises and to energy users. Because of the long lead-times of investments in coal extraction and the requisite infrastructure, the coal supplies of the nineties are already being determined today. These decisions should be initiated by

consumers through their investment decisions and appropriate long-term purchasing contracts.

Realisation of the projected world coal production and coal consumption, as well as the rapid expansion of international trade in coal, calls for investments along the entire coal chain. Tomorrow's international coal industry requires the employment of new capital-intensive extraction, transport and user technologies. The aimed-at increase in extraction will mean that the mining centres in the principal coal-producing countries will shift to little developed regions and that coal will increasingly have to be extracted from less readily accessible seams.

To this must be added large and growing investments in environmental protection. New, modern, usually capital-intensive means of bulk transport will first have to be created both in the producing and in the consuming countries. This applies not only to inland but also to overseas transport. Equally capital-intensive will be the coal liquefaction and gasification plants on a large industrial scale which have yet to be set up. It will also be necessary in some cases to set up complete housing settlements for miners in regions with few of the comforts of civilization. The Wocol study has made a model calculation of the necessary capital. In spite of its colossal scale, the mobilisation of capital is not seen as the decisive problem.

#### **Obstacles to Western Exports**

One of the major obstacles today to a rapid increase in export potential is the hitherto insufficiently prepared infrastructure in the Western coal-producing and coal-consuming countries. The importance of the

development of the infrastructure in ensuring a flexible and efficient coal chain has been demonstrated by the trend in the international coal market since the end of 1980. After many years of being a buyer's market the international coal market turned within a few months into a seller's market. Against a background of a world-wide increase in demand for coal, it was mainly the loss of Polish deliveries which triggered off a run on the Western coal countries – the USA, Australia and South Africa. This boom in demand resulted in a total overburdening of the American transportation chain, especially in the ports, so that it was impossible fully to meet the demand for exports. Coal on the world market became scarce and expensive.

During the second half of 1981 the international coal market increasingly came under the pressure of a potential supply surplus, due to a decline in demand. A major cause was the depression in the international steel industry with a world-wide decline in demand for coking coal. But the demand for steam coal for the replacement of oil and natural gas also showed only a modest increase.

On the supply side, American hard coal extraction had taken on the part of the "swing" supplier. Thanks to the miners' waiving of their annual leave, the loss of production caused by the many weeks' strike in the US mines was virtually made up, so that production was only slightly below the 1980 figure. As a result of the change in the registration system for bulk carriers in the big coal ports of the east coast, the backlog of ships was relatively speedily and extensively reduced. Altogether the Western exporting countries, principally the USA,

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were able to more than offset the loss of Polish deliveries and the expected increase in Soviet exports which failed to materialize.

### Political Risks

These recent developments in the international coal market have shown that the market is in an unstable equilibrium. The loss of relatively slight quantities can clearly rapidly trigger off shortages and rising price trends. Moreover, developments have shown that the international coal market, too, is beset not only by economic but also by political risks. Among these, for instance, is the inclination of the East Bloc countries, in spite of their great need of foreign exchange, to regard coal exports as a residual magnitude which can be reduced at any time, *nolens volens*, for reasons of Comecon policy. Admittedly, these risks cannot be compared to those of the international oil market – but they are there. In consequence, a reorientation to secure supply sources can now be observed in the international coal market. Thus the additional supplies of American coal to Western European countries, principally Denmark and Finland, to replace Polish non-deliveries, are likely to lead to lasting relations between the American mining industry and Western European users. The Japanese steel industry – because of frequent strikes in the Australian coal mines – is increasingly buying on the US market. The strengthening of the trade relations of Western European countries and Japan to the USA is a reaction to political and economic supply risks in the international coal market.

The risk that the international coal market may one day witness the formation of cartels cannot be dismissed despite the fact that about half the coal reserves lie in the Western sphere of influence. After all, the number of suppliers is small enough. The question of export availability may arise if in the major coal countries quantities earmarked for export are (suddenly) diverted towards domestic use or if a “coal nationalism” presses for self-sufficiency in energy.

Such reflections will have to be included by the European Community in the calculation of its future coal and energy policy. As a coal importer it has now reached the level of Japan. It is, moreover, likely that the Community will remain in this position in the long term. The Commission of the European Communities, for instance, estimates that coal consumption in the Community could increase to a maximum of 540 mtce per annum by the year 2000<sup>3</sup>. Given a planned extension of domestic coal production to approximately 265 mtce (1980: approximately 215 mtce) this would

mean a requirement of imported coal amounting to 275 mtce. Be that as it may, energy policy is faced with the question of whether the Community can at any time obtain from the world market the quantity of coal it needs, without triggering off economic or political reactions in other consumer countries or in the producing countries<sup>4</sup>.

Coal is not yet a “classical” commodity of international trade. A mere 10 % of annual production is sold on the world market. Coal is still predominantly being used in the countries where it is mined. The development of a flexible and efficient international coal industry, preferably by the end of the eighties, is thus an urgent task for the international energy community, a task which also faces the Western European coal industry, since it is in a position to make a substantial contribution here.

### Developing Countries

A further task in this connection is that of supporting those developing countries with coal reserves in the development of their own coal industry. Compared with the Western industrialised countries and the Eastern Bloc, the coal reserves of the developing countries are relatively modest. They possess only 2.3 % of geological resources and approximately 10 % of the technically and economically extractable reserves. The Third World's share of world coal extraction is likewise still rather modest at barely 8 %. Admittedly, the average growth rate (1973/79) of 5.3 % was distinctly above that of world trade (3.8 %) and even more so above that of the industrialised countries. However, the more rapid average growth in the developing countries was due principally to a lower initial level, so that slight increases had a disproportionate effect.

Moreover, this growth was accounted for almost exclusively by a vigorous increase in extraction in the four biggest coal-producing developing countries – India, Yugoslavia, South Korea and Vietnam. Modest increases in production were recorded by Mexico, Turkey, Brazil and Colombia. This coal is, however, predominantly used in these countries themselves. In India, supplies of primary energy are based to about two thirds on coal, in South Korea the figure is as much as 90 %. At present, coal exports from the developing countries amount to a mere 1 % of the international trade in coal.

<sup>3</sup> Commission of the European Communities: Perspectives of Long-term Demand and Supply Development for Coal in the Community, Doc. COM (80) 117, final of 18 March 1980.

<sup>4</sup> Cf. also: Studienausschuß des westeuropäischen Kohlenbergbaus (CEPCEO): Eine neue Kohlenwirtschaft für Westeuropa (A New Coal Industry for Western Europe), November 1981.

The question remains as to whether, for instance, a developing country such as India, in view of its huge population, its need for industrialisation and hence a correspondingly high and growing domestic demand for energy, will be able to participate to a greater extent in the international coal trade by exporting coal itself. In theory the developing countries, in terms of the potential of their deposits, could gain a 10-25 % share of the world's coal market. This, of course, presupposes that they are able to mine and deliver their qualitatively good steam coal (the existence of which has already been proven) at competitive cost. With the possible exception of Colombia it is unlikely, therefore, that the developing countries will appear as suppliers in the international coal market in the foreseeable future.

Many developing countries would derive by far the greatest benefit from using their native coal deposits for their own energy supplies. Development of a national coal industry calls for enormous sums of capital. The World Bank<sup>5</sup> and the Wocol study have provided model calculations on this point. In view of the requirements and obstacles, the promising growing market for coal in the developing countries is likely to be largely confined to electricity generation. The reason is that the coal deposits frequently lie in thinly populated areas with poor transport facilities and without any appreciable need for coal or energy. All that is left in many cases therefore, is generation of electricity, since current can be transported relatively cheaply over great distances. Insofar as these countries also possess coke and their level of industrialisation permits of the development of a domestic steel industry, this too would provide a market.

A fundamental prerequisite of all these future prospects, however, is that the geological data are brought up-to-date, taking into account the latest developments in exploration technology, and that intensive exploration for steam coal is carried out. The developing countries with coal deposits are divided by the World Bank into three major groups:

- Countries with as yet unknown coal deposits. These will probably need 10 to 20 years before the first coal is extracted.
- Countries with known deposits. These will be able to start extraction within about 8 to 10 years.
- Countries with a well developed mining industry. These countries are in a position to step up extraction substantially within 5 to 8 years. These countries include India, Yugoslavis, Turkey, South Korea and Vietnam.

It is the countries of this third group which alone are likely to realize the increase in coal production in the developing countries expected in this decade. By 1990 other developing countries such as Argentina, Botswana, Chile, Indonesia, Mexico, Swaziland, Taiwan, Thailand and Zimbabwe may also have increased their coal production.

The study of the World Bank proceeds from the assumption that coal extraction in the developing countries can be increased to 440 mtce by 1990. Yet this target will not be realizable without the capital, the technologies, the management and know-how of mining enterprises from the Western industrialised countries. Here Western European mining has a particularly great task to perform.

One prerequisite, of course, is that the developing countries provide a politically stable climate for investment. The present climate for investment is evidently not assessed as being particularly attractive on the part of Western mining enterprises, the length of whose planning horizon is bound to be above average in view of the high capital-intensity and the long gestation periods of mining investments: their investment of capital in the Third World has been declining.

Further-reaching long-term forms of cooperation between coal-producing industrialised countries and coal countries of the Third World are also conceivable, such as:

- export by industrialised countries of modern technologies for the extraction and use of coal in return for long-term firm supplies of coal from developing countries, i.e. transfer of technology for secure raw materials;
- establishment of large-scale liquefaction and gasification plants at low-cost coal deposits in the developing country with capital and management participation of the industrialised country in exchange for the supply of processed coal products.

Such an internationally developed coal industry would be of considerable benefit both to the industrialised and to the developing countries. Coal was the basis of industrialisation and of the supply of primary energy into the second half of our century. It can become the bridge to a new energy future. The "renaissance of coal", however, is not a natural law which operates on its own. The sooner the necessary decisions are taken on a world-wide basis, the more effectively will coal be able to play its new role in the international energy industry and the less will be the frictional losses along the road to a new energy future.

<sup>5</sup> Coal Development Potential and Prospects in the Developing Countries, World Bank, Washington, October 1979.