COMPARABILITY OF HARD COAL RESERVES AND RESOURCES IN EUROPE

Sandro Schmidt[1], Peter Gerling[2], Thomas Thielemann[2] & Ralf Littke[1]

[1] Institute of Geology and Geochemistry of Petroleum and Coal, Aachen University, Lochnerstr. 4 – 20, 52056 Aachen, Germany
[2] Federal Institute for Geosciences and Natural Resources (BGR), Stilleweg 2, 30655 Hannover, Germany

Introduction

The international coal market is tight and coal prices are booming since 2003. For example, spot market prices for steam coal delivered to NW Europe (NWE) increased by 127 % from May 2003 to July 2004. A similar price hike by about 81 % for cross-border prices is noticed for steam coal delivered to Germany from June 2003 to May 2005 (Figure 1). The cross-border price includes spot market and long term contract prices.

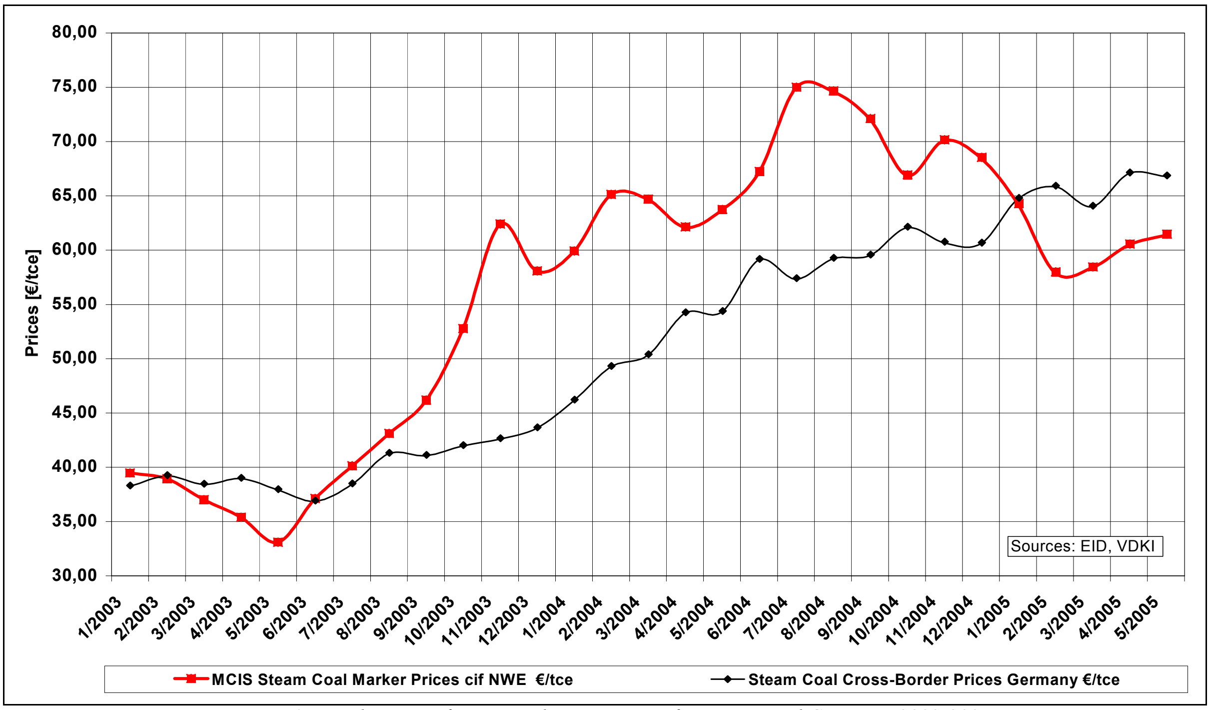

Figure 1: Development of steam coal import prices for Europe and Germany, 2003-2005

The coal demand develops more dynamically than expected and supply is hardly able to manage all requirements. A sound knowledge of the size of economic reserves is one of the key factors for a better understanding of future coal market trends. So far, the comparison of hard coal reserves and resources in the various countries of Europe is very difficult due to heterogeneous classifications with differing terms and definitions. Major variations among these classifications are due to different exploration requirements, e.g. drilling grid, borehole distances, geological structure etc., for the assessment of the reserve and resource categories and due to varying criteria regarding cut-off values for reserve and resource estimations.

The United Nations Framework Classification (UNFC) was introduced in 1997 aiming to an easier comparability of reserve and resource categories from different countries. However, since the UNFC does not include deposit defining criteria, e.g. minimum seam/coal thickness, maximum seam depth, and maximum ash and sulphur contents, the reserve and resource data published by most of the European countries are still not comparable.

The project "Harmonization of the Europe-wide reserves and resources estimations of hard coals" has been launched by BGR to investigate four of the most important European and Russian hard coal basins to obtain more precise and comparable data concerning the size of reserves and resources and their availability. According to our understanding reserves represent that part of the coal which is documented in detail and can be recovered economically using current technologies (BGR 2002). Whereas resources are defined as that part of the total resources which are either proved but at present not economically recoverable, or geologically indicated (BGR 2002). In this article the Polish, Russian and Ukrainian balance resources are referred to as reserves, although some production is subsidised. The off-balance resources and prognostic resources are considered as resources (Figure 2).

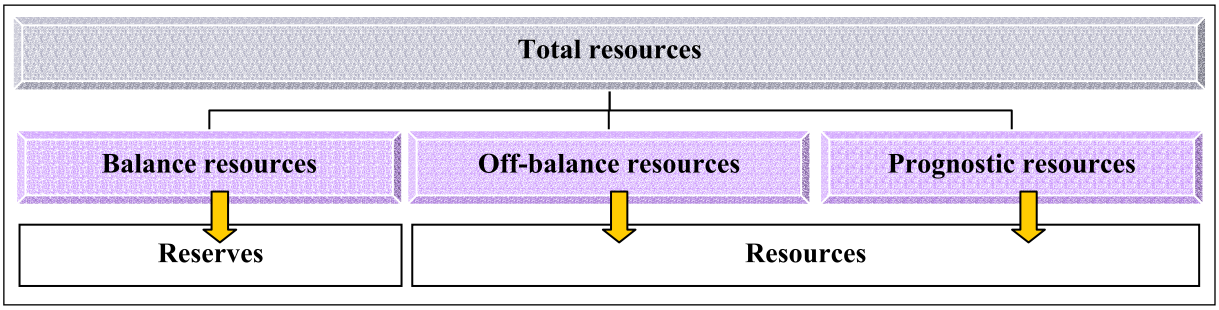

Figure 2: Transcription of the Polish, Russian and Ukrainian resource categories into reserves and resources

Ruhr basin, Upper Silesian basin, Donetsk basin and Kuznetsk basin

The Ruhr basin, the Upper Silesian basin (USB), the Donetsk basin (Donbass) and the Kuznetsk basin (Kuzbass) are the most important hard coal producing basins in Germany, Poland, Ukraine, and Russia. These basins are well explored during their long lasting mining history – main geological properties and coal types are given in Table 1.

Table 1: Geological properties of the four basins after Luzin & Zheleznova (1984) and Walker (2000)

	Type of basin/ characteristics	Time of formation	Area [km²]	Max. thickness of coal bearing formation [m]	Cum. seam thickness [m]	Number of seams	Occurring coal types
Ruhr basin	Subvariscan Foredeep	Upper Carboniferous	8,500	4,200	135	~ 300	long flame to lean coal
USB		Upper Carboniferous	5,800	8,520	339	~ 520	long flame to anthracite
Donbass	Foredeep + platform	Carboniferous	60,000	11,660	54	~ 330	long flame to anthracite
Kuzbass	Foredeep + foredeep edge	Carboniferous - Jurassic	26,700	11,080	366	~ 370	long flame to lean coal

Table 2 shows the main mining characteristics of the four basins. The Kuznetsk basin is the only one operating with opencast mining. Hence, and as well because of excellent mining conditions for deep mining (shallow depth and the thickness of seams) the production costs are low and most competitive – in comparison to the other three basins and even under world market conditions.

Table 2: Mining characteristics of the four basins (Geoinform Ukrainy 2005, IEA 2002, Interfax 2003 - 2005, McCloskey's Coal Report 2004 – 2005, Riatek 2003 – 2005, Statistik der Kohlenwirtschaft e.V. 2005)

	Hard coal production in 2004 [Mt]	Share of national hard coal production [%]	Underground mines in 2004	Opencast pits in 2004	Employees in 2004	Productivity [t/man and year]	Average mining depth [m]	Production costs in 2004 [US$/t]
Ruhr basin	17.8	69	7	-	~ 33,000	536 in 2002 (avg. Germany)	1059 (2004)	199
USB	92	93	40	-	~ 125,000	740 in 2003 (avg. Poland)	~ 800	38.4
Donbass	76.4	95	159	-	~ 400,000	329 in 2004 (avg. Ukraine)	717 (2004)	33
Kuzbass	158.7	76	~ 70	~ 47	~ 140,000	1,163/2,329 in 2004 (avg. deep/opencast mining in Russia)	343 (2001)	10 – 25 / 8 – 12

Hard coal deposit defining criteria

Parameters generally used as thresholds are the depth of the seams, the net coal thickness or seam thickness, the proportion of barren partings in the seam, the ash content in the seam or cleaned coal, the calorific value of the raw or cleaned coal, and the sulphur content.

Besides, one legal aspect differentiates the German resource application from the Ukrainian, Russian and Polish applications: A guideline called "Bereichsrichtline 1/82" (Daul 1995) from the Deutsche Steinkohle AG (DSK) is applied in Germany, whereas in Ukraine, Russia and Poland this is regulated by governmental orders. More specifically, the Polish decree, introduced in 1994, uses partly different parameters and cut-off values for anthracite, steam and coking coal (Niec 1995). The parameters used for coal reserves and resources in the Donbass and the Kuzbass are similar, the cut-off values for steam and coking coal, however, are different. Parameters and cut-off values in the Donbass and the Kuzbass did not change since 1960 (Kusnetzov 1963, Tsherepovski et al. 2003). A differentiation of cut-offs values for reserves and resources does not exist in the German guideline – in contrast to the USB, Donbass and Kuzbass.

Cut-off values

The maximum depths considered for reserves and resources vary from 1,000 m in Poland/USB via 1,500 m in the Ruhr basin to 1,800 m in the Donbass and Kuzbass. In 2004, the maximum average mining depth has reached 1,059 m in the Ruhr basin. This is the greatest depth of all basins considered.

The minimum net thickness for coking coal reserves is ranging from 50 cm in the Donbass to 70 cm in the Kuzbass and to 100 cm in the USB. The minimum steam coal net thickness varies from 60 cm in the Donbass to 100 cm in the Kuzbass and USB. Such a differentiation is not applied in the Ruhr basin, where the minimum net thickness for each coal type amounts to 60 cm. In reality, the average mined net coal thickness in Germany was 170 cm in 2004. This equates to about 226 cm average mined seam thickness (STATISTIK DER KOHLENWIRTSCHAFT 2005). In contrast, about 70 % of the produced coal in the Donbass derives from seams with a net coal thickness of 60 – 70 cm (personal communication GEOINFORM UKRAINY).

The parameter ash content is treated in different ways. The ash content of the barren partings in the seam is used as cut-off criterium in Germany and for the Polish coking coal and anthracite. In addition, a maximum ash content of 10 mass% in the cleaned coal is required for the Polish coking coal. The German maximum barren partings content of 35 vol% (about 50 mass%) presents a very high cut-off value in comparison to the cut-off values used in the other basins. The average barren partings content of the mined hard coal in Germany was 25 vol% in 2004. In the Donbass and Kuzbass usually the ash content of the raw coal is used as cut-off criteria and ranges from 30 to 40 mass%.

Limiting values for the total sulphur content are only known for Germany and Poland - being 2 % for the German hard coals and Polish steam coals. A sulphur cut-off value of 1 % is required for Polish anthracite and cleaned coking coals. More parameters and cut-off values are given in Table 3.

Table 3: Cut-off values of various parameters used for reserve and resource estimations in Ruhr, Upper Silesian, Donetsk and Kuznetsk basin (DAUL 1995, KUSNETZOV 1963, LUZIN & ZHELEZNOVA 1984, NIEC 1995, TSHEREPOVSKI et al. 2003 and YAVORSKI 1969)

		Germany	**Poland**			**Ukraine** Donetsk basin		**Russia** Kuznetsk basin	
		Hard coal	*Hard coal*			*Hard coal*		*Hard coal*	
			Steam coal	Coking coal	Anthracite	Steam coal	Coking coal	Steam coal	Coking coal
Parameter	unit		reserves (resources)	reserves (resources)	reserves (resources)	reserves (resources)	reserves (resources)	reserves (resources)	reserves (resources)
Max. depth	m	1,500	1,000 (1,000)	1,000 (1,000)	1,000 (1,250)	1,800 (1,800)	1,800 (1,800)	1,800 (1,800)	1,800 (1,800)
Min. net coal thickness	cm	60	100 (60)	100 (60)	(40)	60 / 70 (45)	50 / 55 (45)	100 (60)	70 (50)
Min. seam thickness	cm				100 (60)				
Max. barren partings content in the seam	Mass% Vol.%	50 35		20 (40)	40 (40)			30	30
Max. ash content in raw coal	Mass%					30 / 40 (40)	40 (45)	30 (40)	30 / 40 (50)
Max. barren partings thickness to coal thickness ratio	Vol.%			0.2 (0.4)					
Min. calorific value of coal with barren partings (raw coal)	MJ/kg		15 (12.6)						
Max. ash content in washed coal	Mass%			10 (10)	10 (10)				
Max. volatile matter content	%				10 (10)				
Max. total sulphur content	%	2	2 (unlimited)	1.0 in washed coal	1.0 (unlimited)				

The most competitive cut-off values for an economic exploitation of deep hard coal under world market conditions are found in Poland. These Polish cut-off values fit quite well with the actual average mined seam thickness of more than 2 m and an estimated average depth of hard coal mining of around 800 m in the USB.

Reserves and resources

Ruhr basin

Because of the highly subsidised German hard coal production there exist no reserves sensu strictu. An extensive calculation of the resources and extractable resources in the Ruhr basin was made by DAUL for the year 1991 (DAUL 1995). The result for the Ruhr basin with the cut-off values given in Table 3, including the abandoned, producing and prospective part to a depth of 1,200 m for top Carboniferous was 42 billion tons of in-situ hard coal resources. Just 21.2/31.5 billion tons of the 42 billion tons of hard coal resources were available in the producing and prospective part (depth of top Carboniferous 1,000/1,200 m) of the basin (DAUL & JUCH 1999). Subtracting the recently extracted coal and considering its respective utilization of only 34.6 % (DAUL 1995) results in 19.9/28.9 billion tons of hard coal resources for the producing and prospective part in the basin at the end of 2003. This modification is simplified because abandoned as well as new mining fields are not considered. Instead of the internationally used hard coal density of 1.3 t/m^3 the German figures consider mining losses by the appliance of a density of 1.0 t/m^3. The application of the rate of utilization of 34.6 % amounts to about 6.9 billion tons of extractable hard coal resources to a depth of top Carboniferous of 1,000 m at the end of 2003.

Comparison of reserves and resources in the USB, Donbass and Kuzbass

The comparison of reserves and resources of the USB, Donbass and Kuzbass is possible because of similar reserve and resource categories, keeping in mind the different parameters and cut-off values. Table 4 shows the reserves and resources of the three basins. The resource figures, usually called total or geological resources, include different kinds of reserves and resources. The Kuzbass resource figure includes reserves (balance resources), off-balance and prognostic resources, whereas the Donbass resource figure only contains reserves (balance resources) and prognostic resources. The USB resource figure again includes only reserves (balance resources) and off-balance resources. Noticeable is the huge total resource figure for the Kuzbass, which includes 79 % of prognostic resources - a kind of predicted resource. The $A+B+C_1+C_2$-reserves (balance resources) belong to the detailed and general explored reserves, whereas $A+B+C_1$-reserves (balance resources) cover the detailed explored reserves. The $A+B+C_1$-reserve figure from the Kuzbass exceeds the Donbass reserves by about 26 % and the USB $A+B+C_1+C_2$-reserves by about 41 %. In this context it should be mentioned that about 95 % of the $A+B+C_1$-Kuzbass reserves are to be found above a depth of 600 m.

The most interesting figures are the industrial reserves. The industrial reserves represent the amount of available in-situ hard coal reserves in currently exploited deposits. In the USB and Donbass these figures are constantly declining over the last years, especially as a result of mine closures and no construction of new mines.

Especially in Poland the reserve category “operational reserves” is commonly used for the amount of extractable hard coal reserves. For the calculation of the operational reserves an extraction coefficient of 0.7 to 0.8 (NIEC 2003) is applied to the industrial reserves and results in about 4.9 billion tons of operational reserves for the USB at the end of 2003.

Table 4: Hard coal reserves and resources of the USB, Donbass and Kuzbass (GALOS et al. 2004, GEOINFORM UKRAINY 2005, PRZENIOSLO 1998, TSHEREPOVSKI et al. 2003)

	USB 31.12.2003 [Gt]	Donbass/Ukraine 1.1.2004 [Gt]	East-Donbass/Russia 1.1.1997 [Gt]	Kuzbass 1.1.2001 [Gt]
Total resources	72.4 (1997)	82.8	24.6	502.5 (1.1.1998)
Reserves (balance resources) $(A+B+C_1+C_2)$ $(A+B+C_1)$	 33.9 	 52.3 41.6	 9.6 6.6	 72.5 56
Industrial reserves (Available reserves in exploited deposits)	6.8	8.9	1.3	10.7

The influence of cut-off values

In order to demonstrate the influence of different cut-off values, USB and Ruhr basin reserve and resource figures were compared. Only the parameters with the heaviest weight, the minimum net coal thickness and the maximum depth of seams, have been considered. Relevant information from the Ruhr basin are taken from the KVB-model (coal resource calculation-model), which covers most portions of the producing and the whole prospective part of it (JUCH et al. 1994, DAUL & JUCH 1999).

The total resources of the USB – as given in Table 4 – amounted to 72.4 billion tons at the end of 1997. This figure includes reserves (balance resources) and off-balance resources and hence all $A+B+C_1+C_2$-hard coal resources with a minimum net coal thickness of 60 cm down to a depth of 1,000 m. The hard coal resource figure for the year 1991 calculated by DAUL & JUCH (1999) in the abandoned, producing and prospective (depth of top Carboniferous 1,200 m) part of the Ruhr basin was 42 billion tons. This figure considers all resources with a minimum net coal thickness of 60 cm and down to a depth of 1,500 m. When using the real hard coal density of 1.3 t/m^3 the Ruhr basin resources added up to 54.6 billion tons.

The USB reserves $(A+B+C_1+C_2)$, which cover the part of the resources with a minimum net coal thickness of 100 cm and to a depth of 1,000 m (balance-criteria), were 33.9 billion tons at the end of 2003. The appliance of the same cut-off values on the entire Ruhr basin results in a significant decrease of the resources. The resources drop from 54.6 billion tons to 10.4 billion tons in 1991. This includes resources with a minimum net coal thickness of > 105 cm and to a depth of 1,000 m.

The reserves in the developed deposits of the USB, also referred to as total reserves in Poland, were 15.4 billion tons (GALOS et al. 2004). When applying the above mentioned criteria on the producing and prospective part (depth of top Carboniferous 1,000 m) of the Ruhr basin, the modified 19.9 billion tons of hard coal resources at the end of 2003 drop to about 4.9 billion tons. This figure includes all resources with a minimum net coal thickness of > 105 cm and to a depth of 1,000 m in the developed and partly prospective parts of the Ruhr basin.

A proposal for a standardized model to estimate in-situ hard coal contents

There are obviously good reasons to develop a standardized model for hard coal estimates, prior to a comparison of reserves and resources. This approach allows the comparison of the in-situ hard coal content of the basins under uniform genetic-technological parameters. The model includes the most important parameters with corresponding cut-off values to get a more realistic view on potential recoverable hard coal resources in the basins. Input thresholds are the minimum net coal thickness, the maximum ash content and a maximum dipping of seams for the deep mined hard coal.

The minimum net coal thickness has been set to 60 cm, especially due to the fact that otherwise most of the Donbass resources would not be considered. A second argument: the application of fully mechanized long-wall mining – like in Germany – requires at least a thickness of 60 cm. On the other hand, 90 % of the mined hard coal in the Ruhr basin in 2002 resulted from coal seams with a thickness of more than 120 cm (MVEL NRW 2002) and it should be considered that the Polish reserve cut-off value is 100 cm.

To define a common cut-off value for the maximum ash content is quite difficult because of the usage of either the ash content for the raw coal (in Ukraine and Russia) or the proportion of the barren interlayers (in Germany and Poland). In the latter case, the ash content in the mined hard coal increased continuously over the last decades and was 25 vol.% in 2004, which corresponds to approximately 36 mass%. Together with the ash content of the coal itself of 4 to 9 % (WALKER 2000), the resulting ash content of the mined raw coal in the Ruhr basin is about 40 to 45 mass%. A similar increase can be observed in the Donbass. The ash content of the mined raw coal was 38.7 mass% in the Ukraine in 2004 (UGOL UKRAINY, April 2005). Accordingly a cut-off value of 50 mass% for the ash content of raw coal should be considered as reasonable.

Apart from the open cast mining the dipping of seams is very important for the long-wall deep mining where flat-lying seams are preferred. In 2002, about 98 % of the hard coal in the Ruhr basin was produced out of seams with an inclination of just 0 to 20 gon (MVEL NRW 2002). This trend towards shallower dipping seams might occur in the other basins as well. Therefore a dip cut-off value of 20 gon is applied in this model.

After the application of these initial cut-offs a further splitting of the remaining hard coal content is considered. Thus a differentiation of the hard coal content in types of coal, depth of the seams, thickness of the coal in the seam and – if possible – as well the sulphur and ash contents of the coal without barren interlayers is possible (see Figure 3). The intervals used in Figure 3 can still change depending on available data and new information. The application of this model enables the comparison of the hard coal contents (resources) of different basins on equal terms and allows a better estimation of the occurrence of the mineable hard coals.

The complete calculation of the in-situ hard coal model results in 144 different categories - 48 categories for anthracite, steam coals and coking coals each. Sometimes the full application will probably not be possible, particularly with respect to the sulphur and ash content of each category.

The application of the described in-situ hard coal content-model is currently underway for the Ruhr basin. The differentiation of the hard coal content is possible with the help of the KVB-model (JUCH et al. 1994).The results will allow a good estimation of the remaining recoverable hard coal content of the basin. For the other three basins it will be more difficult to apply this model especially due to the absence of similar basin models.

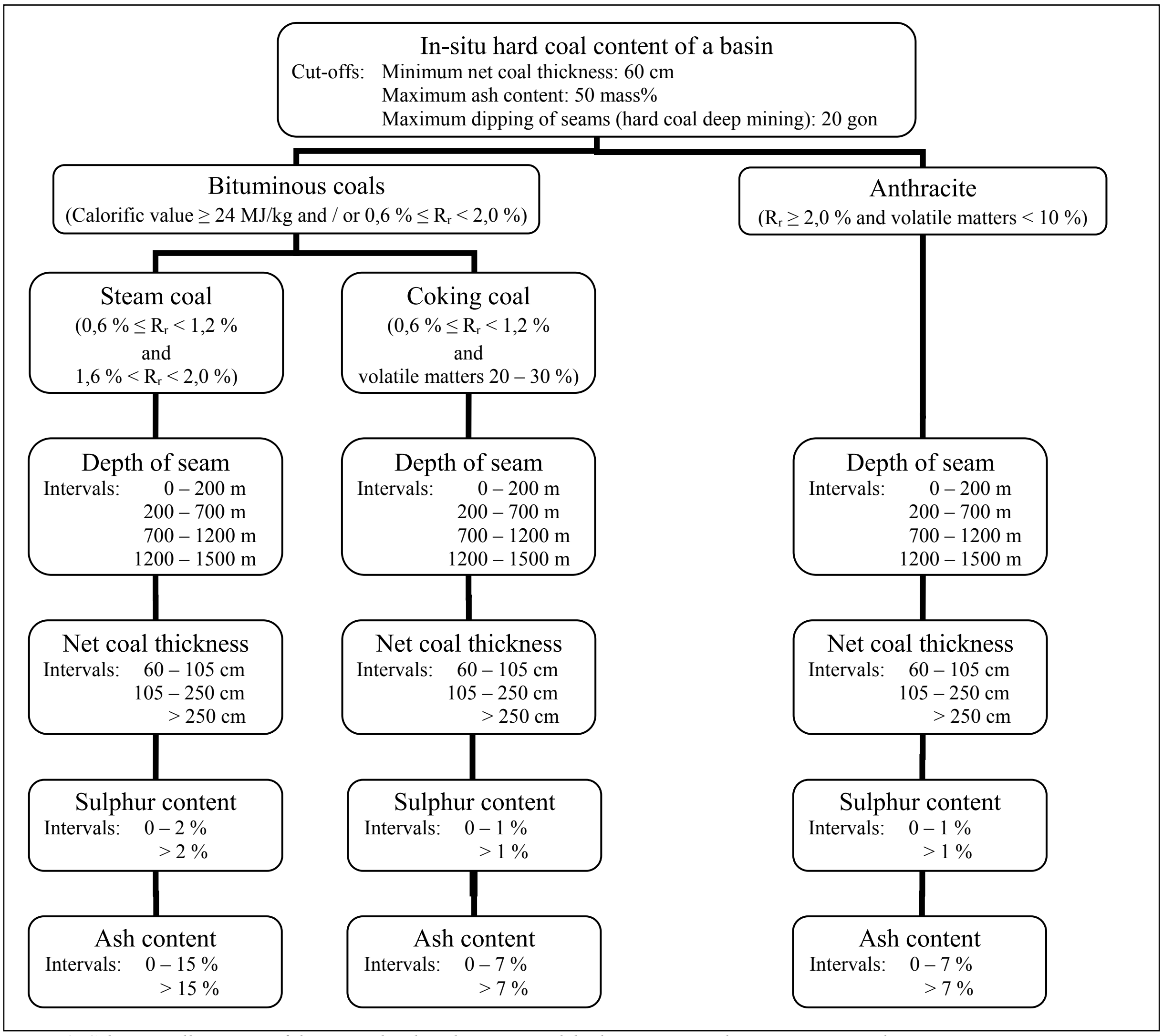

Figure 3: Schematic illustration of the in-situ hard coal content model taking into consideration genetic and technological parameters

European hard coal demand and supply

The EU-25 countries produced 180 Mt of hard coal in 2004 (Figure 4). This satisfied their needs by only 46 % – another 210 Mt (Figure 5) of hard coal have been imported (VDKI 2005). Since a further decline of the hard coal production in the European Union can be expected in the next years, e.g. due to a decline of German hard coal production to 16 mt in 2012 or due to the continuous fall in the UK hard coal production, the missing amount of hard coal has to be compensated by growing imports. At the moment, Europe imports hard coals from a number of different countries and regions (Figure 4). However, in the future a further strongly rising demand of hard coal imports especially of some Asian countries can not be excluded and seems to be very possible. The Pacific and in some parts even the Atlantic hard coal market would be affected. European imports from Australia, Indonesia and Colombia add up to 31 %. According to EIA projections hard coal imports of the United States will increase from 17 Mt in 2002 to 46 Mt in 2025, mostly from South America (EIA 2004). From this perspective the European hard coal supply will probably change. The domestic European hard coal resources and thereby especially the huge resources of Eastern Europe and Russia could get more in focus again for the European security of supply. Noteworthy is – according to VDKI 2005 data – the development of Russian hard coal exports to the EU-25: The Russian hard coal exports to Spain and the UK increased five times each from 1999 to 2004, to Germany even 18 times.

The energy strategies are different for Germany, Poland, the Ukraine, and Russia. Whereas the Russian and the Ukrainian strategies favour a growth of domestic hard coal production capacities, orientate Germany and Poland in the opposite direction. The Russian energy strategy forecasts a growing hard coal production to about 260-290 Mt for the year 2020, from currently 210 Mt (RUSSIAN MINISTRY OF ENERGY 2003). This forecast is very much dependent on the development of the domestic gas price, which is below the world market price and which makes it difficult for coal to compete in the domestic energy market. On the other hand this situation enables the Russian hard coal industry after tough years of restructuring to expand their exports. Exports towards non CIS-countries rose by more than four times since 1998 to 65.5 Mt in 2004 (VDKI 2005).

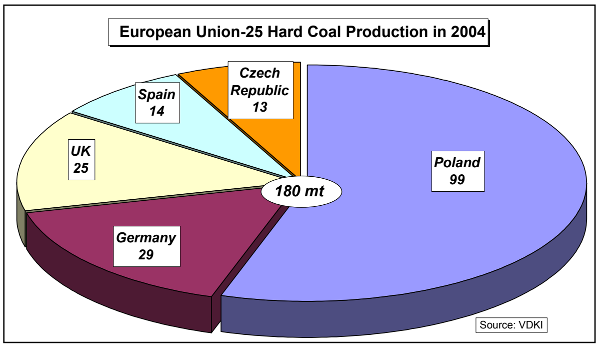

Fig. 4: EU-25 hard coal production (VDKI 2005)

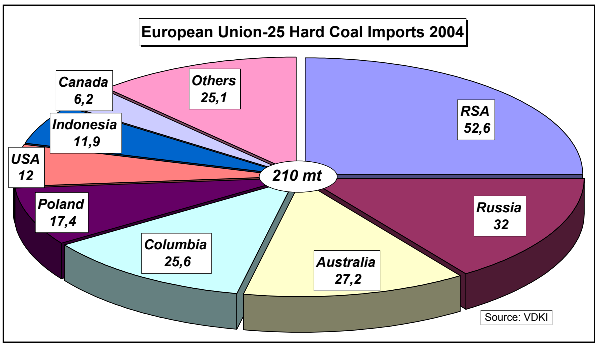

Fig. 5: EU-25 hard coal imports (VDKI 2005)

According to the Ukrainian ministry for fuels and energetic there are concepts to increase the hard coal production towards 96.5-112.2 Mt until 2015, from currently 80.1 Mt (2004). At the moment, the Ukraine is a net hard coal importer although it exported about 4.3 Mt of mainly anthracite in 2004 (VDKI 2005). Even if the planned extension in the hard coal production will be realized there is only a limited potential for more hard coal exports due to the domestic needs. The Polish hard coal production is projected to be reduced down to 88 - 95 Mt in the year 2006 from 100 Mt in 2004, depending on the development of world hard coal market prices (MCCLOSKEY´S COAL REPORT, MCR ISSUE 87, 11.06.2004). A further reduction of hard coal production will follow as a result of the restructuring process. These reductions will probably affect as well the amount of Polish hard coal exports. The German hard coal production is highly dependent on subsidies which were lowered year by year. In line with the reduction of subsidies, four out of 10 hard coal mines in Germany are scheduled for closure by 2010 (EUROPEAN COMMISSION 2005) and the production will be reduced via 18.5 Mt (2010) to 16 Mt in 2012.

Availability of hard coal

Most of the hard coal produced on earth is consumed in the vicinity of its production sites. The share of world trade was 16 % in 2004. Out of this, the share of the seaborne trade was about 90 % (VDKI 2005).

The produced hard coal in the Ruhr basin is either consumed on site or shipped via rail or barges inside Germany. There is no noteworthy export of German hard coal.

The USB is about 1,100 km away from Polish Baltic seaports like Gdansk, Gdynia or Swinoujscie (GRUß et al. 2002). The hard coal has to be transported by rail to the seaports or directly by rail to e.g. Germany or the Czech Republic. In 2004 the Polish hard coal exports were about 20.8 Mt – approximately 20 % of the domestic production (VDKI 2005).

About 80 % of the Russian hard coal exports came from the Kuzbass in 2004, which is far away from European (Baltic and Black sea) and Pacific ports. The average rail distance to the Baltic and Black sea ports adds up to 4,300 km (ROSINFORMUGOL 2005). This is a long distance compared to other major coal exporting countries like Australia or South Africa. The average coal hauls in New South Wales/Australia are 135 km and 250 km in Queensland/Australia, compared with 600 km in South Africa (PRODUCTIVITY COMMISSION 1998). As shown in Table 5, the Russian rail tariffs are – with about 0.4 US-cents/t and km in 2004 – clearly lower than the Polish ones with about 1 US-cents/t and km in 2001.

Table 5: Breakdown of hard coal fob-costs for the USB and Kuzbass
(GRUß et al. 2002 and ROSINFORMUGOL 2004, 2005)

	Production costs [US$/t]	Rail shipment costs to seaports [US$/t]	Rail shipment costs [US$/t and km]	Port handling costs [US$/t]	FOB costs [US$/t]	Revenues [US$/t]
USB	~ 33 (in 2001)	~ 12 (in 2001)	0.01 (in 2001, distance 1,100 km)	~ 2 (in 2001)	~ 47 (in 2001)	30 – 38 (steam coal in 2001)
Kuzbass	~ 11 (steam coal 1th Qtr 2004) ~ 14 (coking coal 1th Qtr 2004)	~ 16 (in 2004 to European ports)	0.004 (in 2004, distance 4,300 km)	~ 5 est. (European ports)	~ 32 ~ 35	60.4 (steam coal 4th Qtr 2004) 85.2 (coking coal 4th Qtr 2004)

Compared with estimated international railway transport costs of 0.7 - 2 US-cents/t and km (WELLMER 1992) the low Russian railway tariffs offer a great advantage. At the same time it is getting obvious that increased Russian/Kuzbass exports are only possible as long as the tariffs stay low or the world hard coal prices remain on a high level.

The most important Ukrainian port for the export of hard coal from the Donbass is the Black sea port Mariupol, which is situated about 100 km south of the Donbass. The Ukrainian hard coal exports are much smaller than the Polish or Russian exports. In order to secure the domestic supply the government increased the railway and port tariffs during the last months. Thus the railway transport costs from the Donbass to the about 1000 km (air-line distance) far away western Ukraine border increased to 40 US$/t (MCCLOSKEY´S COAL REPORT, MCR ISSUE 115, 22.07.2005) and made exports via railway uneconomic.

REFERENCES

BGR (BUNDESANSTALT FÜR GEOWISSENSCHAFTEN UND ROHSTOFFE) (2002): Reserves, Resources and Availability of Energy Resources 2002. 35 p., Hannover.
http://www.bgr.de/saf_energie/energiestudie_en_2002.pdf

DAUL, J. (1995): Untersuchung über die Verteilung und Veränderung von Steinkohlevorräten im Ruhrgebiet und über deren Ausnutzung. 160 p.; Leoben. (PhD-thesis)

DAUL, J. & JUCH, D. (1999): Die Verteilung der Vorräte der Steinkohlenlagerstätten an der Ruhr vor dem Abbau und zum 1. Januar 1995. - *Glückauf*, **135**(1/2): 34-42; Essen.

EIA (2004): International Energy Outlook 2004. - 256 p.;
http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2004).pdf

EUROPEAN COMMISSION (2005): European Commission approves "coal package" authorising restructuring plans for the Polish, German and Hungarian coal industry until 2010. 2 p.;
http://europa.eu.int/rapid/pressReleasesAction.do?reference=MEMO/05/217&format=HTML&aged=0&language=EN

EVTUSHENKO, A., E. & MALYSHEV, Y., N. (1999): Mineral and Natural Resource Base of Coal Industry of Russia. Vol. 2 (regions and coalfields). 448 p.; Moscow. (in Russian)

GALOS, K., KAMYK, J., LEWICKA, E., SMAKOWSKI, T.& SZLUGAJ, J. (2004): Hard Coal and Anthracite. - In: NEY, R. & SMAKOWSKI, T. (eds.) (2004): Minerals Yearbook of Poland 1999-2003: 223-228; Cracow.

GEOINFORM UKRAINY (2005): Mineral resources of the Ukraine and the world at 01.01.2003. p. 51 – 69; Kiev. (in Russian)

GRUß, H., KANTELBERG, E.-O. & SCHIFFER, H.-W. (2002): Weltmarkt für Steinkohle. RWE Rheinbraun, 72 p.; Köln.
http://www.steinkohle-portal.de/medien/other/20030924141516.pdf

IEA (2002): Coal Information (2003 Edition). – 718 S.; Paris.

INTERFAX (2003 – 2005): Interfax MINING&METALS report. Volume XI - XIV.

JUCH, D., ROOS, W.-F. & WOLFF, M (1994): Kohleninhaltserfassung in den westdeutschen Steinkohlenlagerstätten. – In: DROZDZEWSKI, G., JUCH, D., LOMMERZHEIM, A. J., ROOS, W.-F., WOLFF, M. &WREDE, V.: Das Subvariscikum Nordwestdeutschlands: 189 – 307, 55 fig., 7 tab.; Krefeld.

KUSNETZOV, I. A. (1963): Geologiya mestorozhdenii uglya i goryuchnikh slantsev SSSR; t. 1, Ugolnye basseiny i mestorozhdeniya yuga Evropeiskoi chasti SSSR (Donetskii bassein, Dneprovskii bassein, Lvovsko-Volynskii bassein, mestorozhdeniya zapadnykh oblastei Ukrainy i Moldavii, Belorussii, severnogo Kavkaza i Zakavkazya). p. 1210; Moscow. (in Russian)

LUZIN, G. & ZHELEZNOVA, N. (1984): Coal basins and deposits of the CMEA member countries and Yugoslavia. 506 p.; Moscow. (in Russian)

MCCLOSKEY´S COAL REPORT (2004 – 2005): Report number 86 – 113.

MVEL NRW (Ministerium für Verkehr, Energie und Landesplanung des Landes Nordrhein-Westfalen) (2002): Bericht über die Tätigkeit der Bergbehörden des Landes Nordrhein-Westfalen im Jahr 2002. 150 p.
http://www.mvel.nrw.de/cipp/mvel/lib/all/lob/return_download,ticket,g_u_e_s_t/bid,7834/no_mime_type,0/~/Jahresbericht_2002.pdf

NIEC, M. (1995): Polish Approach to Resources/Reserves Classification. – In: Proceedings of Workshop on Reassessment of Coal and Mineral Deposits under Market Economy Conditions, Hanover, Federal Republic of Germany, December 4 – 6, 1995. 137 – 148.

NIEC, M. (2003): Coal resources and reserves in a changing economy. Polityka Energetyczna, Tom 6, Zeszyt 1, p. 5 – 11.

PRODUCTIVITY COMMISSION (1998): The Australian Black Coal Industry - Inquiry Report. Vol. 1, 378 p.; Canberra.;
http://www.pc.gov.au/inquiry/coal/finalreport/coal1.pdf

PRZENIOSLO, S. (1998): Bilans zasobow kopalin i wod podziemnych w Polsce – wg stanu na 31 XII 1997r., 368p.; Warszawa.

RIATEK (2003 – 2005): RIATEK News; http://www.riatec.ru/shownews.php

ROSINFORMUGOL (2004): Economy and Finances of the Coal Industry; http://mkt.rosugol.ru/ugol/help/obzor/economica.html (in Russian)

ROSINFORMUGOL (2005): Russian Coal Export Deliveries and Coal Imports to Russia in 2004. – 30 p., Rosinformugol JSC.

RUSSIAN MINISTRY OF ENERGY (2003): Russian Energetic Strategy until 2020. – 118 p.;
http://www.mte.gov.ru/files/103/1354.strategy.pdf (in Russian)

STATISTIK DER KOHLENWIRTSCHAFT E.V. (2005): Zahlen zur Kohlenwirtschaft. Heft Nr. 153, 73 p.; Essen und Köln.

TSHEREPOVSKI, V. F., BYKADOROV, V. S., GOLIZYN, M., V. & TROPKO, L. A. (2003): Ugolnaya basa Rossii, Tom II. Ugolnye basseiny i mestorozhdeniya Zapadnou Sibiri (Zapadno-Sibirskaya plita, Gorlovskii i Kuznetskii basseiny. Respublika Altai i Altaiskii krai), 604 p., Moscow. (in Russian)

VDKI (2005): Verein der Kohlenimporteure – Jahresbericht 2004. – 84 p.; http://www.verein-kohlenimporteure.de/VDKI-2004-deutsch.pdf

WALKER, S. (2000): Major coalfields of the world. IEA, 131 p.;London.

WELLMER, F.-W. (1992): Rechnen für Lagerstättenkundler und Rohstoffwirtschaftler. Teil 1, Berechnen und Bewerten von Lagerstätten sowie Umrechnen von Einheiten. - *Clausthaler tektonische Hefte*, **22**, 291 p.; Köln.

YAVORSKI, V. I. (1969): Geologiya mestorozhdenii uglya i goryuchnikh slantsev SSSR; t. 7, Kuznetskii, Gorlovskii basseiny i drugie ugolnye mestorozhdeniya Zapadnou Sibiri. p. 910; Moscow. (in Russian)