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# The IEA WEO 2008: Long term prospects for coal production

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A common day in the life of a Chinese coal truck driver
The traffic jam of solely coal trucks
on the highway from Mongolia to Bejing

Photo courtesy of Eefje Aarnoudse

The International Energy Agency expects coal production to nearly double by 2030 in their World Energy Outlook 2008 if no large scale governmental intervention occurs. In this post, I analyse the likelihood of this happening from the perspective of available coal reserves.

My conclusions are that if we look at a global level, taking coal reserve data at face value, the global IEA reference scenario for coal production to 2030 is possible. However, when focusing on China, the country that now produces 41% of all coal, the scenario is unlikely to occur because China possesses insufficient coal reserves to sustain production to 2030 at the level expected by the IEA. Only in a highly optimistic case, if China's coal reserves are more than double those currently known, will China be able to sustain coal production as expected in the IEA reference scenario.

Based on available coal reserve data and scenarios (EWG 2007; Tao and Li 2007), it is much more likely that China will reach a plateau in coal production somewhere between 2015 and 2025. The implications of this are significant, because it will be extremely difficult, if not impossible, to substitute other energy sources for coal on the vast scale needed for Chinese growth. The quality of reserve data is poor, however. Better reserve data is needed, particularly for China, to have certainty with respect to these findings.

In a follow up post, I will take a look at the short term prospects to 2015 for coal production, imports, exports, and prices in relation to the World Energy Outlook 2008.

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## Introduction

According to "common wisdom", coal is an abundant energy resource. The amount of coal underground is expected by most energy experts to be sufficient to sustain coal consumption until at least the end of the 21st century. Recently, doubts have been raised about this view by two independent studies analyzing the quality of coal resource/reserve data, as well as potential for future coal production (EWG 2007; Kavalov 2007). These reports make it clear that the quality of coal data is very poor and does not support the view that coal consumption can continue to grow in the second half of the 21st century. More importantly, obtaining sufficient coal could become problematic for coal importers in the next two decades due to coal export constraints. For the details on these reports, see an earlier post by Chris Vernon published on the Oil Drum.

In this post, I take an in-depth look at the coal production scenario of the IEA's World Energy Outlook 2008, building upon the research of EWG (2007) and Kavalov (2007). I do not make a distinction among the different types of coal (Bituminous, Sub-bituminous and lignite) in most of my analysis, as this makes the analysis easier, and I think that it will not change the picture to a significant extent.

**The Reference scenario for coal from the IEA WEO 2008**

In order to understand a scenario, we need to know how it has been constructed. The IEA looks at future coal production from two perspectives: the availability of the resource and the price of coal in different coal producing markets. Since the formulas used in the IEA model have not been published, I cannot tell in detail how the reference scenario has been created. The following snippet is the only piece of information available:

> "The coal module is a combination of a resources approach and an assessment of the development of domestic and international markets, based on the international coal price. Production, imports and exports are based on coal demand projections and historical data, on a country basis. Three markets are considered: coking coal, steam coal and brown coal. World coal trade, principally constituted of coking coal and steam coal, is separately modelled for the two markets and balanced on an annual basis." (IEA World Energy Model 2008)

From that piece of information and some personal experience with economic models, my guess is that model uses separate coal reserves and average price levels for each coal producing country. Based on the demand model that I described in an earlier post, coal production likely occurs in the model in the location where it is most cost effective to produce. Production likely also considers constraining import/export factors, leading to an expected pattern of coal production and trade. I expressly state that I could be wrong here, since no formulas are available. In any case, the World Energy Model of the IEA leads to the following reference scenario in the World Energy Outlook 2008:

*Table 1 - World Primary Coal Production in the IEA WEO 2008 Reference Scenario*

**Table 5.2 • World coal production in the Reference Scenario**
(million tonnes of coal equivalent)

| | 1980 | 2000 | 2006 | 2015 | 2030 | 2006-2030* |
|---|---|---|---|---|---|---|
| OECD | 1 378 | 1 384 | 1 446 | 1 566 | 1 684 | 0.6% |
| North America | 672 | 835 | 878 | 962 | 1 048 | 0.7% |
| *United States* | *640* | *778* | *824* | *894* | *981* | *0.7%* |
| Europe | 603 | 306 | 273 | 246 | 208 | -1.1% |
| Pacific | 104 | 243 | 294 | 358 | 427 | 1.6% |
| *Oceania* | *77* | *238* | *293* | *358* | *427* | *1.6%* |
| Non-OECD | 1 196 | 1 792 | 2 950 | 4 180 | 5 327 | 2.5% |
| E. Europe/Eurasia | 519 | 306 | 357 | 443 | 481 | 1.3% |
| *Russia* | *n.a.* | *167* | *205* | *295* | *354* | *2.3%* |
| Asia | 568 | 1 250 | 2 316 | 3 367 | 4 435 | 2.7% |
| *China* | *444* | *928* | *1 763* | *2 647* | *3 399* | *2.8%* |
| *India* | *77* | *209* | *283* | *352* | *607* | *3.2%* |
| Middle East | 1 | 1 | 1 | 2 | 3 | 2.2% |
| Africa | 100 | 187 | 203 | 257 | 271 | 1.2% |
| Latin America | 9 | 48 | 73 | 110 | 137 | 2.7% |
| World | 2 574 | 3 176 | 4 396 | 5 746 | 7 011 | 2.0% |
| *European Union* | *n.a.* | *306* | *273* | *232* | *180* | *-1.7%* |

* Average annual rate of growth.

As we can see from the table, the scenario shows continuing growth in coal production until 2030 in nearly all regions of the world except Europe. Average annual coal production growth on a world-wide basis between 2006 and 2030 is expected to be 2%.

**What is written in the IEA WEO 2008 about coal reserves?**

The International Energy Agency (IEA) uses coal reserve data from the World Energy Council's (WEC) survey of energy resources. This is the only public source of coal reserve data in the world; other publications with coal reserve data in the public domain always use data from the WEC Survey of Energy Resources. An example is the widely used BP Statistical Review of World energy 2008*.

The IEA uses the WEC coal reserve data without questioning its validity:

> "Coal is the most abundant and geographically dispersed fossil fuel. Proven reserves at the end of 2005 were 847 billion tonnes (WEC, 2007)...Current reserves are more than adequate to meet projected growth in coal demand through to 2030 in this Outlook." (IEA WEO 2008, page 127).

In my opinion, the unquestioned use of WEC data by the IEA is a core problem of the coal analysis in the World Energy Outlook 2008. Most of the data provided by WEC is of poor quality and outdated (EWG 2007). This is a result of the manner in which the WEC collects its data. It is collected by member committees of respective WEC member countries. Members of these teams are in nearly all cases not experts in the field of coal reserves/resources. They rely on asking institutes within their respective country to provide useful data, which is subsequently forwarded

to the editors of the survey of energy resources. Furthermore, every individual committee uses its own definitions of reserves and resources (WEC 2007, page III, 1 and 2).

The effect on coal data can be assessed by looking at the individual WEC reports. I have compared the data on coal reserves from the WEC Survey of Energy Resources 2001, 2004 and 2007. Earlier editions are not available digitally and have thus not been included. In the Survey of Energy Resources, 68 countries are reported to have coal reserves. Of these countries, a total of 39 have had unchanged reserves since the 2001 WEC Survey of Energy Resource (which contains reserve data as of the end of 1999). In addition to these 39 countries, another 8 countries show unchanged reserve data from the 2004 to the 2007 survey. I made a table of the reserves for all 68 countries, together with each country's latest known reserve year, which can be viewed by clicking this link. The top-15 coal reserve holding countries, which account for 96% of all coal reserves, are shown below in Table 2.

*Table 2 - WEC Survey of Energy Resources 2007 Coal Reserve Figures in Million tonnes (Top 15 coal reserve countries) - click for large version*

| Source: The Oil Drum | WEC Survey of Energy Resources 2007 Coal Reserve Figures in Million Tonnes (TOP 15) | | | | | |
|---|---|---|---|---|---|---|
| Million tonnes | Bituminous including anthracite | Sub-bituminous | Lignite | Total | Year of reported reserve figures | Change in reserves of survey 2007 versus 2004* |
| United States | 112261 | 100086 | 30374 | 242721 | 2005 | 1.6% downward revision |
| Russia | 49088 | 97472 | 10450 | 157010 | 1996** | No change |
| China | 62200 | 33700 | 18600 | 114500 | 1990*** | No change |
| Australia | 37100 | 2100 | 37400 | 76600 | 2005 | 2.4% downward revision |
| India | 52240 | | 4258 | 56498 | 2005 | 38.9% downward revision |
| South Africa | 48000 | | | 48000 | 1987**** | 1.5% downward revision |
| Ukraine | 15351 | 16577 | 1945 | 33873 | 2005 | 0.8% downward revision |
| Kazakstan | 28170 | | 3130 | 31300 | 2005 | 0.07% upward revision |
| Serbia | 6 | 379 | 13500 | 13885 | 2005 | 16.31% downward revision |
| Poland | 6012 | | 1490 | 7502 | 2005 | 46.4% downward revision |
| Brazil | | 7068 | | 7068 | 2005 | 35.8% downward revision |
| Colombia | 6578 | 381 | | 6959 | 2005 | 5.2% upward revision |
| Germany | 152 | | 6556 | 6708 | 2005 | 0.5% downward revision |
| Canada | 3471 | 871 | 2236 | 6578 | 1999 or earlier | No change |
| Czech Republic | 1673 | 2617 | 211 | 4501 | 2005 | 18.9% downward revision |
| **TOP 15 total** | **422302** | **261251** | **130150** | **813703** | | |
| **All countries total** | **430856** | **266837** | **149755** | **847488** | | |

* Revision in reserve figures from 2004 to 2007 report includes changes due to production, quality differences have not been incorporated in the reserve change figure but are based on comparing total figures of all coal

**Russia, WEC member committee is unable to obtain more data for reasons of confidentiality, hence reserves are retained from those given at end 1996

***China, Figures from the 1992 survey of energy resources have been retained since each new edition

****South Africa, data is based on an assessment published in 1987 which has been adjusted with annual production

The table of the top-15 has five anomalies that make it clear that the coal reserve data is of very poor quality:

**1)**The lack of a reserve updates from the 2nd largest coal reserve holding country, Russia. According to the WEC report this is due to confidentiality issues over Russian coal reserves. WEC has chosen to retain the latest Russian reserve figures available which date back to the end of 1996.

**2)**The lack of a reserve update from the 3rd largest coal reserve holding country, China. No valid

reason is given as to why the figures from 1990 have been retained. One argument is given to support the original data in the WEC report, but this argument leaves a lot to be desired. It is a reference to a paper that was presented at the 11th Session of the UN committee on Sustainable Energy co-authored by Professor Huang Shengchu, vice-president of the China coal Information Institute. In this paper the same reserve figure of 114.5 billion tonnes was published as the one published by WEC in 1992, which according to WEC "indicates a degree of continuity in the official assessments of China's coal reserves and supports the retention of the level originally advised by the Chinese WEC Member committee in 1991" (WEC 2007, page 26).

**3)**The large 38.9% downward revision in the 5th coal reserve holding country, India, in the 2007 Survey of Energy Resources versus the 2004 edition. This is a result of reporting reserves on a recoverable basis instead of reporting in-situ coal resource data (WEC 2007, page 2).

**4)**The lack of a reserve update from the 6th largest coal reserve holding country, South Africa. In the Survey of Energy Resources it is stated that the South African Department of Minerals and Energy has initiated a comprehensive survey to re-evaluate coal reserves but that no information was available as to the progress of this study. Hence the WEC member committee had to revert to using a number from the latest report from the Department of Minerals and Energy which dates back to 1987. This figure has been adjusted by WEC for all the coal produced since then.

**5)**The large downward revision in the 10th largest coal reserve holding country, Poland. The revision is due to a change in the type of reserves reported. Poland now reports only the ultimately recoverable amounts in developed deposits; previously reserves from all known coal deposits were reported.

These fives anomalies in some of the largest coal reserve holders in the world make it clear that there is a need to worry about the quality of coal reserve data. Better data is needed as coal reserves could very well be much lower than currently reported. The IEA, however, does not share this concern over data quality:

> "Coal is the most abundant and geographically dispersed fossil fuel. Proven reserves at the end of 2005 were 847 billion tonnes (WEC, 2007). . .Current reserves are more than adequate to meet projected growth in coal demand through to 2030 in this Outlook. However the rapid increase in demand in recent years has seen the global reserves-to-production ratio fall sharply, from 188 years in 2002 to 144 years in 2005 (WEC, 2007 and 2004). This fall can be attributed to the lack of incentives to prove up reserves, rather than a lack of coal resources. Exploration activity is typically carried out by mining companies with short planning horizons, rather than by state-funded geological surveys. With no economic need to prove long-term reserves, the ratio of proven reserve to production is likely to fall further." (IEA, WEO 2007, page 128)."

While the IEA does note that the Reserve to Production ratio is dropping sharply, mainly due to increasing demand**, this is not seen as a potential limitation to coal production. A favorable impression of future prospects is given by stating that a lot of coal is left to be explored. This is a hollow statement in the sense that these amounts left to be explored are not quantified by the IEA in any manner. Interestingly, this opinion is in stark contrast with that from the World Energy Council which states in its Survey of Energy Resources 2007, "After centuries of mineral exploration, the location, size and characteristics of most countries' coal resources are quite well known. What tends to vary much more than the assessed level of the resources (in other words,

the potentially accessible coal in the ground) is the level classified as proved recoverable reserves (that is, the tonnage of coal that has been proved by drilling etc. and is economically and technically extractable). (WEC 2007, page 13)." As I am not an expert on the topic of coal exploration I cannot judge the value of either statements. I do know that some large coal fields are still being found. A large coal field of 23 billion tonnes of total resources has been uncovered in China since last year (China People Daily's Online).

What I can say based on current (poor) WEC 2007 reserve figures is that the IEA WEO 2008 reference scenario appears to be a scenario that holds some merit. In this scenario, humanity will have used up 50% of all coal reserves by 2040, and 60% by 2050 (shown in figure 1 below). The remaining reserve percentage is calculated by adding historic coal production to current WEC reserve statistics. This is done based on the assumptions that no new coal fields will be discovered, that the current reserve figures are accurate, and that reserves will not be added due to technological improvements. While we know that all three of these assumptions are incorrect, such a scenario at least tells us that coal production will not outlast the 2nd half of the 21st century without significant increases in reserves, if coal usage continues to grow.

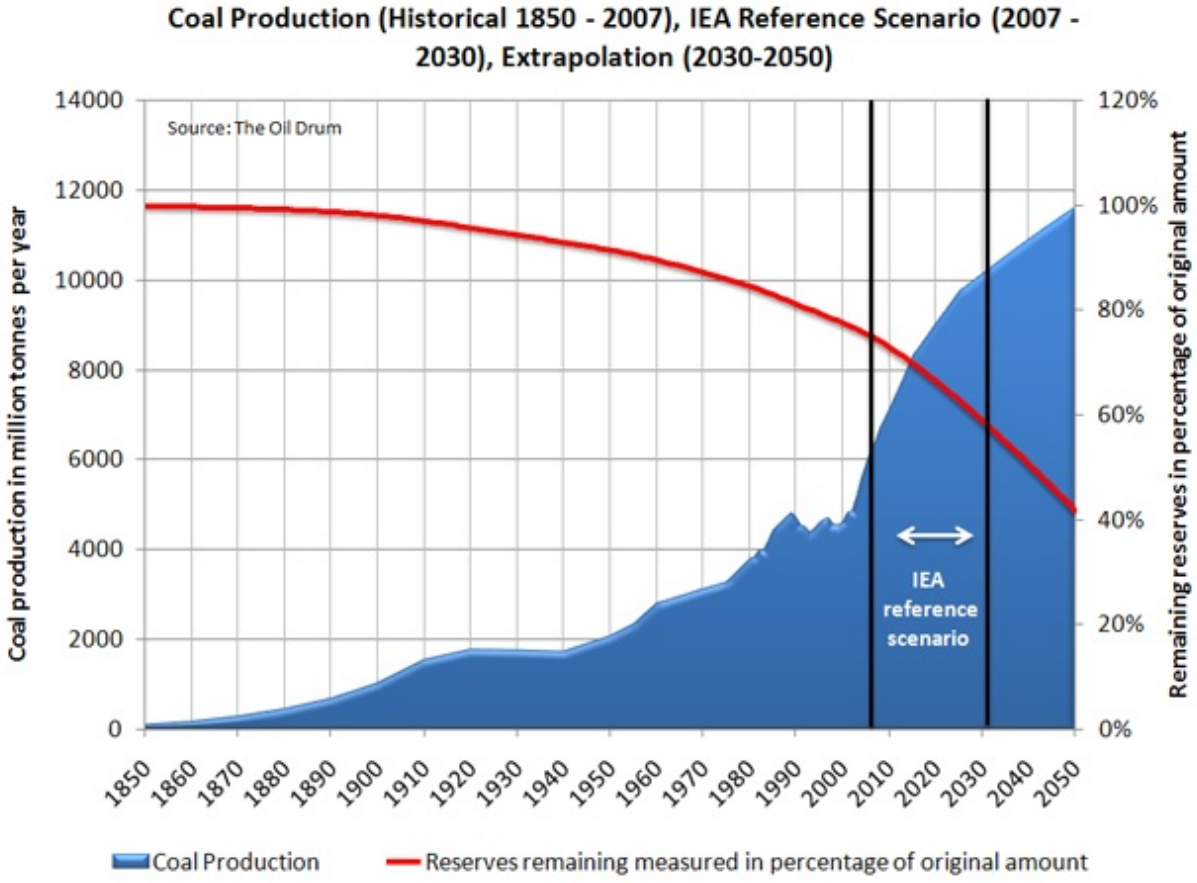


*Figure 1 - World Coal Production in blue with 1850 - 2007 (Historical), 2007 - 2030 (IEA WEO 2008 Reference Scenario), 2030 - 2050 (Extrapolation of IEA WEO 2008 reference scenario) and in red the reserves remaining measured in percentage of original amount of reserves.*

## The shape of coal production

In order to get a better understanding of the long term production of coal, we need to study the expected production path of this resource. This is one of the the big questions that remains unanswered by the IEA. What will be the shape that coal production takes on a country level and

a world level? The IEA just makes a forecast that ends in 2030 without any production shape analysis.

When looking at historical data from the United Kingdom, Germany and Japan, we see a very similar shape for coal production on a country level (Figure 2 below). Coal production reaches a plateau when around 30%/40% of coal reserves have been produced. The plateau lasts for several decades, after which a quite steep decline sets in. I have not studied the underlying economic and geological factors of this shape in detail. My hypothesis is that a physical limitation to coal extraction per time unit occurs due to logistics and energy/economic costs. In the beginning of extraction on a country level, more coal mines can be opened up and it makes economic sense to do so. After several decades the better coal grades in easily mineable coal seams have been depleted, and it becomes more difficult to extract more coal per unit of time out. The costs become too big to increase production; thus a plateau sets in. This is a simple hypothesis that needs to be explored further.

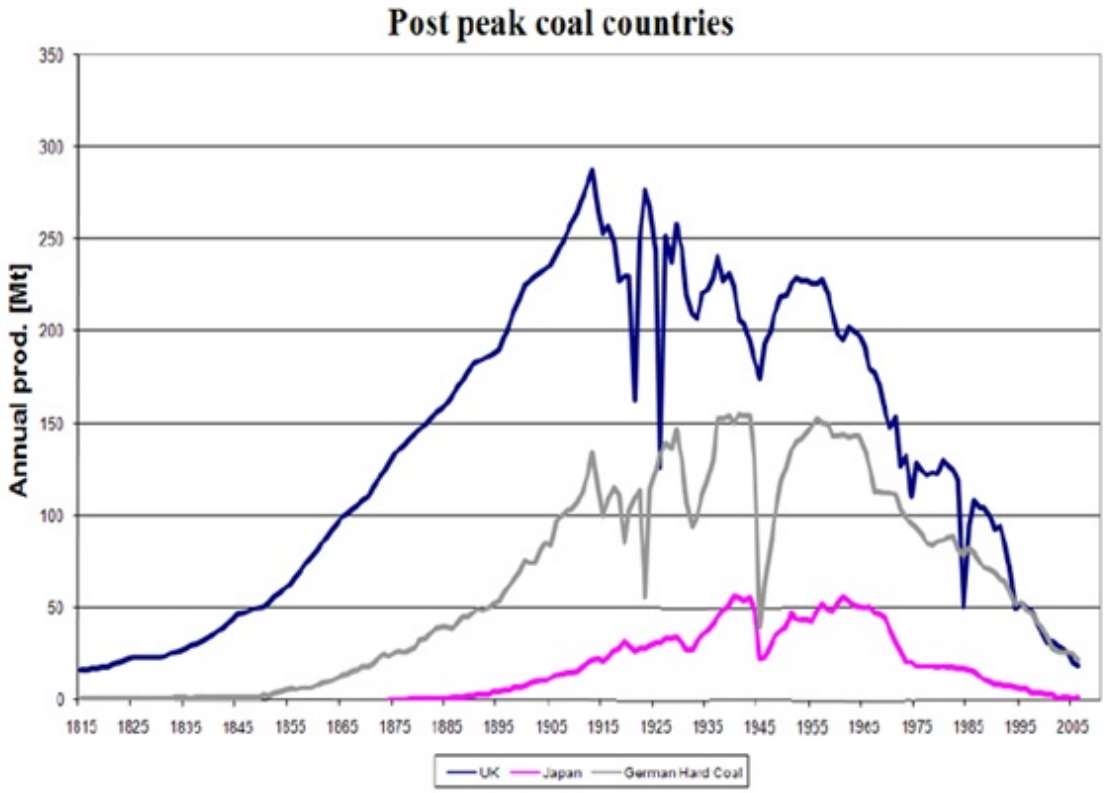


*Figure 2 - Coal production in the United Kingdom, Japan and Germany from 1815 until 2005. Source: Uppsala Global Energy Systems Group*

In case of the three examples shown above, the decline around 1960 began due to factors affecting the energy market. Between 1957 and 1960, there was an oversupply of coal as demand for coal decreased. The oversupply was caused by a combination of mild winters, several years of low economic growth, an increase of efficiency in the industrial sector, and a shift from coal to oil due to a favorable price difference (Messing 1988). The steep decline of production in Japan, Germany and the United Kingdom after 1960 continued because it became more economic to import coal than to produce it at home. Later on, after 1970, natural gas began to be substituted for coal in the electricity market.

The specific factors at play in these three examples should lead to caution in duplicating this particular shape of production to other countries and the world. In the coal studies that analyze the potential for future production, in my opinion, the duplication of a bell shaped curve with a

long plateau is done too readily, without sufficient analysis.

I think that the IEA should work to develop a sound analytical framework for the expected production shape of coal, especially because the geographic spread of coal could cause several important producing countries to run out of coal long before 2050 if usage continues without interference. The first country that is most likely to reach a plateau in coal production is China. This occurs because 41% of all coal production in the world came from the country in 2007.

**China - the key to knowing the long term future of coal**

Relative to its current production, China appears to possess sufficient reserves. China has 13.5% of total global reserves according to WEC statistics, which implies that the country extracts 2% of its reserves each year. However, China's coal extraction is growing rapidly at 12% on average in the past five years (18% in 2003 dropping each year since then to 7% in 2007). If the 2007 growth rate of 7% continues, China will be extracting 5% of its reserves per year by 2017.

According to the IEA World Energy Outlook 2008, this will not become a problem. The growth in Chinese coal production is expected to slow significantly, averaging 2.8% between 2006 and 2030, with growth continuing until 2030. If current WEC reserve figures are accepted at face value, it becomes clear that this scenario is not possible, as shown in Figure 3 below. The red line in the figure shows the percentage of reserves remaining based on adding historic production to the WEC reserve figure, and subtracting the reserves produced in the WEO coal production reference scenario for China from this number each year. As can be seen, China will have used up around 50% of its reserves by 2020, and 80% by 2030, in the IEA reference scenario for Chinese coal production.

Based upon empirical data from Germany, UK and Japan as shown above, it is much more likely that China will reach a plateau in coal production somewhere between 2010 and 2020. Again, I have to state as earlier, this is based on the assumptions that no new coal fields will be discovered, that the current reserve figures are accurate, and that reserves will not be added due to technological improvements. While we know that all three of these assumptions are incorrect, it at least becomes clear that the IEA Reference scenario for China is not possible without a very large increase in Chinese reserves.

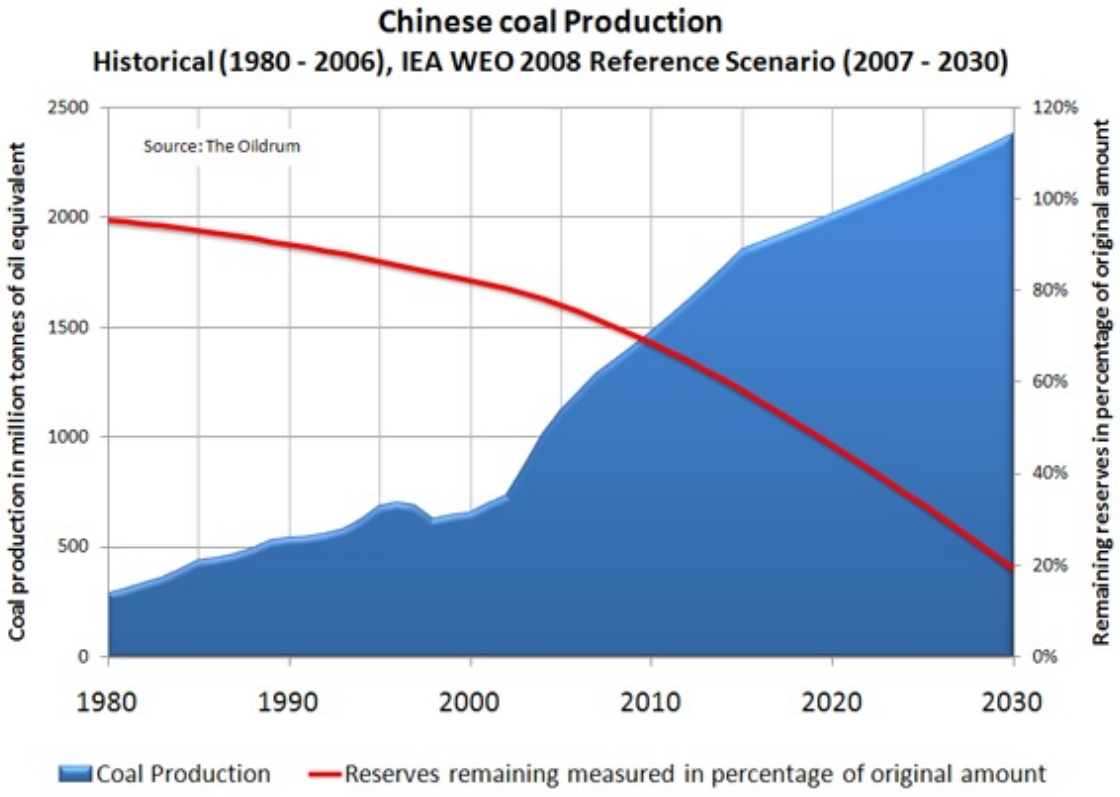


*Figure 3 - Chinese Coal Production in blue with 1980 - 2006 (Historical), 2007 - 2030 (IEA WEO 2008 Reference Scenario), and in red the reserves remaining measured in percentage of original amount of reserves.*

In the WEO 2008, the IEA does not state what assumptions were made in arriving at their scenario for Chinese coal production. However, some information is given in an earlier report, the World Energy Outlook of 2007. In the 2007 edition a more detailed look was taken on China and India, including Chinese coal production and consumption. Regarding Chinese coal resources and reserves the following is stated:

> "China's remaining coal resources are second only to Russia's, totalling 1003 billion tonnes (General Geological Bureau, 1999). These resources have been defined by exploration and mapping, but only 115 billion tonnes can be regarded as proven reserves, yielding a reserve-to-production ratio of around 50 years at current production levels. More recent assessments conclude that proven reserves could be as high as 192 billion tonnes (Barlow Jonker, 2007). A prospecting programme is currently under way to prove up more resources, using revenues from the competitive tendering of mining rights."(IEA WEO 2007, page 334)

The reference to Barlow Jonker in the piece above quoting 192 billion tonnes, as a potential figure for proven reserves, is the only piece of information that the IEA gives to support their Chinese coal outlook. Barlow Jonker is a daughter company of Wood Mackenzie. The report the IEA refers to is Barlow Jonker's China Coal Fourth Edition report from 2007 which is available at an unknown price (probably more than $10,000 dollars) through Wood Mackenzie's China coal market service.

From Barlow Jonker's statement of capability we learn the following about this report:

> "Barlow Jonker's 'China Coal 4th Edition 2007' is the most complete review of China's coal industry available on the market. The 3 Volume Study covers China's coal geology, coal production, transport, consumption and trade. Containing over 500 pages of information and 60 maps it is THE essential reference guide to all involved in and impacted by China's 2.3 billion tonne coal market.
>
> Vol I 'Industry Overview' provides over 250 pages of information on China's entire coal chain from detailed reviews of each province's coal geology, to government policy, coal transport, consumption, and trade. It contains Barlow Jonker's own expert opinion and analysis of a range of drivers shaping the industry and forward outlooks.
>
> Vol II 'Key Producers' has been expanded and contains detailed mine data sheets (including cost estimates) on 66 of China's largest coal producing companies that collectively control over 500 mines together producing over 1,000Mtpa. Also included are data on 230 new coalmine projects with combined new production capacity of over 800Mt. The level of detail, presentation, and analysis of this data exists nowhere else.
>
> Vol III 'Coastal Consumers' is a new addition to the Study examining coal demand in China's coastal provinces – the key region impacting on the international seaborne market. It contains data and analysis of each province's coal demand, including power stations and coke producers. It is essential information for exporters to China, as well as all those impacted by China's involvement in the international seaborne market." (Barlow Jonker 2007)

The report sounds like a worthwhile piece of information, but it is inaccessible due to high costs. Since we cannot read the report, no judgment can be made regarding the validity of the 192 billion tonnes coal reserves figure. However, what is possible is modeling Chinese coal production with a figure of 192 billion tonnes. Even better, to make my life easier, there already is a study in which Chinese coal production is modeled using a similar coal reserve figure. This analysis has been conducted by Tao and Li (2007) from China Northeastern University. In this study a coal reserve figure of 186.6 billion tonnes is taken that comes from the Chinese Ministry of Land and Natural Resources as of 2002. This figure is inserted in a bell shaped production formula after Laherrere (2000) by means of Stella modeling software. Their results show that Chinese production will begin to plateau around 2025, and the eventual decline sets in around 2035 (green curve in Figure 3 below).

A similar study to that of Tao and Li, based on much lower reserves, has been conducted by the Energy Watch Group (2007). This study concludes that China could reach a plateau in coal production already around 2015, if reserve figures are lower then WEC suggests (blue curve in figure 3 below). The EWG uses a coal reserve figure for China of 95.5 billion tonnes, which is the result of subtracting production since 1992*** from the WEC reserve figure.

The International Energy Agency reference scenario for Chinese coal production almost exactly matches the Tao and Li (2007) scenario until 2025. After that, the two forecasts diverge, with the IEA expecting continued increasing coal production in China until 2030 (purple curve in figure 3 below), while Tau and Li forecast a Chinese coal production plateau.

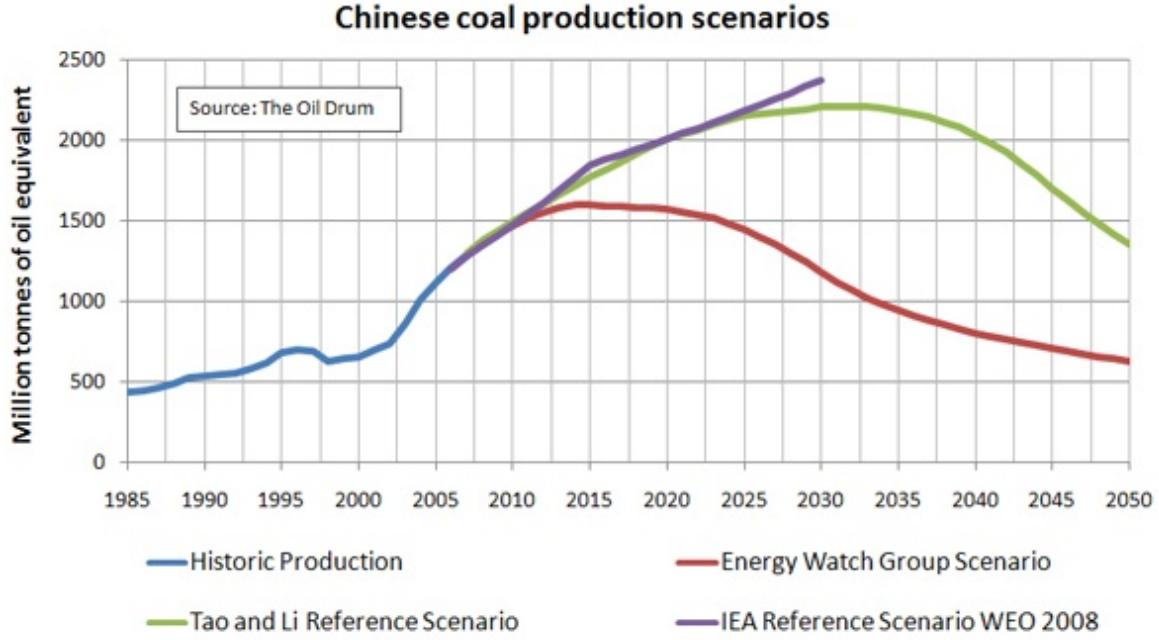


*Figure 3 - Chinese coal production scenarios after Energy Watch Group (2007), Tao and Li (2007), and IEA WEO (2008).*

The difference between the scenarios caused by doubling the reserve estimate is striking. If the Energy Watch Group scenario plays out, the world will be in significant additional trouble soon (on top of the current problems), since it is unlikely that China's growth boom can continue when Chinese coal production plateaus at the beginning of the next century. There are no energy sources that can grow quickly enough to substitute for China's appetite for more energy in such a short period of time, including the import of more coal. (I will come back to this in the third part of this series.) On the other hand, if Tao and Li's scenario plays out, there probably still is sufficient time for China to prepare for substitution of coal by other energy sources around 2030. In any case, the IEA scenario appears to be unfounded even if we look at a very optimistic coal reserve figure for China.

One of the first issues that needs to be sorted out to get a better grasp at future coal production is the actual state of Chinese coal reserves. As I was writing this post, I investigated whether there are other sources of data for Chinese coal reserves outside of the public domain that are not as expensive as Barlow Jonker's coal assessments. The only source that I found was China Coal Resource. This company gathers coal data based on an extensive resource/reserves classification assessment including grade quality, production location, and coal seam depth and thickness. The details could be found earlier here, but this section has been put into the subscriber part as of last week unfortunately. Subscriptions for one year to this data cost $700, which is a very affordable price. Furthermore I am informed by the company after inquiring that the reserves data has just been updated to reflect the latest data as of September of this year. All in all it looks like quite a promising source of data that could shed a great deal of light on China's coal production, and with China the entire world.

## Conclusions

In this post I analyzed the likelihood that the IEA WEO 2008 reference scenario for coal production can happen from a coal reserves perspective. My conclusions are that if we look at a global level and take the coal reserve data at face value, the data is supportive of the global IEA reference scenario for coal production to 2030 which shows on average coal production growth of

2% per year between 2006 and 2030. Beyond this scenario, further growth of coal production into the 2nd half of the 21st century is unlikely to happen without a significant increase in reserves.

However, inasmuch as 41% of coal production is now located in China, looking at whether coal production can match up with global reserves no longer makes sense. When looking at Chinese reserve data, it is not likely that the IEA reference scenario for Chinese coal production can occur, because the coal is simply not there based on current reserve figures. Only in a highly optimistic case, assuming China's coal reserves are more then double those currently known, will China be able to produce the amount of coal that the IEA expects in their scenario. Based on the available coal reserve data and scenarios (EWG 2007; Tao and Li 2007), it is quite likely that China will reach a plateau in coal production somewhere between 2015 and 2025. The implications of this are significant because it will be extremely difficult, if not impossible, to substitute other energy sources for coal in the quantities needed to maintain China's growth in consumption.

In order to be able to better assess the likelihood of a Chinese coal production plateau occurring and to study the effects of this on coal production on a global scale, better data and analysis of coal reserves in general, and for China specifically, is a necessity.

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**Notes**

*In the BP Statistical Review of World Energy 2008 it is stated that the coal reserve data shows proved reserves at end 2007. This is incorrect as the data is until end of 2005, as stated in the original source of the data, the Survey of Energy Resources 2007 by the World Energy Council.

**While the IEA states that the drop in the reserves to production ratio from 188 years in 2002 to 144 years in 2005 is solely due to demand, this is not the case. Coal reserves dropped from 909 billion tonnes in 2002 to 847 billion tonnes in 2005 (WEC 2007; WEC 2004), a difference of 62 billion tonnes. In the same time period 16.6 billion tonnes of coal have been produced (BP 2008). If coal reserves would not have been revised downwards due to other factors than the amount of coal produced, then reserves would have been 892 billion tonnes instead of 847, and the R/P ratio in 2005 would have been 151 instead of 144 years.

***The Energy Watch Group subtracts Chinese production since 1992 from the WEC coal reserve figure for China, as this was the year in which the last Survey of Energy Resources by the WEC

was published that contained new data on Chinese coal reserves. However, WEC normally publishes in their report data that is two years old (the 2007 report showed end 2005 data, the 2004 report end 2002 data etc.). I think it is likely that the 1992 report published end 1990 data. Since I have not been able to find the 1992 report I cannot confirm that this is the case. The Energy Watch Group has assumed that the 1992 report published 1992 data.