Coal Terminology: Resource & Reserve

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Note: All statistics from the US have been converted from short tons to metric tons.

Note: While the exact details may differ, this is basically the same measurement systems used for minerals and petroleum.

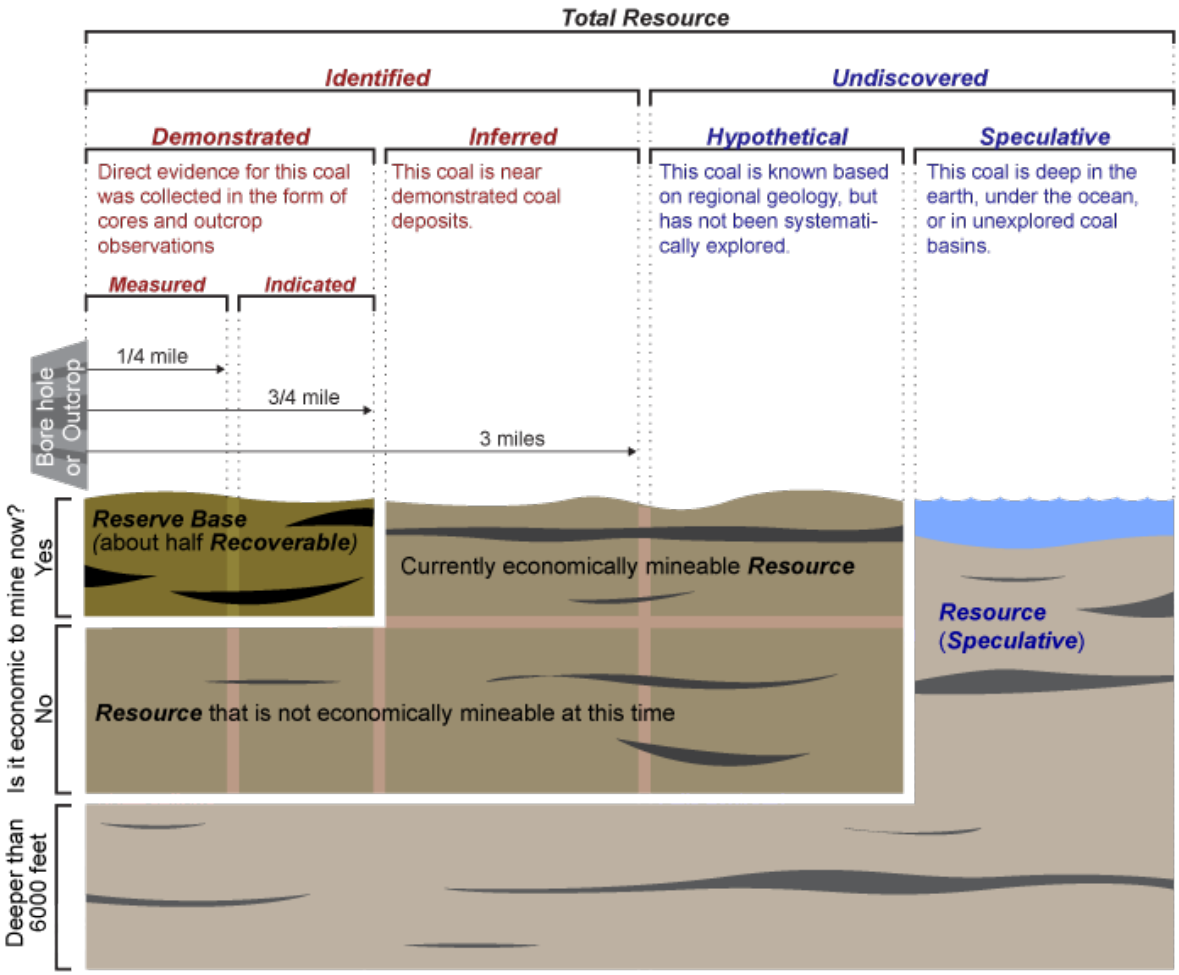
How much coal is there?

Behind the inconsistencies in reported numbers are important distinctions in how we measure the coal underground - and the difference between what exists, and what can be mined.

By almost any standards there is a lot of coal beneath the surface of the earth. The highest estimates put it at as much as 14.5 trillion tons (http://pubs.er.usgs.gov/usgspubs/b/b1412). At the current rate of use (http://www.eia.gov/energyexplained/index.cfm?page=coal_home#tab2) this much coal would last for well over 2000 years. However, most estimates of the reserves to production ratio (http://en.wikipedia.org/wiki/Reserves-to-production_ratio), a simple calculation of how long we could use coal at the current rate, fall in the range of 100-250 years. Even more pessimistic are recent studies suggesting that we might

only be sure of having enough coal until 2030 (http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11977), or that coal production will peak around 2025 (http://www.energywatchgroup.org/fileadmin/global/pdf/EWG_Report_Coal_10-07-2007ms.pdf) and decline thereafter.

While part of this discrepancy is about the fundamental geological question of how much coal is in the ground, most of the difference comes from inconsistency in terminology and definitions and disagreements about economics. This article covers how measurements of coal resources and reserves are measured and described. For a more detailed quantitative discussion of coal resources and reserves in the world, USA, and Alaska see our companion articles; Quantifying Coal (HowMuchCoal.html) and Peak Coal (PeakCoal.html).



COAL TERMINOLOGY (/figures/CoalTerminology/) — How much coal is there? It all depends on how you count it.

Reserve vs. Resource

Broadly defined the coal **resource** is how much coal is actually in the ground. The actual amount is of course unknown, but is estimated based on both direct measurements and inferences from geology. However the coal **reserves** of any particular place are defined as the amount of measured resource coal that could be expected to be economically mineable under the

current economical and technological conditions. Therefore coal reserves represent a small and changeable percentage of coal resources, changing based on the price of coal, the technology used to extract it, and other factors. Both resources and reserves are further subdivided into a number of categories. A brief definition of each of these categories follows, in decreasing order of geologic certainty.

Resource terminology

“Measured” - The amount of coal based on closely spaced, direct measurements such as visual confirmation on the surface, boreholes, or actual mines. Often includes information on coal rank and quality of coal (TypesOfCoal.html) as well. The specifications for this spacing and quality of measurements vary by country and between US states.

“Indicated” - The amount of coal based on a combination of direct measurements and reasonable geologic assumptions made with high confidence.

“Demonstrated” - This is simply a combination of measured and indicated resource as described above.

“Inferred” - This amount of resource is based on the assumed continuity of coal beds, both downwards into the earth and across the landscape from points of direct measurement. In the US a limit of 6000 ft deep is placed on inferred coal beds. For

reference, strip mining is limited to extracting coal up to a few hundred feet and underground mining is currently limited to around 3500 ft (http://pubs.usgs.gov/pp/1625f/).

“Identified” - This term refers to the combination of inferred and demonstrated resources as described above.

“Hypothetical” - This term refers to resources that are present in known but incompletely explored or unmapped coal beds, also limited to 6000 ft of depth and in the US, more than 3 miles from a measurement point. Additional exploration and measurements in a given area would move hypothetical coal to identified coal as appropriate.

“Speculative” - This term refers to coal outside all of the above categories and is rarely used in discussions of coal resources. Speculative resource would include things like coal deeper than 6000 ft or present on the continental shelf.

“Total Resource” - This term includes all of the categories above. Sometimes also called “resource base”.

Other resource terms encountered include “original resource” which is simply the amount of total resource historically present before the start of mining, and the inverse term “remaining resource”.

Reserve terminology

“Reserve base” - This term refers to coal which is both “demonstrated” (meaning we know it exists - see above) and is deemed to be economically and technologically mineable at any given time. In practice this often means only the shallower, thicker coal beds. It also varies by coal type, for example a seam of lower ranked coal has to be thicker than a seam of high-quality coal to be counted in the reserve base, because it is less economically feasible to extract the lower ranked coal. Therefore some of the demonstrated coal resource is counted as the reserve base, and some is considered subeconomic. As described below, the definition of reserve base can also vary significantly by country.

“Recoverable reserve” - This term refers to the amount of the reserve base that might reasonably be expected to be actually mined and used. The “recoverability” factor of coal depends on a number of factors such as the method of coal mining (CoalMining.html) used, but in general is considered to be about 50% of the reserve base. Sometimes also called “proved reserve” or “proven reserve”.

Additional considerations

Calculating how much of a given region’s demonstrated coal resources should actually be considered “reserves” depends on a complex interaction between technology, economics, and environmental regulations. For example a strict carbon tax

(http://en.wikipedia.org/wiki/Carbon_tax) would presumably dramatically shrink the size of reserves. Conversely, the successful development of new technology such as Underground Coal Gasification (UndergroundCoalGasification.html) could increase the size of coal reserves.

Additionally, uncertainties in the underlying resource estimates will also change the reserves - increasing as more coal is discovered, or decreasing as incompletely-mapped coal deposits turn out to be smaller than anticipated.

As a result of these kind of uncertainties, official estimates of coal reserves have changed over time, sometimes upwards but usually downwards. An extreme example of a change in coal reserves occurred in Germany in 2004. At that time the government downgraded the size of their “proven reserve” (http://energywatchgroup.org/wp-content/uploads/2014/02/EWG_Report_Coal_10-07-2007ms.pdf) from 23 billion tons to 0.183 billion tons, a reduction of over 99%. Changes can also occur in how the reserve base is defined, for example in 2007, Poland redefined the reserve base in that country to only include developed deposits, thereby removing over 6 billion tons (http://www.worldenergy.org/wp-content/uploads/2012/10/PUB_Survey-of-Energy-Resources_Interim_update_2009_WEC.pdf) from their reserve base. These uncertainties also have an effect on the investment climate relating to new coal projects. If investors are uncertain about the amount of coal actually available for production then they will be more hesitant to invest in expensive long-term coal

prospects, in particular carbon capture and sequestration (LowCarbonCoal.html), and so called “clean coal (http://en.wikipedia.org/wiki/Clean_coal)” projects.

Additionally, in almost all these calculations coal is treated as a single entity, when in fact coal varies widely in quality (TypesOfCoal.html), primarily heat content and in the presence of contaminants such as sulfur. Much of the world’s easily accessible and high-quality coal has already been mined, potentially leading to diminishing returns on energy output even if coal production continues at current levels.

Further Reading

> Coal Resources of the United States (USGS 1975) - Note: Requires free DjVu viewer (http://pubs.er.usgs.gov/usgspubs/b/b1412)

> Coal Resource Classification System of the U.S. Geological Survey (USGS 1983) - Note: Requires free DjVu viewer (http://pubs.er.usgs.gov/djvu/CIR/circ_891.djvu)