



Coal
Futures trading in
India

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Coal is currently the most abundant fossil fuel in the world with reserves which are estimated to last more than a century, well after oil and gas reserves have run their course. The introduction of coal futures trading in India provides the market with the right platform to get an in depth knowledge and understanding of the characteristics and factors that affect its supply-demand balance.

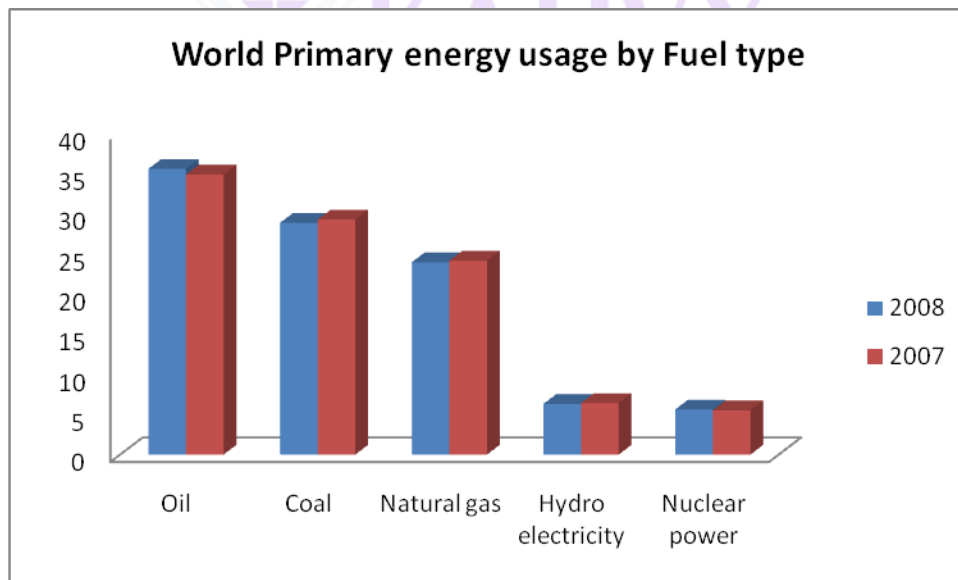
Contents

1. Coal: A brief Introduction	3
2. Varieties.....	4
3. Mining of Coal	6
4. World Reserves	7
5. Major producers and Consumers	8
6. Major Exporters and Importers	9
7. World Production and Consumption	10
8. Uses of Coal	10
9. Fuel substitutes.....	11
10. Correlation with other fuels	12
11. Indian Coal Industry.....	12
12. Contract details	14
13. Conversion factor.....	14
14. Factors affecting prices.....	14
15. Technical point of view	14
16. References	15

1. Coal: A brief Introduction

Coal is one of the three most widely used fossil fuels occurring inside the earth's crust. Together with oil and Natural gas the World primary energy consumption using fossil fuels is over 80 percent. Total primary energy consumption through coal has been close to 29 percent in 2007 and 2008 as shown in the figure below.

Coal is a black or brownish-black sedimentary rock that is composed of carbons and hydrocarbons. Fossil fuels are found inside the earth's crust and are formed by the application of extreme temperature and pressure on the dead remains of plants and micro organisms over a period of time which can go up to a few hundred million years. *The energy obtained from the burning of coal is actually the energy from sunlight stored by plants.* As plants die and decay this energy gets released. But under certain circumstances the decaying process gets interrupted and the energy is locked within the debris.



Source: BP Statistical review of World Energy 2009

Coal formation began in the carboniferous period which started some 360 to 290 million years back. The built up of silt and other sediments along with tectonic movements of the earth caused a structural and chemical transformation in the dead remains of plants. As they got buried deeper and deeper within

the earths crust they got subjected to extreme pressure and temperature that transformed them into coal.

The quality of a coal deposit is determined by several factors some of which are mentioned below.

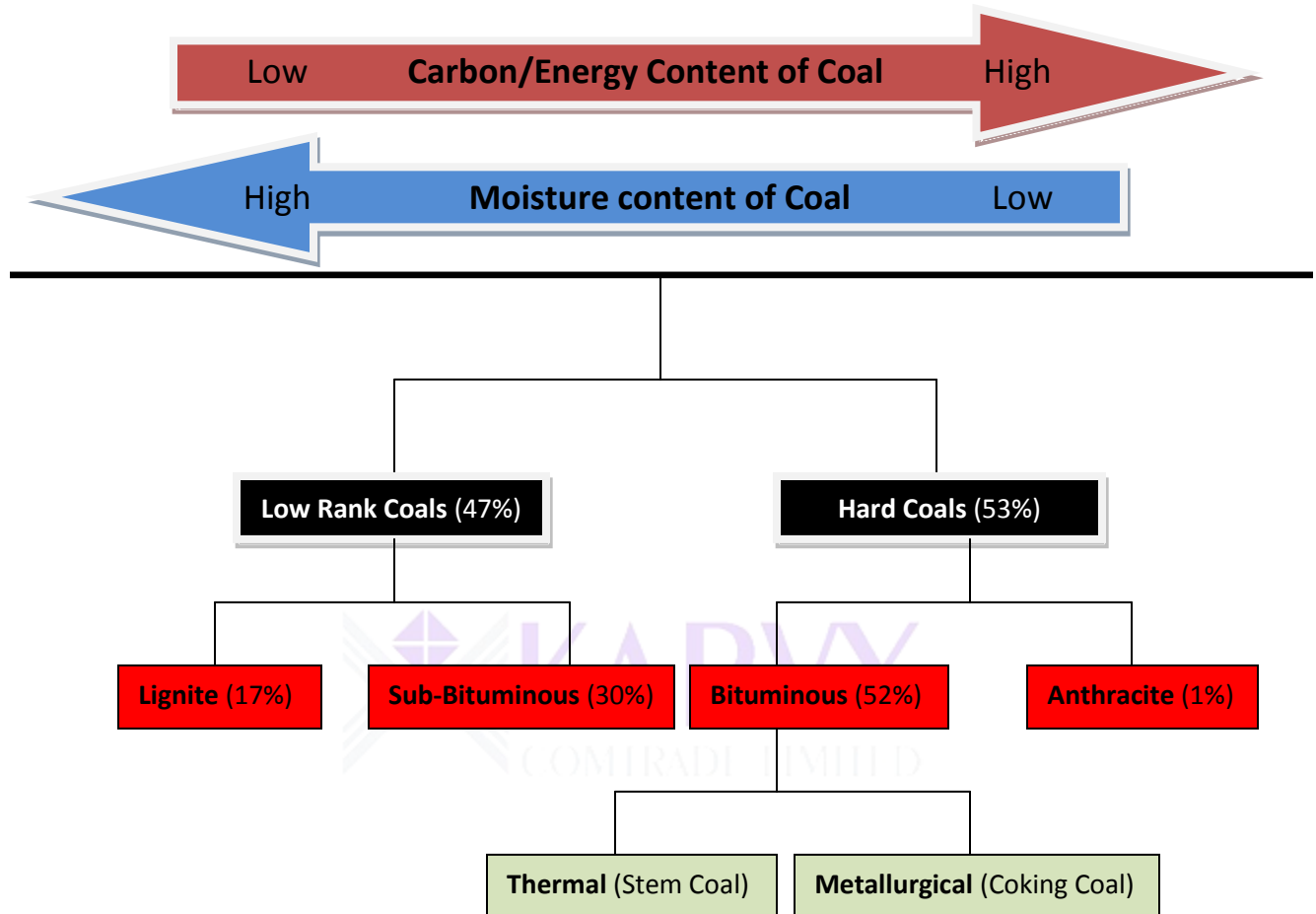
- a. Types of vegetation from which coal originated.
- b. The depth at which the remains of the vegetation are buried.
- c. Temperatures and pressure at those depths.
- d. The duration for which coal had been in formation.

Coalification is a measure of the change undergone by the decaying vegetation (peat) to transform into coal. It determines the physical and chemical properties of coal and is otherwise determined as the rank of coal.

2. Varieties

There are four different varieties of coal depending on the above mentioned factors. They are as follows

- a. **Lignite:** This is the lowest rank of coal available and has the lowest energy content among the available varieties of coal. The carbon content ranges from 25 to 35 percent.
- b. **Subbituminous:** It has relatively higher heating value compared to lignite and has a carbon content of 35 to 45 percent. This type of coal is at least 100 million years old.
- c. **Bituminous coal:** It is composed of 45 to 86 percent carbon content and has a heating value that is two to three times that of lignite. It has an age lying in the range of 100 to 300 million years. Talking about U.S this variety accounts for almost half of U.S coal production. It is primarily used for steam and electric power generation.
- d. **Anthracite:** It is the highest rank of coal and contains 86 to 97 percent carbon. It is used for residential and commercial space heating. Otherwise called as hard coal it contains a high percentage of fixed carbon and low percentage of volatile matter. It is the cleanest burning fuel and the most efficient among the varieties.



Source: World coal institute

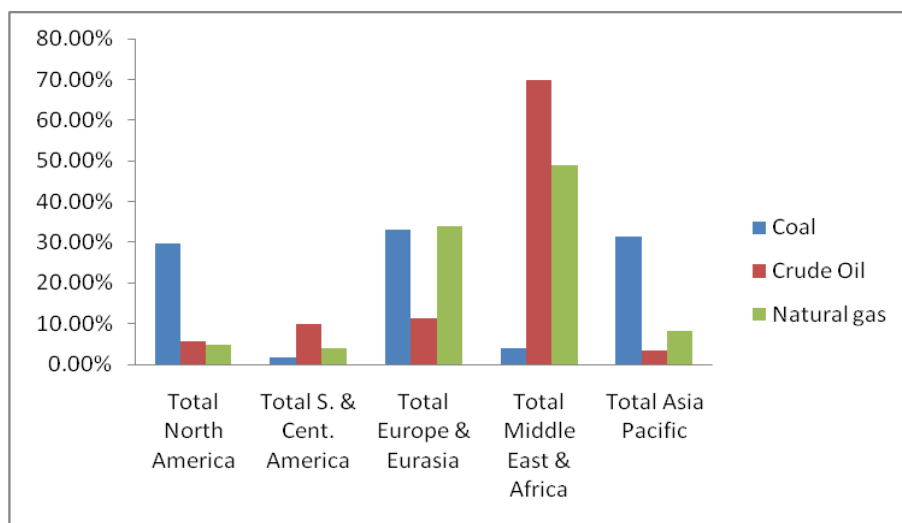
The figures in brackets in the above figure indicate the percentage of world reserves contained in each variety. Going by the above figures bituminous reserves are the highest among all coal varieties at 52 percent in the world. Bituminous coal is subdivided into Thermal coal and metallurgical coal. Anthracite has the higher carbon and energy content among all the varieties while lignite has the least energy content. However anthracite reserves are minute compared to reserves of other kinds of coal. As the moisture content in the coal increases the carbon content and the energy content fall. Overall the reserves of low rank coals and hard coals are fairly distributed with hard coal deposits holding a little over 50 percent of all coal reserves.

Coal Variety	Use
Lignite	Largely for Power generation
Sub-Bituminous	Power generation, Cement manufacture and Industrial uses
Thermal Steam coal	Power generation, Cement manufacture and Industrial uses
Metallurgical coking coal	Manufacture of Iron and Steel
Anthracite	Domestic/Industrial including smokeless fuel

3. Coal Mining

Mining of the coal is done through **surface mining** or **underground mining**. When coal deposits are found at shallow depths generally up to 200 feet surface mining is done while if the deposits are found a few thousand feet beneath the earths crust underground mining is implemented. In surface mining giant machines are used to uncover the surface soil or rock. Once the coal beneath is extracted the pit is filled up to restore it to its original state. In underground mining coal workers are lowered into underground locations where coal exists. Once the coal is lifted up to the surface it is transported through a conveyor belt to a near by plant where the coal is cleaned up to improve its heating value.

Source: BP Statistical review of World Energy 2009

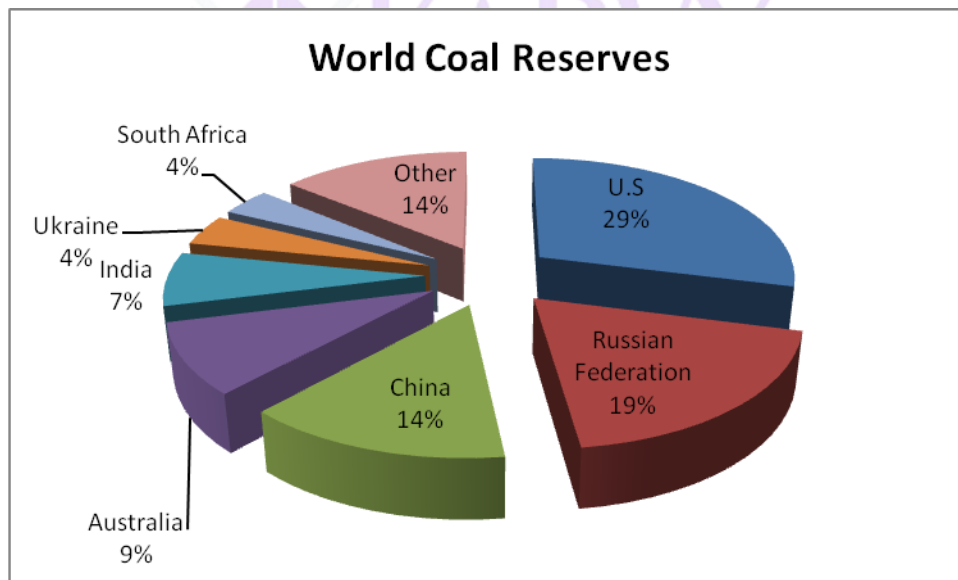


The figure shows the distribution of coal, oil and gas reserves in different regions across the world. Going by the figure Asia, Europe and North America have significant coal reserves while Middle East has significant oil and gas reserves.

4. World Reserves

According to world coal institute over 840 billion tonnes of coal reserves are available in the world. In other words the economically recoverable reserves will last 130 years whereas Oil and Natural gas reserves will last upto 42 years and 60 years respectively.

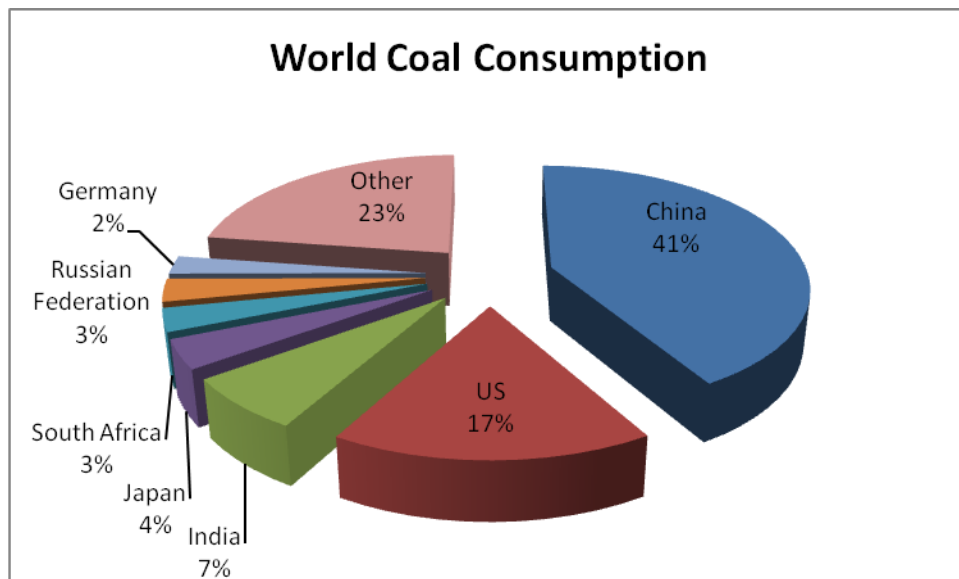
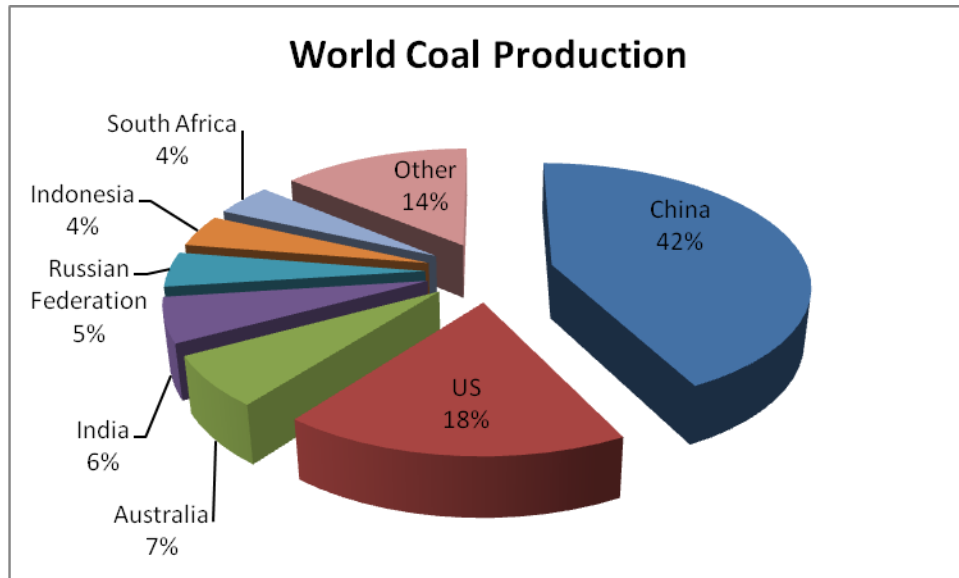
From the figure below it can be seen that U.S has the largest coal reserves in the world followed by Russian federation and China. Other countries which have substantial reserves are Australia, India, Ukraine and South Africa. Over the years the RP ratio has been on a decline which has prompted speculation on whether the world has reached the peak coal. Peak coal refers to the point of time when world coal production has reached a peak and from there on production will decline irreversibly.



Source: BP Statistical review of World Energy 2009

5. Major producers and Consumers

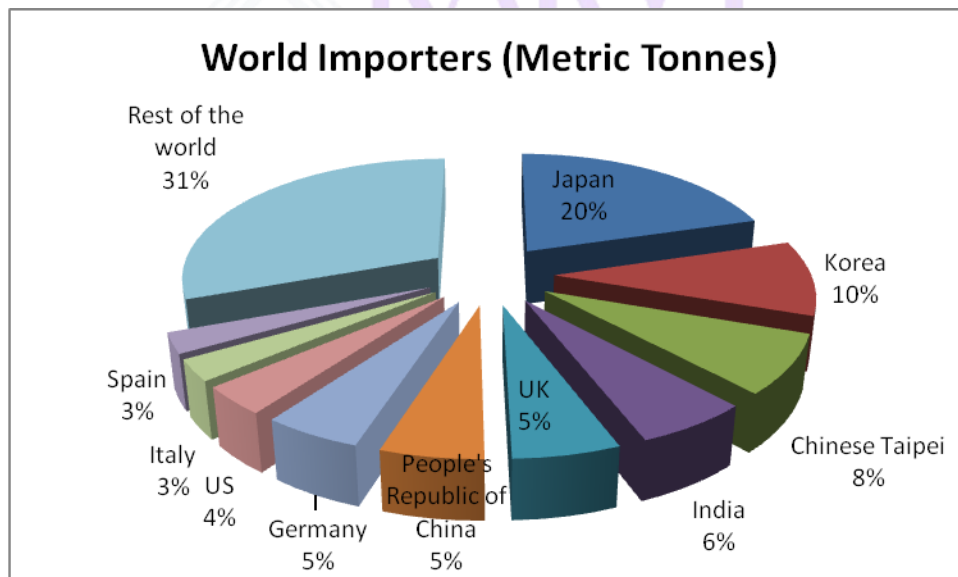
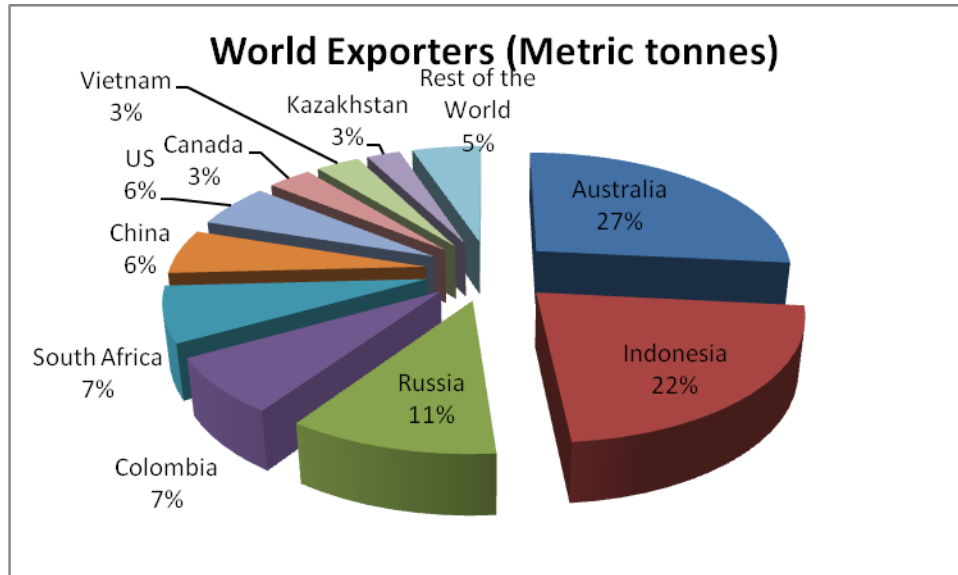
China occupies the first place in terms production of coal in the world. It is followed by U.S, Australia, India and the Russian federation. Coming to world consumption China, U.S and India are among the top 3 consumers in the world. Together the top 5 consume more than 70 percent of all coal consumed in 2008.



Source: BP Statistical review of World Energy 2009

6. Major exporters and Importers

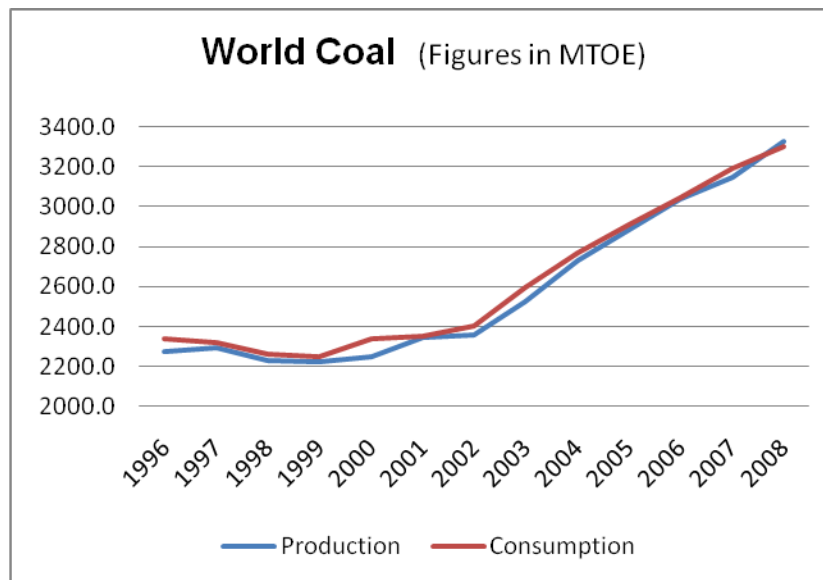
The figure shows Australia is the largest exporter in the world. Asia dominates the import market with China, India, Japan and Korea among the top 5 Importers.



Note: The data shown above is for the year 2007

Source: IEA 2008

7. World Production and Consumption



Note: MTOE stands for the million tonnes of oil equivalent. It is a unit of energy.

1 Tonne of oil equivalent: It is the amount of energy released by the burning of 1 tonne of crude oil.

The figure above refers to world production and consumption. As shown below consumption has been going slightly over coal production year on year. The figures are provided in million tonnes of oil equivalent.

Coal (Metric Tons)	
Total World Reserves Jan 1st 2009	841086192000
World Usage per second	203
Estimated date of exhaustion	15:35 May 19, 2140

Source: Energy.EU

The table above indicates that currently the world uses around 203 tons of coal per second. At this rate the current reserves which total over 840 billion tons should last for nearly 130 years from now on.

8. Uses of coal

- The main purpose of coal is for electricity generation. More than 50 percent of the electricity generated in America comes from coal while over 90 percent of the coal consumed in U.S is used for electricity generation. In 2006 over 40 percent of electricity generated in the world came through

coal which is by far the highest for any fuel type. In 2030 coal is expected to continue its dominance in electricity generation producing 44 percent of total electricity produced in the world. In INDIA coal contribution to electricity generation was a huge 69 percent according to IEA 2008 while in countries like South Africa, Australia and Poland the figure was between 80 to 95 percent.

Coal after being cleaned at a plant is crushed in to a powder or small pieces to increase the surface area which allows it to burn more quickly. The powdered coal is blown in to the combustion chamber of a boiler. Here hot gases/temperatures produced are used to convert water present in tubes adjoining the boiler to steam. High pressure steam is then passed through a turbine. The shaft of the turbine has thousands of propellers like blades which move the shaft at a very high speed. An electric coil wound around the shaft when rotated in the presence of magnetic field produces electricity.

- **Industry purpose:**

Ethylene and Methanol that are obtained as separate ingredients from coal are used in making plastics, tar, synthetic fibers, fertilizers, and medicines. It is also used in concrete and paper industries.

- Coal that is baked in hot furnaces produces coke that is used in the process of smelting where by a metal like steel can be produced from its ore (Iron ore).The high temperatures that are produced in the use of coke give strength and flexibility for steel.
- Coal gasification is used to produce syngas, a mixture of carbon monoxide and hydrogen gas. This syngas can then be converted to motor fuels like gasoline and diesel using a process called Fischer-Tropsch process.

9. Fuel substitutes:

The single toughest competition to coal comes from Natural gas as Natural gas is also significantly used for electricity generation and is a cleaner burning fuel compared to coal. Natural gas burns comparatively cleaner compared to coal while coal releases almost double the amount of carbon dioxide released by Natural gas. But since Natural gas reserves will last a little over 60 years compared to coal reserves which are expected to last for the next 130 years the world will be more dependent on coal.

10. Correlation of other fuels with Coal

Data Frequency	Data period	Crude oil	Natural gas	Gasoline	Heating oil
Daily prices	2008-2009	0.334	0.041	0.325	0.128

Since coal futures had been introduced on ICE there has not been much of a correlation between coal and other fuel price movements as evident from the table.

Unit: A general measurement used for calculating the mass of coal is a metric ton or a short ton. A short ton is the weight equal to 2000 pounds or around 907.19 kg. The world production stood at 7081.1 million short tons while consumption was slightly lower at 7073.7 million short tons.

One cubic feet of natural gas has energy content of 1027 Btu (British thermal units) while 1 tonne coal has 16,200,000 to 26,000,000 Btu. Coal prices needed to generate the same amount of energy as one cubic feet of gas lie in the same range.

11. Indian Coal industry

State	Geological Resources of Coal (in Million Tonnes)			
	Proved	Indicated	Inferred	Total
1. Jharkhand	39480	30894	6338	76712
2. Orissa	19944	31484	13799	65227
3. Chhattisgarh	10910	29192	4381	41483
4. West Bengal	11653	11603	5071	28327
5. Madhya Pradesh	8041	10295	2645	20981
6. Andhra Pradesh	9194	6748	2985	18927
7. Maharashtra	5255	2907	1992	10154
8. Uttar Pradesh	866	196	0	1062
9. Meghalaya	89	17	471	577
10. Assam	348	36	3	387
11. Bihar	0	0	160	160
12. Arunachal Pradesh	31	40	19	90
13. Sikkim	0	58	43	101
14. Nagaland	9	0	13	22
Total	105820	123470	37920	267210

Note:

- Proven (Measured) Reserves.* Reserves for which (a) quantity is computed from dimensions revealed in outcrops, trenches, workings or drill holes, grade and/or quality are computed from the results of

detailed sampling and (b) the sites for inspection, sampling and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth and mineral content of reserves are well- established.

- b. *Probable (Indicated) Reserves.* Reserves for which quantity and grade and/or quality are computed from information similar to that used for proven (measured) reserves, but the sites for inspection, sampling, and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for proven (measured) reserves, is high enough to assume continuity between points of observation.
- c. *Inferred reserves.* Reserves that haven't been physically proven but had been projected to exist through data analysis.

Coal Resources in India as of 1.4.2009 (in Million Tonnes)

Type of Coal	Proved	Indicated	Inferred	Total
(A) Coking				
<i>Prime Coking</i>	4614	699		5313
<i>Medium Coking</i>	12449	12064	1880	26393
<i>Semi-Coking</i>	482	1003	222	1707
Sub-Total Coking	17545	13766	2102	33413
(B) Non-Coking	87798	109614	35312	232724
(C) Tertiary Coal	477	90	506	1073

Non-Coking coal is mainly used for power generation and also used in Cement, Fertilizer, Glass, Ceramic, Paper, Chemical, Bricks manufacturing and for other heating purpose.

Coal imports by India (in Million Tonnes)

Coal	2002-03	2003-04	2004-05	2005-06	2006-07
Coking Coal	12.95	12.99	16.93	16.89	22.00
Non-coking Coal	10.31	8.69	12.03	21.70	23.00
Coke	2.25	1.89	2.84	2.62	3.80
Total Import	25.51	23.57	31.80	41.21	48.80

Source: GOI Ministry of Coal, Geological survey of India.

12.Contract details:

	ICE Inter Continental Exchange	MCX
Symbol	XWA	TCOAL
Price quotation	\$/MT	Rs/MT
Tick Size	\$0.05/MT	Rs 1 /MT
Contract size	1000 MT	100 MT
Active contracts	70	4
Coal description	New Castle coal	New Castle (Non Coking coal)

13.Conversion /Parity Factor:

Since New castle ICE coal futures are being taken as the standard for pricing New castle (Non Coking coal) futures on MCX the prices on ICE are converted to Indian rupees to get parity pricing per Mt for coal futures on MCX.

Example : If ICE FUTURES for September delivery are priced at \$75 per tone and if the conversion rate for USD/INR is 49 then futures on MCX are priced at $75 \times 49 = \text{Rs}3675$ per tonne.

14.Factors affecting prices

- As coal is a major component for electricity generation in India, Prices of coal are going to be determined by prices for electricity or vice versa.
- Since the Indian consumption is higher than production and looking at recent trend in deficit which had been steadily increasing over the years prices are expected to move up.
- One of the factors to look is the USD/INR exchange rate. As Indian imports are increasing with each year it inevitably becomes costlier for Indian importers of coal to import as the INR depreciates with respect to USD and vice versa.
- As carbon dioxide emissions from coal are high stringent rules and regulations from environmental protection agencies or the government might restrict the use of coal.

15.Technical view

ICE -New Castle- COAL-(XWA) - The coal futures at ICE exchange is currently trading around \$69 levels. Market is expected to move higher having resistances at \$75/78 and then \$85 levels. Likewise, on the lower side the supports are at \$60. We expect coal futures to trade higher in the long run.

Supports: \$60, \$53.

Resistances: \$75-\$78, \$85.

16.References

- World coal institute
- BP Statistical review of world energy
- www.eia.doe.gov
- Wikipedia
- Coal.nic.in



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