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Implications and Challenges of Coal as a Source of Energy

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Abstract: *The high tempo of industrialization that was precipitated by industrial revolution changed the pattern of energy use. High temperatures are necessary when heat is to be converted into mechanical energy and these high temperatures are easily derived from high-energy concentrated sources. Thus apart from the depletion of wood as a source of energy, the quest for high energy concentrated sources led man to discover fossil fuels and their conversion principles. Coal, the most abundant fossil fuel has a distribution that is so wide that it is usually not necessary to import or export large amount of it. Incidentally most of the major industrialized nations have large coal deposits, thus further reducing the need for large-scale international trade in coal. Using old and new literatures, and interpolating and extrapolating some of the information, the amount of coal that has been used till date was estimated and its effects determined. It was also deduced that the world total consumption of coal from 1700 to 2011 which was estimated to be 175,186,562,325 tonnes also emitted an estimated amount of 642,935 million tonnes of CO_2 into the atmosphere while world total coal reserves on the planet earth pre-industrial revolution was estimated to be 1,036,124,562,000 tonnes.*

Keywords: *Coal, Consumption, Reserves, Atmosphere, Emitted, CO_2,*

I. Introduction

Before the industrial revolution, energy needs were modest, for heat, man relied on the sun or burn wood or straw when the sun fails while for transportation, the muscle of animals and the power of the wind in sails took man to every corner of the world. Similarly, animals were used to do works that could not be done with man's power while water and wind drove the simple machines that were later invented to grind the grains and pumped water. The high tempo of industrialization that was precipitated by the industrial revolution that started in Britain changed the pattern of energy use. High temperatures are necessary when heat is to be converted into mechanical energy and these high temperatures are easily derived from high-energy concentrated sources. Thus apart from the depletion of wood as a source of energy, the quest for high energy concentrated sources led man to discover fossil fuels and their conversion principles. Today, fossil fuel powers most of the conventional technologies in industries, transportation, agriculture and domestic life. Fossil fuels are combustible substances of organic origin capable of exothermic reaction in the presence of oxygen supplied directly or extracted from air (Crawford 1987; Gaver et al, 1986;Meadows and Meadows, 1992;).

Coal, the most abundant fossil fuel, is thought to be partially decayed remains of vegetation, which grew on wet lands such as swamps, bogs and marshes.This compacted vegetation in the absence of air and under the influence of high temperature and pressure will continue to undergo transformation. As the aging process progresses, the coal become harder, hydrogen and oxygen content decreases, and the carbon content increases(LeBel, 1982; Nef, 1977; Masters, et al 1997;).

The distribution of coal is so wide that it is usually not necessary to import or export large amount of coal. Incidentally most of the major industrial nations have large coal deposits, thus further reducing the need for large-scale international trade in coal. It is impossible to estimate accurately the amount of mineablecoal in the world. Coal is a good industrial and domestic fuel. There are technologies for its conversion into other types of fuel that can prime small units like cars but the cheap availabilityof petroleum resources is making these technologies competitively expensive at least for the now(Pearce and Turner, 1998; Ross and Williams, 1981).

Coal is composed primarily of carbon along with variable quantities of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen,(Blander, 2011). Throughout history, coal has been a useful resource. It is now primarily burnt for the production of electricity. Coal is the largest source of energy for the generation of electricity worldwide, as well as one of the largest worldwide anthropogenic *(Scott,(2008)*) sources of carbon dioxide released (Wikipedia). Coal is burnt to produce heat energy and is used to manufacture steel. Fuel companies also often convert coal into energy transportable fuel (gasoline and diesel) which is produce through the process of thermal or catalytic cracking. The resulting fuel also known as synthetic fuel could be liquid or gaseous fuel. The aim of this work is to investigate some of the effects of the use of coal on the environment.

II. Methodology

Usingold and new literatures, and interpolating and extrapolating some of the information, the amount of coal that has been used till date can be estimated and its effects determined. Coal mining can result in a

number of adverse effects on the environment. Surface mining of coal completely eliminates existing vegetation, destroys the genetic soil profile, displaces or destroys wildlife habitat, degrades air quality, alters current land uses, and to some extent permanently changes the general topography of the area mined. During the burning of coal, carbon dioxide (CO_2) which is the main byproduct is released. The contribution of CO_2 to global climate change is one of the fundamental problems of fossil fuel on the economy.

Carbon dioxide (CO_2) is a colour less and odour less gas formed by the combustion of carbon and the respiration of animals and is considered a greenhouse gas. There are both natural and human sources of carbon dioxide. The natural sources include decomposition, ocean release and respiration. Wright, Kemp, & Williams (2011), defined carbon footprintas the sum of all emissions of CO_2 (carbon dioxide), which were induced by humans' activities in a given time frame. Usually a carbon footprint is calculated for the time period of a year. Since the industrial revolution atmospheric concentration of carbon dioxide has been rising. Seventy-two percent (72%) of the totally emitted greenhouse gas is CO_2. It is a very important greenhouse gas since when released into the atmosphere it remains for 100 to 200 years leading to its increasing concentration in the atmosphere which in turn causes average temperature on the earth to rise.

III. Results

Coal proved reserve is generally taken to be those quantities which geological and engineering information indicates with reasonable certainty can be recovered in the future from deposit under existing economic and operating conditions.The rate of production and consumption combined with the proved reserves are as shown in table 1. To estimate total amount of coal that have been mined and used from the pre-industrial revolution era, that is, from the year 1700, tables 2 was generated by interpolation and extrapolation from table 1. And adding the total consumption of 175,186,562,325 tonnes from 1700 to 2011 and its present proved reserves of 860,938,000,000 tonnes it will give the estimated amount of the pre-industrial coal reserves. Consequently, the pre-industrial coal reserve is estimated at about 1,036,124,562,325 tonnes.

Table 1: World Coal Production, Consumption and Proved Reserves

Year	Total World Production Million Tonnes	TOTAL World Consumption Millions Tonnes	Total World Proved Reserves Million Tonnes
1991	4557.127	3525.523	981780
1992	4519.215	3485.793	981499
1993	4395.781	3496.961	980585
1994	4484.125	3522.259	981239
1995	4605.409	3616.11	982138
1996	4680.157	3679.829	982692
1997	4730.399	3705.555	983064
1998	4651.902	3687.372	982482
1999	4638.229	3710.803	982381
2000	4701.418	3842.99	982849
2001	4917.917	3857.369	984453
2002	4960.761	3957.91	982545
2003	5313.802	4273.09	966847
2004	5723.105	4599.652	948646
2005	6049.043	4831.313	934153
2006	6356.513	5085.207	920478
2007	6588.29	5292.964	910171
2008	6822.116	5384.994	899773
2009	6904.639	5421.432	896103
2010	7254.589	5721.834	880541
2011	7695.441	6033.433	860938

Source: British Petroleum Statistical Review (2012)

Table 3: Estimation of Coal Consumption

Year	Tonnes	Year	Tonnes	Year	Tonnes
1700	3,318,300	1960	1942382168	1990	3575284000
1710	4,258,485	1965	2311730000	1991	3525523000
1720	5,198,670	1966	2338761000	1992	3485793000
1730	6,138,855	1967	2303223000	1993	3496961000
1740	7,079,040	1968	2337395000	1994	3522259000
1750	8,019,225	1969	2390199000	1995	3616110000
1760	8,959,410	1970	2428873000	1996	3679829000
1770	9,899,595	1971	2413553000	1997	3705555000
1780	10,839,780	1972	2447640000	1998	3687372000
1790	11,779,965	1973	2516662000	1999	3710803000
1800	12,720,150	1974	2513994000	2000	3842990000

1810	19,541,100	1975	2570501000	2001	3857369000
1820	31,482,837	1976	2672804000	2002	3957910000
1830	33,183,000	1977	2761281000	2003	4273090000
1840	61,388,550	1978	2802797000	2004	4599652000
1850	89,594,100	1979	2913740000	2005	4831313000
1860	164,022,378	1980	2922535000	2006	5085207000
1870	235,709,910	1981	2944952000	2007	5292964000
1880	365,344,830	1982	2988434000	2008	5384994000
1890	556,700,130	1983	3068917000	2009	5421432000
1900	835,547,940	1984	3209126000	2010	5721834000
1910	912,832,074	1985	3341101000	2011	6,033,433,000
1920	1,060,205,385	1986	3391646000		
1930	1,162,448,961	1987	3518143000	**Total**	**175,186,562,325**
1940	1,386,499,837	1988	3619768000		
1950	1,557,816,650	1989	3648199000		

From elementary chemistry it is stated that matter cannot be created non destroyed. The combustion of coal as earlier stated will yield carbon dioxide principally among other products.Tony(2008) deduced that one tonne of coal combust to produce 3.67 tonnes of carbon dioxide. This implies that the 175,186,562,325 tonnes of coal estimated to have been burnt in this work would have produce 642,935 million tonnes of carbon dioxide. Therefore, the estimated amount of CO_2 emitted into the atmosphere by coal through its consumption from 1700 to 2011 is about 642,935 million tonnes.

IV. Discussion

The result has shown that 175,186,562,325 tonnes of coal has been consumed and that consumption is on the increase.The rate of depletion of the proved reserves are also increasing indicating that coal will exhausted in not too distant future. It has also been deduced that the world total consumption of coal from 1700 to 2011 which has been estimated to be 175,186,562,325 tonnes has emitted an estimated amount of about642,935 million tonnes of CO_2into the atmosphere while world total coal reserves on the planet earth pre-industrial are estimated to be 1,036,124,562,000 tonnes.

V. Conclusion

175,186,562,325 tonnes of coal has been removed from the earth between the year 1700 and 2011 which in turn has emitted an estimated amount of 642,935 million tonnes of CO_2into the atmosphere thus destabilizing the earth's system resulting in global warming as one of the consequences. Also the rate at which the consumption is increasing is alarming and if not checked by sourcing alternate energy resources, the earth is definitely heading for a catastrophe.

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