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Research Article

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Policy Adopted to Make Power Engineering More Efficient and Economical

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Abstract Power is very essential to develop economy and increase the standard of living in a country. Proper management, choice of fuel for a country depending on availability of that fuel in the country will make the power industry more economical and profitable. By constructing carbon emission lesser abruptly in electrical power industries the world economy may be kept stable. This paper is made to produce power from coal by efficient power engineering management. This paper is prepared based on secondary data and descriptive in nature. Carbon based fuels are more available, also less expensive and profitable to use in power industries than other resources. Solar PV required large area, also are not yet efficient and most of the people do not know how to use properly. Therefore, making solar PV efficient and less expensive like other conventional resources, it may be a solution.

Keywords Energy, Power, Coal, Solar PV and economy.

Introduction

The world has been changed. The lifestyle of human being has been improved. The engineering is implementation of natural science. Its' attempt is to make our life more comfortable. To do these task its need to do research. Major branches of research are Energy conversion, Electronics , Communication , Environment , Mechatronics , Robotics , Mechanical, Civil , Aerospace , Bioinformatics, Food science. Now days engineering has got such success that would not thought in the previous century. It has invented Photovoltaic cell (Solar based energy conversion), Wireless based switch control, Smart phones, Computers, Vehicles for transportation, Robot, Buildings for shelter, Equipments for treatment, Storage for food conservation and many other's smart products. These products is contributing as well as controlling the world economy. Energy is one of the indispensable inputs for the survival of human beings in the earth [1]. Energy plays an important role in the industrial and economic growth of the nations. Bangladesh has been experiencing energy crisis especially of electricity since its independence. Energy has adversely affected the growth and development of all economic sectors. The paper attempts to emphasis on the electricity generation by coal than other renewable energy especially solar. Coal was the primary and cheap source of energy; mostly advanced countries used coal in power sector. Coal was in abundance, easy to store and transport than other resources. About 40% of the world used coal in electricity generation [2].

Current status of Coal

Coal reserves in the world

Coal is certain to play a major role in the world's energy future for two reasons. First, it is the lowest cost fossil source for base-load electricity generation, even the capital cost of a supercritical pulverized coal combustion plant (SCPC) is about twice that of a natural gas combined cycle (NGCC) unit. Second, in contrast to oil and natural gas, coal resources are widely distributed around the world. It is shown in the figure 1 [3].

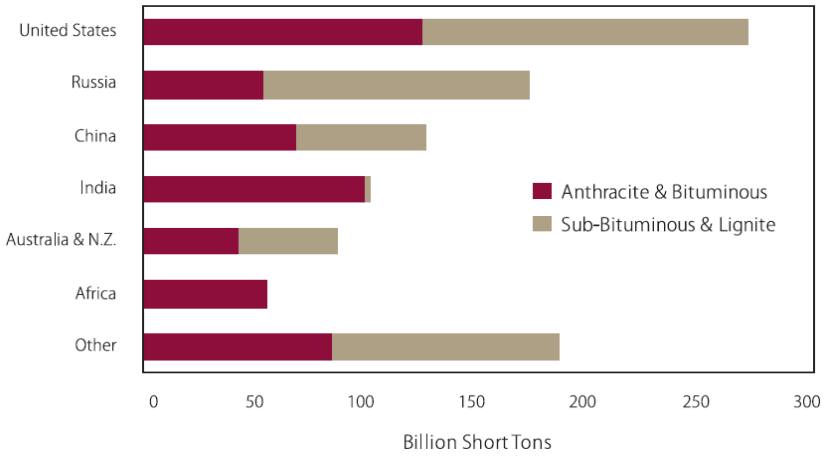
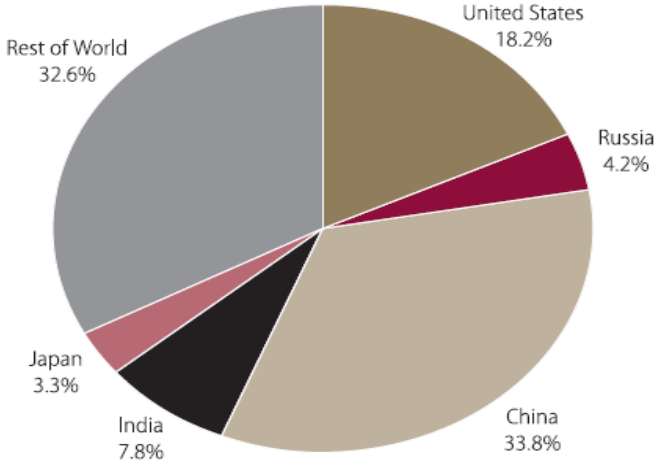


Figure 1: Recoverable coal reserves

Consumptions of coal in the world

Patterns of coal use differ among countries. In developed economics, like US, coal is used almost exclusively to generate electricity. In emerging economy, a significant portion of coal used is for industrial and commercial purposes. The overall consumption of the coal in the world was projected to be around 6.7 billion tons and it is estimated to increase by 98% to 9.98 billion tones till 2030[4]. Global consumption of coal reached 7238 million tons in 2010. And 1199 new coal fired plants with a total installed capacity of 1401278MW are being proposed globally [4]. For the economic year 2004, the world's consumption of coal is shown in the figure 2.



Source: Energy Information Administration, 2006

Figure 2: Consumption of coal in 2004

Electricity from coal and Solar PV for 2014 in USA

Solar has already penetrated the most expensive generator the 'Peaking Plant'. More than 20% of solar and wind would require major investments in transmission lines, not only are transmission lines expensive but they are hard to permit because of the NIMBY (not-in-my back-yard) factor. The coal was inexpensive and primary source of energy [4]. Coal is an efficient estimator than other energy resources [5].

Table 1: Comparison between the price of coal and solar based electricity in USA

Electricity from coal		Electricity from solar (per DC watt)	
Residential	12.50c/ Kwh	Residential rooftop	$3.46/ w(DC)
Commercial	10.75c/ Kwh	Large commercial	$2.19/ w(DC)
Industrial	7.01c/ Kwh	Utility scale	$1.58/ w(DC)
Source: EIA, US Energy Information Administration, 2014			

Current status of electricity production of different countries based on coal

Electrical energy is serving the world economy greatly. Power generation is based on coal, natural gas, hydro power, bio mass wind etc. Among the systems coal is most important one. Coal is cheaper, low maintenance cost, Easy to store. Australia has 10% of total reservation. It is sufficient for around 125 years. In Australia 88%

of coal is used to generate electricity. In USA 39% of electricity is used to generate electricity and Coal fired power plants currently fuel 41% of global electricity [6].

Table 2: Coal in Electricity Generation

User	% of Coal based Electricity
South Africa	93%
Poland	87%
PR China	79%
Austrilia	78%
Kazakhsthan	75%
India	68%
Israel	58%
Czech Rep	51%
Morocco	51%
Greece	54%
USA	45%
Germany	41%

Source: IEA 2012

Data shows that Coal is mostly used to generate power. Yet it has limitations like carbon emission, non renewable in nature. Since Australia has availability of coal they produce 78% of electricity based on coal. Also South Africa 93%, Poland 87%, PR China 79% and other some countries. This is more economical to them than other fuel. Since U.S.A. has reservation of both coal and natural gas they produce most of their electricity using coal and natural gas .Nuclear energy getting popularity throughout the world because it has little emission of greenhouse gases and low cost of production . Solar PV requires large area. So it is not implemented largely. If we implement it largely feeding land will decrease [6].

Table 3: U.S. energy sources and percentage of electricity generation in 2013

Name of energy source	%of electricity generated
Coal	39%
Natural Gas	27%
Hydropower	7%
Nuclear	19%
Biomass	1.48%
Geothermal	0.41%
Solar	0.23%
Wind	4.13%
Petroleum	1%
Other Gases	1%
Source: EIA, 2014	

Solar PV is still expensive than other resources. It needs larger area. The efficiency of solar PV is so much little. Total global generation is100GW. Solar PV global capacity is given in the Table 4.

Table 4: Solar PV using in the world to generate electricity

Name of the country	%Use
Germany	32%
Italy	16%
United State	7.20%
China	7.00%
Japan	6.60%
Spain	5.10%
France	4.00%
Belgium	2.60%
Australia	2.40%
Czech republic	2.10%
Other EU Countries	7.40%
Rest of World	6.70%

Discussion

Annual percentage growth of using coal

The table shows the growth rate for coal energy for the period 2003-2030. In the world, energy consumption grows at about 2% per annum, with emerging economies increasing at a rate about three times.

Table 5: Coal use projections and average rate of increase 2002-2030

	2003	2010	2015	2020	2025	2030	AV. % Increase
US							
Total (Quadillion Btu)	22.4	25.1	25.1	27.6	30.9	34.5	1.6
% Ekectric	90	91	91	91	91	89	1.6
China							
Total (Quadrillion Btu)	29.5	48.8	56.6	67.9	77.8	89.4	4.2
% Electric	55	55	57	55	56	56	4.2

Source: EIA, 2006

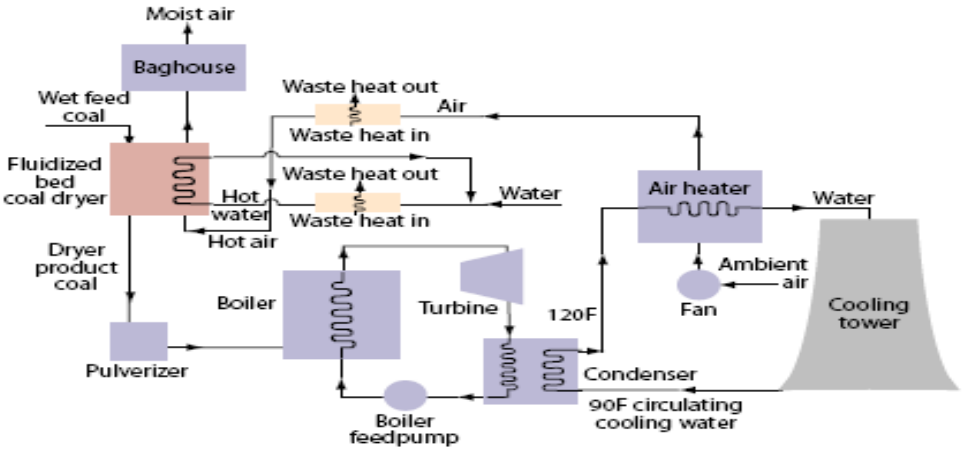
Table 6: Average annual percentage growth 2002-2030

	OECD	US	Non-OECD	China	India	Total
Energy	1.0	1.2	3.0	4.2	3.2	2.0
Coal	1.2	1.8	3.3	4.2	2.7	2.5

Source: IEA, 2006

Waste Heat Recovery Boiler (WHRB)

Waste Heat Recovery Boiler (WHRB) is fully packaged smoke tube industrial boilers to deliver maximum possible heat recovery. These boilers are ideal to recover heat from gen sets, incinerators, blast furnace exhausts etc. It enhances the system efficiency and help save fuel and money. WHRB is designed for easy inspection and maintenance [7].



Source: Henderson, 2008

Figure 3: A schematic diagram of a coal based power plant

Integrated gasification combined cycle

Coal based IGCC uses a combination of gas and steam turbines to produce electricity. The gas used to fire the gas turbine is first made by gasifying or partially oxidizing the coal to produce a fuel gas which is cleaning as shown in the figure 4.

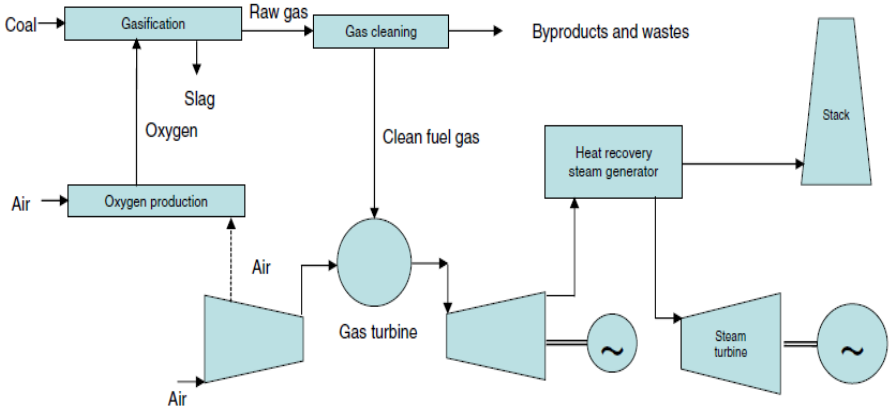


Figure 4: Major Components of an IGCC system without CO_2 capture

Major subsystems within IGCC that have the potential to influence the overall efficiency, cost and reliability, are Gasifier which affects the conversion of carbon in coal to fuel gas and Gas cleaning system which affects the emission of pollutant gases and gases harmful to either to the environment, the gas turbine or both. At present, many gasification plants are using a variety of fuels for chemical production, but only six coal based IGCC plants are in operations as Buggenum plant in Netherlands using Shell technology, 253 MWe (net), started in 1994 with a dry feed O_2 blown gasifier and 1060^0 C gas turbine; Elcogas plant in Puertollano, Spain using Prenflo technology, 300 MWe (net), started in 1998 with a dry feed O_2 blown gasifier and 1120^0 C gas turbine, the plant uses a mix of petcoke and coal; Nakoso plant in Japan using Mitsubishi technology, 250 MWe (gross), started in 2007 with a dry feed air blown gasifier and 1200^0 C gas turbine; Tampa Electric plant in Florida, United States, using GE Technology, 250 MWe (net), started in 1996 with a slurryfed O_2 blown gasifier and 1200^0 C gas turbine; SUV/EGT plant in Czech Republic, 350 MWe (net), started in 1996 using Lurgi Dry Ash technology; and Wabash River IGCC repowering project in Indiana, United States, using E GAS technology, 262 MWe (net), started in 1995 with a slurry fed O_2 blown gasifier and 1200^0 C gas turbine [7].

Developments in coal treatment

Coal treatment can bring considerable environmental benefits including reduced emissions of SO_2, NOx particulates and CO_2, the supply of clean coal of consistent quality to downstream utilization processes. Coals are extremely heterogeneous, varying widely in the content. Principle impurities are ash forming minerals and sulphur, some are scattered through the coal seam, some are introducing by the mining process and some principally organic sulpher, nitrogen and some mineral salts are hurdle organically to the coal. Coal beneficiation is in principle possible for most bituminous coals and anthracite which account for two third of world coal production. Presently one third of potential amount is washed. Most coals from U.S., Australia and South Africa are already washed close to the economic limit; while China, India, Russia, Poland etc. are increasing coal beneficiation [8]. Lignites and sub bituminous coals pose a different set of problems. As they are often low in ash and sulpher, they tend to contain a high percentage of moisture, from 20% to 60%. This will cause a range of problems in coal fired boiler, involving more energy and also causing higher mill, coal pipe and burner maintenance. Beneficiation techniques involve drying these coals as efficiently and cost effectively as feasible [9].

Coal beneficiation

India, China, Czech Republic, Poland, South Africa, Romania and Turkey use high ash coals for power generation. During the mining operations, ash and other extraneous matter are also extracted with the coal. Coal beneficiation is a process which improves the quality of coal by reducing the extraneous matter of reducing the related ash or both. Two main processes of beneficiation are Dry de-shaling which is non coal matter of shaly coal and removed using no liquid media; and Wet process in which coal is crushed and put in a liquid media. Rejects from the wet process also contain carbonaceous matter. Major gains of coal beneficiation include cost reduction by transporting rock over shorter distances and operating cost of the power plant, particularly the boiler, coal handling and ash handling systems. [10] Cost of power generation may also be reduced if the washed coal increases the plant load factor and washery rejects are utilized efficiently in fluidized bed boilers [11]

Developments in coal drying

Low rank coals holding high moisture, 30% to 70%, represent a significant resource worldwide. 45% of the world's coal reserves are lignites, brown coal. These are inexpensive, low in ash and sulpher, but have a high moisture content of up to 65%. Brown coal represents an important source of power generation in different countries as Australia, Germany, Greece, Poland, Russia, Turkey and United States [11, 12].

Conclusions

Energy conversion becomes profitable depending on availability of resources. Every resource has some limitation. Coal also has some limitations. Step should be taken to remove the limitations like carbon emission radio activity. If solar PV can contribute largely in power generation largely keeping world economy unstable as it customers' have to pay high cost of solar PV. Bangladesh has huge coal reserves and our proper authority can produce electricity from the coal. More and more research should be taken to make solar PV more efficient.

References

[1]. Halder, P. K., Paul, N., Joardder, M. U. H., & Sarker, M., "Energy scarcity and potential of renewable energy in Bangladesh". Renewable and Sustainable Energy Reviews, Vol. 51, pp. 1636-1649, 2015.
[2]. http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/natural_gas_1998_issues_trends/pdf/it
[3]. http://envfor.nic.in/legis/eia-2006.htm
[4]. https://www.iea.org/publications/freepublications/publication/key-world-energy-statistics-2014.html

[5]. Akhtar, S., Mugal, K. & Khan, M., A., "The potential impact of coal on electricity generation and economic growth of Pakistan". Far East Journal of Psychology and Business, Vol. 2(3), pp. 60-70, 2011.
[6]. Burnard, K. & Bhattacharya, S., "Power generation from coal". Information Paper, IEA, 2011.
[7]. Henderson, C., "Future developments in IGCC" Report ccc/143, IEA clean coal centre, London, UK, 2008.
[8]. Ghosh, S. R., "Global coal beneficiation scenario and economics of using washed coal". Workshop on coal beneficiation and utilization of rejects: Initiatives, Policies and Practices, Ranchi, India, 22-24 August, 2007.
[9]. Jarrell, P. M., Fox, C. E., Stein, M. H. & Webb, S. L., "Practical aspects of CO_2 Flooding". Society of Petroleum Engineers, Richardson, TX, USA, 2002.
[10]. Satyamurty, M., "Coal beneficiation technology 2007: Initiatives, Policies and Practices" Workshop on coal beneficiation and utilization of rejects: Initiatives, Policies and Practices, Ranchi, India, 22-24 August, 2007.
[11]. Massachusetts Institute of Technology, "The future of coal". 978-0-615-14092-6
[12]. Yang, A. & Cui, Y, "Global coal risk assessment: Data analysis and market research". WRI Working Paper, World.