

COAL POWER UTILIZATION AS AN ENERGY MIX OPTION FOR NIGERIA: A REVIEW

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Abstract

This work reviews the impact of coal energy utilization as a viable energy mix option for Nigeria. Adequate power supply is unavoidably a prerequisite for any nation's growth and development. Electric power drives industrialization, which improves communication, helps innovation in science and technology, provides sound healthcare delivery system and generally improves the standard of living of citizens. Nigeria's economy face growing challenges: a widening trade imbalance, growing competition from developed countries, a collapse of big manufacturing companies, and a sharp increase in the cost of doing business, all owing basically to energy and its related infrastructural costs. Recent years have seen government's desire to increase electricity generation through the utilization of its abundant coal deposits but the challenges are still not surmounted. These challenges and recommendations on the way to overcome them are also highlighted. It is the issue of "getting it right the first time" that this work emphasizes hence it is among the short range reviews of the energy problem in Nigeria.

Keywords: *Coal, energy, power generation, energy demand and supply, technological opportunities, energy mix.*

1.Introduction

It is a well known fact that adequate power supply and national development are not mutually exclusive concepts. Also the Earth as a resource system has a limited capacity for supporting a growing human population with an intensive exchange of materials and energy with its environment, hence the need for a growing awareness to achieve a more sustainable societal use of materials (Karlsson, 1999). One important material in this context is coal. Coal is a combustible black or brownish-black sedimentary rock normally occurring in rock strata in layers or veins called coal beds or coal seams. Coal is composed primarily of carbon along with variable quantities of other elements, chiefly sulphur, hydrogen, oxygen and nitrogen, [(Van Krevelen, 1957); (Gluskoter, 1975); (Speight 1994)].

Coal begins as layers of plant matter-accumulate at the bottom of a body of water. For the process to continue the plant matter must be protected from biodegradation and oxidation, usually by mud or acid water (Francis, 1961). The wide shallow seas of the Carboniferous period provided such conditions. This trapped atmospheric carbon in the ground in immense peat bogs that eventually were covered over and deeply buried by sediments under which they metamorphosed into coal. Over time, the chemical and physical properties of the plant remains (believed to mainly have been fern-like species antedating more modern plant and tree species) were changed by geological action to create a solid material (Speight, 2005). Coal, a fossil fuel, is the largest source of energy for the generation of electricity worldwide, as well as one of the largest worldwide anthropogenic sources of carbon dioxide emissions. Coal is extracted from the ground by mining, either underground by shaft mining through the seams or in open pits. [(Montgomery, 1978); (Vores, 1993); (Gluskoter, 1975)]. World coal consumption was about 6,743,786,000 metric tonnes in 2006 (U.S. Energy Information Administration, 2008a) and is expected to increase 48% to 9.98 billion short tons by 2030 (EIA International Energy Statistics, 2010). China is reportedly the world's top producer of coal (U.S. Energy Information Administration, 2008b). Coal is also used to generate more than 80% of Australia's electricity (Gladstone Centre for Clean Coal, 2007). South Africa's coal is obtained from collieries that range from among the largest in the world to small-scale producers. The major use of coal in South Africa is for power generation and the petrochemical industries. Nigeria has the potentials to produce cheaper electricity from coal to solve its perennial power problem through diversification of her energy base (Nonso, 2010). It is heart-warming to note that three Coal fired power plants each with an installed capacity of 1,000 Mega Watts are due to commence full operation in three states of the federation

namely Enugu, Gombe, and Benue States although the power conversion technologies and adaptation methods are still unclear [(FRCN, 2011); (Nnaji, 2012)].

Apart from hydro-power station, coal still offer the cheapest source of electricity generation that would also guarantee adequate energy mix fit for the country's industrialisation and other uses. Fortunately, Nigeria provides a veritable and safe ground for investors, thus the need a review of coal power utilization to fix the energy problem cannot be overemphasized.

2.HISTORY OF COAL IN NIGERIA

Nigeria is one of the tropical countries of the world which lies approximately between 4° and 13° with landmass of 9.24 x 10⁵ km² (Bala et al., 2000). Nigerian Coal is one of the most bituminous in the world owing to its low sulphur and ash content and therefore the most environmental friendly. There are nearly three billion (3,000,000,000) tonnes of indicated reserves in seventeen identified coalfields and over 600 million tonnes of proven reserves in Nigeria. Some of the states where coal has been discovered in commercial quantity include Enugu, Benue, Kogi and Plateau States (Anaekwe, 2010). In 1909, coal was discovered and mined at Ogbete, Amansiodo, Ezinmo, Inyi, Onyeama in Enugu state, Ogwashi-Azagba Lignite Field in Delta state, Owupka Mine in Benue State, and Ogboyoga I & II Coal field in Kogi. The Ogbete drift mine opened in 1915, but was closed and flooded during the Civil War. It reopened in 1972, and became the country's largest coal mining operation until its closure. The Ogbete mine's operations and others in the country were merged into a new corporation in 1950: The Nigerian Coal Corporation. The NCC was tasked with exploring coal resources with production capacity of five hundred tons a day for seven years and held a monopoly on coal and coke mining, production, and sales until 1999 [(Godwin, 1980); (Daily Times of Nigeria, 1962)]. Nigeria's coal industry suffered a blow in the 1950s when oil was discovered. Up until this point, the Nigerian Railway Corporation was the largest consumer of coal in the country. However, after the discovery of oil, the Railway Corporation began to replace its coal burning trains with diesel-powered engines. An additional negative impact came when the Electricity Corporation of Nigeria began converting its power generation equipment from coal to diesel and gas as well [(Godwin, 1980); (Daily Times of Nigeria, 1962)]. The Nigerian Civil War also negatively impacted coal production; many mines were abandoned during the war. Following the war, production never completely recovered and coal production levels were erratic. Attempts at mechanizing production ended badly, as both the implementation and maintenance of imported mining equipment proved troublesome and hurt production (Godwin, 1980).

Coal exploration in Nigeria started as far back as 1916. Available data show that Coal (mainly sub-bituminous steam Coals except for the Lafia-Obi bituminous Coking Coal) occurrences in Nigeria have been indicated in more than 22 Coalfields spread over 13 States of the Federation. The proven Coal reserves so far in Nigeria total about 639 million metric tonnes while the inferred reserves sum up to 2.75 billion metric tonnes (Obi, 2005). M2M Workshop-Nigeria (2005) has extensively reported Nigeria's coal mines, their type, estimated reserves (million tonnes), proven reserves (million tonnes), depth of coal (m), and mining method(s). The determination of this information is a complex exercise as new findings are made thus; any estimate is likely to be out of date when it is published (Eastop and McConkey, 2002).

3.ENERGY DEMAND AND SUPPLY IN NIGERIA

It has been estimated by experts that a coal powered plant would cost one-sixth the cost of powering the plant by gas and due to its use in powering railways, coal mining and processing is highly desirable (Anaekwe, 2010). Attempts have been made to assist the Nigeria over its deplorable power situation, through exploration of the vast coal deposits as an alternative source for electricity generation (Nonso, 2010). A feasibility study conducted by Behre Dolbear in 2006 indicates that electricity demand in Nigeria is projected to increase from the current 3.5 Giga WATTS (GW) to between 12 and 15 GW in 2025. Coal is expected to provide for a significant portion of the projected electric power demand (about 6 GW to 7.5 GW). Consequently, coal demand is projected to increase to 19-24 million tonnes by 2025 (Ogunsola, 2008). World Bank reports underground and surface coal production potential to be 200,000 to 600,000 tonnes per year and 400,000 to 800,000 tonnes per year respectively (World Bank, 1983). This will be significantly higher in the future if coal is to play a major role in meeting the country's projected increase in electric power demand (Ogunsola, 2008). The current electricity supply in the country does not meet national demand. The estimated daily power generation was about 3,700MW as at end-December 2009 while the peak load forecast for the same period was 5,103MW, based on the existing connections to the grid, which does not take account of suppressed demand. Projected electricity

demand has been translated into demand for grid electricity and peak demand on the bases of assumptions made for transmission and distribution losses, auxiliary consumption, load factor and declining non-grid generation. Figure 2 shows that for a 13% GDP growth rate, the demand projections rose from 5,746MW in the base year of 2005 to 297,900MW in the year 2030 which translates to construction of 11,686MW every year to meet the demand (Sambo, 2008).

Electricity production in Nigeria over the last 40 years has varied from gas-fired, oil fired, hydroelectric power stations to coal-fired stations with hydroelectric power systems and gas fired systems taking precedence. Presently there are a total of 16 power plants in Nigeria 10 owned by Power Holding company of Nigeria and another six plants belonging to independent power producers. The summary of the installed and available electrical capacity in the Nigerian generating stations are shown in figure 3 and table 1.

4. CHALLENGES

According to Sambo (2009) and Emovon et al (2011), some of the factors militating against the growth and development of the power sector and concurrently the coal industry in Nigeria include:

- Host community discontent.
- Environmental degradation in the mining area.
- Health and safety practices in the mining industry.
- Inadequate financial & fiscal Incentives in the mining Industry.
- Inadequate maintenance attitude of power plants.
- Poor maintenance planning.
- Inadequate funding.
- Poor electricity pricing.
- Monopoly.
- Lack of energy mix.
- Vandalization of Generation facilities.
- Poor inventory management.

5. RECOMMENDATIONS

Sambo (2009) has identified the way forward for the effective utilization of coal and its related clean technologies. These are but not limited to:

- Full implementation of the National Energy Policy and the National Energy Master plan.
- Provision of incentives to the local community and encouragement of grassroots participation.
- Enhancing public enlightenment & discouraging community agitation.
- Enforcing environmental protection law.
- Improving the legal, regulatory, financial, institutional, and other conditions necessary to attract investment in coal exploration and utilization projects.
- Energy mix (Emovon et al, 2011).

6. CONCLUSION

Coal is used as fuel and in industrial production of tar, gas and non edible oils. Unarguably, the most singular impediment to the attainment of the vision 20:2020 in Nigeria is power (electricity) because of the direct bearing it has on other economic indicators like unemployment rate and low capacity utilization in the manufacturing sector. Nigeria can, against the emphasis on gas for power generation, tap into the rich coal deposit scattered in different parts of the country to generate electricity. Nigerians support efforts to improve the current power deficit the country is experiencing. With Nigeria's abundant coal deposits, this is just the time to use this resource to the nation's benefit. Clearly, the nation must diversify its power-generation portfolio. Recent power problems have revealed that the reliance on Gas and Hydroelectric dams for power have suffered due to interruptions in oil output/supply, dwindling seasons and of course, pure corruption. The use of coal and its related technologies in some parts of the country would therefore, be a beneficial energy mix for power generation in Nigeria.

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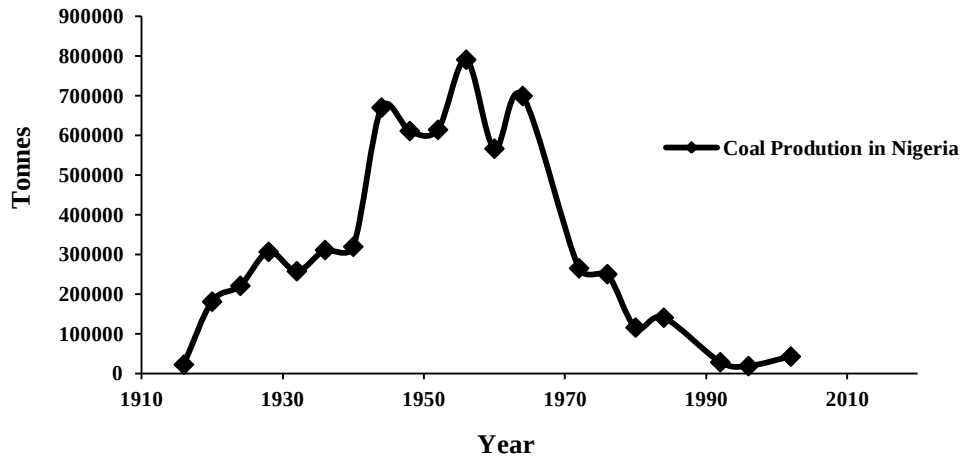


Figure 1: Coal Production in Nigeria (1916-2002). (Source: Ministry of Mines and Steel Development, 2008)

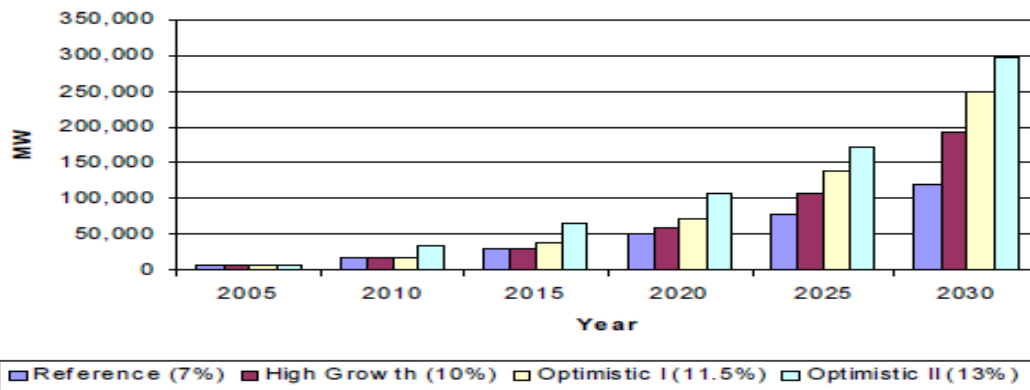


Figure 2: Electricity Demand Projection in Nigeria. (Source: Sambo, 2008)

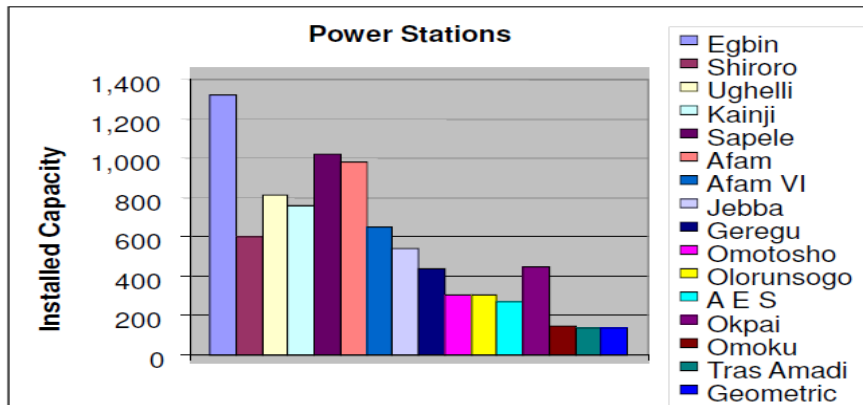


Figure 3: Power Generating Stations versus Installed Capacity. (Source: Emovon et al, 2011).