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COAL DEVELOPMENT IN NIGERIA: PROSPECTS AND CHALLENGES

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ABSTRACT

This paper presents an overview of the production capacity of the Nigerian Coal Corporation since inception. It highlights the progress made in production, the challenges and set-backs of this great economical root that has become stagnant today. Local coal production began as early as the advent of the British merchants who came into Nigeria in the close of the nineteenth century and wake of the twentieth century.

The production of the coal industry in Nigeria started dwindling seriously in the past decades and eventually came to an end today. This was a major setback to the economy of a developing nation like Nigeria because the coal production propelled the advancement of Nigerian Cement Factory, Nigerian Railway Corporation (NRC), National Electric Power Authority (NEPA) and other industrial and domestic ventures.

The paper highlights the causes of its failure, as a guide to seek possibilities for future growth and rise. Technical performances of the coal industry in Nigeria were examined being the core origin of its failure. Production capacities, yearly output and economic returns were also delved into. Government influence and contributions to the life of the industry were identified as significant factors towards the development of the industry..

Key words: Coal, industry, production, challenges, performance

1.0 INTRODUCTION

Coal was discovered in Enugu, Nigeria in 1909. The Ogbete drift mine opened six years later. Its operations and others in the country were merged into a new corporation in 1950 known as the Nigerian Coal Corporation (NCC). The NCC was tasked with exploiting coal resources, and held a monopoly on coal and coke mining, production, and sales until 1999. The Nigerian coal production was managed by a Polish firm-KOPEX from inception until the time of collapse [5].

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. 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. After the civil war, the Nigerian coal industry was not able to return to its peak production.

Nigeria still holds large coal reserves, estimated to be at least 2 billion metric tonnes [9]. The discovery of bituminous coal suitable for use in coke production for the iron and steel industries opened up new domestic markets. With the loss of its largest domestic consumers, the NCC began exporting coal to Italy and the United Kingdom, as its low sulphur content was desirable. In 1999, the NCC lost its monopoly over the Nigerian coal industry as the Obasanjo government allowed private companies to begin operating coal fields in joint ventures with the NCC, with an eventual goal of completely selling off the NCC's assets to private investors. The Nigerian government planned to sell 40% to private investors and 20% to the Nigerian public, while retaining 40% [9].

In 2002, work stopped at NCC-operated mines and in 2003, the Nigerian government announced plans to create a technical advisory committee that would be tasked with reviving Nigeria's coal industry. By 2004, the technical committee had still not issued their report, and the NCC found itself almost bankrupt. To raise funds, it began to sell off some of its assets in an attempt to pay off its mounting debts, including salary that was owed to its employees. In addition, the Enugu State Government protested the planned NCC privatization and demanded the ability to consult with the Federal Government on any planned sale [1]. While references are made in the news media to a possible sale of the NCC, the Nigerian Bureau of Public Enterprises, the government body tasked with selling public corporations, still lists the NCC as an asset for sale on their website as of April 2008, and no news reports to date provide any information about the supposed sale.

2.0 STATEMENT OF PROBLEM

Coal production in Nigeria has faced many challenges which inhibited its development and ultimately led to the closure of the industry. This study seeks to investigate the possible reasons for the failure of the industry which could be: inadequate capital, choice of inappropriate technology, Government bureaucracies. As well as to investigate under what terms the foreign technology for the coal production chosen and proffer solutions for those problems encountered as well as to come up with suggestions on ways of rejuvenating coal production in Nigeria.

The collapse of the Nigerian Coal industry brought about the closure of numerous companies in South-eastern Nigeria which had great dependence on coal as their chief raw-material. Examples of such companies are: The Turners- Emenite Roofing Sheet Manufacturing Company, Enugu; The Nigerian Cement Factory, Nkalagu; The Marine front at Portharcourt which used coal to fire boats; The Nigerian Steel Company, Enugu which uses coal for coke production for steel production, The Nigerian Railway Corporation used coal to drive engines and it collapsed, The Nigerian Project Development Institute depended much on coal, Chemical & Pharmaceutical Companies in Enugu which uses benzene for its works collapsed its production and relocated; Nigerian Briquette Company, Enugu and the Nigerian Gas Company, Enugu. The closure of the Nigerian coal industry also resulted in a reduction of power generated by the National Electric Power Authority since all their coal-fired power plants were grounded.

As a result of the above developments, thousands of personnel and workers lost their jobs and the economic strength of many cities which hosted the coal mining activities waned drastically. This led to a rapid urban migration of personnel and workers to other cities of Portharcourt, Lagos, and Abuja in search of jobs.

The closure of many companies also brought about a reduction in the country's GDP.

3.0 RESEARCH OBJECTIVES AND QUESTIONS

3.1 Research Objectives

The objectives of this study were to examine the technical-change process in the Nigerian coal industry for the past 30 years and also look at the way NCC made a technological choice for a major investment project.

The research actually focused more on the latter objective because institutional memory was insufficient for generating credible bases for past behaviour. The project was designed to capture the industrial and enterprise behaviour of NCC during a long period to allow policymakers to make informed policy prescriptions for the expected future under rapidly changing conditions.

3.2 Research Questions

1. What specific technical and economic regimes led to the observed performance of NCC and the Coal industry at different times?
2. To what extent did the industry adopt technical advances over time and what was the impact on productivity growth?
3. What has been NCC's human resources policy, quantitatively and qualitatively? What has the trend been in its labour productivity?
4. What informed the huge technology investment of 1976–79? Was it plant obsolescence, simply a drive to "modernity," or a serious effort to achieve greater production capacity and higher efficiency?
5. Above all, why and how did the project fail?

4.0 NIGERIAN COAL RESOURCES AND LOCATIONS

Nigerian coal has been found suitable for use as boiler fuel, production of high calorific gas, domestic heating, briquettes, formed coke and the manufacture of a wide range of chemicals including waxes, resins, adhesives and dyes. Their characteristic properties (low sulphur and ash content and low thermoplastic properties), make these sub-bituminous coals ideal for coal-fired electric power plants. Some Nigerian coals can also be used to produce formed-coke of metallurgical quality.

The domestic coal market is latently large. Besides the potential for power generation, Nigeria currently imports coals of various grades and qualities including coke, pellets, briquettes, Anthracite, coking coal and form coke. There is also the potential for coal exports to countries such as China, Israel, Japan, Ghana, the U.S., Europe and India. The Nigerian government has recognized the need to revitalize the country's coal mining industry to provide fuel for power generation and domestic use. Under a grant from the United States Trade and Development Agency (USTDA), Nigeria's Ministry of Solid Minerals Development undertook a Feasibility Study in 2005 to determine the potential for coal resource development. The Study is being conducted by Behre Dolbear & Company (USA), Inc. - an international mining consulting firm. [9]

4.1 The Anambra Coal Basin:

The coal deposits of the Anambra Basin, located in southeastern Nigeria, appear to contain the largest and most economically viable coal resources. This basin covers an area of approximately 1.5 million hectares and is constrained by the Niger River on the west, the Benue River on the north and the Enugu Escarpment on the east. The coal is predominantly in one seam that outcrops along the eastern side of the basin at the base of the Enugu Escarpment and dips gently toward the

centre of the basin. However, coal outcroppings have been reported at Idah and Dekina on the northwestern side of the basin, demonstrating that coal exists on the western side of the basin as well as the east. Exploration within the basin is limited, but there are four small coal mines in the eastern outcrops of the basin northwest of the city of Enugu and two smaller mines farther north.

4.2 Kogi District:

The Kogi Coal District, covering 225,000 hectares of the Anambra Coal Basin, lies on the northeastern side of the basin. Two areas within the district have been explored to a limited degree. The greatest amount of available drill data has been found in Ogboyoga, which is further North, 27 holes have been drilled and cored and 15 separate measurements have been taken of outcrops of the main coal seam in stream drainages. Behre Dolbear used the guidelines of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (also known as the JORC Code) to delineate a total of 123 million metric tonnes of coal (Demonstrated) underlying an estimated 8,900 hectares. An additional 165 million tonnes of coal classed as non-reportable resource by the JORC Code definitions, is projected to lie in the Ogboyoga area. The coal thickness in this area is approximately 2.0 meters. The other area of interest is Okaba, the site of a small idle surface mine. 17 core holes have been drilled near Okaba, all of which intersected the main coal seam. No outcrop samples have been reported for this area. A total of 100 million tonnes of demonstrated coal (JORC) have been estimated to underlie 2,770 hectares in the Okaba area and an additional 435 million tonnes of non-reportable coal resource are projected to the west of existing drilling. In total the Kogi Coal District is estimated to have a Demonstrated Coal Resource of 223 million tones averaging 3.6 meters thick, which underlies 8,900 hectares, or 4 percent of the District. The total non-reportable resources by JORC Code are 600 million tonnes.

4.3 Benue District (Omkpa-Ezimo):

The Benue Coal District, covering 175,000 hectares of the coal basin, is immediately south of the Kogi District along the eastern outcrop of the Anambra Basin. It also has two areas of interest. The more northern of the two, Orukpa, includes a small idle surface mine and a total of 11 drill holes. Six coal outcroppings have also been measured in streams in the area. Based on these
data, Behre Dolbear estimates that a reportable coal resource of 81 million tonnes (Demonstrated-JORC) exists along the outcrop. Another 117 million tonnes of non-reportable coal, as defined by the JORC Code, is projected to exist west of the existing drilling. The average coal thickness is 3.1meters. Immediately south of the Orukpa area is the Ezimo area. This area has limited exploration, with only four drill holes penetrating the main coal seam. Based upon this limited data, a total of 43 million tonnes of demonstrated coal resource have been projected for the Ezimo area. An additional 263 million tonnes of non-reportable coal resource is projected to exist west of the existing drilling. The average coal thickness in this area is also
3.1 meters. In total the Benue District (Orukpa-Ezimo) is estimated to have a Demonstrated Coal Resource of 124 million tonnes, which underlies 4,700 hectares, or 3 percent of the District. The total non-reportable resources, as defined in accordance with the JORC Code, are 380 million tonnes which underlies 4,700 hectares, or 3 percent of the District. The total non-reportable
resources, as defined in accordance with the JORC Code, are 380 million tonnes.

4.4 Enugu District:

The Enugu Coal District, covering 270,000 hectares of the coal basin, is centered around Enugu City, south of the Benue District. It has supported the largest amount of commercial mining in the past. In addition to two

underground mines, there are a total of 36 drill holes drilled in the area. Previous studies have estimated the demonstrated coal resource to be 49 million tones averaging 2.2 meters thick. An additional 111 million non- reportable tonnes of in-place coal are inferred to exist west of the old mine workings.

4.5 Other Coal Deposits:

Other potentially significant coal and lignite resources in Nigeria include:

- The Inyi Deposit south of the city of Enugu with a potential resource of approximately 10 million tonnes;
- The Afikpo deposit located south and east of Inyi in an area that is heavily populated, where mine development might be expensive;
- The Lafia Obi deposit located northeast of the mining districts described above with an estimated inferred resource of 33 million tonnes of potential metallurgical coal resources. Over 139 holes have been drilled and exploration shafts have been sunk in the area. The Nigerian Government has paid considerable attention to the potential commercialization of this resource, but additional exploration is required before this can be defined as a commercial resource;
- The Gombe deposit is located east of Lafia-Obi. Preliminary drilling has indicated the presence of metallurgical grade coal, but no resource estimates have been made for this area;
- The Asaba Lignite deposit is on the coastal plain south of the Anambra Basin. A total of 19 holes have been drilled in two areas. Although these data are limited they strongly suggest that a significant lignite resource exists in this area. More exploration is required to determine if it is an economic resource.

5.0 POTENTIAL POWER GENERATION FROM COAL-FIRED PLANTS:

It appears that the Kogi District and the Benue (Orupka- Ezimo) District can each support a coal-fired power plant with ultimate capacity of approximately 3,500 MW [10]. These plants would be built in phases to match the production buildup of the associated coal mining operations. They will probably consist of several units in the size range of 500 to 700 MW. Based on the economics and logistics of coal transportation it is recommended that the power plants be sited near the portals of the underground mine where coal can be conveyed directly to the generating facility. This region is considered to be tropical, so sufficient water might be available to operate a plant with cooling towers. If sufficient water is not available, it might be more economical to build a 50 to 76 kilometer pipeline from the Benue River to the plants than to transport the coal to a plant located on the river. Based on their coal resource potential these Districts should ultimately be able to support electrical generating capacity of approximately 7,000 MW. There is the possibility that a third power plant of 2,500 to 3,500 MW might be supported by Enugu's resources.

6.0 NIGERIAN ENERGY POLICY ON COAL

The nation's coal industry faces some daunting challenges, which need to be addressed if the potential for coal utilization is to be optimally exploited. These include creating and finding markets for the coal, increasing the productivity of the coal mines, reducing cost of production through mechanization and establishing a cost-effective transportation system through an expansion of the rail system and port facilities for the export of coal (National Energy Policy, 2003).

Policies

i. The nation shall pursue vigorously a comprehensive programme of resuscitation of the coal industry.
ii. Extensive exploration activities to maintain a high level of coal reserves shall be carried out.
iii. Private sector as well as indigenous participation in the coal industry shall be activity promoted.
iv. The exploitation and utilization of the coal reserves shall be done in an environmentally acceptable manner.

Objectives

i. To promote production of coal for export.
ii. To promote effective utilization of coal for complementing the nation's energy needs and as industrial feedstock.
iii. To attract increased investment into, and promote indigenous participation in, the coal industry.
iv. To utilize coal in meeting the critical national need of providing a viable alternative to fuelwood in order to conserve our forests.
v. To minimize environmental pollution arising from the utilization of coal.

7.0 METHODOLOGY AND FACTS-FINDING APPROACH

Following from the above, the study entailed tracing of the Nigerian Coal Corporation (NCC)'s operations over a long period to bring out the factors responsible for the observed behaviour and those responsible for the productivity performance. There are several approaches we could take, we can emphasize one major obstacle (absence of "modernity") in an occasionally tautological way, and the implicit hypotheses are largely incapable of being tested or quantified. A more fruitful approach involves the identification of the most likely major sources of deviation from best-practice productivity and the quantification of each of them where possible.

The "fruitful" approach suggested is more holistic and considers (1) factors at the national and industry levels; (2) techno-managerial capability at the firm level; and (3) productivity of industrial workers at the task level. For this study, the following six tagged issues were proposed:

- *Issue 1* — NCC's management made little or no effort to build plant-level technological capacity to cope with the idiosyncratic nature of the plant.
- *Issue 2* — NCC lacked the basic knowledge and experience to operate the new manufacturing process.
- *Issue 3* — Both KOPEX and NCC management paid little attention to the organization of human resources during the important start-up phase.
- *Issue 4* — The poor performance of the new equipment is directly traceable to the initial decisions NCC made in the pre-investment phase.
- *Issue 5* — External infrastructural and economic constraints played a big part in NCC's poor performance.
- *Issue 6* — NCC's choice of frontier technology was not appropriate for the mine's environment.

The conceptual framework adopted for the study of coal production was flexible enough to capture the range of activities undertaken in NCC's technical-investment process before, during, and after the installation of its operating plants and to compare these with the activities in the typical technical-investment process, which has three phases: the pre-investment phase, the investment phase, and the post-investment phase. The Pre-investment preparation involves the Identification of the project's technical and economic requirements, the investment construction involves basic engineering studies, design engineering, equipment specification, procurement, and testing; supplier and capital goods selection, civil engineering works and equipment erection, commissioning, and start-up. The Post-investment: production involves

Plant debugging, modifications, redesign, and adaptations; process and product engineering.

Technical, economic, and financial data were collected for each phase and these were analyzed to determine the project costs, financial clauses, and choice of technique, raw materials, and energy and how well these latter variables were suited to the techno-economic environment.

It is inevitable that the choices made during the first two phases would bear heavily on the post investment phase. Analysis of operational data would provide useful evidence of the way the project was conceived and implemented. Data were collected to reveal maintenance capability and the quality of machinery and equipment.

In the post-investment phase, a process plant requires certain basic technological, material, and managerial inputs to function well. These include basic feedstock (e.g., raw materials, energy, utilities); technical and organizational capacities, (e.g., operational, maintenance, and innovation capabilities); and replacements (e.g., spare parts and consumables).

The overall technical capability of an enterprise is a function of its ability to simultaneously provide all these components. To capture firm-level performance, the following parameters were explored:

- capacity utilization, which represents the ratio of the level of output actually produced (Q_a) to the capacity output of the plant (Q_p);
- production rate, which is tonnage/hour;
- capital use or plant availability (%), which is the number of operating hours divided by the number of available hours within the period; this indicator measures plant efficiency and, indirectly, maintenance capability; and
- labour productivity, which is tonnes/person per shift.

7.1 Data collection

Data and information were lifted and used to collect NCC primary data on its technical performance. Visits were made to the mines to see the working environment. Economic and financial data were collected from the firm, the Mines and the Power and Steel Ministry. Secondary enterprise data and policy papers were obtained from other research institutes: the Nigerian Institute of Social and Economic Research; the National Institute for Policy and Strategic Studies; and the Nigerian Export Promotion Council (which collects data on export statistics). Questionnaires were used to randomly sample the users and potential users of coal and coal products: NEPA, NRC, and the steel plants. I was unable to visit the various NEPA installations and had to seek information from the headquarters.

8.0 RESULTS AND DISCUSSIONS

From records of operation and maintenance of the production phase, documented are the details of the Nigerian Coal corporation inadequacies and these inadequacies were traced to the several factors such as:

Machinery and equipment failures

Equipment failure was pervasive and frequent. It is obviously technical issues that grounded the coal industry in Nigeria. Lack of robust technical support and background was the main root of the cause that led to the demise of the economic gain from coal.

Geological and infrastructural weaknesses

The geological problems were very severe. Very little was known about the characteristics and nature of the mine waters, the constraints the fault patterns would have on the longwall layout, or the roof and floor pressures. One consequence was excessive weight on the powered roof supports along the face line. The undulating seam floor made it impossible to establish a definite gathering ground for mine water. This posed severe problems to longwall operations

and also created excessively acidic mine waters. Within 2 months of operation, the Polish pumps began to break down as a result of the excess acid in the water. The pumps were made of cast iron and not easily repaired.

The operations also suffered considerably from inadequate transportation. Railway wagons needed to evacuate the coal were in very short supply, and the resulting dumping of coal created blockages in the coal bunkers. Nominal production targets could not be met, and what was produced could not find its way to the consumer. Power supply was inadequate, and outages were more the rule than the exception. The estimated production loss resulting from power outages alone was about 21 000 t in 215 h. Power outages also created severe flooding problems because the pumps were inoperative most of the time.

Human resources deficiency

As already pointed out, different stages of technology acquisition demand different levels of technical competence. The needed levels of competence were deficient. Although a broad engineering and economic knowledge base may well suffice in the pre-investment phase, specific competence is needed as the project progresses to the investment phase. At the time of the technical change, junior staff made up 87.5% of total human resources at Nigerian Coal industry, professionals and management staff, 12.5%.

Lack of Government Interest

After the oil boom, the government lost interest in coal production because much revenue was generated from crude oil and that led to much dependence on the oil even till today. The coal industry lost grip of government adequate funding for its operations.

8.1 Analysis Of Research Findings

This section focussed on the period 1976–82, the period during which the major investment was made on coal production. However, to provide a context for analysis, the physical output preceding the period is given below:

Period	Average output (t/year)
1960/61–1966/67	645 000
1967/68–1969/70	Nil (during civil war)
1970/71–1975/76	281 000

This shows high rate of liquidity of the corporation. Nigerian Coal Corporation's liquidity problem was so severe that regular overdraft spending was needed to cover operating costs.

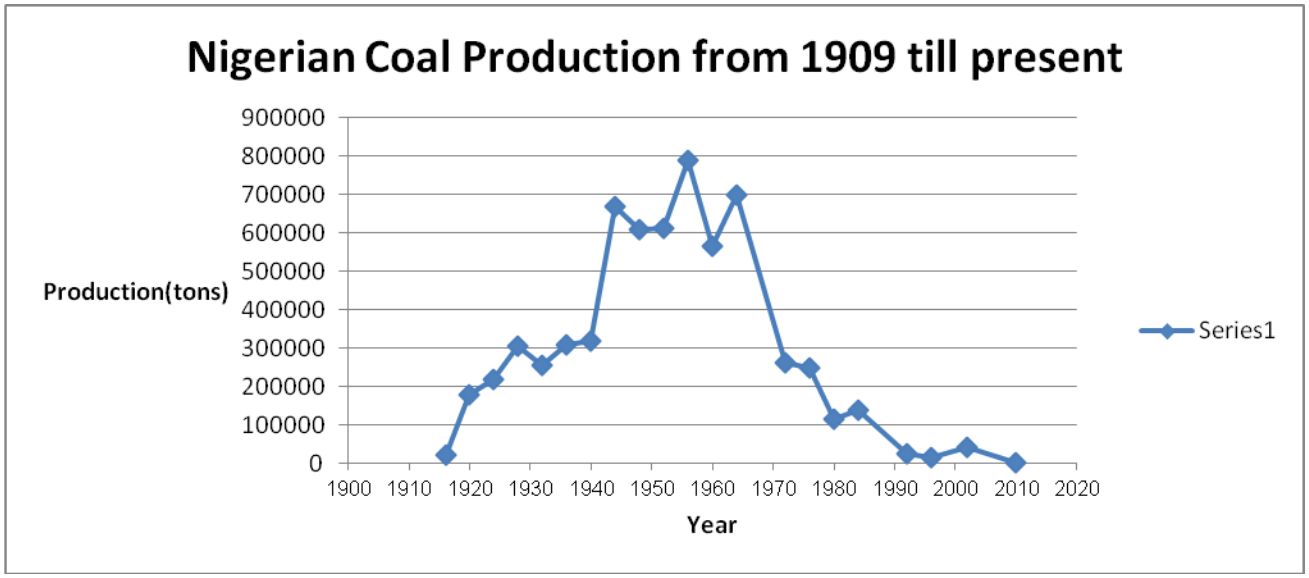

Figure 8.1 Graph showing the Coal production levels according to year.

Figure 8.1 and table 8.1 show how coal production rose steadily from 1915 to 1960. Thereafter it started reducing till there was no production at all in year 2010. A sharp fall in production was observed in the mid-sixties till 1970, which was the era in which oil was discovered in Nigeria. This confirms the assertions made by the authors that the oil boom was a major cause of the fall of the coal production industry in Nigeria.

Table 8.1: Coal Production Levels in Nigeria

YEAR	Production (Tonnes)
1916	24,511
1920	180,122
1924	220,161
1928	305,745
1932	256,860
1936	310,308
1940	318,640
1944	669,158
1948	610,283
1952	613,374
1956	790,030
1960	565,681
1964	698,502
1972	264,258
1976	249,446
1980	114,875
1984	139,744
1987	117,159
1992	27,686
1996	17,797
2002	41,771
2003	-
2011	-

9.0 RECOMMENDATION

Nigeria's goal is to revitalize the coal mining industry and expand power generation by attracting foreign companies to develop these large coal resources and construct coal-fired generating plants that will connect to the country's electrical distribution grid (National Energy Policy,2003) The exploitation of coal for electricity generation and the production of coal briquettes for domestic and industrial heating will bring a number of benefits including: Increased and more reliable electricity supply, Lower cost electrical energy, Expanded industrialization of the economy, Increased employment and human resources development, Increased capacity utilization of existing industries, Increased national income through taxes, Reduced deforestation and prevention of

desert encroachment in the northern parts of the country.

Power generation through the use of coal could be sufficient to supply at least one-third of the remaining megawatts needed in Nigeria and there are still large deposits of coal in Nigeria which will succor the high energy demand of the populace. The Government's intention to dive into power generation from nuclear resources should be discouraged because we do not have the technical capacity to manage the technology of nuclear power plants and its intricacies. Instead of the government going to spend huge amount of funds in nuclear power exploitation, such an amount of fund could be sunk into the coal powered plants for generation of electricity because it is cheaper and its technology is simple.

10.0 CONCLUSION

Coal production in the Nigerian coal industry increased annually from 583,487 tonnes to a peak of 905,397 tonnes before the independence. After 1959, production decreased significantly each year, until today no production is recorded on book. Several factors contributed to its failure, prominent among them is poor technical method chosen to operate with.

This trend showed a decrease in the coal production and how it has affected other sectors of the economy. There is high need for government to map out strategies which would be applicable to rejuvenating this industry. This include intensifying the drive for coal exploration and production activities, completing the privatization of the coal sector, creating awareness both locally and internationally on the potentials of the Nigerian coals for energy production, providing adequate incentives to indigenous and foreign entrepreneurs so as to attract investment in coal exploration and production, fast-tracking the passage of the new minerals and mining bill at the parliament, continuing the exploration and concession of the coal deposits for open biddings to investors and ensuring transparency in the acquisition of mining titles.

These are just but few measures in addition to what we ought to do to revive the coal industry which has collapsed wholly.

The abundant coal deposit underneath various seams of most lands in Nigeria should not be allowed to be wasted or remain untapped. The time is set to arise and derive the energy which is in our coal.

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