

Energy Crisis in Nigeria-The Way Forward

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Abstract— The economy of any nation is in arithmetic progression with the available energy supply. Nigeria is a nation where most of its populace are below the middle class. Small scale industries would be the best platform for the citizens to improve their standard of living. The availability of energy is the prime mover that drives this small industries but unfortunately 60% of these class of people have no access to electricity while the rest can't boast of complete 4hours of constant supply in a day. The current generation of less than 2,300MW creates a crisis in the demand and supply of power despite the abundant reserves of all the necessary fuel for self sufficient supply of electricity in Nigeria. This paper x-rays the different generating alternatives in Nigeria to choose the most appropriate means to address this crisis. From the experiences of other world leading energy producers, coal fired power plant has the potential of supplying adequate power to the country while bringing more job opportunities.

Index Terms— Energy, hydro, coal, costs, generation and reserves

I. INTRODUCTION

The stability of energy supply is a useful tool in improving the economy of any country. The country's current energy supply of 2,300 MW is very far from being adequate. The consequences of this have been the relocation of some industries to neighbouring countries, high cost of goods, loss of labour etc. Nigeria is the most populated country in Africa but only about 40% of the people are connected to the national grid [1]. In a country already battling with high rate of unemployment, the effect of low energy supply is quite enormous.

Electricity Corporation of Nigeria (ECN) was established in 1951 as the utility company to manage its energy sector. The Niger Dams Authority (NDA) was established in 1962 with a mandate to develop the hydro-power sub-sector. It was merged with the ECN in 1972. It was followed by the coming of the National Electric Power Authority (NEPA) and Power Holding Company of Nigeria (PHCN) as the search for stable power supply in the country continues. The utility company is made up of three divisions, generation, transmission and distribution. With the unbundling of the PHCN, it now has 18

companies as follows: six (6) generating companies, one (1) transmission company (i.e. Transmission Company of Nigeria-TCN), and eleven (11) distribution companies. The generating companies are AFAM, EGBIN, KAINJI, SAPELE, SHIRORO and UGHELLI. There are also some new Independent Power Producers under the auspices of the Niger-Delta Power Holding Company (NDPHC). The 11 distribution companies are Abuja Electricity Distribution Company (AEDC), Benin Electricity Distribution Company (BEDC), Eko Electricity Distribution Company (EKEDC), Enugu Electricity Distribution Company (EEDC), Ibadan Electricity Distribution Company (IEDC), Ikeja Electricity Distribution Company (IKEDC), Jos Electricity Distribution Company (JEDC), Kaduna Electricity Distribution Company (KEDC), Kano Electricity Distribution Company (KNEDC), Port-Harcourt Electricity Distribution Company (PHEDC), Yola Electricity Distribution Company (YEDC).

Nigeria will need an estimated 12,000 MW of electricity to achieve steady power supply to the connected customers [2]. This figure is expected to rise when more of its citizens are connected to the national grid. The transmission system in Nigeria system does not cover every part of the country and currently does not have the capacity to transmit a maximum of about 12,000 MW but technically it is not in crisis since the deficit is still far from being actualized. In most locations in Nigeria, weak and inadequate network coverage, overloaded transformers resulting in constant load shedding, substandard distribution lines and poor billing system are the characteristics of the distribution system. Some individuals and communities in partnership with local authorities in many ways helps to reduce part of these problems thereby averting the crisis in the distribution area. The deficit in demand resulting from low generation in no doubt puts the generation as the major problem of power supply in Nigeria. Electricity generation is capital intensive and is either through fossil fuel or renewable energy sources. Fossil fuel includes, oil, natural gas, coal and nuclear while the renewables includes hydro, solar, wind and geo thermal. The available power generation in Nigeria are based on oil (13%), natural gas (54%) and hydro (33%) as compared to the global energy production by source [3]. A number of factors are considered before citing a power generating station which may include; Government incentives, Capital (investment) cost, Fuel costs, air emissions controls for coal and natural gas plants. In table 1, the breakdown of world and Africa's leading electricity production by different energy sources are shown [4].

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Table 1: world and African leading electricity producers

Countries	Total Capacity (GW)	Hydro (%)	Coal (%)	Renewables (%)	Natural gas (%)	Nuclear (%)	Oil (%)
CHINA	1,467.42	16.8	73	2.7	3.8	3.7	-
USA	1,068.4	6	39	7	27	19	2
INDIA	303	15	61	13	9	2	-
RUSSIA	239.2	16	18	3	51	12	-
JAPAN	282	7.8	49.3	0.28	39.5	3.1	-
S. AFRICA	40	0.1	69.0	10.8	2.9	2.4	14.8
EGYPT	30	2.1	2.0	1.9	50	-	44
NIGERIA	0.23	33	-	-	54	-	13

These five world leading energy producers accounts for 50% of energy production in the world. It will be wise that we study the pattern, reasons and probably explore the best other alternatives of energy production from these leading energy producers to solve our energy crisis so as to restore our position as the leading economy in Africa

2. HYDRO POWER GENERATION

Hydro-electric power uses the potential energy from rivers to generate electricity, it accounts for 16% of world energy production. Apart from a few countries with an abundance of it, hydro capacity is normally applied to peak-load demand, because it has a quick start up time. From the table above, the interest of the government in hydro energy is clear. The capital cost for a hydropower is quite high. But generally the cost of generating electricity through hydro is relatively low because of no extra fuel cost, making it a competitive source of renewable electricity. However, damming interrupts the flow of rivers and can harm local ecosystems, and building large dams and reservoirs often involves displacing people and wildlife [8]. A hydropower plant produces no direct waste, and has a considerably lower output level of the greenhouse gas emission than fossil fuel powered energy plants. Nigeria has two major rivers flowing through its territory, the Rivers Niger and Benue. Nigeria has a proposed 8,602MW of power from hydro at a cost of US\$13.5Bn [9]. Since 50% of the stations on this proposal are on river Niger, the efficiency of the output power will be very low compared to the cost making this proposal to be more of a paper work.

3. COAL POWER GENERATION

In electricity generation worldwide, Coal plays a vital role. Coal-fired power plants currently provides 41% of global electricity and, in some countries, coal fuels a higher percentage of electricity. Nigeria has large coal reserves in Enugu, Kogi, Benue and Delta states but unfortunately, Government interest in energy generation through coal has been in the cold since the discovery of oil and the Nigerian civil war. The advantages of Coal fired plants includes, continuous, predictable and reliable Source of Power, abundance, Low Capital Investment, low Cost, high load factor, Large Potential compared to Oil, Big Industrial base etc. **Although coal fired plants has issues with Greenhouse Gas Emissions, Emission of harmful Substances like Sulphur Dioxide, Carbon Monoxide etc., these cannot outweighs its advantages.** Black carbon emissions are shown to have detrimental effects on the environment because

of their light absorbing qualities. The theory is that when black carbon lands on snow and ice, the reflective properties of ice are decreased and more melting occurs [10]. Nigerian has been known to have no cases of ice and snow falls. Also, clean coal technology describes a new generation of energy processes which have the ability to sharply reduce air emissions and other pollutants.

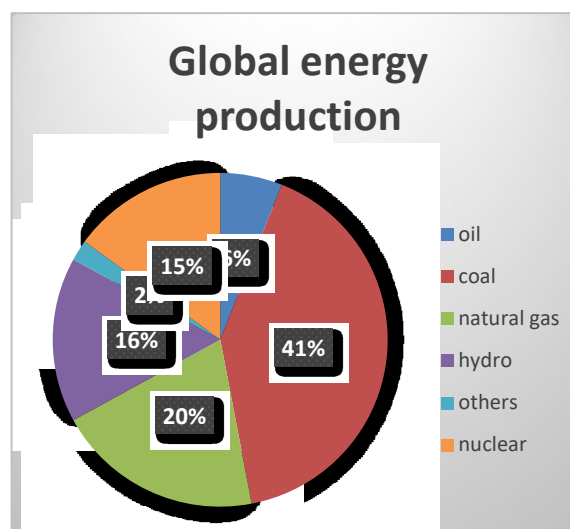


Fig. 1: Global energy production by sources [4]

4. GAS FIRED POWER GENERATION

Energy generation through natural gas accounts for 20% of world energy. The efficiency of the plant is high and can be easily installed. The economics of this plant is heavily influenced by the volatile cost of fuel, normally natural gas. Nigeria has abundant reserves of natural gas in the Niger Delta areas which might be the reason for Government’s interest in this mode of power generation. Gas energy resources accounts for 54% of Nigeria’s energy generation. Although, natural gas has little emissions to the environment, the mode of transporting the fuel to the gas plants has caused serious power breakdown due to the volatile nature of the Niger Delta region.

5. OIL FIRED POWER GENERATION

Nigeria has large oil reserves and ranks 11th in the world. Its production capacity is about 2.32million barrels/day, with a very minimal refining capacity. Most of the oil consumed within the country are imported. 13% of power generated in Nigeria are through oil. Only about 6% of global energy

production are from oil. Oil is easily combustible, and produces high energy upon combustion. They are comparatively inexpensive due to large reserves and easy accessibility

However, it is non-renewable and fast depleting. The burning of oil releases carbon dioxide, a powerful greenhouse gas which is a major cause of global warming.

6. NUCLEAR POWER GENERATION

A nuclear power plant is a thermal power station in which the heat source is a nuclear reactor. As is typical in all conventional thermal power stations the heat is used to generate steam which drives a steam turbine. Nuclear energy accounts for 15% of global energy production. There is no atmospheric emissions with nuclear energy generation but waste handling and risk of disasters are major problems associated with it. Getting approval from the International Atomic Energy Agency (IAEA) is a huge task and at the moment Nigeria has no plan of establishing a nuclear plant.

7. OTHER RENEWABLE POWER GENERATION

Renewable energy (exception of hydro) cannot drive the industry effectively but it is a source of relief to the grid network especially in distributed generation. Renewable energy has considerable potential in Nigeria, and could bridge the major energy gaps in rural areas, especially in northern Nigeria where the intensity of the sun and the wind speed are quite high. An efficient installation of renewables, solar and wind will reduce the pressure on already stretched grid facilities and also increase the access of more rural areas to electricity. Most of the harnessed renewable energy in Nigeria are mainly household installations.

8. ENERGY RESERVES IN NIGERIA AND THE PRODUCTION COST

As the population of a nation grows, there is every need to expand the available energy to serve the population. The future expansion of a power network depends on the cost of installations and the available energy reserves. Nigeria has a large natural supply of fossil fuel making it relatively easy to access and it would be the cheapest resource to develop into energy plants [11]. Nigeria's crude oil, natural gas and proven coal reserves are estimated to be 16×10^9 barrels, $3 \times 10^{12} \text{m}^3$ and 3.67×10^8 million tonnes respectively. The two rivers, Niger and Benue are the major sources of hydropower generation in Nigeria. The rivers passed through Niger and Cameroon before entering Nigeria. The Nigerian government agreed to export part of the generated power from hydro as a compensation to discourage them from building dams along the river. This however puts the energy reserve in hydro in a low quantity. The only accessible energy reserves for Nigeria are the oil, coal and natural gas. The efforts made to attain the revised projection of 5000MW in Nigeria continues to be frustrated by the vandalism of Trans Forcados crude oil pipeline (TFP) and the Escravos to Warri gas pipeline in the west, and the Trans Niger crude oil pipeline (TNP) in the East[11]. These vandalism acts on the pipelines in recent times has impacted negatively on the electricity generation and as such Natural gas and oil holds little meaningful future in the Nigerian energy mix. In addition to the energy reserves, the cost of generating power from the available reserves will help to recommend the best option for tackling the energy crisis in this country.

The cost of generating electricity depends on the type of the generation employed. This cost which is given per kilowatt-hour (kWh) or megawatt-hour (MWh) is calculated up to the point of connection to the national grid. The levelized cost which is the net cost to install a generating plant divided by its expected life-time energy output [12] is the appropriate yardstick to determine the cost of installing new energy system. The cost of generation here should matter less since the two available opportunities (coal and gas) have close levelized cost as shown in Fig. 2.

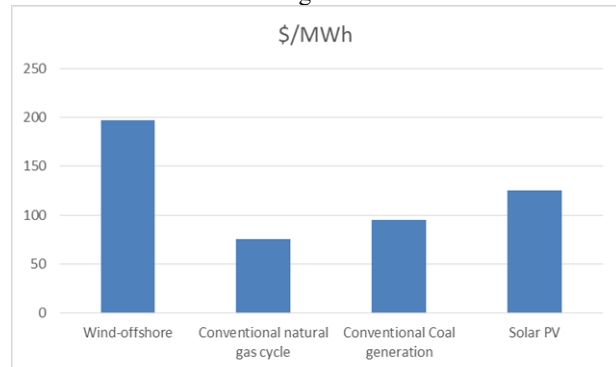


Fig. 2: Levelized cost of generating energy in \$/MWh [10]

CONCLUSION

Generation, transmission and distribution of electrical energy makes up the power systems. The reliability of power supply to a country depends on the above three being economically vibrant. When any of them is in crisis, the energy needs becomes insufficient which invariably slows down economic activities. The available power generation at the moment is less than 20% of the nation's forecast which puts generation in serious crisis. The pattern of generation of electricity in Nigeria are centred only on gas fired and hydro power. In order to reduce this deficit in generation, other vibrant sources of generation should be explored which is similar to those applicable to the world's leading energy producers. Of all the available reserves, coal powered stations stands tall among the rest due to its availability, high efficiency, lower cost and ability to provide more job opportunities. The vast reserves of coal in eastern and middle belt part of the nation will serve both the industry and the exportation very well. If government will look towards this direction, the crisis in energy sector will be adequately addressed

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