



Electrical Energy Access: A Viable Alternative for the Alleviation of the Nigerian Economy



Adeoye OS* and Adeloye AA

Department of Electrical and Electronic Engineering, The Federal Polytechnic, Nigeria

*Corresponding author: Adeoye OS, Department of Electrical and Electronic Engineering, The Federal Polytechnic, Ado-Ekiti, Ekiti State, Nigeria, Email: adeoyesamuel2012@gmail.com

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Abstract

Every sector of life, since the beginning of creation, has been impacted upon by one form of energy. The resultant effect varies globally depending primarily on the output desired. Electrical energy access and consumption in Nigeria was critically examined in this manuscript. The prevailing access status was identified and compared with existing consumption indices in other parts of the world. Consequently, the per capita demand for Nigeria was computed from its subsisting load requirement and population size. A significant disparity was observed upon comparison of the power generated and the load demand within the Nigerian nation. Similarly, specific values of the same parameters were obtained for different countries across the world and compared with the values obtained for Nigeria. Insufficient power supply and access was identified as a defect to national growth and development while a direct proportionality between the growth in electrical energy access and national economy was discovered. The factors of production were analysed with a view to proffer solution to the state of economy. Energy mix was proposed as an option that would alleviate the present economic status of Nigeria.

Keywords: Energy access; Energy mix; Load demand; Per capita demand; Economy

Introduction

Energy is defined as the ability to do work or the capacity of a system to perform a work. It can neither be created nor destroyed. However, it can be transformed from one form to another and its unit of measurement is Joules. Different forms of energy include light, chemical, heat, sound, nuclear, mechanical and electrical [1]. Every sector of life requires energy. In agriculture, it is used for pumping water for irrigation and methods of production. Electrical energy is superior to all other forms due to cheapness, convenient and efficient transmission, easy control, cleanliness, greater flexibility, versatile form [2]. The growing population of Nigeria is put at over 180 million while the power generation increased from less than 3000MW to 4000MW by September, 2016 [3,4]. This is paltry energy access for a sovereign federation with a total land mass of 923,768km² [5].

Literature Review

Factors of production

This is the means or agent of production. It is made up of the tangible and intangible resources that are combined together for production of goods and services. The factors are land, labour, capital and entrepreneurship.

Land: Land in economics refers to free gift of nature which Nigeria has in abundance. It's inclusive of natural resources such as water, sunshine, weather, forest, mineral deposits, animals, hills

and fishing ground. Each of the items mentioned under this factor of production exists in abundance in the Nigeria and should be properly harnessed for growth and development.

Labour: This may be defined as all human efforts both physically and mentally that are directed towards production. It could also be described as the varieties of natural talents available within the society. This is a great weapon for development in Nigeria. Nigeria has a population of over 170 million. Skilled labour such as economist, engineers, lawyers, accountants, doctor among others, requires special skills and training. Semi skilled labour deals with acquisition of some training or skills due to constant exposure eg: clerical staff, auxiliary nurses, laboratory attendants. Unskilled Labour has no formal training eg: messengers, cleaners and guards.

Capital: Is the stock of previous wealth invested in order to obtain future wealth. It could be fixed capital such as machineries, buildings, motor vehicles, furniture etc. Working or circulating capital is inclusive of examples such as raw materials and cash in hand while current capital is required for day to day running of a firm or production activities. Also, there is a third subcategory called real capital which encompasses illustrations such as road, electricity (electrical energy) and water.

Entrepreneur: Can be defined as the factor of production that bears the risk of business activities. An entrepreneur controls and

manages the business. In summary, the success or failure of the business depends on his or her ability to put things in the right perspective.

Energy resources in Nigeria

It is the continent's most prolific oil-producing country, which, along with Libya, accounts for two-thirds of Africa's crude oil reserves. It ranks second to Algeria in natural gas [6]. Most of Africa's bitumen and lignite reserves are found in Nigeria. Several energy resources are available in Nigeria in abundant proportions. The country possesses the world's sixth largest reserve of crude oil. Nigeria has an estimated oil reserve of 36.2 billion barrels. It is increasingly an important gas province with proven reserves of nearly 5,000 billion m³. Coal and lignite reserves are estimated to be 2.7 billion tons, while tar sand reserves represent 31 billion barrels of oil equivalent. The identified hydroelectricity sites have an estimated capacity of about 14,250MW.

Nigeria has significant biomass resources to meet both traditional and modern energy uses, including electricity generation [7]. In spite of these resources, an obvious supply and demand gap subsists as a result of the inadequate development and inefficient management of the energy sector. The supply of electricity, the country's most used energy resource, has been inconsistent [8,9].

With the restructuring of the power sector and the imminent privatization of the electricity industry, the rural areas that are farther from the grid and/or have low consumption. Meanwhile, electricity is required for such basic developmental services as pipe borne water, health care, telecommunications, and quality education. The absence of reliable energy supply has not only left the rural populace socially backward, but has also left their economic potentials untapped. Energy consumption patterns in the world today shows that Nigeria and indeed African countries have the lowest rates of consumption. Nevertheless, Nigeria suffers from an inadequate supply of usable energy due to the rapidly increasing demand, which is typical of a developing economy. Paradoxically, the country is potentially endowed with sustainable energy resources such as solar, wind, biomass, and small hydropower potentials [10].

Energy consumption

Table 1: Country statistics of electricity generation and per capita consumption.

Continent	Country	Population (Million)	Generation Capacity (MW)	Per Capita Consumption (Kw)
North America	USA	250	813,000	3.2
South America	Cuba	10.54	4,000	0.38
Europe (Central)	UK	57.5	76,000	1.1
Europe (Eastern)	Ukraine	49	54,000	1.33
Middle East	Iraq	23.6	10,000	0.42
Far East	South Korea	47	52,000	1.1

Nigeria is rich in conventional energy resources, which include oil, natural gas, lignite, and coal. It is also well endowed with renewable energy sources such as wood, solar, hydropower, and wind [8].

Per capita energy consumption in Nigeria

The energy consumption per capita in Nigeria is very small about one-sixth of the energy consumed in developed countries. This is directly linked to the level of poverty in the country. Gross domestic product (GDP) and per capita income are indices that are used to measure the economic well-being of a country and its people [11]. GDP is defined as the total market value of all final goods and services produced within a given country in a given period of time (usually a calendar year). The per capita income refers to how much each individual receives, in monetary terms, of the yearly income that is generated in his/her country through productive activities. That is what each citizen would receive if the yearly income generated by a country from its productive activities were divided equally between everyone. At present, the Generation Companies (GENCOs) of the Nigerian electricity utility accounts for about 50% of the total generation [10]. Electricity is largely dependent on fuel such as fuel oil, natural gas, and diesel oil. These sources of energy have decreased significantly in recent years [11]. Comparing the per capita power generation to that of other countries, Nigeria has the lowest among the countries, as shown in Table 1, while the USA has the highest per capita electricity generation.

The estimated per capita demand for the entire country was computed using Equation 1. A value of 22.22kW per capita was obtained. In spite of the increase in the Nigerian power generation from less than 2000MW to 4000MW within September, 2016

$$PCD = \frac{\text{Power supply to a specified area}}{\text{Population of the area}} \quad [4].$$

$$= \frac{4000 * 10^6}{180 * 10^6} \quad (1)$$

$$= 22.22kw \text{ per capita}$$

Africa	Nigeria	140	< 4,000	0.03
	Egypt	67.9	18,000	0.27
	South Africa	44.3	45,000	1.02

Source: IEA Energy statistics [9].

Table 2: Electric power consumption in developing and developed countries.

S/N	Countries	Power Consumption (kWh)
1	Algeria	133
2	Angola	86
3	Argentina	871
4	Bangladesh	11
5	Bolivia	165
6	Canada	9301
7	Denmark	3059
8	Ethiopia	19
9	France	2746
10	Germany	4064
11	Iceland	7002
12	Libya	180
13	Mozambique	50
14	Nepal	6
15	Nigeria	22
16	Switzerland	4615
17	Tanzania	30
18	Togo	64
19	United Arab Emirate	687
20	United Kingdom	4255
21	United States of America	7517

Source: World bank data indicator [14].

The value of this parameter ranks highest among developed countries as illustrated in Tables 1 & 2. America is less than 5% of the world's population and yet consumes as much as 25% of its energy. Energy consumption means consumption of the sources of energy that generate power including fossil fuels, and renewable energy. The main fossil fuels are oil, coal, and natural gas while the renewable energy sources include wind, solar, hydro electric power and bio-fuels. The world's energy consumption is about 15 Tera watts of power [12].

Energy challenge

The consumption of energy globally has increased steadily over the last 40 years with dramatic growth rates in many developing countries as described in Table 3. Even though there is imbalance in access to modern energy services. From 1970 to 1988, the developing countries' share of global primary energy consumption rose from 13% to about 30%. In 2005, the non- OECD accounted for

52% of global primary energy consumption. The average per capita consumption of energy in the OECD countries was more than four times the per capita average in all non OECD countries and nearly seven times the per capita average in Africa [13]. At least a quarter of the world's population of 6.6 billion people are unable to take advantage of basic amenities and opportunities made possible by modern forms of energy [9].

Table 3: Nigeria economy data.

Years	2011	2012	2013	2014	2015
Population million	160	165	169	174	179
GDP (%)	4.9	4.3	5.4	6.3	2.7
GDP(USD bn)	418	446	498	553	479

Source: Wikipedia [3].

The price of oil was US\$ 20 per barrel in 1999 and rose to US\$ 126 per barrel in 2008. The International Energy Agencies (IEA) projected that oil price will considerably drop in the next 20 years [13]. Per capital commercial energy demand is ten times greater in the richest developing countries such as Uruguay and Israel where less than 5% of the population is classified as poor than in the poorest countries such as Nigeria and India where more than 75% of the population lives on less than \$2 a day. Table 4 depicts exchange rate of the Nigerian Currency to the American Dollar with a sharp 100% increase within 3 years [2012- 2015].

Table 4: Exchange rate of Nigeria currency to American's dollar

2012	1 USD	155.05 - 165 NGN
2013	1 USD	153.21-162.9 NGN
2014	1 USD	160 -165 NGN
2015	1 USD	304.96

Source: World bank [15].

Energy access and economic growth

Energy access, as an important economic factor, is not solely sufficient for creating the conditions for economic growth [14,15]. However, it is certainly very necessary. Economic growth almost always requires energy access especially in the tertiary stage of economic development. Access to energy contributed in no small measure to the economic growth in countries such as Brazil, Turkey, and Korea. Its impact was milder in India and China [16].

The significant difference in average indicators of social and economic conditions between developing and industrialized countries are briefly expressed as follows

Social: the citizens of OECD countries have a larger life expectancy of 76 years compared with an average 64 years in

developing countries [17]. This is due to largely lower infant mortality rate of 9/1000 live births compared to 71 developing countries.

Economic: average per-capital incomes are more than 8 times higher in OECD countries than in the developing countries.

Energy Development index is made up of the per capita commercial energy consumption, share of commercial energy in total fuel energy being utilized and the share of population with access to electricity. This parameter is depicted by Equation 2 [18] (Table 5).

Table 5: Contribution of factors of production and productivity of GDP growth, 1980-2001.

Countries	Average Annual Growth GDP	Energy	Labour	Capital	Productivity
Brazil	2.4	77	20	11	-8
China	9.6	13	7	26	54
India	5.6	15	22	19	43
Indonesia	5.1	19	34	12	35
Korea	7.2	50	11	16	23
Mexico	2.2	30	60	6	4
Turkey	3.7	71	17	15	-3
United States	3.2	11	24	18	4

Source: IEA analysis based on IEA databases and World Bank [9].

$$\text{Dimension Index} = \frac{(\text{Actual value} - \text{Minimum value})}{(\text{Maximum value} - \text{Minimum value})} \quad (2)$$

Methodology

Information was obtained from reputable journals regarding the level of consumption of electrical energy in different parts of the world. Energy resources available in Nigeria were identified and

the capacities of each were discussed [19]. The per capita demand for Nigeria was computed from its subsisting load requirement and population size while the value obtained was compared to that of selected countries in the world. The level of access of Nigerians to electricity was assessed and other factors of production were appraised in order to improve the present economic status of the nation. The sudden drop in the cost of crude oil per barrel was discussed as it affects the economy of the country.

Discussion

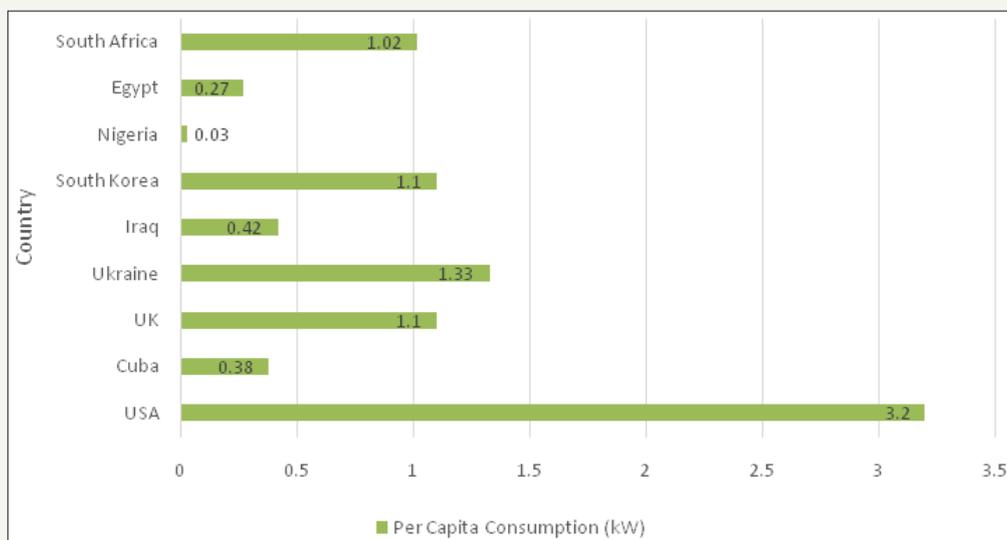


Figure 1: Bar chart of per capita energy consumption in various countries of the world.

Source: A review of latin america and africa [17].

The present per capita (PPC) computation of Nigeria from equation 1 is 22.22kW. This is better than the value of 0.03 it had in 2016 as displayed in Table 1 & Figure 1, where Nigeria had the least per capita value among the group of nations under consideration. The present PPC value is far less than what is obtainable in

countries such as Angola, Togo and Libya as depicted in Table 2. The Nigerian economy data makes obvious the direct proportionality between the steady increase in the country's population size as well as the percentage gross domestic product (GDP). The price of a barrel of crude oil in the world is \$ 70 as against peak value of

\$135 few years ago. It is no longer news that the price of Premium Motor Spirit (PMS) is ₦ 145 which has affected the cost of living in the country [20]. Prices of commodities have sky rocketed and have become unaffordable for citizens. The exchange rate of a dollar to naira is ₦ 360. Since the economy of the country is import driven, cost of imported goods have increased and unaffordable by the citizens. The country should focus on energy mix by investing on renewable energy which will give room for close to 100% access to electricity in both rural and urban centres of the country. The use of generators as an alternative power source to homes and industries should be discouraged in order to minimize the amount of carbon mono oxide in the atmosphere which is poisonous to human health [21]. Agricultural sector must be revolutionised by using modern techniques whose bedrock is electrical energy. Refineries in existence should be revamped and new ones should be built to increase the capacity. Corruption campaign of this government should continue until our society is free from this menace.

Conclusion

The estimated 22.22 kW per capita demand depicts about 5 % access to electrical energy in Nigeria. The incorporation of energy mix through renewable energy in every part of Nigeria will provide close to 100% access to electricity in the country. This will drive other sectors of the economy and life will be better.

Recommendation

- 1) Electricity access to every citizen of Nigeria at all year round will improve productivity and by extension, the economy of the Nigerian nation.
- 2) Renewable energy through energy mix will reduce incidences of power outage and invariably provide an improved living standard for Nigerians.
- 3) Agricultural revolution through the inclusion of modern mechanized techniques based on energy access will boost the economy.
- 4) Building of more refineries in the country will positively impact the naira to the dollar exchange rate, thereby reducing the rate at which Premium Motor Spirit (PMS) and other hydrocarbon derivatives are produced thereby, diminishing the fiscal recession of the Nigerian economic status.
- 5) The three tiers of government should put in place enabling environment for investors.

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