The Potential of a Nuclear Power Plant in Nigeria

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1. Introduction

The economic growth of a nation is a function of the quality of its power supply and capacity. Electricity in Nigeria is epileptic in nature, although endowed with both natural and human resources. Nigeria has a population of 185 million with a growth rate of 2.6% annually, yet ranked 141 out of 148 countries in terms of the quality of power supply [1]. Notwithstanding, Nigeria hopes to be amongst the world's twenty largest economies in the year 2020, but as of 2018, there is still much work to be done to make this vision 2020 a reality in the power sector. Therefore in this paper, we evaluate the Nigerian electricity load demand of historical energy consumption data 2000-2012 [2], using a least square method to project a trend line for future energy consumption up to 2050 and to study their relationships in 2015 with possible nuclear energy requirements to meet this growing need.

2. Methods

In this section, an electrical load demand for 2000-2012, was used by a researcher to forecast for years 2013-2030 [2]. Taking the same trend line as the research result, we further increase the forecast year to 2050. For the relationship, we converted from units of power (MWh) to units into energy (TWh) and assuming an optimistic scenario of constant electricity supply to meet demand, we multiplied it with hours in a year, being 8760 hours. Furthermore, electric energy sent out, less transmission loss, from power stations in Nigeria for 2015-2017 was also used for this study.

Data from International Energy Agency (IEA) on Nigerian electricity consumption from 1990-2015 was also considered to forecast 2010-2050 [3]. All data are presented graphically to show the pattern and nature of projections.

Lastly, all data are in Tera watt-hour (TWh) and plotted in a single graph to show the relationship between electrical load demand by forecast (2015-50), electricity supplied (2015-2017), Nigeria energy consumption over the year (1990-2015) by IEA and, the Nigeria national electricity demand projection (2010-50) [4].

2.1 Energy Consumption and Demand Forecast 2000-2012

Table 1 represents the electrical energy consumption in Nigeria from 2000-2012. This is separated into three components namely residential, commercial, and industrial loads [1].

Table I: Energy consumption [2].

	Energy Consumption (MW)			*(MW)*
Year	*Industrial*	*Commercial*	*Residential*	*Total*
2000	*1011.60*	*2346.00*	*4608.40*	*8688.90*
2001	*1987.20*	*2439.00*	*7714.80*	*9034.40*
2002	*1830.00*	*3297.60*	*7668.50*	*12842.40*
2003	*1659.80*	*3583.00*	*7668.50*	*12866.60*
2004	*1605.00*	*3830.30*	*7725.30*	*13160.60*
2005	*1615.50*	*3851.00*	*7760.00*	*13226.60*
2006	*1575.00*	*3900.80*	*7650.00*	*13125.80*
2007	*1530.50*	*3915.00*	*7860.30*	*13305.80*
2008	*1502.50*	*3852.00*	*7910.08*	*13264.55*
2009	*1585.00*	*3865.50*	*8075.00*	*13525.50*
2010	*1589.40*	*3925.80*	*8205.20*	*13720.40*
2011	*1615.50*	*4004.70*	*8285.60*	*13905.80*
2012	*1648.00*	*4025.40*	*8350.00*	*14023.40*

(a) The data for industrial energy consumption in Table I was regressed using a least squares method. This was also done for commercial energy consumption and residential energy consumption. Each relationship was then projected to encompass 2013 to 2050 with the results summed together to arrive at the final projection as shown in Fig. 1.

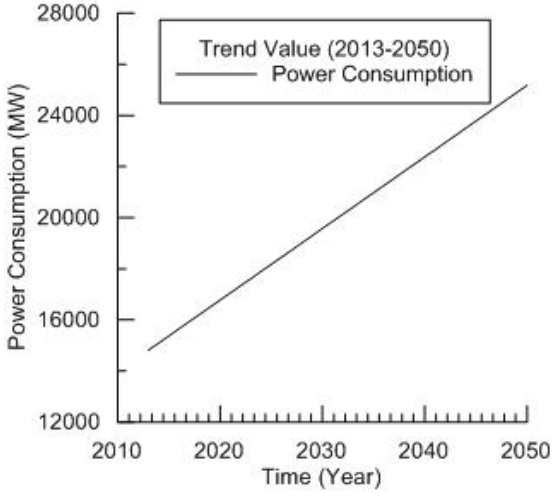


Fig. 1: Energy consumption forecast for Nigeria.

(b) Fig. 2 is an exact representation of Fig. 1 above, in Terawatt-hour (TWh) but it is taken for 2015-2050:

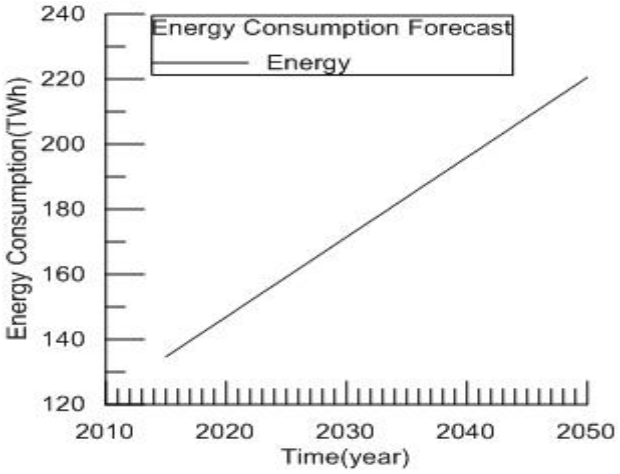
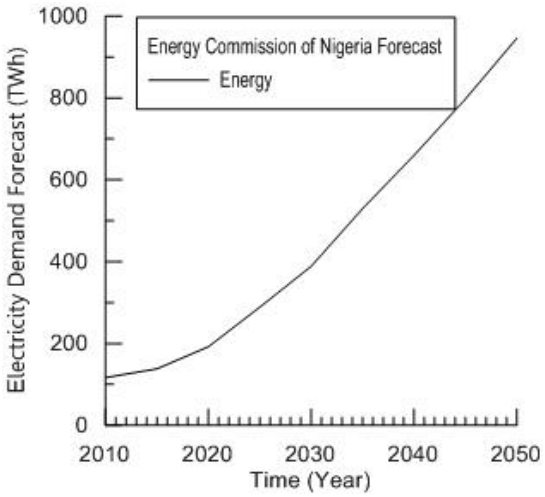


Figure 2: Energy Consumption in TWh

Here, we see that the energy forecast for 2015 is 135 TWh of energy that will be needed to meet the increasing electrical load demand.

2.2 Nigeria Electricity Demand Forecast

Nigerian electricity demand forecasts from 2010-2050 as prepared by the Nigerian energy commission will be used here to understand the Nigerian governments expectations. The data in Fig. 3 below depict the electricity load demand of Nigeria by the agency responsible for national strategic planning in the energy field. Here, the energy planned for 2015 was 138 TWh.



Source: Energy commission of Nigeria

Figure 3: Nigeria electricity load demand (2010-50).

2.3 International Energy Agency (IEA)

IEA is an organization that comprises twenty nine industrialized nations under the Organization for Economic Development and cooperation (OECD). However, IEA has its own record on energy consumption of many countries and Fig. 4 is a summary of their data on Nigeria energy consumption from 1990 to 2015. Fig. 4 shows that energy consumption in 2015 was 26.17 TWh as compared with other predictions in Fig. 1 and 2 above, it is a far cry.

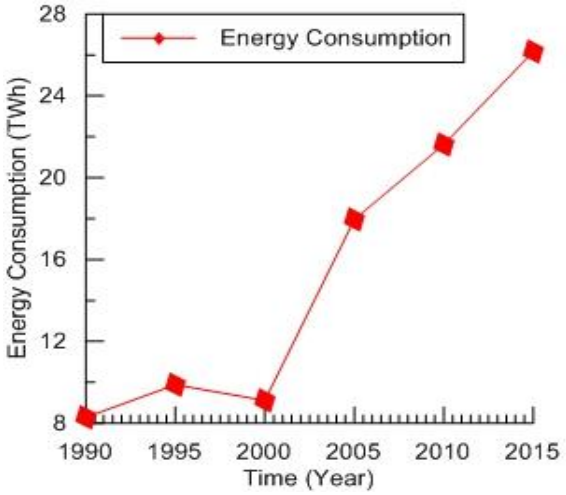


Figure 4: Nigeria energy consumption 1990-2015 [3].

2.4 National Bureau of Statistics

The data from the National Bureau of Statistics is collated by adding up, in a continuous manner, all daily electricity sent out from power stations and transmitted across the country into distribution lines without transmission loss [4].

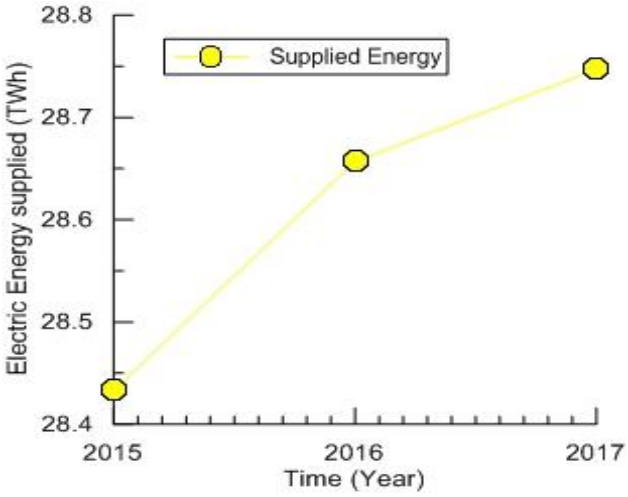


Figure 5: Electricity supplied from 2015to 2017 [4].

3. Discussion

In 2015, we can see that the energy consumption forecast is very close to the national electricity demand forecast. This means the government projected enough energy to meet the electrical load demand in 2015. However, the reality in energy production for 2015 is a far cry from what was projected in other forecasts. The International Energy Agency pinned Nigeria electricity consumption at 26.17 TWh in 2015 and our research have 28.4 TWh in 2015 (data inclusive of distribution loss). Fig. 6 summarizes these findings graphically.

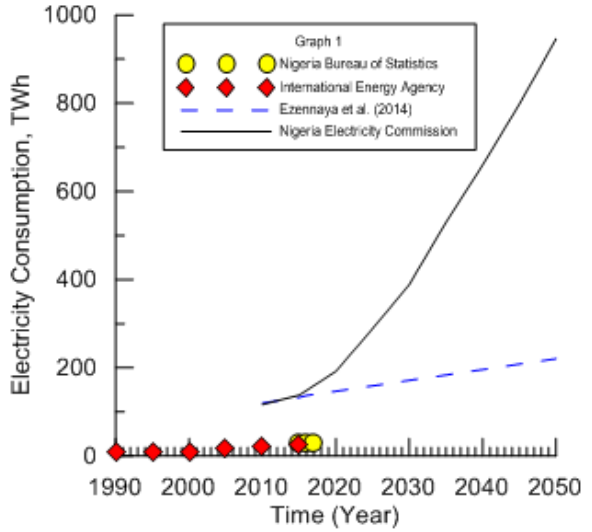


Fig. 6. Characteristics of all sources and projections.

Additionally, there is no doubt henceforth that the Nigeria government has a lot to do in the area power plant installation and transmission as only 59.3% of it populace are connected to the national grid [5].

The Advanced Power Reactor 1400 MWe (APR 1400) can be used to reduce the huge gap between the Nigeria electricity demand and supply. One unit of APR 1400 can generate electricity of 1400 MWe at 100 per cent efficiency and with 5 per cent in house load consumption and 91.95% from transmission loss, can deliver approximately 11 TWh annually. Therefore, two units can generate approximately 22 TWh of energy annually to improve the power security in Nigeria

4. Conclusion

Data from several sources projecting Nigeria's electricity demand and related matters were studied and consolidated to help produce our own projections. Data from the other researchers, the International Energy Agency, and also the Nigerian Bureau of Statistics show a modest consumption of electricity in the region. Based on these forecasts, we regressed a combination of the data using a least squares approach and each source showed large projections in Nigerian electricity demand. This would partially justify the need for more secure energy sources such as nuclear power, with the APR 1400 as a candidate plant.

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