



**TRANSMISSION COMPANY OF NIGERIA
INDEPENDENT SYSTEM OPERATOR (ISO)**

Part 3

Demand Forecast Report

Outlook for 2017 - 2027

By
Market Operator

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Contact: Engr. Musa Musa Gumel
Ag. Managing Director Independent System Operator (ISO)
No. 14 Zambezi Crescent, Maitama, Abuja, Nigeria

Contact: Engr. Moshood Saleeman
Ag. Managing Director Market Operator (MO)
No. 14 Zambezi Crescent, Maitama, Abuja, Nigeria

Author:

Castalia
1747 Pennsylvania Avenue NW
Suite 1200
WASHINGTON, DC 20006
United States of America
Tel: +1 (202) 466-6790
washington@castalia-advisors.com

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No 2 Dr. Clement Isong street, Asokoro, Abuja/Nigeria
Contact: Ina Hommers (ina.hommers@giz.de)
T 00234 (0)8057601986

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1. Introduction

The system adequacy assessment is based on the demand forecasts developed by the Japan International Cooperation Agency (JICA). JICA forecasted Nigeria's energy demand and peak demand, both nation-wide and for each region, for the period 2015 to 2040. For each forecast, JICA developed three cases representing different GDP growth scenarios: a Base Case with an average annual GDP growth rate of 6.1% over the period, a Low Case with an average annual GDP growth rate of 4.8%, and a High Case with an average annual GDP growth rate of 7.3%.

According to JICA's forecasts, under the Base Case scenario, grid electricity demand is projected to grow from 63,787 GWh in 2015 to 173,055 GWh in 2027 (section 1.1), and peak demand is projected to grow from 9,499 MW in 2015 to 27,972 MW in 2027 (section 1.2). These forecasts represent the estimated unsuppressed demand of the grid-connected load; taking into account the estimated grid-connected electricity demand that is currently not supplied due to power shortages (see section 1.3 for a brief description of the methodology used for developing the forecasts).

Nigeria's estimated (unsuppressed) electricity demand per capita in 2011 is lower than Ghana's demand per capita, and the forecasted demand per capita for Nigeria in 2040 is over four times lower than South Africa's demand per capita level in 2000 (section 1.4).

1.1. Energy Demand Forecast

Figure 1.1 below presents the forecasted national energy demand for each of the three GDP growth scenarios between 2015 and 2027. The forecast represents total on-grid demand—which includes demand from the Transmission Company of Nigeria (TCN), as well as from auto producers, and exports. Energy demand is projected to increase from 63,787 GWh in 2015 to 173,055 GWh under the base case, 135,254 GWh under the low case, and 215,068 GWh under the High Case scenario in 2027.

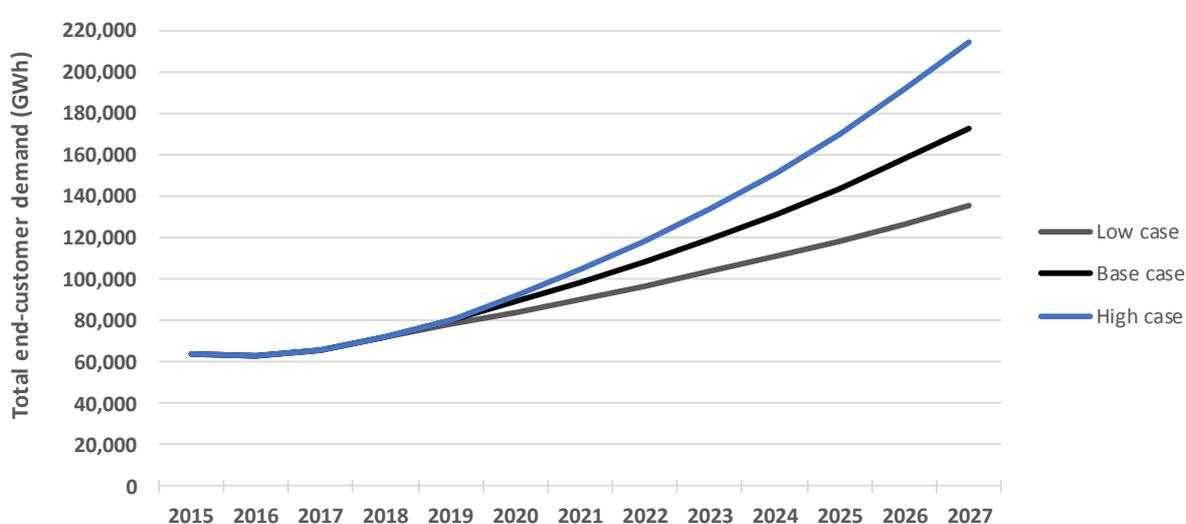


Figure 1.1: Forecasted Energy Demand (on-grid, including exports), 2015-2027 (GWh) [1]

Figure 1.2 below shows the estimated on-grid energy demand per region under the Base Case scenario. According to these estimates, Abuja, Kano, and Kaduna are projected to have the

highest growth rates of electricity demand in the country over the 2015-2027 period (374%, 273%, and 246% growth between 2016 and 2027, respectively).

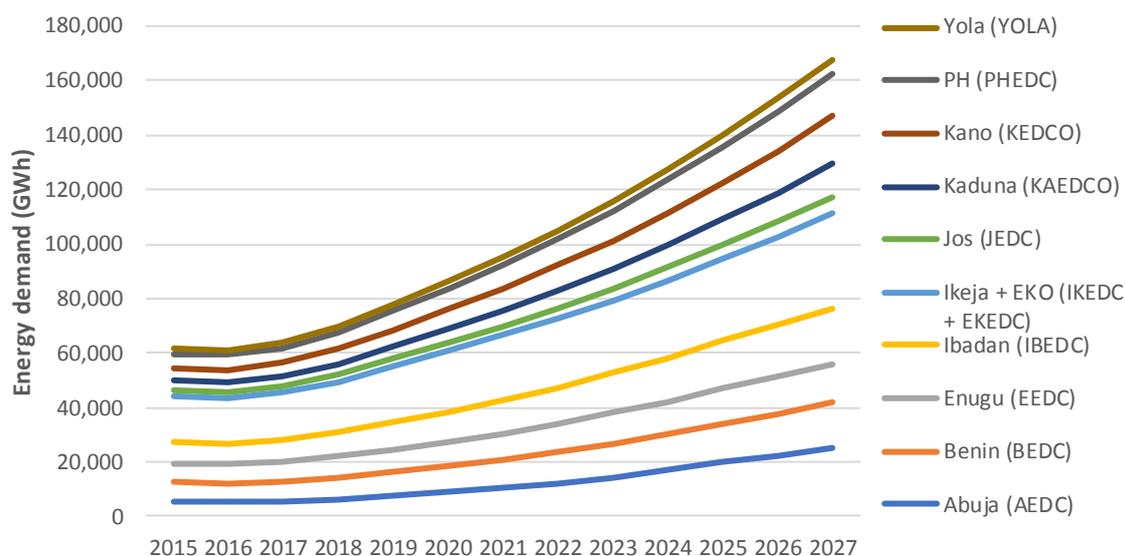


Figure 1.2: Forecasted Energy Demand per Region (Base Case, on-grid, excluding exports), 2015-2027 (GWh) [1]

1.2. Peak Demand Forecast

Figure 1.3 below presents Nigeria's on-grid peak forecast (including exports) for the Base Case, Low Case, and High Case scenarios between 2015 and 2027. Peak demand is projected to increase from 9,499 MW in 2015 to 27,972 MW under the Base Case, 21,808 MW under the Low Case, and 34,824 MW under the High Case scenario in 2027.

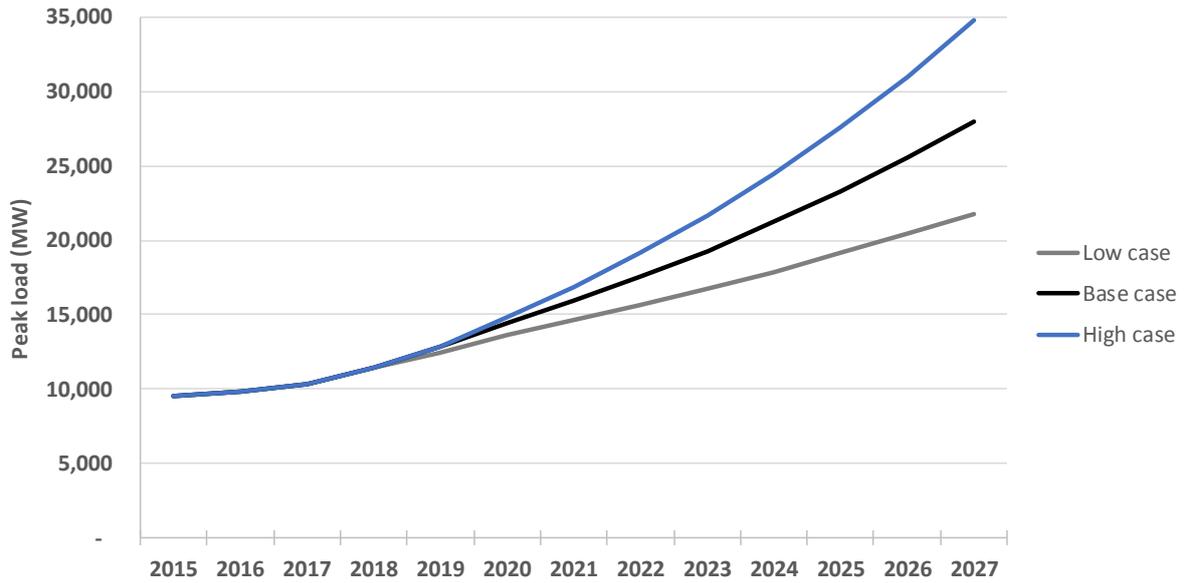


Figure 1.3: Total Estimated Peak Demand (on-grid, including exports), 2015-2027. [1]

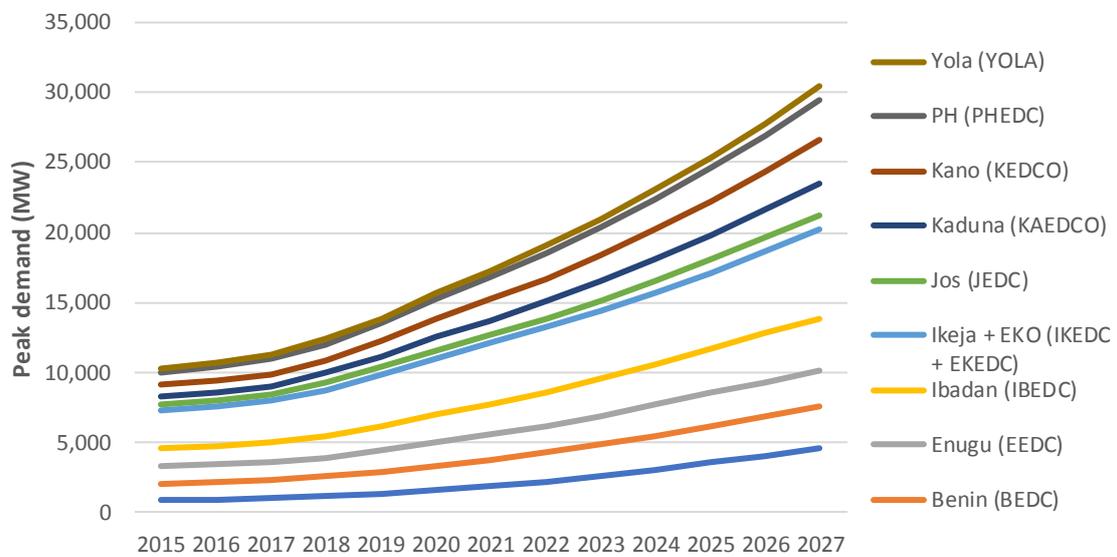


Figure 1.4 below presents the estimated peak demand per region under the Base Case scenario.

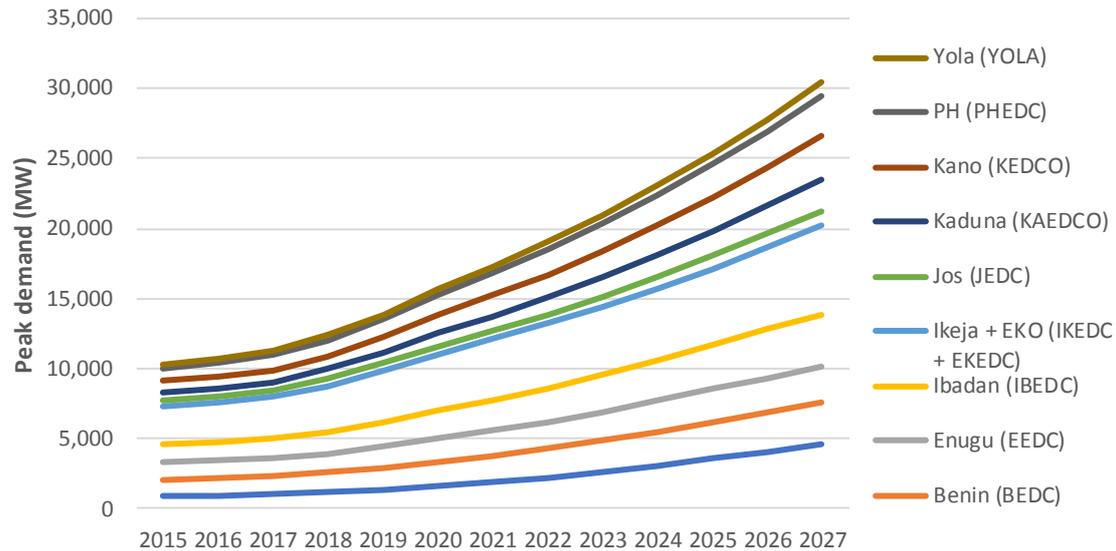


Figure 1.4: Estimated Peak Demand per Region (Base Case, on-grid, excluding exports), 2015-2027 [1]

1.3. Methodology

JICA developed its power demand forecasts through the following steps:

1. Estimate unsuppressed demand for the base year
2. Forecast sectoral (and nationwide) electricity demand
3. Forecast nationwide peak demand
4. Forecast electricity demand per region.

The following subsections briefly explain the methodology used for each of these steps.

Note: JICA also forecasted off-grid electricity demand, however this forecast is not included or described in the present report because off-grid electricity demand is not relevant for the purpose of the System Adequacy Outlook. The System Adequacy Outlook relies on an estimate and forecast of unsuppressed demand of people and businesses connected to the electricity grid.

1.3.1. Estimate Unsuppressed Demand for the Base Year

Unsuppressed demand, which JICA refers to as 'actual potential power demand', is calculated by adding the estimated shortage of power to the recorded consumption of electricity. The shortage of power is estimated by examining load shedding data from a regional survey implemented by TCN and Fichtner in 2016 across the various electricity distribution companies (DISCOs).

The figures below compare, for total electricity and peak demand, the evolution of recorded demand with 'computed' demand. Computed demand means recorded demand plus the estimated power shortage between 2000 and 2016.

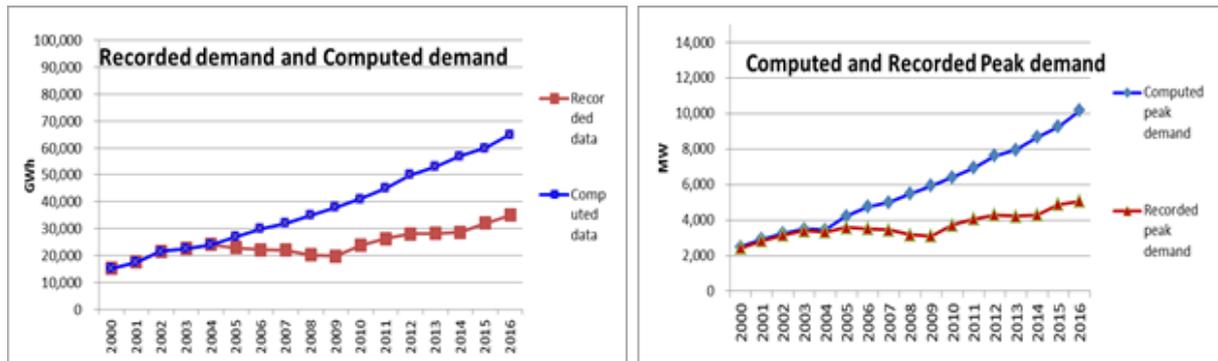


Figure 1.5: Recorded demand and computed demand, 2000-2016. [1]

1.3.2. Forecast Sectoral Electricity Demand Forecast

Having estimated unsuppressed demand in the base year, JICA forecasts electricity demand (in GWh) for the agriculture, industry, commercial, public, and residential sectors. The sum of forecasted demand for all of these sectors constitutes the nationwide electricity demand forecast.

To forecast electricity demand for the various sectors, JICA:

- a. Predicts social economic indicators such as population, GDP, inflation, and exchange rate. As explained earlier, JICA consider three different scenarios for GDP growth rate:
 - A Base Case under which GDP grows at an annual rate of 4.3% from 2015 to 2020 and 6.5% thereafter
 - A Low Case under which GDP grows at an annual rate of 4.3% from 2015 to 2020 and 5% thereafter
 - A High Case under which GDP grows at an annual rate of 4.3% from 2015 to 2020 and 8% thereafter.
- b. Examines key sectoral policies and activities, to identify major trends affecting power consumption growth in each sector
- c. Predicts energy prices and electricity tariffs over the forecast period
- d. Examines key plans and policies affecting grid electricity demand, including:
 - the electrification plan: to determine how many new connections will be added each year as a result of the system rollout plan, and the resulting proportion of population with access to electricity
 - energy efficiency and conservation policies: as these policies can affect electricity consumption per capita.
- e. Estimates the income elasticity of demand and price elasticity of demand for each sector. To do so, JICA analyses historical data on income (for the residential sector) or GDP (for productive sectors) growth vs electricity consumption, and on electricity tariffs vs electricity consumption.

JICA then predicts electricity consumption using elements a-e described above, and the following formulas:

- For the productive sectors:

$$Y_t = Y_{t-1} \cdot (1 + \alpha \cdot \text{Sectoral GDP growth rate}) \cdot (1 - \beta \cdot \text{Tariff growth rate}) \cdot (1 - \text{EE\&C rate}/100)$$
- For the residential sector:

$$Y_t = Y_{t-1} * (1 + \alpha * \text{Income per capita growth rate}) * (1 - \beta * \text{Tariff growth rate}) * (1 - \text{EE\&C rate}/100) * (\text{Electrification rate growth rate})$$

Where:

, α ' = Income or GDP elasticity of demand

, β ; = Price elasticity of demand

, 'EE&C rate' = The Energy Efficiency & Conservation rate resulting from energy efficiency and conservation activities, and defined as 'power savings / power demand'

, 'Electrification rate growth rate' (in %) = Electrification rate in year t / Electrification rate in year t – 1.

1.3.3. Forecast Peak Demand

Peak demand (expressed in MW) is estimated from the total electricity demand forecast and using a load factor assumption of 70%. This load factor assumption is the same as the load factor assumption used for the Multi-Year Tariff Order II.

1.3.4. Forecast Regional Electricity Demand

JICA followed the following main steps for forecasting regional electricity demand:

- Forecast regional population
- Allocate/match the regional population to the DISCOs
- Forecast the electrification rate and customer numbers of each DISCO
- Calculate power consumption per customer
- Estimate future power consumption per customer, using the estimated income elasticity of demand and the estimated growth rate in income per capita for each DISCO
- Calculate the forecasted electricity demand for each DISCO by multiplying the forecasted power consumption per customer by the forecasted number of customers.

1.4. International Comparison

below shows JICA's comparison of forecasted electricity demand per capita for Nigeria with electricity demand per capita in South Africa, Ghana, Malaysia, and China.

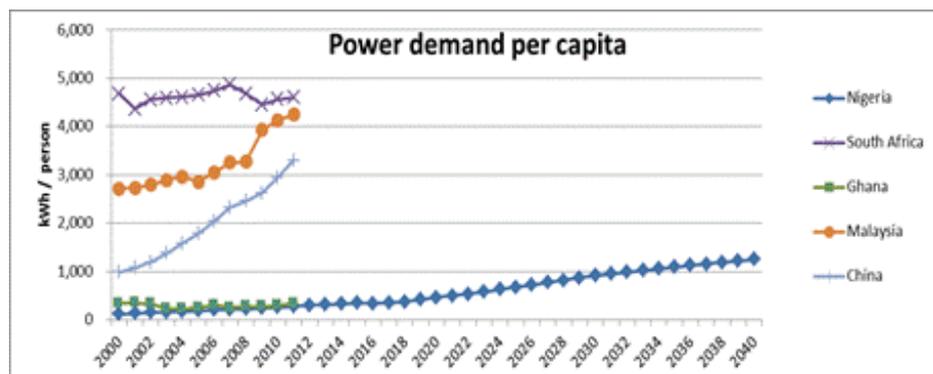


Figure 1.6: Comparison of electricity demand per capita (JICA). [1]

As shown in the above figure, Nigeria's estimated (unsuppressed) electricity demand per capita in 2011 is low even compared to Ghana's demand per capita. The forecasted demand per capita for Nigeria in 2040 is lower than China's demand per capita in 2004, and over four times lower than South Africa's demand per capita level in 2000.

References

- [1] Japan International Cooperation Agency, "Draft Final Report - Power Demand Forecasts (Chapter 4)," May 2017.

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