EmPower Nigeria
Improving Nigeria's electricity supply industry through public education
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Nextier Power is a consulting firm that provides policy advisory, investment advisory, and support services to the electricity supply industry. The firm aims to use this weekly publication to educate Nigerians on the intricacies of the Nigeria electricity supply industry on the assumption that a more informed public would advocate for the right policies and programmes which, in turn, would lead to a robust market that delivers the electricity needs of Nigerians. This column will cover everything from the basics of the industry to the more intricate, sometimes, complex policies and programmes.

How Generation Works:

The Process, Nigeria's Energy Mix and Future Plans

Economic productivity in Nigeria is dependent on improved electricity supply. In fact, Nigeria's *Economic Recovery and Growth Plan* is hinged on improving energy security that would require significant increases in Nigeria's electricity generation and supply. This essay aims to explain how electricity generation works. It presents an overview of electricity generation in Nigeria, explains how generation plants work, and discusses Nigeria's generation mix.

Power Generation in Nigeria

Nigeria's effective electricity demand is estimated at about 31.2GW. Currently, Nigeria has a total installed capacity of 10.4GW from 23 grid-connected power plants. Of this capacity, only about 6.1GW is available for supply through the grid. It is estimated that Nigerians generate up to 14GW of electricity from privately owned gasoline and diesel generators.

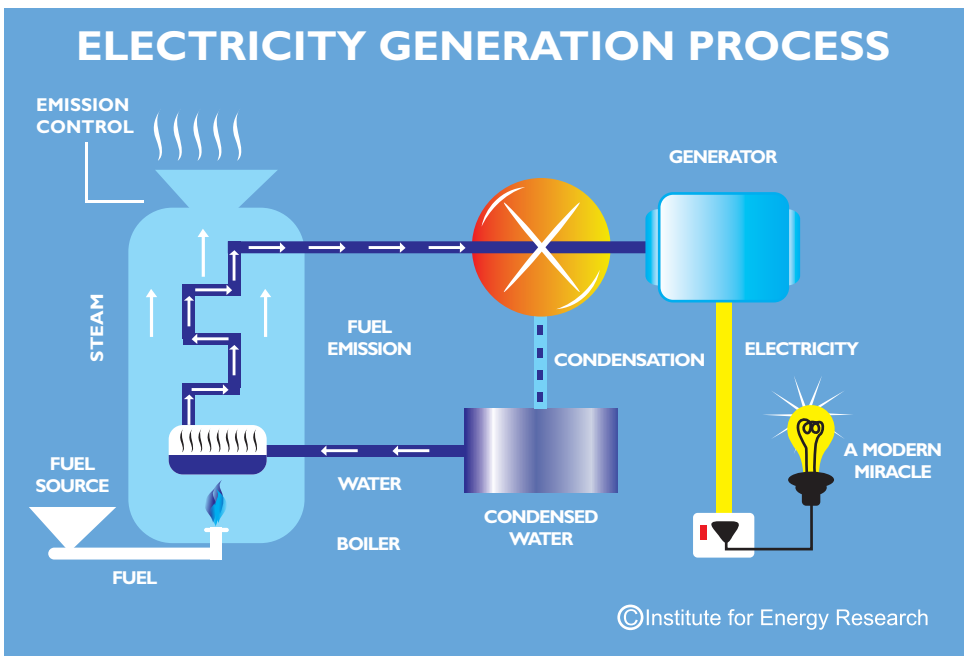
Of the 23 grid-connected power plants, 6 plants were previously owned by the government but privatised in 2013. Ten (10) power plants were developed by the Niger Delta Power Holding Company (an agency of the government) and these plants would be subsequently privatised. The rest of the plants are independent power plants owned by various corporations, however, the electricity produced is fed into the national grid.

There are two predominate fuel sources for power generation in Nigeria: gas, and hydro. Eighty-six (86) percent of the grid-supplied power in Nigeria is from gas; fourteen (14) percent is from hydroelectric power plants. Despite significant coal deposits in Nigeria, there is no coal-fired power plant in Nigeria. The first plant is currently under construction in Itobe, Kogi State. In 2016, the Buhari administration issued power generation licenses to 14 solar power companies; however, only one of the firms has reached financial close. Despite high wind velocities (especially in the flat plains of Northern Nigeria and off the coasts of South West and South South Nigeria), there is only one grid capacity wind power project in Katsina state.

How Generation Works

With the exception of solar power, most of the power plants operate under the same basic process: a "substance" is required to rotate a turbine which generates mechanical energy, which, in turn, spins an electro-magnetic generator to produce electrical energy.

Hydroelectric power plants use flowing water (from a stream, river, dam, etc.) as the "substance" that rotates the turbine while thermal power plants use natural gas, at high-pressure and high-temperature, to rotate the turbine. Coal power plants burn pulverised coal to produce high-temperature and high-pressure fumes that rotate the turbines. For wind power plant, it is airflow that rotates the turbines.



A power plant is like a production line where a "fuel" is fed in at one end, and electricity is produced at the other end. In a typical process, the fuel (gas, oil, coal) is fed into the power plant and burnt in a furnace to release heat energy.

The heat energy from the furnace flows around pipes that are filled with cold water to generate steam. The steam is pushed at high pressure towards a turbine, which, by rotating, generates kinetic energy. The turbine is a wheel made up of tightly packed metal blades. The turbine rotates when the high temperature, high pressure steam hits these blades. Exiting the turbine, the hot air pass through condensers in a cooling tower where the steam is converted to water. The water is then fed back into the pipes for reuse to generate steam.

An axle connects the turbine to a generator and the spinning of the latter converts the kinetic energy into electricity. The electricity is conducted out of the generator into transformers and then onwards to the grid.

Hydropower generation follows a similar process. However, in this case, it is the flow of water (and not steam) that turns the turbines. Typically, a dam is built across a body of flowing water to build up the pressure. The water is let out through a hole (called the penstock) at high pressure and gravity to rotate the blades of the turbine, and by so doing, generate electricity. Hydropower is advantageous because it does not entail burning of fuels that produce carbon emissions that can be damaging to the environment. However, dams constitute a different type of environmental challenge such as flooding of the surrounding areas, and may also alter the local flora and fauna.

Solar power generation, on the other hand, harnesses energy from the sun using technology that poses no detrimental effects to the environment. Typically, solar generation consist of solar panels that have photovoltaic (PV) cells which converts sunlight to direct current (DC) and, through an inverter, this is further converted to alternating current (AC).

Generation Mix

Currently, 86 percent of electricity generation in Nigeria is from thermal sources while 14 percent is from hydropower. Most of this electric power is supplied via the national grid.

Mindful of the challenges of upgrading and maintaining the grid, the Buhari administration is making efforts to promote off-grid power supply. It is anticipated that the Nigeria Electricity Regulatory Commission would release a regulation to guide the use of mini- and micro-grids to provide electricity. This regulation is expected to unleash private sector investments in this space. As a complement, Federal Government of Nigeria (FGN) recently announced its plans to increase renewable energy contribution to the generation mix. The plan aims to achieve by 2020 a 5:3:2 ratio of thermal, hydropower and solar power.

Current Status, and the Future of Electricity Generation in Nigeria

Power generating companies in Nigeria should be incentivised to build new power plants and replace decommissioned ones. The challenge, however, is the over-reliance on gas as the main fuel source. The persistent pipeline vandalism is a major challenge with improving power generation in Nigeria. It is therefore imperative to increase the number of new power plants that use solar, wind, and biomass. This imperative would play to the strengths and endowments of the various geographic locations in Nigeria.

Furthermore, utilisation of renewable energy would ensure that Nigeria could reach full industrialisation without significant increase in environmental pollution. The FGN has taken the initiative in this respect. As of July 2016, Nigeria signed Power Purchase Agreement with 14 solar power firms to generate about 1,125 MW of electricity.

As part of the conditions for privatisation, GenCos committed to increase generation by 5,000 MW over a five-year period. As of November 2016, Bureau for Public Enterprises (BPE) confirmed that most GenCos had exceeded their contractual obligations. For instance, at takeover in 2013, Egbin generated at 300MW, however, by September 2016, the plant had generating capacity of 1,320 MW.

Conclusion

As it stands, generation may not be the primary concern for Nigeria's electricity supply industry because the installed capacity outpaces the capacity of the transmission grid. The grid can only transmit about 5,300MW of power. There is need to significantly increase Nigeria's transmission capacity.

The likelihood of this upgrade is quite low because of the resources required to upgrade and expand the grid: $10 billion per annum for ten consecutive years. Nigeria needs new ides on how to leapfrog the constraints. The government must work hand-in-hand with the private sector to innovate around off-grid solutions: captive generation, embedded generation, mini-and micro-grids, etc.

Finally, being that power supply is a set of interconnected processes, there is need for a holistic implementation plan that covers all aspects of the sector including boosting bill collection efficiency, security for gas infrastructure, and other sundry issues.

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