

# POWER SECTOR REVIEW

*Source: National Integrated Infrastructure Master Plan  
(2014) Federal Republic of Nigeria*



## **CURRENT STATE OF INFRASTRUCTURE**

The energy sector comprises the oil and gas as well as the power sub-sectors. It is one of the most important sectors to Nigeria because of its multiplier effect across all sectors of the economy, its contribution to government revenues, and its potential to spur significant economic growth. Nigeria has an abundance of most of the energy sources (fossil fuels, hydro, solar, tidal, geothermal and biomass) which if properly harnessed can meet the country's energy needs in the short to medium term.

### **Oil and gas infrastructure**

Nigeria's oil reserves at present stand at 36.6 billion barrels while the gas reserves stand at 182.8 trillion cubic feet. Crude oil production delivers an average of 2.5 million barrels per day (mbpd). Nigeria installed refining capacity of 445,000 bpd, but the actual output of the refineries is as low as 45,000 bpd, which is insufficient to meet national demand and necessitates imports. Current capacity utilisation at just above 30% is significantly below international benchmarks, which typically operate at 95% of installed capacity.

The Nigerian National Petroleum Corporation (NNPC) owns a 5,120 km network of pipelines from its refineries. The storage facilities owned by the NNPC include 258 tanks in 22 depots, with a combined holding capacity of 2.6 billion litres of PMS<sup>15</sup>. Other storage and transportation networks are owned by the Depots and Petroleum Marketers Association as well as the major petroleum companies and independent petroleum marketers across the country.

The country's plan is to open up the sector to investment, thereby increasing national reserves to 40 billion barrels at a production rate of 4mbpd by 2020. NNPC has begun a significant turnaround maintenance (TAM) plan to revamp its deteriorated refineries. There are also plans to construct additional refineries in Lagos, Bayelsa and Kogi states. However, construction is yet to commence on any new refineries.

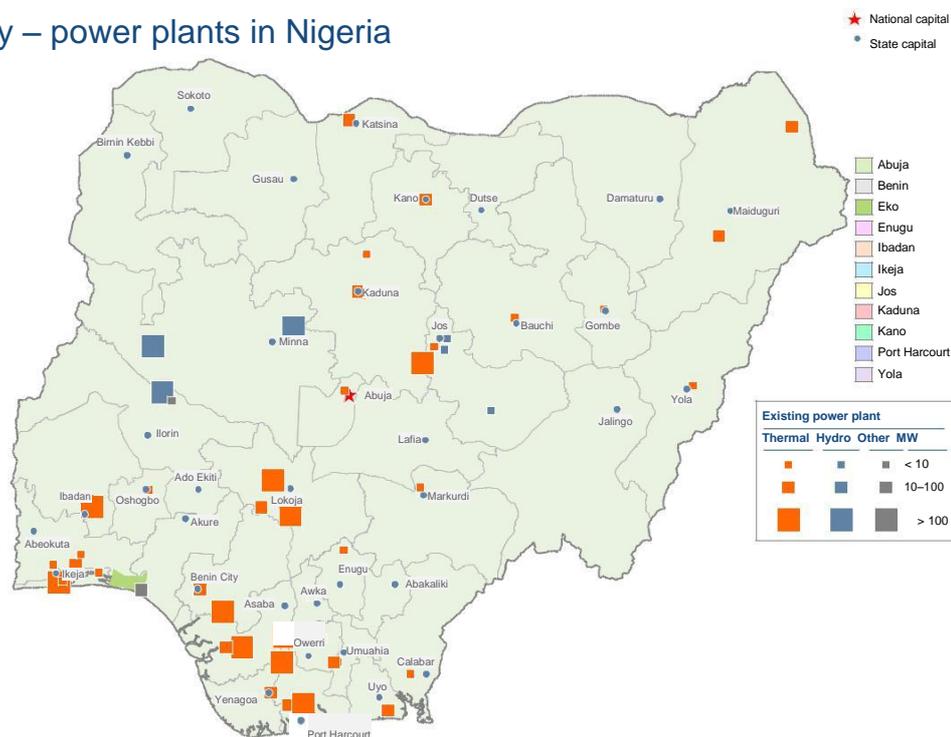
The average refining capacity utilisation of the 4 refineries has fluctuated from 47.55% of installed capacity (2002) to 20.82% (2006) to 26.37% (2011). This fluctuation reflects challenges in the sector, especially the need to improve maintenance so as to operate refineries at optimum capacity. Furthermore, transport and storage infrastructure in the oil and gas sector is capital intensive, and investment in Nigeria has been slow compared to other countries with similar potential.

## **Power infrastructure**

**Generation:** Nigeria has installed electricity generation capacity of ~7,000 MW, but capacity utilisation currently ranges between 3,500- 4,500 MW and in June 2013 was as low as 2,200 MW. 70% of Nigeria's current installed capacity is gas-fired, with the remaining 30% coming from hydro. The country's total exploitable large-scale hydropower potential is estimated to be over 12,000 MW. Nigeria is estimated to have sufficient gas reserves to generate over 50,000 MW, but currently only has installed capacity of 5,000 MW. Recent reforms in the power sector have seen increased participation of private sector players. 55 licenses have been issued to private sector entities since 2000. Of this number, 20 small private electric power generation plants are operational, while 9 are under construction. With the privatisation of the PHCN and NIPP assets, there will be quite a few generation companies operating in Nigeria.

FIGURE 24

## Energy – power plants in Nigeria



SOURCE: Natural Earth; AfDB

The biggest challenge faced in generation is insufficient investment over the past decade and low availability of fuel. Although the NIPP plants have been built, this level of investment is insufficient compared to the overall need.

Furthermore, although Nigeria has significant fuel supplies, especially gas, limited supplies are available for power generation.

The energy sector is currently going through a privatisation process in both Generation and Distribution. The first round of privatisation is nearly complete. 10 of the 11 Distribution companies and 5 of the 6 generation (only thermal and hydro will remain in government control) companies have been privatized with 25% down payments paid by the winning bidders. This should increase much needed investment in generation assets. Additionally, a further 10 generation plants built under the National Integrated Power Project (NIPP), a fast-track scheme launched in 2004 to build government-funded, gas-powered plants during the implementation of the 2005 Electric Power Sector Reform Act, have just begun the process of being privatised. The plants, which have reached varying levels of completion and have a total design capacity of 5,454 MW, are owned by the Niger Delta Power Holding Company (NDPHC) and are located in the gas-producing southern states.

FIGURE 25

Overview of current generation capacity

Generation plant	Location	Installed capacity MW	Available Capacity MW
<b>Hydropower</b>			
Kainji	Niger	760	480
Shiroro	Niger	600	450
Jebba	Kwara	540	450
<b>Subtotal</b>		1,900	1,380
<b>Oil-fired</b>			
Ijora	Lagos	60	-
<b>Gas-fired</b>			
Afam	Rivers	726	60
Ughelli	Delta	900	300
Egbin	Lagos	1,320	1,100
Sapele	Delta	1,020	90
Geregu	Kogi	414	276
Omosho	Ondo	304	76
Olorunsogo	Ogun	304	76
<b>Subtotal</b>		4,988	1,978
<b>Coal-fired</b>			
Oji	Enugu	30	-
<b>Total</b>		6,978	3,358

**Transmission** – Nigeria’s transmission network splits into 2 types, i.e., a 330 kV network and a 132 kV network. For each network, there are 2 elements of basic transmission infrastructure: transmission lines and transmission substations. As of 2009, Nigeria possessed 5,524 km of 330 kV transmission lines and 6,802 km of 132 kV lines. There are 32 330/132 kV substations spread across the country with total installed transformation capacity of 7,688 MVA (equivalent to 6,535 MW). The available capacity of the 330/132 kV transmission network is about 96% of installed capacity.

FIGURE 26

### Energy – power lines in Nigeria



SOURCE: Natural Earth; AfDB

Nigeria currently faces losses in energy transmission (including distribution) of as much as 30% due to deteriorating transmission lines as a result of the need for better maintenance. Furthermore, the current transmission grid begins to face significant technical constraints and issues once it goes above 5 to 5.5 GW of capacity. Transmission is a critical bottleneck to achieving generation above this level. This will need to be increased as an immediate priority. There is critical short-term need for investment and capability building to deliver immediate network improvements and the maintenance programme to strengthen the grid. Getting the basics right, completing high-priority projects and delivering significantly more stable network capacity should be the focus in the short term.

Ongoing projects by the federal government and NIPP are expected to increase the length of transmission lines by 6,577 km of 330 kV lines and 1,514 km of 132 kV lines, and to also increase the capacity of 330/132 kV and 132/33 kV transformers by 6,940 MVA and 4,663 MVA respectively. The proposed construction of 10 new 330/132 kV substations and 7 new 132/33 kV substations, as well as the expansion/reinforcement of 32 existing 330 kV and 13 existing 132 kV substations will also boost the transmission capacity of on-grid power in the near term.

**Distribution** – distribution infrastructure is made up of distribution lines and substations of varying capacities. The total length of 33 kV, 11 kV and 0.416 kV distribution lines as at 2009 was 37,173 km, 29,055 km and 70,799 km respectively. There were 102 132/33/11 kV substations with a combined installed transformation capacity of 9,130 MVA (7,761 MW). The available capacity of these distribution networks averaged 94.1% of installed capacity (8,448 MVA).

## **SECTOR ASPIRATION AND TARGETS**

Nigeria has set ambitious objectives for the energy sector. For the power sub-sector the Technical Working Group identified the following priorities:

- Increase power generation to 20 GW by 2018 and to 350 GW by 2043, with focus on gas as the immediate priority and adding alternative sources after 2023;
- Strengthen and increase transmission capacity, with immediate focus on the national backbone;
- Increase distribution capacity, with priority placed on making power available for industrial users and reducing distribution losses;
- Finalise privatisation of power generation and distribution, and extend privatisation to include NIPP assets;
- Build capabilities, increasing human capacity 20 times by 2023 and 40 times by 2043;
- Increase rural electrification.

For oil and gas, these objectives are to:

- Provide gas distribution infrastructure to increase gas utilisation;
- Increase capacity in oil/gas production;
- Increase refining capacity to fully meet national demand;
- Intensify exploration activities;
- Increase the percentage of capital expenditure in-country;
- Increase bulk storage capacity for oil and gas;
- Increase the capacity of the pipeline network;
- Increase the use of sustainable fuels;
- Establish links to the regional gas network (West African Gas Pipeline, Nigerian phase of the trans-Saharan gas pipeline);

The TWG has broken down these objectives into specific goals for 2018, 2023 and 2043 [Figure 27].

EXHIBIT 27

Sector goals

TWG - Energy

Sub-sector	2018	2023	2043
Power	<ul style="list-style-type: none"> <li>Increase efficiency of existing power infrastructure – increase load factor, decrease losses in transmission, as well as distribution, billing and collection</li> <li>Revamp and expand transmission network to match capacity increase in generation</li> <li>Grow generation capacity by ~4.5 GW per annum – ~70% gas, 30% hydro and other sources</li> <li>Increase human capacity through improved quality and quantity of training programmes</li> </ul>	<ul style="list-style-type: none"> <li>Ramp up and stabilize capacity additions at very high rate of 8-10 GW per annum</li> <li>Expand the national grid in line with capacity addition and implement smart grid technologies</li> <li>Develop hydro and other alternative generation capacity to maintain 70:30 fossil fuels to alternative ratio</li> <li>Develop human capacity</li> </ul>	<ul style="list-style-type: none"> <li>Reduce transport and consumption losses to global standards</li> <li>Increase share of alternative energy to 35%</li> <li>Export electricity to other ECOWAS countries</li> </ul>
	<ul style="list-style-type: none"> <li>Revamp existing refineries and build new refining capacity</li> <li>Ensure adequate gas supply for power generation needs</li> <li>Reduce theft, vandalism and oil spill</li> <li>Increase oil and gas production and reserves</li> <li>Increase local content and human capacity</li> <li>Grow oil and gas based petrochemical manufacturing capacity</li> </ul>	<ul style="list-style-type: none"> <li>Increase local refining capacity to fully meet national demand</li> <li>Increase gas production, handling and transport capacity in line with power sector needs</li> <li>Increase oil and gas reserves and production</li> <li>Zero oil/crude theft and minimal oil spill</li> <li>Promote use of sustainable fuels</li> <li>Link to regional gas network</li> </ul>	<ul style="list-style-type: none"> <li>Increase production and refining capacity in line with national demand growth</li> <li>Reduce greenhouse gas emissions to be in line with the Kyoto Protocol</li> <li>Eliminate operation-related oil spill</li> <li>Align with global health and safety practices</li> </ul>

SOURCE: Energy TWG

Furthermore, these objectives have been translated into a set of specific targets for the full 30-year period, as detailed.

**Power**

For the power sub-sector, there are several targets for the period until 2043 [Figure 28]. One of the most important is the goal to increase average generation capacity from today’s ~7 GW to 350 GW by the end of the 2043, and to ensure sufficient transmission and distribution capacity for delivery of this energy output to end users. This will give Nigeria 80% of the per capita generation capacity of the present day USA in 2043, and will require Nigeria to build in excess of 10,000 MW of capacity p.a. for the next 30 years.

It is also important not to lose sight of the need to develop national capabilities. Low local content in both technological and human input has grossly affected activities in the sector in general. This needs to be seriously addressed through aggressive training and research and development activities, so that in the future Nigeria can largely domesticate activities in the sector.

FIGURE 28

**Sector targets**  
 TWG – Energy (Power)

Name	Unit	Definition	Current	Target		
			2013	2018	2023	2043
▪ Generation capacity	▪ GW	▪ Total Installed generation capacity	7	20	56	350
▪ Transmission route lines: 330 KV	▪ km	▪ Total length of 330 KV transmission lines	5,552	8,000	10,000	16,600
▪ Transmission route lines: 132 KV	▪ km	▪ The total length of 132 KV transmission lines	7,040	12,000	15,000	22,000
▪ Transmission capacity	▪ MW	▪ The total transmission transformer capacity	~5,000	40,000	75,000	470,000
▪ Distribution capacity	▪ MW	▪ The total distribution transformer capacity	6,000	36,000	67,000	420,000
▪ Access to electricity	▪ Percent	▪ Proportion of population that have access to electricity where access means customer premises within 1 km of 11/KV network	40	75	90	100

SOURCE: Energy TWG

## **Oil and gas**

In oil and gas, one of the main goals is to advance “gas to power” in order to meet the rapidly growing energy demand of the country. A further central objective is to increase oil production to 4 mbpd, and increase refining capacity to a level which would fulfill local demand and export potential, estimated at 4 mbpd by 2043, with the target of becoming premium motor spirit (PMS) self-sufficient by 2030. Similarly, Nigeria plans to increase its gas production capacity from 7,580 to 11,000 mcfpd by 2018, 15,000 mcfpd by 2023 and 30,000 mcfpd by 2043. The increase in gas production is necessary to supply the planned gas power stations and develop other gas-based industries, e.g., fertilizers, agro-processing and petrochemicals.

These are ambitious targets, especially against the backdrop of historical performance. For example, upstream oil production has been between 2.1 and 2.6 mbpd in the last 8 years as a result of security issues, crude theft, and long-term funding challenges of NNPC. Concerning midstream, there is a huge shortfall in refined products (about 12 billion litres), with the difference made up in very expensive subsidies. Current data suggests that Nigerian refineries run at a low utilisation rate of below 35%.

At the same time, Nigeria plans to increase its gas production capacity from 7,580 to 11,000 mcfpd by 2018, 15,000 by 2023 and 30,000 by 2043. The increase in gas production is necessary to supply the planned gas power stations and develop other gas-based industries, e.g., fertilizers, agro-processing and petrochemicals.

The corresponding manufacturing capacities of the gas-based industries are set to grow accordingly. In terms of exploration, the goal is to grow natural gas reserves from 187 Tcf to 191.5 Tcf in 2023 and 200 Tcf in 2043 (which translates into a need for finding 85 Tcf over the 30-year period).

Against the backdrop of these targets, it needs to be stressed that insecurity, especially in the Niger Delta, poses a substantial threat to growth in the oil and gas sector. Steps being taken to address the issues need to be vigorously pursued to stem the tide and foster a conducive environment for oil and gas activities. Government funding, especially in the area of exploration which has suffered some negligence for more than a decade, has to be urgently and strategically addressed. The menace of pilfering and theft of products needs to be urgently addressed in order to fully realise the targets set for oil and gas in general, and for oil in particular.

FIGURE 29

## Sector targets

TWG – Energy (oil and gas)

Name	Unit	Definition	Current	Target		
			2013	2018	2023	2043
Production capacity – oil	kbpd	Facilities required to safely and sustainably produce discovered volumes	2,500	2,750	3,000	4,000
Production capacity – gas	mcpd	Facilities required to safely and sustainably produce discovered volumes	8,000	11,000	15,000	30,000
Refining capacity	kbpd	Totality of facilities required to refine crude oil	445	750	1,000	4,000
Refined products storage capacity	billion litres	Total stock of storage facilities/depots required to hold strategic number of days of national daily consumption	2.6	3.2	3.8	5.2
Pipeline length (refined)	km	Length of pipeline installed for transportation of refined products	5,120	6,000	7,000	10,000
Pipeline – (crude oil)	km	Length of pipeline installed for transportation of crude oil	3,000	3,300	3,600	4,800
Pipeline capacity (crude oil)	kbpd	Daily volumetric throughput	1.65	1.815	1.98	2.64
Pipeline capacity (refined)	m litres	Daily volumetric throughput	30	38	47	60

SOURCE: Energy TWG

## **PRIVATE SECTOR EXPECTATIONS AND PRIORITIES**

The private sector, as represented by the various members of the BSG, offered recommendations on the enablers for private sector participation in and priorities for the Energy sector.

Expectations of the private sector for the Energy sector include:

- Complete privatisation of power generation and distribution assets;
- Create a clear path for development of the Transmission Company of Nigeria (TCN), including a mandate to lead future industry planning and allow for private sector investment;
- Implement the Transmission Reinforcement Plan to address transmission constraints and improve grid capability;
- Complete implementation of the Gas Master Plan;
- Progress LNG projects that have viable economics and adequate gas supply;
- Enable completion of joint venture gas supply projects (funding, incentives, etc.).

To enable increased private sector participation in the sector, the BSG highlighted the following enablers:

- An effective, efficient regulatory environment for timely approval of projects, contracts, permits, licences, etc., related to infrastructure development;
- Expedition of Right of Way issues for infrastructure development and reduced cost of securing access rights;
- Improved regulation of gas pricing to attract investment in gas supply infrastructure;
- Government credit enhancement for IPPs (e.g., secure World Bank PRG);
- Incentives for private sector investment;
- Passing the Petroleum Industry Bill to accelerate expected reforms.

## **REQUIRED INFRASTRUCTURE INVESTMENTS**

In order to achieve the goals and objectives of the Energy sector, Nigeria needs to increase its investment in Energy infrastructure. Estimates using international benchmarks suggest USD 1,000 billion will be required over the next 30 years to achieve the specific sector targets – USD 600 billion for power and USD 400 billion for oil and gas, which includes maintenance cost.

For power, the bulk of the investment will be required to increase generation capacity from current levels of ~7 GW to 350 GW (which will be largely funded by the private sector), to build the transmission network to transfer the generated electricity across the country and to distribute electricity to Nigerians (which will be funded by the private sector). The unit cost estimates for generation are expected to decline in the period 2024–43 as Nigeria becomes more efficient at building power plants and economies of scale exert downward pressure on costs. Over the next 5 years, Nigeria needs to spend USD 23 billion in power, of which USD 14-16 billion will be required to increase generation capacity from current levels of ~7 GW to 20 GW by 2018, USD 3-5 billion to increase transmission capacity, and USD 3-5 billion to increase distribution capacity.

For oil and gas, the biggest cost drivers will be increasing existing refining utilisation to match the 445 kbpd capacity, increasing refining capacity to meet local crude production capacity, building additional pipelines, increasing oil production capacity and developing the infrastructure to increase production capacity in oil and gas. Over the first 5 years, Nigeria will spend USD 37 billion: USD 12 billion to increase gas production from current levels of 8,000 mcfpd to 11,000 mcfpd, USD 16 billion to increase oil production capacity by 250 000 bpd and USD 9 billion to increase refining capacity by 300 000 bpd. Most of the

refining and oil production increase will be funded by the private sector, whereas a significant part of gas expansion will be funded by the public sector.

To ensure that Nigeria reaches its ambitious targets, it will need to ensure an appropriate cost reflective tariff for power, drive transmission and distribution losses down to a reasonable level in order to make the tariff more affordable, put appropriate gas contracts in place to ensure gas is delivered to power stations and make adequate upfront investments in skills and capabilities to deliver and operate the necessary infrastructure.

## **LEGAL ENABLERS**

The legal technical working group reviewed the relevant infrastructure-related legislations in the Energy sector and developed a perspective on some of the key legal enablers for infrastructure development in the sector as outlined below.

Under this sector, 24 principal legislations, 16 amendments and 10 sub-legislations governing the oil and gas industry in Nigeria were identified, the key legislations being the NNPC Act, the Petroleum Act, and the Petroleum Control Act. The highly complex laws in this sector were found to not be investor-friendly.

Furthermore, it was identified that the provisions of Sections 7(4), 11(2) and 12 of the NNPC Act are all in breach of the provisions of Section 162 of the Constitution which requires that revenues collected by the government be paid into an account called the Federation Account. In addition, Paragraph 2 of the Deep Water Block Allocation (back-in rights) regulation 2003 (a subsidiary legislation under the Petroleum Act) that gives the federal government the right to acquire five-sixths of an OPL (Oil Prospecting License) or OML (Oil Mining Lease) interest is invalid to the extent that it is inconsistent with paragraph 35, First Schedule to the Petroleum Act which provides that such participation must be made on terms to be negotiated between the federal government and the holder of the OPL or OML.

The laws in the sector cannot be said to be state-friendly as minerals, gas, and oil rights are all vested in the federal government of Nigeria.

Furthermore, it was agreed by legal TWG that most of these laws are out-of-date as they are not in line with modern practice. On the ease of such legislations, the TWG agreed that it was possible to bring this multiplicity of laws into one document in the form of Petroleum Industry Bill (PIB) currently before the National Assembly.