RECP
Africa-EU Renewable Energy Cooperation Programme

Africa-EU Energy Partnership

Captive Power in Nigeria

A Comprehensive Guide to Project Development

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As part of this study, the researchers have conducted interviews and communicated with over 70 persons from different government agencies, non-governmental organisations and the private sector (GenCos, DisCos, financiers, relevant experts, power project developers and agri-food sector companies). More than 40 companies active in the agri-food sector have been visited, often multiple times. We would like to express our gratitude to all those that have cooperated in this study as their input has been very important to the outcome of this report.

Special thanks goes to Godwin Eni Aigbokhan, Renewable Energy Market Adviser of the National Competitiveness Council of Nigeria and focal point for the RECP. Godwin was involved in many interviews and field visits. The researchers also would like to thank the RECP team for their flexibility and providing their suggestions on how to improve the outcome of this study.

NOTES FROM THE AUTHORS

The information in this report is based on interviews, site visits and desk- and literature research. Finding recent and reliable data in Nigeria is challenging. The researchers therefore had to use many different data sources with often different time frames and units. Combining these sources provided new insights but also raised new questions, especially in relation to reliability of the gathered data.

Some data was not available, e.g. energy demand for the different manufacturing sectors (especially the agri-food sector) or the amount of self-generated captive power in Nigeria. The researchers had to use combinations of old and recent, direct and indirect data and extrapolations to be able to provide an estimate for these figures.

The information in chapter six of this report is based on quality sources and is accurate at the time of writing (2016). However, the Nigerian energy sector is still in development and processes, procedures, timelines, fees and the likes are subject to change. Moreover, more than one respondent indicated that there are hidden obstacles and processes. Therefore, for any entity intending to set up a power project in Nigeria it would be wise to liaise with relevant experts who can use their insider knowledge and relationships to ensure all necessary steps at that point of time are indeed taken.

ABBREVIATIONS AND DEFINITIONS

AFD	Agence Française de Développement
AfDB	African Development Bank
APC	All Progressive Congress
BMZ	German Federal Ministry for Economic Cooperation and Development
BOOT	Build-Own-Operate-Transfer
CAC	Corporate Affairs Commission
CBN	Central Bank of Nigeria
CCI	Certificate of Capital Importation
CNG	Compressed Natural Gas
CP	Condition Precedent
CPS	Country Partnership Strategy
CREN	Council for Renewable Energy
DBOM	Design-Build-Operate-Maintain
DCS	Detail Commercial Solicitors
DFID	Department for International Development
DisCo	Distribution Company
DMB	Deposit Money Bank
ECN	Energy Commission of Nigeria
ECOWAS	Economic Community of West African States
EFB	Empty Fruit Bunch
EIA	Environmental Impact Assessment
EOI	Expression of Interest
EPC	Engineering, Procurement & Construction
EPSRA	Electric Power Sector Reform Act
EPZ	Export Processing Zones
FCO	Foreign and Commonwealth Office
FCT	Federal Capital Territory
FDI	Foreign Direct Investment
FEC	Federal Executive Council
FFB	Fresh Fruit Bunch
FGN	Federal Government of Nigeria
FME	Federal Ministry of Environment
FMP	Federal Ministry of Power
FTZ	Free Trade Zone
GACN	Gas Aggregation Company Nigeria Limited
GDP	Gross Domestic Product
GenCo	Generation Company
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GNI	Gross National Income
GSA	Gas Supply Agreement
GTA	Gas Transportation Agreement
HYPPADEC	Hydro Electric Power Producing Areas Development Commission
IEDN	Independent Electricity Distribution Networks
IFC	International Finance Corporation
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
LTSA	Long term Service Agreement
MAN	Manufacturers Association of Nigeria
MEND	Movement for the Emancipation of the Niger-Delta
MFB	Micro Finance Bank
MFI	Microfinance Institutions
MIGA	Multilateral Investment Guarantee Agency
MoF	Ministry of Finance
MoP	Ministry of Power, Works and Housing
MoPR	Ministry of Petroleum Resources
MSMEs	Micro, Small and Medium sized Enterprises
MYTO	Multi-Year Tariff Order
NAE	Nigeria Alternative Energy
NAPTIN	National Power Training Institute of Nigeria
NASENI	National Agency for Science and Engineering Infrastructure
NBET	Nigerian Bulk Electricity Trading Plc
NBS	Nigeria Bureau of Statistics
NCAPMA	National Cassava Processors and Marketers Association
NCERD	National Centre for Energy Research and Development
NCHRD	National Centre for Hydropower Research and Development
NCP	National Council on Privatisation
NDPHC	Niger Delta Power Holding Company
NEEDS	National Economic Empowerment and Development Strategy
NEITI	Nigeria Extractive Industries Transparency Initiative
NEMSA	Nigerian Electricity Management Services Authority
NEMSF	Nigeria Electricity Market Stabilization Facility
NEP	National Energy Policy
NEPA	National Electric Power Authority

NEPP	National Electric Power Policy
NERC	National Electricity Regulatory Commission
NESI	Nigerian Electricity Supply Industry
NESP	Nigerian Energy Support Programme
NGC	Nigerian Gas Company
NGN	Nigerian Naira
NIAF	Nigerian Infrastructure Advisory Facility
NIFOR	Nigerian Institute for Palm Oil Research
NIPC	Nigerian Investment Promotion Commission
NIPP	National Integrated Power Projects
NNPC	Nigerian National Petroleum Corporation
NOTAP	National Office for Technology Acquisition & Promotion
NPC	National Population Commission
NPDC	Nigerian Petroleum Development Company
NREEEP	National Renewable Energy and Energy Efficiency Policy
O&M	Operation & Maintenance
ONEM	Operator of the Nigerian Electricity Market
OPC	Odua People's Congress
PAPs	Project Affected Persons
PCOA	Put Call Option Agreement
PDP	People's Democratic Party
PHCN	Power Holding Company of Nigeria
PKO	Palm Kernel Oil
PPAs	Power Project Agreements
PV	Photovoltaic
REA	Rural Electrification Agency
REAP	Renewable Electricity Action Programme
RECP	Renewable Energy Cooperation Programme
REMP	Renewable Energy Master Plan
REPG	Renewable Electricity Policy Guidelines
RFP	Request for Proposal
ROW	Right of Way
SCPZs	Staple-Crop Processing Zones
SERC	Sokoto Energy Research Centre
SHP	Small Hydro Power
SHS	Solar Home Systems
SPO	Special Palm Oil
TCN	Transmission Company of Nigeria
TEM	Transitional Electricity Market
TPA	Transmission Project Agreement
TPO	Technical Palm Oil
TUOS	Transmission Use of System Agreement
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
USAID	United States Agency for International Development

Important definitions

Agri-food sector	The agri-food sector includes those enterprises engaged in agriculture (and life stock) and the processing of food and drink.
Grid-connected power	Power plant where the electricity generated is evacuated on the national (TCN) grid
Embedded power	Electricity directly connected to and evacuated through a distribution system which is connected to a transmission network operated by a System Operations Licensee
Captive power	The generation of off-grid electricity that is entirely consumed by the generator itself and has an installed capacity exceeding 1 MW (no upper limit)
Off-grid power	Small scale (0–1 MW) electricity generation to a single or limited number of customers, including the use of mini-grids

This report uses the European notation of numbers.

Exchange rates used of 2nd of May 2016:
€ 1 = 228 Naira and $ 1 = € 0,85[1]

1) The Naira is highly volatile with inflation rates in 2016 above 11%, therefore, prices converted from Naira to Euro in this report may not be accurate at the time of reading.

EXECUTIVE SUMMARY

The energy situation in Nigeria is critical and a key constraint for economic development. About 55% of the population has no access to electricity and out of the total energy consumption, traditional biomass (firewood and charcoal) accounts for 86%. Population growth and economic development contribute to an increased need for electricity. The gap between production capacity and demand in combination with poorly maintained generation installations and a poor national and regional electricity grid, results in unstable and unreliable electricity supply for both households and companies.

As a consequence, many companies and households rely on diesel generators for their electricity supply. Of the total energy consumed by Nigerian industries only 4% is from grid-connected electricity. 96% is self-produced, using either natural gas, oil products (usually diesel) or biomass and waste (usually wood products and agri-waste).

Privatisation of the energy landscape

In recent years, the energy landscape in Nigeria has undergone drastic changes due to the ongoing privatisation of the sector. In 2013 the government privatised the electricity sector with the aim to improve the reliability of electricity supply. However, the restructuring of the sector has not yet led to the anticipated improvements. In recent decades the electricity market has changed from a vertically-integrated organisation under the state-owned National Electric Power Authority (NEPA), to a multi-stakeholder privatised market.

Within the Nigerian electrical power landscape, four basic power generation options are to be differentiated. These are:

I. Grid-connected: a power plant where the electricity generated is evacuated on the national grid.

II. Embedded: electricity that is directly connected to and evacuated through a distribution system which is connected to a transmission network operated by a System Operations Licensee.

III. Captive: the generation of off-grid electricity that is entirely consumed by the generating entity itself and has an installed capacity exceeding 1 MW, with no upper limit.

IV. Off-grid (including mini-grids): small scale (0–1 MW) electricity generation to a single or limited number of customers.

Use of generators in the manufacturing industry

Nigeria's manufacturing sector is one of the major driving forces behind the country's economic growth. The manufacturing sector accounted for 9% of GDP (€ 40 billion) in 2013. Growth in the sector has been rapid at a pace of almost 18% per annum in the period 2011–2013, although it is hampered by supply bottlenecks, including disruptions in electricity supply.

Due to irregular power supply and the need for manufacturing industries to sustain production, Nigerian manufacturers have resorted to the use of diesel and gas for their energy needs. Estimates suggest that between 8 and 14 GW of decentralised diesel generator capacity is currently installed in the country. About 86% of the companies in Nigeria own or share a generator and about 48% of their total electricity demand is covered by these private generators. With several millions of privately installed diesel generators, Nigeria leads Africa as a generator importer and is one of the highest importers worldwide.

For manufacturing companies, access to, reliability of and cost of energy are both important. The inadequate supply of grid-connected electricity is the main reason for industry to generate power themselves. The price (Total Cost of Ownership) of electricity from renewable technologies is comparable and often even below the price of diesel generated electricity.

Renewable energy potential

Nigeria's abundant renewable energy resources are largely untapped. Nigeria's estimated installed renewable capacity is currently only 1.979 MW. Of this installed capacity, 1.900 MW is from three large hydropower plants, and 64,2 MW derives from small hydropower plants. Finally, it is estimated that about 15 MW of dispersed solar PV installations are installed.

Nigeria's bio-energy is high due to the availability of agricultural, forestry and food waste residues. Research suggests a total technical potential of 2.300 PJ annually. With 1.700 PJ from energy crops and 600 PJ from agricultural crop residues.

Captive energy potential in the agri-food sector

For the substitution of diesel and gas generators, especially the primary and secondary processing steps in the agri-food sector have a relatively high potential for the use of renewable energy, especially bioenergy. This is because in primary and secondary processing large amounts of energy are used and feedstock and agricultural residues are often available at the processing location. Especially in the processing of rice, cassava, and palm oil there seems to be a good potential of substituting diesel and gas generators with renewable captive bioenergy technologies.

Developing captive power projects in Nigeria

Doing business in Nigeria is far from easy, and for a project developer working in the rapidly changing energy sector it can be even more challenging. The experienced industry stakeholders that have been interviewed for this report suggested the following strategies to overcome these challenges:

Be flexible and willing to adjust

A developer needs to be flexible and be willing to adjust with time. Essentially, investors need to understand that the rules and road map are not very clear, and should be able to accommodate for that.

Work with a local partner

In nearly every sector in Nigeria, market entry and development is greatly facilitated when working with a local partner.

Secure financial viability of your project

Establish power projects where you can directly sell to clients who you can negotiate a proper price with. This is often not possible in practice due to regulatory constraints. For non-captive projects it would only be possible in an embedded structure, with a financially strong and committed DisCo.

Be as self-reliant as possible

The developer's independence should stretch to ensuring control over the entire value chain, starting with owning the land on which you base the power plant as well as having ownership and maintenance of power lines under own control. The thought is by 'controlling' or having a stake in the entire value chain you can avoid challenges that might otherwise arise.

CONTENT

Reading guide

This Guide has been drafted for the Africa-EU Renewable Energy Cooperation Programme (RECP). The research for this market study has been conducted in the period November 2015 until September 2016.

This report specifically addresses captive power (both electricity and other types of energy) in Nigeria, with a focus on the agri-food sector.

Chapter one provides an introduction of Nigeria, detailing all aspects of the country relevant for the energy sector. Chapter two 'the energy sector' describes energy demand, production and distribution, including key-stakeholders and policies. In chapter three the focus is on renewable energy; resources, potential, plans, stakeholders and policies and regulations. Chapter four describes the Nigerian manufacturing sector in more detail, providing figures for consumption, self-generation capacity and energy costs. Chapter five is focussed on captive power, detailing major crop value chains and providing provisional lists of important market actors. Chapter six is specifically meant for renewable energy project developers, providing information on the steps to take to implement on- and off-grid electricity projects in Nigeria, including captive and embedded power projects.

Please note that the Naira is highly volatile with inflation rates in 2016 above 11% Therefore, prices converted from Naira to Euro in this report may not be accurate at the time of reading.

CHAPTER 1
NIGERIA COUNTRY PROFILE

Nigeria is a federal constitutional republic that lies between latitudes 4°N and 14°N and longitudes 2°E and 15°E. Nigeria gained independence from Britain in 1960. Its 923.768 km² land mass is politically divided into 36 states and a Federal Capital Territory (FCT), Abuja. Nigeria shares borders with the Republic of Benin to its west, Cameroon and Chad in the east, and Niger in the north whilst to its south is the Atlantic Ocean which runs along the Gulf of Guinea.

Abuja, which is located in the centre, has been Nigeria's administrative capital since 1991 and a separate Federal Capital Territory. The capital was once Lagos, a port city located on Nigeria's South-West coast with the Atlantic Ocean. This change was mainly initiated in order to symbolise equal access to political power for the largely Islamic north and the largely Christian south.

Nigeria is a member of the Economic Community of West African States (ECOWAS), the West African Power Pool (WAPP), and a member of the African Union.

The main characteristics for Nigeria are:

- Population (2015 estimate): 182.202.000
- Total area: 923.768 km²
- Land coverage: 910.835 km²
- Water coverage: 12.933 km²
- Perimeter: 4.047 km
- Coastline: 853 km
- Arable land: 38,97%
- Permanent crops: 3,46%
- Total renewable water resources: 286,2 m³

Figure 1.1 Geographical map of Nigeria with the 36 states and the Federal Capital Territory. (Source: www.nyenet.com)

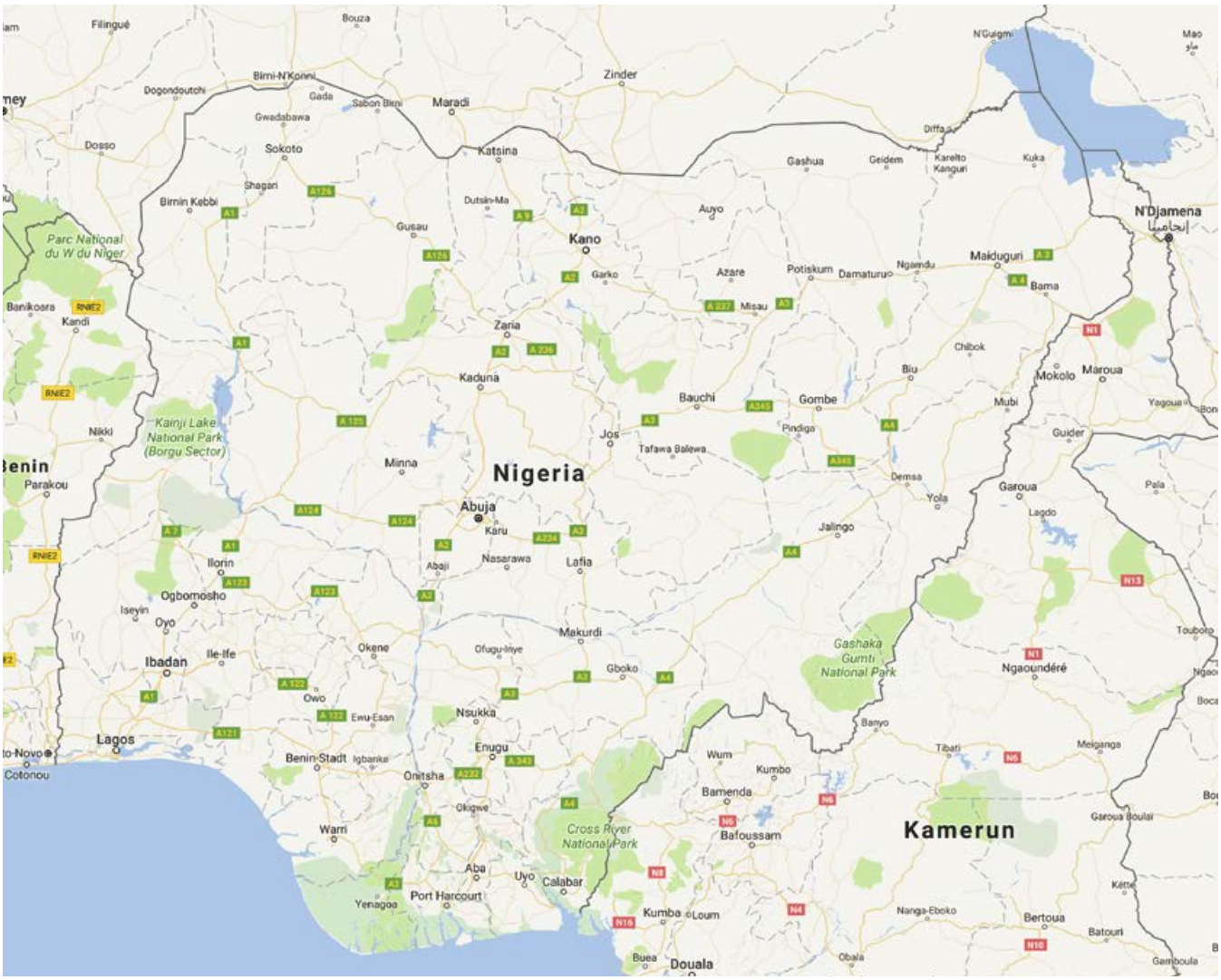
Geography and climate

Nigeria measures approximately 1.050 km from north to south and 1.200 km from east to west, and ranges from lowlands along the coast and in the lower Niger Valley to high plateaus in the north and mountains along the eastern border. Figure 1.2 shows the map of Nigeria.

The differences in topography cause a wide range of vegetation and multi-climatic nature in Nigeria. Nigeria has five climate zones (Peel et al., 2007) which range from mangrove swamps in the south to semi-arid lands in the north. The five climate zones are: mangrove swamp, high rainforest, Guinea savannah, Sudan savannah and Sahel savannah.

Nigerian temperatures, normally averaged in the mid-thirties (Celsius), exhibit regional difference with slight variations in seasonal and diurnal ranges. Across all climate zones, Nigeria has two main seasons namely:

Figure 1.2 **Map of Nigeria. (Source: Google maps, November 2016)**



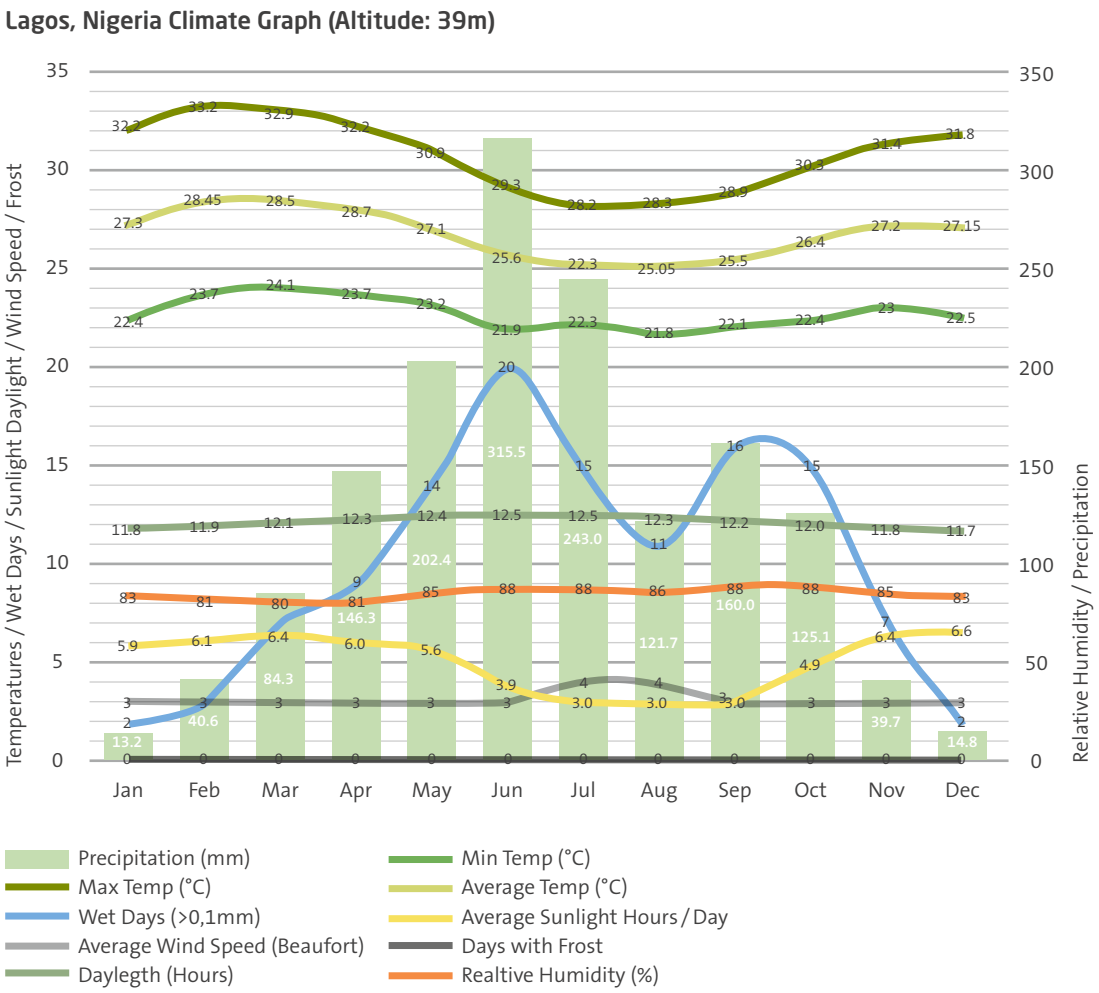


Figure 1.3 Climate chart for Lagos. (Source: http://www.lagos.climatemps.com/)

» Wet (rainy) season which begins in April and lasts till late October.

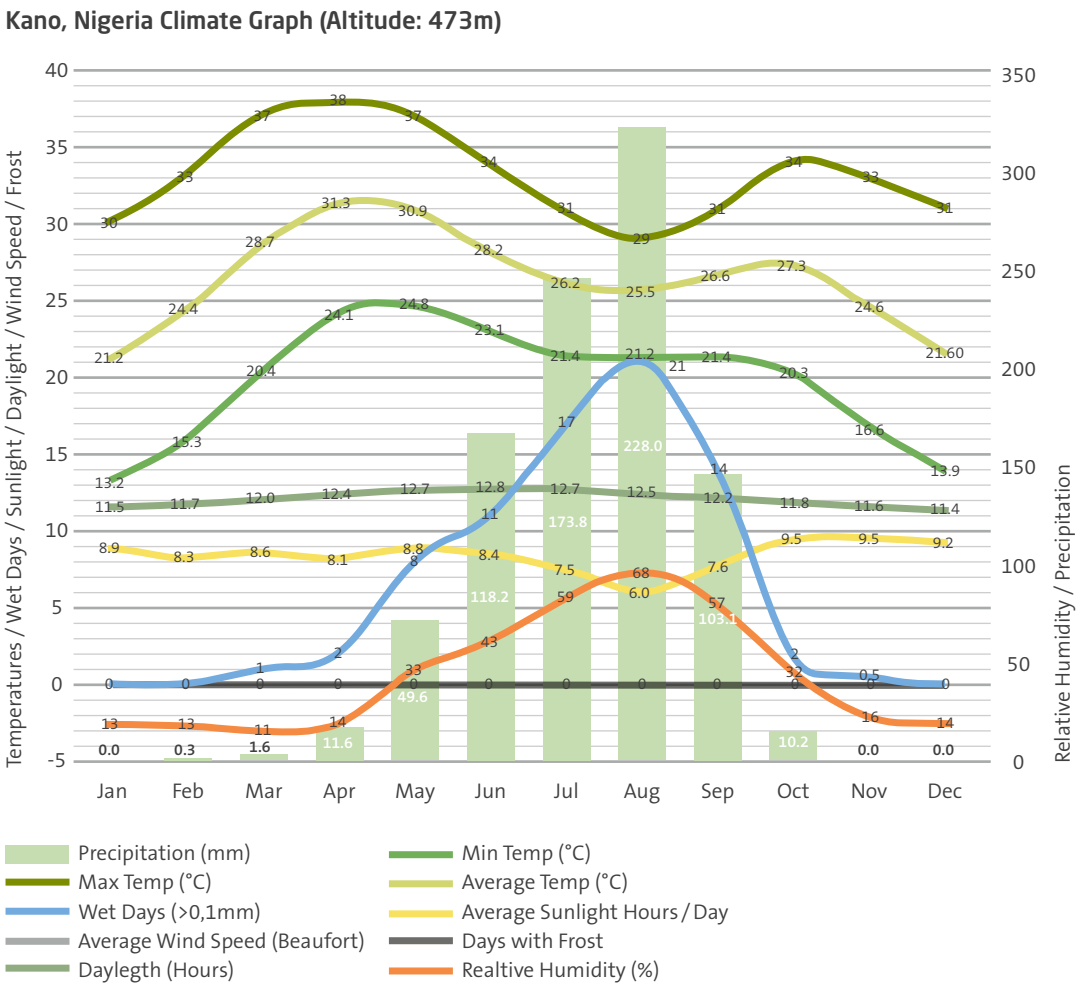
» Dry (Harmattan) which begins in early November and lasts till late March.

The dry season starts with dry chill spells of wind (referred to as Harmattan in Nigeria), that run till February and normally come with lower temperatures and dust. The dust is carried by the North-East trade winds from the Arabian Peninsula across the Sahara Desert. February to March is usually the hottest part of the year, as average temperatures ranges between 33 – 38°C. During this period, temperatures in the semi-arid north sometimes reach highs of mid-forties.

Nigeria records a mean annual rainfall of 4.000 millimetres (NESP; 2015). The absolute values of rainfall vary greatly as you move from one climatic zone to the other with the highest amounts of rain falling in the southernmost regions of the country. Figures 1.3 to 1.5 illustrate examples of climate charts for three different locations across Nigeria; Lagos (south-west), Kano (north) and Minna (central).

There are numerous rivers in Nigeria, but the two major rivers are the Niger and the Benue. The Niger originates from the Guinea highlands and is 4.180 km long whilst the Benue originates from the Adamawa Plateau in Northern Cameroun and measures 1.400 km. The territorial waters to the

Figure 1.4 Climate chart for Kano (Source: http://www.lagos.climatemps.com/)



south of Nigeria measure twelve nautical miles out to the sea with an exclusive economic zone measuring 200 nautical miles offshore.

Demography

With a population, which is currently estimated at 182 million people, Nigeria is home to over 250 different ethnic groups, speaking more than 500 different distinct dialects and languages. Nigeria is Africa's most populous country (one in every six Africans is a Nigerian), the eight most populous country in the world and its population is growing with an annual rate of 2,55% (CIA, 2012). The 182 million Nigerians are spread across the states in an uneven manner with the states recording varying population densities. Population is less dense in the semi-arid North Eastern and North Western states while in the southern states, population densities are usually high. Nigeria's population is estimated to grow over the next 20 years to reach a population size of 310 million by 2035.

Being the commercial capital of Nigeria, Lagos is the biggest and most densely populated city in Nigeria, containing 7.000 inhabitants per square kilometre. Lagos is estimated to have a population of approximately 25 million people.

The Nigerian population consists of Muslims (50%), Christians (40%), and traditional religions (10%) (CIA, 2015).

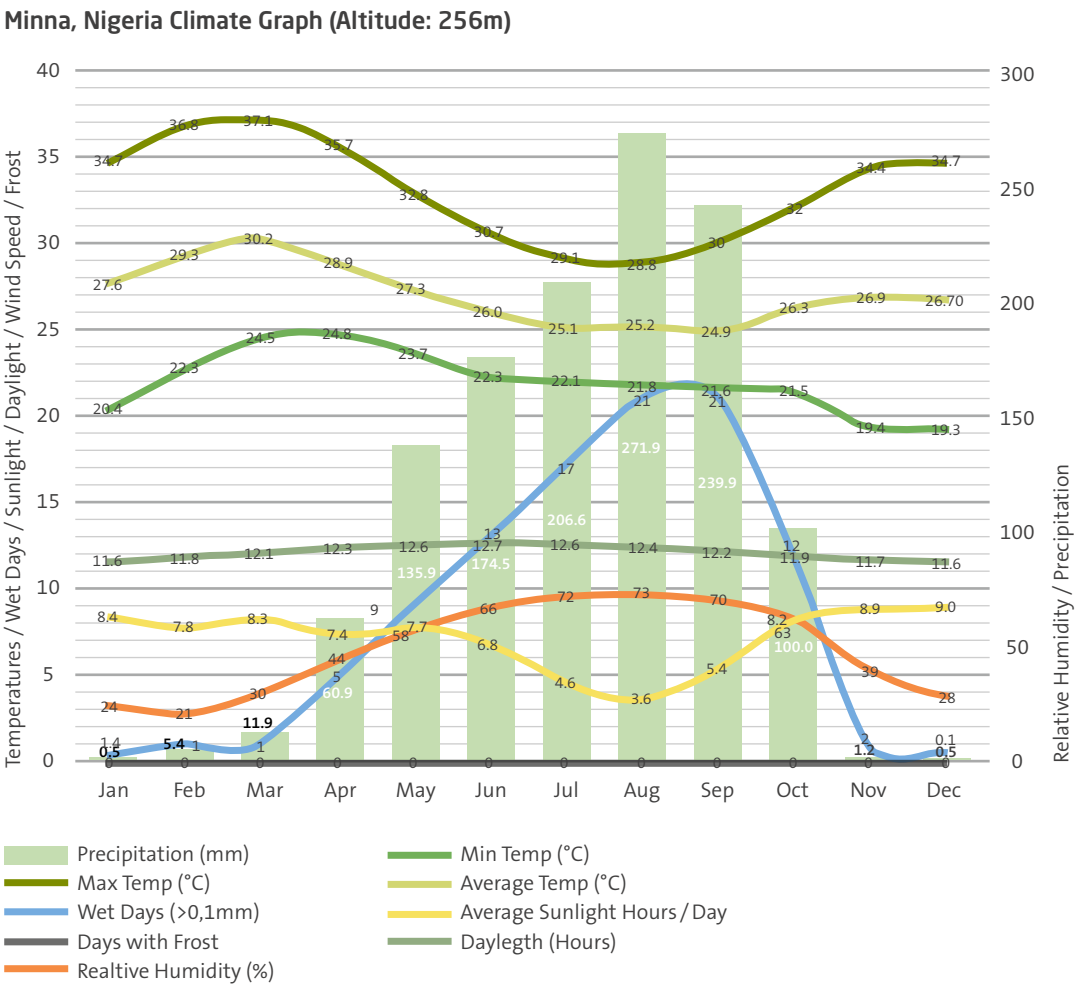


Figure 1.5 Climate chart for Minna (Source: http://www.lagos.climatemps.com/)

Political situation

After experiencing several military coups and a very bloody civil war in which an estimated two million Nigerians were killed, Nigeria returned to democratic governance in 1999. Nigeria maintains a presidential democratic style of governance, which is akin to the American system with a bicameral legislature.

The political party system has gone through various phases, with the last 16 years being dominated by the People's Democratic Party (PDP). At the 2015 general elections, the All Progressives Congress (APC), a fusion of four main opposition parties, contested against and defeated the governing party in what was deemed the most free and fair election in Nigeria's history. The 2015 general elections saw the emergence of former military ruler, Muhammadu Buhari of the APC as the president of Nigeria, making him the first opposition candidate to win a presidential election in Nigeria. Buhari had previously led Nigeria (from January 1984 to August 1985) as head of a military Junta which successfully staged a coup against a democratically elected government. The incumbent during the 2015 general elections, Goodluck Jonathan of the PDP was president of Nigeria since 2010, following the death of then President Umar Yar' Adua, whom he was Vice President to.

Since the return of democratic rule, Nigeria has witnessed the formation of several degrees of armed groups, mostly based along ethnic or religious sentiments or a combination of both. Groups such as the Odua Peoples' Congress (OPC) in the south west and the Bakassi Boys in the south east are ethnicity focused vigilante groups who have granted themselves a right to bear arms over the last 16 years. Other armed and more militant groups that have sprung up in Nigeria during the last 16 years are the Movement for the Emancipation of the Niger-Delta (MEND) in the far-south and the infamous Boko Haram mainly in the north east. Furthermore, pockets of civil unrest spring up from time to time, such as in the Northern part of the country in which southerners and Christians are targeted, often due to religious differences, or in the south-east states with increasing sentiments of perceived marginalisation by the federal government.

Safety and security situation in Nigeria

The safety and security situation for foreigners in Nigeria continues to be risky and for certain areas dangerous. The Foreign and Commonwealth Office (FCO) of the UK government[2] advises against all travel to: Borno State, Yobe State, Adamawa State, Bauchi State, Gombe State, Kano city, riverine areas of Delta, Bayelsa, Rivers, Akwa Ibom and Cross River States and within 20 km of the border with Niger in Zamfara State.

The FCO advise against all but essential travel to: Kano State, Kaduna State, Jigawa State, Katsina State, Kogi State, Abia State, Jos City in Plateau State, within 20 km of the border with Niger in Sokoto and Kebbi States, Riyom and Barkin Ladi Local Government Areas of Plateau State and Non-riverine areas of Delta, Bayelsa and Rivers State. Before traveling to Nigeria one should consult the FCO or other websites on travel restrictions.

2) https://www.gov.uk/foreign-travel-advice/nigeria, 1 May 2016

The Nigerian economy

Nigeria is a well-endowed country. The country has a healthy GDP despite the poor infrastructural base in all key sectors (power, transportation, housing etc.). According to Trading Economics[3]:

"The Nigerian economy grew by 2,84 percent year-on-year in the third quarter of 2015, following a 2,35 percent expansion reported in the previous period. The oil sector, accounting for nearly 11 percent of total production rebounded while services sector growth slowed. Quarter-on-quarter, GDP increased by 9,19 percent, following a 2,57 percent growth in the previous period. GDP Annual Growth Rate in Nigeria averaged 5,91 percent from 2005 until 2015, reaching an all-time high of 8,60 percent in the fourth quarter of 2010 and a record low of 2,35 percent in the second quarter of 2015. GDP Annual Growth Rate in Nigeria as reported by CBN".

In 2013, the Nigerian GDP was revised by the government. To re-base the Nigerian economy, the National Bureau of Statistics used 2010 as the base year. These new figures gave weighted importance to rapid growing sectors such as telecom and film-making that have emerged since 1990. Data collection has improved since the 1990's, leading to more accurate statistics. As an example the old GDP figures were calculated based on outputs only, while the new figures were calculated based on surveys carried out on spending and income.

The estimate for Nigeria's GDP in 2013 was reviewed upward from 42,4 trillion Naira to 80,2 trillion Naira (€ 351 billion); (NESP; 2015) an increase of 89%. The World Bank, following different estimations, estimated the Nigerian GDP in 2014 at 111,9 trillion Naira (€ 491 billion)[4].

3) http://www.tradingeconomics.com/nigeria/gdp-growth-annual

4) http://databank.worldbank.org/data/reports.aspx?source=2&country=NGA&series=&period=

The annual growth rate of the GDP was estimated at 6,3%. Projections from the World Bank for GDP growth show that Nigeria's economy is expected to decelerate from the 6,3% growth in 2014. The estimated GDP growth in 2015 decreased to 3,3%, after which the GDP is projected to grow at an estimate growth rate of approximately 5% from 2015 to 2018 annually.

The deceleration of the economy is experienced throughout sub-Saharan Africa, but most pronounced among oil exporting countries. Nigeria is among the countries hit hard by the recent crash of oil prices. The slowdown of economic growth is associated with fiscal deficits and devaluating currency. The Naira has lost over 75% of its value since mid-2014. The current fall in the price of crude oil forced the new government to announce budget cuts, amongst them, removal of a fuel subsidy. Simultaneously, the government is faced with a looming unemployment crisis.

Nevertheless, the non-oil industry has driven the Nigerian economy, with average growth of about 10% in 2012, compared to the -0,35% for the oil and gas industry (IMF, Oct 2013). The growth of the non-oil industry was mainly driven by high consumer demand. The top five drivers of the economy, accounting for over 70% of total GDP, are agriculture, mining, information and communications, and manufacturing.

From these figures it shows that the Nigeria economy has grown to be one of the largest economies in Africa. The Nigerian economy contributes about 55% of the GDP of West Africa, making it a regional economic power house. As an example, the GDP of Lagos is bigger than that of Ghana.

Nigeria has a huge potential in various sectors, not least the agricultural sector. The complete value chain, 'from farm to food' is largely untapped. For instance, less than 50% of the arable land

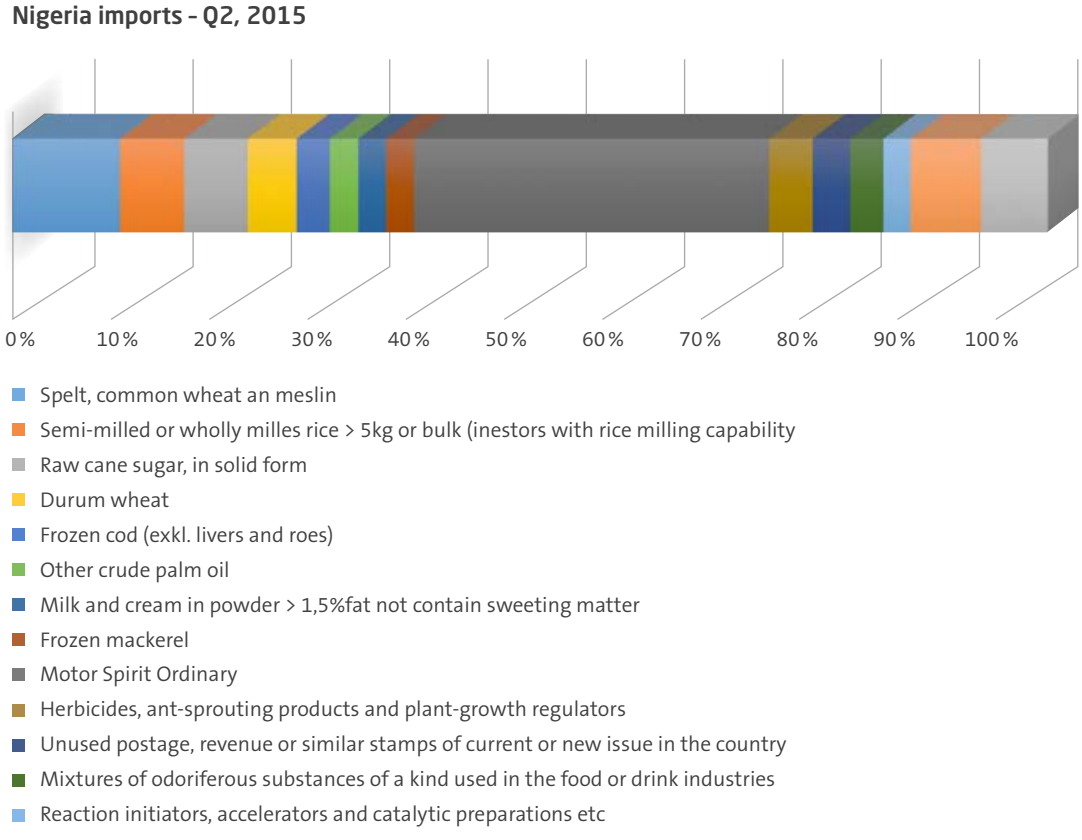


Figure 1.6 Import of agricultural products first half of 2015 (WB, 2016)

in Nigeria is cultivated. The low agricultural productivity is caused by a lack of modernisation in the sector, therefore the agricultural sector has a huge potential for upscaling its volume of annually produced goods. The country has approximately 70 million hectares of farmland mostly located in the Middle Belt. The areas in the sub-Sahel zone are currently largely uncultivated mainly due to lack of irrigation capacity. Other opportunities in the value chain of the agricultural sector are found in the food processing sub-sector. For example, Nigeria spends an estimated NGN 1 trillion (approximately € 4,39 billion) per annum for the importation of rice, wheat, sugar and fish. The agricultural sector accounts for about 20% of GDP and employs about 70% of the work force in Nigeria. Figure 1.6 shows Nigeria's total imports for Q2 of 2015 which was valued at 400,9 billion Naira (€ 1,75 billion). Agricultural products, process inputs and final products constitute 31% at a total of 124,28 billion Naira (approximately € 545 million) (NBS, 2015) of the total amount of imports for that period.

Although the economy of Nigeria is growing according to the new statistics, the economy still suffers from the lack of diversity. The Nigerian economy has been largely built on crude oil since the first discovery of commercial quantities in 1958. In the mid 1980's, the manufacturing industry began its collapse, leading to the halt of car assembly and tyre industry. The manufacturing industry has not recovered properly yet, partly due to inadequate electricity supply. The inadequate electricity supply causes manufacturers having to rely on diesel generators for their electricity needs. According to the World Bank report "Doing Business in Nigeria 2015" the biggest hindrance to business in Nigeria is electricity constraints.

Wealth and poverty distribution

Nigeria has been variously described as a country with strong growth potential. Reports indicate that the Nigerian economy has been growing at an average of 6% per year consistently for over seven years. Yet despite this growth in the gross domestic product (GDP), unemployment, poverty and inequality have continued to expand (UNDP, 2010; FGN, 2010). The National Bureau of Statistics (NBS) reported that the percentage of people living in poverty increased from 27,2% in 1980 to 46,3% in 1985, dropped to 42,7% in 1992 and then increased to 65% in 1996. By 2010, the poverty level was at 69%, indicating that about 112,47 million Nigerians are living below the poverty line (ActionAid Nigeria, 2015). Nigeria is therefore aptly described as a paradox of poverty in the midst of plenty.[5]

Poverty in Nigeria also has a regional dimension. Statistics show that people living in the northern part of the country are more likely to live in poverty than those living in the rest of the country. More specifically, NBS reports that in 2004 the poverty incidence was highest in the North-East zone (67,3%) and lowest in the South-East zone (34,2%), with similar figures for 2010. The three geo-political zones in the North consistently showed higher levels of poverty than those in the South. Similarly, both the 2004 as well as the 2010 figures show that the three northern zones also have higher absolute poverty rates. This disparity may be attributed to high levels of illiteracy, low productivity, poor infrastructure, and unemployment. Poverty in the South-South zone resulted from several factors, including social instability, poor local governance, competition for economic resources and environmental degradation (NBS, 2010). [4]

The Gross National Income (GNI) per capita in Nigeria is about $ 3.000, meaning less than $ 10 per day. However, a staggering 54% of the Nigerians live beneath the international poverty line of $ 1,25 a day.[6]

5) ActionAid Nigeria, "Corruption and Poverty in Nigeria", 2015

6) World DataBank: http://databank.worldbank.org/data/reports.aspx?source=2&country=NGA&series=&period

Indicator	2016 rank (out of 188)	2015 rank (out of 188)	Remark
Starting a business	139	131	Declined
Dealing with construction permits	135	135	Static
Getting electricity	182	181	Declined
Registering property	181	185	Improved
Getting credit	59	52	Declined
Protecting minority investors	20	33	Improved
Paying taxes	181	181	Static
Trading across borders	182	182	Static
Enforcing contracts	143	143	Static
Resolving insolvency	143	143	Static

Figure 1.7 Doing business in Nigeria 2015 & 2016 (WB, 2016)

No.	RISK TYPE	RISK RATING	RISK YEAR
1	Country risk	High	Q4 2015
2	Risk of doing business	Very high	Q4 2015
3	Banking sector vulnerability	Low	Q4 2015
4	Legal and regulatory risk	Very high	Q4 2015
5	Exchange transfer risk	High	Q4 2015
6	Political interference risk	High	Q4 2015
7	Sovereign non-payment risk	Medium high	Q4 2015
8	Supply chain disruption risk	High	Q4 2015
9	Political violence risk	High	Q4 2015

Figure 1.8 Investors risk map (Source: AEON risk map www.riskmaps.aon.co.uk)

Business climate

Nigeria has committed itself to become an investment friendly country. In order to invest in Nigeria, there are specific ownership licences and restrictions which are required in sectors like Mining, Telecommunications, Aviation, Oil and Gas, Banking, Insurance, Energy, etc. Full or partial ownership of businesses by foreign investors is allowed in Nigeria. Foreign investors can import capital and are allowed to freely repatriate both the returns and capital once exchange control requirements have been met.

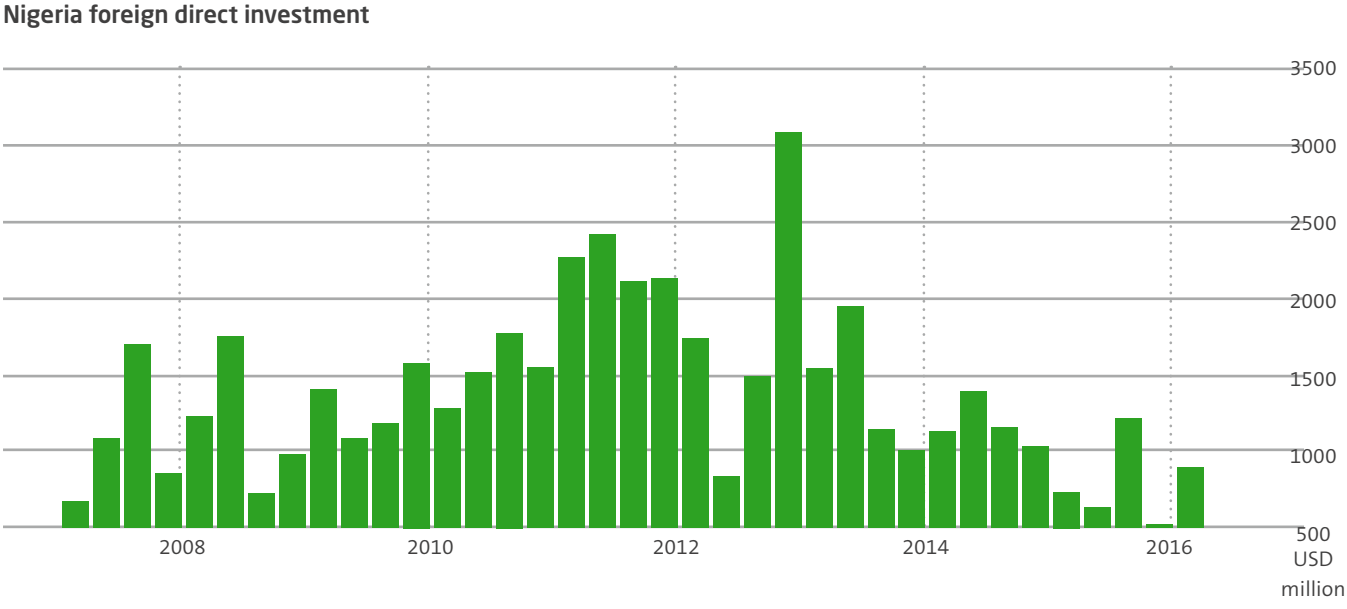
Nevertheless, doing business in Nigeria is often a tricky affair. Nigeria has suffered from severe political unrest, persistent ethnic tensions and an opaque legal and regulatory environment. The low oil prices undermine Nigeria's economic resilience, reducing fiscal space and putting downward pressure on the Naira value, although overall debt levels are minimal. The new government received a sizeable mandate in the 2015 elections, but has a difficult set of tasks and very limited financial resources. Capital outflows have increased foreign exchange risks. As a lower middle income country, with a Gross National Income per capita of $ 2.950 (WB, 2016), Nigeria is ranked 169th out of 188 countries surveyed by the World Bank in its annual business report for 2016 in terms of ease of doing

business. The report which measures indicators important to local entrepreneurs indicates that whilst regulatory reforms are progressing, Nigeria's business climate is still full of challenges. Figure 1.7 compares indicators measured for years 2015 and 2016.

While there have been improvements in two aspects which are critical for new businesses and investors namely registering property, and protecting minority investors, the conditions for expanding or starting a new business in Nigeria have deteriorated when compared to the other 188 countries surveyed in the report. In addition, getting access to reliable and affordable electricity supply and obtaining credit is challenging. This can be attributed to the fact that Nigeria's electricity sector is still going through a reform process and the shortage in electricity generation capacity in combination with the bad state of transmission and distribution infrastructure has not been solved. The record low oil prices are severely undermining the state budget.

Endemic corruption makes private-sector activities challenging and security concerns leave several geographic areas off limits to foreign investors. The government is fighting an Islamist militant insurgency in the north-east (Boko Haram) and terrorist attacks have increased in severity and frequency, undermining the security situation domestically and in neighbouring countries. Although much of Nigeria's territory is unaffected by these attacks, the government's focus on these developments and greater defence spending have inevitably weakened its policy effectiveness in other areas. The poor infrastructure, particularly in the power sector, and sporadic fuel shortages are a particular constraint on businesses and heighten the risk of supply chain disruptions in all sectors. Currently (2016) interest rates of the Central Bank of Nigeria (CBN), stand at 11% per annum whilst commercial banks offer loans in the range of 23–29%. It must be noted that the business climate throughout Nigeria is by no means consistent. According to the World Bank sub-national report on doing business in Nigeria 2014, there are various state-specific regulatory hurdles to doing business in Nigeria. These variations can be attributed to differences in state laws as well as irregular implementation of federal legislation nationwide. Figure 1.8 shows the most important risks for investors in Nigeria.

Figure 1.9 **Nigeria foreign direct investment (M USD) (Source: www.tradingeconomics.com ; Central Bank of Nigeria)**



Foreign Direct Investment (FDI)

Between 2007 and 2016, significant changes can be seen for all major sectors of the Nigerian economy in attracting foreign direct investment flows. Between 2007–2013 FDI gradually increased, whilst recently FDI is at its lowest levels in ten years. The major sources of FDI into Nigeria are typically from the United States, United Kingdom, France, South Africa, India, Canada and China. The trade between India and Nigeria has grown in recent years estimated to be about $ 20 billion in 2013. China has contributed mostly in the construction sector and in capital projects.

Energy

The lack of access to reliable and affordable energy is an important business risk in Nigeria. This is the case for electricity (grid-connected) but also for energy from fossil fuels (primarily diesel and gas) due to reoccurring unavailability of these fuels.

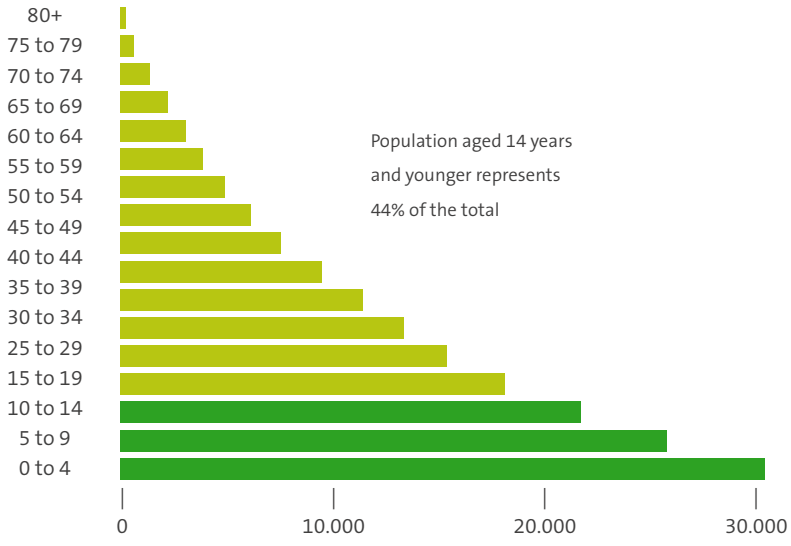
The electricity sector has undergone major reforms in recent years and as a result almost the entire value chain of the electricity sector, covering generation to distribution is fully privatised. The government owned electric utility, National Electric Power Authority, was unbundled into 16 distribution companies (DisCos) and seven generation companies (GenCos) owned and operated privately, as well as one Transmission Company (TCN) owned by the Federal Government of Nigeria (FGN). Currently, it is estimated that the installed capacity on the Nigerian grid is approximately 13 GW, but it only has a generating capacity of 6,8 GW, due to the poor state of the grid infrastructure and poor maintenance of power stations (GIZ, 2015).

Within the last two years, major financial support agreements have been signed between the Central Bank of Nigeria (CBN), Deposit Money Banks (DMBs), and the regulator, the National Electricity Regulatory Commission (NERC). The idea behind these agreements is to offer financial support to power generating and distributing companies, through the Nigeria Electricity Market Stabilization

Total population (in thousands)	**172.817**
Annual population growth (%)	2,7
Population 15–24 years (in thousands)	32.803
Rural population (% of total population)	53
Total fertility rate (births per women)	5.7
Infant mortality rate (per 1.000 live births)	72
Life expectancy at birth (years)	52
Prevalence of HIV (% of population aged 15–49 years)	3,2
Poverty headcount ration at 2 PPP$ a day (% of total population)	76,5
GDP per capita – PPP$	5.911
Annual GDP growth (%)	6,3
Total debt service (% of GNI)	0,1
GDP in billions – PPP$	1.049

Figure 1.10 Socio-economic indicators and age distribution. (Source: UNESCO www.uis.unesco.org)

Total population by age group, 2014 (in thousands)



Facility (NEMSF), from which € 934 million will be disbursed (see chapter 6, page 94 for more information on NEMSF).

Employment and labour force

In 2013 the National Population Commission (NPC) and the Nigeria Bureau of Statistics (NBS), published an unemployment rate of 24%. The Nigerian labour force was reclassified in 2014, totalling the labour force at 73 million people, where unemployment rate stood at 6,4% and labour underutilization rate was 17,9%. Nigeria's National minimum wage, valid for public and private actors in all sectors of the economy, currently stands at 18,000 Naira a month (USD 90)[7].

43,3% of the youth (15–24 years) is either unemployed or underemployed. Unemployment in Nigeria is largely attributed to the phenomena of jobless growth, increased number of school graduates with no matching job opportunities, a freeze in employment in many public and private sector institutions and continued job losses in the manufacturing and oil sectors.

Nigeria developed the National Action Plan on Employment Creation 2009–2020. The action plan highlights the major activities that need to be undertaken in the eleven key sectors of the Nigerian economy to meet unemployment challenges. Furthermore, with ILO support, the Federal Government of Nigeria is reviewing the National Employment Policy in order to address the contemporary issues in employment creation and the policy aims to harmonise the different strategies of the government in addressing unemployment challenges (www.ilo.org, July 2016).

Business ownership models

There are several business models on which Nigerian businesses can be based. The most common models used are:

- Sole proprietorship
- Partnership

Sole proprietorship

This generally refers to a form of business ran by an individual, where there is no legal distinction between the business and the owner. A foreigner is allowed to engage in lawful business activity as a sole proprietorship, but only when he/she obtains Nigerian citizenship or residency status for immigration purposes. In addition, local partners are required for foreigners to start a business in Nigeria.

The way to obtain residency in Nigeria is by acquiring a CERPAC (Combined Expatriate Residence Permit and Aliens Card). This document is a combined residency and work permit. Although the process involves a lot of paperwork, it should not be too troublesome for expats. An important notice is that the CERPAC is tied to a specific job. If one decides to change jobs, he/she needs to re-apply.

Partnership

A form of business where two or more persons come together to own a business and they are personally responsible for the debts and other obligations of the business. Foreign participation is possible when the investors obtain citizenship or residency status for immigration purposes and a work permit.

7) Throughout the report, the exchange rate of May 2016 is used. However, due to the volatility of the Naira, the values in USD or EUR may be inaccurate

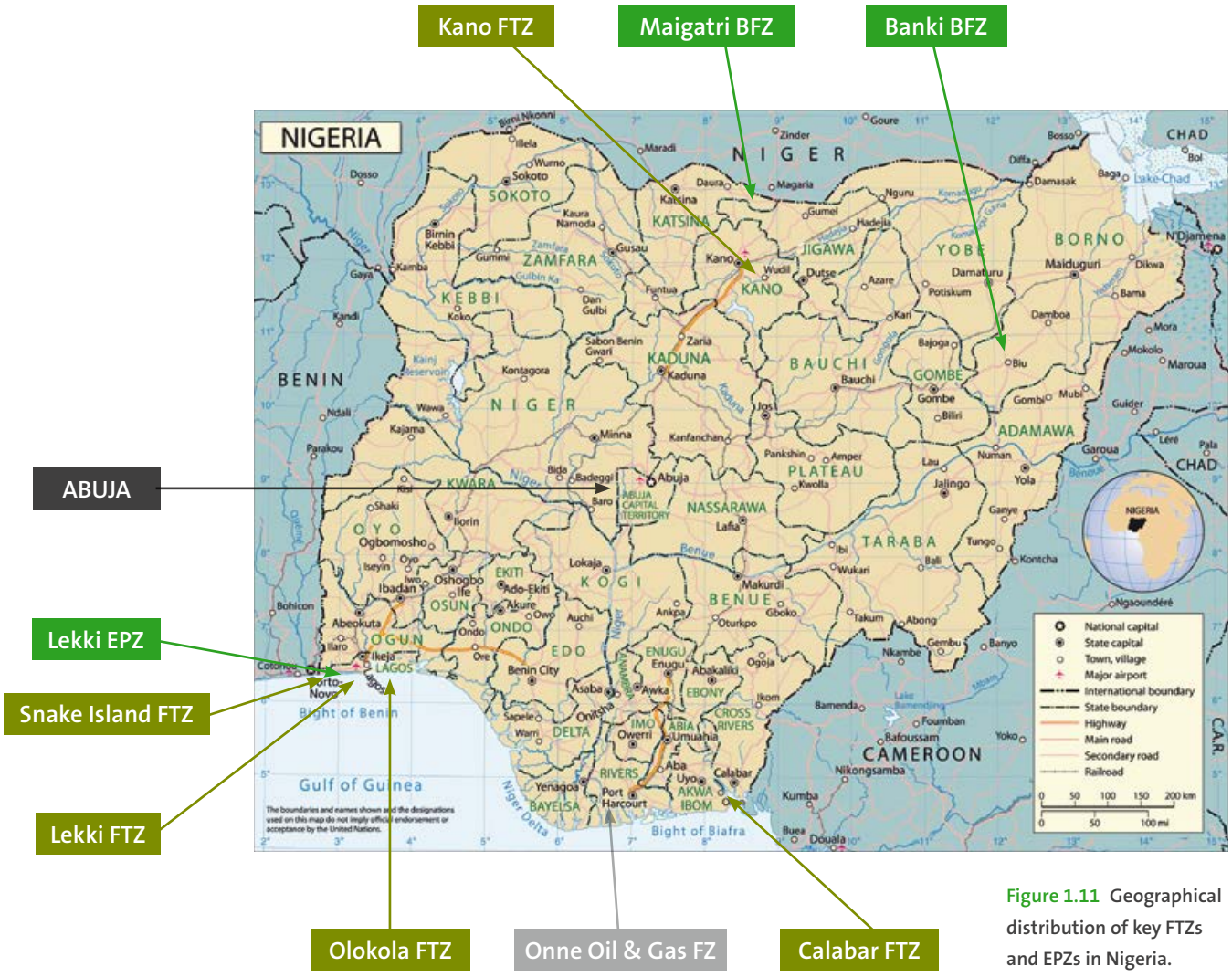


Figure 1.11 Geographical distribution of key FTZs and EPZs in Nigeria. Source: NESP, 2014

Company

Any company with a foreign shareholding must possess a minimum share capital of 10 million Naira (about $ 50.000), in order to secure a business permit from the Nigerian Investment Promotion Council (NIPC). In some more regulated sectors like aviation, banking and insurance, the share capital may be higher. For example, in the banking sector the share capital required is 25 billion Naira (€ 109 million).

Free Trade Zones (FTZs) and Export Processing Zones (EPZs)

As part of its efforts to drive growth in the industrial sector, the Federal Government of Nigeria established Free Trade Zones (FTZ) and Export Processing Zones (EPZ) in various locations around the country. Both zones are clearly delineated industrial estates within a nation's customs and trade regime. They are normally set up for manufacturing concerns producing mainly for the export market. The Nigerian trade zones, designed to insulate the industrial sector from the effects of external risks such as blackouts from the national grid, would benefit from the use of

common infrastructure facilities such as power generation plants, and logistics hubs among other things. The majority of the manufacturing clusters are located in the southern parts of the country, due to close proximity to the seaports on the Atlantic Ocean. Figure 1.11 shows the geographical location of the main zones. A full list of FTZs is provided in Annex B.

In total 31 Free Trade Zones are to be established. 14 of them are currently operational, while the other 17 are under construction. The most notable operational FTZs are: Calabar Free Zone, Kano Free Zone, Lekki Free Zone, Tinapa Free Zone and Tourism Resort, Onne Oil and Gas Export Free Zone, Ogun Free Zone. Most manufacturing activity is concentrated in three industrial clusters, two of which are located in the south:

- Lagos-Ota-Agbara industrial cluster
- Port Harcourt-Aba industrial zone
- Kano-Kaduna axis

Foreign investors are allowed to set up businesses directly in any of the FTZs, and it's not necessary to incorporate a company in the customs territory. Also fully registered companies are allowed to register separately and carry out operations in an FTZ. Such companies though will be required to add FZE as a suffix to the end of its name. A company that has a Free Trade Zone entity, benefits 100% capital and profit repatriation. It is also exempted from all Federal, State, and Local Government taxes, levies, and rates, alongside waivers on customs and import duties.

Fiscal incentives and exchange control

- The Federal Government of Nigeria targets to have a power generation capacity of more than 40 GW by 2020, with an energy mix that will consist of 69% thermal generation, 17% hydro, 10% coal; and about 4% renewables[8].

This aspiration of 40 GW should move Nigeria to a much more stable socio-economic position. However, the enormous capital required to achieve this target cannot be funded by the government alone, the private sector will have to participate. Therefore, a number of investment incentives are provided by FGN, forthe power sector. They include:

- 0% duty on power generation equipment;
- 20% capital allowance (tax allowance on assets) for five years;
- Tax holiday for manufacturing activities (up to 5 years' tax holiday for renewables).

In addition, companies active in independent power generation utilizing gas, coal and renewable energy sources, can apply for a 'pioneer status' at the Nigerian Investment Promotion Commission. The pioneer status can provide companies additional tax holidays (www.nipc.gov.ng).

Exchange transactions are regulated by the Foreign Exchange (Monitoring and Miscellaneous Provisions) Act 1995. The Naira is used for the day to day transactions. Cross border transactions are permitted, with some level of restrictions to curb money laundering, prevent the funding of terrorist groups and protect the Naira.

Import of capital

Investments as share of capital or loan, are permitted in foreign currency, however information on such transaction must be submitted to CBN within 24 hours, so the investor can be issued a Certificate of Capital Importation (CCI). Once the CCI has been obtained it allows for the repatriation of the following:

- Royalties
- Dividends
- Rent
- Profits (net of taxes) that can be attributed to the investment

8) www.nipc.gov.ng

» Payment of interest and capital on foreign loans

» Remittance of proceeds (net of taxes) and any other obligation to the investment.

Dealers of foreign currencies, who are duly authorised, must inform the CBN of any cash transfer to or from a foreign country of any amount that exceeds $ 10.000. To remit dividend out of Nigeria, a tax clearance certificate is also required.

Financial services

The CBN is the independent government agency vested with the duty of policy formulation and implementation, regarding monetary and credit policies, trade, exchange. It also regulates the foreign exchange market, as well as formulation of currency policies. Commercial Banks in Nigeria carry out foreign exchange transaction, but are controlled by the CBN based on foreign exchange regulations.

The Legal System

The Constitution of Nigeria is the supreme law of the country. There are four distinct legal systems in Nigeria:

» English law which is derived from its colonial past with Britain;

» Common law, a development of its post-colonial independence;

» Customary law which is derived from indigenous traditional norms and practice, including the dispute resolution meetings of pre-colonial Yorubaland secret societies and the Èkpè and Okónkò of Igboland and Ibibioland;

» Sharia (Islamic) law, used only in the predominantly Muslim north of the country. Civil sharia law has always been enshrined in the various Nigerian constitutions since independence. The most recent constitution came into effect in 1999. With the return of the country to democratic rule in 1999, some of the predominantly Muslim northern states have instituted full sharia law (criminal and civil). Full sharia law was first passed into law in Zamfarain late 1999 and the law came into effect in January 2000. Since then eleven other states have followed suit. These states are Kano, Katsina, Niger, Bauchi, Borno, Kaduna, Gombe, Sokoto, Jigawa, Yobe, and Kebbi.

The country has a judicial branch, the highest court of which is the Supreme Court of Nigeria. The Nigerian constitution recognizes courts as either Federal or State courts. A primary difference between both is that the President appoints Justices/Judges to federal courts, while State Governors appoint Judges to state courts. All appointments (federal or state) are based on the recommendations of the National Judicial Council.

The Federal courts are: The Supreme Court, the Court of Appeal and the Federal High Court. The State courts include: The High Court of a State, the Customary Court of Appeal of a State and the Sharia Court of Appeal of a State. Each of the 36 states is constitutionally allowed to have all of these courts. However, the predominantly Muslim northern states tend to have Sharia courts rather than Customary courts. The predominantly Christian southern states tend to have Customary courts and not Sharia courts.

CHAPTER 2
ENERGY SITUATION IN NIGERIA

The energy situation in Nigeria is critical and is a key constraint for economic development. About 55% of the population has no access to electricity (Nigeria Power Baseline Report[9]) and out of the total energy consumption, traditional biomass (firewood and charcoal) accounts for 86%. Population growth and economic development contribute to an increased need for electricity. The gap between production capacity and demand in combination with poorly maintained generation installations and a poor national and regional electricity grid, results in unstable and unreliable electricity supply for both households and companies. Firms from around Nigeria report average power outages of 8 hours per day. As a consequence, many companies and households rely on diesel generators for their electricity, with larger companies relying on gas or diesel for both electricity and power. However, also gas and diesel supply has proven unreliable.

Total energy consumption in Nigeria in 2013 (in ktoe)

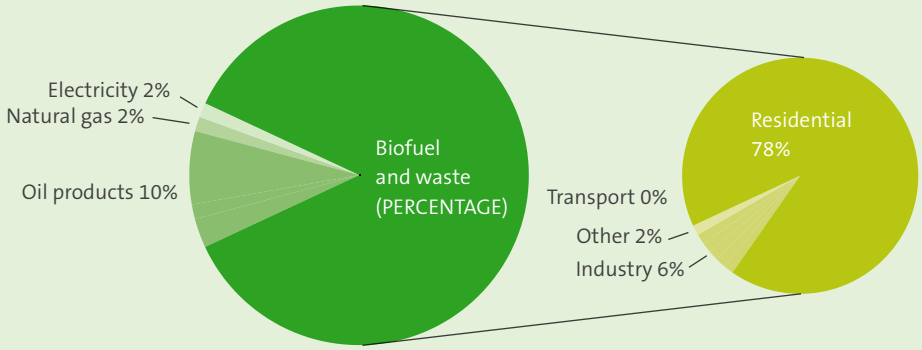


Figure 2.1 Total energy consumption in Nigeria in 2013 (in ktoe). (Source: IEA statistics www.iea.org)

Sector	Coal	Oil products	Natural gas	Bios and waste	Electricity	Total*
Industry	27	405	Declined	6.997	335	9.801
Transport	0	8.227	Static	0	0	8.227
Residential	0	529	Declined	91.227	1.157	92.914
Other	0	2.146	Improved	2.385	527	5.058

* Totals may not add up due to rounding
Annex I provide a glossary of the terms used in above figure

9) nesistats.org

Figure 2.2 Total electricity consumption by economic sectors and consumption per capita for Nigeria and peer countries, 2012 (Source: IEA)

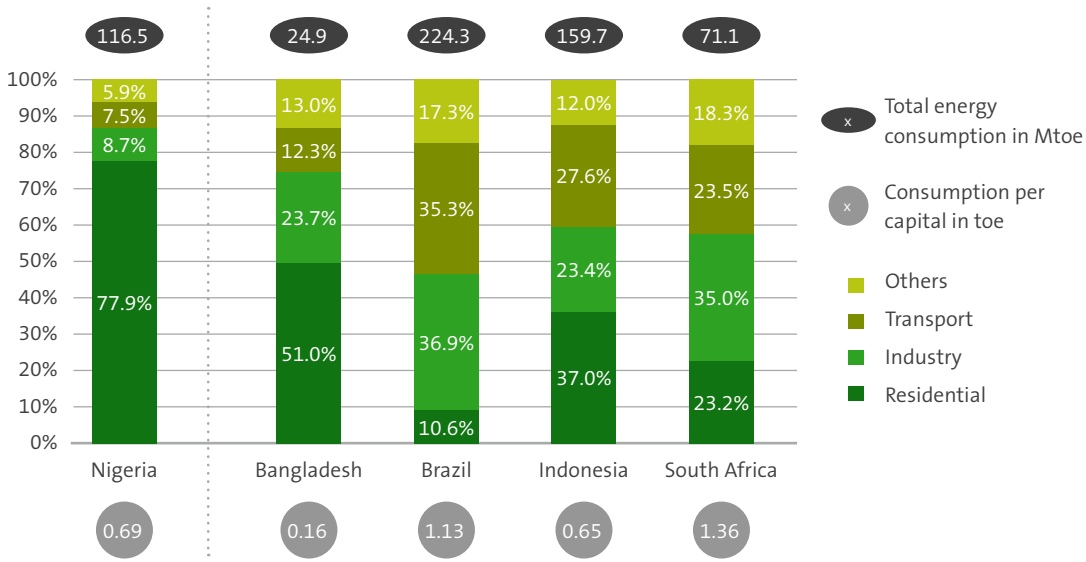


Figure 2.3 Total energy consumption in Nigeria (in ktoe) (Source: IEA statistics www.iea.org)

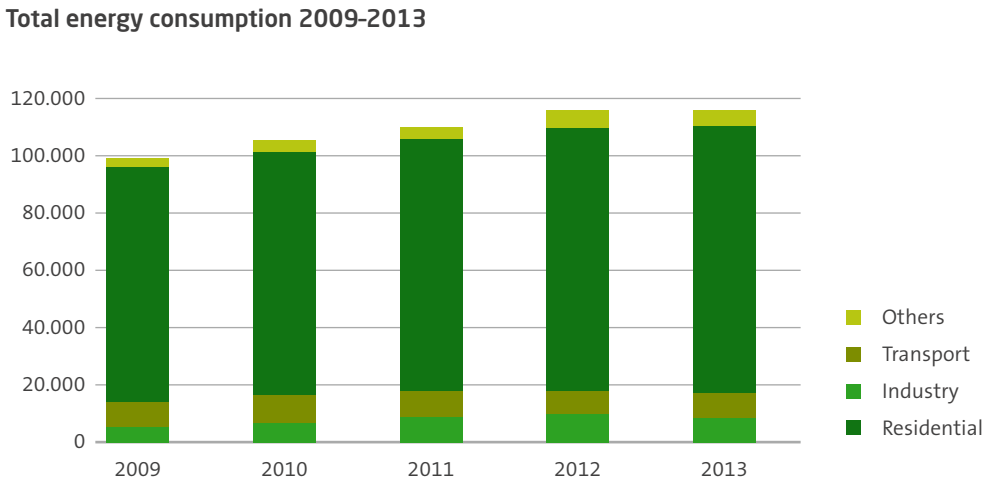
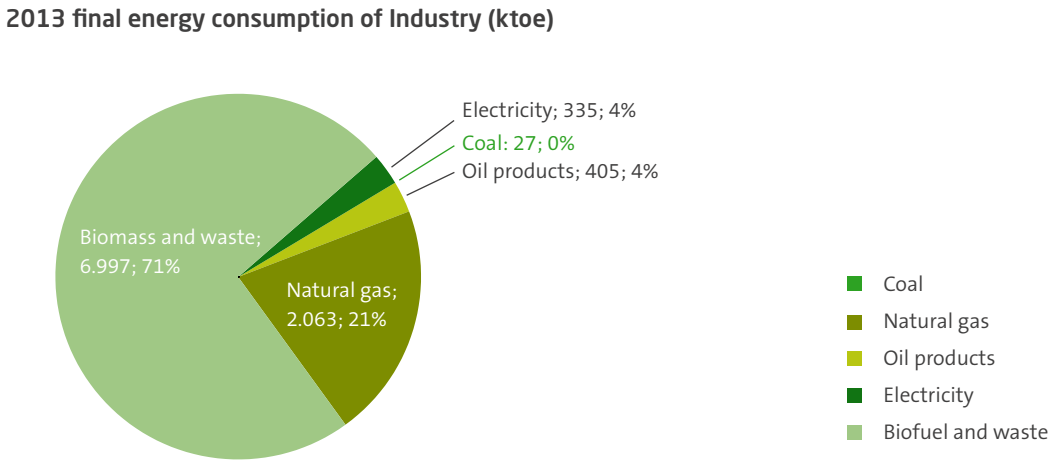


Figure 2.4 Total energy consumption (ktoe) of Industry in Nigeria in 2013. Source: IEA statistics (www.iea.org)



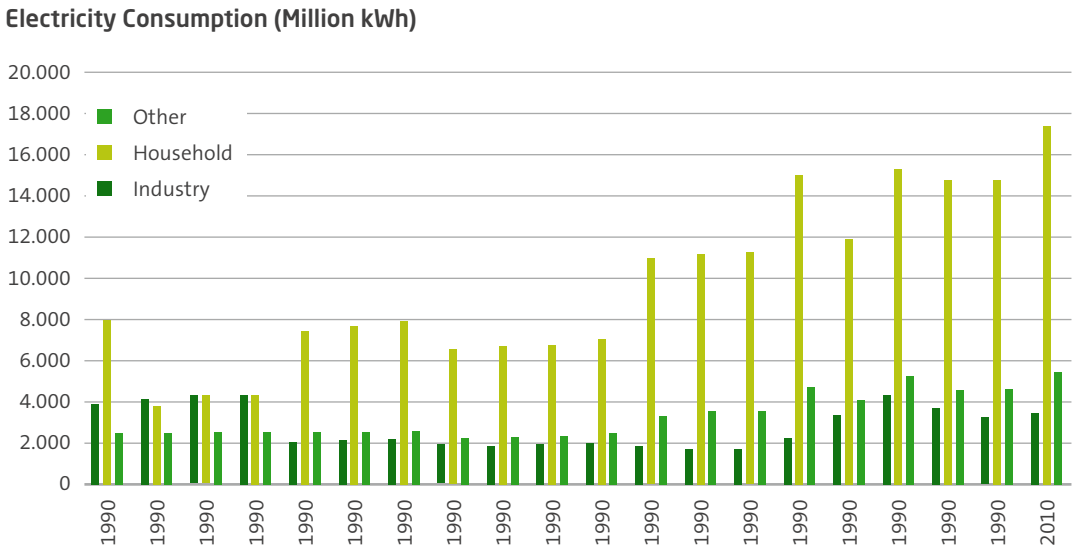


Figure 2.5 Grid-connected electricity consumption in Nigeria (Source: United National Energy Statistics Database[1])

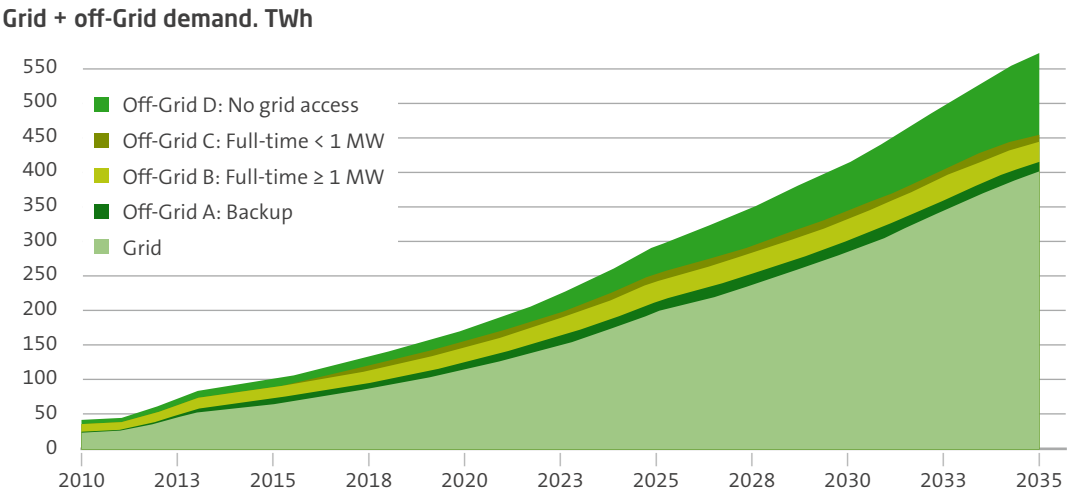


Figure 2.6 Projected Grid-connected & Off-Grid Electricity Demand (Source: NESP, 2015b)

Energy consumption

The available data on electricity consumption in Nigeria per sector reveals that – similar to energy consumption in general – the residential sector consumes most electricity (Figure 2.2 and 2.3). Figure 2.2 shows a comparison between the electricity consumption in Nigeria and some other countries. However, these figures do not account for captive generation from decentralized diesel and gas generators that are used in many industries, which exceeds the available grid-connected capacities. When taking this privately owned generating capacity into account, the share of industrial consumption is much larger.

As can be seen from Figure 2.4, of the total energy consumed by Nigerian industries only 4% is from grid-connected electricity. 96% is self-produced, using either natural gas, oil products (usually diesel) and biomass and waste (usually wood products and agri-waste). This explains why the share of electricity consumption of the industry sector is relatively low for Nigeria in previous figures.

1) Unstats.un.org/unsd/energy/edbase.htm

In Figure 2.5 the historical development of grid-connected electricity consumption per sector is presented. From this picture it shows that it is the residential sector (households) where the increase over the ten-year period is most pronounced. This can be attributed to the rapid population growth from 95 million in 1990 to almost 160 million in 2010. As a result of a growing population and economic growth, the on- and off-grid demand for energy and electricity are expected to grow significantly in the coming years. Figure 2.6 shows the projected increases in demand for electricity.

Electricity and power generation

But there are positive signals. The current government has started (but not yet completed) very important and constructive additional reforms. The successful implementation of these reforms is key to provide an enabling environment for private investment in generation capacity (and other phases of the electricity value chain). New regulation, which entered into force in February 2016, sets up dollar-denominated Feed-in-Tariffs with 20 year PPAs and a 50% renewable energy procurement goal for electricity distribution companies (DisCos). Nigeria also has several hydro projects under construction, which are equivalent to nearly 5 GW. Late last year, a 450 MW greenfield gas fired power plant called Azura-Edo raised € 745 million, providing a framework for project finance for Independent Power Producers (IPPs) in Nigeria.

Electricity generation

Within the Nigerian electrical power landscape, four basic power generation options are to be differentiated. These are:

1. Grid-connected: the electricity generated is evacuated on the TCN grid.
2. Embedded: electricity that is directly evacuated through a distribution system which is connected to a transmission network operated by a System Operations Licensee.
3. Captive: the generation of off-grid electricity that is entirely consumed by the generator itself and has an installed capacity exceeding 1 MW, with no upper limit.
4. Off-grid (including mini-grids): small scale (up to 1 MW) electricity generation to a single or limited number of customers.

While licenses are needed to operate a generator according to options 1 and 2, captive generation only requires a permit by the NERC. In this report, options 1 and 2 will be discussed in greater detail in chapters 2 and 3, while captive generation (option 3) will be discussed in greater detail in chapter 4 and 5. Off-grid electricity will be briefly discussed in this chapter.

Grid-connected and embedded electricity generation

Grid-connected electricity generation refers to a system of power generation evacuated through the national grid to off-takers which may be the Nigerian Bulk Electricity Trading company (NBET), who through vesting contracts supplies the power to Distribution Companies (DisCos); or directly to eligible customers, as may be declared by the Minister of Power.

In Nigeria, licenses for grid-connected power plants (including GenCos) amount to 19.407 MW. Of this licensed capacity, approximately 13.000 MW is actually installed. The remainder 31% licensed capacity is not yet built or is under development. Of the 13.000 MW, approximately 6.000 MW is available capacity and approximately 7.000 MW is non-operational, due to poor grid infrastructure and poor maintenance to the power stations. In 2015, 84% of the installed capacity came from gas and 18% from hydro.

Table 2.1 shows the historical grid-connected energy supply in Nigeria. This table shows an overall growing trend in the generation of energy, but a decline over the last year in per capita energy supply. Because of issues such as unavailability of gas, breakdowns, water shortages, and grid

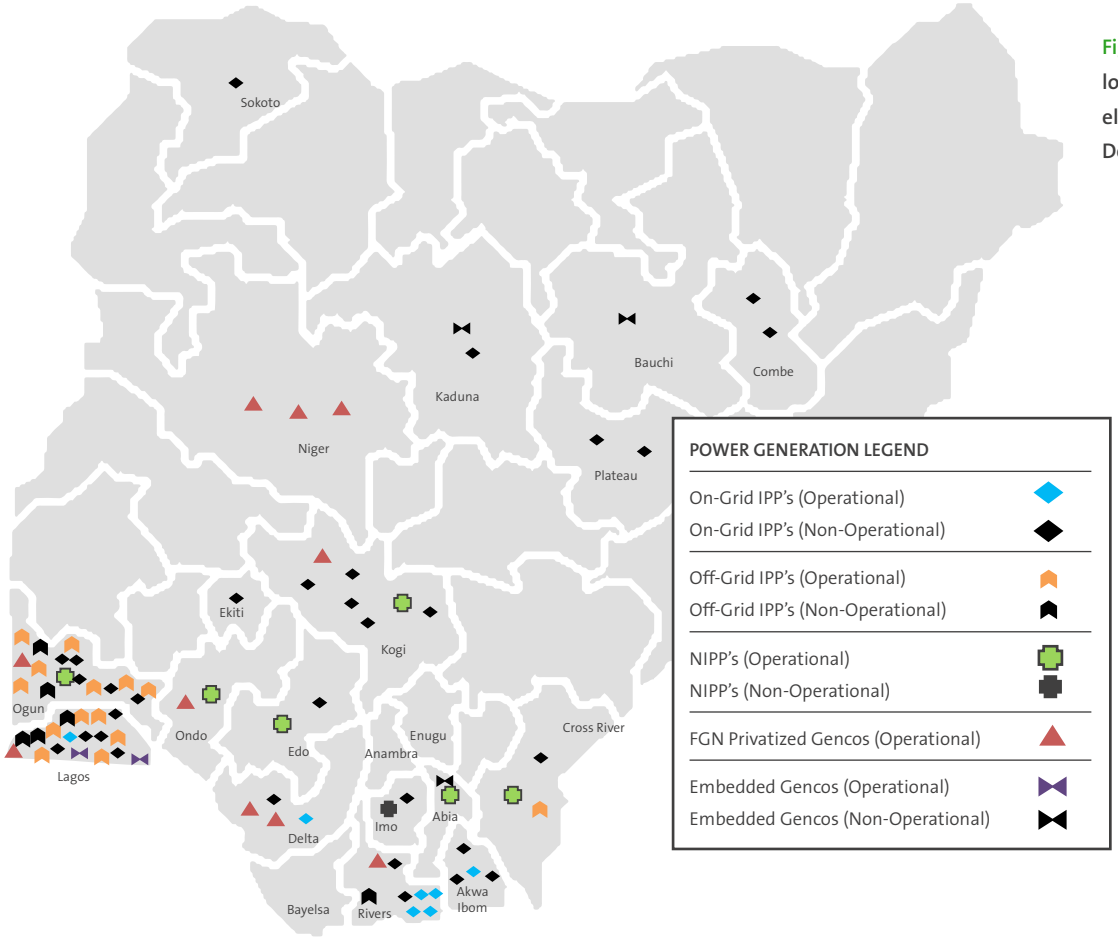


Figure 2.7 Geographical location of Nigeria's electricity plants (Source: Detail, 2015)

constraints only between 3.000 and 4.500 MW are actually being generated. Up to 2.700 MW is regularly lost due to gas shortage, another 500 MW is often lost due to water shortages, and some 100 MWs are lost due to line constraints.

There are currently two main types of grid-connected power plants operating in Nigeria: (1) hydro-electric and (2) thermal fossil fuel power plants.

The power plants in Nigeria can be classified, based on ownership, as either:

» Owned by the Niger Delta Power Holding Company (NDPHC). The Federal Government incorporated NDPHC as a limited liability company to serve as the legal vehicle to hold the National Integrated Power Project (NIPP) assets using private sector-orientated best business practices. The National Integrated Power Project (NIPP) was conceived in 2004 as a fast-track government funded initiative to stabilize Nigeria's electricity supply system while the private-sector-led structure of the Electric Power Sector Reform Act (EPSRA) of 2005 took effect. The NDPHC is owned by the three tiers of government in Nigeria: Federal, State and Local.

» Wholly owned by state governments and/or private companies. Such power plants are referred to as being an Independent Power Producer (IPP). Some of these plants originally were fully owned by the Federal Government of Nigeria (Power Holding Company of Nigeria; PHCN) but have been privatised in recent years.

Table 2.1 Historical grid connected energy supply in Nigeria (Source: Energy sector study (NESP, 2015b))

Year	Average generation capacity (MW)	Max. peak generation (MW)	Max. daily energy generated (MWh)	Total energy generated (MWh)	Total energy sent out (MWh)	Per Capita Energy Supply (kWh)
2007	3.781,3	3.599,6	77.322,3	22.519.330,5	21.546.192,2	155,3
2008	3.917,8	3.595,9	86.564,9	18.058.894,9	17.545.382,5	120,4
2009	4.401,8	3.710,0	82.652,3	18.904.588,9	18.342.034,7	122,0
2010	4.030,5	4.333,0	85.457,5	24.556.331,5	23.939.898,9	153,5
2011	4.435,8	4.089,3	90.315,3	27.521.772,5	26.766.992,0	165,8
2012	5.251,6	4.517,6	97.781,0	29.240.239,2	28.699.300,8	176,4
2013	5.150,6	4.458,2	98.619,0	29.537.539,4	28.837.199,8	181,4
2014	6.158,4	4.395,2	98.893,8	29.697.360,1	29.013.501,0	167,6

NIPP was originally designed around seven medium sized gas fired power stations in the gas producing states, and the critical transmission infrastructure needed to evacuate the added power into the national grid. A commitment to electrify host communities in the vicinity of the power stations and major substations gave rise to the distribution component of the project. In August 2005, the National Council of State and the National Assembly approved an initial funding for NIPP from the 'excess crude savings account' which statutorily belongs to the Federal, State and Local Governments.

Early 2016, there are 23 grid-connected power generating plants "in operation" in the Nigerian Electricity Supply Industry[10] (NESI), with a total installed capacity of 10.396 MW and available capacity of 6.056 MW. Most generation is thermal based, with an installed capacity of 8.457,6 MW (81% of the total) and an available capacity of 4.996 MW (83% of the total). Hydropower from three major plants accounts for 1.938,4 MW of total installed capacity (and an available capacity of 1.060 MW).[11]

Figure 2.7 shows the list of power plants with capacities and the geographical position of the power plants. This figure shows that of the available power plants, only 31% of the installed capacity is operational capacity.

Grid-connected power generation is faced with different challenges, some of which are[12]:

» Unavailability of gas: About 85% of installed generation capacity is thermal. Although Nigeria has the world's 9th largest gas reserves, gas production is significantly low. This constraint is said to reduce power generation capacity by 1.995 MW; reasons for this include uneconomical gas prices; pipeline vandalism; insufficient gas infrastructure; and uncertainty in regulation and fiscal policies for gas.

» Inadequate electricity transmission infrastructure: The existing electricity transmission system is only capable of delivering about 5.300 MW (out of the total installed capacity of 12.522 MW) to DisCo trading points. The majority of Nigeria's infrastructure is radial, which means a single path of transmission with a power source at one end. This implies that any fault in the path could potentially lead to a collapse of the entire transmission

10) The entire electricity value chain (generation, transmission and distribution) including the associated fuel supply

11) www.nipptransactions.com, July 2016

12) Detail Commercial Solicitors, published in www.financialnigeria.com on 13 January 2016

network. The issue with transmission has been estimated to reduce the power generation capacity by a total of about 263 MW. TCN plans to upgrade the transmission system to a capacity of 11.000 MW by 2020 (subject to adequate funding and completion of projects planned for implementation).

» Liquidity issues in the Nigerian Electricity Supply Industry (NESI): The NESI has, since the privatisation of the government owned generation companies (GenCos) and DisCos in November 2013, been faced with liquidity issues resulting from non-cost reflective tariffs and non-paying customers. The DisCos, being the cash collectors in the power value chain were unable to collect sufficient revenue to pay their power bills which should sustain the rest of the value chain (GenCos, gas suppliers and service providers). As a result, all the market participants in the power value chain cannot get their revenues in full, and this has led to a cash deficit in the sector. This is clearly a disincentive to investment in additional generation or capital expenditure for the DisCos. Even with the new tariffs (MYTO), the liquidity issues should not be expected to disappear over night.

» Nigerian Integrated Power Project (NIPP) privatisation: Closely related to the liquidity issues, are the issues affecting the completion of the NIPP privatisation. The privatisation process of

Figure 2.8 List of Nigeria's hydro and thermal Power Plants and Capacities (Source: Advisory Power Team, 2015)

Power plant		Installed capacity[1] MW	Avg. available capacity[2] MW	Avg. operational capacity[2] MW
EGBIN	IPP	1.320	941	539
AFAM VI	PRIVATISED PHCN	685	587	455
OKPAI	IPP	900	536	375
DELTA	NIPP	480	463	374
JEBBA	IPP	570	431	262
OLORUNSOGO GAS	PRIVATISED PHCN	335	277	189
IHOVBOR NIPP	PRIVATISED PHCN	434	374	182
GEREGU NIPP	PRIVATISED PHCN	450	328	179
KAINJI	NIPP	720	444	173
OLORUNSOGO NIPP	IPP	760	260	171
OMOTOSHO NIPP	NIPP	500	306	169
OMOTOSHO GAS	PRIVATISED PHCN	335	280	163
SHIRORO	PRIVATISED PHCN	600	508	153
GEREGU GAS	NIPP	414	159	131
SAPELE NIPP	IPP	450	184	111
IBOM	PRIVATISED PHCN	190	91	76
SAPELE	NIPP	504	219	69
ALAOJI NIPP	IPP	720	158	67
ODUKPANI NIPP	PRIVATISED PHCN	561	234	64
AFAM IV-V	NIPP	724	3	2
ASCO	IPP	294	270	0
OMOKU	PRIVATISED PHCN	110	0	0
TRANS AMADI	NIPP	150	0	0
AES GAS	PRIVATISED PHCN	180	175	0
RIVERS IPP	IPP	136	0	0
TOTAL		12.522 → 57% →	7.141 → 54% →	3.879

31%

Less than 10% operational

1) Average daily capacity Jan to Aug 15 2015 with data extrapolated for days on which data not available
2) Average of daily total across plants

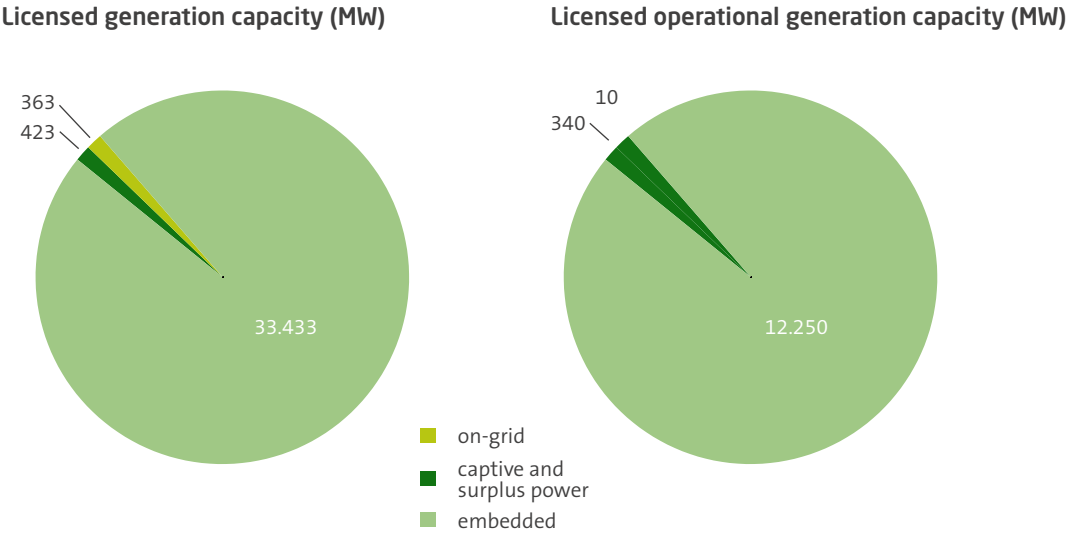
NIPP Power Plants, which has a capacity to add up to 4.775 MW to the grid, has been fraught with issues including the ones described above and a lack of government credit enhancements. This is especially complicated by the fact that most Nigerian Banks have a substantial amount of exposure to the power sector from the PHCN privatization, and the alternative is international funding which would be subject to more scrutiny by international banks.

Despite these challenges the power sector has elicited high investment interest, and many developers have secured generation licenses from NERC. Zuma Energy Nigeria Limited recently executed its first power purchase agreement (PPA) with NBET for construction of a 300 MW coal power plant in Kogi State. The 300 MW plant is reported to be the first phase of the 1200 MW coal fired power plant Zuma Energy will develop. There has also been a recent upsurge in interest in solar power projects in Nigeria. As at 10 November 2015, NBET indicated that it was negotiating eight PPAs with solar power developers whose projects are at different phases. However, due to varied reasons, none of the greenfield IPPs have commenced operations.

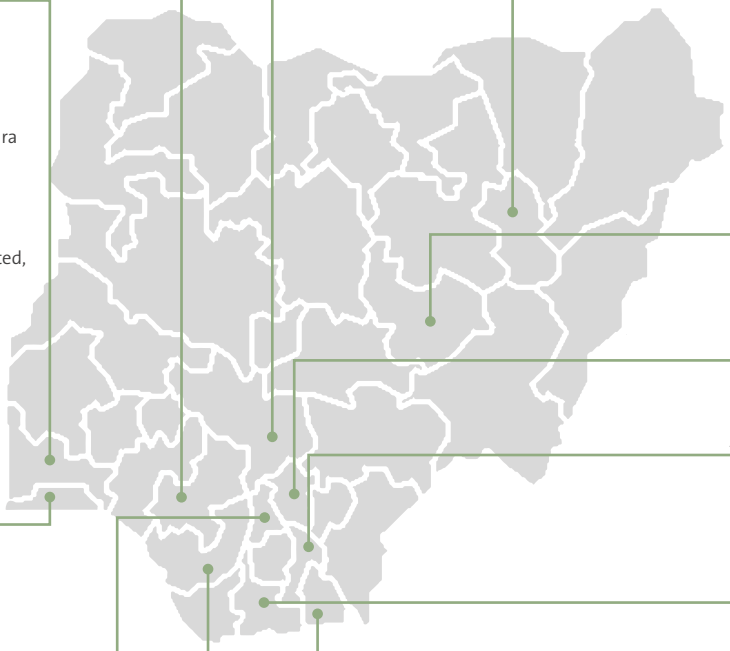
Based on an overview of the licenses that have been issued by NERC (see Annex C), the following can be concluded:

- The majority (98%) of licensed generation capacity is grid-connected.
- A little over a third (37%) of the licensed generation capacity is operational.
- Licenses have been issued for 423 MW of captive and surplus power. Only 340 MW is operational.
- Three quarters (77%) of licensed renewable generation capacity (1.969 MW) is from hydro power.
- Of the licensed renewable generation capacity only hydropower is actually operational (1.930 MW).
- Since 2013 the number of issued (and probably also requested) generation licenses and the overall generation capacity (in MW) is declining. An exception is the number of 'small' (<100 MW) renewable energy projects; between 2011–2015 the number of issued licenses has grown from zero to four annually.
- Embedded power generation is almost non-existent.

Figure 2.9 Issued licenses for generation capacity (NERC, January 2016)



Captive and surplus power means:
generator produces electricity mainly for own use (off-grid) but sells electricity (in excess of 1 MW) to an off-taker.



Edo State
- Azura Power Plant, Benin City
  459 MW | Gas

Ogun State
- Westcom Tech & Energy Service
  1000 MW | Gas
- Magboro Power Plant/ Bresson A.S. Nigeria Limited, Magboro
  90 MW | Gas
- Agbara Shoreline Power Limied, Agbara
  100 MW | Gas
- Paras Engergy & Natural Resources Development Limied, Ogijo
  96 MW | Gas
- Westcom Tech & Energy Service Limited, Sagamu
  1000 MW | Gas
- Farm Electric Supply Limited, Ota
  150 MW | Gas
- Hudson Power Limited, Warawa
  150 MW | Gas
- Ibafo Power Station Limited, Ibafo
  200 MW | Gas

Lagos State
- AES Barge Power Plant, Egbin
  270 MW | Gas
- Anita Energy Limited, Agbara
  90 MW | Gas
- MBH Power Limited, Ikorodu
  300 MW | Gas
- Energy Company of Nigeria (NEGRIS), Ikorodu
  150 MW | Gas
- Ibafo Power Station Limited, Ibafo
  140 MW | Gas

Anambra State
- Century Power Generation Limited, Okila
  495 MW | Gas

Akwa Ibom State
- Ibom Power Limited, Ikot Abasi
  190 MW | Gas

Gombe State
- Mabon Limied, Dadinkowa
  39 MW | Hydro

Kogi State
- Itobe Power Plant (Zuma Energy Limied), Itobe
  1200 MW | Coal
- Knox J&L Energy Solutions Limited, Ajaokuta
  1000 MW | Gas
- DIL Power Plc, Obajana
  135 MW | Coal

Plateau State
- JBS Wind Power Limited, Maranban Pushit, Mangu
  39 MW | Hydro

Enugu State
- Minaj Holdings Limited, Adu-Amorji
  115 MW | Coal

Abia State
- Aba IPP, Aba
  141 MW | Gas
- Supertek Limited, Akwete
  1000 MW | Gas

Rivers State
- Eleme Petrochemical Company Limited, Eleme Complex, Port Harcourt
  135 MW | Gas
- Notore Power Limited, Onne
  50 MW | Gas

Delta State
- Okpai Power Plant/Nigeria Agip Oil Company Okpai
  480 MW | Gas
- Delta Electric Power Limited, Etiope
  116 MW | Gas
- Ethiope Energy Limited, Sapele
  2800 MW | Gas

Key:
Installed/Licensed Capacity (MW) | Feed Stock

Figure 2.10 Current IPPs in Nigeria (Latham & Watkins, 2016)

Embedded generation

Embedded power currently is almost non-existent in the Nigerian electricity system. However there seems to be a major prospect for embedded power. Only in Lagos State, in eleven industrial areas and residential estates, more than 6.500 diesel generators, totalling 600 MW, are installed (see Annex G).

Captive generation

In Nigeria, captive power is a widespread form of off-grid power generation. Captive generation is defined as generation of electricity for the purpose of consumption by the generator and which is consumed by the generator itself and not sold to a third party. The NERC Captive Power Generation Regulation reinforces the definition in the Electric Power Sector Reform Act 2005[13] (EPSRA) and goes to define captive power generation to mean generation of electricity exceeding 1 MW for the purpose of consumption by the generator and which is consumed by the generator itself and not sold to a third party[14] (Detail Commercial Solicitors, Nigeria Power Guide, Volume 3, 2015 Edition).

13) Nigerian Ministry of Power, Works and Housing

14) Detail Commercial Solicitors, Nigeria Power Guide, Volume 3, 2015 Edition

Figure 2.11 Overview of issued Captive Power permits 2010–2013 (NERC)

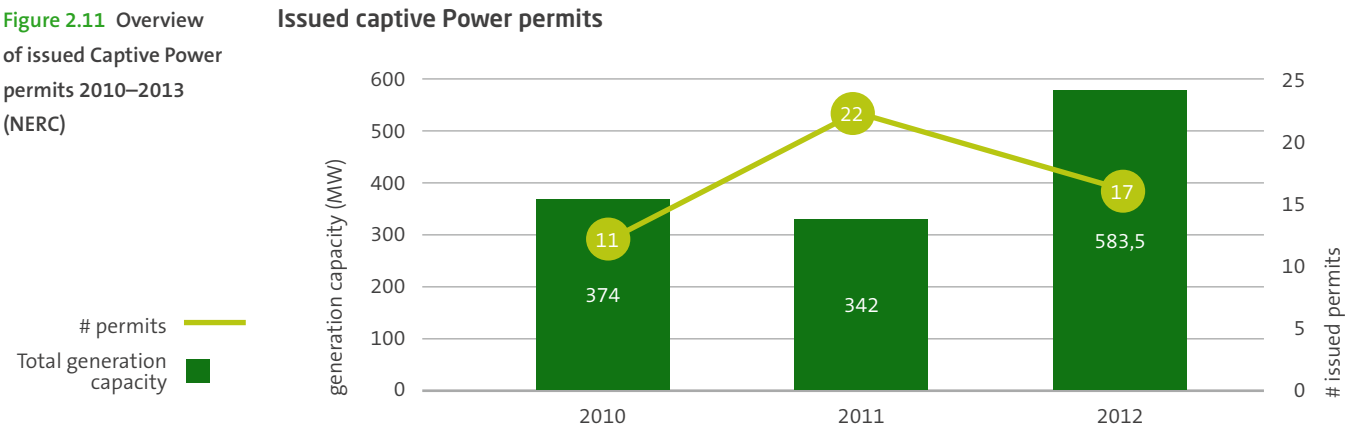
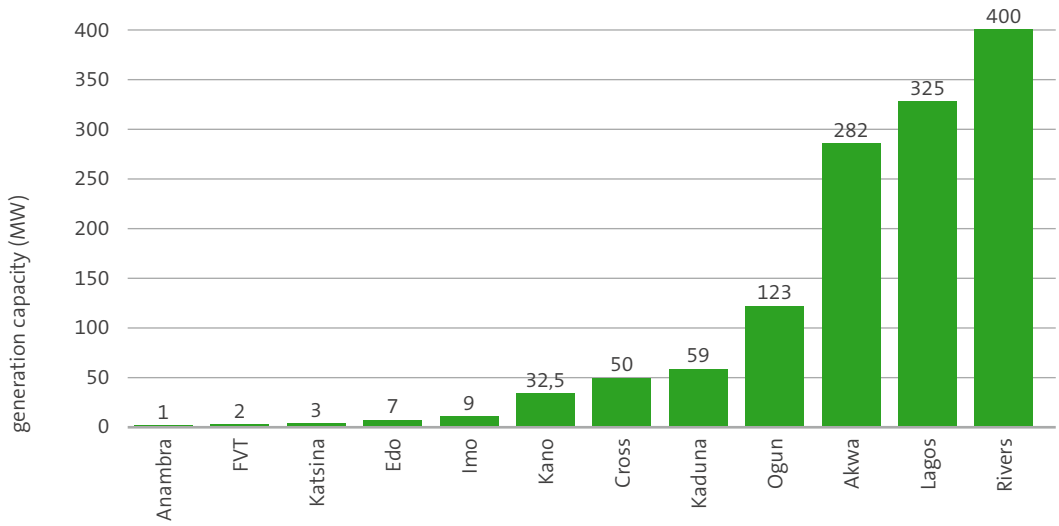


Figure 2.12 Overview of issued Captive Power permits per state between 2010–2013 (NERC)



According to a 2013 survey[15], approximately 80% of the Nigerians use alternate sources of electricity supply such as diesel generators or solar PV. Estimates suggest that between 8 and 14 GW of decentralised diesel generator capacity is currently installed in the country[16], mostly in industry. About 86% of the companies in Nigeria own or share a generator and about 48% (of their total electricity demand) is covered by these private generators [GIZ; Mar 2015]. With several millions of privately installed diesel generators, Nigeria leads Africa as a generator importer and is one of the highest importers worldwide, with a total annual import figure being worth NGN 17.9 billion (€ 95 million).

The total captive power capacity for which licenses and permits have been issued by NERC add up to about 1.700 MW. Based on rough estimations that the total market for self-generated power in Nigeria is between 8 and 14 GW, it seems a very large share of the self-generated power market has a maximum generation capacity below 1 MW and / or captive power generation is not accounted for in the overviews of permits and licenses that are available (see Annex C). Permits might have

15) Survey of Power Demand and Energy Consumption in the Industrial Sector in Nigeria, GIZ, 2013

16) GIZ and NIAF estimation (taken from: The Nigerian Energy Sector, GIZ, 2015)

been issued before 2010 and licenses before 2006 (if required at that time), excluding them from current statistics.

Based on the overview of issued permits (Figure 2.11 and 2.12 and Annex C), the following can be concluded:

- In total 1.300 MW of Captive Power permits have been issued.
- 78% of the issued permits is in three states: Akwa Ibom (22%), Ogun (25%) and Rivers (31%); the major industrialised and oil and gas states.
- No permits or licenses have been issued for renewable captive power (or not registered as such).

Off-grid generation

Off-grid generation in Nigeria is defined as stand-alone power generation systems (up to 1 MW), which typically provide smaller communities (e.g. rural areas; industrial clusters or residential estates) with electricity through independent electricity distribution network systems or mini-grids. Off-grid electricity is not evacuated on the electricity grid of the TCN or a DisCo. The total off-grid electricity generation capacity is still marginal. Considering Nigeria's plans to increase generation capacity in the coming years and the low level of access to electricity in the rural areas, there is need for significant investment in off-grid generation.

There are some very good prospects for off-grid solutions in Nigeria[17]:

- Potential to grow industrial clusters and small cottage industries: These businesses require uninterrupted power supply to function optimally. The power supplied could be generated through fully off-grid power plants (or embedded power). Steps are already being taken in this direction with the development of a proposed framework for micro-grid power generation for industrial clusters in Nigeria. The Manufacturers Association of Nigeria (MAN) identified about 28 clusters for mini-grid modular plants ranging from 5 to 50 MW in areas including Ogun and Lagos States.
- Opportunities for household mini-grids: Unserved households in (usually rural) areas that do not fall within a DisCo concession, can be served by investors who may wish to create off-grid supply over their own local grid. In line with the NERC Regulation for Independent Electricity Distribution Networks (IEDN Regulations, 2012), off-grid generation plants require an IEDN (often a mini-grid) to supply electricity to end users. Topographical and geographical challenges in rural areas make it uneconomical to extend the grid to such areas. Rural electrification in Nigeria is low, hence there is a direct need for investments. End of 2015, bids were requested by the Rural Electrification Agency (REA) for several rural electrification projects across Nigeria. It is expected that several rural electrification projects will be realised in 2016.
- Opportunities for DisCos cooperating with IEDNs: Expansion of the electricity grid with IEDNs in areas outside and within the DisCo concession areas could potentially be a win-win situation for DisCos. After an independent developer has established the off-grid generation and distribution system, the DisCo could either collaborate with developers to expand or refurbish their network (then becoming embedded generation), which will add to their number of paying customers, or acquire the developer assets, given the right regulatory framework.
- Opportunity to collaborate with State Governments: Many state governments are looking to partner with investors to develop off-grid projects. This may be to avoid regulatory constraints (as a result of the fact that most laws, regulations, and agencies for grid-connected projects are controlled by the federal government) which state governments may experience when executing on-grid projects.

17) Detail Commercial Solicitors, published in www.financialnigeria.com on 13 January 2016

Notably, the Lagos State Government has initiated some Independent Power Projects (IPPs) to provide electricity to its own establishments, including schools, ministries, hospitals, and courts. As at July 2015, the state had commissioned five IPPs with an accumulated capacity of 47,5 MW.

» Considerable insulation from the issues within the NESI: off-grid solutions within a cluster of customers willing and able to pay, presents a viable investment opportunity for power developers, particularly because the investment would be insulated from the current liquidity issues in the NESI.

Electricity transmission

Nigeria's transmission network consists of 159 substations with a total (theoretical) transformation capacity of ca. 19.000 MW and 15.022 km of transmission lines. The national grid operates at 330 kV and 132 kV high voltage level. 126 approved TCN projects worth approximately € 1,2 billion are underway to strengthen the transmission network. For electricity generation, however, delivery has been slow and only 22 of the 126 approved TCN projects have been completed, primarily because of inadequate funding and invoicing delays (ongoing FGN funded projects are generally ineligible to access external funding reserved for new projects). Of those yet to be completed, ca. 30% have been underway for more than five years and eight even started in 2001. In addition, various external funding sources have been made available to finance new projects

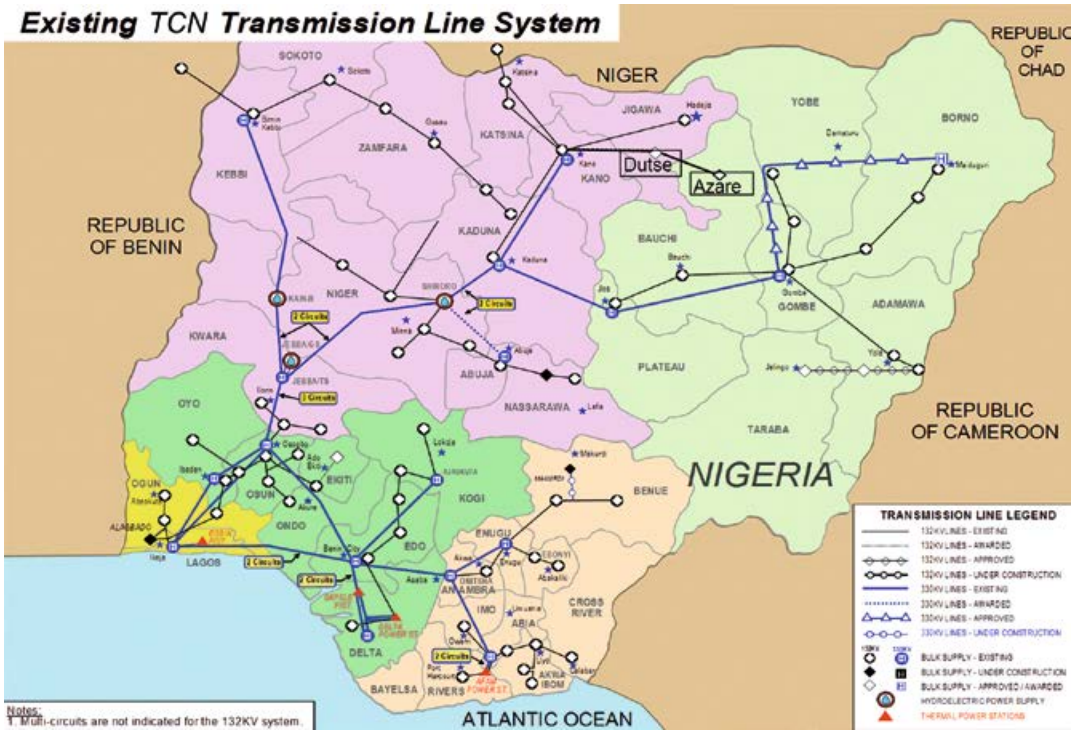


Figure 2.13 Existing Transmission Line System (Transmission Company of Nigeria, 30 June 2015)

within the transmission sector. However, much funding has yet to be accessed as the number of bankable projects is low. When complete, these projects could increase grid-wheeling capacity to ca. 7.200 MW and the length of the network to ca. 21.000 km. Figure 2.13 shows the transmission grid of Nigeria as of 2015. Currently the network is not well developed in the Northern and Eastern regions of the country.

Electricity distribution

The Nigerian government moved to privatise the power sector with the Electric Power Sector Reform Map of 2005 and the launch of the Roadmap for Power Sector Reform in 2010. In this Roadmap, the former National Electric Power Authority (NEPA) was unbundled and replaced by the Power Holding Company of Nigeria (PHCN). From 2007 until September 2013, the PHCN was the state-owned company in charge of generating, transmitting and distributing electricity in the entire country. In addition, 10 new National Integrated Power Projects (NIPP) were under development. As part of the privatisation process, the government owned (PHCN) generation facilities were sold to private parties (GenCos), the NIPP projects were put-up for sale and the distribution network was broken up into eleven regional grids (DisCos), which were then partly sold off to local and foreign investors. A minority stake of the DisCos was retained by the government of Nigeria. The resulting distribution companies vary greatly in terms of network size, number of customers and geographic area. Figure 2.14 and Figure 2.15 show the distribution companies and their customers, network distribution and allocated percentage of electricity. The privatisation was performed through a competitive bidding process and was completed in November 2013. TCN is still fully owned by the government but has been under a management contract with Manitoba Hydro International for four years. In July 2016 the federal government has resumed the management of TCN.

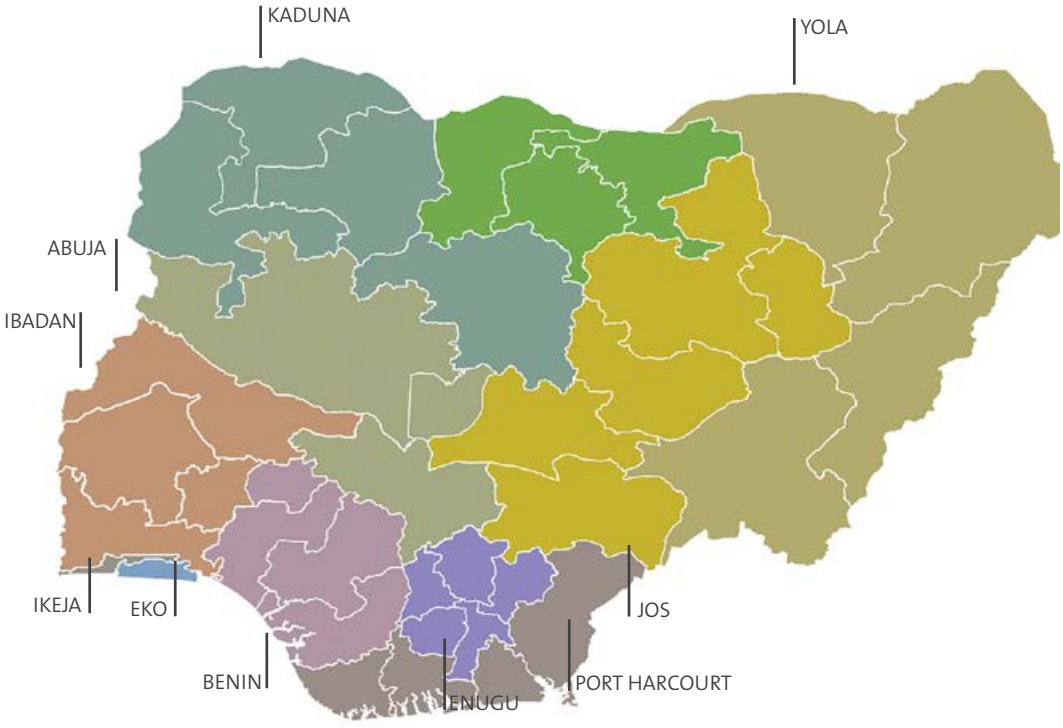


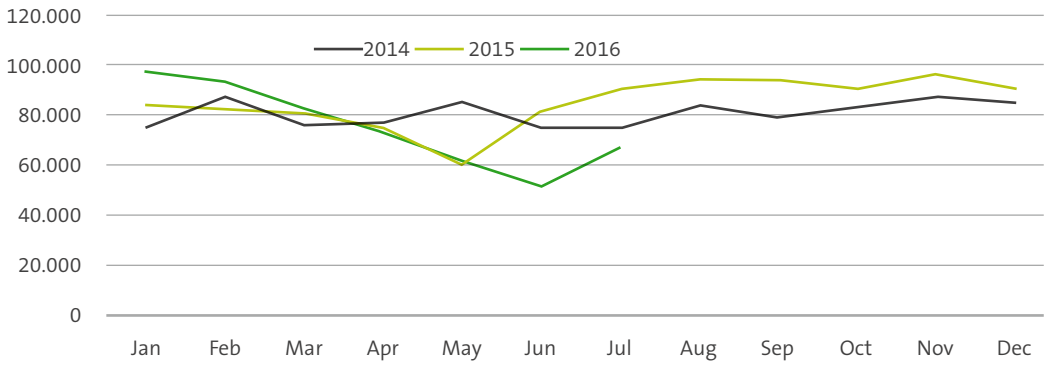
Figure 2.14 The 11 DisCos in Nigeria (Source: Advisory Power Team, 2015)

Figure 2.15 Customers, network length and allocated energy per DisCo. (Source: Advisory Power Team, 2015)

	VARIATION OF CUSTOMERS AND NETWORK DISTRIBUTION		ALLOCATED ENERGY[1] (% OF TOTAL ENERGY ALLOCATED)	
AREA	NUMBER OF CUSTOMERS ('000, 2014)	DISTRIBUTION NETWORK (KM, 2008)	ALLOCATION (% OF GRID ENERGY)	ACTUAL AVERAGE (JAN' 14 – APR' 15)
ABUJA	755	107.254	12 %	15 %
BENIN	1.187	104.702	15 %	14 %
EKO	581	8.093	13 %	13 %
ENUGU	819	25.078	9 %	12 %
IBADAN	1.750	24.355	9 %	11 %
IKEJA	1.128	12.466	11 %	9 %
JOS	466	12.227	8 %	8 %
KADUNA	459	26.653	7 %	7 %
KANO	598	21.041	6 %	5 %
PORT HARCOURT	557	17.989	8 %	5 %
YOLA	345	6.505	4 %	2 %

[1]) Due to rounding percentages don't add to 100%

Figure 2.16 Monthly (daily average) – Energy sent out MWh (NERC, July 2016)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	74,555	86,772	75,548	76,297	84,318	74,890	73,807	830,96	78,793	83,229	86,705	83,948
2015	83,425	81,821	80,101	74,803	60,422	80,630	89,813	93,462	94,110	91,110	95,756	91,278
2016	96,686	92,981	81,648	73,539	61,322	51,637	66,986					

The privatization has not (yet) brought major improvements in the electricity situation. Figure 2.16 shows an overview of the daily cumulative electricity supply for Nigerian households. Over the period of 2013–2015, the average hours of electricity supply per connected household was 6,2 hours (www.noi-polls.com, October 2015). This situation forces both households and industry to rely on privately owned petrol and diesel generators for much of their power requirements. Before February 2016, generating electricity from these generators was more than twice as expensive (€ 0,27 – € 0,41/kWh) than grid-based power (end user tariff of € 0,11 – € 0,16 /kWh).

As of February 1, 2016 there was a 45% increase in on-grid electricity tariffs (see Annex H for the latest electricity tariffs) as established by NERC. According to NERC the increase in tariff will boost private investment in the sector. However, this tariff increase has been declared illegal by the Federal High Court in Lagos on July 13, 2016. NERC has filed for stay of execution and a notice of appeal of the judgement.

The biggest challenge the distribution sector faces is the level of distribution losses. This includes technical, commercial (electricity not billed for), and collection losses (electricity billed but not paid for). When the distribution companies were privatised, the transactions assumed particular loss levels. After the asset hand-over, however, it became clear that the losses were much higher than had been estimated. In 2014, ca. 46% of potential revenues were lost through technical (12%), commercial (6%), and collection losses (28%).

Stakeholders

In this section the key stakeholders in the power sector are introduced briefly. In chapter 6, the relevant stakeholders for captive renewable energy are described in more detail.

The key decision, policy, and regulatory bodies active in the sector are:

- The Presidency
- Nigerian Electricity Regulatory Commission (NERC)
- Energy Commission of Nigeria (ECN)
- Ministry of Power (MoP)
- Ministry of Environment (MoE)
- Ministry of Petroleum Resources (MoPR)
- Ministry of Finance (MoF)
- National Council on Privatisation (NCP) with its secretariat, the Bureau of Public Enterprises
- Hydro Electric Power Producing Areas Development Commission (HEPPADC)
- Nigerian Investment Promotion Commission (NIPC)
- Rural Electrification Agency (REA)

The main players in the daily operations of the power market:

- Nigeria Bulk Electricity Trader (NBET)
- Transmission Company of Nigeria (TCN)
- Nigerian National Petroleum Corporation (NNPC) and its key operational subsidiaries, the Nigerian Gas Company (NGC) and the Nigerian Petroleum Development Company (NPDC)
- Niger Delta Power Holding Company (NDPHC)
- Private sector natural gas producers: international and indigenous oil and gas companies
- The divested generation companies (GenCos)
- The divested distribution companies (DisCos)
- The independent power producers (IPPs)

Figure 2.17 presents an overview of the key power market actors in Nigeria. From this figure it shows that NBET buys in the electricity generated from the GenCos or IPPs. After this the electricity is transmitted by TCN, against transmission charges, to DisCos who distribute and sell the electricity to the end-user. NERC functions as an overarching regulatory commission in the electricity sector. Embedded power is directly distributed by DisCos without any interference from TCN, NBET or NERC.

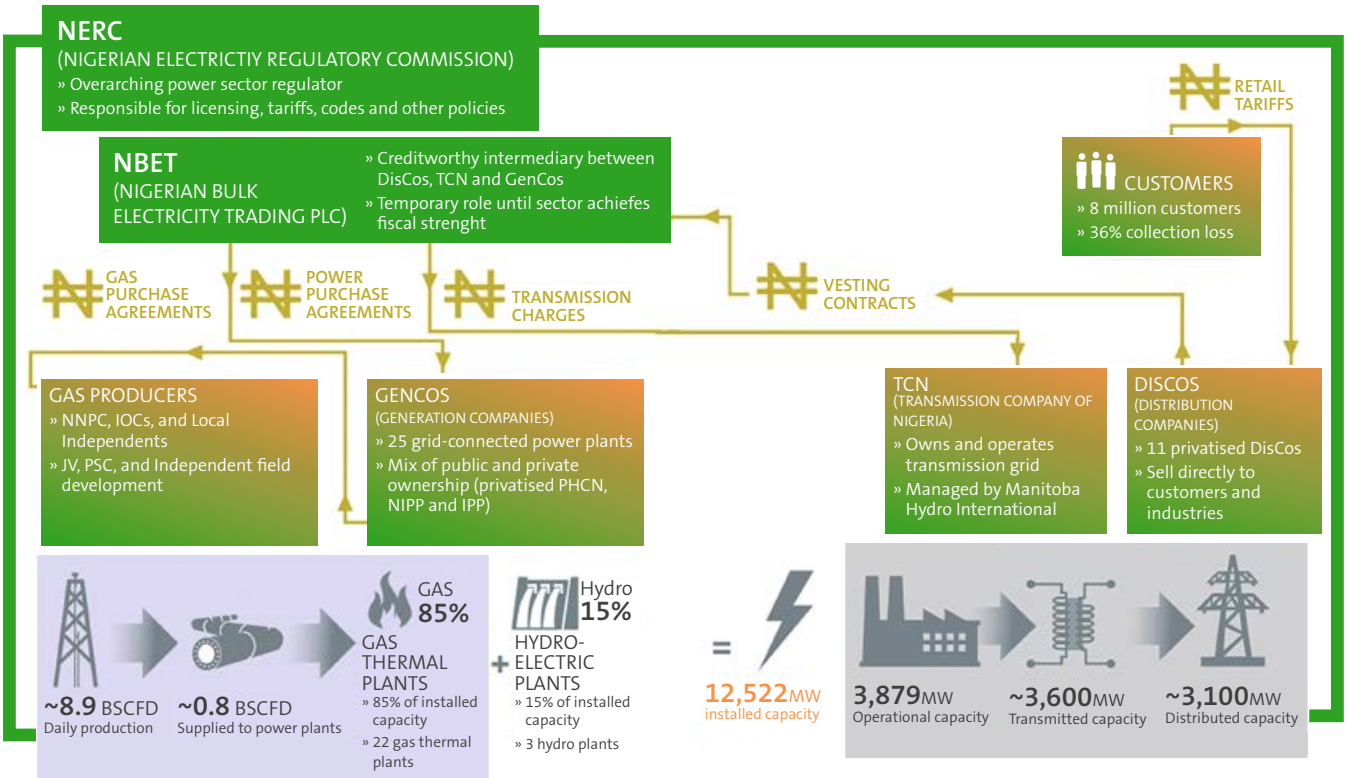
Policies and regulations

The energy landscape in Nigeria has undergone drastic changes in recent years due to the ongoing privatisation of the sector. In recent decades the electricity market has changed from a vertically-integrated organisation under the state-owned National Electric Power Authority (NEPA), to a multi-stakeholder privatised market. In the following the existing policies and regulations are summarized in chronological order. Some are less relevant due to the many changes in the sector in the last ten years. The following policies and regulations specific to renewable energy are mentioned in more detail in chapter 3 (page 60):

Renewable Electricity Policy Guidelines 2006 (REPG)

- Renewable Electricity Action Programme (REAP), 2006
- National Biofuel Policy and Incentives (2007)
- Renewable Energy Master Plan (REMP), 2012
- National Renewable Energy Action Plan, 2016

Figure 2.17 **Overview of key power market actors (NERC, July 2016)**



National Electric Power Policy (NEPP), 2001

Because of population- and economic growth in the late 1990s, the demand for energy grew rapidly. NEPA was unable to keep pace with the growing demand, which led to an energy supply crisis in 2001. Because of the crisis, the National Electric Power Policy (NEPP) was launched, aiming at fundamental changes in the ownership, control, and regulation of the electricity sector. The NEPP focused on creating a privatised sector that was able to overcome the poor service, low availability and high frequency of outages in the system through the creation of an investor friendly environment with low government involvement.

The NEPP consisted of three principal phases. The first step aimed at privatisation and the introduction of independent power producers (IPP). The second step aimed at increasing the competition between market participants, reduction of subsidies, and sale of excess power to DisCos. The final step consisted of a further intensification of the market and competition through full cost pricing of supply, liberalised selection of supplier beyond the local DisCos and full competitive market trading. The implementation of the NEPP was later incorporated in the Electric Power Sector Reform Act (EPSRA) of 2005.

National Energy Policy (NEP), 2003

This policy was designed as a framework for the development of the sector. It covers the development, exploitation, and supply of all energy resources and their utilisation. The policy programme consists of three topics with individual policy goals, namely:

- Renewable Energy: The NEP recognizes the conversion of all energy resources as vital for development and therefore makes a provision for renewable sources and how they can effectively be utilised. However, no quantitative targets are given.
- Energy efficiency and conservation: The NEP points out that energy efficiency is very low in Nigeria and called for the promotion of energy conservation. However, no quantitative targets are given.
- Rural electrification: The NEP recommends the promotion of off-grid and standalone power systems in order to supply electricity to remote areas.

National Economic Empowerment and Development Strategy (NEEDS), 2004

The NEEDS programme was intended as an overarching statement for the period 2003–2007 combating the social, political and economic decay in the country. The policy promotes the privatisation of infrastructure. Furthermore, the programme promotes the uptake of renewable energy in the total energy mix. The policy makes provisions for the vertical and horizontal unbundling of the electricity company into separate and competitive entities.

Electric Power Sector Reform Act (EPSRA), 2005

The NEPP was the basis for the Electric Power Sector Reform Act of 2005. Through this reform act, the energy sector of Nigeria was privatised in the following decade. This policy provides a new legal and regulatory framework for the sector. The fundamental reform was the privatisation of the government owned NEPA to the PHCN holding company including the subsequent splitting of its assets into 18 separate successor companies responsible for the generation, transmission, and distribution. The Act makes provisions for the vertical and horizontal unbundling of the electricity company into separate and competitive entities, thus restructuring the whole energy landscape with different players for the generation, transmission, distribution and commercialisation of the electricity. The intention of the programme was to increase competition significantly by establishing a wholesale electricity market and promoting the participation of private companies. The Act is the most important legislature in the

electricity sector. The Act also mandates the NERC to ensure that all electricity generated is efficiently sourced and distributed to the customer.

Vision 20:2020, 2010

The Vision 20:2020 outlines the path to position the country amongst the leading 20 economies of the world in 2020. The vision recognises the importance of Nigeria's renewable energy resource potential in meeting the national electricity targets. Therefore, the vision called for various measures and strategies as contained in the document to support the sustainable integration of renewable energy generated electricity into the energy mix of the country. Some of the goals highlighted in the document include:

- Achieving a 15% and 20% contribution of hydro-power to the nation's electricity generation mix by 2015 and 2020 respectively;
- Ensuring a 1% contribution of wind energy to the nation's electricity generation mix;
- Attaining a 1% contribution of solar energy to the nation's electricity generation mix;
- Replacing 50% of firewood consumption for cooking ;
- Putting in place a power generation capacity of 1,000 MW using biomass resource;
- Maintaining a biofuel blend not exceeding 10% in transport fuels, using locally produced renewable biofuels from secondary biomass.

Embedded Generation Regulations, 2012

In this regulation, the NERC defines the standards for embedded generators and the operation of electricity supply systems. Embedded generation is defined as generating units that are connected to the distribution grid. Embedded generators are not obliged to provide electricity to the public. However, the regulation prescribes that the embedded generator must enter into various network agreements such as power purchase agreement, and an ancillary services agreement with the NERC and NBET.

Regulations for Independent Electricity Distribution Networks (IEDN), 2012

This regulation provides the provisions for the issuance of licenses for DisCos and electricity distributors independent of a distribution company (DisCo). An IEDN entails an isolated rural or urban network not connected to the national grid. An IEDN is required to operate its own generator or to obtain electricity from another distribution company via a purchase agreement.

Renewable Energy Master Plan (REMP), 2012

The Renewable Energy Master Plan (REMP) sets out in the short, medium and long term what the national energy supply mix should be and articulates the strategic approach and measures to meet the targets. For more details, see chapter 3, page 61.

Roadmap for Power Sector Reform, 2010 and 2013 update

The updated roadmap of 2013 was based on the roadmap of 2010 and includes fine-tuned plans and strategies to finalise the power sector reforms. The roadmap does not introduce new policies but sets strategies to accelerate achieving the objectives of the NEPP of 2003.

National Renewable Energy and Energy Efficiency Policy (NREEEP), 2015

In May 2015, NREEEP was approved by the Federal Executive Council. NREEP targets for power generation using biomass, wind, solar and hydropower as well as renewable electricity overall supply projections. For more details, see chapter 3, page 61.

Multi-Year Tariff Order (MYTO), 2015

The MYTO is set to cover a total of 15 years and is reviewed biannually. It sets feed-in tariffs in order to ensure there are clear rules in the interim market for energy. In January 2015, the MYTO 2.1[18] was initiated that sets feed-in tariffs for:

- New entrance gas power plants
- New entrance coal power plants
- Small hydropower plants
- Land-mounted wind power plants
- Solar power plants

National Renewable Energy Master Plan, 2016

The National Renewable Energy Action Plan (NREAP) describes the opreationalisation of NREEEP, and includes baseline data, information on renewable energy sources and technologies, various activities and programmes in renewable energy in Nigeria, barriers to the development of renewable energy, and targets for 2020 and 2030. For more details, see chapter 3.

Licences for market participants

The players in the Nigerian electricity market are often referred to as market participants. In order to carry on business as a market participant, it is imperative that such entities obtain the appropriate licences from NERC. In chapter 6, detailed information is provided on the steps a market participant has to take to implement on- and off-grid electricity projects in Nigeria, including captive and embedded power projects.

18) http://www.nercng.org/index.php/myto-2/96-myto-2


ONIGBAGBO
SOLAR STATION
95,702KWh/Y
This station is fitted with photovoltaic solar panels producing electricity.
Thanks to this equipment, 95,702kWh is produced every year.
The operations of this station contributes to reducing 125 tons of CO_2 impact on the environment per year.
SUNPOWER
TOTAL

CHAPTER 3
RENEWABLE ENERGY IN NIGERIA

Resources and potential

Nigeria's abundant renewable energy resources are largely untapped. Table 3.1 shows the renewable potentials per resource type for Nigeria.

Hydro power potential

The gross hydro potential for the country is approximately 14,75 GW (11,25 GW large and 3,5 GW small), enough to solely power the current electricity generation in the country. Of this potential only 13% is currently utilised. The Federal Ministry of Power (FMP) classifies hydropower plants that generate less than 30 MW as small, and of less than 1 MW as mini hydropower plants. Hydropower power plants larger than 30 MW are considered medium plants and those larger than 100 MW are considered large plants (FMP; 2015). Table 3.2 shows the potential of SHP in five selected states and Figure 3.1 shows the geographical location of river basins with hydropower potential in Nigeria.

A more detailed study on the overall hydropower potential for Niger State (Rufai, 2012) revealed a total untapped potential of about 2.491 MW. This includes construction of new small, medium and large dams, using existing dams for hydro and ensuring the existing hydropower stations across are not operating below capacity. Still the potentials claimed by ECN have to be assessed carefully: A recent study [GIZ; 2015] based on a data set provided by JICA suggests that hydropower potential might be more limited than the ECN figures suggest. Flow patterns

State	River basin	No of sites	Potential capacity (MW)
Cross River	Cross River	18	28,1
Niger	Niger	30	117,6
Ogun	0		
Plateau	Lower Benu	32	110,4
Sokoto	Sokoto-Rima	22	30,6

Table 3.2 ECREE, Baseline Report on Small-scale Hydropower in the ECOWAS Region (2012)

Resource type	Reserves (natural units)	Current utilization and further remarks
Hydro (large)	11.250 MW	1.900 MW exploited
hydro (small)	3.500 MW	64,2 MW exploited
Solar PV	4,0 – 6,5 kWh/m²/day	15 MW dispersed solar PV (estimate)
Wind	2–4m/s @10m hub height on-shore	N/A
Biomass (non-fossil organic matter)	Municipal Waste	18,5 million tonnes produced in 2005 and now estimated at 0,5kg/capita/day
	Fuel wood	43,4 million tonnes annual fuel wood consumption
	Animal waste	245 million assorted animals in 2001
	Agricultural residues	91,4 million tonnes/yr. produced
	Energy crops	28,2 million hectares of arable land; 8,5% cultivated

Table 3.1 Estimated renewable energy resources in Nigeria (ECN, 2014)

Figure 3.1 River basins with large and small scale hydro power potentials (ECREE, 2012)

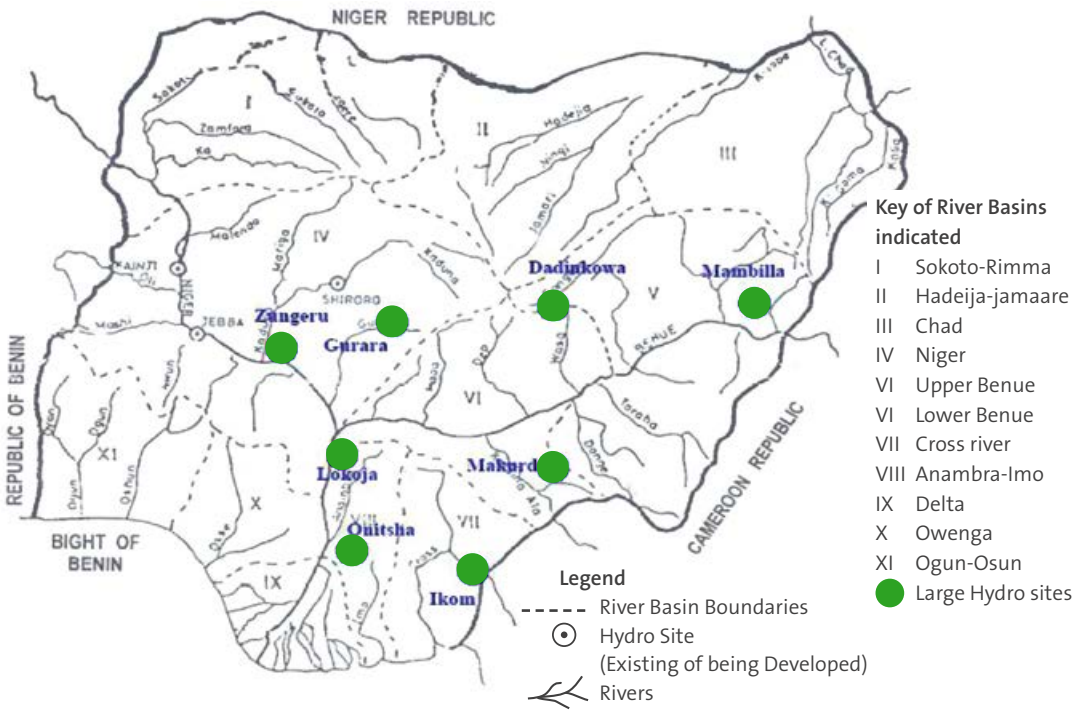


Figure 3.2 Locations of major dams in Nigeria (GIZ, 2015)

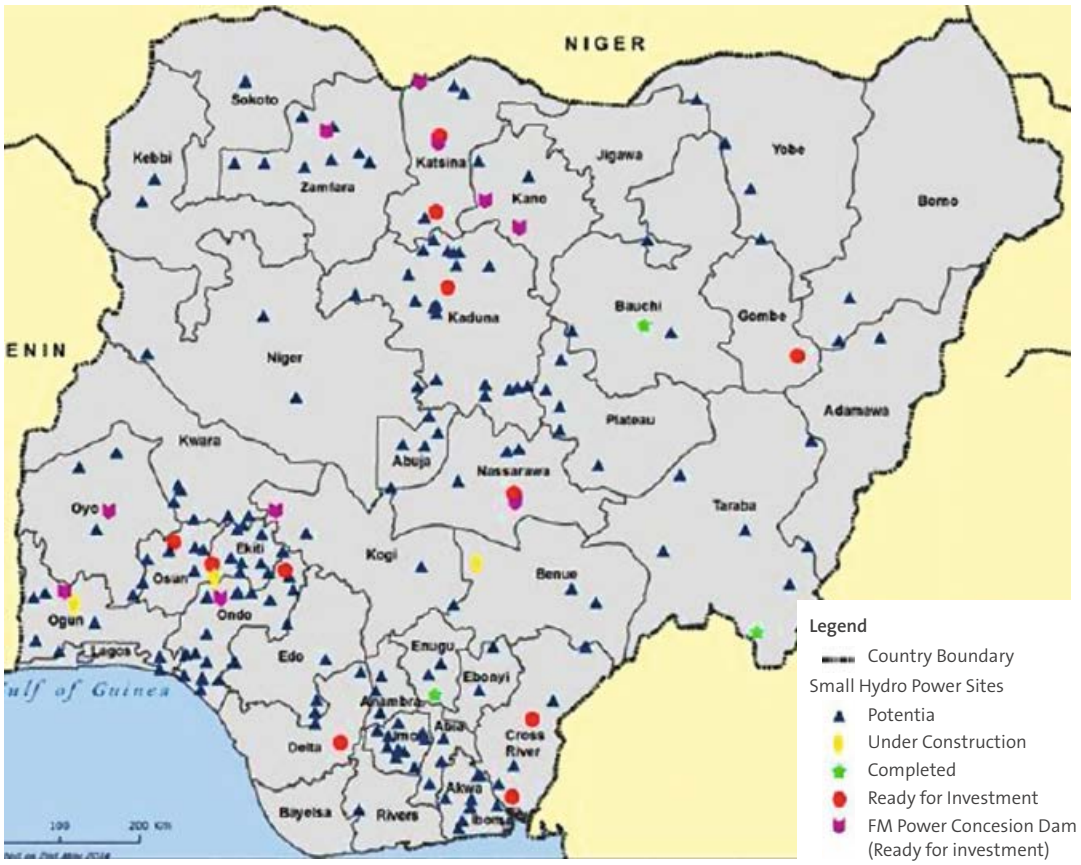


Figure 3.3 SHP and potential SHP sites in Nigeria (GIZ, 2015)

vary considerably between wet and dry season. The large seasonal variation (some rivers only showing 5 to 10% of flow in the dry season) may significantly restrict the economic viability potential for hydropower in the country. This is particularly true for run-of-river plants typically applied for small and mini hydro power (SHP). While large hydro is quite viable and expansions and new dams are being developed, the potential for SHP is questionable.

Solar energy potential

Nigeria has a great potential for solar energy. The country lies just north of the equator, in a region where there is an abundance of sunshine all year around. Annually, Nigeria receives an average of 2.000 kWh/m^2 of irradiation. As can be seen from Figure 3.4, the best potential for large-scale solar power plants lies in the northern part of the country. Horizontal irradiation ranges from 4 kWh/m^2/day in the south to 7 kWh/m^2/day in the north. The south of Nigeria has less potential for solar energy than the north, as it is often cloudy and has a longer rainy season. The high irradiation means that if only 1% of Nigeria's land mass (920 km²) is covered with crystalline PV modules, it can potentially generate 207.000 GWh per year, being ten times the total electricity currently generated in Nigeria in 2011 (NESP, 2015b).

Solar photovoltaic, off-grid or mini-grid, is a good alternative in rural communities where the grid does not extend to, and petrol or diesel are often difficult to obtain. PV-diesel hybrid systems are already competitive economically, compared with gasoline and diesel generated power. GIZ has done a national GIS survey of Nigeria to identify and

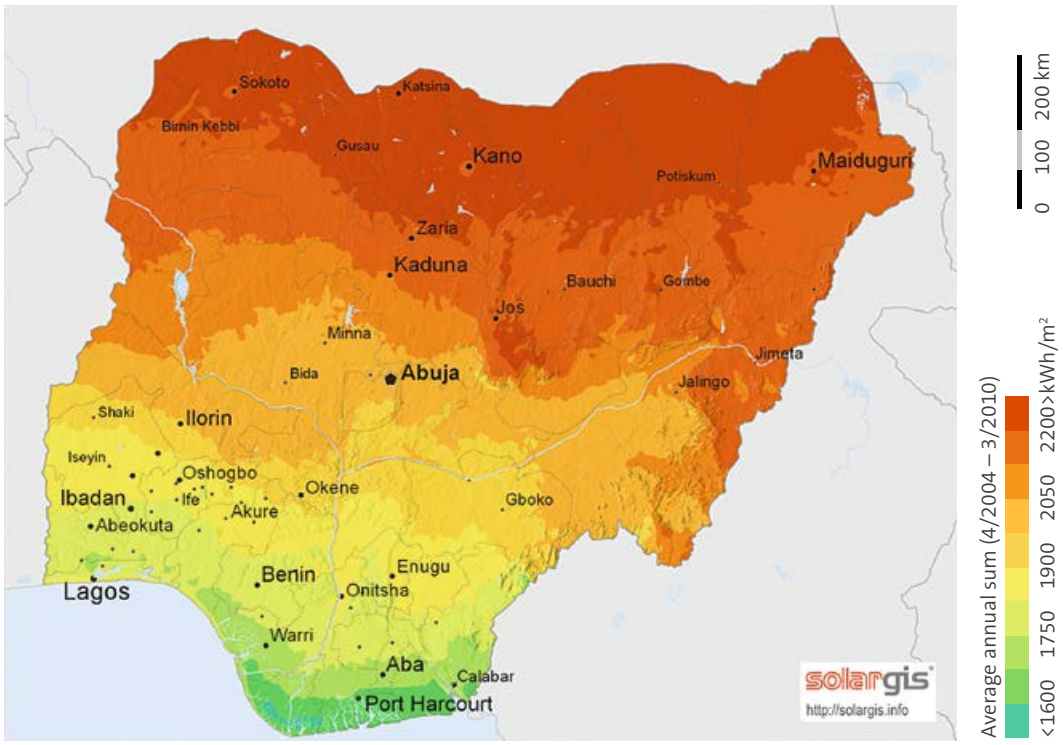


Figure 3.4 **Solar radiation in Nigeria (GIZ, 2015)**

quantify about 8.000 clusters of a total population of 26 million people that could be served with mini-grids, generating a capacity of over 3.300 MW.

Wind energy potential

The Ministry of Science and Technology has carried out wind energy resource mapping [Lahmeyer; 2005] (see Figure 3.5). This wind mapping project indicated wind speeds of up to five meters per second in the most suitable locations, which reveals only a moderate and local potential for wind energy. The highest wind speeds can be expected in the Sokoto region, the Jos Plateau, Gembu and Kano / Funtua. The stations at Maiduguri, Lagos and Enugu also indicated fair wind speeds, sufficient for energy generation by wind turbines. Apart from these sites, other promising regions with usable wind potential are located on the Nigeria western shoreline (Lagos Region) and partly on the Mambila Plateau. The calculations indicate the highest energy yield at the coastal area of Lagos, followed by the Sokoto area and the Jos Plateau. Figure 3.6 shows geographical locations with potential for wind generated electricity in Nigeria.

Bioenergy potential

Nigeria possesses huge potentials in biomass considering the country's potentials in agriculture and forestry. Of the total land area of 91.077 kha for Nigeria, 78% (70.800 kha) is arable land and less than 9% (7812 kha) is forest area (FAO, 2013). Several biomass resources are available in large quantities in Nigeria. These include agricultural crop residues, forestry and wood processing residues, animal waste, human faecal waste, municipal solid waste, organic waste from food and feed processing industry and agricultural and forestry energy crops. In addition, there are several agricultural crops (that can be) cultivated in Nigeria that have the potential to be transformed into liquid and solid biofuels, e.g. Jatropha, Cassava, Maize, Sugar Cane, Oil Palm and some more (Agba et al., 2010). Since 2010 the general view on the cultivation of energy crops,

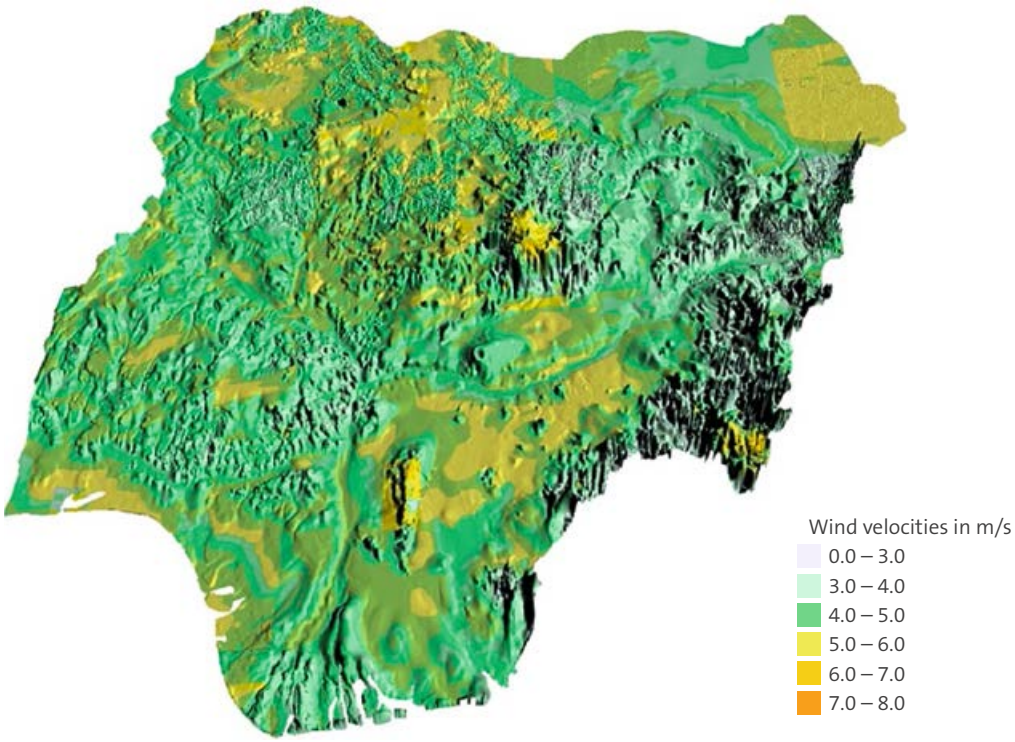


Figure 3.5 Wind speed map in Nigeria (GIZ, 2014)

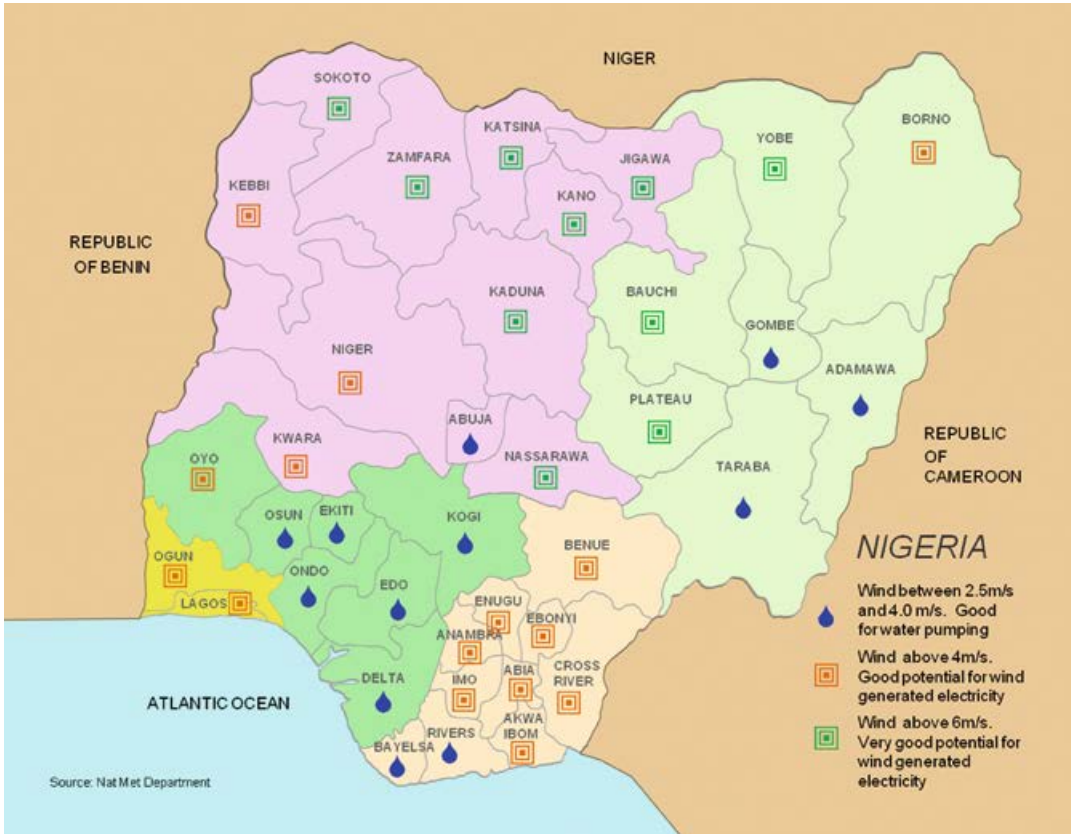


Figure 3.6 Potential for wind energy application in Nigeria (CRET, 2015)

and their viability as well as their potential impact on sustainability, food security and land rights has become more nuanced and actual potentials are likely to be lower.

Table 3.3 summarises the different bioenergy potentials in Nigeria. From this table it shows that energy crops and agricultural residues have the greatest potential for bioenergy production.

Table 3.3 Bioenergy potential in Nigeria (Simonyan and Fasina, 2013)

Source	Bioenergy potential (GJ/year)
Agricultural crop residues	604×10^6
Forestry and wood residues	18×10^{-3}
Municipal solid waste	186
Animal waste	29
Human waste	8
Food and feed processing waste	Limited
Energy crops	1.700×10^6
Total	**2.3×10^9**

Agricultural crop residues

Simonyan and Fasina (2013) estimated the amount of agricultural residues that are available in Nigeria on the basis of production data[19] of 14 annual and perennial crops. Using the residue-to-product ratios of the different crops and a conservative 30% energy conversion rate, they have estimated that agricultural crop residues can provide 604×10^6 GJ in energy. Table 3.4 and table 3.5 show some annual and perennial crops from which agricultural residues can be won.

Forestry and wood residues

In Nigeria, forestry residues consist of residues from logging, sawmilling, plywood production, and particle board production (Table 3.6). According to Simonyan and Fasina (2013), these combined sources can provide 17,7 MJ in energy. The bioenergy potential from these forestry and wood residues seems unreasonably low but no further study has been performed to validate this data.

Municipal solid waste

Municipal solid waste composition in Nigeria is estimated to be 87% organic (Eisa and Visvanathan, 2002). With an estimated 3.168 million tonnes of waste generated by the urban population in Nigeria in 2010 and 60% recovery rate, potentially 186,33 GJ of energy per year can be generated (Simonyan and Fasina, 2013). This potential is currently not utilised as municipal solid waste is landfilled.

Animal (livestock) waste

In 2010, it was estimated that there was a total of 15,76 million tonnes of dry matter animal dung available in Nigeria (Simonyan and Fasina, 2013). This amount of animal dung has a potential biogas yield of $4,19 \times 10^9$ m^3/year, which potentially can be converted to 29,25 GJ of energy. Table 3.7 shows the bioenergy potential from animal waste. As animal dung is often disposed of without proper treatment, livestock companies cause severe negative environmental impacts and create potential health hazards. Also with the cattle and poultry sector showing steady and steep growth in production volumes for the last ten years, there might be good opportunities for combined waste treatment and energy production. In Nigeria, cattle, goat and pig farms have the highest biogas potential.

Human (faecal) waste

Also human (faecal) waste can be utilized for bioenergy production. With a population of over 180 million, Nigeria has a vast amount of human faecal waste that can be used for biogas production. In 2010, the estimated amount of dry matter human waste was 2,59 million tons (Simonyan and Fasina, 2013). With a biogas yield of 0,45m^3 per kg dry matter, the total energy potential from human waste is 8,13 GJ.

19) 2012 production data taken from FAO and Nigeria National Assembly (NASS)

Crop	Production (million tons)	Residue	Amount available (million tons)	Energy available (*1000 GJ)
Rice	3,37	Straw	7,86	125.920
		Husk	1,19	23.000
Maize	7,68	Stalk	10,75	211.350
		Cob	2,10	34.190
		Husk	0,92	14.320
Cassava	42,53	Stalks	17,01	297.680
		Peelings	76,56	812.300
Groundnut	3,90	Shells	1,81	28.350
		Straw	4,37	76.830
Soybean	0,36	Straw	0,91	11.270
		Pods	0,37	4.580
Sugar cane	0,48	Bagasse	0,14	1.990
		Tops/leaves	0,14	2.210
Cotton	0,60	Stalk	2,25	41.870
Millet	5,17	Straw	7,24	89.630
Sorghum	7,14	Straw	7,14	88.390
Cowpea	3,37	Shell	4,89	95.060
Total			**145,62**	**19.588.940**

Table 3.4 Energy potential from annual agricultural crops in 2010 (Simonyan and Fasina, 2013)

Crop	Production (tons)	Residue	Amount available (million tons)	Energy available (*1000 GJ)
Oil palm	8.500	Fibre	1.020	11.570
		Empty bunches	1.955	15.950
	1.170	Palm kernel	0.878	16.530
Cocoa	360.000	Pods	0.188	2.740
Coconut	170	Husk	0.072	1.340
		Shell	0.028	51
Natural rubber	143.500	Leaves	0.338	5.960
Total			**4.472**	**54.600**

Table 3.5 Energy potential from perennial plantation crops in 2010 (Simonyan and Fasina, 2013)

Table 3.6 Energy potential from forest and wood residues (FAOSTAT, 2010 and Simonyan and Fasina, 2013)

Types	Residues	% of residue	Total residues (m^3)	Energy potential (MJ)
Logging	Solid wood	40	911.600	6,36
	Dust	20	455.800	3,18
Sawmilling	Sawdust	12	273.480	1,91
	Solid wood	38	866.020	6,06
Plywood	Solid	45	25.200	0,18
	Dust	5	2.800	0,02
Particle board	Dust	10	4.000	0,00
Total				**17,7**

Table 3.7 Energy potential from Animal Waste in 2010 (Simonyan and Fasina, 2013)

Type	Population	Dry matter produced per year (kg) *	Dry matter available per year (kg)	m^3/kg dry matter **	Total potential m^3 biogas / year
Cattle (cow)	18.900.000	19.700×10^6	5.910×10^6	0,20	1.182×10^6
Goat	65.700.000	13.230×10^6	5.292×10^6	0,25	1.323×10^6
Pig	6.000.000	14.570×10^6	1.457×10^6	0,56	815×10^6
Sheep	37.400.000	4.493×10^6	1.348×10^6	0,25	337×10^6
Chicken	101.700.000	160×10^6	1.596×10^6	0,28	447×10^6
Duck	9.600.000	18×10^6	159×10^6	0,56	89×10^6
Total			**15.760×10^6**		**4.190×10^6**

Food and feed processing waste

Food processing industries (e.g. abattoirs, rice millers, bakeries, pastry production, fruit and vegetable processing) usually have limited amounts of organic waste streams that can be used for energy production. Also, these waste streams are often already utilised for feed purposes and as such not available for energy. There are exceptions, for example companies producing starch from cassava. The waste is usually not being used for feed and is of high volume.

Energy crops – biofuels

Nigeria has immense potential for energy crops cultivation and the production of bioethanol and biodiesel. Existing figures show that Nigeria produces huge amounts of crops that can be used for energy production such as soybean, palm oil, sesame and cassava. The rainfall distribution shows that most energy crops can be grown in Nigeria. Some of the major crops can produce a total 1,7 EJ of energy annually. However, the production of energy from food and non-food crops is highly disputed and should be treated with care.

Installed and planned renewable capacity

Table 3.1 shows that Nigeria's estimated installed renewable capacity is currently only 1.979 MW. Of this installed capacity, 1.900 MW is from three large hydropower plants, and 64,2 MW derives from small hydropower plants. Finally, it is estimated that about 15 MW of dispersed solar PV is installed.

Grid-connected

Up to date, no commercial large-scale grid-connected renewable energy project other than hydropower has been successfully implemented. The mentioned 1,9 GW of hydropower capacity is installed in three large power plants:

- Kainji hydropower plant; 760 MW
- Jebba hydropower plant; 570 MW
- Shiroro hydropower plant; 600 MW

From these hydropower plants, approximately half of the installed capacity is operational.

There is a 10 MW wind project (supported by the Ministry of Power) in Katsina implemented by Vergnet, a French company. However, in 2015 the project has been stalled. It is unclear if and when the project will be finalised.

Hydropower forms the backbone of Nigeria's electricity generation capacity. As dams require extensive maintenance some of them are only partly operational reducing their contribution to the overall electricity generated. The World Bank, in its report "Low-Carbon Development Opportunities for Nigeria", which captured the plans of the Federal government and feedback from stakeholders, highlights the plans to increase hydropower utilisation to 7,2 GW by 2035, following the Renewable Energy Master Plan of 2012 (WB, 2013). As shown in Figure 3.2, various dams are available for retrofitting with hydropower plants.

There are numerous plans and initiatives for grid-connected renewable installations (see Annex D). The majority of these plans are still in an early development stage, with most just completing the Environmental Impact Assessment. In total six wind energy, one hybrid solar-wind, 38 solar, nine hydroelectric, nine biofuel and four waste to energy and biomass projects have been identified.

Name of Licensee	Capacity (MW)	Fuel Type	State	Geopolitical Zone
JAP Energy Limited	504	Biomass	Lagos	South-West
Premier Energy Limited	50	Hydrogen fuel cell	Adamawa	North-East
Rook Solar Investment Limited	50	Solar	Osun	South-West
Quaint Global Nigeria Limited	50	Solar	Kaduna	North-West
Nigeria Solar Capital Partners	100	Solar	Bauchi	North-East
Anjeed Kafanchan Solar Limited	10	Solar	Kaduna	North-West
Lloyd and Baxter LP	50	Solar	Abuja	North-Central
KVK Power Pvt Limited	50	Solar	Sokoto	North-West
Pan African Solar	54	Solar	Katsina	North-West
Mabon Limited	39	Hydro	Gombe	North-East
JBS Wind	100	Wind	Plateau	North-Central

Table 3.8 Renewable Energy projects with a license from NERC (CRET, 2015)

See Annex D for a full overview of projects. The reality in Nigeria may be that most of the planned projects will not be implemented. So far eleven project proposals have received a NERC license (table 3.8).

Mid-2016 NBET has approved solar PPAs with 14 developers which are reported to have the potential of adding about 1.125 MW in capacity to the grid. The fact that there is now a 20-year NBET-agreed tariff of $ 0,115 per kWh (€ 0,0978) for large solar grid-connected generators outside the REFIT Regulations, could encourage an influx of project developers interested in the Nigerian electricity sector. Some of the current projects that received a PPA include: Nigeria Solar Capital Partners' 135 MW plant in Bauchi State; the Pan Africa Solar project for the development of a 75 MW solar photovoltaic power project located in Katsina State; the Nova Scotia power project and CDIL project for the development of a 80 MW plant in Jigawa State; and the 383 kW Solar PV plant hybrid technology being built by General Electric in Kaduna State.

No embedded[20] renewable energy power projects, operational, under construction or planned have been identified.

Off-grid

There are many different off-grid renewable energy solutions. These can be grouped into:

- Solar-Home-Systems (up to 100 kW) and solar appliances (lamps, phone chargers and etcetera).
- Mini-grids, typically supplying smaller communities (e.g. rural areas; industrial clusters or residential estates) with electricity through independent electricity distribution network systems. The electricity can be generated by solar, wind or other renewable sources or a hybrid system.
- Captive power[21]; electricity and other power that is entirely consumed by the generator itself. This can be schools, hotels, offices and industrial companies.
- Small-scale stand-alone renewable energy systems (e.g. for water pumping)
- Clean cookstoves, using solid biomass (pellets, briquettes or alternative charcoal) or liquid biofuels (e.g. bio ethanol).

Off-grid renewable electricity solutions are useful in Nigeria in view of some topographical or geographical challenges in the rural areas (notably long distance to the grid and low population densities) which make it uneconomical to extend the grid to such areas.

In the 1990s, the Energy Commission of Nigeria (ECN) and the former Federal Ministry of Power and Steel pioneered the installation of off-grid solar PV in Nigeria, including mini-grids and stand-alone systems for residential, irrigation and cooling purposes. However, only recently renewable energy based off-grid electrification has been addressed more comprehensively. In 2014 the Federal Ministry of Power launched the initiative Operation Light-up Rural Nigeria, which was aimed at utilizing renewable energy for electrifying rural communities in all 36 States in the country including the Federal Capital Territory (FCT), but in 2015 this initiative was terminated. In recent years, the Rural Electrification Agency (REA) and the Federal Ministry of Environment (FME) have also started developing activities using solar PV for social uses.

20) Electricity is evacuated through a transmission network operated by a System Operations Licensee (DisCo).

21) In Nigerian regulations Captive Power is defined as: the generation of off-grid electricity that is entirely consumed by the generator itself and has an installed capacity exceeding 1 MW.

Solar Home Systems (SHS)

There is a huge market for SHS[22], rooftop installations, solar lights and solar phone chargers[23], due to the unreliable supply of power by the utilities and increasing electricity prices. As a result, many households and businesses are opting for solar stand-alone systems as an alternative to diesel generators, which are also challenged with supply issues. World Bank's Lighting Africa has supported the increased uptake of these products. Lighting Africa is aimed at facilitating access to finance through Microfinance Institutions (MFI) and cooperatives. In addition, they supported a phased roll-out of nationwide consumer education campaigns commencing in August 2015, and are providing Business Development Support including: retail channel development, corporate outreach, business networking events. Nowadays many solar companies are offering solar PV on rooftops and on other structures for homes, SMEs, Bank ATMs and branches, petrol stations, street lights, markets, and shopping centres.

A survey amongst 55 solar companies, carried out by the Nigerian Energy Support Programme (NESP) in 2015, showed that about 2.034 kW of off-grid photovoltaic was installed, combining mini-grids and stand-alone systems. Most installations have been installed for residential or commercial purposes in un-electrified rural areas, but there are also some that have been built in grid connected areas as grid backup systems. Most of the mentioned projects were installed using grants from international donors or the federal, state and local government.

An example of a SHS-project is the Lagos State Government 5 MW Lagos Solar Project (in collaboration with the UK Department for International Development) for electrification of multiple public secondary schools and primary healthcare centres in Lagos State.

Mini-grids

The Nigeria Energy Support Programme, NESP, is supporting the development of five mini-grid projects in Ogun, Cross River, Niger, Plateau, and Sokoto States, realisation is planned for 2017. More information on these mini-grids, one for each State, were selected based on a Guided Ideas competition. More information on the above mini-grids can be found on www.energyplatformnigeria.com.

The Bank of Industry (BOI) through Ecobank, financed a consortium of companies (Schneider Electric, Green Village Electricity and Arnergy Solar) to install solar PV mini-grid systems in villages in Ondo and Rivers States.

SERC, together with the World Bank, ECN and the Sokoto Government, installed a hybrid mini-grid combining 10 kW solar and 2 kW wind in Danjawa Village, Sokoto. The Manufacturers Association of Nigeria has identified about 28 clusters with potential for mini-grid modular plants ranging from 5 to 50 MW in areas including Ogun and Lagos States.[24]

Other small-scale stand-alone renewable energy systems

Small wind turbines for water pumping have been installed in some parts of the country for testing. For instance, the Sokoto Energy Research Centre (SERC) installed a turbine in Sayya Gidan Gada Village, Sokoto. Other technologies such as off-grid PV street lighting have also been

22) Examples of companies active in this market are: SME Fund, Lumos, Arnergy, Solynta, Rubitec and many others.

23) Examples of companies active in this market are: d.light, Barefoot Power, Rubitec and many others.

24) www.thisdaylive.com, December 22, 2015.

tested in Danjawa. The Bank of Industry recently commissioned a 24 kW off-grid solar project located in Kaduna State.[25]

Captive power

There are very few examples of renewable captive power projects, both operational or in development. Honeywell Flour Mill is working on a solar/diesel hybrid captive project in Shagamu, Ogun State that was initially planned to be about 1 MW. Plans have been scaled up to allow selling electricity to industrial clusters in the area.

Clean cook stoves

With 75% of the population in Nigeria still relying on solid biomass (e.g. charcoal, briquettes) for cooking, this leaves an enormous potential for clean cooking solutions (e.g. solar cooking, ethanol cook stoves or pellet cook stoves). A number of initiatives and companies are active in this field (e.g. SME Fund, Green Social Bioethanol) and stoves and fuels are being distributed in large quantities and also through Micro Finance Banks (MFBs).

Key renewable energy stakeholders

The key renewable energy stakeholders that are active in Nigeria can be grouped in: public authorities, private sector, foreign development cooperation organisations, development banks and key players in research, capacity development and training.

Public authorities

In the renewable energy sector of Nigeria, the Federal Ministry of Power has the leadership position in terms of policy and regulation formulation. Two other important Ministries are the Federal Ministry of Environment and the Federal Ministry of Water Resources. In addition, NERC, ECN, NBET and TCN are important stakeholders. Table 3.9 presents the functions of the different public authorities that play a role in the renewable energy sector.

Private sector actors

A large number of private companies, both local and foreign, is active in the renewable energy sector in Nigeria. No sole local contractor or project developer is currently deemed capable of implementing medium or large scale renewable energy projects. As the sector is getting traction and knowledge and experience are building up, amongst others due to the involvement of foreign companies, this may change. Local actors are available for example for civil and electrical engineering, cable manufacturing, legal support, management consulting and E(S)IA studies. For solar installations a pool of solar PV technicians and installers is readily available.

Since the privatisation of the sector in 2015, a large number of foreign investors, developers, and consulting and engineering companies have become active in the Nigerian renewable energy market. Some have acquired DisCos and GenCos.

In recent years also some industry associations have become more and more active:

- The Council for Renewable Energy (CREN) is a not for profit, multi-stakeholder association, which promotes the appropriate use of renewable energy technology in Nigeria.
- Nigeria Alternative Energy (NAE) is a global consortium with the vision of increasing capacity in Nigeria with alternative energy solutions. The network is dedicated to the use of renewable energy and energy efficiency.
- The Renewable Energy Association of Nigeria (REAN) has been launched in 2016 and focuses on decentralised renewable energy, specifically related to energy access.

25) http://www.financialnigeria.com/prospects-of-solar-power-in-diversifying-nigeria-s-energy-mix-feature-67.html; Detail Commercial Solicitors

Main actors	Functions	Role in Renewable Energy
Federal Ministry of Power (FMP)	FMP is responsible for policies, programs and monitoring of the power sector in the country.	To promote a diversified electricity mix for the country including electricity generated from renewable energy sources. Drafted the National Renewable Energy and Energy Policy and leads the Inter-ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE)
Federal Ministry of Environment (FMENV)	The FMENV prepares comprehensive national policies for the protection of the environment and conservation of natural resources, including procedure for environmental impact assessment of all developing projects	Plays a secondary role, as it has no direct mandate in the power sector. It approves ESIA. In addition, FMENV grants tax holiday for utility scale PV plants.
Federal Ministry of Water Resources (FMWR)	The FMWR formulates National Water Resources policies towards ensuring adequate water supply for agricultural, industrial, recreational, domestic and other uses. It develops programmes and policies towards surface water storage schemes and guiding principles for dam construction nationwide	Role in hydro development (e.g. dam construction, hydrological activities etc.). Currently, the FMWR undertakes civil works on hydropower stations in cooperation with the FMP.
Nigerian Electricity Regulatory Commission (NERC)	NERC is a key organisation responsible for regulation of the power sector across power generation, transmission and distribution. NERC is responsible for the creation of a competitive power sector; establishment of operating codes and standards; licensing and regulation of persons engaged in any of the power subsector activities; tariff determination; approval of amendments to electricity market rules; and other related regulatory functions. It is governed by seven commissioners, six from geopolitical regions and one designated Chairman/Chief Executing Officer (CEO).	NERC issues generation licenses to applicants in Renewable Energy and administers and implements preferential tariffs (e.g. the MYTO feed-in tariffs).
Energy Commission of Nigeria (ECN)	ECN's role as per the ECN Act is mainly research, data gathering and coordination.	The commission promotes the use of renewables and alternative energies via research, pilot project and strategy development. These ECN activities are carried out by the departments at its head office and the Energy Research Centres located at Nsukka, Sokoto, Lagos, Bauchi, Ilorin and Benin.
Nigerian Bulk Electricity Trading Plc (NBET)	NBET is the off-taker o electricity and inter alia concludes PPAs. NBET receives payments from DISCOs for energy received and pays generation companies for bulk power sent to the grid.	Enter into and execute PPAs with power generating companies and procure new generation capacity on competitive basis, as required.
Transmission Company of Nigeria (TCN)	State entity responsible for the transmission of electricity from power plants to distribution companies, eligible customers and for export. Acts as Transmission Services Provider (TSP), System Operator (SO) and Market Operator (MO). Managed by Manitoba Hydro International of Canada under a three year management contract.	TCN is responsible for grid-connection agreements and may assist in the determination of MW targets for renewable energy

Table 3.9 Public authorities in the renewable energy sector in Nigeria (GIZ, 2015)

Foreign development cooperation organisations and development banks

A number of different international donors and organisations are active in the renewable energy sector in Nigeria. The major bilateral implementing agencies with offices in Nigeria are[26]:

- Agence Française de Développement (AFD), French development cooperation agency
- Department for International Development (DFID), British development cooperation organisation
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, German Agency for International Cooperation
- Japan International Cooperation Agency (JICA)
- United States Agency for International Development (USAID)
- The DFID-supported Nigeria Infrastructure Advisory Facility (NIAF)

Besides the bilateral agencies, different development banks are active in Nigeria. The following are active in projects related to renewables:

- African Development Bank (AfDB)
- International Finance Corporation (IFC)
- Word Bank (WB) – Lighting Africa

More information on these organisations is provided in Annex K.

Key players in research, capacity development and training

Several pilot projects, surveys and studies have been undertaken under the supervision of the Energy Commission of Nigeria, which has registered five energy research centres. Four centres are dedicated to renewable energy and energy efficiency:

- National Centre for Energy Research and Development (NCERD), at the University of Nigeria, Nsukka (research in solar and renewable energy).
- Sokoto Energy Research Centre (SERC), at Usmanu Danfodiyo University, Sokoto (research in solar and renewable energy).
- National Centre for Hydropower Research and Development (NCHRD) at the University of Ilorin (research in hydropower).
- The National Agency for Science and Engineering Infrastructure (NASENI) advises the science and engineering community and SMEs to take advantage of the facilities available to fast-track their manufacturing processes and upgrade their Research and Development (R&D) knowledge.
- The National Power Training Institute of Nigeria's (NAPTIN) primary purpose is to provide training for power sector personnel and coordinate training activities in the sector. In pursuit of this mandate, NAPTIN has taken over the management of existing seven regional training centres of PHCN.

Policies and regulations

In chapter 2 (page 42) the relevant policies and regulations for the power sector in general have been summarised. In the following paragraphs the most important policies and regulations regarding renewable energy in Nigeria are summarized in chronological order.

Renewable Electricity Policy Guidelines 2006 (REPG)

This policy provided the Federal Government vision, policies and objectives for all electricity from renewable sources. This REPG document was issued in 2006 by the then Federal Ministry

26) GIZ, 2015

of Power and Steel. The document stated that the government will expand the renewable electricity market to at least 5% of total electricity generated and a minimum of 5 TWh of electricity production by 2016. The National Renewable Energy and Energy Efficiency Policy (NREEEP) has replaced the REPG, which has been approved by the Federal Executive Council in 2015.

Renewable Electricity Action Programme (REAP), 2006

This is a corresponding policy document by the then Federal Ministry of Power and Steel produced in 2006 as well. This programme seems to have been abandoned with the restructuring of the Federal Ministry of Power and Steel to the Federal Ministry of Power.

The main focus of this document is utilising all forms of renewable energy sources for electricity generation. It highlights potential gaps, technical assessments and the financial implications of utilising renewable energy and looks at the general overview of the potentials for renewable energy technologies, and potential markets, elaborating on the development targets per technology, application and strategies for achievement.

National Biofuel Policy and Incentives (2007)

This is a policy document that came about during the peak interest in liquid biofuels. Hence it was meant to support a biofuel programme, with the aim of integrating the agricultural sector of the Nigerian economy, as well as the downstream sector of the petroleum industry.

The major targets of this policy documents are:

- All biofuels companies to contribute 0,25% of their revenue to fund research into feedstock production, development of local technology and improved farming practice.
- Granting an import waiver for biofuels for ten years and exemption from taxation for biofuel companies in Nigeria.
- The biofuel programme aspired to achieve 100% domestic production consumed in Nigeria by 2020, with off-take guarantee from the NNPC, as buyer of last resort.

Although this policy appears to be in force, no information is available as to which extent it has been implemented or adapted. The supposed major player in this area, NNPC has only performed some feasibility studies on ethanol, cassava and palm-oil based production and only mentions a handful of projects and initiatives on its website.

Renewable Energy Master Plan (REMP), 2012

The REMP was drafted by the Energy Commission of Nigeria (ECN), supported by the United Nations Development Programme (UNDP), in 2005 and reviewed in 2012. The document projects Nigeria's vision and lays out a road map for the increased role of renewable energy in attaining sustainable development. Though there is no clear differentiation between on-grid and off-grid generation, it refers to integrating renewable energy into buildings, electricity grids and other distribution systems (ECN, 2014).

The 2005 version is an approved document, which sets out short, medium and long-term targets for renewable energy sources in the national energy mix. However, the revised 2012 version has not been approved by the Federal Government. The National Renewable Energy and Energy Efficiency Policy (NREEEP) replaces REMP.

REMP is solely dedicated to the utilization of renewable sources of energy. It identifies Nigeria's potential for generating electricity from solar, small and large hydro, biomass and wind across the country. REMP also focuses on the gradual move away from a fossil based economy, to one driven by an increased share of renewable energy, combined with the need for private sector participation.

National Renewable Energy and Energy Efficiency Policy (NREEEP), 2015

The National Renewable Energy and Energy Efficiency Policy (NREEEP), is a document developed by the Federal Ministry of Power in 2013 and 2014 and has been approved by the Federal Executive Council in 2015 (FMP, 2015). The NREEEP seeks the development of a national renewable energy action plan and a national energy efficiency action plan to stimulate the overall achievement of the objectives set out by this policy. The National Renewable Energy Action Plan was published in July 2016[27].

NREEEP outlines the national thrust of the policies and measures for promoting renewable energy and energy efficiency. The document aims to draw the attention of policy makers to the political, social and economic potentials of renewable energy and prescribes that appropriate strategies should be developed to harness these potentials so as to add value to the ongoing changes in the power sector of Nigeria.

NREEEP calls for an integrated renewable energy and energy efficiency policy. NREEEP seeks to consolidate all previous policies and strategies in one document, hence it can be considered an umbrella document. Recognising the multi-dimensional nature of energy, NREEEP delves into several issues like renewable energy utilisation and supply, pricing and financing, legislation, regulation and standards, energy efficiency and conservation, research and development, training and capacity building. Furthermore, it acknowledges gender, environmental issues, as well as planning and policy implementation. Overall the focus of this policy document is to fully utilise the renewable energy resources of Nigeria

27) Available for download at the website of the Ministry of Power: http://www.power.gov.ng/Press%20Release/NATIONAL%20RENEWABLE%20ENERGY%20ACTION%20PLANS%20(NREAP).pdf

Table 3.10 Summary of renewable electricity targets (GIZ, 2015)

S/N		2012 [MW]	Short Term (2015) [MW]	Medium Term (2020) [MW]	Long Term (2030) [MW]
1	Hydro (LHP)	1,938.00	2,121.00	4,549.00	4,626.96
2	Hydro (SHP)	60.18	140.00	1,607.22	8,173.81
3	Solar	15.00	117.00	1,343.17	6,830.97
4	Biomass	–	55.00	631.41	3,211.14
5		10.00	50.00	57.40	291.92
All renewables plus LHP		(1,985.18) 2,023.18	(2,438.00) 2,483.00	8,188.20	23,134.80
All energy resources (on-grid power plus 12,500MW of self-generated power)		21,200**	24.380**	45,490**	115,674**
% of renewables incl. LHP		(23%)	10%	18%	20%
% renewable energy excl. LHP		0.80%	1.30%	8%	16%

The figures shown in the table are original figures from the source. Figures in (green) are obviously arithmetically wrong.
** The projection for "all energy resources (on-grid power plus 12,500 MW of self-generated power)" is based on the addition of on-grid power, and a base capacity of 12,500 MW of self-generation (i.e. power generated for own use) including off-grid generation from year 2012 to 2030.

for sustainable development and to meet the renewable energy generation and energy efficiency targets for ECOWAS for 2020 and beyond.

National Renewable Energy Action Plan (2016)

The National Action Plan presents the expected development and expansion of renewable energies in Nigeria in order to achieve the national target under ECOWAS Renewable Energy Policy (EREP), and thus Nigeria's contribution to the overall ECOWAS target of 23% and 31% renewable energy in 2020 and 2030. It contains existing and currently planned measures, with which the national target is to be achieved. The NREAP specifies targets for the Nigerian energy sector (on-grid, off-grid, cooking energy, solar water heaters and liquid biofuels) in 2020 and 2030, as well as the 2010 baseline. The implementation of the NREAP will be monitored by the Federal Ministry of Power, Works and Housing.

Challenges for renewable energy solutions in Nigeria

The development of renewable energy solutions in Nigeria, both grid-connected and off-grid, faces several challenges. In the following, the main challenges to this development are summarized:

- Capabilities and know-how of local private sector: No sole national contractor or project developer is currently deemed capable of implementing a medium or large scale renewable energy project. The sector, in cooperation with foreign companies and financiers, is working hard to gain the competence to design, build, operate and maintain larger renewable energy installations.
- Regulatory framework: There is still a considerable amount of uncertainty with respect to the regulations as it relates to off-grid projects. An example of uncertainty in the regulations is whether isolated IEDNs can exist within a DisCos franchise area.
- Resistance from existing market players: There is a likelihood of objections to the grant of off-grid licences from DisCos in the areas currently covered by DisCo licences.
- Access to land: For renewable energy, there must also be access to land for project construction, mostly in the case of solar PV and large hydropower.
- Financing and other considerations: Establishing medium or large scale renewable energy installations is capital intensive with long pay back periods, and acquiring finance for these projects, especially early stage finance for project development, is not easy.

CHAPTER 4
NIGERIAN MANUFACTURING INDUSTRY

Nigeria's manufacturing sector is one of the major driving forces behind the country's economic growth. In light of the plunge in global oil prices, this sector becomes even more significant for Nigeria. The manufacturing sector accounted for 9% of GDP (€ 40 billion) during 2013. Growth in the sector has been rapid at a pace of almost 18% p.a. during 2011–13, although it is hampered by supply bottlenecks, including disruptions to the electricity supply. In total the manufacturing industry grew 63% in the period 2010–2013 (KPMG, 2015). The food, beverages and tobacco sub-sector is the biggest, accounting for more than half of nominal factory output (see the Figure below).

The manufacturing sector in Nigeria is divided into 10 sub-sectors:

1. Food and beverage & tobacco
2. Chemical and pharmaceutical products
3. Non-metallic products
4. Base metal,iron & steel
5. Automotive
6. Pulp and paper products
7. Textile, apparel and footwear
8. Plastic and rubber products
9. Wood and wood products
10. Other manufacturing

Figure 4.1 **Manufacturing industry usage of raw and intermediate materials**

Nigeria Manufacturing: Raw & Intermediate Materials Usage ($bn)									
	Raw Materials: Domestic Supply			Raw Materials: Imported			Intermediate Goods		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
Food, beverages & tobacco	1.7	2.7	3.8	4.5	5.9	5.9	19.8	19.7	22.0
Textiles, apparel & footwear	8.5	8.5	8.7	3.1	3.8	4.3	3.2	4.3	5.4
Wood & wood products	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
Pulp, paper & paper products	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3
Chemical & pharmaceutical products	33.2	18.6	12.9	8.5	9.2	9.9	0.3	0.3	0.5
Other non-metallic products	1.5	2.7	2.8	0.5	1.0	1.1	0.9	0.9	1.1
Plastic & rubber products	0.2	0.3	0.4	0.2	0.3	0.5	0.5	0.6	0.9
Base metal, iron & steel	1.4	1.1	1.3	1.1	0.7	1.1	0.5	0.7	0.7
Motor vehicles & assembly	1.3	1.7	2.3	1.0	5.2	1.2	0.0	0.0	0.0
Other manufactures	0.6	3.2	3.3	0.2	1.9	1.6	0.7	1.0	1.3
Total	**48.6**	**39.1**	**35.7**	**19.2**	**28.2**	**25.6**	**26.9**	**28.6**	**33.0**

Intermediate goods are producer goods or semi-finished products

Source: Nigeria's National Bureau of Statistics (NBS)
Latest available data, published October 2014

The manufacturing sector has shown strong growth in recent years. Nonetheless, the sector faces ongoing challenges, including an inadequate electricity supply, poor infrastructure and plant maintenance, and heavy dependency on agricultural inputs, which themselves are vulnerable to shocks. Its strengths are nonetheless abundant; semi-skilled yet low paid workforce, the availability of domestically sourced inputs and most importantly, a huge domestic demand for consumer products. It therefore displays great potential for future expansion.

The food, beverages and tobacco sector is the largest contributor (50,44%) to the total manufacturing output, followed by textiles apparel and footwear representing (18,82%). In the food, beverages and tobacco sub-sector, the largest contributor to total manufacturing output is sugar manufacturing which constituted 44,20% of the sub-sector's total in 2012, and contributed the majority of the growth in the entire manufacturing sector at 27,59% in 2012. Bread production is the second largest contributor at 21,52% to the sub-sector and 13,43% of the manufacturing total output in 2012. This is followed by rice representing 12,41% of total output, and biscuits constituting 8,21% in 2012 (NBS, 2014).

Staple Crop Processing Zones (SCPZs)

In the food, beverages and tobacco sub-sector, Nigeria already produces amongst others, large volumes of cassava, palm oil, rice, cocoa, cowpea, groundnuts, maize, and sweet potatoes. This is further stimulated by federal policies. An important policy is on establishing Staple-Crop Processing Zones (SCPZs). The Federal Executive Council (FEC) in May 2015 approved the National Policy on Staple Crops Processing Zones to guard the development, management and operation of these zones in the country. Currently, there are 14 SCPZs, located in six states (Kogi, Kano, Lagos, Anambra, Enugu and Niger). Main objectives of the SCPZ are to develop commercial agriculture; to attract private sector food processing companies into rural areas; to add value to staple food crops; to reduce post-harvest losses; to reduce Nigeria's dependence on food imports; create jobs and revive the rural economy. However, there is an immense deficit of electricity supply along the value chain of these crops especially in the processing. SCPZs are focused on attracting private sector agribusinesses to set up processing plants in zones of high food production, and to process commodities into food products. Government has put in place appropriate fiscal, investment and infrastructure measures for SCPZs, such as:

- Tax breaks on import of agricultural processing equipment
- Tax holidays for food processing companies
- Complimentary investments by government in infrastructure (e.g. transport and logistics, power and irrigation and flood control)

Energy consumption in the manufacturing sectors

From Figure 4.3 it can be seen that only 3–4% of the energy consumption of the Nigerian manufacturing industry is coming from grid-connected electricity. The majority of the energy consumption is using 'biofuels and waste'. In the IEA definitions (see Annex I), 'Biofuels and Waste' is comprised of solid biomass, liquid biofuels, biogases, industrial waste and municipal waste. The huge contribution of biofuels and waste in the energy consumption statistics is likely a result of the huge informal and non-mechanised sector in Nigeria (70% of all jobs) and their dependence on cheap solid biomass fuels (briquettes, fuelwood and charcoal) and agricultural waste (shells, stems, leaves, cobs, fibre and sawdust).

However, also the formal sector is consuming large amounts of energy, not being grid-connected electricity. They often depend on a mix of grid-connected electricity and self-generation capacity, using diesel and gas.

In 2007, the Manufacturers Association of Nigeria (MAN) carried out a power and energy consumption survey in which power demand for the sector was projected for a period of five years. In total 1.500 industrial units spread across the country were surveyed. However, the report flawed in certain ways, according to the Scoping Study: Energy Efficiency in the Manufacturing Sector in Nigeria (2014) by the Nigerian Energy Support Programme (NESP, 2014) *"It is important to note that the survey data revealed some loop holes; some extrapolation is missing, creating gaps between capacity installed, energy consumption and the geographic distribution of the industries. The survey data was nevertheless used as it provides at the same time a vital overview about energy user patterns in the industrial clusters."*

From Figure 4.3, it can be seen that the food & beverage sector is, together with the chemicals & pharmaceuticals sector, the largest consumer of power.

Self-generation capacity

Due to irregular power supply and the need for manufacturing industries to sustain production, Nigerian manufacturers have resorted to the use of diesel and gas for their energy needs. Estimates suggest that between 8 and 14 GW of decentralised diesel generator capacity is currently installed in the country.

Figure 4.4 shows the self-generation in each of Nigeria's manufacturing sub-sectors.

Without discussing the total volume required by Nigeria's manufacturing sector, the scoping study distributes the diesel requirement sector-wise as illustrated in Figure 4.5.

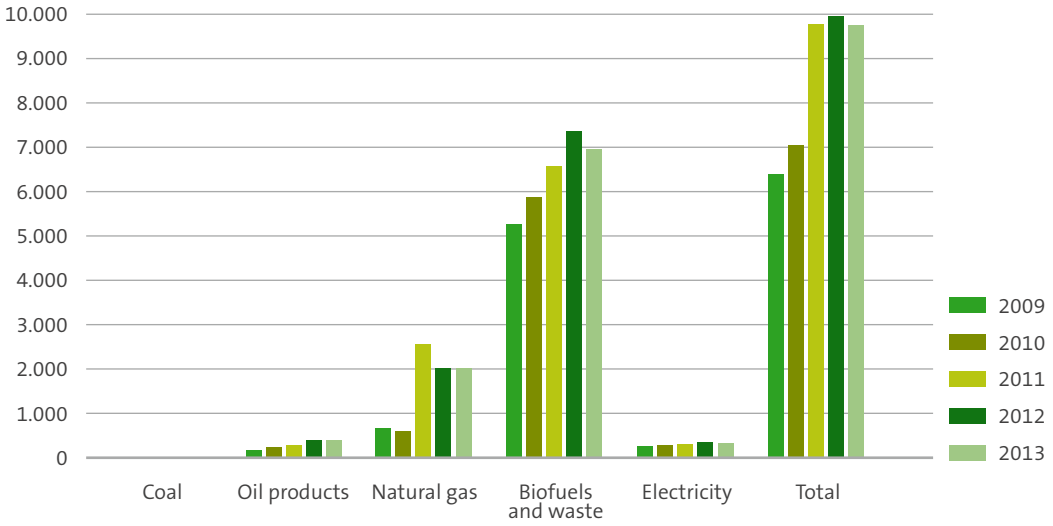


Figure 4.2 Manufacturing Industry energy consumption in 2009–2013 (in ktoe) (Source: IEA statistics www.iea.org)

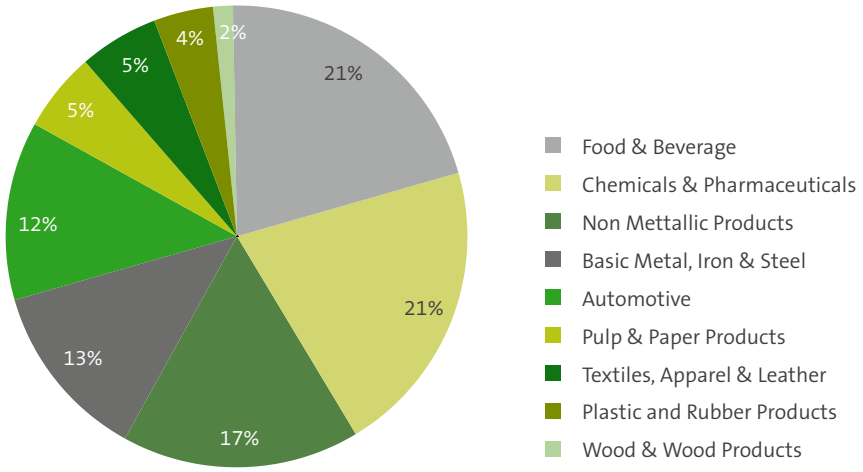


Figure 4.3 Percentages of power consumption per sector (MAN, 2007)

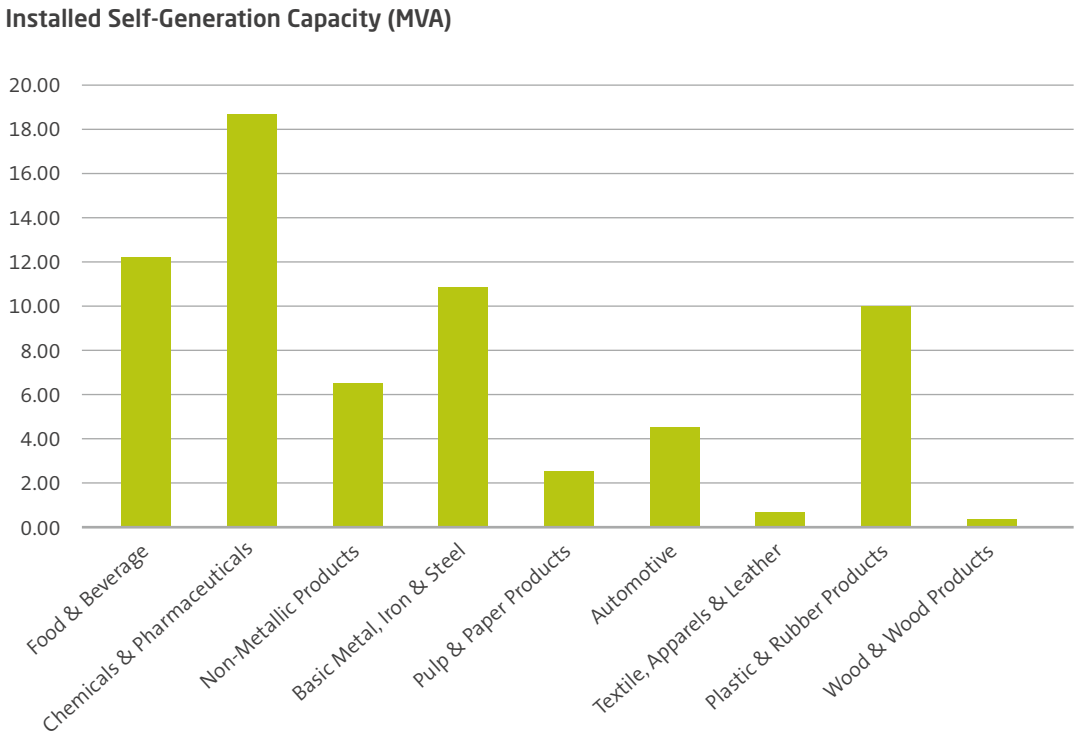


Figure 4.4 Installed self-generation capacity in Nigerian industry (Source: Scoping Study: Energy Efficiency in the Manufacturing Sector in Nigeria (NESP, 2014))

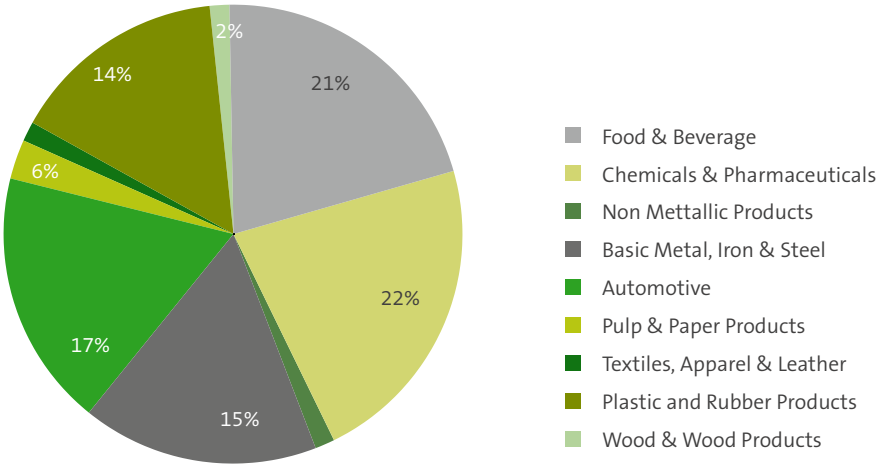


Figure 4.5 Distribution of diesel consumption of Nigeria's industrial subsector (NESP, 2014)

Energy costs and security of supply

Based on the interviews with food and beverage companies, it seems electrical power is mainly produced using diesel or gas, with smaller companies mainly using diesel generators.

In the first half of 2016, the supply of diesel and gas was irregular impacting the fuel price. In April 2016 the diesel price was at an all-time high level. Since then availability and prices have normalised again.

For manufacturing companies, access to and cost of energy are both important. The inadequate supply of grid-connected electricity is the main reason for industry to generate power themselves. The grid-connected electricity is used when available, as the costs for this electricity is much lower than the self-generated power. Figure 4.7 presents estimated prices of different energy solutions. From this figure it shows that the price for renewable off-grid solutions is competitive when substituting diesel generators.

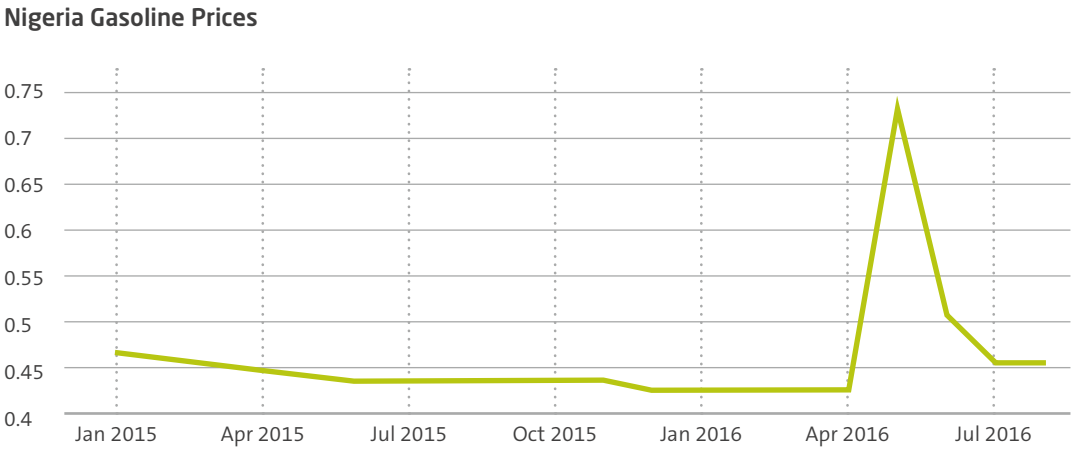


Figure 4.6 Nigeria gasoline prices in 2016 (www.tradingeconomics.com)

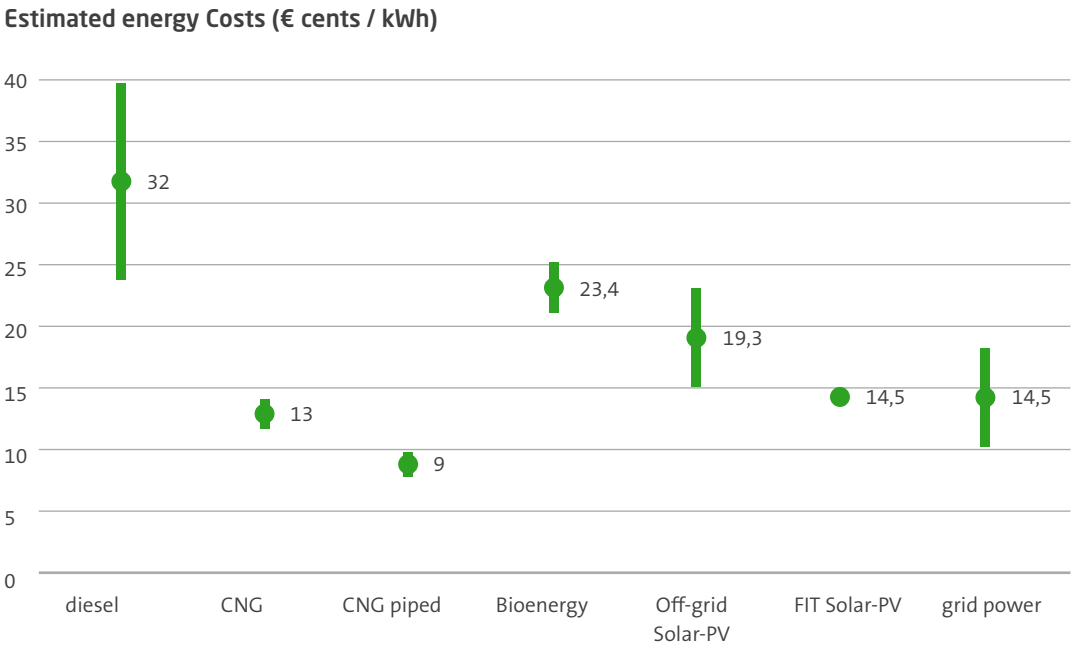


Figure 4.7 Estimated energy costs captive power for food and beverage companies in Nigeria (Sources: Oladokun, 2015, interviews with food and beverage companies, (ODI, 2016))

Also (large-scale) solar-PV is competitive with grid electricity (with the new MYTO tariffs) and coming close to CNG.

The above estimates are current Total Cost of Ownership cost, using a genset of > 100 KVA. The grid power costs are based on the different DisCo tariffs.

Grid electricity prices – MYTO

Since privatisation of the energy sector, electricity prices have been set by the Multi-Year Tariff Order (MYTO). The consumer pays a set price per region and consumer category to the local DisCo. For consumer categories, a distinction is made between private, commercial, and industrial customers. The energy bill for customers is made up from two elements: a fixed charge and an energy charge. The fixed charge covers the capital goods and operational fixed costs, while the energy costs cover the costs of consumption (fuel costs, variable costs, maintenance costs, tax). In Table 4.3, the energy charges per consumer group are presented for Abuja and Jos DisCos. Web links to the tariffs for the other DisCos are provided in Annex H.

Agricultural, food and beverage companies fall under customer classification 'Special'. Table 4.3 shows that a 'Special' industrial customer with a single phase and 3 phase connection pays NGN 23,16 (€ 0,10) in the Abuja district and NGN 25,63 (€ 0,11) in the Jos district per kWh of electricity in 2015. In 2016 both prices have increased respectively with 51% and 59%. For all DisCos, the new tariffs have increased significantly, on average 45%. For some DisCos (Abuja DisCo), the published tariffs will steadily increase until 2017 or 2018 and then decrease again. For some (Abuja DisCo) the tariffs will steadily increase for almost the entire period of ten years.

Table 4.2 **Tariff classes typically relevant for agricultural, food and beverage companies (NERC)**

Customer Classification	Description	Remarks
Special		
A1	Single and 3 Phase	Customers such as agriculture and agro-allied industries, water boards, religious houses, hospitals, government research institutes and educational establishments.
A2	LV Maximum Demand	
A3	HV Maximum Demand	

Customer Classification	Abuja DisCo (Naira/kWh)					Jos DisCo (Naira/kWh)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Residential										
R1	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00	4,00
R2	14,70	24,30	24,30	24,03	20,40	16,75	26,93	29,81	30,93	32,05
R3	32,25	46,23	47,09	45,72	38,82	35,70	43,91	45,76	47,64	49,28
R4	32,25	46,23	47,09	45,72	38,82	35,70	43,91	45,76	47,64	49,28
Commercial										
C1	23,61	36,65	37,39	36,25	30,78	25,94	38,91	42,64	44,27	45,80
C2	29,98	46,23	47,09	45,72	38,82	33,18	42,61	45,55	47,29	48,92
C3	29,98	46,23	47,09	45,72	38,82	33,18	42,61	45,55	47,29	48,92
Industrial										
D1	24,19	35,35	36,07	34,96	29,68	25,94	38,91	42,64	44,15	45,67
D2	31,43	46,23	47,09	45,72	38,82	34,78	39,25	41,54	43,25	44,74
D3	31,43	46,23	47,09	45,72	38,82	34,78	38,37	40,40	41,05	41,50
Special										
A1	23,16	35,02	35,74	34,63	29,40	25,63	40,74	44,65	46,23	47,82
A2	23,16	35,02	35,74	34,63	29,40	25,63	40,74	44,65	46,23	47,82
A3	23,16	35,02	35,74	34,63	29,40	25,63	40,74	44,65	46,23	47,82
Street Lighting										
S1	19,11	26,84	27,14	26,54	22,53	24,70	41,04	44,98	46,57	48,18

Table 4.3 **Electricity prices in Naira/kWh per customer type (NERC website, 1 July 2016)**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CHAPTER 5
CAPTIVE POWER

According to the Nigerian Electricity Regulatory Commission (NERC) in its *Permits for Captive Power Generation Regulations 2008* (Regulation No: NERC-R-0108), captive power generation is defined as the generation of electricity exceeding 1 megawatt (MW) for the purpose of consumption by the generator, that is entirely consumed by the generator itself. Captive power projects need a permit. Hence captive generation is technically off-grid, meaning that it is not evacuated to the national grid or a distribution grid, even though the location where the electricity is generated (i.e. the company premises) may be grid connected. Generation of (off-grid) power for own use up to 1 MW is not regulated.

Based on an overview (see Annex C) of Captive Power permits (5-year tenure) that have been issued by NERC between 2010 and 2013 (www.nercng.org), the following can be concluded:

- In total 1.300 MW of Captive Power permits have been issued.
- The majority of the issued permits (23, 46% of the total) is for the oil and gas sector and this sector also represents the highest planned generation capacity; 941 MW, 72% of the total planned capacity.

Captive Power permits issued by NERC

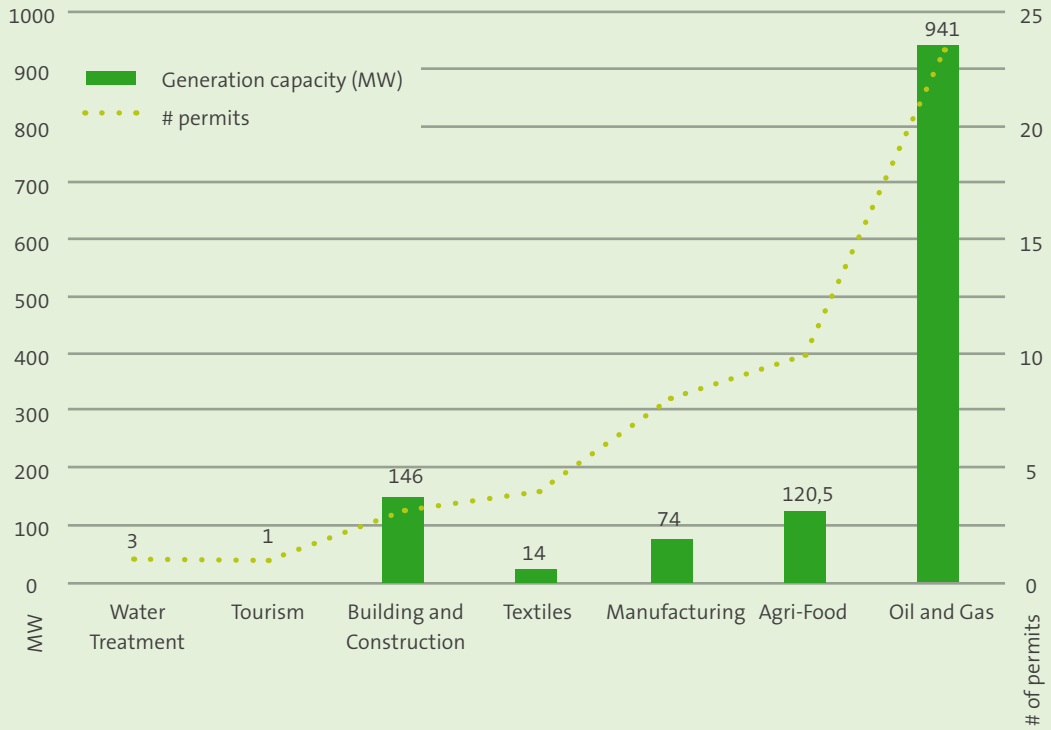


Figure 5.1 Overview of issued permits and planned generation capacity per sector, 2010–2013 (NERC)

» 78% of the permits are issued in three states: Akwa Ibom (22%), Ogun (25%) and Rivers (31%); the major industrialised and oil and gas states.

» The Agri-Food sector is second with ten permits and planned generation capacity of 121 MW (9%).

» It is unclear if there are renewable energy projects amongst these captive power projects but it seems unlikely.

Rough estimations suggest the total market for self-generated power in Nigeria is between 14–20 GW. The total issued licenses and permits that can be regarded as (off-grid) self-generated power, adds up to about 1,700 MW. This leaves a huge gap of self-generated power not accounted for. The most likely explanation is that the self-generated power is not included in the overview of licenses and permits as it has a maximum generation capacity below 1 MW, or licenses ad permits are not obtained or incorrectly registers.

Figure 5.2 shows the value of diesel gensets that have been imported into Nigeria in the period 2010–2014. In the past five years about 4.000 diesel gensets with an output capacity of more than 375 kVA have been imported in Nigeria (based on calculations using the cost for a 500 kVA genset) and about 56.000 diesel gensets with an output capacity between 75–375 kVA have been imported (based on calculations using the cost for a 100 kVA genset). With an estimated lifespan of 7,5 years, one can expect there are at least 2.000 gensets with output > 375 kVA and 20.000 with output 75–375 kVA still in use in the country. This means at least an estimated:

» 75.000 gensets with output 75–375 kVA

» 6.000 gensets with output > 375 kVA are still operational in Nigeria.

The above number of gensets are likely to be an underestimation as field visits and interviews suggests the lifespan of many diesel generators is much longer. The field visits and interviews with agri-food processing companies suggests enormous numbers of diesel generators are being used in small and medium sized enterprises with a power capacity requirement of 100–500 kW. Also in other manufacturing

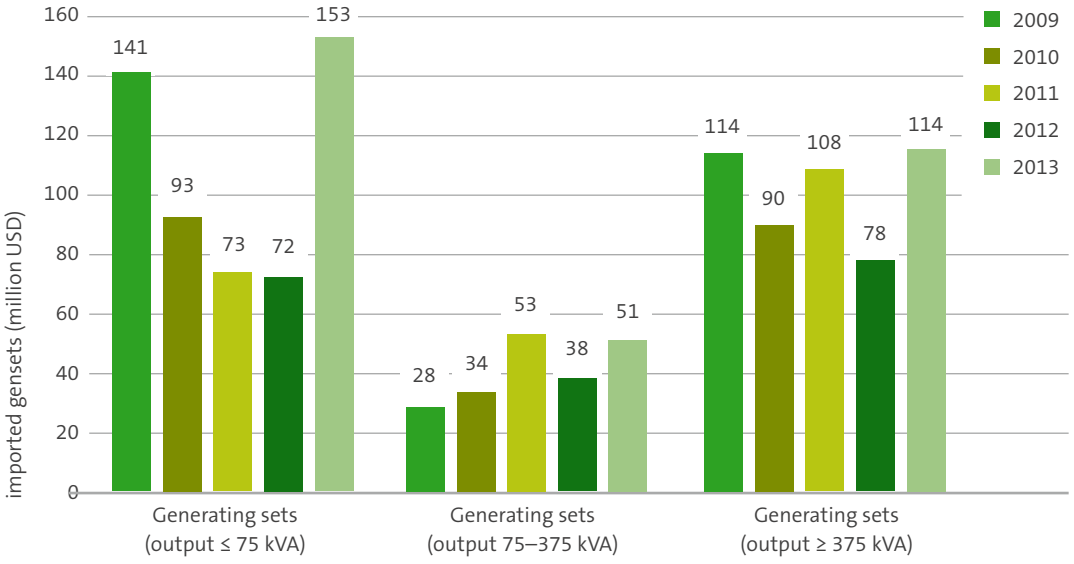


Figure 5.2: Imported diesel generators in Nigeria (Source: own calculations based on UN COMTRADE statistics[1])

1) www.intracen.org

gure 5.3 Different rocessing steps in the alue chain of agricultural roducts

	Agriculture sector	Food processing sector		
	Primary products	**Lorem**	**Lorem**	**Lorem**
Crop products	Grains and cereals	8.500	Fibre	1,020
	Fruits and vegetables		Empty bunches	1,955
	Grasses (sugar cane and sorghum)	1.170	Palm kernel	0,878
	Oil seeds	360.000	Pods	0,188
	Beverages (grains / fruits / leaves)	170	Husk	0,072
Dairy products	Milk		Shell	0,028
Livestock products	Meat and poultry	143.500	Leaves	0,338
	Marine products			

sectors, hotels, restaurants, and etcetera, diesel generators with a capacity between 100–500 kW seem to be abundant.

Agri-food sectors suited to captive renewable energy

Figure 5.3 provides an overview of the sub-sectors and processing activities for different agricultural, dairy and livestock products. Especially the primary and secondary processing steps have a relatively high potential for the use of renewable energy, especially bioenergy. This is because of the following:

» In the production of primary products (agriculture sector), relatively little energy is being used.

» In primary and secondary processing large amounts of energy are used and feedstock and agricultural residues are often available at the processing location.

» In tertiary processing, large amounts of energy are used but very limited feedstocks and agricultural residues are available.

In some cases, primary processing is already done by the farmer. In these instances, this reduces the potential for using agricultural residues for power production.

In addition, most often primary and secondary processing is done in the vicinity of the locations where the primary products are produced (to avoid transportation of large volumes of primary product). This primary product is produced in rural, often remote, areas with poor access to grid electricity. Tertiary processing is often done in close urban areas and / or industrial areas, close to the customer base or transportation hubs, with often better access to grid-electricity.

Based on their overall renewable energy potential in Nigeria (see Tables 3.3 – 3.7), the availability of biomass at the processing location and existence

Table 5.1 **Major crop value chains with highest renewable energy potential**

Agricultural products	Production 2013 (10^6 tons)	Residue type	Residue 2013 (million tons)	2013 Energy potential (PJ)	
Rice	3,37	Straw	7,86	125,92	149
		Husk	1,19	23	
Cassava	42,53	Stalks	17,01	297,68	1.110
		Peelings	76,56	812,3	
Oil palm	8.500	Fibre	1,02	11,57	44
		Empty bunches	1,96	15,95	
	1.170	Palm kernel	0,88	16,53	

of medium and large processing companies, the three agricultural value chains with the best potential for captive renewable energy are:

» cassava;

» rice;

» oil palm.

When processing palm oil also a voluminous waste water stream–Palm Oil Mill Effluent (POME)–is produced. When not treated correctly this POME causes heavy water pollution, contributes to global warming and causes odour emissions for nearby communities. It is generally acknowledged that palm oil mills in Nigeria are not able to treat their waste in ways that meet effluent standards (GreCo Power & Energy Ltd., 2016)

The three agricultural products are further detailed in the paragraphs below.

Cassava

Nigeria is the largest producer of cassava in the world, followed by Thailand and Indonesia. Nigeria's cassava production is estimated to be 54 million metric tonnes annually (FAOSTAT). Nigeria is facing significant future demand for processed cassava; the cassava sector is expected to reach € 7,2 billion in value by 2020.

Cassava is important in Nigeria, not just as a food crop but even more so as a major source of cash income for households. As a cash crop, cassava generates cash income for the largest number of households, in comparison with other staples, contributing positively to poverty alleviation. Cassava is usually consumed in processed forms, its processing by traditional methods is labour intensive but the applications of improved processing technology has reduced processing time and labour and encouraged further production. Industrial utilisation of cassava products is increasing but this accounts for less than 5 % of the total production (Sanni et al., 2012). For many years the government of Nigeria is stimulating the cassava value chain, as cassava production and processing is a viable option to boost employment in the county. Measures taken to stimulate market growth in the cassava sector include: institute up to 40% of High Quality Cassava Flour requirements in wheat bread and 10% ethanol requirements in gasoline (of which 50% from cassava).

Cassava waste products are suitable for power generation as it contains relatively large amount of starch; 20–35% fresh and 80,6% dry weight (Okudoh et al, 2014).

Production chain

Cassava is regarded as a staple food in Nigeria, as it is used to produce "Garri" a kind of porridge or cereal. Besides "Garri", cassava is used to produce "Atteke", a sort of cassava couscous. Finally, cassava is also used for animal feed, cassava starch, flour, ethanol, adhesives and recently, bread. The production chain on the left of Figure 5.4 shows the production chain of cassava to "Garri" and "Atekke". The production chain on the right of Figure 5.4 shows the production chain of cassava starch from cassava. From both production chains it can be seen that substantial residue streams become available when processing cassava.

The amount of residue becoming available in the different cassava processing steps provides an excellent basis for renewable energy captive power production. However, despite this potential and the boost in cultivation of cassava, there is no reported operational captive power plant, using cassava residue in Nigeria.

Technology

For the production of energy from cassava residues, several energy conversion technologies can be utilized, depending on the type of residue and energy requirements of the processor. Figure 5.4 shows the peels and pulp residues are available in large quantities. However, also the wastewater, cassava bagasse and starch residues can be used for energy production. Table 5.2 gives an overview of the most suitable technologies, and conversion processes for energy generation from cassava waste streams. Combustion and digestion

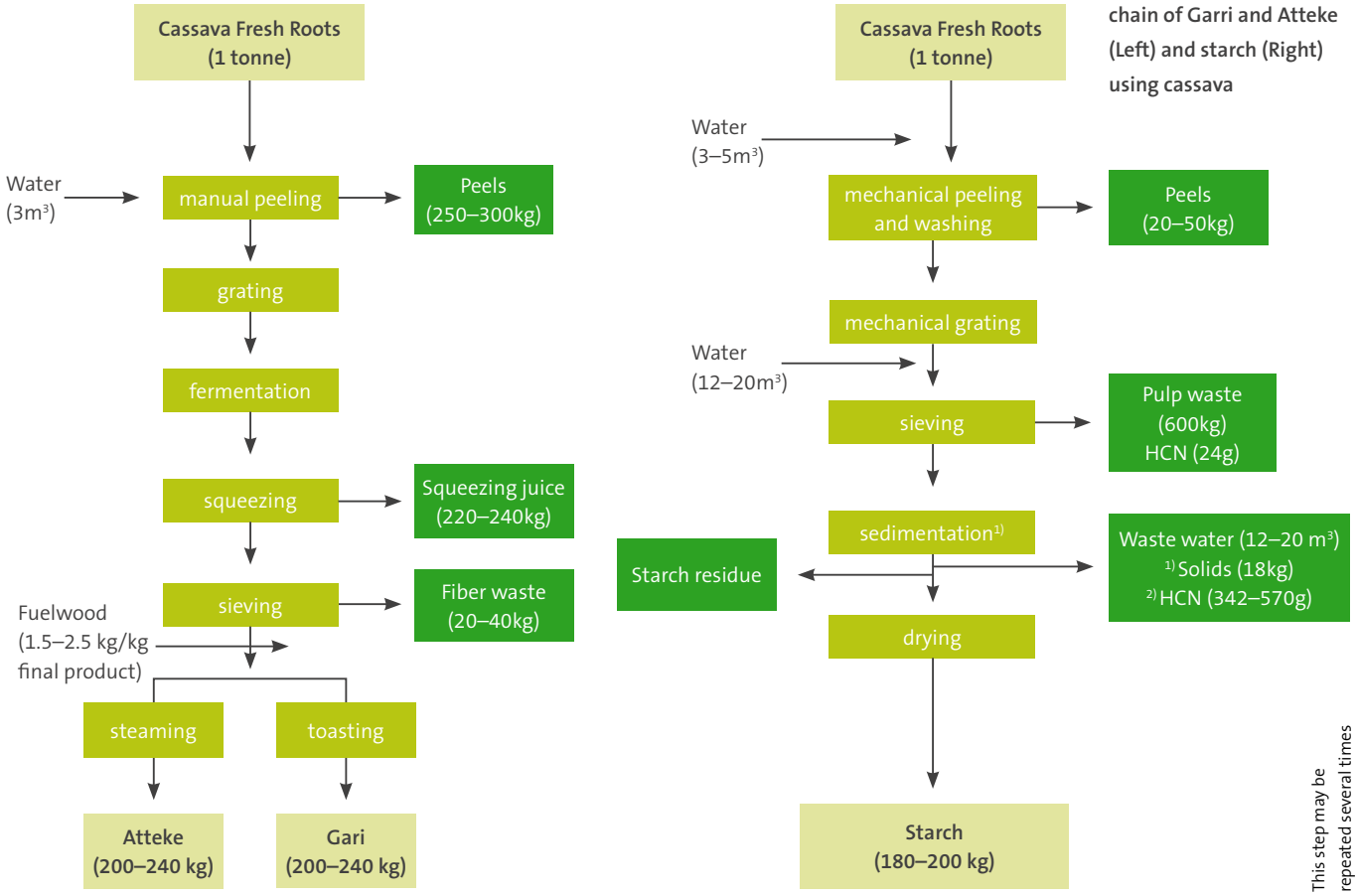


Figure 5.4 The production chain of Garri and Atteke (Left) and starch (Right) using cassava

Table 5.2 Cassava residues, energy conversion technologies and type of energy produced

Cassava residue (Solid waste =10-25% of fresh root)	Conversion technology	Energy / fuel
Peels	Combustion, Gasification, CHP (large scale), and fermentation	Heat, Syngas, electricity, and ethanol
Squeezing juice and pulp, waste water, and starch residue	Anaerobic Digestion	Biogas

can be used at a relatively small scale. CHP and gasification usually require a somewhat larger scale, for cost efficiency reasons. In addition to the options mentioned in the table, fermentation technology can be used to convert cassava into bioethanol. However, this technology usually uses the entire cassava and not only the residues, and is therefore not included. The selection of the most appropriate technology depends on the scale of operation, availability of sufficient space for an installation and the energy demand of the company.

Business models

Potential business models for the realisation of renewable energy captive power projects depend on the size of the cassava processing company.

Large scale, well equipped cassava processors, usually can develop, build, maintain and operate a captive power generation installation themselves. These companies are able to bear the capital investments required to build a power system and are likely to have (or be able to acquire) the know-how and experience needed. Another option for these companies is to engage in a Design-Build-Operate-Maintain (DBOM) or a Build-Own-Operate-Transfer (BOOT) contract with a third party. With this third party a PPA can be negotiated by the cassava processor. This way, the cassava processor is able to receive a steady supply of energy, without having to manage the plant itself.

For medium- and small scale cassava processors, it will hardly be feasible to develop and build a captive power plant internally. This can be ascribed to two facts. Firstly, the capital investments required for a captive power plant will most likely be too large for a medium- or small scale entrepreneur in the cassava processing industry. Secondly, they usually do not have the required know-how and skills within their firm, to develop, build, operate and maintain a waste to energy captive power plant. Therefore, the most suitable business model for using captive power for medium- and small scale cassava processor is a third party that will exploit the captive power plant and that supplies the energy to the cassava processor under a PPA agreement.

Both business models show a commercial potential. When the captive power plant is managed internally, cost savings for the cassava processor can be achieved through the substitution of diesel and grid electricity. When a third party exploits the captive power plant, cost savings through the substitution of diesel can occur for the cassava processor as well, and additional income for the exploiting party is generated. An example of a potential captive power project is presented in Figure 5.5.

Cassava processors

Cassava is mainly cultivated in Anambra, Delta, Edo, Cross River, Ino, Oyo, Ogun, Niger, Rivers, Kwara and Benue. There are about 1.200 large scale farmers (10–1000 ha) and 5.000 medium scale farmers (6–10 ha) in Niger Delta, supplying a handful of large processing industries and about 50 small-medium scale industries (PIND, 2011b). The National Cassava Processors and Marketers Association (NCAPMA), mention 65 members on their website (http://ncapma.org/directory/listing/). Table 5.3 shows an overview of the large

Potential business case for a biogas cassava residue captive power project

In order to estimate the commercial viability of captive power for the cassava processing industry, an analysis of a potential captive power project for a SME company, producing food-grade starch from cassava in Ogun State, has been conducted. On site, the company peels the cassava, produces the starch and dries and packages the end-product. This makes the company suitable for captive power generation as it possesses the waste streams at their location. The company produces a daily average of 25 tonnes of starch Currently, they use boilers and diesel generators to provide electricity. Table 5.3 gives an overview of the estimated costs of energy for the company.

Table 5.3: Estimated energy costs

	Diesel per year (l)	Costs per year (Naira)	Costs per year (€)
Boilers	270.000	36.450.000	€ 163.661
Electricity	375.000	50.625.000	€ 227.306
Total	**645.000**	**87.075.000**	**€ 390.967**

A waste to energy project using a biogas digester appears to be most suitable. It is estimated that the company has 750 tonnes of cassava waste per year. When this cassava waste is used for the production of biogas (which can be converted to electricity or heat), substantial costs savings on energy occur. Table 5.4 shows an overview of the amount of the costs savings that can be achieved by using the cassava wastes as feedstock for captive power generation.

Table 5.4: Estimation of annual biogas production and diesel substitution

Amount of cassava waste (kg/year)	Biogas production (m^3/year)	Electricity production (kWh/ year)	Substituted diesel (l/year)	Cost savings (€/year)
750.000	487.500	1.023.750	268.125	162.524

The capital expenditure (including design and building) for a biogas digester of the size needed is (depending on the technology chosen) estimated to be between € 350.000–700.000. A very rough estimation of the payback time (including operation and maintenance costs) results in a payback between 2,5 – 4,5 years. A biogas digester also produces significant amounts of excess heat, that can be utilised e.g. for drying of cassava.

Figure 5.5 Case study for a potential captive power project

State	Company	Activities
Cross River	Godilogo Farms	Cassava processing
Niger	Dewo Integrated Farms Ltd	Cassava chips
Ogun	GreenTech Industries Limited	Cassava processing
	Cassava farming village, Boodo	Cassava processing
	Ilugun North Cassava Processing	Cassava processing
	Matsol Farms Ltd	Cassava processing
	Golden Hebron Company Ltd	Cassava processing

Table 5.3 Large scale processors of cassava in Cross river, Niger and Ogun state

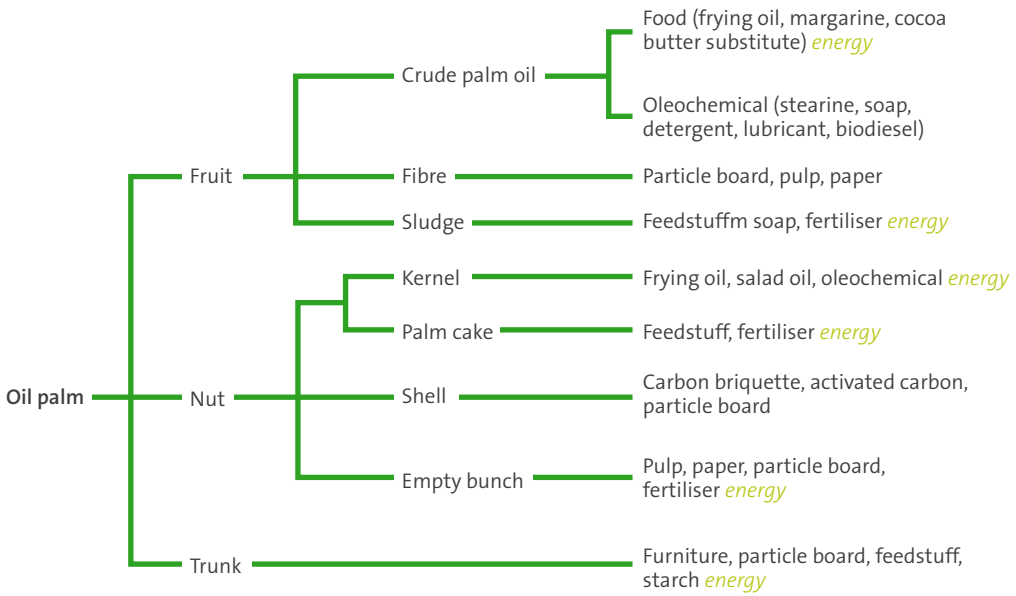


Figure 5.6 Potential use of oil palm tree and opportunities for energy use (Source: adapted from PIND, 2011a)

agri-food processing companies in the cassava sector that have been identified in Cross river, Ogun and Niger state.

Oil palm

Nigeria produced nearly 8 million tonnes of oil palm fruits (resulting in about 1 million tonnes of palm kernel) and is the third largest producer in the world after Indonesia and Malaysia. Oil palm processing offers the empty fruit bunches, the processing waste effluent (POME) and the palm kernel shells as options for bioenergy. About 80% of production comes from scattered smallholders spread over an estimated 1.6 million hectares of land. Plantations occupy between 200.000 and 360.000 hectares. Oil palm provided direct employment and income to about 5 million Nigerians.

Oil palm is grown abundantly in southern Nigeria, with a majority of large and small holder farms found in the south-east and south-south. The Niger Delta's nine states (Akwa Ibom, Abia, Rivers, Edo, Imo, Ondo, Bayelsa, Cross River and Delta) account for about 80% of total Nigerian palm oil production. But this production is dominated by the collection of palm fruit e.g. Fresh Fruit Bunches (FFB) from wild groves (74% of area and about 50% of supply of FFB), followed by production from private plantations (small, medium and large farmers, 19% of area and 34% of supply of fruit) and large corporate and government owned plantations (about 7% of area 25% supply of fruit). Other important oil palm producing states are: Ekiti, Ogun, Enugu, and Oyo.

In 2012, the Government of Nigeria initiated the Agricultural Transformation Agenda for increasing palm oil production in the country. Government sources indicate that they have distributed hybrid seedlings to farmers to replace the low-yielding and old trees and the government is collaborating with farmers and private sector organizations to expand palm plantations. Some production increases have been recorded from this initiative.

The government also supports domestic production through research. The Nigerian Institute for Palm Oil Research (NIFOR) was set up to support the palm oil production and it has been under the control of the Federal Ministry of Agriculture since 1992. The current formal mandate of NIFOR is to conduct research on production of palm oil and other palm plant and to transfer the research outputs to producers,

especially the traditional small-scale processors (for further information about NIFOR, visit: http://nifor.org/).

Production chain

The Nigerian palm oil processing industry is made up of four identifiable channels (see also Figure 5.7):

- Channel 1: Traditional TPO (Technical Palm Oil)
- Channel 2: Medium Technology TPO
- Channel 3: Medium Technology SPO (Special Palm Oil)
- Channel 4: Integrated

Channel 1 is the largest of the four channels, but it is shrinking. It is dependent on the wild grove harvest and tens of thousands of small processors, each producing between 40 and 200 litres poor quality product, produced with traditional production techniques. In this channel the end markets / end-users are food vendors, hoteliers and households.

Channel 2 is driven increasingly by improved farming techniques (commercially oriented) and by an improved processing technology for crude palm oil. The channel is comprised of the larger private producers of FFB who are integrating vertically into using more efficient processing technologies. Channel 2 is attracting the more commercially oriented actors from Channel 1 to upgrade and move into a more productive segment. It is generally expected Channel 2 will become the dominant channel in the oil palm value chain. This channel is already handling more than 50% of all the oil palm that is mechanically processed and commercially marketed. It has more than a thousand processors around the Niger Delta Area alone.

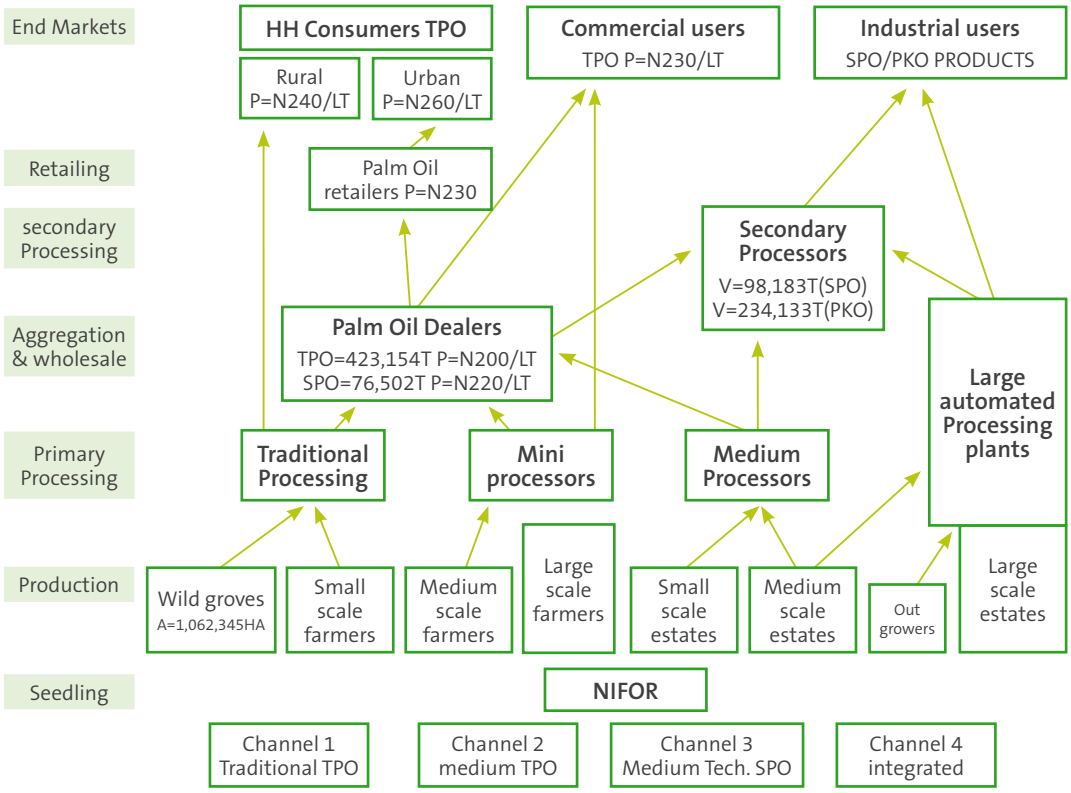


Figure 5.7 Value chain map for palm oil in Nigeria (Source: PIND, 2011a)

Table 5.4 Oil palm residues, energy conversion technologies and type of energy produced

Oil palm residues	Conversion technology	Energy / fuel
Empty Fruit Bunch (EFB), Palm kernel shell (PKS) and Palm Fibre	Combustion, Gasification, CHP (for large scale)	Heat and electricity
Palm Oil Mill Effluent (POME)	Anaerobic Digestion	Biogas (converted in heat and electricity)

Channel 3 represents an intermediate technology between the semi improved processing and the expensive modern methods. The majority of oil palm estates produce of Special Palm Oil (SPO). The channel has different actors in all of the functions from input supplier, producer, processors, wholesalers, retailers, and end-users so the vertical coordination is complex. The channel is growing gradually due to high demand for the product in Nigeria.

Channel 4 is comprised of the large estates with vertically integrated through processing with fully automated processing plants. Some of the companies, like PRESCO, take the product all the way through to the fractionated Oleins and Stearins, while others sell their SPO to the secondary processors for fractionating. This channel is the model being used by the largest industries in the world from Malaysia and Indonesia, which are able to control the production of the fruit, the timing of its delivery to the mills, and the access to the end markets. Medium and large scale farmers in both the TPO and SPO channels seem very suitable to adapt to renewable energy captive power.

Technology

For the production of energy from oil palm residues, different energy conversion technologies can be utilized, depending on the type of residue and the energy requirements of the oil palm processor. Table 5.4 gives an overview of the most suitable technologies, and conversion processes for energy generation from oil palm residues. The selection of the most appropriate technology depends on the scale of operation, availability of sufficient space for an installation and the specific energy requirements of the company. An example of a captive power project is included in Annex L.

Business models

Potential business models for the realisation of renewable energy captive power projects depend on the size of the oil palm processing company.

Large (automated) palm oil processors, usually can develop, build, maintain and operate a captive power generation installation themselves. These companies are able to bear the capital investments required to build a power system. Moreover, these companies are likely to have, or be able to acquire, the know-how and experience needed. Another option for these companies is to engage in a Design-Build-Operate-Maintain (DBOM) or a Build-Own-Operate-Transfer (BOOT) contract

Table 5.5 Large scale processors of oil palm in Cross river, Niger and Ogun state

State	Company	Activities
Cross River	Wilmar Group / PZ Cussons	Plantation and refinery
	Real Oil	Plantation and mills
	Pamol	Plantation and mills
	IBAD Farms	Plantation and mills
	ROYAL Int. Farms	Plantation and mills
Ogun	Diamond Pearl Agro Allied Ltd	Palm oil processing

Rice residues	Conversion technology	Energy / fuel
Rice husk	Combustion, Gasification	Heat and syngas
Straw (not available at mill)	Combustion	Heat

Table 5.6 **Rice residues, energy conversion technologies and type of energy produced**

with a third party. With this third party a PPA can be negotiated by the cassava processor. This way, the palm oil processor is able to receive a steady supply of energy, without having to manage the plant itself.

For medium and mini-processors, it will hardly be feasible to develop and build a captive power plant internally. This can be ascribed to two facts. Firstly, the capital investments required for a captive power plant will most likely be too large for these companies. Secondly, they usually do not have the required know-how and skills within their firm, to develop, build, operate and maintain a waste to energy captive power plant. Therefore, the most suitable business model for these oil palm processors is using the DBOM model, having a third party exploit the captive power plant and supplying the energy to the oil palm processor under a PPA agreement.

Both business models show a commercial potential. When the captive power plant is managed internally, cost savings for the oil palm processor can be achieved through the substitution of diesel, gas and/or grid electricity. When a third party exploits the captive power plant, cost savings through the substitution of diesel, gas and/or grid electricity can occur as well, and additional income for the exploiting party is generated.

Oil palm processors

Two companies in channel 4 are currently at the fore front in the production of SPO. These companies are PRESCO & Okomu Oil, both located in Edo state. Other actors in this channel are Golden Oil company and Envoy Oil Industries located in Anambra state, Agro Ideas International located in Akwa-Ibom state, EFB Industries Limited in Abia state and Sudit Oil in Oyo state. Table 5.3 shows an overview of the large oil palm processing companies that have been identified in Cross river, Ogun and Niger state.

Support organisations

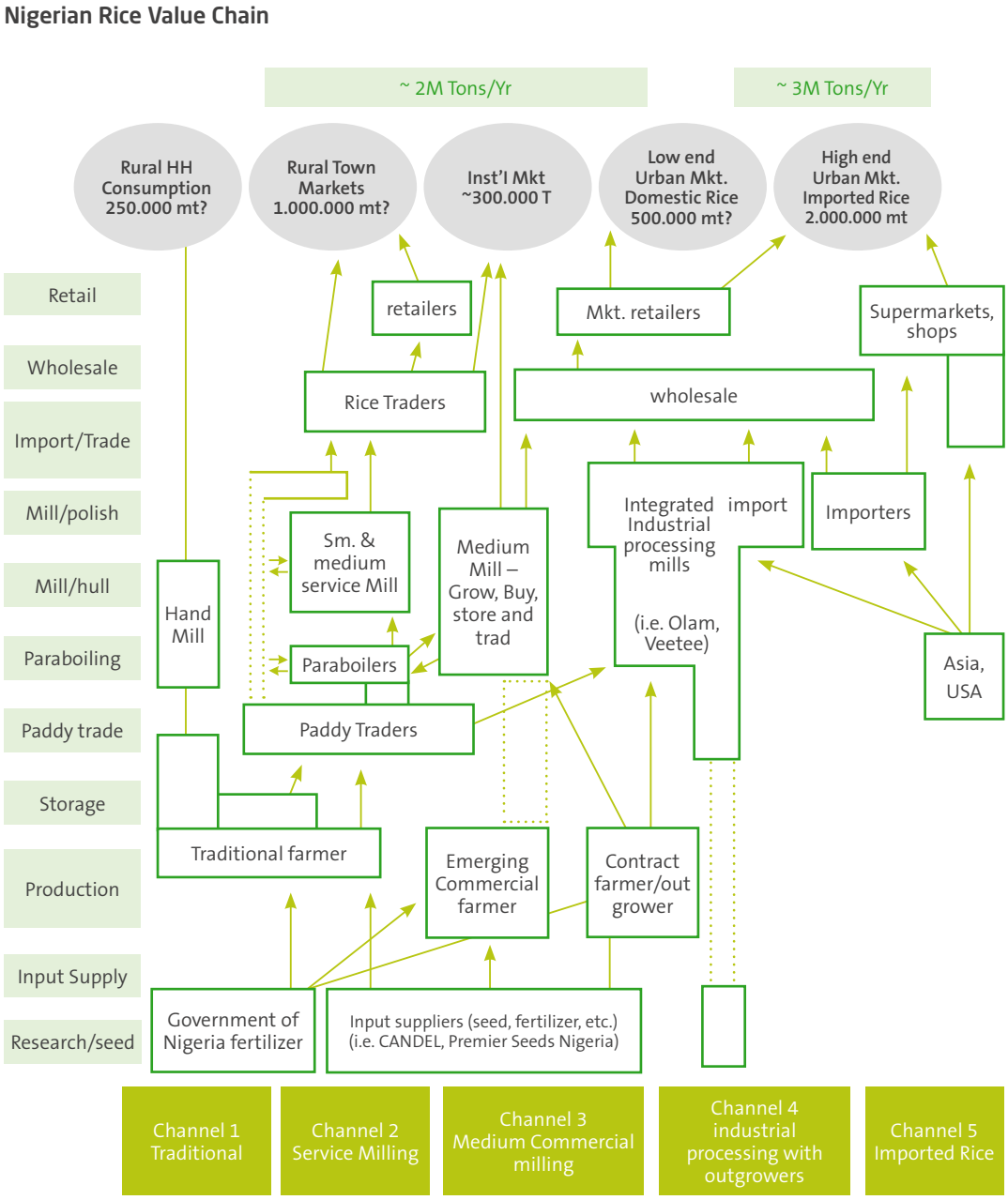
NIFOR is the dominant institution in support of the palm oil industry. It is charged with all research on palm varieties, identification and propagation of the best varieties of palm plants, and research into the best technologies for processing the fruit into oil.

Rice

Rice production in Nigeria seems to have gradually increased in recent years' to 6,7 million tons in 2014 (FAOSTAT). Estimates indicate that over 90 % of domestic rice production comes from resource-poor and weakly organized small holders. Niger State produces the largest amount of paddy in the North Central zone at 473.000 tonnes paddy per annum (GIZ, 2015b).

In the last few years' backward integration in the form of installation of rice mills and direct farming seems to be gaining more ground. Good examples of this are Olam and Dangote. In 2015 Olam Nigeria has invested € 94 million in an integrated farm and milling facility in Nasarawa State. One of the biggest commitments for investing in rice processing was made in 2014 by Dangote Group. This Nigerian conglomerate committed to spend more than N165bn (€ 750 million) in mills, farms and related infrastructure in a bid to support the country in its goal of becoming a net-exporter of rice. The group acquired farmland in five states,

Figure 5.8 Value chain map for rice in Nigeria (Source: Simpson, 2011)



which will be used for the commercial production of rice paddy. It will also set-up two rice mills with an installed capacity of 240.000 tonnes of rice per day.[28]

Sources note that the government regime may adopt the Agricultural Transformation Agenda's rice policy for self-sufficiency. Encouraged by official policy proposition to ban rice imports by 2017 as well as Nigeria's differential tariff policy, private sector investments in local rice farming have increased, partly offsetting production declines by small scale farmers.

28) http://www.oxfordbusinessgroup.com/news/nigeria-full-swing-rice-production

Production chain

The Nigerian rice value chain is made up of five different channels (see Figure 5.8). The integrated industrial processing mills seem the most suitable to adapt to renewable energy captive power.

Technology

For the production of energy from rice residue, different energy conversion technologies can be utilized, depending on the energy requirements of the processor. As straw is usually not available at the milling site, this residue is not a suitable feedstock for renewable energy captive power at the mill location.

Business models

For the large scale rice millers, it is possible to install and manage the captive power generation facility internally. The large milling companies are able to bear the relatively high capital investments required to start generating power using rice husk. Moreover, these companies are likely to have access to the know-how required to build, own, maintain and operate a captive power plant. Another option for these companies is to appoint a third party that will be responsible for the exploitation of the captive power plant. With this third party a PPA can be negotiated. This way, the processor is able to receive a steady supply of energy, without having to manage the plant itself.

For medium scale rice millers, it will hardly be feasible to develop and build a captive power plant internally. This can be ascribed to two facts. Firstly, the capital investments required for a captive power plant will most likely be too large for these companies. Secondly, they usually do not have the required know-how and skills within their firm, to develop, build, operate and maintain a waste to energy captive power plant. Therefore, the most suitable business model for these rice millers is using a DBOM model, having a third party design, build, operate and maintain the captive power plant, supplying energy to the rice processor under a PPA agreement. Some might prefer to use the BOOT model. For small rice millers only the DBOM model seem suitable.

All business models show a commercial potential. When the captive power plant is managed internally, cost savings for the rice miller can be achieved through the substitution of diesel, gas and/or grid electricity. When a third party exploits the captive power plant, cost savings through the substitution of diesel, gas and/or grid electricity can occur as well, and additional income for the exploiting party is generated.

Rice millers

In recent years' significant investments have been made in increasing the rice processing capacity in Nigeria. Resulting in the number of rice mills rising from one plant five years ago to 24 at present (see Annex F) according to the Rice Millers, Importers and Distributors' Association of Nigeria.

State	Company	Activities
Cross River	Ogoja Central Rice Mill Cluster	Rice Mill
Niger	Pearl Universal Impex Badegi Rice Mill Minna-Kpakakungu Clusters	Rice Mill Rice Mill Rice processing
Jigawa	Danmordi Rice Mill	Rice Mill
Kano	Stallion Rice	Rice Mill
Ebonye	Ebonyi Agro rice mill Ebonyi State Government rice mill	Rice Mill Rice Mill

Table 5.7 Examples of medium scale Rice Millers, identified in different states

CHAPTER 6
PROJECT DEVELOPMENT PROCEDURES

This chapter highlights the steps a project developer has to take to implement on- and off-grid electricity projects in Nigeria, including captive and embedded power projects.

The information below is based partially derived from official policy and regulatory documents as well as 22 interviews with key governments agencies (NERC, NBET, NIPC and others), and industry players such as the GenCos, DisCos, financiers, relevant experts and those that have (attempted to) established power projects in Nigeria. Information was collected between May and July 2016.

Further topics addressed in this chapter are:

- Business environment in general
- Transparency and procedural challenges
- Financial considerations
- Feedback from key stakeholders on liaising with regulatory bodies
- The relation between generation companies and distribution companies
- Key challenges as mentioned by project developers
- Strategies proposed by stakeholders to overcome key challenges

Processes, procedures, timelines, fees and the likes are subject to change, and several respondents indicated that there are hidden obstacles and processes. Therefore, any entity intending to set up a power project in Nigeria would be wise to liaise with local experts who can use their insider knowledge and relationships to ensure all necessary steps are indeed taken.

The role of the government

Nigeria is a federation of 36 States and the Federal Capital Territory (Abuja). In the federal system, political power is shared between the three tiers of government (federal, state and local government). Roughly based on the American model of a federation, States in Nigeria play an important role in the daily lives of the citizens. More on the role of state governments below, but first the key government player in the Nigerian energy sector will be discussed; The Federal Government.

The Federal Government and associated agencies

The Federal Government of Nigeria (FGN) has a responsibility of ensuring a power system of generation, transmission, distribution and marketing that is efficient, safe, affordable and cost-effective throughout the country. This is made possible by ensuring that the power sector attracts private investment both from Nigeria and overseas.

In developing private investment and enhancing indigenous capacity, the FGN is working towards a transparent and effective regulatory framework for the power sector. The FGN is also divesting its interest in the state-owned entities thus restructuring and privatizing the electric power sector.

In promoting competition to meet growing demand through the full liberalization of the electricity market, the key roles of the FGN are:

- To review and update electricity laws in conformity with the need to introduce private sector operation and competition into the sector;
- To ensure that electricity supply is made more reliable, economically efficient and equitable so as to effectively support the socio-economic development of the country;
- To provide access to electricity, on or off-grid;
- To encourage domestic production of electrical equipment in Nigeria, and the development of related software and services;
- To establish and meet the targets of the rural electrification programme;
- To ensure minimum adverse environmental impact;
- To create the enabling environment, including the provision of incentives, that will attract investors and resources to achieve the objectives earlier stated;
- To minimize government guarantees for privately funded investment;
- To ensure that subsidies are efficiently targeted.

Related to the FGN are a number of government agencies who are jointly responsible for the development of the electric power sector. The ultimate goal of all agencies is to ensure that Nigeria has an electricity supply industry that meets the needs of its citizens. In the following, these agencies are described.

Federal Ministry of Power

Website: http://www.power.gov.ng/

Description: Formulation of broad policies for the development of the power sector and coordinating activities within the sector. Its function is to:

- Ensure the establishment of a robust power sector: fully supporting the socio-economic needs of the nation in ensuring an efficient, safe, affordable and cost-effective system of generation, transmission, distribution and marketing.

Energy Commission of Nigeria

Website: http://www.energy.gov.ng/

Description: The ECN also developed the first ever Renewable Energy Master Plan (REMP) with the support of the United Nations Development Programme (UNDP) in 2005 and this was reviewed in 2012. Its functions are:

- Recommending to the Government any alternative or new energy sources;
- The ECN is charged with the responsibility for the strategic planning and coordination of national policies in the field of energy in all its ramifications;
- Creating awareness in Government in order to improve the investing environment;
- Proposing incentives the Government can give to private sector investors. Some of these incentives have been adopted by the Nigerian customs and this is available on their website;
- According to information provided by ECN, they also provide technical information on private, local and foreign investors in Nigeria about the RE market;
- The ECN can also carry out specific studies/research/ for the investor and can provide advisory services to the investors;
- ECN liaises with international agencies on energy matters, thus the ECN is the focal agency in Nigeria for bodies like the International Renewable Energy Agency, World Energy Council and IAEA (before the establishment of the Nigerian Atomic Agency).

Federal Ministry of Environment

Website: http://environment.gov.ng/

Description: The Federal Ministry of Environment was established to ensure effective coordination of all environmental matters. Its function is to:

- Advise and cooperate with the Federal Government on national environmental policies and priorities, the conservation of natural resources and sustainable development and scientific and technological activities affecting the environment and natural resources;
- Promote cooperation in environmental science and conservation technology with similar bodies in other countries;
- Prescribe, monitor and enforce regulations on water quality, environmental protection, effluent limitations, air quality, atmospheric protection, ozone protection, noise control as well as the removal and control of hazardous substances;
- Assess Environmental- and Social Impact Assessments submitted by project developers.

Hydro Electric Power Producing Areas Development Commission (HYPPADC)

Description: HYPPADEC was established to manage the impact of ecological issues due to the operations of dams and hydroelectric power activities in power producing areas. Its functions are to:

- Protect the host communities of areas where dams and hydro-power energy infrastructure are planned and located;
- Manage the fund containing 10% of hydro power revenue by DisCos (this fund is not yet in function and therefore it is still unclear how this fund will operate).

Nigerian Bulk Electricity Trading Plc (NBET)

Website: http://nbet.com.ng/

Description: NBET enters into power purchase agreements with generation companies and resells power to distribution companies through the vesting contracts. Its functions are:

- Buying power from IPPs that are connected to the national TCN grid and reselling the power to the distribution companies (DisCos) and eligible customers;
- Manage existing PPAs and new procurement of power in the transition.

Nigerian Electricity Regulatory Commission (NERC)

Website: http://www.nercng.org/

Description: Tasked with the promotion of the managerial efficiency of the power sector and improving access to electricity services through technical regulations, protecting consumers. Two of NERC's key regulatory functions are:

- Licensing: NERC issues licenses for on and off-grid generation of power, as well as for distribution of electricity to end users.
- Tariff setting: NERC manages price regulation through the Multi-Year Tariff Order (MYTO).

Nigerian Investment Promotion Commission (NIPC)

Website: http://www.nipc.gov.ng/

Description: The Nigerian Investment Promotion Commission (NIPC) was established to promote, co-ordinate and monitor all investments in Nigeria. Its function is to:

- Co-ordinate, monitor, encourage and provide necessary assistance and guidance for the establishment and operation of enterprises in Nigeria;
- Initiate and support measures which shall enhance the investment climate in Nigeria for both Nigerian and non-Nigerian investors;
- Promote investments in and outside Nigeria through effective promotional means;
- Facilitate the registration of foreign businesses in Nigeria over the One Stop Investment Centre.

Rural Electrification Agency

Website: http://www.rea.gov.ng/

Description: REA's mandate is the expansion of the grid to rural areas, development of isolated and mini-grid systems, and renewable power generations. Its function is to:

- Administer and manage the Rural Electrification Fund (REF). REF targets grid extension projects, solar projects, the installation of transformers, and mini hydro power projects;
- Provide overall support and coordination of rural electrification activities in Nigeria.

The role of state and local governments

Although electricity projects are licensed and regulated by the federal government (agencies), state governments are known to compliment the efforts of the federal government by implementing electrification projects in their states. State governments play a major role in land acquisition to private investors looking to establish power projects in the state. The key aspects to their role are:

- Acquisition of land
- Consent for land usage
- Right of way surveys and assessments

Respondents who have set up power projects in Nigeria, or who have acted as advisors on such projects, all confirm the importance of developing a good relationship with the State. The right of way survey, for example, has to be submitted when applying for a license. When the State delays the survey process, the entire licensing process will be delayed.

Private sector respondents on State & Local governments

Energy projects are a way to score political points for a State Government; they are therefore keen to (appear to) support a project developer. However, bureaucracy can be crippling and transparency remains an issue. Moreover, State Governors have far reaching powers and can support the speedy execution of projects; developing a positive relationship prior to setting up a power project, and choosing a more efficient State to locate a project, is thus recommended.

Local government in a number of states are a mere political compensation for the government loyalists. Corruption is widespread. The inadequacies of operational and capital funds constitute a setback on local government implementation of regular services and investment programme.

Role of the local government

The local government is the third tier of government and represents the interest of (small) communities in a state. They help facilitate development from the grassroots. Local governments only play a minor role in the development of electric power projects. However, in rural areas where the State has little oversight, the local government acquire greater significance. Most interactions between local governments and private electric power companies relate to the collection of local taxes and levies.

The role of, and relation between, GenCos and DisCos

After the privatization, the Federal Government only retained control in the energy sector of the transmission and system operation, owning 100% of the Transmission Company of Nigeria (TCN), while its equity in the generating companies is 20% leaving 80% to private investors. In the case of distribution companies, the Government only sold 60% while it retained 40% equity. The structure of the privatised power sector is shown in the following picture.

The GenCos, DisCos and TCN are all co-dependent and the activity of one (or lack thereof) has an effect on the others. The relationship is often suboptimal, as financial streams are frequently interrupted and the business environment is challenging. NBET and NERC are pivotal in this (financial) relationship, as is depicted below.

Financial concerns

The sometimes strenuous relations between the stakeholders are caused by the inability to generate enough cash for the operations and/or to remit it to the relevant players. Especially the DisCos battle with customers who do not pay their bills – the biggest culprit being governmental institutions. As at Q1–2016, the government had about $ 300 million in unpaid electricity bills according to a report by Financial Derivatives

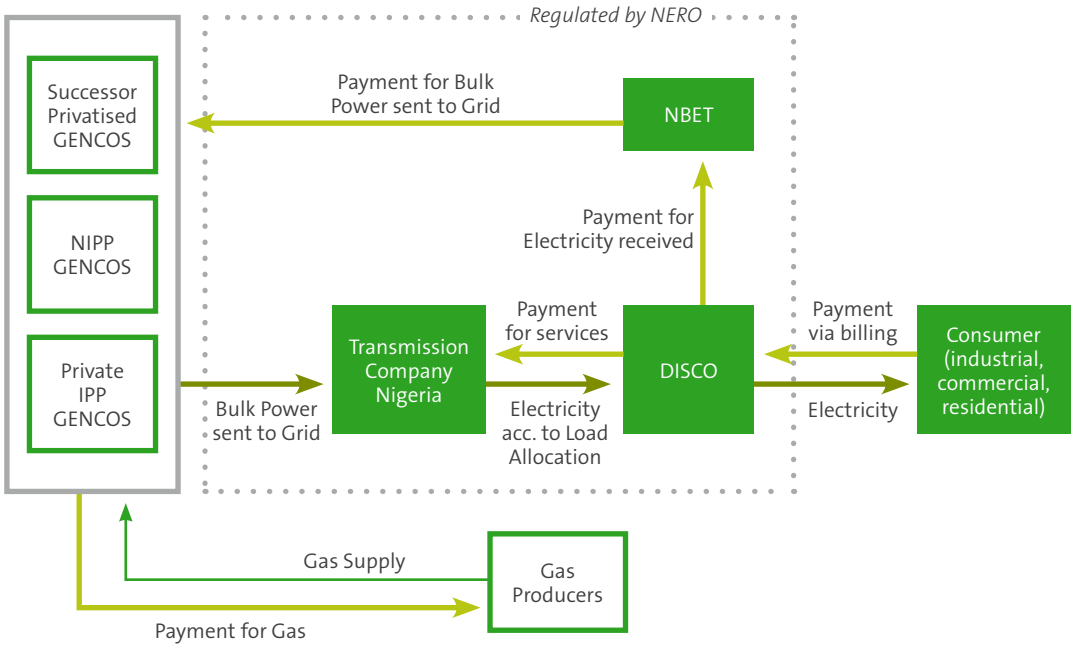
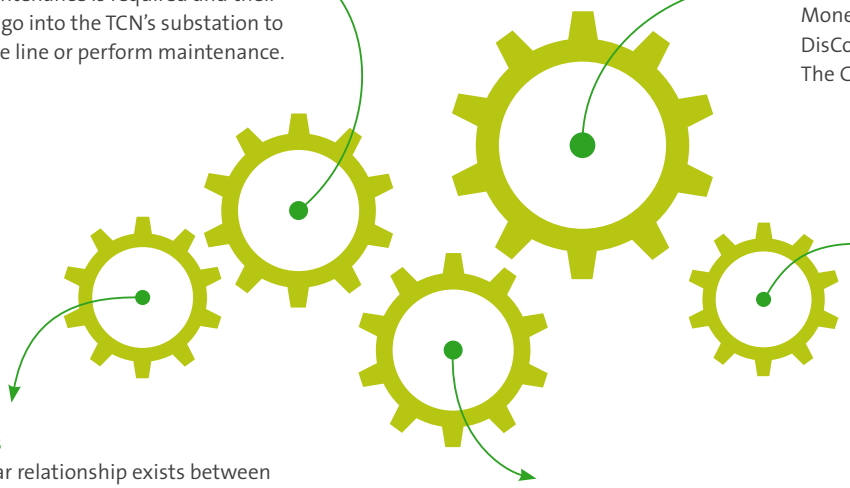


Figure 6.1 Structure of the power sector (NESP, 2014)

Figure 6.2 The relationship between major power stakeholders (illustration adapted from TCN, NERC, NBET and interviews)

DisCos
Currently the most interaction DisCos have with the TCN is when the line trips off or maintenance is required and their operative go into the TCN's substation to restore the line or perform maintenance.



NERC
Money collected from customers by DisCos is shared among NBET, NERC, TCN, The GenCos and the DisCos.

NBET
NBET is the market operator. Purchases and sells electricity from gernerating companies to distirbution companies.

GenCos
A similar relationship exists between the TCN and the GenCos as well with the power generated that is fed into TCN infrastructure at the power plants.

TCN
The TCN is the Systems operator. TCN invoices NBET and collects its share on the tariff for its services after the DisCos collect money from the customers they pay that money into an account.

Company. While it is easier for DisCos to threaten the average citizen with notices and written warnings, it is more difficult to do so with e.g. a ministry or army barracks. As a result, at the time of writing this report, the DisCos have only paid 30% of their invoices over the past three months, according to the NIAF.

During the last administration, the CBN in conjunction with the NERC, the Ministry of Power and the Ministry of Petroleum Resources developed the Nigeria Electricity Market Stabilization Facility (NEMSF). The NEMSF is designed as an intervention fund to ameliorate the effects of a liquidity shortfall in the value chain of the Nigerian Electricity Supply Industry. Managed by the Bank of Industry (handling the operational aspects) and the Central Bank of Nigeria, the NESMF is meant to support the distribution companies to fulfil their market obligations (i.e. the cost of power supplied to them by NBET and the cost of services including the transmission and market operations services etc). The CBN intervention fund arose as a result of several entreaties made by the power generating companies (and gas suppliers owed by some of the thermal generating plants) who were not being fully paid for their monthly invoices raised in respect of power generated. Thus the measures proposed by the CBN and its partner government agencies included:

- Providing liquidity support
- Tariff adjustments
- Commitments by electricity market participants

The facility was disbursed back to back and the distribution companies were not given the money directly but were disbursed up the value chain (i.e. the GenCos and gas companies were the chief beneficiaries) yet the DisCos were obligors for the facility. According to a representative from the NERC, the fund is almost exhausted.

Operators also complain that the current tariffs are not sufficient to break even. The Nigerian Electricity Regulation Commission had been ordered to reverse its 45% hike in tariffs by the Federal High Court in Lagos. Backed by the Ministry of Power, the NERC is seeking appeal at the Supreme Court. It is therefore no surprise that these energy industry players have huge debt burdens. As at March 2016, the generating companies had outstanding loans worth N367 billion. TCN and the DisCos have a joint debt of N162 billion. This increases the risk of the sector and discourages further private investments.

Another complication in this relation between GenCos and DisCos is that some of the generating companies are contemplating delivering straight to key clients, bypassing the DisCos -and have a direct financial relationship with them. Some of our respondents believe this will only make the distribution companies more territorial, as they would be competing with such GenCos for key, high value clients.

TCN and the changing roles of industry players

At present, the TCN has a large role to play in grid-connected power projects. A schematic overview of their role is given below:

NBET is a transitional agency for the period where the Nigerian electricity supply industry is still immature. Once the privatisation has been finalised, direct bilateral agreements will govern the relationships between the DisCos and the GenCos. A model for this future market structure is currently being experimented. A good example is the Egbin Power Plant in Lagos. For their 6th turbine (capacity of 220 MW) they signed an agreement with the Ikeja DisCo to provide power to certain customers. As Ikeja DisCo is part of the same group of companies as Egbin, they feel payment issues will be minimalized. AES Barge

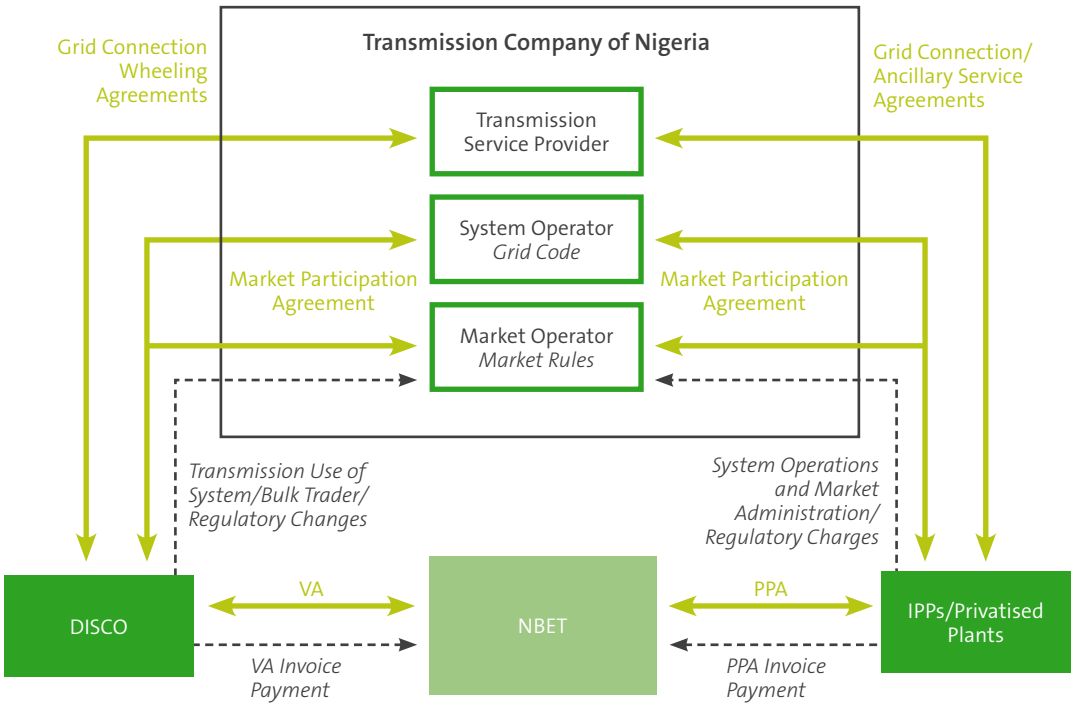


Figure 6.3 The position and role of the Transmission Company of Nigeria (GIZ, 2014)

DISCO: Distribution Company
VA: Vesting Agreement
NBET: Nigerian Bulk Electricity Trader
IPP: Independent Power Producer
PPA: Power Purchase Agreement

and a private company, Paras, have also signed an agreement with the DisCos to provide power using TCN's infrastructure.

Currently the most interaction that the DisCos have with the TCN is when the line trips off or when maintenance is required and their engineer has to go into the TCNs substation to restore the line or perform maintenance. A similar relationship exists between the TCN and the GenCos as well as with the GenCos generating power that is fed into TCN infrastructure at the power plants.

DisCos and GenCos in relation to project developers

Power project developers can have the intention to set up generating companies of their own (IPPs), which would make them competitors to GenCos; the privatised generating plants. Considering the huge requirement for power generation in Nigeria, the competition for demand is not fierce. However, GenCos are contractually obliged to supply to the grid, whereas an independent power producers can decide to have an embedded or captive structure.

Developing a good relationship with DisCos is essential when developing an embedded project. For a grid-connected power project, the relationship between DisCo and IPP will go

through NBET, as they are remitting funds to the IPP. However, for embedded project a power developer has to work in association with the DisCo relevant for that area on grid connection matters. If there is no DisCo in the area, the project developer can supply users directly.

A DisCo can consider an IPP as a competitor if the IPP targets a company or area that is potentially lucrative in terms of willingness and ability. An example for this would be a large new residential estate which will have a power plant of its own without a relationship with any DisCo.

Power generation regulations and procedures

Embarking on a power generation project has the potential to be attractive in Nigeria as there is a far higher demand for power than there is supply. However, one of the biggest challenges developers and investors face is the lack of clarity around the rules and regulations governing power generation in Nigeria.

Any developer will be dealing with several government agencies at once: NERC for licenses, NBET for PPAs, Ministry of Environment for ESIA, and TCN for evacuation approvals. Obviously, the Ministry of Power is pivotal, their policies drive initiatives within the sector. Moreover, the Ministry of Power gives NBET the approval to sign the PPAs. Lastly, a developer has to work closely with the State Government as well. Essentially, a project developer will have to inform all relevant stakeholders about his decision to set up a power project, and carry those stakeholders along in the process.

The key agencies to work with when starting a power project are NERC (for all types of power projects) and NBET and TCN for those that also involve feeding electricity into the grid.

Stakeholder consultations

Taking along the government is always relevant in a country like Nigeria, and it will enable a faster project implementation. Some project developers would do this even for a mini-grid or a solar project of under 1 MW: part out of courtesy, part out of the intention to build awareness and capacity with government entities.

Overview of steps to take to initiate a power project in Nigeria

Four different power projects are distinguished in this report: grid-connected, embedded, captive and mini-grid. There are a number of similar steps to be taken for each one of them, but the flows below have a few relevant distinctions.

These steps below are a high-level overview of official rules and regulations only. Note that the ‘appoint local advisors’ and ‘stakeholder consultations’ are not part of the official regulation (see also text blocks on this page).

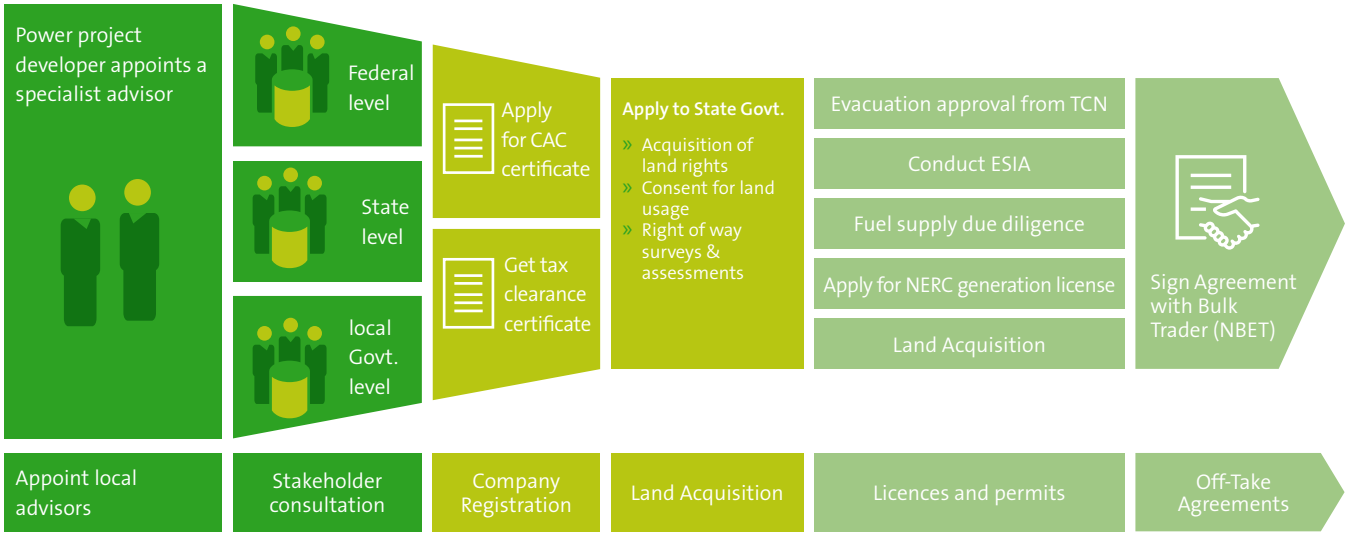
It is also worth to note that many steps in the process can be initiated more or less at the same time due to the duration before completion. The next sections of this chapter will dive deeper into the application process for licenses/ approvals/ permits from NERC, NBET and TCN.

Appointing local advisors

The sector is still very young: the privatization of the sector was only concluded a few years ago and all relevant agencies will have to find their feet in a new role. This adds to the difficulty to get all processes and guidelines crystal clear at this point in time. It is therefore recommended that any power project developer works with a specialist advisor who is entirely up to date.

1 Grid-connected power projects

Grid-connected generation refers to a system of power generation evacuated through the national grid to off-takers which may be the Bulk Trader (NBET), who through vested contracts supplies the power to distribution companies; or directly to eligible customers, as may be declared by the Minister of Power.

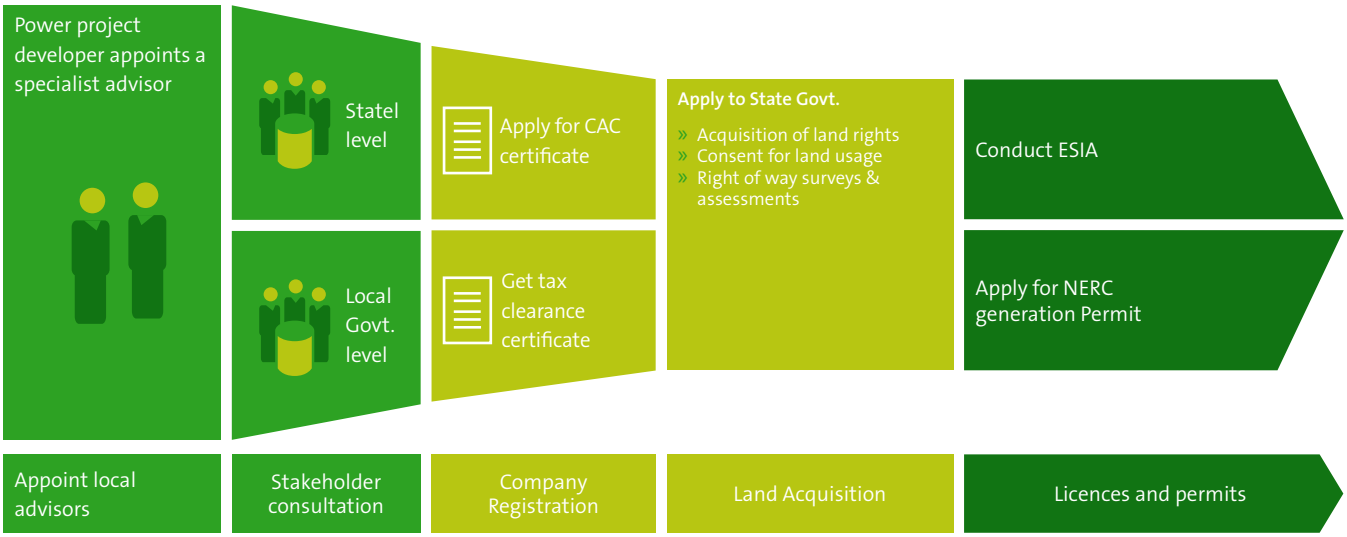


2 Embedded power projects

The Nigerian Electricity Regulatory Commission (NERC)'s embedded generation regulation allows an independent power producer to embed power within the network of the local distribution company without connecting to the transmission network. The generation of electricity is directly connected to and evacuated through a distribution system. This is connected to a transmission network operated by a System Operations Licensee.

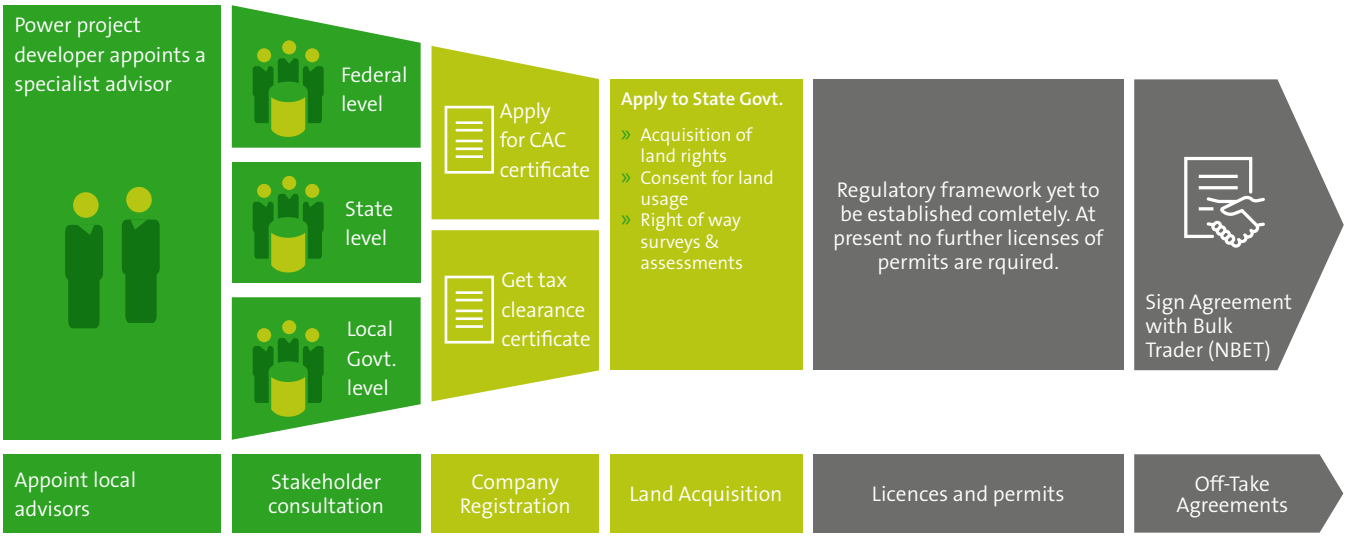
3 Captive power projects

Captive power generation is the generation of electricity for the purpose of consumption by the generator itself, and not sold to a third-party. For projects below 1 MW it is not necessary to obtain a license or permit, the figure below refers to a project of over 1 MW.



4 Mini-grid projects

A mini grid, also sometimes referred to as a "micro grid or isolated grid" it is a set of electricity generators and possibly energy storage systems interconnected to a distribution network. It supplies electricity to a localized group of customers, usually without connection to the national grid.



NERC application for generating licence

As stated earlier, the Nigerian Electricity Regulatory Commission (NERC) issues licenses for on and off-grid generation of power, as well as for distribution of electricity to end users. Section 62 of the Electric Power Sector Reform Act 2005 states that any entity intending to engage in the business of electricity generation, transmission, system operation, and distribution or trading shall be required to obtain an operator's licence from the NERC.

- To be able to generate more than 1 MW of power for your own use (Captive Power Generation), you need to apply for a permit. For self-generated power less than 1 MW no regulation is in place.
- To be able to Transmit, Distribute or Generate power for sale, you need to apply for a license.

On the following page the eligibility criteria and pre-NERC application steps are detailed.

COMPANY REGISTRATION

Company must be registered in Nigeria and must possess tax clearance certificate for immediate past three (3) years

AUDIT OF FINANCIAL STATEMENT

Company is also expected to have conducted an audit of its Financial Statements and Accounts for immediate past three (3) years

EXEMPTIONS FROM AUDIT

Where the company is a newly incorporated Special Purpose Vehicle, exemptions would need to be sought in respect to audits

ENVIRONMENTAL IMPACT ASSESSMENT

Company is expected to have conducted an EIA in respect of the proposed area of operation or where the proposed generation capacity is less than 10 MW, an assessment of how effluents and discharges will be managed

OFF-TAKE AGREEMENT

It is expected that the IPP would have in place an Offtake Agreement or arrangement with a power purchaser. Where the IPP proposes to supply power to the grid, this would involve negotiating a PPA with the Nigerian NBET

OTHER IPP REQUIREMENTS

In addition to documents evidencing the above requirements, NERC as well as NBET will require certain information in dealing with an IPP

Eligibility criteria

NERC provides the "mandatory submissions for applications" on its website. Relevant documents such as the application form are also obtainable from the official website (www.nercng.org). The following requirements have to be met in order to obtain a license:

S/N	Requirement for license	S/N	Requirement for license
1	Completed Application Form;	11	Ten-year Business Plan;
2	Certificate of Incorporation and Memorandum and Articles of Association, or Deed of Partnership, or Deed of Trust, etc. (as applicable);	12	Off-take Agreement or Arrangement;
3	Registered Title Deed to Site, or Sale Agreement, or Deed of Assignment/Gift, or evidence of submission of a title deed to a relevant land processing agency (as applicable);	13	Environmental Impact Assessment (EIA) Approval Certificate, or Proof of submission and acceptance for processing of the Report on EIA to the Ministry of Environment, Housing & Urban Planning, or Details on how effluents and discharges will be managed;
4	Tax Clearance Certificate for immediate past three (3) years;	14	Fuel Supply Agreement, or a letter from a fuel supplier and transporter indicating the inclusion of the fuel needs of the applicant in the supply plans of the fuel supplier and transporter;
5	Certified Audited Financial Statements and Accounts for immediate past three (3) years;	15	Agreement/Approval with Ministry of Water Resources (where applicable);
6	Detailed CVs of managerial and technical staff of the power plant;	16	Letter of intent or an MoU from Engineering Procurement Contract (EPC) Contractor;
7	Location Map;	17	MoU or Letter of Intent from the technical partner;
8	Single Line Diagram;	18	Evidence of confirmation from Transmission Company of Nigeria, proposed connection point has capacity to take load which will be fed to it (only for application for Generation Licence);
9	Power Plant Design (only for application for Generation Licence);	19	Financing Agreements or Letter to fund the project from bank(s); and
10	Site Plan Drawings;	20	Timelines for commissioning of the power plant and on the date when different capacities of the plant will come into operation, relative to date of issuance of a licence.

The different fees charged by NERC

The NERC clearly indicates on its website the fees (see Annex J for a full list of all the fees) involved at various stages of the process:

Processing Fees for Applications

- Every application for a licence made to the Commission shall be accompanied by the non-refundable Application Processing Fees as specified in the Schedules.
- The Fees payable under these Regulations shall be paid by means of bank draft or cheque drawn in favour of the "Nigerian Electricity Regulatory Commission".
- All Fees received by the Commission under these Regulations shall be acknowledged by the issuance of the Commission's official receipt.

Licence Fees

- Upon approval by the Commission of an application for a licence, the Commission shall inform the applicant, in writing, of such approval and be informed of the licence fee required to be paid by the applicant for the grant of a licence.
- The licence fee to be paid shall be as specified in the Schedules (see below).
- Where the licence fee is not paid within the time specified in the terms and conditions of the Licence, a surcharge will be payable on the amount due at the rate of 1% per week up to a maximum period of 12 (twelve) weeks after which period the grant of a licence shall lapse.

Processing Fees for Amendment, Renewal, and Extension Tenure

- Every application for the Amendment, Renewal or Extension of Tenure of an existing Licence by a licensee shall be accompanied by the applicable processing fees as specified in the Schedules.
- The processing fee for Amendment, Renewal or Extension of Tenure shall be non-refundable.

Annual Operating Fees

- Licensees shall pay Annual Operating Fees.
- The Annual Operating Fee payable shall be charged in accordance with the rates specified in the Schedules.
- Where the Operating Fee is not paid within the time specified in the terms and conditions of the licence, surcharge shall be payable on the amount due at the rate of 1% per week up to a maximum period of 12 (twelve) weeks after which period the Commission shall apply appropriate penalties in accordance with the terms and conditions of the licence.

Steps for obtaining a PPA from NBET

NBET is a bulk purchaser and seller of electricity from generating companies to distribution companies. It manages existing Power Purchase Agreements (PPA's) and new procurement of power in the Transitional Electricity Market (TEM). The below is a graphic depiction of NBET's role:

There are two ways of getting PPA:

» Unsolicited bids

» Competitive procurement

Unsolicited bids have been used until now; 13 projects have been initiated under the unsolicited bidding phase, and the competitive procurement phase will now be the next phase that will ensure the best price for all parties.

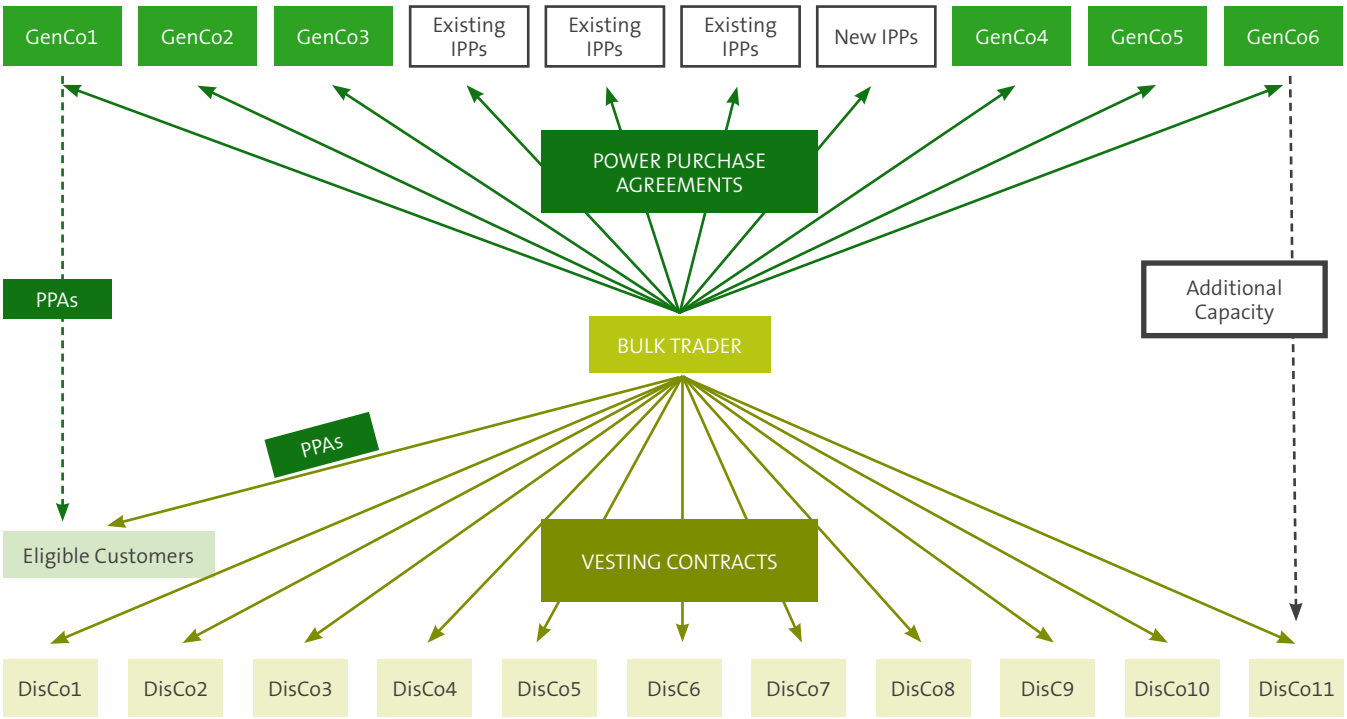
Unsolicited bids:
NBET's unsolicited power procurement

STEP 1

NBET has four mandatory requirements for its due diligence exercise:

1. Land: NBET will request for any one of the following documents relating to your land:
   I. Registered title deed to project site land.
   II. Notarized sale agreement of the project site land.
   III. Deed of assignment of the project site land.
   IV. Evidence of submission of a title deed to a relevant land processing agency regarding the project site land.
2. ESIA: The Environmental and Social Impact Assessment (ESIA) has to be completed. An ESIA is required for the project which meets the Federal Ministry of Environment

Figure 6.4 **NBETs role and position (GIZ, 2014)**



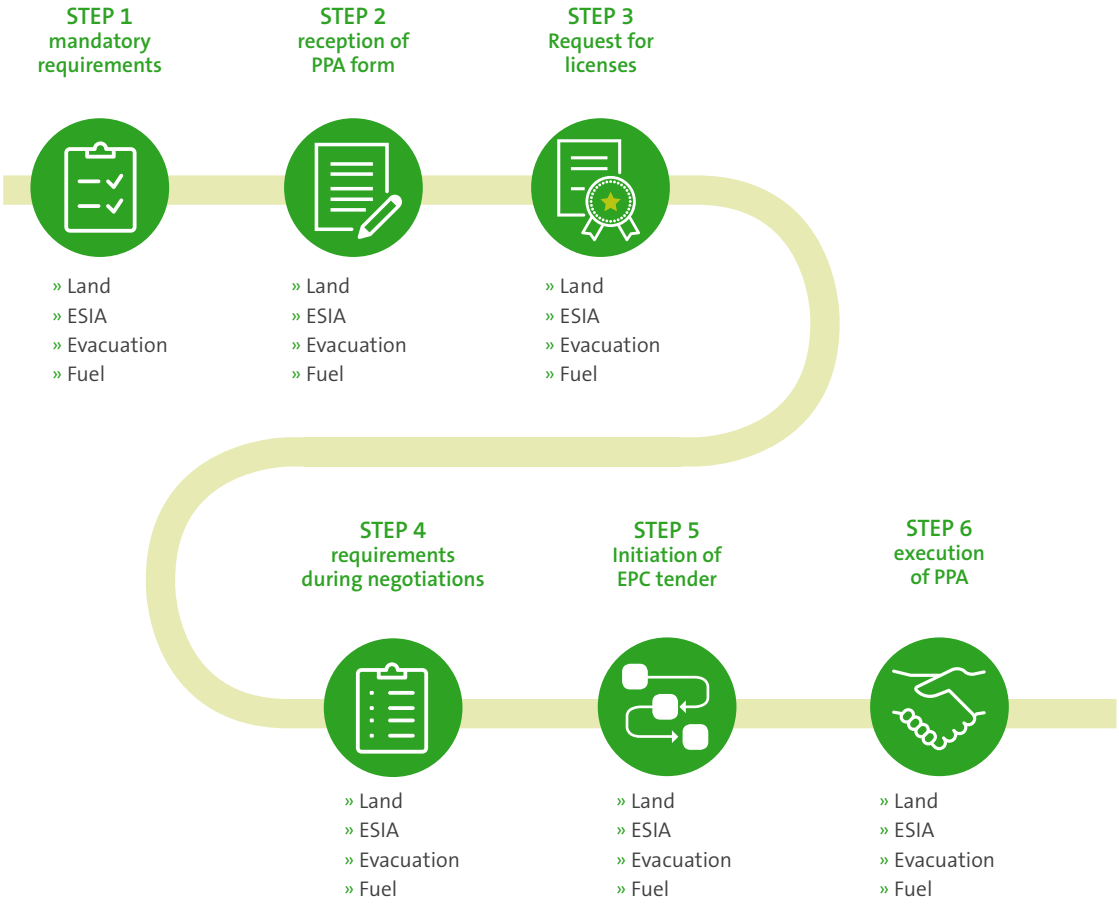


Figure 6.5 Overview of NBETs 'step-by-step guide' for unsolicited bids (adapted from NBET)

standards. The final and complete ESIA for the project and also the evidence of approval from the Federal Ministry of Environment must be submitted to NBET.

3. Evacuation: A comprehensive evacuation study at the project site must be completed and the project must get a provisional evacuation approval from the Transmission Company of Nigeria (TCN). This will provide NBET the assurance of no stranded generation capacity.
4. Fuel: In case of gas based electricity generation, NBET requires a gas supply agreement from a reputable gas supplier.

The above are the four mandatory requirements that must be met before NBET starts any negotiation with IPPs. Additional due diligence documents the developer should provide include information on:

- Project partners – sponsors, technical and financial partners.
- Status of license application and other permits.
- Project – capacity, technology, initial timelines.

STEP 2

Once the developer satisfies NBET's four mandatory due diligence requirements, NBET will share the Form PPA with the developer to review before commencement of PPA negotiations. All proposed modifications to the Form PPA should be inserted in Schedule 1, and

are subject to agreement between both parties. The developer will be charged a token fee for due diligence verification.

STEP 3

If a developer does not have a generation licence, but has completed the bulk trader's four mandatory requirements, a Letter of Intent will be issued to NERC indicating NBET's commitment to procure power from the developer.

STEP 4

Prior to the PPA negotiations, the developer is required to provide an 'Issues' list concerning his review of NBET's Form PPA. Consequently, a date will be scheduled to discuss the issues list and other Project Agreements.

NBET requires the following documents from the developer during PPA Negotiations:

- Financial Model
- For a renewable plant: the Energy Yield Report
- Transmission Use of System Agreement (TUOS)

STEP 5

The developer is required to initiate a tender process for its Engineering, Procurement & Construction (EPC) contract: the developer must exercise due care in the execution of the EPC contract. NBET will not entertain any requests from the developer to cater for project cost over-runs after the PPA has been executed. Two other Agreements to be tendered alongside the EPC are the Long Term Service Agreement and the Operation & Maintenance (O&M) Agreement.

STEP 6

Finally, when NBET and the developer agree on the terms in the PPA, the tariffs, and the developer has completed his bid for the appointment of an EPC contractor and O&M contractor in addition to having his LTSA executed, both parties will execute the PPA.

Competitive procurement: NBET's competitive power procurement

Before a developer goes into the expression of interest (EOI) it is expected that some level of development is done. Once the EOI stage is completed, the project will enter the Request for Proposal (RFP) stage where the following documents will have to be shared:

- PPA template
- Put or Call Option Agreement
- Grid Connection Agreement
- Partial Risk Guarantee

Moreover, any project developer should meet four criteria before the PPA is signed:

- Land title
- Evacuation approval from the TCN (see also below)
- ESIA from the Federal Ministry of Environment, done to meet World Bank standard
- Yield study completed

Timeline for acquiring PPA

The timeline for acquiring a PPA through competitive procurement from NBET is a function of how good the documents for request for proposal (RFP) are, according to NBET officials. Typically, a six to nine-month period is expected between the date of advertising for the EOI to when the PPAs are signed. Then the developer is given another twelve months to meet the conditions precedent in the PPAs before reaching financial close. To finish the bidding process, you need to meet the condition precedence (CP) to be able to reach financial closure which is dependent on the project developers.

Fees for the competitive bid

Fees for the competitive procurement phase are yet to be made public. As it is, there is a bond for the RFP that must be put in place to confirm investor commitment. This bond will be returned to unsuccessful bidders, but will be kept when the bidder is successful. After emerging successful, a developer will be given a time limit to meet the financial closure. If not met, the project developer forfeits the bond. When financial closure is met in time, the developer has an option to convert the bond into a performance bond.

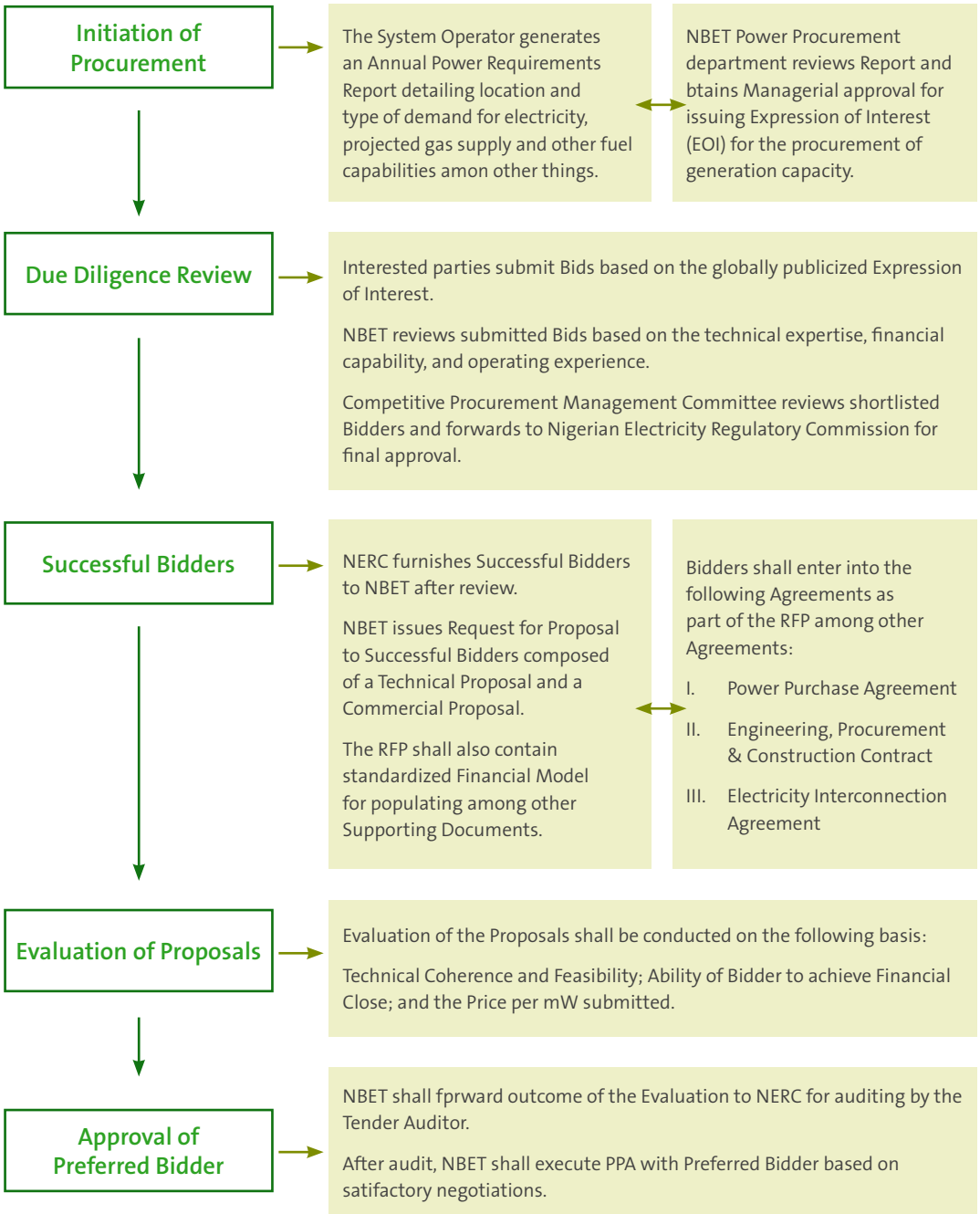


Figure 6.6 Overview of NBETs process for competitive procurement (NBET)

Application for Provisional Approval (PA) to TCN

Any prospective grid-connected IPP is required by NERC to obtain a provisional approval from TCN which will show that the TCN has the capacity to evacuate the power generated on site.

The procedure required for an IPP to have their produced power be transmitted by the TCN is depicted in Figure 6.7. It is necessary to conduct an "evacuation study" which in the past was done by TCN, but these days the TCN has an approved list of consultants who perform this study. The provisional approval allows the prospective IPP to connect to the grid and from this point the IPP promoter can go to NERC to start processing a licence. The evaluation of the evacuation study is done free of charge by the TCN.

Note that just before publication of this document the management of the Transmission Company of Nigeria has changed when the contract with the Canadian company Manitoba was not renewed. There may be new processes and regulations as a result.

Stakeholder feedback on liaising with regulatory bodies

The processes for licencing and other legal requirements for starting and running a power plant can be quite complex. There are a lot of processes that are not explicitly stated. The system lacks standardisation; therefore, different entities may be subject to varying licencing processes. These processes are seen to be in constant flux.

In addition, stakeholders interviewed for this report mention the following challenges:

» Planning processes are interrupted by different political administrations and the involvement of different government agencies.

Procedure required for an IPP to have their produced power be transmitted by the TCN

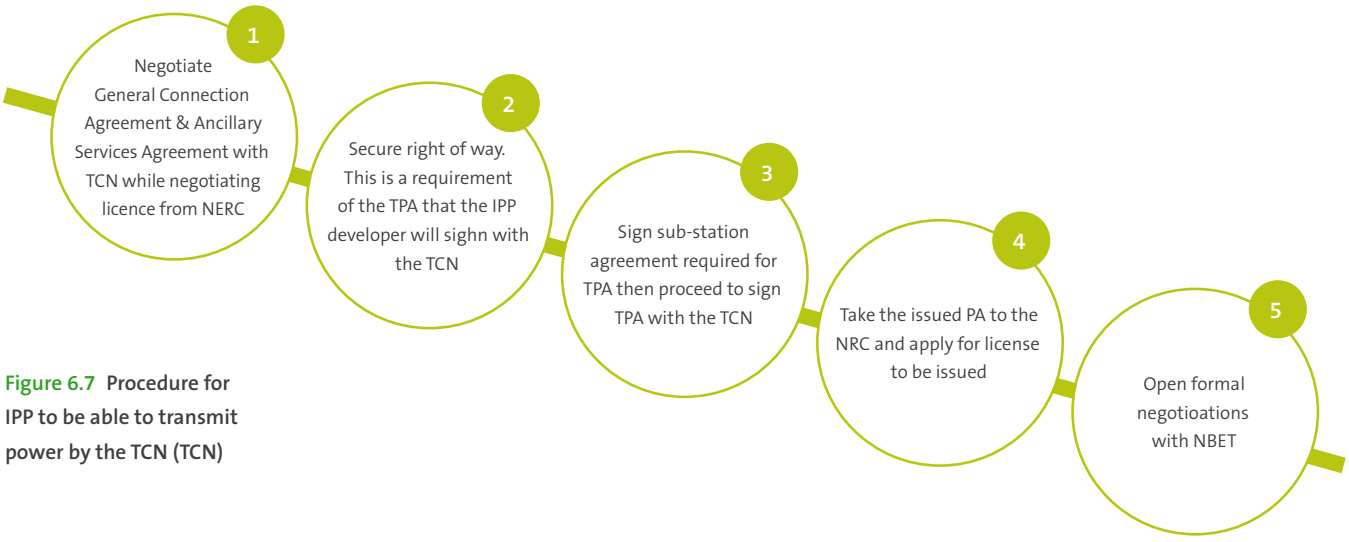


Figure 6.7 Procedure for IPP to be able to transmit power by the TCN (TCN)

- Lack of transparent and competitive bidding for a power project.
- Many PPAs are structured as "take-or-pay" agreements, which means that the purchaser will pay the seller not only for the power actually delivered to the point of delivery, but also for "available capacity," or power that would have been delivered but for the curtailment. The unnecessarily long duration of a power purchase agreement (PPA) will lock in a high cost structure in the grid system because of this take-or-pay clause in the agreement.
- Regulatory governance is not sufficiently transparent or accountable.
- Unpredictability of the regulatory decisions.
- Poor communication within the agencies.

While many developers report challenges with the regulatory process, there are also entities that call the process smooth. From the interviews conducted for this report, it emerges that the challenges were more pronounced at the beginning of the privatization process, but great efforts to streamline the process have been made recently. Furthermore, officials show a willingness to support project developers, even if they sometimes lack the specific knowledge required. This holds particularly for renewable energy, as most officials are more informed about conventional energy. The only regulatory difficulty remains with off-grid/ mini grid projects, for which there is no clear regulatory framework yet.

Some of the larger, foreign-backed players in the industry confirm that the regulators tend to listen to industry players. Moreover, the feedback is that it is possible to deal with the government in a transparent and effective way as well.

Other relevant regulations

Obtaining land rights

Purchasing or leasing land, and obtaining the right of way are described as some of the major hurdles by our respondents. However, it is important to note that in Nigeria, acquiring land and the right of way is only one step: a project developer also should bring the local community on board before, during and after this process. While this is not a regulatory requirement, it is essential in the Nigerian context. It is not uncommon for local communities to demand free electricity for hosting a power plant in their area, or to demand employment and training for the youth.

State Governors grant statutory right of occupancy and determine lease conditions on both urban and non-urban land, with ease periods of up to 99 years for residential plots and 40 years for industrial plots. Nigeria has no restrictions on property ownership by non-residents. However, a foreigner or foreign entity must obtain written approval of the Governor of the State in which he or she wants to buy land, before the transaction can be executed. Moreover, a foreigner can obtain these land rights for only 25 years.

The Land Use Act as amended in 2004 establishes a uniform system of landholding for the entire country. Land acquisition in Nigeria involves the same basic legal principles, regardless of the particular State of the Federation in which the land is located. This provision does not discriminate between indigenes and non-indigenes. When properly applied it would mean all entities have equal opportunity for acquiring land throughout the entire country.

While the Act applies to the entire country, there are differences in some processes and fees between States, and any project developer would do well to check such specific requirements.

Procedure for right of way acquisition

Acquiring the Right of Way is a necessary step when setting up a power plant. It must be secured from the State government for the construction of the spur line that will connect a power plant to the approved connection point. This is a requirement of the Transmission Project Agreement that the power project developer will also sign with the TCN.

The procedure for right of way acquisition is divided into four steps. These steps are:

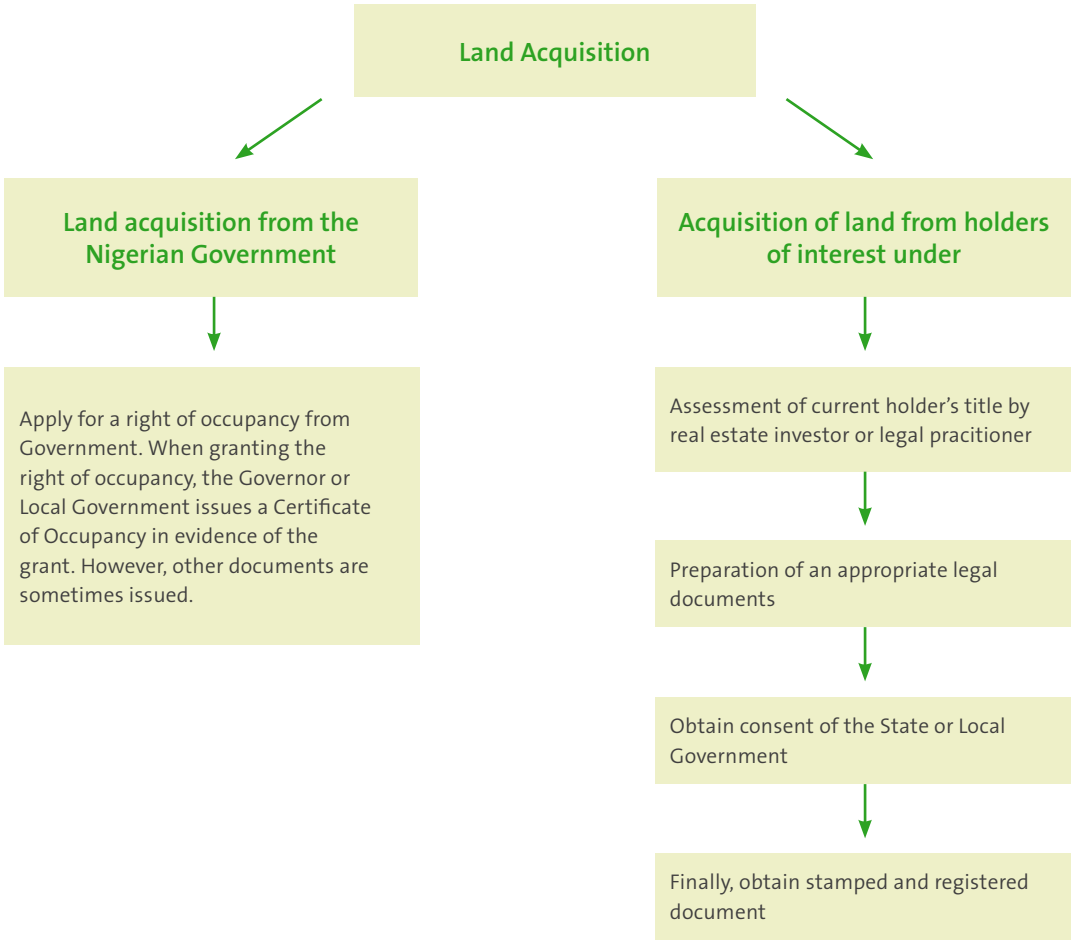
Step I: Notification / Sensitization

Notification and sensitization of State and Local Government(s), communities as well as individuals affected.

Step II: Identification, Census, Enumeration and Valuation

After the approval of the route survey and line profile by TCN, census, enumeration and valuation of properties along the right of way (ROW) were commenced by representatives. Claimants are notified of the date of enumeration of their properties in specified areas. They are required to be present to identify their property.

Figure 6.8 Procedure for land acquisition



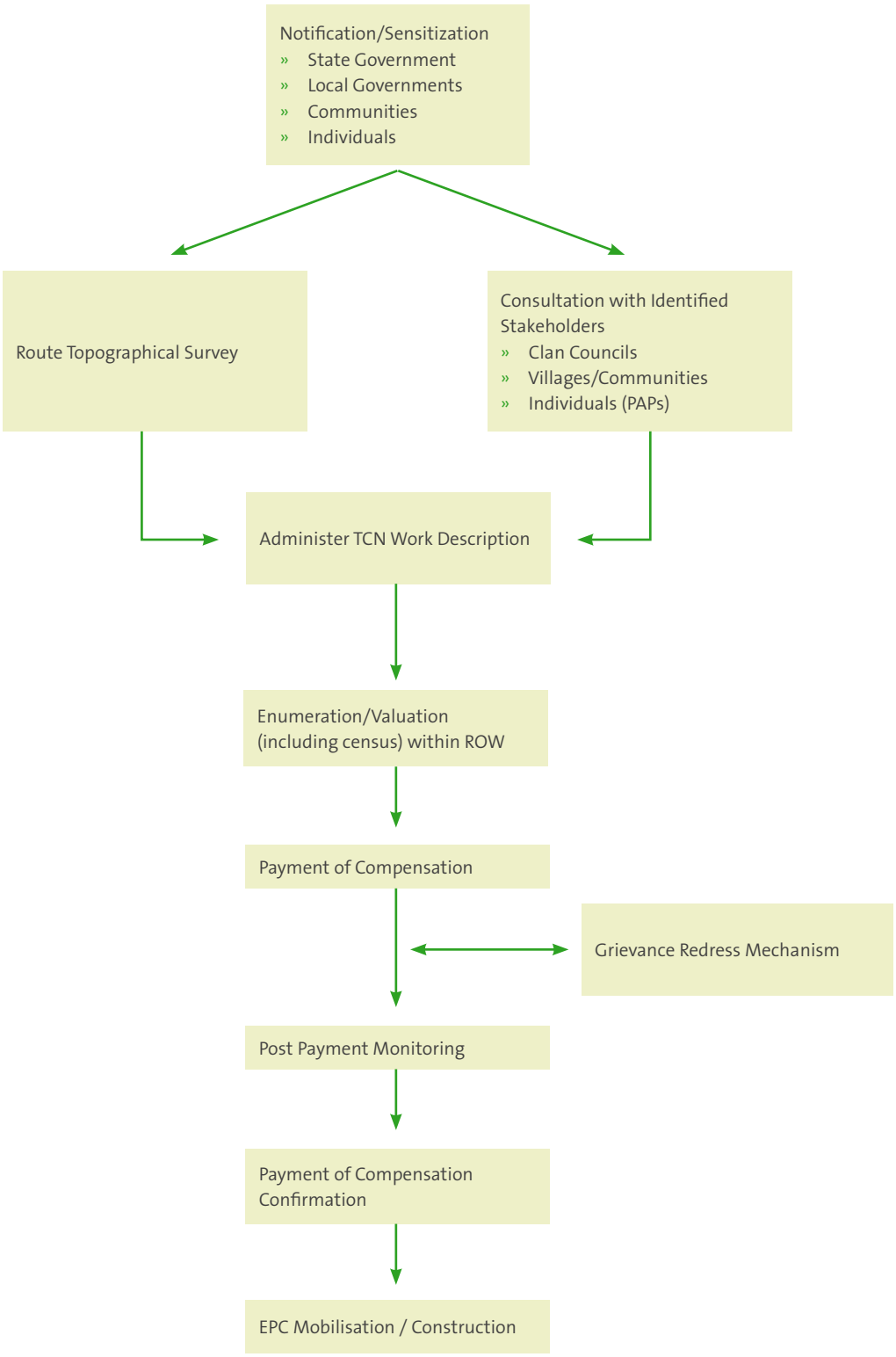


Figure 6.9 Procedure for right of way acquisition

Step III: Payment of Resettlement/Compensation

Payment of compensation is based on the value of affected properties. Payments are made directly or indirectly to the owners of the property after consultations with affected parties.

Step IV: Post-compensation Issues

Project Affected Persons will be encouraged to direct all post-compensation grievances to TCN for investigation and verification through the Grievance Redress Committee. Work activities will not commence until resettlement/compensation payments have been made to all affected persons.

Regulations on foreign investment

The Nigerian Investment Promotion Council (NIPC) is a one stop investment centre for the registration of Foreign Businesses in Nigeria. General rules of registering a business in Nigeria with the Corporate Affairs Commission, Federal Inland Revenue Service etc. also apply for investors, but foreign investors will be required to register with NIPC as well as the Ministry of the Interior and the Ministry of Power. The full registration process takes around 30 days. In 2016 Nigeria ranked 139th out of 189 countries in the category "starting a business" – a deterioration of the 2015 ranking (131), but a higher ranking than for most of the other indicators Nigeria was ranked on.

The NIPC Act of 1995 allows full foreign ownership of firms, except in the oil and gas sector where investment stays limited to joint ventures or production-sharing agreements.

Power project developers are afforded pioneer status. Under this rule power companies are granted a statutory three year company income tax holiday and an additional two years if they satisfy certain conditions.

Foreign investors must register with the NIPC after incorporation under the Companies and Allied Matters Decree of 1990. The Act prohibits the nationalization or expropriation of foreign enterprises except in cases of national interest.

This regulation is done with the Corporate Affairs Commission. Other agencies that play a role in relation of foreign investment in Nigeria are the National Office for Technology Acquisition & Promotion (NOTAP), the Ministry of Internal Affairs with the Nigerian Immigration Service. Nigerian laws apply equally to domestic and foreign investors. Relevant laws include:

- The Nigerian Oil and Gas Content Development Act 2010,
- Nigerian Minerals and Mining Act of 2007,
- Nigeria Extractive Industries Transparency Initiative (NEITI) Act of 2007,
- Central Bank of Nigeria Act of 2007,
- Electric Power Sector Reform Act of 2005,
- Money Laundering Act of 2003,
- Investment and Securities Act of 2007,
- Foreign Exchange Act of 1995,
- Banking and Other Financial Institutions Act of 1991, and
- National Office of Technology Acquisition and Promotion Act of 1979

Regulations on export of capital and profits

Investments in form of share capital contribution or loans may be made in foreign currency but information on such transactions must be submitted to the CBN by the dealer within 24 hours in order to obtain a Certificate of Capital Importation (CCI).

The following can be repatriated without hindrance provided the foreign investor has a CCI:

- Dividends, rent, royalties, profits (net of taxes) attributable to the investment.
- Payment of interest and capital on foreign loans.
- The remittance of proceeds (net of taxes) and other obligations in the event of a sale or liquidation of the enterprise or any interest attributable to the investment.

Authorized dealers of foreign currencies need to notify the CBN of any cash transfer to or from a foreign country of any sum in excess of $ 10,000. A tax clearance certificate is required to remit dividend and interest out of the country.

Security of investment

World Bank guarantee products provide credit support to the Nigerian Bulk Electricity Trading Company PLC as it enters into power purchase agreements with successor generating companies and existing independent power producers (IPPs) as well as potential new entrants into the power generating market. The Multilateral Investment Guarantee Agency (MIGA)'s mandate is to promote foreign direct investment (FDI) in developing countries by providing guarantees (political risk insurance and credit enhancement) to investors and lenders. MIGA's guarantees protect investments against non-commercial risks and can help investors obtain access to funding sources with improved financial terms and conditions. Covers are against Currency Inconvertibility and Transfer Restriction / Expropriation / War, Terrorism, and Civil Disturbance / Breach ofContract.[29]

The Business Environment

Nigeria is known to be a difficult country for doing business; the World Bank consistently ranks Nigeria in the lower regions (see also the first chapter). Generally speaking, there are many inefficiencies and bottlenecks in Nigeria. The result is a relatively high cost for executing any project, and for doing business altogether.

Project developers have developed strategies on how to overcome these challenges, some of which are highlighted below. A fundamental challenge experienced by investors in the Nigerian power sector is the lack of integrity and frequent breaches of contracts. Equally challenging is the financial environment.

Financial considerations

Investors are concerned about the bankability of their project ideas and see the market as challenging at the moment. Financial Derivatives Company states in one of its reports that the Multi-Year Tariff Order (MYTO) is not cost reflective as most NERC allowable revenue variables (exchange rate, inflation, gas cost etc.) are not in tandem with current macroeconomic landscape thus with implied implication on a company's profitability. This means that without a proper change in the electricity tariff, it will be very difficult to actually make money. Recently the tariff was increased, giving the industry hope, but that decision has been overturned and is currently being fought in court. It is uncertain if a tariff reflecting all costs will be allowed in the near term. This puts further pressure on the developers, in an environment where the earning model is faulty, or rather: where project developers have little influence over the payments they can receive.

Some say the private power market has not yet developed to the stage the government expected that it would be by now. There are a large number of projects NBET is considering at the moment but they are not yet viable, essentially because DisCos have difficulties collecting money and paying the players up the value stream through NBET.

Banks have become reluctant to finance as they consider the risk of default to be high. Furthermore, project developers have limited access to funds in capital markets due to the lack of confidence the financiers have in the government vis-à-vis their obligations, and the local banks' exposure to the under-performing loans of the parties that bought the industry assets upon privatization. Even for smaller and renewable projects, the cost of technology is relatively high. For project developers it is

29) http://siteresources.worldbank.org/EXTGUARANTE/Resources/structure.pdf

moreover important to have multiple streams of investment to reduce risk and increase total investment.

Strategies proposed by stakeholders to overcome key challenges

Doing business in Nigeria is far from easy, and for a project developer in a changing and relatively new sector it can be even more challenging. Stakeholders have developed many strategies and advice for (international) project developers and investors, and their input can broadly speaking be clustered as per the paragraphs below.

Be flexible and willing to adjust

A developer needs to be flexible and willing to adjust with time. Essentially, investors need to understand that the rules and road map are not very clear, and should be able to accommodate for that. You also need to be patient, and be able to be patient in terms of resources. If you can buffer your one or two years of instability getting all your contracts signed, then you are good. Some officials are better than others, which is also why several experts would recommend that a project developer selects a forward thinking and cooperative State when deciding on the venue for the power plant.

However, being flexible does not equate with 'bribing your way'. While many of the industry stakeholders interviewed confirmed that corruption is still a problem in the sector and that you should take on a local 'consultant' to pave the way, you don't have to make the problem worse by taking bribery as your first strategy. Instead, your strategy should be to always be transparent, take everyone along in the process, inform diligently, and build capacity/ knowledge, including with those in charge.

Work with a local partner

In nearly every sector in Nigeria, market entry and development is greatly facilitated when working with a local partner. However, it has to be the right partner, as having the wrong partner can set you back significantly. This means the partner should have the right background, track record, connections and financial capacity to be of support.

Some officials and experts interviewed recommend that foreign investors work with local parties, but that they should also ensure that this local developer has the right documentation and commitment to their project. Foreign investors should verify those documents presented by local developers before commencing the project; due diligence is an integral part in selecting a partner.

When it comes to identifying a local technical partner, project developers should be aware that their capacity is often insufficient, as several of the respondents mentioned. Therefore, several recommend a foreign developer should identify strong international (technical) partners to work with, since local capacity is not yet good enough for large projects in terms of delivering within time and budget, and installing the right infrastructure.

Secure financial viability of your project

Financial concerns are significant, as noted above. Therefore, it makes sense to set up power projects where you can directly sell to clients who you can directly negotiate a price with. This is however often not possible in practice due to regulatory constraints. For non-captive projects it would only be possible in an embedded structure, with a DisCo that is financially strong and committed. This structure is pioneered by Egbin Power Plant, as discussed before.

Be as self-reliant as possible

As several of our respondents argue, the less you require from the government the faster you succeed in setting up your plant. But this independence should stretch to ensuring control over the entire value chain, starting with owning the land on which you base the power plant as well as having ownership and maintenance of power lines under own control. The thought is by 'controlling' or having a stake in the entire value chain you can avoid challenges that might otherwise arise.

Ultimately, doing business in Nigeria will not be easy and the power sector may be even more challenging than some of the other sectors. However, it is possible to get things done. As one of the experts put it: "Don't be opportunistic and think that e.g. with the right government connections you can quickly make money. Instead, be realistic and have a long term focus."


WH.. Be Punctual!! Do it
Always Remember
Safety
EGBIN POWER PLC
UNITS
INSTALLED CAPACITY
CURRENT LOAD/ GENERATION
ST-1 220MW 0MW
ST-2 220MW 0MW
ST-3 220MW 220MW
ST-4 220MW 0MW
ST-5 220MW 0MW
ST-6 220MW 220MW
TOTAL 1320MV
egbin

ANNEXES

ANNEX A. REFERENCES

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ANNEX B.
LIST OF FREE TRADE ZONES IN NIGERIA

Sixteen FTZ's are focussed on Manufacturing and one on Food Processing.

#	Name	Location	Date of designation	Specialty
1	Calabar Free Trade Zone	Cross River	June 14, 1905	*Manufacturing*, Oil & Gas, Logistic Services
2	Kano Free Trade Zone	Kano	June 20, 1905	*Manufacturing*, Logistic Services, Warehousing
3	Tinapa Free Zone & Resort	Cross River	October 7, 2004	*Manufacturing*, Trade, Tourism & Resort
4	Snake Island Int. Free Zone	Lagos	April 4, 2005	Steel Fabrication, Oil & Gas, Sea Port
5	Maigatari Border Free Zone	Jigawa	June 22, 1905	*Manufacturing*, Warehousing
6	Ladol Logistics Free Zone	Lagos	June 21, 2006	Oil & Gas, Fabrication, Oil & Gas Vessels, Logistics
7	Airline Services EPZ	Lagos	March 21, 2003	*Food Processing* and Packaging
8	ALSCON EPZ	Akwa Ibom	June 1, 2004	*Manufacturing*
9	Sebore Farms EPZ	Adamawa	December 21, 2001	*Manufacturing*, Oil & Gas, Petrochemical
10	Ogun Guandong FT Zone	Ogun	February 28, 2008	*Manufacturing*
11	Lekki Free Zone	Lagos	December 4, 2008	*Manufacturing*, Logistics
12	Abuja Tech. Village Free Zone	FCT	May 18, 2007	Science & Technology
13	Ibom Science & Tech. FZ	Akwa Ibom	July 14, 2006	Science & Technology
14	Lagos Free Trade Zone	Lagos	October 4, 2002	*Manufacturing*, Oil & Gas, Petrochemical
15	Olokola Free Trade Zone	Ondo & Ogun	June 26, 1905	Oil & Gas and *Manufacturing*
16	Living Spring Free Zone	Osun	October 12, 2006	*Manufacturing*, Trading and Warehouse
17	Brass LNG Free Zone	Bayelsa	February 2, 2007	Liquefied Natural Gas
18	Banki Border Free Zone	Borno		*Manufacturing*, Warehousing, Trading
19	Oils Integrated Logistics Services Free Zone	Lagos	October 12, 2004	Marine, Logistics, Support Services for offshore Oil Repairs
20	Industrial FTZ	Ogun	April 30, 2007	Rail Cargo Transport
21	Imo Guangdong FTZ	Imo	May 7, 2007	*Manufacturing*
22	Kwara Free Zone	Kwara	July 10, 2009	Trading, Warehousing
23	Koko Free Trade Zone	Delta	December 2, 2009	*Manufacturing*
24	Oluyole Free Zone	Oyo	May 16, 2000	*Manufacturing*
25	Ibom Industrial Free Zone	Akwa Ibom	Feb 20, 2012	*Manufacturing*, Oil & Gas, Trading Services

Figure B.1 List of Free Trade Zones in Nigeria (GN)

Source: http://www.nigeriatradehub.gov.ng/Portals/0/Documents/LIST%20OF%20FREE%20TRADE%20ZONE%20IN%20NIGERIA.pdf

ANNEX C.
OVERVIEW AND ANALYSIS OF NERC LICENSES AND PERMITS

Since 2013, progress has been made with policy reforms for renewable energy, energy efficiency and rural electrification. The focus of the reforms has however been on grid-connected electricity production. A very limited set of relevant policies and regulations is applicable to the captive power sector.

From REGULATION NO: NERC-R-0108 the following definitions are derived:

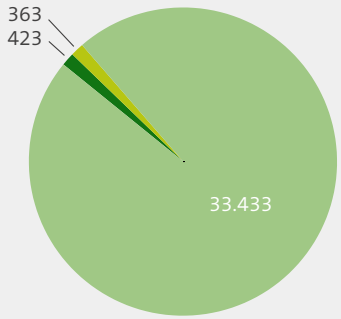
- Captive power means generation of electricity exceeding 1 MW for the purpose of consumption by the generator itself, and not sold to a third-party.
- Any person wishing to construct, own, maintain, install, and/or operate a captive generating plant shall first apply for and obtain a permit issued by the NERC.
- A permit holder must apply for, and receive prior written consent of the NERC before supplying surplus power not exceeding 1 MW to an off-taker.
- A permit holder who intends to supply surplus power exceeding 1 MW to an off-taker must apply for a generation licence in compliance with the provisions of Section 62(2) of the Act.

Licenses

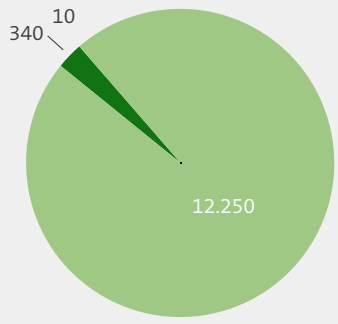
Based on an overview (Figure C.1 and Figure C.2) of the licenses, the following can be concluded:

- The majority (98%) of licensed generation capacity is grid-connected.
- A little bit over a third (37%) of the licensed generation capacity is actually operational.
- Three quarters (77%) of licensed renewable generation capacity (1.969 MW) is from hydro power.
- Of the licensed renewable generation capacity only hydropower is actually operational (1.930 MW).
- Since 2013 the number of issued (and probably also requested) generation licenses and the overall generation capacity (in MW) is declining. An exception is the number of 'small' (<100 MW) renewable energy projects. Between 2011–2015 the number of issued licenses has grown gradually to four annually.
- Embedded power generation is almost non-existent.

Licensed generation capacity (MW)



Licensed operational generation capacity (MW)



Captive and surplus power means: generator produces electricity mainly for own use but sells electricity (in excess of 1 MW) to an off-taker.

Figure C.1 Issued licenses for generation capacity (NERC, January 2016)

Permits for captive power projects

Based on an overview (see Figure C.5 – Figure C.7) of captive power permits (5-year tenure) that have been issued by NERC between 2010 and 2013 (www.nercng.org), the following can be concluded:

- In total 1.300 MW of Captive Power permits have been issued.
- 78% of the permits were issued in three states: Akwa Ibom (22%), Ogun (25%) and Rivers (31%); the major industrialised and oil and gas states.
- The majority of the issued permits (23; 46% of the total) is for the oil and gas sector and this sector also represents the highest planned generation capacity; 941 MW, 72% of the total planned capacity.
- The agri-food sector is second with ten permits and planned generation capacity of 121 MW (9%).
- It is unclear if there are renewable energy projects amongst these captive power projects but it seems unlikely.

A rough estimation of the total market for self-generated power in Nigeria is between 14 and 20 GW, while the total issued licenses and permits for captive power add up to about 1.700 MW. This reveals that a large share of the self-generated power market has a maximum generation capacity below 1 MW and / or captive power generation is not accounted for in the overviews of permits and licenses that are available.

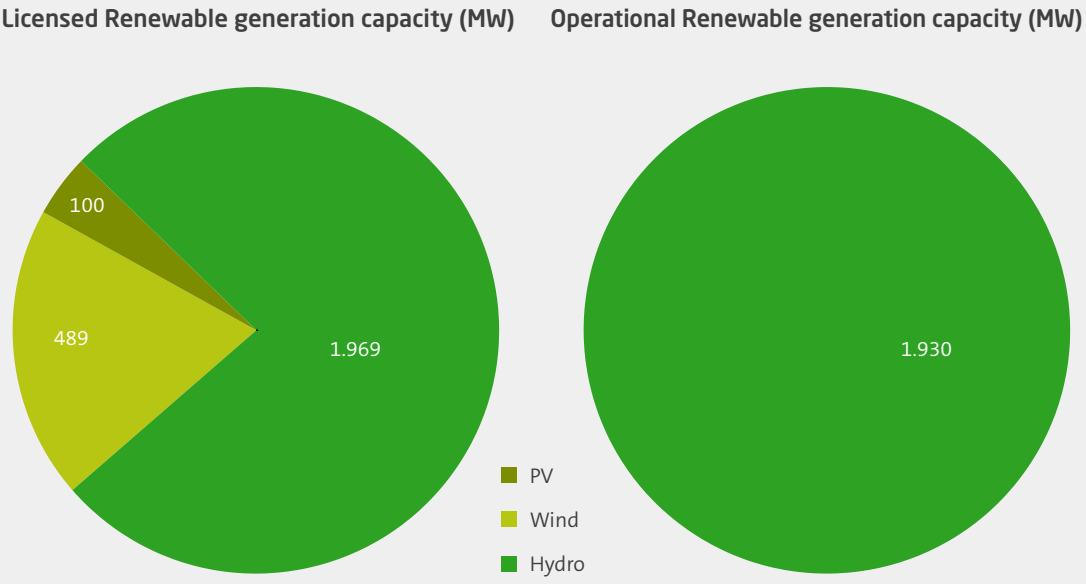


Figure C.2 Issued licenses for renewable generation capacity (NERC, January 2016)

Issued generation licences

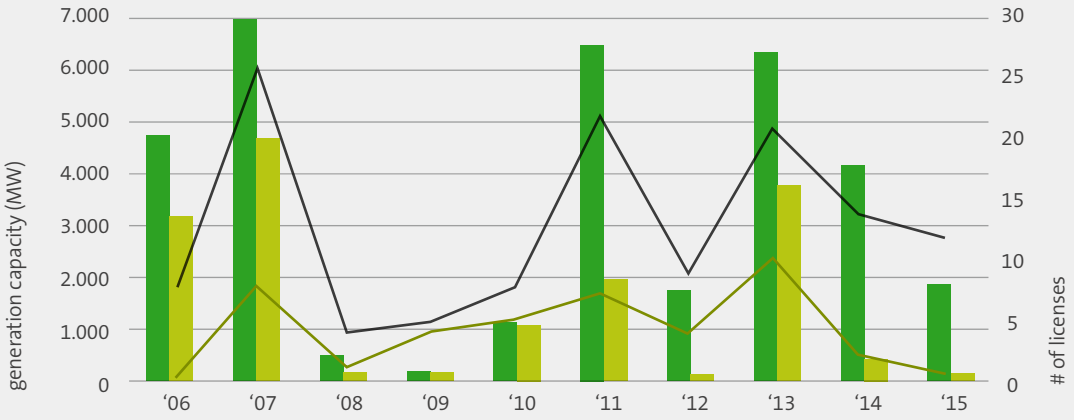


Figure C.3 Overview of issued generation licenses [NERC, January 2016]

Issued Renewable generation licenses

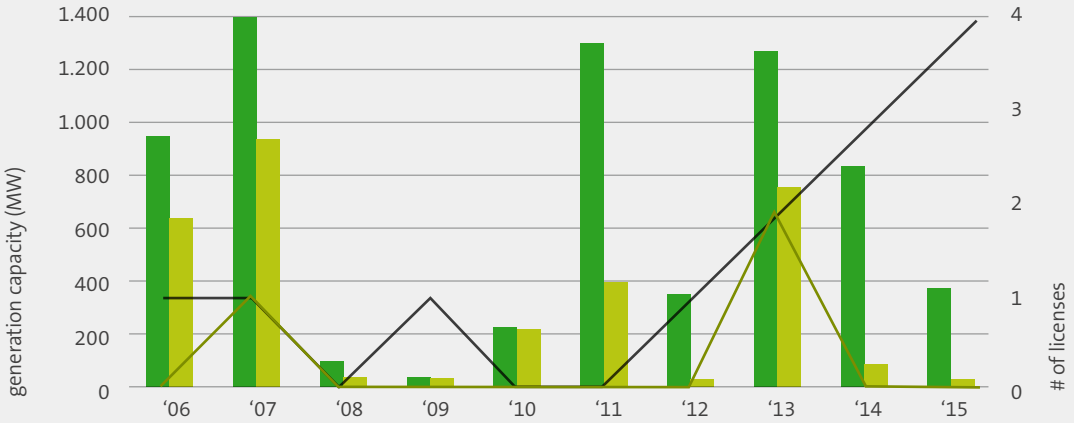


Figure C.4 Overview of issued Renewable generation licenses (NERC, January 2016)

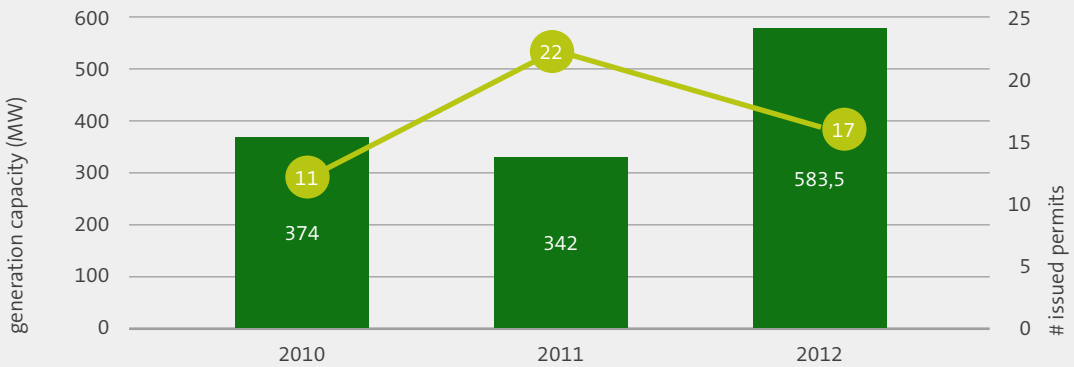


Figure C.5 Overview of issued Captive Power permits 2010–2013 (NERC)

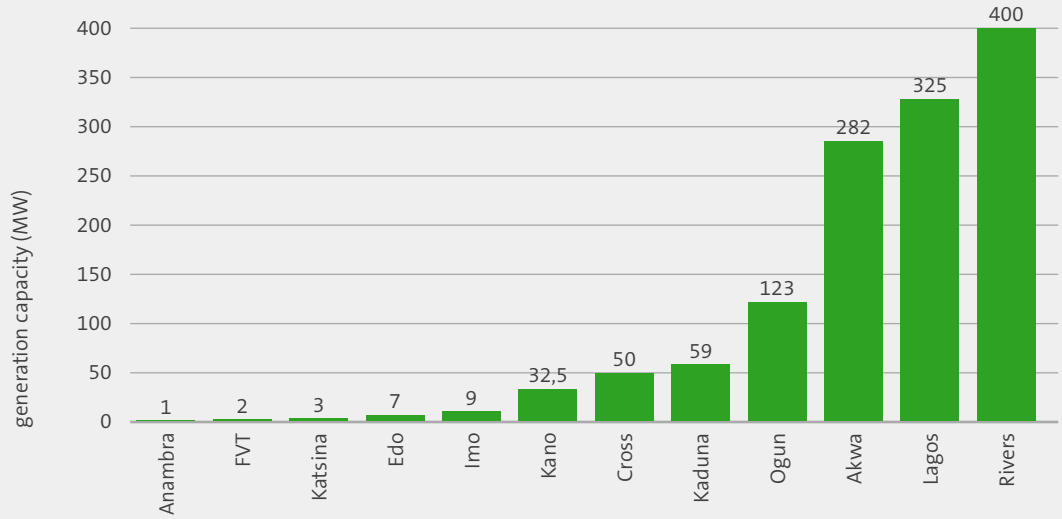


Figure C.6 Overview of issued Captive Power permits per state between 2010–2013 (NERC)

Captive Power permits issued by NERC

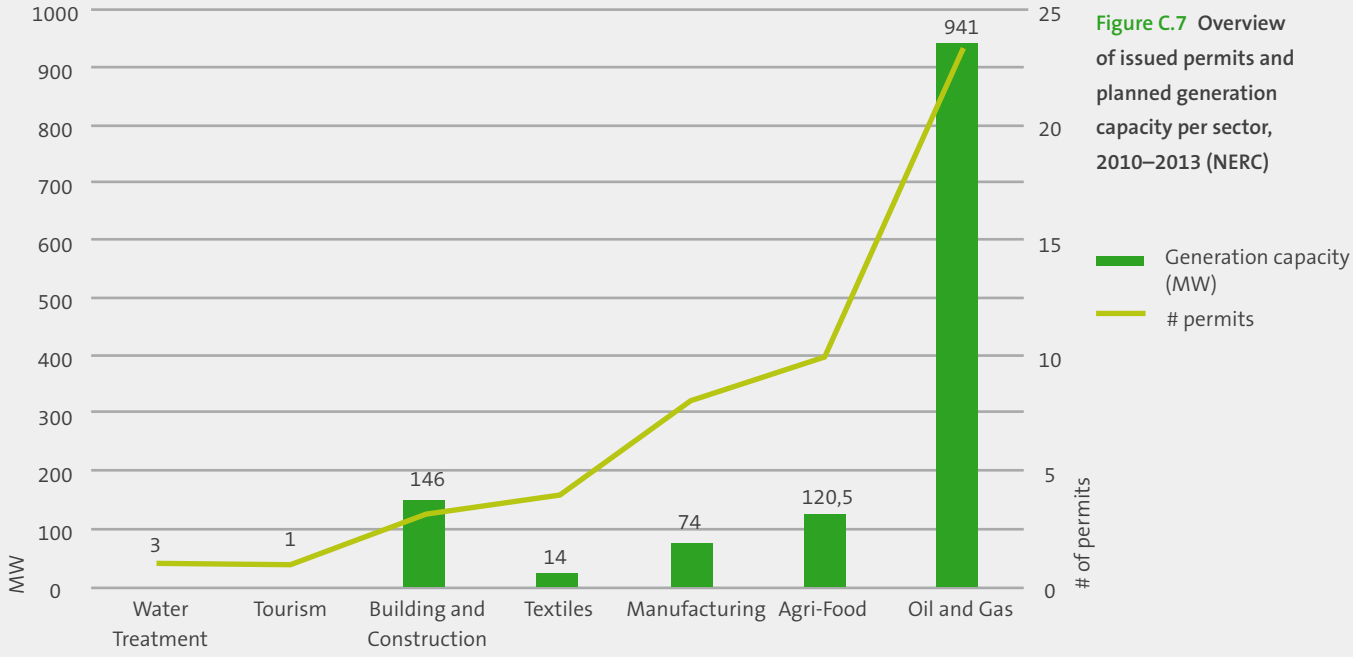


Figure C.7 Overview of issued permits and planned generation capacity per sector, 2010–2013 (NERC)

ANNEX D.
PLANNED RENEWABLE ENERGY PROJECTS

The tables below present an overview of renewable energy projects that have been announced. The status of these projects and the likelihood these projects will be completed, is unknown.

SOLAR AND WIND ENERGY PROJECTS	CAPACITY (MW)	PROPONENT
SOLAR-WIND FARM AT ATACHIDA TOWN, WURNO LGA, SOKOTO STATE.	50	FALMATA AND HINNAI NIG. LTD.

Figure D.1 Hybrid Solar-Wind power systems under development (CRET, 2015; Federal Ministry of Environment)

S/N	SOLAR ENERGY PROJECTS	STATE	CAPACITY (M/W)	PROPONENT
1	PV GRID - TIED GENERATOR SYSTEM AT ATAKUMOSA WEST LGA	OSUN	50	ROOK SOLAR INVESTMENT LTD.
2	EVER POWER SOLAR POWER PLANT AT MANCHOK, KAURA LGA	KADUNA	50	QUAINT GLOBAL ENERGY LTD.
3	SOLAR FARM PROJECT AT NJUMTILO, MAIDUGURI	BORNO	200	BORNO STATE GOVERNMENT
4	SOLAR FARM AT KADO	KADUNA	59	SYNERGENT POWERSHARE NIG LTD
5	SOLAR INDEPENDENT POWER PROJECT, AT GANJUWA	BAUCHI	100	NIGERIAN SOLAR CAPITAL PARTNERS
6	ANJEED KAFANCHAN POWER AT ZIPAK, KAFANCHAN, JAMA'A LGA	KADUNA	50	ANJEED INNOVA LIMITED
7	SOLAR PHOTO-VOLTAIC POWER GENERATION PROJECT AT YABO LGA	SOKOTO	50	GEO ENVIRNMENTAL SERVICES
8	SOLAR FARM PROJECT AT KANKIA	KATSINA	30	KATSINA STATE GOVT
9	JAPANESE GRANT SOLAR POWER PLANT AT LOWER USMAN DAM	FCT, ABUJA	0.9	FED. MIN. OF POWER. ABUJA.
10	ON-GRID SOLAR POWER GENERATION AT USMAN DAM	FCT, ABUJA	200	99 EFFECTS ENERGY LTD
11	PHOTOVOLTAIC SOLAR FARM PROJECT AT KANKIA	KATSINA	20	KATSINA STATE GOVERNMENT
12	SOLAR PROJECT AT DANMARKE, BUNGUDU LGA	ZAMFARA	75	SPGS POWER LIMITED
13	SOLAR POWER PLANT, PANYAM DISTRICT, MANGU LGA	PLATEAU	50	CT COSMOS LTD
14	SOLAR FARM AT RIKO, JIBIYA LGA	KATSINA	10	SINOSUN INVESTMENT LIMITED
15	SOLAR GENERATION PLANT IN DAMATURU	YOBE	1000	GOPA INT'L ENERGY CONSULTANT
16	PHOTO VOLTAIC POWER PLANT IN DUKPA/WUNA, GWAGWALADA	FCT, ABUJA	100	LR-AARON POWER LIMITED
17	SHIRORO SOLAR POWER PROJECT AT SHIRORO LGA	NIGER	300	NORTH SOUTH POWER COMPANY LTD
18	SOLAR POWER PLANT AT ABULE OLOKUTA VILLAGE, IREWOLE	OSUN	50	ROMIX ENERGIES LTD
19	SOLAR POWER PLANT IN LAMBA VILLAGE, BAKURA LGA	ZAMFARA	150	PV BAKURA LIMITED
20	SOLAR POWER PLANT AT USO, OWO LGA	ONDO	25	CECUSAFE LIMITED

Figure D.2 Solar power systems under development (CRET, 2015; Federal Ministry of Environment)

21	SOLAR FARM AT GUSAU, GUSAU LGA	ZAMFARA	50	SINOSUN INVESTMENT LIMITED
22	SOLAR PANELLED POWER PROJECT, KEFFI LGA	NASSARAWA		AVENSOL SOLAR POWER NIG. LTD
23	SOLAR FARM AT KIRU LGA	KANO	40	BRAVOS ENERGY RESOURCES
24	SOLAR PROJECT IN KANKIYA LGA	KATSINA	125	NOVA SOLAR 5 FARMS LTD
25	SOLAR ENERGY PROJECT IN UDI LGA	ENUGU	1200	MOTIR SEASPIRE ENERGY NIGERIA LTD
26	SOLAR PLANTS IN DUTSE LGA	JIGAWA		NOVA SCOTIA POWER DEV LTD
27	SOLAR POWER PLANT (OROCERAM), ISOKUN OLOPAN, ILORIN SOUTH	KWARA	150	OROCERAM LIMITD
28	SOLAR POWER PLANT (OROCERAM), DOBWA JERE PAIKO LGA	NIGER	150	OROCERAM LIMITD
29	SOLAR POWER PLANT IN DUTSE LGA	JIGAWA	75	PAS DUTSE LTD
30	SOLAR POWER PLANT IN HADEJIA LGA	JIGAWA	75	PAS HADEJIA LTD
31	SOLAR ENERGY PROJECT AT GWAGWALADA AREA COUNCIL	FCT, ABUJA		SUPER SOLAR NIGERIA LTD.
32	SOLAR ENERGY PROJECT AT GWAGWALADA AREA COUNCIL	FCT, ABUJA	100	ENERLOG LIMITED
33	SOLAR POWER PROJECT IN YABO	SOKOTO	100	KVK POWER NIGERIA PVT LTD
34	SOLAR POWER PLANT IN KANKIA LGA	KATSINA	80	PAN AFRICA SOLAR LIMITED
35	SOLAR POWER PLANT AT LAMBAN VILLAGE, BAKURA LGA	ZAMFARA	300	BAKURA ENERGY LIMITED
36	SOLAR PLANT IN ONYI, KOKONA LGA	NASARAWA	50	AFRINGIA POWER LIMITED
37	SOLAR POWER PLANT AT NUMAN, NUMAN LGA	ADAMAWA	35	HILL CREST ENV. MANAGEMENT COY LTD.
38	RENEWABLE ENERGY AT OWO LGA	ONDO	10	GOTTPOWER LIMITED

S/N	WIND ENERGY PROJECTS	CAPACITY (M/W)	PROPONENT
1	WIND POWER PROJECT AT VWEI KURU, JOS PLATEAU STATE.	100	JBS WIND POWER LTD
2	WIND IN COASTAL AREA PROJECT IN LEKKI TOWN, LAGOS STATE		PRICEWATER HOUSE COOPERS LTD
3	WIND FARM POWER PLANT AT LAMBA, RIMI LGA, KATSINA STATE	10	FED. MIN. OF POWER
4	WIND FARM PROJECT AT ADO EKITI	8.5	ENERSYS NIG LTD
5	KATSINA WIND FARM	10	FED. MINISTRY OF POWER
6	CGC NIG. LIMITED LOCATED AT PLOT 674 CAD ZONE, ALONG LUGBE EXPRESSWAY, FCT ABUJA		CGC NIGERIA

Figure D.3 Wind power systems under development (CRET, 2015; Federal Ministry of Environment)

S/N	POWER STATION	CAPACITY (M/W)	COMPLETION YEARS
1	Zungeru, Niger State	700	2017[4]
2	Mambilla, Taraba State	3,050	2018
3	Gurara I, Niger State	30	2014
4	Gurara II, Niger State	360	N/A
5	Itisi, Kaduna State	40	N/A
6	Kashimbilla, Taraba State	40	2015
7	Kano, Kano State	100	2015
8	Zamfara, Zamfara State	100	2012
9	Kiri, Adamawa State	35	2016

Figure D.4 Hydropower systems under development (CRET, 2015)

WASTE TO FUEL ENERGY PROJECTS	PROPONENT
RENEWWABLE (GREEN) ENERGY WASTE/MANAGEMENT PROJECT AT UBIMA, RIVERS STATE	SIAT NIGERIA LTD (SNL)
60 MW WASTE-TO-ENERGY POWER PLANT AT IKORODU	HIGHLAND NIG LTD
GREEN ENERGY PRODUCTION SYSTEM- WASTE REDUCTION PRODUCTION AT BENIN/ SAPELE RD.	PRESCO PLC
BIOFUEL (BIOMASS AND WASTE) INJECTION AT SHAGAMU, OGUN STATE.	WAPCO

Figure D.5 Biomass and waste projects under development (CRET, 2015, Federal Ministry of Environment)

S/N	BIO FUELS ENERGY PROJECTS	PROPONENT
1	NNPC BIOMASS FUELS PROGRAMME (PLANTATION PROJECT)	
2	AUTOMOTIVE BIOMASS ETHANOL PROGRAMME AT AKURE	NNPC
3	INTEGRATED SUGARCANE PLANTATION AND ETHANOL DISTILLERY PLANT IN BURUKU, BENUE STATE	NNPC
4	INTEGRATED SUGARCANE PLANTATION AND ETHANOL DISTILLERY PLANT IN AGASHA, BENUE STATE	NNPC
5	AUTOMOTIVE BIOFUEL PROGRAMME AT EBENEBE ANAMBRA STATE	NNPC
6	INTEGRATED PALM OIL BASED BIODIESEL ON 25,000HA LAND SIZE IN IKOM CALABAR, CROSS RIVER STATE	RENEWABLE ENERGY DIVISION NNPC
7	CASSAVA-BASED ETHANOL PROCESSING FACILITY IN EKU/ABRAKA/ KOKORI IN ETHIOPE LGA IN DELTA STATE	LIFEWAY ETHANOL REFINERY LTD.
8	AFRO-FORESTRY JATROPHA CURCAS PLANTATION DEVELOPMENT PROJECT.	THRESHOLD BIOFUEL ENERGY COMPANY LTD.
9	180,000 LPD CASSAVA ETHANOL AND 100 TPD CASSAVA STORAGE/ FLOUR FACTORY AT IYAMERE IKOLE LGA, EKITI STATE.	

Figure D.6 Biofuels projects under development (CRET, 2015, Federal Ministry of Environment)

ANNEX E.
IDENTIFIED INVESTMENT OPPORTUNITIES ON THE LAKAJ AGRICULTURAL GROWTH CORRIDOR

Focussed Niger, Lagos and Ogun State (USAID, 2013)

Investment Type	Name	Brief Description	Investment Value(M/W)	
			Low End	High End
Production; Processing	Rice Production and Milling	Establish new rice production and milling sites involving smallholder farmers	$ 30,000,000	$ 100,000,000
Production; Warehousing and Logistics	Maize and Soybean Production and Storage	Increase size of maize and soybean production and create new storage and warehousing facilities	$ 15,000,000	$ 100,000,000
Processing	Maize and Soybean Processing Mills	Create new processing mills and link aggregators to these	$ 2,000,000	$ 5,000,000
Processing	Industrial Shea Processing	Establish industrial size shea processing facility	$ 3,000,000	$ 5,000,000
Production; Processing	Honey Production and Processing	Establish industrial size honey processing facilities	$ 100,000	$ 500,000
Production; Processing	Cassava Processing and Aggregation	Establish new cassava processing facilities and expand aggregation and market linkages with smallholder farmers	$ 5,000,000	$ 25,000,000
Processing	Cashew Processing and Aggregation	Establish an industrial size processing facility for cashew	$ 25,000,000	$ 30,000,000
Production; Processing	Cocoa Aggregation and Processing	Improve capacity of existing processing facility, improve yield and quality of multiple cocoa product lines	$ 3,000,000	$ 7,000,000
Production; Processing	Poultry Farming and Processing	Create a new poultry farm and/or processing facility	$ 3,000,000	$ 6,000,000
Production	Acquaculture	Create new acquaculture production sites	$ 2,000,000	$ 5,000,000
Production	Vegetable Production	Expand commercial vegetable production	$ 500,000	$ 2,000,000
Manufacturing	Agricultural Equipment Manufacturing	Increase productivity of an existing agro-allied equipment manufacturing plant	$ 2,000,000	$ 6,000,000
Warehousing and Logistics	Cold Storage Facility	Create a new cold storage facility in Lagos at the Inland Container Depot	$ 3,000,000	$ 7,000,000

Type of Financing	Type of Deal	State	Location Identified	Land Acquired	Value Chain
Working capital; CAP-EX	Greenfield	Niger	No	No	Rice
Working capital; CAO-EX	Joint venture or equity partnership	Niger	Yes (existing firms); new land for expanded production not yet identified	No	Maize and Soybean
CAP-EX	Greenfield, potentially joint venture	Niger	No	No	Maize and Soybean
CAP-EX	Greenfield, potentially joint venture	Niger	No	No	Shea
CAP-EX	Greenfield	Niger	No (unless co-located in new agro-industrial park)	No	Honey
CAP-EX; working capital	Greenfield	Ogun	No	No	Cassava
CAP-EX; working capital	Greenfield	Ogun	No	No	Cashew
CAP-EX; working capital	Greenfield	Ogun	No	No	Cocoa
CAP-EX	Greenfield, joint venture, acquisition	Lagos	No (unless rehabilitate existing infrastructure)	No	Poultry
Working capital; CAP-EX	Greenfield, joint venture	Lagos	No	No	Fish
Working capital; CAP-EX	Greenfield, joint venture	Lagos	No	No	Tomatoes, cucumbers, peppers, onions
Working capital; CAP-EX	Joint venture, equity partnership	Lagos	Yes (existing firm)	Yes	Infrastructure (mineral and agro-allied equipment)
CAP-EX	Greenfield	Lagos	Yes (Inland Container Depot)	Yes	Logistics

ANNEX F.
LARGE RICE MILLS IN NIGERIA

S/No.	Name	Location	Region	Contact Person	Type	Installed Capacity (MT/ Annum)	Present Status
1	Onyx Rice Mill	Bida, Niger State	North Central	Peter Sheshi (07033009917)	IRM	12.000	Functioning
2	Olam Nigeria Limited	Rukubi Village, Doma LGA Nassarawa	North Central	Ade Adefeko (08037420080)	IRM	105.000	Functioning
3	Masco Agro Allied Industry	Makurdi, Benue State	North Central	Amit Rai (GM Agric Business, 08058604300)	IRM	70.000	Under construction
4	Mikap Nigeria Limited	Makurdi, Benue State	North Central	Hon. Aondoaka (08078131246)	IRM	60.000	Functioning
5	Ashi Rice Ltd.	Makurdi, Benue State	North Central	Joseph Tsawsar (08033455595)	IRM	10.000	Functioning
6	Quarra Rice Mill	Tsaragi, Kwara State	North Central	Mr. Emeka (08177744058)	IRM	20.000	Functioning
7	Klysat Foods and Beverages Ltd	Hadejia, Jigawa State	North East	Inuwa Musa (08023108014; klysatfoods@gmail.com)	IRM	52.000	Installation, nearing completion
8	Gouria Rice Mills	Bauchi State	North East	Dr. Dogo Muhammed (08037042486)		5.000	Functioning
9	3 Brothers Rice Mills	Hadejia, Jigawa State	North East	Alhaji Widi Muhammadu (08022300456)	IRM	30.000	Newly completed, not yet functioning
10	Danmodi Food Processing Ltd	Kaffi Hausa, Jigawa State	North East	Alhaji Umar Namadi (08023898740)	IRM	12.000	Functioning
11	Al Umalau Nigeria Enterprises Limited	Jalingo, Taraba State	North East	08087934585	IRM	9.000	Functioning
12	Popular Farms and Mills Ltd	Kano State	North West	Amit Rai (GM, Agric Business; 08058604300)	IRM	150.000	Functioning
13	Umza Rice Mill	Kano State	North West	Alhaji Abubakar (08033475657)	IRM	75.000	Functioning
14	Labana Rice Mill	Kebbi State	North West	Sen. Muhammad Adamu Ailero (07066847000)	IRM	100.000	Functioning

15	A.A. Ibrahim and Company Limited	29, Unity Road Kano	North West	08150999436	IRM	30.000	Under construction
16	Tara Agro Industry Ltd.	Km 4 Ogurugu Road, Adani, Uzo-Uwani, Enugu	South East	080741961111	IRM	42.000	Functioning
17	Integrated Grains Processor Nig. Ltd	Oma-Eke, Udi LGA, Enugu	South East	08034068151	IRM	12.000	Functioning
18	Stine Industries Limited	Amichi Nnewi South LGA, Anambra	South East	Mr. Akai Egwuonwu (07081435500)	IRM	132.000	Functioning
19	Ebony Agro Industry Ltd	Ikwo, Ebonyi State	South East	080741961111	IRM	30.000	Functioning
20	Mordern Rice Mill	Ikwo, Ebonyi State	South East	Engr. Uche Emmanuel (08037856069)	IRM	12.000	Functioning
21	Mordern Rice Mill	Iboko, Ebonyi State	South East	Engr. Uche Emmanuel (08037856069)	IRM	12.000	Functioning
22	Mordern Rice Mill	Oso-Edda, Ebonyi State	South East	Engr. Uche Emmanuel (08037856069)	IRM	12.000	Functioning
23	Conti Agro (Eko Rice Mill)	Imota, Ikorodu, Lagos State	South West	Raja Valecha (08035354407) Dr. Rotimi Fashola (08034549326)	IRM	13.200	Functioning
24	Popular Farms and Mills Ltd	Lagos State	South West	Amit Rai (GM, Agric Business; 08058604300)	IRM	210.000	Functioning

ANNEX G.
OPPORTUNITIES FOR EMBEDDED POWER GENERATION IN LAGOS STATE

The table below presents an estimation of the amount of diesel generators that are currently being used for embedded power generation in eleven industrial- and residential estates. The table shows all generators that are used for power generation that is transmitted to the end user through a distribution network. Many of these generators are relatively small-scale. The table was presented in a workshop on the embedded generation framework in the Nigerian electricity supply industry on November 15th, 2012. The table below shows that a total installed capacity of almost 600 MW is used for embedded generation in the eleven industrial- and residential estates, for which more than 6.500 generators are used.

No	Area	Installed capacity (MW)	No. of generators
1	Somolu Printing Community	11	300
2	Matori Industrial Estate	40	105
3	Ilupeju Industrial Estate	25	105
4	Ikorodu Industrial Estate	135	31
5	Lagos Island (broad street & Marina only)	100	252
6	Ikeja GRA	68	804
7	Oba Akran	69	548
8	Agindingbi	70	820
9	Omole 1	13	89
10	Omole 11	43	2.410
11	Dolphin Estate	22	1.089
	TOTAL	**596**	**6.553**

Source: Presentation on Power Sector Development: Lagos State Economic Summit April 23–25 2012, Detail Commercial Solicitors

ANNEX H.
AMENDED MYTO 2015 TARIFFS

A new MYTO was proposed to be effective from the 1st of February 2016 until 2024, however, at the time of writing, these tariffs were subject to a legal case and implementation is not guaranteed. The proposed tariffs for each DisCo can be found via the following link:

http://www.nercng.org/index.php/media-and-publicity/press-releases/325-myto-2015-distribution-tariff-2015–2024

On the 21 December 2015, NERC issued the Amended MYTO 2015 after tariff proposals had been received from the DisCos. The links to the tariffs for each DisCo are provided in the table below:

S/N	DisCo	TARIFF LINKS
1	Abuja	http://www.nercng.org/index.php/document-library/func-startdown/468/
2	Benin	http://www.nercng.org/index.php/document-library/func-startdown/438/
3	Eko	http://www.nercng.org/index.php/document-library/func-startdown/480/
4	Enugu	http://www.nercng.org/index.php/document-library/func-startdown/471/
5	Ibadan	http://www.nercng.org/index.php/document-library/func-startdown/472/
6	Ikeja	http://www.nercng.org/index.php/document-library/func-startdown/473/
7	Jos	http://www.nercng.org/index.php/document-library/func-startdown/474/
8	Kaduna	http://www.nercng.org/index.php/document-library/func-startdown/475/
9	Kano	http://www.nercng.org/index.php/document-library/func-startdown/476/
10	Port Harcourt	http://www.nercng.org/index.php/document-library/func-startdown/477/
11	Yola	http://www.nercng.org/index.php/document-library/func-startdown/478/

ANNEX I.
GLOSSARY OF TERMS USED

In Figure 2.1 the following terms are distinguished:

- Industry
- Transport
- Residential
- Other
  - Agriculture/Forestry
  - Commercial and Public Services
  - Fishing
  - Non-specified
- Coal
- Oil products
- Natural gas
- Biofuels and waste
- Electricity

The above sectors and definitions are taken from IEA (iea.org/statistics/resources/balancedefinitions), with the exception that the residential sector is mentioned separately and is not included in 'other'.

Industry

Industry consumption is specified as follows (energy used for transport by industry is not included here but is reported under transport):

- Iron and steel industry [ISIC Group 241 and Class 2431];
- Chemical and petrochemical industry [ISIC Divisions 20 and 21] excluding petrochemical feedstocks;
- Non-ferrous metals basic industries [ISIC Group 242 and Class 2432];
- Non-metallic minerals such as glass, ceramic, cement, etc. [ISIC Division 23];
- Transport equipment [ISIC Divisions 29 and 30];
- Machinery. Fabricated metal products, machinery and equipment other than transport equipment [ISIC Divisions 25 to 28];
- Mining (excluding fuels) and quarrying [ISIC Divisions 07 and 08 and Group 099];
- Food and tobacco [ISIC Divisions 10 to 12];
- Paper, pulp and print [ISIC Divisions 17 and 18];
- Wood and wood products (other than pulp and paper) [ISIC Division 16];
- Construction [ISIC Divisions 41 to 43];
- Textile and leather [ISIC Divisions 13 to 15];
- Non-specified (any manufacturing industry not included above) [ISIC Divisions 22, 31 and 32].

Note: Most countries have difficulties supplying an industrial breakdown for all fuels. In these cases, the non-specified industry row has been used. Regional aggregates of industrial consumption should therefore be used with caution. ISIC codes refer to the International Standard Industrial Classification of All Economic Activities, Series M, No. 4/Rev. 4, United Nations, New York, 2008.

Transport

Consumption in transport covers all transport activity (in mobile engines) regardless of the economic sector to which it is contributing [ISIC Divisions 49 to 51], and is specified as follows:

- Domestic aviation
- Road includes fuels used in road vehicles as well as agricultural and industrial highway use.
- Rail
- Pipeline transport
- Domestic navigation

Note: International marine bunkers and international aviation bunkers are shown in Supply and are not included in transport as part of final consumption. ISIC codes refer to the International Standard Industrial Classification of All Economic Activities, Series M, No. 4/Rev. 4, United Nations, New York, 2008.

Agriculture/Forestry

Agriculture/forestry includes deliveries to users classified as agriculture, hunting and forestry by the ISIC, and therefore includes energy consumed by such users whether for traction (excluding agricultural highway use), power or heating (agricultural and domestic) [ISIC Divisions 01 and 02].

Commercial and Public Services

Commercial and public services [ISIC Divisions 33, 36–39, 45–47, 52, 53, 55, 56, 58–66, 68–75, 77–82, 84 (excluding Class 8422), 85–88, 90–96 and 99].

Fishing

Fishing includes fuels used for inland, coastal and deep-sea fishing. Fishing covers fuels delivered to ships of all flags that have refuelled in the country (including international fishing) as well as energy used in the fishing industry [ISIC Division 03].

Non-specified

Non-specified includes all fuel use not elsewhere specified as well as consumption in the above-designated categories for which separate figures have not been provided. Military fuel use for all mobile and stationary consumption is included here (e.g. ships, aircraft, road and energy used in living quarters) regardless of whether the fuel delivered is for the military of that country or for the military of another country.

Coal

Coal and peat includes all coal, both primary (including hard coal and lignite) and derived fuels (including patent fuel, coke oven coke, gas coke, BKB, gas works gas, coke oven gas, blast furnace gas and oxygen steel furnace gas). Peat is also included in this category.

Oil products

Oil products comprise refinery gas, ethane, LPG, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes, petroleum coke and other oil products. Oil products are any oil-based products which can be obtained by distillation and are normally used outside the refining industry. The exceptions to this are those finished products which are classified as refinery feedstocks.

Natural gas

Natural gas comprises gases, occurring in underground deposits, whether liquefied or gaseous, consisting mainly of methane. It includes both “non-associated” gas originating from fields producing only hydrocarbons in gaseous form, and “associated” gas produced in association with crude oil as well as methane recovered from coal mines (colliery gas) or from coal seams (coal seam gas). Production represents dry marketable production within national boundaries, including offshore production and is measured after purification and extraction of NGL and sulphur. It includes gas consumed by gas processing plants and gas transported by pipeline. Quantities of gas that are re-injected, vented or flared are excluded.

Biofuels and waste

Biofuels and waste is comprised of solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. Note that for biomass commodities, only the amounts specifically used for energy purposes (a small part of the total) are included in the energy statistics. Therefore, the non-energy use of biomass is not taken into consideration and quantities are null by definition.

Electricity

Electricity shows final consumption and trade in electricity (which is accounted at the same heat value as electricity in final consumption; i.e. 1 GWh = 0.000086 Mtoe).

ANNEX J.
NERC LICENSE FEES

http://www.nercng.org/nercdocs/Licence-and-Operating-Fees-Regulation.pdf

Grid-connected generation

Licence Category	Validity Period (Years)	Processing Fees for Application & Amendment of Licences	Licence Fees (US Dollars) or Naira equivalent	Processing Fees for Renewal & Extension of Tenure (Naira)	Annual Operating Fees
Generation:					
1 – 10MW		N 70,000.00	US$ 5,000.00	N 35,000.00	
11 – 50MW		N 150,000.00	US$ 30,000.00	N 75,000.00	
51 – 100MW		N 200,000.00	US$ 40,000.00	N 100,000.00	
101 – 200MW	10	N 250,000.00	US$ 60,000.00	N 125,000.00	1.5% of Licensee's Charges /kWh
201 – 300MW		N 350,000.00	US$ 80,000.00	N 175,000.00	
301 – 400MW		N 400,000.00	US$ 100,000.00	N 200,000.00	
401 – 500MW		N 450,000.00	US$ 120,000.00	N 225,000.00	
Above 500MW		N 500,000.00	US$ 140,000.00	N 250,000.00	

Embedded generation

Licence Category	Validity Period (Years)	Processing Fees for Application & Amendment of Licences	Licence Fees (US Dollars) or Naira equivalent	Processing Fees for Renewal & Extension of Tenure (Naira)	Annual Operating Fees
Generation:					
1 – 10MW		N 50,000.00	US$ 10,000.00	N 25,000.00	
11 – 25MW		N 150,000.00	US$ 35,000.00	N 75,000.00	
26 – 40MW		N 175,000.00	US$ 40,000.00	N 87,500.00	
41 – 60MW		N 225,000.00	US$ 45,000.00	N 112,500.00	
61 – 85MW		N 250,000.00	US$ 50,000.00	N 125,000.00	1.5% of Tariff
86 – 100MW	Up to10	N 275,000.00	US$ 55,000.00	N 137,500.00	Charge /kWh
101 – 200MW		N 300,000.00	US$ 75,000.00	N 150,000.00	
201 – 400MW		N 400,000.00	US$ 95,000.00	N 200,000.00	
401 – 500MW		N 500,000.00	US$ 150,000.00	N 250,000.00	
Above 500MW		N 600,000.00	US$ 200,000.00	N 300,000.00	

Captive generation

Licence Category	Validity Period (Years)	Processing Fees for Application & Amendment of Licences	Licence Fees (US Dollars) or Naira equivalent	Processing Fees for Renewal & Extension of Tenure (Naira)	Annual Operating Fees
Generation:					
1 – 10MW		N 50,000.00	US$ 10,000.00	N 25,000.00	
11 – 25MW		N 150,000.00	US$ 35,000.00	N 75,000.00	
26 – 40MW		N 175,000.00	US$ 40,000.00	N 87,500.00	
41 – 60MW		N 225,000.00	US$ 45,000.00	N 112,500.00	
61 – 85MW		N 250,000.00	US$ 50,000.00	N 125,000.00	1.5% of Tariff
86 – 100MW	Up to10	N 275,000.00	US$ 55,000.00	N 137,500.00	Charge/kWh
101 – 200MW		N 300,000.00	US$ 75,000.00	N 150,000.00	
201 – 400MW		N 400,000.00	US$ 95,000.00	N 200,000.00	
401 – 500MW		N 500,000.00	US$ 150,000.00	N 250,000.00	
Above 500MW		N 600,000.00	US$ 200,000.00	N 300,000.00	

Mini grids

Licence Category	Validity Period (Years)	Processing Fees for Application & Amendment of Licences	Licence Fees (US Dollars) or Naira equivalent	Processing Fees for Renewal & Extension of Tenure (Naira)	Annual Operating Fees
Generation:					
1 – 10MW		N 70,000.00	US$ 5,000.00	N 35,000.00	
11 – 50MW		N 150,000.00	US$ 30,000.00	N 75,000.00	
51 – 100MW		N 200,000.00	US$ 40,000.00	N 100,000.00	
101 – 200MW		N 250,000.00	US$ 60,000.00	N 125,000.00	1.5% of
201 – 300MW	10	N 350,000.00	US$ 80,000.00	N 175,000.00	Licensee's
301 – 400MW		N 400,000.00	US$ 100,000.00	N 200,000.00	Charges/kWh
401 – 500MW		N 450,000.00	US$ 120,000.00	N 225,000.00	
Above 500MW		N 500,000.00	US$ 140,000.00	N 250,000.00	

ANNEX K.
KEY DEVELOPMENT COOPERATION ORGANISATIONS

A number of international donors and organisations are active in the renewable energy sector in Nigeria. The major bilateral implementing agencies with a local office in Nigeria are[30]:

- Agence Française de Développement (AFD), French development cooperation agency
- Department for International Development (DFID), British development cooperation organisation
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, German Agency for International Cooperation
- Japan International Cooperation Agency (JICA)
- United States Agency for International Development (USAID)

Agence Française de Développement

Since its inception in Nigeria in 2008, AFD has been giving support to the power sector. In May 2016, a new funding was granted by AFD to enable the expansion and modernization of infrastructure, better training of technicians and development of public-private partnerships in the power sector.

A partnership has been established between the National Power Training Institute of Nigeria (NAPTIN) and Schneider Electric Nigeria (SEN), for training local electricians on safety compliance standards for domestic installations and for the promotion of entrepreneurship in the power sector. A second partnership agreement was signed between the Association of Nigerian Electricity Distributors and CODIFOR, a non-profit organization founded by French professional organizations in order to share their experience, expertise and know-how at international level in the development of employees' skills and support to power stations. This second partnership should enable the implementation of a technical cooperation programme for public – private partnerships in the electricity sector.

Two credit facility agreements were signed:

- to modernise the National Power Training Institute of Nigeria (€ 40 million);
- to facilitate the financing of investments by private electricity distribution companies through a credit line granted by Zenith bank to private Power Distribution companies (€ 85 million).

Department for International Development (DFID) – Solar Nigeria

DFID will provide € 44 million of grant finance, through the Solar Nigeria programme, over six years (2014 – 2020) for the installation of solar photovoltaic (PV) systems in 200 schools and eight health centres in rural areas of Lagos State. Moreover, DFID will expand the PV market and build a commercial base for that market in the North of Nigeria. Solar Nigeria collaborates with other donors and Nigeria's federal and state governments. The programme works directly with companies that manufacture, install, and finance solar energy systems in Nigeria, supplying technical assistance to companies; providing facilities for affordable consumer credit; and delivering demonstration projects that show how well-designed solar systems are sustainable, save money, and reduce greenhouse gasses.

30) GIZ, 2015

DFID also supports the Nigeria Infrastructure Advisory Facility (NIAF) which provides rapid and flexible consulting expertise to help the Nigerian government to improve its infrastructure and private sector investment. NIAF does not work with developers directly.

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

In the energy sector, GIZ provides advisory services to Nigerian partners on rural electrification, energy efficiency and renewable energy. The Nigerian Energy Support Programme (NESP) is commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) and the European Union.

NESP's activities are focused around the following topics:

- Policy reform and on-grid renewable energy: the programme is supporting implementation of the Electric Power Sector Reform Act, while helping to improve the legal framework for investment in renewable energy. Key stakeholders in the sector are also supported to coordinate and harmonise their activities.
- Energy efficiency: the programme is contributing to draw up strategies and standards for energy efficiency in accordance with international best practice, and to encourage the implementation via support mechanisms and demonstration projects.
- Rural electrification and sustainable energy access: a standardised approach at national level for the planning and promotion of rural electrification is supported. Five federal states are supported to produce electrification plans and develop a data management system. The electrification of off-grid villages, social facilities and small businesses will demonstrate how renewable energy can contribute to providing electricity access to rural areas.
- Capacity development: the National Power Training Institute of Nigeria (NAPTIN) and other training institutes are being assisted to deliver a range of relevant training courses on renewable energy and energy efficiency for engineers, architects and technicians. Interventions also train selected professionals of partner institutions and enhance capacities of the power sector as whole.

Japan International Cooperation Agency (JICA)

The purpose of JICA's cooperation in the energy sector entails:

- Contribution to realizing a low-carbon society that can develop sustainably
- Contribution to inclusive growth and poverty reduction by improving energy access
- Contribution to boosting global vigour by utilizing Japanese technologies and know-how

Concrete projects include:

- A grant for the Federal Capital Territory: The Project for Emergency Improvement of Electricity Supply Facilities in Abuja.
- A grant for The Federal Capital Territory: The Project for Introduction of Clean Energy by Solar Electricity Generation System.

United States Agency for International Development (USAID) – Power Africa

USAID's Power Africa supports the development of the energy sector through credit enhancement, grants, technical assistance, and investment promotion efforts. Through these measures, Power Africa is working to mobilize affordable and long term financing to support capital and operational expenditure requirements for successor generation and distribution companies to accelerate electricity market development. Furthermore, Power Africa is helping to advance major infrastructure investments, promote U.S. technological solutions, and strengthen Nigerian national systems through targeted technical assistance of national organizations dedicated to improving electricity procurement and regulatory functions.

Lending through Power Africa is delivered across a variety of recipients, including agro-processors, healthcare facilities and households willing to retrofit facilities, and companies willing to establish and maintain plants to generate clean energy. Late in 2014, Power Africa, in association with Guarantco, partnered with Standard Chartered Bank to make critical lending available to the privatized DisCos and GenCos for capital expenditures to reduce energy losses and improve operational efficiencies. In partnership with General Electric, the U.S. African Development Foundation and others, Power Africa has awarded seven $ 100.000 grants to entrepreneurs for innovative, off-grid energy projects in Nigeria. Power Africa also financially supported a green 100 MW field Wind Power project.

In addition, USAID has initiated a credit line with EcoBank that provides partial risk guarantees to the bank, thereby bringing down the interest rate and collateral requirements for loans.

The following multi-lateral organisations are working on renewables:

- African Development Bank (AfDB)
- World Bank: International Finance Corporation (IFC)
- Word Bank: Lighting Africa
- United Nations Development Programme (UNDP)
- United Nations Industrial Development Organisation (UNIDO)

Table K.1 Power Africa financial support (Source: www.usaid.gov/powerafrica/nigeria)

Name	Type of Transaction	Value (USD)	Timeline	Power Africa Support
JBS Wind Power	100 MW Green field Wind Power Project	$300 million	* Finalize negotiation of PPA Q2 2016 * Commence negotiation of PCOA [1]Q2 2016 * Financial Close Q2 2016 * Construction starts Q3 2016; Completion in 2018	* USAID drafted form PPA and PCOA for Wind Project * USAID providing Technical Assistance to negotiate the PPA and PCOA

Table K.2 AfDB activities in Nigeria related to energy (AfDB 2013–2017 Nigeria Country Strategy Paper)

Activity	AfDB Contribution
Support the implementation of power sector reforms to unlock the huge economic and environmental potential benefits of the large reserves of gas to generate power	Significant
Investment in small hydro power plants	Moderate
Promotion of renewable energy alternatives, particularly solar and biomass (energy crops)	Moderate
Energy efficiency programmes in public, industrial and residential buildings	Moderate
Reduce transmission and distribution losses	Small

African Development Bank (AfDB)

The AfDB 2013–2017 Nigeria Country Strategy Paper[31] mentions the focus area "Contribution to low-carbon climate resilient development". The specific activities are mentioned in the table above.

World Bank: International Finance Corporation (IFC)

As part of a wider programme to help mitigate climate change, IFC is investing in and providing advisory services to private enterprises in the renewable energy sector, throughout emerging markets, and across all parts of the supply chain.

IFC is supporting a 120 MWp PV project. In December 2015 IFC signed a Joint Development Agreement with Alten's Middle Band Solar One Limited, a Nigerian solar power project company, to co-develop the project with a consortium of developers. The project is expected to reach financial close by the end of 2016.

Word Bank (WB)

In April 2014 The World Bank Group in collaboration with the Federal Republic of Nigeria endorsed a new Country Partnership Strategy (CPS)[32] that includes support for development of targets and interventions up to 2017. The World Bank Group's support for Nigeria is structured around three strategic priorities, one is focussed on energy, especially the reforming of the power sector.

The "Lighting Africa" programme is also targeting Nigeria. The aim is to improve access to clean, affordable, quality-verified off-grid lighting and energy products by catalysing the market through a number of activities:

- Market intelligence on the off-grid market and providing critical data to help manufacturers, distributors and retailers to make informed business decisions
- Quality assurance of off-grid lighting products and solar home systems
- Access to finance for actors all along the supply chain
- Consumer education on off-grid lighting products and solar home systems
- Business development support

31) www.afdb.org/en/countries/west-africa/nigeria

32) www.worldbank.org/en/country/nigeria

United Nations Development Programme (UNDP)

One of UNDP's interventions in Nigeria is to strengthen the country's capacities to address the various environmental challenges at national, state and local government levels by sharing with government partner's experiences from other parts of the world and provide innovative policy advice and building of lasting partnerships.

The Access to Renewable Energy UNDP/Bank of Industry project is focussed on increasing the national capacity to invest in and utilize renewable energy resources to improve the access to modern energy services for MSMEs and households. It also aims to build capacity in the business and financial sectors to incorporate renewable energy in business planning and development, and to support the evolution of renewable energy policy and public planning. It aims to enable:

- MSMEs to incorporate renewable energy either as a business in and of itself, or as service for business development;
- Financial institutions to better understand and assess the credit and financial risks of renewable energy investments and services;
- Government to develop and implement renewable energy policies and regulatory frameworks.

UNDP has funded an ECN solar-power energy project for five rural communities in Bwari Area Council in the FCT. The benefitting communities are Tokulo, Zhiko, Sunape, Youpe and Goipe. In each community in total 400 solar home systems were installed, 14 solar street lights, solar PV systems at each primary health centres, 400 clay-based efficient woodstoves and a solar-powered water supply borehole with 10.000 litres storage tank.

United Nations Industrial Development Organization (UNIDO)

The UNIDO regional office in Nigeria is presently working with the Government of Burkina Faso, Benin Republic, Niger, Mali and Nigeria to promote inclusive and sustainable industrial activities.

Under the "Safeguarding the environment" focus area, UNIDO currently supports the following projects related to renewable energy:

- Scaling up small hydro power in Nigeria: this project is aimed at promoting renewable energy based mini-grid as an alternative to diesel based energy generation systems in Nigeria.
- Mini-grids based on renewable energy (small hydro and biomass) sources to augment rural electrification: UNIDO is assisting the Government of Nigeria through this GEF funded project to foster a public-private partnership for the investment of $ 12 million to establish a 5 MW rice husk fuelled power plant in Ebonyi State and to encourage its replication across other states in Nigeria.

UNIDO and to a lesser extent UNDP have been involved in a number of pico and small hydro power development projects. Examples are: Evboro II pico-hydropower plant in Edo State, the 70 kW micro-hydropower plant in Osun State for village electrification, and the 400 kW mini-hydropower plant in Taraba State for self-generation at a beverage company. All these hydropower projects are meant to be used for village electrification with the exception of the last one which will be used for self-generation at a beverage company. However, none of these installation have been realised and are currently operational.

ANNEX L. EXAMPLE OF A CAPTIVE POWER PROJECT IN OIL PALM PROCESSING

Below information is generated from publicly available sources. It is unclear what is the current status of the captive power installation.

Introduction Presco

Presco is the Nigerian market leader for specialty fats and oils. It is a fully-integrated agro-industrial establishment with oil palm plantations, a palm oil mill, a palm kernel crushing plant and a vegetable oil refining and fractionation plant.

Presco is one of the largest employers of labour in Edo and Delta states, with about 3.500 employees. Currently the total planted area is 11.537 hectares of oil palm plantations. The palm oil mill capacity has increased from 48 to 60 tonnes fresh fruit bunches (FFB)/hour. The palm kernel crushing plant operates at 45 tonnes/day. The refinery has recently been increased to 100 metric tonnes per day and fractionation plant capacity and refined products to 60 tonnes/day.

Waste production

The production of palm oil results in the generation of large quantities of polluted waste water, commonly referred to as palm oil mill effluent (POME). Typically, one ton of crude palm oil production requires 5–7,5 tonnes of water; over 50% of which ends up as POME. Fresh POME is a hot, acidic, brownish colloidal suspension. The Presco POME is characterized by high amounts of total solids (35 g/l), oil and grease (17 g/l), COD (50 g/l) BOD (64 g/l) and a PH of 4,4.

POME has been identified as one of the major sources of aquatic pollution, since its normal treatment is solely ponding and/or digestion in open digesting tanks; the emission of greenhouse gases (GHG) (CH4–methane and CO2) from these systems to the atmosphere has been reported as a major source of air pollution from the palm oil mills.

Biogas waste treatment plant

The installed posttreatment system is bag digester. After the effluent is treated, the characteristics are improved to:

- pH =7,1
- Total solids = 8,6 g/l
- COD = 19,v6 g/l

The by-products of this anaerobic digestion are biogas and sludge. The biogas is used for energy purposes and the sludge is used as an organic fertiliser for the palms.

Biogas

In ten months' time (December 2013-September 2014) a total of 3.508.966 m^3 of biogas has been produced. This biogas is used for:

- Thermo-oil boiler
- Stand-by boiler
- Generator (substituting diesel)

	Diesel	US$
Kerosene	999.653	709.754
Diesel	4.643	3.900
Kerosene equivalent sent to the flare	976.251	693.138

Note: The price of the kerosene was considered to be US$ 0.71/litre and the price of diesel US$ 0.84/litre.

Costs savings for this ten months' period is thus totalling 713.000 $. The excess gas is flared.

Sludge

- For a 135.000 T/year milling, the sludge production in PRESCO is estimated to be around 23.000 m^3/year. It means the sludge generation is around 17% of the milling, and represents around 100 m^3/day x 230 days. For an average dry matter (total solids) content of 3%, the average NPK nutrients content is:
- N: 2,3 kg/m^3 (=2,5 US$/$m^3$)
- P2O5: 1 kg/m^3 (=1,1 US$/$m^3$)
- K2O: 1,6 kg/m^3 (=1,6 US$/$m^3$)

In six months 6,600 m^3 of sludge has been spread in the plantation, totalling 34.320 $ worth of fertiliser.


2