NIGERIA COUNTRY STUDY **2021**

CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

Asejire Reservoir is a dam over Osun River in Oyo State.
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CICSA
CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

Frankfurt School
FS-UNEP Collaborating Centre
for Climate & Sustainable Energy Finance

UN environment programme

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The electronic copy of this report can be downloaded at *www.captiverenewables-africa.org*.

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SUMMARY OF PUBLICATION

This country report presents the state of the clean captive installations market in Nigeria as of year-end 2020, with a focus on the commercial and industrial market and solar photovoltaic (PV) technology.

The project team collected stakeholders' views on their experiences with: a) the current clean captive installations for the commercial and industrial sector; b) the perceived barriers for its development; c) potential synergies between their activities and the project; and d) industry sectors and technologies to be targeted under this project (for modelling support and to initiate a pilot project). For the purposes of confidentiality, the names of persons and/or institutions have not been included in this report.

The information presented in this report was collected during the last quarter of 2020 and is valid as of that date. The Nigerian energy and captive market and its regulatory framework are changing rapidly. Readers are invited to consider any evolution that may have taken place since year-end 2020.

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ABBREVIATIONS AND ACRONYMS

AFD	Agence Française De Développement
AfDB	African Development Bank
AGF	African Guarantee Fund
AMCON	Asset Management Corporation Of Nigeria
AMES	Ariria Market Energy Solutions
ANED	Association Of Nigerian Electricity Distributors
BOI	Bank Of Industry
BOOT	Build-Own-Operate-Transfer
BPE	Bureau Of Public Enterprises
CAPMI	Credit Advance Payment For Metering Implementation
CBN	Central Bank Of Nigeria
CET	Consolidated Energy And Trading
CRR	Cash Reserve Requirement
DCA	Development Credit Authority
DFID	UK Department For International Development
DisCO	Distribution Companies
ECN	Energy Commission Of Nigeria
ECOWAS	Economic Community Of West African States
EDFI	European Development Finance Institutions
EEI	Energizing Economies Initiative
EEP	Energizing Education Programme
ElectriFi	Electrification Financing Initiative
EMSL	Electricity Management Services Limited
EPC	Engineering, Procurement And Construction
EPSRA	Electric Power Sector Reform Act
EPZ	Export Processing Zones
EREP	Ecowas Renewable Energy Policy
ESCO	Energy Service/Supply Company
ESIA	Environmental And Social Impact Assessment
FMBN	Federal Mortgage Bank Of Nigeria
FMP	Federal Ministry Of Power
FMWH	Federal Ministry Of Works And Housing
FS	Frankfurt School
FTZ	Free Trade Zones
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft Für Internationale Zusammenarbeit
GW	Gigawatt
GWh	Gigawatt-Hour
HEART	Health, Education, Agriculture, Renewable Energy And Transport
IEA	International Energy Agency
IEDN	Independent Electricity Distribution Networks
IKI	International Climate Initiative Of Germany
IPP	Independent Power Producer
ktoe	Kilotonne Of Oil Equivalent
kW	Kilowatt
kWh	Kilowatt-Hour
LRMC	Long Run Marginal Cost
MIGA	Multilateral Investment Guarantee Agency
MSMES	Micro Small And Medium Enterprises
MVA	Mega Volt Amperes
MW	Megawatt
MW(p)	Megawatt (Peak)

MWh	Megawatt-Hour
MWh/h	Megawatt-Hours Per Hour
MYTO	Multi-Year Tariff Order
NAPTIN	National Power Training Institute Of Nigeria
NBET	Nigeria Bulk Electricity Trading Company
NDIC	Nigeria Deposit Insurance Corporation
NDPHC	Niger Delta Power Holding Company Limited
NEEDS	National Economic Empowerment And Development Strategy
NEP	National Energy Policy
NEPA	National Electric Power Authority
NEPP	National Electric Power Policy
NERC	Nigerian Electricity Regulatory Commission
NESI	Nigerian Electricity Supply Industry
NESO	Nigeria Electricity System Operator
NESP	Nigeria Energy Support Programme
NIC	National Insurance Commission
NIPC	Nigerian Investment Promotion Council
NIPP	National Integrated Power Project
NREAP	National Renewable Energy Action Plan
NREEEP	National Renewable Energy And Energy Efficiency Policy
O&M	Operation And Maintenance
PACP	Presidential Action Committee On Power
PCOA	Put Call Option Agreement
PHCN	Power Holding Company Of Nigeria
PPA	Power Purchase Agreement
PTFP	Presidential Task Force On Power
PV	Photovoltaic
REA	Rural Electrification Agency
REAP	Renewable Electricity Action Programme
REF	Rural Electrification Fund
REMP	Renewable Energy Master Plan
REPG	Renewable Electricity Policy Guidelines
SDGs	Sustainable Development Goals
SEC	Securities And Exchange Commission
SEforALL-AA	Sustainable Energy For All Action Agenda
SPV	Special Purpose Vehicle
SUNREF	Sustainable Use Of Natural Resources And Energy Finance
TCN	Transmission Company Of Nigeria
TEM	Transition Electricity Market
TWh	Terawatt-Hour
UBA	United Bank Of Africa
UN	United Nations
UNEP	United Nations Environment Programme
USAID	United States Agency For International Development
W	Watts

Bayero University Kano Hosts Africa's largest Solar Hybrid Power Plant – The Guardian.
© Rural Electrification Agency of Nigeria

1/ INTRODUCTION

This report is published under the project titled "Clean Captive Installations for Industrial Clients in Sub-Sahara Africa" developed in four partner African countries: Ghana, Kenya, Nigeria and South Africa.

The project aims to demonstrate the economic and financial viability of clean captive energy installations for industries and to enhance their adoption in the four partner countries and beyond to the entire continent. Captive energy installations are electricity generation facilities that are used and sometimes also managed by a commercial or industrial energy user for its own energy consumption. Captive power plants can be operated off-grid or can be connected to the grid to feed in excess generation wherever regulations allow for it.

Renewable energy captive installations alleviate the pressure to generate electricity from national grids and reduce industrial clients' needs to rely on private supplementary fossil-fuelled generators, which are expensive to run. These clean captive installations are frequently referred to as the second generation of renewable energy business models, as they do not rely on national governments' incentivizing policies to enhance the deployment of clean energy technologies.

The project will strengthen the ability of partner countries to move towards low carbon-emitting development strategies. It also contributes to several Sustainable Development Goals, including Climate Action (SDG 13), Responsible Consumption and Production (SDG 12), Affordable and Clean Energy (SDG 7) and Industry, Innovation, and Infrastructure (SDG 9). The project will raise awareness among industry players, financiers, and governments, and will support the dissemination of clean modern energy technology through business models tailored to the national contexts and beyond throughout Sub-Saharan Africa.

This project is part of the International Climate Initiative (IKI) of Germany. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety supports this initiative based on a decision adopted by the German Bundestag.

The implementing team of the project comprises the United Nations Environment Programme (UNEP) in partnership with its collaborating centre at the Frankfurt School of Finance & Management (Frankfurt School), together with locally hired consultants who provide local market and captive power expertise.

THE PROJECT

The project's activities fall under four components:

Component 1	Baseline studies and awareness raising
Component 2	Economic and financial tools and assessments
Component 3	Realization of one pilot project per country
Component 4	Knowledge dissemination and outreach

This country report is part of Component 1. Initial desktop research was conducted followed by extensive consultation by the project team of local public and private sector stakeholders through a week-long scoping mission.

In Nigeria, the scoping missions took place from 18 November 2019 until 22 November 2019. The official kick-off meeting held at the Energy Commission of Ghana on 18 November gathered 31 stakeholders from 16 institutions. Following this in-depth discussion of the Nigerian market with public stakeholders, the project team met with 48 stakeholders representing 18 public institutions and private sector firms throughout the week.

The project team collected stakeholders' views on their experiences with: a) the current clean captive installations for the commercial and industrial sector; b) the perceived barriers for this development; c) potential synergies between stakeholder activities and the project; d) industry sectors and technologies to be targeted under this project (for modelling support and to initiate a pilot project).

This report contains information from both desktop market research and the feedback from in-person interviews with local public and private stakeholders. For the purposes of confidentiality, names of relevant persons and/or institutions have not been included in this report.

The information collected during the desktop research and in-person interviews will inform the overall design of the project and guide its implementation. This country report presents the state of the clean captive installations market in Nigeria as of year-end 2020 with a focus on the commercial and industrial market and solar photovoltaic (PV) technology.

The information collected will also support the development of a robust financial model to be used as a tool to prove the financial viability of clean captive PV technology installations. Relevant and key information about the clean captives markets in the four partner countries and the project progress will be shared through the project website: *www.captiverenewables-africa.org*.

The information presented in this report was collected during the last quarter of 2020 and is valid as of that date. The Nigerian energy and captive market and its regulatory framework are changing rapidly. Readers are invited to consider any evolution that may have taken place since year-end 2020.

2/ KEY FINDINGS

Nigeria has a very poor supply of national and regional grid electricity.	Only 31 per cent of Nigeria's total installed generation capacity (12.5 gigawatts, GW, in 2018) is available for supply; daily generation is in the range of only around 4-4.5 GW. This is due to myriad constraints in the power sector, including ageing grid infrastructure, insufficient availability of gas (more than 80 per cent of grid-generated electricity is from gas-fired power plants), and structural inefficiencies in transmission and distribution systems.
Nigeria suffers from poor transmission and distribution systems.	Frequent system collapses and forced outages affect Nigeria's transmission system, which has a capacity to transmit around 5 GW. Although the transmission capacity is currently higher than operational generation capacity (around 4-4.5 GW), it is far below the total installed generation capacity of 12.5 GW. In addition, almost 46 per cent of energy is lost through technical, commercial and collection issues, incurring huge losses for Nigeria's distribution companies.
Nigeria has one of the lowest rates of electricity consumption per capita in the world.	The peak electricity consumption per capita recorded was 156 kilowatt-hours (kWh) in 2012. This is less than a third of the global minimum average electricity consumption per capita for developing economies (500 kWh).
Captive generation used in many industries exceeds the available grid-connected capacities.	Frequent load shedding and outages due to poor grid infrastructure have led to widespread self-generation of power, especially by manufacturing industries, mainly from off-grid diesel and gas generators, as well as biomass and waste. This is estimated to be between 8 GW and 14 GW. This represents 96 per cent of energy consumed by Nigerian industries. The remaining energy comes from poorly maintained grid connections.
Nigeria has privatized the generation, transmission and distribution of centralized grid power.	Almost 40 per cent of the population lacks access to grid-connected electricity (FGN 2015). The Electric Power Sector Reform Act (ESPRA) of 2005 was created to improve power availability and re-structure the power sector. This act dissolved the monopoly of the vertically integrated National Electric Power Authority (NEPA), eventually splitting into 18 successor companies. The Nigerian Electricity Regulatory Commission (NERC) was also established as an independent regulating body for the electricity industry in Nigeria (including tariff regimes, etc.).
Regulations on captive projects under 1 megawatt (MW) can support growth in mini-grids.	Fiscal regulations such as import duties and value-added tax on solar components have greatly stifled the wider penetration of captive power projects in Nigeria. Consequently, this increases the capital expenditure of projects and contributes to the existing challenge of limited financing. However, regulations by the NERC on captive projects under 1 MW enjoy a no-objection certification under the "willing buyer and willing seller" clause for mini-grid regulations. A few captive projects above 1 MW have obtained licences from the NERC as mandated by law but still enjoy the no-objection certification as they are single-client projects.

Nigeria aims to achieve 30 GW of electricity capacity by 2030, with a 30 per cent share of renewable energy in the mix.	In order to achieve its target of 30 GW of electricity capacity by 2030 (including 30 per cent renewables), the Government of Nigeria published a feed-in tariff regulation in 2015; however, no related projects have been completed yet. Based on stakeholder interviews, it is understood that the Nigerian government is looking to support clean captive power projects going forward to meet its power generation targets.
Mini-grid uptake in Nigeria is strong and accelerating.	The project pipeline for mini-grids has been growing, particularly since the launch of the mini-grid regulation in 2017 and a number of interventions, including the Nigeria Electrification Program of the World Bank and the Nigeria Energy Support Program of GIZ. Most projects are for rural households and are usually under 100 kilowatts (kW) (Yakubu *et al.* 2018), but many micro, small and medium enterprises with an estimated 20 MW of installed capacity in 2018 are positioning themselves in the commercial and industrial segment as well.
The off-grid market in Nigeria is attracting support from several donors, both public and private donor agencies.	The Nigerian off-grid market has attracted increased support over the last three years in the form of grants, low-interest loans and equity investments. Organizations including the US Agency for International Development's Power Africa, the US Africa Development Foundation, the African Development Bank, GIZ, the UK Department for International Development, the Heinrich Boell Foundation and the Shell-funded All On have provided funding, advocacy and technical support for off-grid and energy access projects and energy companies in Nigeria.
Prohibitive lending rates and tenors are offered by local commercial banks.	Commercial bank lending is largely absent from the commercial and industrial solar market, offering debt that developers consider too costly (e.g., over 25%) and short tenors, i.e., up to two years. Local financing in Nigeria requires developers to provide physical assets as collateral, as banks do not accept solar equipment as acceptable security assets due to a perceived lack of secondary market value. Borrowers are therefore required to own real estate. As a result, developers are mostly financing projects through their own balance sheets. Foreign exchange risks are largely not hedged by banks and are expected to be covered by the client.
Some banks are introducing products to become game-changers in the Nigerian market.	Sterling Bank and FCMB have been offering lending facilities to the sector. The introduction of active lending to the sector either via direct loans to end users, or via facilities provided to developers and energy service/supply companies (ESCOs), is expected to act as a game-changer, as other banks will act as "fast-followers".
An ecosystem of captive power players is being developed in Nigeria.	The ecosystem of captive power players is largely being developed around the financing support initiatives of the international development agencies and the government agencies led by the Rural Electrification Agency (REA). Some government funding is being placed with the Bank of Industry (BOI), expected to increasingly support the market as it becomes more user friendly, following reviews that should lead to the implementation of less-stringent qualification criteria. Developers perceive major financial barriers to more commercial and industrial solar in Nigeria, from debt availability to credit risk and foreign exchange hedges and high import tariffs.

Off-The-Grid Thinking To End Nigeria's Blackouts. © *Rural Electrification Agency of Nigeria*

3/ NIGERIA KEY SOCIO-ECONOMIC INDICATORS

Table 1: Nigeria key socio-economic indicators

SOCIO-ECONOMIC INDICATORS	RESULT	DATE	SOURCE
Population	206 million	2020	World Population Prospects (UN)
Population growth	2.6%	2019	World Bank
Female population	49.3%	2019	World Population Prospects (UN)
Youth population (<15 years)	39.4%	2018	UN Statistics Division
Gross domestic product (GDP)	$448 billion	2019	World Bank
GDP growth	2.1%	2018	World Bank
Average GDP growth	1.9%	2018	World Bank
Contribution to GDP growth	- Agriculture (21.2%) - Industry (25.8%) - Service (52.0%)	2018	World Bank
GDP per capita	$2,049	2018	World Bank
Total labour force (% of total population >15 years)	60.6%	2018	World Bank
Female labour force (% of female population >15 years)	62.4%	2018	World Bank
Unemployment rate	23.1%	2018	National Bureau of Statistics
Inflation rate	12.1%	2018	National Bureau of Statistics
Corruption perception index	27 points 144/180 ranking	2018	Transparency International
Ease of doing business	131/190 ranking	2019	World Bank

4/ ELECTRICITY MARKET

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This section provides an overview of the electricity market in Nigeria, including the current situation and forecasts for the country's generation, transmission and distribution networks. The section highlights the strong potential of captive power generation to address the current barriers facing the electricity market. The concluding text further analyses the market potential for clean captive installations in Nigeria.

Table 2: Key energy indicators

ENERGY INDICATOR	RESULT	DATE	SOURCE
Access to electricity	56.5%	2018	World Bank
Electrification – urban areas	81.7%	2018	World Bank
Electrification – rural areas	31.0%	2018	World Bank
Electricity generation	36 277 GWh	2018	International Energy Agency
Electricity consumption	26 315 GWh	2018	International Energy Agency
Electricity exports	NA		
Electricity imports	NA		
Electricity total installed capacity	12 522 MW	2019	US Agency for International Development

Note: NA = data not available; GWh = gigawatt-hours; MW = megawatts

4.1/ ELECTRICITY MARKET STRUCTURE

Under the Electric Power Sector Reform Act (EPSRA) of 2005, the government of Nigeria restructured the power sector. This act dissolved the monopoly of the vertically integrated National Electric Power Authority (NEPA) and formed the Power Holding Company of Nigeria (PHCN), which served as a transitional corporation that comprised 18 successor companies unbundled from the NEPA: 6 generation companies, 11 distribution companies and one transmission company (Transmission Company of Nigeria, TCN). The Nigerian Electricity Regulatory Commission (NERC) was established as an independent regulating body for the electricity industry in Nigeria (including tariff regimes, etc.).

From 2007 until September 2013, the PHCN was the state-owned company in charge of generating, transmitting and distributing electricity in the entire country. During that time, ten new National Integrated Power Projects (NIPPs) were under development (Bagu *et al.* 2016) (Box 1). By November 2013, the privatization of all 6 generation companies and ten distribution companies was completed, with the federal government retaining ownership of the transmission company (TCN). The privatization of the 11th distribution company was completed in November 2014.

BOX 1: The National Integrated Power Project (NIPP)

The NIPP was conceived in 2004 as a major fast-track initiative to add new generation capacity to Nigeria's electricity supply industry using gas-based power plants. Transmission, distribution and gas transport infrastructure projects were added to these generation projects. The Niger Delta Power Holding Company Limited (NDPHC) serves as the administering institution for the contracts, management and operation of the assets.

Source: Ley, Gaines and Ghatikar 2015

The timeline in Table 3 shows the different steps of Nigeria's electricity market privatization and the institutions that have emerged from this process (Ley, Gaines and Ghatikar 2015).

Table 3: Timeline of Nigeria's electricity market privatization

YEAR	EFFECT
2001	Adoption of the National Electric Power Policy.
2005	Enactment of the Electric Power Sector Reform Act (EPSRA).
2005-2007	Establishment of the Nigerian Electricity Regulatory Commission (NERC); formation of the Power Holding Company of Nigeria (PHCN); unbundling of the PHCN into 18 independent companies.
2008-2009	Publication of the Multi-Year Tariff Order (MYTO); formation of the Power Sector Reform Committee.
2010-2012	Launch of the Nigeria Vision 20:2020; establishment of the Presidential Action Committee on Power (PACP) and the Presidential Task Force on Power (PTFP); release of the Roadmap for Power Sector Reform; establishment of the Bulk Trader.
2012	Approval and release of MYTO 2.
2013	Full privatization of the generation and distribution sub-sectors; the transmission sub-sector was retained by the Government but its management is currently under concession
2015	Approval and release of MYTO 2.1. Petitions by various consumer groups, evoked by electricity price increases of up to 80%, led to amendment of MYTO 2.1 and a price drop of around 50%.
1 Feb 2015	Commencement of the Transition Electricity Market (TEM), after NERC declared all Conditions Precedent listed in the market rules as satisfied.
May 2015	Unbundling of the Transmission Company of Nigeria (TCN) into an Independent System Operator (public) and a Transmission Service Provider (private).
2015	Official transformation of the Ministry of Power to the Ministry of Power, Works and Housing.
2015	7 out of 10 National Integrated Power Projects (NIPPs) completed.
2015	Transitional Power Market established.
2016	Credit Advance Payment for Metering Implementation (CAPMI) regulation ended.
2016	Appointment of a new Managing Director for the Nigerian Bulk Electricity Trading plc.
2017-2018	NERC Commissioners appointed new Managing Director, TCN appointed Declaration of Eligible Customers

Source: Ley, Gaines and Ghatikar 2015

4.1.1/ ELECTRICITY GENERATION MIX

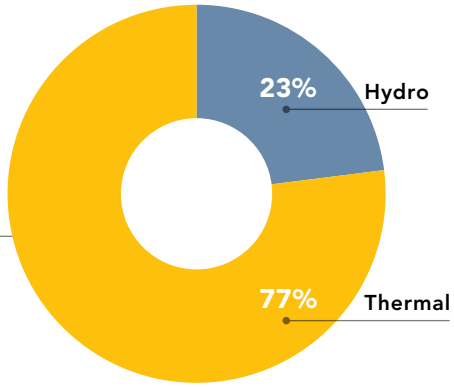
This section explores the existing and projected electricity generation mix in Nigeria, which currently comprises a high share of thermal resources.

Nigeria faces a critical energy situation that is hindering its economic development. According to the *Nigeria Power Baseline Report* (Ogunbiyi and Abiodun 2015), 40 per cent of the population does not have access to grid electricity, while traditional biomass accounts for 81 per cent of total energy consumption.

The electricity generation mix in Nigeria remains dominated by thermal resources. Gas-fired power plants represented 77 per cent of the country's electricity generation in 2018, while hydropower compromised 23 per cent of the generation mix (NERC 2018), as shown in Figure 1.

Figure 1:
Electricity generation installed capacity mix as of 2018 (%)

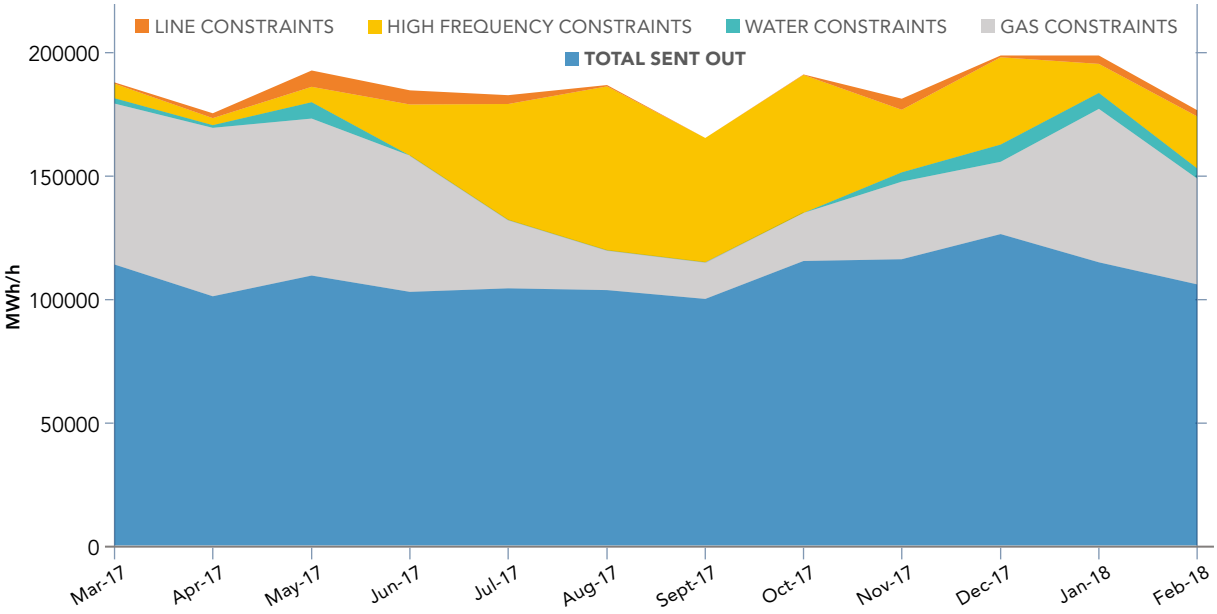
Source: NERC 2018



In 2018, according to NESISTATS, Nigeria had a total gross installed generation capacity of 12.5 gigawatts (GW) from 27 grid-connected power plants (24 gas-fired power plants and three large hydropower plants). Companies comprising former PHCN generation companies, independent power producers and National Integrated Power Projects (NIPPs) operate these power plants. (For a full list of grid-connected power plants, see the Annex.)

Of the total 12.5 GW of installed generation capacity as of 2018, only around 31 per cent was being actively utilised during the peak demand period on 14 November 2018, according to the Federal Ministry of Works and Housing (FMWH) (FMWH 2018). This is in line with daily generation of around 4-4.5 GW in 2018, indicating that Nigeria still faces persistent problems in the power sector (i.e., inadequate gas supply, ageing infrastructure, and inefficient transmission and distribution systems) and that little/no improvement has occurred. Figure 2 shows the influence of each of these constraints on the final generated power sent out from March 2017 to February 2018.

Figure 2: Generated power sent out and constraints (MWh/h)



Source: NESISTATS n.d.

4.1.2/ FUTURE PROJECTION

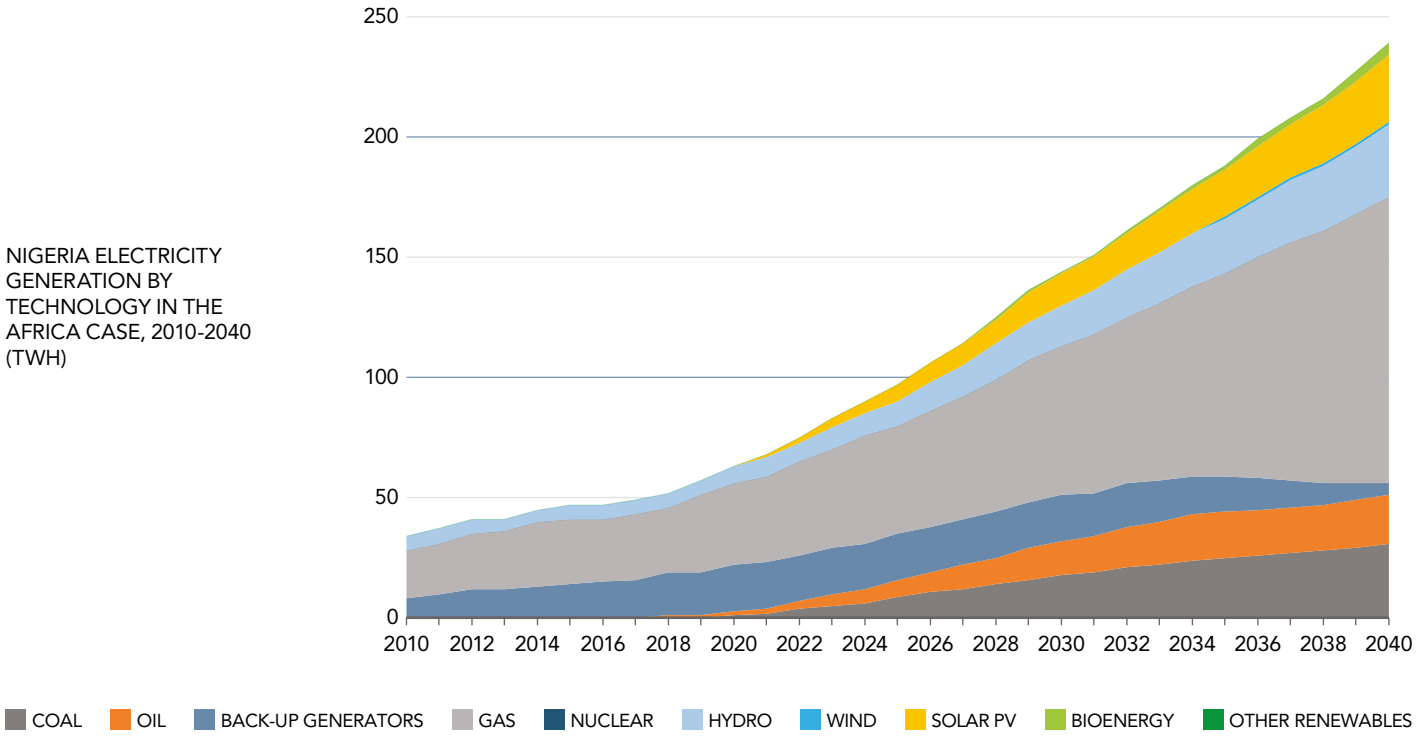
The Nigerian power sector experiences many broad challenges related to electricity policy enforcement, regulatory uncertainty, gas supply, transmission system constraints and major power sector planning shortfalls that have kept the sector from reaching commercial viability.

The overall electrification rate for Nigeria is just 45 per cent, compared to 32 per cent average electrification in Sub-Saharan Africa. Going forward, the government plans to achieve an overall electrification rate of 75 per cent by 2025, as emphasized in the "Vision 20:2020" and the draft Rural Electrification Strategy and Plan (Federal Ministry of Power, Works and Housing 2016).

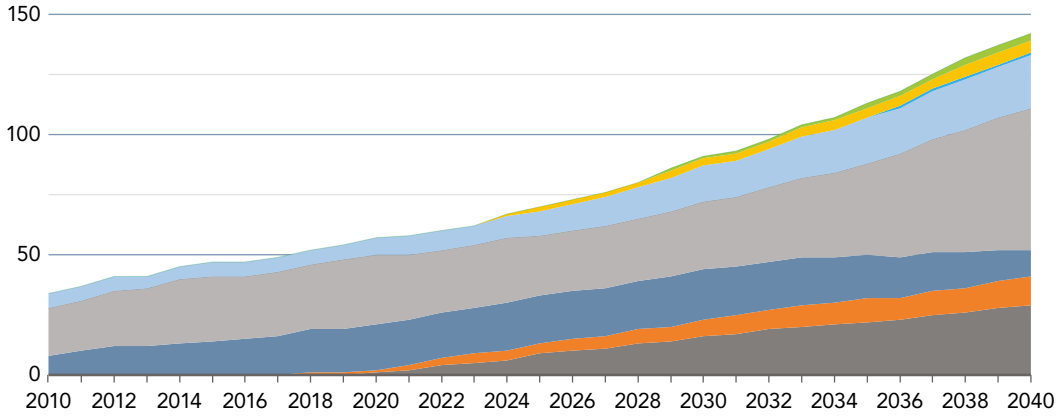
Based on two possible scenarios for the future generation mix in Nigeria, developed by the International Energy Agency (IEA), the country could diversify its electricity generation to adapt several technologies, as illustrated in Figure 3. This would help to reduce Nigeria's dependency on gas, although generation from gas is still expected to play a vital role in the country's future electricity generation.

Figure 3: Nigeria electricity generation by technology, two scenarios (2010-2040) (TWh)

NIGERIA ELECTRICITY GENERATION BY TECHNOLOGY IN THE AFRICA CASE, 2010-2040 (TWH)



NIGERIA ELECTRICITY GENERATION BY TECHNOLOGY IN THE STATED POLICIES SCENARIO, 2010-2040 (TWH)



Source: IEA 2019

4.2/ ELECTRICITY TRANSMISSION AND DISTRIBUTION

This section explores the current situation of the transmission and distribution system in Nigeria. Nigeria is most affected by poor grid infrastructure, and future plans target new transmission and distribution lines, including inter-country transmission lines, to mitigate the situation.

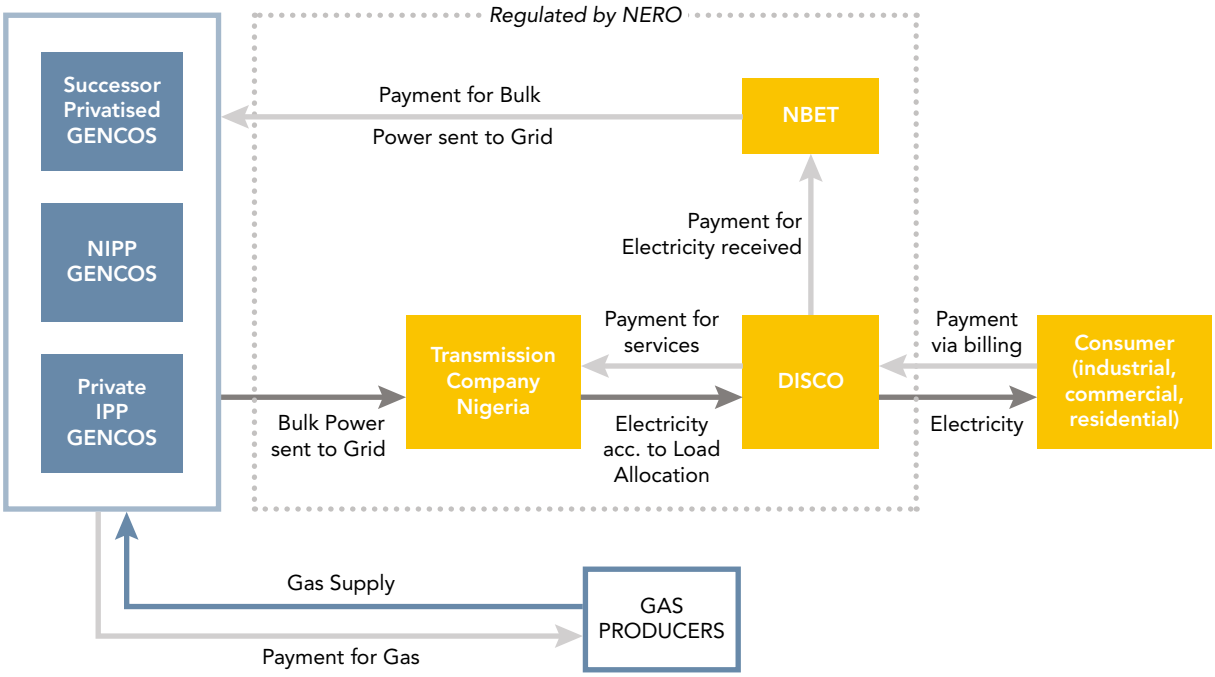
4.2.1/ CURRENT SITUATION

Currently, only 31 per cent of Nigeria's 12.5 GW (2018) of total installed generation capacity reaches the end user. To fully appreciate the extent of the current challenges faced and the opportunities for investors to play their part in the growth of the electricity sector, it is essential to understand the three stages in delivery of power to customers: generation, transmission and distribution.

OVERVIEW OF THE POWER SECTOR STRUCTURE

Post-privatization, Nigeria's power sector is structured such that the electricity produced by various generation companies (former PHCN, National Integrated Power Projects, independent power producers) is sent to the regional distribution companies via the Transmission Company of Nigeria (TCN). (See Annex for the locations of the 11 distribution companies.) The distribution companies then sell the electricity they receive to industrial, commercial or residential consumers (Figure 4).

Figure 4: Structure of the power sector post-privatization



Note: GENCOS = generation companies; DISCO = distribution company; IPP = independent power producers

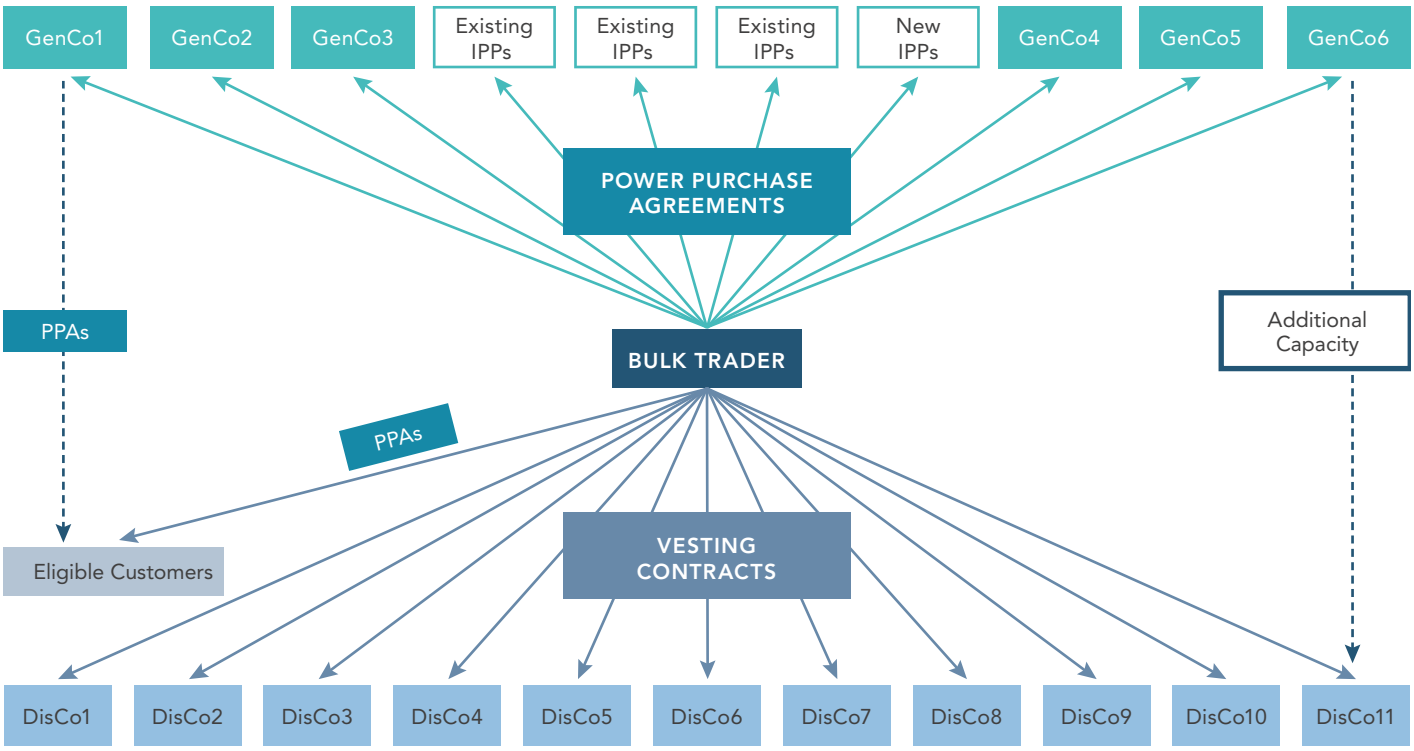
Source: Ley, Gaines and Ghatikar 2015

The end consumers pay the distribution companies for the electricity drawn from the distribution network. These payments are forwarded by NBET (Nigerian Bulk Electricity Trading company, the state-owned electricity supplier) to the generation companies. For providing network services, Transmission Company of Nigeria (TCN) receives payment. Contractually, as shown in Figure 5, NBET signs power purchase agreements with all the different generation companies. NBET also resells power via vesting contracts with distribution companies and also signs power sales agreements directly with eligible customers (see later discussion) (Ley, Gaines and Ghatikar 2015).

NBET's power purchase agreements with independent power producers are backed by credit enhancement instruments provided by the Federal Government of Nigeria. These projects benefit from a Put Call Option Agreement (PCOA), which, in the event of termination of the power purchase agreement due to default by the federal government, provides termination payments (in US dollars), guaranteed by the Ministry of Finance, to cover outstanding debt together with equity contributions and returns (Africa Finance Corporation 2019).

All these institutions are regulated by the Nigerian Electricity Regulatory Commission (NERC). The commission provides a 15-year tariff path, which undergoes major reviews every six years with minor reviews biannually. As part of its mandate, NERC has set the Multi-Year Tariff Order (MYTO), which defines generation and consumer off-take prices (see later discussion). Additionally, NERC is responsible for assessing applications for on-grid and off-grid generation, distribution and transmission licences (NERC 2021a).

Figure 5: NBET's role and position



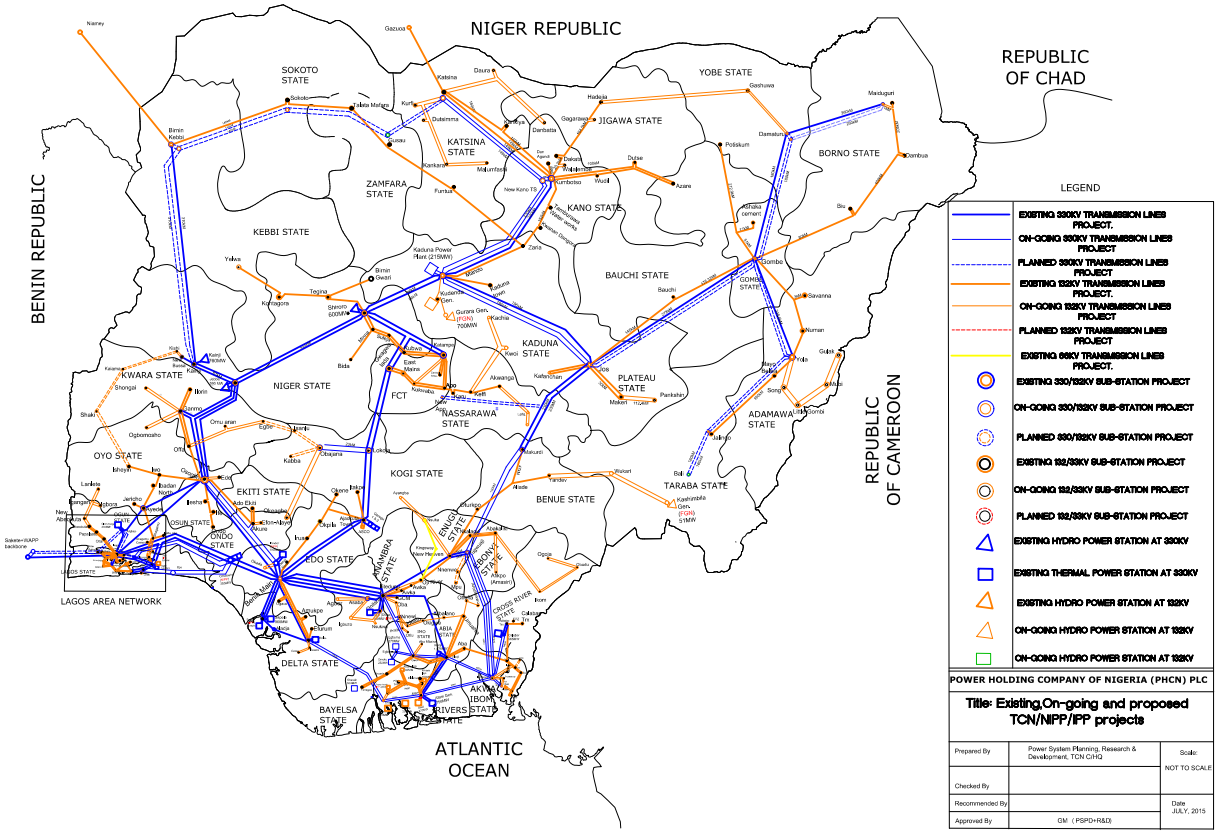
Source: Ley, Gaines and Ghatikar 2015

ELECTRICITY TRANSMISSION

Inadequate transmission infrastructure is among the constraints plaguing on-grid power generation. Although the wheeling capacity of Transmission Company of Nigeria (TCN) has increased from 5,300 megawatts (MW) in 2015 to 7,124 MW in 2018, this is still far below the total installed capacity of 12.5 GW. From January 2017 to May 2018, the average transmission losses across the network were as high as 8.8 per cent, which is much higher than the benchmarks for emerging countries of around 2-6 per cent (NERC 2018). The national grid also sustains very high technical losses, which further impacts the quantity of electricity that can be transmitted.

TCN plans to upgrade its transmission capacity to 11 GW by 2020, subject to funding and the completion of planned projects. Map 1 illustrates both existing and planned transmission lines in the country as published by TCN.

Map 1: Existing and planned transmission lines in Nigeria



Source: Grid map for existing transmission and generation network, Transmission Company of Nigeria.

ELECTRICITY DISTRIBUTION

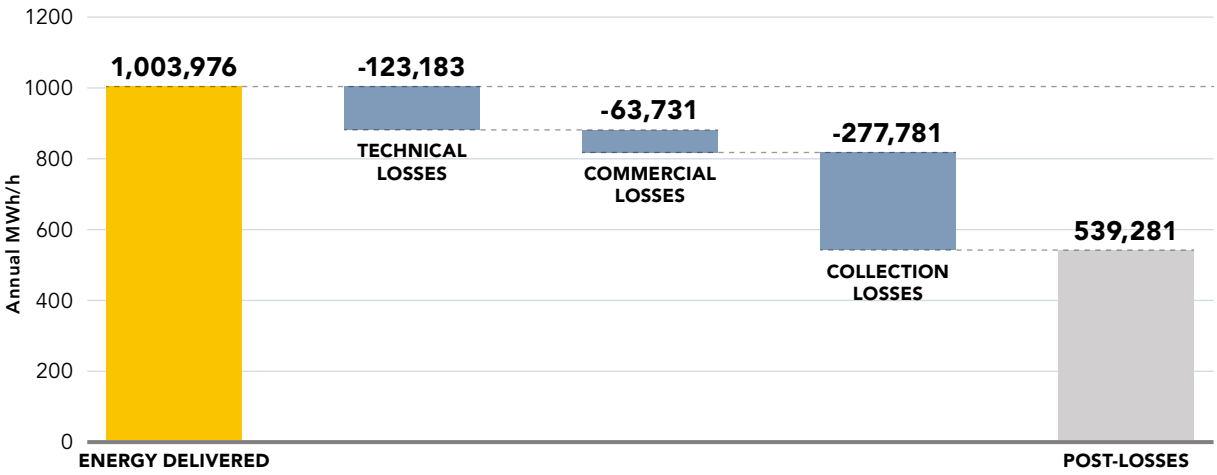
The privatization of the distribution system assets was based on the capability and the assumption of prospective investors to reduce aggregate technical, commercial and collection losses in the distribution network (which together account for energy losses of 46 per cent; see Figure 6). However, there has been an increased demand for the distribution companies to invest in network infrastructure and to improve efficiency to deliver the targets specified in their performance agreements with the Bureau of Public Enterprises (BPE) on behalf of the Government of Nigeria. According to the Advisory Power Team Trend for 2020, Nigeria's average generation and transmission were 4,000 MW, and the average of 3,000 MW is being distributed to electricity consumers in the country (KPMG, 2021).

Despite this improvement, distribution companies are still not able to receive all of the electricity that can be transmitted through the now-expanded grid (7,000 MW), meaning that around 2,000 MW of capacity is stranded. The distribution network cannot distribute greater than 57 per cent of the available electricity, according to a recent stress test (Olawoyin 2017). This means that a majority of the distribution companies reject power, which causes high-frequency problems within the transmission network. The load rejection is driven by two major factors: technical (poor state of the distribution infrastructure) and commercial (where distribution companies are selective in their supply of electricity to customers who are able and willing to pay). Post-privatization, distribution companies have realized that they need to reinforce and strengthen the existing 33/11 kilovolt (kV) network.

Operating losses for the distribution companies, as reported by the Association of Nigerian Electricity Distributors (ANED), were over 10 Nigerian nairas (around 2.7 US cents) per kilowatt-hour (kWh) in 2015[1]; meanwhile, the average tariff was 27 naira (7.5 US cents) per kWh against a total cost of 35 nairas (9.7 US cents) per kWh (ANED 2016).

1 *1 naira = $0.00277451 as of 23 July 2019.*

Figure 6: Distribution losses in 2014 (MWh/h)

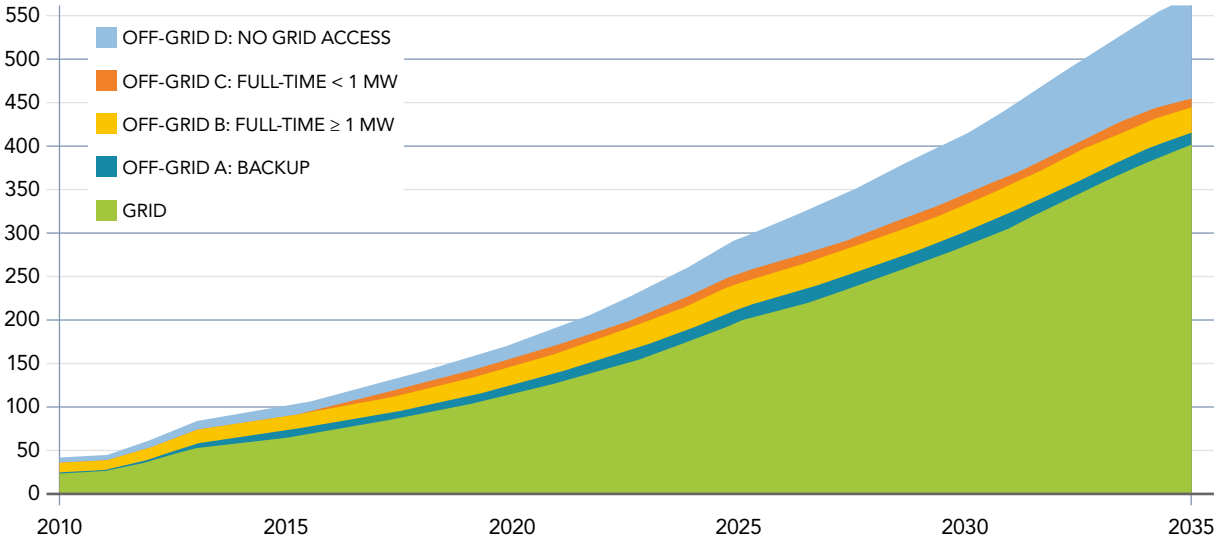


Source: Ogunbiyi and Abiodun 2015

4.2.2/ FUTURE PROJECTION

Population and economic growth in Nigeria are expected to increase the demand for both on-grid and off- grid energy and electricity in the coming years, as shown in Figure 7. The projected increase in electricity for on-grid and off-grid supply is divided into four classes, as defined by the Energy Commission of Nigeria. This future increase in electricity demand will need to be matched with additional investment in generation, rehabilitation, and expansion of the existing grid, while tackling the financial issues of the Nigerian Electricity Supply Industry (NESI).

Figure 7: Growing demand for on- and off-grid electricity (TWh)



Note: Off-grid A is backup off-grid generation that is used only when on-grid power is unavailable; Off-grid B is used full-time even though there is grid access, with generators greater than or equal to 1 MW (which require government registration); Off-grid C is used full-time even though there is grid access, with generators under 1 MW (not needing government registration); Off-grid D is generation in rural locations with no grid access.

Source: Bagu et al. 2016; Cervigni, Raffaello and Rogers 2013; Ley, Gaines and Ghatikar 2015

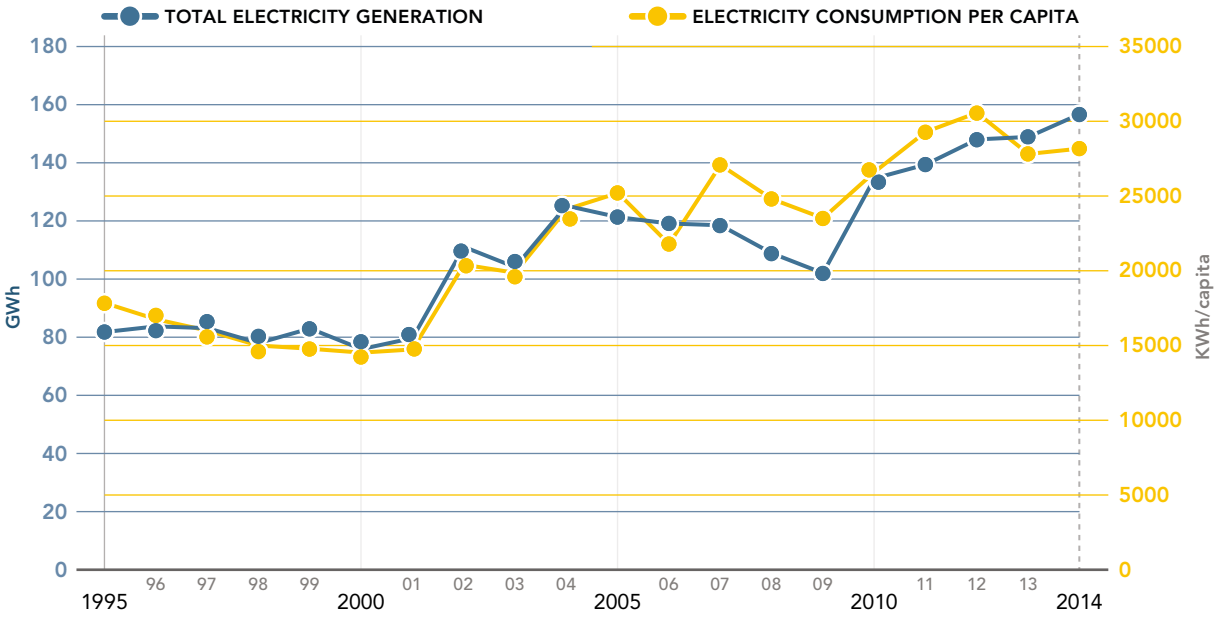
4.3/ ELECTRICITY DEMAND OF COMMERCIAL AND INDUSTRIAL CLIENTS

This section explores the electricity demand of commercial and industrial clients in Nigeria in the context of the overall supply situation.

4.3.1/ ELECTRICITY SALES AND CONSUMPTION

Between 1995 and 2014, per capita electricity consumption in Nigeria grew 3.2 per cent annually on average, from 91 kWh to 144 kWh, and electricity generation increased 4.6 per cent annually on average, from 14 terawatt-hours (TWh) to 30 TWh (Figure 8). However, Nigeria still lags far behind other developing countries in grid-based electricity consumption. To match countries that have similar GDPs, electricity consumption in Nigeria would need to be at least 4-5 times higher. For example, per capita consumption in Ghana is 403 kWh (around three times higher than Nigeria) and in South Africa is 4,363 kWh (around 31 times higher) (Central Intelligence Agency 2016).

Figure 8: Electricity consumption per capita and total generation (1995-2014)



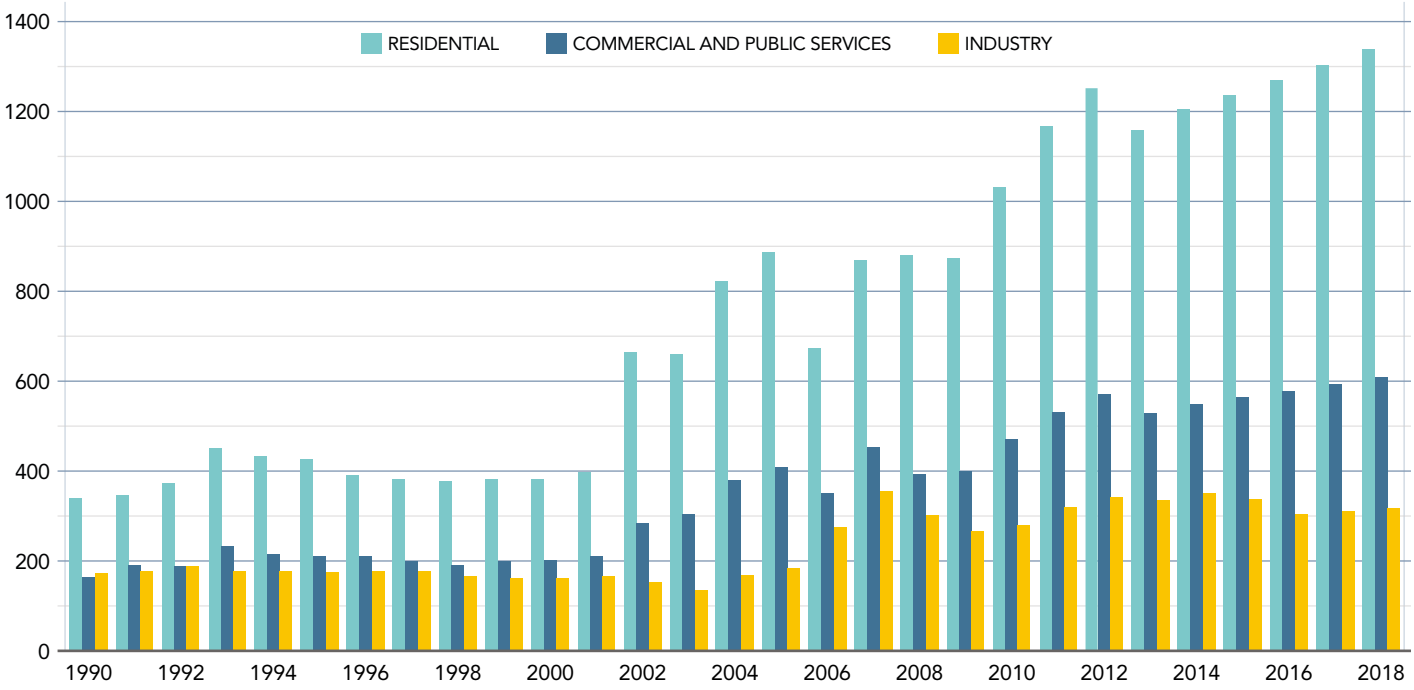
Source: UNdata n.d.

4.3.2/ ELECTRICITY DEMAND

Electricity demand in Nigeria has increased at a rate of 7 per cent annually over the past decade due to population growth and economic development, despite little investment in generation capacity (Africa Finance Corporation 2019).

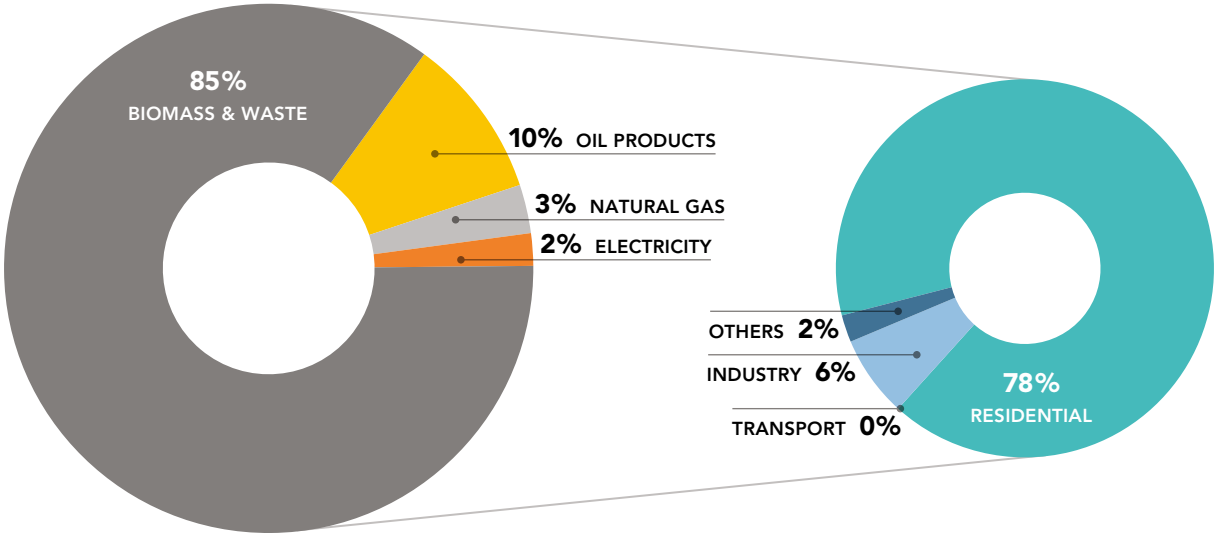
Due to rapid population expansion – from 95 million people in 1990 to almost 160 million in 2010 – electricity consumption in the residential sector was the most pronounced during the 18-year period to 2018 (Figure 9). The residential sector also consumes most of the country's grid-connected electricity (Figure 10), which does not include captive generation from decentralised diesel and gas generators.

Figure 9: Rising household electricity needs (1990-2018) (ktoe)



Source: IEA n.d.

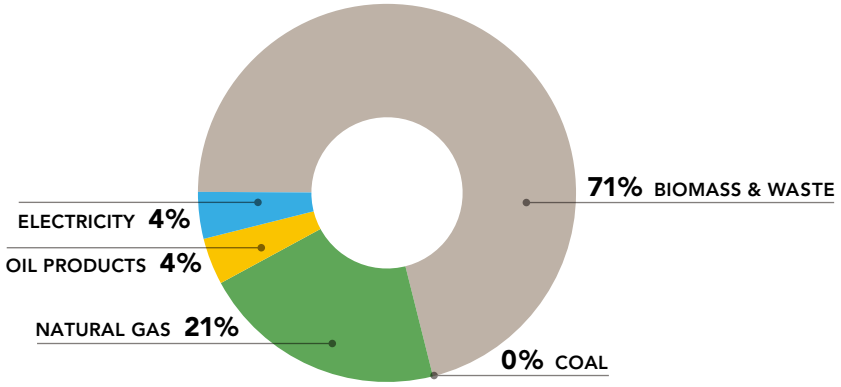
Figure 10: Total on-grid energy consumption in Nigeria by different economic sectors (2013, ktoe)



Source: IEA 2013

Industry accounts for only 6 per cent of the on-grid electricity consumed; meanwhile, the bulk of the energy consumed in the industry sector (96 per cent) is from privately owned self-generating capacity (including biomass and waste as well as diesel and gas generators) (Figure 11).

Figure 11: Final energy consumption of industry sector (2013, ktoe)



Source: IEA 2013

4.3.3/ DEMAND / SUPPLY BALANCE

According to the National Control Center, Osogbo (Nigeria Electricity System Operator [NESO] 2019), the daily peak demand forecast between April and July 2019 was around 26 GW, whereas peak generation fluctuated at around 4-5 GW for the same period, indicating severe shortages in electricity supply. Table 4 provides additional details between January and July 2019 based on the National Control Center operational daily report (NESO 2019).

Table 4: Gap between electricity demand and generation, January to July 2019

	APRIL - JULY 2019	MARCH 2019	FEBRUARY 2019	JANUARY 2019
National peak demand forecast	25 790 MW	24 900 MW	23 960 MW	23 000 MW
Installed generation capacity	12 910 MW	12 910 MW	12 910 MW	11 165 MW
Peak generation capacity	Daily fluctuation between 4 000 MW and 5 500 MW			

Source: NESO 2019

The demand-supply gap coupled with poorly maintained power plants and an ineffective grid has led to unstable and unreliable electricity supply for both households and companies (Bagu *et al.* 2016). According to a GIZ survey (2015) companies in Nigeria's industrial sector report electrical outages lasting an average of 7.8 hours per day. As a result, many companies and households revert to self-generated power using diesel and petrol generators, with larger companies relying on gas or diesel (Bagu *et al.* 2016).

4.4/ ELECTRICITY GENERATION OPTIONS

Different business models are available for power producers to generate and sell electricity. The total power generated in Nigeria is a mix of the following different power generation options:

Grid-connected: The electricity generated is evacuated on the Transmission Company of Nigeria (TCN) grid.

Embedded: The electricity is directly evacuated through the distribution system of an external distribution company; hence embedded generators are usually connected to the distribution grid.

Off-grid (including mini-grids): For systems exceeding 1 MW, which require an external off-taker, a power purchase agreement is allowed (as opposed to captive power). For systems up to 1 MW, mini-grid regulation is applicable.

Any entity that intends to engage in electricity generation, transmission, system operation, and distribution or trading is required to obtain an operator's licence from the NERC (NERC n.d.-a).

- To generate **on-grid, embedded or off-grid** power **for sale with a 1 MW minimum capacity**, a generation licence is required.
- To generate more than 1 MW of power for private use (such as **captive power generation**), a permit is required. For self-generated power **less than 1 MW, no regulation is in place**.
- For **mini-grids**, a regulation issued in 2017 states that **below 100 kW** of **distribution capacity**, mini-grids may or may **not apply for a permit**. Above 100 kW of distribution capacity (but below 1 MW of generation capacity), mini grids must obtain a permit (Lane *et al.* 2018). Above 1 MW of generation capacity, the general rule in bullet 1 applies, and generators must obtain a licence as they are no longer considered mini-grids but are instead considered independent power producers, either connected to the main grid or not.

Captive: This describes the generation of off-grid electricity that is consumed entirely by the generator itself (no power purchase agreement required) and that has an installed capacity exceeding 1 MW (with no upper limit). Captive generation is technically off-grid, meaning that the electricity generated is not evacuated to the national grid or to a distribution grid, even though the location where the electricity is generated (for instance, the company premises) may be grid connected (Bagu *et al.* 2016).

4.4.1/ GRID-CONNECTED GENERATION

Table 5: Features and regulations for grid-connected generation

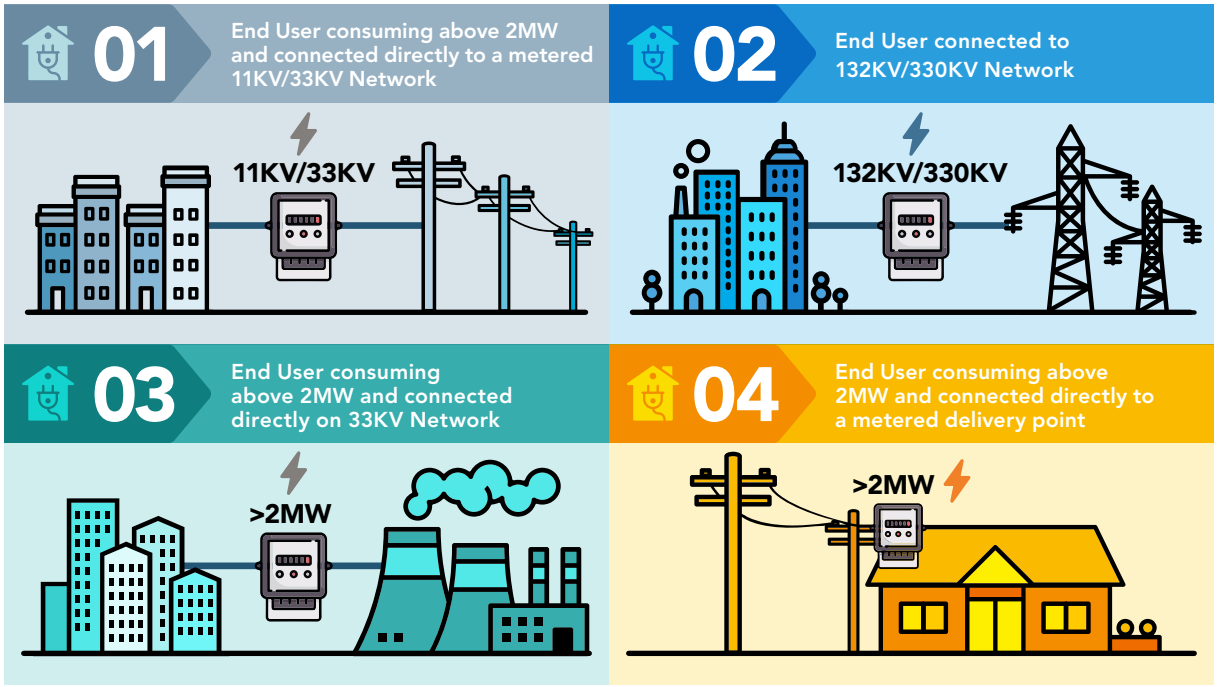
FEATURES	REGULATIONS
- Generation plant is connected to the grid - Power is evacuated to the national grid - Suitable for large-scale projects - Requires a power purchase agreement with the bulk trader (NBET) - Subject to capacity needs and system constraints - Requires a licence from the NERC	- NERC Application for License Regulation, 2010 - NERC Generation Procurement Regulations, 2012 - Eligible Customers Regulations, 2017

Source: NERC 2021a

Grid-connected electricity generation is evacuated through the national grid to off-takers; the off-taker may be the Nigerian Bulk Electricity Trading company (NBET), which through vesting contracts supplies the power to distribution companies; or the power may go directly to "eligible customers" (NERC 2021b). Until recently, the eligible customers regime was not yet implemented and hence the selling and purchase of electricity was restricted, and generation licensees were obliged to sell their production only to the distribution companies. However, the 2017 directive on eligible customers has since defined criteria for eligibility, and this regime will be applied in two phases (Figure 12):

- **Phase 1** – Implementation of categories 2, 3, 4 and part of category 1 (i.e., those connected to a metered 33 kV delivery point)
- **Phase 2** – Implementation of the second part of category 1 (i.e., those connected to a metered 11 kV delivery point)

Figure 12: Categories of customer eligibility and pre-qualification criteria



Source: Detail Commercial Solicitors 2017

Based on the above criteria, many Nigerian industries may qualify for the eligible customer regime, in particular in the sub-sectors of chemicals and pharmaceuticals, food and beverage manufacture, and plastic and rubber products (Barba 2018).

From a regulatory viewpoint, any generating facility (independent power producer) that wants to connect to the grid and sell to the NBET via a power purchase agreement could do so either through unsolicited bids or through competitive procurement (Bagu *et al.* 2016). The generation procurement regulations are applicable for facilities above 10 MW (Ley, Gaines and Ghatikar 2015). Unsolicited bids have been used until now, and competitive procurement will be the next phase. The licencing process for this type of generation option is not part of the document (NBET n.d.).

4.4.2/ EMBEDDED GENERATION

Table 6: Features and regulations for embedded generation

FEATURES	REGULATIONS
- Plant directly connected to distribution network - >1 MW - Power sold directly to distribution companies through bilateral contract - Licence required from the NERC - Good for clusters of customers (e.g., industrial estates)	- NERC Regulation on Embedded Generation, 2012

Source: NERC 2021a

The NERC defines embedded generation as "generating units that are directly connected and evacuated through a distribution system, be it an existing distribution facility of distribution companies or through independent distribution licensee (IEDN). The embedded generator engages and negotiates relevant PPAs with these two entities and does not require power purchase agreement with NBET, nor connection agreement with TCN".

Embedded power currently is almost non-existent, and as of 2015 only 49 MW had been licensed. This lack of projects explains the missing liquidity of distribution companies, which constrains them to off-take power from potential embedded generators (Bagu *et al.* 2016).

However, recently a special purpose vehicle, Ariria Market Energy Solutions (AMES), formed by three Nigerian companies, was awarded an embedded electricity generation licence by NERC. The licence for a 9.5 MW gas power plant was for the Ariria Market in Aba, a leading commercial hub in the country (BusinessDay 2018). It was structured in a way that the project developers created Ariria Independent Energy Distribution Network Limited, which was awarded an IEDN licence (Box 2).

BOX 2: Regulations for Independent Electricity Distribution Networks (IEDN), 2012

This regulation outlines the provisions for the issuance of licences for distribution companies and electricity distributors independent of a distribution company. 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 service agreement.

As a result, Nigeria's total power generation is a mixture of the power generation options described above. These options include 1) transmission-based on-grid generation, 2) embedded generation, 3) off-grid generation and 4) captive generation. While licences are needed to operate a generator according to options 1-3, captive generation only requires a permit from the NERC.

4.4.3/ OFF-GRID GENERATION

As mentioned previously, under captive generation, systems above 1 MW that will supply off-takers need to apply for an off-grid generation licence. Systems under 1 MW will need to comply with the Mini Grid Regulation issued in 2017, which provides three thresholds of authorization (Castalia 2017):

- **Below 100 kW of distribution capacity**, mini-grids have the choice to apply for a permit. It will only guarantee compensation to the mini-grid for the takeover of assets when the grid arrives. Operators must register and will also freely choose the location of operation.
- **Above 100 kW of distribution capacity, but below 1 MW of generation capacity**, mini-grids must obtain a permit and comply with the mini-grid regulation.
- **Above 1 MW of generation capacity**, mini-grids must obtain a licence. They are not considered to be mini-grids under the regulations, but rather to be independent power producers, either connected to the main grid or not.

Mini-grid operators have opted for registered systems with a capacity lower than 100 kW. They can set their own tariffs and choose their location, while observing how regulation is enforced for projects above the 100 kW threshold (Castalia 2017).

Table 7 describes the typical characteristics for mini-grid projects audited by The Nigerian Economic Summit Group in 2018. According to the audit, cost-reflective mini-grid tariffs are around 200 naira (57 US cents) per kWh, which is less costly than a small diesel or petrol generator set (Yakubu *et al.* 2018). Based on the estimation in 2018, mini-grid tariffs have been reduced by 60 per cent as of 2020 (Yakubu *et al.* 2018).

Table 7: Characteristics of mini-grids as of 2018

INDICES	RANGE OF SITE CHARACTERISTICS
Population	1 200 – 5 000
Economic activities	Farming: maize, millet, sorghum, cocoa, oil palm, rubber, yam, cassava, plantain, bananas Fish farming
Commercial activities	Welding, retail, grain milling, oil palm processing, cassava grinding, barbing
Commercial energy use	Welding, barbing, retail/provision stores, grinding
Household energy use	Electric bulbs, electric fans, television sets, radio sets, cell phones, refrigerators
Local cost of petrol	145-300 naira ($0.41-$0.86) per litre
Local cost of diesel	160-300 naira ($0.46-$0.86) per litre

Source: Yakubu et al. 2018

4.4.4/ CAPTIVE GENERATION

Table 8: Features and regulations for captive generation

FEATURES	REGULATIONS
- Off-grid - Power consumed by generating entity - >1 MW - No distribution infrastructure required - Permit required from the NERC	- NERC Captive Power Generation Regulation

Source: NERC 2021a

According to the NERC, captive power generation is defined as the generation of electricity exceeding 1 MW for the purpose of self-consumption by the generator. Captive generation is not evacuated to the national grid or a distribution grid, even though the location where the electricity is generated (the company premises) may be grid connected. Generation of captive power for own use up to 1 MW is not regulated (Ley, Gaines and Ghatikar 2015).

In Nigeria, captive power is a widespread form of off-grid power generation, with the total permits issued by NERC between 2010 and 2013 adding up to around 1,300 MW of capacity. Based on rough estimations, between 8 GW and 14 GW of decentralized electricity is installed, while around 86 per cent of companies in Nigeria own or share a generator and around 48 per cent of their total electricity demand is covered by these captive power generators (Ley, Gaines and Ghatikar 2015).

This suggests that a large share of the self-generated power market has a capacity below 1 MW, and/or captive power generation is not accounted for in the overviews of permits and licences that are available (Bagu *et al.* 2016). Based on the overview of issued permits, the following can be concluded:

- 78 per cent of the issued permits are in three states: Akwa Ibom (22 per cent), Ogun (25 per cent) and Rivers (31 per cent), the major industrialised and oil and gas states.
- The agri-food sector is second to the oil and gas sector, with 10 permits and planned captive generation capacity of 121 MW (9 per cent).
- No permits or licences have yet been issued for renewable captive power (or not registered as such).

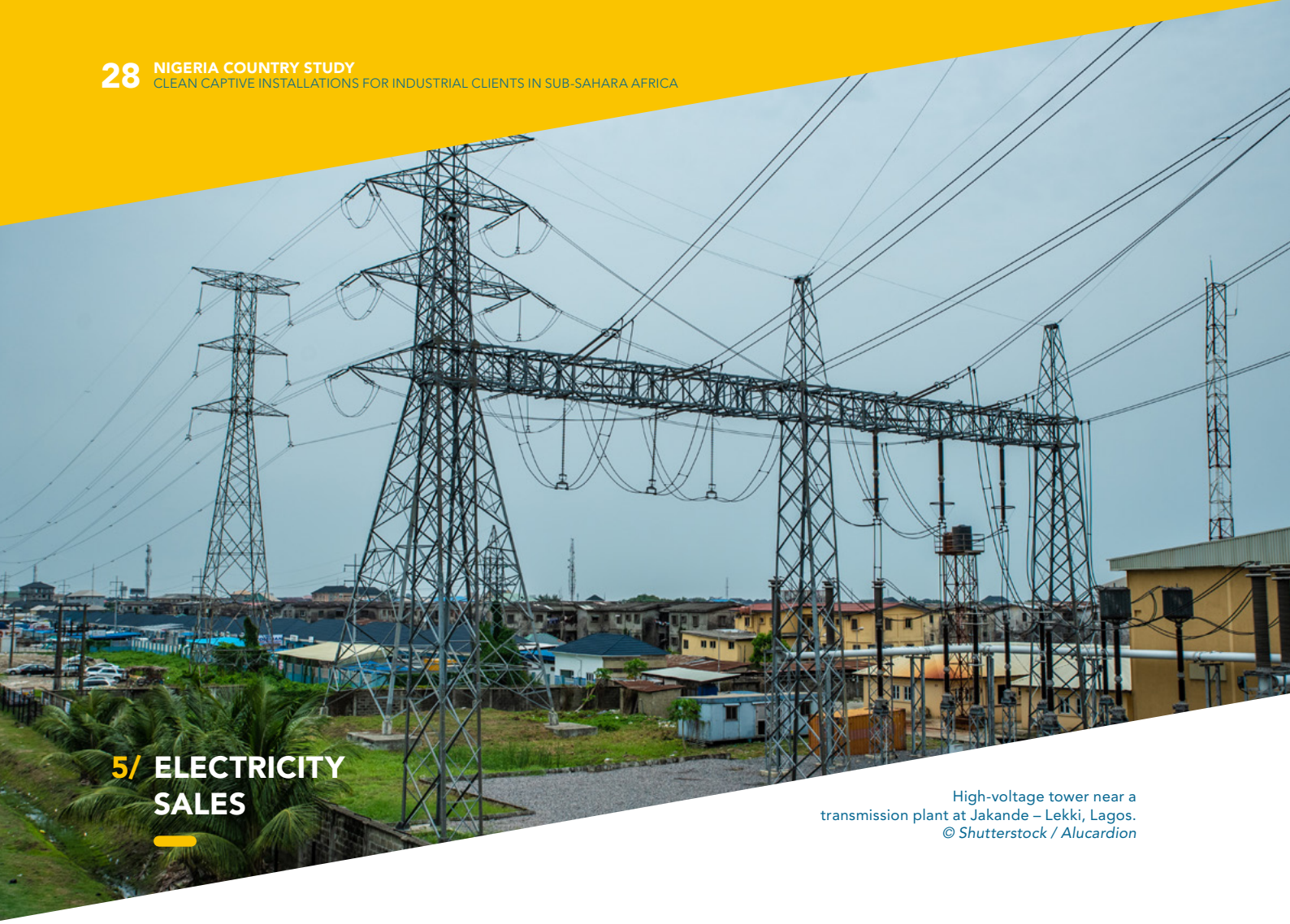
According to the captive power regulation, "a permit for captive generation does not however allow for supplying external off-takers". To be able to generate surplus power:

- A permit holder must apply to, and receive prior written consent from, the NERC before supplying surplus power not exceeding 1 MW to an off-taker.
- A permit holder that intends to supply surplus power exceeding 1 MW to an off-taker must apply for a generation licence (choosing off-grid generation in the application).

4.5/ CONCLUSION

Nigeria's power sector has experienced a series of challenges related to power policy implementation, regulatory uncertainty, gas supply, transmission system constraints and inadequate planning of the main power sector. Natural gas plays an important role in the country's power generation system. Moreover, the infrastructure of Nigeria's power system lags behind, with significant losses and inefficiencies in generation, transmission and distribution.

According to the demand-supply analysis, there are severe shortages in electricity supply in Nigeria. In the coming years, both population and economic growth are expected to increase the demand for on- and off-grid energy and power, requiring significant investment and construction in the power system, particularly in generation units. Among the four generation options – grid-connected generation, embedded generation, captive generation and off-grid generation – captive generation holds great promise. Currently, a large share of the self-generated electricity market has a capacity of less than 1 MW, and/or self-generation is not accounted for in the existing overview of permits and licences.



5/ ELECTRICITY SALES

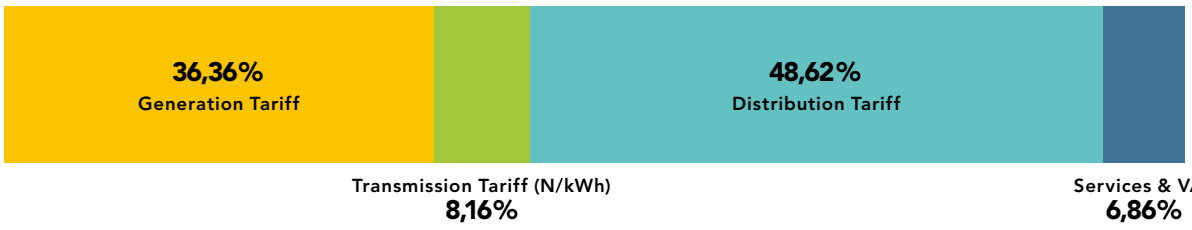
High-voltage tower near a transmission plant at Jakande – Lekki, Lagos.
© Shutterstock / Alucardion

The discussion of tariffs in this section refers to end user (consumer) tariffs.

5.1/ ELECTRICITY TARIFFS

As part of the privatization process, electricity prices are determined by the NERC in line with its Multi-Year Tariff Order (MYTO), as the framework for determining the NESI pricing structure (Figure 13).

Figure 13: Electricity retail price structure (%)



Source: NERC n.d.-b

According to the NERC's website (NERC n.d.-b), the MYTO provides "a 15-year tariff path for the NESI with limited minor reviews each year in the light of changes in a limited number of parameters (such as inflation, interest rates, exchange rates and generation capacity) and major reviews every five years, when all of the inputs are reviewed with stakeholders".

From the inception of the privatization exercise to date, various versions of the MYTO have included MYTO 2, MYTO 2.1, MYTO 2.1 amended and MYTO 2015 (Ajumogobia & Okeke 2015).

During the Interim Period (November 1, 2013 – January 30, 2015), which was designed as a learning phase of Nigeria's electricity market for market actors, as envisaged by the regulators, market actors did not smoothly adopt the expectations of the MYTO 2.1. Consequently, monies paid to the market were done in a haphazard manner, and there continued to be inconsistencies in remittances from the distribution companies in different months.

At the time of the privatization, the MYTO 2.1 model grouped the costs in generation, transmission and distribution. However, the MYTO 2015, which is currently being used, breaks down the cost further. The main change in the MYTO 2015 was the splitting of transmission into the market operator, the system operator and ancillary services (Table 9).

Consumers pay distribution companies for the electricity consumed; distribution companies then pay NBET for the electricity they receive from the generation companies. NBET pays the generation companies for the bulk/wholesale power sent to the grid. The price to be paid by the end consumer (distribution tariffs) is not to be mixed with the price paid to the generation companies (generation tariffs) (Ley, Gaines and Ghatikar 2015).

Table 9: Multi-Year Tariff Order 2015: Split-up of transmission into the market operator, system operator and ancillary services

GENERATION	TRANSMISSION	TCN (SYSTEM OPERATOR AND MARKET OPERATOR)	ANCILLARY SERVICES	DISTRIBUTION
Wholesale generation costs + PPAs	Operating expenditure - Variable operation and maintenance (O&M) costs - Administrative costs (fixed) - Fixed O&M costs	Operating expenditure - Variable O&M costs - Administrative costs (fixed) - Fixed O&M costs	Ancillary services charge	Operating expenditure - Fixed O&M costs - Administrative costs (fixed) - Variable O&M costs
Annual NERC licence charge	Return on capital	Return on working capital		Return on capital
	Depreciation	NERC charge		Depreciation
	NERC charge			NERC charge
				Bulk trader charge

Source: Sipasi, Okworionu and Abraham 2019

5.2/ GENERATION TARIFFS

These prices are fixed according to the fuel source. For example, the bulk price paid by distribution companies to generation companies for a gas power plant in 2013 is in the order of 10,257 nairas ($64.10) per MWh, while for hydropower, wind, solar and biomass, it varies between 25,400 nairas ($158.75) per MWh for hydropower and 73,300 nairas ($458.13) per MWh (2013) for solar PV (Ley, Gaines and Ghatikar 2015).

From the NERC website, the generation tariff is determined using a benchmark Long Run Marginal Cost (LRMC)[2] that an efficient generator is expected to operate below. However, each new entrant independent power producer that requires a tariff beyond the MYTO benchmark must apply to the Commission for approval, and an individual (site-specific) LRMC model will be utilized.

Notably, under the Feed-in Tariff Regulation approved in 2015, feed-in tariffs have been developed for investors wishing to invest in generation capacity that utilizes other sources of energy including solar, wind, biomass and small hydropower. Table 10 provides the feed-in tariffs issued from the regulation. These are reviewed every three years, and the resulting tariffs are applicable to new projects (IEA/IRENA Renewables Policies Database 2017).

2 *This involves calculating the full life cycle cost of the lowest-efficient-cost new entrant generator, considering current costs of plant and equipment, return on capital, operation and maintenance, fuel costs, etc.*

Table 10: Feed-in tariffs for 2016 base year

YEAR	DESCRIPTION	UNIT	SOLAR	WIND	SMALL HYDROPOWER	BIOMASS
FIT 2016 (Nigerian naira)	Capital cost	naira/MWh	35 370.05 ($98.13)	24 791.55 ($68.78)	30 887.43 ($85.71)	22 400.51 ($62.15)
	O&M	naira/MWh	29.49 ($0.08)	302.73 ($0.84)	55.92 ($0.16)	8541.11 ($23.70)
	Total	**naira/MWh**	**35 399.54** ($98.22)	**25 094.28** ($69.42)	**30 943.35** ($85.85)	**30 941.62** ($85.85)
FIT 2016 (US$)	Capital cost	$/MWh	176.85	123.96	154.44	112.00
	O&M	$/MWh	0.15	1.51	0.28	42.71
	Total	**$/MWh**	**177.00**	**125.47**	**154.72**	**154.71**

Source: NERC n.d.-c

5.3/ DISTRIBUTION / END USER TARIFFS

According to the NERC (NERC n.d.-d), the consumer pays a set price per region and consumer category to the local distribution companies. A distinction is made between private, commercial and industrial customers. The full consumer categories are provided in Table 11.

Table 11: Consumer categories

	CUSTOMER CLASSIFICATION	DESCRIPTION	REMARKS
1	Residential		A consumer who uses his premises exclusively as a residence – house, flat or multi-storeyed house where people reside.
	R1	Lifeline (50 kWh)	
	R2	Single and 3-phase	
	R3	LV maximum demand	
	R4	HV maximum demand (11/33 kV)	
2	Commercial		A consumer who uses his premises for any purpose other than exclusively as a residence or as a factory for manufacturing goods.
	C1	Single and 3-phase	
	C2	LV maximum demand	
	C3	HV maximum demand (11/33 kV)	
3	Industrial		A consumer who uses his premises for manufacturing goods including welding and ironmongery.
	D1	Single and 3-phase	
	D2	LV maximum demand	
	D3	HV maximum demand (11/33 kV)	
4	Special		Customers such as agriculture (agro-allied enterprises involving processing are excluded), water boards, religious houses, Government and teaching hospitals, Government research institutes and educational establishments
	A1	Single and 3-phase	
	A2	LV maximum demand	
	A3	HV maximum demand (11/33 kV)	
5	Street Lighting		
	S1	Single and 3-phase	

Note: LV = low voltage; HV = high voltage
Source: NERC n.d.-e

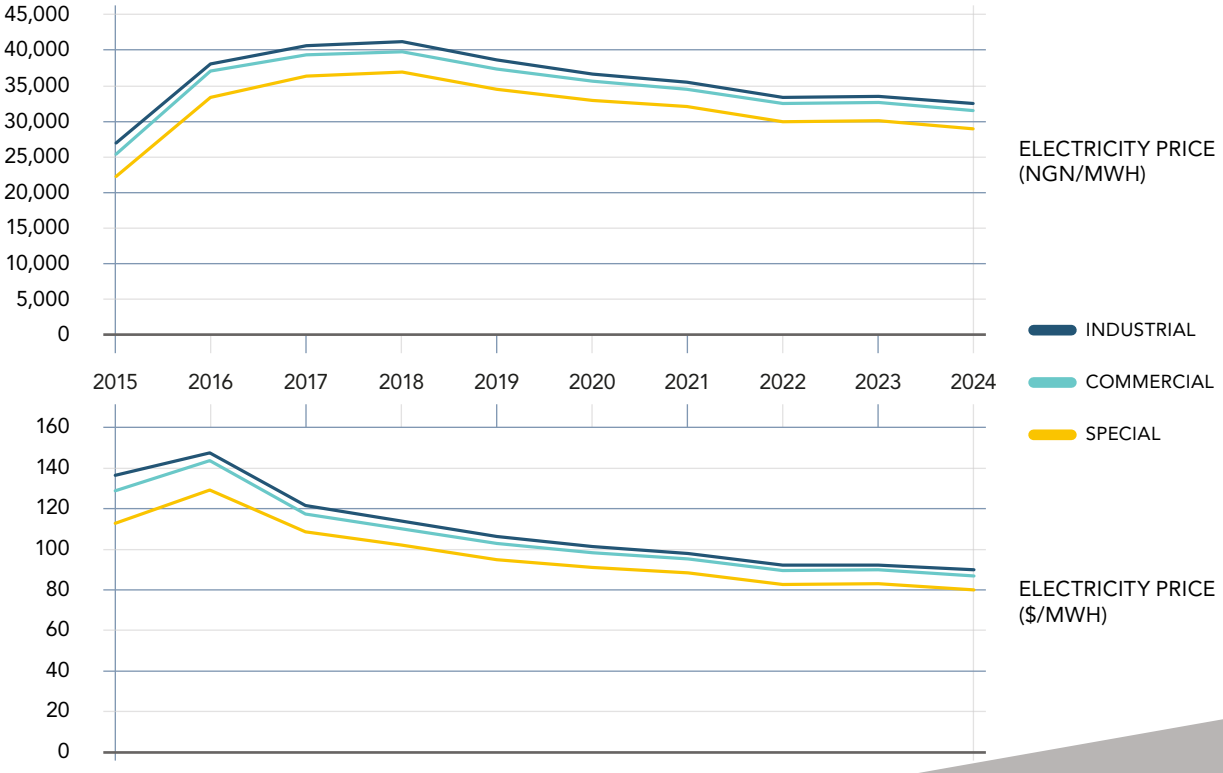
The energy bill from distribution companies for customers is composed of a fixed charge and an energy charge. The fixed charge covers the capital goods and operational fixed costs, and the energy costs cover the costs of consumption (fuel costs, variable costs, maintenance costs, tax) (Bagu *et al.* 2016). The energy charges (in naira) per consumer group are presented for Abuja In Table 12, and those of commercial, industrial and special categories are shown in Figure 14. The NERC publishes all distribution company tariffs (NERC n.d.-f) on its website. Notable is a uniform lifeline tariff of 4 nairas (1.1 US cents) per kWh for the low-income R1 customer sub-class in all 11 distribution companies.

Table 12: Abuja distribution companies retail price (2015-2024) (naira/kWh)

CLASS	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
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	19.69	19.74	19.51	19.40	19.25
R3	32.25	46.23	47.09	45.72	38.82	37.46	37.56	37.12	36.91	36.62
R4	32.25	46.23	47.09	45.72	38.82	37.46	37.56	37.12	36.91	36.62
C1	23.61	36.65	37.39	36.25	30.78	29.70	29.78	29.43	29.26	29.03
C2	29.98	46.23	47.09	45.72	38.82	37.46	37.56	37.12	36.91	36.62
C3	29.98	46.23	47.09	45.72	38.82	37.46	37.56	37.12	36.91	36.62
D1	24.19	35.35	36.07	34.96	29.68	28.64	28.72	28.38	28.22	28.00
D2	31.43	46.23	47.09	45.72	38.82	37.46	37.56	37.12	36.91	36.62
D3	23.16	46.23	47.09	45.72	38.82	37.46	37.56	37.12	36.91	36.62
A1	23.16	35.02	35.74	34.63	29.40	28.38	28.45	28.12	27.96	27.74
A2	23.16	35.02	35.74	34.63	29.40	28.38	28.45	28.12	27.96	27.74
A3	23.16	35.02	35.74	34.63	29.40	28.38	28.45	28.12	27.96	27.74
S1	19.11	26.84	27.14	26.54	22.53	21.75	21.80	21.55	21.43	21.26

Source: NERC 2021a

Figure 14: Nigeria retail power prices for commercial, industrial and special categories



Source: BloombergNEF 2019

The Nigeria Electricity Regulatory Commission (NERC) announced the increase of electricity tariffs being paid by consumers happening April 2020. However, this plan was subsequently suspended. While the idea was welcomed by the distribution companies and other actors in the value chain, both electricity consumers and the National Assembly spoke out against it. The implication of the hike in tariff would benefit the electricity market and push the market closer to cost-reflective tariffs that ultimately start to address the lingering liquidity challenges. However, the increase in tariffs also could adversely affect unmetered customers due to an increase in the already over inflated electricity bill. Many have also argued that the increase in tariff may lead to energy poverty, especially in a country where a large percentage of people live in extreme poverty.

According to the NERC website (NERC n.d.-b), NERC factors three modules into the MYTO methodology calculation for distribution companies: the allowed return on investment, the allowed return of capital, and efficient operating costs and overheads. However, when NERC tries to increase electricity prices, petition and pressure from consumer groups results in a downward review of the tariffs.

5.4/ MINI-GRID TARIFFS

NERC has published a Multi-Year Tariff Order (MYTO) tool to calculate the appropriate tariff, not related to national grid tariffs, that must be used by isolated mini-grids in order to obtain a permit. The regulation for the tariff for both isolated and interconnected systems is summarized in Table 13; in either case, it requires final approval from NERC (Lane *et al.* 2018).

Table 13: Regulations for mini-grid tariff

	REGISTRATION (UNDER 100 KW)	PERMIT (100 KW-1 MW)
Isolated mini-grid	Developer sets tariff through MYTO calculation tool or agreement with the community	Developer must use MYTO calculation tool to determine tariff, and attach calculation spreadsheets to its application.
Interconnected mini-grid	Developer agrees with the distribution company and the community	Developer agrees with the distribution company and the community on retail tariff, usage right for the distribution company's network infrastructure, and tariff for electricity generated by the mini-grid and fed into the distribution company's network. MYTO must be used only to calculate the retail tariff, and calculation spreadsheets must be attached to the application.

Source: NERC n.d.-b

5.5/ CONCLUSION

Over the years, the Nigerian electricity supply industry has moved from a simple integrated system to a privatized and diversified system with market players saddled with unique responsibilities. This new system has given rise to policies and regulations that have created the enabling environment for exploring various power generation options with the aim of increasing electricity generation, improving transmission and distribution, and supplying electricity to more off-grid communities.

The privatization of the distribution companies has improved meter roll-outs, increased customer awareness and provided general understanding to the public on the need for updated cost-reflective tariffs on electricity supply, hence the periodic Multi-Year Tariff Order that reviews the cost of power to end users. Overall, improvements in the electricity supply industry have resulted, based on improvements in the overall players in the industry. However, limited transmission capacities remain a bottleneck, affecting the increase in electricity availability to end users.

6/ ENERGY POLICY AND REGULATORY FRAMEWORK

Lagos Harbor, Lagos Island Central Business District.
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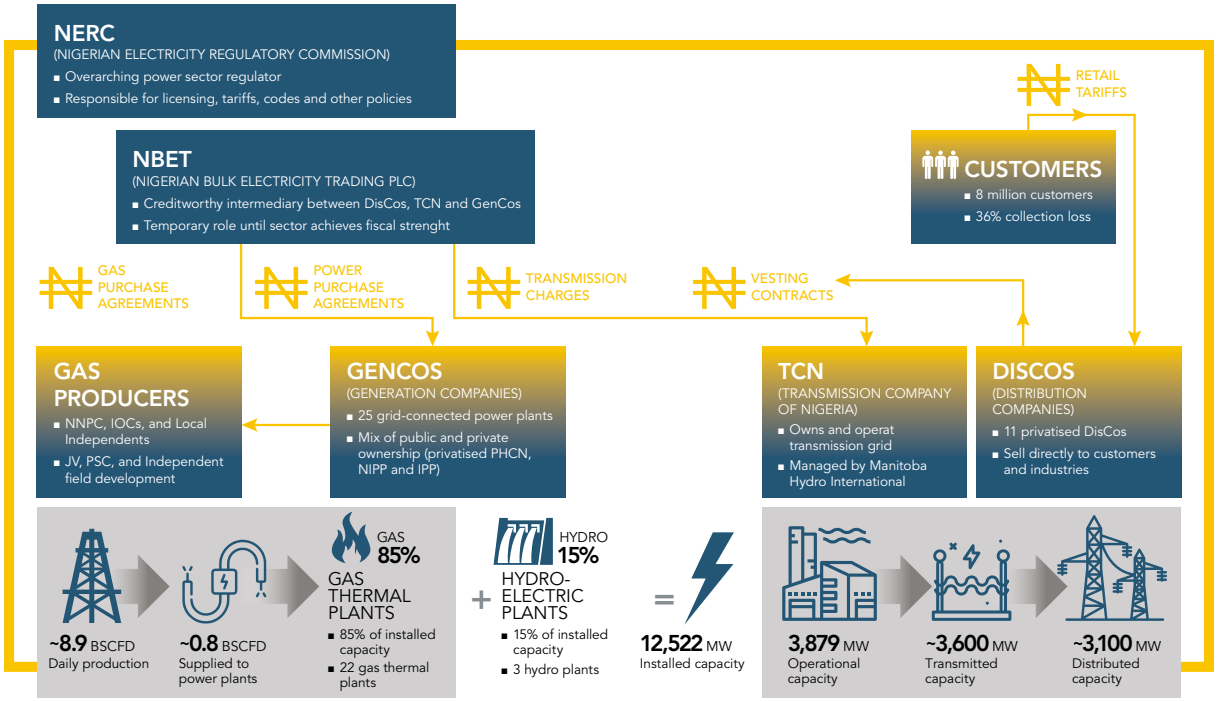
This section provides an overview of the structure of the power sector in Nigeria; the policies, laws and regulations governing the electricity sector; the licencing requirements for various generation options; key sector actors; and the cost of electricity as they relate to captive power.

At the time of writing this report, Nigeria has a comparatively unregulated market for renewable energy. It does not have a dedicated code or act that states the different business models under which a private company can generate and sell renewable electricity. For on-grid generation, however, there is a regulation for a feed-in tariff for renewably sourced electricity approved in 2015. See below for other business models on the regulations applying to the development and operation of a renewable energy plant in Nigeria.

6.1/ OVERARCHING ENERGY POLICIES AND LAWS

The energy landscape in Nigeria has undergone drastic changes in recent years due to the ongoing privatization of the sector. In recent decades, the electricity market has changed from a vertically integrated organization under the state-owned National Electric Power Authority (NEPA), to a multi-stakeholder privatized market. Figure 15 presents an overview of the key power market actors in Nigeria.

Figure 15: Overview of key power market actors



Source: Bagu et al. 2016, as cited from NERC

Note: NNPC = The Nigerian National Petroleum Corporation; IOCs = International Oil Companies; JV = joint venture; PSC = Production Sharing Contractors.

The National Electric Power Authority (NEPA), before the unbundling of the sector, was divided into 6 generation companies, 11 distribution companies and the Transmission Company of Nigeria (TCN). Following the energy crisis of 2001 and through the formulation of the Electric Power Sector Reform Act (ESPRA) (2005), the federal government unbundled the power sector. The objective was to transform the Nigerian power sector into a private sector-driven market ("The Reform Objective") by introducing transparent and responsible management, limiting political and governmental interference in utility management, and encouraging private investment in power generation (privatization of PHCN and Niger Delta Power Holding Company (NDPHC)) assets. The reform process intends to support and improve service maintenance and delivery to the Nigerian energy consumers ("The Service Delivery Objective") (Bundesverband Solarwirtschaft e.V. 2018).

6.1.1/ 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 privatized 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 privatization and the introduction of independent power producers. The second step aimed at increasing the competition between market participants, reduction of subsidies and sale of excess power to distribution companies. The final step consisted of a further intensification of the market and competition through full-cost pricing of supply, liberalized selection of suppliers beyond the local distribution companies and full competitive market trading. The implementation of the NEPP was later incorporated in the Electric Power Sector Reform Act (EPSRA) of 2005.

6.1.2/ 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 utilization. The policy programme consists of three topics with individual policy goals:

1. 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 utilized. However, no quantitative targets are given.
2. 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.
3. Rural electrification: The NEP recommends the promotion of off-grid and stand-alone power systems in order to supply electricity to remote areas.

6.1.3/ 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 privatization 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.

6.1.4/ 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 privatized in the following decade. This policy provides a new legal and regulatory framework for the sector. The fundamental reform was the privatization of the government-owned NEPA to the PHCN holding company including the subsequent splitting of its assets into 18 separate successor companies responsible for 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 legislation in the electricity sector. The Act also mandates the NERC to ensure that all electricity generated is efficiently sourced and distributed to the customer.

6.1.5/ ROADMAP FOR POWER SECTOR REFORM, 2010 AND 2013

The Power Sector Reform Roadmap and its 2013 revision include plans and strategies that have been reviewed and fine-tuned to finalize the reform of the power sector and put the country on a stable path to produce clean and efficient electricity at competitive rates. The Roadmap aims to provide an update on the status of reforms and identify key issues and challenges that should be addressed during 2013-2014. After describing the memoranda of the major market institutions and assessing their respective performance in implementing the reforms, the roadmap takes a closer look at the sector and key aspects of development, including fuel-to-power (i.e., fossil fuel supply), generation, transmission and distribution, and the National Integrated Power Project. It makes a series of recommendations and proposals for continued development, and reviews media coverage of the reforms (Ley, Gaines and Ghatikar 2015).

6.1.6/ VISION 20:2020, 2010

Vision 20:2020, released in late 2010, outlined the path for a global and national vision to place Nigeria among the leading 20 global economies by 2020 and aimed to achieve an overall transformation of the economy. The vision programme identified obstacles to the country's development – for example, unreliable electricity supply, outdated and decaying infrastructure, and high dependence on the oil sector – and used three main pillars of mutually reinforcing strategies to name the direction for achieving the goals. Energy supply was considered a key component of all three pillars. Its development was intended to be led by the private sector in a liberalized market. The role of government and state institutions would then be limited to providing the legal and regulatory environment. Overall, the plan was to increase installed capacity to 35,000 MW by 2020. Vision 20:2020 also recognized the importance of Nigeria's renewable energy resource potential in achieving national electricity targets (Ley, Gaines and Ghatikar 2015).

6.1.7/ 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 was initiated that sets feed-in tariffs for new-entrance gas power plants, new-entrance coal power plants, small hydropower plants, land-based wind power plants and solar power plants.

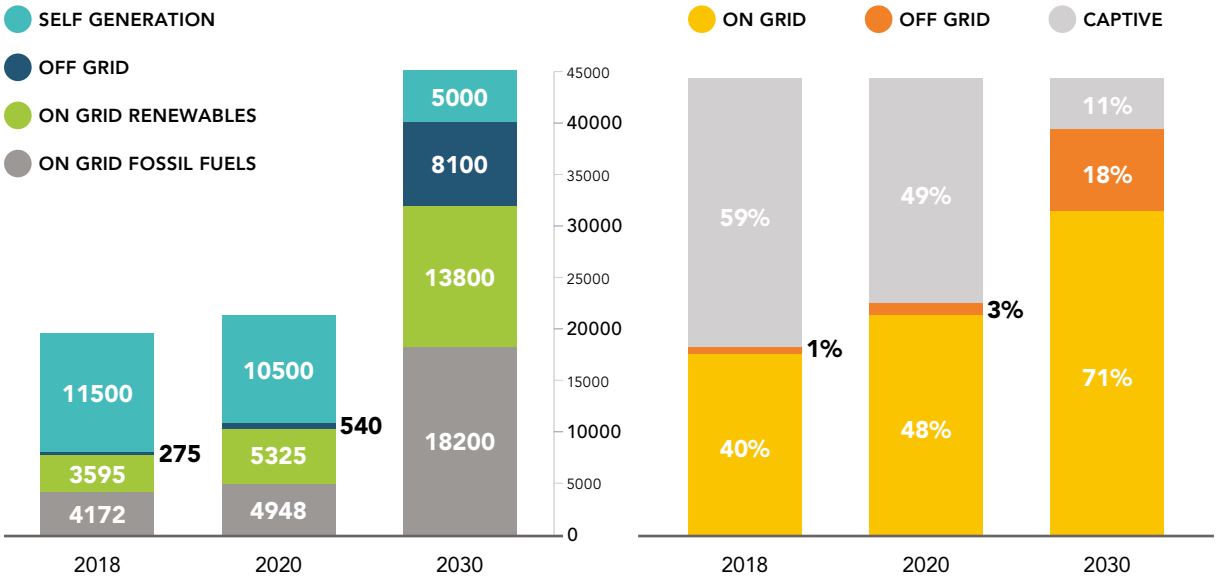
6.2/ ENERGY-RELATED POLICIES RELEVANT FOR CAPTIVE POWER

Since 2013, renewable energy policies such as the National Renewable Energy and Energy Efficiency Policy (NREEEP) and action plans such as the Sustainable Energy for All Action Agenda (SEforALL-AA) and the National Renewable Energy Action Plan (NREAP) have been developed for the renewable energy sector. For instance, in the NREAP, the Nigerian government is targeting an additional 30 GW of electricity generation capacity by 2030, with 30 per cent of this capacity to come from renewable energy, as part of the Electricity Vision 30:30:30 (Figure 16) (ECREEE 2021).

Total electricity generation capacity is therefore targeted to reach

- 23.5 GW in 2020, including 10.5 GW of captive self-generation and 0.54 GW of off-grid generation, and
- 45 GW by 2030, including 8 GW of off-grid generation and 5 GW of captive self-generation.

Figure 16: Nigeria generation capacity targets by 2030 (in MW)



Source: Lane et al. 2018

Table 14 outlines the detailed targets in terms of capacity per technology (Zindler *et al.* 2018):

Table 14: Renewable energy targets for 2020 and 2030, by capacity per technology

TECHNOLOGY	TARGET BY 2020	TARGET BY 2030
Small hydropower	265 MW	1 200 MW
Solar PV	2 000 MW	5 000 MW
Solar thermal	50 MW	1 000 MW
Onshore wind	170 MW	800 MW
Biomass	300 MW	1 100 MW
Mini-grids	180 MW	5 414 MW
Solar PV (home + streets)	360 MW	2 786 MW

Source: NERC, in Zindler et al. 2018

- All renewables (incl. off-grid PV): 3,325 MW (by 2020), 17,200 MW (by 2030)
- All renewables (on-grid only): 2,785 MW (by 2020), 9,100 MW (by 2030)

The previous section summarized the relevant policies and regulations for the power sector in general. In the following paragraphs, the most important policies and regulations related to renewable energy in Nigeria are discussed.

6.2.1/ RENEWABLE ELECTRICITY POLICY GUIDELINES 2006 (REPG)

This policy provided the federal government's vision, policies and objectives for all electricity from renewable sources. The REPG document was issued in 2006 by the then-Federal Ministry of Power and Steel and called for the government to expand the renewable electricity market to at least 5 per cent 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 since replaced the REPG, which was approved by the Federal Executive Council in 2015.

6.2.2/ RENEWABLE ELECTRICITY ACTION PROGRAMME (REAP), 2006

This is a corresponding policy document by the then-Federal Ministry of Power and Steel, also produced in 2006. This programme seems to have been abandoned when the Federal Ministry of Power and Steel was restructured to the Federal Ministry of Power. The main focus of this document is utilizing all forms of renewable energy sources for electricity generation. It highlights potential gaps, technical assessments and the financial implications of using 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.

6.2.3/ RENEWABLE ENERGY MASTER PLAN (REMP), 2005 AND 2012

The REMP was drafted by the Energy Commission of Nigeria (ECN), supported by the United Nations Development Programme, in 2005 and reviewed in 2012. Although it provides 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 was never approved by the Federal Government, and the REMP has been replaced by the National Renewable Energy and Energy Efficiency Policy (NREEEP). The REMP is solely dedicated to the use of renewable sources of energy, and identifies solar, small and large hydropower, biomass and wind energy across the country. The 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.

6.2.4/ NATIONAL RENEWABLE ENERGY AND ENERGY EFFICIENCY POLICY (NREEEP), 2015

The NREEEP was developed by the Federal Ministry of Power (FMP) in 2013 and 2014 and was 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.

The 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. The NREEEP calls for an integrated renewable energy and energy efficiency policy. It seeks to consolidate all previous policies and strategies in one document, hence it can be considered an umbrella document.

Recognizing the multidimensional nature of energy, the NREEEP delves into issues such as renewable energy use and supply, pricing and financing, legislation, regulation and standards, energy efficiency and conservation, research and development, training and capacity building. Furthermore, it acknowledges gender and environmental issues, as well as planning and policy implementation. Overall, the focus of this policy document is to fully utilize the renewable energy resources of Nigeria for sustainable development and to meet the renewable energy generation and energy efficiency targets for the Economic Community of West African States (ECOWAS) for 2020 and beyond.

6.2.5/ NATIONAL RENEWABLE ENERGY ACTION PLAN (2016)

The National Action Plan presents the expected development and expansion of renewable energy in Nigeria in order to achieve the national target under the ECOWAS Renewable Energy Policy (EREP), and thus Nigeria's contribution to the overall ECOWAS target of 23 per cent renewable energy in 2020 and 31 per cent in 2030. It contains existing and 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 is monitored by the Federal Ministry of Power, Works and Housing.

6.2.6/ LICENCING

On-grid renewable energy

As of 2019, the only on-grid renewable energy source in Nigeria was hydropower (the remaining on-grid generation, around 80 per cent, is from gas-based power plants). No large-scale solar projects have been implemented yet in the country. Although the federal government signed power purchase agreements with 14 solar independent power producers in 2016, there have been challenges with agreeing on a suitable tariff for both parties (NERC n.d.-g).

According to the NERC website, the feed-in tariff regulation for renewably sourced electricity approved in 2015 has the following main features:

- The Feed-in Tariff for Solar, Wind, Biomass & Small Hydro entered into force in February 2016. It is applicable for all projects over 1 MW, including solar up to 5 MW, wind power plants and biomass cogeneration power plants up to 10 MW, as well as small hydropower schemes not exceeding 30 MW. This feed-in tariff can be attributed under the unsolicited bids. Competitive tenders for capacities above these thresholds are to be procured through NBET.
- A standard power purchase agreement is based on a plant life cycle of 20 years.
- The distribution company is to procure a minimum of 50 per cent of the total projected renewable sourced electricity.
- NBET is to procure a minimum of 50 per cent of the total projected renewably sourced electricity.
- The feed-in tariff should make it possible to reach a 2 GW renewable energy target by 2020.

According to a recent article (Akanonu 2019), in 2016 Nigeria signed power purchase agreements worth $2.5 billion with 14 independent power producers for on-grid solar PV plants, for a total capacity of 1,125 MW. The solar independent power producers are planned mostly in the northern parts of the country, where higher solar radiation is present (see Annex for a list of independent power producers). However, none of these projects have been implemented, as the tariff structure for the power purchase agreements appears to be a source of disagreement between the government and the independent power producers. "While IPPs want to sell power at the initially agreed US$0.115 per kWh, the government is insisting on a tariff of $0.075 per kWh, citing declining solar costs and comparable projects in countries such as Senegal ($0.05/kWh) and Zambia ($0.06/kWh)" (Bungane 2018).

Licencing for self-power generation options

To summarize the main options for solar power, captive independent power producers with a generating capacity of more than 1 MW must hold a captive generation permit from NERC. Captive generation for self-consumption of less than 1 MW does not require a permit or licence. If a power purchase agreement is involved, between a developer and an off-taker, an off-grid generation licence is required, not a captive power permit.

If the independent power producer will provide power to two or more neighbouring businesses or residents, a mini-grid distribution licence is needed, for capacities between 100 kW and 1 MW. If the project exceeds 1 MW of capacity and provides power to neighbours, its operator needs to obtain an IEDN licence.

Figure 17: Captive power generation licencing process

Source: Bagu et al. 2016

Licensing for captive power generation (2008, 1 MW-plus) (NERC n.d.-c).

According to the NERC regulation website, an application to NERC contains an application form specified in Schedule I of the respective regulation and requires all the information to be filled. The application form is obtained from the office of the Commission. The full application process can be seen in Figure 17.

The permit is valid for five years with an application fee of 50,000 nairas ($138), a permit fee of 200,000 nairas ($550) for projects between 1 and 10 MW(peak), and a fee of 50,000 nairas ($138) for permit renewal. Renewal is guaranteed if the renewal fees are paid and all requirements are met, but the permit renewal application must be submitted at least three months before expiry.

According to the regulation, a permit holder must apply for, and receive prior written consent of the Commission, before supplying surplus power not exceeding 1 MW to an off-taker. However, a permit holder that intends to supply surplus power exceeding 1 MW to an off-taker must apply for a generation licence in compliance with the provisions of the ESPR Act, 2005.

Application for off-grid generation licences (2010, 1 MW-plus) (NERC 2010)

This licence would be required if an industry wants to get captive energy under a power purchase agreement with a developer.

NERC provides the mandatory submissions for applications on its website. Relevant documents such as the application form are also obtainable from the official website. Table 15 outlines the requirements that have to be met in order to obtain a licence.

It can take a maximum of six months from the acknowledgement of the licence application to get the decision of the NERC's approval or refusal.

Table 15: Documents required for application of off-grid generation licences

S/N	REQUIREMENT FOR LICENSE	S/N	REQUIREMENT FOR LICENSE
1	Completed Application Form;	11	Ten-yeas 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	Certificate 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 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	Timeliness 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.

Source: Bagu et al. 2016

Mini-grid regulation (2016, 100 kW to 1 MW) (NERC, n.d.-e)

Only mini-grids can be operated in a bundled generation and distribution mode under one company. Systems above the 1 MW threshold are classed as unbundled independent power producers and independent electricity distribution networks (IEDN) (Lane *et al.* 2018).

Table 16: Mini-grid regulation

AUTHORIZATION TYPE	PERMIT
Location	- Isolated: restricted to unserved areas, except when local distribution company gives written consent for an underserved area not assigned to another IEDN. - Interconnected: restricted to underserved areas.
Administrative procedure	- Isolated: Developer identifies an unserved area, and signs an agreement with the community; developer submits online permit application, confirmation of non-interference with distribution company's five-year expansion plan or distribution company's written consent, and agreement with the community to NERC. - Interconnected: Developer identifies a community that is 1) underserved and 2) willing to pay higher tariffs than for the main grid; developer signs a tripartite contract with local distribution company and the community; developer sends online permit application to NERC; developer submits proposal to distribution company. - NERC gives decision within 30 days upon receipt in both situations - Developer that is awarded a grant by the REA must sign a Grant Agreement with the REA within six weeks.
Documents	- A certificate of incorporation. - Land permit, delivered by the State Ministry of Land. - Building permits, issued by the State Government and approved in three or four months. - Filled standardized spreadsheets used for tariff calculation, with a template provided by NERC on its website. - For mini-grids that interconnect, six schedules are contained in the Regulations, which must be signed by the mini-grid operator, the distribution company and the community.
Environmental impact assessment	The Regulations generally require mini-grid developers to comply with all applicable environmental legislation. Mini-grid developers must perform an analysis of the environmental effects of the project. If the analysis reveals that the project would affect the environment, the developer must undertake an environmental impact assessment, but the NERC does not require a sign-off by any environmental agency to approve the application.

Source: Castalia 2017

Eligible customer regulation, 2017

According to NERC, since 2017 there has been a possibility for an independent power producer to enter into a power purchase agreement with a customer providing that the customer is qualified as an "eligible customer". The power purchase agreement is a document in support of the customer's application to obtain the eligible customer status. The two parties will be entitled to use the grid and/or a distribution network for the delivery of the output under the terms of a "Transmission Use of System Agreement" or a "Distribution Use of System Agreement". Suppliers wishing to sell and supply electricity to eligible customers must be granted any of the following licences: 1) a generation licence (which means that generation facilities under 1 MW of installed power capacity cannot qualify since they have no generation licence) or 2) a trading licence (NERC 2017).

Advantages and way forward of this regime:

This new regime should liberalize the sale and purchase of electricity in Nigeria, and contribute to better quality of supply to the customer as well as a higher bankability for independent power producer projects. In January 2019, the Director-General of the Manufacturers Association of Nigeria declared that "over 40 companies have indicated interest to benefit from the scheme and they are at one stage or another in processing their applications, however only 14 have actually submitted their applications" (Onuba 2019). He further stated that the eligible customer scheme "is a good solution to liberate the industry from what has become the major issue it is facing, having access to electricity". According to him, "one of the major constraints delaying the process is the fact that distribution companies have to give a letter of consent stating they do not have an objection for the company to access the scheme" (Onuba 2019).

From a commercial point of view, the eligible customer regime enables the generation licensees to benefit from lower risks in payment based on the creditworthiness of the eligible customer as opposed to the distribution companies (Barba 2018).

6.3/ NON-ENERGY POLICIES RELEVANT FOR CAPTIVE POWER

The following non-electricity sector regulations and permits are applicable to captive power systems:

6.3.1/ RIGHT OF WAY

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: 1) Notification/Sensitization, 2) Identification, Census, Enumeration and Valuation, 3) Payment of Resettlement/Compensation and 4) Post-compensation Issues.

6.3.2/ NIGERIAN INVESTMENT PROMOTION COUNCIL (NIPC)

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 on which Nigeria was ranked. 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.

6.3.3/ MULTILATERAL INVESTMENT GUARANTEE AGENCY (MIGA)

World Bank guarantee products provide credit support to the Nigerian Bulk Electricity Trading company (NBET) as it enters into power purchase agreements with successor generating companies and existing independent power producers as well as potential new entrants into the power generating market. The Multilateral Investment Guarantee Agency's (MIGA) mandate is to promote foreign direct investment 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 of Contract.

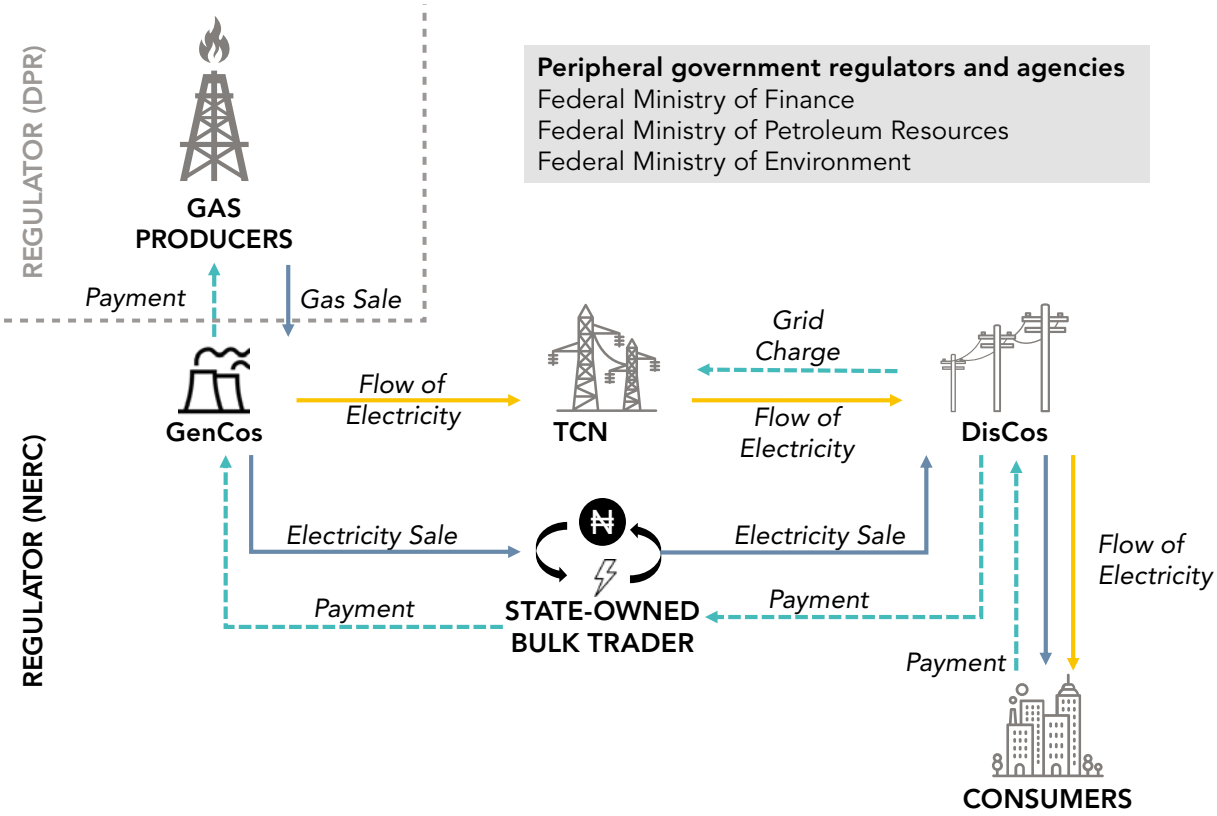
6.3.4/ LAND USE ACT

The Land Use Act (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 in which the land is located. 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.

6.4/ INSTITUTIONAL FRAMEWORK

The Nigerian on-grid electricity sector has a partially liberalized market with a single-buyer model, where the government-owned buyer is the sole buyer of electricity from public and private generation companies and the sole seller of electricity to all distribution companies, which are privatized. There is also a government-owned and -run nationwide transmission network. The current market structure, shown in Figure 18 (Adeniyi 2019), came into effect in 2013 when some government-owned generation companies and all the distribution companies were privatized, with a total transaction cost of $3 billion (Ajayi *et al*. 2016). The following sections summarize the main institutions in Nigeria participating in the energy sector.

Figure 18: Existing structure of the electricity sector in Nigeria



Source: Adeniyi 2019

6.4.1/ FEDERAL MINISTRY OF POWER

The Federal Ministry of Power is the policy-making arm of the Federal Government of Nigeria and is responsible for the provision of power in the country. The work of the Ministry is guided by the provisions of the National Electric Power Policy (NEPP) of 2001, the Electric Power Sector Reform (EPSR) Act of 2005 and the Roadmap for Power Sector Reform of August 2010. The vision of the Federal Ministry of Power is to "be a key enabler of community and economic growth by facilitating delivery of functional, affordable and reliable power supply in Nigeria". In order to promote the diversification of the country's energy mix, the Ministry is encouraging the use of renewable energy sources for electricity generation, especially in rural areas.

The Rural Electrification Agency of Nigeria (REA), the Electricity Management Services Limited (EMSL) of Nigeria and the National Power Training Institute of Nigeria (NAPTIN) are affiliated to the Federal Ministry of Power. The Nigerian Electricity Regulatory Commission (NERC) is under the supervision of the Nigerian Electricity Regulatory Commission (NERC).

6.4.2/ FEDERAL MINISTRY OF ENVIRONMENT

The mandate of the Federal Ministry of Environment is to protect the environment from pollution and degradation and to ensure the conservation of natural resources for sustainable development in Nigeria. The Federal Ministry of Environment is also responsible for coordinating all climate change issues in its Department of Climate Change, which aims to promote renewable energy and energy efficiency. The Federal Ministry of Environment is also the regulatory body for Environmental and Social Impact Assessment (ESIA).

6.4.3/ OTHER PERIPHERAL INSTITUTIONS

Table 17: Other peripheral institutions related to clean captive power

FEDERAL INSTITUTION	MISSION
Federal Ministry of Science and Technology	To formulate and implement Nigeria's science and technology development strategy. Inside the Ministry, the Renewable and Conventional Energy Technology Department is responsible for energy issues.
Federal Ministry of Lands, Housing and Urban Development	To provide adequate housing for all Nigerians in a favourable and livable environment. The Ministry plays a strategic role in the energy efficiency of buildings, by incorporating energy issues into the ongoing re-examination of building codes.
Federal Ministry of Industry, Trade and Investment	To create an economic environment in Nigeria that attracts investment, advances the industrialization process, and expands trade and exports to strengthen the domestic economy. The Ministry oversees products, processes and companies in the energy industry and supports and enacts renewable energy and energy efficiency measures.
Presidential Task Force on Power	To facilitate the implementation, monitoring and performance evaluation of the power reform agenda. The Task Force's mandate includes developing a roadmap and providing effective technical support for the power sector reform agenda. In addition, it serves as the interagency interface to ensure that each milestone in the power sector reform roadmap is achieved.

Source: Ley, Gaines and Ghatikar 2015

6.5/ CONCLUSION

For captive power generation below 1 MW for the generator's own consumption, the project developer requires a no-objection certificate, which is fairly easy to obtain. If the electricity generated exceeds 1 MW, a permit needs to be obtained from NERC. Sale of electricity generated requires a licence from the regulatory authorities. The federal government (both past and present) and renewable energy stakeholders in Nigeria have continued to make concerted efforts to increase renewable energy generation capacity through the formulation of various policies, regulations and action plans. These measures have greatly increased the adoption of renewable energy in Nigeria.

7/ NIGERIA MARKET POTENTIAL FOR CAPTIVE POWER

Lagoon front in Marina, Lagos.
© Shutterstock / ariyo olasunkanmi

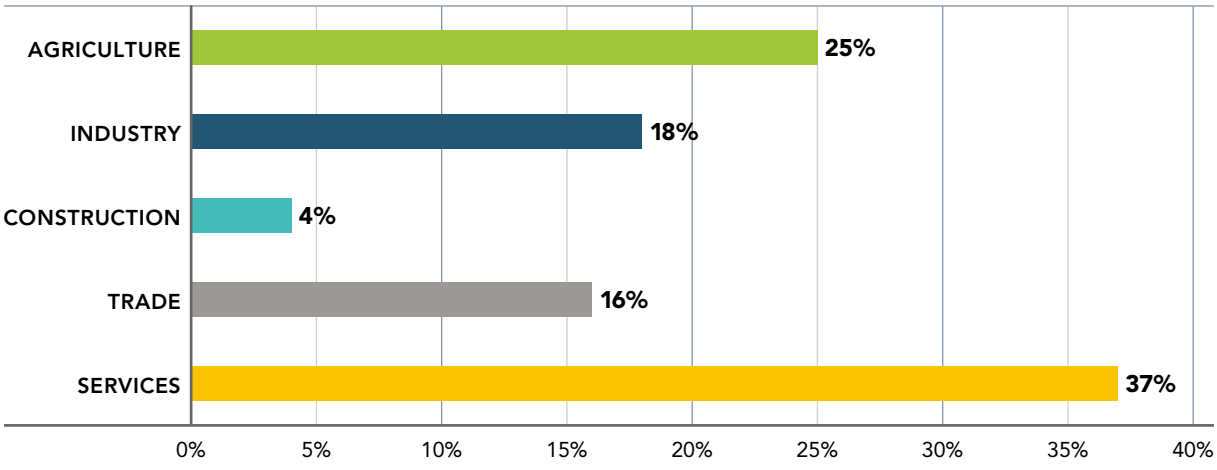
This section presents an overview of the industrial sector in Nigeria and identifies sub-sectors that might have the highest potential for the adoption of clean captive installations.

7.1/ INDUSTRIAL SECTOR OVERVIEW

Nigeria has the largest economy in Africa – in tight competition with South Africa – and is home to a growing population of close to 200 million people, with the 30th largest economy in the world. Figure 19 shows the contribution of different sectors to the GDP in 2018. The industry sector contributes 18 per cent to the country's real GDP; however, Nigeria's economy is reliant on oil revenues, and any variation in oil prices and production level makes it very vulnerable (Santander Trade 2019).

Nigeria emerged from a recession in 2016, but growth remains fragile and sectoral growth patterns are still unstable. In 2018, the oil sector recorded a negative growth rate of -1.62 per cent, and non-oil revenue came in lower than planned, despite economic reforms. The economy grew by slightly under 2 per cent in 2018, driven by the non-oil industry – mainly mining, quarrying, and manufacturing, and the service sector (Figure 20).

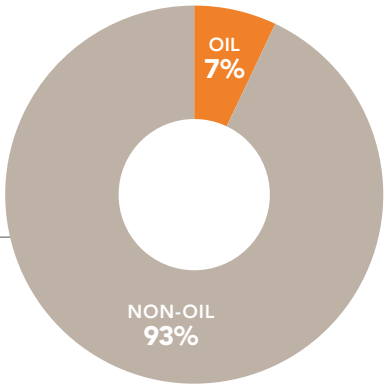
Figure 19: Contribution to real gross domestic product by sector, 2018



Source: Central Bank of Nigeria n.d.

Figure 20:
Contribution of oil and non-oil sectors to GDP

Source: Santander Trade 2019



7.2/ MANUFACTURING SECTOR

Among the main industrial sectors in Nigeria, the manufacturing sector is the most assessable and relevant industrial sector under the scope of this study, as it is likely to have the greatest potential for clean captive power uptake. This section assesses the potential of the manufacturing sector and identifies the manufacturing sub-sectors that have the greatest prospect for clean captive installations.

According to the World Bank Enterprise Surveys 2014 for Nigeria (World Bank Group n.d.), 48.1 per cent of the enterprises in the manufacturing sector identify electricity as a major constraint. Average losses due to electrical outages incurred by these firms were 18.3 per cent of annual sales.

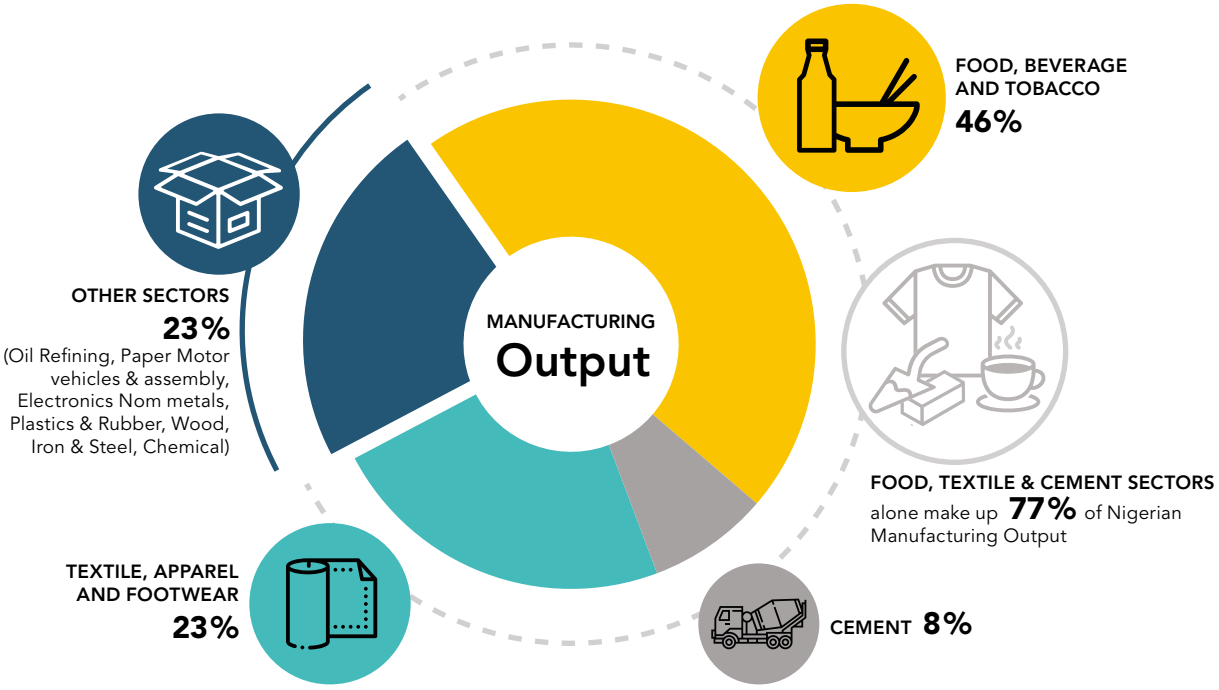
7.2.1/ OVERVIEW

The manufacturing sector in Nigeria is divided into 13 sub-sectors (National Bureau of Statistics 2019). A full list of the composition of each sub-sector is provided in the Annex.

1. Food and beverage & tobacco	2. Chemical and pharmaceutical products		3. Non-metallic products	4. Base metal, iron & steel
5. Motor vehicles and assembly	6. Pulp and paper products	7. Textile, apparel and footwear	8. Plastic and rubber products	9. Wood and wood products
10. Other manufacturing	11. Oil refining	12. Cement	13. Electrical and electronic	

In 2017, just 3 out of the 13 sub-sectors contributed 76 per cent of the overall manufacturing GDP (Figure 21). These are food, beverage & tobacco (45.5 per cent), textile, apparel and footwear (23.3 per cent) and cement (8.4 per cent). The remaining 22.7 per cent of manufacturing GDP is shared among the other 10 major sub-sectors including "other manufacturing".

Figure 21: Share of manufacturing GDP by sector, 2017

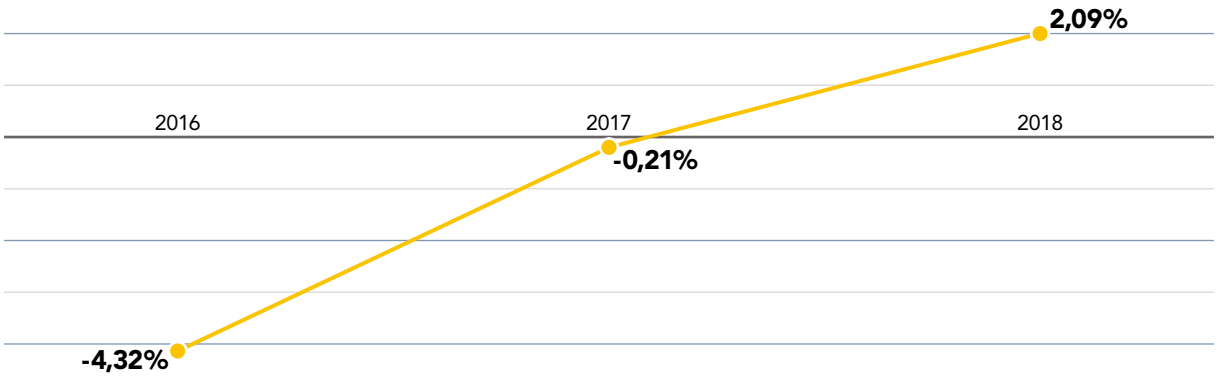


Source: National Bureau of Statistics 2018

7.2.2/ ECONOMIC GROWTH IN THE MANUFACTURING SECTOR

The focus of this study is on the manufacturing industry, as it is a major driving force behind Nigeria's economic growth. According to official data, the manufacturing sector accounted for 9.3 per cent of GDP and grew 2.09 per cent in 2018, rebounding from a decline in growth of -0.21 per cent in 2017 and -4.32 per cent in 2016 (Figure 22). Reportedly, the major challenge for the sector's development is inadequate electricity supply. As the president of the Manufacturers Association of Nigeria stated in April 2018: "A situation where you generate your own power for production does not make you competitive, because whatever is produced in this country is produced at a higher cost when compared to other parts of the world" (Raji 2018).

Figure 22: Manufacturing GDP growth (2016-2018) (%)



Source: National Bureau of Statistics 2019

Table 18 shows the yearly growth of Nigeria's manufacturing sub-sectors from 2016 to 2018, based on the country's 2018 GDP Report (National Bureau of Statistics 2019). Most of the sub-sectors grew steadily during these three years, including the main contributors of the manufacturing sector (green font). Plastic and oil refining fluctuated (orange font), whereas chemicals and pharmaceutical products, non-metallic products and base metal, and iron and steel witnessed a decrease (grey font).

Table 18: Yearly growth (%) of Nigerian manufacturing sub-sector (2016-2018)

SUBSECTOR	2016	2017	2018
Food and beverage & tobacco	-6.27	2.35	2.93
Textile, apparel and footwear	-1.09	0.82	1.69
Cement	-5.36	-2.2	4.5
Pulp and paper products	-4.17	0.12	3.44
Electrical and electronic	-8.13	-2.79	3.75
Motor vehicles and assembly	-29.01	-21.52	-2.54
Wood and wood products	-4.04	0.53	1.7
Other manufacturing	-14	-6.99	-0.11
Plastic and rubber products	3.59	0.99	1.54
Oil refining	2.53	-27.7	-3.97
Chemical and pharmaceutical products	1.19	0.79	0.61
Non-metallic products	3.2	1.96	-0.48
Base metal, iron & steel	0.72	0.17	-0.75

Source: Castalia 2017

7.2.3/ GEOGRAPHICAL LOCATION OF MANUFACTURING INDUSTRIES

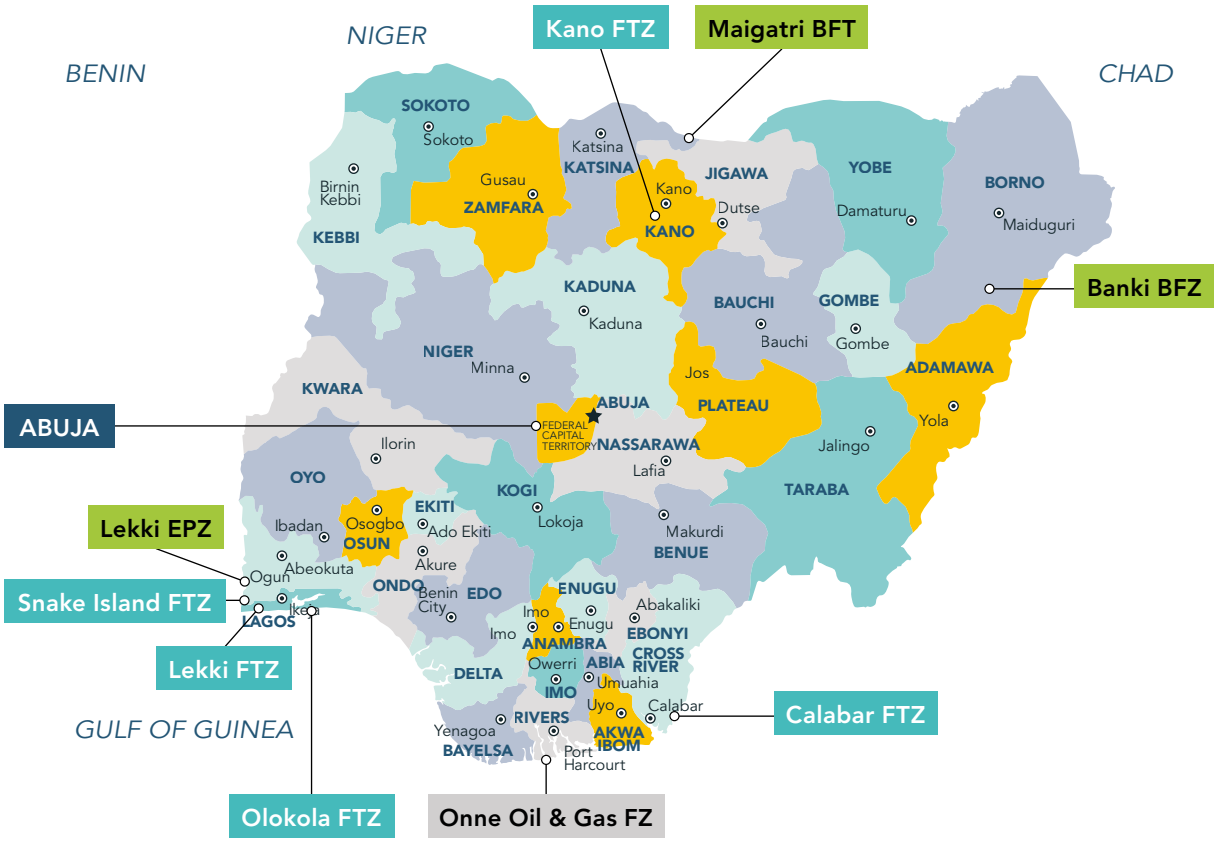
Lagos and its surroundings are home to around 60 per cent of Nigeria's industrial activities. Most manufacturing activity is concentrated in three industrial locations, two of which are in the south (Bagu *et al.* 2016):

- Lagos-Ota-Agbara axis (South-west)
- Port Harcourt-Aba axis (South-east)
- Kano-Kaduna axis (North)

This is partly explained by the location of free trade zones (FTZ) and export processing zones (EPZ) that the federal government established as part of its efforts to drive industrial growth. Most of the manufacturing clusters are in the country's south, due to their proximity to Atlantic Ocean seaports. Both southern zones are clearly delineated industrial estates within the nation's customs and trade regime. They are generally set up for manufacturing that produces mainly for the export market.

Map 2 shows the geographical location of the main free trade and export processing zones. In total, 31 free trade zones are to be established, with 14 currently operational and 17 under construction (Bagu *et al.* 2016). The most notable operational ones are: Calabar Free Zone, Kano Free Zone, Lekki Free Zone, Tinapa Free Zone and Tourism Resort, Onne Oil and Gas Export Free Zone and Ogun Free Zone.

Map 2: Geographical distribution of key free trade zones and export processing zones



Source: Bagu et al. 2016, (GISGeography: Nigeria Physical Map 2021)

In addition to free trade zones, industrial clusters may be a promising target for the development of captive renewable power as they have similar needs with regard to the provision of reliable power supply. Industrial clusters are made of companies whose main concern may not be lack of capital but rather reliable and stable access to electricity for securing stable production (Ley, Gaines and Ghatikar 2015). Most of these industrial zones are dominated by small and medium enterprises[3]. Two relevant industrial clusters are described below.

NNEWI AUTOMOTIVE PARTS INDUSTRIAL CLUSTER (SOUTH)

Nnewi, the second largest city in Anambra State (South-East Nigeria), has positioned itself as a major manufacturing hub in Africa. It is home to many indigenous manufacturing companies such as Ibeto Group, Cutix Plc, Uru Industries Ltd, Omata Holdings, Innoson Group, Tomy Group, Chicason Group and many more. Such industrial zones face a common challenge in obtaining electricity to drive their heavy-duty machines due to the unreliability of the grid (Ley, Gaines and Ghatikar 2015).

ONITSHA PLASTIC CLUSTER (SOUTH)

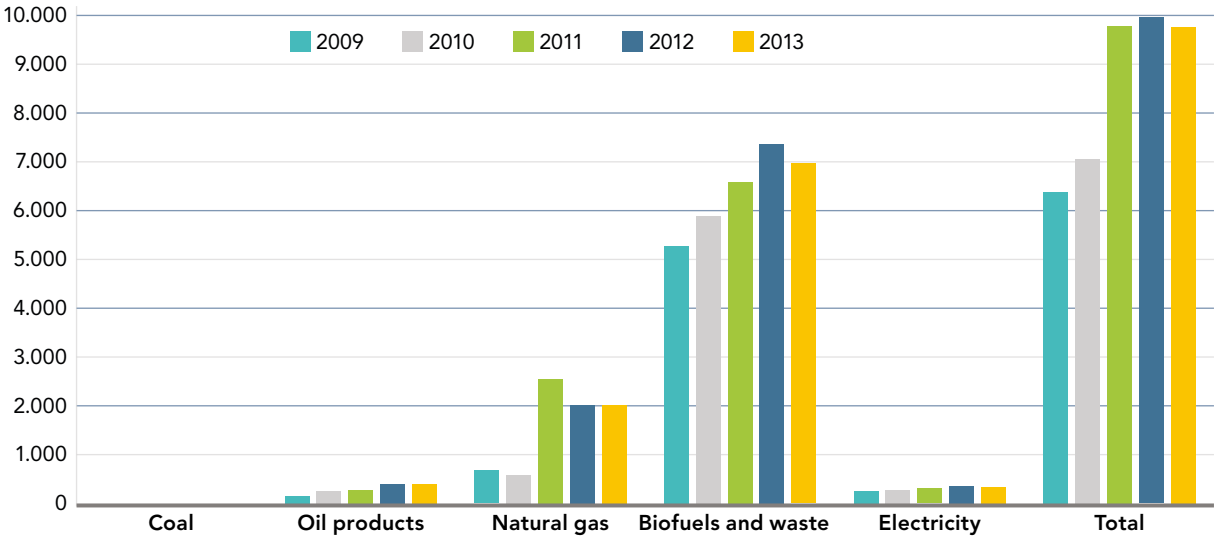
The plastic cluster in Onitsha is situated at Awada layout in Onitsha and has around 75 businesses employing more than 1,800 people. Onitsha is a very dynamic city and has the highest concentration of manufacturers in Eastern Nigeria with products including plastic film extrusion, plastic pipe extrusion, plastic injection, plastic blow moulding, polythene bag making and plastic waste recycling. It attracts trading partners from the rest of the country and different parts of the West African sub-region (Ley, Gaines and Ghatikar 2015).

3 *According to the Central Bank of Nigeria, small and medium enterprises are businesses whose annual turnover does not exceed 500,000 naira.*

7.2.4/ ELECTRICITY DEMAND IN THE MANUFACTURING SECTOR

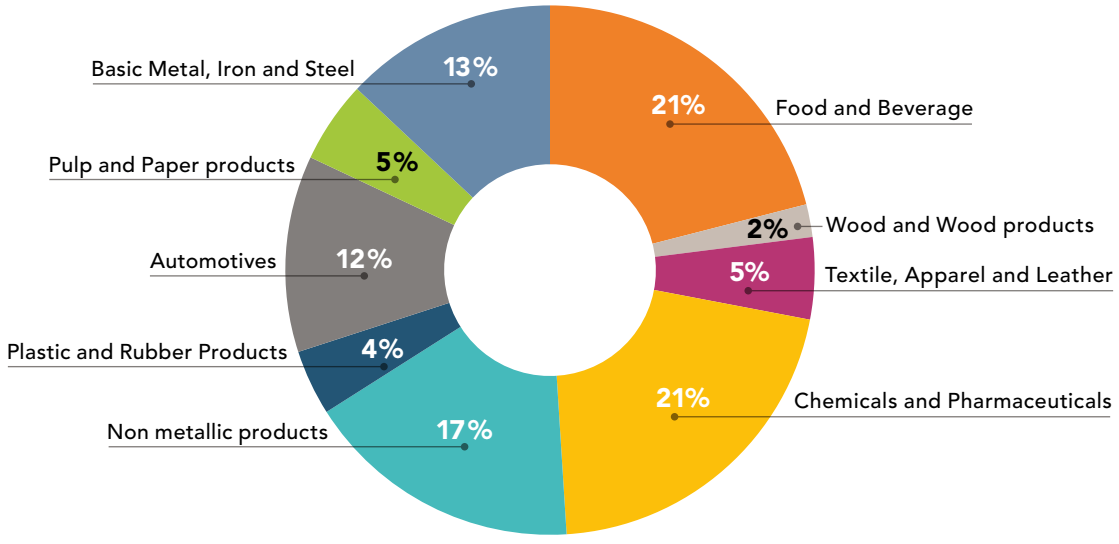
As shown in Figure 23, only 3-4 per cent of the energy consumption of the Nigerian manufacturing industry comes from grid-connected electricity. The food and beverage sector, together with the chemicals and pharmaceuticals sector, are the largest consumers of on-grid power according to a study conducted by the Manufacturers Association of Nigeria on power and energy consumption (Figure 24).

Figure 23: Energy consumption in the manufacturing sector (in ktoe)



Source: IEA statistics; Bagu et al. 2016

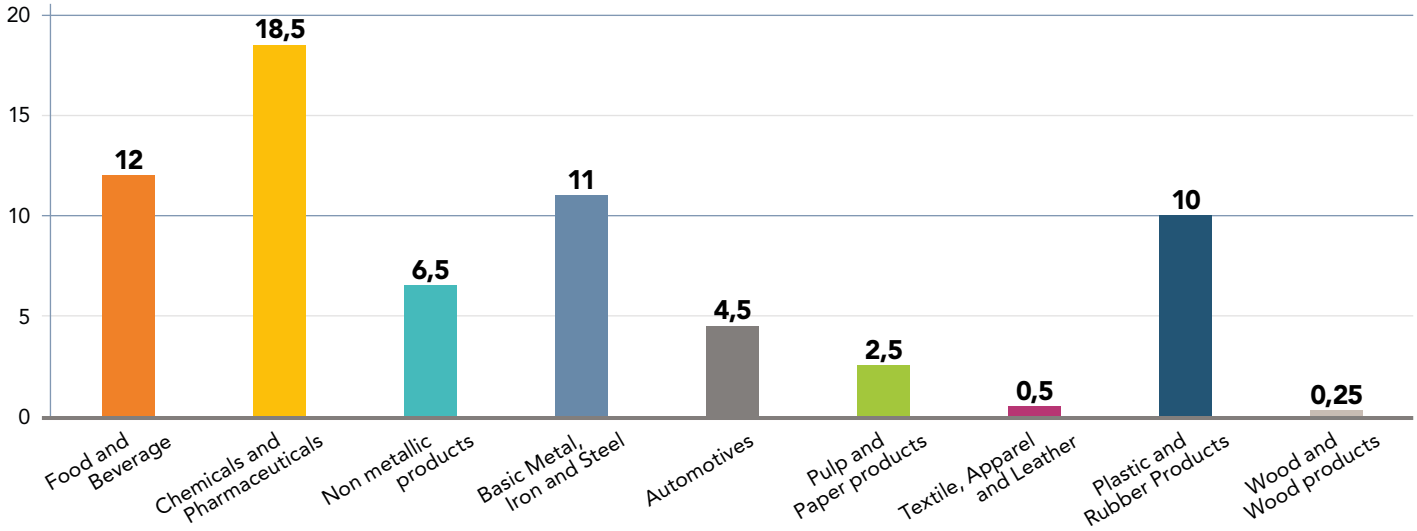
Figure 24: Shares of power consumption by manufacturing sub-sector (%)



Source: Manufacturers Association of Nigeria 2007

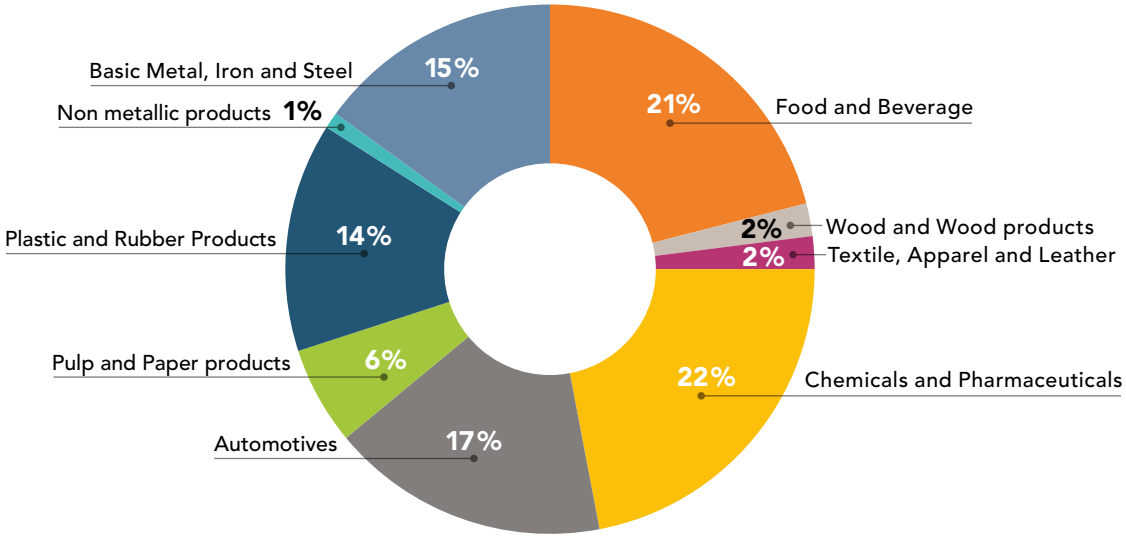
A GIZ study on energy efficiency in the manufacturing sector shows the self-generation capacity in each of Nigeria's manufacturing sub-sectors (Figure 25). Without discussing the total volume required by the country's manufacturing sector, the scoping study distributes the diesel requirement by sub-sector, as illustrated in Figure 26. The food and beverage, chemicals and pharmaceuticals, and automotive sub-sectors have the most distributed diesel generators.

Figure 25: Installed self-generation capacity (MVA) in Nigerian industry



Source: Nigerian Energy Support Programme 2014; Bagu et al. 2016

Figure 26: Distribution of diesel consumption by industrial sub-sector (%)



Source: Nigerian Energy Support Programme 2014; Bagu et al. 2016

Consultations conducted by the Africa-EU Renewable Energy Cooperation Programme (Bagu *et al.* 2016) with agri-food processing companies similarly suggest that "enormous numbers of diesel generators are being used in small and medium sized enterprises with a power capacity requirement of 100-500 kW. Diesel generators with a capacity between 100 kW and 500 kW seem to be abundant in other manufacturing sectors, such as hotels and restaurants".

7.2.5/ POTENTIAL OF THE MANUFACTURING SECTOR FOR OFF-GRID GENERATION LICENCES AND CAPTIVE PERMITS

Based on the off-grid generation licences (NERC 2006) (mainly diesel and gas) given by NERC to companies wishing to sell electricity to industries through a power purchase agreement, the main independent power producers identified are CET Power (CETPOWER n.d.), ContourGlobal, Shoreline Power, Tower Energy (Tower Energy 2015) and MBH Power (MBH Power 2016), and the main generator suppliers are TPN and JMG (more information in Annex B. Stakeholder Mapping). Based on cross referencing the licences' list with the websites of the identified independent power producers and suppliers, a few international brands including Unilever and Nestlé have installed off-grid conventional electricity. The listed clients belong to the following sectors:

1. Food processing	2. Dairy industry	3. Cement factories	4. Construction and glass	5. Bottling and packaging
6. Tobacco	7. Breweries	8. Confectionery and chewing gum	9. Flour mills	10. Pharmaceutical company
11. Soap manufacturing	12. Industrial states like Ota Industrial have two off-grid generators of 20 MW each			13. FTZ (the Tinapa, Lagos)

Figure 27 shows a list of clients for which CET Power is providing electricity under an off-grid generation licence. The CET Power clients are mainly located in the Lagos-Ota-Agbara axis, the Port Harcourt-Aba axis and the Kano-Kaduna axis, as mentioned previously.

Figure 27: Off-grid generation clients of CET Power

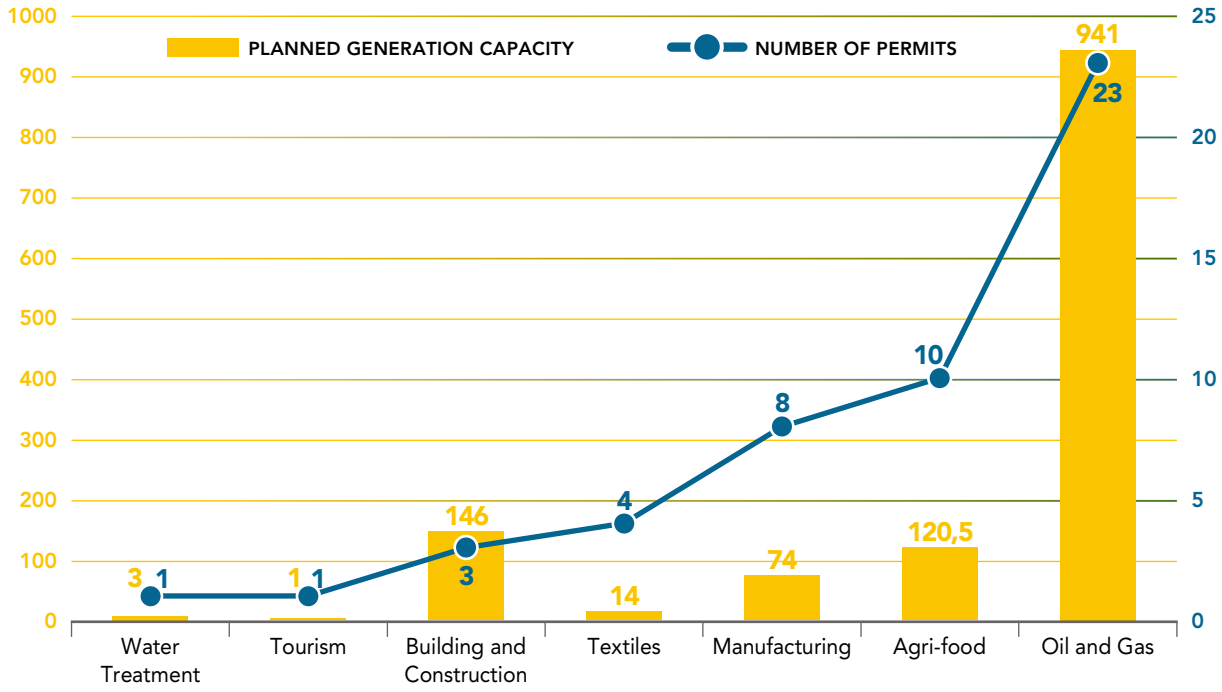
Nigerian Bottling Company Plc Location Benin, Ikeja, Kano, Maiduguri and Port Harcourt, Asejiere Plants **Installed Capacity** **10MW @ 400- 415V**	**Du I Prima Foods Plc** Location Choba, Port Harcourt **Installed Capacity** **3.48MW@415V**	**Nigerite Limited, (an ETEX Group Company)** Location Ikeja **Installed Capacity** **3.48MW@11kV**	**Atlas Cement Company** Location Onne **Installed Capacity** **3MW@400V**	**Lafarge Cement Wapco Nigeria Plc** Location Shagamu and Ewekoro Cement Plants **Installed Capacity** **44MW @ 11kV**
The Tinapa Free Trade Zone LOCATION Calabar **Installed Capacity** **4MW @ 11kV**	**The Nigerian Security Printing and Minting Plc** Location Lagos and Abuja Factories **Installed Capacity** **7MW @ 11kV**	**Transcorp Hilton** Location Abuja **Installed Capacity** **3MW @ 11kV**	**British American Tobacco Nigeria** Location Ibadan **Installed Capacity** **3MW @ 11kV**	**African Breweries Ltd** Location ----- **Installed Capacity** **4.64MW**
Sierra Rutile Limited Location 30 Siaka Stevens Street, Freetown, Sierra Leone **Installed Capacity** **2.00MW**	**AshakaCem Plc** Location Gombe **Installed Capacity** **6.00MW**	**Solewant Nigeria Limited** Location 22 Ahoada Street, Rumuibekwe, Port Harcourt, Rivers State **Installed Capacity** **4.00MW**	**Perfetti Van Melle Nigeria Ltd, Agbara Factory** Location Ogun State **Installed Capacity** **1.00MW**	**Prima Corporation Ltd** Location Alaba Coker, Lagos **Installed Capacity** **2.00MW**

Source: Nigerian Energy Support Programme 2014; Bagu et al. 2016

In addition, based on an overview of captive power permits (five-year tenure) that were issued by NERC (2013) between 2010 and 2013, the following can be concluded (Figure 28).

- A total of 1,300 MW of captive power permits were issued.
- Most of the issued permits (23; 46 per cent of the total) were for the oil and gas sector, which represents the highest planned generation capacity, at 941 MW or 72 per cent of the total planned capacity.
- The agri-food sector is second with 10 permits and planned generation capacity of 121 MW (9 per cent of the total).

Figure 28: Overview of issued permits and planned generation capacity by sector (2010-2013) (MW)



Source: NERC 2013

7.3/ CONCLUSION

Geographically, the markets with the greatest total potential for clean captive installations in the industrial sector in Nigeria are expected to be the Lagos-Ota-Agbara axis (South-west), the Port Harcourt-Aba axis (South-east) and the Kano-Kaduna axis (North) due to the number of industrial establishments and the demand for electricity in these regions.

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 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. Hence, an opportunity exists for clean captive power installations in the manufacturing sector, particularly in the sub-sectors of food, beverage & tobacco, pharmaceuticals and automotive.

However, other characteristics of industries such as daily load profiles, operating days of a facility, ownership structure and foreign currency income could not be retrieved to further analyse the market. For this reason, most of the energy services/support companies (ESCOs) and engineering, procurement and construction (EPC) companies are generally sector agnostic, and other sub-sectors could also present higher opportunity on a case-by-case basis.

8/ FINANCING CAPTIVE POWER

Anambra Community
Powers Hospital Equipment with REA 7.3kWP.
© Rural Electrification Agency of Nigeria

This section starts with a review of the banking sector in Nigeria and delves into the captive power financing landscape, closing with a discussion on the various financing models being used in the country for captive solar PV systems.

8.1/ BANKING SECTOR OVERVIEW

The Nigerian financial system is regulated by the Central Bank of Nigeria (CBN), the Federal Ministry of Finance, the Nigeria Deposit Insurance Corporation (NDIC), the Securities and Exchange Commission (SEC), the National Insurance Commission (NIC) and the Federal Mortgage Bank of Nigeria (FMBN). According to CBN, 22 commercial banks are currently operating in Nigeria. Of these, 21 are operated privately and 1 (Polaris Bank) was taken over by the Asset Management Corporation of Nigeria (AMCON). Nigeria has a concentrated banking sector, with the 5 largest banks accounting for 62 per cent of total commercial bank assets in 2016. The remaining 17 banks held 38 per cent of the market share (Infomineo 2013).

In response to the COVID-19 pandemic, CBN rolled out a stimulus package to combat the effects of the pandemic on critical sectors, including cutting the interest rate on its intervention facilities from 9 per cent to 5 per cent. Profitability in the banks is constrained due to the Cash Reserve Requirement (CRR), which, at 27.5 per cent, is among the highest in the world. The CRR requires banks to park an increasing amount of local currency deposits with the central bank, and restricts their ability to lend as these reserves are only available for intervention funds. Amid all this, the CBN's aspiration to achieve a financial inclusion rate of 80 per cent by 2020 has led to increasing competition in payments from non-bank challengers (Kola-Oyeneyin and Kuyoro 2020).

The Nigerian financial system consists of the formal sector (bank and non-bank financial institutions) and the informal sector (savings and loan associations, local money lenders, etc.).

8.2/ RENEWABLE POWER FINANCING LANDSCAPE

8.2.1/ COMMERCIAL BANKS

For the majority of the commercial banks in Nigeria, the typical long-term lending/loan term for financing off-grid energy solutions is between five and seven years. This loan term cuts across several other sectors. However, given the amount of investment needed to develop these solutions, the developer needs an average of 10-15 years to recoup the investment.

In terms of finance, commercial banks are largely absent from the commercial and industrial solar market, offering debt that developers consider too costly (e.g., in excess of 25 per cent) and only for tenors up to two years. All local financing in Nigeria requires the developer to provide physical assets as collateral, and because they do not accept solar equipment as a guarantee, they require borrowers to own real estate. As a result, developers are mostly financing projects through their own balance sheet, in US dollars if they are a multinational corporation, or in Nigerian naira in the case of local developers (BloombergNEF 2019).

Information on the financing of captive power in Nigeria is lacking. However, some of Nigeria's key financial sector players – including commercial banks such as Access Bank, Sterling Bank and UBA – are working towards being at the forefront of the renewable energy landscape.

ACCESS BANK

Access Bank Plc. is a full-service commercial bank. As part of its continued growth strategy, it is focused on mainstreaming sustainable business practices into its operations. Access Bank strives to deliver sustainable economic growth that is profitable, environmentally responsible and socially relevant. It implements energy-efficient and environmental projects in its business operations and activities, and has invested in renewable technologies and adopted more environmentally friendly practices such as waste recycling across all its branches. Access Bank (along with UBA) benefits from $80 million in debt capital through the SUNREF programme of the European Union / AFD, which finances energy efficiency and renewable energy projects.

BANK OF INDUSTRY

The Bank of Industry (BOI) is the oldest and largest development finance institution operating in Nigeria. It focuses on financing industrial projects in key sectors of the economy such as agro and food processing, light manufacturing, gas and petrochemicals, engineering and technology, and solid minerals. BOI also focuses on promoting renewable energy projects.

In the first half of 2019, BOI signed an agreement with All On to provide 1 billion naira (around $2.77 million) in local currency debt (10 per cent annually for seven years) for off-grid energy developers operating in the Niger Delta. Rural community renewable energy projects have been a focus area, where the impact on economic activity in the area is affected by the access to power. Projects have been undertaken via developers.

InfraCredit's guarantee fund has provided a partial payment guarantee to support lending via the Solar Power Fund of the BOI, and a memorandum of understanding is in place covering this. The BOI operates the Solar Energy Fund, described later.

ECOBANK NIGERIA

A transnational commercial bank with a base in Nigeria, Ecobank has funded off-grid projects in the past including the Rubitec Solar mini-grid in Ogun state. Among its restrictions on expanding loans to the commercial and industrial solar PV sector, Ecobank requires collateral and three years in a trade before it can lend, which is uncommon in Nigeria. Ecobank is therefore looking to partner with development finance institutions, such as an existing partnership with the African Guarantee Fund.

STERLING BANK

A mid-tier commercial bank in Nigeria, Sterling Bank's focus is on unique/niche areas of business where it can lead the market. It is actively considering off-grid and renewable projects and has previously funded import-retailers in the off-grid space. The bank is looking to develop a financing mechanism for mini-grids, as well as a platform as a marketplace to match developers to off-takers and finance, possibly blended with concessional financing from development finance institutions to reduce the offered interest rate and increase the tenor.

The bank aims to innovatively stir up business processes in the following core areas: Health, Education, Agriculture, Renewable Energy and Transport (HEART). Three models of financing are accepted by the bank using its renewable energy financing system: lease to own, power as a service and outright purchase. The bank is currently the most active financial house supporting the commercial and industrial renewable energy space. Its online marketplace, Imperium, was launched in 2020 and aims to connect the demand to the supply end of the renewable energy sector.

UBA

The commercial and investment banking arms of the United Bank of Africa (UBA) group are both interested in the power sector and have an interest in promoting renewable energy projects, having been approached by prospective project developers. The group is keen to get immersed in financing commercial and industrial projects and expects to learn-by-doing in the short term. UBA along with Access Bank are the identified banking partners for the SUNREF initiative.

FCMB

FCMB is a Nigerian commercial bank that has a dedicated renewable energy projects team on both the debt and advisory side of projects. On the debt side, FCMB has funded the solar PV project development company Starsight alongside equity funds including Helios. The bank has interest in providing further support in this area and is also a recipient of solar power as part of the Starsight project, with a number of bank branches using solar PV installations. Most of the bank's lending for commercial and industrial solar PV has been in support of the agriculture sub-sector, for the use of energy for productive purposes.

FIDELITY BANK

Fidelity Bank has a commercial bank desk that has renewable energy lending as part of its products focus. The terms are standard commercial terms used by commercial banks in Nigeria.

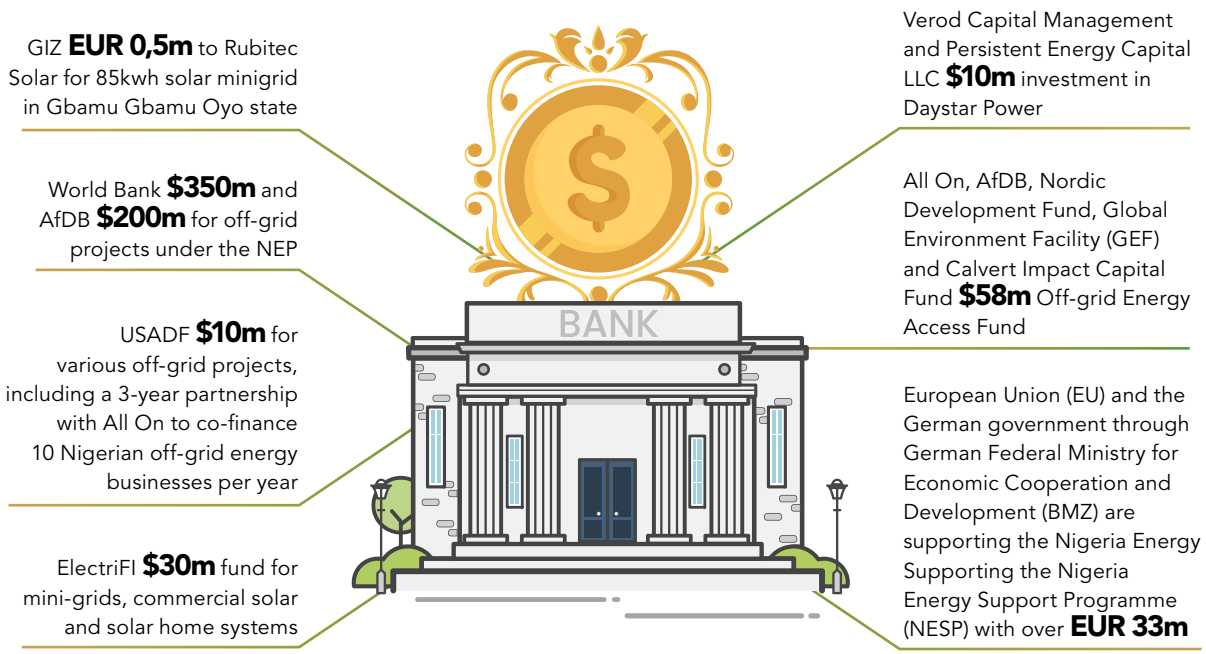
DEVELOPMENT BANK OF NIGERIA

DBN is in the early stage of developing a loan product in support of renewable energy projects in Nigeria. The managing director of DBN, Tony Akponachi, has made clear that this is more of a medium-term plan for the DBN. The bank is part of the Green Energy Fund Programme described later.

8.2.2/ FINANCING PROGRAMMES

The Nigerian off-grid market has attracted significant support over the last three years in the form of grants, low-interest loans and equity investments. According to the *Nigerian Energy Report* (Anyaogu *et al.* 2019), this sector is the largest source of foreign direct investment in Nigeria. In the past, organizations such as the US Agency for International Development's Power Africa, the US Africa Development Foundation, the African Development Bank, GIZ, the UK Department for International Development, the Heinrich Boell Foundation and the Shell-funded All On have provided funding, advocacy and technical support for off-grid and energy access projects and energy companies in Nigeria. Impact investors are also seeking investment opportunities in the off-grid energy sector, as observed in the *Nigerian Energy Report* (Anyaogu *et al.* 2019). Figure 29 shows some financing and investment programmes dedicated to off-grid electricity.

Figure 29: Financing and investment of off-grid programmes



Note: GIZ fund to Rubitec Solar between 2017 and 2018, World Bank and African Development Bank funding to off-grid project in 2018, USADF funding from 2017 onwards, ElectriFi fund in 2019, Verod Capital investment in 2019; Energy Access Fund in October 2018, EU and BMZ Nigerian Energy Support Programme from 2013 until 2021 in two phases.

Source: Anyaogu et al. 2019

Following is an overview of some active financing programmes in Nigeria.

AFD SUNREF

SUNREF was developed by AFD (Awolo 2018) to promote the emergence of green finance tailored to the needs of economic actors in countries in transition. SUNREF Nigeria helps develop the practices of three local partner banks via financial support and technical assistance to facilitate access to green energy and promote the sustainable management of natural resources. The local partner banks are Access Bank and UBA, while the technical assistance will be hosted by the Manufacturers Association of Nigeria and the Nigerian Industrial Association.

The objective is to finance a minimum of 10 projects, for all renewable sources of energy combined, with an installed capacity per project of between 1 MW and 10 MW over a period of two to three years. The call for applications is available on the SUNREF Nigeria website.

GREEN ENERGY FUND PROGRAMME

The Green Energy Fund Programme is a partial risk guarantee programme from the African Guarantee Fund (AGF) that will enable access to the available local currency concessional loans (also known as intervention funds) from three local development banks via local commercial banks in Nigeria (Climate Finance Advisory Limited n.d.). These three banks are the Central Bank of Nigeria (CBN), the Development Bank of Nigeria (DBN) and the Bank of Industry (BOI).

The objective of the programme is to ease access to (and the flow of) flexible funding/finance for clean energy developers in order to provide clean and dependable electricity to households as well as clusters of micro and small businesses, and industries. The fund size is 36 billion naira (around $100 million) targeted at individuals / home owners, businesses, cluster(s) of micro and small businesses in a market area(s) and industries, such as manufacturing and agro-processors. A hybrid captive power plant is one of the eligible project types. The limit for a single project is either a maximum power generation of 2 MW, or a maximum of $5 million (70-80 per cent of the project cost/value).

BANK OF INDUSTRY – SOLAR ENERGY FUND

BOI operates a clean energy fund (BOI 2020) of 6 billion naira (around $15.8 million) where an end-user or developer can secure a loan of up to 350 million naira, equivalent to $920,000 per customer (not per project). BOI expects this to be enough to fund the construction of up to a 1 MW solar power plant or a 400 kW solar-plus-storage installation (which is the target optimum size for projects accessing the fund). As of year-end 2018, this is one main source of naira financing for commercial and industrial solar that is considered affordable by solar developers in Nigeria, according to BloombergNEF (2019). BOI offers a loan that covers up to 80 per cent of the capital expenditure. The funds can be accessed directly from BOI or indirectly through deposit money banks or microfinance banks by end users or solar energy companies.

BOI only dispersed funds for rural mini-grids and had not yet disbursed any money for commercial and industrial solar projects as of November 2019, although some projects had already been approved. This is because it has been challenging for developers to provide collateral that meets stringent lending criteria of BOI.

The advertised rate for BOI financing from the 6 billion naira (around $15.8 million) Solar Energy Fund is 9 per cent, and the tenor is up to five years. There is an additional appraisal and commitment fee charged at a total of 2 per cent of total loan value, and a monitoring fee of 0.125 per cent per quarter on the outstanding balance." (BloombergNEF 2019).

The main challenges with disbursement of the Solar Energy Fund persisted as of November 2019. Chief among these is the inability of some borrowers to meet the extensive criteria set by the BOI. A key challenge as stated by the BOI is the requirement to have in place collateral in excess of 150 per cent of borrowing. Additionally, most borrowers need to access BOI loans via their commercial banks, which have discretion to add a margin to the cost of borrowing, which can increase the cost by 14-15 per cent. These banks further require adequate collateral and guarantee support for the borrowing, all of which leads to a disconnect between the funders and those requiring funding. The financial institutions have been reluctant to relax lending criteria due to their experience from lending to the still illiquid utilities.

THE NIGERIA ELECTRIFICATION PROJECT

The Nigeria Electrification Project is an ambitious off-grid energy intervention that seeks to provide electricity access to households, Micro Small and Medium Enterprises (MSMES) in off-grid communities through renewable energy. The programme is supported by the World Bank and the African Development Bank and driven by private sector funding. It has four components:

- Solar Hybrid Mini-grids ($150 million in World Bank funding, leveraging $100 million in private sector investment)
- Stand Alone Solar Systems ($75 million in World Bank funding, leveraging $200 million in private sector investment) (REA n.d.)
- Energizing Education Programme (EEP) and
- Technical Assistance.

ALL ON

An independent impact investing company, seeded with funding from Shell, All On works with partners to increase access to commercial energy products and services for underserved and unserved off-grid energy markets in Nigeria, with a special focus on the Niger Delta.

WORLD BANK AND AFRICAN DEVELOPMENT BANK

The World Bank, working with the Ministry of Power, Works and Housing, plans to contribute $350 million to the Nigeria Electrification Project. Through this, the World Bank aims to provide $250 million to solar mini-grids in phase 1 (5-10 years away from the building of any distribution company networks) through a $70 million matching grant (likely set to 75 per cent or $300,000, whichever is less) followed by an $80 million performance-based connection subsidy (likely 30 per cent). The African Development Bank is also contributing $200 million towards the World Bank-funded Nigeria Electrification Project (Lane *et al.* 2018).

GET.INVEST

GET.invest is a European programme that aims to mobilise investments in decentralised renewable energy projects with a focus on Sub-Saharan Africa. The programme works across different market segments of decentralised renewables, such as small on-grid independent power producers, commercial and industrial power, mini-grids, small stand-alone solar systems including solar home systems, and clean cooking solutions. The scope of support includes market information, access to finance, networking and information events. GET.invest was launched in early 2019, building on its predecessor, the Africa-EU RECP. It delivers by mobilising the private sector and by building a pipeline of viable investment projects.

DFID'S SOLAR NIGERIA

Solar Nigeria is assisting solar companies to electrify more than 535,000 homes through grants to eligible companies in the solar value chain. Solar Nigeria is also partnering with State governments to bring solar power to key health and education facilities in areas of the country where the need is greatest.

PERSISTENT CAPITAL AND VEROD CAPITAL MANAGEMENT

Persistent Energy Capital LLC, an impact investment firm based in Lagos, New York and Zurich, and Verod Capital Management, a Lagos-based private equity firm, have invested $10 million in Daystar Power, a renewable energy solutions company. This will allow Daystar Power to expand its solar power solutions for commercial and industrial customers across the West African region (Verheijen 2019).

Founded in Lagos in 2017, Daystar Power provides complete power solutions to African companies in various sectors, including banks, consumer goods, agriculture and manufacturing. The company's solar power systems range from 20 kWp up to 5 MWp.

USAID NIGERIA

The Power Africa programme is USAID's focal programme for energy (mainly on-grid). The recently completed Renewable Energy and Energy Efficiency Project (REEEP) supported by USAID and Power Africa aimed to facilitate access to finance through technical assistance to banks and developers, combined with promotion of policy changes to improve the business environment. USAID's Development Credit Authority (DCA) also ran a guarantee fund with Ecobank, but found limited engagement from developers due to the inhibiting loan terms (Lane *et al.* 2018).

Beyond the Grid is a programme supported by USAID and Power Africa focusing on off-grid energy. Through this programme, USAID has supported the Rural Electrification Agency (REA) to improve the mini-grid regulation and on the development of REA's electrification master plan, as well as coordinating a Task Force of off-grid stakeholders with Power for All. Beyond the Grid is accelerating off-grid electricity access, focusing on two strategic priorities – household solar and micro-grids – to add 25-30 million new connections by 2030, in support of achieving the overall Power Africa goal of adding 60 million new home and business connections (USAID 2021). The Nigeria Power Sector Program implemented by Deloitte is also providing technical assistance to the REA and other stakeholders to increase electricity access in Nigeria.

ELECTRIFI (THE ELECTRIFICATION FINANCING INITIATIVE)

ElectriFI is a flexible financial facility funded by the European Union and managed by the Association of European Development Finance Institutions (EDFI). It is a specialist equity and debt financing facility for renewable energy companies active both on-grid and off-grid in emerging markets. The business models that ElectriFI finances are independent power producers, captive power, solar home systems and micro-grids. In Nigeria, along with the Renewable Energy Performance Platform (REPP), ElectriFi has set up a $10 million line of credit for the UK company PAS Solar Limited, helping the company boost the distribution of its home solar kits in Nigeria.

The ticket size varies from 0.5 to 10 million euros, capped at 50 per cent of the project cost / funding being in both local currency and hard currency financing.

REA

The Rural Electrification Fund (REF) initiative is the federal government's intervention that provides grant financing to project developers to subsidize mini-grid development in Nigeria. It has developed and is implementing many off-grid electrification programmes with the help of the World Bank, the African Development Bank, GIZ, USAID, the UK Department for International Development and the private sector. These programmes mostly support the deployment of solar power to electrify, homes, communities, schools and businesses (Anyaogu *et al.* 2019).

Among the REF's current programmes is the Energizing Economies Initiative (EEI) (REA 2019). According to the Rural Electrification Agency website (REA 2019), the EEI has been developed to support the rapid deployment of clean and sustainable off-grid electricity solutions to economic clusters in Nigeria. These include markets, shopping complexes, and agricultural or industrial clusters. Over 340 economic clusters have already been identified across the country demanding an estimated 3-4 GW of energy with a combined market opportunity of around $955 million annually. An estimated 70 per cent of these projects will be based on renewable energy. All developers interested in the EEI must send the REA their business plan, financial model and energy audit (BloombergNEF 2019).

GIZ

Germany's GIZ is a key actor in Nigeria, providing longstanding support to the energy sector, especially through its Nigerian Energy Support Programme (NESP). The first phase of NESP ended in 2017 and targeted greater investment in the energy sector through four themes: 1) Policy Reform and on-grid Renewable Energy, 2) Energy Efficiency, 3) Rural Electrification and Sustainable Energy Access, and 4) Capacity Development and Training. The second phase of NESP continued until March 2021 to work with more states, helping them to scale up to around 20 mini-grids reaching 100,000 people (Lane *et al.* 2018).

8.3/ FINANCING MODELS FOR CAPTIVE POWER DEPLOYED IN NIGERIA

All the main financing models for clean captive power can in principle be (and in some cases already are being) implemented in Nigeria, including in the industrial sector. Those financing models can be applied to all renewable energy technologies.

8.3.1/ OUTRIGHT PURCHASE / ASSET FINANCE

Under this model, the owner purchases the solar PV or other system upfront, financed with either company capital or debt. Once purchased, the user can either take on the responsibility of operations and maintenance (O&M) or enter into an O&M contract with the engineering, procurement and construction (EPC) contractor or system supplier.

8.3.2/ RENT-TO-OWN (FINANCING LEASE)

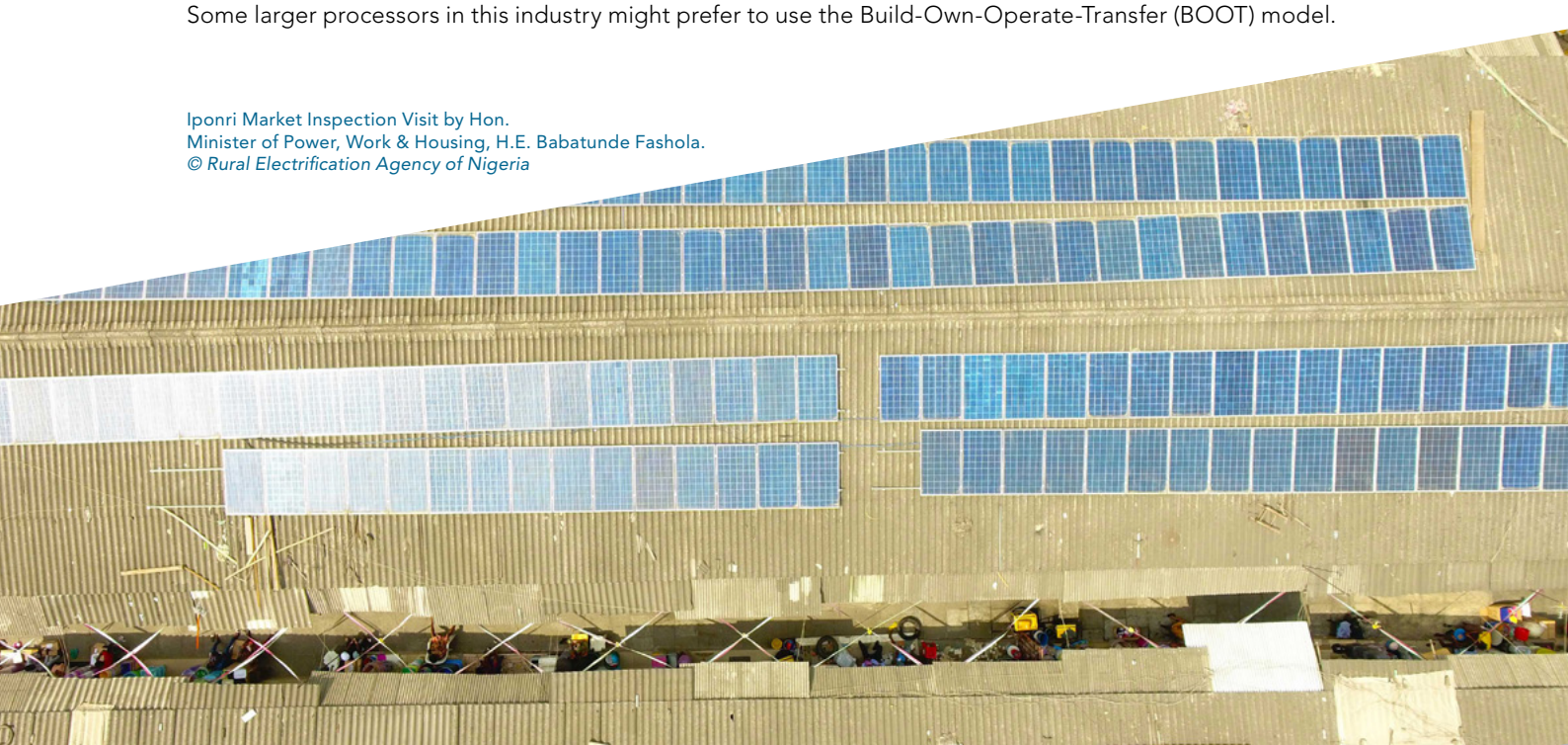
With rent-to-own, a third party finances the captive plant either fully or partially. The client makes a small upfront capital investment and thereafter a monthly lease payment for the duration of the contract. The client effectively pays off the value of the solar plant through the monthly payments, and ownership is transferred to the client at the end of the contract. The contract may have a long duration (for example, up to 15-25 years). Under this model, system O&M is usually the responsibility of the developer for the duration of the lease contract. Some rent-to-own contracts have an early buy-out option where the client can purchase the system at an agreed residual value.

8.3.3/ Operating Lease

With this model, an end user makes little or no upfront payment and the lease period spans several years, the term of which is largely dependent on the financing institution. The developer is responsible for plant O&M during the lease period. In some contracts, the developer/financier provides performance guarantees to the end user in terms of energy production. At the end of the lease period, the end user may be given the option to purchase the system at residual value or to extend the lease, or the developer removes the plant from its premises.

8.3.4/ POWER PURCHASE AGREEMENT (PPA)

This model differs from the rent-to-own and operating lease arrangements in that monthly payments are not fixed but based on the energy consumed (X amount per kWh consumed) over a long-term contract (for example, 15 years or more) by an end user from a third-party-owned captive plant on either the end user's premises or a nearby premises. The plant owner is responsible for developing, financing, building and operating the plant. In Nigeria, companies often engage in a Design-Build-Operate-Maintain (DBOM) contract, especially in the food processing sector (e.g., cassava, palm oil, rice, etc.). Under this a third party designs, builds, operates and maintains the captive power plant, supplying energy to the rice processor under a power purchase agreement. Some larger processors in this industry might prefer to use the Build-Own-Operate-Transfer (BOOT) model.



Iponri Market Inspection Visit by Hon.
Minister of Power, Work & Housing, H.E. Babatunde Fashola.
© Rural Electrification Agency of Nigeria

8.4/ CONCLUSION

Commercial bank lending to clean captive power project owners in Nigeria has been fairly limited to date due to number of factors including stringent lending terms, perceived poor risk-reward profile, lack of bank experience with such projects and in some cases foreign currency risks. To date, the financial institutions have provided only a few loans to support commercial and industrial solar PV installations, based on their normal commercial criteria.

A handful of projects have been undertaken due to their support by intervention funds via the BOI or initiatives in support of local agencies, i.e., the Rural Electrification Agency (REA) and international development institutions including the UK Department for International Development, the World Bank and USAID, which have provided grants, concessionary loans and guarantees for initiatives aimed at kick-starting lending to the commercial and industrial renewable energy market sector. These initiatives have encouraged some of the banks to undertake lending and gain some sector exposure with the benefit of the background support provided by the various agencies. Banks like the African Development Bank, the Development Bank of Nigeria, Access Bank and the Bank of Industry support renewable energy projects through operating their own funds and/or collaborating with other organizations for funding programmes.

Most direct loans of the banks to support this sector have been undertaken on the basis of normal commercial evaluation of underlying business strength – i.e., years of successful operation of the business, ability to provide both collateral and guarantees – and not expressly as loan products to support renewable energy projects within the commercial and industrial space.

Various business models available to be adopted are: outright purchase/asset finance, rent-to-own (financing lease), operating lease and power purchase agreement. Remaining challenges include a lack of awareness and understanding of potential captive power end users, conservativeness and preferences of facility owners (for example, risk adversity to long-term contracts), capital constraints and still-limited financing, and the cost associated with financing. Project developers have complained about the high interest rates of commercial banks, indicating average interest of 20-27 per cent. While this has limited growth in the sector, with the support of grants, external funds and private support, developers have been able to raise capital to support some form of credit business to sell renewable energy solutions under lease-to-own or energy-as-a-service modalities.

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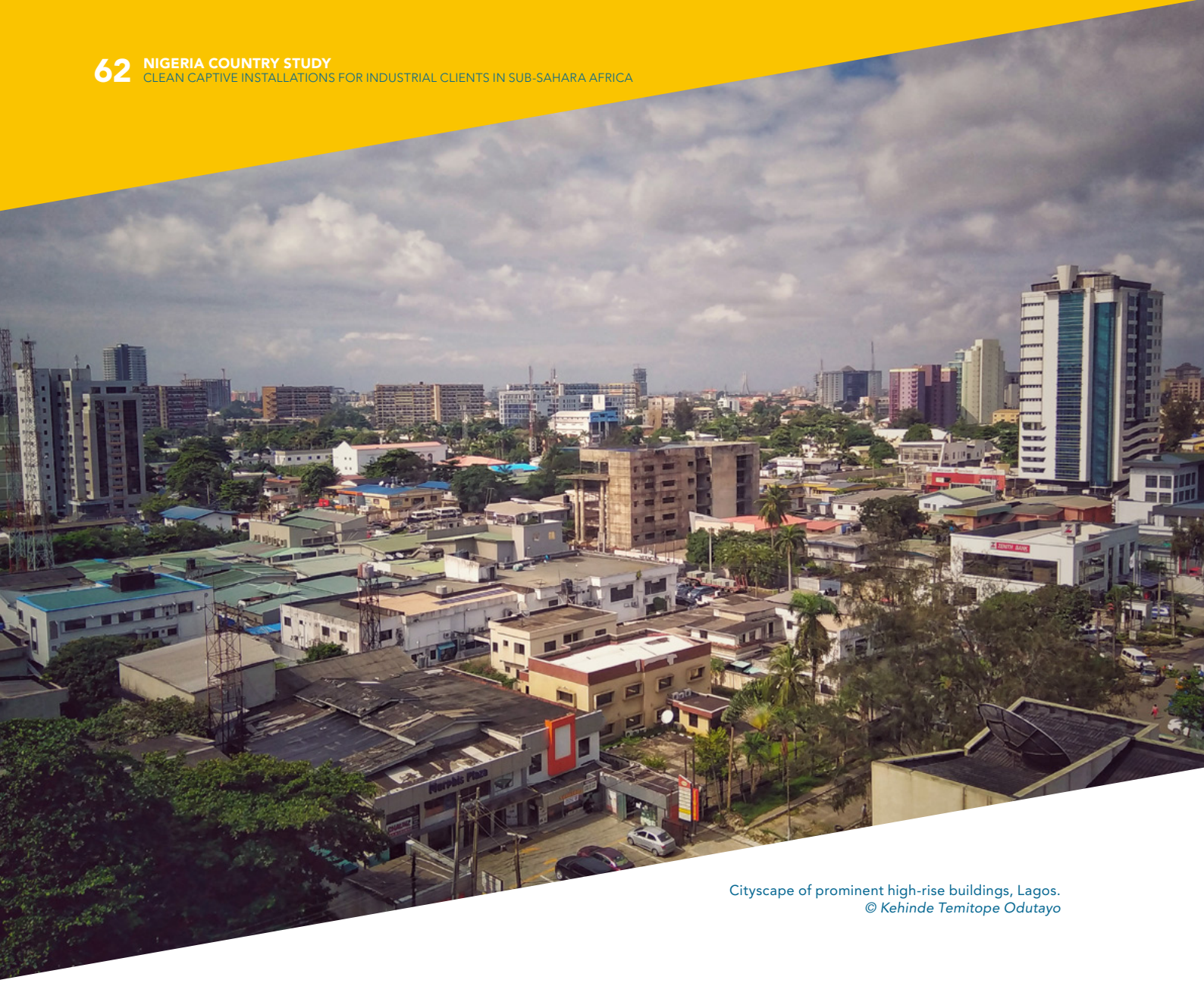

Cityscape of prominent high-rise buildings, Lagos.
© Kehinde Temitope Odutayo

9/ CONCLUSION

The Nigeria country report for clean captive Installations for industrial clients in Sub-Saharan Africa has presented and analysed information on the electricity sector of the country, regulatory considerations, electricity tariffs, market potential, the financing landscape and stakeholders relevant to captive power in industry. The study was based on reports and data available at the time of writing and on interviews with key stakeholders.

While data limitations did not allow for in-depth analysis of specific industrial sub-sectors, the study has highlighted important findings and areas for consideration and, in some cases, further investigation. This will inform the design of interventions for the scale-up of clean captive installations in the service and industrial sectors in Nigeria, including the preparation of case studies, business models and financing structures, awareness raising, and identification and implementation of a pilot project. The current energy situation of Nigeria offers a good potential for clean captive installations.

Currently, Nigeria is experiencing severe electricity supply shortages, and there is a significant gap between electricity peak demand and peak generation, which has left many companies in the industrial sector facing extended power outages. Meanwhile, Nigeria has fragile electricity transmission and distribution systems. The growing population and economy will create increasing electricity demand in the coming years, which requires additional demand for electricity generation, and the clean captive generation as an option could be widely considered. For captive power below 1 MW for the generator's own use, the project developer needs to obtain a no-objection certificate. For generation over 1 MW, a Nigerian Electricity Regulatory Commission (NERC) permit is required.

FG Unveils Solar Hybrid Power Plant in Kogi Community – The Sun.
© Rural Electrification Agency of Nigeria

Over the years, Nigeria's electricity sector has undergone privatization and diversification. The centralized monopoly of the National Electric Power Authority has been distributed into 18 successor companies, and electricity prices are mainly determined by the independent regulatory body (NERC) in line with its Multi-Year Tariff Order (MYTO), which periodically reviews the cost of power to end users. Overall, the privatization and diversification as a result of the joint efforts of all industry players have empowered electricity consumers. Moreover, the Federal Government of Nigeria is cooperating with industry players to update energy policies and regulations to pave the way for increasing the share of renewables in the energy mix.

The manufacturing sector is the main driving force behind the Nigerian economy, and the development of the sector is hindered by the electricity shortage. The manufacturing clusters, industrial clusters and 31 free trade zones that have been or are being established will be the main targets for the development of clean captive installations. Electricity shortage caused by poor fuel supply and lack of infrastructure is the main factor limiting the manufacturing sector in Nigeria. As a result, extensive opportunities exist for clean captive power in the manufacturing sector, with the food, beverage and tobacco, pharmaceutical and automotive industries having the greatest potential.

Nigeria's off-grid market has attracted increased support in the form of grants, low-interest loans and equity investments. Development organizations such as USAID's Power Africa, the US African Development Foundation, the African Development Bank, GIZ, the UK's Department for International Development, etc., provide funding, advocacy and technical support for a series of energy projects related to off-grid generation, energy access and energy companies in Nigeria. Until recently, commercial bank loans have been largely absent from the commercial and industrial solar energy market. However, Sterling Bank and FCMB have been providing lending facilities to the commercial and industrial industry, which will allow other banks to act as "fast followers". Developers consider debt availability, credit risk, foreign exchange hedging and high import tariffs to be the major barriers to developing the commercial and industrial solar energy market.

Overall, Nigeria has a promising and emerging clean captive power market with strong potential in the manufacturing industry and an active ecosystem of renewable energy actors. Proactive interventions, more mature policies and regulations, and well-designed market mechanisms and institutions will help increase the scale-up of clean captive installations.

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A/ NIGERIAN COMMERCIAL AND INDUSTRIAL SOLAR ENERGY MARKET MAPPING

NIGERIAN GENERATION COMPANIES

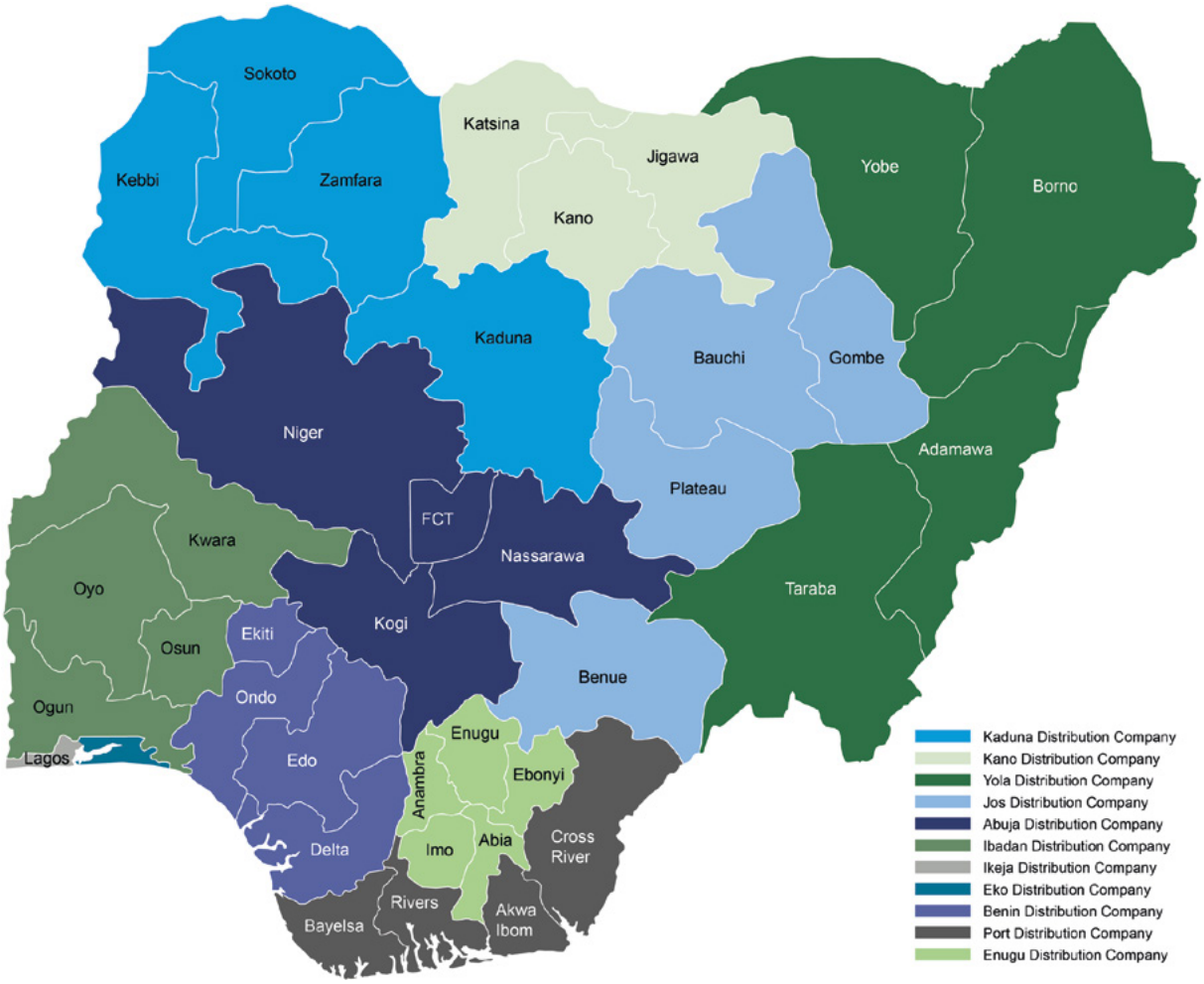
Table 19: List of Nigerian generation companies

POWER STATION	TYPE	YEAR COMPLETED	INSTALLED CAPACITY (MW)	INSTALLED AVAILABLE CAPACITY (MW)	PEAK GENERATION (MW) AS OF MARCH 2018
AES	Simple Cycle Gas Turbine	2001	270	267	0
Afam IV-V	Simple Cycle Gas Turbine	1982	580	98	104
Afam VI	Simple Cycle Gas Turbine	2009	980	559	281
Alaoji NIPP	Combined Cycle Gas Turbine	2015	335	127	0
ASCO	Simple Cycle Gas Turbine	2016	294	270	0
Azura Edo IPP	Simple Cycle Gas Turbine	2018	450	400	301
Delta	Gas Fired Steam Turbine	1990	740	453	507
Egbin	Simple Cycle Gas Turbine	1985	1 320	931	478
Gbarain NIPP	Simple Cycle Gas Turbine	2017	225	200	74.4
Geregu	Simple Cycle Gas Turbine	2007	414	282	71
Geregu NIPP	Simple Cycle Gas Turbine	2012	434	424	100
Ibom Power	Simple Cycle Gas Turbine	2009	142	115	82.1
Ihovbor NIPP	Simple Cycle Gas Turbine	2012	450	327	107
Jebba	Hydropower	1986	570	427	412
Kainji	Combined Cycle Gas Turbine	1986	760	180	384
Odukpani	Simple Cycle Gas Turbine	2013	600	400	392.4
Okpai	Simple Cycle Gas Turbine	2005	480	424	195
Olorunsogo	Combined Cycle Gas Turbine	2007	335	244	123
Olorunsogo NIPP	Simple Cycle Gas Turbine	2012	675	356	0
Omoku	Simple Cycle Gas Turbine	2005	150	0	78.4
Omotosho	Simple Cycle Gas Turbine	2005	335	242	168.1
Omotosho NIPP	Simple Cycle Gas Turbine	2012	450	318	107.8
River IPP	Simple Cycle Gas Turbine	2009	136	166	125
Sapele	Gas Fired Steam Turbine	1978	900	145	55
Sapele NIPP	Simple Cycle Gas Turbine	2012	450	205	212.2
Shiroro	Hydropower	1989	600	480	131
Tran Amadi NIPP	Simple Cycle Gas Turbine	2017	150	100	41.3
TOTAL			**13 225**	**8140**	**4530.7**

Note: NIPP = National Integrated Power ProjectSource: Oyedepo et al. 2018

NIGERIAN DISTRIBUTION COMPANIES

Map 3: Coverage by state of Nigeria's 11 distribution companies



Source: Oyedepo et al. 2018

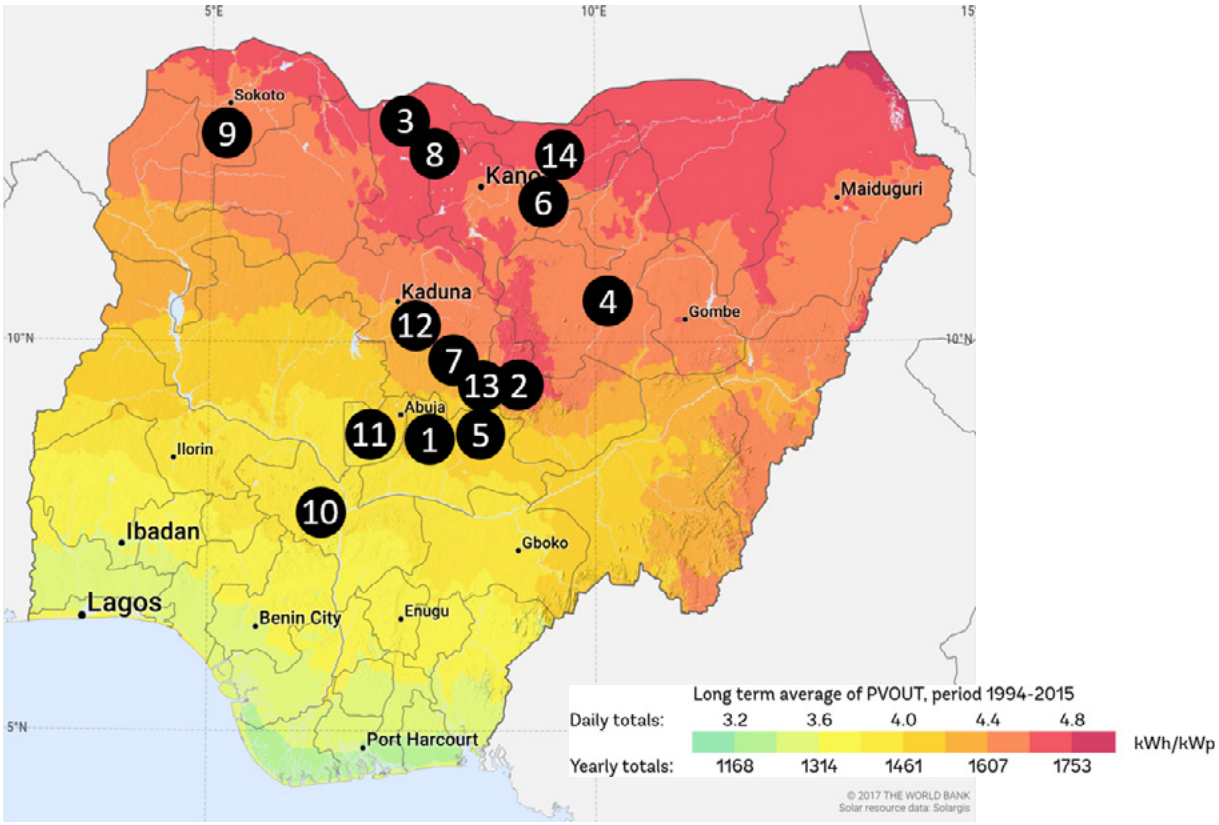
SOLAR INDEPENDENT POWER PRODUCERS

Table 20: List of solar independent power producers

	COMPANY	CAPACITY	STATE	PCOA SIGNED
1.	Afrinergia Power Limited	50 MW	Nasarawa	April 2017 (7.5 US cents/kWh)
2.	CT Cosmos Limited	70 MW	Plateau	April 2017 (7.5 US cents/kWh)
3.	Pan Africa Solar	75 MW	Katsina	Not signed
4.	Nigeria Solar Capital Partners	100 MW	Bauchi	Not signed
5.	Motir Desable Limited	100 MW	Nasarawa	Not signed
6.	Nova Scotia Power Dev Ltd	80 MW	Jigawa	Not signed
7.	Anjeed Innova Group	100 MW	Kaduna	Not signed
8.	Nova Solar 5 Farm Limited	100 MW	Katsina	Not signed
9.	KvK Power Limited	100 MW	Sokoto	Not signed
10.	Middle Band Solar One Limited	100 MW	Kogi	Not signed
11.	LR Aaron Power Limited	100 MW	Abuja	Not signed
12.	En Africa	50 MW	Kaduna	Not signed
13.	Quaint Abiba Power Limited	50 MW	Kaduna	Not signed
14.	Oriental Renewable Solutions	50 MW	Jigawa	Not signed

Source: Akanonu 2019

Map 4: Distribution of solar independent power producers



Source: Akanonu 2019

LIST OF NIGERIA'S MANUFACTURING SUB-SECTORS

Table 21: List of Nigeria's manufacturing sub-sectors

SECTOR	SUB-SECTOR
Food, Beverage & Tobacco	Beer
	Starch and Other Miscellaneous Food Products
	Flavouring
	Soft Drinks and Carbonated Water
	Flour and Grain Milling
	Meat and Fish Products
	Tea, Coffee and Other Beverages
	Dairy Products
	Fruit Juices
	Tobacco
	Biscuits and Bakery Products
	Animal Feeds
	Poultry
	Sugar
	Distillery and Blending of Spirits
	Cocoa, Chocolate and Sugar
	Confectionery
	Vegetable & Edible Oil
	Palm Oil and Palm Oil Products
	Rice Processing
Chemical and Pharmaceuticals	Paints, Vanishes and Allied Products
	Medical and Special Gases
	Soap and Detergent
	Petrochemicals, Plastics
	Agro-Chemicals (Fertilizers and Pesticides)
	Pharmaceutical, Safety Matches, Domestic Insecticide and Aerosol
	Dry Cell Battery, Petroleum Refineries, Gramophone Records and Musical Tapes, Candle, Printing Ink, Toiletries and Cosmetics
	Ball Point Pen, Basic Industrial Chemicals, Automotive Battery
Non-Metallic Mineral Products	Glass
	Ceramics
	Asbestos
	School Chalks & Crayons
	Cement
Domestic and Industrial Plastic & Rubber	Rubber Products
	Domestic and Industrial Plastics
	Foam Manufacturers

SECTOR	SUB-SECTOR
Basic Metal, Iron and Steel and Fabricated Metal Products	Steel Pipe
	Metal Packaging
	Foundry
	Metal Manufacturers and Fabricators
	Primary Aluminium Producers
	Enamel Wares
	Welding Electrode
	Galvanised Iron Sheets
	Nail and Wires
	Steel
Electrical & Electronics	Electronics
	Refrigerators & Airconditioning / Domestic Appliances
	Electric Bulb Lamps, Accessories & Fittings
	Electrical Power Control & Distribution Equipment
	Cable and Wire
Textiles, Wearing Apparel, Carpet, Leather/Leather Footwear	Textile & Wearing Apparel
	Leather Products
	Carpet and Rug
	Footwear
	Cordage, Rope and Twine
Pulp, Paper & Paper Products, Printing & Publishing	Chemical & Stationery
	Printing. Publishing & Packaging
	Pulp, Paper & Paper Products
	Sanitary Towels & Diapers
Motor, Vehicle & Miscellaneous Assembly	Boat/Ship Building
	Automobile Components
	Electric Generators Assemblers
	Miscellaneous Machine & Equipment
	Bicycle
	Motorcycle
	Horology
	Motor Vehicle Assemblers
Wood and Wood Product (including Furniture)	Wood Products and Furniture (Excluding Metal Furniture) Plywood & Particle Board

Source: Author compilation

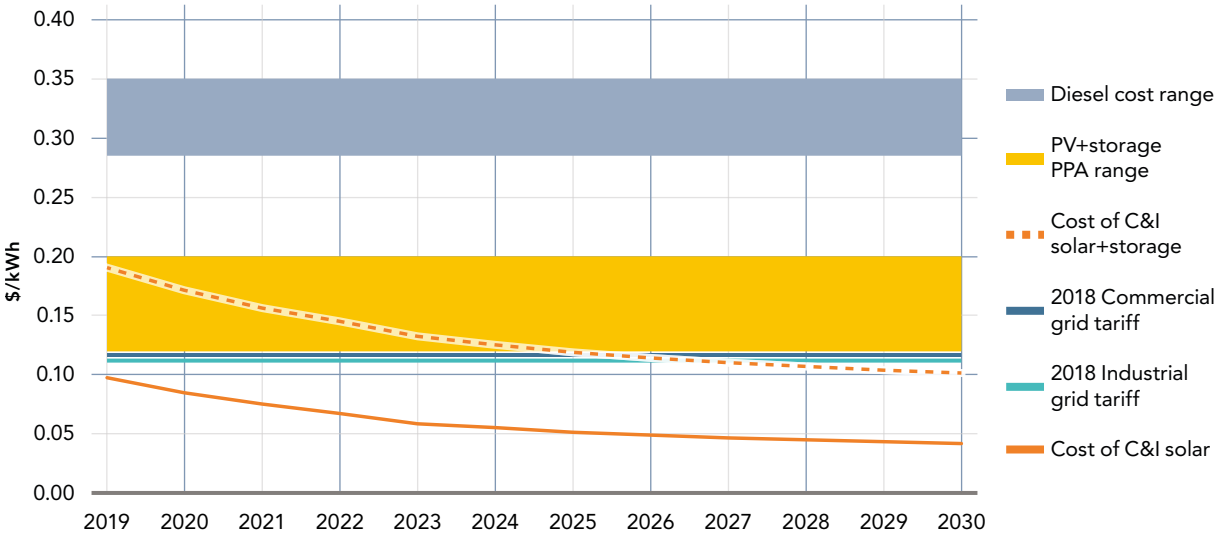
LESSONS LEARNED FROM IMPLEMENTING COMMERCIAL AND INDUSTRIAL PROJECTS

As of November 2018, at least 20 MW of commercial and industrial solar was installed in Nigeria (BloombergNEF 2019). Most installations are smaller than 30 kW, while sites over 30 kW add up to just an estimated 8.9 MW. The 12 developers interviewed by BloombergNEF for this study reported working on a total project pipeline of 49 MW to 55 MW. Most of this pipeline is located in industrial areas where land is abundant.

As of November 2018, the largest reported commercial and industrial solar project in Nigeria was the 2.35 MW Tulip Cocoa Processing Plant, followed by the 1.2 MW Usuma Dam Solar Power Plant built by Japan International Cooperation Agency (JICA) in Abuja, and the 1 MW project built by Enerwhere for Bayero University in Kano state (BloombergNEF 2019).

Economically, commercial and industrial solar is already cheaper than grid electricity tariffs in Nigeria at 10 US cents per kWh. Solar with a two-hour battery costs around 19 US cents per kWh. Vendors signing take-or-pay power purchase agreements are charging between 12 US cents to 20 US cents per kWh, which is cheaper than electricity from a diesel generator (Figure 30). Commercial and industrial customers expect developers and engineering, procurement and construction (EPC) companies to provide them with a guarantee on total system reliability. Since almost all developers use a combination of solar, batteries, grid and diesel generators, most of them guarantee that their systems will provide power for 98 per cent or more of the time over the year (BloombergNEF 2019).

Figure 30: Nigeria cost of commercial and industrial solar forecast versus 2018 electricity tariffs ($/kWh)

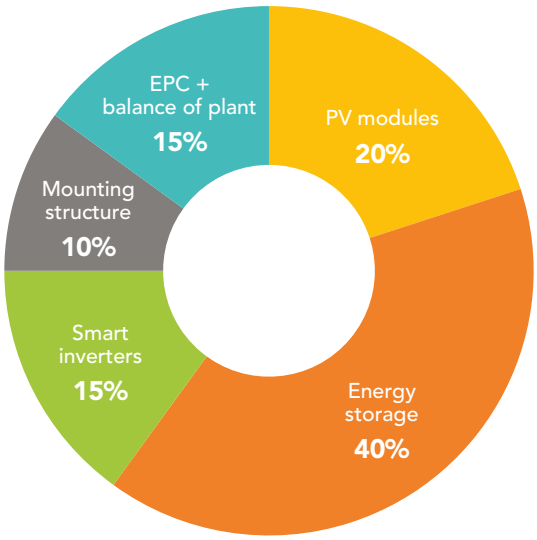


Source: BloombergNEF 2019

Flat-fee energy deals are common. According to the interviews conducted by BloombergNEF for its study, around half of the developers in Nigeria do not charge their customers on a per kWh basis, but rather charge a fixed fee per month. The installation and commercial offer is usually sized so that total energy costs are lower than the monthly electricity bill and diesel power prior to installing solar (BloombergNEF 2019).

In terms of costs, the capital expenditure for a system without storage varies between $1.10 per watt to $1.60 per watt, compared with $3.00 per watt for systems using the most reputable lithium-ion batteries. Figure 31 shows the capital expenditure breakdown (BloombergNEF 2019). Most systems are built with a two-hour battery because it is impossible to guarantee minimum uptime and system performance without it, as these are the primary selling points for customers.

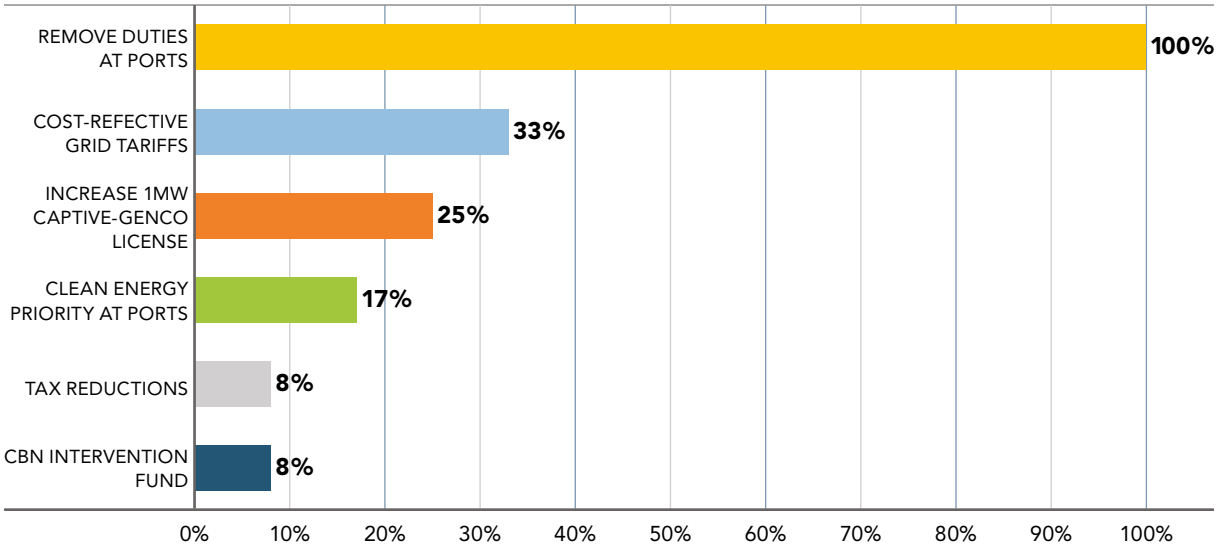
Figure 31: Average capital expenditure breakdown for commercial and industrial solar with energy storage (total $2.45/W)



Source: BloombergNEF 2019

Developers perceive major financial barriers to more commercial and industrial solar in Nigeria, from debt availability to credit risk and foreign exchange hedges (Figure 32). Many developers called for a reduction of import tariffs. As of the end of 2020, import duties are 5 per cent and value-added tax is 7.5 per cent (increased on 1 February 2020) for each solar module, and add up to around 27.5 per cent for batteries.

Figure 32: Reform wishes by Nigerian commercial and industrial solar developers (%)



Source: BloombergNEF 2019

PROJECT EXAMPLES

CHOCOLATE FACTORY (2.35 MWP)

Tulip Cocoa was established in 2006 in Nigeria to expand the production capacity of Dutch cocoa trader and producer Theobroma. It is a manufacturer and exporter of cocoa liquor, butter and cake. It has the largest commercial and industrial solar installation in Nigeria, developed by Solarcentury and commissioned in October 2018 (Solarcentury 2019).

BREWERY (650 KWP)

Nigerian Breweries Plc (NB) (Nbplc News 2019) and CrossBoundary Energy announced in March 2019 the signing of Heineken's first solar project in Africa. CrossBoundary Energy will be installing and operating a 650 kW solar plant located at NB's Ibadan Brewery, with the solar energy plant becoming operational in 2019.

CrossBoundary Energy will operate the rooftop facility on behalf of Nigerian Breweries as part of a 15-year solar services agreement. Under the agreement, NB will only pay for solar power produced, receiving a single monthly bill that incorporates all maintenance, monitoring, insurance and financing costs. CrossBoundary Energy has commissioned TPN to design and build the plant as well as performing operations and maintenance immediately after commissioning.

PLASTIC MATS FACTORY (73 KWP)

Rumbu Industries Ltd produces plastic mats, exporting them to West Africa and beyond. Based in Kano, Northern Nigeria the company has over 1,000 employees and operates 24/7 with average daily power needs of over 500 kW. To fulfil its energy needs, Rumbu decided to use Enerwhere's solar hybrid solution. The first stage of this project is a 73.5 kWp solar rooftop installation, completed in May 2017. The system works in parallel with the utility grid and diesel generators. The success of this project is evidenced by the development of a phase 2 expansion of Enerwhere's solar solution for Rumbu (Enerwhere 2017).

FLOUR MILLING COMPANY (60 KWP)

Founded in 1985, **Honeywell Flour Mills PLC (HFMP)** is a major flour milling company in Nigeria. It is part of the Honeywell Group, a Nigerian conglomerate engaged in select businesses in key sectors of the Nigerian economy, namely foods and agro-allied, energy, real estate, services and infrastructure. HoneyWell FlourMill contacted Ecowatt to assess the feasibility of solar PV solutions, conduct structural and shading analysis; to design a solar PV system with possible integration of grid and existing diesel power generation; and to propose tariff structure for use of solar PV alone and a hybrid solar PV, grid and diesel-powered system. Ecowatt carried out the necessary measurements and determined feasibility for a 60 kWp solar system (Ecowatt 2019).

STERLING & WILSON NIGERIA LTD SOLAR HYBRID OFF-GRID POWER PLANT (1 MW)

This system is a 1 MW captive generation plant developed by Sterling & Wilson Nigeria Ltd. under the EEP for the Federal University Ndufu-Alike, Ebonyi State. Below is the summary of the findings from the university before the deployment of the plant, as highlighted by the Ministry of Power:

Measured daily energy consumption	3,783 kW
Measured daily power demand (peak)	214 kW
Measured daily power demand (off-peak)	804 kW
Total number of generating sets	10
Measured power demand	214 kW
Estimated power demand forecast	860 kW
Daily operational hours (diesel generator)	15 hours
Monthly fuel consumption	20,000 litres
Installed capacity (diesel generator)	804 kW

Source: Author compilation

METKA SOLAR HYBRID PROJECT FOR BAYERO UNIVERSITY KANO (3 MW)

The Metka 3 MW solar hybrid power project is one of the largest solar hybrid projects in Africa. Metka was contracted by the Federal Government through the Rural Electrification Agency (REA) to develop the project for Bayero University Kano as part of the Energizing Education Program (EEP). The objective of the EEP is to supply clean and reliable power to 37 federal universities and 7 affiliated university teaching hospitals. In addition, it will provide street lighting for illumination and safety, as well as a world-class renewables training centre at each of the EEP beneficiary institutions. The captive generation plant is characterized by the following:

SOLAR INFRASTRUCTURE	
Solar panels installed	**10,680**
Total capacity of the solar panels	**3.5 MWp**
Total capacity of backup generators	**2.4 MW**
Total capacity of battery storage	**8.1 MWh**

POPULATION AND BUILDINGS			
Students	**55,815**	Hostels	**29**
Staff	**3,077**	Staff accommodation	**478**
Academic buildings	**277**	Commercial buildings	**120**

Source: Ley, Gaines and Ghatikar 2015

Average solar irradiation per day on the site is between 6.09 kWh and 6.24 kWh (Nwokocha, Okoro and Usoh 2018). Furthermore, the capacity of the existing petrol and diesel generators to be removed is 16.5 MW with an annual CO2 savings of 49.38 million kilograms.

Commissioning of the 1.35MW Solar Hybrid Project at the Federal University of Petroleum, Effurun.
© Rural Electrification Agency of Nigeria

700MW Zungeru Hydro-Electric Power Project – Kaduna River, State of Niger.
© Decrown West Africa Company

B/ STAKEHOLDER MAPPING

With a focus on captive solar PV power, key stakeholders in Nigeria include several government entities, banks, related industry associations, ESCOs / private financiers, EPCs/ESCOs, equipment suppliers and current industrial users of captive renewable energy.

GOVERNMENT AND AGENCIES

Government entities of relevance include the Nigeria Electricity Regulation Commission (NERC), the Rural Electrification Agency (REA), the Federal Ministry of Power, the Energy Commission of Nigeria, the Transmission Company of Nigeria (TCN), the Nigeria Investment Promotion Council (NIPC), and the Ministry of Environment.

Table 22: List of government entities of relevance

INSTITUTION	RELEVANCE
Nigeria Electricity Regulation Commission (NERC)	Independent regulatory agency that was inaugurated on 31 October 2005 as provided in the Electric Power Sector Reform Act 2005. The Commission is mandated to carry out: - the monitoring and regulation of the electricity industry - issuance of licences to market participants - ensuring compliance with market rules and operating guidelines.
Rural Electrification Agency (REA)	Established under the EPSR Act in 2006 (Section 88) under the Ministry of Power, Works and Housing, the agency was not fully operationalized until 2016. The REA's mandate includes: - promoting rural electrification in the country - coordinating the Rural Electrification Programmes in the country - administering the Rural Electrification Fund to promote, support and provide rural electrification through public and private sector participation.
Federal Ministry of Power	Responsible for policies, programmes and monitoring of the power sector in the country. Drafted the National Renewable Energy and Energy Efficiency Policy and leads the Inter-ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE).
Transmission Company of Nigeria (TCN)	State entity responsible for the transmission of electricity from power plants to distribution companies, eligible customers and for export. TCN is responsible for grid-connection agreements and may assist in the determination of MW targets for renewable energy.
Nigerian Investment Promotion Commission (NIPC)	Established to promote, coordinate and monitor all investments in Nigeria.
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 energy sources via research, pilot projects and strategy development.
Nigeria Bulk Electricity Trading Company (NBET)	A wholly Federal Government of Nigeria owned company incorporated in 2010 as part of the roadmap for power sector reform towards the full implementation of the Electric Power Sector Reform (EPSR) Act.
Ministry of Environment	Responsible for ensuring environmental protection, natural resources conservation and sustainable development.
Nigerian Sovereign Investment Authority (NSIA)	A government agency that manages the Nigeria sovereign wealth fund, into which the surplus income produced from Nigeria's excess oil reserves is deposited. The NSIA is interested in supporting activities to drive project development in the commercial and industrial space for solar and mini-grids serving industry across all regions of Nigeria, and has funds available to support this. They will be interested in working with UNEP / Frankfurt School on this new initiative, as this should also provide them needed technical assistance in this area.
Gas Aggregation Company of Nigeria (GACN)	Established to stimulate the growth of natural gas utilization and manage allocation of gas to buyers.
Niger Delta Power Holding Company of Nigeria	Special purpose vehicle jointly owned by the federal, state and local governments to stabilize electricity supply through management of the National Integrated Power Projects.
Nigeria Electricity Management Services Agency (NEMSA)	Enforces technical standards and regulation in the Nigeria power sector.
Nigeria Electricity Liability Management Company (NELMCO)	Created to assume and manage the defunct PHCN legacy debts and power purchase agreement obligations.
National Power Training Institute of Nigeria (NAPTIN)	Responsible for human capital development in Nigeria's power sector.
Bureau of Public Enterprises (BPE)	Charged with the responsibility of privatizing the Nigerian power sector. They also liaise with NERC to ensure that the operators meet their performance agreements.

Source: Author compilation

FINANCIAL INSTITUTIONS

Some of Nigeria's key financial sector players include commercial banks such as Access Bank, Sterling Bank and UBA, which are working towards being at the forefront of the renewable energy landscape.

Table 23: List of key financial sector players

INSTITUTION	DESCRIPTION	RELEVANCE
Access Bank	Access Bank (along with UBA) benefit from $80 million in debt capital coming through the EU/ AFD's SUNREF programme that finances energy efficiency and renewable energy projects.	
Africa Finance Corporation (AFC)	Has a strong team that develops renewable energy projects using various technologies including solar across Africa, and has shown interest in supporting renewable energy projects using commercial and industrial solutions in Nigeria, but has yet to make much progress in this area in the country.	
All On	An independent impact investing company, seeded with funding from Shell (95%) and the Rockefeller Foundation (5%), that works with partners to increase access to commercial energy products and services for underserved and unserved off-grid energy markets in Nigeria, with a special focus on the Niger Delta (not exclusive to this area though). The objective of All On is to provide targeted investments and technical support to small and medium-scale companies in the private and non-governmental sectors active in the access-to-energy space, as well as engage in broader market-building activities such as research and advocacy. The company is a for-profit fund for the Nigerian market in solar PV installations and development finance.	As at year-end 2019, 16 companies had their installations funded including mini-grids and solar installations from 1 to 5 kW.
Bank of Industry	- The Bank of Industry (BOI) is the oldest and largest development finance institution operating in Nigeria. The bank focuses on financing industrial projects in key sectors of the economy such as: Agro and Food Processing, Light Manufacturing, Gas and Petrochemicals, Engineering and Technology, and Solid Minerals. BOI also focuses on promoting renewable energy projects. - In the first half of 2019, BOI signed an agreement with All On to provide 1 billion naira (around $2.77 million) in local currency debt (10% annually for 7 years) for off-grid energy developers operating in the Niger Delta. - Rural community renewable energy projects have been a focus area, where the impact on economic activity in the area is affected by the access to power. Projects have been undertaken via developers. - InfraCredit guarantee fund has provided a partial payment guarantee to support lending via the Solar Power Fund of the BOI, and a memorandum of understanding is in place covering this.	16 small-scale community projects were completed by the BOI as of year-end 2019 across all of the geo-political zones of Nigeria. Projects have impacted hospitals and filling stations with commercial outlets attached.
Bettervest	Bettervest provides foreign loans at low interest rates to project developers under the GIZ-implemented Nigerian Energy Support Programme for the first five mini-grids in Nigeria. These loans were in euros raised from crowd funding sources and managed by Bettervest. Interest rates range from 7.5% to 10%.	

INSTITUTION	DESCRIPTION	RELEVANCE
Ecobank Nigeria	A transnational commercial bank with a base in Nigeria, Ecobank has funded off-grid projects in the past including the Rubitec Solar mini-grid in Ogun state. Restrictions on expansion of loans to the commercial and industrial solar PV sector include that Ecobank requires collateral and three years in a trade before it can lend, which is uncommon in Nigeria. Ecobank is therefore looking to partner with development finance institutions, as with an existing partnership with the African Guarantee Fund.	USAID assistance has been provided in the past, and similar would be required in the future given the experience of that lending. The UK Department for International Development has also provided grants to some of the bank's clients in the past, and this would be welcomed in the future, especially for early-stage support.
FBN Quest (Merchant Bank)	Has a full-service merchant bank that supports project finance of various projects via debt and advisory services. Although the bank has not done much in the renewable energy space, it is open to having structures in place that allow it to support this business.	
FCMB	- A Nigerian commercial bank that has a dedicated renewable energy projects team on both the debt and advisory side of projects. - FCMB has funded Starsight (the solar PV project development company), on the debt side alongside equity funds including Helios. They have interest in providing further support in this area, and are also a recipient of solar power as part of the Starsight project, where a number of the bank's branches use solar PV installations. - Most impact from commercial and industrial solar PV renewable energy lending by the bank has been in support of the agriculture sub-sector, specifically the use of energy for productive purposes.	- The bank has funded the Heritage place project (Heritage bank HQ) for solar PV, and 70 (i.e., 35%) of the bank's 200 branches are now solar powered. - The Gbamu Gbamu project (under the REA's Minigrid Acceleration Scheme) FCMB helps in the agent banking funds recollection process. FCMB used the collection of funds and strength of the cash flow from the project to support further debt funding of the ESCO (Rubitec Solar) for other projects in agriculture (solar irrigation) via concessional funds at rate of 15-16%; with tenor of 5 years. - Starsight is a project developer that FCMB works with; as part of its offering Starsight must guarantee a minimum level of savings of 25-30% on pre-project energy costs.
Fidelity Bank	Has a commercial bank desk that has renewable energy lending as part of its products focus; the terms are standard commercial terms used by commercial banks in Nigeria.	
Sterling Bank	A mid-tier commercial bank in Nigeria, Sterling Bank's focus is on unique/niche areas of business where it can lead the market. It is actively considering off-grid and renewable projects, and has previously funded import-retailers in the off-grid space. The bank is currently looking to develop a financing mechanism for mini-grids, and a platform as a marketplace to match developers to off-takers and finance, possibly blended with concessional financing from development finance institutions to reduce the offered interest rate and increase the tenor. In 2020, the bank aimed to innovatively stir up business processes in the following core areas: Health, Education, Agriculture, Renewable Energy and Transport (HEART). Three models of financing are accepted by the bank using its renewable energy financing system: lease to own, power as a service and outright purchase. The bank is currently the most active financial house supporting the commercial and industrial renewable energy space. It has developed an online marketplace called Imperium that launched at the start of 2020. The aim of the platform is to connect the demand to the supply end of the renewable energy sector.	- Three projects have been funded as part of the Energizing Economies Initiative of the Rural Electrification Agency (REA); cash and balance sheet lending has been used to support this lending, and the full launch of the bank's renewable energy product platform – Imperium happened in 2020. Previous funding was done at 17%, with tenors of around five years with a six-month moratorium, using a CBN blended facility to derive this rate. - The bank has identified that a 7-10 year model for project developers will fit its cash flows more adequately. It is seeking more long-term financing and is in discussions with international banks and providers of support guarantees to support the longer-tenor business. - At least 48 of the bank's branches out of 180 are on off-grid solar PV or hybrid systems. The headquarters were expected to be taken off the grid in 2020 using solar PV as the main energy source, and the other branches will be taken off-grid as the bank rolls out further solar installations with its five ESCO partners from 2020.
UBA	The commercial and Investment banking arms of the UBA group are both interested in the power sector and have an interest in promoting renewable energy projects, having been approached by prospective project developers. The group is keen to get immersed in financing commercial and industrial projects and expects to learn by doing in the short term. UBA along with Access Bank are also the identified banking partners for the SUNREF initiative.	

Source: Author compilation

INDUSTRY ASSOCIATIONS

The recognized renewable energy industry associations in Nigeria include the Renewable Energy Association of Nigeria (REAN), the Council for Renewable Energy of Nigeria (CREN), the Sustainable Energy Practitioners Association of Nigeria (SEPAN) and the Africa Minigrid Developers Association (AMDA- Nigeria Chapter).

REAN is an independent association comprising project developers and organizations focused on promoting private sector interest in Nigeria's renewable energy sector. It is dedicated to promoting and mainstreaming the growth and development of the renewable energy industry by engaging with the public and private sectors to guide advocacy, policy formulation and investment in the sector48. The association consists of 50 members.

CREN is a larger industry association that includes members from academia, government agencies, financial institutions, electricity consumers and more. The association is focused on advocating for renewable energy in Nigeria and the reduction of carbon emissions.

SEPAN is focused more on advocating for renewable energy policies in Nigeria, with over 200 registered members. The Nigeria Chapter of AMDA is the industry association of mini-grid developers that collectively advocate for sustainable policies and promote investments for mini-grid development in Nigeria.

PRIVATE SECTOR / DEVELOPERS

There are several private project developers, ESCOs and EPCs. Some companies provide both ESCO and EPC/ O&M services for outright purchase. Others are purely focused on EPC[4].

Table 24: List of private sector developers, ESCOs and EPCs

INSTITUTION	RELEVANCE
AMP Ventures LLC	AMP has developed several commercial and industrial captive power installations for Total, with a focus on downstream outlets and filling stations, up to 55 kVA. It has funded projects so far where off-takers paid for the system installation, as it has found that banks and funders have not been forthcoming with solutions. Other projects in process include the development of a hybrid commercial and industrial solar system with Shoprite, and another with a mall developer (Top Services Ltd) in four states of Nigeria.
Blue Camel	Blue Camel is an industry leader in northern Nigeria, with a solar streetlight and light manufacturing assembly plant in Kaduna as well as a renowned solar training academy in the same location. It provides solar streetlight services to the government of Plateau states and Kaduna state under the energy-as-a-service and direct debit payment systems.
Consistent Energy Limited / SolarDirect	A stand-alone rooftop solar energy company incorporated in January 2015. The company owns and promotes the SolarDirect brand aimed at displacing generators through rooftop solar projects for small and medium enterprises on a lease-to-own model, predominantly in urban and peri-urban areas.
DayStar Energy	DayStar offers a sustainable solar power and cooling service to help customers enjoy green energy without concerns about carbon emissions and noise pollution. Supporting strictly the commercial and industrial space with energy-as-a-service and lease-to-own options, DayStar is a leading player in the renewable energy space in Nigeria, with projects across the country.
Enerwhere	Enerwhere is the first and leading distributed solar utility in the Middle East and Africa. It provides innovative and sustainable power solutions tailored to the needs of a wide range of commercial and industrial customers. The company developed a 75 kWp solar hybrid industrial solution in northern Nigeria for a plastic mats factory and plans on an expansion project. Enerwhere also carried out the EPC for the 1 MW solar plant located at Bayero University Kano, with the support of the UK's Department for International Development under the Solar Nigeria Programme.
Green Village Electric (GVE)	GVE is Nigeria's biggest mini-grid developer, with 12 mini-grids in operation (500 kW cumulative capacity) and 5 more under development, to reach 1 MW total capacity. With ongoing support from the Bank of Industry, GVE has a six-phase expansion plan to reach 500 mini-grids and a total of 1 million customers.
Havenhill Synergy	Havenhill Synergy is an Abuja-based green energy technology utility company founded in 2010. It started as a power backup system installing inverters and batteries for homes, and from there it started installing small solar systems, rooftop solar and 1-2 kW solar installations. The company does not play in the mini-grid space alone, it also has projects in the commercial and industrial space. It has operational commercial and industrial projects and a pipeline of almost 2 MW that is currently fundraising.
Jinko Solar Co. Ltd	The company is a global leader in the solar industry and distributes its solar products and sells its solutions and services to a diversified international utility, commercial and residential customer base. In Nigeria, it was the supplier for a 1 MW solar project by Enerwhere to power Bayero University Kano.

4 *A full list of solar companies is available in the report* ***Mini-Grid Market Opportunity Assessment: Nigeria*** *by SEforALL Africa Hub and African Development Bank. The members of the REAN also provide a list of main market players.*

INSTITUTION	RELEVANCE
Nayo Tropical Technology	Founded in 1996, Nayo is a high-tech company that specializes in research and development, manufacturing and marketing of power solutions products and systems. The company has offices at Abuja-FCT, Lekki in Lagos State and Awka in Anambra State, with business partners at major cities around Nigeria. The company has repositioned itself as a pioneer indigenous manufacturer and distributor of power solutions for domestic, industrial and telecom applications. Its portfolio includes EPC expertise, solar mini-grids and solar power plant construction. Its subsidiary, Nayo Utilities, deployed and operates one of the largest mini-grid projects in Nigeria, the 100 kW solar mini-grid in Tungan-Jika Magama LGA, Niger state.
North South Power	Concessionnaires for the Shiroro large-scale hydropower plant, North South Power is studying opportunities in the commercial and industrial solar space to add to its existing offerings. It is preparing project feasibility studies aimed at this segment of the market.
Pirano Energy Limited	Pirano is a renewable energy business based in Nigeria focused on the provision of affordable energy solutions to urban and peri-urban businesses that are unserved or underserved by the grid. Through the deployment of small-scale commercial and industrial solar ("SCIS") solutions (offered in stackable 5 kWp solar solutions), Pirano offers a five-year rent-to-own payment plan to its client base and has funded itself through equity investors to date. Pirano has near-term pipeline projects of around 250 kW of installations with off-takers including agricultural offices in Northern Nigeria (8 sites with loads of 3-5 kW each) and pharmacies in Lagos (10 sites with loads of 15 kW each). Previous experience was via collaborations with Rensource Ltd in markets across Northern and Southern Nigeria to serve over 40,000 merchants under the Energizing Economies Initiative (EEI).
Protergia Energy	An indigenous solar PV EPC company operating strictly in the commercial and industrial space, Protergia has been responsible for the solar PV installations in schools, religious houses, and a few commercial and agricultural businesses. It has around 750 kW of installed solar PV across various clients.
Renewable Energy Association of Nigeria (REAN)	Launched in 2016, REAN is an independent, non-profit industry association whose mission is "to be the umbrella association for all renewable energy promoters enabling and encouraging the sustainable development of the Nigerian economy through renewable energy".
Rensource Energy	Rensource started out as a small solar systems PV company but quickly evolved into the aggregated market cluster solar solution providing space. It is a leading renewable energy solutions provider with a very strong investment background and is highly funded and supported in the donor space. It is presently embarking on providing solar solutions to 11 commercial markets in Nigeria by aggregating solar PV power over metered shops and selling energy as a service. This solution is enabled by the REA, and Rensource has successfully installed solar PV in four markets serving over 10,000 shops across Nigeria.
Rubitec Solar	Rubitec works as both a mini-grid project developer and a consulting firm. It developed one of five Stage I Nigeria Energy Support Programme mini-grids, as well as installing 65 off-grid ATMs. Rubitec commissioned in February 2018 its first mini-grid in Gbamu Gbamu community in Ogun State Nigeria, installing a 85 kW solar hybrid mini-grid. Rubitec is also actively working on several other projects including an interconnected commercial and industrial project, which it has started engaging on with the distribution company and the community. The energy generated is expected to be used by an industrial cluster and schools, among others.
Solad Ventures	Solad is an investment firm that has undertaken various small-scale energy projects in Lagos and collaborated on projects in northern Nigeria. It is currently managing distribution for some Lagos State independent power producers. Solad has to date participated in two special purpose vehicles (SPVs) as an investor and a deal lead that are solar and captive power solutions, as follows: 1) Sabon Gari Energy Solutions is an SPV with Rensource and Solad. It is a 13,000 shop market in Kano and an economic cluster, cost $4.6 million, and is 4 MW in size; it has institutional investors (Subsidiary of EDF); and2) Virtus is an SPV with Rensource Energy and Solad to power 10 markets across Nigeria (around 30,000 shops in Lagos, Kano, Ogun, Edo and Oyo). It recently closed debt funding of 450 million naira (around $1.25 million) with Sterling Bank. Solad is also developing (on its own) the Ijora market in Lagos. It is a mixture of gas and solar hybrid, with 1.3 MW demand and a cost in the range of $1.5 million. Feasibility in the Alaba market – the largest market in Lagos and possibly West Africa – is also being explored for up to 200,000 shops.
Solarcentury	Solarcentury is a UK company that offers an integrated service: developing, structuring finance, building and operating solar projects at the commercial and utility scale. It has a global presence and a dedicated team for the African market particularly in Nigeria, Kenya and South Africa. Solarcentury completed its largest project in Africa, and the most significant commercial and industrial solar installation in Nigeria, for Tulip Cocoa Processing (TCP), commissioned in October 2018.
Starsight Power Utility	Starsight proposes a sustainable solar power and cooling service to help customers enjoy green energy without concerns about carbon emissions and noise pollution. It has 200 operational projects in 33 states across all geo-political zones. The energy company has 14.5 MW of installed generating capacity, 7.5 MW of solar capacity and a 7 MW diesel generator. Starsight also boasts 12.5 MWh of installed battery storage and 5,000 horsepower of installed cooling capacity. According to the CEO, following the success in the small and medium enterprise space and the additional $30 million investment from Helios and AIIM, Starsight is now poised to expand its service offering to the industrial sector in Nigeria, which is lacking a viable alternative to diesel.
Triple E Systems Limited	Triple E Systems is undertaking a solar PV rooftop cluster project in southwestern Nigeria and awaiting the outcome of an application for support funding of up to EUR 500,000 from the NEP of the REA. Eight clusters have been identified, including an office complex, AAU University Ondo State and Bowen Medical Centre Ogbomoso. The targeted total installed capacity is 5-10 MW, using a hybrid, solar PV, lithium battery and diesel set-up.

Source: Author compilation

INDUSTRIES USING CAPTIVE RENEWABLE ENERGY TECHNOLOGY

There are no available data on the total installed capacity for captive power generation in Nigeria; however, the majority of the issued permits (23 permits, or 46 per cent of the total) are for the oil and gas sector, and this sector also represents the highest planned generation capacity: 941 MW, or 72 per cent of the total planned capacity. The agri-food sector is second with 10 permits and planned generation capacity of 121 MW (9 per cent).

Furthermore, there are several captive system users across the country. They include: Nigeria Bottling Company, Dufil, Larfarge, Transcorp, the Tinapa free trade zone, Rumbu Industries, Nigeria Breweries, etc. Other users are the Bayero University Kano and the Federal University Ndufu-Alikwe Ikwo in Ebonyi states, which are both under the Energizing Economies Initiative (EEI) of the REA.

Table 25: Selected clean captive power systems in Nigeria

INSTITUTION	RELEVANCE
Agrale Automated Services	A vehicle security assembly and manufacturing company using a 70 kW solar PV system for all its operational needs. Mostly daytime power is required, although battery back-up is installed for security lights and minimal night-time operation.
Bayero University Kano	A premier federal university in Nigeria recently equipped with a 3 MW solar hybrid solution to power the lecture theatres, hostels and laboratories under the Energizing Education Initiative of the REA.
Manufacturers Association of Nigeria	Established in 1971 and with more than 3,000 members, MAN is a trade group headquartered in Lagos. The group acts as a platform that manufacturers use to influence economic, industrial, labour and social policy within Nigeria.
Nigerian Association of Small Scale Industrialists	The Association admits those in manufacturing, processing, mining and service industries and whose capital investment falls within the definition of small-scale industry, as may be reviewed from time to time by government.
Rumbu Sacks	A 73 kW solar hybrid solution installed in a straw mat manufacturing factory to augment energy needs and reduce dependency on diesel generators especially during idle operation times.
Wedotebary Nigeria Limited	Wedotebary Nigeria Limited operates a 5 MW solar power plant in Jos, Plateau State that is supposed to serve industrial clients. There is no information on whether the plant is operational and which companies are benefiting from the plant output.

Source: Author compilation

GENSET SUPPLIERS / OFF-GRID INDEPENDENT POWER PRODUCERS

Table 26: List of genset suppliers / off-grid independent power producers

INSTITUTION	RELEVANCE
JMG	Established in 1998 in Nigeria, it is a diversified solution provider with a broad portfolio in power generation, electrical infrastructure, industrial equipment, and elevators and escalators. Its project references include installations of diesel and gas generators across industries.
TPN Nigeria	Based in Lagos, TPN is a Nigerian-registered company operating in the field of Power Generation, Electrical Distribution (both low and medium voltage) and Service & Maintenance of all related equipment and installations. TPN provides energy solutions from generator sets to operations and maintenance throughout Nigeria, focusing on engineering, installation and maintenance of electric power systems and ensuring the availability of electricity wherever and whenever needed. TPN currently operates throughout southern Nigeria, from Lagos and Ibadan to, among others, Onitsha, Enugu, Aba and Uyo.
Clarke Energy	Clarke Energy is a multinational specialist in distributed power generation solutions. In Nigeria, its services range from the supply of a gas or diesel-fuelled power generation engine, to the turnkey installation of a multi-engine power plant. Clarke Energy is the authorised distributor and service provider for Jenbacher reciprocating gas and diesel engines in Nigeria. Since its establishment in 1999, it has delivered around 300 MW of electrical generation capacity to many large industrial facilities across Nigeria, seeking economical, reliable captive power plants.
Cummins Energy Solutions Nigeria (CESN)	CESN is the official Cummins Nigeria gas generator distributor and after-sales support. More than 200 Cummins gas generator sets are installed in Nigeria, delivering over 270 MWe of power in the country across a wide variety of industries, including FMCG, bottling, breweries, plastics, steel, residential estates and office buildings.
CET Power	CET Power is a leading operator in the captive/embedded power industry in Nigeria. It provides power to organizations with both mid-layered and industrial-scale operations requiring power either for short-term (EPP) or long-term (independent power producer), on an outsourced basis. Clients include breweries, food processing companies, tobacco, cement factories, etc.
Tower Energy	Tower Energy is an independent power producer with a more than 50 MW gas-fired power generation facility operational in Nigeria. It is part of Clovis Group, established in 1915 and present in aluminium and steel processing, building products, kitchen wares and household products and in the power and gas sector.

Source: Author compilation

SUMMARY OF ACTIONS TAKEN BY BANKS/FUNDERS

- To date, financial institutions have provided only a few loans to support commercial and industrial solar PV installations in Nigeria, based on their normal commercial criteria. A handful of projects have been undertaken due to their support by intervention funds via the BOI or initiatives in support of local agencies, i.e., the Rural Electrification Agency (REA) and international development institutions including the UK's Department for International Development, the World Bank and USAID (see others listed in section 8.3). These agencies have provided grants, concessionary loans and guarantees for initiatives aimed at kick-starting lending to the commercial and industrial renewable energy market sector. These initiatives have encouraged some of the banks to undertake lending and to gain some sector exposure with the benefit of the background support provided by the various agencies.
- Most direct loans of the banks to support this sector have been undertaken on the basis of normal commercial evaluation of underlying business strength, i.e., years of successful operation of the business, ability to provide both collateral and guarantees, and not expressly as loan products to support renewable energy projects within the commercial and industrial space.

The characteristics of these loans to date are as follows:

- They have mostly been short-tenured, i.e., 3-5 years and with interest rates of between 12 per cent and 24 per cent typically, with the lower-end rates being achieved from the few that have accessed intervention funds or facilities from (new to the market) impact funds that are bringing new initiatives to the market to support the sector.
- The loans have supported EPC firms and developers with the import of equipment via the use of Letters of Credit (LCs), i.e., where the repayment source and security over the assets is clear. In addition, the banks already have an established multi-year relationship with the EPC firm / developer and have built up a comfortable risk profile of the client.
- The banks have largely not yet developed specific lending criteria for commercial and industrial renewable energy loan products, so standard commercial terms have been used. There are a few instances, i.e., Sterling Bank and FCMB, where (based on their initial sector lending experiences) initiatives are well advanced to develop products to support lending to the sector. The introduction of active lending to the sector either via direct loans to end users, or via facilities provided to developers and ESCOs is expected to act as a game-changer, as other banks will act as "fast-followers" to the market leaders, once the products take off and are shown to have been well-structured with significant market interest.
- In the few instances where lines of credit have been in place to support renewable energy lending, there has to date been low usage of these lines due to the limited knowledge of the banks in assessing the risks of renewable energy lending; hence very stringent criteria are applied to any lending undertaken, which the largely new entrants to the market, i.e., on the developer side, are unable to meet, especially when considering the prohibitive upfront costs and excessive collateral requirements.
- All the banks with interest in the sector expressed an interest in accessing further technical assistance on a live transaction, and expressed the importance of initiatives by the CBN or international financial institutions to support the sector via use of concessional lines of credit with tenor availability up to 15 years, risk guarantees and/or insurance support products.
- Foreign exchange risks are largely not hedged by the banks and are expected to be covered by the client using either 1) previously acquired capital importation approvals (which enables pre-approved bank clients to access foreign exchange funds at the CBN for any foreign exchange fund loans they use to import equipment), or 2) matching loans with revenues (i.e., loans in US dollars must show that revenues in US dollars will be earned) otherwise the client must demonstrate ability to access foreign exchange itself with a margin applied to holding an adequate proportion of client naira liquidity in repayment accounts, over which the bank has a lien. The client will then be required to source for foreign exchange to effect any repayments of foreign exchange facilities from these funds, with access to funds only above the required minimum account balance threshold.
- The development of risk mitigation instruments such as payment guarantees in support of this type of lending has not yet taken off. However, many discussions are well-advanced with a number of interested market participants (i.e., Proparco and InfraCredit, among others) who have shown interest in supporting banks' lending via the use of risk guarantees that will be approved alongside the request for renewable energy lines of credit. In the meantime, the most advanced banks in this area have stated that the use of their normal commercial assessment methods for guarantees, and collateral for lending would be applied (as this is a CBN requirement), until products have been fully developed specifically for the commercial and industrial space.
- SUNREF and its local project partners, the Manufacturers Association of Nigeria and AFD, have identified two banks that are the partner financial institutions for the SUNREF facility.

SUMMARY OF ACTIONS TAKEN BY PROJECT DEVELOPERS

- Project developers have indicated that technical knowledge in the sector has not been lacking, with donor agencies such as GIZ and USAID actively supporting the space. However, there is room for improvement in the standards and quality of equipment supplied to the country. Project developers who provide energy as a service or under the lease-to-own options have no choice but to use quality equipment, as this must operate through the life span of the service period of the project.
- Project developers complained about the high interest rates of commercial banks, indicating average interest of 20-27 per cent. While this has restricted growth in the sector, with the support of grants, external funds and private support, developers have been able to raise capital to support some form of credit business to sell renewable energy solutions under lease-to-own or energy-as-a-service modalities.
- Despite lower interest rates from foreign sources of funds to improve renewable energy projects, these funds must be obtained via local banks which in turn also hedge risks which slightly increase the interest rates. Sadly, foreign loans must be repaid in the foreign currency and the economy is highly supported by the debt reserve of the central bank, hence the risk of currency fluctuation is very high. This has made project developers desist from obtaining foreign loans. Solutions to improve and support the hedge are therefore needed.
- Project developers indicated that present regulations in the sector have been favourable, especially for solutions under 1 MW. The developers also noted the seeming ease in obtaining licences and no-objection certificates for captive projects even when above 1 MW.
- Solar products and associated components such as the batteries and electrical balance of systems face import duties. These costs (which are waived in other electricity-deficient countries) are indirectly transferred to the customer. Project developers noted that this has not been much of a problem in the rate of adopting renewable energy solutions, but a reduction in import duty will help drop prices and ease payment to the customer.
- Energy audits and improved energy efficiency are a crucial part of the improved energy adoption process; however, the cost of conducting the audits and improving the efficiency of systems remains high and risky cost are borne by project developers. Initiatives providing a sustainable means of revolving this cost are therefore needed. Almost all project developers expressed concern about the huge cost of conducting energy audits and the risk of not translating to business despite embarking on the audits for clients.
- Consumer awareness and improvement in renewable energy best practices, improved awareness of energy efficiency and consumer knowledge in cost-benefit awareness will go a long way in improving overall adoption in the market. Project developers spend resources to educate their clients; however, this is an important way in which initiatives might support the sector.
- The present non-reflective electricity tariff is another inhibiting factor for the adoption of renewable energy solutions. Project developers have identified that an increase in the cost of electricity from the grid will naturally improve the case for renewable energy adoption. The present tariff for residential and commercial users comes heavily subsidized and does not truly reflect the cost of generation and distribution. Renewable energy solutions are better adopted in areas with very poor grid supply and where there is a high reliance on fossil fuel-generated electricity.

KEY TAKEAWAYS

STAKEHOLDERS

To date, the impact of the intervention funds and initiatives by various international development agencies, local development agencies and development finance institutions has largely been to create an introductory set of support tools and financial models for the market. This has led to a few model projects being developed and larger funding initiatives starting to be put in place by bodies including the World Bank and the African Development Bank (which in 2019 announced dedicated funds of $550 million to assist renewable energy project initiatives of the Rural Electrification Agency, REA).

The REA in its role has acted as an important and effective galvanizing agency of the government to pull together project development expertise, grant and bank funding and government support for renewable energy projects in favour of small businesses, including marketplaces in Kano and Lagos. Other REA projects have supported mini-grids for rural areas, and recent Requests for Proposal (RFPs) for grid-connected mini-grids. Banks and project developers have been able to build their knowledge of the sector via support for a number of these structured initiatives.

A good example of how this will assist the market going forward is the recent announcement by Rensource (one of the pool of project developers used by the REA on its projects), which in December 2019 raised $20 million for further project development of solar PV installations in 20 new markets across Nigeria. Funds were raised from an international venture capital firm and a pool of impact investors.

For the banks and the developers/EPCs, the direct support on models for funding, on both the lending and borrowing side, has focused on areas that ensure borrowers have adequate cash flow to meet credit requirements of the banks. Meanwhile, for developers / EPC firms, the focus has been on the clients' ability to pay under a lease agreement or outright from cash flows (some of which have had the additional support of donor grants). The focus for financing has thus been on areas such as bank branches, markets with multiple small and medium enterprises, rural business hubs, universities, and various established manufacturing industries and services, such as petrol stations.

It is too early to say that any particular market sector has a discernible advantage over another from the viewpoint of the UNEP commercial and industrial renewable energy support programme. The impact would be equally effective at the level to support and leverage the work of the REA, the most experienced project developerwho currently tend to act as market aggregators, and the banks that have already shown initiative in support to this sector, including the government-supported BOI. These parties continue to fund equipment purchases, design and develop projects, provide grant funding, act as a quality check for equipment used in projects (usually requiring tier 1 original equipment manufacturers, or OEMs, to be used in approved projects), mostly via the use of various lease models, and they also undertake the O&M.

Developers and new impact funding institutions have been able to source most of the renewable energy funding that has been provided by the banks to date, fine-tuning existing funding models to offer low hanging fruit, as there is already an established path, with the various support agencies especially the REA and the coming of SUNREF. New initiatives by banks, such as Sterling Bank's Imperium marketplace platform for renewable energy project funding, are among other initiatives already establishing a financeable project pool.

The new level of interest seen from banks and impact funds now needs to be enhanced to become more friendly to commercial and industrial renewable energy, in terms of structure. Specific areas of support are needed for:

- **Accessibility to and lowering of intervention fund loan interest rates** charged. The BOI rate of 11.25 per cent works well if more accessible.
- **Increasing tenors provided** above 10 years with a possibility of 15 years. This is a target of the BOI, but it requires regulatory reform to accept risk guarantees and reduce collateral and other stringent requirements such as personal guarantees. This would in turn assist the developers with extending longer lease periods to their clients and having more affordable pricing models to increase the number of market participants.
- **Technical assistance** and grants are also required as part of the support mechanism for the developers, especially to support the early-stage development costs of undertaking energy efficiency audits. These costs are currently prohibitive for both the developers and off-takers, leading to sub-optimal installations in some instances where only minimal energy audit reviews have been undertaken.
- **The implementation by commercial lenders of renewable energy lines of credit that have lower rates** (ideally all-in costs of 12.5 per cent or less) and longer tenors (over 10 years). These will support the take-off of credit to the commercial and industrial solar PV sector and will enhance the ability to repay lending comfortably. This in turn would lead to the parallel development of adequate credit enhancement tools, i.e., payment guarantees, insurance of equipment, better quality equipment as collateral, take-off of a secondary market for solar PV installations. All of this will provide the banks with extra comfort for their lending.
- **Continued ease of regulation for installations of 1 MW and below**. It is clear that for installations of under 1 MW, current regulation allows for installations by energy service providers, with no significant regulatory obstacles (i.e., a permit must be obtained from NERC, under a relatively straightforward process set out under the Mini Grid Regulations issued in 2017). Various initiatives of the REA have also opened up the interconnected segment of the market, where the distribution companies are now cooperating with developers by entering into standard agreements with developers to ring-fence (under-served or unserved) areas of a distribution zone that will be served by the developer/ESCO's mini-grid, for an agreed number of years.

CICSA

CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

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