Ministry of Foreign Affairs

Solar Report Nigeria

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Sector Study

Solar Renewable Energy in Nigeria

May 2021

Executive Summary

Nigeria is the largest economy in sub-Saharan Africa with a GDP of approximately $448 billion. It also has the continent's largest population, estimated at over 200 million. Despite this and being one of the largest oil and gas producing countries in the world, it struggles to provide power. With only about 60% electrification, Nigeria falls behind comparable sub-Saharan countries like Ghana (83% electrification rate) and Kenya (64% electrification rate).

Despite investing billions of dollars in improving electricity supply and privatizing the sector in a bid to reach more efficiency, progress has been slow. Meanwhile, electricity demand continues to grow on the back of population growth and increased local production.

Solar energy is considered one of the main ways for Nigeria to reach its electrification targets. It is increasingly adopted across the country: by households to power small appliances, in the shape of mini-grids powering entire markets or (rural) communities, and by corporate entities who seek to reduce their reliance on expensive diesel generators.

The reduced cost of solar panels and batteries has made a transition to solar more feasible, and Nigeria is said to be among the fastest growing markets for solar around the world. Still, the relatively high upfront installation cost deters the lower segment of consumers. Government policies and institutional finance schemes are gearing up to facilitate further growth in solar.

There are many opportunities to tap into Nigeria's solar energy market, including in offering solar solutions on a B2B level. We interviewed over 50 companies across different industries relevant for the solar sector: companies that consume large amounts of energy as well as companies actively involved in solar already. These stakeholder interviews further confirmed that solar in Nigeria is a large and growing industry, and that there are opportunities in several applications from agriculture to manufacturing and home systems.

The market is looking for better technology at a competitive price as well as engineering skills which can be brought to Nigeria in collaboration with local companies. There is a large playing field of potential partners and many competitors have discovered Nigeria's solar potential. Despite their presence, there will be abundant chances for Dutch companies to become involved because the opportunity is everywhere.

List of Acronyms

Acronym	Meaning
AfDB	African Development Bank
ATM	Automated Teller Machine
BoI	Bank of Industry
CCVO	Combined certificate of value and origin
CFAL	Climate Finance Advisory Limited
CREE	Committee on Renewable energy and Energy Efficiency
DisCo	Distribution Company
ECN	Energy Commission of Nigeria
EIA	Environmental Impact Assessment
EPC	Engineering, procurements and construction
EPSR	Electricity Power Sector Reform Act
ESP	Economic Sustainability Plan
EXC	Excise Duty
FGN	Federal Government of Nigeria
GDP	Gross Domestic Product
GenCo	Generation Company
GHG	Green House Gases
Green Energy Fund	Green Energy Fund
GW	Giga Watt
ID	Import Duty
IEA	International Energy Agency
IMF	International Monetary Fund
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
KW	Kilo Watt
LCOE	Levelized Cost of Energy
LVY	Levy
MAP	Meter Asset Provider
MESL	Mainstream Energy Solutions Limited
MESSAGE	Model for the Energy Supply Strategy Alternatives and their General Environmental Impact
MIGA	Multilateral Investment Guarantee Agency
MW	Mega Watt
MYTO	Multi-Year Tariff Order
NASENI	National Agency for Science and Engineering Infrastructure
NBET	Nigeria Bulk Electricity Trading Company
NCS	Nigeria Customs Service
NEMSA	Nigerian Electricity Management Services Authority
NEP	Nigeria Electrification Project
NERC	Nigerian Electricity Regulatory Commission
NESI	Nigerian Electricity Supply Industry

NESREA	National Environmental Standards and Regulations Enforcement Agency
NNPC	Nigerian National Petroleum Corporation
NREEEP	National Renewable Energy and Efficiency Policy
OBF	Output-Based Fund
OECD	Organisation For Economic Co-Operation and Development
PAAR	Pre-Arrival Assessment Report
PAYG	Pay-As-You-Go
PC	Product Certificate
PO	Purchase Order
PPA	Power Purchase Agreement
PRG	Partial Risk Guarantee
PV	Photovoltaic
REA/NREA	(Nigeria) Rural Electrification Agency
REF	Rural Electrification Fund
REMP	Renewable Energy Master Plan
REMP	Renewable Energy Masterplan
RESIP	Rural Electrification Strategy and Implementation Plan
SEFA	Sustainable Energy Fund for Africa
SHS	Solar Home Systems
SMEs	Small and Medium Scale Enterprises
SON	Standard Organization of Nigeria
SONCAP	SON Conformity Assessment
SPDC	Shell Petroleum Development Company
SU	System Unit
UN	United Nations
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USTDA	US Trade and Development Agency
VAT	Value Added Tax
Wp	Watt Peak

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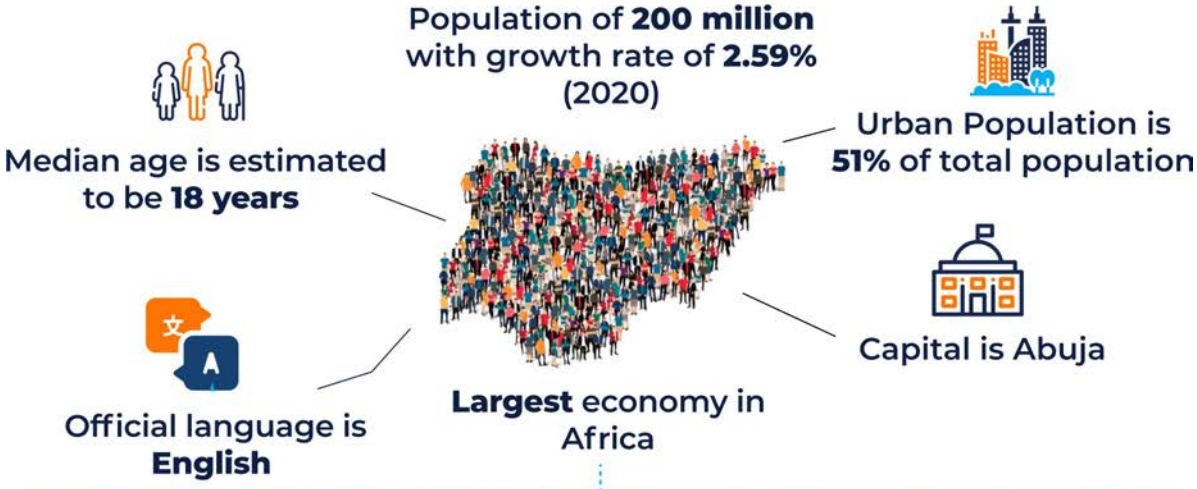
NIGERIA IN FIGURES



World Bank GDP ranking is **30**

National currency is **Naira, NGN**

GNI per capita (2018) is **$5,710**

34m households earn **>$7,500p.a.** by 2030

GDP is projected to grow from **USD 448 billion** in 2021 to **USD 1 trillion** in **2030**

Oil accounts for **<10%** of GDP but **96%** of export earnings

Largest sectors include **Agriculture, Trade, ICT, Manufacturing and Mining & Quarrying**

Ease of doing business ranking rose from **146** in 2019 to **131** in 2020

Main import partners are **China, The Netherlands, South Korea, Belgium and United States**

FDI valued at **USD 2,6bn** (2020)

Introduction

Nigeria is the largest economy in sub-Saharan Africa, with a consumer market of about 200 million people. The Dutch government has identified Nigeria as a key focus in its Africa strategy because of its size, but also the opportunities for bilateral cooperation and Dutch businesses.

Nigeria is endowed with large oil, gas, hydro and solar resources, and has the potential to generate about 12,000 MW of electric power from existing plants, but limitations in the power sector constrain growth.

The Netherlands is one of the world's leaders in renewable energy. According to the "Nationaal Solar Trendrapport 2021", the Dutch solar market grew by 40% in 2020. It is therefore an important sector for Dutch involvement in Nigeria, as it offers energy sector development in Nigeria as well as business opportunities for Dutch companies.

This report is part of the wider efforts of the Netherlands to play a significant role in the development of Nigeria's energy sector, solar energy in particular. The goal is to deepen existing knowledge, find opportunities for the Dutch companies and explore additional fields for business in energy between the Netherlands and Nigeria.

Dutch government agency RVO retained Naijalink as a consulting partner for this project. Naijalink is an advisory and services company that supports international companies in accessing the opportunities in Nigeria. Moreover, we help companies understand Nigerian market conditions and identify relevant in-country business partners.

This report provides an overview of the solar energy sector in Nigeria to facilitate a better understanding among the Dutch businesses that wish to explore doing business in that sector. The report is based on data gathered from existing databases and open sources. Moreover, we held over 50 stakeholder interviews with a focus on validating open source information and of course: identifying actual and concrete opportunities for Dutch businesses.

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ELECTRICITY IN NIGERIA

Commenced electricity generation in **1896**

Distribution and generation companies were privatized in **2014**

Energy demand in Nigeria is projected to grow **52%** over 2010-2035

Generation: **12,522 MW** potential/ average output **4,000 MW**

Installed transmission capacity of **8,100 MW** with peak transmission of **5,459 MW**

Approx. **25% (3100 MW)** of installed generation capacity reaches end users

30.9% in rural areas and **81% of urban** areas have access to electricity

Generator economy: Nigerians spend **$22bn** yearly on fuel

Key demand drivers are **population growth, economic growth and infrastructural development**

Cost of electricity ranges between **30 and 60 ₦/kwh**

Africa's largest electricity generation company is based in Lagos

90 million Nigerians have no access to electriciy

23 grid-connected energy plants and many independent power plants

Households & companies rely on the use of diesel/petrol **generators**

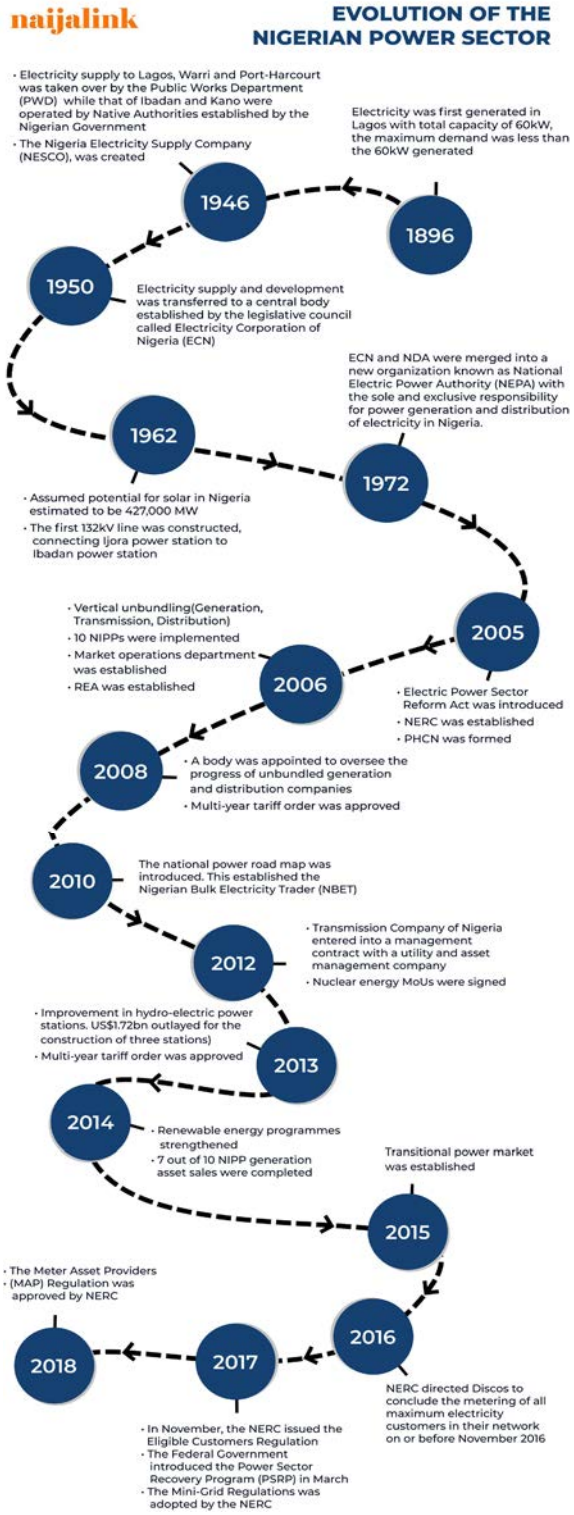
Most electricity is derived from **thermal** and hydropower

Contribution of solar to Nigeria's energy generation: **1.1%**

1. Electricity in Nigeria

NEPA, a former acronym for Nigeria's electricity company, was usually 'translated' as Never Expect Power Always. After a name change to the Power Holding Company of Nigeria (PHCN), Nigerians simply referred to it as "Problem Has Changed Name". This anecdotal evidence points to an inconvenient truth: Nigeria's electricity production is far below demand. About 90 million Nigerians have no access to electricity at all, while the others receive less electricity through the grid than they need.

No matter the billions of dollars invested to 'fix' the sector and privatization of electricity assets in a bid to drive efficiency, Nigerians remain dependent on diesel and petrol generators. This does not only fuel pollution but also comes at a great cost to the economy: cost of production in Nigeria (and cost of operation) is significantly higher than in peer countries due to the absence of a proper grid.



Electricity Demand

Nigeria is the most populous country and largest economy in Africa. No wonder then that demand for electricity is strong. The current daily power demand is estimated at 17,520 MW while peak generation capability is 5,300 MW. According to the World Bank Electric power consumption (kWh per capita) in Nigeria stands at 144.52 (compared to over 5,500 in Europe) while other sources put it even lower at 123kWh.

The demand for electricity is set to grow strongly over the next few years. Some European sources say that Nigeria's electricity demand will grow by a factor of 16.8 by 2030, while others mention that demand for 2025 and 2030 will be 77,450 MW and 119,200 MW respectively. The Central Bank of Nigeria has stated that energy demand in Nigeria is projected to grow by about 52% over the period 2010 through 2035 – a more modest but still staggering forecast.

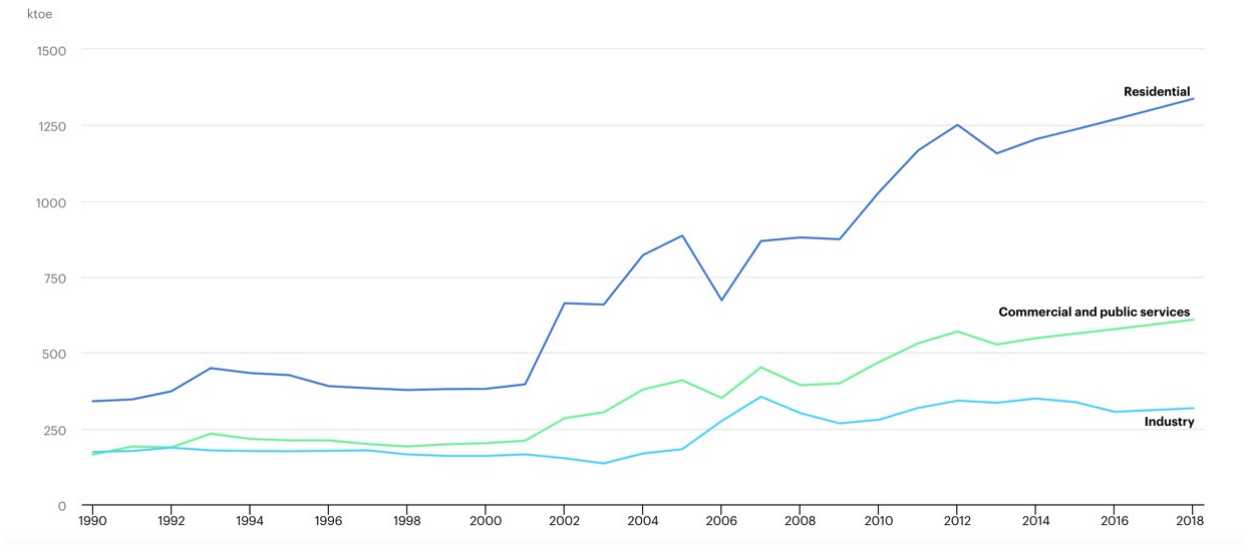
Growth in demand is driven by 2 main factors:

- **Population growth**: Nigeria's population of about 200 million people increases about 3% annually. In fact, by 2050, Nigeria is set to overtake the USA as the 3rd most populous country on the planet.
- **Economic growth** and infrastructural development: even if growth is tepid, it invariably leads to increased electricity needs. Moreover, Nigeria actively tries to increase local production to become less dependent on imported goods and this drive in particular will mean more electricity consumers will be established.

At the same time, demand is hampered by the following factors, according to NERC:

- The height of the tariffs for energy usage in combination with widespread poverty
- Inefficient billing and collection system
- Inadequate generation and transmission
- Distribution of retail facilities due to numerous bottlenecks including a poor road network
- Access to the national grid which doesn't reach most rural areas and some parts of cities due to underinvestment over decades as well as the sheer size of the country
- Inadequate infrastructure

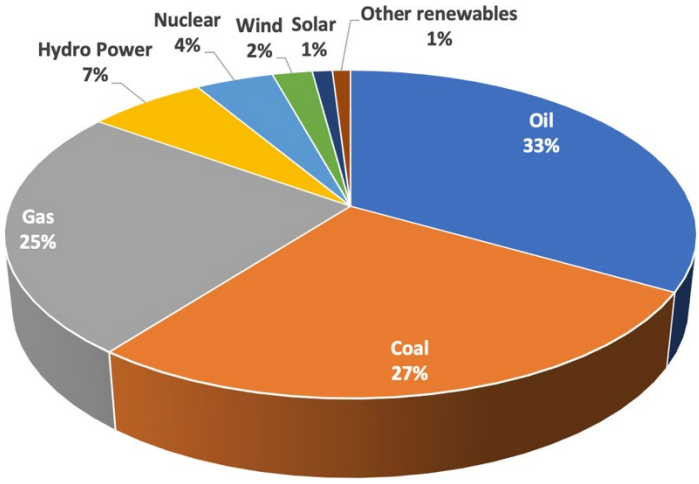
Demand is driven by residential use and much less by commercial and industrial use, as EIA data on final electricity consumption by sector shows:



Nigeria's largest industrial users are cement manufacturers and (petro)chemical companies. Africa's largest refinery will come on steam in 2022 and will increase demand as well. Moreover, Nigeria is home to many large FMCG manufacturers including the continent's largest breweries. This includes Dutch giant Heineken, which has converted one of its breweries to a solar powered one.

Electricity Generation

Currently just about 60% of the population has access to electricity, up from 40% in 2000. The target is 80% in 2030 but even if they have access, the question will be if how constant electricity will be given that Nigeria doesn't generate nearly enough even at the moment.



As the pie chart to the right shows, Nigeria's energy mix for a significant part exists of oil and coal, used to generate energy that would otherwise come from gas, hydro or renewable sources. In rural areas, most people rely on charcoal for cooking and the sun is often the only source of light. Across the country people are heavily reliant on oil for their generators - spending a staggering $22bn yearly (about 5% of GDP) to fuel them, according to the Energy Commission of Nigeria. Houses but also shops and office buildings have big diesel-powered generators while cheap petrol generators help the average Nigerian live and do business with the added value that they can be switched off when there is no need and/or when money is tight.

Nigeria's National Grid is an interconnected network for delivering electricity from producers to consumers and has three major components:

- **Generation** (12,522 MW potential/ Average output 4000MW)
- **Transmission** (8,100 MW capacity/ All-time transmission peak 5,459MW)
- **Distribution** (Only about 25% or 3,100MW of installed capacity reached the end user)

Transmission was the only part of the value chain that wasn't privatized. The generation sub-sector presently includes 23 grid-connected generating plants existing of two main types of power plants: hydro-electric and thermal fossil fuel power plants.

Supply is lower than possible along all parts of the value chain. Factors limiting power generation:

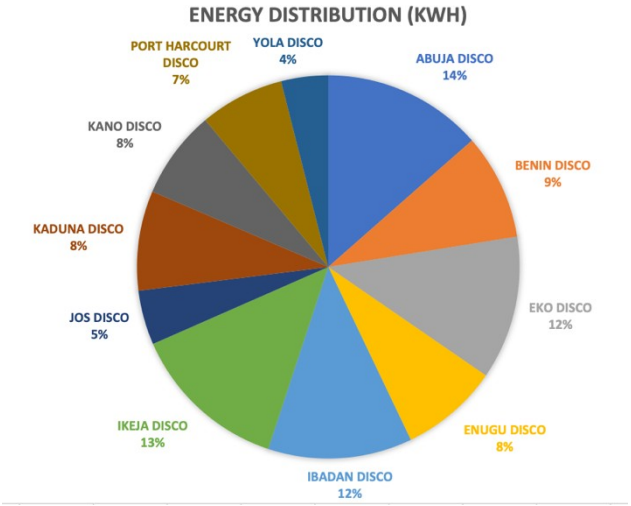
- lack of input: unavailability of gas is a key constraint to electricity generation while hydro plants are seasonal to some extent
- challenges in billing end users and recuperating monies
- the requirement to feed electricity back to the grid putting local investment at a disadvantage
- limited infrastructure generally

Electricity supply drivers are policies, regulations and investment. According to the Nigeria Renewable Energy and Efficiency Policy, an investment of USD 3.5bn is required to meet the 30GW target by 2030. A game changer in terms of electricity generation may be the deal between Siemens and the Federal

Government of Nigeria. In July 2020, Siemens Nigeria officially received approval from the Federal Government of Nigeria for the pre-engineering phase of the expansion of Nigeria's electricity capacity to 25,000MW. However, due to the covid pandemic, the project has been off to a slow start.

To increase electricity generation, Nigeria also plans to execute a 2,000MW hydropower plant in the Mambilla plateau (Taraba State) with the help of a $5bn loan from China, but this project has been plagued by many delays. Electricity generation has been more impacted through smaller plants (e.g. several 30MW hydropower plants planned for the nearby future) as well as Independent Power Plants (IPPs) and captive energy projects. Such plants do not need to sell their output to the national grid but can produce for (and invoice) particular off takers directly. Most IPPs are gas fed, while only a few feed on coal or hydro.

Electricity from the grid is distributed by privatized distribution companies who each have a geographically constrained territory. They can bill consumers directly though in reality they have many financial challenges, principal of which is that not all houses have an electricity meter.



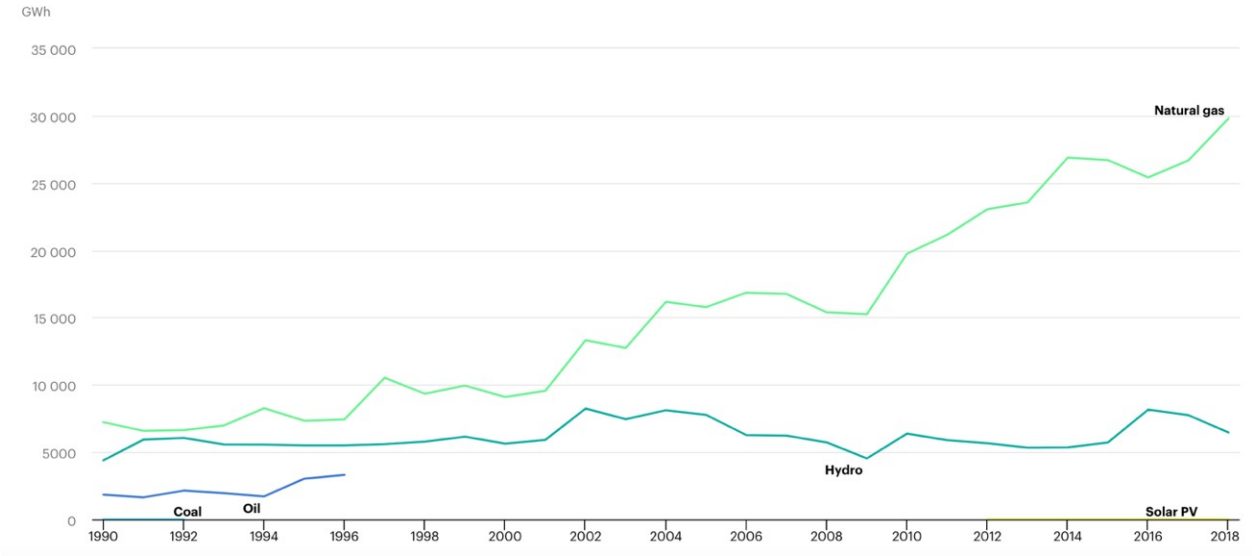
The bulk is delivered through Lagos with Ikeja disco and Eko disco distributing a combined 25% of all electricity. Together with nearby Ibadan disco, the south west of the country distributes 37% of total electricity generated, which reflects that that part of the country is home to most economic production. Indeed, Lagos State has an economy larger than those of Ghana and Kenya combined.

An exciting new development is that Lagos State is considering the establishment of their own electricity market independent of the federal grid, to ensure stable supply. Lagos, the undisputed commercial capital of Nigeria, currently receives 1,000 MW from the national grid, for just 12 hours a day. It needs at least 9 times as much and around the clock to satisfy the needs of its population, companies, and industries.

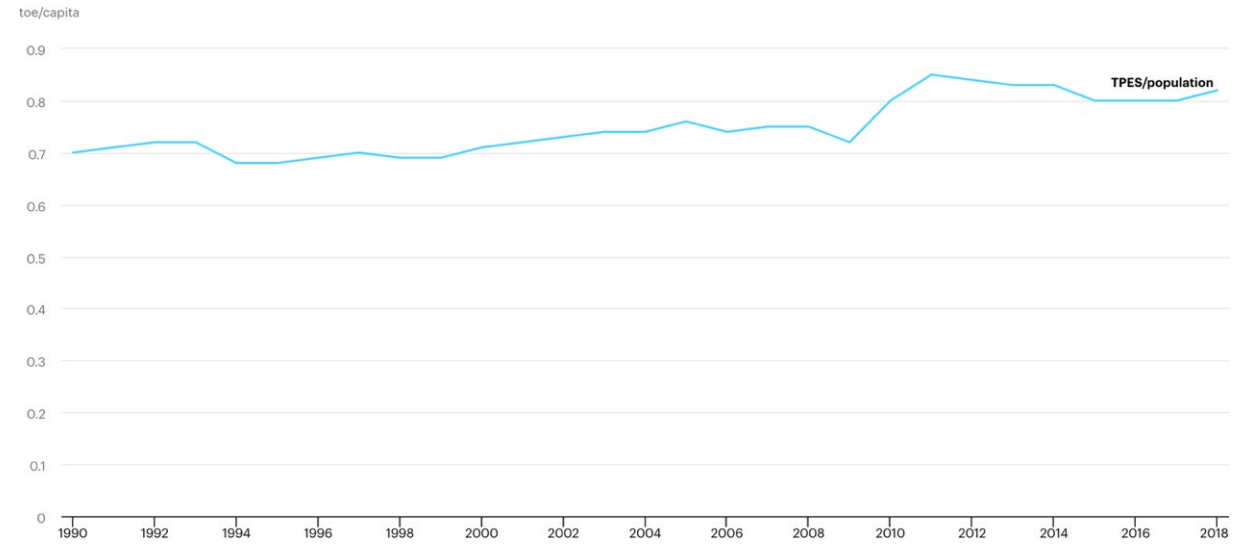
Bloomberg reported in April 2021 that the Lagos government is proposing that generation, transmission, and distribution functions “be owned and operated substantially by the private sector” and supervised by a regulator. It intends to publish an electricity policy before July 2021 and submit a draft law for the sector’s development to the state’s legislative assembly in the third quarter of 2021. If the plan can go ahead, we can expect far more investment in the Lagos energy market and other states may follow suit.

Without such initiatives, it will remain challenging to generate enough electricity and transmit and distribute it to consumers.

Irrespective of all challenges, data from the International Energy Agency shows how generation has increased over the years:



But total energy supply (TES) per capita has remained fairly stable according to the same source:



As a comparison: TES per capita is more than 5 times higher in the Netherlands and 2.8 times higher in South Africa -Nigeria's main Sub-Saharan competitor in terms of economic weight. Clearly, Nigeria's demand far outstrips supply.

Market structure & pricing

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

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

Electricity seller types are classified into the following based on the types license issued to them by the Nigerian Electricity Regulatory Commission:

- Generation License holders (Private)
    - On-Grid Electricity Generation License holders
    - Embedded Generation License holders
    - Off -grid Electricity Generation License holders
- Transmission License holders (Public)
- Distribution License holders (Private)
- Trading License holders (Public)
- Captive Permit holders (Private)

The market is consolidated and strongly regulated with the following government agencies involved:

- Nigerian Electricity Regulatory Commission (NERC) https://nerc.gov.ng/
- Nigeria Bulk Electricity Trading Company (NBET) https://nbet.com.ng/
- National Environmental Standards and Regulations Enforcement Agency (NESREA) https://www.nesrea.gov.ng/
- Federal Ministry of Power, Works and Housing https://worksandhousing.gov.ng/
- Nigerian Electricity Management Services Authority (NEMSA) https://www.nemsa.gov.ng/
- Energy Commission of Nigeria https://www.nigatom.org.ng/
- Federal Ministry of Water Resources http://www.waterresources.gov.ng/

In accordance with the EPSR Act 2005, NERC established a methodology for determining electricity tariff in the Nigerian Electricity Supply Industry (NESI) and subsequently issued a Tariff Order called the Multi-Year Tariff Order (MYTO) that sets out tariffs for the generation, transmission and distribution of electricity in Nigeria. The MYTO methodology uses a building blocks approach in setting Transmission and Distribution tariffs, which provide the benefits of both price cap and incentive-based regulation. It is simply a way of bringing together all of the industry's costs in a consistent accounting framework. The three building blocks are:

- The allowed return on capital –fair (market based) rate of return on capital invested,

- The allowed return of capital – recoup capital over the useful lives of the assets (depreciation),
- Efficient operating costs and overheads.

The price of electricity (end user tariff in naira per kWh) differs across the country:

Disco	2015	2016	2017	2018	2019	2020	2021
ABUJA DISCO	25.85	32.30	32.66	32.66	32.66	42.46	44.29
BENIN DISCO	25.90	26.75	32.50	32.50	32.50	42.25	43.79
EKO DISCO	25.2	28.3	28.3	28.3	28.3	36.8	39.2
ENUGU DISCO	24.6	31.1	35.3	35.3	35.3	45.9	41.6
IBADAN DISCO	26.9	28.3	30.6	30.6	30.6	39.7	44.2
IKEJA DISCO	22.8	27.3	27.3	27.3	27.3	35.5	37.1
JOS DISCO	28.2	30.9	33.8	33.8	33.8	43.9	54.9
KADUNA DISCO	22.8	30.3	30.3	30.3	30.3	39.3	41.7
KANO DISCO	24.3	27.1	30.1	30.1	30.1	44.7	41.8
PORT HARCOURT DISCO	24.6	29.0	33.8	33.8	33.8	44.0	47.8
YOLA DISCO	26.9	26.8	26.8	26.8	26.8	34.9	46.5

Prices were increased in 2020 which led to an outcry as the average Nigerian suffers economic hardship. However, the cost to power a generator exceeds the cost of electricity especially now that the government has (partially) abandoned the fuel subsidy which creates an artificially low price for petrol.

Current developments

Every new Nigerian government prioritizes an improvement of the electricity situation, but the results have not been impressive. This can be due to spending in the wrong places, lack of overall investment, challenges along the value chain and also vested interests and corruption. However, many power related projects are in the pipeline or are under construction. The sector is impacted mainly by the following developments:

Presidential Power Initiative (PPI)

In July 2020, Siemens Nigeria officially received approval from the Federal Government of Nigeria for the pre-engineering phase of expanding Nigeria's electricity capacity to 25,000MW. This project, which is

expected to be completed in 2025, will take place in three phases. It is however likely to take longer than 4 years to ramp up electricity supply that significantly, especially since the project was already impacted by the Covid pandemic.

Better usages of Nigeria's gas reserves

Some say that Nigeria's oil is a drop in an ocean of gas, meaning that its gas reserves are enormous. The country has realized the potential and is working on improving its gas infrastructure and LPG policies to enable gas-powered manufacturing. In December 2017, the Nigerian National Petroleum Corp. (NNPC) announced the plan to build three natural gas-fired power plants in the country. Situated at Abuja, Kaduna, and Kano, the plants are expected to have a total capacity of 4,600 MW.

Increase in the number of coal plants

The Federal Government plans to add six coal power generating plants to the 23 already existing plants and nine gas plants, making it a total of 15 power plants by 2037. This would see the country's struggling power generation leap by 11, 163 MW.

More independent and captive energy projects

Small thermal generating plants are being constructed, owned and operated by IPPs specifically for businesses or manufacturing companies. This way the IPP will have a committed client to pay the electricity bill. Examples include the portfolio of gas-fired power generation plants built and operated by Cummins Power Generation and Viathan's 3.88MW Ilupeju IPP. Moreover, Nigeria is now supporting independent power producers through a partial risk guarantee agreement.

Better rural electrification

In 2020, REA completed 7 mini-grids and deployed over 6,000 Standalone Solar Home Systems to off-grid communities across the nation under the Rural Electrification Fund (REF). 3 mini-grids and 2 grid extension projects were also delivered using the Federal Government's Capital Appropriation. 3 others were delivered through the Performance-Based Grant of the World-Bank and AfDB-funded Nigeria Electrification Project (NEP) and one project was delivered under the Energizing Education Programme (EEP).

Increased use of renewable energy

Across the line, more Nigerians are adopting solar energy in their houses and for their businesses. Larger projects are also in the pipeline. Mainstream Energy, operator of two of Nigeria's large hydro power plants – Kainji and Jebba – has announced that it will build a 500 megawatts (MW) solar facility. Meanwhile, the FGN announced it will construct a 1GW Solar IPP Project in Jigawa state which is expected to be developed by the Rural Electrification Agency (REA) and backed by AfDB via the Sustainable Energy Fund for Africa (SEFA). Overall, the Rural Electrification Agency has shifted its strategy from grid expansion to deployment of solar mini-grids, with a plan to have 10,000 mini-grids operational across the country by 2023.

The next chapter will discuss (developments in) the solar market in more detail.

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SOLAR IN NIGERIA

30% of total energy expected from renewable sources by **2030**

Currently ranked **5th** in sales volume globally

Sustainable sunshine of **6hrs/day**

China is Nigeria's number one trade import partner for solar equipment.

The Netherlands is in **10th** position with a value of about **$370,000**

Import dependency: local assembly of solar panels can cover just **10% of demand.**

$150 million worth of solar equipment and related devices imported in 2019

Average cost of 4kW solar PV System is **N1.8 million** ($9,090)

Cost of going solar has reduced by **40%** in recent years

$9.2bn/yr market opportunity for Mini-Grids and Solar Home Systems

The federal government targets **25m Nigerians** with solar home system

$2bn/yr is the potential value of the solar home system market alone

Import value of solar equipment grew by about **51%** between **2015 and 2019**

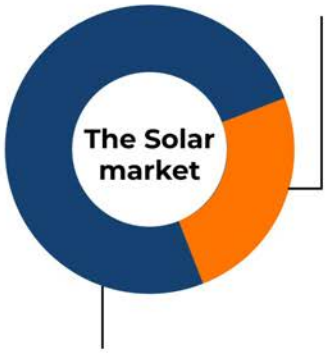
28 MW of cumulative installed capacity for solar energy

500 MW installed capacity planned for 2025

10,000 mini-grids planned for operations in 2023

Assumed potential for solar in Nigeria estimated to be **427,000 MW**

Solar Lanterns and Multi-light Systems (<11 Wp) have **30%** share of the Solar market



Solar Home Systems (>11Wp) have **70%** share of the Solar market

2. Solar in Nigeria

Nigeria has a fairly distributed solar radiation average of 19.8 MJm2/day and average sunshine hours of 6h/day. However, this is higher in the top half of the country which has a savanna climate (and even a semi-arid/ desert topography in the farthest north), while the southern half of the country has a mainly tropical climate. The abundance of sunshine in combination with Nigeria's chronic lack of electricity explains why many are now targeting the country for solar energy.

A growing market

Nigeria is said to be one of the fastest growing markets for solar. The Heinrich Boll Stiftung calculated that the country's off-grid market for mini-grids and solar home systems is estimated to yield $10 billion annually in revenue and savings of $6 billion for Nigerian homes and businesses. According to the Global off Grid Market Report, Nigeria is the 5th largest market in terms of volume of solar products sold. Sales of off-grid solar systems (50 – 100W output) increased by more than double in value from $23 million in 2018 to $63 million in 2019. Adding related products, the total import value is closer to $150m.

The International Renewable Energy Agency (IRENA) disclosed that Nigeria only posted approximately 28 MW of cumulative installed capacity in 2019. However, this is up from the 15MW in 2012 and 19MW in 2018. This buttresses the belief that solar will now break through in Nigeria. The Renewable Energy Master plan targets 500 MW installed capacity for solar PV in 2025, and the Nigerian government aims to generate 30% of total energy from renewable sources by 2030. The assumed potential for concentrated solar power and photovoltaic generation is around 427,000 MW.

Solar is increasingly used in Nigeria for a wide range of needs: from lighting and powering of (small) appliances, to water pumping, irrigation, refrigeration, telecommunications and general electrification. The increasing adoption is generally driven by a reduction in the cost of solar: The prices of solar panels went from $5 per watt in 2000 to $0.37 in 2017, and this represents a 93% drop in prices. The cost of going solar has significantly reduced by more than 40% due to falling manufacturing costs and market competition. Still, the average cost of installing a 4-kW solar PV system for an average three-bedroom household in Nigeria is N1.8 million ($9,090) including the costs for a battery bank for energy storage. This is beyond reach for most Nigerians, hence the popularity of PAYG models.

The government also actively brings solar to people. REA has a target of bringing home solar systems to 1.5 million households and the Presidency has offered 25 million Nigerians to own 5 million solar systems at N4,000 monthly through Solar Home Systems, under the Economic Sustainability Plan (ESP). Private company Lumos has fitted more than 100,000 of its systems in homes around Nigeria and plans to increase its reach by ten times thanks to government funding.

Market segments

Until now, solar has been mainly applied on a small scale. As with overall electricity demand, the largest users are the residential users. When looking at solar energy by capacity, the share is as follows:

- Pico solar – approx. 30% of market
- Small household solar systems – approx. 70% of the market

These home systems are used to power:

- Solar appliances: 55%
- TV sets: 32%
- Fans: 13%

Mini grids and grid scale solar have a negligible share but are set to increase strongly over the next few years. Entire communities are now served by mini grids set up by REA or private companies. Moreover, growth will be driven by the adoption of solar by companies and industries. An example is Union Bank which switched to clean power sources in 2016 and currently has 130 branches with solar solutions.

When looking at segmentation by type of solar panels in the Nigerian market, the most popular are:

- Monocrystalline solar panels
- Polycrystalline solar panels
- Thin film (amorphous) solar panels

The quality varies widely with most of them sourced from India and China. Often their capacity is different from what the product specification sheet says. Moreover, faulty installation at the wrong angle can lower the panel's energy output.

Solar energy value / supply chain

Import and manufacturing

Almost all solar panels and related products are imported with very little local added value. Nigeria currently does not have capacity to manufacture solar panels but does limited assembly in volumes that cannot meet up to 10% of market demand by only two operators: Lagos based Auxano Solar and Blue Carmel Energy Ltd based in Kaduna.

This is a situation that may be set to change. In 2017, the government granted solar panel manufacturing pioneer status to encourage the sector in 2017. Moreover, it has commissioned the National Agency for Science and Engineering Infrastructure (NASENI) to produce solar panels. Furthermore, in early 2020 impact investor All On announced its decision to invest $1.5 million in Auxano Solar. However, for the nearby future, Nigeria will remain import dependent especially considering the anticipated growth in demand for solar energy.

Marketing and distribution

Marketing can be challenging due to the fragmentation of the market. Moreover, awareness of solar can be low -even if it has increased in recent years. Solar companies can target the large corporations, or seek to form 'clusters' of potential clients, e.g. a housing estate or a market. Individual households are now also targeted with adverts through (social) media to drive demand. Within specific sectors, solar can also be marketed through associations -e.g. in agricultural applications. For example, the Poultry Association of Nigeria informed us that it would be happy to connect Dutch solar companies to its members, especially in the north of the country where sunshine is even more abundant than in the south, and where access to electricity is often less.

Solar power distribution occurs predominantly through business-to-business linkages connecting manufacturers with distributors, and distributors with retailers. Solar energy companies operating in the Nigerian market can sell solar products through partners who have marketing and sales agents or through employed marketing staff. Most international manufacturers work in this model, appointing a Nigerian solar (installation) company as their local representative.

Another option is to partner with a non-energy company to market and distribute solar products. The best-known example in Nigeria is Lumos, which has MTN, the country's largest telecom operator, as its partner. It is possible to buy a Lumos package through most MTN branches against a basic upfront fee while the electricity payments are processed through mobile phone credit.

Distribution is generally challenging seeing that the country is so huge and the (road) linkages often poorly maintained. Moreover, the sub-distributor network is not fully developed, and solar companies often distribute based on project requests and out of their main office and send their engineers along to wherever there is demand for a particular installation.

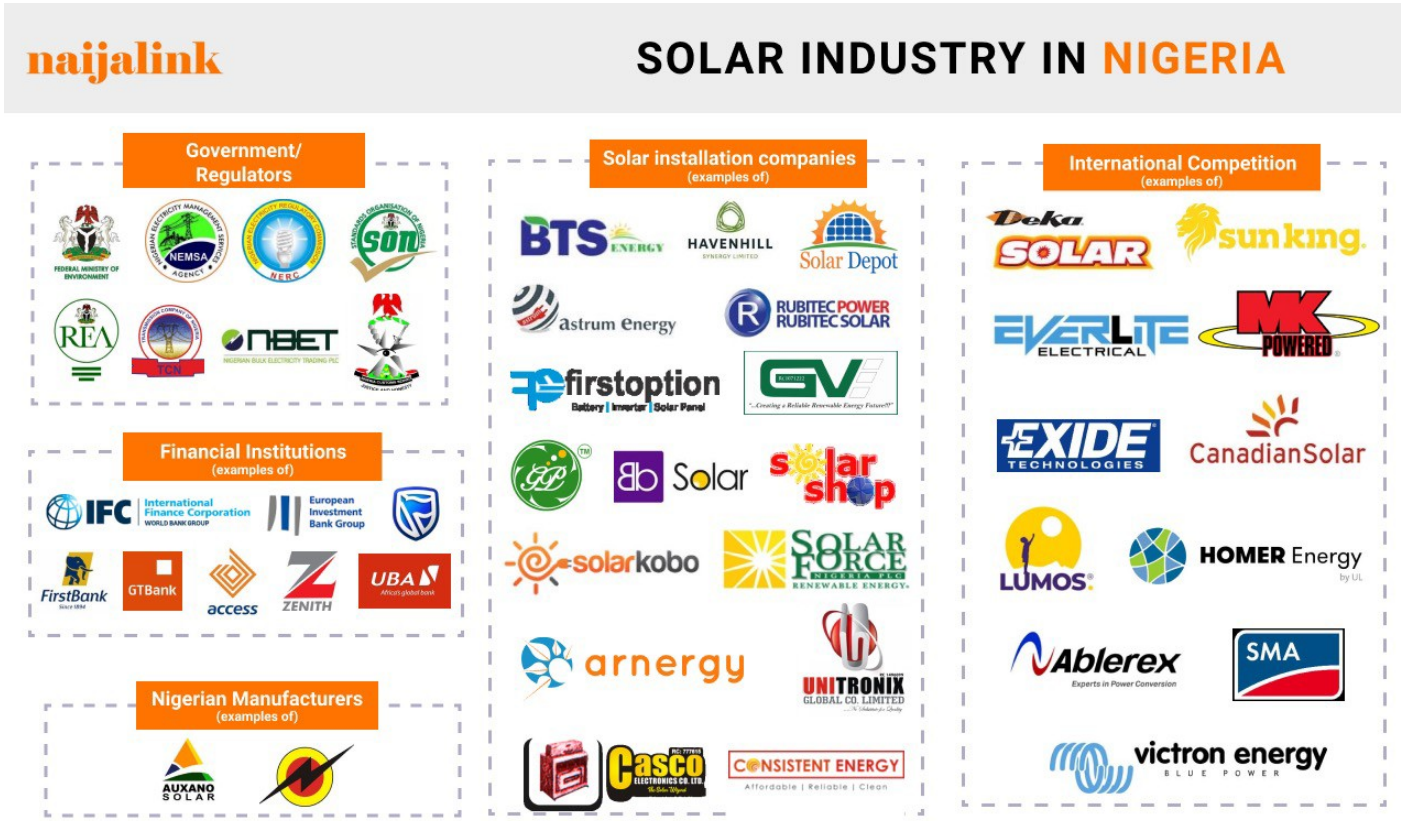
Installation and service

Solar energy installation is usually carried out by companies/professionals that specialize in the set-up of such equipment. Most of the time, these companies are also the importer/ distributor of that equipment. Installation services are either carried out by a technical partner or a solar engineering, procurement and construction (EPC) contractor.

Many stakeholders we interviewed stated that there is a huge lack of engineering skills and proper technological knowledge. One corporate solar user even mentioned that their own in-house technical team was better trained in solar than the supplier of solar equipment. We also heard reports of faulty installations and sub-standard equipment. In fact, one of the opportunities for Dutch companies relates to improving the standards in the industry. Especially clients with spending power will require quality installations.

Most solar energy companies in Nigeria offer after sales services which include free maintenance checks on solar products while the warranty is still running. The warranty tends to be 1 year on cheap Asian imports but corporate clients like banks won't accept a warranty shorter than 5 years.

Key Players



The main government players are mentioned in the previous chapter. However, others relevant for solar energy (including trading with Nigeria in such products) include:

- Nigeria Customs Service (NCS) https://customs.gov.ng/
- Standards Organization of Nigeria (SON) https://www.iso.org/
- Nigerian Rural Electrification Agency (REA)https://rea.gov.ng/

The first two are mainly important for exporters as they set the import tariffs as well as the minimum quality of technology. On the other hand, REA is seen as embracing solar technology and a catalyst for scaling of solar energy solutions in rural areas.

In terms of main importers and distributors, the Nigerian landscape has grown significantly -again reflecting growing demand and the size of the opportunity. Companies have grown in number but also in maturity/ capability. It's a fragmented market though. We have listed the main players in the **appendix** section of the report.

The same holds for competition. The solar energy market is composed predominantly of foreign players and more have entered the market in recent years as Nigeria is increasingly seen as the 'next big frontier' for solar companies. A list of notable players can be found in the **appendix** section.

Strategies of main players tend to focus on the following components:

- Entering into partnerships to scale up
- Tapping into international and local funding
- Targeting specific clients like markets & businesses
- Developing a PAYG system to become more affordable

Some examples of companies and their operations are given below:

Company	Strategy
Mini-grid	
Green Village Electricity (GVE) projects Ltd	GVE employs cost effective strategies for deploying renewable energy solutions to clients. Its focus is on making solar energy affordable. GVE sells power to communities through a network of vendors who purchase electricity in bulk and resell to consumers.
Havenhill Synergy Limited	HSL focuses on providing lease – to – own solar financing services. It builds mini-grids in off -grid communities and vends power to residents who pay a fee between N1000 and N2000 depending on usage.
Rubitec Solar Limited	Rubitec Solar Limited, a first mover in the solar energy sector, is working towards being an Integrated Renewable Energy company and Independent Power Producer. It operates a mini-grid in Ogun state, which is composed of 300 solar panels. It provides power to homes and business that have pay for connection
Commercial and Industrial	
Starsight Power Utility Ltd	Starsight focuses on reducing carbon emission for clients' businesses. It offers roof top, ground mount and cooling solutions for clients.

Rensource Distributed Energy Limited	Rensource Energy focuses on the provision of off-grid energy utilizing a subscription model under the Energizing Economies Initiative of REA.
ColdHubs	ColdHubs provides solar-powered cold storage for farmers at a rental price per box stored. The goal of ColdHubs is to reduce food waste, while increasing local farmer income.
Solar Energy Systems	
Arnergy Solar Limited	Anergy focuses on deploying products, services and systems that power business operation. It provides power to mini-grids, commercial and industrial businesses. It has extended its services to include hospitals as part of its expansion strategy
Solar Home Systems	
Lumos Nigeria	Lumos Nigeria has the goal of providing people with access to clean and reliable electricity in Nigeria. Lumos offers a portable solar unit that is supplied though MTN stores across Nigeria.
Smarter Grid International	Smarter Grid develops and distributes solar systems, appliances and services for homes in Nigeria. SGI finances and provides various flexible payment options such as Pay - As- You-Go and Lease to Own as well as payment platforms such as Paga and Angaza.
Local Manufacturing	
Auxano Solar Limited	Auxano intends to become an indigenous solar energy service provider in Nigeria. It focuses on manufacturing and operates a two 120 square meters assembly plant for building solar panels

Barriers to entry

That more players are entering or starting up in Nigeria does not necessarily mean it has become easier. An example is how in early 2018, the Nigerian Custom Service (NCS) re-classified solar panels from its previous classification under Heading 8541 (8541.40000) to Heading 8501. Initially duty exempt, solar panels are now classified as generators and attract 5% import duty and 5% VAT. This was widely seen as a step back and damaging growth potential of solar in Nigeria.

An analysis of the returns from investments in solar mini grids shows that operators can make a return of up to 12.5%. Commercial banks offer loan facilities at 22% interest and the imposition of this new tariff could wipe off 50% of their revenue due to high prices and consequent slow demand growth. There is a strong lobby to return solar equipment to the duty-free basket, but this is a good example of how government policy can (negatively) impact the sector.

Several barriers to entry and expansion are present, as mentioned in the Energy Commission of Nigeria and United Nations Development Programme (ECN-UNDP) Renewable Energy Master Plan:

Barriers to entry

- Government policy (inconsistency)
- High cost of importation (combined with fluctuating exchange rates)
- High cost of operation and maintenance
- Ineffective quality control of products

Barriers to distribution/ installation

- Grid unreliability
- Variability and intermittency of radiation
- Competition with land uses
- Lack of awareness and information
- Insecurity of solar plant infrastructure

Technical Barriers

- Lack of skilled personnel
- Lack of code of standard
- Lack of maintenance and operation
- Lack of training facilities and entrepreneur's development mechanism

Generally, in Nigeria it pays off to collaborate with local players who know the landscape and know how to navigate their way around challenges.

Impact of the Covid-19 pandemic on the sector

The global Covid-19 pandemic hasn't impacted Nigeria as much as some other countries in terms of disease burden. There have been relatively few deaths and hospitals are not overwhelmed. While people are aware that another wave might come, the covid pandemic seems to have been moved to the backburner in the minds of most Nigerians. After initially implementing a very strict lockdown for several weeks at the beginning of 2020, Nigeria has gone back to 'normal'.

However, the economic impact of the pandemic has been far more profound. Crucially, the global lockdowns affected the demand for, and thus price of, oil -Nigeria's main FX earner and responsible for over 70% of government income. It plunged Nigeria into its second recession in just 5 years while the country hadn't fully recovered from the previous recession. As a result, unemployment and inflation are up, while the value of the local currency has dropped significantly.

There are two ways in which this impacts the solar sector:

- **The price of fuel**: Nigeria runs on generators which are powered by petrol and diesel. For years, the price of fuel has been subsidized by the government and many Nigerians see a low price of fuel as their right because Nigeria is an oil producing country. However, its refineries are not working and essentially all fuel is imported. As the pandemic reduced government income significantly while the drop in the naira has made fuel imports more expensive, the subsidy has become unsustainable. For the first time in years, the government let the price of petrol go up significantly though a partial subsidy remains in place -the labour unions have insisted that the refineries need to be fixed first. In any case, the price has gone up and will go up further, while the cost of solar has decreased. Solar is thus becoming more attractive.

- **Purchasing power**: unemployment and underemployment combined surged to over 50%. Nigeria is already the country with the highest number of people living under the poverty line. Many of those still in employment received a pay cut. As Nigeria remains dependent on imports of both industrial raw materials as well as most consumer products, the cost of living has gone up significantly. Moreover, inflation crept up to over 18% with food inflation at 24%. These stats indicate that most people have very little spending power left after meeting their basic needs. Solar equipment is still expensive to purchase hence the average Nigerian will only commit to PAYG plans. Low disposable income also drives the need for industries to cut costs as they can't increase consumer prices. Solar can be a cost-cutting investment and has therefore become increasingly interesting for corporate Nigeria.

The effect of Covid-19 on Nigeria's solar industry is therefore a bit mixed. However, ultimately the impact is relatively limited as the energy demand-supply gap is so significant in Nigeria that solar projects will continue to be implemented. Moreover, with more people working remotely since the pandemic started, having stable power supply at home has become more of a priority as well.

The future of solar energy in Nigeria

Nigeria's economy is projected to grow by 1.5% in 2021 and around 3% in subsequent years. This is not enough to increase per capita GDP as the population grows at about 2.9% annually. In fact, in the past 5 years, economic growth has consistently lagged population growth, meaning that per capita Nigerians have become poorer.

However, the economic situation is not that much of a determinant for the prospects of solar in Nigeria. After all, the strong growth in the solar industry recorded over the past 2 years took place despite reducing income, a recession and volatile exchange rates. There is a massive gap between the supply and demand for electricity and any solution that brings electricity to people will be in demand.

Supply of solar will be driven by a reduction of the barriers to entry as described earlier. Partnerships with government and finance institutions will also put suppliers in a stronger position to scale.

Demand, on the other hand, will be driven mainly by:

- Population growth
- Inadequate and erratic power supply (growing energy poverty)
- High cost of grid expansion opening the door to alternatives
- The reducing cost of solar energy equipment like panels and inverters
- Higher capacity of solar equipment, making it more attractive to e.g. companies
- Increase of finance schemes and government support to make solar more affordable
- Greater awareness of solar as an alternative and its (financial) benefits over the longer term

The future of the burgeoning solar energy sector is bright, and the trade and investment opportunity is large. Developing off-grid alternatives to complement the grid creates a $9.2bn/yr (N3.2tn/yr.) market opportunity for mini-grids and solar home systems that will save $4.4bn/yr. (N1.5tn/yr.) for Nigerian homes and businesses. About $2b/yr is the potential value of the solar home system market alone. Moreover, there is a large potential for scaling — installing 10,000 Mini- Grids of 100 kW each, can occur by 2023 and will still only meet 30% of anticipated demand.

Combining the Solar Home System and Solar Mini-Grid with a Pay As You Go model has created a bankable opportunity to increase electricity access across Nigeria. As increased finance meets more efficient solar systems, it is anticipated that Nigeria will move from the home systems dominated market to larger mini-grid and captive energy solar plants for specific business uses, as well as grid-scale solar projects.

As the cost of running a generator will increase when the expected increase in the fuel price, solar will become more attractive. However, Nigeria's solar companies need to scale up and by doing so become more price competitive for more people and companies to adopt solar as an energy source.

Nigerian Breweries: using solar to power its breweries

"Nigerian Breweries aims to reach carbon neutrality in its production by 2030 through increased energy efficiency efforts and transition to renewable energy and green electricity in all its brewing sites by 2030. This is part of the company's ***Brew a Better World*** sustainability strategy which has just been refreshed with an accelerated action plan to tackle climate change, ensure watershed protection, and drive prosperity for the people and planet.

Working with suppliers, Nigerian Breweries aims to cut carbon emissions by 30% across its entire value chains by 2030. This mission is already in motion, piloted by its Ibadan Breweries, where the organization has already installed a 663.6kWp solar plant through a fully financed Solar Purchase Power Agreement with CrossBoundary Energy. The solar plant will supply approximately 800 MWh to the brewery annually, delivering a significant discount to their current cost of power, while reducing the site's CO2 emissions by over 10,000 tonnes over the lifespan of the plant. This is a first of its kind for any Nigerian Brewing company. It further demonstrates the company's commitment to the United Nations Sustainable Development Goal (7) which has as one of its targets, to increase substantially the share of renewable energy in the global energy mix. Nigerian Breweries will also expand its renewable energy transition with similar installations in its 8 other breweries across Nigeria.

Beyond solar energy, Nigerian Breweries is also exploring powering its breweries situated in suitable climates with alternative energy from wind and hydro-electric energy."

Text culled from the "Nigerian Breweries on an ambitious path to Carbon Neutrality in production by 2030" media release of Thursday 29 April 2021 and inserted in this report with the permission of Nigerian Breweries. Photo credit for pictures on this page: Nigerian Breweries. For inquiries: Sade Morgan, Corporate Affairs Director, Nigerian Breweries, sade.morgan@heineken.com

3. Financing solar in Nigeria

Finance is one of the key barriers in the solar sector. The high up-front cost of equipment can make solar unattractive to potential customers, as described above. However, another challenge is the availability of finance for the solar companies and their projects. In fact, every solar company interviewed consistently mentioned this. At the same time, the financing options are quickly improving. As impact investor All On stated: "solar is now profitable". Others referred to solar being Africa's "new gold" with Nigeria in a prime position to reap the benefits.

Nigerian government funding

The Nigerian government tends to be cash strapped. Its income is mainly derived from the export of oil - the price of which can be volatile. Moreover, most fiscal income is used for debt servicing and recurrent expenditure. This leaves very little for capital expenditure which is one of the reasons why Nigeria's infrastructure development gap is so large.

However, in terms of solar electrification, the government has taken a rather proactive position. Several stakeholders lauded the government's initiatives and, especially, funding support. The Federal Government of Nigeria wants to improve the electricity supply to 25 million people through the installation of five million solar home systems. The World Bank will finance 20% of the nearly $367 million (140 billion Nigerian naira) project via a grant. It has already launched the roll out of 5 million new solar connections through the provision of solar home systems (SHS) under the economic sustainability plan, as mentioned earlier.

Nigeria's government banks are also playing a role:

- The Bank of Industry (BOI), a government owned bank, has reviewed its Solar Energy Fund into a N6 billion (approx. $15m). The Bank of Industry recently disbursed a total of N75.8 million (approx. $190 thousand) to GVE Projects Ltd, and Arnergy Solar Ltd to provide solar home systems to off-grid communities in six states.
- The Central Bank of Nigeria (CBN) has introduced the Solar Connection Intervention Facility to complement the Federal government's effort of providing affordable electricity to rural dwellers through the provision of long-term low interest credit facilities to the Nigeria Electrification Project (NEP) pre-qualified home solar value chain players that include manufacturers and assemblers of solar components and off-grid energy retailers in the country. The fund is worth N500 billion or approx. $1.2bn.

As described earlier, the Rural Electrification Agency employs solar energy as a key means to achieve its targets. These are some examples of solar projects commissioned by REA according to their website:

S/N	Project name/ Details
1	85 kWp Solar Hybrid Project in Dakiti Community Akko, LGA Gombe State.
2	40kWp Mini Grid Project in Goton Sarki Community, Paikoro LGA, Niger State.
3	234kWp Solar Hybrid Mini-Grid Shimankar Community, Shendam LGA, Plateau State
4	Commissioning of EEP Solar Hybrid Project Federal University of Agriculture, Makurdi
5	2 Solar Power Grids at Kogi Hospitals
6	65kWp Solar Hybrid Mini-Grid as well as a 5.4kWp in Kogi state
7	Budo-Are Community Solar Hybrid Mini Grid Project Commissioning
8	Olooji Community Solar Hybrid Mini Grid Project Commissioning
9	30KWP Solar Mini Grid in Bambami Village Batagarawa LGA Katsina State
10	Mini Grid Extension of 33/0.415kV Transformer in Unguwar Dutse town Malumfashi LGA Katsina State.
11	100KW Solar Hybrid Mini Grid in Eka Awoke Ikwo LGA Ebonyi State
12	7.5KWP Solar Mini Grid Project in Ozubulu ,Ekwuesigo LGA Anambra State
13	Anambra Community Powers Hospital Equipment with REA 7.3kWP
14	Akipelai and Oloibiri Solar Hybrid Mini Grid Plants in Bayelsa State commissioning
15	Solar Hybrid Mini Grid to COVID-19 Health Laboratory, Yaba, Lagos
16	Handover of Solar Mini Grid to UATH COVID -19 Isolation Centre Gwagwalada, Abuja
17	Mini-Grid in Rokota Community, Niger State
18	Akwa Ibom Community Gets 100KW Solar Hybrid Mini -Grid Power Plant
19	90KWP Solar Hybrid Project Commissioning in Kare- Dadun Kowa Community, LGA Kebbi State
20	Ariara Market Independent Power Project in Aba, Abia State.
21	Iponri market solar project, Lagos

Commercial funding

Banks in Nigeria charge a double-digit interest rate, often above 20%, which makes such funding unrealistic to most. The banks are however very active in transitioning to solar power to reduce their own cost of operations. A list of such projects is provided in the **appendix**.

The funding options that currently exist include grants, debt financing and equity. Most of the debt-financing clean energy stakeholders in Nigeria get is from international banks and there is the challenge of fluctuations in foreign exchange rate.

Commercial funding is then more often provided by equity investment companies or impact investors, like these examples show:

All–ON
https://www.all-on.com/
All–on, an entity owned and funded by Shell, has a mission to increase access to commercial energy products and services for under-served and un-served off-grid energy markets in Nigeria, with a special focus on the Niger Delta.

Nigeria Solar Capital Partners
http://www.nigeriasolarcapitalpartners.com/
Nigeria Solar Capital Partners is a Nigerian renewable energy company focused on the development and management of utility-scale solar projects in Nigeria.

Opticom Finance
https://opticomfinance.com/solar-power-financing/#
Opticom is a non-bank financial company determined to promote the use of solar energy in Nigeria by helping companies acquire solar equipment and solutions needed to solve electricity problems in Nigeria.

Sunfunder
https://www.sunfunder.com
Daystar has raised $4 million in funds from SunFunder.

Vetiva Capital
https://www.vetiva.com
Vetiva Capital Management Limited (“Vetiva”) announced the signing of a Memorandum of Understanding with Climate Finance Advisory Limited (“CFAL”) and the African Guarantee Fund West Africa (“AGF”) on the Green Energy Fund (GEF) Program. The Green Energy Fund will focus on bankable, commercially viable and socially responsible renewable / clean energy generation and distribution.

Bi/multi-lateral funds

There are many funds available for renewable energy. Some of them are multilateral like the Africa Renewable Energy Fund (AREF), while others are operated by some of the largest international funding agencies in the world including the African Development Bank, The European Union and the World Bank/ IFC. Some notable examples include:

Funds accessible to companies

Grants/Funds with asterisks are also accessible to Government bodies.

Africa Enterprise Challenge Fund
https://www.aecfafrica.org/

Climate Investment Funds*
https://www.climateinvestmentfunds.org/

Efficiency for Access Research and Development Fund
https://efficiencyforaccess.org/grants

EDP Energy Access Fund
https://www.edp.com/en/access-energy-fund-program

Green Climate Fund*
https://www.greenclimate.fund/

Global Environmental Facility (Small Grants Program)
https://sgp.undp.org/

Energy Catalyst Programme – Innovate UK & African Power Platform
https://apply-for-innovation-funding.service.gov.uk/competition/612/overview

Enterprise Expansion Grants - United States African Development Foundation*
https://www.usadf.gov/

Nigeria Off-Grid Energy Challenge (Usadf / All – On)
https://www.all-on.com/the-all-on-hub/usadf-all-on-nigeria-off-grid-energy-challenge.html

Power Africa (SIDA, USTDA) *
https://www.sida.se/en/for-partners/private-sector/power-africa

Sustainable Energy Fund for Africa*
https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/sustainable-energy-fund-for-africa

Funds accessible to Government

Africa Clean Energy Program
https://www.ace-taf.org/

Ecowas Renewable Energy Facility
http://www.ecreee.org/page/renewable-energy-facility-peri-urban-and-rural-areas-eref

Devco (PIDG)
https://www.ifc.org/wps/wcm/connect/Industry_EXT_Content/IFC_External_Corporate_Site/PPP/Partners/DevCo/

Nigerian Energy Support Program I And II – GIZ
https://www.giz.de/en/worldwide/26374.html

4. Business opportunities in solar

The high demand for energy in combination with the inadequate supply of electricity, creates clear opportunities for Dutch renewable energy companies in Nigeria's homes and industries. We interviewed over 50 industry stakeholders and large companies in different sectors to seek their opinion on where the Dutch could come in. Generally, those interviewed said they were looking for: **better technology at a lower** cost, while some added the need to have **a faster roll out** which requires **finance**.

Solar for households

The demand for energy is only partially met in the cities and often not met at all in the rural areas. While there are many companies in Nigeria now offering home solar systems, the market is not saturated at all and there are ample opportunities for Dutch companies to come in.

Mini grids

These can be designed to supply entire villages or residential estates. They are increasingly developed in rural areas by companies such as Rubitec, but there is scope for many more and all over the country. When targeting this market, it is crucial to know who the target group is and to have a sound payment structure in place. Nigeria's electricity generation companies are also looking at developing mini grids to reduce their dependency on hydro and/or thermal sources to produce electricity. Some of these mini grids are developed as part of a government project. For example, the REA is very active in rolling out solar across the country. However, we recommend undertaking government projects in close collaboration with an experienced local partner.

Home solar

The largest segment remains home solar for now. Both the government and solar companies are primarily targeting this segment. In fact, several solar companies confirmed that home solar is the most attractive segment given the technology available. However, it will likely require a financing plan as clients are used to paying as they use the electricity, not for the purchase and installation of solar equipment.

Solar for high-brow urban areas

Individual houses have their own generators, and in estates or up-market apartment complexes there is a significant monthly or annual diesel charge for the use of the generator. Sometimes it is metered, and people pay a fixed fee per kWh whether it's provided by the government or by the facility management. While many in this segment are used to paying a lot for generators, they are not transitioning to solar as much as can be expected. The main reason is that solar is not seen as capable of powering air conditioners, big screen TVs and double door fridges. However, if there

is a large capacity system and the pricing on or below the price of diesel, such clients will gladly consider it.

This is confirmed by our interviews as well. For example, Victoria Garden City (VGC) in Lagos intends to start using solar power in the shortest possible time. Moreover, Novarick Home & Properties is currently developing a housing project that will incorporate solar and will continue to use solar for future building projects. Solar will also play a major part in the International Economic City Abuja (IECA), which should house 10,000 -100,000 persons and will include light manufacturing. Furthermore, James Cubitt Facilitator Managers (the FM arm of one of the country's leading architectural firms) would be interested in meeting Dutch companies and understand how solar power will be applied to upcoming projects as they are currently exploring alternatives to diesel generators. Facility management company Banksome even has its own renewable energy arm, further confirming the direction the housing market is headed towards.

Solar appliances

Currently most solar appliances in the market are small (lamps, fans) while there is a market for larger appliances such as fridges, air conditioners and televisions.

Private sector and industrial applications

Business opportunities for solar are everywhere where there is insufficient electricity from the grid (read: everywhere). However, some of the most interesting opportunities may be found in the B2B segment. Captive energy projects for a large energy consumer can be a mutually beneficial collaboration because solar can be a cost saving measure for companies while more and more (multinational) entities also proactively seek to reduce their carbon footprint and become more circular.

Agriculture

There is an increasing need for off-grid sources of energy in rural Nigeria and in areas where access to the grid is either limited or hindered. In Northern Nigeria, where cloudless skies practically all year round provide greater access to sunlight, farms are considering shifting larger amounts of their energy needs to solar power. Impact investor All-On mentioned that there is less competition in the agricultural solar space than in e.g. the home solar space, while it's a segment in which the Netherlands has the right technology, experience and knowledge.

Specifically, the Dutch can provide solutions for:

- Irrigation and water pumps, especially of >2HP for larger (fish) farms.
- Cold rooms: Ecotutu and ColdHub are currently the only ones focusing on this segment while the need for cold storage in agriculture is immense. It is said that 40% of Nigeria's agricultural products spoil due to lack of suitable storage capacity.

- Green houses and controlled growing temperature farming are growing in Nigeria in both horticulture and livestock farming.
- Solar for the poultry sector. Large poultry farms are sited far from the grid with little or no power to run the farms, while use of solar is very low especially in the north.
- Vertical farming: solar to power such (urban) farming projects.
- Solar power systems strong enough to power heavy compressors for food storage (also during transport).
- Longer lasting batteries to power industrial machinery.

Healthcare

A stable electricity supply is critical for hospitals -and impossible to guarantee in Nigeria without back-up solutions. This is one reason why the Federal Government's Rural Electrification Agency is rolling out a plan to supply 200 government owned primary healthcare facilities with solar power between now and April 2022. However, the private sector will transition (part of) their energy supply to solar as well. For example, we spoke with the St. Nicholas hospital, one of the country's first premier hospitals. They are currently looking to install solar power systems for two major branches. Oxford Consulting Hospital (Lagos) also told us that they are looking to transition to solar power if it can power air conditioners and all other equipment.

Industrial applications

Quite a few manufacturing companies in Nigeria are open to looking outside existing sources to fulfil their power needs. The grid is often either insufficient or unstable, and rising fuel prices are making formerly cheap diesel less and less attractive. However, with existing solar power technology seen as not powerful enough to be their sole source of energy, Unilever's Agbara factory has set up a hybrid installation that uses both solar power and diesel. Nigerian Breweries has recently done the same with their Ibadan brewery as described elsewhere in the document.

From our interviews, we also gathered some company specific developments. Since there are many manufacturers in Nigeria, there are likely more of such examples:

- Diageo is currently not using solar in Nigeria but is exploring options to reduce carbon footprint in Nigeria. They are open to solar solutions from abroad but will deal in naira contracts only to avoid foreign exchange risks.
- Flour Mills of Nigeria has shown keen interest in the use of solar and is currently seeking solar companies with strong technical knowledge about how solar works in Europe with experience in Nigeria.
- Lafarge is interested in becoming more sustainable and is currently looking for a company that can install, manage, and provide a naira per kilowatt extensive contract on a long-term basis.
- Nestle Nigeria is currently not using solar energy but is looking towards transitioning to solar energy soon. Decisions are however not taken in Nigeria.

Most of these projects would involve a hybrid plant, not purely solar, due to the high energy consumption of manufacturers.

IndAut Engineering Solutions & Drives Ltd (formerly Eriks Nigeria – a leading supplier of imported industrial products) will soon incorporate industrial solar solutions (especially pumps). This is another indication that manufacturers and industries are moving to solar.

Shopping malls

The number of large shopping malls is quickly increasing in Nigeria where informal markets are still leading. These new malls often house a cinema and many food outlets as well as shops. They consume huge amounts of energy and tend to have a large roof area: a suitable target for solar. An example is the Jabi Lake Mall in Abuja, where UK firm Actis has built a 609 kilowatts peak solar hybrid power plant in early 2021. Moreover, we understand that the Novare Mall in Lagos is currently discussing with solar energy companies to transition gradually (with a long-term plan to go green). We anticipate that more malls will follow. Dutch companies can partner with the shopping mall developers and/or operators of existing malls and offer to transition them to solar.

Essentially every sector is looking into solar as an alternative or to use in a hybrid model. Other interesting targets include:

- **Churches** – Abuja is home to the world's largest auditorium (accommodating 80,000 people) but across the country there are many mega churches which consume significant amounts of energy.
- **Universities and schools** – especially universities have the land for solar farms and Nigeria has around 200 universities across the country. Some government run, but around 80 private.
- **Transport** – there are now electric motorbikes in Lagos (Max EV) that are powered through solar. Such projects are likely to be repeated in other parts of the country or expanded.

It is impossible to list each opportunity and sector. Moreover, within a sector there will be those that believe in the capacity of solar while others think it can't meet their needs. It is important to have the proposition right, which often means that solar must be provided as a service so that companies don't need to develop their own capacity in solar but can consume it the same way they do with other energy sources.

Public sector

The federal government is implementing various solar projects as described earlier, while several state governments are equally active. For example, Lagos State has built a track record over the years in powering schools and healthcare centres with solar. We spoke to a number of government entities who provided the following points where Dutch companies can come in:

- Engage in local manufacturing to reduce cost and to make Nigeria less dependent on imports. This is a strong focus for the government in general and once there is more local manufacturing, the government will likely impose some form of import restrictions on imported solar equipment.

- Developing structures for continuous training, development and capacity building.
- Maintenance of existing infrastructure for the government.
- Creation of adaptive business and financial models for the industry
- Standardization and quality control.
- Comprehensive mapping of the entire value chain.

However, most government projects are best entered into with a strong local partner who has the experience, relations and registrations with e.g. local ministries to successfully bid for such a project. Moreover, while many projects may appear lucrative it can be challenging getting full payment.

Solar companies

Solar companies are also open to skills development and capacity building. Having good technical staff is key for a successful project but there is a lack of training facilities. Solar companies can also learn from the Dutch when partnering on projects.

The solar companies we interviewed, also identified the following gaps/ opportunities within the sectors and segments described above:

- Maintenance Services – for electricity generating companies (GENCOs) and mini grids, components and accessories, maintenance on a large scale.
- Project implementation - technical and financial implementation
- Smart metering models
- Distribution lines and accessories
- Improved energy storage capacity

Generally, Nigerian solar companies are open to collaborating with Dutch companies. The opportunity is so large that the Dutch would not be seen as competitors per se. However, several people told us that they would like the Dutch to put skin in the game: not just sell their technology but operate locally and co-finance projects.

5. Doing business in Nigeria

For companies that successfully entered the market, Nigeria tends to be among their biggest global markets due to the size of the country in terms of both economy and population. Think of Dutch companies like Heineken and Shell but also many mid-sized companies in various industries ranging from logistics to food and from agriculture to software.

The Nigerian business environment is unique and differs markedly even from other African countries. Today, many international companies thrive in the Nigerian market. Key factors responsible for the success of businesses in Nigeria include:

- Strong value proposition tailored to Nigeria
- In-depth knowledge of the Nigerian market as well as the country's policies – or having a Nigerian partner who possesses all that
- Frequent visits to the market to support your partner or clients
- Patience - deals often take long to be concluded
- Ability to adapt to a changing environment/ tolerance for delays and shocks from government agencies in Nigeria in terms of regulations and policies.
- Attractive price or cost saving proposition: China remains one of Nigeria's largest trade partners given their unique selling point of low prices. Nigerian consumers are price sensitive and have over the years gotten use to lower priced products from China and fairly used products from other continents like Europe with the same price range. This implies that Nigerian companies may be unwilling to buy unless the prices are competitive.

While Nigeria has moved up on the ease of doing business index, it can still be frustrating to do business in the country. Some key challenges include:

- Difficulty and delay in obtaining permits and licenses
- Corruption in bidding process for public infrastructure development projects
- Short supply of highly skilled labour; high unemployment rate
- Port congestion, importation bottlesnecks and delayed clearing periods
- HS Code inconsistency and re-classification by the Nigerian Customs Service.
- Multiple taxation risks; multiple payments on each solar components, product, and associated appliances.
- Supply chain and infrastructure challenges
- Getting paid, mainly because of foreign exchange risks/ volatility and difficulty in accessing foreign currency from the Central Bank of Nigeria (CBN)
- Security issues -especially in rural areas and away from Lagos

Nigeria is not a country for easy success, but it can be a profitable market for those that prepare well, work with reliable local companies and advisors, and have a long-term commitment to the market.

Dutch-Nigerian success in solar

"SolarCreed B.V is an off-grid solar product development and last mile startup that supports smallholder livestock and horticulture sectors in Nigeria. Over the past 4 years, SolarCreed has empowered over 500 small and medium sized poultry farms in 18 States in Nigeria by boosting food production, saving energy cost (by up to 80%) and significantly improving the revenue of smallholder poultry farmers.

As a purpose-driven enterprise led by Nigerian founders, SolarCreed targets the most effective means of achieving energy transition from the bottom-up. This dynamic approach, we believe, is the most constructive way to achieve long-term sustained local economic development in the off-grid solar and agriculture nexus.

This dynamic approach to successfully doing business in Nigeria requires a fluid business model which may include: providing flexible financing options to accommodate cash flow and working capital constraints of smallholder farmers; adopting a human-centred methodology to product portfolio development; and an unwearying versatility in the operations model.

As a Dutch accelerated startup, SolarCreed recognises the opportunity for agribusinesses to effectively support social, economic and environmental progress within the framework of sustainable development goals 2,5,7,8,10 & 13. This recognition is critical for guiding impact for long term success in the Nigerian productive offgrid solar market.

Dutch businesses that seek to be successful in Nigeria require a "dynamic and versatile purpose-driven business approach" to finding product market fit; to structuring operations; and to impacting local communities. By dynamic and purpose-driven business approach, we mean that building a business in Nigeria is not for the short-termist but requires a long-term orientation which puts social and environmental needs before profit."

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Routes to market

While many routes are possible, below are the most commonly taken routes to market in Nigeria:

- **Partners***:* These can often be invaluable in guiding you through what can often seem like a myriad of customs and practices in the Nigerian working environment. It is worth establishing the exact parameters of a working relationship to avoid complications in the future. Also, note that Nigerian regulations greatly favour appointing a local partner.
- **Distributors**: Because of the absence of adequate transport infrastructure, as well as often stifling bureaucratic interference, distribution in Nigeria can be unduly frustrating. It is important to work with distributors who can navigate this terrain and can effectively reach (most of) the country.
- **Direct Sales:** Many international companies sell directly to Nigerian entities who appreciate the lower cost as local partners tend to put a sizeable margin on the sales price. However, the need to regularly follow up and the often long sales process can quickly make direct sales more expensive for the exporter.

Nigeria is a 'relationship economy' where deals are made, and contracts won, based on relationships. This is why the majority of international companies appoint a local entity or person to support them in the market so they can hit the ground running and can leverage on an existing business network. It's critical to do proper due diligence when identifying a partner and to verify their claims. The key challenge is not to avoid ending up with a fraudulent partner, but to find one that has the capacity to help you expand your business effectively.

Business culture

Some things facilitate the ease of doing business in Nigeria. For example, although there are numerous ethnic groups and dialects in Nigeria, English is the de facto language of business. Moreover, many business leaders will have studied overseas and will know European business culture as well.

One should be flexible and willing to improvise and compromise – this is vital to cement a working business relationship. Therefore, be prepared to be patient and wait for trust to develop before diving into the small details of business discussions. A resilient attitude is a key requirement for staying in business in Nigeria.

Most likely, you will need to have business meetings during social occasions and outside office hours, as this provides a framework for the creation of solid interpersonal relations. Be respectful of elders and those in higher positions of authority. Equally, take care to familiarise yourself with the customs of the people you are engaging with as Nigerians respond very positively to such efforts.

Personal relationships are essential for successful business transactions. The preferred means of business communication is face-to-face meetings after an introductory email or phone call has been made. It is important to note that no worthwhile transaction can be completed quickly and must be followed up closely. Furthermore, having a local entity either through an established office or through a partner gives confidence to potential clients.

Travelling and geography

Many Nigerian companies have their headquarters in Lagos. However, there are business opportunities in other cities such as the capital Abuja and Port Harcourt. There are international flights into these three key cities, and less frequently to Kano (serving the north) and Enugu (serving the east). KLM flies to Nigeria daily.

Lagos Airport is less than an hour from the main business district. You will need a valid visa and yellow fever certificate to enter the country. There are many quality hotels, especially in Lagos and Abuja, though generally they are relatively expensive.

Nigeria is one hour ahead of GMT, and on GMT in the summer. Temperatures are around 30° most of the year. The best travel season is the dry season during October to April.

6. Renewable energy laws and regulations

Nigeria is a federation with 36 states + the Federal Capital Authority (Abuja). In terms of renewable energy, most policies and regulations are set on the federal level. However, state governments play a major role in land acquisition to private investors looking to establish power projects in the state. The key aspects to their role are for acquisition of land, consent for land usage and right-of-way surveys and assessments.

The legal and regulatory framework

There is a set of regulations and policies that together shape the framework for renewable energy in Nigeria. The most important are:

The National Electric Power Policy (2001) which is the outline of the entire energy sector and also created opportunities for privatization of the sector. It mandates NERC to create a level playing field in the Nigerian electricity market. The Act provides for licensing by NERC for any electricity generation of 1MW and above. A more recent regulation, the **NERC Mini Grid Regulations** (2017), aims to accelerate electrification in served and unserved areas but this is not limited to rural areas. The regulation is limited to distributed power of less than 100kW up to 1MW.

The National Renewable Energy And Energy Efficiency Policy (NREEEP) of 2015 is the key policy in relation to renewable energy. This policy document addresses diverse issues such as renewable energy supply and utilization; renewable energy pricing and financing; legislation, regulation and standards; energy efficiency and conservation; renewable energy project implementation issues; research and development; capacity building and training; gender and environmental issues; planning and policy implementation. The overall thrust of this policy is the optimal utilization of the nation's energy resources for sustainable development. Incentives under NREEEP include:

- tax incentives to manufacturers of renewable energy and energy efficient equipment and their accessories to promote widespread use including a five-year tax holiday for manufacturers from the date of commencement of manufacturing; and a five-year tax holiday on dividend income from investments on domestic renewable energy sources; and
- incentives for importers to offer energy-efficient appliances and lighting through exemption from excise duty and sales tax; custom duty rebate for two years on the importation of equipment and materials used in renewable energy and energy efficiency projects; and provision of soft loans and special low-interest loans from the power sector development fund for renewable energy supply and energy-efficiency projects.

The Regulations on Feed-In Tariff for Renewable Energy Sourced Electricity in Nigeria (REFIT) provide the tariff framework for renewables. The Regulations apply to renewable energy sourced from wind, hydro, biomass and solar PV with a capacity of between 1MW and 30MW that is connected to the grid or

the distribution networks. The REFIT set a target generation output cap from renewable sources at 2,000MW by 2020. The DisCos and NBET are obligated to purchase the power on a 'must buy' basis, thereby providing priority grid access to renewable generators. The projects that exceed the threshold provided by REFIT are to be procured by the bulk trader (NBET) through competitive tendering.

The Environmental Impact Assessment Act makes it mandatory for an EIA to be conducted on projects that are likely to have significant effect on the environment. A power developer who wishes to generate power through the use of renewable energy must submit an EIA report to National Environmental Standards and Regulations Enforcement Agency (NESREA). In obtaining a generation licence from NERC, the EIA approval certificate must be submitted to NERC.

Licensing

The Renewable Energy Regulation stipulates that applications to qualify as a Renewable Energy Generator shall be made together with the applications for license to generate electricity which shall state the technology and capacity size.

Schedule 1A of the Licence Regulation provides that the mandatory documents for application for generating licence are:

- Completed Application Form
- Certificate of Incorporation and Memorandum and Articles of Association, or Deed of Partnership or Deed of Trust
- 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)
- Tax Clearance Certificate for immediate past three (3) years
- Ten-year Business Plan
- Off-take Agreement or Arrangement
- Environmental Impact Assessment (EIA) Approval Certificate, or Proof of submission and acceptance for processing of the Report on EIA to the Ministry of Environment, or Details on how effluents and discharges will be managed (if proposed capacity is less than 10MW)
- 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
- Memorandum of Understanding with or Letter of intent from Engineering Procurement Contract (EPC) Contractor (if applicable)
- Memorandum of Understanding with or Letter of Intent from the technical partner (if applicable)
- Financing Agreements or Letter to fund the project from financial institution(s)
- Timelines for commissioning of the power plant and on the date when different capacities of the plant will come into operation

Regulatory approvals and their corresponding timelines are given below:

Nigerian Electricity Regulatory Commission (NERC)

- Generation license: six months from acknowledgement of the application;
- Mini-grid permit: 30 days from the date of receipt of a completed application; and
- Captive generation permit: three months from acknowledgement of the application.

Federal Ministry of Environment (FMoE)

- EIA/EMP certificate: Timeline not specified

Nigeria Electricity Management Agency (NEMSA)

- NEMSA certificate: one month.

Import regulations

Suppliers of solar products must provide the importer with the following documents upon receipt of Purchase Order (PO):

1. Proforma Invoice (FOB)
2. Bill of Lading / Airway Bill
3. Packing List
4. Manufacturer certificate
5. Product Certificate (PC)
6. Combined certificate of value and origin (CCVO)

Mandatory documents required for importation of Solar products:

1. Marine Insurance
2. Form M
3. SON Conformity Assessment Programme (SONCAP) Certificate
4. Environmental Import Clearance Certificate
5. Pre-Arrival Assessment Report (PAAR)
6. Tariff Payment

Documents the are required to be submitted by the importer to the processing bank after clearance of goods include:

1. Pre-Arrival Assessment Report (PAAR)
2. SGD print out
3. Combined certificate of value and origin (CCVO)
4. Manufacturer's Certificate with standards adopted stated thereon
5. Laboratory/Phytosanitary Test Certificate for Chemicals, food, beverages, etc
6. Import duty Payment receipt with SGD No. stated thereon
7. Bill of Lading/Airway Bill/Road waybill etc
8. SONCAP Certificate for Petroleum products

9. Terminal Delivery Order/Gate Pass
10. Packing List

HS Codes and relevant taxes for solar components

CET Code	Description	SU	ID	VAT
8504402000	Battery chargers	U	5	
8504401000	Uninterruptible power supply (UPS)	U	5	
8419191000	Solar water heaters	U	5	
8502391000	Solar powered generator	U	5	
8541401000	Solar cells whether or not in modules or made up into panels	U	0	
8501200000	Universal AC/DC motors of an output exceeding 37.5 W	U	5	7.5
8542310000	Processors and controllers, converters. or other circuits	U	10	
8506300000	Primary cells and primary batteries made of Mercuric oxide	U	20	7.5
8506400000	Primary cells and primary batteries made of Silver oxide	U	20	7.5
8506500000	Primary cells and primary batteries made of Lithium	U	20	7.5
8506800000	Other primary cells and primary batteries not specifies	U	20	7.5
8507200000	Other lead-acid accumulators not specified	U	20	7.5
8513100000	Lamps designed to function by their own source of energy	U	20	7.5
8535210000	Automatic circuit breakers for a voltage of less than 72.5 kV	KG	10	
8536300000	Other apparatus for protecting electrical circuits	KG	20	7.5
8535300000	Isolating switches and make-and-break switches	KG	10	
8535400000	Lightning arresters, voltage limiters and surge suppressors	KG	10	
8535900000	Other elect. apparatus for switching, protecting circuits, connections... not specified	KG	10	
8536300000	Other apparatus for protecting electrical circuits	KG	20	7.5
	Diodes, transistors, etc; photosensitive devices; light emitting diodes			
8541100000	Diodes, other than photosensitive or light emitting diodes	U	10	
8541210000	Transistors, other than photosensitive transistors with a dissipation rate of < 1 W	U	10	
8541290000	Transistors, other than photosensitive transistors with a dissipation rate of> 1 W	U	10	
8541401000	Solar cells whether or not in modules or made up into panels	U	0	
8541409000	Other Photosensitive semiconductor devices	U	0	
8541500000	Other semiconductor devices	U	0	

Conclusion and next steps

The data collected for this report clearly point to one thing: the potential for solar energy in Nigeria is enormous. Not only is electricity demand higher than current supply, but there is also an increasing adoption of solar as an energy source and the country's climate is suitable for its application. While the cost of solar energy has deterred many households, there are more and more financing and grant schemes that help spread solar across the country.

The positive developments are likely to be followed by larger scale projects -an example is Heineken's drive to establish a fully solar powered brewery. Such projects will increase in number. Moreover, the government is rolling out solar across the country and with more awareness and better technology combined with competitive pricing, individual homeowners will follow suit.

We recommend that Dutch companies will (virtually) visit Nigeria to meet with potential partners and explore a collaboration. Moreover, Dutch companies with complementing solutions can target large commercial and industrial potential clients and offer them a turn-key solar solution. If the companies bring along a financing solution, whether from themselves or from funding partners, there will be a possibility to roll out faster and scale up, also in the potentially lucrative home solar systems segment.

There are few countries in the world where solar is both incredibly needed and effective given the climate. Connecting the dots of demand + supply + technology + finance can mean that Dutch companies can hit the ground running and develop a mutually beneficial relationship with Nigeria.

Appendices

Appendix 1: key Nigerian companies

Company Name	About	International partnerships
ACOB Lighting Technology Limited www.solarworks.ng/acob	ACOB Lighting Technology Limited is an indigenous Renewable Energy Company and Pioneer Energy Efficient LED Lighting.	Exclusive distributor for EverLite brand in West Africa Region of Africa.
Arnergy www.arnergy.com	Arnergy is a solar energy company that provides urban rooftop solutions, rural electrification, solar for businesses and solar rental solutions.	Not a brand specific solar company
Astrum Energy www.astrumenergy.com.ng	Astrum Energy is a major solar energy service provider in the country. The company is one of the pioneers in the development of solar energy throughout Nigeria.	Solar World, Trinasolar, Victron energy and Yingli solar in Nigeria
Auxano Energy www.auxanosolar.com	Auxano Energy is an indigenous company that deals in procurement, sales, design, installation, and maintenance of solar and inverter systems.	Not a brand specific solar company
AWPS Renewable Energy Limited www.atlanticwastepower.com	AWPS Renewable Energy Limited is a subsidiary of Atlantic Waste and Power System, inc. They provide solar power for homes, offices, schools, and organizations.	Not a brand specific solar company
Blackbit Energy Limited www.blackbit.com.ng	Blackbit Energy Limited is a sustainable energy player in Nigeria focusing on the Renewable Energy Space.	Exclusive distributors for SunKing products in Nigeria.
BTS Renewables Limited www.btsenergy.com.ng	BTS specialises in the distribution, marketing, management, and operation of projects involving the generation of electricity from renewable energy sources particularly solar energy.	Official distributors for MK Powered, OutBack Power, Sensata Technologies, Schneider Electric

Casco Electronics Limited www.cascocoltd.com	Casco electronics are importers and exporters of high-quality solar equipment.	Not a brand specific solar company
Cloud Energy Photoelectric Limited www.cloudenergy.com.ng	A solar energy company that focuses on providing energy conserving solutions, services, and equipment.	Not a brand specific solar company
Consistent Energy Limited www.consistent-energy.com	Consistent Energy Limited is a stand-alone rooftop solar energy company that promotes the Solar Direct brand aimed at displacing generators by putting solar on every rooftop in Nigeria.	Distribution of Solar Direct panels in Nigeria.
Dalex Integrated Systems Limited www.dalexintegrated.com	Dalex Integrated Systems designs and installs electrical solutions, such as solar and inverter backup.	Distributors for brands like ICellPower, Kyocera, Canadian Solar
Ecozar Technologies www.ecozartech.com	Ecozar Technologies deals in the sales of solar energy equipment installation of solar and inverter thunder arrestor and earthling, electrical wiring, and electrical installations.	Not a brand specific solar company
Em-One Energy Solution www.em-one.com	EM-ONE provides renewable energy solutions with a focus on power infrastructure, solar minigrid, intelligent microgrid systems, solar photovoltaic systems, and energy efficiency.	Authorised distributors and service centre for Schneider Electric, Canadian Solar, Homer Energy in Nigeria.
First Option Nigeria Limited www.firstoption.ng	First Option provides power solutions for individual homes and estates either as SHS “solar home system”, or hybrid residential power system or small grid formation with solar or any appropriate green power generation.	Magnum Energy, Grundfos, Schneider Electric, Opti-Solar, Deka Solar, OutBack Power systems, SunTech
Gennex Technologies www.gennextechnologies.com	Gennex Technologies specializes in the sales and expert installation of renewable energy equipment and accessories.	Authorised service centre for products of Canadian Solar

GreenPower Nigeria Limited (GP) www.greenpowernig.com	GreenPower GP is a renewable energy and electromechanical engineering company providing energy related services like solar and power electronic systems.	Distributor foe the following brands: IREM, Gamatronic Solaredge, INGESCO, SureChill
Nombizz Nigeria Limited www.nombimz.com.ng	A solar solutions and electrical products supplying company in Nigeria.	Not a brand specific solar company
Penatech Nigeria Limited www.penatechgroup.com	Penatech Nigeria Limited distributes and installs inverter systems, solar systems, and batteries.	Not a brand specific solar company
Powercell Limited www.powercelllimited.com	Powercell is a privately-owned power systems company established in 2005 in Lagos, Nigeria, and one of the foremost renewable energy solutions providers in Nigeria.	Exclusive partners with ABB and Ashley Edison in Nigeria
Prag Global www.prag.global	PRAG is into the distribution of alternative energy products in Nigeria.	Not a brand specific solar company
Prewoh Nigeria Limited www.prewohng.webs.com	Prewoh Nigeria Limited sell, install and design renewable energy products.	Not a brand specific solar company
Rubitec Nigeria Limited www.rubitecsolar.com	Rubitec Nigeria Ltd. specialises in renewable energy – specifically Solar and Inverter, Backup Systems etc	Not a brand specific solar company
Sholep Energy Limited www.sholepenergy.com	solar-technology producers and the largest Nigerian and West African Solar panel manufacturer.	Duke Energy
Solar Depot Nigeria www.cascocoltd.com	Solar depot Nigeria specializes in importation, sales, installation, and maintenance of renewable energy equipment.	Not a brand specific solar company
Solar Force Nigeria Limited www.solarforcenigeria.com	Solar Force-Nigeria is a retailer, distributor and installer of renewable energy products and systems.	Not a brand specific solar company
SolarKobo www.solarkobo.com	SolarKobo is a solar energy company in Nigeria that offers full and partial solar installation,	Not a brand specific solar company

	system maintenance, financing, and energy audit services	
Solarmate Engineering Limited www.solarmateng.com	Solarmate designs, supply, installation, and maintenance of renewable energy system for various sectors in Nigeria.	Solar23, Magnum Energy, Selectronic, Schneider Electric, Victron Energy, TellCo, SMA Sunbelt, OutBack Power, African Energy and GreenOne Tech
Solynta Energy www.solyntaenergy.com	Solynta Energy is an urban solar power provider.	Not a brand specific solar company
SPE Energy Solutions Limited www.speenergysolutions.com	SPE Energy provides renewable energy solutions which includes maintenance, training, sales, and lease of solar powered projects.	Consul Neowatt, Fuji Electric, Narada and Sorotec.
The Solar Shop Nigeria www.solarshopnigeria.com	An alternative energy company specialising in product sales, technical support, engineering, procurement of solar products and equipment.	Jinko energy, Canadian solar, Solar world, Ultron solar, Schneider electric, Victron energy, SMA Solar, Phocos, Grunfos.
Unitronix Global www.unitronixglobal.com	Unitronix Global designs and supplies solar panels, batteries, a hybrid auto-sensing inverter for micro-grid, on/off-grid, hybrid applications.	Felicity Solar, Blue Gate, Genus, Schneider Electric, Microtel, Su-Kam.
Wandel International Nigeria Ltd www.wandel.com.ng	Wandel International Nigeria is an alternate energy power solutions provider.	Genus, Kstar and Sollatek.

Please note that we have endeavoured to map the most important stakeholders in the industry, however this list is not exhaustive and is subject to change.

Appendix 2: international competition

Company Name	Country of Origin	Role in Nigerian Solar market
ABB www.global.abb/group/en	Switzerland	Energy equipment manufacturer and distributor
Ablerex www.ablerex.eu	Taiwan	Solar products manufacturer
African energy www.africanenergy.com	USA	Energy solutions provider
Ashley Edison www.ashleyasia.com	United Kingdom	Energy solutions provider
Canadian Solar **www.canadiansolar.com**	Canada	Energy solutions provider
Deka Solar	USA	Solar battery producer
Duke Energy www.duke-energy.com/home	USA	Solar products manufacturer
Everlite Electrical www.everliteelectrical.com.au	Australia	Everlite electrical specializes in the production of Solar PV products in Australia.
Exide Technologies www.exide.com/en	USA	Energy storage solutions provider
Felicity Solar www.felicitysolar.com	China	Solar products manufacturer
Fuji Electric www.india.fujielectric.com	Japan	Energy solutions provider
Gamatronic Solaredge www.solaredge.com	Israel	Solar products manufacturers
Genus www.genusinnovation.com	India	Solar products manufacturers
GreenOne Technologies **www.greentechnology.com/eng**	Italy	Energy solutions provider
Grundfos www.grundfos.com	Denmark	Energy solutions provider
Homer Energy www.homerenergy.com	USA	Solar products manufacturer
ICellpower www.icellpower.com	USA	Energy equipment manufacturer
INGESCO www.ingesco.com/en	Spain	Lightning solutions provider
Kohler Company www.us.kohler.com/us/	USA	Power generator manufacturers
Kyocera www.global.kyocera.com	Japan	Energy equipment producer
Lumos www.lumos.com.ng	The Netherlands	Energy solutions provider
Magnum Energy www.magnum-dimensions.com	USA	Energy solutions manufacturer

Microtel www.microtel.com	USA	Solar products manufacturer
MK Powered www.mkbattery.com	USA	Solar battery manufacturer
Narada www.en.naradapower.com	China	Energy solutions provider
Opti-Solar www.opti-solar.com	Taiwan	Lightning solutions providers
Outback Power systems www.outbackpower.com	USA	Energy solutions providers
Phocos www.phocos.com	USA	Solar products manufacturer
PSC Solar UK www.pscsolaruk.com	Nigeria	Energy solutions provider
Schneider Electric www.se.com	France	Schneider Electric are global manufacturers of electric parts.
Selectronic www.seletronic.com	Australia	Energy solutions provider
Sensata Technologies www.sensata.com	USA	Energy solutions provider
Siemens www.siemens.com	Germany	Energy equipments manufacturer
SMA Solar www.sma.de/en/	Germany	Solar products manufacturer
SMA Sunbelt www.sma-sunbelt.com	Germany	Energy solutions provider
Solar 23 www.solar23.com	Germany	Energy solutions provider
Solar Direct www.solardirect.com	USA	Energy solutions provider
Solar Force USA www.solarforce.com	USA	Energy solutions provider
Sorotec www.sorotecups.com	China	Solar products manufacturers
Su-Kam www.multipower.com.ng/sukam-solar.html	India	Solar products manufacturer
SunKing www.greenlightplanet.com	USA	Energy solutions provider
SunTech www.sun-tech.org	China	Manufacturers of photovoltaic, crystalline silicon solar cells and modules
TellCo www.tellco-europe.com	Switzerland	Energy solutions provider
Trinasolar www.trinasolar.com/us	China	Energy solutions provider
Victron Energy	The Netherlands	Energy solutions provider

www.victronenergy.com		
Xantrex www.xantrex.com	Canada	Solar products manufacturer
Yingli solar www.yinglisolar.com/au/	China	Energy solutions provider

Please note that this list is not exhaustive and is subject to change.

Appendix 3: examples of solar adoption among companies

Name	About	Source
Abba's Heart school	Abba's Heart Montessori school is a private creche, nursery and elementary school that is solely powered by Solar energy.	www.dw.com/en/nigerias-off-the-grid-solar-powered-school/
ABG-CAPS Clean Energy Group	Provided solar energy solutions (irrigation and water pump systems) in Sokoto, Zamfara, Kebbi, Jigawa, Kaduna and Oyo States for Solar Farms ranging from 50MW to 100MW and are all at various stages of development.	www.abgcapsenergy.com/farmingsolarprojects
Adamma Apartments & Student Hostel, Imo	Arnergy deployed a power system of 102kWh with a storage capacity of 345kWh for Adamma Apartments in Imo state.	www.arnergy.com/adamma-apartments-and-student-hostel
Cranac Metal	Their production site is powered by an 18kWp Solar equipment	www.prag.global/cranacmetal
Federal Airport Authority of Nigeria (FAAN)	Federal Airport Authority of Nigeria (FAAN) has an agreement with Flash Technology to install solar airfield lights on the airport runways.	www.flashtechnology.com/nigerian-airports
Guzape District, Abuja	Guzape District in the heart of Abuja lies a unique 10-apartment block building, running totally off the grid following the deployment of 30KW Solar & Wind Hybrid Solution to Power all 10 Apartments.	www.bluecamelenergy.com.ng/guzapedistrict
Kolo Community Hospital, Olobiri	The Kolo Hospital Modification project was financed by Shell Petroleum Development Company. Arnergy deployed a 40KWh rooftop solution with a storage capacity of 108KWh.	www.arnergy.com/kolo-community-hospital
KPMG Nigeria	Arnergy set up a solar solution for KPMG office building in Gbagada, Lagos state, with a PV capacity of 5KWh.	www.arnergy.com/kpmg
MTN Nigeria	MTN Nigeria is in partnership with Dutch Nova Lumos to provide accessible solar energy solutions to homeowners and small businesses in Nigeria. Some of these solutions include their LUMOS Eco Solar kit (80W solar panel and 200Wh battery) and LUMOS Prime Solar Kit (160W solar panel and 300Wh battery). A 60W inverter is included in both kits.	www.solarkobo.com/mtn-lumos-solar-inverter
Nigerian Breweries	Nigerian Breweries Plc (NB) and Cross Boundary Energy Limited have signed a Solar Power Purchase Agreement to	www.guardian.ng/energy

	construct Nigeria's first solar powered brewery, a 650kW plant, at Ibadan brewery.	
Nigerian Navy Reference Hospital	The Nigerian Navy Reference Hospital has a 15kW solar powering hospital system.	www.solarworks.ng/auxano
Ofanema247 Ventures	A fish farm fully powered by solar energy.	www.thefishsite.com/ofamena247
Ogun state government	An 85kWp solar mini grid project was deployed by Rubitec Solar to provide electricity to 490 homes and businesses in Gbamu Gbamu.	www.guardian.ng/energy/gbamugbamu
Pivot Farms	A fish farm fully powered by solar energy.	www.thefishsite.com/pivotfarms
Premium poultry farms	Premium poultry farm in Abuja has an agreement with renewable energy supplier Rensource Energy and Empower New Energy to install a solar photovoltaic system with the capacity of 700 kWp.	www.afrik21.africa/en/premium-poultry-farm/
Rivers state government	Rivers state government has employed the use of several solar powered streetlights across the state.	www.solexsolarpower.com/governmentprojects
Shell Nigeria	Shell Nigeria employed the services of Apex BP Solar and AO Demarg to set up a cathodic protection equipment entirely empowered by solar energy. Integral photovoltaic generators of 14 kWp were launched in 6 different sites in Nigeria (84kWp).	www.phaesun.com/references/industrial-projects/shell-nigeria

Examples of solar related projects executed by banks to reduce their dependency on diesel generators:

- **Access Bank Plc**
  Presently, Access Bank has over 240 solar powered ATMs across Nigeria. The bank also has a branch fully powered by solar energy, with plans power more branches with solar energy.

- **First City Monument Bank (FCMB)**
  FCMB has over 100 branches running on solar power. In early 2021, the bank won an award for making effective use of solar energy.

- **Guaranty Trust Bank Plc**
  The number branches/business offices powered by solar energy has increased by 13 (From 29 to 42) from 2018 to 2019. The bank presently has 6 Main Branches, 6 e-branches and 30 offsite locations which are powered by a hybrid of solar and conventional energy supply (Grid and Diesel

Generators). 8 Automated Teller Machines (ATMs) and Communication devices are powered by solar panels.

- **Polaris Bank**
  Business offices of the bank are being solar powered whilst also maintaining a strict closing time of 6pm across all branches nationwide to reduce energy consumption and carbon emission.

- **Stanbic IBTC Plc**
  As of December 2019, 82 ATMs and 17 branch locations of the bank had been on-boarded on alternative power sources (solar hybrid).

- **Sterling Bank**
  More than 60 sterling bank branches have solar solutions attached to them and 8 of them are fully run by solar.

- **Union Bank Of Nigeria Plc**
  UBN Lekki branch in Lagos is a modern solar-powered structure with drive-through ATM facility. To date, UBN has over 61 ATMs and 99 branches which are solar powered with three fabricated panel buildings and three container buildings.

- **United Bank For Africa Plc (UBA)**
  Presently the UBA is dedicated to the installation of solar-powered ATMs across several locations and over 113 ATMs are currently solar-powered nationwide.

- **WEMA Bank**
  Wema Bank recently launches a solar-powered mobile branch. In 2019, 18 branches were migrated to solar power energy. In addition, all ATMs use hybrid power supply (solar, grid and inverter) to meet the needs of our customers within and outside our business locations.

- **Zenith Bank Plc**
  Zenith bank is taking action to move from diesel power to solar. At the end of 2019, Zenith bank had 397 solar-powered branches and 1012 solar powered ATMS

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We interviewed 53 companies across different industries relevant for the solar sector: companies that consume large amounts of energy as well as companies actively involved in solar already.

Contacts	Company Profile
ACOB Lighting Tech www.acoblighting.com	ACOB Lighting Technology is a renewable energy company in Nigeria that carries out the installation and maintenance of renewable energy products.
Adewura Farms www.facebook.com/Adewura-Farms-1003163709733011/	Adewura farms is majorly into agro-based business, crop farming, livestock production, animal husbandry.
All – On Hub www.all-on.com	All On, a fund by Shell oil company, invests in off-grid energy solutions deployed by both foreign and local alternative energy companies that complement available grid power across Nigeria. The All On Hub provides services for (start-up) companies in the sector.
Alpha Pharmacy www.alphapharmacyltd.com	Alpha Pharmacy is a wholesale and retail pharmacy store with 14 branches nationwide, making it one of the larger chains.
Aspire Power www.aspirepowersolutions.com	Aspire power solutions offers Distributed Energy Utility that integrates clean energy solutions such as Solar with intermittent but affordable grid electricity to form Nano-grids and Micro-grids that provide cleaner, more affordable and healthier on demand power.
Atlantic Shrimpers Ltd www.primstar.com	Atlantic Shrimpers Ltd is a producer and exporter of the premium PRIM7*STARS brand of sea frozen products from Nigeria.
Blackbit Energy Limited www.blackbit.com.ng/	Blackbit Energy Limited is renewable energy distributors with focus on solar and hydro energy. Partnered with Total and Greenlight Power.
Brains and Hammers www.brainsandhammers.com	Brains and Hammers is a high-end estate developer delivering housing development and maintenance services.
Climate Innovation Centre (CIC) www.nigeriacic.org	The Nigeria Climate Innovation Center is an organisation set up by the World Bank and supported by the Federal Government of Nigeria to develop and deploy solutions to climate change challenges in Nigeria with a focus on renewable energy, waste management, smart agriculture and water solutions.
Consistent Energy Limited www.consistent-energy.com	Consistent Energy Limited provides rooftop solar energy for homes and businesses. Solar Direct brand.
Council for Renewable energy (CREN) www.renewablenigeria.org.ng	The Council for Renewable Energy Nigeria (CREN) offers advocacy, training and support for the solar industry in Nigeria.

Dangote Industries Ltd www.dangote.com	Dangote Group is leading provider of essential daily needs produce in Africa. Their activities span across 19 different industries.
Diya Fatimilehin & Co www.diyafatimilehin.net	Diya Fatimilehin & Co is one of Nigeria's foremost real estate firm with surveyors and valuers.
Ecozar Technologies www.ecozartech.com	Ecozar Technologies is one of Nigeria's leading solar energy company. They provide complete engineering, procurement, and construction (EPC) services to households and businesses.
Emobella Engineering www.emobellaengineering.com	An indigenous mechanical and electrical engineering service company with core competency in metal fabrication and plant equipment installation.
Family Homes Fund www.fhfl.com.ng	Family Homes Funds is Sub-Sahara Africa's largest housing fund focused on affordable homes for Nigerians on low income.
First City Monument Bank (FCMB) www.fcmb.com	FCMB is a full service national commercial bank in Nigeria.
First Option www.firstoption.ng	First Option is a supplier of renewable energy products. It is affiliated with international brands like SMA, schneider Electric, Out Back Power Systems and Deka Solar.
Flour Mills Nigeria PLC www.fmnplc.com/foods	Flour Mills Nigeria PLC is a leading food business company furthered by entities operating in agriculture, livestock feed and pasta manufacturing.
Guinness Nigeria (Diageo) www.diageo.com	Guinness Nigeria (Diageo) is one of Nigeria's leading producers of beers and spirits.
IndAut Engineering Solutions & Drives Ltd (formerly EISNL) www.indauts.com	IndAut Engineering Solutions & Drives Ltd (formerly EISNL) provides electrical, plumbing & hardware wholesale in Nigeria.
Intra Fisheries www.primlaks.com	Intra Fisheries is a fish importer and operator of large fish farms. The company is part of the Primlaks group of companies.
James Cubitt facility managers www.jamescubittfacilities.com	The facility Management business arm of James Cubitt Group in Nigeria, one of the most established architectural firms in Nigeria.
Karlflex Fisheries www.karflexfisheries.com	Karlflex Fisheries focuses on industrial and commercial fishing in Nigeria and West Africa.
Kasi Healthcare Limited www.kasihealth.com	Kasi Healthcare Limited commenced as an Orthopedic and Sports clinic that has grown to various fields including providing VIP healthcare services. The company

	also manufactures their brand of medical equipment and consumables.
Lafarge Africa Plc www.lafargeholcim.com	Lafarge Africa Plc is a member of the LafargeHolcim Group one of the biggest building and concrete solutions company in the world.
Lagos Homes Ilupeju NA	Government Housing Scheme estate located in Ilupeju in Lagos.
Naston Engineering Nigeria Limited www.nastonnigeria.com	Naston Engineering Nigeria Ltd. is an engineering and contracting company in the field of water and wastewater treatment systems, vending, sewage treatment, tank fabrication and liquid transfer system.
Nestle Nigeria www.nestle-cwa.com/	Nestle Nigeria is one of the largest food and drink manufacturers in Nigeria with 3 manufacturing sites and 8 branch offices in Nigeria.
Nigerian Breweries Plc www.heineken.com	Nigerian Breweries is the country's largest beer brewer with 7 breweries and highest market share. Its majority shareholder is Heineken.
Niji Group www.nijigroup.com	Niji provides practical end - to - end agricultural solutions to Nigeria's agricultural sector and across other African countries.
Novare Real Estate Africa www.novare-realestate.com	Novare Real Estate Africa develops and manages modern retail and commercial facilities across sub-Saharan Africa, with 4 retail facilities in Nigeria.
Novarick Homes www.novarickhomes.com	Novarick Homes and Properties Limited is a real estate development company, dedicated to providing affordable housing and investment solutions across the real estate spectrum.
Oakleaf Pharmaceuticals Ltd www.oakleafpharma.com	Oakleaf Pharmaceuticals Ltd is an importer and distributor of pharmaceuticals in Nigeria. (nutraceuticals and vitamins).
Osapa London Estate NA	Prime estate located in Osapa London, Lekki axis.
Oxford HealthPlus Hospital www.oxfordhealthplushospitalscom	Oxford HealthPlus Hospital is an offshoot of Oxford health consulting, an innovative health care consulting company.
Poultry Association of Nigeria www.facebook.com/PoultryNigeria	Poultry Association of Nigeria is a platform that connects poultry farmers and other allied stakeholders, helping to maximize the full benefits of the poultry industry.
Rensource www.rensource.energy	Rensource manages power provision in urban and rural economic clusters.
Rubitec www.rubitecsolar.com	Rubitec Nigeria Ltd. is a Nigerian Company specializing in Renewable Energy – specifically Solar and Inverter,

	Backup Systems, Small Hydro Power, Biomass energy systems, Waste to energy plant, Land-Fill Gas Plants and Wind Energy.
Rural Electrification Agency www.rea.gov.ng	The Nigerian Rural Electrification Agency (REA) is the implementing Agency of the Federal Government of Nigeria tasked with electrification of rural and unserved communities.
Sebore Farms and Extension Services www.sebore-epz.com	Sebore farms covers 14,000 hectares of land in Adamawa State, Nigeria and is engaged in Horticulture, Aquaculture, Feed Production, Diary and Cattle farming covering Animal Husbandry, Nutrition, Genetics, Artificial Insemination and other extension services such as staff training.
Solar Creed www.solarcreed.com	Solar Creed is and offgrid solar power provider that supports smallholder livestock and horticulture sectors in Nigeria.
St. Nicholas hospital www.saintnicholashospital.com	St. Nicholas hospital is a top tier multi-specialist hospital located in Lagos. They have 3 facilities in Nigeria.
Sterling Bank www.sterling.ng	Sterling Bank Plc is a full service national commercial bank in Nigeria.
Sweet Green Farms Services Ltd www.sweetgreenfarms.com.ng	Sweet Green Farms Services Ltd sells organic vegetables and fruits.
Tarabaroz Fisheries Limited www.nalcomet.com/sister-companies/tarabaroz-fisheries-ltd	Tarabaroz Fisheries Ltd runs a successful fishing company in Nigeria.
Unilever Nigeria PLC www.unilever.com	Unilever is one of the leading manufacturers of consumer products primarily in the home, personal care and foods categories.
Vestates Limited www.vestatesng.com	Vestates Limited is a real estate and property management company in Nigeria.
Victoria Garden City (VGC) N/A	Victoria Garden City is a high-end residential estate in Lagos.
WECO Engineering & Construction Company www.weco-nig.com	WECO specialises in heavy metal fabrication and steel structures piping and instrumentation

	in composite mechanical, electrical and instrumentation projects, land and swamp pipelines as well as for both onshore and offshore sub - sectors.
Young Professionals network, Energy Institute Nigeria www.energyinst.org/whats-on/search/events-and-training?meta_eventId=2010NIGYPN	Energy Institute is a professional organization for engineers and other professionals in energy related fields focused on tackling global challenges.

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Throughout the document, we have listed several companies and entities. We've endeavored to select the largest companies with international partners and/or significant projects that relate to the topic of this report. However, note that the companies and entities have been identified based on their general (public) profile and that no due diligence has been done on any of them. The about section in the tables serves as a guidance only.

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