Fossil fuel genset market assessment: Nigeria

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IKEA Foundation

CARBON TRUST

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Executive summary

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Nigeria's generator market is primed for a transition to cleaner energy sources; however, several market barriers need to be addressed to enhance adoption

Scope of work/methodology

Scope of work -The purpose of this market research report was to gain deeper insights into the Nigerian fossil fuel generator* (FFG) market and identify opportunities for solar genset alternatives to replace harmful FFGs

Methodology - Carbon Trust, Open Capital, and A2EI's insights have been derived from a combination of 39 consultations and in-depth secondary market research to collect insights on the FFG and solar genset markets. To better understand energy usage and fuel spend, A2EI installed 492 smart meters (298 directly used for 5 prioritized use cases) and analyzed 12 months of data to inform our analysis and recommendations

Selection of use cases – The selection of use cases analyzed for this report was determined by two criteria (i) current FFG usage and (ii) desire to transition to solar, resulting in a selection of five use cases for further analysis

Use Cases selected

1. **Households**
2. **MSME Markets**
3. **Universities & Schools**
4. **Healthcare Centres**
5. **Hotels**

Market overview

Continued unreliability and availability of the national grid is forecasted to continue driving the growth of fossil fuel generators (FFG) and solar gensets

- Due to the unreliable nature of the national grid, 40% of Nigeria's electricity consumption is met by generators, with FFG demand projected to reach 30 million by 2030
- However, soaring inflation, fuel prices, and depreciation of the Naira are making FFGs more unaffordable to Nigerians. There is an opportunity to replace FFGs with solar generators, a nascent market which has grown by 9% CAGR since 2011

Supply-side assessment

Both the FFG and solar genset markets are reliant on importation; however, solar gensets currently face punitive customs tariffs, discouraging demand

- The FFG market can be segmented by installed capacity and fuel type ranging from small petrol and diesel (<15 kVA) up to large diesel generators (>100 kVA)
- The solar genset market is divided by installed capacity ranging from standalone PV systems (up to 3kW) and utility-scale (>5 MWp)
- In Nigeria both these markets are heavily dominated by imports due to a lack of local capacity to facilitate local manufacturing

***Notes**: * Fossil Fuel Generators include generators powered by petrol, diesel and gas; ^ A photovoltaic (PV) cell, also commonly called a solar cell, is a nonmechanical device that converts sunlight directly into electricity; ^^ Clean generator converts mechanical energy from clean power sources (including technologies such as solar PV gensets, Solar home systems, mini-grids) into electrical energy for use, within the context of this report we are only considering technologies capable of replacing FFGs within the documented use cases; ^^^ Solar genset (the term commonly used among Nigeria customers as it works to displace Fossil fuel generators), are made up of Solar Panels, Battery Storage, an Inverter, and a Controller*

While there are numerous barriers stopping customers to switching to cleaner gensets, high costs were by far the largest obstacle to overcome

	Market barrier	Summary
Market intelligence	Limited customer awareness	Potential customers in the market are largely unaware, misinformed, or sceptical about solar gensets as a replacement for FFGs
	Lack of consumer insights and market data	Distributors in the market face a shortage of valuable customer data to inform their customer segmentation and targeting ambitions, limiting the ability to tailor products to specific customer needs
Finance and investment	High upfront costs and financing challenges	Nigerian distributors are highly dependent on costly imported solar gensets, compounded by the depreciation of the Naira against the dollar, and long sales cycles overall increasing their business risks
	Inflexible customer financing model	Customers interested in transitioning to solar consistently complain that the up-front and ongoing costs of purchasing solar gensets are prohibitive
Ecosystem building	Non-existence and poor enforcement of quality standards	The Nigerian solar genset market suffers from an enforcement system that does not properly vet and enforce quality standards on solar gensets, therefore enabling an influx of poor-quality solar gens and harming customer perceptions of solar gensets
	Ineffective regulation, policies, and initiatives	Beyond punitive custom tariffs and red-tape, Nigerian regulators have elected to omit key supportive regulations for solar in their policy frameworks, while those that exist are not upheld or enforced
	Lack of local specialized skills and competencies	The labour force to install and maintain solar gensets in Nigeria is significantly lower compared to FFGs, which is cause for concern among customers who seek long-term maintenance services
Product innovation	Technical limitations	Limited space for installation, concerns over solar genset size, mobility, security, and uncertainties of battery performance and lifespan are key technical challenges highlighted by interested customers

There are key initiatives and interventions can help overcome market barriers and help expedite the transition to cleaner energy gensets

	Market barrier	Recommendation overview	Overall score
Market intelligence	Limited customer awareness	Fund consumer awareness programs and support distributors to disseminate customer testimonials and directly engage potential customers	**4**
	Lack of consumer insights and market data	Support installation of smart meters for unexplored use cases, develop a customer management platform for PAYGo, and disseminate product-market fit training	**3**
Finance and investment	High upfront costs and financing challenges	Expand on the inventory financing services offered within GGF, grant facilities for distributors with larger inventory needs, and FX solutions to manage the Naira	**4**
	Inflexible customer financing model	**Support distributors to implement and market a variety of flexible payment options and promote the adoption of carbon credits to reduce consumer costs**	**5**
Ecosystem building	Non-existence and poor enforcement of quality standards	Develop quality standards guide in collaboration with the Standards Organisation of Nigeria (SON) and support the promotion of certified solar gensets	**2**
	Ineffective regulation, policies, and initiatives	Advocate for the implementation of feed-in-tariff systems, enforcement of existing supportive policies, and adoption of favourable importation policies	**3**
	Lack of local specialized skills and competencies	Support the increase in the number of maintenance staff with basic and advanced training for third parties and distributors, and setup mentorship programs	**2**
Product innovation	Technical limitations	Distributors to further analyse customer needs, including technical requirements, and work closely with suppliers to ensure products meet consumer needs	**3**

***Notes**: *Overall recommendation scores for overcoming key market barriers have been graded on a sliding scale based on two factors: (i) ease of implementation and (ii) degree of impact. Each factor is scored between 1 and 3, with 3 being the highest possible score for each factor, scores between 2-3 are to be considered after implementing other recommendations, scores of 4 should be implemented in the medium to long term, while scores between 5-6 should be implemented at the earliest opportunity*

Market overview

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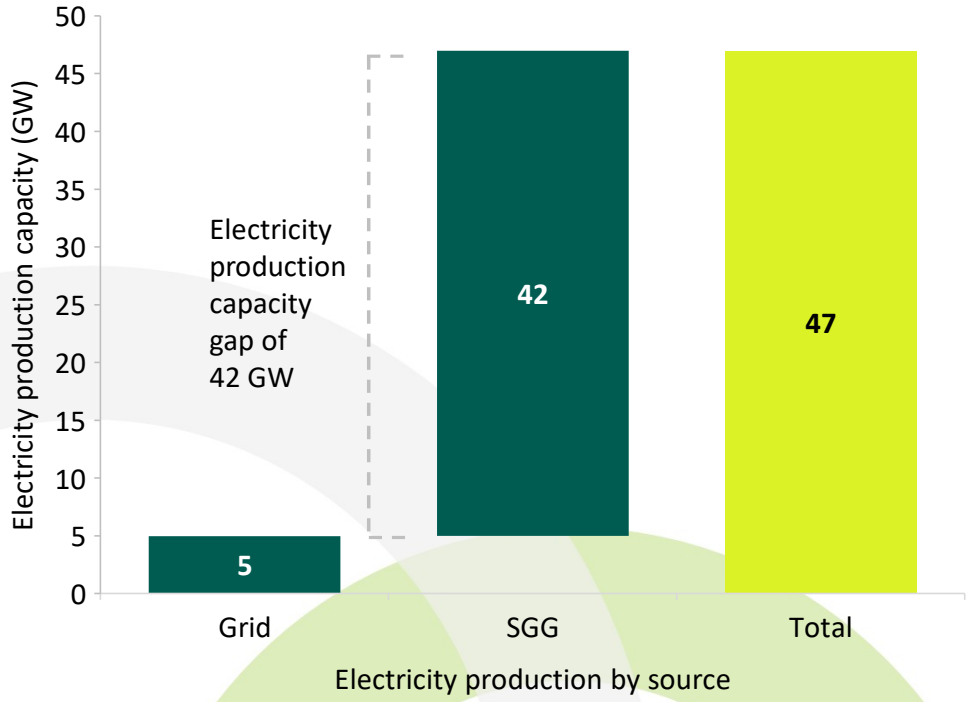
89% of Nigeria's installed capacity is provided by FFGs due to the grid's unreliability and lack of widespread availability

Electricity production capacity - grid vs small gasoline generators (SGG) [1, *]
(GW)



Nigeria fossil fuel electricity generation overview

- 86 million Nigerians lack access to electricity[2] resulting in the country being ranked as the **largest national electricity access deficit in the world**[3], only achieving an **electrification rate of ~60%** (urban: 86%; rural 41%)[3]
- The country's transition to the Power Holding Company Nigeria in 2005 **failed to resolve legacy issues faced by the national grid** (deteriorating infrastructure, energy loss, energy theft, and non-cost-effective tariffs) resulting in **households on average only receiving about 7 hours of grid connection per day**[3]
- Nigeria's fossil fuel electricity generation is produced from the national grid and fossil fuel generators, however, due to the grid's unreliability and incomplete reach, **89% of electricity production capacity in the country is sourced by small gasoline** generators alone[1, **]

***Sources**: 1) A2EI & Dalberg (2019), link; 2) Arise News (2023), link; 3) Sterling x Stears, (2022) link*
***Notes**: * Small gasoline generators (SSG) - Small gasoline generators are defined to have a capacity/size of 0-4kVA; ** small gasoline or petrol generators are but one of four generator types in the country*

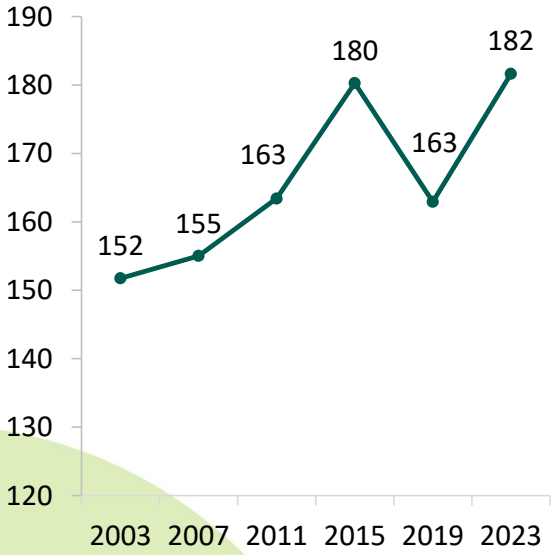
Poor infrastructure and a steady rise in electricity power consumption per capita will continue to drive FFG usage, resulting in 30M generators by 2030

Legacy issues affect the national grid, hindering its ability to supply reliable electricity[1]

- Deteriorating infrastructure
- Energy theft
- Energy loss
- Non-cost-effective tariffs

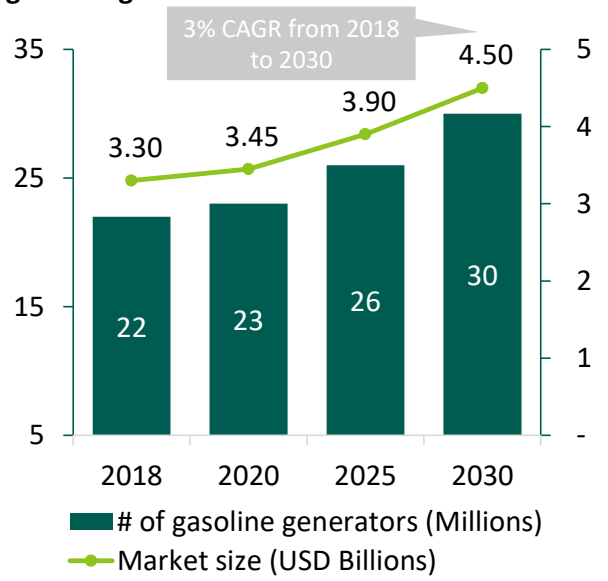
Electricity consumption per capita has risen by 20% between 2003-2023

Electricity power consumption[2]
(kWh per capita)



Legacy grid issues and rising electric consumption will contribute to the ongoing growth of FFGs

Projected number and market size of gasoline generators



***Sources**: 1) Sterling x Stears (2022), link; 2) Our World in Data, link; 3) A2EI & Dalberg (2019), link*

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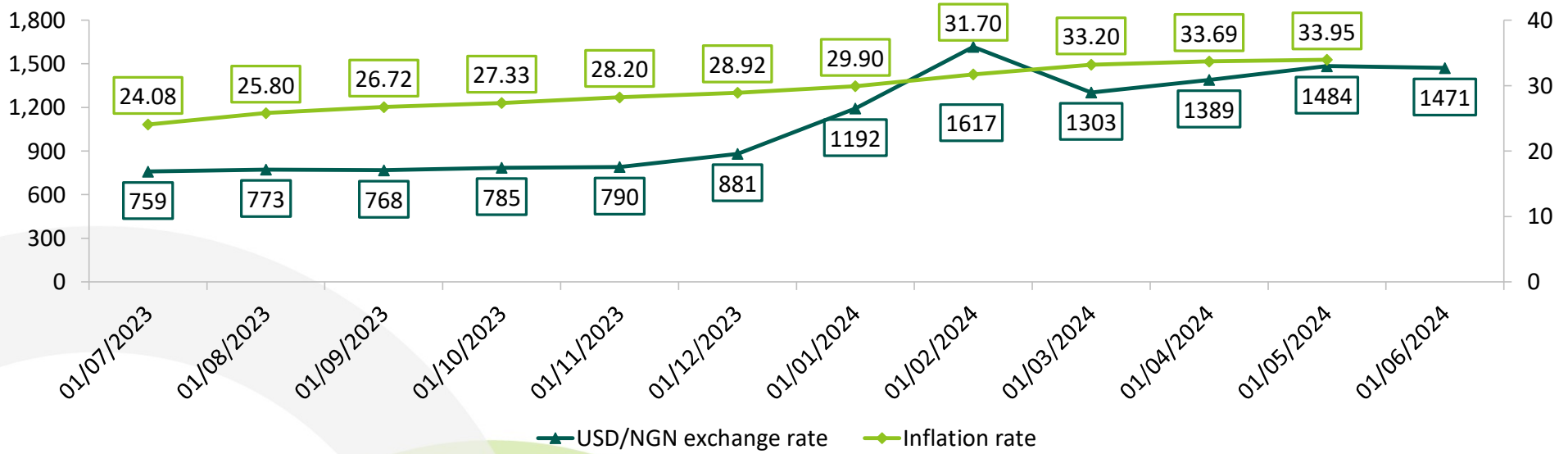
Despite the continued growth, FFGs are increasingly expensive due to record high fuel prices, the continued depreciation of the Naira, and soaring inflation

Since June 2023, the Naira has depreciated 48% against the dollar[1] while inflation rose from 24 to 33%[2]

USD vs Nigeria currency exchange and monthly inflation rate



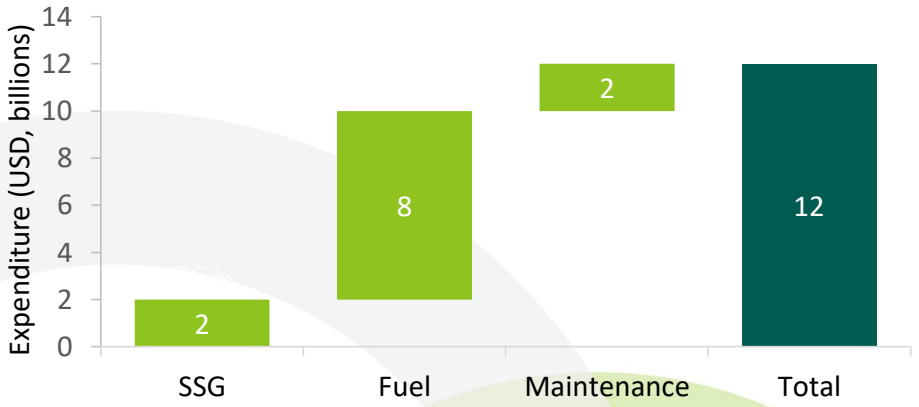
Between June 2023 and June 2024, petrol prices hit an all-time high in Naira, however, maintained the same price range in USD (0.4-0.5)/ litre, year on year[3] due to the depreciation of the Naira. This depreciation, coupled with the continued rise in inflation, had made ownership and the operation of generators significantly more expensive in local currency

***Sources**: 1) Investing – Financial Markets (2024), link; 2) Trading Economics (2024), link; 3) Trading Economics (2024), link*

Annual spend on small gasoline generators, which are the most prevalent in Nigeria, stands at $12bn, with fuel expenses being the main contributor

Total annual expenditure on small gasoline generators (typically found in households) is $12 billion[1]

Distribution of total annual expenditure on small gasoline generators[2,*]
(USD, billions)



Total individual cost over 8-9 years: $4,500[1]

Fuel costs are continuously the main expenditure for gasoline generator owners

- **Fuel – 67% of total expenses**: Annually, Nigeria spends $8 billion on diesel and petrol[2] to power generators, such high fuel costs have been a leading cause for the failure of small businesses since fuel expenditures are double the average cost of grid electricity[3]. High fuel costs have also been a main contributor to increased interest in transitioning to cleaner energy generators.
- **Generator costs – 16% of total expenses**: A typical small gasoline generator found in households and markets costs ~$150[2]; small generators have an optimal life span of only 5 years, which is a quarter of the optimal life span of Solar gensets
- **Maintenance and repair – 17% of total expenses**: Based on poor quality, poor storage, and over-usage, generators consistently need repairs and maintenance[2]

During our consultations, cost continued to be the number one complaint and worry about running FFG, as fuel costs in recent times have reached highs of $0.43 per liter[3]

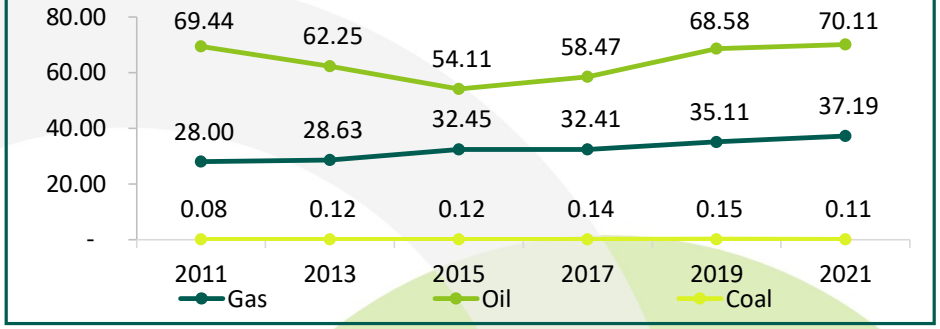
Sources: *1) A2EI & Dalberg (2019), link; 2) IFC (2019), link; 3) Okay Nigeria (2024), link*
Notes: ** Small gasoline generators are defined to have a capacity/size of 0-4kVA; ** Small gasoline generators are the most common type of generator owned by Nigerian households, thus, analysing their cost profile is key to finding opportunities to catalyse solar transition*

Beyond costs, FFGs are also incredibly harmful to the population and increase lung cancer risk, impaired hearing, and fire incidents

Air pollution

- FFG emissions have been linked to the harmful **contribution of emissions of $PM_{2.5}$, SO_2, NO_x, CO_2,** and other pollutants[1,*]
- Between 2008-2014, **10,000 deaths were caused by FFG emissions** in Nigeria[2]
- FFG emissions also have impacts on non-communicable diseases as **increasing the risk of lung cancer by 70%**[2]

Nigeria's CO_2 emissions by source 2011- 2023[2]
(Million, tones)



Noise pollution

- Common complaints cited by Nigerian residents against FFGs is the **significant noise pollution** they generate, with >2/3 of Nigerians reporting impaired hearing[2]
- The average **noise level of typical generators in Nigeria is in excess of 90db**, above the recommended limits of the WHO
- Studies have shown that long-term noise pollution exposure is linked **to increases in stress & illness**[3]

Fire threats

- Due to the **combustible nature of FFGs and its fuel sources, along with inadequate implementation of generator safety measures**, FFGs are prone to fire incidents
- As a result, fossil fuel generators have been attributed to **causing 10% of fire-related incidents in Nigerian markets**[2]

With the rising costs of fuel and increasing environmental concerns, Nigeria has begun its transition to cleaner, long-term cost-effective solar gensets and more broadly other solar pv products

***Sources**: 1), IFC (2019), link; 2) All-On (2021), link; 3) A2EI & Dalberg (2019), link; 4) Ibhadode et al (2018), link;*
***Notes**: *PM – particulate matter; SO_2 – Sulphur dioxide; No_x- Nitrogen oxide; CO_2 – Carbon dioxide*

While there are multiple clean energy options, our study focused on solar gensets primarily due to their low cost, efficiency, and use-case adaptability

There are several alternative clean generator options available in the market including:

Solar generators (gensets)

For this research, we've defined "solar gensets" as any AC-powered solar technology capable of directly displacing FFGs, they typically consist of solar panels, batteries, inverters and/or controllers.[1]

Solar gensets can be segmented into four groups by electricity production capacity[2] (see supply-side assessment for more detailed info. on each segment, slides 16-23)

Other clean energy technologies[3,4,5]

Wind Turbines

Use mounted blades and turbines to harness kinetic energy from wind and convert it into electricity

Hydroelectric

Use turbines to harness power from flowing water, typically from rivers and dams

Fuel Cells

Use electrochemical processes to convert fuels directly into electricity

Biogas

Rely on the combustion of methane produced from the anaerobic digestion of organic matter

Biomass

Rely on the combustion of organic materials to drive a generator and produce electricity

CHP*

Use a single fuel source to produce both heat and electricity

Rationale for report's focus on portable and inverter + solar panel systems

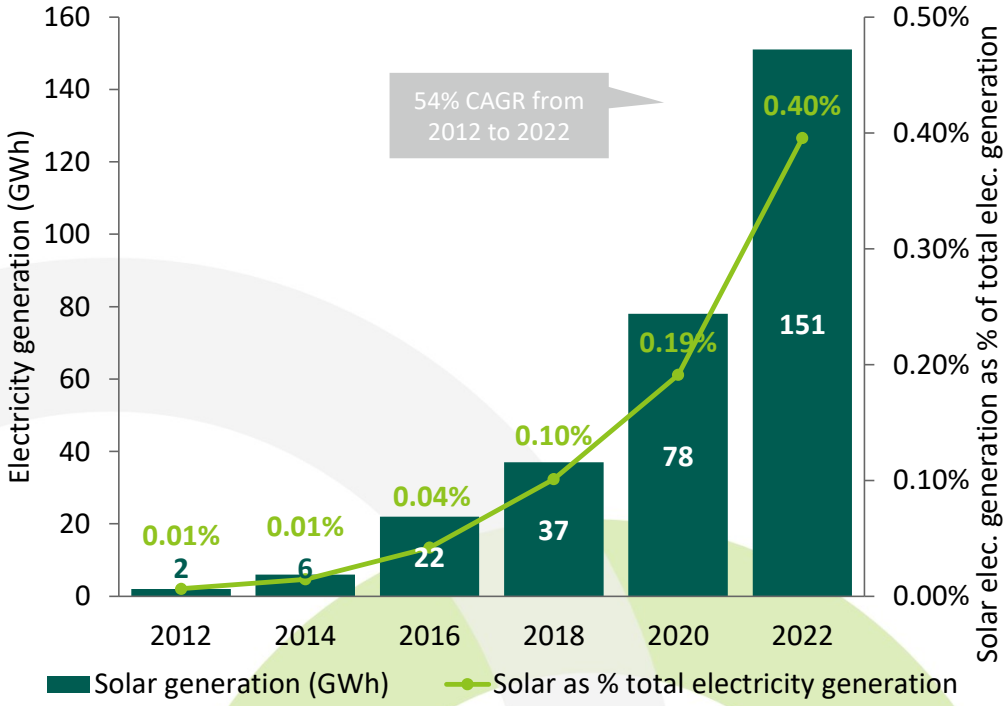
Solar backup has proven to be the most efficient replacement for FFGs

- Solar genset energy has a lower busbar cost compared to other clean energy options, driven by technological advancements
- Solar gensets are more efficient, with relatively small energy losses arising from combustion, conversion and storage processes
- Solar gensets' electricity production capacity can be scaled up and applied across a variety of technologies and systems, ranging from SHS to mini-grids
- Comparative to other clean energy solutions, solar gensets have lower space requirements

***Sources**: 1) Palmetto (2024), link; 2) Hansen et al (2015), link; 3) Iberdrola, link; 4) NRDC (2022), link; 5) HAL Open Science (2023), link;*
***Notes**: * Combined Heat and Power - CHP*

Solar gensets' technical capabilities and decreasing costs make them an excellent alternative to FFGs, reflected in the market's 54% CAGR since 2012

Nigeria solar PV electricity generation in GWh & percentage of total electricity generation 2012-2022[1,*]



There have been some positive trends in the Nigeria Solar PV electricity generation sector

- To encourage the adoption of renewable energy sources, the government has instituted a range of **supportive policies including the National Renewable Energy Action Plan** (NREAP)[2] and **NERC's Guidelines on Distribution Franchising**[3]
- Solar PV modules have **experienced a drastic fall in prices**, falling from USD 0.381 / kWh to USD 0.057 / kWh (an 85% decrease)[4,*], however, the significant up-front costs of Solar PV (e.g., batteries and inverters) remain a major barrier, limiting widespread adoption
- The volatility of fuel prices especially in local currency in the last four years has acted as a 'push-factor' for consumers to transition to Solar PV
- **$227M has been invested** in Solar PV, with an estimated **$1.3B secured funding awaiting allocation** into the country[5]

Despite the positive trends exhibited in the Solar PV market, significant market barriers exist which hinder its rapid adoption (See *Market Barriers* section, pgs. 33-38)

Sources *1) IEA (2023), link; 2) IEA (2015), link; 3) KPMG (2020), link; 4) IRENA (2020), link; 5) World Bank (2024), link*
Notes*: * Solar PV electricity generation sources include residential roof-top systems up to utility-scale power generation installations; ** Solar PV modules - cells are connected together in chains to form larger units known as modules or panels*

Supply-side assessment

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FFGs are typically imported from China and India, while the supply landscape is characterized by a variety of players serving the continuous growth in demand

Fossil fuel generators supply assessment

Overview	Nigeria is the largest user of fossil fuel generators in Africa, accounting for almost half (18 TWh of power) of Sub-Saharan Africa's back-up generating capacity (40 TWh)[1]
Market Trends	There have been significant technological improvements on the FFGs over the years, including improvements in fuel management efficiency, automatic controls for ease of use and emergence of hybrid systems (combining fuel and natural gas)
Manufacturing & Production	Most generators are manufactured outside of Nigeria and imported from China and India.[2] There are three main FFG models: petrol and diesel, which are the most prevalent, and natural gas
Distribution Chain	The main distribution channels for fossil fuel generators (FFGs) across Nigeria include local retail stores, online stores, authorized dealerships, and informal markets that sell power generation equipment alongside other electrical components
Regulations	In November 2015, the Nigerian Customs Service (NCS) announced a ban on the bulk imports of small generators (0-4kVA)[3, 4,] with the Senate passing a bill in 2020 enforcing 10 years imprisonment for bulk generator distributors.^ In May 2023, Nigeria announced the end of its fuel subsidy, increasing the running costs of FFGs

Number of suppliers

~ 80-100 Suppliers[5]

Est. market size, 2030

30M units

Avg. annual importation value**

USD 538 M[7]

Sources: *1) Africa Energy Outlook 2019, Link; 2) Trade Map, Link; 3) Daily trust, Link; 4) Resolution law NG, Link; 5) Volza Grw Global, Link; 6) A2EI & Dalberg (2019), Link; 7) Analysis of ITC data, Link*
Notes: ** Electric motors and generators (excl. generating sets) **Includes Electric motors and generators (excl. generating sets) and electric generating sets and rotary converters; ^ Bulk = >1*

There are four fossil fuel generator types found in Nigeria which can be segmented by fuel type and installed capacity

Type	Characteristics	Installed capacity	Relevant use cases*
Small petrol or diesel	Typically powers small household appliances and lighting for users in all regions of the country; producing high levels of noise pollution	<2 kVA	Residential users and informal standalone businesses in MSME markets
Small-medium diesel	Commonly utilized for more small-scale commercial operations in peri-urban/urban areas and for households with relatively high energy needs	5 kVA – 15 kVA	Wealthy residential users, standalone business shops within formal MSME markets, and workshops
Medium diesel	Adopted by larger-scale non-residential users; typically found in urban areas and central public facilities within each of Nigerian states' capitals	15 kVA – 100 kVA	Commercial businesses, hospitals, hotels, Educational institutes and small industrial operations
Large diesel	Essential for off-grid industrial operations, core federal and state institutions, and large commercial complexes found in urban areas	>100 kVA	Medium and large industrial operations, data centres, shopping malls, and Educational buildings

Sources: *1) IFC (2019), link*
Notes: ** Relevant use cases listed are not exhaustive to applicable use cases found throughout Nigeria*

Petrol-powered FFGs are most popular for residential use cases as it is inexpensive, while diesel-powered FFGs are more popular for C&I use

Overview of commonly purchased fossil fuel generators in Nigeria[1]

Users	Fuel	Size (kVA)	Cost (USD)*	Photos
Residential	Petrol	• 1-1.5 • 2-2.5 • 3-4 • 5-6 • 7-8 • 10	• USD 130-165 • USD 182-364 • USD 200-586 • USD 254-1,513 • USD 500-1,382 • USD 1,026-1,973	 
Commercial & Industrial	Petrol	• 2.5-10	• USD 315-987	 
	Diesel	• 9-1000 • 1000-1750	• Sizes and costs of C&I gensets differ based on business needs	
	Natural Gas	• 350-750 • 1500-2500 • 20-1000		

Additional insights: The optimal life span for generators vary by the sector type - small gensets for residential use range from 3-5 years, while medium range from 5-9 years, and much larger industrial gensets can function optimally for >10 years. The noise levels range from 50-80 decibels[8]

***Sources**: 1) OCA consultations; 2) Firman, Link; 3) Sumec, Link; 4) Scanfrost, Link; 5) Haier Thermocool, Link; 6) Mikano, Link; 7) Perkins, Link; 8) Bison, Link;*
***Notes:** *All costs were converted from Naira to USD using current day prevailing rate; $1 = N1520.5*

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The supply side of FFGs in the market can be split between distributors and OEMs, distributed respectively by their installed capacity

***Notes**: * OEMs – Original Equipment Manufacturers (these manufacturers do not manufacture in the country)*

The growth and recent plateauing of solar genset sales in Nigeria can partially be explained the closure of the Nigerian Electrification Project (NEP)

Solar generators supply assessment

Overview	The contribution of solar home systems to Nigeria's energy mix grew from 2.1MW in 2016 to 48.2MW in 2022[1] (of which ~75% was contributed by >50W systems). Renewables accounted for 25% of power generation, with solar PV accounting for 0.4% of total generation (hydro accounted for the rest of the renewable generation)[2]
Market Trends	The annual sales volume of solar energy technology increased from 240K units in H1 2021 to 729K in H2 2023[3]. However, the end of the subsidization for larger systems under NEP's RBF has been speculated to contribute to the plateauing of PAYGo sales
Distribution Chain	Most brand owners sell their products through trade channels, independent agents, and door-to-door sales networks, while some have branded shops serving as retail outlets and mini-depots. MFIs sell to individuals or organized groups, mostly in cities
Key players	An ACE study identified 99 unique SHS brands[4], with market led by d.light, SunKing, and Saroda; REA qualified 62 companies under NEP distributing verified products[5]
Financing	There is limited financing for traders; traders receiving formal financing and supplier credit are <5% and 17% respectively. Most households and MSMEs make upfront cash payments[3] although financing models like energy-as-a-service (asset ownership remains with the financier) and energy-as-an-asset (asset ownership is ultimately transferred to the customer) exist usually following a down payment of 10–20%, with loan tenors ranging between 8–36 months

Number of suppliers

~ 60-99 Suppliers[4,5]

CAGR (H1 2021–H2 2023)

20%[3]

H2 2023 sales volumes

730K units[3]

Sources: *1) IRENA (2023), link; 2) IEA (2023), link; 3) GOGLA (2023), link; 4) ACE-TAF (2021), link; 5) Consultation with REA*

Notes: ** NEP - Nigeria Electrification Project; **ACE- Africa Clean Energy Technical Assistance Facility, Energy as an asset is offered on a 10-year lease by BBOXX; ^Soler energy technology- lanterns, multi-light systems, solar home systems; ^^Solar genset is defined in previous slides (ES & Slide 13); *** MFI – Microfinance Institution, bodies specifically established to support business development and community empowerment, especially owners of small business entities or MSMEs*

We have defined the "solar genset market" into four groups, all which can help replace FFGs and serve customers with varying needs

Type[1]	Characteristics	Installed capacity	Relevant use cases*
Solar home systems (SHS)	AC-powered, medium-sized solar systems designed to meet the energy needs of households unmet by the grid. Powering multiple lights, fans, TVs and radios, and small fridges	10-300 W	Residential users
Stand-alone 'institutional PV systems'	Independent solar power systems (typically larger than SHSs) composed of solar panels and batteries supplying power for more demanding appliances such as washing machines and fridges	500-1000 W	Small government public institutions (schools, hospitals, health clinics), MSMEs markets
Mini-grids	Consist of a network of solar panels and batteries that supply electricity to small rural off-grid communities or cluster of buildings	5 kW – 1 MW	Rural utility infrastructure, small scale rural commercial operations
Large-scale, grid connected PV systems	Extensive solar power installations connected directly to the national grid. They include large solar farms with significant capacity, capable of powering high volumes of homes and businesses	1-50 MW	Medium to large scale rural commercial operations and IPPs

Most solar genset technology suppliers and distributors in Nigeria either have specific focuses on 1-2 of the technologies listed above or have a variety of solar options customized to individuals, businesses, or community needs.

***Sources**: 1) Hansen et al (2015), link; 2) OCA consultations*
***Notes**: * Relevant use cases listed are not exhaustive to applicable use cases found throughout Nigeria*

Several products exist in the residential segment to cater to the energy needs of all income groups, whereas commercial products are often customized

Overview of commonly purchased solar technologies which can displace FFGs in Nigeria[1]

	Product/Segment	Size (Wp)	Cost (USD)**	Suppliers*	Example	Photos
Residential segment	Charging capsule	3W	USD 197	Reeddi, Saroda	Reeddi capsule	
	Solar lanterns	5.5W	USD 5-55	D.Light, SunKing		
	Solar home systems (panels only)	10-80W	USD 40-168	D.Light, SunKing, Salpha, Solar Talkers	Sun King Home 200X Plus	
	Solar home systems (panels, inverters and batteries)	500-1000 W	USD 165+	D.Light, SunKing, Wiices	D.Light iMax 10	
Other segments	Institutional	(100W-5 kW)	Customized to business/project requirements			
	Commercial and industrial (C&I)	(10 kW-2MW)		Daystar, Chromevolt		
	Mini-grids	(5 kW-1 MW)		A4&T Power, Havenhill Synergy, Rensource Energy		
	Utility-scale	(>5 MW)				

***Sources**: 1) OCA consultations*
***Notes:** * The Suppliers listed above is not an exhaustive list but just a list of some active players **All costs were converted from Naira to USD using the current day prevailing rate; $1 = N1520.5*

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Several distributors were identified for each customer segment, with fewer players in large scale utilities

Most suppliers offer more than one product type, the above table highlights the segment in which the suppliers are commonly known for. For example, A4&T Power Solutions offers SHS systems and commercial & industrial solar solutions, but best known for Mini-grids.

***Sources**:1) Get.Invest, link*

Generator Customer Use Cases

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As part of our study, we focused on key FFG customer use cases to better understand customer needs; We made our selection using a scoring approach

Current FFG usage
The extent of reliance on FFGs as primary backup energy source and significance of resulting economic impact of transition

Desire to transition to Solar
The willingness of a particular use case to explore and adopt cleaner energy genset solutions as an alternative to traditional FFGs

Scoring rank
3 - Maximum score, potentially >10K units for scale
2 - Moderate score, potentially 2-10K+ units for scale
1 - Low score, potentially <2K units for scale

Cut-off: Minimum score for consideration of 5

Included within scope of study
Excluded from scope of study

Use case selection **methodology**

Use Case	Current FFG usage	Desire to transition to solar	Overall score
Household	3	3	**6**
MSME Markets	3	3	**6**
Universities & Schools	2	3	**5**
Primary Healthcare Centres	3	3	**6**
Hotels	3	2	**5**
Farms	2	2	**4**
Refugee camps	2	2	**4**
Commercial & Industrial buildings	2	2	**4**

ASSESSMENT OF IDEAL USE CASES TO TARGET FOR SOLAR TRANSITION
Use cases most likely to transition to solar in Nigeria could be Healthcare Centres, Hotels, and Universities; this is because of their (i) requirement for day-round electricity supply, (ii) ability to pay and (iii) available space to accommodate the solar panels.

Nigerian households represent the largest impact opportunity when transitioning from FFG to solar gensets due to their sheer scale

Use Case	Overall comments/justification
Household	• Being the largest customers of FFGs, there is a high potential for scaling clean energy genset solutions across residential areas, coupled with the ability to install smart meters for monitoring energy consumption
MSME Markets	• Micro, Small and Medium-sized Enterprise markets also represent a significant segment of the FFG market, with research showing a desire for reliable and cost-effective energy solutions amongst these MSMEs, making them a viable target focus for scaling clean gensets
Universities & Schools	• Educational institutions have a strong incentive to transition to sustainable energy sources and can serve as influential adoption drivers within their communities
Primary Healthcare Centres	• Recent efforts and investments from different sector players to improve electrification rates within the health sectors, as well as the proof of concept by the few HFs already using cleaner gensets, presented this use case as an attractive option for initial focus with a potential for broad implementation
Hotels	• The hospitality industry's constant need for electricity, ability to leverage from mixed energy sources and the significant potential for scale make them a good use case focus area for this research

***Notes**: * These unselected use cases are still great examples of the dependency on fossil fuel generators by citizens of the countries and transition opportunities can still be explored around them in the future*

Initial secondary research of the 5 customer use cases shows a fairly narrow spectrum of energy needs between customer types

Use case	Median monthly consumption (kWh)**	Median monthly fuel spend (USD)**	Market size*	Peak usage	Median daily usage (hours)	Most common generator type	Size of generators
Households	7.4	12.1	16,800,000	Evenings	2.0 hours	Petrol generators	0-4kVA
MSME Markets	7.5	12.2	1,200	Day time	2.2 hours	Petrol generators	1-5kVA
Universities & Schools	4.3	7	265	Day time (particularly noon); seasonal demand in-line with school breaks	1.5 hours	Diesel generators	400-1,000**kVA** (Universities) 1.5-3 kVA (Schools)
Primary Healthcare Centres	6.9	10.3	34,000	Day time	2.2 hours	Mostly diesel	**PHCs:** 2.8-4.8kVA
Hotels	43.7	71.3	13,400	Peak tourism periods	3.1 hours	Mostly diesel	1-3kVA (with a few 7-30kVA)^

To estimate data in this section, we used a mix of primary data collected by 492 smart meters installed by A2EI and secondary research from a variety of publicly available resources to collect information for all seven-comparison metrics used in the above table

Sources: *1) Data is sourced from A2EI metering; 2) Lambert, link*
Notes*: * Market size = Total number of users within use case, not # of units, for example Nigeria has about 13,400 hotels that utilise fossil fuel generators; ** Average monthly consumption and monthly fuel spend are for generators only; ^ Larger hotels were not part of this study, but have energy needs up to 15MW²*

17M households spend ~$12.10 per month on fuel, equivalent to a total annual spend of $2.5bn, making it one of the largest fuel expenditure markets

Key data and impacts

40%

of Nigerian households own fossil fuel generators[3]

$12.10

Median monthly household fuel spend[4]

0-4kVA

Avg. generator size range[4]

Description

- Households use fossil fuel generators (FFGs) as a critical energy backup due to the unreliable electricity grid, which provides power for only **~8 hours a day;** on average Households seek electricity for **15 hours/day,** with the remainder of their needs being met by generators.[2,5] But due to costs, the median daily usage is 2 hours[4]
- The major customers of FFGs are often found in **urban & and peri-urban areas (84%** of the population in these areas use FFGs); these areas typically have **higher purchasing power**, enabling affordability for generators & fuel
- In **rural areas, only 20%** of the population uses FFGs due to lower purchasing power[3]
- Households use FFGs to power appliances such as **refrigeration, cooking equipment, and electronic devices**

Usage profile

- ***Peak usage:*** The peak usage of FFGs occurs in the **evening/nighttime[4]** when residents are at home for ~7hours[2]; outages occur throughout the day and night and are rarely scheduled
- ***Type of generators*:** Mostly **small petrol generators**; petrol generators are more prevalent because of the cheaper (although less efficient) fuel[4,5]
- ***Generator lifetime:*** Typical generator lifetime is **5 years**[1]
- ***Fuel consumption:*** Median monthly fuel consumption is **14.8 litres[4]**
- ***Energy consumption:*** Median monthly energy consumption is **7.40 kWh[4]**

Survey insights^

- ***Total respondents:*** 104
- ***Brand:*** Firman (33%), Tiger (21%)
- ***Avg. life:*** 5+ years (59%), 2-5yrs (36%)
- ***Capacity:*** 3kVA (33%), 1kVA (24%)
- ***Maintenance:*** $3.40 monthly
- ***Median monthly fuel cost:*** $12.10

Considerations for transitioning to cleaner gensets

- Solar gensets provide **cost savings over time**, but **high upfront cost** (2.6x that of FFGs) acts as a major adoption hurdle across all income levels[5]; the survey showed that all respondents were open to transitioning to solar with easy financing as the leading incentive
- However, **rising fuel prices** (4x between 2020 and 2023) are a significant incentive for households to transition to cleaner gensets as petrol accounts for 67% of the yearly FFG costs; solar gensets **become cheaper after 4-5 years,** if financed appropriately[1,*]
- Nigerian households tend to focus on total cost rather than daily rates; therefore, **flexible financing like Energy as a Service, PAYGo or lease to own[**],** is crucial to enhance affordability and adoption. However, selling small solar gensets yields low margins within these financing models, therefore suppliers need substantial quantities for suppliers to achieve sustainable profits[5]

***Sources**: 1) A2EI & Dalberg (2019); link; 2) Sterling x Stears (2022), link; 3) Federal College of Forestry, Forestry Research Institute of Nigeria (2022), link; 4) A2EI Smart meter data 5) OCA calculation or consultation;*
***Notes**: * Price of a new solar home system is assumed to be $1,500, ** Energy as a Service - Service provider offers customer access to energy and management services based on reoccurring costs without any associated upfront costs; PAYGo – incremental payments for a genset, until the total cost is covered, after which ownership is transferred to the user; Lease to Buy – Allows customers to lease a genset for a set period with the option to purchase it outright at the end of the lease term; ^ Survey insights are reliant on respondents understanding of the question and honesty of their response, thus affecting overall results*

86% of MSME businesses depend on backup generators for reliable energy supply, having a massive impact on enterprises across the country

Key data and impacts

86%

Of Nigerian MSMEs own or use fossil fuel generators (FFGs)[2]

$12.20

Median monthly MSME fuel spend[4]

1-5kVA

Avg. generator size range[1,4]

Description

- **Micro, Small and Medium-sized Enterprises (MSME) markets refer to clusters of businesses that have a smaller number of employees (<50).** Businesses are commonly clothing stores, mobile phone stores, food markets, and bet shops, amongst others
- In Nigeria, there are **41+ million MSMEs and 1,200+ market clusters**, with Lagos state having the highest number of markets and Anambra state hosting the largest single market (Onitsha Main Market)[3,5]
- **The use of FFGs vary based on business needs within the marketplace;** FFGs aid in sustaining business activities in the face of power uncertainties, powering appliances like **computers** in bet shops, **refrigerators** in food/drink stalls as well as a variety of devices including **light bulbs, radios, TVs, and air conditioners[5]**

Usage profile

- ***Peak usage:*** Peak usage occurs **during the day**[4] when most shops are open; businesses have 1-5 hours of grid electricity during typical business hours and depend on FFGs for the remaining business hours (1- 4 hours); at night demand for electricity is reduced[1]
- ***Type of generators:*** Most shops/markets opt for **petrol generators** to spend less on fuel, but users with comparatively higher energy needs use **diesel generators**, which are more fuel-efficient[4,5]
- ***Generator lifetime:*** The typical generator lifetime is **5 years**[1]
- ***Fuel consumption*:** Median monthly fuel consumption is **15 litres[4]**
- ***Energy consumption:*** Median monthly energy consumption is **7.50 kWh[4]**

Survey insights^

- ***Total respondents:*** 204
- ***Brand:*** Firman (27%), Tiger (18%)
- ***Avg. life*:** 5+ years (60%), 2-5yrs (19%)
- ***Capacity:*** 2-3kVA (56%), 1kVA (18%)
- ***Maintenance:*** $3.40 monthly
- ***Median monthly fuel cost:*** $12.20

Considerations for transitioning to cleaner energy gensets

- To reduce upfront capital requirements, MSMEs need **flexible financing models like Energy as a Service, Lease to Buy, or PAYGo** which have proven to have levels of early successful (e.g., d.light and ChromeVolt)[5]
- MSEs within the same market cluster can **share solar systems** to reduce financial burden, however, according to customer insights, **most businesses would rather self-own its backup energy systems[1]**
- Businesses are open to switching due to the **noise, air pollution, and the high maintenance costs and labour required for** FFGs[1]

***Sources**: 1) A2EI (2019); 2) GIZ (2015), link; 3) National Survey of Micro Small & Medium Enterprises (MSMEs) (2017), link; 4) A2EI smart meter data; 5) OCA consultation*
***Notes**: ^ Survey insights are reliant on respondent's understanding of the question and honesty of their response, thus affecting overall results*

Educational institutes: We analysed both universities and schools in this research, but with metering data and survey insights only available for schools.

UNIVERSITIES

SCHOOLS

Key data and impacts

~265
Universities use FFGs[1]

400-1,000kVA
Avg. university generator power range[2,*]

$7
Median monthly fuel spend per school[3,*]

1.5-3 kVA
Avg. school generator power range[3,***]

Description

- **Universities are the main users of fossil fuel generators among educational facilities,** particularly when located in rural regions, which have highly unstable power infrastructure
- **Schools and education and technology colleges**[**], both public and private, also use generators to maintain essential services during electricity shortages *(this is where smart meters were placed)*
- For this use case, we analysed universities and schools, with the latter having metering data
- Most schools depend on public grid electricity as the primary source of energy, with **FFGs as their backup, while few use solar gensets**
- Generators power **space cooling machines, lighting, computers, lab machines, refrigeration, cooking electronics,** etc.[2,3]

Usage profile *(for schools only)*

***Peak usage*:** Schools experience peak electricity demand during **daytime hours**[4] and the months when classes are in session (Sept-May), however, back-up energy system use is relatively low, averaging only 1.5 hours per day[3] for per generator
***Type of generators*:** Mostly diesel generators[3,4]
***Generator lifetime*:** The typical generator lifetime is **20 years**[4]
***Fuel consumption*:** Median monthly fuel consumption is **8.6 litres**[3,*] while schools are in session
***Energy consumption*:** Median monthly energy consumption is **4.3 kWh**[3,*]

Survey insights *(for schools only)^*

- ***Total respondents:*** 19
- ***Brand:*** Firman (37%), Parsun (21%)
- ***Avg. life*:** 5+ years (100%)
- ***Capacity:*** 3kVA (68%), 1.5kVA (32%)
- ***Maintenance:*** $10.20 monthly
- ***Median monthly fuel cost:*** $7.00

Considerations for transitioning to cleaner energy gensets

- Educational Institutes, especially universities, need to evaluate **between opting for the replacement of fossil fuel generators on a per-building basis or the installation of solar mini-grids** to support the entire campus
- **Private (for-profit) institutes** may be able to afford the upfront capital requirements, while **public schools** could try to leverage government/NGO subsidies

***Sources**: 1) Nigeria University Commission, link; 2) Nile University of Nigeria (2023), link; 3) A2EI Smart meter data; 4) OCA consultations;*
***Notes**: *This data is indicative and not based on a representative sample. It comes from a single study conducted at Nile University in Nigeria. At this university, four generators are used, ranging in size from 400 kVA to 100 kVA, providing a combined system capacity of 2,600 kVA; **Colleges of education and technology are typically less populous, offering differing qualifications when compared to universities; ***Metering data is only for schools.^ Survey insights are reliant on respondent's understanding of the question and honesty of their response, thus affecting overall results*

Primary Healthcare Centres could transition to clean energy generators by leveraging their potential to attract donor grants and subsidies

Key data and impacts

34k

Primary Healthcare Centres (PHC) use fossil fuel generators (FFGs)[1]

$10.30

Median monthly fuel spend per PHC [5]

2.8-4.8kVA

Avg. generator size range[2]

Description

- Nigeria has ~**40k total Health Centres, of which 40% are not connected to the grid**[1]; given their critical electricity needs and the limited and unreliable grid access, **nearly all health centres in Nigeria use FFGs** either as primary energy source or as backup
- Primary Health centres (PHCs), which are 85% of all health centres, are **the first point of contact** for medical services and **serve 10k-20k people each**[1], are the main focus for this use case
- **57% of PHCs are grid-connected**[2] the remaining PHCs exclusively rely on fossil fuel generators for their electricity
- Electricity consumption varies **by capacity, occupancy, and appliances**; large **heath centres are typically located in urban areas with high population density and electricity demand**
- Health centres rely on generators for critical appliances such as **medical equipment, medicine and vaccine refrigeration, computers, and telecommunications**

Usage profile

- ***Peak usage*:** Peak usage of FFGs among PHCs is typically found in rural areas, averaging 2.2 hours a day, with peak energy demand occurring **during the day**[5]; PHCs typically receive 4 hours of grid supply, below the average of 6.8 hours[4] due to their rural location's weak grid infrastructure[2]; however, larger PHCs, typically in urban areas, require 24/7 power supply to meet patient demand
- ***Type of generators*:** Mostly diesel generators[5]
- ***Generator lifetime*:** Generator lifetime ranges from **5** - **20 years**[2]
- ***Fuel consumption*:** Median monthly diesel consumption is **13.8 litres**[5]
- ***Energy consumption:*** Median monthly energy consumption is **6.9 kWh**[5]

Survey insights^

- ***Total respondents: 79***
- ***Brand:*** Firman (88%)
- ***Avg. life*:** 5+ years (100%)
- ***Capacity:*** *1.5kVA (92%)*
- ***Maintenance:*** $3.40 monthly
- ***Median monthly fuel cost:*** $10.30

Considerations for transitioning to cleaner energy gensets

- **Lease-to-own model** could be suitable for PHCs as the majority (82%) are government-owned and may have a limited budget to afford the upfront cost of cleaner energy alternatives
- However, Healthcare centres are also more likely to receive **donor grants or government subsidies,** which would help support the upfront capital requirements when transitioning to cleaner gensets

***Sources**: 1) SEforALL (2022), link; 2) The Heinrich Boell Stiftung Nigeria (2018), link; 3) LinkedIn article EM-ONE (2023), link; 4) Business Daily Nigeria (2020), link; 5) A2EI smart meter data;*
***Notes**: ^ Survey insights are reliant on respondent's understanding of the question and honesty of their response, thus affecting overall results*

Hotels are one of the highest electricity consumers, and their for-profit model enables them to be early adopters of clean energy generators

Key data and impacts

13.4k

Hotels own fossil fuel generators[1]

$71.30

Median monthly fuel spend per hotel[4]

1-3kVA

Avg. generator size range[4,*]

Description

- Hotels only receive **6 hours of daily power supply from the national grid[3],** therefore, **relying heavily on backup fossil fuel generators** for an uninterrupted electricity supply (24/7)
- Electricity consumption varies by **hotel capacity, occupancy, and amenities**; the **largest electricity consumers are luxury and business hotels** located in major cities such as Lagos and Abuja.
- **Luxury and business hotels** have additional uses of FFGs for functional and leisure appliances such as **meeting/conference room equipment, gym equipment, swimming pool heating systems, kitchen food refrigeration, etc.**
- **Smaller informal and economy hotels** mostly use FFGs to power room appliances such as **TVs, mini-fridges, ACs, shower heaters, etc.**

Usage profile

Usage profile

- ***Peak usage:*** Occurs in **December, January, and April**[2] when hotels have higher occupancy in the periods around the Christmas and Easter holidays, on average these hotels use their FFG systems for 3.2 hours per day within an average operational window of 18 hours per day
- ***Type of generators*****:** Mostly **diesel generators**[4,5]
- ***Generator lifetime:*** Typical generator lifetime is **20 years**[5]
- ***Fuel consumption*****:** Median monthly diesel consumption is **87.4 litres**[4]
- ***Energy consumption:*** Median monthly energy consumption is **43.70 kWh**[4]

Survey insights^

- ***Total respondents:*** 74
- ***Brand:*** *Firman (55%)*
- ***Avg. life:*** 5+yrs (97%)
- Capacity: 1.5-3kVA (67%), 7kVA (20%)
- ***Maintenance:*** $5.00 monthly
- ***Avg. monthly fuel cost:*** $71.30

Considerations for transitioning to cleaner energy gensets

- Hotels could be **early adopters of clean energy gensets** given their **purchasing power** and other incentives such as significant **long-term savings on fuel costs, reduction in noise pollution, and eco-friendly marketing opportunities**
- Hotels require clean gensets with **technical specifications (e.g. power levels, battery capacity) aligned with their high and continuous electricity needs;** Current research indicates there is a **lack of local supply of clean gensets** that can meet larger hotel demands, which will need to be addressed

Sources*: 1) Rentech Digital, link; 2) C. Okpala, H. Njoki, and P. Ako, link; 3) Premium Times, link; 4) A2EI smart meter data; 5) OCA consultations 6) Lambert, link*
Notes*: ^ Survey insights are reliant on respondents understanding of the question and honesty of their response, thus affecting overall results; *Off-grid hotels included in the study showed significantly higher energy capacity (many with 7kVA and above) compared to their on-grid counterparts, reflecting the need to provide consistent power supply for guest comfort. Larger hotels were not included as part of this study, but have energy needs up to 15MW (Lambert, link)[6]*

Market barriers

ZE-Gen.

Despite the implementation of policies and programs to push for greater usage of clean energy sources, adoption has been limited due to 8 market barriers

Despite promising growth in the wider Nigerian clean energy sector…

There have been several initiatives to help promote clean energy transition from the government and other ecosystem players:

- Nigeria Electrification Project (NEP) is a USD 550M initiative by the government of Nigeria intended to improve rural electrification by providing performance-based grants to reduce the cost burden of solar adoption on the end users through solar companies[1]
- SUNREF Nigeria supported by the French Development Agency, provides technical assistance and a credit line of USD70 million to SUNREF partner banks (Access Bank and UBA) to offer attractive terms (concessional rate loans, long tenors, grace period) for private sector stakeholders[2]
- The Solar Energy Fund is a USD 4 million fund financed by the Bank of Industry (BOI) to enable end users to acquire solar solutions. The fund is disbursed through Deposit Money Banks or Microfinance Banks with a single obligor limit of USD 0.22M, a 5-year tenor, 9% interest rate, and securitized by a commercial bank guarantee[4]

Despite these efforts, Nigerians still rely on fossil fuel generators as backup generators, indicative of a massive market opportunity for additional transition to clean energy generators. In this section, we explore eight key market barriers that have slowed the growth of clean energy transition in Nigeria

…the Nigerian clean genset market continues to be hindered by 8 key barriers

Market intelligence	
Limited customer awareness	Lack of consumer insights and market data

Finance and investment	
High upfront costs and financing challenges	Inflexible customer financing model

Ecosystem building		
Ineffective regulation, policies, and initiatives	Non-existence and poor enforcement of quality standards	Lack of local specialized skills and competencies

Product innovation
Technical limitations

Sources: *1) About NEP, link; 2) Energypedia (2023), link; 3) World Bank (2023), link; 4) Bank of Industry, link; 5) Afrobarometer (2024), link*

Gaps in market intelligence for both suppliers and customers serve as a critical barrier to help increase the adoption of solar generators

Limited customer awareness

Constraint: Demand side

There is a limited understanding among potential customers about clean alternative solutions such as solar gensets, the long-term cost savings and other associated benefits. Many customers have heard of solar but do not know how it works, who to buy from, or how it will reduce costs by avoiding ongoing FFG* maintenance and fuel costs.

Additionally, there is resistance to adopting these new technologies due to familiarity with traditional fossil fuel generators, coupled with a lack of trust in new technologies and their effectiveness. Change can be difficult. Research found that people who did not personally know others who used and were satisfied with solar products were more reluctant to switch from their familiar FFG.

Case study: Our survey showed that 43% of MSMEs did not know how solar gensets operated or the financing options available in the market, hence majority had no real perception of solar generators and relied heavily on reference from friends and other shop owners.

Lack of consumer insights and market data

Constraint: Supply-side

There exists knowledge gaps for suppliers and distributors as they face a lack of reliable market intelligence regarding consumer data such as customer preferences, energy consumption patterns, load profiles for various use cases, and financing capabilities.

This lack of comprehensive customer data contributes to the information asymmetry in the market making it challenging for suppliers and distributors to accurately assess the market, understand customer needs, develop appropriate products for different customer segmentations, build adequate distribution plans, and create effective strategies to increase consumer willingness to pay for these solutions.

Case study: A local bar owner with significant energy consumption needs, particularly for running multiple refrigerators, was unable to find a solar option that was both sufficiently powerful and affordable, highlighting the critical need for tailored product offerings based on accurate consumer needs.

***Sources**: 1) IFC (2021), link; 2) OCA consultations; 3) GOGLA (2023), link*
***Notes**: * FFG- fossil fuel generators*

Surveys and in-person consultations showed that financing is by far the biggest barrier to transition to solar for all use case customer types

High upfront costs and financing challenges for suppliers

Constraint: Supply-side

Distributors in the Nigerian market face substantial financial barriers due to the high capital requirements for importation of clean energy gensets and their components. While distributors can assemble clean energy gensets locally, the core components are not produced locally, necessitating importation which further increases costs tightening profit margins. The situation is further compounded by continuous foreign exchange fluctuations and long sales/repayment cycles, which increases overall business risk. Due to high capital expenditure requirements, distributors require significant upfront capital investments, which are becoming increasingly hard to secure, as evidenced by the 43% drop in investment in the global OGS* industry in 2023.[3]

Case study: A distributor struggled for months to secure a USD loan for importing solar gensets and simultaneously faces increased repayment issues with the continued depreciation of the Naira and customers reduced ability to afford payments in Naira tied to USD market prices.

Inflexible customer financing model

Constraint: Demand-side

Upfront costs for purchasing clean gensets pose the largest overall challenge for customers. Consultations revealed that **100%** of the customers identified cost as the most significant barrier to transitioning. Coupled with this, there is also a lack of customer-friendly financing options. As a result, many customers opt to purchase FFGs due to their inexpensive upfront costs. However, this decision often overlooks the longer-term cost savings that clean gen-sets provide over FFGs. Although progress has been made with the introduction of PAYGo and EaaS models, some consumers still find it hard to access these options from distributors and still perceive solar as more expensive than FFG. For larger systems, customers found batteries to be cost prohibitive often opting for direct inverters without storage capabilities, leading to the continued, albeit reduced, reliance on FFGs.

Case study: A barber in Lagos currently spends about N55,000/month on fuel & maintenance and has struggled to find a solar payment model, despite looking into PAYGo, that would reduce his monthly costs.

***Sources**: 1) IFC (2021), link; 2) OCA consultations; 3) GOGLA (2023), link*
***Notes**: * OGS – Off-grid solar*

At an ecosystem level, regulatory challenges and poor enforcement of quality standards are significant barriers, hindering solar gensets market growth

Ineffective regulation, policies & initiatives

Constraint: Supply-side

While supportive wider clean energy policies and programs exist (e.g., NEP's* Solar Hybrid Mini Grid Fund, Feed-in Tariff** for Renewable Electricity, etc.), the level of implementation of these policies and incentives for clean energy genset solutions is very low. Insufficient execution and limited understanding of regulations create uncertainties, which discourages private-sector investment. Additionally, punitive customs policies (i.e. recent 43% tariff increase) has made it more difficult and expensive to import, assemble, purchase (for consumers), and maintain solar gensets, due to high import costs on replacement parts.[2] Finally, as key programs like NEP come to an end, there is a need for more effective programs (i.e., Feed-in Tariffs) and to incentivize the uptake of solar and other clean energy solutions.

Case study: Consultations with suppliers and industry associations revealed a drop in demand once some key subsidy programs ended (e.g. NEP SHS programs, SNP^), indicating that government subsidy programs can be successful and should be continually available.

Non-existence and poor enforcement of quality standards

Constraint: Demand | Supply

The ecosystem lacks enforced quality standards, leading to widespread non-quality verified brands, price discrepancies, and a high presence of counterfeit products. Around 64% of traders have reported moderate to high levels of counterfeit products. Customers are often not aware of the requirement for official verification markers on products, so even highly recognizable and popular brands are sold without verification, furthering the confusion for buyers when the products are of low quality. This absence of a robust and enforced quality assurance framework creates an environment where the market is filled with low quality goods and consumers struggle to differentiate between quality products, further hurting their trust in solar genset technologies.

Case study: A hotel in Nasarawa purchased a solar genset, only to experience difficulties with storing energy as batteries stopped charging after some time, leading to growing distrust in solar gensets and a reluctance to invest further in such technologies.

Sources: *1) All-On (2021), Link; 2) Vanguard (2024), link; 3) OCA consultations*
Notes: ** NEP- Nigerian Electrification Program; ** Feed-in Tariffs – mechanism for solar power producers to sell excess electricity generated from solar installations back to the grid; ^ SNP- Solar Nigeria Programme*

The lack of sufficient specialized skills and while from a product perspective technical limitations pose a challenge to the growth of solar gensets

Ecosystem Building (cont.)

Lack of local specialized skills and competencies

Constraint: Demand | Supply

Although solar companies often offer warranty programs, the Nigerian market still faces a shortage of skilled personnel with the specialized technical expertise required to sell, install, and maintain clean energy gensets, especially in local communities, which is not the case for FFGs. This lack of competencies within the workforce sometimes poses significant challenges for suppliers, hindering their ability to effectively market, deploy, and provide after-sales support for the gensets. Additionally, the lack of a local presence from solar companies exacerbates this issue. Many customers interviewed indicated that they were concerned about the maintenance of solar gensets and would only consider purchasing one if an agreement with the supplier is made to include long-lasting local technical expert support and maintenance.

Case study: A government building that installed a 400kVA solar panel system had difficulties post-installation due to supplier technicians not being on the ground. These prolonged maintenance periods often led to frustration and agitation amongst staff.

Product Innovation

Technical limitations

Constraint: Demand

Potential consumers in the Nigerian market stated that a few technical hurdles impeded their adoption of clean energy gensets. These limitations include insufficient space for solar panel & battery installations, concerns over the size, mobility, and safety of gensets, and uncertainties related to battery performance and lifespan. Space availability, especially in urban areas and for consumers with limited ground/roof space, is a significant barrier to overcome. Furthermore, solar gensets often lack the portability and ease of movement provided by FFGs, which can be a hindrance for consumers who require a mobile power source. The risk of theft or vandalism of solar panel equipment is also of concern, as users seek the ability to lock away their genset when vacating their home or business for extended periods of time.

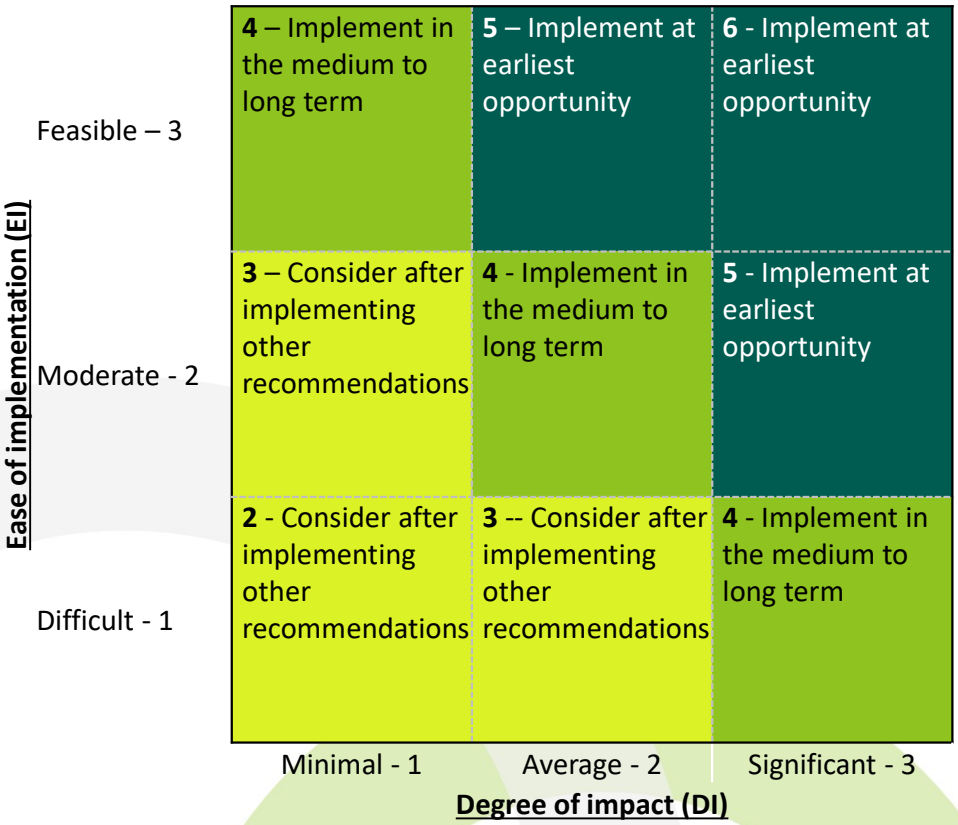
Case study: A hospital in Lagos is installing a 0.3MW solar system, noting that they encountered challenges in having enough space for the panels so decided to instead use a hybrid (grid-solar-FFG) model as they could not install enough solar panels to power their energy needs.

***Sources**: 1) IFC (2021), link; 2) OCA consultations*

Recommendations

ZE-Gen.

Recommendations for overcoming key market barriers have been graded on a sliding scale for ease of implementation and degree of impact



Recommendations have been assessed based on their ease of implementation and degree of impact

Assessment criteria: The scoring system assesses recommendations based on two key factors: ease of implementation and degree of impact

1. **Degree of impact (DI):** Evaluated across three tiers: minimal, average, and significant with scores ranging from 1-3, indicating the anticipated effect the recommendation will have on helping to overcome market barriers facing solar gensets
2. **Ease of implementation (DI)**: Categorized into three tiers: feasible, moderate, and high with scores ranging from 1-3, reflecting the level of difficulty in implementing the recommendation

Colour scheme: High-scoring recommendations are both easier to implement with high significance of impact translating to an emerald green colouring, while recommendations that have low scores are coloured green and light green

Assisting the market to integrate flexible financing mechanisms to lower up-front costs & increase customer repayment periods is key to catalysing solar

	Market barrier	Recommendation overview	Overall score
Market intelligence	Limited customer awareness	Fund consumer awareness programs and support distributors to disseminate customer testimonials and directly engage potential customers	**4**
	Lack of consumer insights and market data	Support installation of smart meters for unexplored use cases, develop a customer management platform for PAYGo, and disseminate product-market fit training	**3**
Finance and investment	High upfront costs and financing challenges	Expand on the inventory financing services offered within GGF, grant facilities for distributors with larger inventory needs, and FX solutions to manage the Naira	**4**
	Inflexible customer financing model	**Support distributors to implement and market a variety of flexible payment options and promote the adoption of carbon credits to reduce consumer costs**	**5**
Ecosystem building	Non-existence and poor enforcement of quality standards	Develop quality standards guide in collaboration with the Standards Organisation of Nigeria (SON) and support the promotion of certified solar gensets	**2**
	Ineffective regulation, policies, and initiatives	Advocate for the implementation of feed-in-tariff systems, enforcement of existing supportive policies, and adoption of favourable importation policies	**3**
	Lack of local specialized skills and competencies	Support the increase in the number of maintenance staff with basic and advanced training for third parties and distributors, and setup mentorship programs	**2**
Product innovation	Technical limitations	Distributors to further analyse customer needs, including technical requirements, and work closely with suppliers to ensure products meet consumer needs	**3**

To resolve limited customer awareness, ZE-Gen can fund consumer awareness initiatives and support distributors to directly engage potential customers

Recommendation overview: Fund consumer awareness programs and support distributors to disseminate customer testimonial, and directly engage potential customers

Market barrier addressed
Market intelligence: Limited customer awareness

Recommendation details

- Provide grant funding and support partnerships between distributors, advocacy groups and marketing firms to tailored launch awareness campaigns^ in high volume areas such as Abuja and Lagos, highlighting long-term savings and flexible payment schemes to ease customer concerns[1]
- Provide grant funding to local distributors to enable them to engage local marketing agencies to disseminate customer testimonials of users who have transitioned to solar through radio, TV, and other relevant social media channels^^ emphasizing the utility and long-term benefits customers derived from the installation of solar and battery technology
- Support local distributors to increase their market presence to increase opportunities for them to engage with potential customers and discuss customer concerns around transitioning to solar; Collaborate with local advocacy groups to persuade existing solar customers to communicate the benefits of solar products to their social networks[2]

Key considerations

- Effective customer testimonials campaigns will need to be tailored to fit customer profiles based on (i) regional needs, (ii) preferred marketing channels and (iii) primary transition concerns, requiring mobilization of significant capital and labour resources coordinated and funded by Carbon Trust, with additional funding provided by local solar distributors, assemblers, investors and other ecosystem players
- Local distributors may face resource constraints, such as limited marketing budgets and personnel, so they would require external funding from organizations such as Carbon Trust

GLOBAL SOLAR COUNCIL

Example:
- Consumer awareness programs – Global Solar Council 'Empowering people with solar PV'[3]

Overall recommendation score

DI* - score	EI* -score	**Total score**
1	3	**4**

Sources: *1) Use-case consultations; 2) Non-use case consultations; 3) Global Solar Council, link*
Notes: ** DI – Degree of impact; EI – Ease of implementation; ^ Awareness campaigns may include activities such as demonstration events and live testing opportunities for event attendants; ^^ Other relevant social media channels include Tik Tok, WhatsApp, Instagram, and Facebook*

ZE-Gen

Overcoming the information asymmetry will require increased smart-metering, product-market fit training and a customer management platform

Recommendation overview: Support installation of smart meters for unexplored use cases, develop a customer management platform for PAYGo, and disseminate product-market fit training

Market barrier addressed
Market intelligence: Lack of consumer insights and market data

Recommendation details	Key considerations
• Mobilize funding from investors & financiers to continue supporting the wide-spread installation of smart meters among all generator users to increase data availability to accurately assess the opportunity for solar, with an initial focus on under-explored use cases (e.g. industrial and commercial operations)^^ • Support distributors to make greater use of available customer data by replicating or promoting customer repayment platforms, similar to the platform implemented by GGF, enabling solar genset distributors to assess PAYGo customers' data to determine their creditworthiness • Collaborate with local facilitators to provide product-market fit training for solar distributors to assist them in better leveraging existing customer data to match their solar inventory against the needs of their target customer groups, such as (i) MSEs interested in mini-grid systems and (ii) households that require small portable solar systems^,^^	• Widespread installation of smart meters would be costly and require ongoing funding to keep the data up to date, however, exploration of data sharing agreements with existing suppliers can reduce this investment requirement • Setting up a repayment platform to monitor customer's loan worthiness will require high technical capacity and significant investment to execute, however, this may be circumvented by collaborating with GGF to leverage their existing platform • Developing impactful customer targeting training materials at scale requires tailoring to the varying internal technical capacities of suppliers and addressing the unique nuances they face, including regional differences, budgets, and energy demands of their target customers

Examples:
- Smart meter suppliers – The Smart Meters Company LTD[1]

Overall recommendation score

DI - score	EI -score	Total score
2	1	**3**

***Source**: 1) The Smart Meters Company LTD, link*
***Notes**: ^ Use cases consultations revealed that potential users had a strong preference for small portable solar systems that could be moved for safe storage due to theft-related concerns; ^^ Industrial and commercial operations includes but is not limited to office buildings, shopping malls, restaurants, data centres, agricultural farms, food and beverage processing facilities;*

ZE-Gen.

Purchasing cost for suppliers can be addressed through expanding GGF, grant funding for larger inventory needs and management of FX risks

Recommendation overview: Expand on the inventory financing services offered within GGF, grant facilities for distributors with larger inventory needs, and FX solutions to manage the Naira

Market barrier addressed
Finance and investment: High upfront costs and financing challenges

Recommendation details

- To lower barriers to access and mitigate transactional costs of purchasing solar gensets, Carbon Trust should replicate and build on (in-scale) the inventory procurement services offered by GGF, expanding the ranges of inventory amounts provided to distributors between $25K-$750K
- To combat importation pressures for distributors that require significant working capital ($750K+ to manage inventory), Carbon Trust should continue exploring the voluntary carbon credits market to better fund the GGF facility, with levels of revenue bookmarked to helping temporarily subsidize upfront costs of solar gensets
- Collaborate with foreign financial institutions to establish FX hedging for solar suppliers to mitigate Naira depreciation. Simultaneously, prioritize partnerships with local banks to secure essential local currency financing, helping distributors manage FX risk and access financing for solar genset imports in local currency

Key considerations

- To aid efforts to improve data availability in the market, the contracts given to interested distributors should outline clear terms of open data-sharing agreements aimed at aggregating users' usage profiles, rough geographical location, and power consumption
- Distributors might become reliant on grants rather than developing self-sufficient business models, potentially hindering market growth and resilience. As such funding in the medium and long-term should be tied to specific financial sustainability performance metrics
- Establishing such FX hedging or local funding guarantees requires considerable financial expertise and careful selection of financiers who are strategically and financially aligned with Carbon Trust's aims, delaying the timing of this recommendation's implementation

GGF

Example:
- Inventory procurement services for solar distributors – Green Genset Facility[1]

Overall recommendation score

DI - score	EI -score	**Total score**
3	1	**4**

***Source**: 1) Green Genset Facility (GGF), link*

ZE-Gen.

Distributors need to implement more consumer-friendly financing while the facilitation of carbon credit programs can significantly reduce up-front costs

Recommendation overview: Support distributors to implement and market a variety of flexible payment models through peer learning, and promote the adoption of carbon credits to reduce consumer costs

Market barrier addressed
Finance and investment: Inflexible customer financing model

Recommendation details

- Collaborate with solar distributors to assess the viability of integrating one or a combination of the following models (a) 100% cash payments, (b) PAYGo/lease-to-own, and (c) energy-as-a-service (EaaS) based on their target customers groups to accommodate their unique needs[1]
- Provide grant funding to reduce the cost of expensive batteries, which is a major barrier for being able to completely remove reliance on FFGs
- Engage in partnership with REEEA to assist individual MSMEs to form into cooperatives, unlocking carbon credits funding opportunities to reduce up-front cost of solar transition for the cooperative members[2]
- Organize or sponsor peer learning conferences and webinars where solar suppliers with innovative flexible financing models share insights and best practices with those offering limited financing options, guiding them to adopt and implement these flexible financing solutions

Key considerations

- Use case consultations revealed that potential users would only be willing to consider options (ii, and iii) if monthly payments were (a) equal to or less than the current monthly spend of ~$30[2] (b) based on electrical usage and (c) maintenance and repair guarantees were made for 2-4 years from the date of initial product purchase[1]
- When advertising cost-effective options to price-sensitive customers, distributors should highlight the downward trend of solar genset component costs (in dollar terms) and clearly outline the time to 'break-even' to showcase the comparatively low lifetime cost of solar[2]
- The adoption of innovative financing models by solar suppliers may be hindered by gaps in their understanding of the models and access to customer credit-worthiness data necessary for effective implementation

Examples:
- PAYGO distributors – Opti-Solar[3]
- EaaS ecosystem players peer learning opportunity – See For All 'Universal Energy Facility: Stand-alone Solar for Productive Use'[4] & ChromeVolt[5]

Overall recommendation score

DI - score	EI -score	Total score
3	2	5

***Sources**: 1) Use-case consultations; 2) Non-use case consultations; 3) Opti Solar, link; 4) SeForAll (2022), link; 5) ChromeVolt, link;*
***Notes**: ^ For payment options with ownership features users were willing to spend slightly than the $30 price point; ^^ hybrid lease-to-own involves users making monthly payments based on their energy usage*

Strengthening standards will require a guide for quality standards along with its widespread adoption and promotion of certified solar gensets in the market

Recommendation overview: Develop quality standards guide in collaboration with the Standards Organisation of Nigeria and support the promotion of certified solar gensets

Market barrier addressed
Ecosystem building: Non-existence and poor enforcement of quality standards

Recommendation details	Key considerations
• Partner with local advocacy groups to replicate the quality standards guide developed by Lighting Global and Verasols, outlining the sets of standards for product quality, safety, durability, and performance of solar systems ranging from pico-systems to mini-grids • Collaborate with the Standards Organisation of Nigeria, local marketing agencies, and other government agencies to promote the adoption of the aforementioned standardized rating system for relevant solar gensets across high demand markets such as Lagos and Abuja • To curtail the sale of uncertified solar gensets, Carbon Trust should engage local marketing agencies to promote certified solar genset. Additionally, support international solar suppliers in growing their physical market presence in Nigeria, enabling customers to directly purchase solar products from certified manufacturers, ensuring product quality and reliability[1]	• The Lighting Global and Verasols quality of standards guide is only applicable to solar systems up to 350 Watts power rating, as such additional research will be required to cover systems exceeding this power rating • Suppliers may resist changes due to increased costs to meet regulatory requirements, or fear of revealing poor-quality products. Without strong incentives and enforcement mechanisms may cause this initiative to struggle to gain traction in the market • The effectiveness of the centralized monitoring platform may be limited by inconsistent enforcement of quality standards and potential resistance from some ecosystem players who may not fully comply with the agreed-upon standards, undermining the platform's reliability and credibility

Examples:
- Supportive initiatives to strengthen demand for solar gensets in Nigeria – SUNREF Nigera[2]

Overall recommendation score

DI - score	EI -score	Total score
1	1	**2**

Sources: *1) Use-case consultations; 2) Sunref, link;*

Advocacy for feed-in-tariff systems, the reduction of 'red-tape' and customs tariffs can help improve the financial viability of solar genset adoption

Recommendation overview: Advocate for the implementation of feed-in-tariff systems, enforcement of existing supportive policies and adoption of favourable importation policies

Market barrier addressed
Ecosystem building: Ineffective regulation, policies, and initiatives

Recommendation details

- Support local advocacy groups and associations to persuade regulatory bodies to implement feed-in-tariff systems, enabling grid-connected solar users to sell excess electricity back to the grid, thereby improving the financial viability and adoption of solar energy
- Advocate for the government to play a more active role in implementing supportive policies and regulations for solar products, following suit from countries such as Namibia^ and India which have introduced net metering, strong incentives for independent power producers[2], and subsidies for individual subsidies systems up to 10kW[3]
- Foster coalition building with like-minded organizations to amplify advocacy efforts to push custom authorities to adopt favourable policy to ease 'red-tape' importation restrictions and tariffs targeted at solar gensets, effectively reducing time and importation costs for solar gensets^

Key considerations

- With respect to feed-in tariff systems, there may be a significant lack of interest from policy makers to implement such policies due to vested interests and lack of incentives, furthermore, there are likely to be technical capacity gaps with existing solar products and grid infrastructure to facilitate the system
- Navigating conflicting agendas of various solar ecosystem players will pose challenges to aligning interests. Moreover, entrenched bureaucratic procedures and, in certain instances, corruption, require collaboration with senior officials within customs authorities to ensure policy reform

Examples:

- Supportive frameworks to strengthen quality standards – Lighting Global Quality Standards[4]

Overall recommendation score

DI - score	EI -score	**Total score**
2	1	**3**

Sources: *1) Use-case consultations; 2) International Trade Administration (2024), link; 3) Centre for Energy Finance (2019), link; 4) Lighting Global (2014), link;*
Notes: *^ Namibia offers favourable import incentives on renewable energy technologies, exempting solar panels and batteries from import duties*

Upskilling the local labour force around solar gensets will require basic maintenance training as well as advanced courses and mentorship programs

Recommendation overview: Support the increase in the number of maintenance staff with basic and advanced training for third parties and distributors, and setup mentorship programs

Market barrier addressed
Ecosystem building: Lack of local specialized skills and competencies

Recommendation details	Key considerations
• Support distributors to increase their maintenance labour force and setup basic training covering with inclusion of activities such as (i) frequently wiping dust-off solar panels to maintain the panel's energy efficiency and (ii) earthing solar panels to mitigate degradation and damage from surges[3] • Develop training programs tailored to equip third-party organizations to manage handover from distributors to manage installation and maintenance of solar gensets. For advanced topics such as system integration and performance optimization partner with large international suppliers, local industry experts, and educational partners to design a curriculum for both distributors and third-party organizations • Encourage collaboration between knowledgeable local technical experts and less mature distributors to facilitate knowledge transfer and skill development facilitated through apprenticeship and mentorship programs	• As solar adoption expands, technicians may face time constraints in regularly maintaining their customers' panels. Therefore, operational service agreements should include specific provisions outlining the frequency of technician maintenance visits • Limited availability of local experts capable of offering advanced training programs may restrict access to specialized education for the workforce. Additionally, the capacity of existing institutions to adapt curriculum and resources to meet the dynamic needs of the clean energy sector may pose a challenge • Resistance from local experts or seasoned professionals to participate in mentorship programs may hinder the effectiveness of knowledge transfer initiatives. Additionally, suppliers' way be unwilling to give insights of their own solar technologies

SkillCat

Examples:
• Free solar genset training course – SkillCat Solar Installation Training[3]

Overall recommendation score

DI - score	EI -score	**Total score**
1	1	**2**

Sources: *1) Use-case consultations; 2) Non-use case consultation; 3) SkillCat, link*

Distributers need to work closely with suppliers to ensure product design to tailored to meet local customer needs

Recommendation overview: Distributors to further analyse customer needs, including technical requirements, and work closely with suppliers to ensure products meet consumer needs

Market barrier addressed
Product innovation: Technical limitations

Recommendation details	Key considerations
• Encourage distributors to collaborate with smart meter installation companies to gather more detailed data on energy usage and power consumption profiles of undocumented use cases • Distributers should collate key technical needs of a variety of customer types and share findings with solar genset suppliers abroad, so products are tailored to the Nigerian market (e.g., increased access to portable battery technology capable of being charged by the grid • Support targeted marketing campaigns on updated product specifications and capabilities to the relevant consumers to increase product awareness	• The success of this initiative may be hindered by challenges in integrating and standardizing data from various sources to accurately inform product development and marketing strategies • Meeting the price and technical requirements of the consumers by the suppliers will be a major hurdle so ensuring high consumer demand will be important to ensure continued product innovation

Jackery Solar Generator

Examples:
- Portable solar genset solutions – Jackery Solar Generator SolarSaga 200W[3]

Overall recommendation score

DI - score	EI -score	Total score
2	1	**3**

***Source**: 1) Use-case consultations; 2) Non-use case consultation; 3) Jackery Solar Generator, link;*

Mitigating each market barrier can not be done overnight, but progress can be made through targeted investments, programs and initiatives

Overview of market insights & barriers

The unreliability of the national grid across Nigeria has contributed to the continued growth in demand for both fossil fuel generators and solar gensets; However, solar gensets still face eight key barriers that are limiting its rapid adoption for potential customers

- **FFGs continue to dominate the backup energy market** – There are an estimated 20million FFGs, while solar gensets lag significantly behind with annual sales of less than 720,000 in 2023
- **The number of solar genset players in the market is growing** – As solar genset technology improves increasing its viability in the market, consequentially there are 99 registered suppliers in the market
- **Growing the solar genset market will require additional segmentation** – Unique customer needs presents product limitations preventing a universal solar genset solution, as such more attention in the Nigerian market is required to develop unique solar solutions for segmented customer groups
- **Eight other significant barriers exist in the market** – The Nigerian solar genset markets faces eight barriers that limit the transition of FFGs to solar gensets, with the primary concern of potential customers being high up-front costs
- **Resolving these barriers will require a multi-faceted intervention** – To overcome these issues this report outlines a variety of recommendations aimed at mitigating the market barriers faced in the solar genset market

Sequence of recommendations to address

1. Increase market availability of flexible customer financing models and use of carbon credits to reduce up-front costs
2. Enhance customer awareness of solar gensets through marketing and awareness programs
3. Reduce up-front and working capital pressures through expansion of inventory procurement services
4. Improve customer data analysis for improved product development to fit local market
5. Advocate for the enforcement and expansion of supportive government policies, practices and initiatives
6. Collaborate with suppliers to supply solar gensets designed to meet unique technical requirements
7. Expand the local labour force of installation and maintenance support staff
8. Guide regulators to setup national solar genset standards and support promotion of certified solar gensets

Appendix

ZE-Gen.

We consulted ~40 distinct demand- and supply-side stakeholders across potential consumers and key industry players

S/N	Name	Use case	Location	Classification	Interview mode
1	Court of Appeal	Large office complex	Abuja	Urban	In-person
2	Glass fabricator	MSMEs	Abuja	Peri-Urban	In-person
3	Phone accessories	MSMEs	Abuja	Peri-Urban	In-person
4	Small Health centre	Healthcare Centres	Abuja	Peri-Urban	In-person
5	Ministry of works	Large office complex	Abuja	Urban	In-person
6	Health Clinic	Healthcare Centres	Nasarawa	Rural	In-person
7	Hair Salon	MSMEs	Nasarawa	Rural	In-person
8	Computer/printing shop	MSMEs	Nasarawa	Rural	In-person
9	Local Bar	MSMEs	Nasarawa	Rural	In-person
10	23 Room hotel	Hotels	Nasarawa	Peri-Urban	In-person
11	Peter	Households	Nasarawa	Peri-Urban	In-person
12	Primary School	Educational Institute	Nasarawa	Peri-Urban	In-person
13	Borehole house	Households	Abuja	Peri-Urban	In-person
14	Emmanuel	Households	Abuja	Peri-Urban	In-person
15	Potters Health	Healthcare Centres	Abuja	Urban	In-person
16	Starville Schools	Educational Institute	Abuja	Urban	In-person
17	Nile University	Educational Institute	Abuja	Urban	In-person
18	Wali's Suites	Hotels	Abuja	Urban	In-person
19	Eti-Osa LGA	Large office complex	Lagos	Urban	In-person
20	Evercare Hospital	Healthcare Centres	Lagos	Urban	In-person
21	Barber shop	MSMEs	Lagos	Urban	In-person
22	Bet Shop	MSMEs	Lagos	Urban	In-person
23	NOUN University	Educational Institute	Lagos	Urban	Virtual
24	AfricaWorks	Large office complex	Lagos	Urban	In-person
25	Corporate worker	Households	Lagos	Urban	In-person
26	Corporate worker	Households	Lagos	Urban	In-person
27	Corporate worker	Households	Lagos	Urban	In-person
28	Corporate worker	Households	Lagos	Urban	In-person
29	Maroko Bayshore	Hotel	Lagos	Urban	Virtual

S/N	Name	Interviewee position(s)	Stakeholder type	Interview mode
1	Access to Energy Institute (A2EI)	• Project manager • Technical manager	Solar PV distributor	Virtual
2	d.light	• Chief Strategic Officer	Solar PV distributor	Virtual
3	Chromevolt	• Chief Executive Officer	Solar PV distributor	Virtual
4	International Finance Corporation (IFC)	• Climate team member, DC	Development partner	Virtual
5	Sustainable Energy for All (SEforALL)	• Research & communications Associate	Development partner	Virtual
6	Nigeria Off-grid Market Acceleration Program (NOMAP)	• Program managers	Government body	Virtual
7	Rural Electrification Agency (REA)	• Project Manager, SHS component of NEP	Government body	Virtual
8	All On	• Investment officers	Solar PV investor	Virtual
9	GOGLA	• Head of Performance and Investment • Senior Business Innovation Manager	Industry association	Virtual
10	Renewable Energy & Energy Efficiency Association (REEEA-A)	• National vice chairman • Financial secretary • Project assistant • Coordination desk officer	Industry association	Virtual

***Sources**: 1) OCA use case consultation; 2) OCA non-use case consultations*

As of the July 2025, A2EI have successfully installed 492 smart meters, 292 apply to the use case analysis, and have qualified survey insights for 492 users

Cluster	Installed	Applicable for use case analysis
SME markets	213	135
Households	104	61
Healthcare Centres	81	45
Schools	19	11
Hotels	75	46
Total	**492**	**298**

Cluster survey insights available	Count
SME markets	204
Households	104
Healthcare Centres	79
Schools	19
Hotels	74
Total	**480**

***Sources**: 1) A2EI Analysis*

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