

ARRIVES

IS THE SOLAR POWER SECTOR FOR YOU?

Business and job
opportunities in Nigeria

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An aerial photograph of a vast solar farm at sunset. The sun is low on the horizon, casting a warm orange glow over the landscape. The solar panels are arranged in neat, parallel rows, reflecting the light. In the background, there are some industrial structures and a line of trees. A white rectangular text box is positioned in the lower-left quadrant of the image, containing the title and introductory text. The overall scene is peaceful and highlights the scale of renewable energy production.

ABOUT THE PAPER

This solar power sector brief is developed within the framework of the ARRIVES project.

The Assisting the Reintegration of Returnees through Integrated Vocational and Entrepreneurship Support (ARRIVES) project aims to support the reintegration of voluntary returnees into the Nigerian economy. Targeting Nigerians who have returned from abroad, particularly Germany, the project focuses on sustainable livelihoods through entrepreneurship, skills development and economic empowerment. It offers tailored support such as capacity building, psychosocial coaching and business development services.

Recognizing the need for returnees to understand Nigeria's evolving economic sectors, ARRIVES also develops economic sector briefs to highlight opportunities, challenges and support mechanisms for successful entrepreneurial ventures.

An aerial photograph of a vast solar farm at sunset. The rows of solar panels stretch across the landscape, reflecting the warm orange and yellow light of the setting sun. In the background, a flat landscape with some trees and distant structures is visible under a hazy sky. A large, semi-transparent white rectangular box is positioned in the lower-left to center area of the image, containing the title and body text.

ACKNOWLEDGEMENTS

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ACRONYMS

Unless otherwise specified, all references to dollars (\$) are to United States dollars (and \$1 = ₦1,700). Percentages may not add up to 100% due to rounding.

ARRIVES	Assisting the Reintegration of Returnees through Integrated Vocational and Entrepreneurship Support
CAC	Corporate Affairs Commission
C&I	Commercial and industrial
COREN	Council for the Regulation of Engineering in Nigeria
DRE	Decentralized renewable energy
EPC	Engineering, procurement and construction
IFC	International Finance Corporation
IPPs	Independent power producers
IRENA	International Renewable Energy Agency
ITC	International Trade Centre
NCS	Nigerian Customs Service
NERC	Nigerian Electricity Regulatory Commission
NESREA	National Environmental Standards and Regulations Enforcement Agency
NGO	Non-governmental organization
PAYG	Pay-as-you-go
PUE	Productive use of energy
PV	Photovoltaic
REA	Rural Electrification Agency
SHS	Solar home system
SON	Standards Organisation of Nigeria

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INTRODUCTION

INTRODUCTION

One of the key sectors identified for economic growth and sustainable business opportunities is the solar power sector. Nigeria faces various energy challenges and the solar energy industry offers a viable solution for meeting the country's growing demand for reliable and affordable energy. It also presents a strategic opportunity for voluntary returnees, particularly those with technical or vocational training, to start or scale businesses in this sector.

This brief will be an essential resource for voluntary returnees interested in entering the solar energy sector. It will provide detailed information on the following aspects:

1. Overview of Nigeria's solar energy sector: Provides an overview of Nigeria's solar power market, including trends, growth factors and current demand. It highlights key players and relevant laws and focuses on regions with limited electricity access and urban areas pursuing

sustainable energy. Additionally, it maps the solar equipment value chain to help voluntary returnees understand market dynamics and entry points.

2. Exploring business opportunities:

Solar energy offers various business opportunities in both product and service-based sub-sectors, including installing systems, selling products and providing maintenance services. Key areas include productive use of energy solutions, solar home systems, solar engineering, procurement and construction services, and mini-grid development.

3. Key players and regulatory environment:

Discusses the main stakeholders in Nigeria's solar sector and reviews key policies and regulations shaping the solar sector to help voluntary returnees understand legal requirements and benefits.

Nigeria faces various energy challenges and the solar energy industry offers a viable solution for meeting the country's growing demand for reliable and affordable energy.



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4. Challenges and barriers for entrepreneurs:

This section outlines the main barriers affecting the sector and suggests support mechanisms.

5. Labour market insights:

This section analyses job opportunities in the solar sector and the skills required for roles such as installation and project management. It provides insights into job growth, expected income levels and top training providers, helping returnees enhance their skills and employability.

6. Financial aspects:

This section outlines investment needs for starting a solar business, detailing initial costs, funding options and potential returns. It serves as a guide for voluntary returnees seeking financial insights for their ventures.

This brief is based on primary and secondary research involving discussions with key stakeholders in the solar sector, including private companies in manufacturing, distribution and installation, as well as public institutions and non-governmental organizations focused on rural electrification. The methodology combines field research, content analysis of reports, strategic documents and relevant policies to provide a comprehensive understanding that integrates empirical data with industry insights.



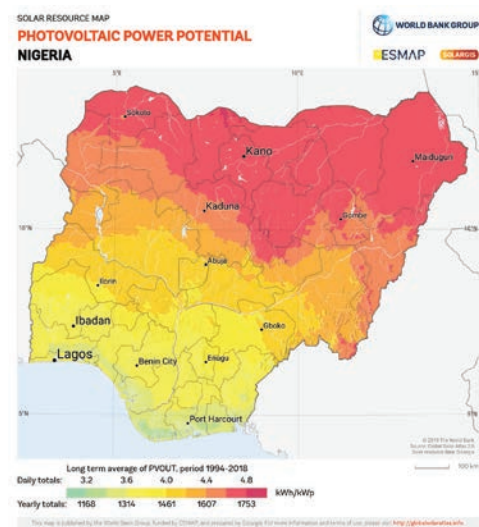
CHAPTER 1

Overview of the Nigerian solar energy sector

Nigeria's solar energy sector is ready for growth and transformation as it seeks to address power challenges and adopt renewable energy solutions. Nigeria has an electricity access rate of about 59.5%, with 88.5 million people lacking access to reliable power (Sustainable Energy for All, 2023). This energy gap presents a market opportunity for solar energy solutions, particularly in the off-grid and on-grid segments. The Nigerian solar market encompasses a broad range of applications, from small solar home systems (SHSs) and mini-grids for rural communities to larger rooftop installations and commercial-scale projects in urban centres.

The geographic location of Nigeria provides abundant solar resources, with an average of 5.5kWh/m²/day of solar radiation and 6–8 hours of effective sunlight daily (NASA, 2024). This makes the country ideal for solar photovoltaic (PV) systems for residential and commercial use.

Figure 1 Nigeria solar resource map



Source: Solargis, 2021.¹

Despite its potential, the sector is still underdeveloped, with limited penetration in urban and rural areas. This is mainly due to high capital costs, lack of technical capacity and consumer misconceptions.

Nigeria's vast solar resources enable the sector to meet a large share of

energy demand, particularly in the off-grid sectors (rural communities), solar home systems in urban and rural areas, both commercial and industrial. The sector offers great opportunities for returnee entrepreneurs and can contribute to employment and economic development.

The United States Agency for International Development projects that the solar sector will create major economic opportunities, with a market potential in Nigeria of \$9.2 billion annually for mini-grids and solar home systems. This will stimulate economic activity and lead to significant savings for households and businesses (Alliance for Rural Electrification, 2024).

The sector's expansion is expected to generate jobs across various sectors, including manufacturing, installation, maintenance and sales of solar technologies. Additionally, the sector fosters skills development and training opportunities, contributing

to a more skilled workforce, which is essential for Nigeria's broader economic development.

Integrating solar energy into Nigeria's energy mix also aligns with the Government's commitment to reduce greenhouse gas emissions and achieve net-zero emissions by 2060 as indicated in Nigeria's Energy Transition Plan, emphasizing its economic and environmental significance.

Market trends and growth drivers

Nigeria's solar energy market is experiencing robust growth, driven by increasing energy demand, unreliable grid power and rising costs of traditional energy sources. With around 59% of the population—or 132 million people—lacking consistent access to electricity, solar power is gaining traction as a sustainable and cost-effective alternative.



¹The North East and North West zones have the highest power output values, ranging from 4.4–4.8 kWh/kWp/day, while the North Central zone and parts of the South West show moderate power output levels between 3.6–4.0 kWh/kWp/day, and the South South and South East zones have lower power output values ranging from 3.2–3.6 kWh/kWp/day.



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With around **59%** of the population or

132 million

people lacking consistent access to electricity, solar power is gaining traction as a sustainable and cost-effective alternative.

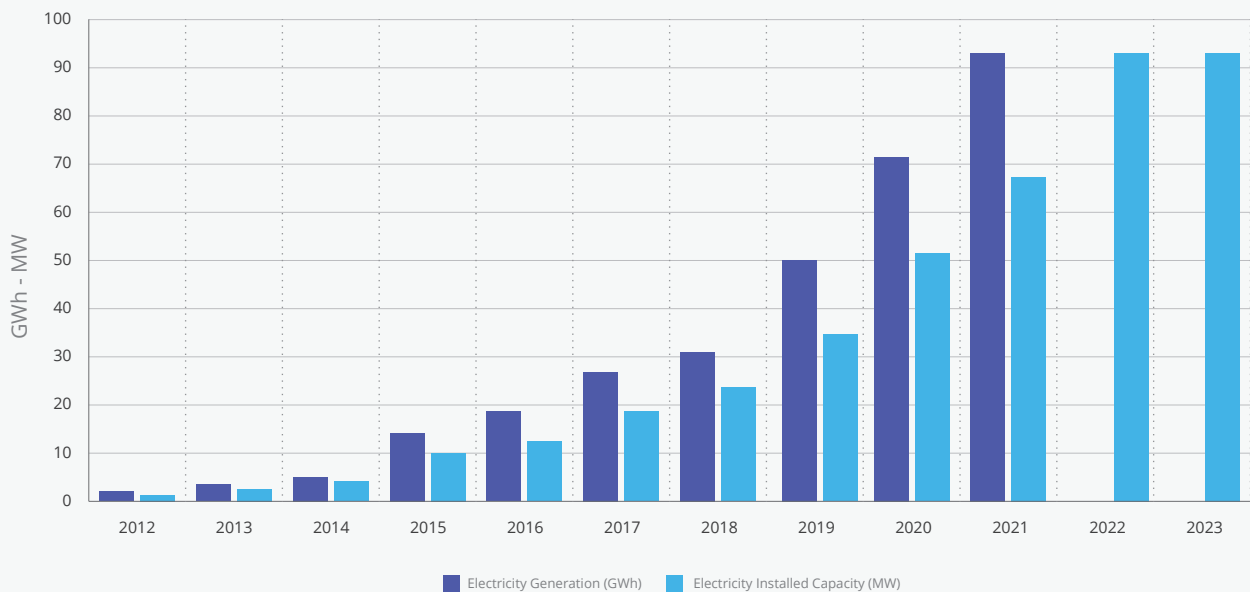


Nigerians spend an estimated **₦5 trillion (\$14 billion)** annually on power generation using petrol or diesel generators.

While the initial investment in solar installations can be high, making it challenging for some households, the growing availability of financing options—such as pay-as-you-go (PAYG) plans and microloans—has made solar power more accessible. Furthermore, solar systems have little to no running costs, which gives households a cost-effective, long-term energy solution.

This is especially appealing given the removal of the fuel subsidy in 2023, which increased the operational costs of diesel and petrol generators. Nigerians spend an estimated ₦5 trillion (\$14 billion) annually on power generation using petrol or diesel generators (USAID, 2022). The biggest jump was recorded in June 2023, when the average price of petrol soared more than 129% (Statista, 2024).

Figure 2 Evolution of electricity generation and installed capacity for off-grid



Source: International Trade Centre (ITC) calculation based on IRENA, 2024

As shown in Figure 2, Nigeria has made progress in solar energy deployment, especially after 2016, with electricity generation peaking in 2021 with 93MW and installed capacity reaching a peak of 90 MW in 2022 and 2023 (IRENA, 2024). This growth can be attributed to substantial investments in solar infrastructure, facilitated by government initiatives such as the Nigeria Electrification Project and Solar Power Naija and international donors, including the World Bank and the African Development Bank.

Despite these advancements, the United States Agency for International Development says 10,000 mini-grids of 100kW each would only satisfy 30% of Nigeria's energy needs, indicating vast opportunities for further investment in the sector (USAID, 2022). The Rural Electrification Agency (REA) projects that the mini-grid market will require at least \$3.6 billion in annual investment (Alliance for Rural Electrification, 2024).

The affordability of solar energy has improved due to a global decline in the cost of solar components, such as panels and inverters. Prices have fallen by around 80% worldwide over the last decade (Ritchie, 2024). Innovative financing models such as PAYG² systems are making solar solutions more accessible, especially for off-grid communities. This system allows

consumers to pay in small instalments. Moreover, the rise of productive use of energy (PUE) solutions—such as solar-powered freezers and irrigation pumps—has boosted economic productivity in rural areas. Furthermore, the efficiency of solar solutions can be linked to advances in battery storage and energy management technologies that are paving the way for smart homes and large-scale commercial applications.

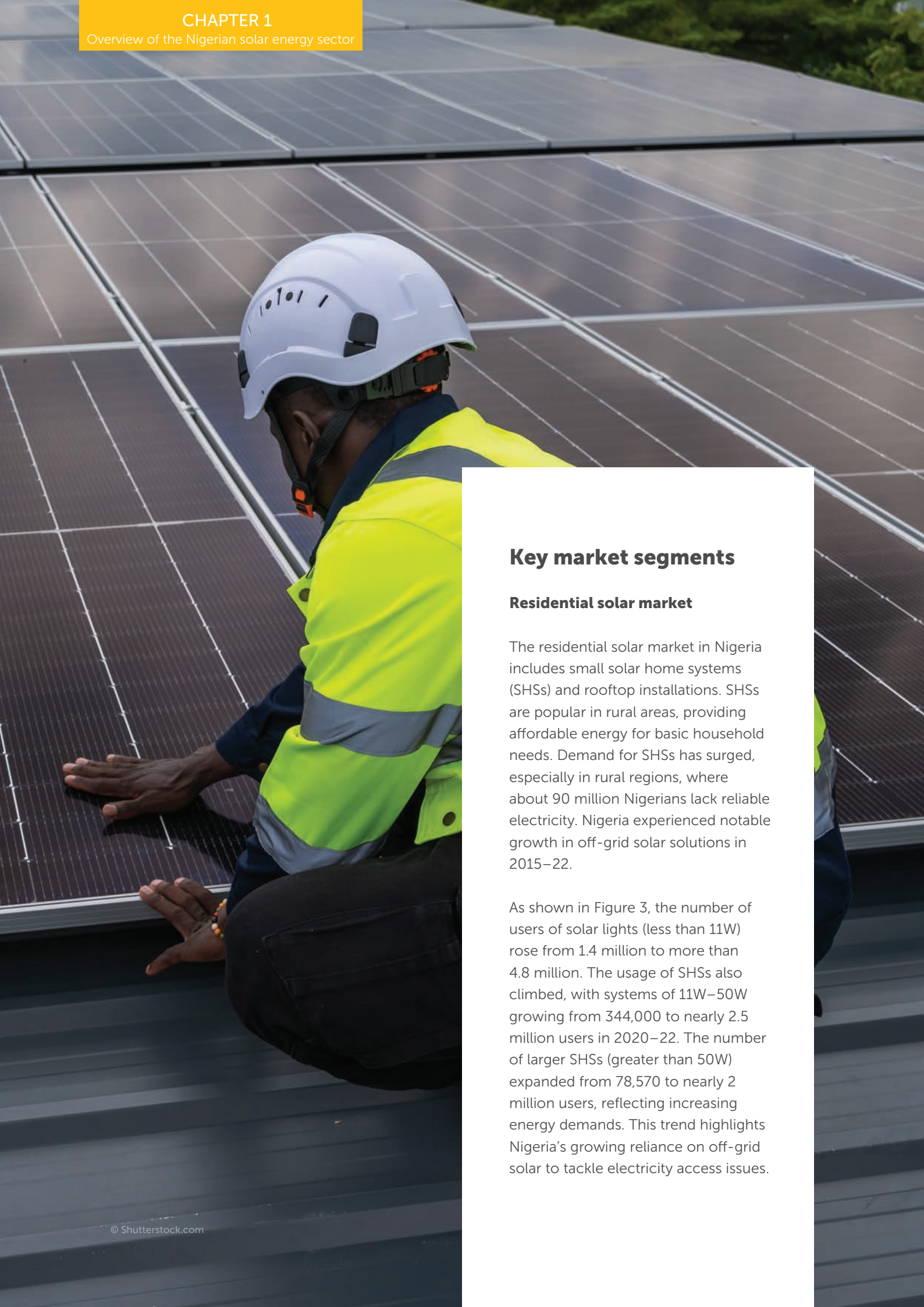
The solar market in Nigeria is expanding because solar technologies are gaining more interest across residential, commercial and industrial sectors. This traction is reinforced by flexible financing options (PAYG and lease-to-own) and a growing commitment from international investors and developers.



²Pay-as-you-go models: PAYG systems allow consumers to pay for energy as they use it, which is appealing in a market where upfront costs can be a barrier. This model has been successful in increasing solar adoption, especially in rural areas, where traditional financing options are limited.



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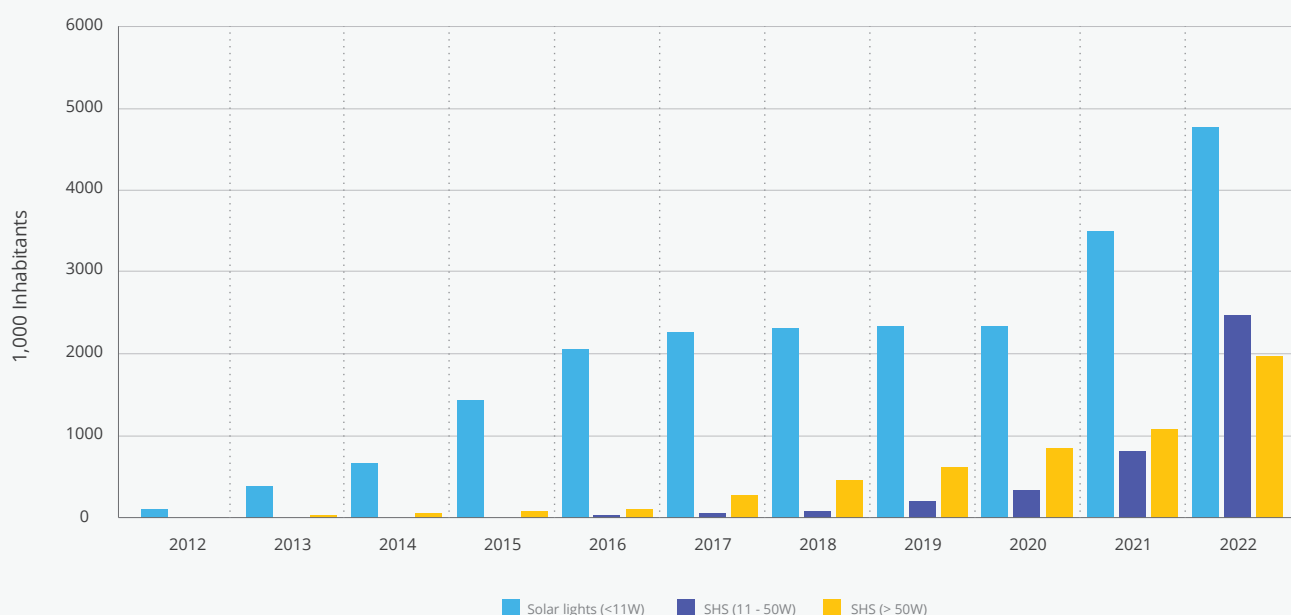
Key market segments

Residential solar market

The residential solar market in Nigeria includes small solar home systems (SHSs) and rooftop installations. SHSs are popular in rural areas, providing affordable energy for basic household needs. Demand for SHSs has surged, especially in rural regions, where about 90 million Nigerians lack reliable electricity. Nigeria experienced notable growth in off-grid solar solutions in 2015–22.

As shown in Figure 3, the number of users of solar lights (less than 11W) rose from 1.4 million to more than 4.8 million. The usage of SHSs also climbed, with systems of 11W–50W growing from 344,000 to nearly 2.5 million users in 2020–22. The number of larger SHSs (greater than 50W) expanded from 78,570 to nearly 2 million users, reflecting increasing energy demands. This trend highlights Nigeria's growing reliance on off-grid solar to tackle electricity access issues.

Figure 3 Off-grid electricity access in Nigeria (1,000 inhabitants)



Source: ITC calculation based on IRENA, 2024.

Most customers are middle- and upper-income households looking to reduce dependence on the grid and diesel generators. Urban centres such as Lagos, Abuja and Port Harcourt are seeing rising adoption.

Sustainable Energy for All says Nigerians spend about \$10 billion annually on petrol and generator maintenance.

Despite the potential in urban areas, few households have adopted solar, often due to misconceptions about the ability of solar to power high-demand appliances such as air conditioners. These doubts frequently stem from poor installation experiences by unqualified installers, which reinforced scepticism about solar reliability. The high initial capital cost for a solar system suitable for urban homes further limits market penetration.

Voluntary returnees can target high-income neighbourhoods for rooftop solar installations, highlighting energy reliability and cost savings in the long run. Another avenue is to collaborate with established solar companies or to start as independent installers. These can provide a robust entry point into this market.

Commercial and industrial solar market

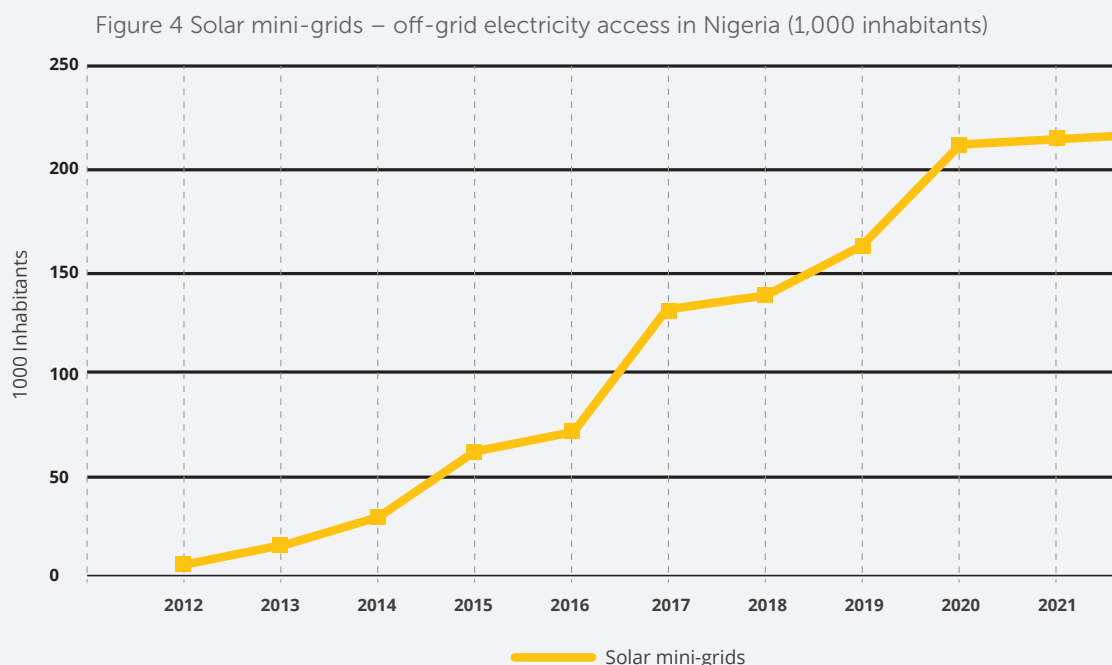
The commercial and industrial (C&I) segment encompasses large-scale solar installations for businesses, manufacturing plants and commercial buildings. This market is driven by the demand for reliable power and long-term cost savings. Although some industrial companies rely on gas-powered systems due to lower fuel costs, these often function as backup solutions rather than

primary power sources. Many firms, especially medium-sized businesses prioritizing sustainability, are turning to solar solutions.

C&I installations provide considerable cost savings over time, enhance reliability and reduce environmental impact, making them increasingly appealing as part of a hybrid energy approach. People with project management, engineering or financial backgrounds may find roles in technical sales, project development or financial modelling within the C&I segment.

Mini-grids and off-grid markets

This segment focuses on rural and peri-urban communities with limited or no grid connectivity. Mini-grids, supported by the REA and international partners, are being deployed to electrify schools and health centres. As Figure 4 shows, access to electricity via solar mini-grids in Nigeria climbed over 2012–20, with some 200,000 people gaining access. This growth reflects a preference for community-scale power solutions in areas with unreliable grids.



Source: ITC calculation based on IRENA, 2024.



The off-grid solar market is projected to create a market potential of \$9.2 billion annually for mini-grids and solar home systems, saving Nigerian homes and businesses about \$4.4 billion per year (Netherlands Enterprise Agency, 2021). The SHS market alone is estimated at \$2 billion a year (Netherlands Enterprise Agency, 2021), which signals many opportunities for investment in off-grid solutions. Voluntary returnees can engage as distributors of SHS or mini-grid project developers, and entrepreneurship opportunities are available through innovative business models such as PAYG or community energy cooperatives.

Productive Use of Energy market

PUE refers to using solar energy for income-generating activities such as agriculture, retail and small-scale manufacturing. This segment is rapidly expanding as communities recognize the advantages of solar energy for powering irrigation pumps, grain mills, refrigeration and other productive equipment.

Although PUE deployment in Nigeria remains largely grant-driven, business models include lease-to-own and PAYG solutions for individual and cooperative

usages. PUE enables communities to increase productivity, create jobs and improve livelihoods by using solar power to drive agricultural, commercial and industrial activities. Examples of PUE applications include:

- Solar-powered cold storage solutions such as [ColdHubs](#) and [Koolboks](#) are types of PUE that provide refrigeration for small-scale farmers and food vendors, reducing post-harvest losses and prolonging the shelf life of perishables.
- Solar water pumps provide a reliable and cost-effective irrigation solution, enabling farmers to cultivate crops year-round.
- Solar-powered processing units can power mills, grinders and other processing units, adding value to agricultural products and boosting rural farmers' incomes.

Building on the key segments in the solar energy sector, it is essential to examine the broader structural framework that underpins these developments, as presented in the value chain mapping section.



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Value chain mapping

In Nigeria's solar energy sector, the value chain primarily focuses on midstream to downstream activities, encompassing system assembly, distribution, installation and end-user consumption. The Nigeria Green Manufacturing Policy and Investment Guide notes a growing interest in local manufacturing of solar components to reduce import reliance and create jobs. For the Government, local manufacturing is a crucial priority and is embedded in Nigeria's Energy Transition Plan, launched in 2021.

1. Solar panel manufacturing and assembly

This segment involves assembling solar panels, inverters and batteries. Nigeria is trying to establish local manufacturing capacity for solar components to harness its abundant renewable energy resources. The country is actively working on projects to transition to cleaner energy sources and reduce greenhouse gas emissions.

An example of these efforts is the launch of a solar PV manufacturing plant in Ibeju-Lekki (African Energy

Council, 2023). This privately owned PV manufacturing company commissioned a new 100MW plant in mid-2023. Operating at half capacity today, it plans to hire more people to reach total capacity. The midstream sector is growing, offering more job opportunities. To compete in the market, manufacturers must ensure the quality and efficiency of solar products by adhering to international standards.

2. Import and distribution

With limited local manufacturing, many solar products are imported, with major market players acting as distributors. Distribution networks



include formal retail outlets and informal vendors, particularly in rural areas with limited access to solar products. The total import value of solar products in Nigeria is estimated at around \$150 million (Renewable Energy Association of Nigeria, 2021).

3. Installation services

This segment comprises installing solar energy systems, including SHSs and mini-grids, as explained in the previous chapter. Companies including [Green Village Electricity](#) and [Havenhill Synergy Limited](#) offer installation services and work to make solar energy affordable.

4. Maintenance and support

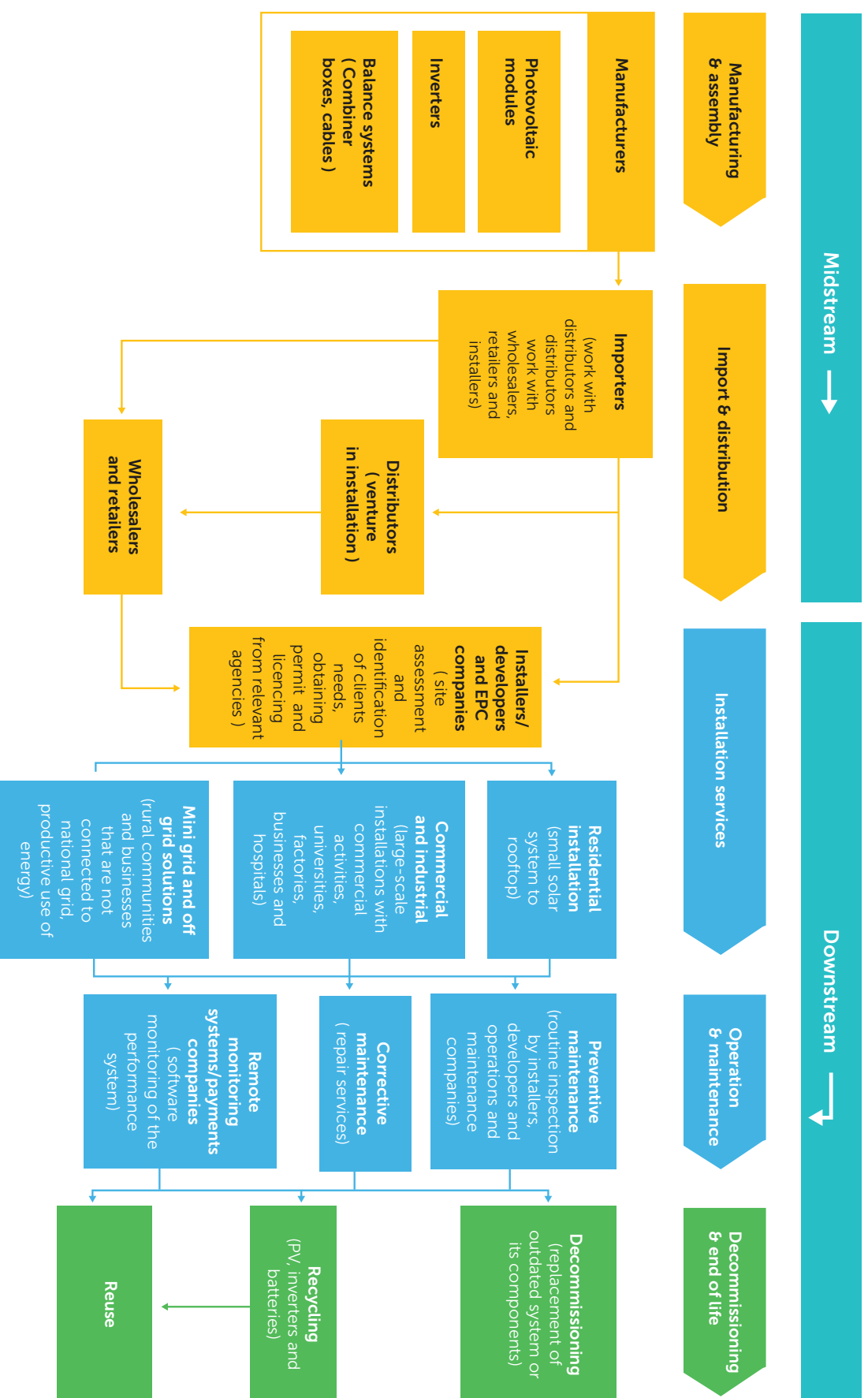
This segment, which is usually neglected, is critical to ensure the longevity and efficiency of solar—and, therefore, the sector's sustainability. Companies often offer warranties and service contracts to customers. This service can also raise awareness and educate consumers about the benefits and operation of solar systems to maximize their usage and satisfaction.

5. Decommissioning and end of life

Solar system components such as panels and batteries require proper disposal at the end of their lifespan to minimize environmental impact. There is a focus in Nigeria as well as globally on recycling materials such as silicon, glass and metals. Batteries, however, pose specific challenges due to their hazardous content. It is important for Nigeria to establish recycling frameworks and waste management processes to support its green energy goals and promote sustainability.



Figure 5 Nigeria's solar power equipment value chain



Source: ITC

Exploring business opportunities

Opportunities in key market segments

The solar energy sector offers a range of opportunities for voluntary returnees looking to invest in sustainable ventures. As Nigeria grapples with energy supply challenges, demand is growing for sustainable, off-grid solutions catering to rural and urban populations. Solar energy is a rapidly expanding field with numerous business models that align with the country's needs for renewable power and improved productivity in underserved areas.

Stakeholder interviews indicated that the key business opportunities in the solar sector are PUE solutions, SHS installation, distribution, retail, solar engineering, procurement and construction (EPC) services and mini-grid development. Each of these business models addresses specific market needs, capitalizes on emerging consumer trends and offers lucrative opportunities for returnees.

Productive Use of Energy solutions

PUE solutions are solar-powered appliances and systems designed to enhance productivity and economic outcomes in rural and off-grid areas (GET.transform, 2022). These are high-impact ventures suitable for agricultural communities and small businesses in off-grid and underserved areas.

Solar kiosks

A solar kiosk is a small-scale business that provides essential solar services, such as phone charging, to off-grid or underserved communities. The solar phone charging business model presented by Oriki Energy and other companies offers returnees a low-skill entry into entrepreneurship, with a pay-as-you-go system requiring a 20% down payment on a solar system.

Returnees can earn between ₦200,000 and ₦250,000 monthly, as highlighted by success stories from [Oriki](#), where additional services such as point of sales or cold drink sales can boost profits.

- The model's asset-based financing ensures accountability and sustainability, giving returnees an accessible pathway to financial independence.

Solar-powered freezers

The lack of reliable refrigeration at rural markets and small food-processing businesses leads to spoilage of fish, meat and dairy products. This has increased demand for solar-powered appliances and energy-efficient ways to store products.

In addition, growing awareness of eco-friendly technologies is driving a shift from diesel generators to solar-powered equipment. Koolboks offers business owners a solar freezer for a 35% down payment and flexible payment plans starting at ₦25,000 per month. For a solar freezer selling for about ₦3 million, entrepreneurs can purchase the unit with solar panels for a ₦1 million down payment (Koolboks Nigeria, 2024).

Solar water pumps

Agriculture remains the backbone of many rural economies in Nigeria. However, using diesel-powered pumps for irrigation is costly. Solar-powered water pumps offer a sustainable and cost-effective alternative. Many farmers are acquiring solar water pumps to reduce fuel costs, boost crop yields and minimize their environmental impact. The long-term cost savings and reliability of solar power make it a popular choice for smallholder farmers.

- Business model: Selling pumps, providing installation and maintenance services, and renting pumps for specific seasons.

Solar-powered cold storage solutions

Post-harvest losses are a major challenge in agriculture, particularly for perishable crops, fish and meat. Solar-powered cold storage offers an energy-efficient



solution to reduce these losses. Farmers and traders are increasingly looking for affordable, off-grid cold storage to extend the shelf life of their products. Mini grids in rural communities are integrating cold storage systems as part of a broader energy access strategy.

- The business model includes leasing cold storage units, pay-per-use models and integration with logistics services. Mini-grids in rural communities are always open to cold room developers to integrate their cold rooms with their mini-grids to achieve profitability. This can be seen through the Energizing Agriculture Programme of the REA and the Rocky Mountain Institute.

Solar-powered milling and processing equipment

Smallholder farmers often struggle

to process their crops due to a lack of affordable milling and processing equipment. Solar-powered equipment enable farmers to add value to crops such as maize, cassava and rice. Demand for solar-powered milling equipment is growing among cooperatives and farming communities as they recognize the benefits of on-site processing and the reliability of solar compared to diesel.

- The business model includes equipment sales, maintenance contracts and training services. The initial investment varies depending on the type of equipment. Rent-to-own and PAYG models can help lower entry barriers, targeting rural farmers, cooperatives and small and medium-sized enterprises in agribusiness. These models require less skill to develop, and a short business management and sales training could be sufficient.

OR





Table 1 Pros and cons of entering the PUE market

Advantages of entering the PUE market	Challenges to consider
■ Interest in solar-powered products is growing, particularly in rural areas. Their products align with renewable energy initiatives and attract partnerships with non-governmental organizations (NGOs) and government agencies. ■ PUE solutions improve access to energy and benefit agriculture, health and education. For example, solar refrigerators aid vaccine storage, water pumps enhance agricultural output, and solar lighting creates safer environments at night. ■ Governments and donors provide funding options, such as grants and concessional loans, to help new firms manage risks and scale operations. ■ Solar PUE systems usually have lower operating costs than diesel alternatives, resulting in higher profit margins after the initial investment is recouped.	■ In some rural areas, limited awareness of solar-powered solutions may lead to slower adoption, posing challenges for scaling quickly (UNDP, 2018). ■ Poor infrastructure, such as inadequate roads or limited market access in certain regions, can complicate logistics, maintenance and the scalability of PUE solutions (McCall and Santana, 2018).

Source: ITC



Solar home system installation, distribution and retail

SHS distribution is one of the fastest-growing segments in the solar sector, presenting immense opportunities for new entrants. This market can be largely divided into three major components:

- **Lanterns:** These are single-piece solar lanterns that may include a separate charging panel.
- **Complete solar kits:** These kits are comprehensive units that include a solar panel, multiple lighting points, a control unit and associated DC appliances, all packaged together.
- **Solar panels and components:** This group encompasses solar panels and essential power components that create a complete solar energy solution. Additional components may include batteries, charge controllers, inverters and wiring.

The initial investment required for this business varies considerably depending on the scale of operations.

For instance, light solar lamps can retail for ₦20,000–₦50,000, while lower-cost alternatives are available for as little as ₦5,000. These price differences illustrate the range of investments needed based on the target market.

In this context, the starting investment for distributing SHSs can vary greatly, from as low as ₦20,000 for a single solar lamp to higher amounts based on the allocated inventory costs. This flexibility enables businesses to scale according to their available capital and to tailor their offerings to specific customer segments based on product pricing and market demand (ACE-TAF, 2021).

Business models:

- Selling SHS kits directly to end-users through retail outlets, e-commerce platforms or door-to-door sales

- Establishing a network of franchisees or dealers to expand market reach and provide after-sales support
- PAYG method allows customers to make small, regular payments over time using mobile money platforms until they own the system outright

This business model involves importing, distributing, retailing and installing solar kits and components to households and small businesses in rural and urban areas.

Table 2 Pros and cons of entering the SHS market

Advantages of entering the SHS market	Challenges to consider
■ Entry-level SHSs, like solar lanterns, require relatively low capital, making them accessible for returnees with limited budgets. ■ PAYG systems allow customers to make small, regular payments, increasing affordability and boosting market adoption (World Bank Group, 2015). ■ SHS solutions cater to a wide range of customers, from low-income households to small businesses, offering flexibility to scale (IFC, 2012).	■ The SHS market, particularly in urban areas, is crowded with established players, making it difficult for newcomers to stand out. Differentiating goods and services in a saturated market will be key to success. ■ The prevalence of counterfeit and low-quality solar products can damage consumer trust. New entrants need to ensure product quality to build a reputable brand, which may require sourcing from verified suppliers and emphasizing quality assurance. ■ PAYG models depend on mobile payment systems that may not be accessible or trusted by all customers, especially in rural areas. Understanding local payment behaviours is vital. ■ Providing SHS solutions demands robust after-sales service, including ongoing maintenance. This requirement can add to operational costs and necessitates reliable customer support to ensure satisfaction and retention.

Source: ITC

Solar engineering, procurement and construction services

Solar EPC services involve designing, procuring, installing and commissioning solar power systems for residential, commercial and industrial clients. The shift to solar has created a growing need for skilled professionals who can provide full solar services, from initial feasibility studies to ongoing maintenance. Customized solar solutions and systems that combine solar power with other energy sources are becoming popular. Depending on one's background, this business may require advanced education.

Key services provided:

- Solar project feasibility studies and energy audits to help clients assess their energy needs and the potential for solar power
- System design and component procurement—sourcing and designing tailored solar solutions for clients
- Installation, commissioning and maintenance, providing complete installation services and long-term maintenance contracts

Starting an EPC business needs less direct investment in materials as clients often cover these costs. The main investments include setting up an office, getting basic equipment and managing logistics such as vehicles and tools. Monthly costs typically cover salaries, office rent, marketing and transportation. Once established, EPC firms earn money by signing contracts for commercial, industrial and high-end residential projects.

An EPC firm typically charges a fee based on a percentage of the project cost, usually 10%–20%. For example, a solar project worth ₦20 million can result in a profit of ₦2 million to ₦3 million. With steady contracts, an EPC business can earn between ₦1 million and ₦3 million monthly, depending on project size and frequency.

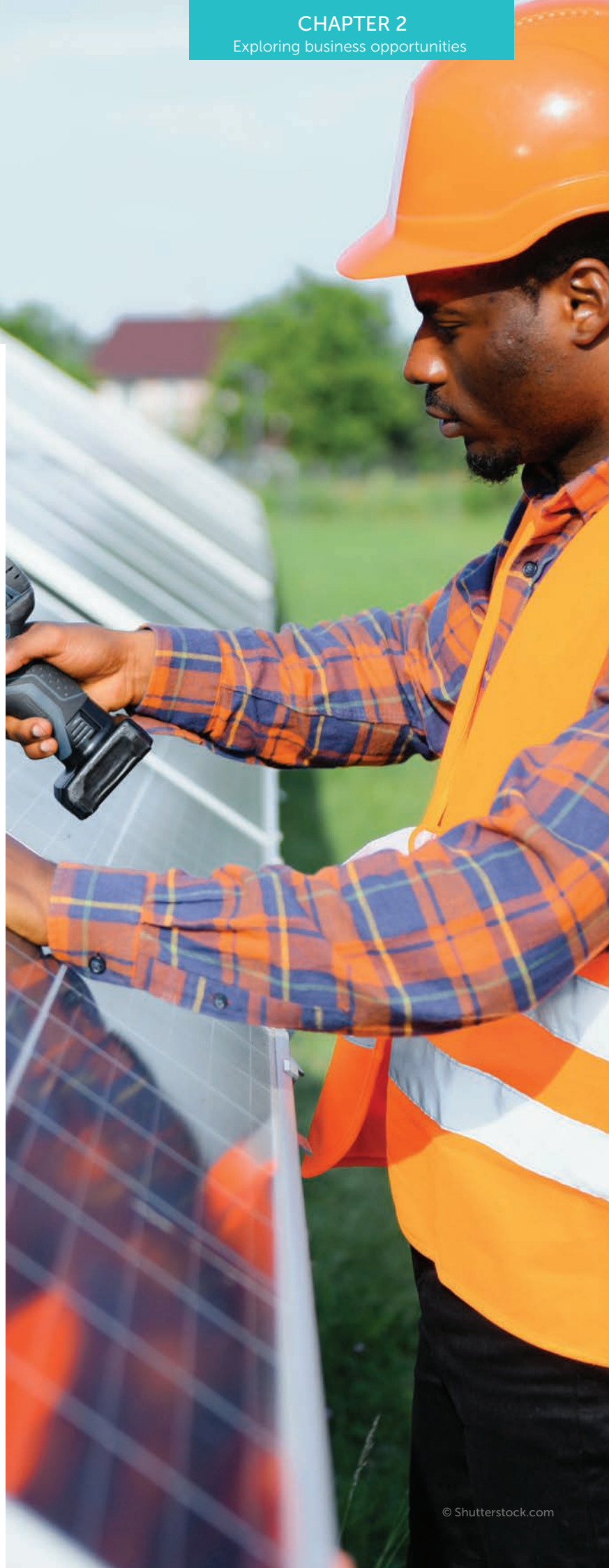


Table 3 Pros and cons of entering the EPC market

Advantages of entering the EPC market	Challenges to consider
Businesses, residential estates and industrial sectors are increasingly adopting solar power to offset unreliable grid power, creating high demand for EPC services (IRENA, 2023).	Solar EPC services require specialized technical knowledge, certifications and equipment, which may not be feasible for returnees just entering the sector with limited experience or capital.
Solar EPC firms can secure long-term, high-value contracts from commercial and industrial clients, leading to high profit margins.	Securing EPC contracts can involve long negotiation periods and extensive feasibility studies, requiring patience and sustained investment in business development.
Unlike distribution, where products must be purchased and stocked, EPC firms typically pass equipment costs on to clients, reducing upfront capital requirements.	Delays in project approvals or customer payments can disrupt cash flow, making financial planning more complex.

Source: ITC

Mini-grid development

Mini-grids are localized energy systems that power communities and businesses not connected to the national grid. This business requires more capital and a long-term strategic approach. It requires high initial capital expenditures, depending on the size and scope, targeting rural communities, industrial clusters and commercial hubs. Possible business models include tariff payments, grants and subsidies.



Table 4 Pros and cons of entering the mini-grid market

Advantages of entering the mini-grid market	Challenges to consider
The Nigerian Government and development agencies, through institutions such as REA and Nigeria Electrification Projects, facilitate grants and subsidies to support mini-grid development in rural areas.	Mini-grid development requires substantial initial investment, often in the range of millions of naira, making it a capital-intensive business model (IFC, 2017).
Mini-grids are essential for powering off-grid rural communities and agricultural hubs, where demand for reliable energy is high (African Development Bank, 2016).	Unlike SHS or PUE solutions, mini-grids may take years to break even, especially if tariffs are regulated or customer adoption is slower than expected.
Once established, mini-grids provide a steady revenue stream through tariff payments and service fees, ensuring long-term financial sustainability.	Navigating government regulations, tariffs and licensing for mini-grid operations can be complicated and time-consuming (Nigerian Electricity Regulatory Commission, 2018).
Mini-grid developers can collaborate with government bodies, NGOs and international agencies to share the financial burden and mitigate risks (World Bank, 2022).	Building trust with local communities and ensuring their involvement is crucial for the success of mini-grid projects, which can be a lengthy process.
Once operational, mini-grids can be expanded to serve additional customers and businesses, making them scalable solutions for rural electrification (Sustainable Energy for All, 2020).	Maintaining and operating mini-grids can be expensive, especially if the system requires regular technical support and grid expansion (IFC, 2017).

Source: ITC

Selecting the right business model is crucial for prospective entrepreneurs, as each option presents unique financial implications shaped by investment scale, market dynamics and operational expenses. For instance, high-capital options such as EPC businesses can be relevant for those looking for substantial returns and equipped with the necessary expertise. Equally, newcomers or those with limited resources may find low-capital models such as SHS distribution, solar kiosks and solar freezers more accessible. These offer quicker payback periods and a pathway to sustainable growth.

Ultimately, aligning the business model with personal and market conditions will set the foundation for success in the renewable energy sector. Box 1 illustrates some recommendations to be considered by volunteer returnees.

Box 1 Recommendations for new businesses entering the sector

Understand the market and choose your niche:

- Before diving into the solar market, conduct thorough research to identify potential entry points that align with your skills, interests and financial capacity. Focus on niche areas such as SHSs, productive use applications (e.g. solar kiosks, solar refrigeration, solar irrigation, drying) or technical services for EPCs.
- Consider the specific energy needs of your target region. Urban areas may have more potential for SHS installations, while rural areas may benefit more from mini-grids or productive use applications.

Invest in skill development:

- Obtain relevant technical certifications in solar system installation, design and maintenance. Federal institutions such as the Energy Technology Institute at the University of Port Harcourt offer modular certification programmes that are well-suited for returnees (<https://etiuniportng.org/>).
- Equip yourself with business skills, including project management, business modelling and financial planning. This will help you understand market dynamics and run a profitable business (see Chapter 5).
- For those interested in entrepreneurship, consider specialized training in productive use technologies such as solar refrigeration, water pumping and solar drying.

Choose low-cost, scalable entry strategies:

- For those with limited capital, start with low-risk ventures such as solar kiosks, small SHS distribution or providing auxiliary services such as system monitoring and maintenance.



- Use financing models such as PAYG, lease-to-own or inventory financing to reduce upfront costs. For example, a PAYG model for SHS distribution requires minimal initial investment and provides quick payback through customer payments.

Build partnerships to minimize risk:

- Rather than trying to secure large projects independently, partner with established EPCs or mini-grid developers. Offer subcontracting services in logistics, civil works or project management to gain experience and build a portfolio.
- Join sector associations such as the Renewable Energy Association of Nigeria to network, gain mentorship and stay updated on industry trends and opportunities.

Focus on market differentiation:

- Beyond installation, provide value-added services such as monitoring, system upgrades and customer education to build customer loyalty and differentiate your business.
- Invest in high-quality products and emphasize compliance with industry standards to build a reputation for reliability and avoid the pitfalls of substandard installations.

Embrace digital tools and platforms:

- Leverage digital marketing using digital tools and platforms such as social media, e-commerce sites and customer management systems to reach a broader audience.
- Implement software solutions by using tools system sizing and design to optimize performance and reduce project costs.

Source: ITC based on field research.



▶ CHAPTER 3 ▶

Key players and regulatory environment

Stakeholders that influence the sector

Succeeding in the Nigerian solar energy market means understanding the key stakeholders that influence the sector. Stakeholder mapping helps identify the public, private and international entities that shape policies, drive demand, influence supply chains and provide financing and capacity-building support. This chapter outlines the major stakeholders in the Nigerian solar industry, providing an overview of the institutions and organizations with which new entrants should engage to navigate regulatory requirements, secure funding, access technical support and establish a sustainable business.

Public sector and government agencies

The Nigerian public sector is critical to regulating and incentivizing the solar market. Government agencies set policies, provide licences and monitor compliance with regulations to ensure the industry operates in line with national energy goals. Engaging with these bodies is essential for navigating the regulatory environment and accessing government incentives.

Table 5 Public sector and government agencies

Organization	Role and engagement strategy	Relevance to voluntary returnees
Corporate Affairs Commission (CAC) www.cac.gov.ng	The CAC handles the registration and regulation of companies, business names and incorporated trustees.	Registering with the CAC is the first step for any business in Nigeria. It is required to obtain licences, access grants and engage in formal business activities. Returnees should register a business name or limited liability company to gain legal recognition and build credibility.
Nigerian Electricity Regulatory Commission (NERC) www.nerc.gov.ng	NERC regulates Nigeria's electricity sector, including renewable energy. It issues licences for power generation and mini-grids.	Returnees setting up large-scale solar projects (e.g. mini-grids above 100kW) will need NERC licences. Smaller solar businesses do not need licences initially, making it easier to start small and scale up.
Rural Electrification Agency www.rea.gov.ng	REA provides electricity to rural and underserved areas through renewable energy projects.	REA's mandate involves managing funding initiatives such as the Nigeria Electrification Project and the Energizing Agriculture Programme. These programmes support off-grid solutions and provide grants and subsidies to developers and solar companies. For instance, returnees can apply for grants or collaborate on projects. They can gain experience and access to opportunities by partnering with established companies.
Standards Organisation of Nigeria (SON) www.son.gov.ng	SON sets quality and safety standards for solar products, including imported and locally manufactured equipment. A product authentication mark is applied to each item to ensure traceability and tracking of imported and local goods.	All solar components (e.g. PV panels, inverters) must meet SON standards. Returnees should use SON-approved products to avoid fines. Importers and manufacturers need certifications from SON for regulatory compliance.
National Agency for Science and Engineering Infrastructure www.naseni.gov.ng	This agency promotes local manufacturing of renewable energy technologies and supports research and development.	Returnees interested in local solar manufacturing or research and development can seek the agency's mentorship, technical support and potential funding to help develop their business.

Source: ITC based on field research.

Council for the Regulation of Engineering in Nigeria (COREN) www.coren.gov.ng	COREN regulates engineering practices and training institutions in Nigeria.	Returnees seeking additional training in the solar sector should ensure their courses are COREN-certified to meet professional standards.
State-level agencies and local governments	State and local agencies may require permits for installations and land use.	Depending on the location, returnees may need permits for solar installations and land use approvals, especially for large projects. Engaging early with local authorities will help avoid delays.

Private-sector and industry players

The Nigerian solar energy market is mainly driven by private-sector companies, including local installers, large-scale developers and original equipment manufacturers. New entrants, such as returnees, can benefit from partnerships with these companies.

Opportunities include becoming distributors, sales agents or installation technicians for solar home systems and related products such as solar lanterns, batteries and productive-use appliances. Many companies offer PAYG financing, making it easier to start with minimal capital. There are also possibilities to collaborate with independent

power producers, mini-grid developers and EPC companies, especially for those interested in technical or non-technical roles.

Voluntary returnees can also explore opportunities with original equipment manufacturers for roles in manufacturing, assembly and technology transfer. Partnerships with foreign original equipment manufacturers and multinational companies can help returnees become local distributors, bringing international products to the local market. The table below highlights the key industry players, including avenues of collaboration and opportunities for returnees.



Table 6 Private-sector and industry stakeholders by market segment

Company/ organization	Short description	Relevance to returnees
1. Local solar home system companies and productive use of energy providers		
SunKing https://sunking.com/	SunKing designs, distributes, installs and finances various solar products, including lanterns, home systems and inverters. It offers PAYG financing.	Returnees can become distributors, sales agents or installation technicians. The PAYG model allows for business growth with low upfront investment.
Lumos Nigeria https://www.lumos.com.ng/	Lumos is a leading provider of solar home systems. It offers products and services similar to SunKing, with PAYG options.	The role for returnees entails being sales agents or distributors, using Lumos's PAYG model to market and sell solar systems to households and businesses.
Oriki Energy http://www.orkienergy.com/	Oriki focuses on the productive use of solar energy in agriculture, commerce and wellness, targeting underprivileged communities and women entrepreneurs. Its PAYG system reduces the financial barriers to entry.	Returnees can establish small solar-powered businesses such as phone charging kiosks or equipment rentals. Oriki's low 20% down payment makes it easier for returnees to start entrepreneurial ventures.
Koolboks, Coldhubs, CoolCycle Agro Hub https://www.koolboksnigeria.com/ https://www.coldhubs.com/	These companies specialize in solar-powered refrigeration solutions, using PAYG models to provide cooling services in off-grid areas.	Returnees can become regional distributors, sales agents or technicians for solar cooling solutions. Alternatively, they can set up small cold-chain businesses using Koolboks or Coldhubs technology to offer refrigeration services in rural communities.
Reeddi https://www.reeddi.com/	Reeddi sells compact, solar-powered battery units for small businesses, supporting activities such as hairdressing, welding and manufacturing in off-grid areas.	Opportunities for returnees including distributing Reeddi units or providing installation services to off-grid small businesses, supporting local entrepreneurs in underserved areas.
Powerstove https://powerstove.africa/	Powerstove produces clean cooking stoves with integrated solar-powered battery units that can be used for cooking and phone charging in rural areas.	Returnees can use these multifunctional stoves to create local distribution networks for Powerstove products or set up small businesses such as mobile food stalls or charging stations.

2. Independent power producers/mini-grid developers/EPC companies

Sun Hive; Green Village Electricity; Rubitec Solar Limited Husk Power; Arnergy Solar; https://sunhive.com/ https://gve-group.com/ https://www.rubitecsolar.com/ https://arnergy.com/	Companies including SunHive, Green Village Electricity and Rubitec Solar develop large-scale solar farms and mini-grids for rural electrification.	Returnees can pursue technical roles in solar project development or partner with developers to handle non-technical aspects such as logistics or community engagement. For entrepreneurial returnees, there is potential for joint ventures in solar projects.
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3. Original equipment manufacturers

Auxano Nigeria https://auxanosolar.com/	Assembles and manufactures solar PV modules locally.	Returnees can work in factory operations, packaging or logistics. Auxano also offers training and partnerships for entrepreneurs.
GreenAge Technologies https://greenagetech.com/	Produces solar inverters and offers on-the-job training.	Returnees can join the GreenAge's Hardware Garage programme to receive resources and mentorship for starting solar businesses.
Schneider Electric https://www.se.com/ng/en/	A global leader in energy management and automation.	Returnees can become local distributors or technicians.
Growatt Energy https://en.growatt.com/	Produces inverters and battery storage systems.	Provides opportunities for returnees to establish supply partnerships.
Fronius https://www.fronius.com/en/solar-energy/home-owners	Manufactures high-quality inverters and energy storage solutions.	Returnees can explore technology transfer and distribution partnerships
SMA https://www.sma.de/en/	Solar: Supplies large-scale energy equipment for solar farms.	Returnees can engage as local partners to distribute and support SMA products in Nigeria.

Note: Compilation of private-sector institutions. This list is not exhaustive, but highlights some important players in different subsegments of the solar power sector.

Source: ITC.

NGOs and associations

The table below lists NGOs and association organizations that shape Nigeria's solar sector by playing key roles in policy formulation, advocacy

and market development. Understanding their function can provide insights into support mechanisms and collaboration opportunities that can facilitate business growth and market entry strategies.

Table 7 NGOs and associations

Company/ organization	Short description	Relevance to returnees
Nigeria Off-Grid Market Acceleration Program www.offgridmap.ng	Addresses market barriers in Nigeria's off-grid energy sector by supporting project development, funding pilots and assisting with policy documentation.	Returnees can leverage the programme's support in identifying viable business opportunities in rural areas, engaging in pilot projects and exploring PUE solutions (e.g. rice milling, agroprocessing). The programme also provides resources to facilitate the integration of off-grid energy projects with economic activities.
Diamond Development Initiative/United States African Development Foundation www.ddinigeria.org	This initiative, in partnership with the foundation, provides grants, capacity building and project management support to energy entrepreneurs in Nigeria.	Returnees can access grants and mentorship to develop energy businesses, focusing on solar home systems, mini-grids and PUEs (e.g. solar refrigeration, irrigation). They can also receive training and business support to improve sustainability and scale their ventures.
Clean Tech Hub Cleantechnologyhub.org Clean Technology Hub	An incubator and accelerator in Abuja focused on energy access, climate change and clean energy entrepreneurship. Offers training, research, policy advisories and start-up investment.	Ideal for returnees looking to start or scale clean energy businesses. Clean Tech Hub provides business development support, market insights and potential early-stage financing for promising start-ups.
Renewable Energy Association of Nigeria www.rean.org.ng	The primary trade association for Nigeria's renewable energy sector, promoting solar adoption and industry interests.	Returnees can join the association for networking, accessing industry data and participating in policy advocacy. This helps them build valuable connections and stay informed about market trends and opportunities.

Alliance for Rural Electrification https://www.ruralelec.org/	An international organization supporting sustainable electricity access in developing countries.	Offers resources, connections and best practices for implementing solar projects in rural areas.
Nigeria Climate Innovation Center https://nigeriacic.org/	Provides incubation, training, and development resources for start-ups in the renewable energy sector.	Offers support in business development, funding, and training, ideal for returnees starting new ventures.
African Clean Energy Technical Assistance Facility www.ace-taf.org/	A pioneer in research, policy and advocacy for clean energy in Nigeria.	Provides insights on market trends, policy support and potential collaborations, especially in advocacy projects.
Solar Sisters www.solarsister.org/	Empowers women entrepreneurs in the clean energy sector by providing resources and support.	Offers targeted support for female returnees interested in distributing solar products within their communities.
Rocky Mountain Institute – Energy https://rmi.org/our-work/africa/	Partners with Nigeria to develop clean energy solutions and mini-grids for rural areas.	Useful for returnees interested in mini-grid development and large-scale energy solutions in underserved areas.
The Global Energy Alliance for People and Planet https://energyalliance.org/	This philanthropic initiative supports scalable renewable energy solutions to drive economic growth and environmental benefits. It partners with governments, businesses and communities to enable access to clean energy in underserved regions.	The alliance offers funding and technical support for projects in renewable energy, including solar. For returnees, it provides opportunities to engage in initiatives focused on clean energy access and sustainable development in Nigeria, which can offer financial support, mentorship and collaboration with global stakeholders.

Note: Compilation of private-sector organizations including associations and NGOs.

Source: ITC.

Regulatory environment: Compliance requirements for business operations

The solar energy sector's regulatory environment influences the ease of doing business, investment opportunities and compliance. Voluntary returnees, entrepreneurs and new entrants must understand the regulatory landscape to navigate the complexities of developing and operating a solar business in Nigeria.

Steps that must be undertaken before starting a solar business include business registration at the CAC, which is necessary to obtain licences, apply for grants and secure contracts. Important compliance requirements need to be respected for solar products, as described in Figure 6.

Figure 6 Overview of regulatory bodies



Source: ITC.



Satisfying documentation and certification requirements is crucial when dealing with solar products, including imports into Nigeria, to ensure regulatory compliance and smooth entry into the market. The required import documentation includes a pro forma invoice, bill of lading/airway bill, packing list, manufacturer certificate, product certificate, combined certificate of value and origin, and environmental import clearance certificate.

Solar products must comply with the Standards Organisation of Nigeria Conformity Assessment Programme and international quality standards. Financial compliance involves providing a tax clearance certificate for the past three years, a detailed 10-year business plan and financing agreements. Operational compliance involves following safety standards and maintenance protocols and providing continuous training for technical staff. Solar entrepreneurs in Nigeria must also comply with licensing and permitting requirements, which vary depending on the business model, scale and specific activities in the solar value chain.

- **Licensing for mini-grids and distributed generation:** NERC issues a registration permit or a permit for captive power generation for mini-grid projects up to 1MW, depending on the project's nature.
- **Certification solar home systems:** SON certification is mandatory for distributors or wholesalers to ensure equipment quality and safety. Installers or developers must also use SON-certified products for their projects.
- **Environmental compliance:** Personnel for large-scale installations should be certified through recognized training programmes. Firms handling large projects must obtain an environmental impact assessment certificate from the National Environmental Standards and Regulations Enforcement Agency. Compliance includes proper waste management procedures, especially for end-of-life solar batteries and hazardous materials.

Challenges and barriers for entrepreneurs

Main challenges across the sector

While the solar power sector has great potential and is growing fast, entrepreneurs face challenges. These include the following:

High capital costs

Solar solutions—especially energy storage systems—require a significant upfront investment. Energy storage, specifically batteries, is one of the most expensive components of solar solutions. Cheap, low-quality batteries often fail prematurely, leading to poor customer satisfaction and discouraging further adoption. The high cost of batteries is a major barrier to widespread adoption for residential users.

Both commercial and residential customers find the initial capital expenditure prohibitive. Financing solar solutions is expensive due to limited access to local currency loans and high interest rates, especially for small developers.

Limited awareness and misinformation about solar solutions

Many potential customers in the residential and C&I sectors are unaware of the economic and environmental benefits of solar. A lack of awareness and misinformation, particularly regarding performance and cost, discourage adoption. There is often scepticism about solar technology's performance, especially its ability to power large appliances or provide sufficient energy during peak hours.

Market lacks standardized quality-control measures

The lack of quality-assurance measures for solar products, procurement, installation and maintenance leads to inconsistent performance, substandard installations and dissatisfied customers—especially with battery systems. The market is flooded with subpar solar components—notably low-quality batteries—that frequently fail, leading

to negative customer experiences. The absence of a certification body to ensure quality control exacerbates this problem.

Regulatory and policy barriers continue to slow market growth

While the Government has adopted policies such as tax holidays and import duty exemptions for solar equipment, challenges remain in enforcement, especially with import duties on solar panels and batteries. Lengthy processing times and difficulties in accessing these benefits slow market growth. Some critical components, such as lithium batteries, still attract high import duties, driving up costs and limiting adoption.

Currency risk and financing challenges threaten solar expansion

Many solar developers rely on hard currency loans, which expose them to currency devaluation risks. This risk is especially pronounced in long-term contracts such as independent power producer agreements. The high cost of local currency debt and the unwillingness of most banks to lend to solar projects (as solar is not recognized as an asset class) limit the ability of both developers and customers to finance solar installations.

A fragmented ecosystem disrupts efficiency and customer satisfaction

Developers often lack a streamlined approach to solution design and sales, leading to inefficiencies. The absence of tailored offerings for specific customer segments (e.g. small businesses, healthcare or agriculture) means many customers are not adequately served. The lack of standardized operations and maintenance practices further complicates solar adoption. Inconsistent service level agreements lead to varied customer experiences and deter long-term adoption.

Long sales cycles and financing constraints challenge solar suppliers

Solar firms face long sales cycles, particularly in the C&I sector, that tie up liquidity. This often forces firms to offer short-term financing options to customers, straining their resources and limiting their ability to scale. Solar developers also struggle to secure project financing, making it hard for them to meet growing demand.

Entry barriers and support cost

While more players have entered Nigeria's solar market, this does not mean greater consumer accessibility. A major setback occurred in early 2018, when the Nigerian Customs Service reclassified solar panels from Harmonized System code 8541 to 8501, which led to a 5% import duty and a 5% value-added tax on the previously duty-exempt panels. This change hampered the growth potential of the solar sector, some said (Netherlands Enterprise Agency, 2021).

Still, the new classification—combined with the high interest rate for loans offered by commercial bank, which is about 22%—threaten operators. Higher investment costs could reduce revenue by as much as 50% due to increased prices and less demand (Netherlands Enterprise Agency, 2021). Efforts are underway to restore solar equipment to duty-free status.

Initial set-up and capital requirements

The upfront capital requirements to set up a solar business can vary greatly depending on the scale of the venture (e.g. SHS distribution, EPC services, mini-grid development). Initial costs beyond buying inventory or equipment may



include setting up the business premises, purchasing office equipment, procuring vehicles for logistics and covering initial operating expenses.

- **Small-scale SHS distribution:** Initial capital is typically allocated towards stock inventory, warehousing and marketing for SHS distribution.
- **Solar EPC services:** To operate, EPC business will need a professional office set-up, engineering software tools, logistics support and a basic workforce. However, the EPC business model often allows entrepreneurs to pass project costs onto clients, making initial investments relatively lower than other models.
- **Mini-grid development:** Mini-grid projects are capital-intensive and require significant investment. Effective mini-grid projects often rely on funding combinations, including grants, subsidies, impact investments and blended finance, which help lower the financial threshold for new entrants. This creates a feasible entry point for those looking to gain experience in the sector by partnering with established companies that already have infrastructure and funding frameworks in place.

In essence, the path to enter the mini-grid sector for returnees and new entrants is less about direct investment in entire mini-grid set-ups and more about strategic partnerships that allow them to build expertise while contributing to specific project segments. This method not only provides practical experience but also positions them for potential future independence in the field.

Market access and customer acquisition

Establishing a customer base and gaining trust in a competitive market can be challenging, particularly in a sector dominated by both established players and informal providers. Effective market access strategies often require substantial investment in marketing, community engagement and partnerships.

- **Building market credibility:** Many new entrants struggle with customer acquisition due to a lack of brand recognition. This is especially true for EPC firms and SHS distributors who face competition from well-known brands—especially with the downstream being highly saturated.
- **Community engagement:** Engaging local communities to build trust and awareness is crucial for SHS distribution and mini-grid projects. This may involve conducting community outreach, offering product demonstrations and training local technicians.
- **Customer financing solutions:** High initial costs of solar products can deter customers. Developing customer financing solutions such as PAYG, instalment payment plans or microfinancing partnerships is often necessary to drive adoption.

Technical expertise and training

The lack of skilled labour is a serious barrier in Nigeria's solar sector. There is a high demand for technicians, engineers and business professionals with specialized training in solar technology, energy management and project financing. Without the right technical expertise, businesses may struggle with installation quality, maintenance and customer satisfaction.



Effective mini-grid projects often rely on funding combinations, including grants, subsidies, impact investments and blended finance, which help lower the financial threshold for new entrants.



- **Recruitment and retention challenges:** Hiring and retaining skilled technical staff is difficult due to competition and a limited talent pool. Many firms must invest in in-house training programmes to develop the required skills.
- **Certification and accreditation:** For certain roles, such as system design and installation, industry-recognized certifications (e.g. from COREN-certified institutions) are mandatory to maintain high standards and gain customer trust.

Logistics and supply chain challenges

The fragmented nature of Nigeria's logistics and supply-chain infrastructure adds another layer of complexity. Importation, transportation, warehousing and last-mile delivery are common pain points, especially for firms targeting remote or rural markets.

- **Importation delays and costs:** Imports of solar components are often delayed due to customs bottlenecks, incomplete

documentation and compliance checks. Importers must navigate complex regulations, including Standards Organisation of Nigeria Conformity Assessment Programme certifications, which can increase costs and lead to project delays.

- **Distribution in remote areas:** Reaching rural and off-grid communities poses logistical challenges, including poor road infrastructure and security concerns. Efficient distribution requires a robust logistics network and effective inventory management.

Bureaucratic regulatory compliance issues

As with most nations, navigating the regulatory landscape in Nigeria is often a time-consuming and bureaucratic process, involving multiple agencies and layers of compliance. The primary regulatory bodies include CAC, NERC and SON. Compliance involves considerable paperwork, inspections and certifications, which can delay business launch. Returnees starting small may not need much paperwork at the outset, but the situation becomes more complex as the organization grows.

Box 2 Practical tips to overcome entry barriers including cost

- Leverage partnerships and innovative financing models, such as pay-as-you-go and lease-to-own arrangements, to minimize upfront capital requirements. For example, inventory financing for SHS distribution or service-based contracts for EPC services can defer some initial costs.
- Consider building a local network of sales agents and leveraging community structures (e.g. cooperatives, farmers' groups) to promote your business. Offering flexible financing options can also boost market penetration.
- Invest in training and development for both current employees and new hires. Partnering with local training institutes or universities offering relevant certifications can reduce training costs and improve workforce quality.
- Establish strategic partnerships with reliable logistics providers and consider decentralized warehousing in key locations to reduce transportation costs. Implement a robust supply-chain management system to track inventory and streamline delivery.
- Start early by engaging local legal consultants or compliance experts who are familiar with these processes. Build extra time into your project plan for regulatory approval delays, as this is often a bottleneck.

CHAPTER 5

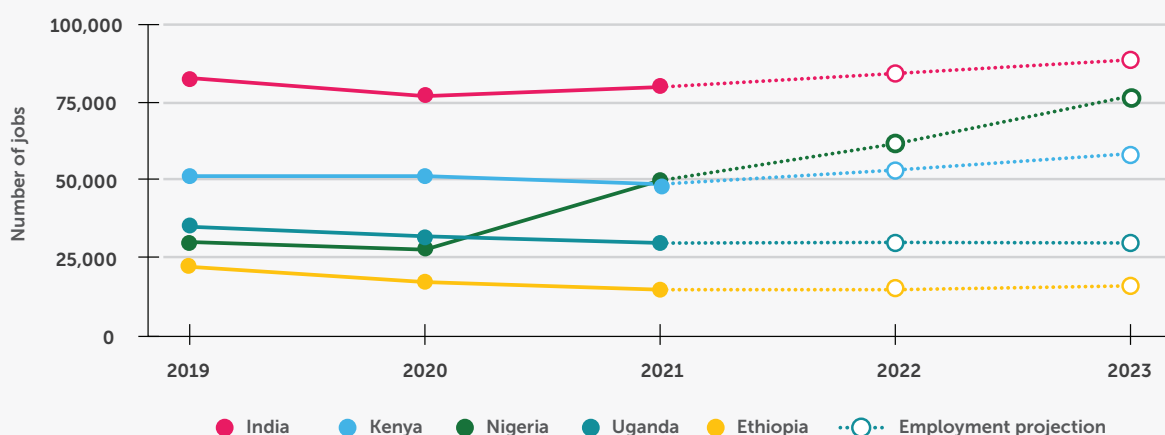
Labour market insights

The rapid growth of Nigeria's solar energy sector is creating a dynamic labour market with rising demand for skilled professionals. Demand for solar energy professionals extends beyond traditional technical roles; the sector also needs professionals with expertise in project management, finance, business development, policy analysis, advocacy and community engagement.

Interviews with sector professionals indicate that the labour market faces a major skills gap, especially in technical and engineering roles. This hinders the quality and scale of solar installations.

Nigeria's decentralized renewable energy segment, which includes small solar appliances, stand-alone solar home systems and mini-grid systems, employed 50,000 people in 2021—nearly rivalling the oil and gas sector, which employs 65,000 people (Pan and Tesfahunegn, 2023). It had been forecasted to add another 26,000 jobs, though it is not clear that this happened (Power for All, 2022). This highlights solar power's crucial role in driving employment growth in Nigeria and its importance as a stable and resilient employer.

Figure 7 Decentralized renewable energy employment trends in five countries



Source: Power for All, 2022.



This growth is driven by rising demand for solar products and solutions, especially in rural areas. It is also important to mention that about 31% of jobs in the decentralized renewable energy sector are informal—well below the national average of more than 80% for the general economy. The wage differences in the sector are smaller than those in the national labour market, suggesting that it offers competitive salaries relative to other industries (Power for All, 2022).

As the solar sector becomes more advanced, demand for skilled labour—particularly installation technicians and maintenance professionals—is rising. Initially, most jobs in the decentralized renewable energy sector were low-skill positions, such as sales agents, but the transition to larger, more sophisticated systems is creating opportunities for skilled workers. However, companies report a shortage of qualified workers—a major obstacle to further growth (Power for All, 2022).

The solar industry could represent up to 5% of Nigeria's labour force, with growth in roles related to solar PV installation, project management and technical design (Gabe-Oji, 2021). Many Nigerian solar engineers have worked on projects ranging from small 5kW systems to larger systems exceeding 100kW (Gabe-Oji, 2021).

With [Nigeria's Energy Transition Plan](#) aiming for net-zero emissions by 2060, the solar power sector is expected to play a key role in meeting the country's energy goals. As the sector matures, the focus on reskilling and upskilling workers, particularly in technical roles, will be vital to sustain the projected 5% annual growth in employment.

Job opportunities and skills requirements

Positions such as project manager, sales and marketing, installation technician, operations and maintenance specialist, and customer service representative involve project planning, sales, installing solar panels, monitoring systems and/or supporting customers. Nigeria's renewable energy workforce is dynamic, with about 56% of workers being skilled. Women comprise around 37% of the sector, mainly in administrative and support roles (Power for All, 2022).

Workers in the renewable energy sector have varying levels of education, with some lacking higher education. There is a recognized need for training and skill-building within the workforce. The industry faces challenges in retaining skilled workers but is expected to grow, leading to more job opportunities.

Technical roles

Technical roles are essential to ensure the proper design, installation and maintenance of solar systems.

- Solar PV installers and technicians install, maintain and troubleshoot solar PV systems. These professionals need strong installation and energy auditing skills, with knowledge of safety standards being critical. High demand for this role means candidates with a technical diploma, NABTEB certifications or a B.Eng and COREN certification are highly sought after.
- Electrical engineers and solar project engineers design and implement electrical systems for both off-grid and on-grid projects. They require expertise in system

design, electrical engineering and tools such as HOMER, PVSyst and AutoCAD. Due to their essential role in large-scale projects, there is a high demand for engineers with qualifications such as a B.Eng and COREN certification.

- Solar project developers and system integration specialists handle the critical tasks of site assessments and system design, ensuring the smooth integration of solar solutions. With strong project management and technical skills, people in these roles are in high demand. They typically require a bachelor's degree and technical certification.
- Energy auditors assess energy needs and recommend suitable solar solutions. Though demand for auditors is moderate, those with technical diplomas or NABTEB certifications are preferred.

Managerial and business development roles

As Nigeria's solar market grows, demand is rising for people to fill managerial and business development roles.

- C-suite executives (e.g. chief executive officers, chief operating officers, chief technical officers, chief financial officers) lead firms by overseeing strategy, operations and finance and guiding businesses towards long-term growth. These positions demand leadership and strategic planning abilities, and people with relevant executive experience and advanced degrees are in high demand.

- Technical sales and business development managers promote solar products, negotiate contracts and expand market reach. This role demands excellent communication and negotiation skills, with high demand for people with sales degrees and proficiency in customer relationship management. Similarly, operations and maintenance managers ensure solar installations' smooth operation and maintenance. They must have troubleshooting and operational management skills; qualifications such as technical diplomas and operations and maintenance certifications are commonly required.
- Administrative roles also contribute to the sector. Procurement and administrative specialists handle equipment procurement and daily office operations, requiring expertise in logistics and office management. Finally, entrepreneurs in the solar energy market drive innovation by identifying business opportunities, developing strategic plans and securing funding. While an entrepreneurial mindset is critical for this role, formal qualifications are not necessarily required; experience and strategic thinking are essential.

Expected income

Nigeria's solar power sector has demonstrated resilience in generating job opportunities, especially in project management, skilled labour and customer service. Powering Job Census 2022 data indicate that wages across various roles as of 2021 underscore the importance of skilled and semi-skilled

workers, showcasing Nigeria's potential to expand its renewable energy workforce and bolster socioeconomic development.

Potential income varies depending on the type of business model or employment role. Returnees need to consider the earning potential of different roles and how this aligns with their career or business goals.

Table 8 Potential income in the solar energy sector

	Monthly salary range (₦)	Description
Solar technician (entry-level)	50,000–100,000	Basic installation and maintenance of solar home systems. Mid-level to experienced technicians can earn 75%–150% more.
Solar sales representative	50,000–70,000 (base) + commission	It involves selling solar products and services. Depending on performance, the commission can be 100,000 or more monthly.
Project manager	150,000–200,000	Oversees large-scale projects and team management for solar installations and mini-grid projects.
Entry-level desk job roles	50,000–100,000	Accounting, legal, administration, personal assistant, research associate and other desk jobs.

Note: Salaries are indicative of local firms. Multinational companies are likely to pay far more than local ones. Also, the Government of Nigeria raised the minimum monthly wage to ₦70,000 in July 2024. Only about 10% of Nigerians earn above ₦100,000, according to the Nigerian Financial Services Market Report. Figures draw from field research/ interviews with stakeholders and public sources (<https://www.mysalaryscale.com/>)

Source: ITC.

In the context of this brief and considering the profile of returnees in the ARRIVES project, solar PV installer has been identified as a top entry-level job in the solar industry. The earning expectation is between ₦50,000 and ₦100,000. The responsibilities and skills required are described in detail in Box 3.

Box 3 Example of a job advertisement for a solar PV installer

Description: Installs, maintains and troubleshoots solar PV systems for residential, commercial and industrial projects. This hands-on role is a great fit for returnees who prefer practical field-based work over desk jobs.

- **Key responsibilities:**
 - Conduct site assessments
 - Set up mounting systems and install solar panels
 - Connect panels to inverters and test systems
 - Troubleshoot and perform maintenance
 - Educate customers on system maintenance and safety
- **Skills required:**
 - Basic electrical skill
 - Physical fitness and safety awareness
 - Tool handling
 - Attention to detail
 - Troubleshooting abilities
- **Entry requirements:**
 - Senior Secondary School Certificate or equivalent
 - Basic literacy and numeracy skills – some experience in electrical work or construction
- **Training pathways:**
 - Short certification courses in solar PV installation are recommended for those without experience.
- **Career progression**
 - Opportunities for advancement to roles such as lead technician, site supervisor or technical trainer.

For voluntary returnees, photovoltaic installation is a practical, low-barrier entry point that offers relatively quick employability. Returnees can transition from this role and similar ones into setting up their firms. Most founders and successful solar entrepreneurs in Nigeria today began in the field, learned the technical aspects of the business and progressed into the successful companies they have today.

Source: ITC.



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Training and education providers

The Nigerian education landscape offers pathways for technicians, engineers and entrepreneurs to build capacity to enter the solar energy sector. Individuals can get certifications, technical training or higher education in renewable energy, or obtain entrepreneurial skills to start their solar businesses. Continued investment in workforce development is crucial to ensure the availability of qualified professionals to drive the country's solar revolution.

1. Higher education and research institutions

Nigeria's universities, including the Federal University of Technology, Akure; the Energy Technology Institute (University of Port Harcourt); the

University of Nigeria, Nsukka – Centre for Energy Research and Development; Covenant University and Ahmadu Bello University, offer advanced academic programmes and research opportunities in solar energy and sustainability. Programme graduates often move into roles such as system designers, solar project engineers, business development and policy advisers. Some of these institutions partner with the industry to provide internship opportunities for trainees.

2. Technical and vocational training, including business and entrepreneurial training

Several Nigerian institutions, including the National Power Training Institute of Nigeria, Lagos Energy Academy, the Nigerian Institute of Electrical and Electronics Engineers, the Renewable

Energy Technology Training Institute and the [Blue Camel Renewable Energy Training Academy](#) offer vocational training programmes in solar power. These programmes focus on essential skills such as solar PV system installation, maintenance, troubleshooting and design, and provide technical certifications management.

As the sector expands, more people are needed with the skills to promote solar products, manage projects and launch solar energy ventures. The Lagos State Employment Trust Fund and the Renewable Energy Technology Training Institute offer entrepreneurial and business-focused training to help people understand market dynamics, customer needs and the financial aspects of solar projects. These programmes teach participants how to launch and manage successful solar businesses. They also allow them to navigate regulatory frameworks in the renewable energy sector.

Returnees should only engage with organizations with certifications from recognized institutions such as COREN.

3. Industry training and international certifications

International certification in the solar energy sector boosts the credibility and expertise of professionals. Certifications from Solar Energy International, the Renewable Energy Institute, RENAC Academy, Berlin, the Project Management Institute, Google, Coursera and the Institute of Electrical and Electronics Engineers are widely recognized and respected globally. They cover a wide range of skills, including solar PV design, installation, system maintenance, project management, business and finance, ensuring that certified professionals meet international standards.

Industry players including Schneider Electric, SMA Solar and local mini-grid developers and EPCs such as Husk Power, Arnergy, Auxano and GreenAge Technologies offer tailored training as part of their corporate social responsibility initiatives or special programmes. These programmes cover areas such as system design, operation and maintenance and participants get certifications that are highly regarded in the industry.

For returnees with limited experience in the solar energy sector, an internship at established companies can be the starting point. This approach allows participants to upskill, obtain certifications and gain access to job opportunities. Starting with an internship rather than jumping straight into business is a more strategic route.



▶ CHAPTER 6 ◀

Financial aspects

The first step for returnees will be to understand the financial landscape so they can make informed investment decisions, funding options and revenue projections. Analysing these factors will enable returnees navigate the financial challenges and opportunities in Nigeria's solar market.

Investment requirements

The solar energy sector offers entrepreneurial opportunities—both product-based and service-based business. The amount of initial investment to start a company in the sector will depend on the venture's nature. Below are practical estimates for key business models and entry-level requirements.

Table 9 Investment required by business type

Business type	Description	Investment requirements	Main expenses
Solar engineering, procurement and construction.	EPC businesses design, procure and build solar systems for residential and commercial clients.	From ₦500,000. For EPC services, companies can transfer the cost of capital to the clients, reducing the need for entrepreneurs to incur personal cost in the project.	Certification fees, office/store set-up, software licences (HOMER, PvSyst), procurement of tools, logistics, labour costs, safety equipment, etc.

SHS distributor/ wholesaler	Focuses on selling solar home systems and lanterns to retailers and residential users.	From ₦500,000. The cheapest solar home system (such as a solar lamp) costs ₦20,000–₦50,000. Capital costs will depend on the product being distributed and the minimum order quantity one can start with.	Stock inventory, office, logistics, distribution network set-up, marketing.
Solar kiosk operator	Provides phone charging, WiFi and small solar product retail services in off-grid areas.	₦250,000 and above.	Through PAYG financing models, companies such as Oriki Energy sell their solar kiosks with just a 20% down payment for a product that typically costs ₦1.3 million.
Solar-powered cold storage/ freezer operator	Operates cold storage facilities for farmers and local businesses, primarily in agricultural, rural or peri-urban regions.	₦1 million and above. Companies such as Koolboks offer financing for their solar freezers for as low as a 35% down payment and a ₦25,000 monthly instalment plan.	Procurement of cold storage units or freezers, land lease (if required), solar panels, logistics, security, operational expenses.

Note: The figures used here are indicative and are for returnees who want to start very small and grow organically. Returnees must still carry out their business plan and market analysis on the location or market they wish to operate to get a more precise investment figure.

Source: ITC field research and company sources.



Available financing models

Foreign investments, including grants from donor agencies and equity or debt from impact funds and international private investors, drive Nigeria's solar power energy market. Various financing instruments are available, including results-based financing, concessional debts, commercial debts, equity, crowdfunding and green bonds. Results-based financing is effective in de-risking commercial investments by providing payments contingent upon successful delivery of energy access.

The high initial capital required to start most solar businesses can be a barrier for returnees. Understanding available financing models can help mitigate this challenge. Below are practical financing options for solar business ventures.

Table 10 Available financial models

Financing model	Description	Related business ideas
Pay-as-you-go financing	PAYG financing is an innovative model where entrepreneurs or consumers pay for solar systems in small, manageable instalments. This model is popular for home solar systems and small business set-ups, such as kiosks and water pumps. PAYG reduces the upfront cost, making it accessible to individuals with limited capital.	SHS distributors, solar kiosk operators, water pump businesses
Leasing options	Leasing allows businesses to acquire solar equipment (e.g. cold storage units, water pumps) without paying the full cost upfront. Instead, they pay a fixed monthly rental fee that can be covered by income generated from the equipment.	Cold storage operators, irrigation businesses
Cooperative financing	Cooperative financing is popular among farmers and small business owners in rural areas. A group of returnees or local entrepreneurs could pool resources to acquire solar equipment, thereby reducing individual financial burdens.	Solar-powered agribusinesses, irrigation businesses, mini-grid developers
Grants and subsidies	Some NGOs and international organizations offer grants to support solar entrepreneurs, notably in areas such as productive use applications (e.g. solar-powered cold storage). Returnees should explore grant opportunities from the United Nations Development Programme, Carbon Trust, UKAID/FCDO, Acumen and the REA.	High-capital businesses like cold storage, mini-grids, solar agribusinesses
Microfinance	Microfinance institutions including LAPO Microfinance Bank offer small loans with flexible repayment terms tailored for small businesses.	Small-scale ventures such as SHS distributors, solar kiosk operators, agribusinesses
Government subsidies and incentives	The Government, through agencies such as the REA, offers subsidies for renewable energy projects. Returnees should explore these incentives to lower capital costs.	All businesses, particularly those focusing on rural electrification and productive use of solar technologies

Source ITC compilation based on interviews and field research

Financial institutions and development partners

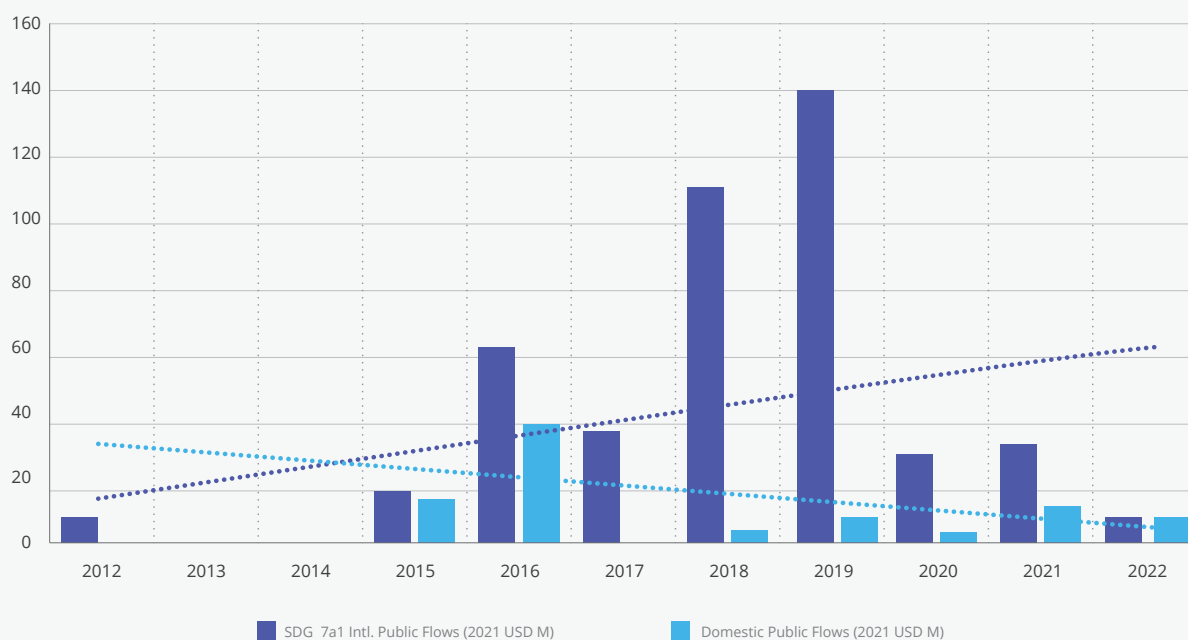
International organizations and multinational companies bring capital, technology and best practices to the Nigerian market. They are involved in mini-grids, productive energy uses and large-scale projects, and they provide technical assistance, funding and market entry support. Figure 8 shows that international development assistance surged in recent years, peaking at around \$140 million in 2019 but dropping to \$10 million in 2022. This earlier trend reflected rising foreign support for renewable energy initiatives, particularly off-grid projects targeting underserved communities.

Domestic public flows, on the other hand, have remained relatively low and

inconsistent, especially compared to international flows. They fell from \$25 million in 2016 to \$20 million in 2020 and the general trend shows a decline. This signals diminishing local government investment, with values mostly below \$30 million, and underscores Nigeria's growing reliance on international funding for energy access. Development partners and government programmes contribute a large portion of the total investment inflow, especially in the standalone solar sector, which has attracted \$227 million over five years (World Bank, 2020).

In summary, the gap between international and domestic flows highlights the critical role of external support in Nigeria's renewable energy strategy, suggesting a need to revitalize local investment efforts to achieve sustainable energy goals.

Figure 8 Public flows, international vs domestic



Source: ITC calculation based on IRENA 2024.

Building strong relationships and understanding the requirements of these organizations can help new entrants unlock funding and capacity-building opportunities.

Table 11 Financial agencies

Agency	Short description and relevance to returnees
World Bank Nigeria Electrification Project https://projects.worldbank.org/en/projects-operations/project-detail/P161885	Funds off-grid and mini-grid solar solutions in Nigeria to improve energy access, especially in rural areas. It provides subsidies and loans to entrepreneurs for mini-grid and solar home system projects.
African Development Bank https://www.afdb.org/en	The African Development Bank supports sustainable energy programmes across Africa, focusing on economic development and poverty reduction. It funds renewable energy projects through initiatives such as the Desert to Power Programme and the Sustainable Energy Fund for Africa. It also offers grants and loans for solar projects in Nigeria, welcoming returnees to apply and join projects.
Bank of Industry https://www.boi.ng/	The Bank of Industry is Nigeria's main development finance institution, supporting industrial and economic growth, including renewable energy. It offers low-interest loans and grants designed for small and medium-sized firms and start-ups in this sector.
All On https://www.all-on.com/	All On, backed by Shell, promotes off-grid energy access in Nigeria by investing in renewable energy solutions. It provides grants, loans and advisory support to help entrepreneurs secure funding for solar projects in underserved communities.
Acumen West Africa https://acumen.org/regions/west-africa/	Acumen is a global nonprofit that invests in companies addressing poverty through renewable energy. It helps entrepreneurs with funding and support for solar initiatives in low-income and rural areas.

InfraCredit
<https://infracredit.ng/>

InfraCredit helps infrastructure projects secure local financing through credit guarantees, supporting larger-scale solar projects and helping to get local bank loans.

Sustainable Energy for All – universal energy facility
<https://www.seforall.org/our-work/initiatives-projects/UEF>

Sustainable Energy for All (SEforALL) – Universal Energy Facility (UEF): This initiative is backed by the United Nations and aims to accelerate the deployment of renewable energy projects globally. The Universal Energy Facility (UEF) is a results-based financing mechanism that provides grants to eligible energy service providers based on verified energy connections delivered. It supports projects focusing on mini-grids, solar home systems, and clean cooking solutions, incentivizing private sector investment and driving progress toward universal energy access.

Box 4 Practical tips for financial planning

- Returnees are advised to start small, focusing on one business line (e.g. phone charging kiosks) before expanding into larger ventures (e.g. cold storage).
- Partner with organizations such as Koolboks, Oriki Energy SunKing to access affordable financing and reduce capital risks.
- Conduct a thorough market assessment to identify demand patterns, price sensitivities and customer preferences in the chosen business area.
- Invest in monitoring tools such as Internet of Things-enabled devices to track equipment usage, ensure system efficiency and manage payments.
- Keep detailed records of all transactions, manage cash flow carefully and reinvest profits to scale up the business. This is also important to raise funding.

Cultural insights

Installation engineers, project managers and field technicians may need to travel frequently, especially for mini-grid or large-scale EPC projects in rural or remote locations. This could affect work–life balance and personal time.

Working hours can be flexible in project-based roles but are often dictated by project deadlines. For instance, technical teams may have to work longer hours to complete installations within project timelines. Roles such as project design, procurement and sales may offer more flexibility in terms of remote work options, allowing for a better work–life balance.

High-stakes projects, tight deadlines and complex logistical challenges can create a high-stress environment, particularly for project managers and technical leads. Organizations often seek professionals who can perform under pressure.

The sector is highly network-driven and employees are often expected to attend industry events, training sessions and networking gatherings outside regular work hours. This can add value to one's professional growth, but may require additional time commitments.

Due to the technical and often project-based nature of solar work, many organizations adopt a result-oriented approach. Employees and contractors are expected to deliver results within specific time-frames and meet key performance indicators.

Organizations range from small start-ups and social enterprises to large multinational corporations. Work culture and conditions vary greatly based on organizational size. Smaller firms may offer more flexibility but less structure, while larger companies are often more formal but provide clearer career paths.

Given the fast-paced growth and evolving regulations in the solar energy market, adaptability is a valued trait. Companies look for individuals who can respond quickly to changing project requirements, new technologies and shifting customer demands.





Left to right: Mr. Adekoyejo (consultant); Ms Funmi (Oriki Energy) and Mr Fadugba

Box 5

Success story: Joseph Fadugba's solar-powered phone-charging business

Background:

- Joseph Fadugba, a seasoned tailor, decided to diversify his business due to the rising cost of fuel and unreliable electricity supply. His tailoring shop had been a staple in his community for years, but with demand growing for phone charging services, he took a bold step into solar-powered entrepreneurship. Joseph purchased the Oriki phone charging system for ₦1.3 million, paying a 20% down payment to get started. His motivation to branch out into phone charging came from a vision to provide an essential service to his community while growing his income streams.

Achievements:

- Joseph's solar-powered phone charging business has been a success. His device allows him to charge up to 10 devices per cycle (which typically takes 90 minutes) and he charges up to ₦200 per device. With about 40 phones charged daily, he can generate up to ₦8,000 a day, or ₦240,000 in monthly income.
- In addition, the solar system powers lights in his shop, attracting even more customers to his tailoring business. He has become a local success story, with many in the community asking how they can acquire similar solar systems. Joseph's shop has become a local hub, known for reliable phone charging and tailoring services.

Challenges:

- Despite his successes, Joseph faces challenges in scaling his business. While he plans to upgrade his solar system to meet rising demand, he is still financing his first system and has not yet completed the payment. Expanding his business by acquiring additional equipment would add to his financial burden, so he aims to fully pay off his initial system before pursuing further investments.

Lessons learned:

- Joseph's journey highlights the importance of diversifying income streams, especially in regions with unreliable power supply. He credits his success to recognizing the market need and responding with a reliable, affordable solution. His advice for aspiring entrepreneurs is to start small, leverage available financing options such as Oriki's pay-as-you-go system and always look for ways to add value. He has seen firsthand how word of mouth and building trust within a community can lead to strong business growth. Looking ahead, Joseph hopes to expand his solar system, allowing him to serve even more customers while continuing to develop his tailoring business.

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