LESSONS LEARNT | NIGERIA

CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

LESSONS LEARNT FROM THE IMPLEMENTATION OF PILOT PROJECT IN NIGERIA

MAY 2023

CICSA
CLEAN CAPTIVE INSTALLATIONS FOR INDUSTRIAL CLIENTS IN SUB-SAHARA AFRICA

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

UN environment
United Nations Environment Programme

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INTRODUCTION

The Clean Captive Installations for Industrial Clients in Sub-Sahara Africa (CICSA) project currently developed in Kenya, Ghana, Nigeria, and South Africa, has been running since 2019 aiming to demonstrate the economic and financial viability of clean captive energy installations for industries and to enhance their adoption in the four African partner countries and beyond to the entire continent. Captive energy installations are electricity generation facilities that are used and sometimes also managed by commercial or industrial energy users for their own energy consumption. Captive power plants can be operated off-grid or can be connected to the grid.

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

The CICSA project is funded by the International Climate Initiative (IKI) of Germany. The Federal Ministry for Economic Affairs and Climate Action (BMWK) supports this initiative based on a decision adopted by the German Bundestag. The implementing team of the project comprises the United Nations Environment Programme (UNEP) in partnership with its collaborating centre at Frankfurt School of Finance & Management (Frankfurt School), together with locally hired consultants who provide local market and captive power expertise.

THE PROJECT

The project's activities fall under four components:

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

autonomy from the grid supply

reliable electricity supply

energy cost savings

Since the project's launch, scoping missions, country reports, awareness raising, calls for proposals, and a selection process for candidates have been held, among other activities, in Kenya, Ghana, Nigeria and South Africa.

Under component 1, scoping missions were held in partner countries to meet with key public stakeholders and to build and strengthen awareness raising of clean captive installations for the commercial and industrial sector. The collected stakeholders' views included gaps and needs of the sector, current trends and potential synergies between stakeholder activities and the project. The scoping mission in Nigeria was held between 18-22 November 2019.

The project has published country studies on clean captive installations markets in the four partner countries Kenya, Ghana, Nigeria and South Africa. The reports dive into each country's electricity market, policy and regulatory framework, tariffs and market potential for clean captive installations, with a strong focus on finance.

Under component 2, economic and financial tools for assessing suitable financing structures of clean captive installations have been developed and published.

Under component 3, open calls for proposals and country studies were launched through dedicated webinars in partner countries. A framework document was presented and published explaining the application process, eligibility criteria, selection criteria and timelines. For Nigeria, the call for proposals ended on 15 July 2021.

During the selection process, an evaluation committee reviewed, scored, and shortlisted the projects for the open call for proposal for pilot projects in partner countries. The selection involved a thorough due diligence process.

A total of six pilot projects received grant funding from CICSA. For Nigeria, PowerGen Renewable Energy Nigeria was selected. Once pilot projects became operational, the financial and economic viability was monitored and proven.

All documents and resources related to Components 1-3 can be found on the project website (https://www.captiverenewables-africa.org/).

This publication is part of Component 4 and serves for knowledge dissemination and outreach. This report series condenses the results of the project in the four partner countries and includes one case study per country.

The project's direct outcome is to support private industrial and financial sector stakeholders in developing successful pilot projects, demonstrating the captive renewable energy business model, and raising peer awareness in the partner countries. The tools developed during the lifetime of the project, and the results of the pilot projects are disseminated to encourage replication of the captive clean energy generation installations business model in the partner countries (intermediate state) and beyond, to other countries of the region. The successful replication of the captive renewable energy business model in various industries and the availability of financing options in the partner countries are expected to result in decreased industrial greenhouse gas (GHG) emissions and enhanced economic development due to more affordable and reliable energy supply. This will ultimately lead the partner countries to advance towards a low-emission development pathway. The ease of replication, combined with the wide applicability of the business models across selected countries and the region, is expected to drive large-scale replication of the model.

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SUPPORTED PILOT PROJECT IN NIGERIA

Pilot projects that have received financial support have played a crucial role in demonstrating the economic and financial viability of captive solar PV installations. CICSA has provided financial support in the form of results-based grants to six pilots, including one in Nigeria. These grants have shared the costs of one of the following types of solar PV installations:

1. **Transaction costs** including advisory services attributable to a captive solar PV plant at a site with a total installed capacity not exceeding 1 MWp (Type 1 project); or
2. Costs associated with creating a **financing vehicle or a financing instrument** dedicated to captive solar PV projects (Type 2 project); or
3. **Capacity building, trainings or certification initiatives** of scope, with a specific focus on captive solar PV financing (Type 3 project).

In Nigeria, following a competitive call for proposal, the following pilot was selected:

PowerGen Renewable Energy: Under type 2 grant funding (financing vehicle/instrument) PowerGen Renewable Energy Nigeria Limited (PowerGen) was supported to set-up a low transaction-cost fund for Commercial & Industrial (C&I) project developers in emerging markets. The fund allows developers to utilize existing projects as collateral to recycle capital and monetise their accounts receivables, allowing them to undertake more projects and scale rapidly. PowerGen is a renewable energy service provider based in Nigeria with a focus on C&I, mini-grids, and O&M services for customers.

CICSA has been actively promoting the use of renewable energy in Nigeria’s commercial and industrial sectors by offering financing and technical assistance. Solar energy is being utilized for various applications, such as powering production equipment, lighting, and cooling systems. While CICSA's primary focus has been on establishing the business case for clean captive installations, it has also provided support for ground PV captive installations. Grant recipient of CICSA, PowerGen has chosen as pilot site chosen the Eye Foundation Centre in Ijebu Imushin, Ogun state, Nigeria with a 10-year PPA contract for energy supplied from a hybrid solar PV plus battery installation.

The healthcare industry in Nigeria often depends on diesel gensets to supplement electricity from the unreliable grid creating an opportunity for more affordable and reliable captive solar PV solutions that can enable better and uninterrupted service and care provided to patients. CICSA’s efforts on this and other projects are also helping to reduce greenhouse gas emissions, create new income-generating opportunities, generate jobs, stimulate economic growth, and contribute to a more sustainable future.

CASE STUDY- POWERGEN RENEWABLE ENERGY

As explained above, CICSA supported PowerGen Renewable Energy Nigeria Limited (PowerGen) to establish a low transaction-cost fund that offers refinancing mechanisms to project developers. The company has successfully established a Power Purchase Agreement (PPA) agreement with a pilot site that would be refinanced through the fund, an eye clinic in Ogun state, Nigeria. The pilot project consists of a hybrid solar PV plus battery storage solution to offset diesel generation and electricity purchased from the grid. The successful project implementation demonstrates the technical and commercial feasibility of scaling this business model.

1. CONTEXT

Nigeria is the most populous country and largest economy on the African continent with a rapidly increasing demand for energy that will be key to unlocking further economic development. According to World Bank's data of 2021, 85 million Nigerians still do not have access to grid electricity, representing 43 percent of the country's population[1].

Access to energy is a prerequisite for quality health care and it is fundamental to the achievement of universal health care coverage and the Sustainable Development Goals. Frequent load shedding and outages due to poor grid infrastructure disrupt operations of healthcare facilities which require uninterrupted power supply. This has led to widespread self-generation of power, mainly from off-grid diesel and gas generators. As the Nigerian government's planned fuel subsidy removal takes effect in 2023, these diesel gensets will become increasingly expensive leaving an unprecedented impact on customers dependent on these gensets. As such, captive solar power plants can be a viable and more sustainable substitute for diesel generators.

In addition, commercial bank lending is largely absent from the commercial and industrial solar market, offering debt that developers consider too costly (e.g., over 25%) and short tenors, i.e., up to two years. Local financing in Nigeria requires developers to provide physical assets as collateral, as banks do not accept solar equipment as acceptable security assets due to a perceived lack of secondary market value. Borrowers are therefore required to own real estate. As a result, developers are mostly financing projects through their own balance sheets, which limits their ability scale and creates opportunity for more innovative financing solutions.

[1] *https://www.worldbank.org/en/news/press-release/2021/02/05/nigeria-to-improve-electricity-access-and-services-to-citizens?cid*

2. COMPANY

Established in 2018, PowerGen Renewable Energy Nigeria Limited is a renewable energy service provider that operates in Nigeria and has sister companies across Africa, with active offices in Kenya, Democratic Republic of Congo, and Sierra Leone. PowerGen has three established lines of business in Nigeria focused on C&I, mini-grids and Operations & Maintenance. PowerGen is backed by stakeholders such as Shell, Acumen, Omidyar Network, Sumitomo, DOB Equity, ElectriFI, REPP, and the Rockefeller Foundation. PowerGen helped to pioneer the solar mini-grid sector in Africa and is a founding member of the Africa Mini-grid Developers Association (AMDA).

3. PROJECT

THE PROBLEM

Many hospitals, clinics and businesses in Nigeria depend on expensive, noisy, and heavily polluting diesel generators to supplement their electricity needs from an unreliable grid. While captive solar installations with battery backup offer a more reliable, sustainable, and cost-effective solution, many businesses lack the funding to pay for the upfront costs of the system. Moreover, local financing is often associated with expensive debt terms for loan repayments making long-term financing of the assets more challenging for developers and their customers.

THE SOLUTION

PowerGen has partnered with TFE Energy[2] to create the Superpower Africa Fund (SAF), a low transaction-cost fund for C&I project developers in emerging markets that will allow the developers to utilize existing projects as collateral to recycle capital and monetise their accounts receivables (PPA energy payments from the C&I customer), allowing them to undertake more projects and rapidly scale their business whilst maintaining an agile business model and an asset light balance sheet.

PowerGen is responsible for project development, debt negotiations and pipeline building, while TFE Energy looks after developing an online platform for monitoring data, finalizing yield prediction algorithm, legal and technical decision making and investor materials.

[2] *TFE Africa Pty. Ltd is a Cape Town based consultancy which blends finance expertise, on-ground energy access experience and digital technology to catalyse energy-centred development.*

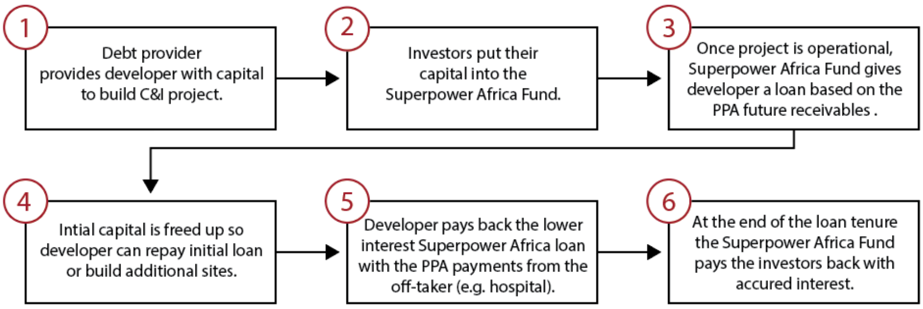


Figure 1: Fund Flow under the refinancing mechanism

For the pilot project, PowerGen signed a 10-year PPA and installed a 180kWp PV, 100KVA PCS[3], 182kWh BESS[4] system at the regional Eye Foundation Center in Ijebu Imushin, Ogun state, Nigeria (see Figure 2 and 3 below). The installation was financed by a mix equity and private capital. Under the refinancing mechanism of SAF, Powergen would be able to use an existing project (the Eye Foundation Center) as collateral to recycle capital that is tied up in the project. This freed up capital can be used to build more projects making Powergen more agile and able to expand more. The monthly payments starting from year 2 will be transferred to the SAF fund for the balance of the PPA tenure.

Figure 2: Solar panel array and Centralised electrical control equipment with energy storage at the Ijebu Eye Clinic

[3] *A PCS is a device that converts the DC power generated by solar panels into AC power that can be used by the customer.*

[4] *Battery Energy Storage System (BESS) are devices that enable energy from renewables, like solar and wind, to be stored and then released when customers need power most.*

Figure 3: Solar panel mounting system showing lightning protection above and below ground

The grant provided the necessary resources to design, build and implement a dedicated platform specifically to facilitate the flow of finance into C&I in Nigeria. Part of the grant funds were used for the development and testing of the online infrastructure (Figure 4) needed to implement an innovative structure like SAF. This includes third party hardware and software systems, GIS platforms[5], API integrations[6] and websites interfacing with users.

The website pulls on data from the hardware installed at customer sites which has already been processed by third party software to track solar PV performance. The SAF website consists of an admin back-end where TFE Africa can analyse, aggregate and package assets into funding windows and manage all loans and investors. Thanks to the hyper precision of the data, assets can be aggregated into very specific windows depending on investor demand. These can be customised into financing windows of, for example, public institutions only (like hospitals and/or schools), female led businesses only or projects with East African geographic focus. The public facing site acts as both an information portal and a sales funnel for investors. Accurately measured data on, for example, every single kWh consumed by individual customers (in near real time) coupled with the top-to-bottom data transparency and third-party authentication means that the system is ideal for data-based monitoring and evaluation (M&E), which would be appealing to carbon finance industries where accountability and traceability is needed.

[5] *A Geographic Information System (GIS) is a computer system that analyzes and displays geographically referenced information. It uses data that is attached to a unique location.*

[6] *An API integration is the connection between two or more applications, via their APIs, that lets those systems exchange data.*

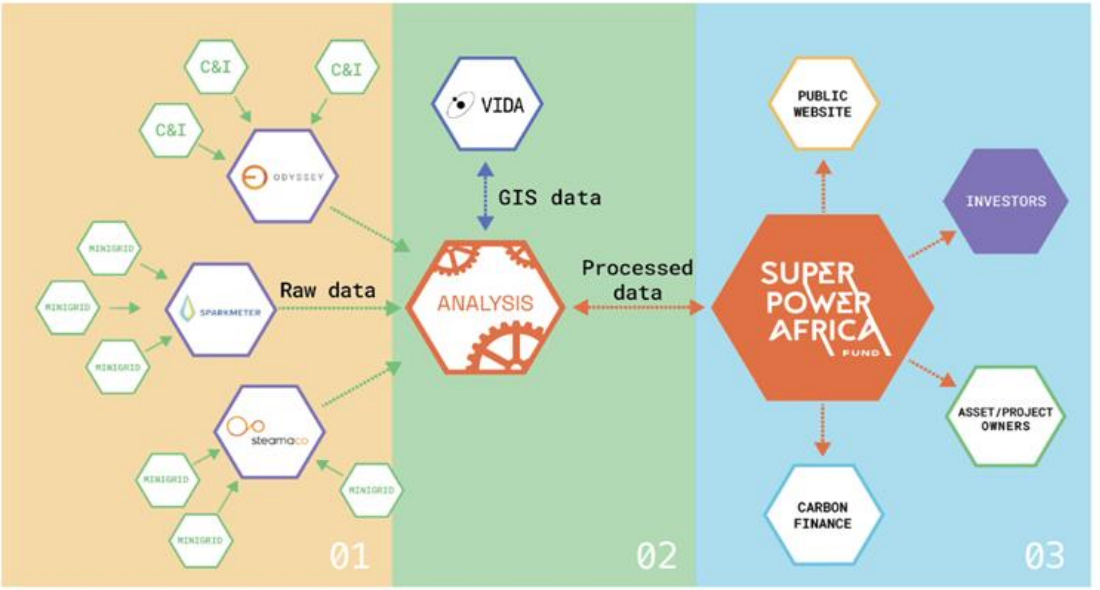


Figure 4: Online infrastructure of the Superpower Africa Fund and its three distinct functions

CHALLENGES

Challenges are an inevitable part of pilot implementation. PowerGen had to deal with and overcome a few challenges during the pilot including:

- Determining the legal structure was complicated, time-consuming, and expensive: The challenge arose due to uncertainty regarding the appropriate legal structure, whereby SAF is a first of its kind project in Nigeria. Identifying a suitable legal structure for this kind of facility has involved a great deal of resources both in terms of time and money. The CICSA grant acted as a catalyst in facilitating such an innovative but resources intensive solution.

- Accounting of complex inherent project risks in financial modelling: The implications of a single C&I off-taker reneging on the PPA are serious as each fund 'window' is made up of a small number of such off-takers. As such, pricing in this risk can significantly reduce the IRR for investors. This risk can be partially offset by minimum guarantee facilities, for example a first loss covering 100% of the first 20% of investor losses should they occur. This can reduce the default risk and increase the return to a more attractive IRR. Higher expected return and reduced risk perception make a big difference in terms of attracting more private investors.

SUCCESSES

- Identification of an efficient legal structure for SAF: The legal advisory and research work undertaken as part of the activities supported by the CICSA grant, indicated that a bona fide securitisation mechanism was not practical at the SAF scale due to the high costs and large volumes needed to set up such a mechanism. The fund therefore will be structured as a private debt offering for a select group of founder investors. SAF will make direct issuance of notes to potential noteholders. The notes will be structured in a waterfall, with different seniority and yields, to limit the downside and attract investors with lower risk appetite. Given the USD$20 million size of the inaugural Superpower Africa Fund 1 (SAF 1) window, this structure offers the lowest relative total expense ratio. PowerGen and TFE teams are targeting investors in the areas of concessionary debt, venture debt and impact-focussed debt funds. The teams are already in advanced discussions with the potential investors. The waterfall structure has been received well by the potential investors whereby concessionary debt can take a subordinated role.

- Commissioning of a pilot site that is meeting the needs of the customer: PowerGen successfully commissioned the system for the regional Eye Foundation Center in Ijebu Imushin in December 2022. The system has been performing well and the customer has been consuming above the minimum consumption value indicating a good match between an appropriately sized system and an accurate contractual agreement signed. Improved reliability, savings on diesel fuel costs, and less pollution from diesel generators for the Ijebu Eye Clinic is a major success of the pilot.

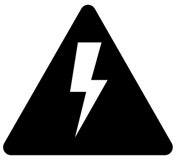
- Identification of a healthy pipeline: PowerGen has identified 30 additional sites across Africa that can be refinanced through SAF. The pipeline building is greatly accelerated by engaging with potential solar off takers that have several sites.

- Mobilization of private finance: The Eye Clinic pilot project mobilized $144,217 of private capital to partially pay for the construction of the solar system, while the balance was covered by PowerGen (the total project cost being $196,665). The finance for the next ten sites (petrol stations) is yet to be confirmed but will likely total roughly $3 million. This will help to enable the construction of all sites over the next 3 years with an estimated cumulative peak generation capacity of 2.4 MW.

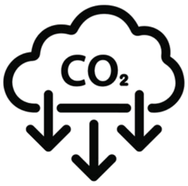
- Digitization of the SAF funding vehicle with data-driven innovation: Part of the grant funds were used for the development and testing of the online infrastructure (Figure 4) needed to implement SAF innovative structure. This has included third party hardware and software systems, GIS platforms, API integrations and websites interfacing with users. The website aggregates real-time energy generation data from projects financed through SAF, allowing for scalable investing and lower transaction costs. The user interface acts as both an information portal and a sales funnel for investors. Accurately measured data, for example, every single kWh consumed by individual customers (in near real time) coupled with the top-to-bottom data transparency and third-party authentication ensures that the system is ideal for data-based monitoring and evaluation (M&E). This would be appealing to carbon finance industries where accountability and traceability is needed.

- Development of a yield prediction algorithm: TFE Energy, the implementing partner of PowerGen for digitalization, developed in-house algorithms that analyse raw data streams in order to identify future potential high value assets and contracts. GIS platforms like VIDA also provide additional data layers (for example to identify C&I sites in high-growth urban areas) and provide the mapping of operational assets.

4. IMPACT



Improved reliability of electricity at Eye Clinic



CO2 emission reduction
Achieved: ~44.7 tonnes[7]
Estimated: ~115tonnes/year

7 temporary jobs created
3 permanent jobs
2 females/minorities employed

Eye Hospital cut energy costs by ~43% with solar covering ~96% of its energy needs

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[7] *Calculated for the period beginning at the start of operations on 12 December 2022 until 03 May 2023*

LESSONS LEARNT IN NIGERIA

The valuable lessons learnt from the implementation of the pilot project in Nigeria build on the published material and experience from the other pilot projects developed under the CICSA project. Such projects have been instrumental in building a strong foundation for proving the economic and financial viability of clean captive installations for the industrial and commercial sector.

A key objective of CICSA is to maximize the potential of scaling of pilot results. However, achieving this objective requires identifying opportunities and overcoming various barriers. Market conditions can either support or hinder innovation, while technical barriers such as compatibility issues between systems can limit the scalability of pilot results. Economic barriers, such as limited access to financing or high implementation costs, can also pose challenges to scaling up. Regulatory barriers, which involve compliance with laws and regulations, can impede progress as well. Additionally, social barriers such as resistance from stakeholders or cultural differences can present significant challenges.

To overcome these barriers and successfully scale pilot results, it is important to address them proactively and develop comprehensive lessons learnt as found below.

These lessons help to identify challenges and opportunities, allowing for more effective and efficient implementation of future projects. As a result, policy makers, financiers, technology providers and local stakeholders are able to make data-driven decisions that ensure optimal results in their respective fields. It is clear that the success of these pilot projects has paved the way to advance more impactful interventions in the future.

Nigeria's power sector faces many challenges

Nigeria is the largest economy in sub-Saharan Africa, but limitations in the power sector constrain growth. Nigeria is endowed with large oil, gas, hydro and solar resources, and it has the potential to generate 12,522 MW of electric power from existing plants. On most days, however, it is only able to dispatch around 4,000 MW[8], which is insufficient for the country's population. Nigeria has a very poor supply of national and regional grid electricity. Only 31 per cent of Nigeria's total installed generation capacity (12.5 GW in 2018) is available for supply; daily generation is in the range of only around 4-4.5 GW. This is due to myriad of constraints in the power sector, including ageing grid infrastructure, insufficient availability of gas (more than 80 per cent of grid-generated electricity is from gas-fired power plants), and structural inefficiencies in transmission and distribution systems.

Strong drivers for captive solar energy systems in Nigeria

Several drivers contribute to the growing demand for captive solar PV in Nigeria including the very unreliable supply of national and regional grid electricity requiring many C&I businesses to install diesel generators. The widespread self-generation of power, especially by industries, is estimated to be between 8 GW and 14 GW from a mix of off-grid diesel and gas generators as well as biomass and waste fueled generators. As the Nigerian government's planned fuel subsidy removal takes effect in 2023, these diesel gensets will become increasingly expensive leaving an unprecedented impact on customers dependent on these gensets. As such, captive solar power plants can be a viable and more sustainable substitute for diesel generators. Furthermore, projects less than 1MW do not require a license in Nigeria, facilitating the growth of the rooftop solar PV market across the country as much of which tend to be below this size threshold. Lastly, in the coming years, both population and economic growth are expected to increase the demand for on-grid and off-grid energy and power, requiring significant investment and construction in the power system, particularly in generation units.

[8] *https://www.usaid.gov/powerafrica/nigeria*

Nigerian captive solar market is competitive for many C&I customers

Factoring in costs incurred by C&I customers in Nigeria for grid electricity, diesel fuel, and loss of business due to low reliability, captive solar projects can offer competitive advantage for many customers. The average electricity retail tariff in Nigeria for C&I customers is estimated to be about US$0.09/kWh (33,000 NGN/mWh)[9] by 2023, but this only accounts for a fraction of energy costs from customers who also pay for diesel gensets and fuel to supplement this grid electricity. Therefore, any captive power plant with similar levelized costs will be very attractive for customers to offset energy from the grid, while an even higher levelized cost of solar PV would still appeal to many customers with diesel generators.

Opportunity exists for innovative financing solutions in Nigeria

The CICSA grant was designed to showcase the feasibility of innovative technologies and financing methods that could be applied to the captive solar market in Nigeria. Grant support was awarded to PowerGen that aimed to demonstrate the feasibility of an innovative financing fund, a new PPA agreement, and a hybrid solar PV and storage installation in Nigeria. PowerGen partnered with TFE Energy to set-up Superpower Africa Fund (SAF) which is a low-cost fund for C&I project developers in emerging markets. SAF helps to overcome the high cost of financing in the country and allows developers to use existing projects as collateral to recycle capital, build more projects and rapidly scale. It is a fund design that refinances existing projects in lieu of fixed monthly payments and is similar to a mechanism called YieldCo[10] which is successfully established in developed markets around the world. SAF can demonstrate that such innovative financing structures can be viable in frontier markets like Nigeria.

[9] *BloombergNEF 2019*

[10] *YieldCos are an emerging asset class of publicly traded companies that were originally formed to own operating assets that produce a predictable cash flow, primarily through long term contracts.*

Mobilizing private investment will help scale industry growth

Affordable financing is still a major challenge for many customers in Nigeria where the banking sector is typically characterized by high interest rates (20-27% from many commercial banks), risk aversion to solar PV technologies, and lack of experience with new business models.[11] Mobilizing private capital for solar captive financing in Nigeria is needed to scale local investment in the captive solar market. There is still a perception of high risks associated with the industry which translates into high financing rates offered by local financiers. Opportunity exists for concessionary capital with a mandate to accelerate the flow of commercial finance into the sector in Africa to help reduce risks associated with off-taker default on monthly payments. PowerGen Eye Clinic pilot project mobilized $144,217 to partially pay for the construction of the solar system, while the balance was covered by PowerGen internally (the total project cost being $196,665). The finance for the next ten sites (the petrol stations) is yet to be confirmed but will likely total US$3 million. This will help to enable the construction of all sites over the next 3 years with a cumulative peak generation capacity of 2.4MW.

Innovative technological solutions can help expansion of captive solar

Innovative technological solutions can play a crucial role in increasing the adoption of captive solar in Nigeria. Digitization of the SAF funding vehicle with data-driven results is an example of such technical innovation. Part of the grant funds were used for the development and testing of the online infrastructure (Figure 4) needed to implement an innovative structure like SAF. This includes third party hardware and software systems, GIS platforms, API integrations and websites interfacing with users. with the development and testing of a Superpower Africa Fund website. The website aggregates real-time energy generation data from projects financed through SAF allowing for scalable investing and lower transaction costs. The user interface acts as both an information portal and a sales funnel for investors. Accurately measured data, for example, every single kWh consumed by individual customers (in near real time) coupled with the top-to-bottom data transparency and third-party authentication ensures that the system is ideal for data-based monitoring and evaluation. This digitization would also appeal to carbon finance industries where accountability and traceability are a necessity. Innovative technological solutions can drive adoption of captive solar in Nigeria by creating online platforms, developing mobile applications, facilitating digital payments, enabling remote monitoring, and implementing smart grids, allowing barriers to the adoption of captive solar to be overcome, and more Nigerians can access the benefits of this innovative technology.

[11] *See CICSA Nigeria Country Study, 2021*

Development and multilateral finance can help de-risk investments

A major risk associated with captive solar installations is the default risk of C&I off-taker reneging on the PPA. Investors usually perceive this risk as high, especially in countries like Nigeria where currency hedging in markets is not cost-effective. Offsetting this risk is an ideal role for concessionary capital and a number of organizations are doing it such as the World Bank MIGA (multilateral investment guarantee agency) facility, the African Development Bank SEFA (Sustainable Energy Fund for Africa) and the UNDP market building efforts with the Climate Aggregation Platform.

If a multilateral first loss facility could be put in place, for example covering 100% of the first 20% of investor losses should they occur, the SAF fund would be able to reduce the default risk from the models and increase IRR for its investors. This return, and the reduced risk perception could make a big difference in terms of attracting more private investors. The SAF management team is currently developing a first loss of approximately 30% of the fund's size, to enhance the return of senior investors. The company has ongoing advanced discussions with SIDA, SEFA and MIGA to explore possible solutions in this regard.

Business models can significantly impact sustainability of captive installations

New financing and business models are developing, enhancing the solar captive installation market. Captive solar projects require significant upfront investment, and financing and business models significantly impact the sustainability of any captive installation project. The 10-year Power Purchase Agreement (PPA) used in this pilot project demonstrates how to reduce the high upfront costs for customers and allow them to pay for the equipment through affordable monthly payments.

The Eye Clinic pilot project operates on a take-or-pay PPA. In this model, the clinic pays a fixed amount for the energy delivered, whether the energy is used or not. This decreases the risk for the project developer (in this case PowerGen) but can mean that the contract negotiation during which key factors such as tariffs are determined is more complicated and protracted. Alternatively, a per kWh PPA model means that the off-taker only pays for the energy consumed. This tends to be more favorable for the off-taker, allowing them to decrease monthly payments in times when their business is underperforming, but is less favorable for the project developers.

Another key factor influencing the appropriate business model and equipment sizing is the potential availability of a feed-in-tariff system or embedded generation tariff. While Nigeria's government published feed-in tariff regulations for large scale renewable energy back in 2015, there remains a lack of feed-in tariffs and standards regulations for small-scale captive solar installations at the distribution level. Opportunity exists for implementing a feed-in tariffs system for small-scale projects to help the customer that installs captive solar PV reduce its monthly energy bill. Depending on the rules, it could also enable 'discounts' on energy units they have used and paid for from the national grid without compromising the financial viability of the DISCO to still provide on-grid customers with required services.

Lastly, businesses can improve their operations thanks to more reliable and affordable energy. For example, hospitals can power diagnostic equipment more regularly, and factories can keep machinery running during the blackouts caused by irregular grid supply. This gives them energy independence, boosts revenues and at scale, feeds a dynamic and resilient economy.

Gaps in the market create opportunity

The CICSA project also identified a gap in the market for concessionary construction capital that would provide a risk tolerant source of funding for the project developer to help isolate the risks of project origination and construction. Commercial capital from sources like the SAF could then refinance the project after it is successfully operating and producing performance data. Separating volatile activities (such as development, R&D, construction) from stable activities of operating assets has been shown to be an effective way to lower the cost of capital.

This capital optimisation approach to use of the ‘right’ capital for the ‘right’ purpose could provide several important benefits:

- Public or concessionary finance can be reinvested to enable more projects and continue delivering impact (e.g. installing PV systems on more schools or hospitals);
- Commercial investors are insulated from the most significant risks of these ‘frontier markets’;
- More solar PV projects get built faster, accelerating the deployment of these essential carbon zero technologies;
- More public institutions and businesses can realize the benefits of affordable and reliable energy

Determining optimal legal structure is crucial when establishing new financial vehicles

Determining the optimal legal structure is crucial when establishing new renewable energy financial vehicles because it affects how the vehicle is governed, regulated, and financed. The legal structure chosen can have a significant impact on the success and scalability of the vehicle, and it is essential to consider various factors such as liability protection, tax implications, and regulatory requirements.

PowerGen spent a portion of the grant funding to research the most appropriate legal structure in order to facilitate a finance mechanism of this nature in Nigeria. The final structure chosen includes a loan made from an internationally registered Fund directly to a Nigerian registered borrower company (the project developer). The factors considered while making this decision included respective regulatory frameworks, complexity of compliance, set-up costs and ongoing running expenses. The jurisdiction is also guided by Superpower Africa’s principle of paying “fair tax” and the growing number of developmental funders engaged who have adopted a tax policy that obliges managers to ensure that no form of aggressive tax planning is applied when it comes to investing in developing countries.

The need for more enabling policies and regulations for captive solar market

While policies and regulations in Nigeria are critical in promoting the growth of the captive solar market, there are also several challenges associated with their implementation. These challenges include inconsistent regulatory environments, limited access to financing, lack of awareness, limited technical capacity, and weak enforcement of existing policies. As of 2021, Nigeria had a comparatively unregulated market for renewable energy. It did not have a dedicated code or act that states the different business models under which a private company can generate and sell renewable electricity[12]. For on-grid generation, however, there is a regulation for a feed-in tariff for renewably sourced electricity approved in 2015.

Enabling policies and regulations are another critical success factor to accelerate growth of the captive solar market in Nigeria. While Nigeria's government published feed-in tariff regulations for large scale renewable energy back in 2015, there remains a lack of feed-in tariffs (aka export tariffs) and standardized regulations for small-scale captive solar installations at the distribution level. Opportunity exists for implementing a feed-in tariffs for small-scale projects to help the customer that installs captive solar PV to reduce their monthly energy bill. Rules could also enable 'discounts' on energy units which customers have used and paid for from the national grid in a cost-reflective way without compromising the financial ability of the Nigerian DISCOs to still provide on-grid customers with required services.

Likewise, wheeling regulations are in place at the level of the Transmission Company of Nigeria (TCN) for projects over 1MW, but gaps remain to also wheel electricity through the distribution network by DISCOs and customers with smaller installations that would also benefit from selling excess energy they're not using from captive solar installations. This also influences equipment sizing for captive solar installations where many projects miss the opportunity to oversize their system and export the excess energy via wheeling or a cost reflective feed-in tariff in Nigeria. [13]

Local partnerships and engagement are critical for success

Working with local partners and engaging with the local community can help ensure the success of a captive solar project or build a strong project pipeline. In addition, engagement with the broader stakeholder community in the solar PV industry can also inform and shape opportunities for success such as SAF. For example, the international investor community, local financiers, impact investors, large donor organizations, project developers and national government have been and will continue to be engaged as the SAF fund continues to be deployed.

[12] *See CICSA Nigeria Country Study, 2021*

[13] *IRENA, Renewable Energy Roadmap Nigeria. February 2023. https://www.nigeria-energy.com/content/dam/markets/emea/nigeria-energy/en/2023/docs/NE23-NigeriaEnergyRoadmap-Report.pdf*

CONCLUSION

The Lessons Learnt from the implementation of the Nigerian pilot project have built upon the published material, experience and lessons learned from the other pilot projects developed under the CICSA project.

Scaling up the deployment of clean captive installations is crucial to meeting climate goals and realizing the energy transformation potential of Sub-Sahara Africa. Pilots play a crucial role in highlighting the challenges and success factors for planning, implementing, and disseminating results.

As the document has shown, the market has the potential to progress with all the market, regulatory or social drivers working together. To realize the full extent of its potential however, proactive interventions are necessary. This can include more mature policies and regulations, as well as well-designed market mechanisms and institutions. However, it is up to countries to take the lead with clear policies and strategies that prioritize clean energy and climate goals.

Scaling pilots knowledge is a powerful tool in accelerating deployment. By sharing best practices and lessons learnt from successful pilot projects, stakeholders can collaborate and support each other in their efforts to build a robust and sustainable clean captive market. To achieve this, it is essential to strengthen, harmonize, and build upon existing knowledge. This will help ensure that clean captive installations can be scaled up efficiently while minimizing risk.

In conclusion, accelerating deployment through pilots and scaling across different contexts is key to unlocking the full potential of clean captive installations for the commercial and industrial sector in Nigeria. While there may be challenges ahead, proactive interventions and collaboration among stakeholders will work towards a more sustainable future powered by clean energy.

CICSA

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