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SDG IMPACT ASSESSMENT
CROWD INVESTMENTS FOR
SOLAR HOME SYSTEMS
NIGERIA

DECEMBER 2021

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SDG Impact Assessment Crowd Investments for Solar Home Systems - Nigeria

Funded by: Islamic Development Bank

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Photo: AS Photostudio

ACRONYMS

CAIT	Climate Action Impact Tool
ERGP	Economic Recovery and Growth Plan
FGN	Federal Government of Nigeria
GHG	Greenhouse gas emissions
GoN	Government of Nigeria
IsDB	Islamic Development Bank
MRV	Measurement, teporting and verification
NDC	Nationally Determined Contribution
OGS	Off-grid solar
PayG	Pay as you go
REA	Rural Electrification Agency
SDGs	Sustainable Development Goals
SHS	Solar home system
SMEs	Small and medium enterprises
SSA	Sub-saharan Africa
VNR	Voluntary National Review
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

BACKGROUND

The Islamic Development Bank (IsDB) is a multilateral development bank that opened formally in 1975 to promote comprehensive human development, focused on alleviating poverty, improving health, promoting education, improving governance and bringing prosperity to people. TRINE AB is a Sweden-based crowd funding platform that invests in solar energy markets with a vision of combating energy poverty in rural and marginalized communities. TRINE and the IsDB have partnered to develop a financing mechanism for off-grid, sustainable energy solutions in IsDB member countries. This partnership will contribute to achieving Sustainable Development Goal (SDG) 7 (affordable and clean energy) and SDG 13 (climate action) and to improving the quality of life in rural communities in sub-Saharan Africa through innovative financing.

TRINE, the IsDB and the United Nations Development Programme (UNDP) have partnered to assess the impact of their financing mechanism on solar home system (SHS) beneficiaries. The IsDB, a global leader in Islamic finance, is working to eradicate energy poverty and achieve universal electricity access in its member countries by 2030.

UNDP has been engaged as a third-party assessor to quantify how this type of finance contributes to achieving the SDGs in the off-grid solar industry. UNDP assessed the impact of solar projects using its Climate Action Impact Tool (CAIT). The tool was developed in 2015 and helps stakeholders during the design, development and implementation of mitigation and adaptation actions under the Nationally Determined Contributions (NDCs). Specifically, the tool helps to consolidate and assess information about a specific intervention. It can ultimately help identify and quantify the intervention's significant impacts in relation to the SDGs.

This assessment was conducted in Nigeria and reviewed the impact of the IsDB's solar investments. Greenlight Planet is a for-profit social enterprise that designs, distributes and finances solar home energy with a specific focus on energy-poor and underserved communities. Through three campaigns launched in 2021, the company has received total funding of €3 million (€1 million directly from the IsDB and €2 million from TRINE's crowd investor platform). This assessment is intended to provide qualitative and quantitative insights on the impact of this investment on the SDGs, climate action and its measures to alleviate energy poverty.

Photo: Greenlight Planet

INVESTING FOR IMPACT

THE ENERGY AND FUNDING CHALLENGE

Despite global attention and successful government and regional initiatives to increase access to electricity grids, 674 million people – 90 percent of whom live in sub-Saharan Africa (SSA) - are still estimated to lack access to electricity. The percentage of connected African households increased from 44 percent early in the 2010s to 56 percent in 2019.

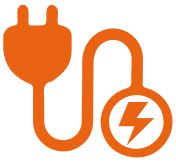
However, infrastructure limitations, population density and per-unit-connectivity costs pose major obstacles to achieving universal electrification across the continent.

The situation in Nigeria presents a distinct microcosm of the sub-Saharan African context. An estimated 70 million citizens lack access to the national grid or a reliable grid connection. Power reliability for grid-connected customers remains limited. With only 25 percent of customers reporting at least four hours of power daily, most opt for back-up generators.

Current International Energy Agency projections suggest that the Nigeria's national grid will not achieve universal coverage by 2030. As such, distributed renewable energy systems will continue to dominate in providing electricity to this population. However, this will require overcoming significant challenges, including consumer awareness, fluctuations in the local currency and a nascent money market.

With a rural electrification rate of 41 percent[1] and a government electrification target of 9 million households, Nigeria represents a significant opportunity for the sale, operation, and distribution of SHS. In 2020, it was estimated that more than 300,000 quality-verified SHS were sold in the country, representing a major leap from near negligible sales in years prior. With a reported market penetration rate of just 13.6 percent, an untapped market for expanded SHS sales exists in Nigeria. The Sun King brand represents a combined brand penetration (Sun King Home 120 and the Sun King Plus) of 10 percent. Despite a comparatively low market penetration rate, Sun King Solar lanterns also enjoy the third-highest usage rate (8 percent) among customers thanks to its vast network of agents.

1 WORLD BANK, 2018.



Nigeria presents a distinct microcosm of the sub-Saharan African context. An estimated **70 million citizens** lack access to the national grid or a reliable grid connection. Power reliability for grid-connected customers remains limited. With only **25 percent of customers reporting at least four hours of power daily,** most opt for back-up generators.

At present, it is estimated that 120 million Nigerians depend on kerosene as their primary lighting fuel source, with estimated daily consumption of 9–11 million litres.[2] The dependence on this fuel source requires a crippling fuel subsidy and generates unknown adverse environmental, health and safety effects. Due to unreliable supply, Nigeria also depends heavily on small and large generators. It is estimated that there are 60 million diesel and petrol generators in the country.[3]

According to GOGLA, the global association for the off-grid solar energy industry, the off-grid solar (OGS) market has the potential to reach 840 million people who lack access to electricity, as well as over 1 billion people who are connected to unreliable grids.[4] To achieve universal access, as set out under SDG 7, the sector would need to reach as many as 617 million people with Tier 1 OGS products as their main source of electricity. This would require US$6.6–11 billion in additional financing. Of that total, $6.1-7.7 billion represents the external investment required in OGS companies and up to $3.4 billion represents public subsidies to bridge the affordability gap.[5] To unlock commercial opportunities, as well as to reach underserved communities, these funds must be raised by 2030.

This funding and financing challenge constitutes one of the obstacles that has prevented the sector from growing and realizing its potential. Start-up companies have relied on financial resources from investors as seed funding to allow the market to be tested. However, obtaining next stage financing, especially from traditional financiers such as commercial

2 Merem, Edmund & Twumasi, Yaw & Wesley, Joan & Isokpehi, P. & Fageir, Siddig & Crisler, Marshand & Romorno, C. & Hines, A. & Ochai, G. & Leggett, Sophia & Nwagboso, E.. (2018). Assessing the Effects of Fuel Based Lighting: The Case of Kerosene Use and Disasters in Nigeria. Public Health Research. 8. 6-23. 10.5923/j.phr.20180801.02.

3 https://ng.boell.org/sites/default/files/true_cost_of_power_technical_report_final.pdf.

4 Lighting Global 2020. OFF-GRID-SOLAR-REPORT.

5 United Nations, 2021. Energy_access_theme_report .pdf (un.org).

Photo: Greenlight Planet

banks, often poses a challenge. This places pressure on working capital since companies are often young, lack financial statements and are unable to secure a credit line with manufacturers due to lack of long-term relationships. All these factors have limited the growth of small and medium enterprises (SMEs), undermining their ability to contribute to providing modern energy services to remote households.[6]

TRINE CROWDFUNDING SOLUTION

TRINE is a crowdfunding platform that facilitates sustainable investments to accelerate energy access in developing countries. The company was established in Sweden in 2015 as a digital debt crowdfunding platform. It addresses the working capital challenge that SMEs, also referred to as solar partners, face in providing off-grid solar. Under its business model, TRINE provides loans to SMEs to

6 Bandar Alhoweish, Khalid Idrissi, and Hussain Mugaibel, Unlocking Energy Access Finance through Crowdfunding.

purchase a specific number of SHSs that will serve a specific number of households in specific areas. The loans are made to companies that have completed a thorough process of due diligence, risk analysis and ranking based on pre-defined criteria. Solar campaigns are then launched on its platform, allowing the crowd to invest as little as €25.

The solar campaigns typically take between 30 and 45 days[7] before they are successfully closed. TRINE typically maintains control of the funds raised until a payment is made directly to the SHS manufacturer after the solar partner submits a disbursement request. Once the SHSs are shipped to the solar partner (after a lead time of around 3-4 months), the solar partner distributes them to the end beneficiaries (mainly rural households) with binding lease agreements that typically range between 18 and 24 months. The instalment payments received from the end beneficiaries and collected by the solar partner help to service the debt through TRINE's platform, allowing the crowd investors to be repaid (typically every quarter).

Crowd investing in solar is relatively new and its risk profile is not well defined. To build investors' confidence in businesses whose volatility varies, companies such as Trine can leverage institutional investors and take the first loss. Thus, institutional investors absorb the potential impact of such volatility, which can catalyse investments by smaller investors.

Overall, the financing of energy companies by investors, both individual and institutional, has numerous benefits for both investors and end users of the off-grid solar solutions. First, the investments make a significant contribution to mitigating climate change by helping communities transition from fossil fuels to clean and renewable energy. The energy provided, which the investments facilitate, offers multiple development benefits to communities well beyond achieving SDG 7, as this report will demonstrate. Finally, the robust model of debt financing ensures that the investors will earn a return on their investments.

7 TRINE ranks the Solar Partner, after examining five core areas: financial strength, organizational strength, track record, technology, and country profile. Only suitable companies with solid track records will be recommended for the loan.

Photo: Shutterstock

FUNDING PERFORMANCE: THREE SOLAR CAMPAIGNS

Between March and May 2021, Greenlight Planet launched three solar campaigns for an investment of €3 million in Greenlight Planet. The IsDB invested €1 million in these campaigns, distributed as shown in *Table 1*. It offered Murahaba financing, also referred to as cost-plus financing.[8] Through this financing, the IsDB catalysed investment and under this financial structure, repayment terms are more patient than those normally agreed to for this type of loan. To reduce the stress of cash flow management on the borrower, the IsDB will receive repayment in one bullet payment, rather than amortization payments. The IsDB's loan tenor will also be longer compared to the typical loans that Trine investors are offered. This serves as an additional incentive for investors to be paid first in case of default.

As *Table 1* shows, funding from the institutional investor, IsDB, did have a catalytic effect. The campaign period was significantly shorter than the average time to fund:

- Campaign 15 raised €650,000 in one day, while the estimated time to fully fund was 38 days. The number of investors totalled 986.
- Campaign 16 was fully funded in four hours with 1,087 investors.
- Campaign 17 was fully funded in seven days, compared to an estimated 74 days to fully fund. The number of investors totalled 1,667.

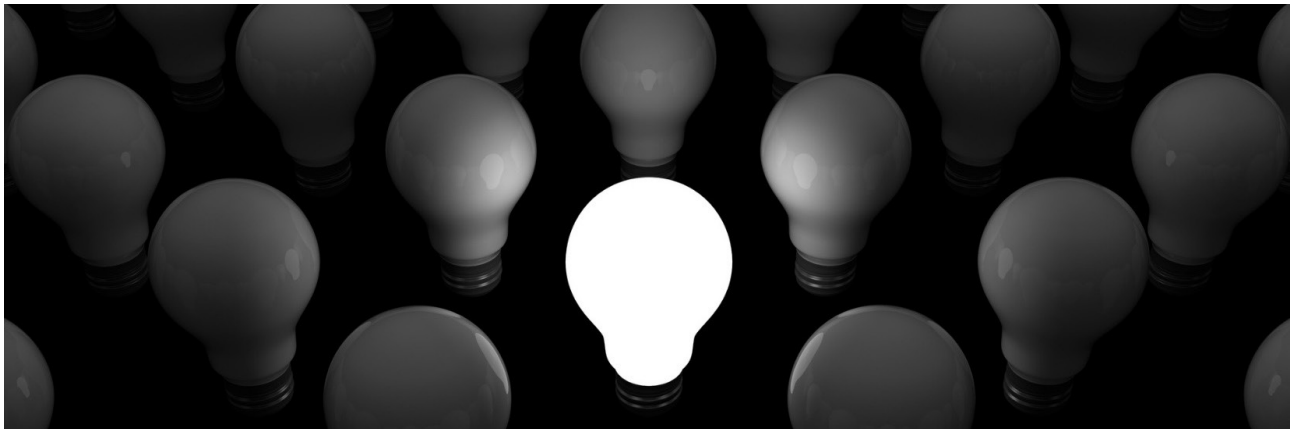
Funding speed performance indicates how fast the loan was fully funded compared to the average funding speed (in days, as predicted by Trine for each transaction prior to going live) and is based on the historic performance of previous loans. The actual days to fully fund represents the number of days between the day the loan went live to fully fund and close.

The COVID-19 pandemic resulted in supply disruptions and uncertainty regarding customer repayments and investments slowed in 2020. Trine attributes the funding performance to increased investor confidence due to robust measures globally to address supply shocks. The IsDB funding also buttressed the immediate needs of energy access enterprises and helped to de-risk and crowd in additional investment from existing and new financing partners that had held back from investing in 2020.

8 Murabaha is an Islamic financing structure in which the seller (here, IsDB) and the buyer (the solar partner) agree to the cost and markup of the SHS.

Campaign No.	Trine Funding Level (€)	IsDB funding (€)	Total funding (€)	Estimated days to fund	Actual days to fund	No. of investors
15	650,000	350,000	1,000,000	38	1	986
16	650,000	350,000	1,000,000	31	1	1087
17	700,000	300,000	1,000,000	74	7	1667
TOTALS	2,000,000	1,000,000	3,000,000			3,740

Table 1: Summary of funding performance: Three Greenlight Planet solar campaigns in Nigeria



GREENLIGHT PLANET OPERATIONS IN NIGERIA

Greenlight Planet designs, sells, installs and finances SHSs to off-grid, under-electrified and largely unbanked consumers in Nigeria. The company has been financing and distributing high quality off-grid solar products in the country since 2011.It uses the pay-as-you-go (PAYG) business model and relies on a network of field agents, office-based credit and collections staff, and device-embedded remote-shutoff technology to manage repayments. The company's agents handle door-to-door product demonstrations and sign up customers.

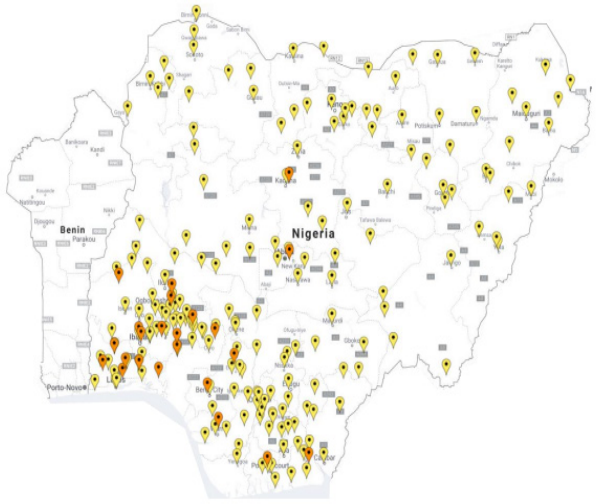


Figure 1:Greenlight Planet's distribution network in Nigeria

Greenlight Planet's centralized credit team then speaks to all prospective customers by phone and approves or rejects them (40 percent rejection rate) based on credit criteria. Once customers are approved, they must pay a deposit and then make follow-on payments, usually by mobile money, until the payment is complete. Customers receive automated SMS payment reminders. If the customer stops making payments, the product shuts off remotely. Unlike a typical loan, if customers do not pay for a period of time, they do not make back payments. Rather, they simply resume repayments and the device reactivates. If customers do not pay for multiple consecutive days, Greenlight Planet's agents, call centre and field teams follow up using an escalating intervention strategy. Once customers have made the full payment, the system is unlocked and they own the asset. Greenlight Planet offers a range of products targeting different customer segments, based on ability to pay.

APPROACH

In 2015, two important frameworks were introduced that are expected to help the world move towards a greener and sustainable future: the Paris Climate Agreement and the Sustainable Development Goals. The Paris Agreement is built on individual, self-defined national commitments to take mitigation and adaptation actions within specific country contexts, referred to as 'Nationally

Determined Contributions' (NDCs). These actions contribute to limiting the effects of global warming, adapting to expected climate-related impacts, and, ultimately, contributing to sustainable development.

The Sustainable Development Goals outline 17 globally defined goals, with 169 targets which have been agreed by all countries to be universally achieved. Each country is expected to establish national frameworks to achieve these goals and define them in their national context. SDG 13 defines targets to tackle climate change.[9] However, most climate actions contribute significantly to other SDGs, such as affordable and clean energy (7), gender equality (5), clean water and sanitation (6), industry, innovation, and infrastructure (9), and sustainable cities and communities (11). Therefore, identifying how climate actions under the NDCs contribute to achieving the SDGs and vice versa will be critical for government programmes and the private sector in the years ahead.

To capture the additional SDG impact of climate actions consistently, UNDP has developed the CAIT, which UNDP, several crowd funding platforms and other platforms use already. Rather than assess impacts ex-post, the tool is designed to help stakeholders consider and integrate sustainability impacts into the design, development and implementation of actions.

The CAIT assesses and visualizes the impacts of climate actions at three levels:

- Descriptive impacts, which can be collated into a single summary report that provides an overview of the planned actions;
- Qualitative impacts that provide a graphic visualization of contributions; and,
- Quantitative impacts, which are assessed in the measurement, reporting and verification (MRV) section of the tool and are updated over time.

9 https://www.carbon-mechanisms.de/fileadmin/media/dokumente/Publikationen/CMR/CMR_2018_02_I4C_Special_eng_bf.pdf.

All mitigation and/or adaptation actions assessed using the tool have impacts on SDG 13 and SDG 17 by default: SDG 13 (climate action) is impacted directly and significantly because the tool targets climate actions, while SDG 17 is automatically impacted by all climate actions that the tool assesses because of UNDP's commitment to ensure global partnerships and national, regional, and global cooperation and its support to access more financial resources and aid.

METHODOLOGY

The assessment involved four steps. The first was a desk review of literature that provided an understanding of the crowdfunding models and Greenlight Planet operations. Some of the literature reviewed included publications by GOGLA,[10] which present trends in financing, markets,[11] and sales in the SHS industry. Other sources include reports by organizations such as the Shell Foundation and Acumen[12] (focused on economic impacts), Greenlight Planet's Impact Metrics, and literature from IsDB and other financing institutions. The second step involved an internal assessment through which a senior Greenlight Planet manager was trained to use the CAIT. The internal training was conducted to help the company understand the tool that can help with continuous monitoring of the company's impact on the SDGs.

The literature review included a review of internal records, including human resource records, internal policies, country climate change and energy policies, strategies, and plans. Other literature reviewed included several publications led by GOGLA, which describes itself as the "voice of the off-grid energy industry." These publications, grouped under the "Powering Opportunity" series, collect data showcasing the socio-economic impact that SHSs can have on households.

10 Investment Data | GOGLA.
11 Global Off-Grid Solar Market Report | GOGLA.
12 Acumen-Energy-Impact-Report.pdf.

The third step was a field assessment conducted in September 2021 in Ogun State in Nigeria's southwestern region, where most of the inventory purchased through the three campaigns was sold. Detailed surveys were carried out to understand the impact on end user beneficiaries. To derive a deeper understanding of consumer trends and demographic data, we analysed a sample dataset of 387 samples provided by Greenlight Planet. Together with the surveys, this provided primary qualitative and quantitative data that were analysed using the UNDP's CAIT and other Excel packages.

IMPACT ANALYSIS ASSUMPTIONS

The quantified impacts are based on an analysis of sample data provided by Greenlight Planet. The analysis revealed a homogeneous customer profile for sales of products purchased from this investment. In terms of income level, 85 percent of the population earns between 30,000 to 200,000 naira (₦) (approximately $73-$243[13]) per month. The gender profile showed that 55 percent of customers are female, while 45 percent are male. The average customer age is 44 years and 20 percent of customers are young (20-35 years). Eighty-one percent of customers are self-employed. Quantified impacts were calculated using GOGLA standardized impact metrics for the off-grid solar energy sector for 2020.The qualitative impacts were obtained from surveys carried out in field assessments in Nigeria.

LINKAGE TO NATIONAL POLICIES

Nigeria's updated NDC[14] recognizes the importance of accelerated adoption of SHSs under the Solar Naija initiative. The NDC highlights the use of both on-grid and off-grid renewables as a major contributor to abated CO_2 emissions, with specific

13 Conversion: 1 USD =411 Naira (November 2021 exchange rate).
14 Federal Government of Nigeria - Nigeria's First Nationally Determined Contribution – 2021 Update.

reference to off-grid solar PV. The NDC sets a target of at least 2.7GW of power generated and used for SHSs and solar streetlights. The overall ambitious objective is to eliminate the use of diesel and petrol generators by 2030.

As an oil-producing country and one whose internal energy consumption demand mix is based heavily on oil's subsidiary products, Nigeria's emissions challenges are tied, clearly and overwhelmingly, to the production and use of oil. As such, obtaining access to modern energy, increasing the contribution of renewables to the demand and generation mix, and abating emissions from the oil sector remain key NDC priorities.

In the wake of a 2016 national recession triggered in large part by plummeting oil prices, many of the goals and ambitions set out in the country's Vision 2020 economic master plan were not achieved.

As such, the Federal Government of Nigeria (FGN) has opted to integrate SDGs into its economic planning. This directive was anchored in the launch of its first Voluntary National Review (VNR) Report on the implementation of the SDGs in 2017 and the development of Nigeria's Economic Recovery and Growth Plan (ERGP) (2017-2020). The ERGP is a medium-term economic growth plan focused on addressing the issues associated with the downturn following the recession. At present, the country has launched its second VNR, focusing on seven SDGs as it works to streamline its Vision 2030 agenda.[15]

In its ERGP, the FGN recognizes that the basis for its economic growth starts with energy and food security. Nigeria's energy generation capacity stands at 12.5 GW of installed nominal capacity, but with less than 4 GW in operational use. Thus, only 15 percent of total installed capacity is distributed to end users. As a direct policy initiative, the ERGP calls for:[16]

- Increased access to electricity for all Nigerians;
- Increased rural electrification through the use of off-grid renewable solutions;

15 Nigeria: A Second National Voluntary Review: Integration of the SDGs into National Development Planning.
16 Federal Republic of Nigeria: Economic Recovery & Growth Plan 2017-2020.

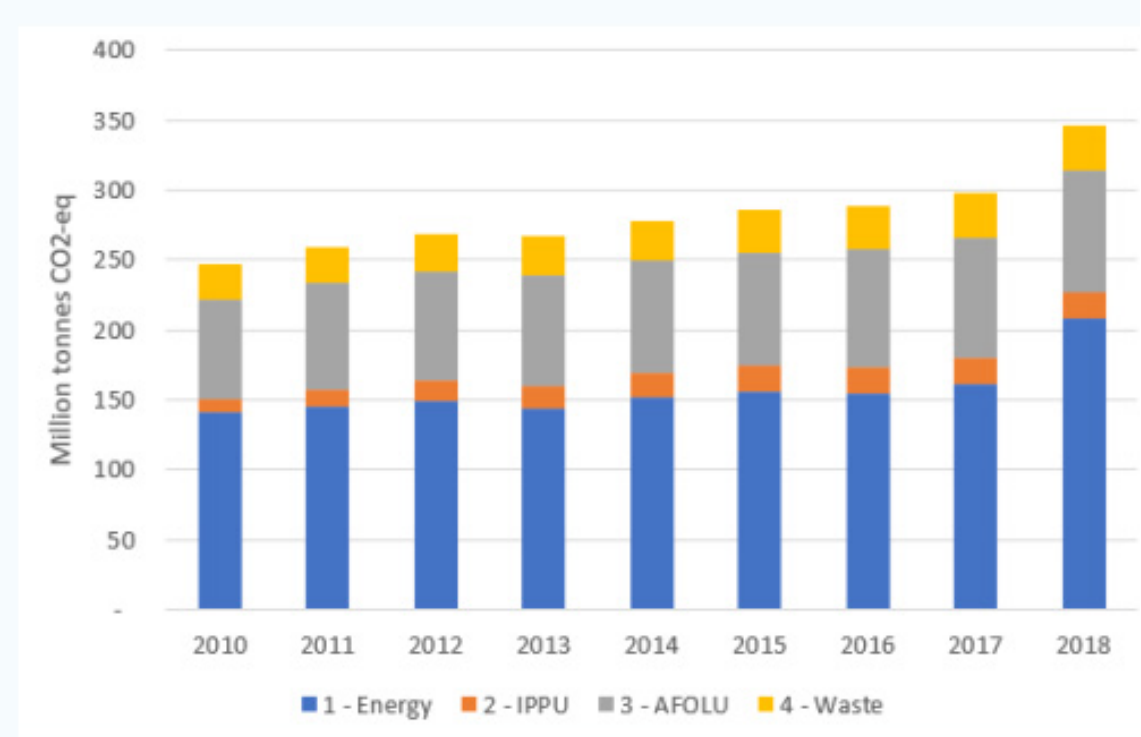


Figure 2: Total GHG emissions in Nigeria between 2010 and 2018

- Implementation of the Rural Electrification Strategy and Implementation Plan;
- A 20 percent increase in the number of households that replace kerosene lanterns with solar lamps; and,
- Development of a data-driven off-grid model for Nigeria.

Nigeria's National Integrated Infrastructure Master Plan (NIIMP) also reflects the specific application of SHSs to meet Nigeria's low rates of electricity access. This policy is to be executed between 2020 and 2043. In it, the FGN states its objective of increasing electrification rates to 90 percent by 2030.[17]

The policy notes that a deteriorating electric power infrastructure has not only adversely affected the rate of access to the national grid, but has also depressed total KWh consumption per capita, as Figure 3 shows.

The Nigerian Electrification Project (NEP) is key to increasing electricity access rates quickly. Working with the World Bank, the Nigerian Rural Electrification Agency (REA) describes it as the most significant off-grid electrification project in West Africa. Structured in four components, the $350 million project will address different facets of the electrification campaign. with Component 2 specifically addressing stand-alone systems.[18] A specific objective of the plan is to contribute to SDG 7, Sustainable Energy for All (SEforALL) as well as the World Bank's Energy Sector Directions Paper (ESDP). It is also aligned with the Multi-Tier Framework for Energy Access (MTF).

The NIIMP also calls for 250,000 SMEs and 1 million households in Nigeria to receive reliable power supply and for support for the government's climate change obligations, under the Paris Agreement, to promote renewable energy and reduce carbon emissions. The specific components of the REA plan for SHSs include:

17 Federal Republic of Nigeria: National Integrated Infrastructure Master Plan: October 2020.

18 Rural Electrification Agency (2018): Nigerian Electrification Project.

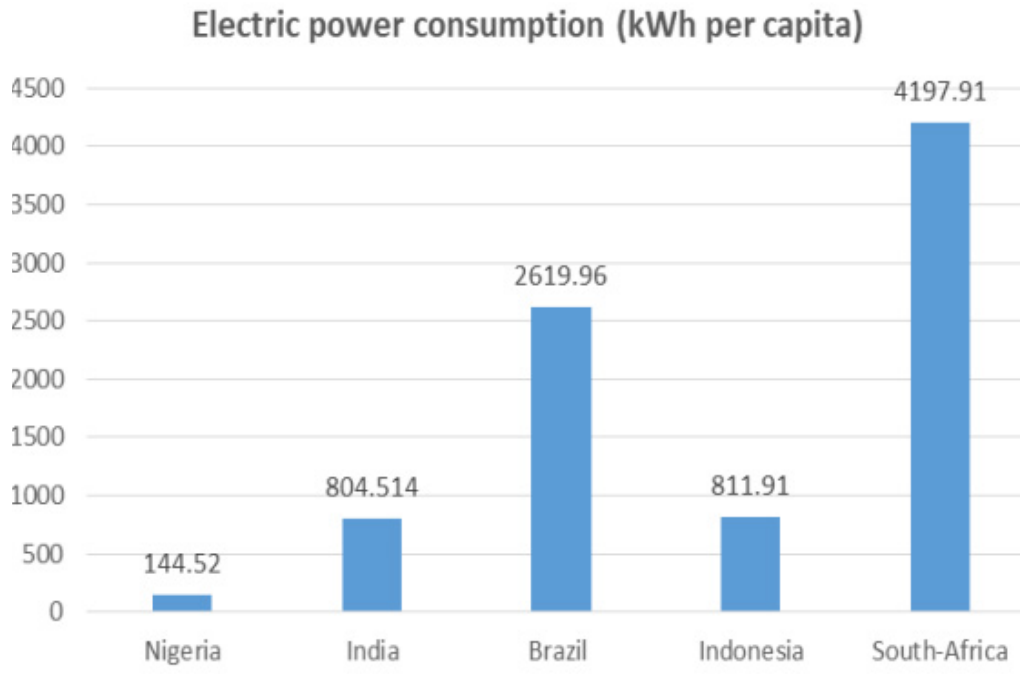


Figure 3: Nigerian per capita electricity consumption across comparative economies

Photo: Shutterstock

- Grants to the most competitive industry players;
- Grants and financial incentives to help scale up businesses; and,
- An output-based fund to provide financial incentives (fixed incentive grants) for each SHS installed.

The National Renewable Energy Action Plan is a policy document that establishes the implementation strategy for the 2015 National Renewable Energy and Energy Efficiency Policy.[19] The plan addresses the policy, regulations, laws and incentives to be implemented to achieve Nigeria's renewable energy targets and the SEforALL goals. With respect to SHS, it sets a target of 5 percent of the population (approximately 9 million people) to be served by stand-alone renewable energy systems.

Regarding the country's COVID-19 recovery plan, the FGN developed a stimulus package of ₦2.3 trillion ($6 billion). Of that amount, ₦240 billion ($63 million) has been allocated to the clean energy sector to provide solar power to 5 million households currently not connected to the national grid and to create 250,000 jobs.[20]

19 National Council on Power (2016). National renewable energy action plans (NREAP) (2015 – 2030).

20 file:///C:/Users/nyoka/Downloads/ExpertNote_SLCP_economic_recovery.pdf.

DETAILED ASSESSMENT OF THE THREE SOLAR CAMPAIGNS

Greenlight Planet 15, 16, 17 - Nigeria

SOLAR CAMPAIGN NO. 15

Solar Campaign 15 was launched on 23 March 2021 and aimed to raise €1 million to purchase inventory for Greenlight Planet to expand its operations in Nigeria. The IsDB invested €350,000 and 986 investors provided the remaining €650,000. This inventory was estimated to impact 55,900 people by providing them access to clean and efficient energy. The investors participating in the campaign raised the targeted funds in four hours, compared to the estimate of 38 days needed to fully fund. This campaign was thus funded 12 times faster than Trine had anticipated. Trine stated that it could not analyse this strong performance accurately because it lacked sufficient data, but the speed of funding is believed to be related to investors' renewed confidence after the government adopted measures to address the impacts of the COVID-19 pandemic and as supply shocks eased. The IsDB investment was also seen as an important factor that could have influenced crowd investments.

Photo: Greenlight Planet

IMPACT ANALYSIS BY THE NUMBERS

The campaign had **impacts on nine of the** SDGs. They include 1 (no poverty), 3 (good health and well-being), 4 (quality education), 5 (gender equality), 7 on affordable and clean energy, 8 (decent work and economic growth), 10 (reducing inequalities), 13 (climate action) and 17 (partnership for goals). Table 3 shows the summary of the impacts.

5,032
people able to pursue additional economic opportunities

22,650
kerosene lamps replaced

579 hours availed for education annually (4 hours/night)

Light **80x** brighter than the kerosene lamps used for education

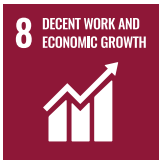
10,144 women benefit from energy financing

39,358 women benefit directly and indirectly from clean and affordable energy

17,890 households have access to reliable and affordable clean energy

2.22 MWh of clean and affordable energy generated every day

71,560 individuals benefit from improved energy services, including quality light, entertainment and mobile



2,847 individuals use the SHS to support their enterprises

18,443 adults benefit from innovative energy financing

29,286 metric tonnes of CO_2e mitigated annually

22,650 kerosene lamps displaced

10,144 women benefit from energy financing

39,358 women benefit directly and indirectly from clean and affordable energy

€1,000,000
invested in the campaign

€350,000 from IsDB

€650,000 from **986** investors on the·platform

Table 2: Summary of impacts: Solar Campaign No. 15

DETAILED ANALYSIS OF THE IMPACT

The impacts presented here are based on an analysis of survey data for customers in Ogijo, Ogun State. Ogijo is a rural area located 36 km from Lagos. Campaign funding was finalized in March and inventory was provided in May 2021. Analysis revealed a homogenous customer profile for sales of products purchased from this investment. In terms of income level, 85 percent of the population earns between ₦30,000 and 200,000 (approximately $73-487) per month. According to the gender profile, 55 percent of customers are female while 45 percent are male. The average customer age is 44. Youth (20-35 years) represent 20 percent of customers. Eighty-one percent of customers are self-employed. The qualitative impacts come from surveys undertaken in field assessments. This section outlines the impacts as described by the customers.

POVERTY REDUCTION

This investment has directly impacted 5,032 people who are now able to pursue additional economic opportunities, including the use of light for income-generating activities. The investment has also enabled 2,847 individuals to support their enterprises, including using appliances such as solar fans for cooling or televisions for entertainment. Take, for example, Funke Obimuyiwa, who runs an eatery. She told us that she previously owned Greenlight Planet's Easy Buy Home 60 and has recently upgraded to the Home 400. The television set that comes with the Home 400 provides entertainment for her patrons. Funke pays a weekly instalment of ₦3,300 (approximately $8), which she considers to be quite affordable. The additional hours of light allow her to keep her restaurant open in the evenings.

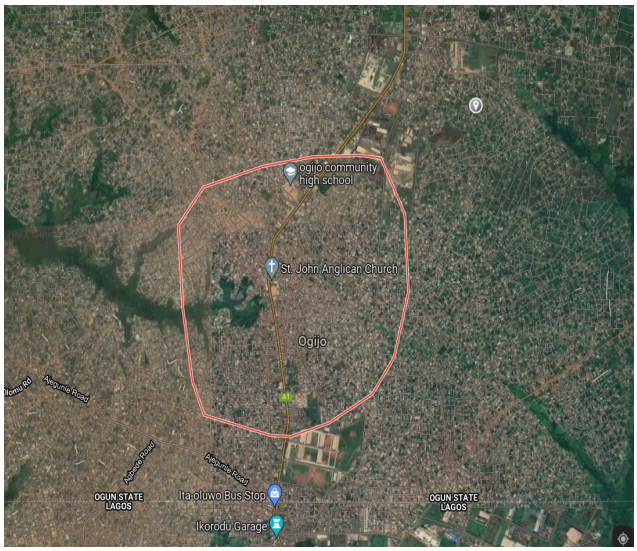


Figure 4: Study area - Ogijo, Ogun State, Nigeria

Mr. Oluwagbeminyi is a 52-year-old mechanic who uses his Sun King Home 60 to provide lighting for additional hours of work. He started paying for his system in May 2021 and uses it to generate additional income, noting that he can extend his work hours by up to three hours per day. This enables him to reduce the backlog of vehicles and create space in his garage for additional vehicles that require his services.

This investment led to the replacement of 22,650 kerosene lamps, thereby avoiding emissions equivalent to 29,286 metric tonnes of CO2e. The benefits of replacing kerosene include improved indoor household air quality, as emissions from kerosene lamps are associated with eye irritation, respiratory diseases and adverse effects on maternal health. The light quality also improves visual health for many. The light from a SHS is 50 to 80 times brighter than from kerosene lanterns, making tasks such as cooking and reading more comfortable.

Photo: Greenlight Planet

Figure 5: SHSs enable entrepreneurs to extend their work hours, thereby increasing their daily income. The clean energy from the system improves the working environment. This investment has allowed 5,032 individuals to pursue income-generating activities.

We observed that the use of small generators has proliferated in markets and homes in Nigeria. Their noise is so loud that it is difficult to hold a normal conversation. Most people we interviewed confirmed that they owned a generator because electricity from the national grid is so unreliable. Ogunyemi Lukman is a 25-year-old man working in the electricity sector. He confirmed that lack of reliability has indeed led to the regular use of generators. He described the adverse effects of generators that he has observed, including in his own home in Ogijo, Ogun State where he lives with seven family members, citing the cost of fuel, which is affected by currency volatility. He noted that he owns a Sun King Home 120 and makes a weekly payment of ₦3,000 ($7). He has been satisfied with the solar system, which provides sufficient light, especially during power cuts. He and his family appreciate the quiet and can converse easily.

QUALITY EDUCATION

The investment has increased the number of education hours by 579 annually (four hours each night). It provides light that is up to 80 times brighter than the kerosene lamp, which improves lighting for after-school study. Fatuma Soneye (pictured below) is a 34-year-old mother of two and runs a pharmacy. She owns the Sun King Home 400 and is also making payments for her Sun King Easy 60. She is connected to the grid, but owns a small petrol generator because of the grid's instability. She has two children who attend school and benefit from the Sun King Home 400 at home, thanks to the high-quality reading light it provides in the evening. She says that her children barely notice the difference in terms of light quality is compared to that provided by electricity from the grid. Her children's education is very important to her and the use of the light for

Image : Greenlight Planet

Figure 6: Fatuma Soneye, 34-year-old mother of two in her shop. She owns two SHSs - the Sun King Home 400 which is used in her home, and the Sun King 60, which she uses in her shop. Her children use the system at home during power cuts so that they can study.

extra study hours is one of the most significant benefits that she associates with the system.

Mrs. Balogun Fatima, a 36-year-old mother of three, reaffirmed the benefits that the SHS offers by providing a reliable supply of light for extra reading in the evening. She reports that while she has a generator, she sometimes had to use candles when she forgets to buy petrol for the generator. The candlelight is so poor that the children lose interest in doing their homework.

GENDER EQUALITY

The PAYG model has provided 10,144 women access to energy financing. This allows them to build a credit profile and own an asset after successful payment. It represented the first loan/credit for 98 percent of these women. Financial inclusion is seen as a means of catalysing gender equality. Access to clean and affordable energy also impacts 39,358 women directly and indirectly.

Fatuma Toneye explained that the systems allow her to keep her pharmacy open for an additional three hours each day. She said that during power cuts, passers-by note that her shop continues to have light but makes no noise from a generator. She said the solar power has been a major source of savings as the money she previously spent on petrol for her generator now pays for additional fuel for her vehicle and for more stock for her shop. She said that PAYG financing was her first experience with a loan. The payments have been manageable and she is now on her second round of financing after successfully purchasing the Sun King Home 400 for her home last year. She makes a weekly payment of ₦1,000 ($2) for her Sun King 60, which she uses for her shop. If sales allow, she sometimes increases that payment. She noted that the solar light provides 12 hours of security lighting.

Mrs. Hassan Lesimot is a 43-year-old woman who runs a food kiosk. She owns the Sun King Home 120, which she uses for her business. She reports that the system has modernized her facility and provided quality light for her to cook even into the night. She says she now operates her kiosk for an additional four hours per day, allowing her to increase her daily earnings.

AFFORDABLE AND CLEAN ENERGY

This investment has provided 17,890 households access to reliable and affordable clean energy. The average household size is four, for an estimated total of 71,560 individuals who benefit from improved energy services, including quality light, FM radio and televisions that are part of the SHS. Fifty-five percent of these beneficiaries (39,358 people) are estimated to be female, while 45 percent (32,202) are male. Twenty percent of beneficiaries (14,312 people) are between 20–35 years. The total energy generated daily is 2.22 Mwh.

In trying to assess the impact of solar energy, we noticed that many customers appreciate the affordability and quality of light. Sixty-three percent of customers earn monthly wages of ₦30,000–00,000 ($73-243). The PAYG system thus provides an affordable way to pay for an asset that offers numerous benefits. Mrs. Kofoworala, a 45-year-old merchant, first signed up to purchase her Sun King 60 on 6 May 2021. She made the final payment for her system on 2 October 2021, for a total of ₦39,900 ($97). She told us that she continued to make regular payments for her system because of the value it offers. She says the country is endowed with good solar energy and she is often able to fully charge her solar system. The weekly payments she makes through the company agent have been affordable and she was keen on owning the asset, so chose to repay quickly. Her average weekly payment totalled ₦3000 ($7). She explained that she does not have a bank account and has never taken a loan. The PAYG model offers her a way to own an important asset and she felt that the company was keen to reach underserved people such as herself. She is proud that she has helped to spread the solar message to her neighbours, who have also signed on to purchase the system. We asked her if she would purchase another system or solar product and she said that she would like to purchase solar refrigerators.

> *'We evaluate and ascertain our customers' financial status after such customers has agreed to buy our products. We ask customers some questions around their financial stability. Over time, customer build credit profile with us and we upgrade such customer to higher product considering the customer have a good credit profile."*
>
> Lisbon Opiyemi, Regional Business Manager, Greenlight Planet, Nigeria

DECENT WORK AND ECONOMIC GROWTH

Energy enables economic activities. This investment has benefitted 2,847 people who use the products to support their enterprises. Of that total, 1,566 are female and 1,281 are male. An estimated 569 young people between the ages of 20–35 also benefit by using the technology for income-generating activities. The innovative PAYG energy financing system has provided 18,443 adults (10,144 are female and 8,299 are male) and 3,688 youth access to the technology. Famuyima is a 34-year-old poultry farmer. She explains that light is important for the performance and welfare of poultry and that the LED light from her solar system produces ideal lighting for breeding and rearing poultry. She says she relies exclusively on solar to raise 600 chickens, allowing her to meet the for this common dish in Nigeria.

SOLAR CAMPAIGN NO. 16

Solar Campaign 16 was launched on 30 April 2021 with the target of €1 million to purchase inventory for Greenlight Planet to expand operations in Nigeria. The IsDB invested €350,000, while the remaining €650,000 was crowded in. This inventory was estimated to impact 55,900 people by providing them access to clean and affordable energy. A total of 1,087 investors participated in the campaign, raising the targeted funds in one day, compared to the estimated 31 days to fully fund, or 30 times faster than Trine anticipated. This performance may be explained, in part, by IsDB's investment. As an institutional investor, its involvement builds investor confidence. In addition, Greenlight Planet has a proven business model, a strong track record and solid experience in the industry. Investors pay attention to all of these important factors.

Photo: Greenlight Planet

IMPACT ANALYSIS BY THE NUMBERS

The campaign had impacts on nine of the SDGs, including 1 (no poverty), 3 (good health and well-being), 4 (quality education), SDG 5 (gender equality), 7 (affordable and clean energy), 8 (decent work and economic growth), SDG 10 (reducing inequalities), SDG 13 (climate action) and SDG 17 (partnership for goals). Table 4 summarizes the impacts.

5,032
people able to pursue additional economic opportunities

22,650
kerosene lamps replaced

579 hours availed for education annually (4 hours/night)

Light **80x** brighter than the kerosene lamps used for education

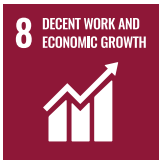
10,144 women benefit from energy financing

39,358 women benefit directly and indirectly from clean and affordable energy

17,890 households have access to reliable and affordable clean energy

2.22 MWh of clean and affordable energy generated every day.

71,560 individuals benefit from improved energy services, including quality light, entertainment and mobile



2,847 individuals use the SHS to support their enterprises

18,443 adults benefit from innovative energy financing

29,286 metric tonnes of CO_2e mitigated annually

22,650 kerosene lamps displaced

10,144 women benefit from energy financing

39,358 women benefit directly and indirectly from clean and affordable energy

€1,000,000
invested in the campaign

€350,000 from IsDB

€650,000 from **1,087** investors on the·platform

Table 4: Summary of impacts: Sol ar Campaign No. 16

DETAILED ANALYSIS OF THE IMPACTS

The quantified impacts are based on assumptions from the analysis of sample data provided by Greenlight Planet. It showed that a homogenous customer profile for sales of products purchased from this investment. Eighty-five percent of the population earns a monthly income of between ₦30,000-200,000 ($73-243). Fifty-five percent of customers are female, while 45 percent are male. The average customer age is 44 and youth (20-35 years) make up 20 percent of customers. Eighty-one percent of customers are self-employed. Quantified impacts were calculated using GOGLA standardized impact metrics for the off-grid solar energy sector (2020). The qualitative impacts were drawn from surveys conducted in field assessments in Nigeria. The narratives presented below are from clients from the Sagamu area in Ogun State, located 25 km from Lagos. This peri-urban area is one of the country's fastest-growing in terms of solar system sales.

Figure 7: Study area - Sagamu is 25 km from Lagos

POVERTY REDUCTION

The investment made through this solar campaign has enabled 5,032 people to pursue additional economic opportunities. Those opportunities involve income-generating activities based on the use of solar lighting. The investment has also enabled 2,847 individuals to support their enterprises, including the use of appliances such as solar fans for cooling or televisions for entertainment. Mrs. Adeyanju Kalifat operates a wholesale cereal shop. She was busy serving customers buying rice when we arrived. The heat in the Sagamu area was unbearable and we hurried to find a seat near a fan, which we noted is a Sun King (pictured below). During the interview, Mrs. Adeyanju mentioned that the fan is one of her prized possessions. It makes the working environment comfortable for her and her four employees, as well as for her customers. She mentioned that since purchasing the Sun King 60, she has not used her generator to light her premises during power cuts. She said the generator only produced smoke and made her workplace noisy, which was irritating. She spent ₦700 ($1.81) every two days for her generator, while the cumulative savings from switching it off have allowed her to expand her business. She often uses the SHS from 6-8 p.m. when it gets dark. She also uses the light for security purposes. A neighbour, who listened as we interviewed her, interjected, telling us that Mrs. Adeyanju

has been one of the strongest solar advocates. We asked her if this is true and she confirmed. She said that no good thing should be kept to oneself - it must be shared and that is why she had referred several other merchants to buy Sun King products.

Mrs. Akiwumi Adeola runs an eatery and uses the Sun King 60 to provide lighting to her patrons in the evening from 6-11 pm. Her restaurant, known as the Sagamu Boys Club, is located in Sagamu, Ogun State. She said that she previously used a petrol generator for back-up power. She previously spent ₦1500 ($3.66) every four days for the generator, which she has since stopped using. She said that her business has attracted more patrons as there is less noise from the generator and no smoke. When she finishes paying for the system, she intends to purchase another one for her home, where she has two children who attend university.

> "No good thing should be kept to oneself, it must be shared, that is why I have encouraged many of my neighbours to purchase the Sun King products that have served me well. The systems are affordable and very reliable. Now that I have completed my payment, I own the system. I will never have to think about buying petrol for my noisy generator or worry about power cuts. My business will continue."
>
> Mrs. Adeyanju Kalifat, cereal shop owner, Sode Sagamu, Ogun

Photo: Greenlight Planet

Figure 8: Additional appliances, such as solar fans, increase comfort at work. SHSs are commonly used to provide security lighting. The solar energy stored in a battery allows the systems to operate for up to 12 hours without any additional cost to the owner. This reduces overhead costs and savings can be redirected to meet other business needs.

GOOD HEALTH AND WELL-BEING

This investment led to the replacement of 22,650 kerosene lamps and is estimated to mitigate 29,286 metric tonnes of CO2e emissions annually. Replacing kerosene improves indoor air quality in households as the emissions from kerosene lamps are associated with eye irritation, respiratory diseases and adverse effects on maternal health. The quality of light also improves visual health. The light from a SHS is 50 to 80 times brighter than from kerosene lanterns, which makes tasks such as cooking and reading more comfortable.

Mr. Odukoga Opeyemi (pictured below) no longer uses his generator. He now uses it as a stool and places items on it. He informed us that this was his second purchase of a Sun King product; his first was a Sun King Home 120, which he uses at home. He uses a Sun King 60 for his tailoring shop. Because most of his business is school uniforms, he must sometimes work late into the night to meet an order. Now, he says, he can sew 10 more uniforms every night, which translates directly into higher revenues and higher income. He also uses the light as security overnight, protecting his premises from thieves who may try to burglarize his shop.

QUALITY EDUCATION

Each SHS provides an additional four hours of light each night. This light is also up to 80 times brighter than that from kerosene lamps, which improves conditions for studying after the end of the school day. Mrs. Kazeem Victoria is a 74-year-old grandmother of three schoolchildren. She opted to purchase the SHS so that her grandchildren can study. One of them, a 13-year-old boy, wants to be an engineer when he grows up. She says engineering will require hard work and a lot

Photo: Greenlight Planet

Figure 9: Mr Odukoga Opeyemi, a 40-year-old tailor, has stopped using his noisy and polluting petrol generator to provide back-up power during power outages. SHSs have made tasks more comfortable and reduce exposure to harmful pollutants from the use of fossil fuels, which affect health and well- being.

of study. For her, the solar system provides comfort knowing that her grandchildren are reading in a safe environment, free from the risks of kerosene and fires. She reports that the quality of light is good for their eyes and their brains. She is thus confident that her grandson can become an engineer one day.

Mr. Odukoga affirms the benefits of the system to his two school-going sons, ages 10 and 12. He says the quality of light is one of its main benefits, as it reduces visual strain when reading. The boys previously used a noisy petrol generator that required him to purchase petrol at a cost of up to ₦600 ($1.46) every two days. He can now use this savings to expand his business and make enough money to keep his boys in school.

GENDER EQUALITY

Financial inclusion is one way to achieve gender equality. This investment has thus provided access to energy financing for 10,144 women. The financial discipline that is required to acquire an asset constitutes one of the benefits of energy financing for 98 percent of these women, who have never taken a loan because of the repayment burden. Energy access is also empowering as it allows women to pursue economic activities, protects them from indoor air pollution and provides an environment that is suitable to their everyday tasks. We calculated that the investment benefits 39,358 women, directly and indirectly.

Photo: Greenlight Planet

Mrs. Dasola Gbenga is a 42-year-old trader. She has been running her business for over seven years and explained the challenges posed by lack of access to reliable and affordable light. Previously, she closed her shop at 6 p.m. due to security concerns. The solar light provides reliable lighting, allowing her to keep the shop open for an additional four hours. Mrs. Shofu Oluwatosin, a small-scale trader who uses the Sun King Light for her home, echoes those comments. She says that cooking after a long day's work is bearable thanks to the light she uses in her kitchen while her children and husband are in the living room.

Photo: Greenlight Planet

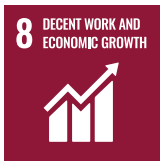
Figure 10: Solar energy provides homes and enterprises in underserved areas sufficient energy for people to undertake their daily tasks. The energy generated through this investment offers an opportunity to enjoy energy services such as light, mobile phone charging, access to information and entertainment.

AFFORDABLE AND CLEAN ENERGY

This investment has provided 17,890 households access to reliable and affordable clean energy. The average household size is four, for an estimated total of 71,560 individuals who benefit from improved energy services, including quality light, FM radio and televisions that come with the SHS. Fifty-five percent of these beneficiaries are estimated to be female (39,358), while forty-five percent (32,202) were male. Twenty percent of beneficiaries – 14,312 individuals - are between 20–35 years. The energy generated daily totals 2.22 Mwh.

The Sun King 400 has modernized the home of Mr. Alh Isa Melu, who enjoys watching television programmes with his wife and children in the evenings. He says that the solar system has also provided sufficient energy to charge his mobile phone. His two children also study comfortably in the evening, while his wife can cook their family delicious meals. He tells us he never struggled with the system and intends to buy a solar fan for his home, too.

Mrs. Bassey, who owns a Sun King Home 120 system, confirms that solar has been very important to her. She is especially keen on the system's safety and affordability. The technology's ease of use – a plug and play system - is also an advantage. She uses her solar primarily for business and security lighting.



DECENT WORK AND ECONOMIC GROWTH

Energy enables economic activities. This investment has benefitted 2,847 people who use the products to support their enterprises. Of that total, 1,566 are female and 1,281 are male. An estimated 569 young people between the ages of 20–35 also benefit by using the technology for income-generating activities. The innovative PAYG energy financing system has enabled access to the technology for 18,443 adults (10,144 women and 8,299 men) and 3,688 youth.

Dosumu Emmanuel is a 30-year-old furniture producer who makes sofas and tables. He has been paying for his Sun King 120 since 6 May 2021. As a young man, he says, work is very important so that he can find stability and start a family. The extra hours he puts in at work allow him to earn income and retain customers who can rely on him to have their order ready in time. He has employed two additional workers in his business, which he attributes to customer retention. His monthly income ranges between ₦100,000-200,000.

Photo Credit: Greenlight Planet

Figure 11: Energy enables economic activity. Investing in the solar campaigns has accelerated deployment of the technology, reaching 1,556 individuals who use the energy for economic activity. The PAYG energy financing system has also benefitted 18,443 individuals who had been considered unbankable. Many have never taken a loan before. This financing will provide the individuals an opportunity to own an asset and build a credit profile. Photo courtesy Greenlight Planet

SOLAR CAMPAIGN NO. 17

The third and last campaign in which IsDB invested was Campaign 17. It launched on 17 May 2021, with the goal of raising €1 million. IsDB invested €300,000, while the crowd of 1,667 investors invested the remaining €700,000. The campaign was fully funded in seven days, compared to the 74 days estimated, or nine times faster than Trine estimated, thanks in part to Greenlight Planet's A- rating, Trine's highest ranking. This has a direct impact on investors' confidence in the company and the ability of its business model to yield a return on investment.

Photo Credit: Greenlight Planet

IMPACT ANALYSIS BY THE NUMBERS

The campaign had impacts on nine of the SDGs: 1 (no poverty); 3 (good health and well-being); 4 (quality education); 5 (gender equality); 7 (affordable and clean energy); 8 (decent work and economic growth); 10 (reducing inequalities); 13 (climate action); and, 17 (partnership for goals. Table 5 presents a summary of the impacts.

4,313
people able to pursue additional economic opportunities

19,414
kerosene lamps replaced

496hours availed for education annually (4 hours/night)

Light **80x** brighter than the kerosene lamps used for education

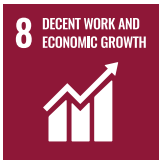
8,695 women benefit from energy financing

33,757 women benefit directly and indirectly from clean and affordable energy

15,344 households have access to reliable and affordable clean energy

1.902 MWh of clean and affordable energy generated every day

51,376 individuals benefit from improved energy services, including quality light, entertainment and mobile



2,441 individuals use the SHS to support their enterprises

15,809 adults benefit from innovative energy financing

25,102 metric tonnes of CO_2e mitigated annually

19,414 kerosene lamps displaced

8,695 women benefit from energy financing

33,757 women benefit directly and indirectly from clean and affordable energy

€1,000,000
invested in the campaign

€300,000 from IsDB

€700,000 from **1,667** investors on the·platform

Table 5: Summary of impacts: Solar Campaign No. 17

DETAILED ANALSIS OF THE IMPACTS

This study was conducted in Obafemi Owode, Ogun State, a rural area located 71.6 km from Lagos. It is a local government area in Ogun State, with total land area 1,410 km^2 and population of 228,851. The impacts quantified below are based on assumptions derived from data analysis showing a homogenous customer profile, using GOGLA standardized impact metrics for the off-grid solar energy sector (2020). The impacts were calculated and impacts estimated by gender as follows: 55 percent of customers are female and 45 percent are male. Twenty percent of customers are young (20-35 years).

Figure 12: Study Area, Egba, Ogun State

Photo Credit: Greenlight Planet

Figure 13: Power outages are a major constraint on small-scale enterprises in Nigeria. Those who can afford a small petrol generator must make an initial investment of 25 percent of their investment costs, The cost of petrol is an additional overhead expense that pulls money out of the business. SHSs thus provide relief to small-scale entrepreneurs, as the PAYG system is affordable. Further, the system is reliable and allows for additionality, with the appliances included with some of the systems - such as televisions - used to support income-generating activities.

POVERTY REDUCTION

This investment has directly impacted 4,313 people, who are now able to pursue additional economic activities. It has also enabled 2,441 individuals using the SHSs to support their enterprises. Mr. Osho Micheal tells us that he owns a Sun King 400 system that includes a television. It provides entertainment to his patrons at his hotel. He also uses the system to charge his mobile phone, which he uses to order stock for his restaurant. He says that the product facilitates his business and saves money that he would otherwise spend on petrol.

GOOD HEALTH AND WELL-BEING

By eliminating 19,413 kerosene lamps, 25,102 metric tonnes of CO2e have been mitigated annually. This has improved indoor household air quality as emissions from kerosene lamps are associated with eye irritation, respiratory diseases and adverse effects on maternal health. The quality of light has also improved visual health for many. The light from a SHS is 50 to 80 times brighter than that from kerosene lanterns, which makes tasks such as cooking and reading more comfortable.

Photo Credit: Creative Commons

Figure 14: Generators produce exhaust fumes that contain more than 40 contaminants harmful to human health, including many known or suspected cancer-causing substances such as benzene, arsenic and formaldehyde. They also contain harmful environmental pollutants, including nitrogen oxide, currently the single most important ozone-depleting emission. In Nigeria, indirect evidence of the impact of diesel exhaust on lung cancer is indicated by its rising incidence among urban-based non-smokers under 60 years, most of whom use diesel generators daily.

Obigbesan is a 52-year-old small-scale trader who had been using a kerosene lantern to light her home. The lamps have irritated her eyes and limited the number of tasks she could undertake at home. She tells us the fumes from the lamps also made the air quality in her home unpleasant. By modernizing her home through the use of the solar system, life for her and her husband has become more comfortable.

QUALITY EDUCATION

The SHSs provide an average of four additional hours of light available for study. This investment has availed up to 496 hours for after-school activity. The quality of light makes the reading environment safe and comfortable for children. Parents and children alike have observed this benefit. The son of Luqmon Isejobi from Isejebu, Ogun is studying at the university and spends up to three hours reading at night. He says the light is comparable to that provided by the grid but this light does not go on and off, making it more reliable. He charges his smart phone using the same system that he uses to access the internet for research.

Mrs. Taiwo Jaiseyemi is a 45-year-old teacher who also views the SHS as enabling education. She tells us that access to good light provides a good learning environment for children, who need to spend time studying after the school day ends. She owns the Sun King 120 and has two children, 6 and 10. She reads with them in the evening. Her 6-year-old son particularly enjoys the storybooks that she reads to him.

Photo Credit: Greenlight Planet

Figure 15: Woman uses her Sun King in the kitchen. The solar products allow women to undertake tasks with ease and in a safe and clean environment.

GENDER EQUALITY

This investment has provided access to energy for 48,263 women, 8,695 of whom have benefitted from energy financing through the PAYG model. Access to clean and affordable energy is one way to empower women, who experience disproportionate health effects from using dirty fossil fuels in homes. Solar energy technology can increase income-generating activities and, in this case, 734 women are using the technology for that purpose.

Mrs. Ashaye Tanwa, 35 (pictured below), runs a small retail shop. She uses the Sun King Home 120 to light her shop in the evening from 6:30 - 9:30 pm. She also informs us that she leaves a light on all night as security. She explains that unreliable electricity has been an inconvenience and interrupted her business. She had always thought that a solar system would be impossible for financial reasons, but once she understood the PAYG model, she found the systems to be affordable. She made an upfront payment of ₦6,000 ($14.63) and pays ₦2,000 ($4.88) weekly on nominal terms. She expects to own the system fully after 252 days.

Photo Credit: Greenlight Planet

Figure 16: Mrs. Ashaye Tanwa, 35, a retail shop owner, uses her Sun King 120 to light her shop from 6:30 - 9:30 pm. She uses the light on low-power mode to provide overnight security light.

AFFORDABLE AND CLEAN ENERGY

This investment has provided access to clean and affordable energy to 61,376 individuals, 33,757 of whom are female, 27,619 are male and 12,275 of whom are between 20–35 years. These individuals live in areas where grid reliability is low, thus limiting their ability to fully benefit from energy services such as the provision of light, including security light, access to information through FM radio and television, as well as mobile charging services. Nigeria receives good solar irradiation. As such, the investment has helped to generate an estimated 1.902 MWh of clean and affordable energy per day.

Mr. Ania Oladipo is 42 years old and works in the electricity sector. He is well aware of the challenges of grid reliability in the country. He also tells us that Nigeria suffers from a "generator habit" and despite the high level of solar irradiation, the uptake of solar technologies has been slow due to high upfront payments required to acquire them and a lack of understanding of technological advances in terms of longer battery life. The solar systems provided by Greenlight Planet are gaining popularity because they are easy to use and offer numerous services such as mobile phone charging and multiple lighting options, together with an innovative and affordable financing system. He says these factors led him to acquire the system and that he is indeed benefitting from its services.

DECENT WORK AND ECONOMIC GROWTH

This investment provides 1,334 people access to a reliable technology that enhances their income- generating activities. It offers direct and indirect

Photo Credit: Greenlight Planet

Figure 17: SHSs provide valuable energy services that create additional income-generating activities. For example, the television set provides entertainment that can lead to increased patronage at eateries.

economic benefits to 734 female and 600 male customers, including 267 young people between 20-35 years. Financial inclusion through energy financing services benefits 15,809 adults who were previously considered unbankable and, thus, could not obtain access to a loan. Mr Oyefesso is 28 years old and runs a small kiosk in Ogijo. He has been making weekly instalment payments of ₦2,000 ($4.88). This is his first experience with asset financing. He has never opened a bank account, much less taken a loan except from relatives. He informs us that he has never struggled with a payment as the repayments are affordable. He uses the system to provide lighting for his house and shop, which is located in front of his home.

Mrs. Mary Olubudon, 40, is also a beneficiary of PAYG financing. It has enabled her to acquire the Sun King 400 system, which provides her light and a means of charging her telephone and accessing information through her television. She says these are all important services for her daily life. She is a food kiosk owner and the system provides her the reliability of energy supply she needs for her economic activities.

Photo Credit: Greenlight Planet

Photo Credit: Everline Wafula

SUMMARY OF SDG IMPACTS

The assessment found that the investment has an impact on nine of the 17 SDGs. These impacts were experienced directly by end users, as well as through Greenlight Planet's partners and employees. These include SDG 1 (no poverty), SDG 3 (good health and wellbeing), SDG 4 (quality education), SDG 5 (gender equality), SDG 7 (affordable and clean energy), SDG 8 (decent work and economic growth), SDG 10 (reducing inequalities), SDG 13 (climate action) and SDG 17 (partnership for goals). Table 3 presents the summary of quantitative impacts against investment.

Table 3: Summary of SDG Impacts for the three solar campaigns

	Indicator	Campaign 15	Campaign 16	Campaign 17	Total
	No. of individuals pursue additional economic opportunities	5,032	5,032	4,313	**14,377**
	No. of kerosene lamps replaced	22,650	22,650	19,413	**64,713**
	No. of hours availed education annually	579	579	496	**1654**
	No. of households accessing reliable and affordable clean energy	17,890	17,890	15,344	**51,124**
	Daily energy generated (MWh)	2.2	2.2	1.902	**6**
	No. of individuals benefitting from improved energy services	71,560	71,560	61,376	**204,496**
	No. of individuals using the SHSs to support their enterprises	2,847	2,847	2,441	**8,135**
	No. of adults benefitting from energy financing	18,443	18,443	15,809	**52,695**
	No. of women benefiting from energy financing	10,144	10,144	8,695	**28,983**
	No. of women benefitting, directly and indirectly, from clean and affordable energy	39,358	39,358	33,757	**112,473**
	Metric tonnes of CO_2e mitigated annually	29,286	28,286	25,102	**82,674**
	No. of kerosene lamps displaced	22,650	22,650	19,414	**64,714**
	Euros invested	1,000,000	1,000,000	1,000,000	**3,000,000**

LESSONS LEARNED AND MARKET CHALLENGES

- **Nascent mobile money market and cash-based businesses:** The Nigerian mobile money market is not as developed as it is in East Africa, which has allowed the latter to tap into innovative financial instruments for SHS distribution. Most SHS sales in Nigeria are made in cash. Greenlight Planet conducted a pilot project in 2019 to establish ways to incentivize microfinance institutions and sales agents to navigate around this key obstacle. As expected, direct cash sales correlate directly to reduced sales during the economic slump caused by the COVID-19 pandemic. The Nigerian Off-Grid Acceleration Programme (NOMAP) is working with Swifta Systems to build and manage a single point of integration for PAYG collection from last-mile unbanked customers.
- **Market risks:** The uptake rate of solar products in Nigeria lags behind East African countries for a variety of reasons. In particular, the combination of limited rural consumer awareness, lower female participation and higher customs duties creates additional barriers that market players will need to overcome to achieve success.
- **Financial risks:** The devaluation of the Nigerian naira makes it difficult to model the financial structures used for borrowing funds for operators. Access to single-digit naira-denominated loans remains a challenge for many operators, further acerbating short-term working capital needs.
- **Consumer behaviour:** Consumers and policymakers will need considerable education to change their current negative perceptions and enable them to make sound energy choices. Greenlight Planet agents, who are also referred to as 'Sun King energy officers', participate in consumer awareness. Their relationships with customers enable easy follow-up on any challenges that consumers experience with the SHSs. This model is scalable and replicable and offers a good model for consumer behaviour change.
- **Emissions from generators:** During our study we found there is a high proliferation of small diesel generators in use in the country. The emissions avoided from the replaced use of the generators with the solar home systems was not accounted for as the methodology for calculating is still being developed. This will be an important component for consideration in future impact studies.
- **Market risks:** The uptake rate of solar products in Nigeria lags behind East African countries for a variety of reasons. In particular, the combination of limited rural consumer awareness, lower female participation and higher customs duties creates additional barriers that market players will need to overcome to achieve success.

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