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Fintech for Cleantech: The Nigerian Pay-As-You-Go Solar Evolution

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Clarence Lakpini is a Digital Policy Hub doctoral fellow pursuing a Ph.D. in intellectual property (IP) law at the University of Ottawa. During his Digital Policy Hub fellowship, he will examine how Nigeria can foster an equitable energy transition by leveraging digital technologies and reforming its IP to accelerate the adoption of solar energy. His research focuses on the intersection of digital technologies, IP law and energy justice in the Nigerian context, with the goal of providing policy recommendations for a just transition that supports underserved populations.

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Bottom Line Up Front

The high upfront cost of solar energy in Nigeria limits the potential of the country's rural, low-income population to transition away from fossil-fuel dependence. The pay-as-you-go (PAYG) business model, though offering a viable solution, is constrained by the regulatory inflexibility of the Central Bank of Nigeria (CBN), the inadequate enforcement of quality standards by the Standards Organisation of Nigeria (SON) and the erosion of customer trust. Overcoming these challenges will require sustained focus on promoting greater regulatory flexibility for the payment infrastructure that powers the PAYG model, guaranteeing the quality of solar systems and strengthening consumer protection.

Key Points

- Nigeria has the world's largest electricity deficit, with almost half of its 220 million-plus population lacking access to electricity from the national grid. The massive shortfall in electricity supply has led to a heavy reliance on expensive, environmentally polluting fossil-fuel-powered solutions.
- Solar energy has emerged as a promising alternative to fossil fuels, providing clean energy, particularly for rural, low-income households that are not connected to the national grid.
- A crucial obstacle to solar energy penetration in Nigeria, particularly in rural, low-income communities, is the high upfront cost of obtaining solar systems. The PAYG solar model, powered by transformative technologies such as mobile money, is helping alleviate this problem.
- Despite the promise of the PAYG solar model, certain challenges, namely the CBN's regulatory inflexibility, the SON's inadequate enforcement of quality standards and the erosion of customer trust, threaten its long-term viability.

Recommendations

- **Regulatory flexibility:** The CBN should exercise greater flexibility in regulating the mobile money market by broadening the list of eligible promoters to include telecommunications companies (telcos). In addition, the CBN should allow Payment Service Banks to extend credit facilities to promote financial inclusion for the underbanked and unbanked.
- **Quality assurance:** Along with providing increased funding, the Nigerian government should fully reinstate SON at the ports and facilitate collaboration with the Nigeria Customs Service to enable it to fulfil its standard-setting objectives proactively. Further, upon full reinstatement, the SON and the Rural Electrification Agency (REA) should work together to establish solar testing facilities nationwide, particularly near Nigerian ports.
- **Strengthening consumer protection:** The SON should actively intensify its efforts to raise public awareness about the risks of purchasing substandard solar products. An effective way to achieve this is for the SON to partner with the REA to embark on mass sensitization campaigns in rural areas. The sensitization will help foster informed consumer decision making, potentially improving consumer trust and further legitimizing solar energy's long-term viability.

Introduction

Nigeria faces a severe energy crisis, with almost half of its population of more than 220 million people lacking access to electricity from the national grid (International Energy Agency et al. 2025, 21).[1] Its current daily power generation is less than 5,000 megawatts, far short of the conservative estimate of 30,000 megawatts required to meet the population's needs (NAN 2022). The country faces the dual challenge of bridging its energy deficit while incorporating renewable energy sources that reduce its fossil-fuel dependence (Adeshina et al. 2024, 2). Solar energy is one of the options available to aid this transition, given Nigeria's favourable tropical climate, which provides an enabling environment for solar energy solutions to thrive (Idogho et al. 2025, 1925).

The phrase "fintech for cleantech" connotes that financial technology, specifically mobile money and digital financial platforms, is essential in the successful scaling of clean technology solutions such as solar energy. While solar energy holds immense promise, its high upfront cost remains a primary barrier to its adoption, particularly for underserved and unserved communities (Anyanele, Isamotu and Akinde 2019, 187; Ibegbulam et al. 2023, 39). The paper highlights the pay-as-you-go (PAYG) model's potential to amplify solar energy's effectiveness in mitigating the environmental impact of traditional energy sources, such as kerosene for lamps and petroleum and diesel to power generators, which have been relied upon to bridge the country's energy deficit (Olofinko 2025). A successful transition to cleaner energy sources can help to alleviate energy poverty among low-income households, providing a more stable platform for them to thrive (United Nations Development Programme [UNDP] 2025).

To this end, the paper first explains what the PAYG model is, followed by a brief account of how mobile money catalyzed its growth in Kenya in the context of solar energy. The paper then argues that although the PAYG model promises solar energy access to low-income Nigerians, its potential is limited by three major obstacles: the regulatory inflexibility of the Central Bank of Nigeria (CBN), inadequate enforcement of quality standards by the Standards Organisation of Nigeria (SON) and erosion of customer trust. Finally, the paper recommends that the CBN adopt regulatory flexibility to promote financial inclusion in Nigeria, that the SON implement quality assurance measures to improve customer trust and that the government put in place more effective consumer protection measures. These measures will help to enhance the PAYG solar model to promote affordable, reliable, clean energy access for low-income communities in Nigeria.

The PAYG Model Explained

PAYG is a business model that allows consumers to pay in installments using payment methods such as mobile money, cash or scratch cards to access services, including solar-powered electricity (Chetty 2023, 4). In the context of solar energy, it is either offered purely as a service, where the consumer never owns a solar system but pays for the service as needed, or on a rent-to-own (RTO) basis, where the customer eventually owns

1 See www.energytransition.gov.ng/; www.unfpa.org/data/world-population/NG.

the system (Guajardo 2021, 79; Riedke and Adelmann 2022, 3). The first instance, referred to as energy as a service, or EaaS, allows customers to enjoy solar energy without the maintenance and repair responsibilities that come with system ownership (Kizilcec, Parikh and Bisaga 2021, 3).

Although more commonly used in Asia, PAYG has emerged as a viable option in African markets. For instance, Econet Solar in Zimbabwe, Off-Grid Electric in Tanzania and Persistent Energy in Ghana use this method (Adwek et al. 2020, 3929). Under the RTO model, the consumer makes an initial down payment, between 10 and 30 percent of the cost of the solar system, and makes periodic payments for a term, usually ranging from 18 to 36 months, after which they will own the solar-powered system or appliance (Riedke and Adelmann 2022, 3; Reichert and Trivella 2015, 256).

The flexibility the PAYG method provides reduces the often-insurmountable financial burden for low-income customers by mitigating the high upfront cost of solar system ownership. This gives them control over how they access electricity, and makes it available on more favourable payment terms (Keane 2014, 129; Adwek et al. 2020, 3902). Using solar home systems (SHS) as an example, the PAYG model is enabled by integrating solar systems with mobile communication, fintech-powered mobile money and remote-control systems that help manage electricity access and facilitate periodic payments (Yadav, Heynen and Palit 2019, 140).

In a typical PAYG arrangement, periodic payments are made using mobile phones, which remotely trigger the supply of the commensurate units of electricity purchased. The provider remotely monitors and controls the system using Global System for Mobile Communications (GSM) or machine-to-machine (M2M) protocols (Montoya-Duque, Arango-Aramburo and Arias-Gaviria 2022, 3; Adwek et al. 2020, 3912). The system is usually embedded with a subscriber identity module (SIM card), which sends a signal to activate it once a payment is received and can also be used to disconnect electricity access when a customer defaults (Rastogi 2018, 98; Adwek et al. 2020, 3916; Riedke and Adelmann 2022, 2).

The PAYG model promotes the democratization of energy by empowering consumers to exercise greater control over their energy access. A core advantage of the model is its adaptability; in addition to offering the flexibility required to promote initial access, it creates an ideal platform for continual optimization using digital capabilities such as artificial intelligence and the Internet of Things (Adwek et al. 2020, 3916; Mergulhão et al. 2022, 1; Deign 2021). This equips service providers with a range of tools to enhance efficiency and scale their operations.

How M-PESA Helped to Spark the PAYG Solar Revolution in Kenya

There are two primary methods for implementing mobile money services: the bank-led and non-bank-led (predominantly led by telecommunications companies) models (Llewellyn-Jones 2016). Kenya pioneered the use of the PAYG solar model in Sub-Saharan

Africa, integrating it with its innovative mobile money platforms, such as M-PESA (a telecom-led initiative) (Adwek et al. 2020, 3901). M-PESA provides a flexible and convenient payment platform for consumers in both urban and rural areas, and powers innovative PAYG solar companies such as M-KOPA Solar (Adwek et al. 2020, 3901; Rastogi 2018, 96).

The ease of payment was enabled by Unstructured Supplementary Service Data technology, which M-PESA leveraged, allowing the model to reach low-income consumers without smartphones (Agarwal and Assenova 2024, 772). As a result of this innovative approach, Kenya was the first country in Africa to achieve an off-grid SHS market penetration of 15 to 20 percent, predominantly in rural areas (Adwek et al. 2020, 3906; Scott and Miller 2016, 7). Its highly developed mobile money infrastructure promoted the adoption and penetration of the PAYG model, increasing the uptake of solar (Chirwa and Qutieshat 2025a, 9).

A crucial selling point for M-PESA following its emergence was its ability to provide an avenue for low-income, unbanked customers to access services, leveraging the telecommunications infrastructure Safaricom had built (Llewellyn-Jones 2016; Mas and Radcliffe 2010, 1). The platform was intuitive and seamless to use, with the company relying on its existing network of agents and extensive sensitization campaigns to ensure its success (Llewellyn-Jones 2016; Mas and Radcliffe 2010, 2). All a subscriber needed to do was create an account with an M-PESA-compatible SIM card and deposit funds on their phone by purchasing a mobile money scratch card, enabling them to acquire goods and services (Llewellyn-Jones 2016). The high level of mobile phone penetration, as well as the trust that Safaricom had built in both its unbanked and banked customer bases, proved to be a crucial factor in the growth in popularity of the PAYG solar model in Kenya (Llewellyn-Jones 2016; Adwek et al. 2020, 3916; Centre for Public Impact 2016). M-PESA continues to drive Kenya's PAYG solar efforts, especially in rural communities (Shamet 2025).

The Nigerian Context: Promise and Challenges for PAYG Solar Adoption

According to World Bank data published in 2023, the level of access to grid-connected electricity in Nigeria stood at approximately 61 percent, with 85 percent in urban areas and only about 33 percent in rural areas.[2] One reason for this urban-rural disparity is that many rural communities are incredibly costly to reach with grid infrastructure, making off-grid options, particularly mini-grids and SHS, the most financially viable alternatives for closing the energy access gap (News Central TV 2025; Oko-Oboh 2025).

The challenging reality is that, due to the massive gap between electricity production and consumption, Nigerians now spend approximately $22 billion annually on fossil fuel alternatives to make up for the epileptic and sometimes non-existent supply from the grid (Olofinko 2025; Dzirutwe 2022). To illustrate how pervasive this problem is,

2 See https://data.worldbank.org/country/nigeria.

more than 80 percent of small and medium-sized enterprises rely on diesel and petrol generators to augment their power supply (Akangbe and Sharifi 2025, 2).

It is against this backdrop that solar energy has emerged as an increasingly viable solution for power generation, especially in low-income rural communities that are otherwise left to rely entirely on fossil-fuel off-grid alternatives. Access to solar energy could lead to improvements in health, educational and economic outcomes for rural, low-income communities (Oko-Oboh 2025). Unfortunately, the high upfront cost remains a significant entry barrier for low-income households, making the option of reducing the burden through an innovative payment model such as PAYG a promising avenue for greater access (International Renewable Energy Agency 2020, 6; Chirwa and Qutieshat 2025b).

An example of a company that has implemented the PAYG solar financing model in Nigeria is Nova Lumos (Appleton 2024; Cholteeva 2020). It targets low-income households, enabling them to access its solar energy systems in exchange for a fraction of the upfront cost and manageable installments using mobile money platforms (Appleton 2024; Cholteeva 2020). Its success is linked to its partnership with Mobile Telephone Networks (MTN), which allows it to leverage MTN's market penetration and customer service (Roach and Cohen 2016). Over the years, the adoption of PAYG solar has grown, but it has not been without challenges (ESI Africa 2025). The following section highlights three major obstacles to the model's effectiveness: regulatory inflexibility by the CBN, inadequate enforcement of quality standards and erosion of customer trust.

Regulatory Inflexibility by the CBN

In Nigeria, approximately 50 million people, half of the adult population, are either underbanked or unbanked (14.6 and 36.8 percent, respectively) and, in many cases, excluded from the formal financial system (UNDP 2024). Regarding mobile phone penetration, there are approximately 150 million active mobile connections, representing about 64 percent of the population (Kemp 2025). This presents an opportunity for mobile money solutions for low-income consumers who the traditional banking system does not capture.

The CBN, the country's financial regulator, has historically been cautious in its regulation of mobile money, predominantly favouring a bank-led approach while curtailing telecommunications companies' potential to make the service more readily available to the unbanked (Llewellyn-Jones 2016). This is illustrated by its regulatory framework on mobile money, which allows for both bank-led and non-bank-led approaches, but excludes the telco-led model, despite acknowledging the crucial role that mobile network operators (MNOs) play in achieving the goal of financial inclusion through their critical telecommunication infrastructure (CBN 2021, 3).

The prohibition is in place to ensure that the CBN maintains "full control of the monetary policy operations, minimise risks and ensure that the offerings of financial services are driven by organizations that have been licensed by the CBN to do so" (CBN 2021, 4). This is an area where the CBN could show greater flexibility, despite its well-intentioned desire to maintain fiscal control. Ghana serves as an example of a country that reformed its mobile money market to include a telco-led approach, driving a 72 percent post-reform increase in its customer base by 2022 (Nkechika 2022, 154).

Following years of excluding MNOs from leading mobile money implementation, the CBN took a leaf from India and introduced guidelines for the licensing and regulation of payment service banks (PSBs) (CBN 2020; Ezechukwu 2021, 448). The aim of the guidelines "is to enhance financial inclusion by increasing access to deposit products and payment/remittance services to small businesses, low-income households and other financially excluded entities through high volume low-value transactions in a secure technology-driven environment" (CBN 2020, 5). Under the guidelines, MNOs, through subsidiaries, are listed among eligible PSB promoters (CBN 2020, 7).

Although this is a positive regulatory advancement, one challenge that this categorization presents is the prohibition of PSBs from granting loans, advances and guarantees (CBN 2020, section 4.2 (i)). They are more strictly regulated and robust than mobile money operators (MMOs), but do not have the full suite of financial offerings of traditional banks. This niche categorization proved a disincentive for MNOs in India because of the strict limitations it imposed, leaving little room for profitability (Ezechukwu 2021, 450). In the Nigerian context, prohibiting PSBs from extending credit facilities limits their ability to build credit profiles for their customer base, thereby negatively affecting poor consumers' access to the full benefits of financial inclusion.

Inadequate Enforcement of Quality Standards

The long-term success of the PAYG solar model in Nigeria depends on the quality of solar components and appliances, whether locally manufactured or imported. This is why standards are crucial, as they build consumer confidence while protecting the integrity of solar energy service providers. Nigeria's standard-setting body is the SON, which, among its duties, is tasked with enforcing standards that it sets and providing quality control of products.[3] To address quality issues in the solar energy sector, the organization has mandated the "adoption of International Electrotechnical Commission (IEC) standard and quality testing methods for stand-alone solar products up to 350 watts" (Akingbesote and Ewetumo 2025, 229). It also administers the SON Conformity Assessment Programme,[4] which aims to ensure that imported products conform to the standards process and the Mandatory Conformity Assessment Programme[5] for locally manufactured products.

Despite the SON adopting standards aligned with international best practices and having quality conformity standards, it continues to face significant enforcement challenges, leading to the proliferation of substandard and counterfeit solar products (*Punch* 2025). Central to its inability to fulfil its mandate is its eviction from the Nigerian seaports in 2012 (Omenazu 2021). This followed the government's decision to streamline port operations and make it easier to do business (ibid.). This has limited the SON's ability to collaborate with the Nigeria Customs Service (NCS) to proactively identify and stop the influx of substandard solar products (Anthony 2024).

The unintended consequence has been a surge in substandard solar imports, which account for over 60 percent of solar products entering the country (Omenazu 2021; Umeh 2025). In 2022, it was reported that the government had reversed its decision and

3 See http://son.gov.ng/.

4 See http://son.gov.ng/soncapservice/.

5 See http://son.gov.ng/mancapservice/.

partially reinstated SON at the ports (Energy Focus Report 2022; Isa 2022). However, as of 2024, the organization was still seeking full reinstatement to the ports (Anthony 2024; Channel Network Afrique 2024). The inability to stop substandard products at the source complicates the organization's standards enforcement efforts (Anthony 2024). It is limited to inefficient methods, such as targeting substandard products that have already reached the open market, with modest results (Uzoho 2022). The government has acknowledged the challenges it faces in curbing the spread of substandard solar products, noting the threat it poses to sustainable renewable energy projects in Nigeria (Jeremiah 2025). To address this, the country's Rural Electrification Agency (REA) "has commissioned its first Mini-Grid Testing and Simulation Centre" to certify solar equipment before they are deployed (ibid.).

Erosion of Customer Trust

The high upfront cost of solar systems influences customers' purchasing decisions by nudging them toward cheaper options that come with a host of problems (Tetra Tech International Development and Africa Clean Energy Technical Assistance Facility 2021, 4). Some of these include reduced efficiency (between 10 and 15 percent, as opposed to 20 percent or higher) and a shorter lifespan (three years on average, as opposed to 10 to 25 years) (Punch 2025; Akingbesote and Ewetumo 2025, 233). A compounding factor is that only one in four solar traders offers after-sales installations, maintenance and repairs, with the majority limiting their services to urban areas (Tetra Tech International Development and Africa Clean Energy Technical Assistance Facility 2021, 5).

In the context of the PAYG model, despite its apparent advantages, the system's viability relies on consumers' ability to make recurring payments, a challenge for the poorest, many of whom are unable to afford the staggered payments from the outset (Chirwa and Qutieshat 2025b, 11). For context, those in rural areas often have to prioritize basic needs, such as food, and can only afford to spend 5–10 percent of their already meagre income on energy (News Central TV 2025). On the provider's side, issues such as foreign exchange volatility and the risk of defaulting customers make it extremely difficult to sustainably run their businesses in a commercially viable way (Chirwa and Qutieshat 2025b, 10).

These suboptimal factors ultimately create a vicious cycle in which supply meets consumer demand for cheaper, substandard products, eroding consumers' trust in solar energy as a solution to their energy needs. In Ethiopia, for example, some solar companies fraudulently used the PAYG model to tie down low-income customers, mostly in rural areas, to contracts for inferior-quality solar systems that failed within months of installation (Ahmed 2025). These nefarious actors caused already struggling consumers to continue paying instalments for products that had broken down (ibid.). Without adequate focus on consumer protection, there is a risk that dishonest actors in the Nigerian solar sector will engage in similarly fraudulent activities to the detriment of low-income households, leaving them in a worse position than when they relied solely on fossil fuels (ibid.). To alleviate the affordability issues, the Nigerian government, through various projects executed by the REA, has provided significant subsidies to underserved and unserved consumers (Arise News 2025). Unfortunately, despite the

positive strides toward subsidizing access, scaling solar energy's impact through the PAYG model has proven difficult.

Recommendations

- **Regulatory flexibility by the CBN:**
  - The CBN should be more open to allowing for a telco-led option in its mobile money ecosystem. While it acknowledges the importance of telcos in achieving mobile money access, it stops short of allowing for a telco-led option, which has been shown to be effective in countries such as Kenya and Ghana. Hence, easing restrictions on eligible MMOs can help improve mobile money adoption in rural communities, thereby driving PAYG solar adoption.
  - The CBN should amend the PSB guidelines to allow PSBs to offer loans to their customer base. While the PSB guidelines partially address the challenge of telcos' exclusion from the financial services sector, their stringency in prohibiting PSBs from offering credit services is limiting. Since PSBs aim to promote financial inclusion for the unbanked population, it is essential that the CBN does not deny these people the opportunity to access credit, given how difficult it is for them to obtain it from traditional banks. PAYG solar payments can help build credit profiles for customers who would otherwise not benefit from the CBN's financial inclusion drive.
- **Quality assurance:**
  - The Nigerian government should fully reinstate SON at the ports. This will enable the organization to proactively intercept substandard solar products at the source. Effectively achieving this would require cooperation and information sharing between the SON and the NCS. There should also be collaboration between the SON and the REA to expand the reach of solar testing facilities nationwide, especially near ports of entry. Crucially, the government should increase funding for the SON to build its capacity and technical expertise to enforce standards for locally manufactured and imported solar products. This will help to create healthy expectations in consumers around the performance of solar systems and build their trust in solar energy as a long-term solution to the energy crisis.
- **Strengthening consumer protection:**
  - In addition to strengthening enforcement of standards, the SON should devote more time and resources to sensitizing consumers to the dangers of purchasing substandard solar products. This should be done in conjunction with the REA, leveraging its reach in rural, off-grid communities, to help consumers avoid fraudulent offers and make informed decisions. The long-term success of this measure will ultimately depend on proactively reducing the volume of substandard solar products in circulation.

Conclusion

The PAYG solar model is indeed a promising avenue to promote access to clean technology for low-income rural households in Nigeria. However, while it may prove revolutionary, mobile money markets must be more flexibly regulated to maximize impact, ensuring the quality of solar products and strengthening consumer protection. Despite the promise, if those issues discussed above are handled with levity, there is a risk that PAYG solar will become an ineffective solution that fails and drives away the very people it aims to benefit, leaving them in perpetual fossil-fuel dependence. There is an incredible amount of work that is required to reach these rural communities with clean, affordable electricity. With the right environment and policy choices, there could yet be a positive outcome that lifts millions of Nigerians out of energy poverty, while protecting their health and the environment.

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Acronyms and Abbreviations

CBN	Central Bank of Nigeria
GSM	Global System for Mobile Communications
M2M	machine-to-machine
MMOs	mobile money operators
MNOs	mobile network operators
MTN	Mobile Telephone Networks
NCS	Nigeria Customs Service
PAYG	pay-as-you-go
PSBs	payment service banks
REA	Rural Electrification Agency
RTO	rent-to-own
SHS	solar home systems
SON	Standards Organisation of Nigeria
SIM	subscriber identity module
UNDP	United Nations Development Programme

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