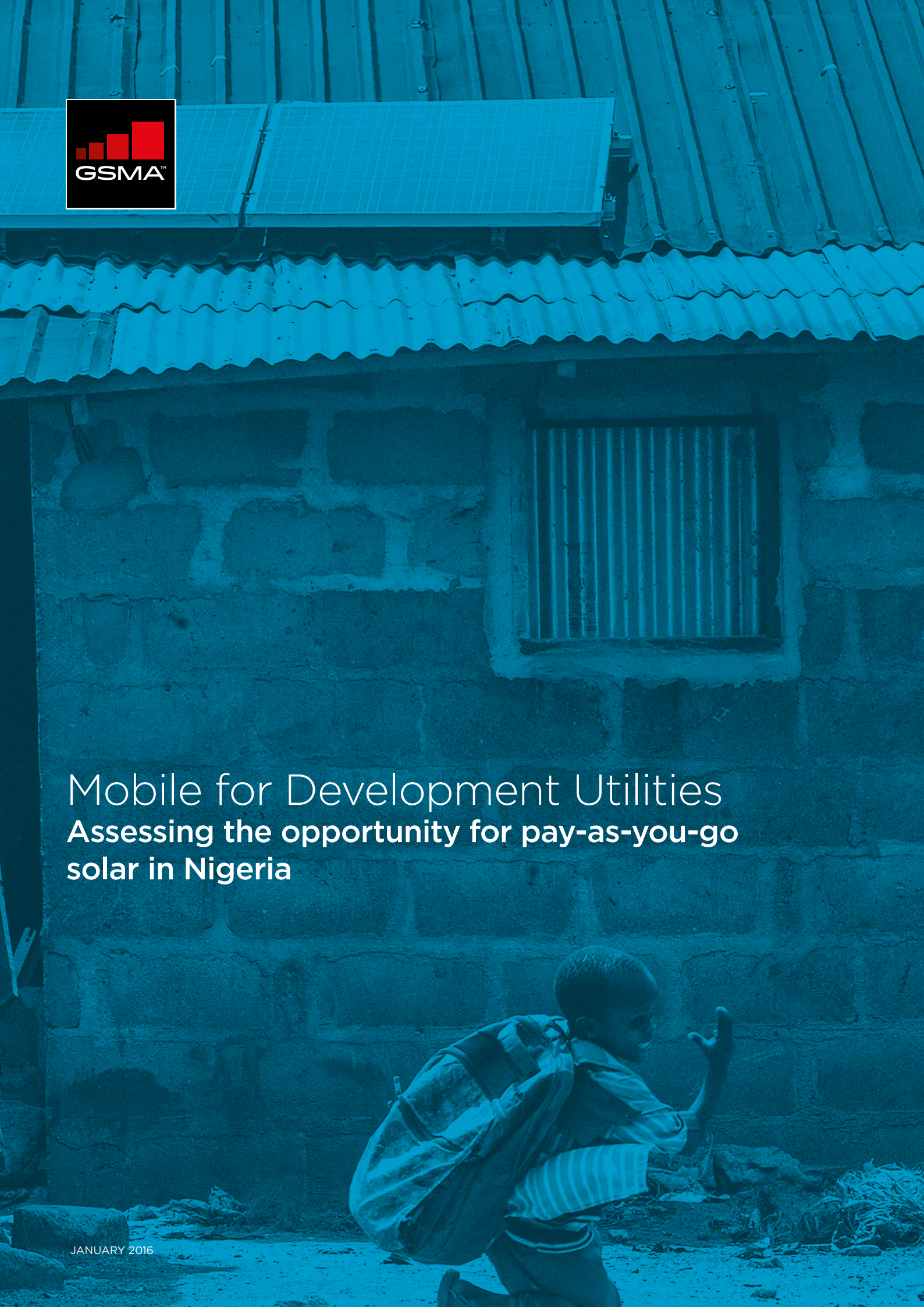


Mobile for Development Utilities

Assessing the opportunity for pay-as-you-go solar in Nigeria

JANUARY 2016

The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 250 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and Internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai and the Mobile 360 Series conferences.

For more information, please visit the GSMA corporate website at www.gsma.com

Follow the GSMA on Twitter: @GSMA

Mobile for Development

Mobile for Development brings together our mobile operator members, the wider mobile industry and the development community to drive commercial mobile services for underserved people in emerging markets.

We identify opportunities for social, economic impact and stimulate the development of scalable, life-enhancing mobile services.

This document is an output from a project co-funded by UK aid from the UK Government. The views expressed do not necessarily reflect the UK Government's official policies.

Mobile for Development Utilities

The Mobile for Development Utilities Programme promotes the use of mobile technology and infrastructure to improve or increase access to basic utility services for the underserved. Our programme focuses on any energy, water or sanitation services which include a mobile component such as mobile services (voice, data, SMS, USSD), mobile money, Machine to Machine (M2M) communication, or leverage a mobile operator's brand, marketing or infrastructure (distribution and agent networks, tower infrastructure). The Programme receives support from the UK Government.

Author: Helene Smertnik

The Innovation Fund

The Mobile for Development Utilities Innovation Fund was launched in June 2013 to test and scale the use of mobile to improve or increase access to energy, water and sanitation services. In two phases of funding, grants were competitively awarded to 34 organisations across Asia and Africa. Seed grants were awarded for early stage trials, Market Validation grants for scaling or replication of business models, and Utility Partnership grants to foster partnerships between utility companies and innovators.

The specific objective of the Innovation Fund is to extract insights from the trial and scaling of these innovative models to inform three key questions for growing the sector:

How can mobile support utility services?
For a mobile-enabled solution to be adopted at scale, what building blocks are needed?

What are the social and commercial impacts of delivering community services to underserved mobile subscribers?

These insights, as well as grant-specific learning objectives, are included in individual case studies and thematic reports that will be published throughout 2016.

CONTENTS

EXECUTIVE SUMMARY 4

Recommendations 5

1. MOBILE FOR ENERGY ACCESS: THE CASE OF PAY-AS-YOU-GO SOLAR 6

1.1 Mobile channels for energy access 6
1.2 Pay-as-you-go solar home systems 7

2. COUNTRY OVERVIEW: NIGERIA 12

2.1 Socio-economics & demographics 12
2.2 Telecoms in Nigeria 13
2.3 Energy access 16

3. PAYG SOLAR IN NIGERIA: AN UNTAPPED OPPORTUNITY 18

3.1 Solar service providers in Nigeria 18
3.2 Priority states for the deployment of PAYG solar 19
3.3 Barriers to market for PAYG solar home systems 20

4. OPPORTUNITIES FOR MNOS TO ENTER THE PAYG SOLAR MARKET 22

4.1 Increase MNOs' Average Revenue per User 22
4.2 Drive growth in mobile money adoption and use 23
4.3 Leverage MNOs' agent network 23
4.4 Improve brand recognition and customer stickiness 23

CONCLUSION 24

Executive Summary

In Sub-Saharan Africa, 57% of the population lack access to electricity.[1] In Nigeria alone, over 100 million people, or ~55% of the population, are un-electrified, mostly living in peri-urban and rural areas.[2] In contrast, mobile networks have become the predominant infrastructure, with over 85% of the population living within mobile coverage.[3]

With high mobile coverage a high mobile coverage and a large un-electrified population, Nigeria's energy addressable market, defined as the number of people who have access to GSM coverage but do not have access to electricity, represents just under 70 million people. In addition to completely off-grid communities, there is also a significant number of people who have only intermittent access to electricity. As a result, over 80% of Nigerians revert to diesel generators as a secondary source of power.[4]

The rise of mobile-enabled pay-as-you-go (PAYG) solar solutions, notably solar home systems, as a response to underserved communities' lack of reliable and affordable lighting and charging solutions in East Africa, highlights the opportunity for the PAYG model to scale into West Africa and Nigeria specifically. Successful PAYG solar service providers, such as Mobisol, M-KOPA and Fenix International, which have grown out of East Africa, are now exploring opportunities to replicate their models in West Africa. A critical enabler for PAYG solar is the uptake of mobile money services to unlock customers' ability to make small payments, through their mobile phone.

The number of mobile money accounts in Nigeria increased from 5.7 million in December 2013 to 8.9 million in December 2014.[5] While not yet as strong a mobile money market as East Africa, with 93.4 million registered accounts as of 2014,[6] these figures show that the market potential is beginning to grow. The case of Nigeria speaks both to the strong market potential for PAYG solar in the region, given the size of the addressable market, as well as the importance of enabling regulations – mobile money services have not yet been widely adopted – for these solutions to scale.

It is estimated that 3 million PAYG solar home systems will be sold globally by 2020.[8] Mobile technology can help the PAYG model to scale, equipping systems with mobile SIMs to enable remote control and monitoring abilities as well as data collection and mobile billing. Moreover, the need for these off-grid energy solutions will only continue to grow with the increasing number of smartphones in the market, as they require more frequent charging: GSMA estimates that the number of 3G connections will account for half of total connections by 2020.[9]

1. International Energy Agency, 2014
2. Ibid
3. GSMA Intelligence data, Q4 2014
4. GIZ Report, The Nigerian Energy Sector: an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification, November 2014 https://www.giz.de/en/downloads/giz2014-en-nigerian-energy-sector.pdf
5. GSMA Mobile Money State of the Industry report, 2014 http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/03/SOTIR_2014.pdf
6. GSMA Intelligence, Mobile Money data, https://gsmaintelligence.com/topics/3363/dashboard/
7. Solar Home Systems are individual systems, powered by solar energy, that offer the ability to light rooms and charge appliances such as mobile phones, radios, DC TV, or fans for households and small businesses.
8. CGAP report, 2014, Access to Energy via Digital Finance: Models for Innovation http://www.cgap.org/sites/default/files/DigitallyFinancedEnergy%20_FINAL.pdf
9. GSMA Intelligence data, 2015

In this light, at the beginning of 2015, the GSMA Mobile for Development Utilities programme (M4D Utilities), with the support of the UK Government, began working with Etisalat to explore the opportunity for mobile operators to partner with service providers in the deployment of PAYG solar home systems, to improve energy access in Nigeria, while growing their off-grid customer base. The findings demonstrate that, while the market for off-grid solar solutions is nascent in Nigeria, a few actors are moving the market forward and exploring the potential for mobile technology to support the deployment at scale of these solutions.
Our main recommendations follow:

Recommendations

Recommendations for Mobile Network Operators

- Mobile Network Operators (MNOs) should leverage PAYG solar to develop their offering for Machine-to-Machine (M2M) and mobile payments, both nascent services in the Nigerian market with 1.9 million M2M connections and just under 13 million mobile money accounts in 2015;
- MNOs should leverage the potential of PAYG solar to develop their services and customer base in the rural market, representing 53% of the total population;
- MNOs would benefit from improving customers' education on the use of mobile money to support PAYG solar solutions to scale as an alternative to current kerosene or other self-generating energy sources.

Recommendations for PAYG solar service providers

- In light of the embryonic PAYG solar market in Nigeria, service providers, who want to embed mobile technology to scale their solar solutions, should work in partnership with MNOs to develop models adapted to the Nigerian context, taking into account the restricted mobile money environment;
- Energy service providers who do not have the technical capacity should identify technology partners, who can provide their licensed PAYG software and hardware, instead of developing their own solutions;
- Service providers should start by piloting the installation of solar home systems in areas with mobile connectivity in order to leverage mobile operators' M2M technology to enable remote control abilities.

Recommendations for the government

A conducive policy and regulatory environment will be critical for decentralised renewable energy solutions, such as PAYG SHSs, to grow and tap into the significant off-grid opportunity in Nigeria. A few recent initiatives such as Lighting Africa and DFID's Solar Nigeria Programmes are signs of the growing support for off-grid projects.

- While currently not providing direct financial support mechanisms, the government should continue to push for new innovative solutions through enabling policies for decentralised energy service providers (e.g. tax exemption on solar products) instead of solely focusing on traditional grid expansion models;
- The government also has a role to play in educating and supporting off-grid households and small businesses shift from diesel to cheaper and ecological solar solutions, where appropriate.

1. Mobile for energy access: the case of pay-as-you-go solar

According to GSMA estimates, over 80% of Nigeria's population is covered by mobile networks[10] with over 148 million mobile connections. In contrast, only 45% of Nigeria's population is electrified, resulting in 70 million people owning a mobile phone before having a place to charge it.

As a result of poor energy access, customers face major limitations on their ability to charge electrical appliances, including mobile phones. The reduced usage of phones will also slow the adoption of life-enhancing but power-hungry smartphones. As of Q2 2015, smartphones in Nigeria accounted for 18% of total connections and this is expected to grow.[13]

1.1 Mobile channels for energy access

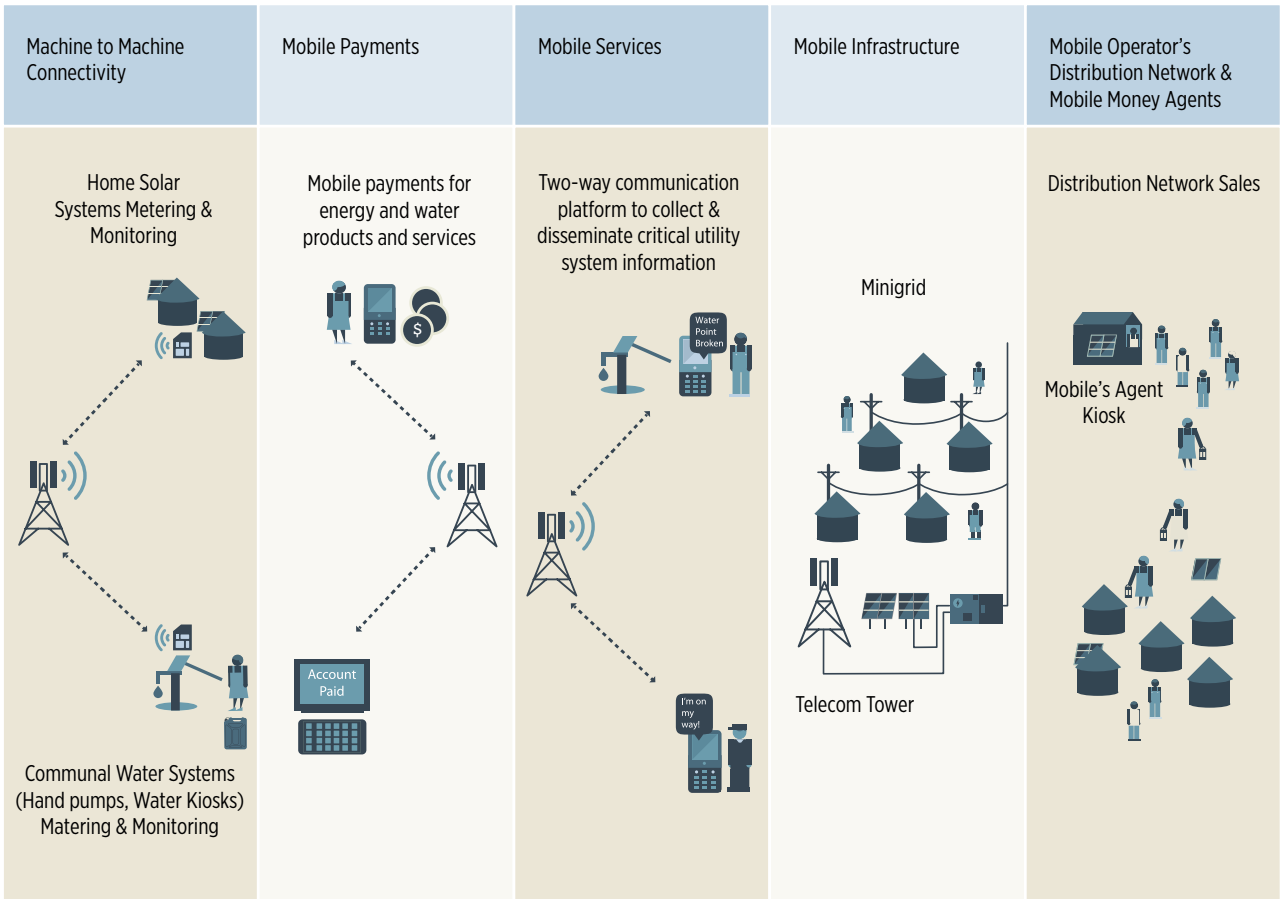
Mobile technology can help improve access to basic utility services across the developing world. Innovative mobile applications, not just for energy but for water and sanitation as well, are bringing critical services to underserved populations through the following five channels:

- **Mobile infrastructure –** Leveraging the presence of telecom towers as anchor tenants in off-grid environments to support rural electrification efforts
- **Mobile operator's distribution and mobile money agent networks –** Leveraging the distribution reach and brand of mobile operators to reach underserved customers
- **Machine-to-Machine connectivity –** Enabling the remote monitoring and control, and PAYG capacities of decentralised utility systems as well as collection of data on customers' habits
- **Mobile payments (mobile money, scratch card, airtime) –** Providing flexible, convenient and secure mobile-enabled payment solutions to low income populations and making off-grid energy solutions affordable through financing
- **Mobile services (voice, SMS, USSD, applications) –** Leveraging increased mobile phone ownership to collect/disseminate critical information on utility services and/or supply chain management.

10. GSMA Intelligence data, Q4 2014
11. GSMA Mobile for Development Utilities, Q1 2015
12. GSMA Intelligence data, Q1 2015
13. Ibid

FIGURE 1

Mobile channels for utilities access



1.2 Pay-as-you-go solar home systems

Solar home systems (SHSs) are individual systems, powered by solar energy, that offer the ability to light rooms and charge appliances such as mobile phones, radios, DC TVs, or fans for households and small businesses. For off-grid households wanting to buy a SHS, one of the biggest challenges is the upfront cost: unable to generate savings as households are often also unbanked, they must rely on other energy products and services which come at a premium. While energy accounts for a relatively large share of their total budget, the rural poor find it difficult to access the financing required to purchase assets such as a SHS which in the longer run would allow them to better manage their cash flow.

Since 2011, there has been a significant rise in the number of enterprises using a PAYG model for energy. Regionally, the PAYG solar market represents over USD 10 billion, a figure calculated by adding the total kerosene and phone charging expenditure in Sub-Saharan Africa. There has also been more than USD 240 million invested in the PAYG SHS market alone in the last 3 years.[14]

14. GSMA Mobile for Development Utilities data, 2015

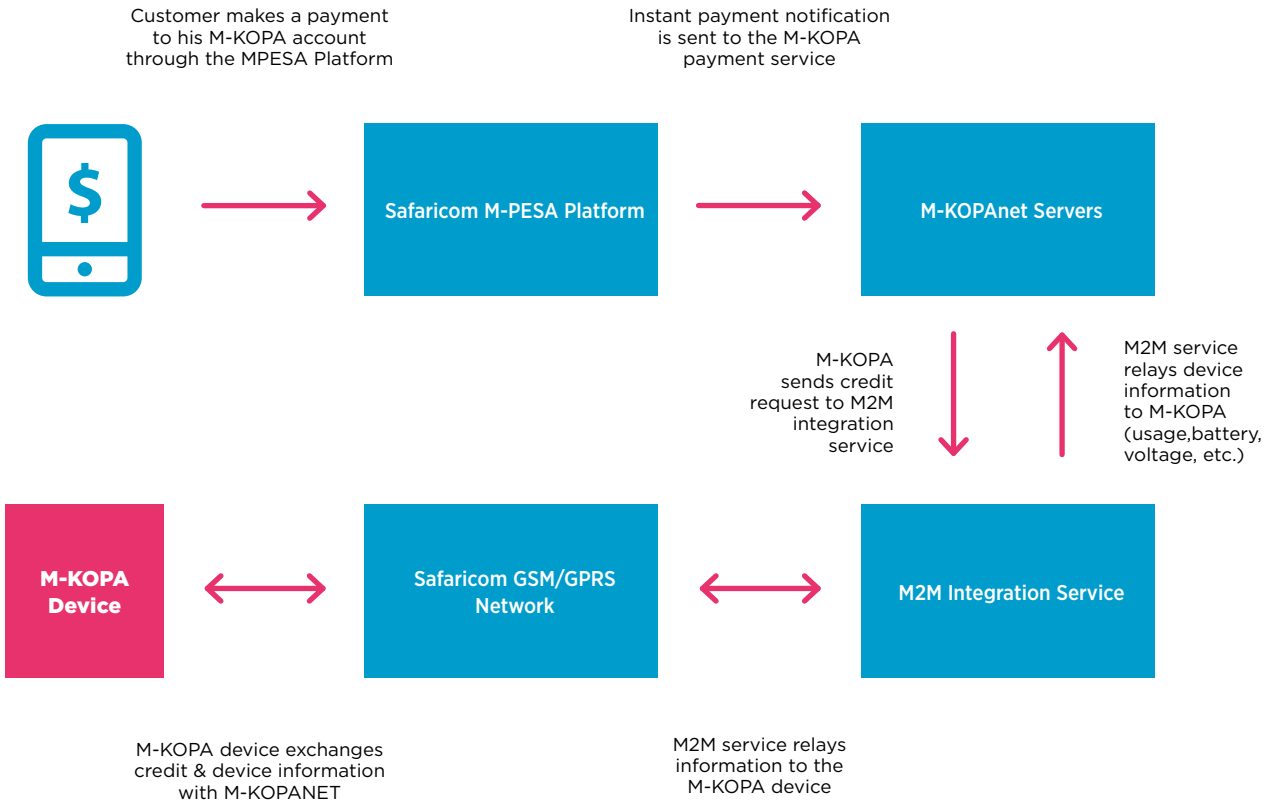
In Nigeria, the PAYG SHS model has the potential to provide electricity to millions of businesses and households that are not expecting to be connected to the grid in the medium to long term because it is too costly and therefore unprofitable for the national utility to extend the grid.

Mobile-enabled PAYG solar home systems

As Figure 1 highlights, we have identified 5 channels to support the delivery of energy services to underserved, remote areas. In the case of PAYG solar, M2M and mobile money are the main two channels that can be leveraged. Figure 2 below shows how these two channels are applied in M-KOPA's PAYG solar model.

FIGURE 2 Source: M-KOPA

Using mobile money and M2M communications for PAYG solar



These two channels, GSM Machine-to-Machine connectivity and mobile payments, have been pivotal in scaling the PAYG solar model, particularly in East Africa, by making the systems affordable through financing. Mobile services, such as SMS or calls, allow providers to regularly interact with their customers and build a strong relationship, thus improving the user experience.

15. CGAP report: Access to Energy via Digital Finance: Overview of Models and Prospects for Innovation, http://www.cgap.org/sites/default/files/DigitallyFinancedEnergy%20_FINAL.pdf, August 2014
16. Saviva Research report, Base of the Pyramid Pay As You Go Solar, http://www.savivaresearch.com/wp-content/uploads/2014/01/January-2014-PAYG-Solar-report1.pdf, January 2014

PAYG business models: Financed purchase or energy as a service

There are two main types of PAYG business models in the market: the financed purchase model, also referred to as lease-to-own, and the energy as a service, also called the perpetual lease model. The former model allows customers to pay for the device in increments until they own it, whereas the latter is comparable to a typical utility service, where the asset ownership remains with the service provider. Both types of PAYG models exist to make systems affordable, by breaking down the cost in small, manageable amounts, especially for off-grid customers who are often cash constrained.

TABLE 1

Business model comparison: Financed purchase vs. energy as a service for solar home systems

PAYG business model	Pricing structure	Ownership	Service support
Financed purchase	Various instalment arrangements and possible down payment, with eventual end to payments as outlined in the contract with customer	Customer owns asset at the end of the repayment period (between 1 and 3 years)	Service and support may be provided, some offering additional service support after warranty period
Energy as a service	Continuous payments for life of service contract, with possible down payment initially	Service provider always maintains ownership of the asset	Service and support are key, offered over the life of the contract

Credit transfer methods: M2M or manual

There are two modes to transfer credit to a mobile-enabled PAYG solar home system: M2M-enabled and manual (i.e. human-assisted). With M2M-enabled PAYG, credit is transferred automatically to the device (over the mobile network) once the user makes a payment as outlined in Figure 2. Manual PAYG can take several forms: the user enters a code into the PAYG device; or uses a mobile phone or another portable device (e.g. keypad) to transfer credit to the PAYG device. Manual PAYG is cheaper because it does not require a GSM module and SIM embedded in the SHS, or an ongoing service plan for the device. Therefore, it does not require reliable mobile network coverage at the installation site. However, it does not allow for remote monitoring so collecting data on system performance and customer usage requires a visit to the customer home.

TABLE 2

Range of credit transfer mechanisms

Credit transfer	Description
M2M enabled credit transfer	• Full connectivity of unit with GSM component (SIM) enabled in hardware of SHS • Remote lock / unlock, operations and performance data transfer • Enables credit transfer to unit, using digital currency (e.g. mobile money, airtime)
Manual credit transfer	• Service agent or customer unlocks unit by either entering a payment code, (scratch card, keypad or SMS-generated) or through a mobile application and a physical connection to the device, such as Bluetooth or open mobile voice channel (playing a tone) • The device is then locally locked/unlocked, there is no direct connection nor data transfer between the device and central server. The device will also independently track progress towards full repayment.



Fenix International ReadySet solar home systems: Manual credit transfer



M-KOPA solar home systems: M2M-enabled credit transfer

Currencies used for payment: Mobile money, airtime, premium SMS, or cash

There are different types of currencies that can be used for mobile-enabled PAYG SHSs: mobile money, airtime, premium SMS and cash (Table 3). Airtime is an alternative currency in markets where mobile money has yet to scale, especially if the PAYG service provider has a strong relationship with the MNO offering the service. However, there are regulatory barriers to take into account that can prove an obstacle in some countries. PAYG solar customers can also make payments using cash, premium SMS, buying scratch cards or through SMS-generated codes / vouchers.

TABLE 3

Choice of currency for payment of PAYG solar home systems

Payment currency	Description
Mobile money	• Customer pays the electricity bill via the mobile money account
Airtime	• Customer pays the electricity bill using airtime, which the MNO translates into credit for the PAYG system
Premium SMS	• Customer pays for the use of the system by sending a premium SMS (higher rate than regular SMS) as payment to the owner of the asset – the service provider directly or local entrepreneur. If the system is owned by an entrepreneur, the entrepreneur's generated revenue will then be shared with the service provider
Cash	• Customer buys a scratch card to top up credit, or pays the agent who tops up the customer's unit

2. Country overview: Nigeria

2.1 Socio-economics and demographics

Located in West Africa, the Federal Republic of Nigeria shares its borders with four countries: Benin, Niger, Chad and Cameroon. The Niger River runs through the south of the country, which is characterised by tropical weather, while the north of the country is arid.

Nigeria is considered the powerhouse of Africa in terms of population and GDP, with over 177 million people and a GDP currently estimated at 80.2 trillion Naira (USD 500 billion).[17] The nation's wealth is in large part due to its petroleum and oil resources.

Despite its considerable wealth, the country is ranked low on the Human Development Index (152 out of 187), with 62% of the population living on less than USD 1.25 a day.[18] Poverty is more concentrated in rural areas, where more than half of all Nigerians live.[19]

FIGURE 3 Source: MAGELLAN Maps

Nigeria



17. GIZ Report, The Nigerian Energy Sector: an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification, November 2014 https://www.giz.de/en/downloads/giz2014-en-nigerian-energy-sector.pdf
18. World Bank, 2010
19. World Bank, 2014

TABLE 4

Key regional indicators

Indicator	Nigeria	Côte d'Ivoire	Senegal
Population[20]	177,500,000	22,100,000	14,670,000
GDP per Capita (current USD)[21]	3,203.3	1,545.9	1,061.8
HDI Ranking (out of 187[22] countries)	152	171	163
Rural population (%)[23]	53	47	57
Population living on less than USD 1.25/day (%)[24]	62	35	34

Note: Senegal and Cote d'Ivoire were selected to provide a regional comparison with Nigeria.

2.2 Telecoms in Nigeria

GSM coverage & mobile statistics

As Table 5 below shows, Nigeria largely has 2G coverage (87.2%), with the exception of remote areas in the very east and north, while 3G coverage is concentrated in urban centres (50.84% of the population).[25] While population coverage is extensive, market penetration by unique subscribers is just 47%, or around 86 million Nigerians who own a mobile phone.

20. World Bank, 2014
21. Ibid
22. UNDP Human Development Index, 2014
23. World Bank, 2014
24. World Bank, 2010
25. GSMA Intelligence data, Q1 2015

TABLE 5

Regional mobile statistics[26]

Mobile statistics	Nigeria
GSM connections, excluding M2M	144,642,123
Unique subscribers	86,084,017
Market penetration, by unique subscriber	46.91%
2G Network coverage	87.2%
3G Network coverage	50.84%
Mobile money accounts	12,921,000
M2M connections	1,576,316

While the market penetration of unique subscribers is still less than 50%, the country's telecom market is quite competitive with seven Mobile Network Operators (MNOs): MTN leads the market with 43% market share, followed by Glo Mobile (20%), Airtel (19.8%) and Etisalat (15.4%). The smaller Code Division Multiple Access (CDMA) players, Visafone and Multi-Link have shares of less than 1% each and are beginning to exit the market which is consolidating the sector.[27]

Mobile money services in Nigeria

There are 19 licensed mobile money service providers, comprising of banks and non-banks, in Nigeria. Despite having the highest number of mobile money service providers in the world,[28] there are just under 13 million mobile money accounts, which compared to the total population of ~177 million people is relatively small.

The Central Bank of Nigeria's regulatory framework, allowing two models of mobile financial services: bank led and non-bank led, but specifically excludes MNOs from providing mobile financial services, limiting their role to solely the provision of the channel through which other providers' mobile money services can be offered. This situation has invariably resulted in under-investment in mobile money by MNOs, the spin-off effect of which has been limited customer adoption levels. GSMA's annual global adoption survey of mobile money services has consistently shown that among the group of the fastest growing mobile financial services, the vast majority are driven by MNOs.[29]

The limited reach of banked and non-banked mobile money services constrains the opportunity for PAYG solar to scale. While not able to provide mobile money services alone, MNOs, partnering with banks, need to work on alternatives to facilitate financing of these energy solutions for off-grid customers.

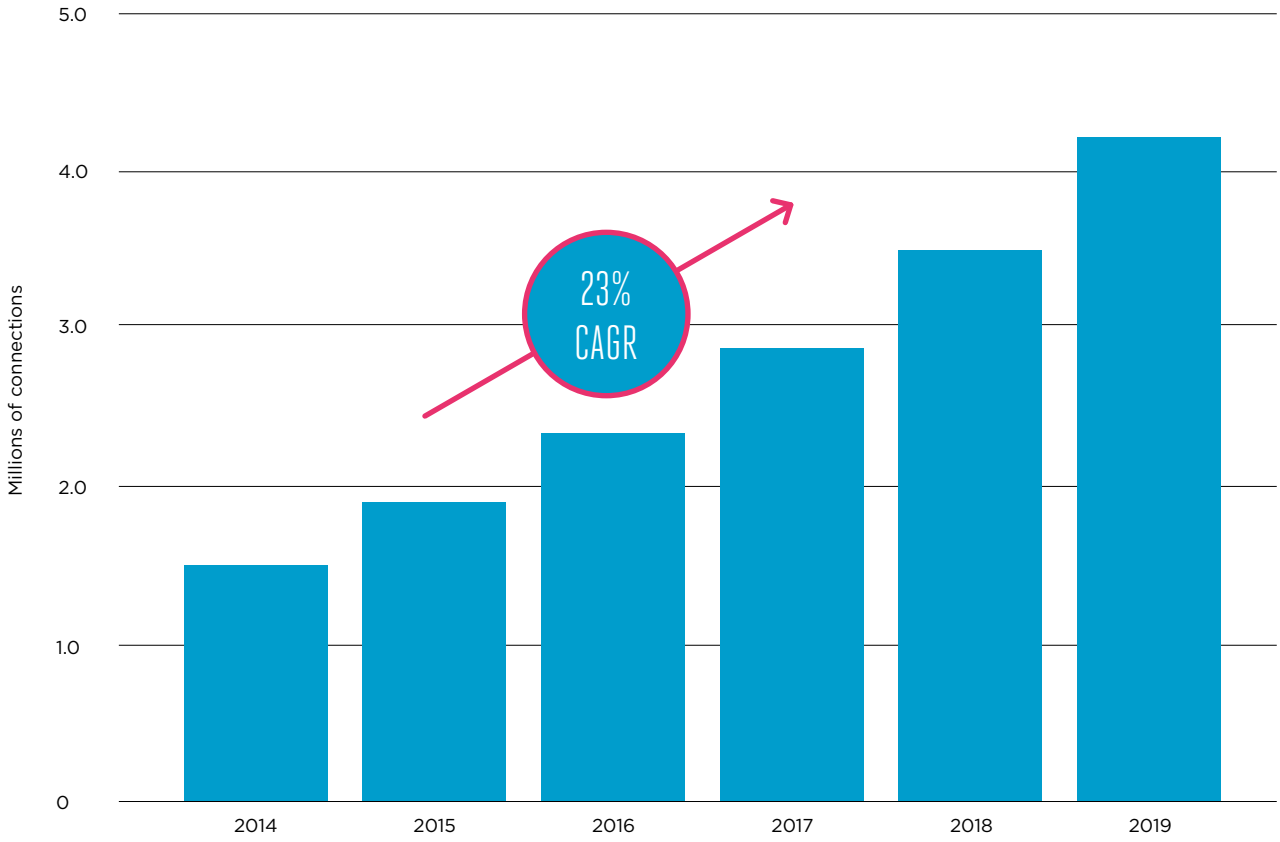
26. GSMA Intelligence data, Q1 2015
27. GSMA Mobile Economy Report, Sub-Saharan Africa, http://www.gsmamobileeconomy.com/GSMA_Global_Mobile_Economy_Report_2015.pdf, 2015"
28. GSMA Mobile Money deployment tracker, 2015
29. GSMA Intelligence report, Country overview: Nigeria, https://gsmaintelligence.com/research/?file=dc840054384a061d436e34793b744abc&download, June 2014

Machine-to-Machine services: a nascent but growing market

GSM M2M technology is the technology that "connects machines, devices and appliances together wirelessly via a variety of [mobile] communications channels, including SMS, to deliver services with limited direct human intervention."[30] The main M2M services that are currently being implemented in Nigeria are fleet management, security monitoring or point-of-sale point-of-sale machines;[31] while advanced M2M applications, such as smart meters, are less developed due notably to lack of connectivity and cost issues. As a result, only 30% of enterprises in Nigeria have implemented M2M technology.[32]

FIGURE 4

Growth of M2M connections in Nigeria (2014 – 2019)[33]



However, despite a slow start, M2M services are growing in Nigeria with just under 2 million M2M connections in Q4 2015 and an expected 4.2 million connections by 2019 (Figure 4).[34] This growth opens up the potential for M2M-enabled devices, including solar home systems, providing real-time data on customer behaviour and equipment performance, which can be used to refine and develop business models and operations.

30. GSMA Intelligence report, Global cellular M2M technology forecasts and assumptions, March 2015
31. International Data Corporation 2014, http://idc-cema.com/eng/about-idc/press-center/58774-nigeria-s-nascent-m2m-and-internet-of-things-markets-tipped-to-gain-traction-as-connectivity-improves
32. Ibid
33. GSMA Intelligence data, Q1 2015
34. Ibid

2.3 Energy access

Nigeria's national electrification rate is estimated at 45%, although urban and rural electrification rates vary significantly at 55% and 35% respectively.[35] In the last ten years, Nigeria's government has made a concerted effort to improve the electrification across the country. However, from 1990 to 2015, the national electrification rate only grew from 40% to 45%.[36] While Nigeria has a higher than average electrification rate for the region (32%), there are still over 100 million Nigerians who do not have access to electricity[37] as a result of complex reforms of the grid and inefficient rural electrification programmes.

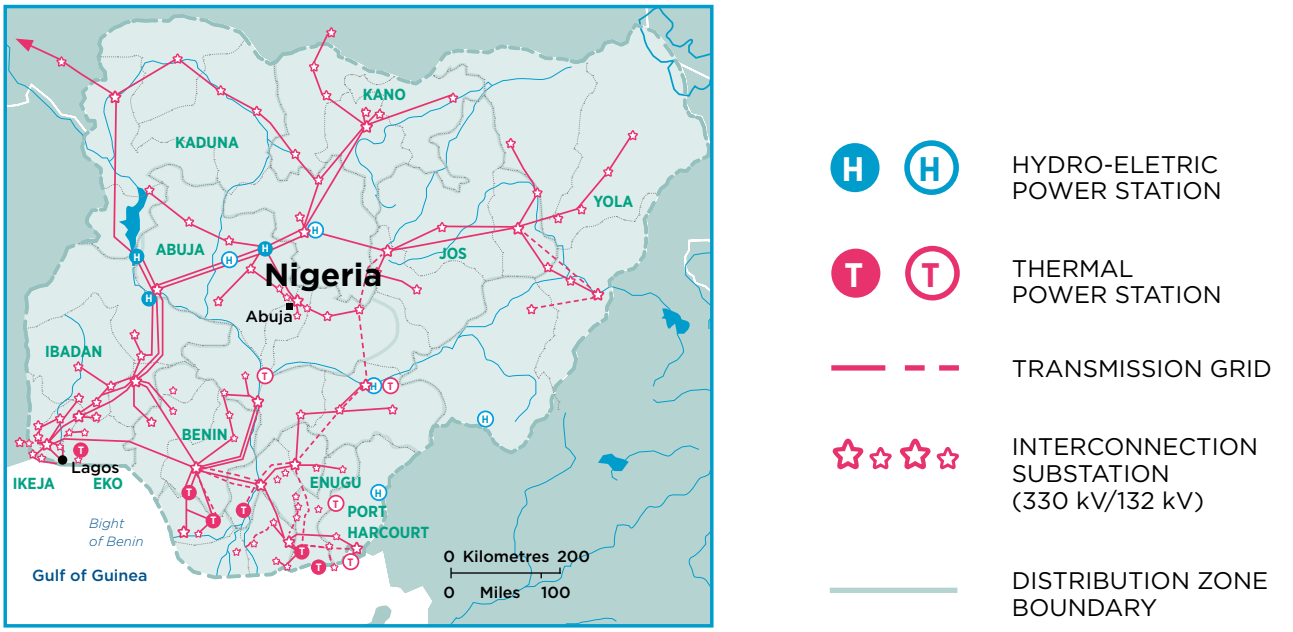
Privatising Nigeria's electricity grid

Reforms to the electric power sector began in the early 2000s, as the state-owned monopoly utility National Electric Power Authority (NEPA) was failing to respond to the growing electricity demand.[38] The following ten years saw various policy reforms put in place to privatise and liberalise the sector. Under the Electric Power Sector Reform Act, the state-owned Power Holding Company Nigeria (PHCN) was formed in 2005 to replace NEPA and was responsible for Nigeria's generation, transmission and distribution of electricity while the government began the sale of the generation and distribution services. Today, there are now five generation companies (GENCOs) and 11 distribution companies (DISCOs) and the power sector has moved away from a monopoly utility.

Overall, the privatisation has had mixed results and challenges around generation, transmission and distribution of electricity remain. Moreover, private companies leading the sector are more reluctant to extend the grid beyond profitable urban areas, where customers pay higher prices for electricity. As a result, remote areas continue to be ignored. As Figure 5 highlights, there is a clear split between the south, which is well covered by the grid and the more rural north of the country.

FIGURE 5 Source: Geni.org

Nigeria's electricity grid



35. International Energy Agency, 2014
36. Ibid
37. World Bank, 2014
38. The transmission subsector is retained by the Government while its management is under concession

Rural electrification in Nigeria: from grid extension to decentralised services

In the 1970s, the Federal Government, through its Rural Electrification Programme, decided to electrify all Local Government Areas' Headquarters that were off-grid.[39] However, these distribution networks are slow to develop, notably due to lack of government funding and will not reach most of Nigeria's remote areas. This energy access gap is instead being filled by decentralised renewable energy service providers.

In the last few years, the Rural Electrification Agency (REA) broadened its electrification strategy to include the deployment of decentralised energy solutions including mini-grids and solar home systems.[41] In 2011, the Nigerian Electricity Regulatory Commission (NERC) listed 58 solar-based rural electrification projects across the country, focusing on street lighting, solar power boreholes, household electrification and large solar projects, such as a 50MW solar farm in Kaduna.[42] Moreover, in 2014, the Federal Ministry of Power developed a National Policy on Renewable Energy and Energy Efficiency, including Light Up Rural Nigeria, the government project focused on the use of renewable energy in rural communities.[43]

Progress in rural electrification has been slow, and stands at 35% of the total rural population. Moreover, Light Up Rural Nigeria's has not shown concrete results. If the country is to reach its 2020 rural electrification target of 60%, 10 million rural households, would need to be electrified.[44] As highlighted by the World Bank, while it is clear now that grid extension alone will not solve the electrification needs of rural Nigeria, there are obstacles to the market development for off-grid solutions.[45] Some of the main challenges are the lack of institutional reforms in the sector and the lack of engagement of the private sector. However, a few recent initiatives illustrate new support to the sector, notably the launch of the Lighting Africa programme in March 2015[46] and the DFID Solar Nigeria Programme,[47] which are expected to provide guidance and funding to energy service providers in the country.

39. Energypedia, 2015, https://energypedia.info/wiki/Nigeria_Energy_Situation
40. World Bank 2014, http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/04/28/000090341_20060428141651/Rendered/PDF/359940UNI0ESM01ural1Access01PUBLIC1.pdf
41. GIZ Report, The Nigerian Energy Sector: an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification, November 2014 https://www.giz.de/en/downloads/giz2014-en-nigerian-energy-sector.p
42. USAID report 2014
43. Ministry of Environment, Nigeria http://renewableenergy.gov.ng/jonathan-inaugurates-light-up-rural-nigeria-project-in-abuja/
44. GIZ Report, The Nigerian Energy Sector: an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification, November 2014 https://www.giz.de/en/downloads/giz2014-en-nigerian-energy-sector.pdf
45. World Bank 2014, http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/04/28/000090341_20060428141651/Rendered/PDF/359940UNI0ESM01ural1Access01PUBLIC1.pdf
46. IFC Lighting Africa, https://www.lightingafrica.org/where-we-work/nigeria/
47. UK Government Development Tracker: Solar Nigeria Programme http://devtracker.dfid.gov.uk/projects/GB-1-203674/

3. PAYG solar in Nigeria: An untapped opportunity

While the mobile-enabled PAYG solar market has begun to scale in countries of East Africa, Nigeria's significant addressable market remains mainly untapped. 56% of the population do not have access to electricity[48] while most of the population is covered by GSM networks. In the light of Nigeria's unmet off-grid energy demand, mobile technology can be leveraged to improve energy access for the 70 million Nigerians who lack access to electricity but live within reach of mobile coverage. In addition to those 70 million people who are completely off the grid, there is also a significant number of people who only have intermittent access to electricity – blackouts occur up to 27 times per month[49] – and revert to decentralised solutions such as kerosene when their power is off. A total of 80% of the population rely on diesel generators as a primary source of energy or as a back-up.

3.1 Solar service providers in Nigeria

In Nigeria, PAYG solar is in its infancy. The first and – to date only – mobile-enabled PAYG solar provider in Nigeria is Nova Lumos. Launched in 2013, Nova Lumos sells PAYG solar home systems in the rural and peri-urban areas of Nigeria. The company leverages GSM M2M technology to remotely control and monitor their systems, and enable customers to pre-pay for electricity, using airtime. Through a close partnership with MTN Nigeria (the leading MNO in the country, with over 60m subscribers), Nova Lumos is able to rapidly scale and deliver its service to Nigerians living with no access to the electric grid. Scale that is reached by leveraging MTN Nigeria's nationwide presence, its billing platform, marketing, sales and distribution.

A few new actors are entering the market by developing off-grid solar products such as Arnergy and Green Village Electricity, exploring the possibilities for mobile-enabled PAYG solar. Both Nigerian providers have received funding from the Bank of Industry of Nigeria, among others, and are developing decentralised energy solutions for businesses and households in peri-urban and rural areas of Nigeria.

International solar companies, d.light[50] and Greenlight Planet,[51] have been successfully selling solar lanterns for the last 4 year, in Nigeria, with most sales achieved in the last year, demonstrating the maturity of the market

48. International Energy Agency, 2014
49. GIZ Report, The Nigerian Energy Sector: an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification, November 2014 https://www.giz.de/en/downloads/giz2014-en-nigerian-energy-sector.pdf
50. D.light Haiti received a grant from GSMA Mobile for Development Utilities Innovation Fund http://www.gsma.com/mobilefordevelopment/mobile-for-development-utilities-awards-new-round-of-innovation-fund-grants-2
51. Greenlight Planet is partnering with SNV Benin, one of GSMA Mobile for Development Innovation Fund grantee, in the introduction of PAYG solar lamps in Benin http://www.gsma.com/mobilefordevelopment/mobile-for-development-utilities-awards-new-round-of-innovation-fund-grants-2

for solar products. At the time of this study, Greenlight Planet was planning the roll-out of their SunKing solar home systems, integrating PAYG technology.

Other non-mobile-enabled models include Solynta and GoSolar Africa. Solynta is a solar provider selling larger systems for urban areas of Nigeria, offering an alternative to customers who currently spend up to USD 1,000/ month on diesel generators. GoSolar Africa started its operations with the sale of solar home systems and is currently re-focusing on mini-grid systems for their customers, in very remote areas of Nigeria.

Finally, Nigeria's technology incubators, such as the CCHub, and tech start-ups,[52] such as Konga, while not necessarily working on energy access, are also a sign of the dynamism of the country, developing innovative technology solutions to respond to the population's demand.

3.2 Priority states for the deployment of PAYG solar

The market opportunity for PAYG solar is clear as the high demand for energy, across urban to peri-urban and rural areas, reveals. Service providers equipping SHSs with mobile technology will condition the choice of pilot location on connectivity or alternatively preferring manual credit and payment systems. Some of the main factors for the successful deployment of PAYG solar systems are:

- High level of un-electrification and high usage of carbon-based fuels
- Medium population density with availability of products and services at market hubs
- Sufficient GSM coverage
- Easy access to payment points and mobile money agent coverage, if applicable

The north is the least electrified part of the country and presents the strongest opportunity for PAYG solar home systems. Looking at the states with the lowest electrification rates and high usage of diesel generators but within mobile coverage, the most promising states for the deployment of these solutions are Kaduna, Niger, Benue and Kano.

52. GSMA Mobile Economy Report, Sub-Saharan Africa, 2015 https://gsmaintelligence.com/research/?file=721eb3d4b80a36451202d0473b3c4a63&download

TABLE 6 Source: GIZ Report, The Nigerian Energy Sector: an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification, November 2014

Target states for the deployment of PAYG solar home systems

State	Total population (2013)	Unelectrified population, %	PHCN /Generator (population relying on the grid and a generator, %)	Rural electrification (number of people)
Kano	11,087,800	47.9	4	352,592
Lagos	10,694,900	0.5	25.9	68,020
Kaduna	7,102,900	46.2	7.6	191,991
Katsina	6,740,500	68.5	4.3	525,152
Oyo	6,615,100	33.3	0.9	31,554
Rivers	6,162,100	34.5	1	858,935
Bauchi	5,515,300	70.3	9.4	233,849
Benue	4,942,100	77.9	10.8	377,181
Delta	4,826,000	21.6	1.5	69,060
Anambra	4,805,600	11.8	15.6	43,298
Niger	4,687,600	48.2	21.7	44,720
Akwa Ibom	4,625,100	31.8	13.1	9,805
Imo	4,609,000	30.1	7.5	122,139
Ogun	4,424,100	27.9	5.2	7,034

3.3 Barriers to market for PAYG solar

Barriers remain to be addressed for PAYG solar to fully develop and grow in Nigeria, the way it has done in East Africa. While not exhaustive, some of the main challenges to address are:

Mobile money services: A constraining regulatory environment

The low uptake of mobile money might be one of the main obstacles to scaling mobile-enabled PAYG solar. Arnergy and Solynta are currently allowing their customers to pay in instalments, through bank transfers. The customer goes to the bank and pays directly to the PAYG service provider's bank account.

There is an opportunity for MNOs, partnering with banks, to find new mobile payment solutions which will facilitate the deployment of PAYG solar in Nigeria including to the unbanked.

A nascent M2M market

Beyond offering regular data plans, MNOs can better define their M2M offering- from providing connectivity to other enabling services such as data management – for impactful partnerships with PAYG solar service providers. Solar service providers interviewed for this study are exploring ways to embed remote control into their systems as a secure and reliable way to scale.

A need for strong partnerships between MNO and PAYG solar service providers

To ensure the take-off of partnerships with PAYG providers, MNOs need to clearly understand the costs and benefits of entering this market; be ready to provide support to small-sized service providers; and allocate resources to these projects. On the other hand, PAYG solar service providers are still few in Nigeria and in the early stages of using mobile technology, and need to work with MNOs to identify the best ways to leverage their services.

The need for funding

As presented in Shell Foundation's report "Accelerating Access to Energy",[53] companies pioneering innovative solutions such as PAYG solar require "significant early-stage support to test, adapt and validate new models". It can take from 6 to 10 years and between USD 5 million and USD 20 million for a breakthrough innovator to achieve a positive cash-flow. In light of the very early market in Nigeria, there is a need for donors and risk-tolerant capital to help these entrepreneurs respond to the significant untapped opportunity. Local energy service providers can also look at partnering with technology providers for existing software and hardware PAYG solar technology and reduce the need for capital to develop PAYG functionalities in-house.

Other specific country challenges

The difficulty of doing business in Nigeria creates another barrier to entry, which pushes PAYG service providers to direct their operations towards other markets of the region – notably in East Africa. Indeed, while Nigeria ranks 169 out of 187 countries in terms of ease of doing business,[54] Tanzania, Uganda, Kenya rank between 130 and 150.[55] Added to the other market barriers mentioned, it is enough to deter private service providers from entering the Nigerian energy access market.

53. Shell Foundation, Accelerating Access to Energy, December 2014 https://www.shellfoundation.org/ShellFoundation.org_new/media/Shell-Foundation-Reports/Access_to_Energy_Report_2014.pdf
54. In October 2015, Nigeria gained one place in their ranking, from 170 to 169 http://www.doingbusiness.org/data/exploreeconomies/nigeria
55. World Bank, 2015 http://www.doingbusiness.org/rankings

4. Opportunities for MNOs to enter the PAYG solar market

The growing number of partnerships between Mobile Network Operators and PAYG solar service providers, especially in East Africa, highlights the fact that, despite their differences in size and resources, both parties can mutually benefit from partnering. PAYG solar providers can leverage MNOs' networks, services, and marketing resources while MNOs can create new revenue streams and grow their customer base by creating innovative relevant services, ensuring increased usage and improving brand loyalty.

There are various benefits that MNOs can realise from partnering with PAYG solar service providers including reducing churn, increasing use of mobile services and improving brand recognition. The more engaged, the stronger the benefits for MNOs. Some of the main benefits include:

- Increase MNOs' Average Revenue per User
- Drive growth in mobile money adoption and use
- Leverage MNOs agent network
- Improve brand recognition and customer stickiness

4.1 Increase MNOs' Average Revenue per User

As the energy addressable market highlights, there are over 70 million people in Nigeria who have a mobile phone before having a place to charge it. Unlocking this opportunity, through PAYG solar will grow customers' airtime usage and in turn increase the MNO's Average Revenue per User (ARPU). As a rule based on previous studies, the ARPU went up by approximately 10 to 14% due to access to energy.[56] This direct benefit is a strong incentive for Mobile Network Operators who are interested in identifying new revenue streams as well as innovative solutions, while requiring a low to medium touch engagement with the PAYG partner.

56. GSMA data, 2012

4.2 Drive growth in mobile money adoption and use

PAYG solar can support the growth of mobile money customers and also help ensure those customers are active, driving more mobile money transactions. When an MNO enables a PAYG service provider to integrate with its mobile money platform, it is estimated that transactions can grow up to 50%.[57] M4D Utilities Innovation Fund grantees Mobisol and Fenix International, PAYG solar providers in East Africa, have also proven the impact of PAYG solar on the growth of mobile money penetration and usage of bill payment. Mobisol estimates that 20% of their business customers are newly registered for MTN Rwanda's mobile money and use mobile bill pay for the first time through Mobisol.[58] Fenix became the third largest bill pay account by transaction volume for MTN Uganda and their customers are very active mobile money users.[59]

4.3 Leverage MNOs' agent network

Some PAYG service providers decide to rely on companies' existing distribution networks instead of developing their own. Leveraging MNOs' extensive distribution networks for the sale of PAYG solar will allow MNOs' agents to increase revenues by selling new services – in addition to airtime– and will act as a differentiator, encouraging customers to prefer one MNO's kiosk to another.

4.4 Improve brand recognition and customer stickiness

Brand recognition is critical for MNOs, especially in a competitive market like Nigeria where customers are rarely loyal to one MNO, rather switching from one network to another depending on the promotion at the time. A mobile operator lending its logo to a PAYG solar service provider can bring significant value to its brand, by providing new and relevant services, such as affordable household energy solutions to its customers, who in turn are more likely to stay loyal to its network or become a new customer.

57. Saviva Research, 2014, http://www.savivaresearch.com/wp-content/uploads/2014/01/January-2014-PAYG-Solar-report1.pdf
58. GSMA Mobile for Development, Mobisol: Pay-as-you-go solar for enterpreneurs in Rwanda, January 2016 http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/01/Mobisol-Pay-as-you-go-Solar-for-Entrepreneurs-in-Rwanda.pdf
59. GSMA Mobile for Development Utilities, Fenix International: Scaling Pay-as-you-go Solar in Uganda, December 2015 http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/12/fenix-international-scaling-pay-as-you-go-solar-in-uganda.pdf

Conclusion

The use of mobile technology – specifically M2M and mobile payment services – are essential to support the deployment at scale of PAYG solar home systems, as demonstrated in East Africa. Although the market is nascent in Nigeria, Nova Lumos – who recently raised USD 15 million debt from OPIC, the U.S. Government's Development Finance Institution – and new aspiring PAYG solar companies are demonstrating the potential for off-grid solutions to grow in this market. With the support of a broad ecosystem of players - including energy service providers, MNOs, as well as investors and the government - there is a strong potential to overcome current market barriers and tap into the significant off-grid opportunity and provide viable energy solutions to millions of Nigerians.

List of abbreviations and acronyms

ARPU: Average Revenue Per User

M2M: Machine-to-Machine

MNO: Mobile Network Operator

OPIC: Overseas Private Investment Corporation

PAYG: Pay-as-you-go

SHS: Solar home systems

SWA: State Water Agency

For more information on the Mobile for Development Utilities programme visit: www.gsma.com/mobilefordevelopment/



GSMA HEAD OFFICE
Floor 2
The Walbrook Building
25 Walbrook
London EC4N 8AF
United Kingdom
Tel: +44 (0)20 7356 0600
Fax: +44 (0)20 7356 0601