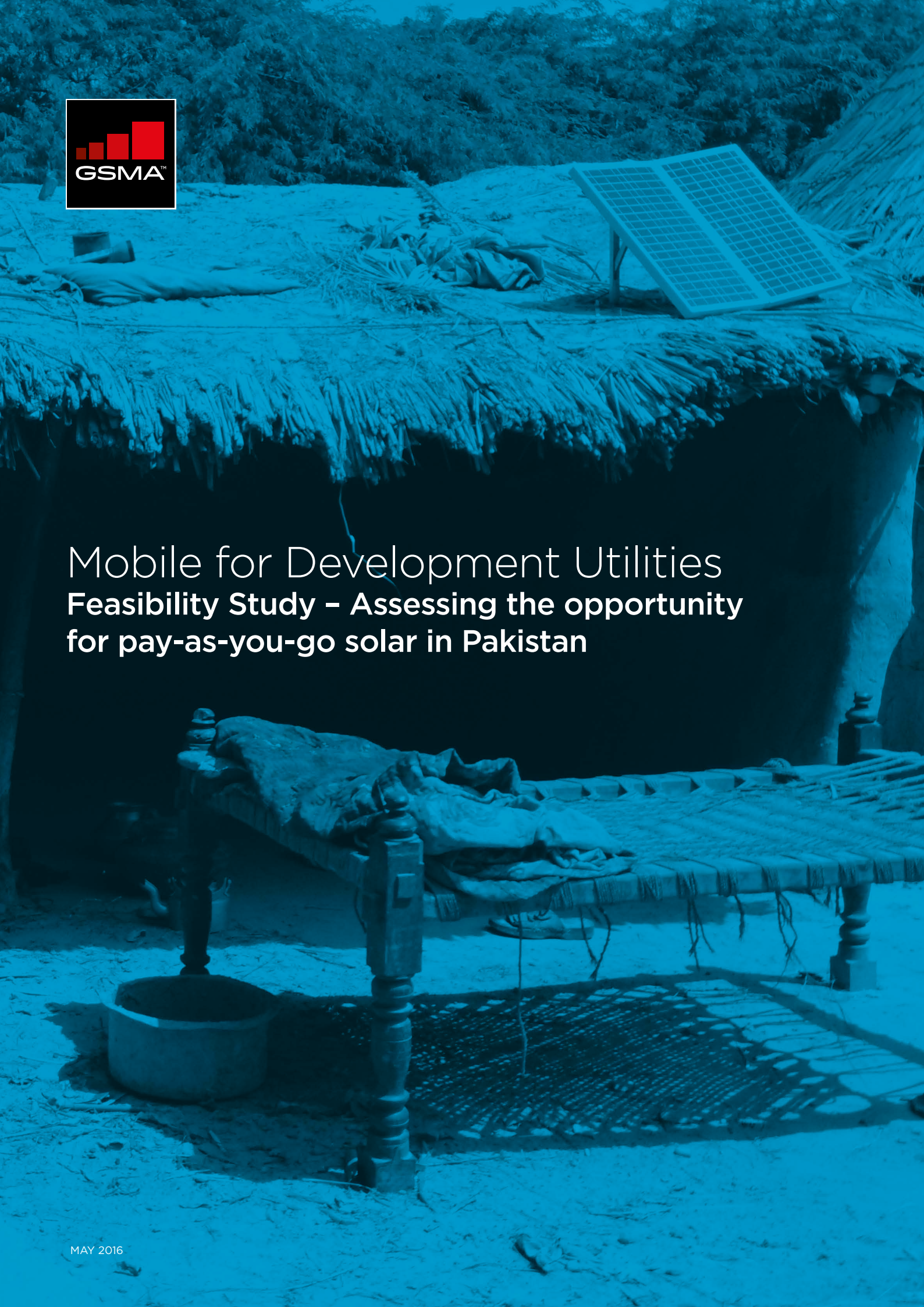


Mobile for Development Utilities

Feasibility Study – Assessing the opportunity for pay-as-you-go solar in Pakistan

MAY 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

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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 such as this one, as well as thematic reports that will be published throughout 2015 and 2016.

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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.

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Executive Summary

In South Asia, approximately 20% of the population lacks access to electricity.[1] In Pakistan approximately 144 million people, or 77% of the population either have no access to electricity or experience energy shortages of up to 12 hours a day.[2] Most of the un-electrified population lives in peri-urban or rural areas.[3] In Punjab, where more than 60% of total electricity is consumed, rural communities spend most of their fuel and lighting expenditures on decentralised energy sources such as agriculture biomass waste (32% of their expenditures) and firewood (17% of their expenditures).[4]

In contrast, mobile networks have become the predominant infrastructure, with 87% of the population living within mobile coverage.[5] Pakistan's energy addressable market, defined as the number of people who have access to mobile coverage but do not have access to electricity, represents 29 million people.[6]

The rise of the solar home system (SHS) market in South Asia, notably in Bangladesh and – to a lesser extent – India, coupled with the growth of the pay-as-you-go (PAYG) solar model,[7] highlight the opportunity for this model to be successfully deployed to respond to the needs of Pakistan's un-electrified or unreliable electrified population.

A critical enabler for PAYG solar is the uptake of mobile money services to unlock customers' ability to make small payments, through their mobile phones. The market for mobile money in Pakistan is growing as mobile money service providers are encouraging customers to shift their payment habits away from cash as well as Over-The-Counter (OTC) transactions[8] towards mobile wallet transactions, done directly through the mobile phone for improved ease of usage and better customer retention. The dynamic mobile money environment, with 10 million registered accounts as of 2015 and an objective to grow ten times, to 50 million, by 2025,[9] speaks to the potential of PAYG solar in the country. In addition to mobile money, GSM machine-to-machine 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.

The need for these off-grid energy solutions will only continue to grow with the increasing number of life-enhancing but power hungry smartphones: GSMA estimates that the number of 3G mobile connections will represent half of total connections by 2020.[10]

In the light of this opportunity, 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 MNOs to partner with energy service providers in the deployment of PAYG solar home systems[11] to improve energy access in Pakistan, while growing their off-grid customer base. The findings demonstrate that, while the market for mobile-enabled PAYG solar is nascent in Pakistan, the conditions are favourable for its growth and a few actors are leading the way, exploring the potential for mobile technology to support the deployment of these off-grid solutions. Our main recommendations follow:

1. International energy Agency (IEA) data, 2014
2. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
3. IEA data, 2014 – variations according to sources. These figures were closest to the country's Alternative Energy Development Boards figures
4. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
5. GSMA Intelligence data, Q4 2014
6. GSMA Mobile for Development Utilities data
7. The report will describe the two PAYG business models: finance purchased or energy-as-a-service. Both exist to make system affordable, by breaking down the cost of the unit into small amounts.
8. Over the counter transactions, where a mobile money agent performs the transactions on behalf of the customer, who does not need to have a mobile money account to use the service http://www.gsma.com/mobilefordevelopment/programme/mobile-money/the-promise-of-biometric-kyc-and-remote-account-opening-for-branchless-banking-in-pakistan/
9. State Bank of Pakistan, http://www.mobilemoney.com.pk/press-release/sbp-to-increase-m-wallets-to-50m-in-five-years-wathra/ March 2015
10. GSMA Intelligence, Q1 2015
11. This study focuses on PAYG Solar Home Systems and therefore does not discuss other decentralised energy models, such as mini-grid

Recommendations

Key recommendations for Mobile Network Operators

- Beyond providing access to their network, Mobile Network Operators (MNOs) should leverage PAYG solar to further develop their offering for mobile payments and Machine-to Machine (M2M), services that have a strong growth potential in the Pakistani market. Mobile money transactions represented 3.5% of GDP in 2015[12] and there were just over 416,000 M2M connections made;[13] and

- MNOs should consider PAYG solar as an opportunity to improve customer acquisition and retention in their underserved, rural market, representing 62% of the total population of Pakistan.

Recommendations for PAYG solar energy service providers

- Service providers who wish to apply a mobile-enabled PAYG model should work early on with MNOs to define the most adapted business model to answer customers' needs; leveraging mobile payment and/or exploring the use of M2M technology to improve both the affordability and the reliability of the service; and

- PAYG solar service providers should be attentive to the country's growing mobile money market, to best identify how to take advantage of the current changes and the convenience it can bring.

Recommendations for the Government & international organisations

- The recent initiative of the State Bank of Pakistan, which aims at facilitating loans to small scale solar projects, under the UN's Green Climate Fund, could prove catalytic for the sector to grow. As this initiative demonstrates, the Government has a pivotal role to play in order to ensure a conducive environment for PAYG solar to scale with adapted regulations and financing structures.

- The international donor community also needs to be engaged, complementing and advising the government's efforts, to support the development of off-grid energy in Pakistan. The IFC Lighting Pakistan was launched in 2015 and will participate in building the PAYG solar market, as it has in Africa, through IFC Lighting Africa.

12. GSMA Mobile Money for the Unbanked, 2015
13. GSMA Intelligence, 2015

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

As of Q1 2016, there were over 134 million mobile connections in the country and about 85 million, or 63%, of these were unique subscribers. While networks continue to expand to uncovered areas, the electricity grid is not following the same pattern and isolated areas are expected to remain largely unconnected to the electricity grid[14]. As a result, the GSMA estimates that there are just under 30 million people, or nearly 16% of the total population, in Pakistan who are covered by mobile networks before having access to the grid.

An IFC Lighting Pakistan survey[15] conducted in 2015 estimates that the total population that is off-grid or has unreliable grid access is significant. Specifically, it estimates that:

- There are around 144 million people (about 78 percent) in Pakistan who are either off-grid or experience more than 12 hours of load-shedding per day.
- Pakistanis with no or unreliable access to electricity spend nearly USD 2.3 billion each year on poor-quality lighting solutions, such as diesel generators and battery-powered torches, that fail to meet their needs.

As a result of poor energy access, customers face major limitations on their ability to charge 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 Pakistan accounted for 12.7% of total connections[16] and is expected to grow. Greater adoption of smartphones would spur customers to sign up for data services and make a strong case for MNOs to support the development of PAYG solar home systems for off-grid customers.

1.1 Mobile channels for energy access

Mobile technology can help to 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 in off-grid environments to support rural electrification efforts;
- **Mobile operator's distribution and mobile money agent networks –** Leveraging the distribution

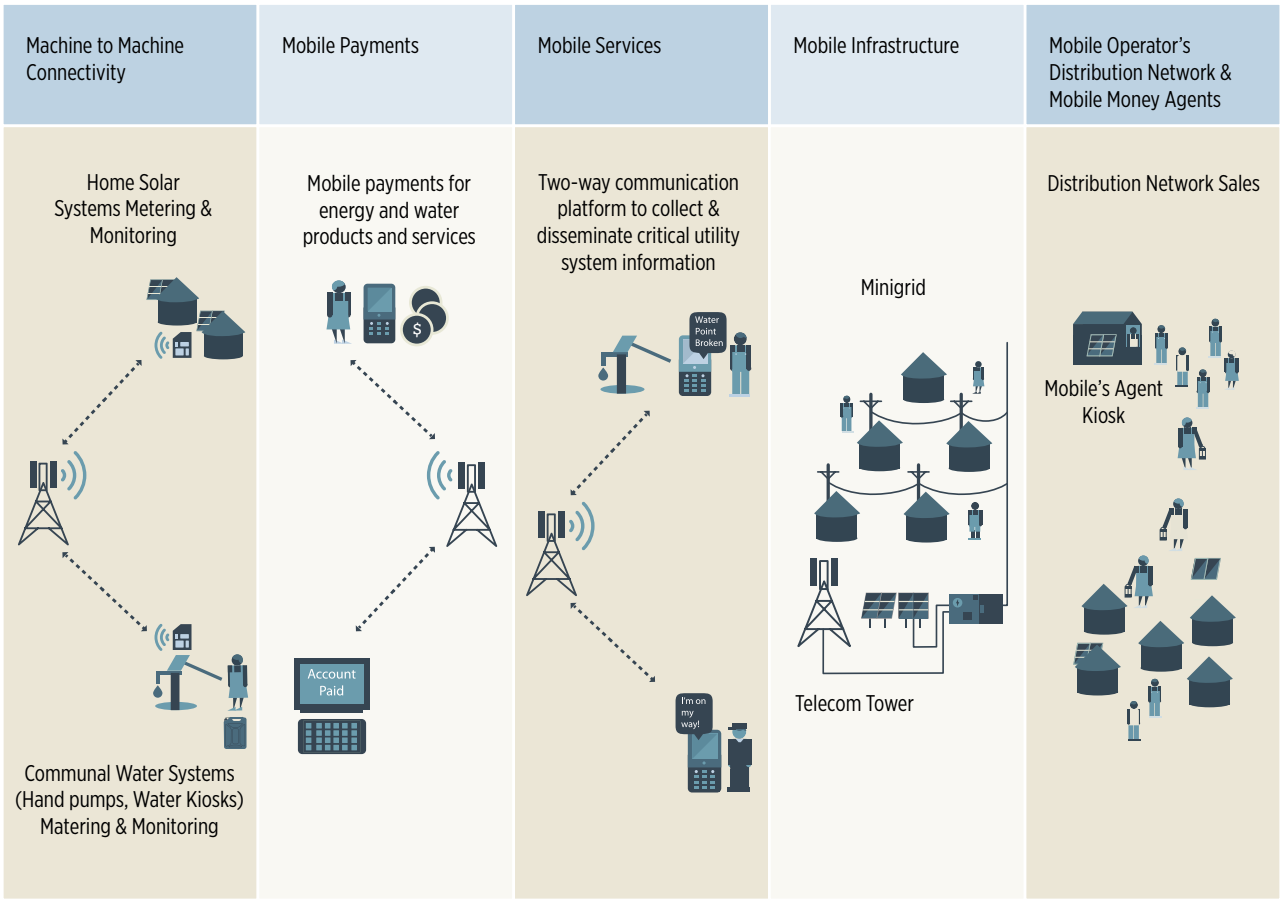
14. GSMA Mobile for Development Utilities data, Q1 2015
15. IFC Lighting Pakistan Survey, Pakistan Off-Grid Lighting Consumer Perceptions, http://www.ifc.org/wps/wcm/connect/d72aa0004886746d8388f7299ede9589/Pakistan+Solar+Consumer+Study+Overview_26thMay2015_LQ.pdf?MOD=AJPERES
16. GSMA Intelligence data, Q2 2015

reach and brand of mobile operators to reach underserved customers;

- **Machine-to-Machine connectivity –** Enabling the remote monitoring, 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; and
- **Mobile services (voice, SMS, USSD, applications) –** Leveraging increased mobile phone ownership to collect/disseminate critical information on utility services and/or supply chain management.

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 batteries 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 unbanked, they must rely on other energy sources, which come at a cost. Un-electrified households are forced to use kerosene for lighting at a cost of USD 5 to 8 per month. In cooking, firewood, agriculture waste and dung cakes are widely used[17]. As energy accounts for a large share of their total budget, rural households find it difficult to access the financing required to purchase assets such as a SHS, which in the longer run would allow them to save money.

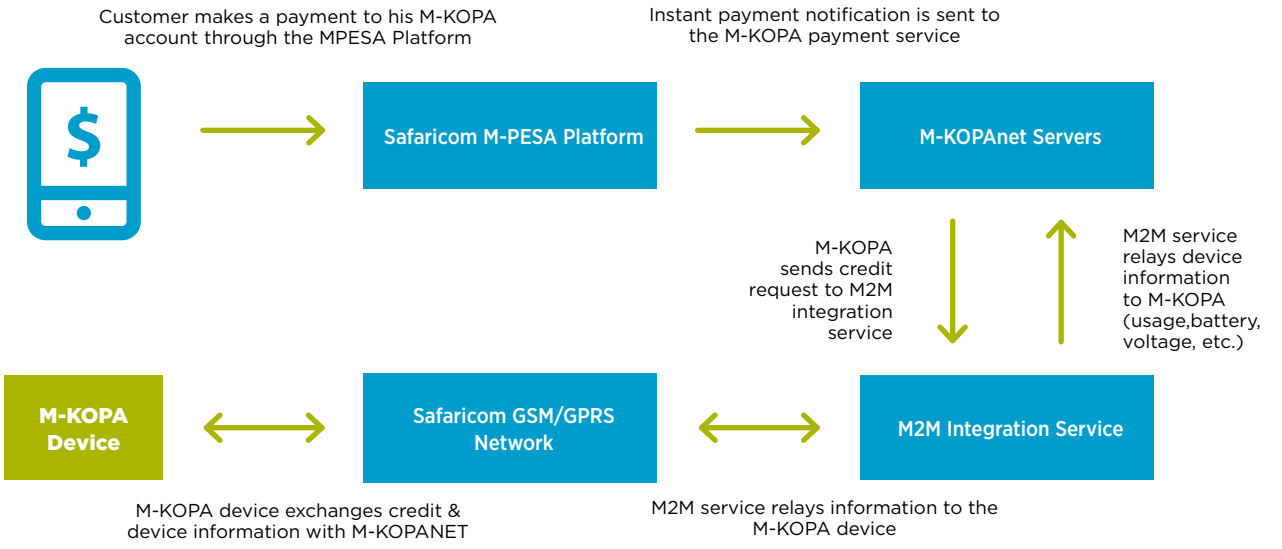
Since 2011, there has been a significant rise in the number of enterprises using PAYG solutions for energy and it is estimated that 3 million PAYG solar home systems will be sold globally by 2020[18]. In Pakistan, the PAYG solar model has the potential to provide electricity to millions of businesses and households that are not expecting to be connected to the grid in the medium – long term because too costly and unprofitable. In addition to the unconnected population are those who are currently connected to the grid but experience an unreliable service. There are around 144 million people (about 78 per cent) in Pakistan who are either off-grid or experience more than 12 hours of load-shedding per day[19].

Mobile-enabled PAYG solar home systems

As Figure 1 highlights, the GSMA has identified 5 channels to support the delivery of energy services to underserved, remote areas. In the case of PAYG solar, GSM Machine-to-Machine connectivity and mobile money are the main two channels that can be leveraged and have been pivotal in scaling the model, notably in East Africa. Figure 2 shows how these two channels are applied to the PAYG solar model of M-KOPA, providing PAYG solar services in East Africa.

FIGURE 2 Source: M-KOPA

Using mobile money and M2M communications for PAYG solar



17. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
18. 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
19. IFC Lighting Pakistan Survey, Pakistan Off-Grid Lighting Consumer Perceptions, http://www.ifc.org/wps/wcm/connect/d72aa0004886746d8388f7299ede9589/Pakistan+Solar+Consumer+Study+Overview_26thMay2015_LQ.pdf?MOD=AJPERES

PAYG business models: Financed purchase or energy-as-a-service

There are two main types of PAYG solar 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 for a fixed term, some offer extended service and support at the end of the fixed term.
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 can be transferred automatically to the device (over the mobile network) once the user makes a payment, as outlined in Figure 2. Alternatively, the M2M component is used only to turn the device on/off while the credit information remains separate, maintained on the cloud.

Manual PAYG transfer can take several forms: the user enters a code into the device's keypad or uses a mobile phone or another portable device (e.g. keypad) to transfer credit to the device. Manual transfer is cheaper because it does not require a GSM module, 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.

Currencies used for payment: Mobile money, airtime or cash

There are different types of currencies that can be used for 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

Payment currency	Description
Mobile money	• Customer purchases energy credit using mobile money.
Airtime	• Customer purchases artime to pay for the the electricity bill, 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 entrepreneur owns the asset, 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: Pakistan

2.1 Demographics & socio – economics

Pakistan is at the crossroads of South Asia, Central Asia, China and the Middle East. The country is divided into four provinces, including Punjab, Sindh, Balochistan, Khyber Pakhtunkhwa. The capital is Islamabad. With over 185 million people, an expanding economy and considerable natural resources, Pakistan has a strong economic potential to respond to the needs of the rapidly expanding working-age population.

TABLE 4

Key regional indicators

Indicator	Pakistan	India	Bangladesh
Population[20]	185,000,000	1,295,000,000	159,100,000
GDP per Capita (current USD)[21]	1,333.5	1,595.7	1,092.7
HDI Ranking[22] (out of 187 country)	146	135	142
Rural population (%)[23]	62	68	66
Population living on less than USD 1.25/day (PPP) (% of population)[24]	21.0	32.7	43.3

Note: India and Bangladesh, neighbouring countries, were selected to provide a comparison with Pakistan

Despite this potential, the GDP per capita remains low at USD 1,333 and an average growth of 3.8% a year[25] (Table 4). Pakistan ranks 146 out of 187 countries in the 2014 Human Development Index (HDI), lower than neighbouring Bangladesh and India (Table 4).

The country faces several governance, socio-economic and security challenges, which need to be overcome in order to reach the Government's target of accelerating growth rate to 7% by 2017[26].

20. World Bank Data Bank, 2013
21. World Bank Data Bank, 2014
22. UNDP Human Development Index, 2014
23. World Bank Data Bank, 2014
24. United Nation Development Programme, 2009-2010
25. World Bank Data Bank, 2014
26. Tribune Pakistan, http://tribune.com.pk/story/716905/gdp-growth-target-revised-upward/, June 2014

2.2 Telecoms in Pakistan

GSM coverage & mobile statistics

As Table 5 shows, Pakistan largely has 2G coverage (87% of the population) while 3G coverage is concentrated in more densely populated centres (57% of the population)[27]. While mobile coverage is extended, market penetration by unique subscribers is only 63%, or just over 85 million unique subscribers. While the market penetration is still relatively low, the country's telecom market is competitive with 9 mobile network operators (MNOs). The four leaders are Mobilink, (27.8% market share), Telenor (26.6%), Zong (19.9%) and Ufone (16.5%), followed by Warid Telecom (8.15%)[28]. In April 2014, the Ministry of Information Technology successfully auctioned spectrum for 3G/4G services in Pakistan in the 1800MHz and 2100MHz bands. Since then, there has been a rapid uptake of 3G services, bringing significant benefits to consumers and the national economy, boosting growth and efficiency in all sectors, as well as being a key enabler for innovative e-services such as m-health and mobile-enabled utilities services in rural and remote areas of Pakistan[29].

TABLE 5

Regional mobile statistics[30]

Indicators	Pakistan
GSM connections, including M2M	134,021,932
Unique subscribers	85,422,461
Market penetration, by unique subscriber	31.30%
Mobile money service providers	7
2G Network coverage	86.98%
3G Network coverage	56.91%
Machine-to-machine connections	416,119

Mobile money services

Pakistan is one of the most competitive mobile money market in the world with 7 mobile money services providers. Mobile money services providers operate under a partnership model with banks. Since 2014, MNOs have interconnected their mobile money services, following in the footsteps of Indonesia and Sri Lanka, where domestic mobile money interoperability was implemented in 2013[31]. Moreover, although banks lead the market, MNOs have a strong role to play, as regulations allow them to partner with or fully own micro-financed banks to deliver mobile money services.

27. GSMA Intelligence data, 2015
28. GSMA Intelligence data, Q1 2016
29. GSMA Intelligence report, Global cellular market trends and insight, Q2 2014
30. GSMA Intelligence, 2016
31. GSMA Mobile Money for the Unbanked, State of the Industry report, http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2015/03/SOTIR_2014.pdf, 2014

While market uptake has largely been focused on the OTC model, mobile money service providers have now shifted priorities to drive uptake in mobile accounts. Through an innovative and flexible approach, allowing biometrically verified SIM holders to open a mobile account through a simple USSD request, service providers have enabled a rise in both registration and activity levels. According to the latest State Bank of Pakistan report there are over 13 million registered accounts. OTC transactions are showing signs of saturation as they increased by 20% from September 2014 to September 2015 while m-wallet transactions grew by 278% during the same period[32].

Mobile accounts offers a greater convenience to PAYG solar service providers, who will not have to rely as heavily on available agents in remote areas to operate OTC transactions.

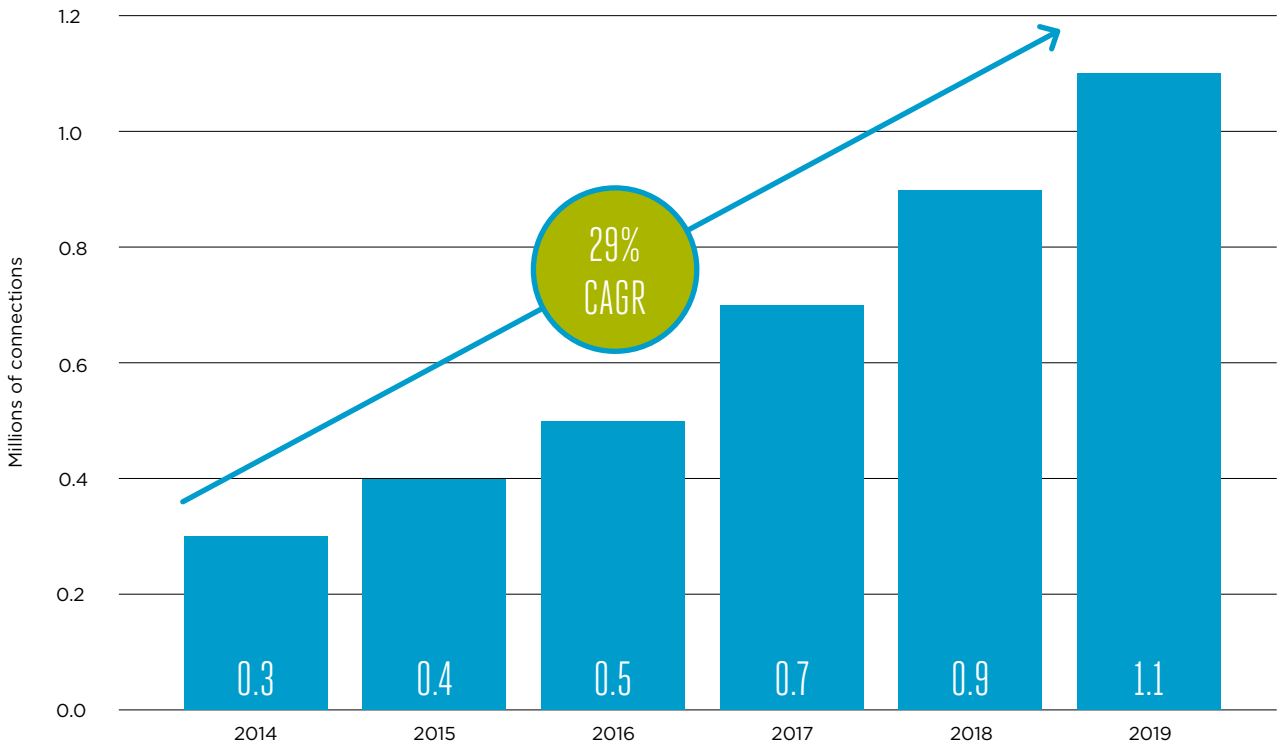
Leveraging mobile money for energy financing can help service providers develop their mobile financial services portfolio further and bring valuable service such as regular purchase of energy credit (airtime or mobile money).

Machine-to-Machine services

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"[33]. Currently, the main M2M services that are being implemented by MNOs in Pakistan are fleet management, security monitoring, and more recently telemetry for the energy sector. With over 415,000 M2M connections in 2015, the market is growing and expected to surpass one million connections by 2020[34].

FIGURE 4

Growth of M2M connections in Pakistan (2014 – 2019)[35]



32. State Bank of Pakistan http://www.sbp.org.pk/publications/acd/BranchlessBanking-Jul-Sep-2015.pdf, April-July 2015
33. GSMA Intelligence data, Global cellular M2M technology forecasts and assumptions, March 2015,
34. GSMA Intelligence data, 2015
35. GSMA Intelligence data, 2014

2.3 Energy Access

Pakistan faces significant energy shortages as officially ~50 million people, or 27% of the total population, are un-electrified, mainly in rural areas, as shown in Table 6.

However, grid-connected areas also suffer from energy shortages and recurrent load shedding of up to 12 hours a day[36].

TABLE 6

Regional electrification rates[37]

	Pakistan	India	Bangladesh
Electrification rate, 2013 (%)	73	81	62
Urban electrification rate, 2013 (%)	91	96	90
Rural electrification rate, 2013 (%)	62	74	48

Pakistan's energy crisis and the potential of renewable energies

Power generation is the responsibility of the Government's bodies, the Water and Power Development Authority (WAPDA) and generation companies (GENCOs), as well as privately-run independent power producers (IPPs) and Distribution Companies (DISCOs)[38]. The supply gap, along with technical losses (poor/old infrastructure and maintenance), non-technical losses (meter failure, tampering or fraud, illegal connections or data tempering in billing) and non-cost-reflective tariffs, contribute to Pakistan energy crisis.

The Government, as part of its efforts to improve the current energy situation, is focusing on the use of renewable energy sources while also encouraging new private investment. The Policy for Development of Renewable Energy for Power Generation, under the Alternative Energy Development Board (AEDB), works on increasing the use of solar energy, wind energy and mini-hydropower plants in the energy supply mix. The national 2014-2015 budget allocated USD 340 million to energy, with an 80% focus on solar, biomass and biogas.

In Punjab specifically, the local government has developed its own framework, laying out financial and fiscal incentives to promote investments in renewable energy technologies[39]. In 2015, the Government of Punjab opened the Quaid-e-Azam solar park, a 100 Megawatt project that intends to become the first utility-scale solar power plant in the country. Finally, net metering is another initiative encouraging the use of renewable energy in response to the country's energy crisis. Two years in the making, this billing mechanism allows solar and wind system owners (small providers or households) to sell extra power supply back to the power supply company.

36. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
37. International Energy Agency, World Energy Outlook 2015 http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/
38. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
39. Ibid

Rural electrification in Pakistan

Just under 45 million people in rural Pakistan do not have access to electricity,[40] and the Government's efforts to improve rural electrification have not been consistent, mostly concentrating on large-scale supply and grid extension. In the early 2000s, the AEDB implemented projects under the Prime Minister's Solar Village Electrification Programmes, including the installation of solar homes systems in villages of Sindh and Balochistan. It also created a duty exemption for solar products. Moving forward, the AEDB has been handing over the responsibility of growing the off-grid market to donors and private energy service providers[41].

The role of donors in improving rural energy access has been critical, especially in view of the low engagement of the Government. Since 2005, GIZ, Germany's international cooperation agency, has provided support to improve the public and private sector's involvement in promoting renewable energy for rural electrification. GIZ reported that around 100 villages have been electrified through solar energy[42]. In 2009, the Asian Development Bank (ADB) launched the regional partnership 'Energy for All' with the World Bank[43] and more recently has approved a new country partnership strategy with Pakistan for 2015-2019, providing funding of up to USD 1.2 billion a year to upgrade infrastructure upgrades in the power, agriculture, and transportation sectors[44]. The IFC Lighting Pakistan was also launched in May 2015 to help provide safe, affordable, high-quality lighting to 1.5 million Pakistanis[45].

Off-grid solar companies also have a pivotal role to play in growing the off-grid market. They are offering adapted decentralised energy solutions for households and small businesses, resolving the issue of distribution companies reluctant to expand their network to low density and low-profitability communities[46]. While the potential for off-grid solutions is undeniable given the size of the un-electrified market, barriers remain. For instance, the Government's electricity regulations currently requires private energy service providers to apply for distribution licences, implying inadequately high costs for small scale electrification projects and risks as consumers in these areas have lower incomes[47].

40. Calculation based on the World Bank's figures; 60% of total population is rural (117,4 million) of which 38% are un-electrified
41. Meetings with AEDB
42. GIZ, http://www.giz.de/en/worldwide/17995.html
43. United Nations SE4all, http://www.energyforall.info/wp-content/uploads/2012/07/Punjab-Energy-Access-Assessment-Report-Final.pdf
44. Asian Development Bank, ADB to Help Pakistan Advance Regional Connectivity, Energy and Food Security, http://www.adb.org/sites/default/files/publication/173368/news-pakistan-august-2015.pdf, August 2015
45. IFC, IFC's Lighting Pakistan to Help Bring Affordable Solar Lighting to Millions, http://ifcext.ifc.org/IFCExt/pressroom/IFCPressRoom.nsf/0/8623D47950AED17685257E45002BC38C?OpenDocument, May 2015
46. GreenTech Media, 4 Lessons Pakistan's Off-Grid Solar Market Can Teach the World, http://www.greentechmedia.com/articles/read/four-lessons-pakistans-off-grid-solar-market-can-teach-the-world, June 2014
47. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014

3. PAYG solar in Pakistan

3.1 PAYG solar: a viable off-grid alternative

Decentralised renewable energy solutions, such as solar home systems, provide a response to the lack of energy access in off-grid areas and to energy shortages in unreliable grid areas.

The case of Bangladesh and India, neighbouring countries of Pakistan, illustrate the uptake of solar home systems. In Bangladesh, IDCOL has pioneered subsidised off-grid renewable energy solutions, partnering with organisations that manage the installation of SHSs and extend credit to end-users, instead of using a PAYG model; a model that has not yet been introduced in Bangladesh. To date over 3 million SHS systems have been installed in Bangladesh, impacting 13 million people or ~9% of the population and aims to finance a total of 6 million SHSs by 2017[48]. In India, Simpa Networks has been selling solar home systems through a PAYG model since 2010. While the market penetration of PAYG solar is slow, Simpa has sold over 10,000 customers in 8 districts of Uttar Pradesh and estimates that 18 million people could be reached by 2024[49].

Asset financing has been critical for these solutions to scale, following the telecom model, subsidising the cost of mobile handsets. The PAYG solar model also allows for customers to pay as they consume electricity, following an initial deposit of up to 10% of the cost of the system. Once the electricity credit runs out, the customer can top up the system in several ways as presented in Table 2. In the case of Simpa Networks, the agent collects cash from customers and tops up the system, using mobile money.

Local solar energy service providers are leading the Pakistani's solar market forward and beginning to tap into the significant market opportunity. For the PAYG solar potential to grow, the broader ecosystem needs to provide its support. For example, the State Bank of Pakistan has taken up green banking as a specialized initiative to increase the participation of banks in addressing the energy shortfall and climate change. The State Bank aims to develop loan programmes to attract international funding, under the UN's Green Climate Fund (GCF) and support small scale solar projects such as SHSs, which would prove very valuable in view of some of the funding barriers' innovators face[50].

48. IDCOL, http://www.idcol.org/
49. Simpa Networks, http://simpanetworks.com/
50. Meeting with State Bank of Pakistan, September 2015

3.2 Solar energy service providers

During the time of the study, the GSMA met with two PAYG solar service providers developing their operations in Pakistan: EcoEnergy Finance and Nizam Energy, exploring the usage of mobile technology for payments and possibly remote monitoring of the systems. Other providers are also active in the market, notably Roshan Energy and Brighterlite that are partnering with Telenor Easypaisa and leveraging their mobile money service. These innovative companies are leading the way, demonstrating the potential for the PAYG solar market to scale in the country.

EcoEnergy Finance

Eco Energy Finance (EEF), started their operations in 2010, following the floods in Pakistan that highlighted and worsened the country's electricity shortage, particularly in remote locations. In 2014, encouraged by the strong demand for their first product, a solar lamp (1W), EEF launched the sale of PAYG solar home systems (30W, 50W) in four remote villages of the Sindh district, with the support of the GSMA's Mobile for Development Utilities Innovation Fund.

EEF focuses on providing off-grid customers with access to affordable and reliable solar solutions, starting with SHSs. These customers lack access to commercial and micro-finance banks, as well as government services, and EEF aims to be the provider of a range of solutions to help these customers build healthier businesses and households. EEF utilises mobile-enabled PAYG technology to ensure that customers make on-time payments and mobile money for convenience in payments.

Nizam Energy

Nizam Energy began by implementing residential and commercial solar projects in 2012. Their portfolio is now expanding to include off-grid products and the company is now developing PAYG solar home solutions. The company estimates that households will save on average $200-300 a year on energy spending in addition to long-term health and educational benefits. Nizam has built their own software to enable remote monitoring and control of their systems as well as mobile payments for energy credits consumed through GSM technology. Leveraging mobile network operators' technology as well as their own distribution networks, Nizam aims to rapidly scale and is projected to serve more than 820,000 lives of people living in poverty by 2020, across Pakistan[51].

Telenor Pakistan and Tameer Microfinance Bank's Easypaisa partner with BrighterLite and Roshan Energy

Supported by the GSMA M4D Utilities Innovation Fund, Telenor and Tameer's mobile payment solution, Easypaisa has partnered with two solar service providers, Brighterlite and Roshan Energy, to develop a solar home solutions for people off the grid or with unreliable electricity access. Their systems vary from 30 to 100 watts solar panels.

Integrating with Easypaisa's mobile money platform, allows customers to benefit from a flexible pay-as-you-go model, where they pay an initial 15% deposit followed by incremental payments for 18 months until they own the system. Customers can pay at an Easypaisa shop or directly through their Easypaisa Mobile Accounts, although currently most people still prefer to go to an agent to make the payment, using cash. The solar home systems have a microcontroller which shuts down the Solar System automatically once the Top-Up amount has been consumed. Once all instalments are paid, the microcontroller becomes inactive and the Solar Solution will continue functioning without any further Top-Ups required. The systems are sold in Hyderabad, Thatta, Badin, Tharparker and Rahim Yar Khan.

51. Acumen Fund, http://acumen.org/investment/nizam-energy/

3.3 PAYG solar addressable market in Pakistan

With 144 million people officially un-electrified or facing power outages up to 12 hours a day,[52] PAYG solar home systems can present a healthier and economical solution for Pakistan - replacing kerosene generators.

Equipping SHSs with mobile technology will condition the choice of pilot locations, as service providers will need to ensure mobile connectivity in these areas or, alternatively choose human-assisted credit and payment systems. Some of the main factors for the successful deployment of mobile-enabled PAYG solar systems are:

- High level of un-electrification and high usage of carbon-based fuels;
- Medium population density with availability of product and service at market hubs;
- Sufficient GSM coverage;
- Easy access to payment points;

The target provinces for the deployment of PAYG solar solutions are Punjab and Sindh with the largest populations and a high number of un-electrified villages. In addition, there are several related projects worth noting, which also provide an understanding of the market appetite per province.

TABLE 7

Target provinces for PAYG solar

Provinces	Capital	Population (2012)	Rural population (1998)	Number of un-electrified people	Related projects
Punjab	Lahore	91,379,615	50,602,000	621,000	• Quaid-e-Azam Solar Energy Park Biomass power plants; Biogas powered irrigation; • Rural network deployments by Telenor and Warid, under the Universal Service Fund programme in DG Khan and Bahawalpur.
Sindh	Karachi	55,245,497	5,600,000	16,198,000	• Solar power for 350 off-grid schools; Solar pumping; • Solar companies piloting the sale of SHSs.
Balochistan	Quetta	13,162,222	4,997,000	3,496,000	• Solar companies piloting the sale of SHSs.
Khyber Pakhtunkhwa	Peshawar	26,896,829	14,750,000	605,000	

52. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014

3.4 Current barriers to market

While the potential for off-grid solutions is clear given the size of the un-electrified market, barriers remain. The technology is mainly ready, if the ecosystem of actors, from regulators, private energy providers to MNOs, are willing to work together to grow the sector.

Mobile money: growing the number of active accounts

Cash still prevails for most payments in Pakistan – more than 85% of all transactions in Pakistan are completed in cash[53] – which is due, at least in part, to socio-political barriers such as weak legal and regulatory frameworks, lack of access to banking infrastructure and digital illiteracy. Mobile money service providers have had to think of innovative approaches to increase the number of mobile accounts.

The PAYG solar market could support mobile money service providers in their efforts to not only convert, but also activate new accounts. As GSMA Mobile for Development Utilities PAYG solar grantee, Mobisol proved during their 2014-2015 pilot of PAYG solar home systems in Rwanda, their customers had a higher mobile money activity than the industry benchmark for active users, over a period of 90 days[54]. It is in the interest of MNOs and PAYG solar providers to encourage the development of services such as PAYG solar home systems, respectively to grow customers loyalty to the network – who would be less likely to switch to other mobile payment applications – and to ensure a reliable service at all times.

M2M: Nascent but promising solutions

While currently focusing on more traditional M2M solutions such as fleet management, MNOs have the capabilities to provide PAYG solar providers with mobile connectivity and data, embedding SIMs into the solar home systems for the units to be remotely monitored and controlled. MNOs are already identifying the opportunity to support centralised utilities' metering upgrade as recent projects have demonstrated.

Facilitated by the Power Information Technology Company (PITC), Pakistani MNOs are helping to convert 22 million customers from manual meters to Advanced Meter Reading (AMR) technology, providing their communication pathway. At the end of 2015, after a year of launch, more than 70,000 meters[55] had been converted to AMR technology.

In the long run, MNOs could realise a range of benefits from developing their portfolio of M2M services to help energy providers improve their efficiencies with automated monitoring, load management and mobile-enabled PAYG billing solutions.

Regulatory policies

One of the main challenges for PAYG solar to expand in Pakistan remains at the level of the Government, who's support is required for the market to grow. While the AEDB and Council for Renewable Energy suggested that the private sector was now the main responsible for developing the off-grid solar sector, it is too early to leave the market development solely in the hands of the private sector. Taking the example of Bangladesh, where SHSs are being successfully deployed, IDCOL – a fully governmental body has been pivotal in enabling this success. In Pakistan, electricity regulations currently require private energy service providers to apply for distribution licenses, implying high costs for small scale electrification projects and risks as consumers in these areas have lower incomes[56].

However, new government policies, such as net metering, could have positive implications for the solar market and indirectly for PAYG solar companies. If it takes off, net metering, which implies the roll-out of solar energy solutions in urban areas, could lead to the development of PAYG solar for larger household systems. In addition, net metering entails the elimination of the 32.5% import tax on solar panels, however some uncertainty remains about the commitment of the government to make net metering a reality.

53. GSMA Mobile Money for the Unbanked, 2015
54. GSMA Mobile for Development Utilities http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/01/Mobisol-Pay-as-you-go-Solar-for-Entrepreneurs-in-Rwanda.pdf, January 2016
55. Meeting with PITC
56. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014

The State Bank of Pakistan, in partnership with the AEDB, is also working towards building the country's green market, supporting financial institutions to provide loans for residential solar systems, with lower interest rates and longer terms[57].

Funding for off-grid energy service providers

Access to finance is a challenge for off-grid energy start-ups. Lending conditions are not adapted in Pakistan, it is common for banks to apply annual interest rates of 16-18%, and as a result, it is difficult for start-ups to take the risk of investing[58].

The World Bank's energy for all programme has urged for the establishment of a programme to support private off-grid energy service providers in accessing finance by working together with the commercial banking sector and micro-financing institutions (MFIs). "In the PAYG solar business model, working capital requirements are significant and possibly catastrophic for equity investors. There can be a 3-year gap between expenditure and repayment on a solar kit. The companies in this space are experiencing rapid and accelerating growth, implying exploding working capital requirements as they scale. Today, efficient trade finance, asset finance, corporate finance, and other low-cost forms of debt remain unavailable to this fledgling sector"[59].

Grants, such as the GSMA Mobile for Development Innovation Fund,[60] and international organisations' initiatives such as the IFC Lighting Pakistan, also have a role to play in supporting these innovative projects to overcome the "valley of the death" gap, and consolidate their business models to then access private capital and debt. To that effect, the State Bank of Pakistan's recent initiative is a strong indicator of the renewed Government support to the off-grid market.

Bottom-Up approach: educating customers

Educating customers on the use of solar home systems and mobile money to building trust in the quality and functionality of the product, are critical success factors. Off-grid customers often have had poor experiences of solar products bought with no clear instructions usage, load capacity or installation - it is not uncommon to see small solar panels on the floor of customers' house when visiting rural areas – or of low quality. Although the AEDB has raised awareness around the use of solar, through public campaigns, there is still much work to be done to inform, educate and train customers on the potential and benefits of adopting solar products. AEDB suggested that the root-based work, at the community and private-sector level, needs to be done for the market to develop.

57. NEPRA approves Net Metering Regulations, September 2015
58. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
59. United Nations SE4all, Energy access assessment Punjab, Pakistan http://www.energynet.co.uk/fr/webfm_send/1183, December 2014
60. GSMA Mobile for Development Utilities programme

4. Opportunities for MNOs to enter the PAYG solar market

The growing number of partnerships between Mobile Network Operators and PAYG service providers, especially in East Africa, highlights the fact that both parties can mutually benefit from partnering. PAYG providers can leverage MNOs' networks, services, and marketing resources while MNOs can create new revenue streams and grow their customer base by creating new 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 the use of MNOs' services and improving brand recognition. Some of the main benefits include:

- Increase MNOs' Average Revenue Per User;
- Drive growth in mobile money adoption and use;
- Leverage MNOs' networks for agents to sell new services; and
- Improve brand recognition and customer stickiness.

4.1 Increase MNOs' Average Revenue per User

As the energy addressable market highlights, there are over 29 million people in Pakistan 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 a previous study, the ARPU went up by approximately 10 to 14%[61]. This direct benefit is a strong incentive for Mobile Network Operators who are interested in identifying new revenue streams as well as innovative solutions.

61. GSMA Community Power from Mobile data, 2012

4.2 Drive growth in mobile money adoption and use

PAYG solar can support the growth of mobile money customers and also ensure those customers are active, driving more mobile money transactions.

GSMA M4D Utilities Innovation Fund grantee Mobisol, a PAYG solar provider in East Africa, has proven the impact of their service on the growth of mobile money penetration and usage of bill payment. Mobisol demonstrated their customers' high mobile money activity levels, of about 80% by the end of the sales cycle, in comparison to the industry benchmark for active users of one transaction every 90 days. Furthermore, Mobisol estimates that 20% of their business kit users are newly registered for MTN mobile money (their MNO partner) when they become Mobisol customers, and data from MTN suggests that almost all of them are using bill pay transactions for the first time through Mobisol. Finally, Mobisol entrepreneurs increased their purchase of airtime through mobile money by 74% over time, which represents cost savings for MTN in printing airtime vouchers[62].

4.3 Leverage MNOs' agent network

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

4.4 Better brand recognition & customer stickiness

Brand recognition is critical for MNOs, especially in a competitive market like Pakistan, where customers are rarely loyal to one operator 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.

62. GSMA Mobile for Development Utilities, http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/01/Mobisol-Pay-as-you-go-Solar-for-Entrepreneurs-in-Rwanda.pdf, January 2016

5. Conclusion

Pakistan presents an exciting and dynamic mobile market, with a high level of competition and a growing basis of advanced mobile services such as mobile money and M2M technology. Working jointly with bold innovators who are paving the way for off-grid energy access, leveraging mobile technology, and with the support of an enabling regulatory environment, there is a strong opportunity for PAYG solar to provide a response to the energy crisis in Pakistan's underserved areas.

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



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