Mobile For Development Utilities

MOBILE FOR SMART ENERGY SOLUTIONS BOTSWANA

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Introduction

In Sub-Saharan Africa, 599 of the 936 million people (nearly 64%) lack access to electricity.[1] Yet mobile networks have become the predominant infrastructure, covering approximately 74% of the population.[2] The gap between access to mobile and electricity services has widened from 2000 to 2012 to the point where, today, we estimate that more than 358 million people in Sub-Saharan Africa are covered by mobile networks but don't have access to electricity.

The ubiquity of mobile services presents a growing opportunity for energy service providers – national utilities and third-party energy service companies (ESCOs) - as well as governments, to leverage GSM networks and technologies to dramatically improve and expand energy services to new scales. Innovative smart solutions, including smart meters and mobile enabling services, can be used to more rapidly and accurately send information between service providers, devices and customers. Smart meters can help energy providers improve the management of their connections, through remote monitoring and more efficient billing processes. Mobile enabling services can provide improved communication with customers, management of data, or remote customer payments. As a result, energy providers can address the key service delivery challenges they face: reducing losses and recovering costs to ensure reliable services and connect more customers.

In this light, at the end of 2013, the GSMA Mobile for Development Utilities programme (M4D Utilities), with the support of the UK Department for International Development (DFID), began working with Orange to explore the opportunity and role of mobile operators in partnering with energy service providers to support smart solutions for improved energy access in Sub-Saharan Africa.

This research included desk-based and field-based research in three selected countries, Botswana, Senegal and Côte d'Ivoire, as well as learnings from attending the African Utility Week 2014 in Cape Town, South Africa. The findings from Botswana are discussed in more detail in this case study, while the full research report "Mobile for Smart Solutions: How Mobile can Improve Energy Access in Sub-Saharan Africa" is available here.

Botswana is a particularly important market for assessing the opportunities for mobile operators to support smart solutions for energy services because smart metering has already been implemented at a reasonably large scale. Additionally, Orange has gained important experience in this market launching mobile payments for purchasing pre-paid electricity credits required for the metering system. Yet Botswana's electrification rate is only 43%. This provides an important opportunity to both understand the success and challenges of the existing smart metering initiative, as well as the opportunities to further develop smart solutions for increased energy access.

[1] International Energy Agency, World Energy Outlook, 2013. http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/

[2] GSMA M4DUtilities, Sizing the Opportunity of Mobile to Support Energy and Water Access, 2014. http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/12/Sizing-the-Opportunity-of-Mobile_Nov-2013.pdf

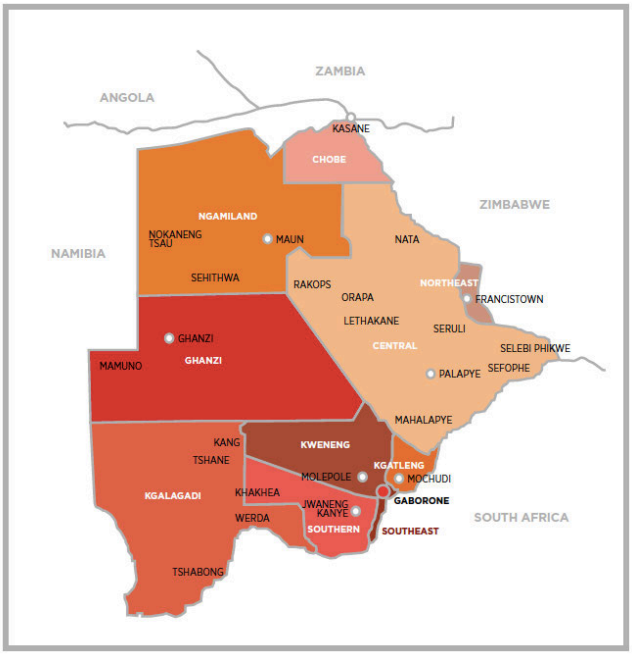
Given that smart-metering has already been widely implemented in Botswana, mobile operators should focus on providing a suite of mobile enabling services that can be used by energy service providers to improve and extend services, and potentially used by other service providers, rather than building an end-to-end solution for this market. The most immediate opportunities for mobile operators to support energy service providers through smart solutions are expanding customer communication services and mobile payments. For example, mobile can be easily leveraged for vital customer communication about service status and peak demand restrictions, while expanding mobile payment services can help increase revenue collection. In the future, there may be more opportunities for mobile network operators (MNOs) to work with the central utility and other service providers to provide more advanced service delivery and data analytics platforms, particularly focused on managing high volume consumers.

1. Key Statistics – Botswana

1.1 Geography

The Republic of Botswana is a landlocked country in Southern Africa, bordered by Namibia, South Africa, Zimbabwe and Zambia. Geographically, it is similar in size to France, with the Kalahari Dessert constituting up to 70% of the territory. It is divided into nine districts, and subdivided into 15 councils, which consists of the nine districts and six urban areas with high populations, including the nation's capital, Gaborone.

Figure 1: Botswana Map



1.2 Demographics and economics

Botswana has a population of just over two million, with 43% of the population living in rural areas and 57% in urban centres.[3] In 1966 the country gained independence from Britain and was one of the poorest on the continent, yet it is now an upper-middle income country, primarily due to the Government's sound management of diamond resources.[4] Botswana's GDP growth has gone from 4.2% in 2012 to 5.4% in 2013, reflecting continuing recovery after the 2008/9 global economic crisis, which dramatically impacted its mining sector, and strong performance in other service sectors (e.g. communication, public services). However, the broader non-mining sector decreased in growth from 6.2% in 2012 to 4.3% in 2013, largely reflecting reductions in water and electricity due to drought.[5]

[3] World Bank Data Bank, 2013. http://data.worldbank.org/
[4] World Bank Botswana Country Overview, 2014. http://www.worldbank.org/en/country/botswana/overview
[5] African Economic Outlook, Botswana, 2014. http://www.africaneconomicoutlook.org/en/countries/southern-africa/botswana/

Still, the country faces significant development challenges with a 17.8% unemployment rate[6] and a relatively low ranking in the Human Development Index (109 out of 187 countries).[7] This reflects low life expectancy related to a high rate of HIV/AIDS, as well as the unequal distribution of wealth, with a Gini index rating of 61.[8] Poverty has a rural bias with 8.4% of the rural population living in extreme poverty (less than $1.25 day) compared to only 2.7% in urban areas.[9] Table 1 below compares these indicators across relevant countries.

Table 1: Key regional indicators*

Indicator	Botswana	Senegal	Cote d'Ivoire	South Africa	Kenya	Uganda
Population[10]	2,021,144	14,133,280	20,316,086	52,981,991	44,353,691	37,578,876
GDP per Capita (current USD)[11]	7,317	1,072	1,521	6,618	994	572
HDI Ranking[12]	109	163	171	118	147	164
Rural population (%)[13]	43%	57%	47%	36%	75%	85%
Population living on less than $1.25/day (PPP) (% of population)[14]	13.4% in 2009[15]	34.1% in 2011	35% in 2008	9.4% in 2011	43.4% in 2005	37.8% in 2013

*Note: The countries selected for this table include the three analysed as part of the study with Orange (Botswana, Cote d'Ivoire and Senegal) and others that provide comparison between West, East and Southern Africa.

1.3 Energy access

In Sub-Saharan Africa, the average rate of electrification is nearly 32%, with an 18% rural rate and 55% urban rate.[16] The figures for Botswana are estimated at 43% for both rural and urban areas. However, data can vary dramatically between sources and the International Energy Agency World Energy Outlook suggests that the rural rate is 10% and the urban is 68%, with an overall rate of 46%.[17] Furthermore, the Botswana Power Corporation (the national utility) states their connection rates are nearly 63% for rural, and 74% for urban, however they view urban as major cities and

[6] World Bank Data Bank, 2012.
[7] UNDP Human Development Index, 2014. http://hdr.undp.org/en/countries
[8] The Gini Index measures the distribution of wealth, where 0 indicates perfect wealth equality and 100 indicates complete inequality. Source: African Economic Outlook, Botswana 2014.
[9] Ibid. However, alternative figures from Statistics Botswana's "Botswana Core Welfare Indicators (poverty) survey 2009/10" suggest these numbers are 8.3% for rural areas, and 3.3% for urban areas.
http://www.cso.gov.bw/templates/cso/file/File/BCWIS%20_Poverty_%20Survey%20Statsbrief%20Nov%202011..pdf
[10] World Bank Data Bank, 2013.
[11] Ibid.
[12] UNDP Human Development Index, 2014.
[13] World Bank Data Bank, 2013.
[14] World Bank Data bank, years vary.
[15] This figure as reported by Statistics Botswana's "Botswana Core Welfare Indicators (poverty) survey 2009/10" was indicated as 6.5% for 2009/2010.
[16] World Energy Outlook, 2013. International Energy Association. Data from 2011.
[17] Ibid.

rural as large villages or small towns, possibly under-representing the most rural areas.[18] This underscores the challenge in accurately assessing electrification, which can hamper initiatives to improve access. Table 2 compares regional electrification rates.

Table 2: Regional electrification rates[19]

	Botswana	Senegal	Cote d'Ivoire	South Africa	Kenya	Uganda
Electrification rate (%)	43	57	59	83	23	15
Urban electrification rate (%)	43	97	80	94	71	67
Rural electrification rate (%)	43	27	37	64	8	5

The Botswana Power Corporation (BPC) is the singular, government-owned utility in Botswana that provides national grid services. BPC is responsible for urban and rural electrification, including generation, transmission and distribution. For the 2012/13 financial year, BPC sent out a total of 3,650 GWh of electricity, though 2,981 GWh or roughly 70-80% was imported from South Africa and the remainder generated from domestic coal plants.[20] Current legislation does not allow for independent power producers or distributors, however new regulations have been under development for several years to change this and also establish a national regulator for energy and water companies.

The one other company that plays a role in rural electrification is BPC-Lesedi which is 45% owned by BPC and 55% owned by EDF (the French government-owned utility). BPC-Lesedi has the remit to provide clean and affordable energy solutions for rural households where extending the grid is not economically viable, targeting 40,000 households. BPC-Lesedi has explored several innovative models and has made the most progress with a franchisee model that provides a solar home system service. In this model, BPC-Lesedi owns the assets and franchisees collect continuous payments and carry out maintenance for customers. They currently have approximately 650 household customers.[21]

Energy access challenges

The challenges to increasing electrification rates in Botswana are primarily insufficient supply and the remote location of some households along with their ability to afford grid connections. Supply is expected to increase in the near future. However, Botswana's rural population (37%) are often in remote areas where the costs of extending the grid is

[18] These figures were provided by BPC during communications in June 2014. However, the later published BPC 2013 Annual Report indicates that the rural electrification rate in 2012/13 was 55%. This may reflect an increase in connections since the original writing of the Annual Report. file:///Users/icohen/Downloads/BPC%202013%20AR_Final%20(1).pdf

[19] Sustainable Energy for All, Global Tracking Framework. Data from 2010. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/05/24/000445729_20130524104654/Rendered/PDF/778890v20GTF0o0Official0Use0Only090.pdf

NOTE: Alternative Data is available from the International Energy Agency, World Energy Outlook which uses 2011 data. However, the data presented here was used to develop the addressable market figures we have provided in previous reports.

[20] Botswana Power Corporation, Annual report, 2013.

[21] Communication with BPC-Lesedi, April 2014.

not commercially viable. Furthermore, the cost of a connection may be too high for lower income rural households. The fee for connecting to the grid for households within 500 meters of a transformer is 5,000 Botswana Pula (US$ 545), which would be unaffordable for the 13.4% living below the poverty line on US$ 1.25/day, although installment plans are available. Some of this fee goes to cross-subsidizing the costs of extending to rural areas. At one point, BPC-Lesedi proposed that a portion of these subsidies go toward reducing the price of their smallest solar home system to make it more affordable for the lowest income households, however this was never approved.

Utility challenges

The country currently faces regular load shedding due to insufficient generation and reduced export by South Africa. At this time, technical challenges at the recently constructed Morupule B Power Plant have prevented it from adding capacity to the national grid. This insufficient generation is the biggest challenge the utility currently faces, as well as the absent communication with customers to alert them of load shedding and service status. Furthermore, decreased spending on public infrastructure was projected for 2014-215 due to "persistent bottlenecks in public utilities (energy and water)."[22]

Off-grid service challenges

BPC-Lesedi is well positioned to address the challenge of unaffordable and unviable grid connections through providing decentralised solar home systems. However, at the time of this report, the funding to BPC-Lesedi has decreased significantly and they have been forced to reduce their solar home system programme and other initiatives.

1.4 Mobile network operators and GSM coverage

The three mobile network operators (MNOs) in Botswana are Orange, Mascom and BeMobile. BeMobile is the government-owned operator and the tightest competition is largely between Mascom and Orange. In early 2014, Orange held 26% market share, Mascom held 53% and BeMobile had 21%.[23] Urban areas largely have 3G coverage, while the rest of the country has 2G coverage. Both Orange and Mascom offer Mobile money services, which allow customers to store, send and receive digital money (which can be withdrawn as cash) through their mobile number. Orange launched Orange Money in June 2011, and while it is still a nascent, Orange has continued to develop a suite of payment services including bill payments and a prepaid visa card linked to users' Orange Money accounts. The First National Bank of Botswana (FNB) also offers an eWallet which allows FNB customers to send electronic money to anyone with a registered Botswana phone number. The total number of people registered for mobile money in Botswana is estimated to be 283,000, representing approximately 18% of unique subscribers.[24]

Botswana has a relatively high mobile market penetration, which may in part reflect the relatively high GDP in terms of handset ownership (see table 1). Its government has also taken a strong role in increasing digital inclusion. At the GSMA's 2014 Mobile World Congress, the Government of Botswana was awarded the Government Leadership Award for leading the regional collaboration of six countries through the "Encouraging Digital Inclusion in South Africa"

[22] African Economic Outlook, Botswana 2014.
[23] GSMA intelligence data from Q2 2014. However, the market shares given by the Botswana Communications Regulatory Authority in their 2013 Annual Report were, Orange 33%, Mascom 53% and BeMobile 14%.
[24] http://www.itwebafrica.com/mobile/403-botswana/232899-botswana-records-300-mobile-money-growth

Ministerial Summit and a subsequent joint communiqué.[25] Table 3 below compares mobile connectivity statistics across the relevant countries.

Table 3: Regional mobile statistics[26]

Indicator	Côte d'Ivoire	Senegal	Botswana	South Africa	Kenya	Uganda
GSM Connections	21,411,382	14,838,666	3,256,021	77,305,618	32, 417,003	21,396,443
Unique Subscribers	10,046,389	7,222,729	1,531,206	36,523,961	18,925,153	10,891,973
Market Penetration	48.29%	49.65%	75.11%	68.73%	41.55%	28.04%
Population Coverage	98%	86%	95%	100%	95%	97%
Number of Operators	7	3	3	4	4	7

1.5 Addressable market: Leveraging mobile to enable energy access

The current figures for Botswana suggest that mobile coverage has reached 95% of the population. Yet, approximately 57% of the population lacks access to electricity. Given the different channels by which mobile can increase access to energy services, this suggests there is an addressable market of 982,665 people or 48% of the population, for which mobile technology could be leveraged to enable energy access. See Annex 1 for more information about these mobile channels. Table 4 compares the Energy Addressable Market across relevant countries:

Table 4: Energy addressable market[27]

Indicator	Botswana	Senegal	Cote d'Ivoire	South Africa	Kenya	Uganda
Population without access to electricity	1,095,792	7,211,562	10,401,821	12,497,825	33,990,140	30,416,462
Energy Addressable Market	982,665	3,250,096	7,526,216	11,081,009	30,009,848	28,840,999

[25] http://www.gsma.com/newsroom/gsma-botswana-lebanon-spain-united-arab-emirates-in-its-government-mobile-excellence-awards/
[26] GSMA Intelligence Data from Q2 2014, or most recent possible
[27] GSMA, Sizing the Opportunity of Mobile to Support Energy and Water Access, 2014.

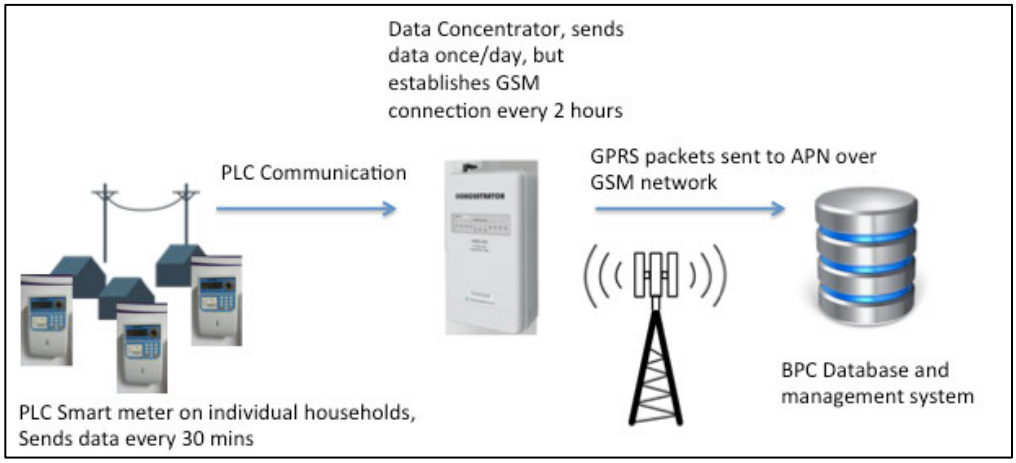
2. Electricity Metering and Payment

2.1 Metering: Current status and challenges

BPC serves 296,799 connections to date, nearly all of which have prepaid meters. Most urban households have pre-paid smart meters and rural households have pre-paid digital meters (budget energy controller), although these are not "smart" as they do not allow remote communication. Thanks in part to these pre-paid meters BPC has very low non-technical losses, estimated at around 2-3%.[28]

BPC's household smart meters (provided by Hexing) are PLC communication protocol based. Up to 350 household smart meters cab be connected via PLC to each data concentrator, which sends the data to BPC's database by GPRS over the GSM network and can also receive information (see Figure 2). This allows BPC to collect data on household consumption and thereby eliminates the need for estimation or meter reading. The smart meters also allow for peak load control through a device that remotely switches off hot water units (locally referred to as "geysers") during peak demand to help minimize load shedding.

Figure 2: BPC smart meter data flow



BPC also uses programmable meters with embedded serial communication for some larger businesses, which have a standard AT – driven GSM modem to translate between serial and GPRS.[29] These are typically post-paid. BPC has installed GSM-enabled smart meters at BPC distribution points for energy balancing purposes.

Challenges

Although the smart meters have made improvements to revenue recovery, BPC and customers have still faced challenges with them, which include the following:

[28] BPC Communication, April 2014. However, BPC's 2013 Annual report indicates significant overall operational losses, primarily due to the costs associated with the technical challenges at the new Morupule B power station.
[29] The meters have been adapted to be connected to GSM modems, and programmed to send data, but the meters alone are not smart meters.

- Complex software integration:

  The integration of the smart meter software and the existing customer account software took significant effort and BPC feels that this integration limits their ability change to another meter supplier if necessary. From a public policy perspective BPC would like prefer to diversify use of private vendors.
- Combined keypad and meter unit placed outside house:

  This makes it difficult to hear sounding alerts from the meter. BPC has also experienced tampering and safety issues as the wires can be easily accessed with their positioning next to the keypad and on customer premises, as opposed to locked in a more secure box located far from the keypad. BPC is currently considering switching to a meter that has a keypad unit that is separate from the meter to address these challenges.
- Lack of real-time information:

  Data from the meters is currently sent from the meters to the data concentrator every thirty minutes. However, the data concentrator only sends it to BPC once per day in a single GPRS packet of information. This is to save costs associated with using the GSM network. The system is therefore not set up to provide real time information or alerts when meter readings indicate likely theft. This means that meters which have been tampered with may not be detected right away and must be manually identified in the data.
- Long voucher code can be difficult to enter:

  When customers purchase pre-paid electricity, they must manually enter a 20-digit voucher code into the meter which can be challenging for the elderly or those less literate. Although the meters have the capacity to receive remote top-up automatically, this is not being utilised currently. The smart metering system is not yet integrated with the prepaid vending system used by super vendors that sell credit, so remote top-up can only be done when customers buy pre-paid credit through BPC.
- Network traffic can disrupt data transmission:

  If the metering data is sent by the concentrators at hours of peak network use, other network traffic can interfere and the metering data will not be received. BPC has now mitigated this by sending data at midnight when traffic is lower.

2.2 Payments: Current status and challenges

Pre-payments for electricity can be made at BPC offices, selected vendors (e.g. grocery stores) and through mobile money payments offered by Orange and Mascom. Orange Money launched mobile payments in August 2013 and continues to promote this service to customers. Customers can select the “buy power” option from a USSD menu and the backend of the Orange Money system will connect to the BPC pre-payment system, ultimately issuing customers with a 20-digit voucher code, which can be entered into the smart meters as well as the digital non-smart meters.

Mobile operators can benefit from offering this service through additional “stickiness” to their brand (i.e. preventing customers from switching to another operator’s SIM) and increased revenue through transaction fees and the PBC-paid commission for the sale. It should also lead to customers increasing the amount of mobile money they deposit in order to be able to instantly and remotely purchase pre-paid power whenever they run out.

Challenges

However, the challenges with the pre-payment system have included the following:

- BPC pre-payment network sometimes goes down, leaving all customers without the ability to buy power: Those using mobile money will have trouble completing the transaction and this can increase demand on operators' customer care services.
- Automatic meter crediting through the system is possible, but not popular: Customers do not commonly use the automatic credit transfer option to send pre-payments directly to their meters, because this is only available if credit is purchased through BPC and not a vendor. Furthermore they may not be fully aware of this option, and are more familiar with entering voucher numbers and may fear that the credit will not be transferred if there is a problem with the mobile network. BPC is also hesitant to move entirely to this method in case a network failure on their side or the mobile network would prevent people from being able to receive the credit for which they had already paid.
- Power outages may reduce usage of mobile payments: Customers are uncertain if they are out of credit or if there is a power outage and often go to a BPC office to get this information, rather than paying by mobile.
- Competition: Mobile payments compete with other convenient pre-payment points for electricity. For example, customers can purchase pre-paid electricity at the grocery store, which avoids the step of having to add money to one's Orange Money account.
- Limited access to Mobile Money: Mobile money can only be purchased through large dealers (e.g. Post-office) rather than individual agents, so topping up mobile money may require queuing at a large store where potentially the bills can be paid directly to BPC.

3. The Opportunities for Smart Solutions and the Role of MNOs

3.1 How a smart solution can help improve energy access?

Smart communication technology can help answer the energy providers' main challenges while better understanding and responding to end customers' energy needs. The main components of a smart solution are the household meter and the mobile enabling services required to serve customers. Although there will be variations in the solutions that are deployed in on-grid and off-grid areas, the main benefits of smart solution deployments include:

- Improving billing efficiency: Inefficient billing systems is one of the main challenges of energy providers resulting in manual collections, leakage of revenues due to a lack of transparency in collection and poor repayment rates. A smart billing solution, allowing for pre or post-payment of energy bills, will allow the energy provider to monitor payments and ensure repayments while offering the end customer an efficient way to pay for the service.

- Better understanding of customer usage: Currently most on-grid and off-grid energy providers must visit their customers' homes to take meter readings, or to evaluate or service decentralized solutions. Remote monitoring and control of infrastructure via a smart meter improves clarity on customer usage and demand, allows for easier detection of illegal connections or early warning systems for technical issues and for the remote shut-off of customers.

In Botswana, BPC has already implemented a fairly suitable smart metering service which uses the GSM network to send household meter information through data concentrators. There are some challenges with the current services, but at this point in time, the greatest opportunity for MNOs is providing a more developed suite of mobile enabling services that support the payment and communication aspects around energy and other utility services, rather than taking a leading role in providing an end-to-end smart metering service.

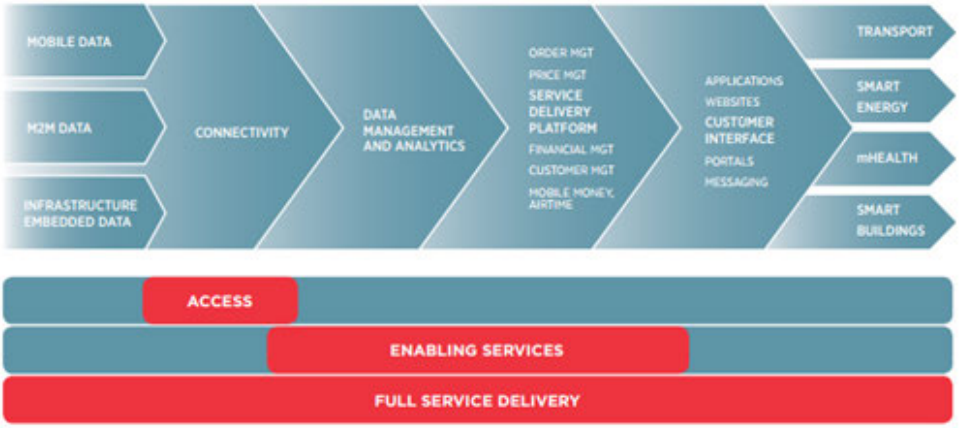
3.2 Beyond connectivity: How MNO services can support energy access

The spectrum of opportunities for operators to support smart service delivery are depicted in Figure 3 below. Providing connectivity services (i.e. SIM cards, voice, SMS and data) is the core of what MNOs can offer to support the deployment of smart solutions, but their value is magnified by providing additional enabling services. MNOs can broaden their offering, providing a full suite of services targeted at smart and non-smart meter deployments that can be leveraged by utilities and energy service companies (ESCOs).

The four key services MNOs can offer to support smart solutions, include:

- Connectivity/managed connectivity – connecting infrastructure and individuals' handsets to central servers and databases;
- Data aggregation/analysis – providing data about the status of connected smart meters and smart grid assets; combining data from multiple sources to produce new insights;
- Service delivery – delivering real-time consumption information to people and machines that will enable them to adapt and respond to events; the use of mobile money to support pre- and post-payments
- Customer interface - providing customer support operations, such as call centers and web portals, as well as delivering messages to subscribers.[30]

Figure 3: Mobile for smart service delivery: Beyond connectivity



3.3 Sizing the opportunity for smart solutions in Botswana

Table 5 below shows the different approximate number of households on and off-grid in Botswana. For each market segment, there are different opportunities to leverage components of smart solutions - both mobile enabling services and smart meters - to improve energy service and increase access.

Opportunity for mobile enabling services by customer segment

As presented in Figure 2, mobile enabling services go beyond connectivity and support customer engagement, such as remote payments and billing reminders.

On-grid households

Mobile enabling services have a high potential to support on-grid customers in urban and rural settings, given that it is expected households would have access to mobile networks. For example, BPC noted that they would like to have more direct communication with customers via SMS to provide service status updates. Additionally, as noted above, mobile money pre-payments are already available, but there have been several barriers to widespread adoption.

[30] GSMA, Guide to Smart Cities The Opportunity for Mobile Operators, 2013. http://www.gsma.com/connectedliving/wp-content/uploads/2013/02/cl_sc_guide_wp_02_13.pdf

Off-grid households

For off-grid households, the opportunities to leverage mobile enabling services, are stronger in urban areas where mobile networks and mobile money are more available. For example, mobile payments could make grid connections more affordable for lower-income households by enabling convenient, regular installments. Indeed, BPC already offers installment plans, but these could perhaps be more widely used with mobile payments. In rural areas, mobile payments could play a role for enabling payment of decentralized services, however, this would require significant effort by mobile operators to increase the availability of mobile money through dealers in those areas, followed by registration and education of customers. The opportunities for smart metering to improve and increase energy access for each market segment are considered below.

Opportunity for smart meters by customer segment

The opportunities for leveraging smart meters for each segment are discussed below.

Table 5: The rural and urban off- and on-grid market segments*

	OFF GRID		ON GRID		
User Type	Rural HH	Urban HH	Rural HH	Urban HH	Large Power Users
Number of Households	124,488	24,410	209,799	87,408	Unknown number
Comment on market	High potential for decentralized solar systems where grid is not economically viable, but unexploited due to political focus on grid and limited scale for smart solutions to enable remote monitoring and payments	Potential to increase connections and pre-paid smart metering	Majority have Budget Energy Controller meters	Of which 73,923 have pre-paid smart meters	5% of all connections assumed to be government and businesses and many have post-paid smart meters

*NOTE: These figures are based on the numbers of urban and rural connections according to communications with BPC in June 2014, and their figures for percentage of households with access to electricity (nearly 63% for rural and 75% for urban, see Section 1.3). However, the Botswana 2011 Census indicated electricity as the primary source of lighting for 247,169 urban households and 46,159 rural households, suggesting very different connection rates from those above. The likely explanation is that BPC considers urban to be the households in the major cities of Gaborone, FrancisTown, Lobtse, Jwamwng, Sowa and Selebi-Philkwe, and rural to be those households in smaller towns. Therefore, the BPC definition of rural may encompass more urban small towns than the definition used for census purposes.

On-grid households

Theoretically, there is a potential to implement GSM-embedded household meters to address the challenges of the current BPC smart meters and have more constant two-way communication, yet the benefits may not outweigh the costs. For example, this would eliminate problems with needing to enter a 20-digit voucher code, and potentially the incidence of tampering with easy to open keypad meter faces, and could potentially send balance alerts to customers'

mobiles. However, it seems there are other potential solutions that would be less costly than retrofitting the meters with GSM. Firstly, the existing meter hardware can provide remote top-up (eliminating the need to enter a voucher code) through the pre-payment system. However, this is currently possible only if purchased through BPC (not at other vendors), and it may not be widely used due to customer fear that the remote top-up will fail if there is a problem with the BPC system or mobile network. If the BPC vending system could be extended to other vendors of pre-paid electricity and made more robust, it could enable remote crediting of meters. Secondly, a split-face meter, which brings the meter display inside the home and reduces likelihood of tampering could also address some current challenges. BPC is already preparing to test the split-faced meter solution.

However, there is an opportunity for BPC to increase the current smart metering programme particularly for rural households. Table 5 above indicates that of the 87,408 urban on-grid households, nearly 74,000 have prepaid smart meters. Yet of the 209,799 rural households which are connected, the majority have digital pre-paid budget energy controller meters which are not smart, so BPC has limited information about power usage from the majority of their connections. Installing smart meters on these households could benefit BPC with more consumption information, however, these benefits would have to be weighed against the costs of upgrading these meters.

Off-grid households

Currently, there are limited opportunities for MNOs to play a role in smart metering or enabling energy access for off-grid households. BPC has nearly 209,799 rural connections, and their stated access rates suggest that only 124,488 rural households are un-electrified. However, given other statistics discussed in section 1, the number of rural un-electrified households may be higher. BPC has continued to electrify rural households, but the budget for this was limited for 2014/15 to not beyond 11 more villages.

BPC-Lesedi has assessed the potential to leverage GSM smart meter technology to remotely manage off-grid solar home systems, and allow for remote payments via mobile money. However, the use of GSM communication was deemed to be unviable given unreliable network coverage in some of these areas, and the limited reach of mobile money due to low population densities. A non-smart meter with a keypad and voucher system to enable pre-payments for off-grid solar home systems would likely be the most viable improvement that could work with or without mobile money. However, there are not currently plans for this, or other improvements given BPC-Lesedi's diminished funding.

Large Power Users

BPC is already using GSM modems on meters for some large power users, however there is an opportunity for this to expand to more customers as it is currently still in a pilot stage. Furthermore, there may be opportunities for mobile operators to offer a suite of corporate energy management solutions that use the GSM network to remotely monitor and control groups of appliances for large businesses.

4. Recommendations

Mobile enabling services to support communication and payment

In the case of Botswana, the strongest opportunities for MNOs to support smart solutions for energy services may be through offering a suite of mobile enabling services to BPC and its customers, as well as BPC-Lesedi and eventually other energy providers. These services can have high value and be adopted beyond the energy sector.

Across the spectrum of possible MNO services, those with the greatest potential to provide immediate benefits to energy service providers are customer communication and payment. Given BPC's existing smart metering programme, and current challenges, the opportunity for communication and payment services is greater than for MNOs to offer an end-to-end smart metering solution. Focusing on communication and payment can support utilities' and ESCO's smart and non-smart meter deployments in urban on-grid and off-grid markets, as well as other types of service providers.

Communication

During this analysis BPC identified the need for better communication with customers around load shedding and peak demand control. There is an "easy win" for MNOs to provide BPC with discounted bulk SMS to alert customers of power outages and remind them to turn off appliances during peak demand. Customers would also benefit from receiving information about their meter credit more directly to their phones, thus encouraging them to pre-pay more regularly and improving recovery for BPC. Furthermore, these types of costumer communication services can be of value to many other service providers with high volumes of clients, e.g. other utilities and public sector organisations.

Mobile payment

Pre-payment has been identified as a key tool for utilities and off-grid ESCOs to support the delivery of reliable services to customers and considerably improve revenue collection. There is a strong opportunity for MNOs to increase the number of customers using mobile money payments for pre-paid electricity and to replicate this service with more bill-pay partners. This firstly requires mobile money distribution networks to be widened so that topping up mobile money can become a more convenient option. Offering bill-pay services with more partners will also encourage customers to keep a higher balance in mobile money accounts in order to be able to easily pay multiple bills, and at the same time reduce churn for operators. There is also a strong opportunity to offer mobile bill payment for the Botswana Water Utilities Corporation as they currently collect all payments at their branch offices, which is not only costly, but highly inconvenient for customers, thereby reducing their likely-hood of making post-paid payments on time.

Furthermore, Mobile operators should consider how bill-pay functions (generally designed for utilities) can be easily extended, with limited bespoke integration, to third-party ESCOs who are seeking to serve a segment of the population who can afford small and relative frequent payments.

Both customer communication and mobile payment services can be linked together for increased value. MNOs can send SMS messages about service updated that may also trigger customers to use that operator's mobile money

service. Additionally, since operators often make a percentage commission on mobile payments, they can develop marketing campaigns that encourage customers to purchase more pre-paid energy in each transaction, for example by tying this to small amounts of airtime.

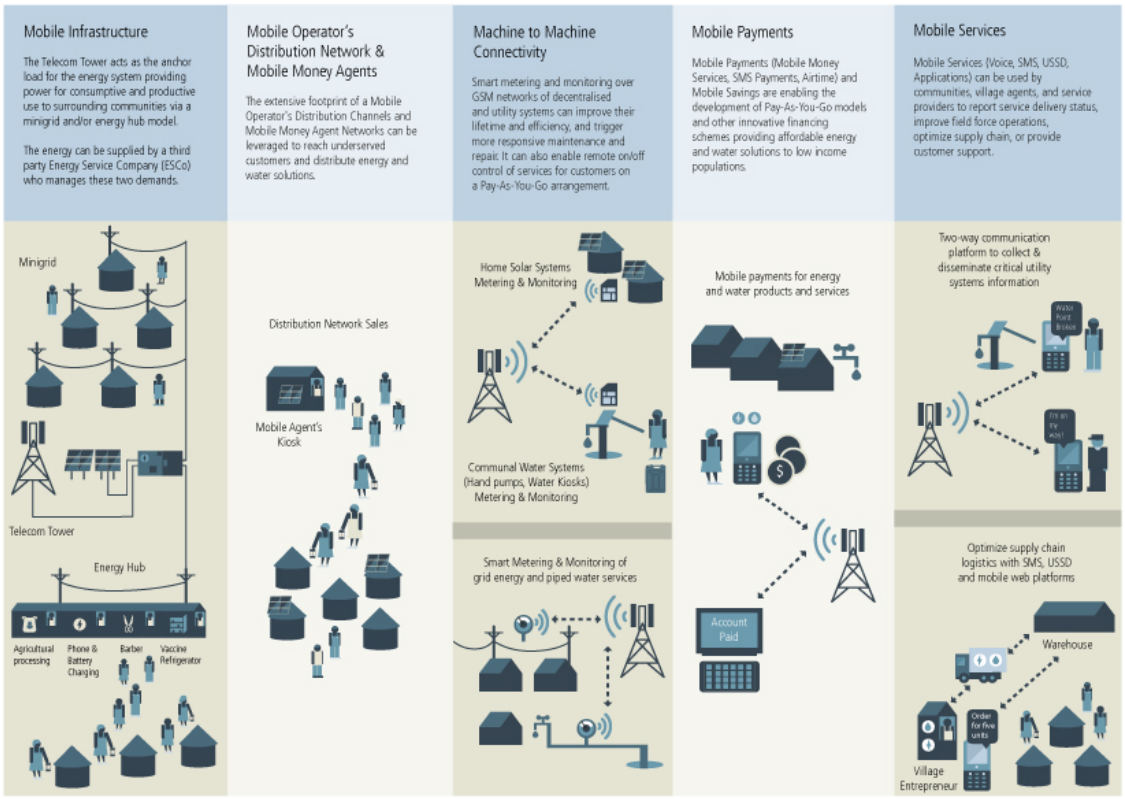
In the future there could be an opportunity for MNOs to offer more advanced service delivery and data analytics platforms for BPC and other utilities or ESCOs. BPC currently uses GSM-enabled smart meters for large power users and MNOs may be able to provide them with corporate management solutions through that data. If cost-effective, this level of smart metering and data analytics could be further deployed to high consuming households.

Concluding remarks

Botswana is relatively well developed in terms of smart metering for electricity. While there is limited opportunity for operators to offer a new end-to-end smart metering service, there are still important opportunities for operators to support a suite of mobile services to support service delivery for a range of partners in Botswana. These include supporting customer communication by mobile money services, and driving customer usage of mobile money payments by increasing mobile money distribution services, and offering payments for more services. These services can create stickiness that help operators reduce churn as well as bring in revenue.

Annex 1

Five mobile channels to improve energy (and water) access



About the GSM Association

The GSMA represents the interests of mobile operators worldwide. Spanning more than 220 countries, the GSMA unites nearly 800 of the world's mobile operators with 250 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and Internet companies, as well as organisations in industry sectors such as financial services, healthcare, media, transport and utilities. The GSMA also produces industry-leading events such as Mobile World Congress and Mobile Asia Expo.

For more information, please visit the GSMA corporate website at www.gsma.com. Follow the GSMA on Twitter: @GSMA.

About Mobile for Development - Serving the underserved through mobile

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

About the GSMA Mobile Enabled Community Services Programme

Mobile Enabled Community Services improves access to basic energy and water services in underserved communities using mobile technology and infrastructure.
Our work encompasses any energy and water service provided to a community which includes a mobile component, whether it is voice, SMS, USSD, Machine2Machine, NFC, a mobile operator's agent network or tower infrastructure.
We aim to seize the opportunity, leveraging mobile technology and infrastructure to enhance access to affordable and reliable energy and clean water in underserved communities.

About Orange

Orange is one of the world's leading telecommunications operators with sales of 41 billion euros in 2013 and has 161,000 employees worldwide at 30 June 2014, including 101,000 employees in France. Present in 30 countries, the Group has a total customer base of more than 236 million customers at 30 June 2014, including 179 million mobile customers and 16 million fixed broadband customers worldwide. Orange is also a leading provider of global IT and telecommunication services to multinational companies, under the brand Orange Business Services.

Contact

For more information on the GSMA's Mobile Enabled Community Services Programme, please contact us on mecs@gsma.com
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