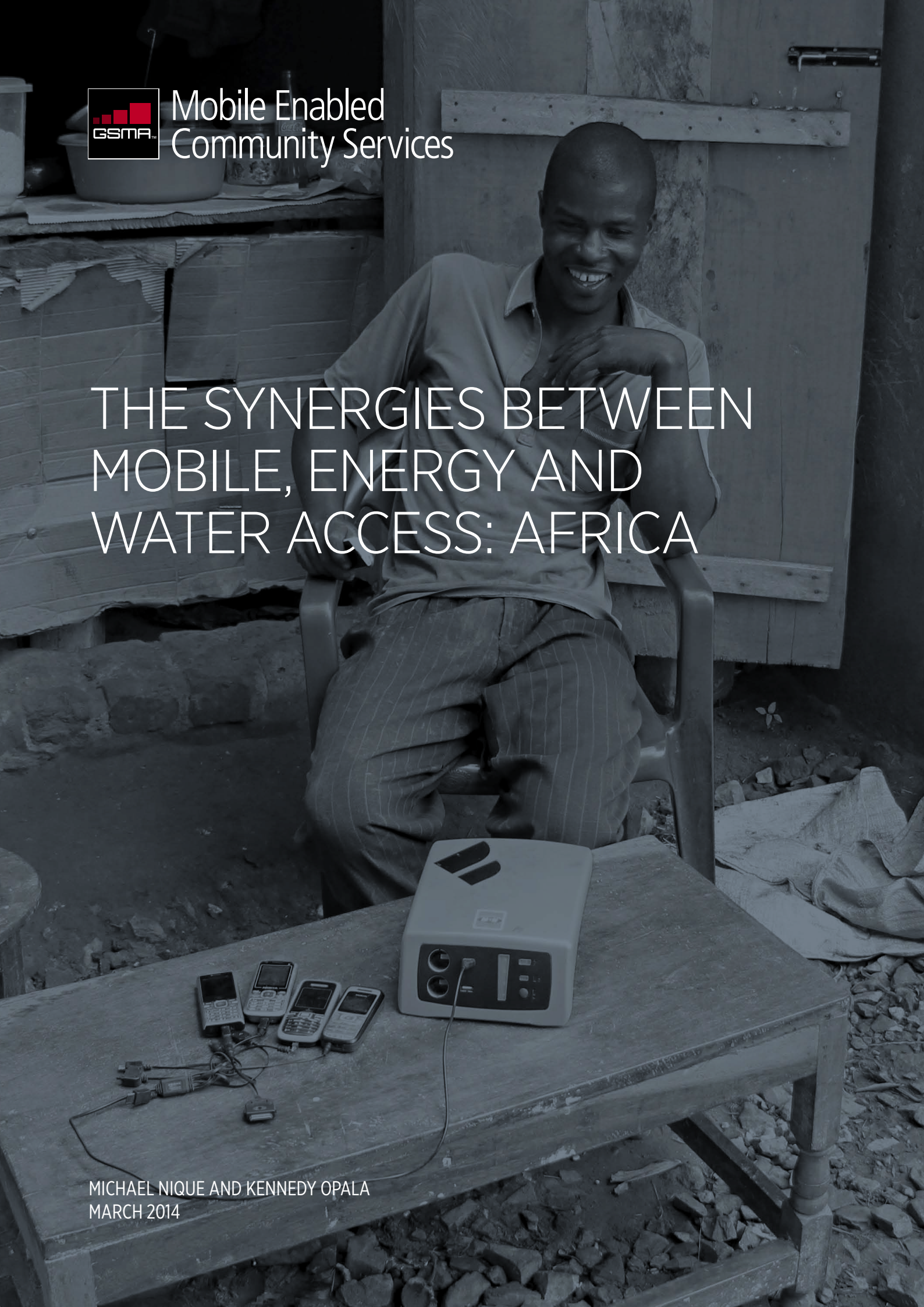

Mobile Enabled Community Services

THE SYNERGIES BETWEEN MOBILE, ENERGY AND WATER ACCESS: AFRICA

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MARCH 2014

CONTENTS

UKaid
from the British people

Executive Summary

From growth to maturity, African mobile markets have an increasing impact on economies and populations. In 2013, more than one in three Africans had at least 1 mobile subscription[1] and GSM coverage was estimated to reach 76% of the African population (a total of more than 690 million persons). This booming mobile adoption contrasts with the lack of access to basic infrastructure: the electrification rate is estimated at 32% of the overall population, and the access to improved water at 63% with only 15% having access to piped connections.

In a context where mobile connectivity outgrew access to reliable and affordable electricity and access to clean water in the last 10 years, an increasing number of public and private organisations are leveraging mobile technologies to bridge the financial and physical divide that might prevent underserved populations from accessing basic life services.

Since 2013, the GSMA's Mobile Enabled Community Services Programme has been supporting the African mobile industry to help solve the challenges of extending and enhancing access to energy and water services. The reach of the mobile industry's infrastructure, (e.g. its telecom tower infrastructure and operators' distribution channels), the growing traction of mobile financial services and the increasing opportunity to leverage Machine-to-machine (M2M) connectivity, offer innovative pathways to achieve reliable energy access and increased water access for underserved communities.

Following the publication on "Sizing the Opportunity of Mobile to Support Energy and Water Access"[2], this document presents in more detail current initiatives, business models and opportunities the mobile sector can play in Africa to better address development challenges around energy and water access.

Some of the key take-aways from this report are:

- from an early phase of growth, Pay-As-You-Go solutions could have an important impact in most Africa countries if the right ingredients are present: working capital, efficient distribution networks and ideally a partnership with a mobile operator to strengthen last-mile delivery channels;
- the advent of mobile financial services offers an increasing opportunity for public and private players to leverage the payment/financing/saving mobile platform to curb the effects of poverty on the lack of access to modern energy and water services;
- there is a real opportunity to leverage the telecom tower infrastructure to pilot mini-grids and/or energy hubs with the tower as an anchor customer, due to Energy Service Companies' increasing maturity, rising diesel costs and the development of smart solutions to increase payment collection and load management in mini-grids;
- pilots on hand pump mobile remote monitoring are showing positive results on water access sustainability, reducing the number of days when water is not available to communities. Coupled with efficient maintenance schemes, solutions such as low-cost smart hand pumps could be part of the solution towards universal reliable water access by 2030 (as mentioned in the post MDG goals).

1. Wireless Intelligence data on Unique Subscriber penetration in 2013 in Sub-Saharan Africa; the proportion will be higher in the more mature North African mobile markets.
2. GSMA Mobile-Enabled Community Services 2013 - http://www.gsma.com/mobilefordevelopment/new-report-on-sizing-the-opportunity-of-mobile-to-support-energy-water-access.

Key mobile-enabled community services trends

Energy Pay-As-You-Go solutions, enabled by mobile technology and services, were sold to more than 60,000 customers in 2013. The positive results showing an early traction of this model can be attributed to the Energy Service Companies (ESCO) innovative value proposition, where energy products are either offered with a financed purchase scheme or under an energy as a service model. The combination of M2M connectivity of energy systems, such as home solar systems, with customer mobile money payments, also enables ESCOs with more control of their unit operations, while providing more flexibility and convenience for subscribers. Marketing and distribution partnership with mobile operators also provides strong logistics and branding support to better reach consumers.

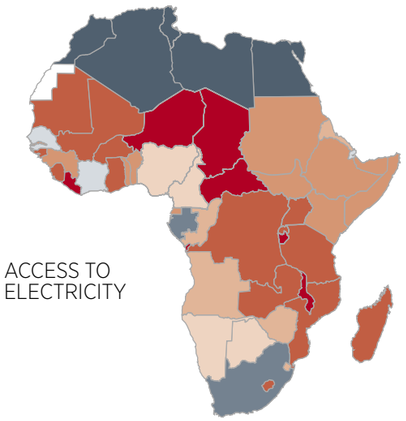
Developing low-cost smart meters for hand pump monitoring is one of the key areas of mobile innovation applied to water services. The lack of recent and adequate data on water availability and the performance of water services and infrastructure is an important hurdle to the development of better policies targeting water supplies in Africa. Portland State University, the University of Oxford and Welldone.org have each developed their own mobile monitoring solutions (hardware and software); the core concept is to embed a micro-controller in the handle of the pump or attached to the pump head, with GSM connectivity coupled to a flow meter or an accelerometer which detects handle movements. As these solutions are currently being tested in the field, more data on the impact of such technologies on improved water access and maintenance should be released in the coming months.

Mobile money has expanded its footprint in Africa in 2013 and confirmed its transformational power in the region. According to the *State of the Industry 2013: Mobile Financial Services for the Unbanked* report[3], 52% of all live mobile money deployments were in Sub-Saharan Africa at the end of 2013, with mobile money available in 36 of the 47 countries. At least nine markets had more registered mobile money accounts than bank accounts, compared to four last year and there were more than 98.3 million registered accounts (with 42.4 million active accounts). Strong opportunities exist for Energy Service Companies and Water Service Providers operating in Africa to leverage mobile payment services to provide micro-financed and affordable prepaid utility solutions to underserved customers, while collecting valuable information about their ability to pay.

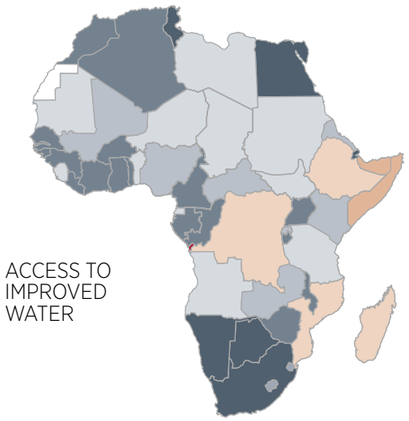
These **operators are involved in partnerships with Energy Service Companies or Water Service Providers**, including distribution and marketing partnerships, branding, shared revenues, data connectivity, and mobile money platforms. As value added services, energy and water services represent an important opportunity for mobile operators across Africa who could benefit from such services according to five channels: telecom power outsourcing, distribution & marketing, M2M connectivity, mobile payments and mobile services. There should be more collaboration between MNOs and Energy or Water Service Providers coming from other African regions in 2014.

3. http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/02/SOTIR_2013.pdf

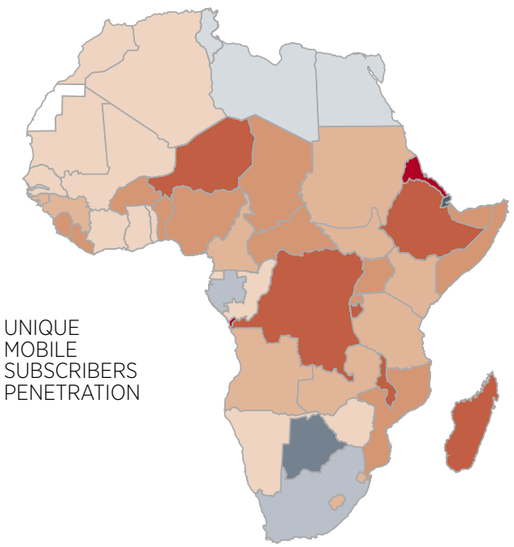
Mobile, energy and water access: key information



ACCESS TO ELECTRICITY



ACCESS TO IMPROVED WATER



UNIQUE MOBILE SUBSCRIBERS PENETRATION

90%+
80%+
70%+
60%+
50%+
40%+
30%+
20%+
10%+
0%+

KEY DATA ON AFRICA (2013):

	ACCESS TO ELECTRICITY (%)	ACCESS TO IMPROVED WATER (%)	GSM POPULATION COVERAGE (%)
SUB-SAHARAN AFRICA	32	63	74
NORTH AFRICA	99	92	94

KEY FACTS ABOUT THE REGION:

IN SUB-SAHARAN AFRICA, PEOPLE HAVE ACCESS TO MOBILE FIRST:

360 MORE THAN MILLION

AFRICANS ARE COVERED BY MOBILE NETWORKS WITHOUT ACCESS TO ELECTRICITY IN THEIR HOME

130 MORE THAN MILLION

AFRICANS ARE COVERED BY MOBILE NETWORKS WITHOUT ACCESS TO IMPROVED WATER SOURCES

35%

OF THE AFRICAN POPULATION (~400 MILLION) ARE UNIQUE MOBILE PHONE SUBSCRIBERS (SUB-SAHARAN & NORTH AFRICA)

135 MORE THAN MILLION

OF THESE UNIQUE MOBILE SUBSCRIBERS LIVE OFF GRID

42.4 MORE THAN MILLION

ACTIVE MOBILE MONEY ACCOUNTS IN SUB-SAHARAN AFRICA, WITH MOBILE MONEY SERVICES AVAILABLE IN 36 OUT OF 47 COUNTRIES.

'ACTIVE' MOBILE MONEY ACCOUNTS HAVE BEEN USED TO PERFORM AT LEAST ONE TRANSACTION WITHIN A GIVEN TIME PERIOD.

Mobile access leapfrogged utility infrastructure access in Africa

As of mid-2013, more than one African out of three has at least 1 mobile subscription.[4] Due to the social nature of mobile communications, this also means mobile phones are shared by several people from the same household or the same community, increasing the impact mobile services can have, especially in resource-constrained environments. The GSM population coverage of the African population reached 76% in 2012 (a total of more than 690 million persons), meaning that more than three-quarters of the people living in urban and rural areas can benefit from the advent of voice, text and data services thanks to the use of cheap low-end mobile phones and higher-end smartphones.

However, even in Sub-Saharan countries facing strong economic and mobile penetration growth, a majority of this population having access to a mobile phone still has limited access to infrastructure and capital:

- 69.9% of the population lives on less than US$2 per day[5] earning low and irregular incomes;
- the electrification rate is estimated at 32%[6] of the overall population, 64% for the urban inhabitants and 13% for the rural dwellers;
- 63% of the population has access to improved water (15% with piped connections and 48 % with other improved sources), 84% in urban areas and 51% in rural areas;[7]
- 30% of the population has access to improved sanitation, respectively 43% in urban and 19% in rural environments. 26% of the Sub-Saharan population still practiced open defecation in 2013.[7]

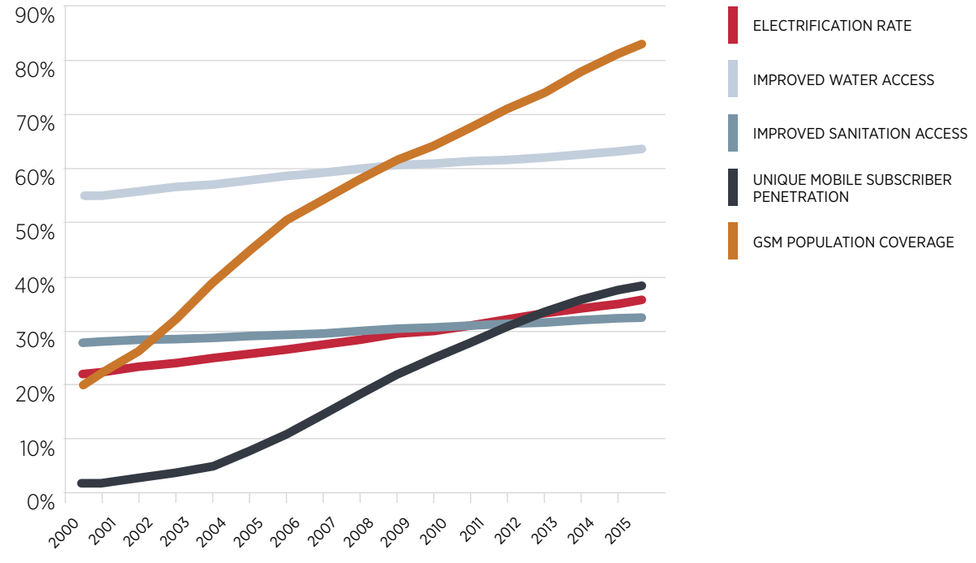
As presented in Figure 1, the gap between access to mobile and electricity services has widened from 2000 to 2012 to the point where, today, we estimate that more than 358 million people (i.e. energy-addressable market[8]) are covered by mobile networks but don't have access to electricity (this represents 59% of the total off-grid population in Africa) (See Appendix 1 for energy and water addressable markets in Africa). Most of this energy-addressable market (~70%) is located in rural settings.

Even though important progress has been made to extend access to improved water across Africa[9], the gap between mobile and clean water access remains important as 125 million people are covered by mobile networks with no access to improved water. This represents 37% of the total population not having access to improved water[10] on the continent. Most of this water-addressable population is rural (~64%). If mobile can support the coverage extension of energy and water services, its role to enhance and strengthen current services is even more critical in a water sector plagued by inefficiencies and unreliability from cities to villages. Overall, the real challenge is around service delivery, not just access to infrastructure.

4. GSMA Intelligence data on Unique Subscriber penetration in 2013 in Sub-Saharan Africa; the proportion will be higher in the more mature North African mobile markets.
5. World Bank 2012.
6. International Energy Agency 2012.
7. WHO & UNICEF Joint Monitoring Programme (JMP) 2013 Update
8. As mentioned in the GSMA MECS report "Sizing the Opportunity of Mobile to Support Energy and Water Access".
9. Based on JMP 2013 figures.
10. As defined by WHO/UNICEF JMP: an improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with faecal matter.

FIGURE 1

MOBILE ACCESS VERSUS ELECTRICITY, WATER AND SANITATION ACCESS IN SUB-SAHARAN AFRICA (2000-2015)[11]



11. Source GSMA

Using mobile channels to support energy and water access

In recent years, a new generation of innovators has begun to experiment with the application of mobile technologies and services to energy and water solutions. From the piloting phase, some of these solutions have moved to commercial deployments, mainly in the East Africa region where the majority of mobile-enabled energy and water solutions have been deployed in the last five years (See Appendix 2 for current mobile-enabled energy and water services in Africa). Because of the reach and ubiquity of mobile services and mobile phones across the African continent, there is a significant opportunity not only to increasingly harness the power of mobile to strengthen current utility services in urban and rural environments, but also develop new service delivery models to address some of the key challenges services providers are facing: affordability of services and products, low payment efficiency, inefficient operations and maintenance, limited customers analytics, low accountability and transparency.

Based on the current footprint and maturity of the mobile industry, the GSMA Mobile Enabled Community Services Programme envisages that Energy Service Companies (ESCOs) and Water Service Providers (WSPs) could benefit from the presence of mobile networks and access to mobile devices, services and technology through five channels:

- Mobile infrastructure – leveraging the presence of telecom towers in off-grid environments to support rural electrification efforts;
- Mobile Network Operator (MNO) distribution and mobile money agent networks – leveraging the footprint and brand of mobile operators to reach underserved customers;
- Machine-to-machine connectivity – enabling the remote monitoring and Pay-As-You-Go capacity of decentralised utility systems;
- Mobile payments – providing financing and affordable solutions to low income populations;
- Mobile services (Voice, SMS, USSD, Applications) – leveraging increased mobile phone ownership to collect/disseminate critical information on utility services and/or supply chain management.

The role of mobile for improved energy and water access can be summarised in Table 1.

TABLE 1

IMPACT OF MOBILE CHANNELS TO IMPROVE ACCESS TO ENERGY AND WATER IN AFRICA[12]

MOBILE CHANNEL	MATURITY OF CHANNEL IN AFRICA	ENERGY	WATER
MOBILE INFRASTRUCTURE	Very limited – a few pilots exist in East and West Africa, but deployments are for now not commercial and mainly CSR, such as the Econet Wireless Energize the Chain project in Zimbabwe.	Increase sustainability of mini-grids providing power for consumptive and productive use.	Provide stable and affordable power solution for water filtration and water treatment.
MNO DISTRIBUTION NETWORK	Limited – a few distribution and marketing partnerships exist in East Africa between Energy Service Companies and mobile operators.	Improve distribution and availability of off-grid solutions (ex. home solar systems).	Improve distribution and availability of household water purification systems and other water-related products.
M2M CONNECTIVITY	Improving – the inclusion of M2M connectivity to home solar systems and hand-pumps are increasingly appealing for remote monitoring purpose and enabling the Pay-As-You-Go model. The number of GSM-enabled Pay-As-You-Go commercial deployments is gaining more traction in East Africa and soon to happen in West Africa.	Improve maintenance, enable better product design through usage monitoring, enable Pay-As-You-Go capacity.	Monitor service delivery to better inform maintenance services and planning, enable Pay-As-You-Go capacity.
MOBILE PAYMENTS	Improving – mobile money services are gaining more traction across regions in Africa and service providers are increasingly trialling mobile financial services as part of their model.	Ability to pay for energy services or products (under a financed purchase model) by small installments tailored to customers income.	Ability to pay for water services by small installments tailored to customers income, improve payment collection, offer innovative financial solutions such as micro-insurance to reduce water insecurity.
MOBILE SERVICES	Improving – services such as SMS, USSD or Apps, can be already leveraged to increase information disseminated or collected from mobile phones. Applications of mobile services to increase supply chain management are currently under development and could be widely applicable to most African markets.	Provide timely information on energy system usage, optimise supply chain operations.	Enable agents/communities to report for service/infrastructure status, optimise supply chain operations to timely deliver water related products (ex. filters).

12. Source GSMA

Mobile infrastructure

Ensuring mini-grid sustainability through partnerships

SUMMARY

MOBILE INFRASTRUCTURE CHANNEL

NEED TO STRENGTHEN PARTNERSHIPS BETWEEN MOBILE OPERATORS/TOWER COMPANIES AND ESCOS FOR MINI-GRIDS AND ENERGY HUBS PILOTS IN 2014: The concept of leveraging the large presence of telecom towers in off-grid environments to support rural electrification efforts is still at an embryonic stage in Africa. Although an increasing number of mini-grids are being deployed across the continent, the sector still heavily rely on subsidies. Kilowatt scale mini-grids could play an important role in rural electrification supported by the presence of off-grid telecom towers to serve as anchor customers. With rising diesel costs, the increased maturity of Energy Service Companies and availability of mobile technologies for payment collection and load management, there is a greater opportunity for mobile operators and tower companies to partner with ESCOs and outsource their power generation as part of a mini-grid or energy hub model. Such pilots would shed more light on the impact and sustainability of these decentralised energy systems involving the telecom tower infrastructure, a model currently lacking in Africa.

Developed as part of the previous GSMA Community Power from Mobile programme[13], the concept of leveraging the large presence of telecom towers in off-grid environments to support rural electrification efforts is still at an embryonic stage in Africa. However, with prices of renewable energy solutions, such as solar, falling, rising diesel fuel costs and the presence of more mature Energy Service Companies (ESCOs), conditions to develop partnerships between mobile and mini-grid operators are increasingly interesting for both parties.

As most of the off-grid mobile towers are running on diesel generators (incurring high operating expenses for operators, and diesel fuel is also subject to theft), leveraging the presence of off-grid telecom towers could lead to a synergetic relationship between the mobile operator or tower company, the ESCO operating a mini-grid or an energy hub, and the community:

- the mobile operator or tower company could reduce its operating expenditures on the long term by partnering with an Energy Service Company, and acts as anchor load in the mini-grid;
- the ESCO secures a mid- to long-term partnership with an anchor client (e.g. the telecom tower) increasing the financial sustainability of the energy infrastructure he's building, either a mini-grid (connecting households with power lines) or an energy hub (see the two models below);
- the community benefits from the mini-grid to gaining access to basic and productive energy services for their households and in doing so, reducing its reliance on fossil fuels, along with a productive use of power for local SMEs and the opportunity to have greater access to clean water requiring filtration techniques.

Two models would be optional for ESCOs providing the power to a telecom tower:

1. the mini-grid model – the ESCO provides power to the telecom tower (the power plant can be adjacent to the site or close by) and builds power lines to connect the rest of the community (households and/or businesses); this model requires high population density to minimise distribution network costs and power losses.
2. the energy hub model – the ESCO provides power to the telecom tower (adjacent to site) and to an energy hub located next to the telecom tower; this hub becomes the centre of energy-related activities for the community, making it possible to charge devices (e.g. mobile phones, batteries), power agri-processing systems and health-related devices (e.g. vaccine fridge).

13. http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/05/Community-Power-Using-Mobile-to-Extend-the-Grid-January-2010.pdf.

More advanced in India where the majority of telecom towers are managed by third-party vendors (e.g. tower companies), this model of leveraging the telecom infrastructure as an anchor load for mini-grids is still nascent in Africa and very few pilots exist (see GIZ Project in Uganda below). There is however an important interest for Energy Service Companies, such as Pamoja Cleantech in Uganda or Sincronicity in Tanzania, to partner with mobile operators to pilot mini-grids with the tower as an anchor tenant. There are also examples of energy hub models, such as Econet Wireless in Zimbabwe, providing power to vaccine fridges.[14] However the power is used for a very specific function (to preserve the cold chain for vaccine storing) and no power is available to the community for personal or commercial use. In several African countries, there are also examples of mobile operators providing power to community buildings on a Corporate Social Responsibility basis: in South Africa, Vodacom implemented at the end of 2011, a solar site on the Emfihlweni school rooftop, providing power to the telecom tower, the school computer room and a local water pump. Results a year after the deployment showed a significant Operating Expenditure (OPEX) reduction for the operator while enabling a better well-being for the community and computer and internet access at the school.

More than 45,000 off-grid towers in Africa

According to GSMA Green

Power for Mobile estimates, there were more than 45,000 off-grid towers operating in Africa in 2012. Although there is a growing trend for operators to deploy renewable energy solutions to power off-grid sites, only a fraction of these sites (~2,365 as of December 2013)[15] used some forms of renewable power (solar, wind, fuel cells, diesel hybrid). Telecom tower loads in rural environments usually are in the 1-3kW range (for a single tenant[16]).

Even though a proportion of these towers are not located in environments conducive to mini-grid or energy hub implementation (e.g. mountain tops), this still represents a strong opportunity for those ESCOs willing to partner with mobile operators and tower companies for anchor load consumption. A previous feasibility study carried out with Safaricom in 2013[17] identified 47 sites where ESCOs could provide significant cost savings to the operator while delivering energy services to the surrounding communities.

25% OF THE TELECOM TOWERS IN EAST AFRICA ARE OFF-GRID

As reported by the Green Power from Mobile team,[18] Kenya, Tanzania and Uganda combined have a total network size of 13,225 tower sites covering a population of approximately 80% across these countries. Due to the limited reach of the grid power infrastructure, close to 25% of the entire network is located in off-grid areas, i.e. without access to electricity supply, and this has led the MNOs and tower companies to rely on diesel generators to power up those off-grid network of tower sites. Even though the remaining 75% of the network is connected to the grid electricity supply, more than 25% of this on-grid network of tower sites lacks the reliability and quality of a grid power supply. This implies that more than 50% of the entire network in these countries is depends primarily on diesel generators to power up.

The tower outsourcing trend in Africa

Compared to Asia (especially India) where the majority of the telecom towers are managed by third-party tower operators, most of the telecom infrastructure in Africa remains the property of the mobile operators. However, as the African telecom markets liberalise and mature, there is a growing trend of the sale of tower assets by operators to tower operators. According to TowerXchange, there are currently 22-23,000 towers owned or managed and marketed by independent towercos in Africa[19] out of a total of 150,000 towers. The number of towers owned, or at least managed, by independent tower companies is expected to increase to more than 30,000 by the end of 2014.

With the mobile operators slowly migrating away from a full tower ownership model and towards managed services and managed infrastructure models, there should be increased opportunities for Energy Service Companies to build inclusive partnerships with operators and tower companies for energy outsourcing deals, providing solid ESCO maturity and interesting kWh rates for operators.

14. Energize the Chain programme – http://energizethechain.org/content/econet-wireless-zimbabwe-%E2%80%93-energize-chain-program-zimbabwe.
15. http://www.gsma.com/mobilefordevelopment/programmes/green-power-for-mobile/tracker
16. When a tower is shared between different operators (tower colocation or sharing model), the load increases with the number of tenants.
17. http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/02/Safaricom-Feasibility-Study.pdf.
18. http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/05/GSM_Vendor_Landscape_EastAfrica_V5.pdf
19. http://www.towerxchange.com/the-future-of-the-african-tower-industry/.

Power outsourcing model

There are three main outsourcing models applicable in the telecom industry:[20]

1. the monthly flat fee model;
2. the power purchase agreement (PPA) model;
3. the energy savings agreement (ESA) model.

The OPEX model or the energy outsourcing model is at the pre-pilot stage[21] in the East African telecom industry. The OPEX model enables the operators to reduce energy OPEX and dependence on diesel generators without having to invest the capital for the renewable energy solution. And also, outsourcing power generation will help the MNO/TowerCo eliminate the challenges associated with power management and increase the focus on core activities.

See GSMA Green Power for Mobile's "Best Practice Procurement Guide:[22] East Africa" for more information on energy outsourcing models.

CASE STUDY
GIZ IN UGANDA

The Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) GmbH is currently implementing several mini-grid projects across Uganda, in partnership with telecom operators and the manufacturer Kirchner Solar Group (KSG). KSG will also act as mini-grid operator and is investing in the solar PV generation capacity. The first mobile tower was connected in November 2012 with an installed capacity of solar energy of 10kWp. For the mobile operator, the cost savings are estimated at more than 40% while increasing customer retention through a new service (payment of electricity through mobile money). A second power supply unit (PSU) of 20 kWp was installed and is dedicated to serve the energy needs of the community of Kabunyata village. 5.5 kms of transmission lines were installed, connecting up to 100 households, 5 social institutions and 20 SMEs. Both PSUs feed into the mini-grid from two locations to minimise technical losses. The project is currently in its roll-out phase with its 1st phase expected to cover up to 100 mobile towers and 30 villages. The impact of the project is estimated to provide electricity services to more than 50,000 people in rural Uganda. It will furthermore improve the production capacities of rural enterprises, create employment opportunities for more than 50 solar technicians per year, and reduce CO_2 emissions through a fuel switch from diesel to solar PV.

20. Best Practice Procurement Guide East Africa 2013 – GSMA Green Power for Mobile.
21. Ibid
22. http://www.gsma.com/mobilefordevelopment/best-practice-procurement-guide-east-africa

Mobile distribution networks

Leveraging the footprint of African mobile operators to reach rural populations

SUMMARY
MOBILE DISTRIBUTION NETWORK

INCREASING PARTNERSHIPS BETWEEN MOBILE OPERATORS AND ESCOs – Based on the impact of existing East African partnerships, there are opportunities to secure distribution partnerships between operators and ESCOs in most of the countries in Africa to couple energy access and mobile communications. The extensive footprint of mobile operators agents coupled to their strong brand and vivid colors can catalyze access and adoption of such innovative products and services. West African distribution partnerships are already underway.

Moving goods in and around African markets is a challenging task for entrepreneurs willing to distribute products to the rural population, due to the high costs of transportation and middlemen, and also because of long lead times.[23] Lead times are even longer in landlocked countries: according to a World Bank study, countries such as Burundi and Uganda are negatively impacted as they depend on transit solutions from neighbouring countries Kenya and Tanzania. Transport costs can make up 50-75% of the retail price of goods in Malawi, Rwanda and Uganda[24] and it is estimated that the cost of transporting goods in Africa is 60-70% higher than in the US and Europe.

For young energy entrepreneurs willing to reach underserved communities, often living far from urban centers, the lack of knowledge on how to build efficient local distribution networks also makes it difficult to reach economic sustainability. In order to reach scale, partnering with institutions having established their own distribution networks is ideal:

- fast moving consumer goods – international companies such as Coca-Cola, Pepsi or Unilever have developed their own networks to move small quantities of their products across nations with difficult road conditions quickly;
- distribution specialists – in recent years, for-profit and non-profit specialists have emerged to provide life-changing products to people living in poverty and outside of the formal and affordable distribution networks. Those companies distributing energy and/or water solutions include: SolarAid Sunny Money in East Africa, Living Goods in Uganda and Kenya, Persistent Energy in Ghana, Station Energy in Senegal and Zamsolar in Zambia;
- mobile operators – since the inception of prepaid mobile communications in Africa in early 2000s, the mobile operator's formal product and airtime distribution channels have become extensive distribution networks which provide last-mile access to mobile communication solutions, but could also provide distribution solutions for ESCOs and WSPs. More developed in East Africa for now, mobile money agent networks could also be leveraged to provide products across a nation as customers make regular journeys to the agents' shops to do over-the-counter transactions or cash in/cash out operations.

23. http://www.howwemadeitinafrica.com/?p=33099.
24. http://www.economist.com/news/middle-east-and-africa/21571920-africas-booming-economy-needs-modern-trade-routes-get-move.

In 2013, three examples of distribution partnerships between operators and ESCOs existed: M-KOPA with Safaricom in Kenya[25], Fenix International with MTN in Uganda and Rwanda and with Vodacom in Tanzania, and Econet Wireless and Econet Solar in Zimbabwe. The strength of the partnership with mobile operators is to leverage their logistics, warehousing and distribution channels via their retail dealer network and service centres.

Usually distribution partnerships also include marketing activities such as:

- products co-branding to the colours of the mobile operator;
- above-the-line marketing (radio, tv and print);
- below-the-line (road shows, market activations and collateral)

In African countries where our estimated addressable energy markets are important, the opportunity to form such partnerships is even higher due to the large presence of mobile networks and low access to electricity. Providing power to mobile subscribers is the first step to increased usage.

25. As of November 2013, M-KOPA solutions were available in more than 750 shops nationwide.

Machine-to-machine connectivity

Enabling remote monitoring and Pay-As-You-Go capacities of decentralised utility systems

SUMMARY

M2M CONNECTIVITY

LOW-COST SMART METER FOR ENERGY AND WATER SOLUTIONS – The integration of low-cost but reliable GSM-enabled meters within decentralised utility systems is one of the cornerstones to the development of modern mobile-enhanced energy and water services in the developing world.

INTEGRATION OF WIRELESS MESH NETWORKS IN MINI-GRIDS – further piloting is needed to better understand the impact and challenges around wireless mesh networks' integration in mini-grids architecture and how coupling this design to GSM connectivity could create the next generation of smart mini-grids, able to efficiently monitor consumption, dynamically allocate loads and propose smart tariffs.

OPERATORS RAMPING UP THEIR M2M STRATEGY – mobile operators are increasingly looking at providing more than connectivity for M2M in order to find new revenue streams. From smart cities to connected communities, there is an opportunity for mobile operators to provide more than M2M connectivity to energy and water service providers.

The addition of GSM connectivity to centralised and decentralised utility systems in rural areas or to households meters connected to the electricity grid or piped water networks provides remote monitoring capabilities to service providers, enabling them to collect information in real time about customer consumption and unit/network operations and detect impending failures. This is a critical factor especially for rural water services in Africa where an important proportion of the recently installed hand pumps are not functioning.[26]

GSM meters are also enabling the implementation of Pay-As-You-Go (PAYG) solutions where an energy or water system can be monitored and switched On/Off remotely according to customers' credit. The prepaid PAYG model is especially attractive when servicing underserved customers with low access to capital and financing options and who can't afford to buy modern energy products or pay for piped water connections. PAYG solutions have currently gained traction in East Africa mainly, where the majority of mobile-enabled energy and water solutions have been tested or commercially deployed; however the rest of Africa could be highly impacted by such solutions provided the right ingredients are in place.

Mini-grids: smart monitoring to improve operations and maintenance

The smart meters that are beginning to be deployed in developed and some developing countries are not tailored for distributed energy systems; they are expensive (~US$150) and do not offer a functionality that serves the mini-grid well. Unlike centralised grid services, mini-grids can have limited operating hours, either a few days per week or a few hours per day depending on peak usage.

26. According to a UNICEF study in 2009, one out of three hand pumps were non-functioning in Africa due to the lack of ongoing maintenance, low community technical training and the difficulty in finding pump spare parts.

Load management technologies can significantly improve mini-grid operations and maintenance through the installation of:

- smart load limiters enabling better supply and demand management;
- prepaid metering enabling payment in small increments;
- data aggregation from generation, distribution and households consumption.

From a cost perspective, embedding a GSM component is each household meter is proving to be expensive for ESCOs as prices of GSM modules are in the US$8-12 range, in addition to the price of a mobile subscription and data communication. If the inclusion of a GSM module within the mini-grid is still highly relevant for long-haul communication, other shorter range wireless technologies are available to transfer low quantities of data at the mini-grid level between households and the central power plant.

Companies such as Devergy operating in Tanzania and Earthspark in Haiti (although not in Africa, this provides an interesting case study) are leveraging the IEEE 802.15.4 (e.g. Zigbee) wireless standard to create wireless mesh networks. Available at a lower cost compared to GSM, technologies such as Zigbee (achieving transmission distance of 10-100 m) can be used in mini-grid environments where meters require low data rate exchange, long battery life and secure networking. access:energy operating in Kenya also developed their own hardware and software solution to enable mini-grid remote monitoring through GSM networks.

Deploying such wireless monitoring units can also detect abnormal distribution losses through power lines due to technical faults or theft. By comparing the power generated at the mini-grid plant level and the power consumed by households, the ESCO has a better control of its operations.

CASE STUDY
DEVERGY IN TANZANIA

Devergy is setting up smart mini-grids, based on small solar towers in rural Tanzania; households and businesses are connected through power lines to these small solar towers. Applications include lighting, phone charging, TVs, fridges and entertainment centres. As of May 2013, Devergy had around 170 customers in two villages. Solar towers and households are equipped with Zigbee-enabled meters allowing real-time monitoring of usage and credits by the household. Load monitoring is also enabling dynamic power allocation according to demand. In each village, a centralised GSM unit is communicating information through SMS about the mini-grid operations to a central server. HTTP://WWW.DEVERGY.COM/

CASE STUDY
ACCESS:ENERGY IN KENYA

access:energy is a young energy technology business developing intelligent electronic solutions for off-grid pico-utilities. They currently sell power and services in Kenya and the UK. They have developed and operated their own mini-grids in Kenya, selling electricity directly to end-users in off-grid locations using metering technology. They also make their monitoring and control technology available to other off-grid operators. HTTP://ACCESSENERGY.ORG/

CASE STUDY
EARTHSPARK IN HAITI

EarthSpark builds kilowatt scale mini-grids in Haiti. The company currently provides electricity to 52 households (as at December 2013) from a diesel generator but is reviewing different designs such as a hybrid solar-diesel mini-grid that is able to connect 400 customers. Expansion to more households will be feasible in the near future thanks to a recent USAID grant through the Powering Agriculture programme. One of the key features of the EarthSpark system is its in-house low-cost smart meter solution, enabling prepaid energy consumption but also creating a wireless mesh network between households and the power plant to have real-time monitoring of mini-grid operations and power consumption. As well as providing power to agricultural processing facilities, EarthSpark is looking to partner with mobile operators to power their towers. HTTP://WWW.EARTHSPARKINTERNATIONAL.ORG/

Off-grid solutions: connecting household energy systems to collect data on usage

As seen in Table 2, entrepreneurs leverage different technologies to enable the PAYG capacity of solar units. Built around the central concept of enabling remote monitoring and remote switching for PAYG purposes, meters connected to the home solar systems embed a micro-controller that will be able to lock/unlock power consumption based on users' credit. This credit information can be obtained either through a keypad on the meter (e.g. Azuri Technology), audio channels (e.g. Angaza Design) or through GSM connectivity (e.g. Mobisol).

Adding a GSM component to an energy system is the most seamless solution for PAYG, as remote monitoring and credit update on the unit meter can be done over the air without an agent or user intervention. Service providers receive real-time information via SMS (usually every minute or less frequently) about the unit operations (power consumption, battery charge/discharge, etc.), customers' payments (frequency of payments, credit) and any maintenance/theft issues. ESCOs are also building an extensive database on unit operations, which could be then analysed to offer better products and services from a user-centric perspective. However the addition of a GSM machine-to-machine module to a home solar system still represents an important financial burden – according to sources, it may add up to US$40 to the unit cost.

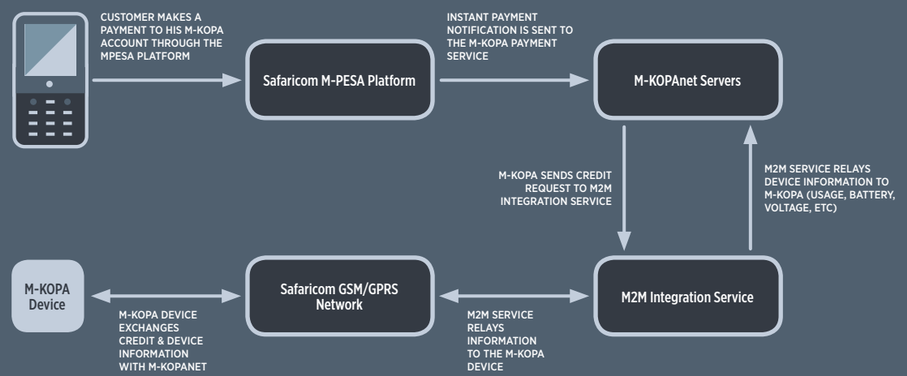
TABLE 2
COMMUNICATION TECHNOLOGIES ENABLING THE PAY-AS-YOU-GO CAPACITY[27]

TECHNOLOGY		PROS	CONS
LONG RANGE	GSM - Data	Automatic control and remote monitoring of units Building database on customers' behaviours Ability to improve product performance through data collected	Cost of the GSM connectivity (chipset and monthly data plan) Needs GSM coverage
	GSM - Audio Channel	Low cost of inclusion to enable the PAYG capacity Ability to collect data on unit remotely through mobile phones	Reliance of user's phone to transfer data Needs GSM coverage
SHORT RANGE	Ex. Zigbee, Bluetooth, Infrared	Average cost of inclusion to enable the PAYG capacity Ability to create mesh networks at the village level	Still needs to be connected to a GSM gateway to transfer data over long haul Might need agents presence to transfer credit to unit or collect information from units
INTERNAL	No Radio Frequency Capacity	Low cost to enable the PAYG capacity	No or limited data collected on unit performance Reliance on user's phone Need agents to unlock the device after contract/ service period (when available)

27. Source GSMA

CASE STUDY
M-KOPA IN KENYA

M-KOPA provides micro-financed energy products in Kenya. As of January 2014, M-KOPA provides two types of home solar systems (4W and 5W including lights, phone charger and a portable lamp); they have sold more than 50,000 units, with recent sales trend of 1,000 units per week. Each M-KOPA unit embeds a GSM module enabling the real-time monitoring and connection/disconnection of the unit according to customer credit. M-KOPA has partnered with M2M specialist Eseye to manage the M2M communication system (see diagram below). Since October 2013, M-KOPA also began to offer larger home solar systems (5-8W) including 3 lights and a portable lamp. Having received a MECS Innovation Fund Grant at the end of 2013, M-KOPA will is also piloting larger systems (~50W) with more appliances (a radio, a security light, a DC TV) in 2014 in Kenya, targeting entrepreneurs and productive use of power. Results and teachings from this pilot will be shared publicly, providing a better understanding of the potential of such mobile-enabled PAYG solutions and the key building blocks to scale. HTTP://WWW.M-KOPA.COM/



SOURCE M-KOPA

CASE STUDY
TAKAMOTO BIOGAS

Takamoto Biogas provides Pay-As-You-Go biogas systems in Kenya where their customers, mainly smallholder farmers, pay a small fee to install the biogas system and then prepay using their mobile phone for the gas they use. Targeting farmers allows Takamoto to leverage the cow dung produced on site, which is directly loaded with water in the system. Part of a virtuous cycle, the fertilizer coming from the system will be used by farmers to replenish the soil. Takamoto monitors the biogas system through a GSM connected smart meter that will send information on unit maintenance and enable the PAYG function according to a customer credit. Added to the biogas system, Takamoto provide biogas household appliances. As of January 2014, 100 farmers in Kenya were benefiting from their biogas solutions. HTTP://TAKAMOTOBIOGAS.COM/

The Pay-As-You-Go models

In the general solar PAYG model, customers usually pay a deposit, a fraction of the unit price (~10%) to get possession of a home solar system – and then pay using their mobile phone (where mobile markets are more mature) for their energy consumption by small increments daily, weekly or more flexibly according to the model and technology used by the Energy Service Company. The instalments

are usually equal to or below what users currently pay for their kerosene expenditures used for lighting and phone charging. In Kenya, underserved customers can spend ~US$0.40 per day on kerosene and up to US$3 per month on phone charging (~US$0.10 per day).

Two models are currently used by entrepreneurs operating in Africa providing PAYG schemes:

- Lease-to-own or financed purchase – the Energy Service Company provides a micro-financed solution to its customers, where users are repaying for the full price of the unit by small increments. Once they repay the full amount, they fully own their device and can use it freely (if the unit is GSM-enabled, the switch will be permanently unlocked without any agent intervention). Customers have then the choice to continue using this unit or benefit from preferential tariffs to upgrade to a new product with larger capacity and improved efficiency. Products usually come with a warranty of one to three years according to contract terms.
- Perpetual lease or "energy as a service" – the Energy Service Company is providing a service to its customers rather than a product as a standalone and the home solar system remains the property of the service provider. The ESCO charges an installation fee and customers purchase energy by small increments (this amount varying according to solution size); for example, Off-Grid Electric charges ~US$6 per installation and as little as US$1.25 per week (~US$0.18 per day). Energy prices are usually lower than in the lease-to-own model as the solar system or other products provided by the ESCO (more lights, TV, fridge , etc.) remain its property. Full maintenance is also ensured under the service agreement with the end-user.

The home solar systems provided under these PAYG models are supplied one of two ways. They might be supplied by solar product specialists: for example, M-KOPA has a partnership with d.light Design, Off-Grid Electric with Fosera. Or they can be developed internally such as Angaza Design and Econet Solar. For more details about current PAYG offers, Table 3 offers a listing of the products available and the technologies used by ESCOs in Africa (as of November 2013).

Customer credit check process

In the PAYG model, ESCOs or distributors are almost fully financing the home solar systems that customers are installing on their rooftops, and only get a fraction of its price when customers make a down-payment. The ESCO bears the financial risk of default by unbanked customers who have little credit information. The deposit a new customer has to put down acts as a first filter for serious customer selection, complemented by the deployment of different methods to assess customers' ability to make repayments for their products: for example, Mobisol rigorously assesses customer credit, through community information and assets ownership (appliances, cattle and goats); Econet Solar, which is affiliated with Econet Wireless, has access to customers' prepaid airtime payment information from the mobile operator, allowing a quick credit check.

Even if default rates have been rather low (<5%) according to entrepreneurs offering PAYG, it remains to be seen if the PAYG model can work on a larger scale and for larger (e.g. more expensive) home solar systems – the key question is, beyond the due diligence on unbanked customers, whether repayment behaviours will be strong enough to support further credit-based energy financing for SMEs.

CASE STUDY
MOBISOL

Operating mainly in Tanzania and Rwanda, Mobisol provides solar home systems solution and appliances under a financed purchase model. The company has developed their own hardware and software solutions, connecting their systems through GSM networks and enabling their customers to pay installments using their mobile money account. One of the core Mobisol principles is also to enable a productive use of power for local entrepreneurs, as they provide several solar solutions ranging from 30 to 200 W. For companies such as Mobisol operating in rural locations, the operational strategy can make the difference more than the product itself. Mobisol relies on the presence of local agents living directly within the community to sell and provide aftersales services to customers. These local workers are trained and paid on a commission basis. Through the development of a local value chain, from a market hub where customers can find Mobisol products, marketing agents and local technicians, customers are at the center of this rural strategy. HTTP://WWW.PLUGINTHEWORLD.COM/MOBISOL/

TABLE 3

COMMERCIAL PAY-AS-YOU-GO SOLUTIONS BY SERVICE MODEL, PAYMENT TYPE AND TECHNOLOGY[28]

COMPANIES	COUNTRY OPERATIONS	DISTRIBUTION MODEL	SERVICE MODEL	PAYMENT TYPE	TECHNOLOGY	CONTRACT LENGTH	DETAILS
M-KOPA	Kenya, Uganda	Partnership with Safaricom	Lease to own	Mobile money – Daily fee	Long Range - GSM data	12 months	M-KOPA provides 2 bundles with 4W and 5W solar panels with lights, phone charging and radio. Warranty is 1 to 2 years. M-KOPA received a MECS Innovation Fund Grant in 2013 to pilot a larger scale solution for income generating activities in Kenya in partnership with Safaricom.
MOBISOL	Tanzania, Rwanda	Own distribution	Lease to own	Mobile money - Monthly fee	Long Range - GSM data	36 months	Mobisol provides several bundles from 30W to 200W, with lights, mobile phone charger and other appliances such as radio, TV and fridge. Warranty usually 3 years. Mobisol received a MECS Innovation Fund Grant grant in 2013 to pilot a larger-scale solution for income generating activities in Rwanda in partnership with MTN.
OFF GRID ELECTRIC (OGE)	Tanzania, Ghana	Own distribution	Solar as a service	Mobile money – Daily fee	Internal – non wireless	-	OGE provides 3W home solar systems with lights, mobile phone charger and other appliances. OGE agents are also equipped with smartphones to register and improve customer relationship management
AZURI TECHNOLOGIES	Kenya, Uganda, Tanzania, Ethiopia, Rwanda, Ghana and South Sudan ...	Partnership with SolarAid Sunny Money in Kenya	Lease to own	Scratch cards or e-payment	Internal – non wireless	18 months	The Indigo Duo solar home system has a 2.5 W PV module, also including a controller housed in a case with a keypad, lights and phone charger. The system also includes a controller housed in a case with a keypad and sockets for the PV module and a USB port for phone charging. New system designs will soon be piloted including a 5 W Indigo Quad system (four lights, phone charging leads and a radio) and a 30 W system (with eleven USB ports) targeting small phone-charging businesses.
ANGAZA DESIGN	Kenya, Tanzania	Own distribution and partnership with SolarAid Sunny Money	Lease to own	Scratch cards or mobile payments – Daily fee	Long Range - GSM Voice Channel	-	Angaza provides 3W home solar systems with lights and a mobile phone charger. The unit is also able to send and receive data through the user's mobile phone audio channels.
ECONET SOLAR	Zimbabwe, Lesotho, Burundi	Partnership with Econet Wireless	Solar as a service	Airtime billing – Daily fee	Long Range - GSM data	-	Econet Solar providers its home power system, including wireless 4 LED lights, a phone charger and other accessories (mosquito repellent, TV, fridge).
FENIX INTERNATIONAL	Uganda	Partnership with MTN Uganda	Lease to own	Mobile money – Daily fee	Short Range Wireless	-	Fenix International provides its ReadyPay kit, including lights, phone chargers and other appliances, especially targeting a productive use of power for small entrepreneurs.
NOVA LUMOS*	Guinea, Nigeria	MTN Nigeria and Cellcom Guinee	Lease to own	Airtime billing	Long Range - GSM data	-	Nova Lumos received a MECS Innovation Fund Grant grant in 2013 and will start piloting their Pay-As-You-Go solution in partnership with MTN Group in West Africa in the first quarter 2014. Their product will package a home solar system, lights and phone charging solution for each household.

*In planning phase

Mobile monitoring solutions to improve operations and availability of water services

There is a high probability of failures of water systems in rural Africa due to limited local capacities and financing for maintenance, and weak accountability of governments, service providers and NGOs. Mobile technologies could be leveraged to improve maintenance and sustainability of operations through the inclusion of a smart meter on a water system or by crowdsourcing information through mobile phones, from water service provider agents and the community. Thanks to the increasing rural mobile coverage, two-way communication platforms can be developed to enhance the information flow between communities and water service providers and governments.

28. Source GSMA

Smart GSM meters to reduce hand pump failures and increase transparency

Developing low-cost smart meters for hand pump monitoring is one of the key areas of mobile innovation applied to water services. The lack of recent and adequate data on water availability and the performance of water services and infrastructure is an important hurdle to the development of better policies targeting water supplies in Africa. Few solutions are available for now and most of them are currently being tested in the field – more data on the impact of such technologies on improved water access and maintenance should be released in the coming months.

Portland State University, the University of Oxford and WellDone International have each developed their own mobile monitoring solution (hardware and software), such as embedding a micro-controller in the handle of the pump or the pump head, with GSM connectivity coupled to a flow meter and/or an accelerometer detecting manual pump operations. These different solutions can indicate the amount of water fetched by the community or by individuals and when the pump is activated or needs maintenance. Information is regularly sent via SMS to a central database which builds up a history of community water usage in terms of volume, frequency of use or pump failures.

In order to maximise the impact of the data collected by mobile tools, open online platforms will be key to the monitoring of development indicators and accurately inform decision makers on how to improve the performance of water supplies. The analysis of this openly accessible data could also lead to direct benefits for the communities, i.e. the greater predictability of breakdowns could help drive down the cost of repairs.[29]

CASE STUDY
PORTLAND STATE UNIVERSITY

The Portland State University SweetLab has developed a proprietary SweetSense sensor technology able to collect and disseminate information over mobile networks on the usage and performances of products (e.g. cookstoves, rural infrastructure such as bridges, sanitation and water systems). In November 2013, the team was awarded a grant from the MECS Innovation Fund to deploy their sensors with GSM connectivity on 200 hand pumps installed by NGO Living Water International (LWI) in Rwanda. The data collected will be recorded and integrated with a smartphone application, alerting technicians when repairs are needed. Portland State's goal is to demonstrate the impact of smart sensors in water programs at scale and to reduce water pump failure. Results and teachings from this pilot will be shared publicly by the end of the year, providing a better understanding on the real impact of mobile monitoring on water service delivery and what next steps are needed to scale and replicate such initiative across regions. HTTP://WWW.PDX.EDU/SWEETLAB/

CASE STUDY
THE UNIVERSITY OF OXFORD

Under the 'mobile/water for development' initiative, a research team from the University of Oxford has trialled smart hand pumps solutions in Kenya and Zambia. A mobile data transmitter and an accelerometer are installed into each hand pump (more than 300 hand pumps have been installed in Kenya as of November 2013), monitoring the amount of water fetched by different communities and transmitting this information via SMS to the Smart Hand Pump database in Nairobi. The data can be analysed and collated into a map which illustrates which hand pumps are being used regularly and where problems occur. When a hand pump stops transmitting information, it is assumed that the pump is failing and an agent is sent on site for maintenance. Results from a one-year trials in the Kyuso district should provide critical data on the impact of such solutions. HTTP://OXWATER.CO.UK/

CASE STUDY
WELLDONE

WellDone, a non-profit based in San Francisco, is developing the MoMo (Mobile Monitor) platform, an open-source mobile technology that will allow donors, businesses, governments and NGOs to aggregate sensor data from remote infrastructure, such as water or energy systems. The core technology consists of a smart GSM meter that attaches to hand pumps, pipes, and power systems and sends regular SMS to the WellDone database. WellDone will be able to remotely monitor the water or energy output to determine how many people are receiving basic services every day. Data from MoMo will also help communities monitor the effects of infrastructure projects and inform future investments. HTTP://WELLDONE.ORG/

29. http://www.safewaternetwork.org/pdf/Hilton%20Ghana%20Market%20Assessment.pdf.

Smart sensors to monitor water kiosk operations

The water kiosk model is more efficient and able to generate profits when located at the heart of a dense community (i.e. peri-urban or rural dense locations). According to Safe Water Network, approaches that rely on capital recovery for water kiosks are generally unrealistic in communities with populations of fewer than 5,000 persons if prices are to remain affordable.[25] Kiosks implemented by Grundfos Lifelink in Kenya and Uganda, and Safe Water Network in Kenya and Ghana, leverage mobile technologies in order to improve operations and optimise services. In the case of Grundfos Lifelink, each site is equipped with a series of sensors coupled to a GSM meter that is able to transmit information in real time about the water availability and customer payments.

CASE STUDY
SAFE WATER NETWORK

Safe Water Network, a non-profit company based in New York, is developing decentralised market-based approaches to support sustainable access to water in Ghana and Kenya. The water service can be provided and managed by a local community or the private sector (i.e. entrepreneurs, private companies). As of August 2013, eight locally-owned water kiosks were covering their operating costs and providing safe water to more than 36,000 people. Safe Water Network is using a remote monitoring system developed by IBM to provide its local operators with real-time data on water station performance for improved decision making.
HTTP://WWW.SAFEWATERNETWORK.ORG/

Mobile payments

Providing financing solutions and payment flexibility to cash-constrained populations

SUMMARY
MOBILE PAYMENTS

MOBILE OPERATORS TO OPEN THEIR MOBILE MONEY API? – there is an increasing number of energy and water solution providers who are eager to leverage mobile money services part of their services. Due to proprietary APIs, it can be difficult for entrepreneurs to integrate mobile money services as part of their solution. Fully opened APIs, or opening it to a selected list of service providers for a piloting period, could generate impactful results for mobile operators and service providers.

UNDERSTANDING THE IMPACT OF PAY-AS-YOU-GO TO INCREASE MOBILE MONEY ADOPTION IN RURAL ENVIRONMENTS – mobile operators are facing difficulties to increase penetration of mobile money services in rural environments. The opportunity to leverage the distribution of GSM-enabled PAYG solutions where customers use a mobile money account to pay for energy or water could impact on mobile money uptake in these environments. Results from commercial deployments and pilots funded by the GSMA MECS Innovation Fund in 2014 will provide insightful information.

PILOTING MICRO-INSURANCE SCHEMES – the use of mobile as a a distribution channel for micro-insurance products is still limited, however its potential to increase access to such schemes could be important especially in places where mobile money markets are more mature. The results of current pilots, for example for increased water security in rural environments, will provide realistic data on this opportunity.

Mobile money services represent one of the biggest opportunities to increase financial inclusion in Africa. According to the *State of the Industry 2013: Mobile Financial Services for the Unbanked*[30], there were more mobile money accounts than bank accounts in 9 African countries: Kenya, Uganda, Tanzania, Madagascar, Cameroon, DRC, Gabon, Zambia and Zimbabwe. East Africa accounts for a particularly large portion of mobile money accounts globally, representing 34% of total registered accounts (more than 98 million registered accounts as of June 2013).

There are strong opportunities for ESCOs and WSPs operating in Africa to leverage mobile payment services to provide micro-financed and affordable prepaid utility solutions to underserved customers, while collecting valuable information about their ability to pay. As mobile money is becoming more mainstream, with services already available in 36 out of 47 countries in Sub-Saharan Africa, more opportunities should arise for entrepreneurs outside of East Africa to leverage this payment platform. Bundling energy or water services with mobile money accounts also represents an important opportunity for mobile operators to drive adoption of these mobile financial services in rural locations, something that has proved difficult so far.

Leveraging mobile payments for off-grid energy access

Affordability of energy services and payment efficiency are two important challenges from a community and service provider perspective. Using a prepaid mode of energy consumption ensures that customers are paying for what they consume, lessening the risk

30. http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/02/SOTIR_2013.pdf

of over-usage in a post-paid case. Coupling mobile prepaid solutions to remote monitoring (through GSM or other wireless technologies) represents one of the most interesting innovation mobile could to bring to the energy sector.

Mobile money payments, airtime billing, scratch cards (similar to airtime purchase) and Premium SMS are the most common methods used by energy entrepreneurs to collect payments. The convenience of autonomous payments such as mobile money services or airtime billing is, however, superior due to its seamless mobile integration as users can top up their energy credit directly from their phone.

The combination of mobile payment and mobile monitoring can allow:

- increasing affordability – Pay-As-You-Go for energy where customers are using their mobile phone to top up for their energy consumption, and mobile payments can be made through mobile money services when available, SMS payments, scratch-cards or airtime billing;
- enabling connection finance – if a household is unable to afford a mini-grid connection, mobile payments could be leveraged to allow customers to repay the cost of the connection when they pre-pay for energy (provided external financing solutions are available);
- proposing smart tariffs – instead of charging fixed monthly tariffs, customers can be automatically charged based on their energy usage or time of usage (e.g. tariffs will be lower at off-peak hours);
- improving payment efficiency – instead of having volunteers or staff collecting payments, these can be processed directly through mobile channels and updated directly on the house meter and online;
- controlling customer consumption – if a mobile-enabled meter is installed in a household, access can be remotely enabled/disabled based on customer credit.

Mobile payments in mini-grid systems have a strong potential in Africa as an increasing proportion of the population who could be serviced by mini-grids have adopted or are adopting mobile payments solutions.

Mobile payments as an enabler across the water service delivery value chain

More than 80% of the African population does not have access to a formal bank account[31]; as a part of this poverty scenario, the unbanked population has limited resources to spend on clean water and is unable to afford expensive piped water connections without external financial support – African households spend, on average, US$4 per month on water[32], representing ~2% of their household income. From a rural perspective, the difficulty of providing sustainable water services is also partly due to the availability of free water resources (e.g. surface water), which might be hazardous to drink but is free of charge to the low-income population.

The growing availability and penetration of mobile money services offer strong opportunities for service providers to increase their payment efficiency while offering a convenient payment method to their customers. It can also trigger the development of innovative water financing schemes based on the partnership between utilities, financial institutions and mobile operators.

Improve utility operations and payment efficiency through mobile channels

Water utilities in Africa are highly challenged by ageing infrastructure inducing leakages and wastages, lack of accountability, theft and corruption – these factors can contribute up to 70% of urban water utilities revenues loss in some African countries.[33] These challenges lead to a situation where urban water services through piped connections are intermittent and poor, reducing the quality of service and expansion possibility. In 2010, only 26% of urban water users were connected to piped supplies, down from 50% in 1990.[34]

In East Africa, water utilities began using mobile-enabled payment methods (i.e. mobile money services, mobile banking channels and wireless pay points) in mid-2009 to augment revenue collection and improve customer services. Paying water bills was, and still is in

31. AfDB 2013 - http://www.afdb.org/en/news-and-events/article/fostering-financial-inclusion-with-mobile-banking-12125/.
32. Banerjee and Morella 2011 – Review of Africa water and sanitation infrastructure.
33. University of Oxford 2013 – Wireless Water: Improving urban water provision through mobile finance innovations.
34. Ibid

some places, a burden for customers which might have to queue for hours at a local utility office only to settle their balance. A recent study in Tanzania by the University of Oxford on mobile water payments has shown that:

- mobile water payments are an effective tool for making improvements in revenue collection;
- mobile payment innovations break down the monthly billing and allow flexible customer payments;
- however, mobile payment innovations did not improve payment timeliness in Dar es Salaam.

As most of the mobile operators offering mobile money services enable utility bill payments, there is an immediate synergy for utility companies to leverage these platforms to reduce non-revenue water.

In informal settlements where there is a lack of information on water utility customers connected to the piped networks, mobile can also bring innovative ways to improve information on water consumption and payment efficiency, through a combination of mobile payments technology and water meter reading through mobile phones. Based on public-private partnerships, more opportunities are beginning to emerge which should encourage more trials.

Mobile money solutions for rural water services

Rural water service delivery from improved sources may often be in competition with free water resources (e.g. open rivers or unprotected wells). This can present challenges in customers' willingness to pay for services, which is further eroded when hand-pumps fail and customers have no choice but to return to alternate and unsafe sources.

Due to their flexible and increasingly ubiquitous nature, mobile payments can be an efficient way for customers to pay their water service providers on a Pay-As-You-Go basis, weekly or monthly. If the Pay-As-You-Go for water model is already widespread in Africa through local water vendors, Grundfos Lifelink is one of the only companies offering water access on this prepaid basis where customers use their mobile money account to purchase water. Using a solar-powered water kiosk model, Grundfos estimates that its unit has a lifetime of 10-15 years and a total life cycle cost as low as US$1 per cubic meter. However the cost of a full unit (including solar energy, pump, storage and tapping station) remains a hurdle towards profitability (cost has been above US$20,000), and the company is currently developing a new version of its mobile-enabled water kiosk for a fraction of its current cost.

Added to payment opportunities, other innovative financing or savings mechanisms can be potentially developed to increase rural water resilience and security. The maintenance of rural water systems is one of the main challenges to sustainability, as paying for this service or spare parts can be difficult to afford for communities that are often unbanked or only now having access to mobile money services. The development of new mobile-based approaches to insure communities against rural hand pump risk could help design an efficient micro-insurance model for poor customers.

CASE STUDY

WORLD BANK PROJECT WITH NAIROBI WATER UTILITY IN KAYOLE SOWETO

In 2012, the Nairobi City Water and Sewerage Company (NCWSC) launched a social connections programme to increase access to clean drinking water and sewerage services to about 90,000 underserved residents of the Kayole Soweto informal settlement in Nairobi's Eastlands area (this represents installing water meters in 2,200 plots).

The average cost of getting piped water connection from the Nairobi Water Company is KES8,215 (about US$100), which includes a non-refundable fee which comprises a deposit for meter installation, piping and fittings. Although residents are willing to pay for improved service, the connection costs are unaffordable to most households.

The social connections approach employs an innovative financing and micro-credit scheme through which low-income households can access subsidised micro-loans and stagger the payment of bills for water consumed. Low-income households can borrow small amounts of money to offset the initial costs of getting a water connection and, through a flexible payment scheme, repay the loans together with the monthly water bill over an agreed period.

The loans accessed under Maji Mashinani, the name of this initiative, are processed through K-Rep Bank, a local microfinance bank, from which 50% is repaid through an output subsidy from the World Bank's Global Partnership on Output-based Aid (GPOBA). NCWSC is also developing an ICT platform that will enable water consumers to use a mobile phone to send their own water meter readings, query and receive current water bills, then pay using mobile money such as Safaricom's M-PESA and Airtel Money.

Mobile Number serves an as ID for customers paying their bills through M-PESA – the mobile number is linked to an address to a water meter with consumption information.

S/NO	S/O	NAME	LR NO	MNO	DATE	MOBILE NO	ARTISAN
9	2488006	GEOFFREY OCHAMI KALOR	11 KAYOLE SOWETO	11 11184	29/8/2012	726993566	ONYANGO
10	2488024	MARY ATIENO ODONGO	9 KAYOLE SOWETO	11 15981	29/8/2012	726950905	MATHENGE
11	2488087	MARK O YOGO	22 KAYOLE SOWETO	11 11187	29/8/2012	723571428	HELLEN
12	2488091	PATRICK ISALU AMARIATI	3/410 KAYOLE SOWETO	11 15987	29/8/2012	721609406	MARTHA
13	2488079	G WAIHENYA	854 KAYOLE SOWETO	11 15985	29/8/2012	727469259	KIBUCHI
14	2488030	ABDULRAZAQ W KILONDO	3/449 KAYOLE SOWETO	11 15989	29/8/2012	724153951	ONYANGO

CASE STUDY

MSABI

MSABI is non-profit based in Tanzania currently piloting a micro-insurance system for rope pumps with 29 schools and 24 communities. Each community or school pays a monthly US$4 premium either through mobile money services or other solutions. Based on early results, MSABI is now testing how they can further demonstrate the value of the system and how proactive maintenance in addition to reactive maintenance of assets improves subscription and payment rates. HTTP://MSABI.ORG/

Mobile services (SMS, USSD & Apps)

Leveraging increased mobile ownership to collect and disseminate information on utitlity services and supply chain management

SUMMARY
MOBILE SERVICES

INCREASED OPEN DATA – data collected through remote monitoring and crowd-sourced methods will began to build important histories on energy and water usage for individual customers and communities. Better information will be channelled to end-users via SMS or Apps to enhance product usage and well-being.

SUPPLY CHAIN MANAGEMENT PLATFORM – as of 2013, there is an increasing trend for distributors to develop mobile tools that will help them manage their supply chain and improve customer relationship management. The solutions which are currently emerging in Africa, where agents can leverage feature phones to order stocks in real time, should better address the last-mile distribution challenge.

There were close to 400 million unique subscribers in Africa at the end of 2013.[35] One-third of these mobile subscribers are estimated to be living off-grid (~135 million people). Considering the growth of mobile networks in Africa versus the slow expansion of modern energy access (grid electricity, mini-grids or off-grid renewable energy solutions), the number of off-grid mobile subscribers is most likely to grow in upcoming years under a business as usual approach.

The increasing presence of mobile phones in underserved off-grid communities makes it an attractive proposition to strengthen rural electricity and water access based on:

- in Africa, phone charging is a highly viable economic activity where the grid is absent.[36] Local micro-enterprises can provide mobile phone charging services to their community when they get access to an affordable source of energy;
- mobile phones owned by the communities and/or agents working for a service provider can be leveraged to increase the dissemination/collection of critical information on community well-being and utility systems operations;
- players in the distribution value chain of energy or water products could also use mobile platforms to better manage sales stocks and operations while improving customer relationship management.

35. GSMAi on Unique Subscribers, representing the total unique users who have subscribed to mobile services (excluding M2M)
36. GVEP 2011 – Phone charging micro-businesses in Tanzania and Uganda.

Mobile-based monitoring solutions for utility agents and communities

With the prices of smartphones falling in Africa (entry level models start at ~US$50) and increased ubiquity of low cost or feature phones within rural communities, organisations such as AKVO FLOW and Manobi have developed their own mobile-phone based solutions to improve rural water supply management and monitoring through on site data collection. Once information is collected by a utility or NGO worker or the community, it can be sent to an online database for further analysis and visualisation, through GSM networks as an SMS or stored on a smartphone and uploaded through WiFi. Using these mobile survey tools, NGOs or water service providers can directly interact with the community members and find out if the water service is reliable, whether someone can fix the problems, and better understand ongoing issues.

CASE STUDY
AKVO FLOW

After Water for People developed the original FLOW software, they entered into an agreement with software specialist Akvo in 2012 to further develop FLOW as an open source tool and to provide technical support for other organisations globally wanting to use it. The FLOW platform consists of:

- Smartphone data collection: the Akvo field survey application runs on Android phones with integrated GPS, camera and custom surveys;
- Web-based dashboard where stakeholders can manage and analyse surveys and data;
- Visual map-based reporting tools displayed geo referenced monitoring data.

As of March 2013, Akvo Flow has been extending its reach and impact, being used by 29 organisations in 27 countries. HTTP://AKVO.ORG/PRODUCTS/AKVOFLOW/

CASE STUDY
MANOBI MWATER

Manobi has developed a mobile phone-based performance monitoring system enabling rural water service providers to facilitate the monitoring of piped water schemes and improve operations in West Africa. The mWater application installed on a feature phone or smartphone allows water scheme managers to forward weekly information about performances, with data being uploaded online. Information includes the bulk water meter index, savings and current accounts and the number of days when the service is not available. Agents can also report systems malfunctions directly through SMS to the maintenance operator. As of November 2013, the mWater service was available in Senegal, Niger, Mali and Benin. HTTP://WWW.MANOBI.NET/

CASE STUDY
SEESAW GHANA

Community Water Solutions (CWS) is a social enterprise based in the US, supporting water entrepreneurs in Northern Ghana to treat and sell safe water to local communities. In partnership with CWS in Ghana, SeeSaw piloted the SeeTell application in 13 CWS-supported communities; SeeTell is a reporting system that uses missed calls to signal information. SeeTell has been customised for CWS in order to permit entrepreneurs to signal issues by using their own or even borrowed mobile phones; these missed calls signaling specific maintenance challenges (e.g. lack of chlorine, damaged tanks, etc.). Customized reports are received three times a week by CWS, who uses this information to reduce their response time and track trends over time. For a limited period SeeSaw and CWS gave all entrepreneurs an airtime incentive of 2 Ghana Cedis (~US$1), for every month they reported, to entice them to use this reporting platform. Since this pilot, the solution has been extended to 55 communities and now airtime is offered via a competitive process to the most reliable reporters. HTTP://GREENSEESAW.COM/

CASE STUDY
IRC TRIPLE-S UGANDA[37]

In Uganda, the mobile phones for improved access to clean water programme (M4W), a collaborative initiative by SNV, IRC/Triple-S, Makerere University, WaterAid and the Ministry of Water and Environment, has been running for more than two years with some level of success. Using the M4W system, a generic data collection and management system that uses multiple technology platforms (PCs and mobile phones), a water user is able to send a message on a faulty water source and have this water source fixed within a short period of time, depending on the magnitude of the fault assessed. In case there is a problem with a water source, the user sends a text message to a specific number, indicating the source identification number and the nature of the problem. Once the system receives the notification, it generates an SMS which is automatically sent to the relevant agent's phone. A comparison between the data from the Sector Performance Report (SPR) (2012) and the M4W (2013) showed a general upward trend in the functionality figures drawn from all the eight M4W implementing districts. Since October 2011 when the system was initiated, at least 1,561 messages on faults have been received, of which 377 water sources have been fixed. This represented 24% of the water sources being repaired in all the eight districts on the basis of the messages received. The M4W system has strengthened the existence of hand pump mechanics associations and their ability to perform operation and maintenance support services in the eight piloting districts where the initiative is being implemented. HTTP://M4WATER.ORG/

Monitoring water quality through mobile

Added to the challenges of water availability, water quality is another important hurdle to the African population's overall well-being – each year, diarrhoea kills around 760,000 children under the age of five years worldwide and a significant proportion of diarrhoeal disease can be prevented through safe drinking water and adequate sanitation and hygiene. Water quality can be impacted both by natural processes and human activities, including domestic, agriculture, industry and environmental engineering.

Sensors that are able to measure the quality of water sources in situ and the use of mobile phones to transmit data about quality could enable real-time (or almost real-time) monitoring of water points. Identifying early regional or community-based water quality issues would help better understand and prevent diseases and epidemics. Data collected through day-to-day mobile monitoring of quality levels could help forecast how quality and contamination may evolve due to environmental factors so to ensure long-term health.

CASE STUDY
MWATER IN TANZANIA

mWater is a non-profit tech start-up that creates technology to improve access to safe water, sanitation, hygiene and health. The flagship mWater mobile app, available on the Android platform or on any computer or device with a compatible web browser, is a free and open-source tool for mapping water points, performing water quality testing and conducting surveys on a mobile device. The mWater platform is designed to encourage collaboration at the local level around water point monitoring and maintenance, increasing the capacity of communities to manage their own water systems while providing valuable data on water sector performance at the regional, national and global scale. HTTP://MWATER.CO/

37. http://www.waterservicesthatlast.org/media/publications/monitoring_functionality_using_mobile_phone_technology

Conclusion

The success of mobile telecommunications in Africa is enhancing the opportunity for energy and water practitioners to develop innovative access models on a continent where poverty and the lack of access to infrastructure have been systemic. According to the mobile market maturity in each African country, five mobile channels can support the growth of innovative models of energy and water service delivery.

Based on the current reach and impact of the mobile infrastructure, technologies and services, the development of mobile-enabled Pay-As-You-Go solutions under a financed purchase or energy as a service model appears to have the highest impact in the short term for the African off-grid population. Thanks to mobile, units can be remotely monitored through machine-to-machine connectivity over mobile networks and customers can make payments directly via their mobile phones. As mobile money services get more traction across markets, this should further support the growth of clean energy solutions. Overall, there is room for innovation – an opportunity to scale-up the PAYG models in most parts of Africa provided the right ingredients are present: namely reliable products, the availability of working capital for the ESCOs, and a stable and efficient distribution and after-sales network. Partnerships with mobile operators can also cement such energy solution deployments, the operators bringing their marketing and distribution power to reach more customers. On a mid-term scale, the impact of mobile on mini-grids and energy hubs operations could also prove important, as mobile can strengthen the business case of these decentralised energy solutions through the presence of off-grid telecom towers as an anchor load, smart metering and monitoring to improve load management, and mobile payment and financing to improve payment collection and affordability of the service.

From a water perspective, mobile is at an early stage of integration, although some initiatives such as the Water for People and AKVO Flow solution has been used for years to improve monitoring of water and sanitation systems. Mobile solutions have an important role to play in the water sector: mobile monitoring could improve the data flow between the water infrastructure (e.g. hand pumps) and utilities in order to improve sustainability; mobile financial services can improve payment collection and offer new financing options for customers. The GSMA Mobile Enabled Community Services Innovation Fund awarded several grants at the end of 2013 to water specialists to pilot mobile technologies and services in 2014 – for example, Living Water International (LWI) in partnership with Portland State University will conduct a national level roll out of machine-to-machine enabled cellular reporting sensors on LWI managed hand pumps in Rwanda, with support from MTN; in Angola, Development Workshop Angola, in partnership with SeeSaw, will trial a suite of mobile enabled tools to evaluate the effectiveness of peri-urban water delivery for the Luanda Water Company (EPAL). By the end of this year, insightful teachings on these pilot operations and results will be shared publicly, providing a better understanding of the real impact of mobile monitoring on water service delivery and what steps are needed next to scale and replicate such initiatives across regions.

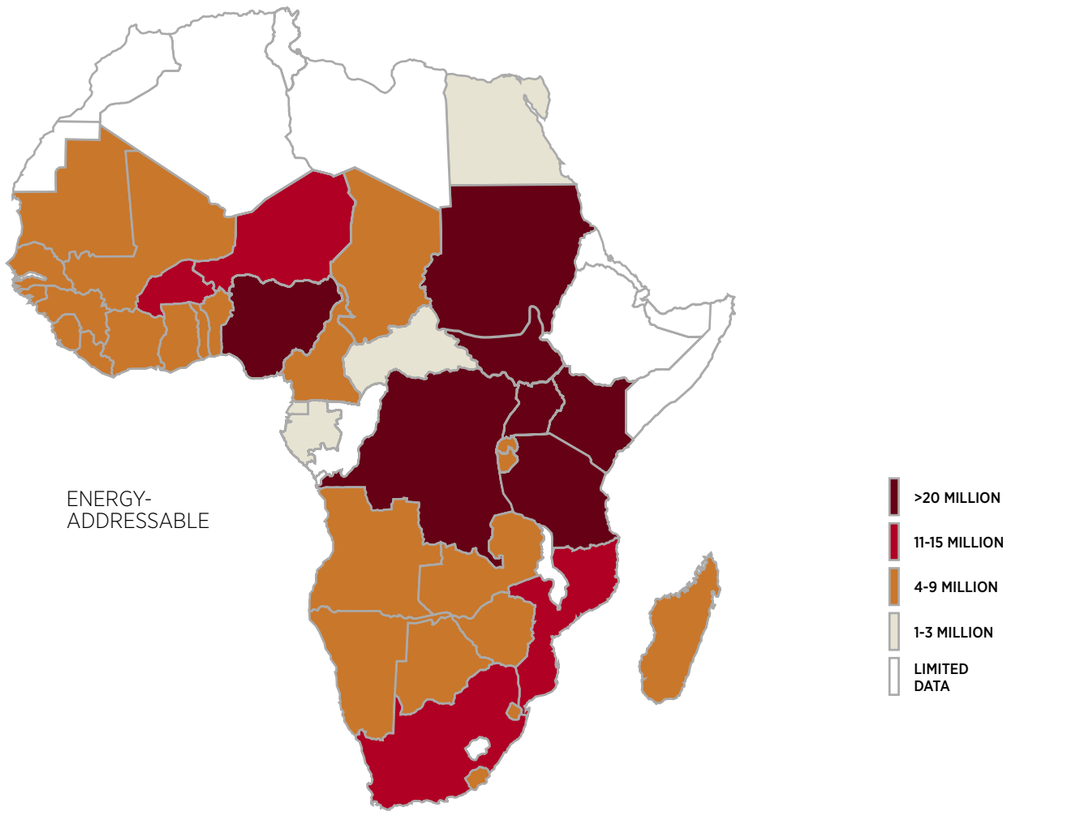
If mobile penetration has been increasing steadily across African markets, there is still important room for growth in terms of penetration and coverage, in order to give the poorest an opportunity to use mobile devices and services in their daily life. There is a clear role that mobile can play today to provide data capabilities for enhanced energy and water services. The symbiotic relationship that can exist between energy, mobile and water could be a game changer to ensure underserved communities have access to basic, scalable and reliable life services.

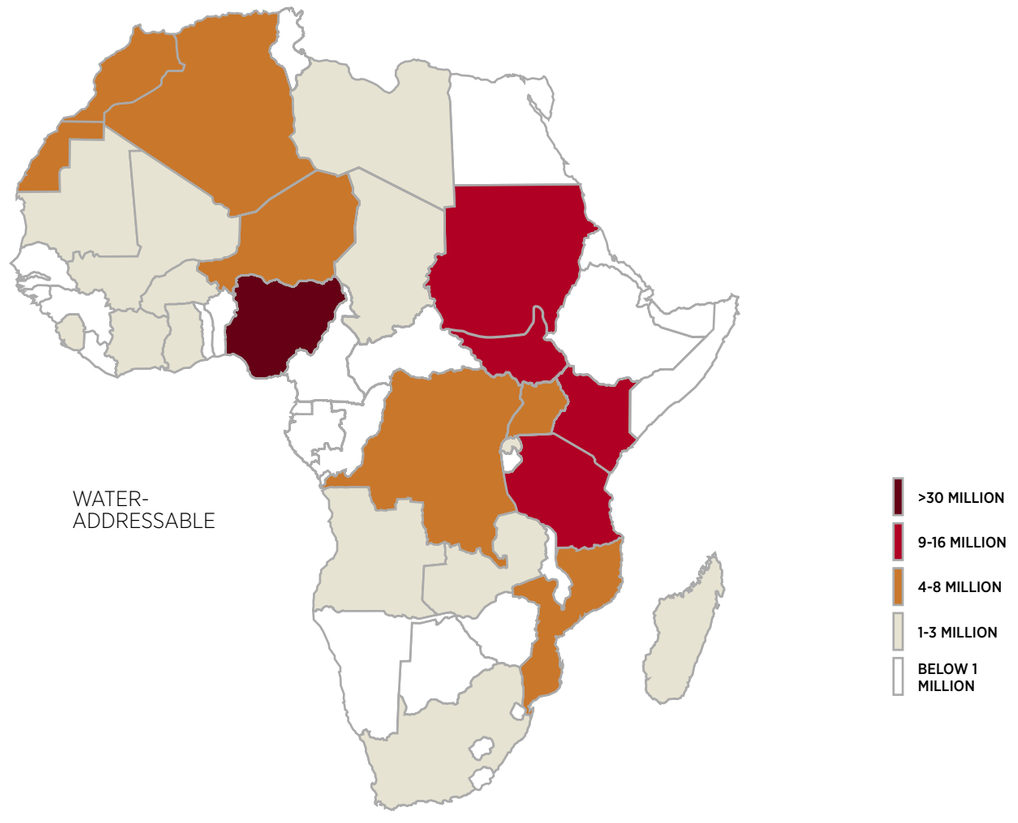
Appendix 1 – Addressable energy and water markets in Africa

In an earlier report ("Sizing the Opportunity of Mobile for Energy and Water Access"), we estimated the size of the energy and water-addressable markets, i.e. the total population covered by GSM networks without access to electricity and/or improved water.[38] The following figure serves as a visual representation of current potential market sizes across the African continent.

The countries in red and dark red on both diagrams are the ones with the highest potential for mobile-enhanced solutions – they denote a low access to electricity and/or improved water and a strong presence of mobile networks. According to these estimates, the following African countries have the largest market potential (according to its size as of 2013): Nigeria, Kenya, Uganda, Tanzania, Democratic Republic of Congo, Sudan, Niger and Mozambique. In terms of energy access, the opportunity is high in countries such as Kenya, Uganda, Tanzania, Rwanda and Burundi, where, according to the current regulation, there are no import duties and customer VAT on solar products.

FIGURE 2
OVERVIEW OF THE MARKETS IN AFRICA BY POPULATION (2013)[39]





38. For more information http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/12/Sizing-the-Opportunity-of-Mobile_Nov-2013.pdf?utm_campaign=M4D_News_03DEC13_MECS%20Report&utm_medium=email&utm_source=Eloqua.
39. Source GSMA

Appendix 2 - Mobile-enabled energy and water services in Africa (as of 2013)

SENEGAL

Manobi

MALI

SharedSolar

Manobi

NIGER

SharedSolar

Manobi
Tech Innov*

GUINEA BISSAU

Nova Lumos*

GHANA

Persistent Energy
Off Grid Electric
Devergy

SeeSaw
Safe Water Network

BENIN

Manobi

NIGERIA

Nova Lumos*

ANGOLA

Nova Lumos*

SeeSaw*

ZAMBIA

Zamsolar

Oxwater*

UGANDA

Fenix International*
Pamoja Cleantech*
GIZ Uganda*
RVE.SOL

Grundfos Lifelink
WellDone*
IRC Triple S
RVE.SOL

KENYA

M-KOPA
Azuri Technologies
Angaza Design
Takamoto Biogas
access:energy

Grundfos Lifelink
University of Oxford (mw4d)
Nairobi Water and Sewerage Company
M-Maji

TANZANIA

Off Grid Electric
Azuri Technologies
Mobisol
Fenix International
Devergy
Sincronicity

mWater
M-SABI

RWANDA

Azuri Technologies
Mobisol*
Fenix International

Portland State University - Living Water International*

ZIMBABWE

Econet Solar
Energize the Chain
(Econet Wireless)

SOUTH AFRICA

Vodacom
Community Power
Emfihlweni

• In planning phase

Appendix 3 - Key Africa metrics

The following table presents key metrics in the mobile, energy and water sectors, in order to compare countries attractiveness to deploy mobile-enabled energy and water services.

TABLE 4
AFRICA METRICS FOR MOBILE-ENABLED COMMUNITY SERVICES (2013)[40]

COUNTRY	IFC EASE OF DOING BUSINESS INDEX	GSM POPULATION COVERAGE	MOBILE CONNECTION PENETRATION (4Q2012)	POPULATION WITHOUT ACCESS TO ELECTRICITY	OFF-GRID MOBILE SUBSCRIBERS	ENERGY-ADDRESSABLE MARKET	POPULATION WITHOUT ACCESS TO IMPROVED WATER	WATER-ADDRESSABLE MARKET	POPULATION BELOW THE POVERTY LINE (%)
MAURITIUS	20	100%	114%	7,687	-	-	12,812	-	6%
RWANDA	32	99%	46%	9,880,325	2,553,242	9,535,021	3,718,402	2,643,967	63%
SOUTH AFRICA	41	100%	129%	12,497,825	3,490,840	11,081,009	4,499,217	3,142,219	14%
BOTSWANA	56	95%	153%	1,095,792	836,074	982,665	80,278	12,475	31%
GHANA	67	82%	98%	9,634,770	3,477,405	4,457,735	3,414,855	1,065,834	29%
ZAMBIA	83	80%	73%	10,496,244	3,866,777	7,495,330	5,041,300	1,296,738	69%
NAMIBIA	98	89%	121%	1,506,971	385,606	1,021,909	159,830	8,803	32%
CAPE VERDE	121	91%	89%	148,800	58,154	81,102	59,520	28,177	21%
SWAZILAND	123	100%	65%	1,008,148	144,649	1,042,666	343,956	293,298	41%
ETHIOPIA	125	10%	23%	68,848,119	6,982,497	-	46,451,743	-	39%
KENYA	129	95%	70%	33,990,140	6,713,969	30,009,848	16,610,200	12,118,205	43%
UGANDA	132	97%	47%	30,416,462	6,009,590	28,840,999	9,358,911	5,158,037	38%
LESOTHO	136	73%	63%	1,823,907	483,001	1,239,169	477,690	52,254	43%
MOZAMBIQUE	139	75%	36%	20,654,045	3,676,345	14,342,019	12,397,105	5,656,412	60%
BURUNDI	140	60%	25%	8,257,106	1,306,727	4,389,994	2,347,198	143,589	81%
SIERRA LEONE	142	86%	58%	5,574,159	1,421,588	4,555,510	2,640,391	1,631,381	53%
LIBERIA	144	80%	56%	3,794,416	1,175,284	2,948,687	1,078,413	90,881	84%
TANZANIA	145	76%	55%	38,608,296	9,686,303	26,663,260	21,075,376	8,460,002	68%
NIGERIA	147	89%	66%	78,261,052	19,985,083	55,902,773	66,537,736	38,279,799	68%
MADAGASCAR	148	64%	28%	16,778,193	3,161,414	9,104,341	11,185,462	2,419,551	81%
SUDAN	149	88%	73%	27,916,794	7,916,847	24,297,014	18,291,815	16,610,764	20%
THE GAMBIA	150	93%	131%	1,382,715	726,788	932,773	190,123	82,770	34%
BURKINA FASO	154	97%	60%	14,064,282	3,512,002	13,548,881	3,458,430	2,834,310	45%
MALI	155	80%	97%	13,832,828	6,163,712	7,901,331	5,533,131	2,521,178	50%
TOGO	157	70%	46%	4,822,238	859,918	2,500,898	2,350,841	272,841	39%

REGION/COUNTRY	IFC EASE OF DOING BUSINESS INDEX	GSM POPULATION COVERAGE	MOBILE CONNECTION PENETRATION (4Q2012)	POPULATION WITHOUT ACCESS TO ELECTRICITY	OFF-GRID MOBILE SUBSCRIBERS	ENERGY-ADDRESSABLE MARKET	POPULATION WITHOUT ACCESS TO IMPROVED WATER	WATER-ADDRESSABLE MARKET	POPULATION BELOW THE POVERTY LINE (%)
COMOROS	158	40%	32%	396,765	53,783	49,349	36,738	-	46%
DJIBOUTI	160	30%	27%	444,358	67,250	-	106,646	-	19%
GABON	163	96%	170%	952,958	153,423	508,134	195,710	70,574	5%
EQUATORIAL GUINEA	166	37%	76%	595,341	186,075	198,435	385,221	26,300	77%
CÔTE D'IVOIRE	167	98%	90%	10,401,821	2,655,500	7,526,216	3,947,560	3,479,061	24%
CAMEROON	168	85%	60%	10,054,230	1,756,393	6,879,418	4,507,744	571,330	10%
ZIMBABWE	170	79%	89%	7,354,301	2,803,388	4,803,319	2,514,291	161,032	72%
MALAWI	171	95%	31%	13,559,765	2,615,196	13,074,502	2,533,143	853,494	74%
MAURITANIA	173	94%	79%	2,594,830	1,333,696	1,779,075	1,729,887	1,366,583	23%
BENIN	174	64%	82%	6,655,119	2,559,735	2,663,880	2,212,473	228,951	47%
GUINEA	175	80%	58%	8,783,799	2,196,562	4,998,496	2,595,213	-	43%
NIGER	176	86%	31%	14,426,116	2,496,796	11,916,762	7,911,096	4,744,197	44%
SENEGAL	178	86%	82%	7,211,562	1,434,403	3,250,096	3,481,444	544,353	34%
ANGOLA	179	60%	69%	14,082,451	4,635,716	2,923,473	9,350,137	1,746,190	54%
GUINEA-BISSAU	180	50%	66%	1,181,875	366,545	285,034	545,481	-	49%
DR CONGO	183	53%	33%	58,643,592	9,708,513	24,530,678	36,281,187	3,984,972	88%
ERITREA	184	50%	5%	3,572,500	101,789	680,746	2,048,934	281,008	60%
CONGO	185	-	98%	2,542,983	1,210,572	-	1,172,441	-	54%
CENTRAL AFRICAN REPUBLIC	188	25%	36%	4,048,967	843,443	836,962	1,452,347	-	63%
CHAD	189	73%	38%	11,002,664	2,481,996	7,552,943	5,501,332	2,009,225	62%
SOMALIA		20%	39%	8,584,402	1,185,439	194,889	6,624,919	-	43%

40. Source GSMA Mobile Enabled Community Services, GSMAi, World Bank, JMP (WHO/UNICEF)

About the GSMA

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 more than 230 companies in the broader mobile ecosystem, including handset 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 the Mobile World Congress and Mobile Asia Expo.

About Mobile for Development

Serving the underserved through mobile

GSMA 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.

For more information on the GSMA's Mobile Enabled Community Services programme, please email: mecs@gsma.com