Green Power for Mobile

Supported by

IFC International Finance Corporation
World Bank Group

Bi-annual Report November 2010

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Welcome Note

The GSMA Green Power for Mobile (GPM) programme was launched in September 2008 to 'extend mobile beyond the grid' with two parallel objectives:

1. Systematically reduce diesel consumption by mobile operators through the promotion of renewable energy technologies and energy efficient base stations,
2. To remove the barriers to handset charging in off-grid communities

The first bi-annual report in November 2009 provided a high level view of the GPM programme, the key challenges the sector faced and case studies from operators and vendors. The last report in June 2010 focused on a specific topic 'Growth from Innovation'. This edition encompasses all three of the GPM workstreams; Renewable Energy Networks, Off-grid Handset Charging and Community Power from Mobile; and gives an indication of the growth in the sector in relation to each of these areas. It also includes a piece surrounding the commonly reoccurring theme of Mobile Energy Efficiency.

The GPM programme continues to work with the International Finance Corporation (IFC) who are providing both financial support for the programme's activities as well as seeking to assist operators with financing for green base station rollouts. An overview of this partnership is contained within.

The 7th GPM Working Group in the Philippines hosted by SMART Communications was a huge success representing the growing interest in the sector. Our previous Working Groups have been a key driving force in catalysing the uptake of green power in the mobile industry, however, two years and seven meetings later, the time has come for a change in direction; something fresh that will re-energise the Working Group and be more focused for each attendee. We aim to do this through 'Regional Special' events. Our first 'Regional Special' is taking place in Delhi, India on the 23rd and 24th November 2010. Following this meeting, we will be hosting an Africa focused Working Group in Q1 2011 and a South East Asia focused Working Group in Q2 2011.

The primary case study in the report surrounds a Feasibility Study conducted in three southern African countries commissioned by Econet: Lesotho, Zimbabwe and Burundi. The study analysed the operator's entire network and ranked the most suitable green sites within each network according to specific criteria defined in the GPM methodology. Vodafone have also offered an article detailing their methods in achieving energy efficiency. This coincides with GSMA's new Mobile Energy Efficiency initiative which provides operators with a service to identify potential energy, cost and carbon emission savings opportunities.

Asia has become the epicentre of innovation in green mobile networks. The scale of the market and power challenges that face Asian operators are driving innovation in technology, procurement and new business models providing excess power from networks to communities. As Asia becomes the catalyst for transformative growth in this sector, all regions will benefit from this progress. Included in this report is an overview of the Asian market.

The remaining chapters of this report reflects the work that the GPM team have undertaken in recent months. This includes feasibility studies into off-grid charging solutions as well as Community Power from Mobile pilots in India and East Africa.

The GPM team looks forward to continued collaboration with our Working Group members and the industry in general to ensure that our work is relevant to stakeholder requirements, actionable and aids advancing this emerging sector within the telecommunications industry. I trust you will find the third edition of our bi-annual report educational and informative. We look forward to seeing many of you over the next few months to work on the issues raised in this report as well as establish the work plan for us all over the next period.

David Taverner
GSMA Green Power for Mobile Director

Meet the Green Power for Mobile Team

David Taverner – Director

David is Director for the Green Power for Mobile (GPM) programme. He has developed GPM through its launch phase in September 2008, having defined the original implementation strategy and business plan. He is responsible for managing the full scope of the programme, leading the team of 7 international staff located in London, Africa, and Asia.

Abirami Thasarathakumar – Programme Coordinator

Abi is the Green Power for Mobile Programme Coordinator. She provides the team with ongoing project management support for all GPM work streams; Renewable Energy Networks, Off-grid Handset Charging and Community Power from Mobile. Abi is particularly involved with organising the GPM Working Groups which are held quarterly around Asia and Africa.

Areef Kassam – Business Development Manager

Areef is the Business Development Manager for the Green Power for Mobile Programme. In this role he is responsible for developing and delivering the programme products and services that are tailored to supporting operators in the decision of deploying renewable energy. Areef also works directly with our vendor partners to understand their products, services and provide visibility to the mobile operators.

If you would like to contact us, please email greenpower@gsm.org

Michael Nique – Strategy Analyst

Michael joined the GSMA as a Strategy Analyst for the Green Power for Mobile programme. In this role, Michael leads the development and dissemination of content on new innovations and trends affecting the sector. A particular focus at present is analysis on the issue and solutions for off-grid handset charging.

Sagar Gubbi – Community Power Consultant

Sagar is a Consultant for the Green Power for Mobile Programme, working on the Community Power from Mobile (CPM) project. Sagar is responsible for establishing and leading GSMA led pilot projects of Community Power from Mobile in India.

Tim Goss – Field Implementation Consultant

Tim is a Field Implementation Consultant for the Green Power for Mobile Programme. Within GPM he is responsible for green power Feasibility Studies and the associated project management. Tim is currently working in Egypt following successful projects in Haiti, Lesotho, Zimbabwe and Cambodia working with operators on the feasibility of using green power to help reduce their reliance on diesel generators.

Ferdous Mottakin – Field Implementation Consultant

Ferdous is the Field Implementation Consultant for the Green Power for Mobile programme. Within GPM he is responsible for Green Power Feasibility Studies and the associated project management. Ferdous has completed successful projects in Burundi and Bangladesh. Ferdous is currently establishing and leading GSMA led pilot projects of Community Power from Mobile in East Africa.

Renewable Energy Networks

Evolution of the Sector

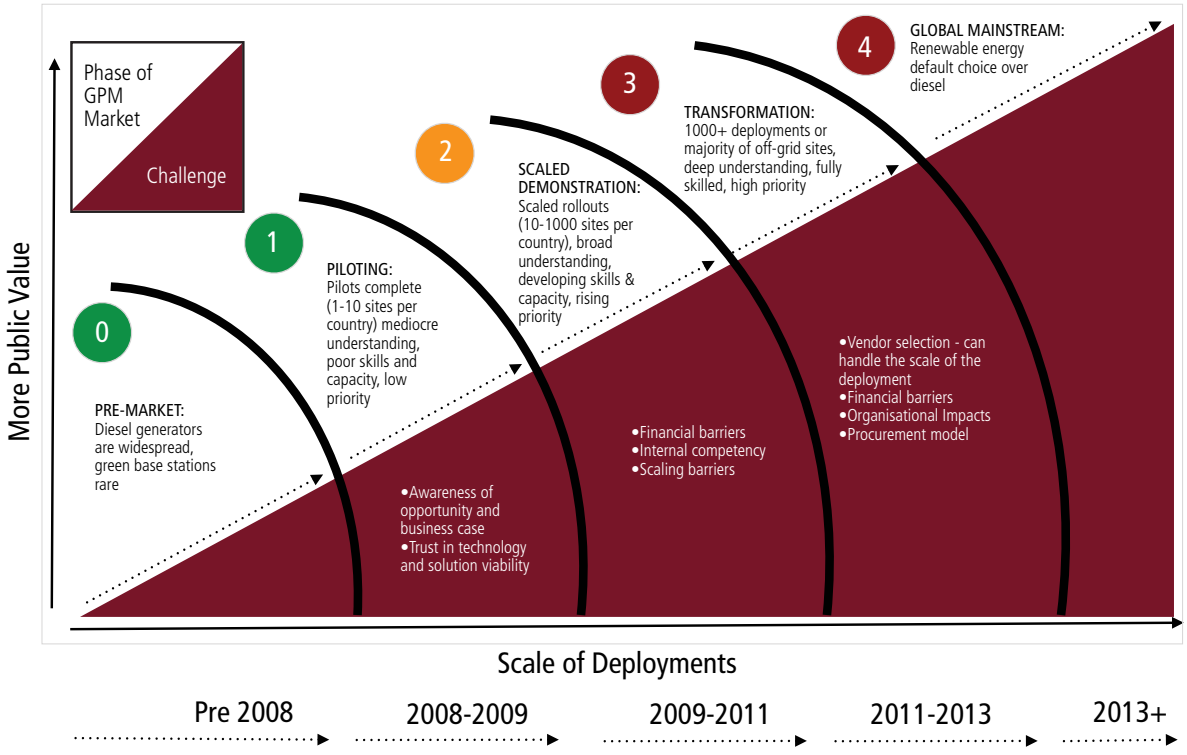
By Areef Kassam, GSMA

Even before the inception of the Green Power for Mobile programme industry experts have been touting the benefits of switching from diesel generators to renewable energy to power remote base station sites where commercial power is unavailable. Some of the benefits highlighted in the argument to switch are:

- **Improved Access to Mobile Services** – 1.6 billion people live off-grid, with an additional 1 billion people in unreliable grid regions. Future network coverage and therefore future subscriber growth in remote, grid challenged regions will face the parallel barriers of operations, maintenance and power costs associated with remote diesel generator base stations. Use of renewable energy equipment minimises operating expenditure (OPEX) and maintenance allowing operators to expand networks to remote, grid challenged regions
- **Reduced Operating Expenditure** – Energy costs can be as high as 40-50% of an operators total OPEX in regions where grid/reliable grid power is unavailable. The GSMA estimates that by 2012 there will 640,000 off-grid diesel base stations with a total diesel bill of US$14.6 billion. Use of renewable energy and energy efficient base stations reduces OPEX, improving profitability but also allowing operators to expand into more remote, lower ARPU areas; improving access to mobile services. The strong business case of reduced OPEX drives scalability for green networks

Now in 2010, having seen the sector change immensely over the past few years, the need for these arguments has passed. The sector has evolved so much that few people remain who question the need for renewable energy solutions, to expand coverage in off-grid areas and its ability to cut operating costs. The majority of the world has moved into a second phase of renewable

Figure 1: Evolution of the Sector



energy deployment. The first phase which occurred in the past was the Piloting phase. At the start of this phase operators had minimal awareness of the opportunity and the business case available, nor did they have the capacity to execute these deployments. Green networks were also a low priority for financial investment and management attention. Through the Piloting phase operators' awareness, knowledge and attention in the area has increased rapidly and operators globally started to invest money into green networks. They demonstrated technical and financial viability as three year payback periods were common with robust reliability.

The second phase of evolution which is ongoing in many parts of the world is the Scaled Demonstration phase. Trust in the viability of the solution and competency of the sector has now been built up so operators are moving forward with larger deployments in the range of 10 to 1000 sites per country. Operators move through this phase before the full conversion, even though viability has been proven during the pilots in order to overcome key scaling barriers such as engagement/trust with new vendors and building skills and capacity within the operators. During this phase operators will have a broad understanding of the benefits and business case of renewable energy networks, but competing financial and resource priorities blocks the full conversion.

The third phase of deployment is the Transformation phase. This phase is defined by the conversion of over 50% of the off-grid sites in a country to renewable energy or having greater than 1000 sites per country. In this phase operators have a deep understanding, an extensive skills base and the capacity to deploy a large number of sites. At present there are only a few operators in three countries that have entered the Transformation Phase. Ongoing there are deployments of several thousand sites in India (2000 with plans for an additional 7500) and China (6000+ sites). One other South East Asian operator has converted over 50% of their off-grid sites.

The challenges that operators face to move from the Scaled Demonstration phase to the Transformation phase are quite different from the challenges when moving on from the Piloting phase. One of the common challenges is financial resource, but the scale of this capital expenditure (CAPEX) needed is drastically different. This large CAPEX requirement has brought about the need for new innovative financing and procurement options for operators. Vendor outsourcing and Power Purchase Agreements (PPA) seem to be leading the way as preferred options for operators as it minimises the CAPEX investment required. One of the unique challenges operators face when moving to Transformation phase is the availability of reliable and experienced vendors that can manage and handle large scale deployments.

Looking to the future, the fourth and final phase – Global Mainstream – is where we will see renewable energy become the default choice for powering off-grid and unreliable grid sites.

IFC Financial Products for Green Power

By Ian Larsen, International Finance Corporation (IFC)

In the long term, green power has significant potential to reduce an operator's carbon footprint and slow the growth in energy consumption. A reliable green power source at a Base Transceiver Station (BTS) can be a very practical component of any operator's current effort to expand its network into those remote areas that lack reliable grid power provision. Moreover, it is expected that future growth of the mobile industry will be highly dependent on expansion in remote parts of the world, many of which lie beyond the grid, reinforcing the critical role of green power alternatives.

One of the key limitations to the quick adoption of renewable solutions at the BTS's is high upfront capital expenditure (CAPEX). Additionally, other potential limitations are posed by the availability and capacity of renewable energy equipment.

In an effort to speed industry adoption of green power solutions, the International Finance Corporation (IFC) is supporting the Green Power for Mobile programme and is working to provide financing to support the operators' CAPEX budget for roll-out. IFC is a member of the World Bank Group that supports private sector development in developing countries and seeks to expand access to mobile technology and ICTs in poor, unconnected areas. As part of this effort, IFC has made a number of financial products available to provide financing for Green Power for Mobile projects. A selected list of these products is described below.

Loans

IFC offers fixed and variable rate "A-loans" from its own account to private sector projects in developing countries. Generally, these loans range from $5 million to $100 million. The loans typically have maturities of 7 to 12 years at origination, with grace periods and repayment schedules determined on a case-by-case basis. If warranted by the project, IFC can provide longer-term loans and longer grace periods. IFC can provide US dollar and Euro financing as well as local currency debt financing in 3 different ways: (i) loans from IFC denominated in local currency; (ii) risk management swaps which allow clients to hedge existing or new foreign currency denominated liabilities back into local currency; and (iii) structured finance which enable clients to borrow in local currency from other sources.

IFC loans can finance both green-field companies and expansion projects in developing countries. The Corporation also makes loans to intermediary banks, leasing companies, and other financial institutions through credit lines.

To ensure the participation of other private investors, A-loans are usually limited to 25% of the total estimated costs for green-field projects. In exceptional circumstances, loans totalling 35% of total project costs may be available. For expansion projects, IFC may provide up to 50% of the project cost, provided its investments do not exceed 25% of the total capitalisation of the project company.

Equity Finance

IFC could take equity stakes in private sector companies. As a long-term investor, IFC usually maintains equity investments for a period of 8 to 15 years. The Corporation does not take an active role in company management. It risks its own capital and does not accept government guarantees. To ensure the participation of other private investors, the Corporation generally subscribes to between 5% and 15% of a project's equity. IFC is never the largest shareholder in a project and will normally not hold more than a 35% stake.

IFC usually exits its investment through a sale of its shares on the domestic stock market in a way that will benefit the enterprise, often in a public offering.

Quasi-Equity Finance

IFC also offers a full range of C-loans – quasi-equity products with both debt and equity characteristics to private sector projects in developing countries. Among other instruments, the Corporation provides convertible debt and subordinated loan investments, which impose a fixed repayment schedule. It also offers preferred stock and income note investments, which require less rigid repayment schedules. Quasi-equity investments are made available whenever necessary, to ensure that a project is soundly funded. Through its programme of syndicated B-loans, IFC offers commercial banks and other financial institutions the chance to lend to IFC-financed projects that they might not otherwise consider. These loans serve to broaden IFC's development impact by mobilising additional private sector financing in developing countries. Through this mechanism,

financial institutions share fully in the commercial credit risk of projects and share the advantages that IFC derives as a multilateral development institution; IFC remains the lender of record.

Structured Finance

IFC also provide clients with a series of cost-effective financing products that may not otherwise be available to them. Such products include credit enhancement structures for bonds and loans through partial credit guarantees or risk-sharing facilities.

Partial credit guarantees allow IFC to use its international triple-A credit rating to help clients diversify their funding sources, extend maturities, and obtain financing in their currency of choice. Partial loan and bond guarantees also help broaden clients' access to international and local capital markets. Credit enhancement structures help clients attract new sources of financing in their currency of choice, reduce borrowing costs, and extend maturities beyond what private investors would otherwise provide.

Risk-sharing facilities allow clients to transfer credit risk to IFC from their own portfolio or from a new portfolio they originate. The assets typically remain on the clients' balance sheet, and the risk transfer comes from a partial guarantee provided by IFC. In general, clients will enter into such a facility with IFC because it helps them increase their capacity to originate new assets within an asset class in which IFC seeks to increase its own exposure.

Together with the GSMA, IFC believes strongly in speeding adoption of green power sources for mobile applications, and it is uniquely positioned to facilitate this transformation through financing solutions not available through other institutions.

Operators interested in learning more about IFC's financing options for green power are invited to contact greenpower@gsm.org for more information.

Asia Leads the World on Green Mobile Networks

By David Taverner, GSMA

Summary

Asia has become the epicentre of innovation in green mobile networks. The scale of the market and power challenges that face Asian operators are driving innovation in technology, procurement and new business models providing excess power from networks to communities. As Asia becomes the catalyst for transformative growth in this sector, all regions will benefit from this progress.

The Growth of Asian Telecoms

The Asian mobile sector has grown at unprecedented speed over the last 10 years. Wireless Intelligence predicts that the number of connections in Asia has exploded from 226 million in 2000, to 2.4 billion today and onwards to a forecast of 3.6 billion by 2014. In 2001, China overtook the US to become the largest cellular market in the world, and India overtook the US in 2008 to become the second. In June 2010 the Asian region represented 47% of the global market.

Future subscriber growth in Asia will be driven by accessing the rural market. In India, December 2009, 88% of the urban population was estimated to have a mobile connection, compared to only 25%[1] for the rural population. Operators across Asia are racing to capture this rural segment but face significant market and power challenges which are driving innovation in green networks.

The Asian Region Faces Significant Market Challenges

Asia has some significant challenges which it is overcoming in order to expand the subscriber base. Taking India as an example, Average Revenue per User (ARPU) is typically declining from US$7 in 2005 to US$3 in 2010[2] but Minutes of Use, the actual number of calls, is amongst the highest in the world at 378[2] minutes per month. The markets can be highly competitive. In India 15[2] operators have driven call rates down to some of the lowest in the world with effective price-per-minute calls below US$0.01[2].

Power Challenges

These market challenges are coupled with severe power shortages. South Asia has the largest off-grid population in the world with 614 million people or ~40%[3] of the population and this alone poses major issues for running mobile networks. Lack of stable grid drives the deployment of vast numbers of diesel generators for primary and backup power. The Indian telecoms sector consumes 2 billion litres of diesel every year to operate these towers, second as an industry only to the Indian railways. These power challenges place huge financial pressures on the mobile sector. The energy bill for an operator can be 40% of network OPEX, or US$500 million in the case of Bharti-Airtel[4].

Green Power Enables Rural Expansion

Over the past few years operators and tower infrastructure companies* across the region have focused their efforts shifting to the use of renewable energy, such as solar and wind power. Base stations powered by renewable energy have almost zero operating expenditure (OPEX), are virtually maintenance free, do not involve delivering volumes of diesel through monsoons and have significantly reduced carbon emissions.

This transformation is allowing expansion of mobile networks into rural, low ARPU, off-grid regions where the running costs of a diesel powered base station would have previously prevented the base station being built.

Asia Leads the World on Green Innovation

China Mobile has the largest renewable energy deployment of any operator with 2,135 sites in 2008 expanding to 6,372 in 2009[5]. In the mountainous, isolated region of the Qinghai-Xizang Plateau, 80% of base stations are powered by solar energy, which allows China Mobile to operate a network in a region out of reach of grid electricity, diesel trucks and maintenance engineers. China Mobile has even deployed a solar base station to provide coverage at Mount Everest, a testament to the combination of mobile networks and renewable energy bringing communications to the most challenging, remote environments.

[1] GSMA
[2] Wireless Intelligence
[3] International Energy Agency
[4] Bharti-Airtel – Featured in GPM Bi-annual Report November 2009
* A tower infrastructure company provides passive infrastructure on a sharing basis to telecom operators

The second largest rollout is in Cambodia where since 2005 Mobitel have deployed 862[6] sites covering over 50% of their off-grid network.

Indian operators and tower companies have been piloting renewable energy for a few years, but 2010 has seen a major shift to large scale deployments. The technology and business case has been proven and deployments of 1000's sites are becoming common. Bharti-Infratel had deployed 500 sites by March 2010, and is on target for 2000 sites by April 2011. This initiative will result in estimated savings of US$16 million per year and a reduction of 58,170 tonnes of CO_2 emissions per year[7].

The scale of these rollouts is being driven by the scale of the market and power challenges outlined above and Asia is leading the way in innovation.

Asia has become a major leader in renewable energy and has become a hot bed for technological innovation. In parallel to the entrance of the major telecoms vendors we are also seeing the emergence of specialist companies focused on the design of renewable energy powered networks. An example of this is ACME Telepower who provide a turnkey site solution incorporating solar power, fuel cells and advanced power management. Another innovative company is VNL who have developed an ultra low power (100 Watt) base station that is fully solar powered and designed specifically for the rural, low ARPU, off-grid regions of Asia.

Asia is also the pioneer of key innovations in procurement. One of the major challenges of deploying renewable energy is the upfront capital expenditure (CAPEX) which can be triple that of a diesel generator. An outsourcing procurement model is rapidly gaining traction in Asia where an operator or tower company outsources the function of power provision to their cell towers to a third party expert for a substantial cost saving.

The final innovation is focused on creating new revenues streams from excess energy. Operators and tower companies are investigating new business models where excess power from the base station is provided to the local community, a concept the GSMA calls Community Power from Mobile.

Where Next for Green Power in Asia?

The number of connections in Asia is expected to increase by over a billion by 2014. To support this market expansion, hundreds of thousands of additional base stations will be deployed and most of these will be in rural regions with poor grid electricity. With an individual off-grid site costing over US$20,000 worth of diesel a year, the challenging economics of the rural market will drive the sector through further innovation to lower costs through renewable energy technology.

Coupling these crippling financials with the challenges and costs of transporting diesel in rural parts of Asia, the GSMA expects renewable energy, and in particular solar power, to become the default choice to power Asian off-grid networks by 2012.

What Does This Mean for the Rest of the World?

GSMA believe the scale of the Asian market for green networks will drive growth in the remaining global regions. The size of deployments in Asia will attract further investment from the vendor community to build capacity, driving down global price points.

Due to the scale of the market and power challenges faced in Asia there is continual, powerful pressure to innovate. It is this innovation and progress from Asia that will become the catalyst for growth in this sector across the globe.

[5] China Mobile – Corporate Social Responsibility Report
[6] GSMA Green Deployment Tracker
[7] Bharti-Infratel – Featured in GPM bi-annual report June 2010

Case Study: Green Power Feasibility Study – Econet

By Areef Kassam, Tim Goss and Ferdous Mottakin, GSMA

Executive Summary

The GSMA Green Power for Mobile (GPM) programme was commissioned by Econet Group during Q1 2010 to complete a Feasibility Study to analyse the operator's networks in three countries in Southern Africa and propose an implementation plan for a green power network. The study analysed the operator's entire network in the three countries, Lesotho, Zimbabwe and Burundi, and ranked the most suitable green sites within each network according to specific criteria defined in the GPM methodology. Although the conditions vary hugely from country to country the GPM team were able to find significant benefits of utilising green energy in all countries.

The main findings of the study are as follows:

- Energy analysis should be undertaken at the network planning stage (i.e. during the land acquisition process)
- Low power, diesel generator only sites show the best financial indicators
- GSMA analysed a total of 900 sites across the three networks, with Zimbabwe having the largest network out of the three countries
- The implementation of green power technology represented a technically feasible and financially attractive solution with a payback period of less than three years at many sites
- GSMA recommended an implementation of 40 solar or hybrid (a combination of solar and wind) sites in Lesotho, up to 101 solar sites in Burundi and up to 181 solar sites for Zimbabwe
- For all the sites analysed, the projected CAPEX spend ranged from US$50,000 to US$130,000 per site depending on the conditions and power usage for the site

Background

Key Facts – Zimbabwe

Zimbabwe is a landlocked country in southern Africa. Most of the country is elevated in the central plateau stretching from the southwest to the northwest at altitudes between 1200m and 1600m. The country's east is mountainous with Mt. Nyangani being the highest point at 2,592m. Victoria Falls, one of the world's biggest and most spectacular waterfalls, is located in the country's northwest as part of the Zambesi River. The country has a tropical climate, moderated by the altitude, with a rainy season usually from November to March. The country has a population of 12.5 million[8] and a Gross Domestic Product (GDP) Per Capita of US$340[9].

Zimbabwe Electricity Supply Authority (ZESA) has the sole responsibility for power generation and distribution. The search for national energy self-sufficiency in the early 1980s led to an emphasis on coal, other thermoelectric projects (78% of supply) and the hydroelectric power from the Kariba dam (22%). Although the second stage of the Hwange thermal power station, commissioned in 1987, raised the total capacity to 2,071 megawatts (MW), supply has failed to keep up with demand, leading to imports from Mozambique and South Africa. Zimbabwe suffers from long power outages due to 'power sharing' and a lack of capacity in the distribution network. This is especially critical in the areas, where outages of 14 hours are not uncommon. To solve these problems there is a heavy reliance on diesel generators to provide the shortfall in commercial power.

Key Facts – Lesotho

The Kingdom of Lesotho is made up mostly of highlands where many of the villages can be reached only by horseback, foot or light aircraft. During the winter shepherds wearing only boots and wrap-around blankets have to contend with snow. While much of the tiny country, with spectacular canyons and thatched huts, remains untouched by modern machines, developers have laid down roads to reach its mineral and water resources. The country has a population of 2 million and a GDP Per Capita of US$1080[9].

Lesotho is now able to provide 100% of its electricity requirements due to the completion of the Lesotho Highland Water Project which also supports power and water supply to neighbouring South Africa. Although electricity is available in most towns, many of the required sites are very isolated and

[8] UN
[9] World Bank

it is not cost effective to connect to the commercial power network. To solve this problem, operators have relied heavily on diesel generators to provide power to telecoms equipment and this has created an environment of high OPEX, increased environmental pollution and logistical challenges for diesel delivery. Considering these factors it makes it tougher for operators to justify expanding their service to rural areas with the existing power infrastructure. The challenge is to come up with an easier, more cost effective and environmentally friendly way to expand network coverage in rural Lesotho, replacing existing generators on off-grid sites.

Key Facts – Burundi

Burundi is a small landlocked hilly country in East Africa with considerable altitude variation, 772m – 2670m. It has a population of over 9.5 million[10], most of which live in rural areas. The climate in Burundi is equatorial and there are two rainy seasons; February-June and September-December; the rest of the year is dry. Despite the rainy seasons, sun radiation levels are satisfactory for green applications throughout the year. Burundi is a small country with no natural gas or oil resources. Civil war and political instability for decades made this country one of the poorest nations in Africa; GDP growth was 3.2% in 2009[10]. The lack of energy sources puts Burundi under extreme pressure when it comes to producing electricity. Currently Burundi provides only 92 million kWh[10] of power on-grid which covers approximately 15% of the total land area. Even in areas where grid connectivity is available, power outages are common and range from 6-16 hours per day due to the limited production. This lack of power infrastructure and production has prevented mobile operators in Burundi from rolling out telecoms infrastructure aggressively.

Suggested Solutions

Funded by Econet and the GSMA, the GPM programme conducted a Feasibility Study, investigating the opportunity to deploy solar, wind or hybrid power generation equipment onsite to replace or greatly reduce the reliance on the existing diesel generator sets.

The GSMA and Econet teams studied a large number of existing base station sites, analysing the power requirements for the sites and designing optimal solar, wind, hybrid or battery powered solutions. Using detailed country specific costing data for the operations and maintenance of each as well as the CAPEX pricing of the solar and/or wind power equipment, the business case for installing renewable energy equipment was determined. The key financial indicators used to determine if the new solution would be a positive investment was ROI (Return on Investment), IRR (Internal Rate of Return), NPV (Net Present Value), Payback Period and initial CAPEX pricing. Using this analysis methodology it was found that many of the sites in each country were to have a payback period of less than three years and ROI greater than 30%.

In Lesotho the financial results showed a payback period ranging from 1.9 to 3.8 years. 17 of the sites analysed were able to achieve a payback period of less than three years based on a delivered to site diesel price of US$1.3 per litre. It was possible to find renewable energy solutions that had a payback period of less than three years in all regions of Lesotho. The CAPEX range for the green power solutions is US$57,000 to US$101,000 per site. The GSMA Development Fund recommended that Econet Lesotho implement a 10 site trial before full scale deployment of 40+ sites in order to test multiple vendor solutions.

In Zimbabwe, 181 sites have the potential to be converted to a green power solution with large savings in OPEX with the implementation of more efficient cooling systems as part of the proposed solution. The financial results showed a payback period ranging from 1.3 years to 5.4 years. It was possible to find renewable energy solutions that had a payback period of less than three years in all regions of Zimbabwe. The delivered to site diesel price is currently US$1 per litre. This could increase in the coming years making the business case for green power solutions even more financially viable. The GSMA Development Fund recommended that Econet Zimbabwe implement a 10 site trial before full scale deployment of 200+ sites, to test multiple vendor solutions.

[10] CIA World Fact Book

Figure 1 – Map of Countries involved in Feasibility Study

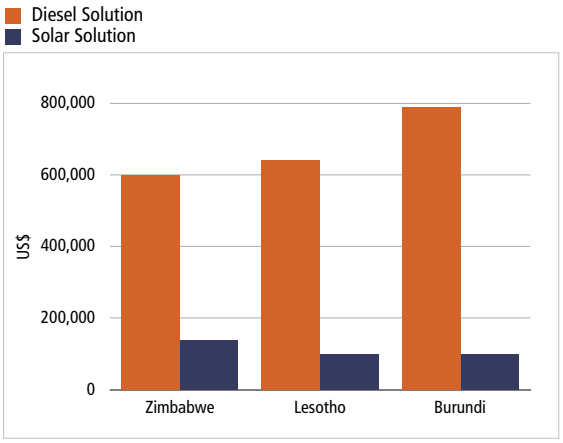
In Burundi up to 45 of the analysed sites showed a payback period of less than three years 76 sites were recommended to use only solar power as a technology. 25 sites were recommended to use solar and diesel generator to reduce CO_2 emission by minimising the usage of diesel generator. Wind turbines were not recommended for any site as average wind speeds in Burundi are below the workable range. GSMA listed and made key recommendations to Econet Wireless Burundi to reduce power consumption and provided ways to optimise power consumption, for example, replace all existing air-conditioners to direct current air-conditioners.

Projected Results

If all the 262 most suitable sites were implemented, there would be a potential saving of 5 million litres of diesel per year, giving a reduction in CO_2 emissions of over 16,000 tonnes per year.

The graph below shows an example of the comparison between OPEX costs using the solar solution and the OPEX cost for a simple diesel solution, for the duration of the 20 year project.

Figure 2 – Accumulated Cost of Ownership over 20 Years



Source: GSMA

Table 1 – Key Financial and Technical Indicators

Country / Site	Solar Photovoltaic (kW)	Battery (48V -Ah)	CAPEX Required (US$)	Payback (yrs)	Number of potential sites
Zimbabwe 1	3	1500	51,968	1.33	102
Zimbabwe 2	6.4	1500	76,468	2.43	81
Lesotho 1	4	1500	65,920	2.24	10
Lesotho 2	7.5	2000	95,460	3.78	12
Burundi 1	4.6	1500	57,880	3.27	12
Burundi 2	7.36	2000	75,614	3.96	29

Source: GSMA

Table 2 – Combined Projected Results for 322 Sites Across the Three Countries

	CAPEX Required (US$)	OPEX Saving / Year (US$)	CO_2 Emissions Reduction / Year (tonnes)
Econet Combined	21.6 Million	8.1 Million	16,000

Source: GSMA

Case Study – Vodafone's Carbon Reduction Commitment: Energy Efficient and Green Technology Solutions for Network Sites

By Mohammed Belfqih and Ulrich Blau, Vodafone and Abirami Thasarathakumar, GSMA

Climate change presents a fundamental challenge to our way of life and is a pressing problem for society. It is clear that we must limit the quantity of greenhouse gases which are being generated in order to prevent permanent and serious damage to the environment. This is particularly challenging at a time when worldwide demand for fossil fuels is growing as developing countries take a more active economic role and the established nations continue to consume at an unsustainable rate. As a result, all organisations need to focus more on energy efficiencies and the generation of power from renewable sources. Vodafone recognises this need and is committed to reducing its own CO_2 emissions as well as to play a more active part in combating global warming. This was formally recognised by the CEO Vittorio Colao, who said "*I firmly believe that Vodafone and the sector in which we operate have a key role to play in shaping a more sustainable society*."

The effects of climate change have the potential to impact Vodafone's networks in a number of different ways; for example through extreme weather events, rising operating costs from fuel prices and taxes on carbon emissions. To address this, Vodafone has set a clear target: to reduce CO_2 emissions by 50% against the 2006/2007 baseline by March 2020. Vodafone has implemented a programme of energy efficiency, renewable energy development, as well as monitoring and evaluating energy and cost savings alongside other business programmes. In addition there are other related goals which align to Vodafone's climate change programme including:

- Vodafone to provide 10 million carbon-reducing Machine to Machine (M2M) connections by March 2013
- Vodafone to develop joint CO_2 reduction strategies with suppliers accounting for 50% of procurement spend by March 2012

Vodafone's main proposal was to adopt a dual-target approach in order to reduce CO_2 emissions in mature markets and emerging markets. This is because the company recognises that there are considerable economic and social benefits around extending telecommunications in emerging markets despite the possibility that there will also be a rise in carbon emissions. As a result, it has adopted a dual-target approach whereby the 50% absolute reduction target remains but only valid for mature markets and a new CO_2 intensity target is being developed for the emerging markets in 2010/11. This will be in keeping with the Kyoto Protocol.

This intensity target is appropriate for emerging markets where the number of subscribers and usage rates are growing exponentially from a low base. The two biggest emerging markets, India (Vodafone Essar) and Turkey (Vodafone Turkey), have already begun implementing local climate change strategies established in 2008/9, which will help them achieve the intensity target.

As a company, there are many things that Vodafone is doing to be more energy efficient. Having recognised that the network is the biggest consumer of energy and contributes the most to carbon emissions, the priority is to ensure that the extensive energy consumption is reduced.

What Changes has Vodafone Made to its Network to Reduce Energy Consumption?

1) Energy Efficient Cooling Solutions:

- Free cooling, i.e. using fresh air to cool equipment. To date this has saved up to 3,500 kWh per year per base station compared to air-conditioning
- Increasing the maximum operational temperatures of equipment in order to reduce the need for air-conditioning has resulted in up to 2,750 kWh of energy savings per year per base station.

Vodafone focuses on reducing emissions from its network by installing more efficient components in all new base stations and replacing less efficient equipment in existing base stations. Today "free cooling" is used at 40% of base stations in 80% of Vodafone operating companies and increasing the operational temperatures of equipments has been implemented in more than 40,000 base stations.

2) Alternating Diesel Battery Hybrid Mode Reducing up to 70% of Diesel Consumption

Alternating mode technology helps to reduce diesel consumption by using batteries managed by smart controllers at the main power source. This diesel/battery hybrid solution can reduce diesel consumption by up to 70%. For sites with high power requirements, batteries can also be supplemented with solar and wind power however the total cost of

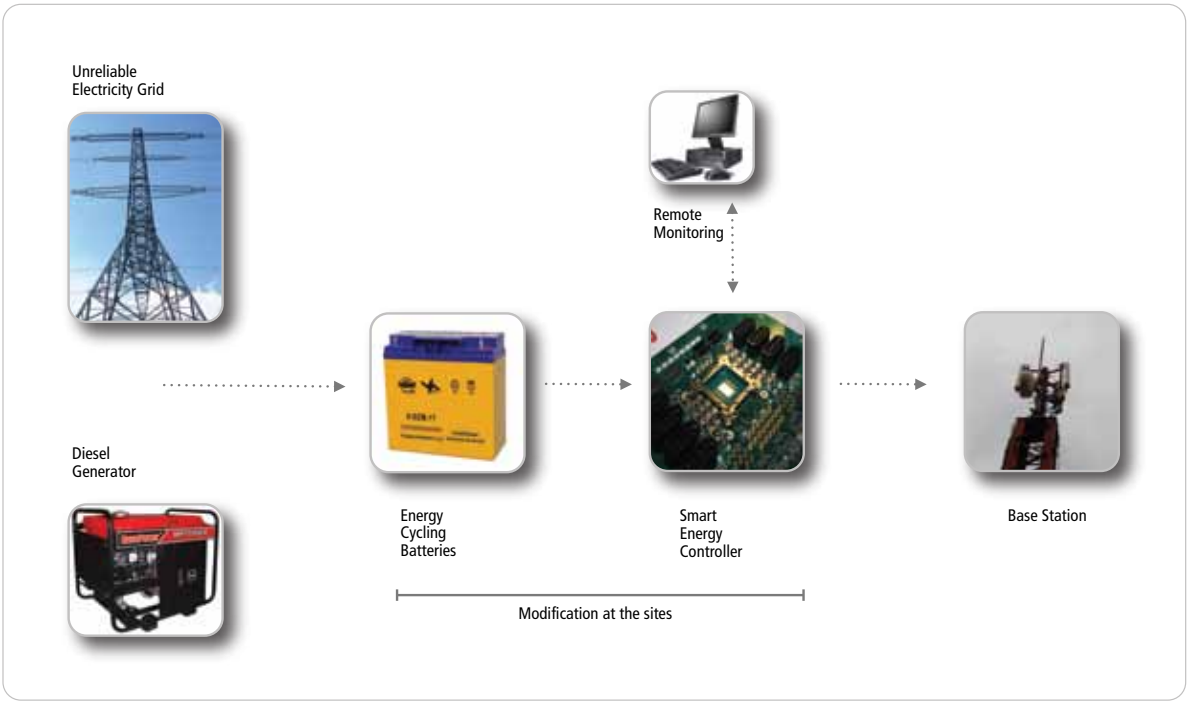
ownership of diesel/battery hybrid is much lower than for solar/wind solutions. Alternating mode technology was therefore deployed to power more than 3000 base stations in the last 18 months and Vodafone now plans to roll it out further in particular to many of its base stations in Africa and India.

> "As a part of our green energy initiatives we are currently deploying alternating hybrid solutions comprising of specially designed batteries and smart energy controllers with an inbuilt remote monitoring system on 2000 outdoor base stations. It has resulted in reduction of diesel generator run time by an average of 10 hrs/day/site thereby saving 50% of the diesel costs and substantial CO_2 reductions."
>
> Ashish Baldua – DGM – Network Commercial at Vodafone Essar

To increase energy consumption efficiencies at the sites, real time measurements of diesel generators and battery backup hours are captured on a daily basis using a remote monitoring system. This also records manual diesel generator run hours and uncontrolled battery discharge time.

Figure 1: Alternating Mode: Smart Energy Controller & Cycling Batteries at VF-Essar Sites in India

Figure 2: Battery as Main Power Source with Smart Energy Controller



Case study alternating mode for 1.5kW base station where typically diesel generators run up to 10hrs at base stations where the power grid is unreliable:

Solution comparison		
	Hybrid Solution	**Diesel Solution**
CAPEX	US$10,000*	US$14,000
OPEX (5 years)	US$10,000	US$38,000

Source VF Essar / India
* incremental investment varies according to grid power availibility

	Diesel (L)/year	**CO_2 (tonnes)/year**
Saving*	1500-7500	4 to 19

* savings vary according to grid power availibility

A key lesson from the alternating mode implementation was to stop using the diesel generator from sites with a reliable grid which was supported by diesel generation running from 2-6 hours per day. This has an impact not only by reducing diesel consumption but also on all the related maintenance costs.

3) Renewable Energy Sites

Currently, Vodafone has 104,344 (plus 93,948 for India) base stations worldwide. More than 850 are of these are now powered by renewable energy. It is anticipated that this number will increase exponentially as we move out of the pilot phase. The anticipated reduction is diesel consumption was around 70% but renewable energy base stations have exceeded performance expectations on average by reducing consumption from anywhere between 80-100%. These base stations also play a key role in cost reduction reducing operating expenditure (OPEX) by about 50%.

Case study alternating mode for 1kW off-grid base station where typically diesel generator is the main power source:

Solution comparison		
	Solar Hybrid	**Diesel Generator**
CAPEX	US$38,000	US$14,000
OPEX (5 years)	US$38,000	US$93,000

Source: VF Essar / India

	Diesel (L)/year	**CO_2 (tonnes)/year**
Savings	9600	25
Payback	<3 years	

Source: VF Essar / India

The key lessons of implementing renewable energy:

- Optimised solution is key for green design. The implementation of energy efficient components for the radio as well the passive network will help to reduce the amount of solar panels and batteries of the renewable energy solution
- The renewable energy solution should be dimensioned based on a site survey, pre-measurement and equipment loads, not just on meteorological data
- The technology behind micro renewable energy generation has made big steps forward in the past couple of years as has ROI due to increased competition. With that said, service and integration must be considered as a composite package

Vodafone Company Information

Vodafone Group Plc is the world's leading mobile telecommunications company, with a significant presence in Europe, the Middle East, Africa, Asia Pacific and the United States through the Company's subsidiary undertakings, joint ventures, associated undertakings and investments. As of the 30th June 2010, based on the registered customers of mobile telecommunications ventures in which it had ownership interests at that date, the Group had 347 million subscribers.

Mobile Energy Efficiency: Save Energy – Lower OpEx: Reduce CO_2

By Gabriel Solomon, GSMA

Executive summary

Mobile Energy Efficiency is a new energy efficiency benchmarking service from the GSMA that identifies potential energy, cost and carbon emission savings opportunities for mobile network operators.

Energy efficiency is becoming a strategic priority for the operators. The GSMA is uniquely placed to assist operators identify areas where energy efficiency can be improved by aggregating operator data, and producing a benchmark and set of Key Performance Indicators (KPIs) for operators to measure network performance across their own footprint and also relative to their peers.

Objectives

The objectives of the GSMA Energy Efficiency Benchmarking service are to:

- Identify and quantify operational cost and greenhouse gas savings for operators
- Promote a consistent methodology for benchmarking energy efficiency with common KPIs
- Collate industry data and benchmark outputs to enable operators to measure themselves externally and internally, highlighting areas for potential efficiency gains
- Coordinate across the industry and with regulatory stakeholders so that the benchmarking methodology is adopted as a global standard.

Approach

Around 80% of operators' energy consumption is in the network, hence the focus of the initiative. However, comparing energy efficiency across networks has been difficult as KPIs and KPI methodologies have differed by technology, market and geography, if employed at all.

The GSMA's approach is to use a **standard methodology that incorporates a normalisation process**, using multi-variable regression, which accounts for factors outside an operator's control and renders a more like for like comparison (apples to apples).

Methodology

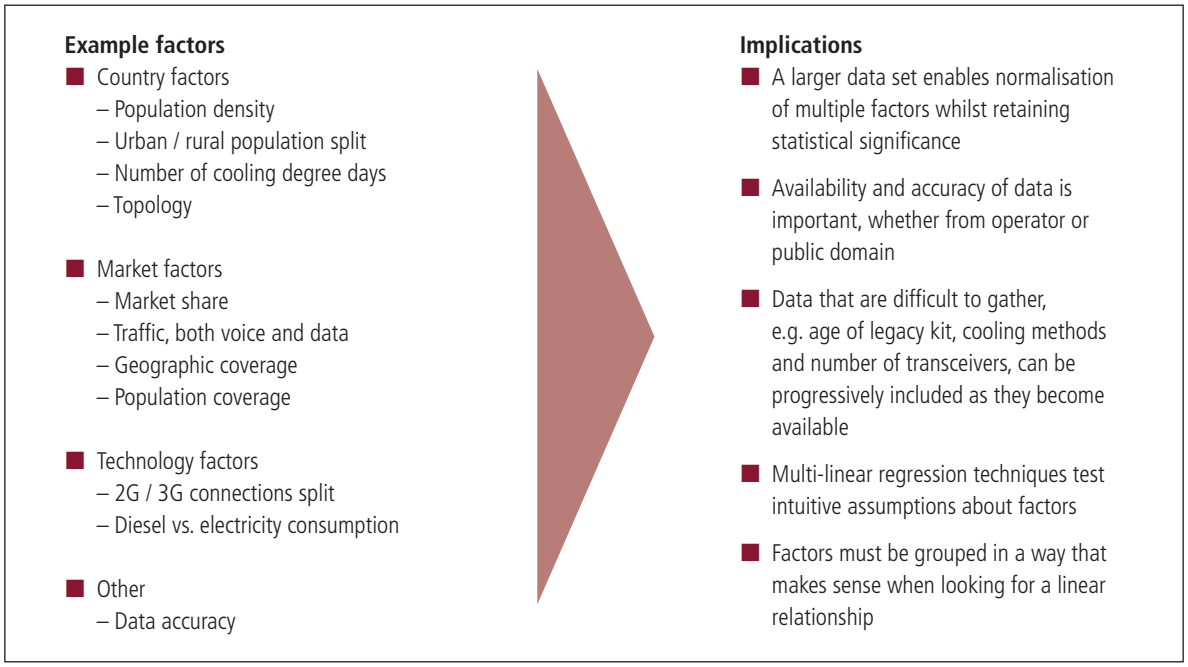
The methodology benchmarks mobile networks by country or region by comparing the four energy KPIs, which are:

1. Energy consumption per mobile connection
2. Energy consumption per unit mobile traffic
3. Energy consumption per cell site
4. Energy consumption per unit mobile revenue.

It is not straightforward to make meaningful comparisons of mobile networks that, for instance, have different technologies, use diesel rather than electricity or are located in countries with different population densities, geographies and climates. The GSMA methodology has been devised to "normalise" or adjust energy KPIs for factors outside an energy manager's control in order to make different networks comparable. After normalisation it is possible to see which networks are over or under performing in terms of energy consumption and management, and where there might be significant potential to reduce energy costs and emissions. See Figure 1.

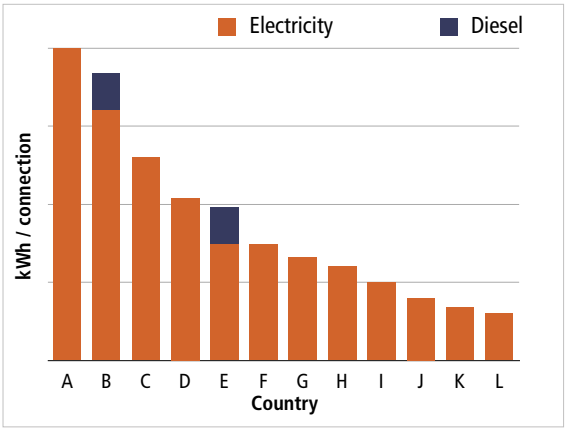
Operator networks are compared across countries against these energy KPIs. This can be insightful but before normalisation the spread is large given the differences in country, market and technology factors, see Figure 2.

Figure 1: Normalisation Factors Impacting Energy Efficiency



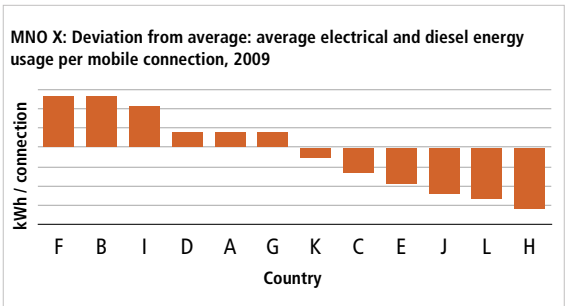
Source: GSMA

Figure 2: Example Output – Comparison of Operator Countries by Energy per Mobile Connection (kWh per connection)



Source: Operator X, GSMA data and analysis

Figure 3: Example Multi-Linear Regression Output For Energy Per Mobile Connection



Mobile operations diesel & electricity usage per connection regressed against:
- % 2G connections of all mobile connections
- Geographical area covered by all MNOs per connection
- % urban population / % population covered by all MNOs
- Number of cooling degree days (population weighted)

Source: Operator X, UN, GSMA data and analysis

Example results of a normalisation are shown in Figure 3, together with the regression variables. The regression has resulted in Country A moving from least efficient in Figure 2 to being near the middle of the pack once the normalisation has been undertaken, as shown in Figure 3. Country I has moved from being fourth most efficient in Figure 2 to one of the least efficient post normalisation.

More variables can be used in a normalisation with a larger data set so that much greater insights will emerge from comparing 50 operators rather than 10, for example. Larger data sets also help with the statistical significance of the results.

What is required from Operators?

Much of the country and market information has been gathered independently by the GSMA. The information required from participating operators is the following, by country or region for 2009:

- Mobile network electrical energy usage and diesel energy usage
- Number of physical cell sites
- Number of mobile connections
- Geographic and population coverage
- Minutes of mobile voice traffic and bytes of mobile data traffic
- Mobile revenues

To participate in the Mobile Energy Efficiency benchmarking service email us at

energyefficiency@gsm.org
Web: www.gsmworld.com/ee

Off-grid Handset Charging

By Michael Nique, GSMA

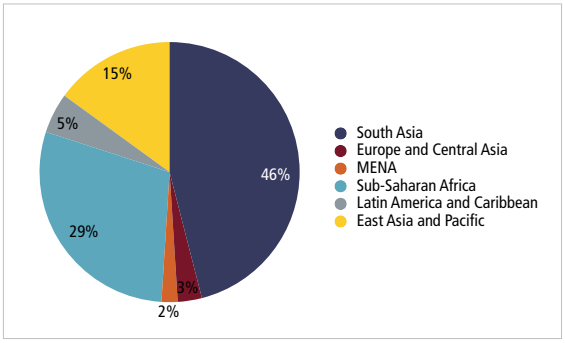
New energy harvesting solutions are crucial in developing countries; most people living in urban areas have access to the electricity grid, but in more rural areas the majority of the population have unreliable grid access or no access at all in very remote rural communities. It is estimated that around 1.6 billion people[11] live beyond the electricity grid meaning that they do not have convenient access to mobile phone charging options.

To create momentum and foster innovation around solar phones and off-grid handset chargers, the GSMA is currently working on a project with operators to address these off-grid charging issues. Amongst other objectives, this project aims to build a knowledge sharing platform accessible to all on the GSMA website as well as to provide operators with advisory services on how to tackle off-grid charging issues.

Key Market Data

GSMA estimates that 600 million mobile subscribers live in off-grid areas today; these subscribers live mostly in two regions, South Asia and sub-Saharan Africa, where the rural percentage of population remains high. The lack of access to electricity represents a major hurdle for subscribers living off the grid when it comes to contacting their relatives, calling the doctor when someone is sick and many other services they would otherwise have access to, for example, mobile banking, weather and price information for farmers.

Figure 1: Regional Off-grid Connections



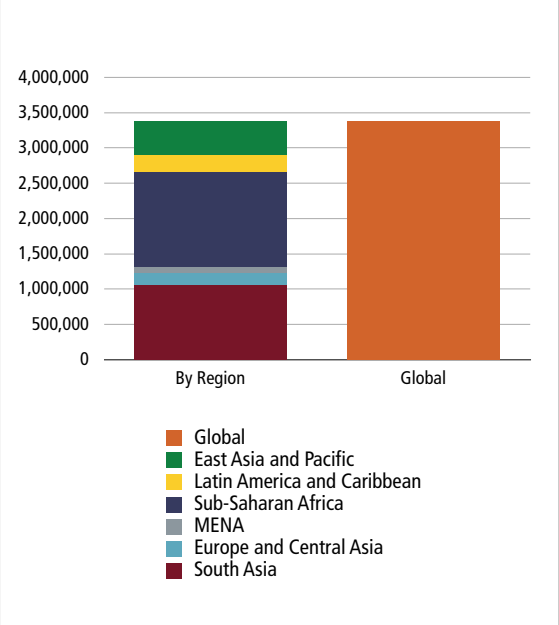
Source GSMA

[11] Source: UNDP
[12] Source: Digicel based on field studies

The GPM Programme also believes there is a commercial reason for mobile operators to deploy off grid charging solutions. Trials in Haiti and Madagascar suggest that when off grid subscribers acquire mobile charging solutions, usage and the average revenue per user (ARPU) increases by 10% to 14%[12].

Incremental revenue opportunities range from US$83 million per year in the Middle East and North Africa (MENA) region, to US$1.36 billion per year in sub-Saharan Africa; on a country level, India is accounting for the majority of these incremental revenues worldwide with an estimated US$778 million. Overall, the total increase in revenue resulting from charging solutions, based on a conservative 10 % ARPU increase per country, amounts to US$3.38 billion for the 600 million off-grid subscribers in 2010.

Figure 2: Incremental Revenues Per Year from Charging Solutions (Million US$)



Source: GSMA

This ARPU increase can be explained by the transfer of the expenditure subscribers spend on charging their phone on airtime. Indeed the main current solution for off grid mobile subscribers to charge their phone is to travel to the nearest "Phone Shop" run by a local entrepreneur. However this process is costly and time-consuming.

Figure 3: A Charging Shop in Kisoro, Uganda

Source: GSMA

For part of this project, the GSMA is currently conducting field studies to better understand the economics and user experience of the charging process for off grid subscribers. First results gathered from the field in Uganda, suggest that users spend US$1 to US$3 per month on charging their phone – this represents between 5–30 % of a subscriber monthly mobile expenditure. This is in addition to the cost of travelling to the nearest charging shop. As an example, people living in the South West of Uganda, in the Kisoro Valley, sometimes have to travel up to 20 km to the nearest village to get access to an electricity point. This essentially is a day trip for them, away from homes and businesses, just to charge their phone. Solutions emerge to make this process more convenient – subscribers sometimes give their phones to a truck/car driver going to the city to get it charged, retrieving it again a few hours later. When off-grid users were asked how they would spend their money if they could save these charging expenditures, most of the people interviewed would spend more money on airtime.

Off-grid Charging Solutions

In order to help off grid users charge their phones, several solutions coexists.

Since 2009, several solar phones have been introduced in developing countries such as India, Kenya and Uganda. The Digicel Group are distributing solar phones in markets such as Papua New Guinea, Tonga and Vanuatu after forecasting a market of over 700,000 customers[13] across Central America, the Caribbean and the South Pacific in 2009.

Innovation is also being driven to address the charging issue for users who do not have easy access to electricity both for their mobile phones as well as other low power devices. External chargers have proven to be really useful to remote communities. Today, most external chargers are either solar or kinetic; the latter using mechanical forces to generate low power. In June 2010, Nokia unveiled a bicycle charger kit in Kenya. It uses a small dynamo or electrical generator, powered by the rotation of the bicycle wheel, to charge a phone. Smaller companies such as Nuru Energy or American startup Fenix International are both providing kinetic chargers for low power devices.

[13] Source: Digicel

Figure 4: Kinetic Charger Developed by Nuru Energy

Source: Nuru Energy

Technology Comparison

Solar

Solar is currently the most widely researched and developed technology; they have a high degree of flexibility and highest efficiency when compared to any other green charger. Solar battery chargers currently occupy majority share (over 90%) of the European green battery charger market. Success and availability of solar phones remain limited but the recent introduction of newer models with better efficiency in major off grid markets such as India should create more momentum around this technology.

Figure 5: Solar Powered Phone

Key Points

1. Well designed and efficient for countries with high solar radiation (sub-Saharan region)
2. Price range still expensive for base of the pyramid (BoP) people living below the poverty line, though this is expected to get cheaper
3. Improved availability, with extensive distribution networks in developing countries
4. Large investments coming to this solution for start ups and technological innovation around solar charging
5. Highest degree of flexibility and efficiency in comparison to any other green charger.
6. Reliable with minimal maintenance requirements

Mechanical (Kinetic)

The mechanical (kinetic) charger has been applied to charge low power mobile devices for a few years. It is based on the motion of a set of magnets spinning around a coiled wire. It could be a hand crank mechanism or a dynamo attached to a bike wheel. Though environmentally friendly, the kinetic charging process could be seen as cumbersome as it involves of lot of work for the limited amount of energy generated. However, its simplicity gives it some potential to reach in increased penetration rate in developing countries.

Figure 6: Bike Charger Developed by Nokia (June 2010)

Key Points

1. A simple yet sturdy solution for remote rural areas – resistant to dust and shocks
2. Small, compact, light and easy to use solution to charge low power devices
3. Availability remains limited in developing countries with no real distribution networks
4. Needs more suppliers and partnerships with players of the mobile value chain to be widespread
5. Remains cumbersome and takes a lot of work for a small amount of energy

Community Power from Mobile

The Charging Services Opportunity

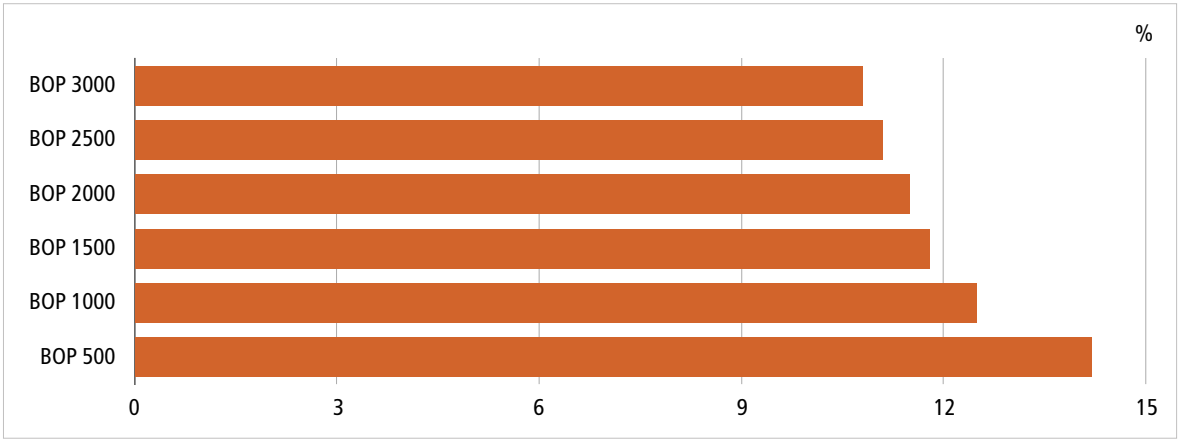
By Sagar Gubbi and Michael Nique, GSMA

According to data from the UNDP, there are 1.6 billion people in the world living without access to electricity with South Asia and sub-Saharan Africa accounting for 1.3 billion of these people[14]. The number of people living in off-grid areas of the world will still be as high as 1.3 billion in 2030. Due to the fast growing mobile communications market in these regions, the mobile telecoms industry could be part of a major evolution in the way rural populations access energy.

Electrification Rate remains Low in Developing Countries

As per 'the Next 4 Billion' report from Washington DC-based World Resources Institute, the total Base of the Pyramid (BoP) household energy market in Africa, Asia, Eastern Europe, Latin America and the Caribbean is estimated to be US$433 billion, representing the spending of 3.96 billion people. Across measured countries, BoP households devote an average of 9% of their expenditures to energy. Asia shows the largest share, at 10%, with all other regions clustering around the average.

Figure 1: Share of Household Spending on Energy



Source: REEEP

Current Solutions for Mobile Phone Charging

Local Phone Shops

As introduced in the previous chapter, across the developing world, many people who lack direct access to the electricity grid are charging their mobile phones through various sources: on a pay-per-charge basis at nearby phone shops, solar phones or external chargers.

Figure 2: A Charging Shop in Kisoro (Uganda)

[14] Source: International Energy Agency (IEA), World Energy Outlook 2008

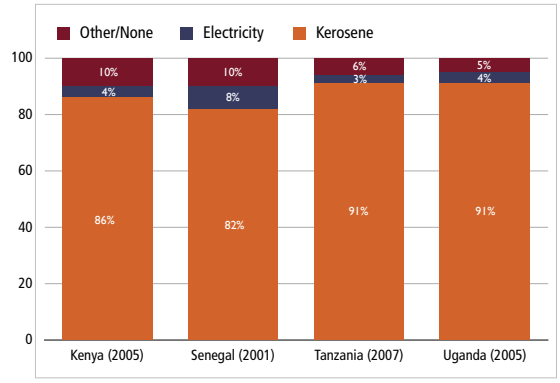
Battery Charging

A typical off-grid household spends US$8 per month on kerosene and AA batteries to provide light and to power radios. These options are expensive, inconvenient and hazardous. Household batteries are becoming popular in off-grid areas, with companies such as EGG Energy in Tanzania providing a household battery (12V, 12Ah) subscription service.

Lighting Applications

Rural customers around the world are estimated to be spending between US$8 and US$12 per month for replacement lighting services, including candles, kerosene, dry cells, or battery charging. As per the Lawrence Berkeley National Laboratory (LBNL)[15] report, a total of US$38 billion is being spent each year by poor households on fuel based lighting with African BoP households spending US$10 billion. These sources of energy are dirty and inefficient, and on a per-kilowatt basis they cost from 5 to 100 times more than modern fuels and electricity. According to data from the Renewable Energy and Energy Efficiency Partnership (REEEP)[16] and Barefoot Power, off-grid households spend US$5 to US$20 per kWh for lighting compared to those connected to the grid (who spend about US$0.15 per kWh). As a result, lighting represents between 10% and 40% of an off-grid family's income.

Figure 3: Lighting Fuels Used in Rural Households



Source: REEEP

Lanterns and lights which can be charged by solar or kinetic chargers are being sold in off-grid areas of India and Africa by companies such as Barefoot Power, D.Light Designs, Nuru Lights, and OSRAM. Another interesting trend is the integration of mobile phone charging capability by recent lantern models. A few programmes provide lantern and mobile phone charging services from solar-based energy hubs:

- Ericsson's Millennium Villages in Africa
- OSRAM's O-Hubs in Kenya
- TERI's Lighting a Billion Lives in India

Figure 4: Solio Solar Charger Model

Figure 5: Fenix International ReadySet Charger

[15] The Lawrence Berkeley National Laboratory (www.lbl.gov) is a reputed research setup supported by the US Department of Energy, which publishes cutting edge research on wide range of topics in science, technology and energy

[16] REEEP is a global partnership that structures policy initiatives for clean energy markets and facilitates financing for sustainable energy projects

The Telecom Tower Based Charging Services Opportunity

In the off-grid regions of the developing world, the mobile telecoms industry is experiencing unprecedented infrastructure growth. The GSMA estimates that nearly 639,000 off-grid base stations will be rolled out across the developing world by 2012; South Asia and sub-Saharan Africa regions gathering the most off-grid deployments. Since these mobile base stations need power to function, operators and telecom tower infrastructure providers (or tower companies) run diesel generators at each site, although increasingly they are installing renewable power, such as wind turbines and solar panels.

In several of these off-grid regions, mobile base stations are typically the only powered infrastructure in the local community. Due to reliability and service level considerations, the power equipment in these base stations are often over-specified, resulting in considerable amount of excess power generation. As per GSMA research, stand-alone off-grid diesel sites (not shared) can have excess power generation capacity as high as 5 kW, even though green powered and shared diesel sites have lesser excess power availability than diesel sites. Thus, off-grid base stations with 5kW of excess power can charge thousands of mobile handsets, provide electricity to 30 homes, power 15 vaccination fridges (~500W of peak power) or 2 clinics.

A few of the major advantages from this charging service model are:

- Economic uplift in off-grid communities driven by improved energy access
- Major cut-down in travel time and costs to charge handsets, lanterns and other electronic devices
- Additional revenue streams and increased site security for developing world MNOs and tower companies

A real opportunity now exists for operators to provide excess power to the local community to charge low power devices. This approach not only has a strong business case for the implementing stakeholder, but also could create a strong social impact within the local communities; in line with the Millennium Development Goals.

Community Power from Mobile Pilots

By Sagar Gubbi, GSMA

The GSMA has been working on the Community Power from Mobile (CPM) concept since mid-2009 and has identified that there is potential to bring significant social benefits to off-grid communities while creating new business opportunities for operators and off-grid energy service providers. The GSMA now intends to test these findings by setting up a number of pilots around India and East Africa.

The aim of these pilots is to demonstrate scalable revenue driven business models for charging services from excess power at base stations. The charging services pilots will be focused on high value, portable charged devices (handsets, lanterns, radios & computers) or portable household batteries (12V); charging locations will be at or in the immediate vicinity of the base station.

Objectives

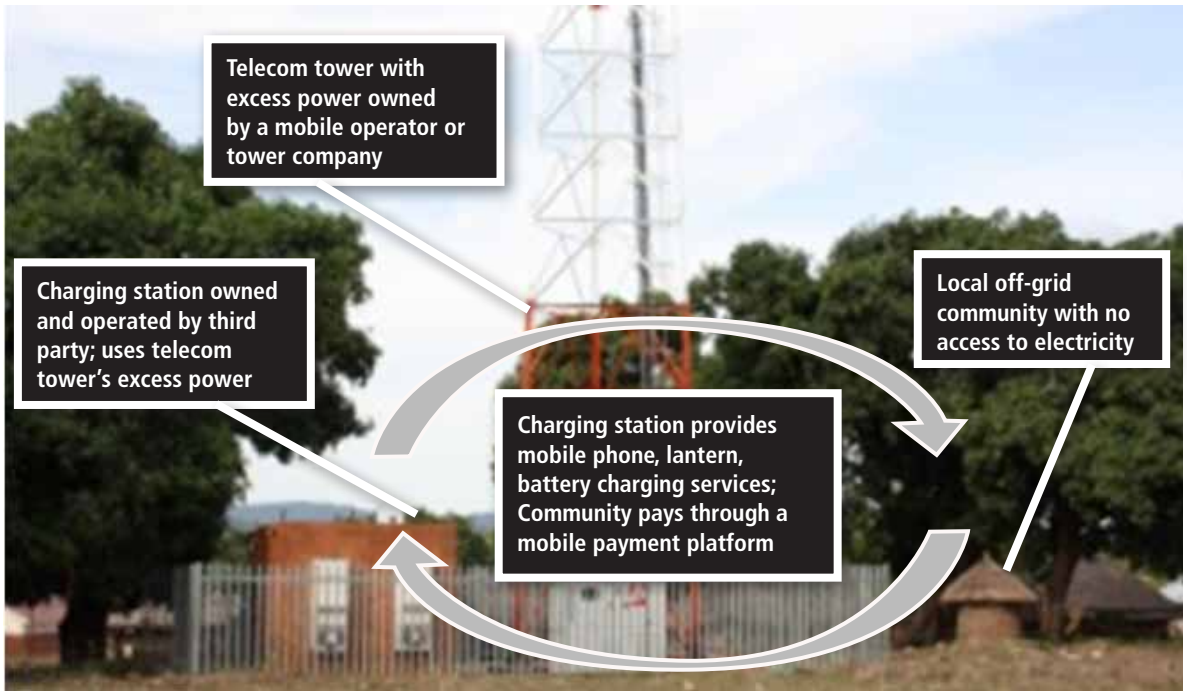
- Improve energy access/charging services for off-grid populations
- Reduce Green House Gas (GHG) emissions by maximising efficiency of existing and future energy system deployments at off-grid base stations
- Demonstrate a scalable, revenue driven business model for charging services
- Improve the business case for off-grid base stations, thus enabling expansion of network coverage, by (a) growing revenue streams, (b) improving base station security and (c) charging mobile phones for increased usage, hence increased ARPUs
- Monitor and evaluate multiple business models and technologies to reduce risks associated with large scale implementation

Community Power from Mobile Pilot Plan

- Pilots with multiple operators in India and East Africa; potentially multiple sites per operator
- Prospective pilot operators and third party partners will be identified by GSMA
- GSMA will provide technical assistance, monitoring & evaluation services and publicity to project partners

This initial phase will provide the results and learnings to identify opportunities for scaling the concept and programme both within India, East Africa and eventually, on a global level.

Figure 1: Community Power from Mobile Charging Services: Proposed Implementation Model



The aim of these pilots is to demonstrate the strategic and social benefits for the various stakeholders involved in charging services projects. At the same time, these pilots would also aim to determine the technical designs, business models, engagement and last mile delivery models to ensure the CPM concept scales up after the pilot phase.

Pilots in India and East Africa are planned to be implemented by Q2 2011 after which the GSMA will conduct monitoring and evaluation.

Glossary

2G / 3G – second-generation and third-generation mobile telephone technology

AC / Alternating Current – an electrical current or voltage with a changeable direction (polarity) with respect to a fixed reference

Ah / Ampere-hour – unit of electric charge, the electric charge transferred by a steady current of one ampere for one hour

ARPU – Average Revenue per User

BoP – Base of Pyramid

BTS / Base Transceiver Station – the name for the antenna and radio equipment necessary to provide mobile service in an area

CAPEX – Capital Expenditure

CO_2e / Carbon dioxide equivalency – a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential when measured over a specified timescale.

CPM – Community Power from Mobile, GPM project

DC / Direct Current – an electrical current or voltage with a constant direction (polarity) with respect to a fixed reference

GDP – Gross Domestic Product

GHG – Green House Gases

GPM – GSMA Green Power for Mobile programme

GPRS – General Packet Radio Service

GSM – Global System for Mobile communications

GSMA – GSM Association

IFC / International Finance Corporation – a member of the World Bank Group

IRR – Internal Rate of Return

kg / kilogram – a kilogram is a unit of mass

km / kilometre – a kilometre is a measure of distance

KPI – Key Performance Indicator

kVA / Kilovolt-Ampere – the unit of apparent power. kVA is used for measuring the power consumption of non-resistive equipments such as generators

kW / kilowatt – a kilowatt is a unit of power (see watt)

M2M – Machine to Machine

MEE – Mobile Energy Efficiency, GSMA Initiative

MHz / megahertz – the hertz is a unit of frequency. It is defined as the number of complete cycles per second.

NGO – Non Governmental Organisation

NVP – Net Present Value

OPERATOR - Mobile Network Operator

OPEX – Operating Expenditure

PV / Photovoltaic – in this instance refers to PV cells which convert visible light into direct current

ROI – Return on Investment

V / volt – the value of the voltage equal to one ampere at one watt of power

W / watt – a unit of electrical power equal to one ampere under a pressure of one volt

GSMA Green Power for Mobile Associate Members

www.altobridge.com/

www.bpsolar.fr/solaire/index.php

www.byd.com.cn

www.uk.cat.com/

www.electrops.it/

www.idatech.com/

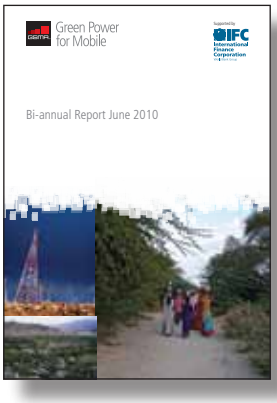
www.m-field.com.tw

www.symantec.com/index.jsp

Resources

www.gsmworld.com/our-work/mobile_planet/green_power_for_mobile/resources.htm

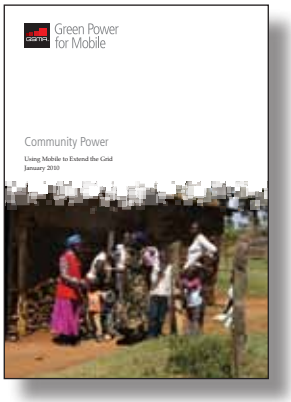
Reports



Green Power for Mobile Bi-Annual Report (June 10)
www.gsmworld.com/documents/GPM_Bi-Annual_Report_June_10.pdf

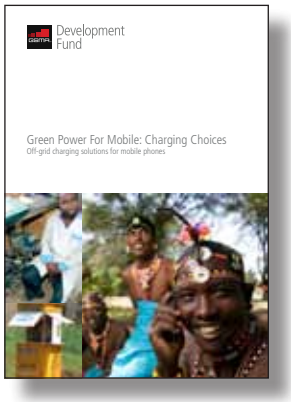
Green Power for Mobile: Top Ten Findings
www.gsmworld.com/documents/green_power_top10.pdf

An overview of the top ten research findings for green power solutions for mobile networks.



Community Power – Using Mobile to Extend the Grid
www.gsmworld.com/documents/gpfm_community_power11_white_paper_lores.pdf

This study discusses how the mobile industry can help provide environmentally sustainable energy to people in the developing world who live beyond the electricity grid.

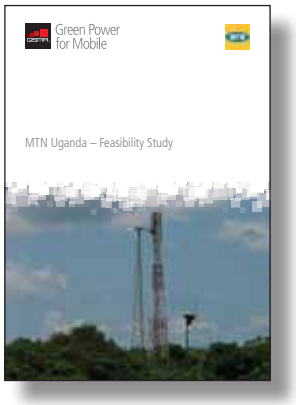


Green Power For Mobile: Charging Choices
www.gsmworld.com/documents/charging_choices.pdf

This study discusses charging solutions for handsets in off-grid areas and identifies a US$2.3 billion market potential for those solutions.

HOMER Software – Training Guide for Renewable Energy Base Station Design
www.gsmworld.com/documents/homer_training_guide_210X297.pdf

A free software application used to design and evaluate technically and financially the options for off-grid and on-grid power systems for remote, stand-alone and distributed generation applications.



Green Power Feasibility Study – MTN, Uganda
www.gsmworld.com/documents/gpfm_mtn_feasibilitystudy_pages.pdf

A Feasibility Study to provide information to mobile operators who are considering or planning to deploy renewable power resources for base station and transmission sites.

Case Studies

Green Power Feasibility Study – Zantel, Tanzania
www.gsmworld.com/documents/zantel_tanzania_page_layout(1).pdf

A Feasibility Study to analyse the operator's network and propose an implementation plan for a green power network.

Green Power Feasibility Study – Digicel, Haiti
www.gsmworld.com/documents/digicel_haiti_04_10_med_res.pdf

Comissioned by Digicel Haiti, this study analyses the operator's network and proposes an implementation plan for a green power network.

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