IFC International Finance Corporation
World Bank Group

GSMA Green Power for Mobile

In partnership with the Netherlands

Bi-annual Report July 2012

Contents

Welcome

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. Fast forward to July 2012 and we are now on our sixth edition of the biannual report, which continues to explore these three workstreams as well as introducing a fourth: enhancing utility access.

The 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. Recently, the IFC awarded the GPM Programme with a further grant to enter Phase 2 – Scaled Demonstration; details of which is contained within this report.

We continue to host regional focused Working Groups and our 3rd Indian and 2nd African Regional events occurred earlier this year in Delhi and Doha, respectively. Both Working Groups were a great success with India bringing in over 100 delegates and both trialling new discussion formats. A summary of the discussions that took place at both Working Groups can be found in Chapter 1 of this report. You will also find the analysis of a focus group discussion on energy storage that was facilitated by GE in Doha in Chapter 5. We are continuously working to make sure that the content of the Working Groups is fresh and exciting to attendees and are ensuring that the knowledge is shared in more efficient and effective ways.

As we wrapped up the writing on this biannual, all eyes were on Rio where the world was convening for Rio+20. A topic of discussion central to our work is the growing support for Sustainable Energy for All. The UN Secretary-General Ban Ki-moon introduced the International Year of Sustainable Energy for All for 2012. The GSMA's Development Fund is a firm believer that the mobile industry is uniquely positioned to leverage itself to drive this opportunity forward. The following Sustainable Energy for All objectives, to be achieved by 2030, aligns with the aims and objectives of the Green Power for Mobile and Community Power from Mobile Programmes:

- To ensure universal access to modern energy services
- To double the rate of improvement in energy efficiency
- To double the share of renewable energy in the global energy mix

The final chapter of this report is a call for commitments. We want to showcase operators who are currently working to, or keen to work towards, the future we want.

The team looks forward to continued collaboration with our Working Group members and the industry in general to ensure that our work is relevant to our stakeholders, actionable and aids in advancing this emerging sector within the telecommunications industry. I trust you will find this edition of the bi-annual report educational and informative. We look forward to working with you on the issues raised in this report and establishing a work plan for the programme's next phase.

Areef Kassam
GSMA Programme Director – Green Power for Mobile

Meet the Team

Who's who in GPM and CPM

Areef Kassam

Programme Director

Areef is the Green Power for Mobile Programme Director. In this role he is responsible for Managing the development and delivery the programme products and services that are tailored to support operators in the decision-making process around deploying renewable energy for base station power.

Michael Nique

Strategy Analyst

Michael Nique joined the GSMA as a Strategy Analyst for the Green Power for Mobile programme. In this role, he is monitoring key innovations in renewable energy applied to the mobile industry and services to the end users. Michael also provide insights on data analysis for the mobile and development markets.

Abirami Birrell

Projects Manager

Abi Birrell is the Projects Manager for the Green Power for Mobile Programme. In this role, she organises key GPM events and supports the team more broadly with planning and research. Abi also leads the management of the Green Deployment Tracker. Abi joined the GSMA in 2009 after completing a Masters in International Business and Global Management, where her thesis explored consumer behaviours which made mobile money products successful in emerging markets. Prior to turning her interest towards technology and development, Abi had a strong bond with bacteria and their DNA whilst pursuing a degree in Human Genetics.

Ferdous Mottakin

India Project Manager

Ferdous is the Project Manager for the Green Power for Mobile programme of GSMA Development Fund and responsible for leading projects for India. Additionally, his role involves creating industry collaborations, leading Green power consultant team to conduct green power Feasibility Study and the associated project management. He also oversees Africa and Asia specific green power related activates. Ferdous has completed successful projects in South America, South Asia and East Africa within Green power work stream of GSMA. He was also part of GSMA lead community power project for East Africa and India.

Prior to joining the GSMA, Ferdous spent much of his career across the globe of working in different layer of telecom industry. Project Management and business development is his area of expertise. Ferdous holds a Bachelor degree of Engineering from Simon Fraser University of British Columbia.

Satish Kumar

Field Implementation Consultant

Satish is a Field Implementation Consultant for the Green Power for Mobile programme. Within GPM he is responsible for conducting Green Power Feasibility studies and is associated with Community Power from Mobile activities in the East African region. He has varied experience working with government bodies and organisations across telecoms, renewable energies and rural enterprises. He holds a Bachelors degree from IIT Kanpur and an MBA from IIM Bangalore.

Charlotte Ward

Community Power from Mobile Programme Manager

Charlotte brings over 12 years of experience in investment banking, carbon finance, renewable energy and telecom to her role in the GSMA Development Fund, managing the Community Power from Mobile programme from Nairobi. Prior to joining the GSMA in 2011, Charlotte consulted government and corporates on carbon and energy projects in East Africa, following 8 years with Deutsche Bank in global capital markets within business development, sales and trading. Charlotte has a Master's Degree in Applied Environmental Science from Sydney University and a Bachelor's Degree in Geography from Bristol University.

Mary Roach

Community Power from Mobile Business Development Manager

Mary Roach joined the GSMA in 2011 as an advisor for the Community Power from Mobile Programme. Prior to joining the GSMA she spent two years working on rural energy solutions in sub-Saharan Africa and five years working with GE Power Generation as a project and operations manager. She holds a MBA from Oxford University and a Bachelors in Chemical Engineering from McGill University.

Chapter 1

Review of Core Activities from the Green Power for Mobile Team

Green Deployment Tracker

When the Green Power for Mobile (GPM) programme launched in September 2008, the aim was to promote the use of renewable energy sources by the telecoms industry. To showcase the hard work and commitment of the industry to reach this target, GPM launched the Green Deployment Tracker; a database which uses Google Earth as a platform to track green deployments worldwide.

The progress is shown by:

- Country
- Individual Operators
- Specific technologies
- Highlighting individual site case studies
- Planned deployments

The tracker currently hosts over 20,000 live and planned sites to date. In April 2012, the GPM team made a significant push to increase the accuracy of the tracker.

Most recent updates include:

- China Mobile increasing their number of deployments by 846, taking their total to almost 9000
- Qtel Group up to 250 across their ops co's
- Zain contributing a further 100 sites

In the latter quarter of this year, we will be moving to a new platform, Mobile and Development Intelligence (MDI). GSMA is building this online, publically accessible data-driven website for our member operators and wider mobile for development community. MDI will cover many sectors including green networks, mobile money and mobile health. The green networks section will include various metrics which can be used in analytics as well as hosting our deployment tracker. It will also include the evolution of our vendor catalogue, enabling users to perform searches and view profiles of organisations and their products or services in certain geographical regions and/or by technology type.

Working Groups

The Working Group has been a key driving force in the industry; however, after our seventh meeting in the Philippines in September 2010, it was clear that encompassing the full spectrum of discussion into just two days was a challenge. To address this, Regional Special Working Groups were created and allow for the tailoring of content specific to the region.

Since the last biannual report GPM has hosted two Regional Working Groups, one in India and the other in Doha. Below is a short review of the outcomes from both:

India: Meridian Hotel in Delhi on the 13th April 2012

- Co-hosted by the Cellular Operators Association of India (COAI)
- Attended by over 100 delegates from 70 organisations

Summaries of the 4 sessions are below:

Session One was the inauguration session. Speakers included: *Sandeep Karanwal, Head of GSMA India; Rajan S Mathews, Director General of COAI; Umang Das, Director General of TAIPA; Gaurav Gupta, Regional Director for Asia, Dalberg; N Ravi Shankar, Administrator USO Fund, Ministry of ICT* ; and Ferdous Mottakin, GSMA. The objective of the session was to understand current status of Indian green telecom and way forward from here.

Session Two title was "Adaptation of Green telecom recommendation for Indian Telecom industry". *PK Panigrahi Senior Deputy Director General, Department of Telecom* was the key speaker. Others included *Ajay Jain, Head of Network infrastructure, Bharti Airtel and Shachidevi T K, CTO of Indus tower* spoke. The main outcome of this session was to create a bridge between government stakeholders and tower operators. There is a lot of ambiguity in the current green telecom recommendation and these were highlighted in the session in order to help the industry to rectify those for the future.

Session Three title was "Energy outsourcing model- successful execution". *Dr. Bibek Bandyopadhyay, Adviser of Ministry of New and Renewable Energy* was the key speaker. Additionally, *Krishnan Raghunathan, CEO of KMRI and Mary Roach, Community Power from Mobile, GSMA* spoke at the session. The main outcome brought further clarity on the possibility of large-scale implementation of energy outsourcing model.

Session Four was a round table discussion on "The Green road map for Indian telecom industry" which was moderated by Ferdous Mottakin, GSMA and co-moderated by *Gaurav Gupta, Regional Director for Asia, Dalberg*. The main outcome opened up the dialogue among all stakeholders in Indian telecom industry to promote green power.

What's Next:

A list of action points were created to follow-up on at the next working group. The aim of this is to ensure the proper momentum of green power promotion across the industry is up-kept and to bring further clarity to the green telecom recommendation from the Government of India to successfully scale-up the green deployment.

Africa Working Group: Ritz Carlton in Doha on the 18th and 19th April 2012

- Co-hosted by Qtel Group
- Attended by 55 delegates from mobile network operators, to vendors, energy service companies, financiers and NGOs

Session One: After a brief introduction from Areef Kassam, Green Power for Mobile Programme Director, the opening presentation was given by Qtel Group who spoke about their Energy Efficiency Strategy. Following this, the International Finance Corporation gave an overview of how they work, possible financing models along the value chain, barriers and challenges as well as newly emerging business models. There was also some insight given into the new phase of the GPM Programme, which was recently agreed with the IFC. Zephyr Corporation, talked about their wind turbine solutions for telecom sites and the value proposition to mobile network operators. A Vodacom site was used as a case study to highlight the benefits of 50% cost reduction, savings of US$24,000 for hybrid and a 2-year payback period.

Session Two: General Electric facilitated a focus group survey for some market research the GPM team requires around batteries. The results of this survey are available in this report. Further, the afternoon was split into two break-out sessions; the GPM team discussed renewable energy Business Models, while the CPM team discussed their new feasibility study offerings.

Session Three: On day two, Satish Kumar opened with a presentation on our recently-completed GPM and CPM feasibility study with TNM in Malawi who have a total of 365 sites; 300 on-grid and 65 off-grid. Off Grid:Electric, the only technology integrator in the group, followed with a presentation initially outlining their services and nascent market opportunities before talking about the benefits of the ESCo Model for the operators, potential barriers as well as the four pricing models; no CAPEX, hybrid CAPEX, PPA and ESA. Charlotte Ward, our Community Power from Mobile Manager discussed in more details the opportunities for African operators. Vodafone Group has been trialling a community power site in Emfihlweni, South Africa, where they have been utilising their infrastructure to power a local school. Mohammed Belfqih, Infrastructure Manager, explained how they installed solar foil on a roof top and increases a nearby site to 14kW. This is enough to power a water pump, 60 laptops, a Webbox and handset charging at a local shop.

Session Four: Through our research into community power emerged the idea of smart solutions for energy access. Areef briefly introduced our findings to day before handing over to Seena Rejal of Eight19, a company producing pay-as-you-go personal solar electricity systems. The afternoon saw the group break into two groups for another break-out session: the GPM group discussed creating an industry task force, and CPM discussed various business models for community power deployments.

Please contact us as **greenpower@gsm.org** if you would like:

1. Further information about our Working Groups or as an Operator, would like to attend
2. If you are able to contribute to the Green Deployment Tracker now with live or planned sites (including diesel battery cycling systems) - your information is invaluable to us

Future Working Group Dates:
Phnom Penh: 24th & 25th July 2012 hosted by Hello! (Axiata Group)
India: August 2012 host TBC
Ghana: 6th & 7th November 2012 host TBC

Chapter 2
GPM Programme Outlook

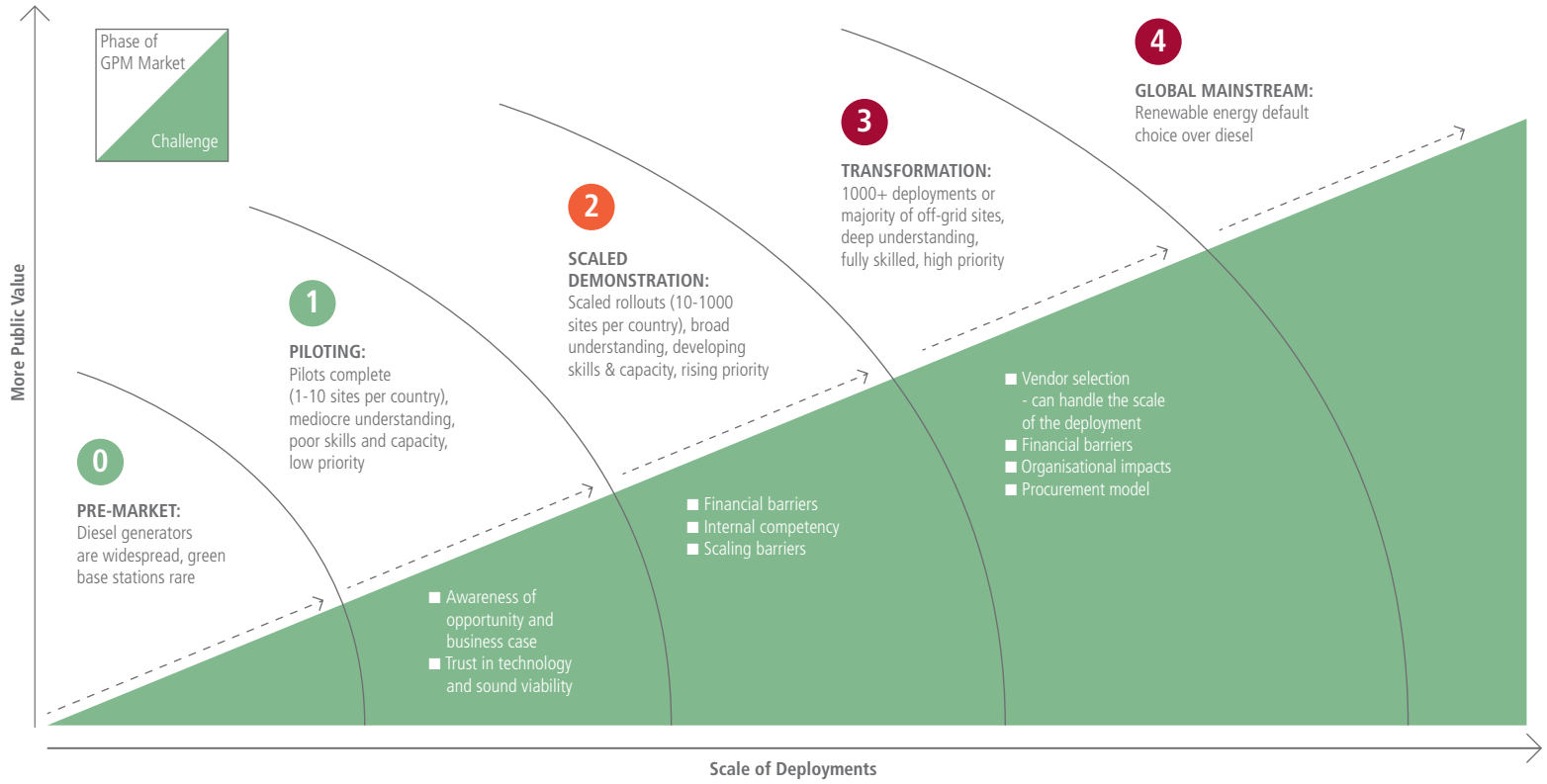
By Arata Onoguchi, International Finance Corporation (IFC) and Areef Kassam, GSM Association

IFC[1] has been jointly managing the Green Power for Mobile Programme with the GSMA since 2009. The Programme aligns very well with the IFC's objective of promoting sustainable business while MNOs penetrating their services into more rural areas with no grid power. People need mobile communication services that will improve their lives.

Together with GSMA, and thanks to its member operators and all other Working Group participants, we have made remarkable progress with the number of green sites growing from 9,093 by 32 operators in 30 countries (2009 Q1) to 12,587 by 66 operators in 52 countries (2012 Q1). Alongside, a number of useful deliverables including 10 Working Group meetings, 6 bi-annual reports, 23 feasibility studies, 15 case reports (+ 2 in process), 3 training reference materials and 2 databases have been achieved. These deliverables have formed a repository of practical knowledge which are mostly available online.

Of the 640,000 total off-grid sites, GSMA estimated there would be approximately 120,000 sites economically viable for green power. Though the current achievement of 12,587 is quite impressive, there is still a long way to go.

The programme identified a multi-stage deployment lifecycle that the MNOs and the sector are traversing which involves specific sequential steps. The stages of this deployment cycle map to the evolution of the sector as a whole, with each stage requiring specific and varying interventions from GSMA and IFC. It is useful to know where we stand now and what tools are available to make things happen on a much wider scale.



1 International Finance Corporation (IFC), a member of the World Bank Group, is the largest global development institution focused exclusively on the private sector. Visit www.ifc.org

As we close off the first phase of this programme and review our deliverables, our achievements to date are astounding. The focus was on technical assistance and public dissemination through the GPM Working Groups, biannual reports, feasibility studies and pilots. This has driven awareness among MNOs and sparked interest in the industry, accelerating the numerous MNOs through the Pilot phase. Whilst the financial and technical viability of green base stations has been proven at a large number of sites, MNOs are traversing an intermediary step before the Transformation Phase (1000+ sites per country) rollouts. They are moving through a Scaled Demonstration Phase of between 10-1000 sites per country due to key scaling barriers. These include engagement / trust with new vendors, building skills and capacity as well as competing financial, management and resource priorities.

Whilst MNOs have a broad understanding of the benefits and business case of renewable energy networks, there are competing financial and resource priorities blocking the full conversion. Most MNOs are at different stages within the deployment lifecycle; the majorities of MNOs in the GPM Working Group have completed pilot sites and are entering the Scaled Demonstration phase. Phase 2 will provide on-site 1-2 day training sessions to operators to help them assess on their own, the viability for green sites for their network.

The industry mapping looks like below according to the current data in the GPM Deployment Tracker Database:

Stage	Operators (#GPM sites)
Global mainstream	(Not about individual operators, but industry-wide)
Transformation	1 operator (7,795)
Scaled-demonstration	39 operators (4,719, average= 121/operator)
Piloting	26 operators (64, average=2.5/operator)
Pre-market	X hundred (all other operators who have off-grid/poor-grid sites)

The table below illustrates typical issues and corresponding resources / opportunities to address the respective issues at each stage

Stage	Typical Issues	Resources/Opportunities
Common to all stages		■ Technology trend analysis ■ Vendor list ■ GPM deployment tracker database
Pre-Market Stage	■ Awareness of opportunity and business case ■ Trust in technology and solution viability	■ Feasibility case reports and some other reports ■ Working group meetings ■ Feasibility study ■ GPM technical training
Piloting Stage	■ Financial barriers ■ Internal competency ■ Scaling barriers	■ Best practice procurement guide report ■ GPM technical training
Scaled-Demonstration Stage	■ Vendors who can handle a lot more scale of the deployment ■ Financial barriers ■ Organisational impacts ■ Procurement model	■ GPM requirement specification with volume estimate ■ Market analysis ■ ESCo business development/ capacity building ■ Procurement model (business model) ■ RFP & tender support

For a full breakdown of this model mapped to the industry, as well as a full list of resources available and deliverables achieved, a report from the IFC will be available on the GSMA and IFC website from July 2012.

Looking forward:

GPM requirement specification with volume estimate: operator participants at the Cape Town Working Group raised that the industry need to clearly define the requirements for GPM solutions for Africa, together with the probable demand volume in the next 3-5 years, so that the vendors can make more suitable products and go for mass production; leading to more economy of scale and unit cost reduction. The GPM Programme will facilitate this through an Industry Task Force which will detail specific requirements and the demand volume.

ESCo business development/capacity building: in many cases, operators find it difficult to get financial buy-in on green initiatives competing with other higher priority investment programmes such as 3G/4G LTE, more spectrum acquisition, license renewal, etc. Additionally, power is not the core business for operators. Typically pay back periods of three years and less are favourable, which green initiatives in the past have not been - though this is changing. We have found that an outsourcing model, OPEX model, with third-party ESCos can resolve this dilemma for the reasons listed below:

- Operators do not invest in CAPEX
- Power is the core business for ESCos
- ESCos may have investment paradigm which may be longer-term oriented than operators

The problem is that there are not enough ESCos that have enough capacity to service base stations that require a small amount (1-2kW) of power at many sites, as opposed to utility power generation that require large amounts (MW, GW) at one site. The service level agreement is normally quite demanding, often a 99.95-99.99% up time guarantee as operators cannot accept a site to shut down due to power failure. Operators will demand ESCos to provide this at very low price.

Currently, there are smaller companies who are very willing to get into this ESCo space, but they have limited access to finance to grow because scalability of their business is yet to be proven. Large, internationally renowned technology vendors are also looking at this space but also have a balance sheet constraint as they do not want to add more assets to it.

There is no clear equation to satisfy all these elements but something that the programme will be deliberating in order to support a better business model.

RFP & Tender Support: in India, MOU's have been signed with Viom and Bharti Infratel to support their procurement activities to scale up the OPEX model GPM solution. For further details, please view the joint Bharti Infratel and GSMA press release. We are keen to support more operators in this way, so if you are interested in such support, please get in touch with the GPM team and gpm@gsm.org.

With the above resources/opportunities, we would like to see many more operators move up from the Pre-Market stage to the Piloting stage and subsequently to the Scaled-Demonstration stage, with at least tens of operators reaching the transformation stage by 2014.

Chapter 3

Case Study: GPM Feasibility Study – TNM

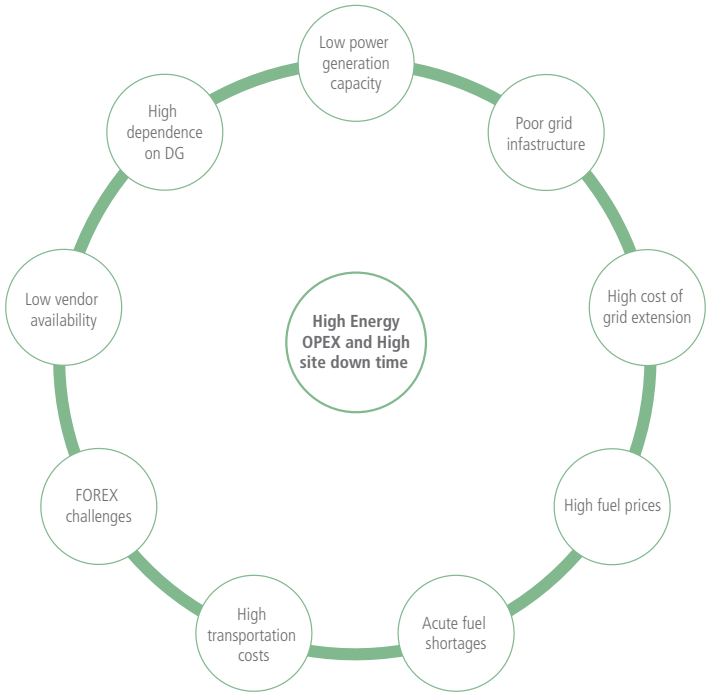
Background

GPM, with the consent of Telekom Networks Malawi (TNM), has conducted a green power feasibility study for TNM's entire network to demonstrate the economic and environmental benefits of deploying green power solutions to power their network. The study was conducted from mid-December 2011 for a period of six weeks.

This green power feasibility study required extensive data collection for the entire network of sites, including technical data on site configuration, power requirements and other specific details such as geography, accessibility, logistics and renewable energy resources. The validation of this data was critical to the analysis. GPM has conducted several iterations to the data validation through field visits and interaction with the operations and field engineering teams.

Overall Context for GPM Green Power Feasibility Study

The figure below illustrates the overall context in which TNM operates and runs its network. Some of the key challenges are highlighted below:



Malawi

Malawi, with a population of about 15 million, is one of the most densely-populated countries in sub-Saharan Africa. Malawi is a land-locked country, connected to ports through Mozambique and sharing its borders with Zambia, Mozambique and Tanzania.

Malawi is predominantly an agriculture-based economy, with agricultural output contributing to about 35% to the GDP and accounting for more than 80% of the export revenues. As a land-locked country, Malawi faces major infrastructure challenges in terms of electricity supply, transport and freight, all contributing significantly to the cost of imports and exports.

Telekom Networks Malawi (TNM)

TNM is the second largest mobile operator in Malawi, with a subscriber base of 1.6 million and a market share of over 42%.[1] A pioneer in offering new services, TNM became the first mobile operator in Malawi to launch and offer 3G services, including video calling, video and music streaming, and mobile broadband access. TNM is a trusted operator in the corporate customer segment with a loyal customer base contributing to a market share of over 67% in the segment.[2]

TNM has been at the forefront in providing access to mobile services to the rural population and has significantly contributed to the increase of penetration levels in the country, which grew from 8% in 2007 to 22% in 2010.[1] With a network of 380 base station sites in the access network, TNM covers about 74% of Malawi and over 85% of its population.[1]

TNM faces a major challenge in powering a network of 380 exiting telecom base station sites. The current network consists of telecom sites deployed in both off-grid and on-grid locations. The on-grid sites have reasonable electricity supply from ESCOM (Electricity Supply Corporation of Malawi), except for an average of 4 hours of power outage per day, due to the scheduled load shedding from the utility. However, the off-grid sites rely completely on diesel generators to power the equipment.

1 TNM Annual Report 2011
2 TNM Corporate profile – www.tnminvestor.com

Objective of GPM Green Power Feasibility Study

- To explore alternative energy options to power and run the network of telecom sites
- To demonstrate technical feasibility and financial viability of green power alternatives
- To reduce energy OPEX and promote green telecoms by reducing dependence on diesel generators and hence by reduction in CO_2 emissions
- To enable capacity building through training and knowledge transfer

1. Infrastructure Challenges

Electricity and transport infrastructure remain the biggest challenges to the economic development of Malawi and impact telecom operators by burdening site operations and increasing OPEX.

Electricity Infrastructure

The availability and supply of electricity remains a major challenge for the operator, contributing significantly to the costs of operating a telecom base station site.

A snapshot of Malawi's power infrastructure:

- Insufficient production capacity to meet the expected demand for electricity. A total installed power generation capacity of 300 MW, of which hydro accounts for 282.5 MW[1]
- Poor transmission and distribution infrastructure
- One of the lowest electrification rates in the world, with only 7% of the country having access to electricity[2]
- Only 1% of rural households are electrified, while around 25% of urban households have access to electricity[3]

Natural Energy Resources in Malawi

- Malawi has no natural oil and gas resources and imports the majority of its fuel requirements
- Coal production meets only 25% of its total requirement[3]

Transport infrastructure

- Poor roads, underdeveloped freight and rail access
- Landlocked with poor access to ports and limited air links

2. Operational Challenges

- Due to unreliable grid access and lack of grid infrastructure, mobile operators have to rely heavily on diesel generators to power their networks
- There has been acute fuel shortages in the country, lasting for over a year in 2011 and early 2012, causing fuel prices to cross US$2 per litre of diesel
- Most of the off-grid sites are in remote locations, where accessibility is a challenge and increasing the cost of running diesel generators by increased logistics costs (as a result of the periodic refill requirements of diesel)
- Fuel inventory planning for energy provision to off-grid and unreliable grid sites is very critical in meeting the demand for network expansion across the country

3. Economic Challenges

- Shortages in foreign exchange reserves resulting in fuel shortages and higher cost of imports
  - Agriculture contributes about 35% of the GDP, and more than 80% of the export revenues with tobacco, tea and sugar being major export commodities[4]
  - Heavy dependence on agricultural exports for foreign exchange reserves make it susceptible to sensitivity in commodity prices in the international markets
- Conservative investment policies, trade barriers and an unsupportive investment environment leading to marginal foreign investment

Within the context and background presented above, GPM analysed the entire network of sites to understand the current scenario in terms of site operations, power provision and the respective costs associated with them.

1 ESCOM Ltd – Corporate Profile
2 REEEP Policy Database (http://www.reeep.org/index.php?id=9353&text=policy-database&special=viewitem&cid=94)
3 TNM Annual Report 2011
4 http://en.wikipedia.org/wiki/Malawi

Key Highlights and Approach

The feasibility study was carried out using the GPM methodology involving detailed data collection, data analysis, model design, business case development, implementation prioritisation and financial analysis, followed by recommendations. The feasibility study and analysis was conducted for 365 of the 380 total sites based on the data availability and data validation.

The key highlights of the TNM Malawi network are outlined below.

Network Highlights:

- Total Sites: 365 (65 off-grid and 300 on-grid)
- Average DG run per day: 15.85 hours (off-grid)
- Average power outage: 3.45 hours (On-grid)
- Overall average site load is 3.22 kW whereas average telecoms equipment load is 1.34 kW
- 87% of the sites are indoor
  - 55% of power requirement is for air conditioner load
  - Average load per indoor site is 3.47 kW
- Average load per outdoor site is 1.47 kW

Solution Design & Approach

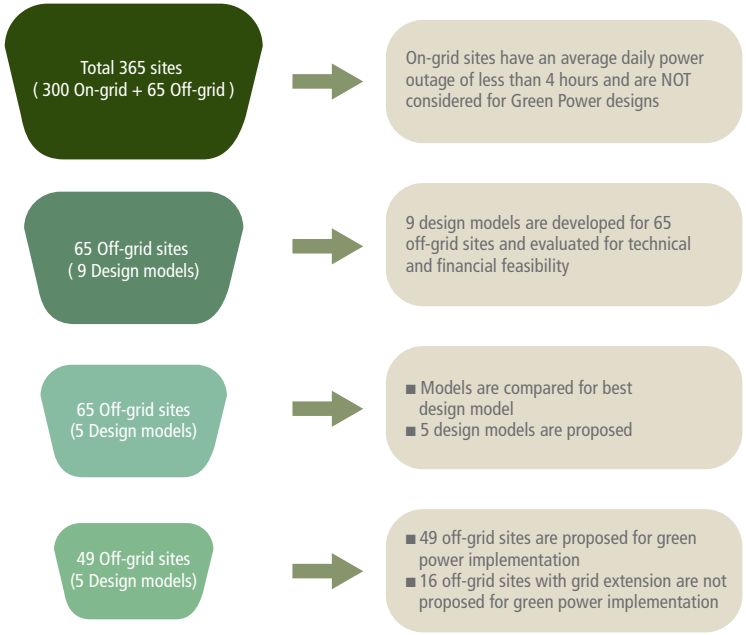
Based on the overall network data analysis, GPM considered the 65 off-grid sites for renewable power solution design. The remaining 300 sites connected to the grid were not considered for green power design as the average daily power outage is less than 4 hours and do not present a viable business case. A total of 9 design models covering 65 off-grid sites were developed and evaluated for financial feasibility.

Design Modelling Approach:

Based on the availability of renewable energy resources for Malawi, solar and wind solutions were considered for design and financial feasibility.

1. Solar designs were considered to cover all 65 off-grid sites. The 65 sites were grouped into 5 solar design models based on similar site configurations and load characteristics
2. Wind-solar hybrid designs were considered for all the sites with poor financial indicators for solar designs and then evaluated against their corresponding solar designs
3. All indoor sites were considered for upgrade to outdoor equipment to reduce site load requirements for green power design. Solar designs were developed for upgraded sites with lower load requirements and the additional cost of site upgrade was considered for business case development. The designs were then evaluated against corresponding solar and wind-solar hybrid designs for each of the upgraded sites to identify the most suitable design with a superior business case

- Five solar designs (three indoor and two outdoor) were modelled and evaluated for financial feasibility
- Two wind-solar hybrid design models were developed and evaluated against corresponding solar models
- Indoor to outdoor site upgrades were considered for green power solution design and evaluation



Recommendations and Outcome

Energy solution recommendations are based on comprehensive technical analysis, design and evaluation, while the energy efficiency recommendations are based on qualitative analysis from site surveys and discussions with the TNM operations team.

1. Energy Solution Recommendations

The phased implementation priorities are set based on site importance, ease of deployment and financial returns. Critical hub sites and sites with better financial indicators are given higher priority for green power implementation.

Considerable savings in OPEX can be achieved by implementing our recommendations at the telecom sites. Key highlights of operational, financial and environmental benefits demonstrated are presented below.

- Dependence on DG reduced to less than 20%
- Savings in diesel consumption of 550,000 L/year
- OPEX savings of up to 90%
- Average pay-back period of 2.25 years
- Green Power generation of ~700,000 kWh/yr
- CO_2 Emission reduction of ~700 Tons/yr

2. Energy Efficiency Recommendations

For overall energy optimisation, GPM created a list of recommendations that can help TNM reduce their energy requirements at every site.

Implementing these recommendations will enable TNM to improve energy efficiency of the network, reduce OPEX by up to 25% and reduce dependency on diesel generators to power the network.

In addition to generic recommendations for improving overall energy efficiency of the network, GPM also proposed specific recommendations to be implemented for on-grid sites which are not considered green power solution designs.

- Save energy bill by deploying FCU or DC aircon for indoor sites
- Save diesel consumption of 2500l per day by implementing grid + battery hybrid at all on-grid sites
- Increase battery life by up to 50% by using separate battery cabinet with cooler for batteries

The CPM program was able to benefit from the knowledge gained from the GPM study on TNM's network and infrastructure, and began its own feasibility study during April 2012. The findings of the study are in the process of being completed, at the time this article went to press and will be released at a later date. The recommendations from the GPM study were a valuable contribution for evaluating how the BTS power infrastructure and their requirements can be leveraged for community energy access.

Chapter 4

MTN's Sustainability Journey

By Zakhiya Rehman, Group Sustainability Manager, MTN

As a company that operates in developing economies across Africa and the Middle East, MTN has a unique opportunity to make a meaningful economic, environmental and social difference in the markets in which we operate. Thus, we have taken a deliberate approach to incorporate sustainability into our core business.

For MTN, sustainability means we are able to economically maintain and grow our business in a way that is environmentally and socially responsible, as well as responsive to the needs of our stakeholders. Our efforts are focused on three key areas: **assuming eco-responsibility; generating sustainable economic value, and advancing the growth of sustainable societies.**

Assuming Eco-responsibility

- We reduced our carbon footprint by 15.7% to 950,564 tonnes in 2011, as a result of decreasing energy use by network sites, switches, hubs, data centres and facilities. We are also working with vendors to implement energy efficiency solutions to power network and data centre technologies
- Approximately 1% of MTN's network is now fully powered by alternative energy sources, and we are increasingly using solar, wind, hydro and other less carbon-intensive energy sources in both urban and rural network deployments
- Our network infrastructure sharing (or site co-location, which involves sharing network infrastructure with competitors), and outsourcing strategies help to reduce the overall environmental impact of national communications infrastructures
- In partnership with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Centre for Cooperation, we are piloting an electronic and electrical waste recycling process among small and medium emerging enterprises in South Africa

Generating Sustainable Economic Value

In recognition of the potentially powerful role that technology and communications could play in economically and socially reshaping the lives of people in the communities in which we operate, MTN is continuously working to increase ICT access and affordability.

- Together with our partners, we have developed technology solutions that help transfer food aid, connect refugees, coordinate communities during disasters and support the growth of agriculture and small enterprises across emerging markets
- With the ITU identifying broadband as a 'powerful accelerator towards the Millennium Development Goals', we have invested over US$230-million in the MTN Y'ello Africa Fibre ring, which includes the West African Cable System (WACS) that was commercially launched in May 2012
- We piloted the first African LTE network in South Africa in 2011, with plans to roll it out across our markets in a few years
- We introduced a $13 cellphone in Zambia three years ago and are now looking at introducing an entry-level $18 GPRS handset to enable affordable digital communication in Africa

Advancing the Growth of Sustainable Societies

Supporting the growth of sustainable societies reinforces our strategic aim to contribute to the socio-economic development of the markets in which we operate. We therefore support the development of small to medium enterprises, which contribute significantly to the GDP of African economies.

- MTN Business' MTN4SME service offers a range of discounts to small businesses
- In Nigeria, MTN's Village Phone project has helped 4,500 vendors increase their income and expand their business skills, while the Bizlift programme supports more than 53,000 retailers
- Through the MTN Foundations we are making a real and valuable impact in the lives of our communities. In 2011, more than R124-million was invested in education, health, arts and culture, enterprise development and other areas of national priority

Solutions that Work (Case Studies)

MTN Uganda's Affordable Solar Charging Solution

Over 1.4 billion people worldwide have no access to electricity. In Uganda, the electrification rate is little over 9% nationally, while handset penetration is estimated to be around 42%. The GSMA puts the average cost for a user to recharge a cellphone at US$2.5. In Africa, where 40% of the population continues to live below the poverty line of US$1.25 a day, such costs are simply exorbitant.

In 2009, MTN piloted an initiative to help solve this problem - a solar powered recharge solution for handsets, called the Fenix ReadySet. The ReadySet can be used to charge MTN EasyTalk phones (which are used to provide funds for the UN World Food Programme) and Y'ello Payphone community phones. In addition to charging phones off an

environmentally-friendly and cheap source of power, this innovative solution also provides power for radios and lighting. The strong demand and need for this solution is evidenced by the fact that end-users could earn up to US$60 a month in income and savings.

MTN Nigeria's Rural Telephony Connectivity Initiative

In a bid to help bridge the digital divide, MTN launched the Rural Telephony project, which has seen 250 solar-powered rural base stations deployed across Nigeria. The use of solar panels has allowed the significant reduction in the emission of greenhouse gases. The monthly reduction in the use of diesel for these sites is estimated to be at least 331 000 litres, while the monthly reduction in the use of electricity is estimated to be 130 000 kilowatts.

Significant business costs, as well as the need for the installation of generators at such sites, maintenance, and travel and fuel expenses have been reduced.

Since the launch of the project, 308 villages have received access to basic telecommunication services (voice and SMS). These villages are spread across 29 states of the country to ensure a proper geographic spread. On completion of Phase 2 of the project, 850 villages are to be provided with access to telecommunication services.

The domino effect of MTN's Rural Telephony project has led to the creation of new entrepreneurs, either as phone centre operators, retailers of recharge cards, or handset sellers in these villages. It has also benefited other local businesses who now offer improved services to the public.

Research has shown that there is a causal link between good telecommunication infrastructure and economic growth and development. As a result of MTN's commitment to connecting rural areas, over 85.24% of Nigeria's land mass and 85.06% of Nigeria's population now has access to telecommunication services.

MTN South Africa's Tr-generation Test and Data Centre

In 2010, MTN unveiled a 2-megawatt (MW), methane-driven trigeneration power plant at its head office in Johannesburg, a selfsustaining power supply initiative that would be the first of its kind on the African continent.

The plant helps to reduce MTN's power consumption and carbon footprint, and increases savings. More than 17,500 tonnes of greenhouse gas emissions are being avoided annually, because of the plant. This is equivalent to taking 140,000 average-sized cars off the road for 2 hours every year.

The innovative design and efficiency of the tri-generation plant has enabled MTN to become the first African telecoms company to have a new methodology approved by the European Union's Clean Development Mechanism (CDM), and the plant is now a registered carbon credit project.

By generating its own energy from cleaner sources, MTN's South African operation has realised multiple benefits, including:

- Increased energy security in an energy-constrained economy
- Avoidance of energy price increases well in excess of inflation rates
- Reduction of possible carbon tax liabilities (carbon taxes are currently under development in South Africa)
- Reduction of its power footprint
- Increased operational savings through the reduction of approximately 50% of power sourced from national energy utility, Eskom
- Initiation of a sustainable model to reduce its carbon footprint
- Reduction of water and energy consumption
- Sustainable procurement and green cleaning
- Development of free operation policies for solid waste management
- Development of actionable programmes and plans to implement these policies

MTN has a unique opportunity – by virtue of our footprint across emerging markets – to contribute to the sustainability of the countries in which we operate. We are building on our successes to implement responsible environmental and social solutions in all our operations.

About MTN Group

Launched in 1994, the MTN Group is a multinational telecommunications group operating in 21 countries in Africa, Asia and the Middle East. The MTN Group is listed on the JSE Securities Exchange in South Africa under the share code: "MTN." As of March 2012, MTN recorded 170.5 million subscribers across its operations in Afghanistan, Benin, Botswana, Cameroon, Cote d'Ivoire, Cyprus, Ghana, Guinea Bissau, Guinea Republic, Iran, Liberia, Nigeria, Republic of Congo (Congo Brazzaville), Rwanda, South Africa, Sudan, Swaziland, Syria, Uganda, Yemen and Zambia.

Chapter 5

GPM Focus Group – Hosted by GE Energy Storage

By Ganesh Balasubramanian, Director - Product Management General Electric

Overview

On April 18, 2012, a team from General Electric's new Energy Storage business conducted a "Voice of the Customer" session to facilitate a discussion of the key issues surrounding OPEX reduction initiatives and solutions for Mobile Network Operators (MNOs), particularly with regards to batteries. Of the ~50 MNOs and vendors attending the session, most represented companies with base operations located in the Middle East and North Africa. For the purposes of discussion, the Working Group members were split into four subgroups, each of which included a mix of MNOs and vendors. All of the subgroups addressed the same set of questions, with individual responses being collected and recorded by the group's facilitator and scribe. What follows here is a qualitative, high-level summary of those responses.

Each group addressed various questions designed to uncover the members' existing telecom operations, as well as their "wish-lists" for the future. The hour-long session included the following topics for discussion:

1. A description of the members' telecom networks, particularly with regards to their unique classifications of cell phone towers, power availability issues and typical purchasing preferences.
2. A summary of the OPEX challenges that members currently face, as well as the initiatives that are underway to address those issues.
3. A discussion of the role that batteries (traditional lead acid or newer advanced battery technologies) play in OPEX reduction efforts.
4. Detailed accounts of how warranties and Total Cost of Ownership (TCO) analysis impact decision making as members consider a transition to a new battery technology.
5. Identification of the factors considered most important when adopting new, advanced battery technology.

Member Responses

Current Telecom Networks

The MNOs all reported using a variety of operational classifications to track and manage their mobile tower networks. For example, while some members utilised a highly-detailed classification methodology to identify site needs and conditions, others limited their classification to power availability at the site (i.e. off-grid, poor grid, good grid). The definitions of power availability or grid functionality also varied widely. A "poor" grid in one country might indicate outages of 4 to 6 hours per day, while elsewhere a "poor" grid would equate to outages of 12 to 14 hours per day.

Seasonal variances also impacted the classification of a site: a site might have a "good" grid during the winter months, but a "poor" one during the summer. In addition, while a site may have been classified as "off-grid" at the time of installation, power availability and grid quality tend to increase over time—requiring a reclassification of the site. When asked to suggest alternative methods of classification, some members indicated that sites could be classified according to measures including the overall importance of the site or the site's level of power consumption (i.e. diesel fuel usage).

As expected, members operate their telecom networks under a wide range of environmental conditions. Across the entire group, MNOs mentioned that the new site rollouts were primarily outdoor installations. While many MNOs preferred outdoor sites as a means of reducing power consumption, some members reported environmental or societal constraints that made outdoor installations less attractive or even impossible. Severe rainy seasons, uncontrolled flooding, and concerns about site security limited some participants to indoor-only installations.

All of the MNOs reported wanting to purchase complete solutions that could be seamlessly integrated into their existing systems, not just individual components. They also preferred a product warranty covering the entire, end-to-end solution. Many members indicated that the decision-making process for the purchase of these products has become more challenging in recent years due to the expanding field of companies that offer "hybrid" solutions in the marketplace.

Existing OPEX Challenges and Initiatives

Every single participant was focused on reducing OPEX across their networks. Diesel generator-related expenses were by far the largest contributor to members' OPEX, and included:

- Fuel costs (where a diesel generator was the prime source of power)
- Fuel delivery logistics for remote installation sites
- Equipment cooling costs (potentially 60% of the total power consumed on-site)
- Generator maintenance

In addition, battery theft was highlighted as a major issue that MNOs faced at cell phone towers. The magnitude of the problem was dependent on the site's location. Members also cited the costs associated with operator training and site security as among the OPEX challenges they face in their existing networks. Battery failures and replacement costs due to extreme environmental conditions or excessive cycling requirements were a concern. Finally, the removal and disposal of batteries at end-of-life was a cost factor that many participants faced.

Most of the MNOs present during the session had an active initiative to reduce OPEX. A popular solution for those managing off-grid or voltage-poor grid sites was active battery cycling—commonly referred to as CDC systems—which combines batteries with the use of a diesel generator, thereby reducing generator run time, and as a direct result, fuel costs. There was also a great deal of emphasis on upgrading to alternative cooling technologies that either consumed less power, or were integrated into battery cabinets to extend lead-acid battery life and reduce replacement costs.

Participants looked to modernisation and the growing field of green power implementation as a means of reducing OPEX overall. Similarly, finding ways to reduce battery maintenance or to ensure that batteries are properly and consistently operated was also viewed as a cost saving measure.

OPEX Reduction and Batteries

Batteries play an integral role in any effort to reduce OPEX. Conventional lead-acid batteries continue to dominate the field, in spite of a range of performance and maintenance issues, including:

- Sudden and frequent battery failures (which increases dependency on diesel generators and decreases the efficiency of hybrid applications)
- Shortened battery life in extreme temperature environments
- Reduction in capacity when stored for any length of time (a regular occurrence in the field)

The key for many participants was not so much the battery technology itself, but rather the effectiveness of the system design as a whole. A successful and reliable solution would include:

- The identification of the right battery for the right application
- An end-to-end solution capable of monitoring and controlling battery charge and discharge cycles to optimise battery operation and diesel generator fuel efficiency
- A way to meet the challenges of integrating with existing rectifiers and control systems
- A design that addresses potential trade-offs, such as considering a smaller battery that features extended cycle life versus a larger battery that features deeper cycles

For CDC systems in particular, members point to the need for designs to limit the starts and stops experienced by the diesel generator—perhaps even limiting them to once per day to prevent over-cycling of batteries and minimise generator wear and tear. Over-sized batteries that could keep depth-of discharge (DOD) to less than 50% were viewed favourably, as were systems that could be sized to provide back-up time based on criteria specific to the installation site (such as the time it takes to reach the site, the site's criticality within the network, generator refuelling times, etc.)

When asked for their thoughts on new, advanced battery technologies, members expressed serious concerns about increasing CAPEX for batteries that might prove unreliable in real-world applications. While some new advanced battery technologies were considered a step forward in terms of performance and lifespan, overall, their higher CAPEX made implementation difficult to justify. Some participants felt that the CAPEX surrounding traditional lead-acid batteries, even with frequent replacement costs and reliability issues, would be less than the CAPEX required for new technologies.

Warranties and Total Cost of Ownership (TCO)

The discussion surrounding warranties held by members on existing batteries revealed strong opinions on the manufacturer's level of responsibility. MNOs felt that many battery manufacturers warranties included hidden conditions and involved inadequate metrics. For example, a warranty based on battery cycles was considered flawed if cycles cannot be accurately quantified within a given battery system. MNOS also pointed out that, recently, system integrators have been offering better warranties than the manufacturers of individual components.

Overall, the group viewed kiloWatt hours (kWh) as a better performance indicator for the purposes of a warranty—provided that a kWh-monitoring system was provided along with the battery. Clearly defined product and solution ownership was cited as critical to facilitating warranty claims, as was a warranty that encompassed the entire solution, not just individual components. As a whole, the participants sought a performance guaranty versus a simple product warranty, especially for new battery technologies.

Group members generally agreed that TCO is the right way to evaluate solutions, but in most cases, CAPEX is the overriding consideration. Even if the MNOs identify an ideal solution, the final decision is primarily based on CAPEX and ROI. Solutions that have an ROI greater than two years are not even seriously considered. Occasionally, a successful argument can be made regarding offsetting higher CAPEX with reduced future OPEX, but most decisions are made based on a combination of system design, CAPEX, contract terms and warranty strength.

New Technology Adoption

When asked to outline what would make their organisations accelerate the adoption of new, advanced battery technology, most participants pointed to the need for greater education on how the technology would work in real-life applications. This could be achieved through:

- Road shows featuring engineering teams and other product experts to increase understanding of the new technology
- Extended on-site pilots to demonstrate the system's performance in the field
- Clearer performance data, particularly in comparison to tried-and-tested lead-acid batteries

The discussion also circled back to the issue of sheer costs. MNOs felt they would be more apt to adopt new battery technologies if they came with a clear performance guaranty and a reasonable CAPEX. New technology companies that can offer an alternative business model based on the OPEX savings or the performance of their solution would be more likely to successfully mitigate the risks associated with their product's high CAPEX.

Chapter 6

Fuel Cell Systems for Mobile Telecom – New Significant Trials Underway

By Michael Nique, GSMA

In April 2012, the Green Power for Mobile team published "Fuel Cell Systems for Base Stations – Deep Dive Study". Fuel cell systems are a clean technology, since heat and water are the only by-products during the chemical conversion of hydrogen to electricity. They have long been considered suitable for remote stationary power applications with a high cost of downtime, such as telecom towers with unreliable or no access to the electricity grid.

The report outlines that, with more than 1,000 deployments at telecom tower sites, fuel cell systems have progressed from being a potentially promising technology to being a commercially-viable power solution. They are currently being successfully used by telecom operators globally to reduce costs, increase reliability and reduce the environmental impact of the mobile industry.

Challenges remain around the production of hydrogen at a competitive price, its storage and transportation, as well as the high capital cost of fuel cell system overall. However, in the last few years, the system technologies and fuel supply options have improved and will continue to improve the economic viability of fuel cell systems. As an addendum to our April report, this article presents two case studies from:

- Diverse Energy with multiple operators in Namibia
- Ballard / Danthern Power with tower operator IDEA cellular in India

Diverse energy in Namibia

By Dr. Mike Rendall and Andrew Clare, Diverse Energy

Between April and June 2012, Diverse Energy,[1] in partnership with a global industrial gas supplier, undertook field trials of the PowerCube in Namibia on four very different sites with multiple operators. PowerCube is a based continuous off-grid prime power fuel cell solution fuelled solely by ammonia.

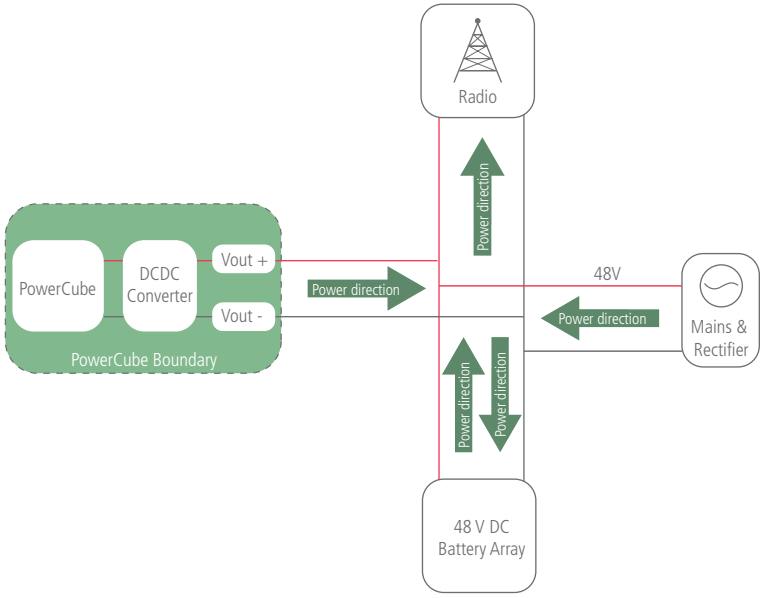
One of the primary objectives of these trials was to determine the performance of the PowerCube units in real-world applications such as telecom operator sites, as well as further examining:

- The logistics of refuelling the PowerCube in partnership with the gas supply partner in Namibia. Unlike the well-established diesel distribution channels, fuel cell supply chains need to be developed to ensure fuel can be deployed on a regular basis to sometimes very remote sites
- The complexity of integrating the PowerCube with a wide range of existing power delivery systems including: solar battery hybrids, existing grid electricity, third-party diesel generators and high- and low-power radio equipment

System Design

The PowerCube is designed to connect to the DC bus of the customer's equipment. The design of the control system is to monitor this bus and to supply power as and when required. This means that the system operates in combination with, or independently of, alternative power sources to provide continuous and uninterrupted power to the telecoms base station.

Figure 1: PowerCube Integration Options



Source: Diverse Energy

1 Formed in 2007, Diverse Energy Ltd. is a UK-based company focused on providing clean off-grid, continuous electrical power solutions with their PowerCube utilising industrial gases. Contact: Dr. Mike Rendall – mrendall@diverse-energy.com

Feedback from Trial

One of the more challenging trial sites was located atop a mountain some 20 miles north of Windhoek, within a wild game park at the end of a winding and tricky trail accessible only by a 4x4 vehicle.

Figure 2: Diverse Energy Fuel Cell Trial In Namibia

Source: Diverse Energy

This rural outreach BTS was measured as requiring 1.5kW, the highest power consumption of the four trial sites. This site, powered by a hybrid solution, was reported to be unreliable with the site going offline repeatedly. Prior to the PowerCube installation, the radio downtime due to low power was 27% with over 250 alarms triggered per month.

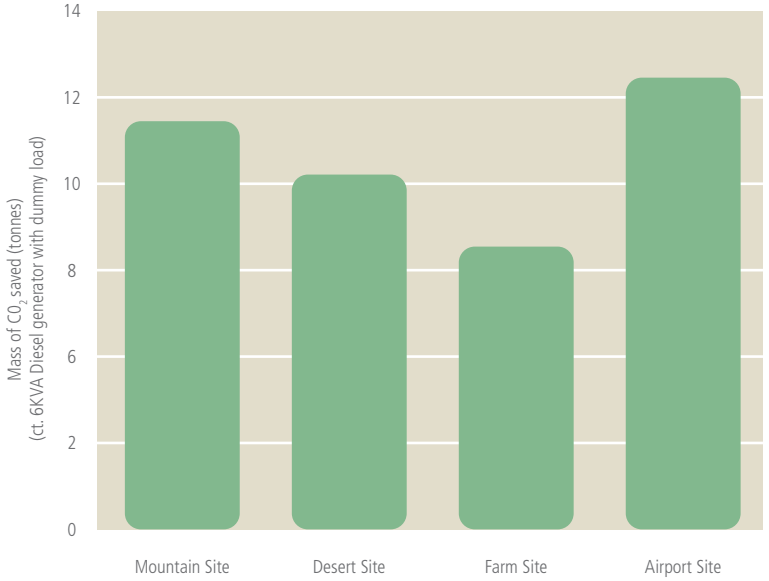
Every night at sunset, the available light gradually diminished, thus reducing the power generated by the solar panel. The capacity of the battery array was found to be significantly depleted due to deep discharging, with the operator facing the prospect of costly and regular battery replacements. With the radio load remaining relatively unchanged overnight, a power deficit was seen as the low capacity battery was unable to power the radio.

The load-following PowerCube, configured to operate in a constant voltage mode, gradually increased its output to support the radio load as the battery charge was depleted. The sum of the power from the PowerCube and the battery matched the load, meaning the customer only had to pay for the power they require.

Overall, results from the trial and the reduction of diesel generator use suggest significant CO_2 savings can be achieved. Financial savings from not using a diesel generator ranged from 20-60%. When the other associated costs are included into the financial model, the savings are magnified. This is due in part to the regular and costly maintenance intervals of the diesel systems, along with their shorter lifespans. The current ammonia price is supplied to each site for a fixed cost however, due to widespread adoption of this technology, new and regular delivery profiles can be adopted leading to further potential fuel cost savings.

Diesel costs are likely to rise in the future, which would also lead to conceivable fuel theft from remote sites leading to site outages, increased costs and loss of revenue. Ammonia, on the other hand, has no domestic use and is not likely to be a theft target. Ammonia can only be supplied through authorised channels, suggesting that it is unlikely that the PowerCube itself would have any black-market value, unlike diesel generator sets.

Figure 3: CO_2 Saving Throughout Field Trial



Source: Diverse Energy

Ballard/Dantherm Power in Asia

With contribution from Alok Goel from Ballard Power systems

Ballard Power Systems is a recognised global leader in the design & manufacture of PEM fuel cells.[1] Ballard announced in November 2011 that Dantherm Power, its backup power systems company, will supply of 30 Hydrogen Fuel cell back-up solution, namely its 2kW DBX2000 systems, for installation at 30 single tenant outdoor sites of IDEA Cellular in India.[2] IDEA Cellular is part of the $35 billion multinational Aditya Birla Group and India's third-largest mobile services operator.

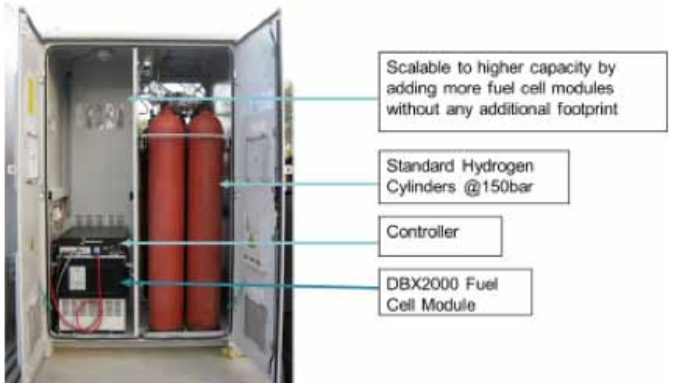
Fuel cell systems will be deployed at cell tower locations in close proximity to an Aditya Birla Group chemical plant in the region of Nadga, Madhya Pradesh. The Aditya Birla Group chemical plant in Madhya Pradesh is a rayon-grade caustic soda manufacturing unit of Grasim Industries. The plant produces a large amount of hydrogen as a by-product, which can be subsequently used in powering telecom towers, as well as in distributed power generation systems within the plant to reduce energy costs and carbon emissions.

Figure 4: Aditya Birla Chemical Plant In Nagda, Madhya Pradesh

Source: Ballard

For sites connected to the electricity grid that have frequent power outages, Ballard's fuel cells in combination with batteries has completely displaced the use of back-up diesel generators. This initial deployment with Idea Cellular will serve as a first step in validating the financial and environmental benefits of Ballard's fuel cell products to Idea Cellular and to prospects in India.

Figure 5: First Site by Ballard, Idea Cellular & Aditya Chemicals Plant Team



Source: Ballard

Additionally, Ballard announced in June 2012 that a total of 50 DBX2000 back-up power systems were delivered by Dantherm Power to China Mobile for deployment at 30 network sites for trials expected to run for several months. Installation will occur in various locations including Beijing, Shanghai, Shenzhen and Xinjiang. Custom integration and local technical support will be provided by partner Azure.

This trial will focus on the adaptability and durability of the fuel cell system as a widespread replacement for existing lead-acid batteries located at outdoor telecom base station sites within the China Mobile network.

Today, there are more than 1.2 million mobile BTS in operation in China and several hundred thousand of these towers require back-up power due to unreliable access or no access to the grid. Considering the reach of these telcos, if these trials are successful, this could lead to further adoption of fuel cells power solutions in China within the next two years.

1 Dantherm Power and Delta Power Solutions operate jointly under a 2011 collaboration agreement.
2 IDEA Cellular has more than 100 million subscribers in India with a network of more than 70,000 cell sites.

Chapter 7

Editorial – Two Weeks in Rural India

By Mary Roach, GSMA

On the back of the 3rd Indian specific Green Power for Mobile Working Group, Ferdous Mottakin and I took the time to visit successful off-grid energy projects to better understand the makings of viable business models and increase our first-hand knowledge of the livelihoods of the 400 million Indians living without access to grid electricity. If we aim to improve access to energy, it is critical to learn how the poor live.

We travelled to the Sunderban Islands of West Bengal to visit one of two demonstration projects installed by CAT Projects using their Bushlight India system. We also travelled to rural Bihar, three hours from Patna, to see two of over 80 Husk Power Systems sites. While the Bushlight India and Husk Power Systems models are at different levels of maturity, they share many similarities and a few core differences. Both organisations use a pay-for-service model where customers pay a fixed amount on a monthly basis regardless of consumption. The main difference between the two models is operational: Bushlight India aims to deliver high quality 24x7 access to power, while Husk Power Systems is focussed on developing a highly scalable system.

How Much Should the Underserved Pay for Access to Energy?

As is illustrated by Priya and her family, the rural poor of India spend a considerable amount for lighting and basic energy services. Both Bushlight and Husk Power charge their customers rates that are significantly higher than the State Electricity Boards (SEBs). The main difference is that the customers of the social enterprises pay for service, not per kWh.

This is a small but important difference. As many of our members know, on-grid towers suffer from significant hours of grid non-availability and telecom players pay a premium to ensure 24x7 access. Adding to this, the *Times of India* reported in April 2012 that 24 states had raised power tariffs in the last 18 months[1] – the appeal of a pay-for-service model becomes apparent. Both the Bushlight and Husk Power systems provide similar levels of Watts to their customers but the major difference is that the Bushlight India model provides customers the choice of when to use the power, as it is available 24 hours a day.

In contrast, the majority of Husk Power Systems provide between 6 and 12 hours of power to their customers per day. While work by both CAT Projects and Husk Power highlight that the majority of their customers primary energy use is for lighting, phone charging and TV viewing, it is exciting to learn that Husk Power Systems is working on systems capable of delivering 24x7 power.

The Cost of Being Connected to Mobile

In rural Bihar I had the opportunity to meet Priya outside her home. It was dusk and I was attracted to Priya's home by the soft light of a kerosene lamp. Like many of the 400 million Indians without access to electricity, Priya's family relies on kerosene for lighting and travels to town to charge their mobile phone. On a monthly basis, her family spends up to $7 on kerosene for lighting and more than $1 to charge their phone.

To put this figure into perspective, the national ARPU for India—including high data consumers in Mumbai and Delhi—hovers around $2/month! While more research is needed to better understand the actual ARPU spend of rural customers to have conclusive evidence, our field visit in Bihar reinforces the research Global Village Energy Partnership (GVEP) International completed in East Africa in 2011: In Uganda and Tanzania, off-grid subscribers are known to spend between $2-3/month on phone charging when ARPU is approximately $4.5 In Sub-Saharan Africa and India, off-grid subscribers can spend half of the national ARPU on charging their phone, before they even make a call.[2]

1 http://timesofindia.indiatimes.com/business/india-business/24-states-raise-power-tariffs-in-18-months/articleshow/12547134.cms
2 http://www.gvepinternational.org/sites/default/files/phone_charging_businesses_report_with_gsma_final_for_web_0.pdf

	Bushlight India	Husk Power Systems
Number of Sites	2 demonstration sites: Western Orissa and the Sundarban Islands	84 mini-power plants, providing electricity to over 200,000 people spread across 300 villages
Service Delivered	24x7 power availability, street lighting and power to essential services; domestic and commercial customers can use up to their daily budget (in Sundarbans average is 200Wh/day)	Financially viable model developed to provide up to 12 hours of power (experimenting with other technologies to provide 24x7 power); In the village we visited, an entrepreneur uses and sells power to local market for three hours per day, offers 6 hours of lighting services to customers in 30W, 45W or 60W increments
Cost per Service	Customers paying 200INR per month receive 6kW/month (33.3 INR/kWh)	30W is 100INR/month, 45W is 150INR/month. At 30W per month, customers receive 5.4kW/month (18.5 INR/kWh)

Build to Last or Build to Scale? Both!

The major difference between the Bushlight India and Husk Power Systems is their operational philosophy. As a business, Husk Power Systems is focused on developing a system that can be replicated and scaled quickly. They have certainly achieved this, and are known worldwide as a large private sector micro-grid energy provider in the world. The Bushlight India demonstration site focuses on ensuring long-term sustainability. Leveraging CAT Project's experience with delivering and maintaining over 150 decentralised energy systems in Australia's outback, the Bushlight India model focuses on the human challenges of decentralised systems. The Bushlight India model includes an in-depth village engagement process, a rigorous operation and maintenance plan and demand side management hardware for use at the household level (The Urja Bandhu household energy meter). The site we visited was one year old and very well maintained. It was easy to envision the system being functional for the next decade without major needs of repair.

There are benefits to both models and it would be great to see both organisations adopt each other's strengths.

Field visits such as these provide us greater insight on the wants and needs of off-grid communities and the opportunities and challenges of delivering decentralised energy to them. Scalability and reliability of energy is a predominant concern of the mobile industry. We believe that to work closely with the mobile industry, rural ESCos should have the capabilities to deliver the high quality, reliable power they require. Harnessing the Community Power from Mobile opportunity in India, will more than likely involve partnerships between ESCos with the experience as well as financial backing to satisfy the scale required by the mobile industry and rural ESCos with the experience of and thoughtfulness that comes with working with disadvantaged rural communities. As mentioned in the 3rd Indian Specific Working Group giving organisations "permission to fail" at Community Power from Mobile, by creating the enabling environment and providing the requisite risk capital, will support the uptake of CPM trials; high levels of iteration will support the longer term development of successful models.

Level of detail of the Bushlight India's Operations and Maintenance Manual. Each potential technical issue has step by step instructions for identifying and troubleshooting the problem complete with picture and translated text

A household at night illuminated by the Bushlight India demonstration, the Urja Bandhu household energy meter visible on the wall

Bushlight India's solar array and power house

The Husk Power plant we visited

Husk Power customers can charge their phones via a power socket in the light fittings

The owner of the spice mill owned the Husk Power plant we visited. During the day power is delivered to the local market and at night power is provided to the local community

Chapter 8
The Current Market Status

By Ferdous Mottakin, GSMA

With the rapid growth of the Indian mobile industry, initiatives such as network cost optimisation, outsourcing of non-core activities and low-cost business model development have been important. Operators are realising efficiencies through extensive outsourcing across the telecom value chain. By hiving off infrastructure elements, such as towers into separate entities, significant investments have been preserved. The Indian mobile industry has benefitted from the sharing of passive infrastructure, reducing the cost burden for each operator and speeding the rollout of mobile services. India is now a leader in sharing network infrastructure. With the CAPEX for network rollouts significantly higher, the benefits of network sharing are apparent.

Due to the steady growth of the mobile industry, a large number of telecom towers are in off-grid or unreliable grid areas. As the industry grows, the dependency on fossil fuel increases because of the lack of grid power availability. India has around 18% of its tower sites in off-grid areas and around 38% of its towers in unreliable grid areas, which together consume a sizeable amount of diesel per year. As a result, the cost of network operations is extremely high. Since energy consumes about 40% of network OPEX, increasing efficiency on energy management can eventually increase the possibility of the profit margin. Additionally, the environment is another crucial factor where India's telecom industry has much to contribute.

Considering the above, the GSMA Green Power for Mobile Programme, in partnership with the IFC, entered the Indian market in 2011 for a specific project to assist the industry with speeding up green power deployments through various catalytic mechanisms. Key findings included:

- The Indian telecom industry lacked clarity on available renewable resources for energy generation
- The green and alternative energy vendor industry was not yet mature with lack of clarity of market potential with little interest from large investors
- Lack of clarity on whether the CAPEX or OPEX is the right business model
- There was no clear decision making process to identify the right solution or business model for the industry
- No industry-wide best practises for green energy procurement had been established
- Lack of connection between industry stakeholders
- A specific platform to promote green energy and energy optimisation did not exist

To address the above findings, the Green Power for Mobile Programme embarked on a new set of objectives specific to the Indian market in an effort to further catalyse the reduction of diesel generator use by telecom operators and tower companies. Details of the project outcomes are as follows:

Original Assumption	Activity Undertaken	Outcome
Lack of clarity on available renewable resources	Create an interactive map/ database of natural resources (e.g. wind, solar) for India	An Interactive Resource Map was published for public access, making it possible to identify what level of renewable resource is available at any given location in India
Immature vendor industry	Create a categorised listing of India-specific green power vendors	An India-Specific Vendor Landscape was published to enable operators to do a primary screening and identify a potentially suitable partner based on vendor provided competency details
	Conduct market research and publish an analytical market potential report	An India-specific renewable energy market sizing and forecasting document was published, to depict the possibility of a renewable energy market for the Indian telecom industry. This document also educates investors about investments in India's green telecom industry
	Introduce IFC and other interested global investors to India	
Lack of clarity on the right business model	Comparative analysis of CAPEX vs. OPEX model	Conducted an extensive comparative analysis of both CAPEX- and OPEX-based renewable business models and published a CAPEX vs OPEX procurement model analysis report
No decision-making process to identify right solution and right business model	Create an interactive decision-making tree or replication guide	Based on available knowledge, an interactive decision making tree was created to enhance market intelligence and assist replication for the Indian market
No industry-wide best practise for green energy procurement was established	Direct engagement with operators to deploy pilot sites	Following direct engagement with operators, a procurement guide was disseminated to ensure proper understanding of various procurement models
	Direct engagement with operators to optimise their business model on green power deployment	
	Publish a best practise green energy procurement guide	
Lack of connection between industry stakeholders	Keep close coordination with all relevant industry stakeholders	All major stakeholders are aware about current market development and GSMA activities
A specific platform to promote green energy and energy optimisation did not exist	Arrange India specific Working Groups	3 India specific Working Groups have occurred so far. The Working Group creates a unified platform for industry stakeholders to interact and share their views, experiences and knowledge

The activities undertaken during the 18-month project managed to successfully create industry awareness and momentum. These activities also helped to establish a bridge between various thoughts and stakeholders. GSMA found some key learnings from the overall project which are significantly for guiding the industry:

- The industry now has more clarity on different renewable energy solutions
- The industry believes that the OPEX-based energy model is the only possible way to reduce energy access challenges and CO_2 emission reduction for the majority of telecom towers
- Last mile operational awareness is still missing for many operators and energy service providers
- None of the earlier deployed OPEX energy models are feasible for country-wide implementations as these are technology driven. A technology-agnostic approach is being established
- The industry requires training, capacity development and confidence building on various green power methodologies, technologies and business models
- Key measurement point and performance benchmarking must be fixed in order to understand the performance of the model and optimise it
- Government policies and recommendations for green power deployments in the telecom industry are not strong enough. Proper incentive and support must be formalised
- Many isolated initiatives were undertaken by various telecom & non-telecom organisations to promote green power. Many different isolated opinions are also circulating in the industry. These different initiatives and opinions must be centralised and available on one platform. The GPM Working Group will play a vital role in this development

The Indian telecom market has progressed significantly over the past few quarters in relation to green power deployments. Almost all mobile operators and tower companies are taking some initiative on this matter. Major tower companies, like Bharti Infratel, Viom and Indus Tower, are at the forefront of these initiatives. Equally, the Tower Industry Association (TAIPA) has played a significant role in promoting green power towers. All mobile operators are directly or indirectly encouraging tower operators to continue with green initiatives and a large number of energy service companies (ESCos) are also very active in this area. Furthermore, major investors are also showing interest in the industry. Above all, the Department of Telecom of Government of India has announced a green telecom recommendation, advising the industry to achieve a suggested target (for more details on this, see chapter 9). The overall market momentum clearly indicates that the Indian mobile industry is rapidly moving toward green power.

Some key highlights of current green telecom activities in India:

- Indus Tower announced plans to convert 20,000 existing towers to green power
- Viom Networks plans to introduce the outsourcing model to encompass those who have energy access challenges
- TAIPA has launched an RFP to convert 100,000 of its member sites to green power
- Idea Cellular is deploying fuel cells on an OPEX model at 30 of their sites. In parallel, more than 100 sites have been deployed with solar hybrid OPEX models
- Applied Solar Technologies (an ESCo) secured a US$150 million investment from the Overseas Private Investment Corporation (OPIC) to invest in green power deployments for the Indian telecom industry
- More than 30 ESCos are now active in India and attend the GSMA Green Power for Mobile Working Group
- The Department of Telecom has approved the green telecom recommendation of TRAI (Telecom Regulatory Authority of India) which advises the telecom industry to set a specific target for the for converting its networks to energy efficient and green sites:
  - 50% of rural towers and 20% of urban towers to be converted to hybrid power (Green + Grid) by 2012. This target should expand to 75% rural towers and 33% urban towers by 2020
  - GHG emission reduction of 5% by 2012-2013, 8% by 2014-2015, 12% by 2016-2017 and 17% by 2018-2019

Though there have been significant progress on green telecom in India, the industry is still missing large energy service providers which can deploy nationwide and with very large scale investment. A lack of proper coordination among different stakeholders still also presents an issue – though this is moving in the right direction. The Green Power for Mobile Programme aims to act as catalyst and to continue to support the green telecom industry by bringing together knowledge, experience and expertise and will continue to do so to instigate a faster pace of development.

"Viom Networks has always been striving to be eco friendly and GSMA has shown us an improved way to reach our goal...Our sincere thanks to GSMA for significantly contributing in promoting use of sustainable green energy solutions for telecom infrastructure. We hope this will lead to optimisation of energy cost, improve energy efficiency and reduce emissions."
VIOM Networks

"While NextGen is committed to provide green & clean energy access to telecom tower, GMSA support will help us to improve our deployment approach and scalability in order to contribute higher RE for telecom tower".
NextGen PMS

Chapter 9

India's Department of Telecommunications-(DoT) Directive on Approach Toward Green Telecommunications

By Ferdous Mottakin, GSMA

India is the 2nd largest mobile telecom market in the world. It has over 900million[1] subscribers and constantly increasing. The rural telecom penetration rate in India is one of the leading rates compared to other emerging markets. The growth of base stations in India over the last 10 years is significantly higher than most Asian countries. In order to sustain such growth and penetration, the Indian mobile telecom industry has gone beyond the penetration of grid power. As a result, a large number of telecom towers are heavily dependent on fossil fuels. This dependency didn't come as a choice, but as a compulsion which is not only environmentally unfriendly but also very expensive.

The growing global awareness of climate change plays a vital role in ensuring reduction of GHG emissions. It's a global priority now: At the Copenhagen Summit of 2009, the Indian government avowed to reduce GHG emissions by 20-25% of the 2005 rates by 2020.[2] To reach this target, the Telecom Regulatory Authority of India (TRAI) created a draft recommendation, "Recommendations on Approach toward green telecommunications" for telecom service providers. The draft report was published on April 2011. In January 2012, the Department of Telecommunications-(DoT) (under the Ministry of Communications and Information Technology) approved the draft TRAI green telecom recommendations and published it as a directive. This directive aims to reduce GHG emissions and increase energy efficiency of mobile networks.

The key targets set in the green telecom directive are as follows:

1. At least 50% of all rural towers and 20% of the urban towers are to be powered by hybrid power (Renewable Energy Technologies (RET) + Grid power) by 2015; a further 75% of rural towers and 33% of urban towers are to be powered by hybrid power by 2020
2. All telecom products, equipment and services in the telecom network should be certified "Green Passport [GP]" by the year 2015. The Telecommunication Engineering Centre will certify telecom products, equipment and services on the basis of ECR ratings
3. All service providers should declare to TRAI the carbon footprint of their network operations. The declaration of carbon footprints should be done twice in a year
4. Service providers should adopt a Voluntary Code of Practice encompassing energy efficient network planning, infra-sharing, deployment of energy efficient technologies and adoption of Renewable Energy Technology (RET) to reduce carbon footprints
5. Service providers should develop a 'Carbon Credit Policy' in line with carbon credit norms with the ultimate objective of achieving a maximum of 50% over the carbon footprint levels of the Base Year (2011) in rural areas, and achieving a maximum of 66% over the carbon footprint levels of the Base Year in urban areas by the year 2020
6. Service providers should aim at Carbon emission reduction targets for the mobile network

– 5% by the year 2012-2013, 8% by the year 2014-2015, 12% by the year 2016-2017 and 17% by the year 2018-2019

The target set by the Government of India is very encouraging. Though the mobile telecom industry is keen to go green, the industry has had mixed feedback on the above directive particularly as a number of areas are unclear on how to make the directive operational. There are lot of concerns for some targets, which have to be achieved immediately (or in the near future), including:

- 50% of rural towers and 20% of urban towers have to be converted to hybrid power by 2015. The definition of hybrid power in the directive is Renewable Energy Technology (RET) + grid power. Since grid power is unlikely in a large number of rural areas, it is unclear how the telecom industry will achieve the 50% target set for rural India by 2015
- It is also not clear which solutions are considered renewable. Technology descriptions given in the recommendation, but with no indication of what is acceptable as a renewable energy source. Questions raised included whether fuel cells or biomass gasifiers are considered renewable
- Targets for deploying RET are very stringent in the initial period
- All telecom products, networks and services must be certified by the "Green Passport" by 2015. The key concern is how the definition of a Green Passport will be set
- Mobile operators are greatly concerned with the methodology for calculating carbon footprint. In several forums they have demanded revisions to the calculation methodology, with hopes to make it more easy and comprehensive
- Due to missing historical data in many cases, telecom operators think the baseline year of 2011 is not feasible and instead feel the baseline year should start from 2012-2013
- The Voluntary Code of Practice is not clearly defined in the directive

1 Wireless intelligence
2 MOEF's report on India's greenhouse gas emission 2007

- There are two similar targets in the directive:
  - Number of towers to be converted by hybrid power source
  - Percentage of Carbon emission reduction

  Instead, the feeling is that the directive should have one target: a year-on-year GHG emission reduction. This would open up options for mobile operators or tower companies to decide how best to achieve this target. Moreover, the above two targets are not aligned i.e. an operator may achieve the emission reduction target by 2015 of 8%, but that does not translate to 60% rural towers and 25% urban towers

Once the process to operationalise the above directive is clarified, it will be easy for the industry to determine a quick deployment model. The industry has already moved forward on this and strongly advocates an energy outsourcing model or Renewable Energy Service Company (RESCo) model. The industry as a whole thinks:

- Adaptation of the energy outsourcing model or RESCo model is the fastest method of deploying green power on mass last mile towers
- Easy and cheap funding mechanisms are still absent for mass green telecom deployments. A fund or funding mechanism has to be created to promote green power
- A pilot project with relevant government stakeholders should be conducted and benchmarked for replication. This will create confidence among stakeholders as well as creating a quality level for industry standards

The green telecom directive for the Indian mobile telecom industry has the potential to be an example for all emerging markets. Successful implementation of this directive can create a milestone in global green telecom history. However, this will only be possible when the industry reaches a consensus for optimising these recommendations to make them possible for field implementation.

An open discussion among all relevant stakeholders is of utmost importance to implement such extensive targets in a practical way.

Chapter 10

CPM Advisory Services - Sizing the Opportunity for Community Power in a Network

By Charlotte Ward, GSMA

Models for leveraging the mobile industry for the delivery of energy access to off-grid communities continue to evolve. The vast presence of mobile services amongst underserved populations provides a new opportunity to develop energy solutions at an unprecedented scale to match unmet demand and overcome failures of other decentralised energy solutions. By leveraging the power systems servicing mobile towers, the infrastructure of agent networks and payment technologies, mobile services can improve the affordability and delivery of energy services. However, like many initiatives which are non-core and relate to the development agenda, it is hard to allocate funds within a profit-driven industry; there is a need to raise executive level ownership and prove commercial viability to develop or enable a service with long term benefits.

The GSMA has responded to this to provide broad and deep analysis that utilises market knowledge and understanding. CPM leverages existing expertise in order to undertake thorough, methodical assessments of the business cases for enabling community services through mobile with dedicated partner mobile operators.

The Objectives of the CPM Feasibility Studies with Mobile Operators

- Size the opportunity & costs of three business cases:
  - Leveraging infrastructure & power systems for energy delivery to the community
  - Using rural service supply chains & agents to distribute & sell energy solutions
  - Using mobile payment technologies for users to pay for energy solutions
- Shortlist trial tower sites with greatest potential for CPM from infrastructure
- Assist Management in defining the strategic and financial goals of CPM

Some business models are proven commercially, others are unproven or under trial with mobile operators.

What do current commercial trials look like?

- Committing as a stable 'anchor' client to a third party ESCo that is powering both BTS and community via a mini grid or energy hub
- Using network of airtime vendors and mobile money platform to distribute and sell phone charging services to their customers and lighting retail kiosks
- Pay-as-you-go energy (and water) services utilising mobile money technology

History has shown that pilots do not provide an immediate path to scale since alone they do not quantify the opportunity. The move from a one-off CSR activity to proving commercial models and a viable opportunity for mobile requires commitment from senior management and engagement with external organisations.

The Impact of Community Power from Mobile Solutions

Distributed energy delivery that leverages mobile has the potential to significantly improve the livelihoods and incomes of entire communities and create far-reaching development outcomes. The demand for mobile connectivity creates a first request for electricity and drives a need for additional power infrastructure from which other basic and productive services can be delivered.

For the mobile industry, more accessible and more affordable off-grid sources of electricity for phone charging drive an immediate increase in mobile phone usage, a reduction in the total cost of ownership and provide positive brand impact when enabled by mobile network providers.

The assets of the mobile industry – infrastructure and technologies – provide multiple opportunities for improved energy access and positive commercial impacts for the operator, therefore a feasibility study requires extensive coordination across multiple departments. The breadth of data collection required spans all aspects of a mobile operator's organisation: Network and Infrastructure, Retail, Consumer Sales, Marketing and Mobile Money. Crucial to the research is a detailed understanding and supporting data on the current cost and availability of energy to off-grid communities.

In the execution of feasibility studies, CPM utilises existing research from field-level engagements and tries when possible to work in tandem with on-going Green Power studies. Additionally, CPM also makes use of the expertise of the Mobile Money for the Unbanked program, to evaluate the business case for consumer financing of energy services via mobile payments.

A CPM Feasibility Study typically takes 6-10 weeks in-country and from GSMA offices for internal meetings, field research and analysis. Tasks involved largely include the following and require a hands-on working relationship with a project manager within the operator:

1. Interview key personnel across multiple departments including Networks, Retail, Marketing Finance, Commercial Sales and Mobile Money / Financial Services
2. Data analysis coupled with geo-spatial assessment of mobile network, national grid and national census data
3. Community focus group engagements to better understand current energy access and needs, coupled with research data from NGOs and the energy sector

Currently, CPM is completing a study with a mobile operator in Malawi (following a GPM study) and Kenya (with the support of the IFC). With the support of the Inter-American Development Bank, the team is currently engaged in a study with Telefonica in Nicaragua. During 2012, we hope to work with more operators in South Africa, Tanzania, Mozambique and Nigeria and are seeking committed partners for further engagements in Africa and India.

Please get in touch with the CPM team if you would like to learn more as we continue to look for committed partners.

Chapter 11

Embedded Solutions for Community Access to Energy and Water

By Michael Nique, GSMA

1 The goal was to halve the proportion of people without access to safe drinking water. According to a report issued by UNICEF and the World Health Organization (WHO), between 1990 and 2010, over two billion people gained access to improved drinking water sources, such as piped supplies and protected wells. http://www.unep.org/newscentre/default.aspx?DocumentID=2676&ArticleID=9068
2 275 million (42%) of the rural underserved are in sub-Saharan Africa, 139 million (21%) in South Asia. Source: UN Data.
3 These companies include Eight19, DTPower, SimpaNetworks, SharedSolar

Energy access is well known to improve quality of life and increase opportunities for economic growth. Poor access to water is equally hindering community development and, even though the UN recently announced that the Millennium Development Goal for access to clean drinking water had been met by March 2012,[1] 783 million people still live without improved sources of drinking water with 653 million of them living within rural areas.[2]

In recent years, the main solution to the challenges and costs of extending the electricity grid has been the uptake of decentralised energy systems, both at the community and household level. Apart from the high capital cost of establishing a decentralised energy system, the commercial viability of off-grid systems has been confronted by serving customers with unpredictable energy demands and incomes, and high on-going operation and maintenance costs.

The mobile industry has extended mobile connectivity beyond the reach of grid energy services and central water utilities. The convergence of mobile handset ownership, mobile payments and smart technologies also offer new ways to achieve reliable energy access and increased water security.

The trial and development of innovative solutions for decentralised, rural utility systems can enable pay-as-you-go solutions, collection of information on consumer behaviour and improved responsiveness to operation and maintenance issues. By partnering with innovative utility service providers, mobile operators can strengthen their presence in rural areas and catalyse community development.

This new initiative is an extension of the Green Power and Community Power from Mobile programmes and is meant to complement our engagements with operators. The initiative will concentrate on research and support the potential of "low-specs" M2M products in emerging markets for utility applications. It will also serve to address the common failure modes of decentralised systems:

- Resilience of Decentralised Systems
- Scale of Solutions
- Payments
- Reporting & Maintenance

Energy Access

The UN Secretary General's Advisory Group on Energy & Climate Change defined universal energy access as "access to clean, reliable and affordable energy services from cooking and heating, lighting, communications and productive uses."

While mobile-enabled solutions reduce many of the barriers to uptake of both basic and productive uses of energy, phone charging remains one of the greatest challenges to overcome, is least risky to solve and offers the quickest return to the mobile industry. The demand for mobile connectivity creates a first request for electricity and drives a need for additional power infrastructure from which other basic services can be delivered.

A new breed of companies has emerged to offer pay-as-you-go solutions for energy access, where customers top up for energy the same way they would top up for mobile airtime.[3] The concept is based on the integration of a GSM communication module to the renewable solution allowing:

- Data exchange over the air with a central server
- Flexible incremental payments from customers
- Remote maintenance and alerts if malfunction

As revenue collection is a major challenge for sustainable off-grid projects, the integration of mobile banking solutions (such as M-PESA in Kenya and GCash in the Philippines) with these energy products represents a clear disruption in the way BoP consumers gain access to affordable energy.

Figure 6: Simpa Networks Progressive Purchase Solution

Source: Simpa Networks

Water Access

Despite decades of development aid and the implementation of thousands of community water projects, ensuring access to water for all is still a major development challenge. The post-construction phase represents one of the biggest challenges, as communities don't have the tools or training to ensure proper maintenance. The remoteness of sites also challenges efficient and fast repair works when needed.

An evaluation of 7,000 rural water schemes in Ethiopia showed that 30-40% of these were non-functional.[1] Generally, in cities, households with metered connections pay less, but they pay for what they use, whereas fixed charges result in huge wastage because people lack the incentive to contain their consumption.

The usage of mobile networks to enhance sustainability of water access projects is gaining some traction, but it remains at a very early stage and an overall proof of concept is required both on a technical and operational level. Mobile water payments could also offer a reliable, low cost and inclusive mechanism to accelerate and maintain improved water service.[2]

As an example of such solutions, Grundfos LIFELINK in Kenya has for the past 2 years been building submersible pump solutions operated by solar panels. These target the rural communities in arid and semi-arid parts of Kenya, where surface water is scarce. Each pump is equipped with an embedded GSM chipset which offers a real-time monitoring solution of the sites. Users collect water from the pump's automatic water dispenser using a smart card containing water credit. Behind the payment system is a partnership between Safaricom and Grundfos LIFELINK. Via an interface using M-PESA, community members can use a mobile phone to transfer credit to the water key, which they use to draw water from the tapping station.

In the two years after the installation of the first LIFELINK system in March 2009, 20 LIFELINK systems were sold and implemented, providing clean water for approximately 50,000 people.

Figure 7: Grundfos Lifelink Water Project In Kenya

Source: Grundfos Lifelink

Beyond Water Access services, mobile technologies are to be investigated for the following sectors:

- Improved access to sanitation – currently in its nascent stage, entrepreneurs are investigating the potential of such technologies to add value to latrine emptying services or enhance payment efficiencies and transparency
- Increased irrigation and water management in the agricultural sector – embedded solutions in the agriculture sector are still at an early stage, but solutions already exist in this space, allowing remote management of irrigation pumps, reducing water wastage and increasing entrepreneurship[3]

A full White Paper on embedded solutions for community access to energy and water will be published by the GSMA later this year. It will explore the opportunities highlighted in this article with supporting case studies as well as how it can link to Community Power from Mobile

1 UN World Water Development Report, 2009
2 Today between 1 and 10% of consumers with piped water connections (in Africa) pay with mobile money thanks to the development of utility bills payment services. Source Oxford University
3 The Nano Ganesh system developed by Ossian Agro Automation in India allows farmers to "call" their irrigation system to start the engine (if running on diesel) and stop when needed. Impacts of such solutions are, farmers save time and reduce dangerous encounters when walking to their pumps, better water management, energy consumption reduction.

Chapter 12

Make it Official: Committing to a Future We Want

By Mary Roach, GSMA

The UN Secretary General has named 2012 the Year of Sustainable Energy for All (SEFA). With the support of the UN Foundation, SEFA aims to catalyse the political will and required investment to achieve three broad goals by 2030:

- Ensure universal access to modern energy services
- Double the global rate of improvement in energy efficiency
- Double the share of renewable energy in the global energy mix

These goals are aligned with the three energy programmes of the GSMA: Community Power from Mobile, Green Power from Mobile, and Mobile Energy Efficiency. Thus it is no surprise that we support the aims of SEFA and believe that our members and the broader community have a vital role to play in making SEFA a success.

We have taken mobile beyond the grid, outpacing the growth of traditional telephony and electrical infrastructure. The growth of the mobile industry in emerging markets would not be possible without the development of large numbers of decentralised power systems providing reliable 24x7 power. Originally powered by diesel engines, off-grid base stations are increasingly being powered by hybrid and renewable energy systems. This has largely been due to the price of alternative solutions coming down, the price of diesel increasing and telecom players becoming increasingly frustrated with the challenges of managing diesel theft.

None of this is new to you, but for many outside of our readership the importance of the energy sector for the mobile industry is often not understood. To deliver the future we want, where off-grid towers are powered by green energy and the communities we impact have access to the basic energy services they require (including phone charging), we have a mutual responsibility to highlight the opportunities and challenges of energy in the mobile industry.

We are tremendously proud of the work you do. That is why we are asking you to make it official and share your plans with the world. As part of SEFA, the UN Foundation is seeking public commitments that support the three overarching goals of the initiative. Using a simplified online form, organisations can publicise their commitment and will be asked for yearly progress updates on achieving their goals.

Telefónica is the first mobile operator to make a public commitment to SEFA (details of their commitment are included on page 46). Nuru Energy and Nokero, both off-grid energy product providers featured in our Community Power from Mobile Vendor Catalogue, have also made commitments. Examples of commitments already made can be seen here: **http://www.sustainableenergyforall.org/commitments**

If you would like to make a commitment you can do so at this link: **http://www.sustainableenergyforall.org/commitments/make**
If you have any question on the process or do choose to make a commitment please let us know.

Telefonica's Commitment to SEFA: 30% Reduction in Networks Energy Consumption by 2015

Commitment Targets

Telefónica has a public goal to reduction of 30% reduction in energy consumption in networks per equivalent access by 2015, taking as the base year 2007. The goal is corporate and includes all the Telefónica Group companies that offer fixed, mobile and television services. Note: The equivalent access are constituted by a balance between fixed, mobile and television customers, supported by internal studies and business and industry bodies of TELCO.

Sustainability for All Goals Addressed

- Access to Energy
- Renewables
- Energy Efficiency

Countries

- Peru
- Czech Republic
- Germany
- Ireland
- Slovakia
- Spain
- United Kingdom
- Argentina
- Brazil
- Chile
- Colombia
- Ecuador
- El Salvador
- Guatemala
- Mexico
- Nicaragua
- Panama
- Uruguay
- Venezuela

Resources

To reduce the carbon footprint in line with its strategy to maximise revenue, reduce operational costs and provide services at attractive prices, Telefónica assesses, defines and implements its overall package of projects based on the following key financial calculations: VPN /Return on investment/EBITDA/Payback/Free cash flow (FCF) In recent years, Telefónica is using the ESCo model to renew their infrastructure equipment's (rectifiers and air conditioners), making their operations more efficient. How Telefonica is a global company, must be in accordance with the Compliance with Regulatory Requirements and standards, as a prerequisite to obtain success in their activities. Today Telefónica participates in the CRC (Carbon Reduction Commitment) scheme is mandatory energy efficiency Aimed at Improving Emissions and cutting in large public and private Sectors' Organisations.

Additional Details

Last year, we attained nearly 20% of the goal we set in 2007 of reducing our network electricity consumption by 30% by 2015 (KWh/access eq). We carried out more than 30 global energy-efficiency projects, which translated into a reduction of 68 GWh, or 24 Kton of CO_2e, and a financial savings of €7.6 million. In addition, our greenhouse gas emissions level was 1.8 million tones of safety in the same as in 2010.

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.

COAI – Cellular Operators Association of India

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

ESCo – Energy Service Company

GDP – Gross Domestic Product

GE – General Electrics

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)

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.

MSC/Mobile Switching Centre – Interface between the base station system, ie the BTS and the switching subsystem of the mobile phone network

Operator – Mobile Network Operator

NGO – Non Governmental Organisation

NPV – Net Present Value

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

Resources

http://www.gsma.com/developmentfund/programmes/green-power-for-mobile/resources/

HOMER Software – Training Guide for Renewable Energy Base Station Design

http://www.gsma.com/developmentfund/wp-content/uploads/2012/06/HOMER-Software-Training-Guide-June-2011.pdf

Green Power for Mobile Vendor Directory

http://www.gsma.com/developmentfund/wp-content/uploads/2012/04/vendorpdfupdateinteractive110112.pdf

Community Power from Mobile White Paper (December 2011)

http://www.gsma.com/developmentfund/wp-content/uploads/2012/04/cpwhitepaper161211interactive2.pdf

Green Power for India Interactive Replication Guide

http://www.gsma.com/developmentfund/wp-content/uploads/2012/06/Indian_ReplicationGuide_300512_Final.pdf

Green Power Vendor Landscape in India

http://www.gsma.com/developmentfund/wp-content/uploads/2012/04/GSMA_Vendor_Landscape_India_v3_030412_Interactive1.pdf

Green Power for Mobile Bi-Annual Report (December 2011)

http://www.gsma.com/developmentfund/wp-content/uploads/2012/05/GPM_Bi-annual_Report_Dec-2011.pdf

Green Power for Mobile: Charging Choices (2011)

http://www.gsma.com/developmentfund/wp-content/uploads/2012/04/chargingchoices2011.pdf

Green Power Feasibility Study – MTN Uganda

http://www.gsma.com/developmentfund/wp-content/uploads/2012/07/MTN-Uganda-Feasibility-Study.pdf

Green Power Feasibility Study – Digicel, Haiti

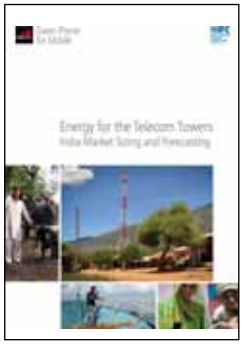
http://www.gsma.com/developmentfund/wp-content/uploads/2012/06/Digicel-Haiti.pdf

Community Power Feasibility Study – Zantel, Tanzania

http://www.gsma.com/developmentfund/wp-content/uploads/2012/06/Zantel-Tanzania.pdf

Green Power for Mobile Replication Guide

http://www.gsma.com/developmentfund/wp-content/uploads/2012/04/gsmagreenpowerformobilereplicationguide.pdf



Indian Market Sizing Forecast

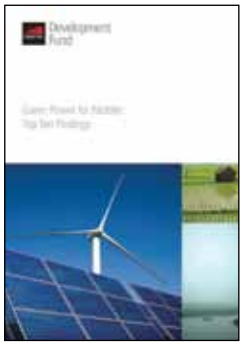
http://www.gsma.com/developmentfund/wp-content/uploads/2012/05/Energy-for-the-Telecom-Towers-India-Market-Sizing-and-Forecasting-September-2010.pdf

Green Power for Mobile Bi-Annual Report (November 2010)

http://www.gsma.com/developmentfund/wp-content/uploads/2012/05/GPM_Bi-Annual_Report_Nov10.pdf

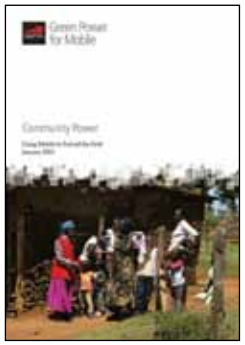
Green Power for Mobile Bi-Annual Report (June 2010)

http://www.gsma.com/developmentfund/wp-content/uploads/2012/05/GPM_Bi-Annual_Report_June_10.pdf



Green Power for Mobile: Top Ten Findings

http://www.gsma.com/developmentfund/wp-content/uploads/2012/04/greenpowerformobiletoptenfindings-1.pdf



Community Power – Using Mobile to Extend the Grid

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