Green Power for Mobile

MTN Uganda – Feasibility Study

This document has been written to provide information to mobile operators who are considering or planning to deploy 'green' renewable power resources for base station (BTS) and transmission sites. It details the experiences gained during the GSMA Feasibility Study conducted for MTN Uganda.

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Executive Summary

The GSMA Development Fund was commissioned by MTN Uganda during April to June 2009 to complete a Green Power for Mobile (GPM) Feasibility Study to analyse the operator's network and propose an implementation plan for a green power network. The study analysed the entire operator's network and ranked the most suitable green sites according to specific criteria defined in the GSMA Green Power for Mobile (GPM) methodology. Field visits to ten sites were conducted and site dimensioning proposals were drafted for the target sites.

The main findings of the study are as follows:

- The implementation of green power technology in BTS sites represented a technically feasible and financially attractive solution for MTN Uganda compared to current power provision systems in the majority of the sites that were studied
- Energy analysis should be undertaken at network planning stage (i.e. during land acquisition process). In existing sites there is often not enough space for installing the ideal photovoltaic system
- Low power, diesel generator only sites show the best financial indicators. In these sites generators are often oversized and run 24 hours a day. The usage of a green power solution would allow a significant decrease in generator run-time and OPEX
- Mobile operators venturing into green power solutions for their networks must be supported by resources experienced in the specific application of green power and telecoms. The GSMA offers technical assistance services through its GPM programme to provide operators with the skills and understanding to implement green power solutions. See 'GSMA Technical Assistance for Operators' for more information
- Accurate data on installed network infrastructure is critical for successful energy planning.

Objective

During the GSMA Development Fund's previous green power technology trials in Namibia, India, Vanuatu and Sri Lanka, implementations of renewable systems to power off-grid BTS and transmission sites were completed. These trials have proved the effectiveness and financial viability of green power solutions – as a result the GSMA has developed a vendor neutral advisory service that is available to member operators through a ten to twelve week feasibility study.

The main objectives of the feasibility study were as follows – to demonstrate the GPM methodology for green power solutions, to provide MTN Uganda with a high level analysis of their network from an energy perspective, to produce a ranking of priority target sites, to complete site dimensioning proposals for target sites and to propose a plan of implementation.

Background

Uganda is a landlocked country on the Eastern Africa plateau. It has a population of over 32 million, most of which live in rural areas, and occupies the 156th position in the Human Development Index. The average height above the sea level is 1,100 metres and it generally has an equatorial climate. There are however huge differences between the North and the South of the country – the North, especially the Eastern side, is usually dry outside the two rainy seasons (March-June and November-December), while in the South rainfall is generally spread throughout the year. Despite the rainy seasons sun radiation levels are satisfactory for green applications throughout the year, while acceptable windy areas are located only in the Karamoja region, in the North-Eastern part of the country.

MTN Uganda is part of the MTN Group and is the largest mobile operator in Uganda. The operator launched its services at the end of 1998 and to date has more than 3.5 million customers, providing GSM coverage to more than 90% of the urban population. Nearly half of MTN Uganda's sites are not connected to the grid and are powered by diesel generator or hybrid battery systems.

Feasibility Study

The Feasibility Study conducted at MTN Uganda was based on the GSMA GPM methodology which has been developed based on the experience of previous GPM trials in combination with consultation with mobile operators and renewable energy experts.

In order to take into account the country's climate diversity BTS sites from three regions were analysed – West Nile and Karamoja in the North East and Masaka district in the East. The study focused primarily on off-grid sites and amongst those, priority was given to single BTS sites having a 4/4/4 configuration. MTN Uganda is supplied by two main telecom equipment manufacturers and the sites selected to be trialled included equipment from both vendors. In order to assess a comprehensive sample of MTN Uganda's network the selected list included indoor and outdoor sites powered by either diesel generator or by hybrid battery systems.

After assessing the operator network and analysing the sites which could best represent MTN Uganda's operating environment in terms of climate, site configuration, equipment and power requirements, eleven priority target sites were identified (ten existing sites and one planned site). The selected sites can be grouped into four main categories according to a two dimension criteria – indoor/outdoor and diesel generator/hybrid battery system powered sites.

Site visits were conducted for ten out of the eleven targeted sites – this was a key element of the site prioritisation. Availability of space on site for green power equipment e.g. solar panels, terrain obstacles, and local knowledge of micro-climate are all key pieces of information that need to be considered when prioritising sites and the most efficient way of gathering this information is through site visits.

For each of the targeted sites accurate financial and renewable power forecasts were completed adopting HOMER (NREL) software to dimension the renewable energy equipment and integrating the results into the GPM methodology.

Results and Recommendations

The outcome of the Feasibility Study at MTN Uganda provided interesting results and key learnings for the MTN that were used to consolidate the GPM methodology.

Key Performance Indicators

Renewable power and financial feasibility indicators were implemented and presented to MTN Uganda with a set of recommendations.

Financial Viability Indicators

Return on Investment (ROI) was established as a key performance indicator for assessing the financial viability of the proposed renewable power configurations versus current or standard configuration. MTN Uganda defined a ROI of 30% or greater as a standard minimum requirement for renewable energy implementations. These parameters together with other financial indicators (Net Present Value (NPV) & CAPEX) were calculated starting with existing agreements with vendors and specific quotations received for renewable energy equipment.

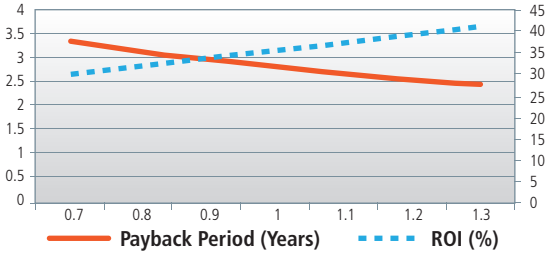
Renewable Energy Indicators

Data collected from weather databases showed that for selected locations wind would not represent a reliable source of power for the sites. In the North-Eastern region of Karamoja wind speed was appreciable but not constant throughout the year. The green power solutions that were designed are all solar power, integrated with deep cycling batteries, and reusing the existing diesel generator as a backup power solution. Essential indicators in the decision making process included the power contribution coming from the renewable energy component to the overall system requirement and the autonomy of the system.

In most cases it was not possible to adopt the best renewable energy configuration due to the limited space available on site for photovoltaic panels. The models that were proposed represent a trade-off between availability of space on site, existing equipment and equipment power requirements.

An analysis of diesel price variation was conducted considering values ranging from US$ 0.7 to US$ 1.2 with increments of US$0.1. In many developing countries besides the diesel market price, currency exchange fluctuations, theft and delivery costs can have a strong impact on final delivered diesel price.

Site #1 - Payback Period and ROI Versus Diesel Price (US$)



Key Results

- Seven out of eleven sites were identified as having a green power solution payback within three and a half years
- The spread of ROI is between 25.1% and 64.8% across ten sites
- The CAPEX range for the green power solutions is US$ 34,177 to US$ 64,315 per site, with an average US$ 48,883
- The GSMA Development Fund recommended that MTN Uganda implement green power solutions in six out of the eleven sites studied
- This rollout has the potential to save 68,885 litres of diesel per year and reduce carbon emissions by 219.6 tons per year.

Summary of Financial Viability and Renewable Energy Indicators

Site	ROI	NPV (US$)	CAPEX (US$)	Contribution to Power	Battery Backup (Hours)	Base Station Type	Suggested for Implementation
Site #1	33.6%	$4,124	$34,177	solar: 41% DG: 59%	13.4	outdoor/DG only	Y
Site #2	32.9%	$8,791	$64,315	solar: 32% DG: 68%	17.6	outdoor/DG only	Y
Site #3	27.9%	-$1,284	$45,830	solar: 37% DG: 63%	13.2	outdoor/DG only	N
Site #4	49.1%	$26,842	$47,874	solar: 41% DG: 59%	13.4	outdoor/hybrid battery system	Y
Site #5	64.8%	$44,230	$45,379	solar: 35% DG: 65%	13.4	indoor/DG only	Y
Site #6	25.1%	-$3,632	$40,840	solar: 36% DG: 64%	17.2	indoor/DG only	N
Site #7	34.5%	$5,378	$40,167	solar: 52% DG: 48%	13.4	indoor/DG only	Y
Site #8	27.9%	$2,360	$56,830	solar: 17% DG: 83%	9.61	indoor/hybrid battery system	N
Site #9	40.4%	$19,561	$56,830	solar: 25% DG: 75%	18.4	indoor/hybrid battery system	N
Site #10	52.8%	$34,042	$57,738	solar: 90% DG: 10%	18.7	outdoor/DG only	Y

Best Practice Methodology for Green Power Solution Design

The GSMA GPM programme has worked with industry partners, including mobile operators, renewable energy equipment manufacturers, and deep domain experts in renewable power to develop a best practice GPM methodology. The methodology enables an understanding of the potential for applying green power in a network, the development of a commercial model, the specification and dimensioning of systems, and the rollout. The key challenge with a commercial scale rollout is reducing the list of candidate sites in an operator's global or country footprint to the optimum targets based on technical and financial viability. The methodology below tackles this challenge.

GSMA Best Practice Methodology for Green Power Solutions Design

Country Economic Modelling/Prioritisation

This first stage is to determine the commercial feasibility of deploying renewable energy resources at a country level. A country level economic assessment is made using a representative range of site types, which are then dimensioned for renewable energy deployment, providing investment indicators such as ROI, NPV, IRR and payback periods to assess commercial feasibility. This stage allows group level operators to compare target countries within their global footprint.

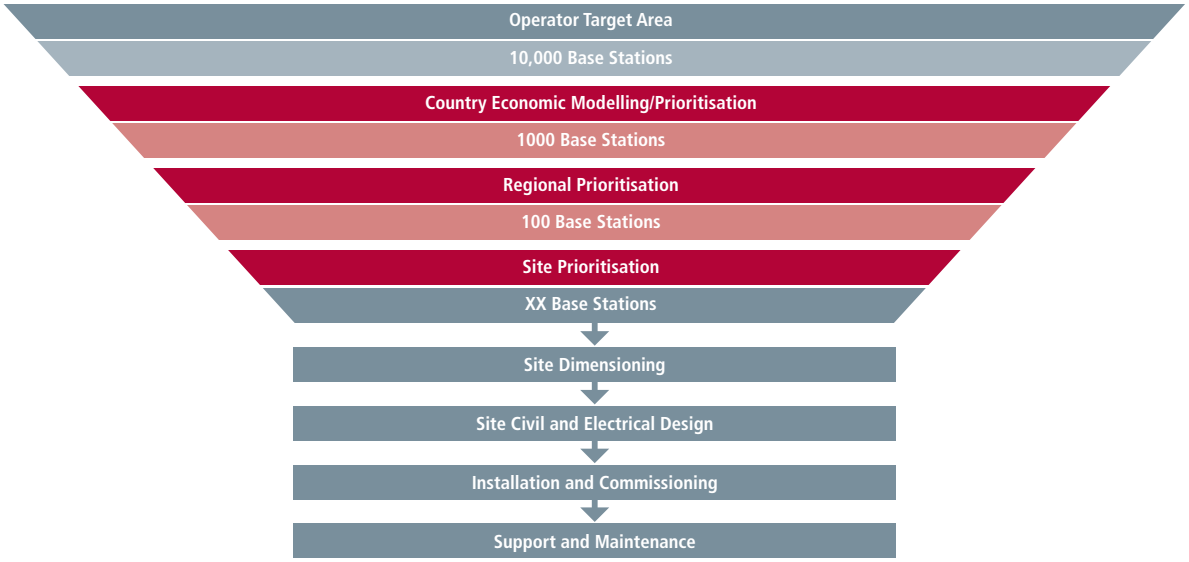
Regional Prioritisation

This stage is to prioritise regions within the target country to reduce the number of candidate sites. Numerous country / operator specific factors are used during this phase – regional logistics and weather data, security concerns and location of operation and maintenance centres, etc.

Site Prioritisation

At this stage sites are prioritised based on suitability and financial viability, taking detailed local information such as micro-climate and access into consideration. Operators can then identify priority sites to target based on CAPEX budgets and rollout objectives.

GSMA Best Practice Methodology for Green Power Solutions Design



Site Dimensioning

Following definition of a target site list, in combination with inputs from previous phases, site visits are normally made to a number of sites. Consideration at this stage is given to the value-at-risk of each site, and determining appropriate levels of autonomy and the impact on disaster recovery. In particular, different plans for transmission backbone, link and edge of network sites are required. Critical consideration is also given to the telecoms equipment on site. In retrofit instances, an evaluation of the existing telecoms equipment is undertaken to establish its suitability for renewable equipment support and whether replacement is appropriate.

Site Civil and Electrical Design

A simpler stage for new site deployments, but more challenging for retrofits where integration of existing equipment and site usage is more complex. Precise positioning of renewable energy equipment must be determined, examining local issues such as shading from masts or vegetation and the effect of local wind variances. For retrofit sites incorporation of all existing electrical equipment into electrical design is required.

Installation and Commissioning

Trained personnel with experience in the renewable power resources being installed are required at this stage.

Support and Maintenance

Plans for support and maintenance must be drawn up and implemented in line with previously prepared disaster recovery plans. In order to validate power performance, this phase must include the ongoing operation of remote monitoring telemetry, along with a long-term assessment of the actual performance of the renewable power equipment with the actual telecoms equipment and its load on site.

GSMA Technical Assistance for Mobile Operators

The GSMA has identified a need for mobile operators to have access to vendor neutral, non-biased technical assistance services. Through its GPM programme, the GSMA has established a service to address this need.

Delivery Approach for GSMA Technical Assistance for Mobile Operators

GSMA contacts

For further details on the MTN Uganda Feasibility Study, technical assistance or any of the parties involved in the GPM programme please contact:

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For more information on the GPM programme go to www.gsmworld.com/greenpower.

Glossary

ADP Accenture Development Partnerships

BTS Base Transceiver Station; the name for the antenna and radio equipment necessary to provide wireless service in an area

CAPEX Capital Expenditure

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

IRR Internal Rate of Return

km Kilometre; a kilometre is a measure of distance

kW Kilowatt; a kilowatt is a unit of power, representing the rate at which energy is used or produced (i.e., the product of voltage and current)

kWh Kilowatt-hour; one kWh represents one hour of electricity consumption at a constant rate of 1 KW

KPI Key Performance Indicator

GSM Global System for Mobile communications, the second generation digital technology originally developed for Europe but which now has in excess of 71 per cent of the world market

GSMA GSM Association

MNO Mobile Network Operator

NPV Net Present Value

OPEX Operating Expenditure

PDD Project Definition Document

PV Photovoltaic; in this instance refers to PV cells which convert visible light into Direct Current

ROI Return on Investment

W Watt; a unit of electrical power equal to one ampere under a pressure of one volt

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