Green Power for Mobile

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Banglalink – Bangladesh – Feasibility Study

Bangladesh; a low-lying Ganges delta, is located in the north-eastern part of South Asia. It borders predominantly with India, but also the Bay of Bengal and a small part of Myanmar. It is a picturesque country with the Himalayas to the north, the Bay of Bengal in the south and the hilly, forested regions of Tripura to the East. Although Bangladesh is a small country, it is the seventh most populous country in the world[1].

Background

Straddling the Tropic of Cancer, the climate in Bangladesh is tropical with a very mild winter from December to March, a hot and humid summer from March to June, and a warm and humid monsoon from June to November. During the monsoon season, natural calamities such as floods, tropical cyclones, tornadoes, and tidal bores occur almost every year. Bangladesh is mainly a low-lying country with most areas less than 12m above sea level[2]; however the highest point is 1,230m[3].

The mobile phone infrastructure of Bangladesh has developed drastically over the last 8 years with six mobile phone operators currently functioning in the market. Nevertheless, market penetration is still only 41.06%[4], which is low considering the total active mobile phone subscriber is now 69.2 million[5].

[1] www.cia.gov/library/publications/the-world-factbook/geos/bg
[2] wikipedia.org/wiki/Bangladesh#cite_note-NatDis-51
[3] www.cia.gov/library/publications/the-world-factbook/geos/bg
[4] www.wirelessintelligence.com
[5] www.wirelessintelligence.com

Banglalink is a subsidiary of Orascom Telecom Holdings in Egypt. It launched in 2005 following a 100% share purchase of Sheba Telecom. Banglalink was the first mobile phone operator to initiate a drastic reduction in call tariffs, which attracted a large number of subscribers in a short period of time. Currently Banglalink has 18.1 million subscribers with 26.15% market share[6] and operates over 5000 base stations in its access network to service its subscribers.

Power Infrastructure in Bangladesh

Despite a large investment within the power sector over the last two decades, the power infrastructure is yet to extend into many of the remote rural areas of Bangladesh. The current electricity penetration rate is 47%[7]. Lack of adequate power generation and increasing demand puts the power infrastructure under pressure. Natural gas-driven turbines and hydro-electric projects are the main sources of power generation in Bangladesh. Due to lack of generation capacity, the grid has not been extended to all rural areas. The Rural Electrification Board (REB) has connected 433 sub-districts out of 486[8], but it's still beyond the reach of a large number of villages. Moreover, the lack of adequate power generation creates long power outages throughout the year which have major impacts the national economy.

There is fierce competition among the mobile phone operators in Bangladesh in-terms of network expansion and tariff reduction. Lack of availability and inconsistent grid power has become the key concern to mobile phone operators in recent years. To increase subscriber base and mobile phone penetration rate, operators are extending their network in off-grid areas by using diesel generators (DG) as a power source. Since the majority of land that in inhabited in Bangladesh is off-grid, operators have no choice but bear the large energy operating expense (OPEX) due to DG usage. Currently there are more than 2000 base stations in Bangladesh that are located in off-grid locations and run by DG.[9]

[6] www.wirelessintelligence.com
[7] www.powerdivision.gov.bd/
[8] www.reb.gov.bd/about_reb
[9] Interview with different mobile phone operator in Bangladesh

Challenges of Banglalink's network

Since Banglalink launched in 2005, it has been expanding rapidly and is continuing to maintain a fast rate of expansion. A large number of base stations are added every year.

Year by Year Base Station Deployment

Year	Base Station added
2005	762
2006	471
2007	1176
2008	1433
2009	491
2010	427 (May 2010)

Source: Banglalink

It is a challenge for operators to keep the energy-related OPEX in line while keeping the countrywide operations running smoothly. Around 16.5% of Banglalink's base stations are off-grid and 70% of the on-grid base stations have frequent power outages. Each day there are around 19,000 to 24,000 hours of power unavailable in Banglalink's on-grid network which forces Banglalink to run DGs. The daily running cost for these DGs on average is US$27,000 which creates a pressure on Banglalink's bottom line.

Network summery of Banglalink

Total Base Stations	4760
Off grid Base Stations	789
On grid Base Stations	3959
Daily Power Unavailability	19,000 to 24,000 hrs
Daily OPEX to Run DG	US$27,000
Daily CO2 Emission	100 Tonnes

Source: Banglalink

Power consumption for air conditioners is another key challenge for Banglalink. Air conditioners for the entire network consume 170,000kWh power daily, which is almost 50% of the entire network energy costs.

Challenges of the Feasibility Study

The GSMA's Green Power for Mobile (GPM) programme worked with Banglalink to analyse the entire Banglalink network, which consists of 4760 base stations, to identify specific solutions for energy cost savings. There were several challenges in doing this analysis, one of which includes the rapidly growing number of subscribers requiring Banglalink to frequently add extra capacity to existing sites making the power requirements dynamic and challenging to forecast.

For the on-grid sites, there were no specific power outage patterns or any previously recorded data, which required follow up with the power company and other organisations that track power outages.

Lack of specific and reliable wind speed data was another challenge which eventually prevented wind based renewable energy solutions from being incorporated into the recommend solutions. In addition to these challenges the large number of sites being analysed proved to be challenging and time consuming.

Approach of the Feasibility Study

Analysing data

Data analysis is the most important part for a Green Power Feasibility Study. GPM analysed year-wise network data for Banglalink that consisted of 4760 sites. While analysing the data, GPM considered all factors that could assist with dimensioning the right solution for the network operator. A data analysis sample is given below for year 2009:

Yearly data analysis example

Year	Basic Analysis	Deep Analysis		Observation	Key Note
		Off Grid*	On Grid*		
2009	• Total 491 sites. • 186 off grid & rest are on-grid. • Almost equal number of rooftop and Greenfield Sites.	• 113 sites have average load of 2kWh. • Rest sites have load of ≥2kWh • Each site has one 20kVA DG	• 98 sites have average load of 2kWh • 193 sites have average load of 3kWh • Rest all sites have ≥3kWh load • 1 site is Outdoor and rest all are Indoor. • Average daily power outage 2-12 hrs • 121 sites have DG as back-up power	• DG runs for 3800hrs everyday • Each Air-conditioner consumes 2.25kWh Power.	• Daily OPEX to run DG is $6,700 • Daily CO2 emission is 24.1 Tonnes

*Site load is calculated without air conditioners load

Design Models

Green power design models were created based on the data analysis. After analysing Banglalink's network data, GPM found 362 sites had the potential for green power implementations. 13 design models were created to cover all 362 sites. These designs were based on solar-DG hybrid solutions. Out of the 13 design models, two were designed for rooftop sites, two for outdoor greenfield sites and the remaining nine models were for indoor greenfield sites. All the design models were carefully prepared to get the best possible technical and financial output.

Business Cases for Design Models

GPM created business cases for each design model with a 10 year business plan in mind. The business cases were prepared based on actual market data and rates, as well as providing a full overview of the CAPEX, OPEX and investment metrics such as NPV and ROI.

Priority Group

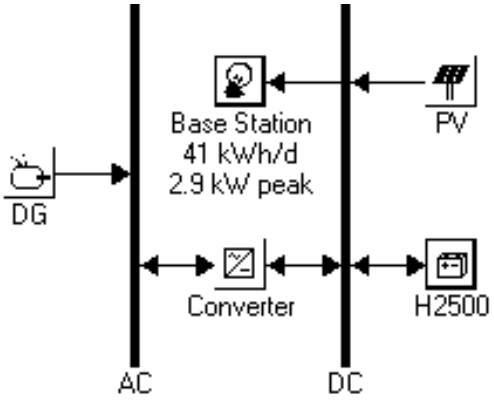
GPM identified priority sites based on technical, financial and environmental indicators. These priority sites were essential for Banglalink to make a more efficient investment plan. The 362 potential green power sites were divided into 6 priority groups, each of which had an associated investment plan and analysis of financial indicators.

Renewable energy results and recommendations

Site Design Example

13 design models were created for off-grid sites. Each of the designs was carefully created to maximise the utilisation of the energy generated. While dimensioning the equipment for the design models, a specific load requirement was calculated and a solution was recommended based on the precise load calculation. Solar-hybrid solutions were proposed for all the designs.

An example of a design model



The technical dimensioning proposed for Banglalink contained detail site and model wise data. An example is as follows:

Model	Proposed Solution Dimensioning				
	PV (kW)	Battery OPzS (Ah)	Auxiliary DG (kVA)	Controller (Amp)	Converter (kW)
1	11.2	2000	20	240	14
2	11.6	2000	20	250	12
3	12	3000	20	250	16
4	12	2500	20	250	14
5	12	3000	20	250	16
OD-1	12	2500	20	250	14
RT-1	12	2500	20	250	14

Site Selection for Prioritisation

Priority groups were set based on site importance, site load, CAPEX, ROI and OPEX savings for each individual site. After preparing technical solutions and business cases for all 362 sites, GPM analysed and came-up with six priority groups.

	Priority 1	Priority 2	Priority 3	Priority 4	Priority 5	Priority 6
Number of Sites	6	23	141	32	139	21

The six sites in Priority 1 are technically more important and financially more attractive than any other group. Setting site priority enabled Banglalink to make their investment plan more flexible and accurate.

Business Case and Financial Analysis for Priority Sites

GPM created an analysis table for each priority group based on the business case of each design model. This detailed analysis brought an easy understanding for the network

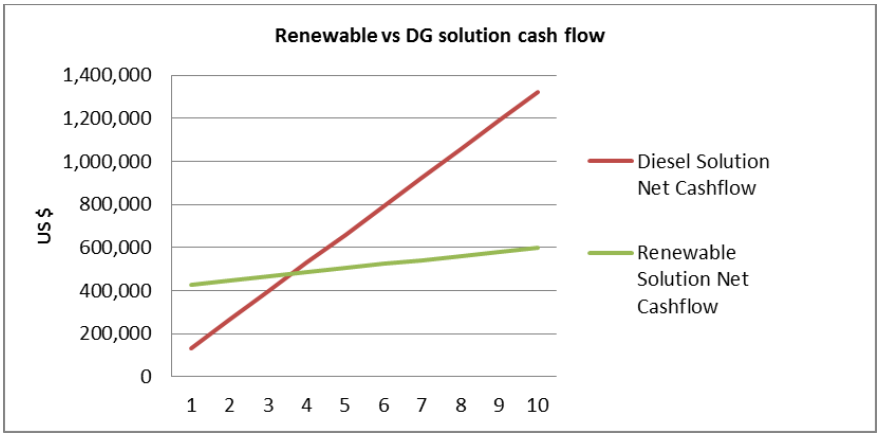
operator to identify the credibility of their investment. The analysis consisted of solution details, performance indicators, financial indicators as well as environmental indicators for each solution. An analysis table for Priority 1 sites is given below:

Analysis for Priority 1 Sites

	Proposed Solution						Performance Indicators					Financial Indicators					Environmental Indicator
Site Code	Homer Model	PV (kW)	Battery OPzS (Ah)	DG (kVA)	Controller (Amp)	Converter (kW)	PV Contribution	DG Contribution	Excess Power	DG Operation hours/ yr	Battery Autonomy (hr)	CAPEX (US $)	Average OPEX (US $)/yr	Payback Period (yr)	NPV (US $)	OPEX can be saved (US $)/ yr	CO_2 Emission reduction (Tonnes/yr)
AAA	OD1	12	2500	20	250	14	87%	13%	7.65%	179	42	68,480	2,584	3.52	80,738	19,448	35.8
BBB	OD1	12	2500	20	250	14	87%	13%	7.65%	179	42	68,480	2,584	3.52	80,738	19,448	35.8
CCCC	OD1	12	2500	20	250	14	87%	13%	7.65%	179	42	68,480	2,584	3.52	80,738	19,448	35.8
DDD	OD1	12	2500	20	250	14	87%	13%	7.65%	179	42	68,480	2,584	3.52	80,738	19,448	35.8
EEE	OD2	12	2500	20	250	14	59%	41%	1.50%	806	28	68,480	4,259	3.85	89,475	17,773	31.9
FFF	OD2	12	2500	20	250	14	59%	41%	1.50%	806	28	68,480	4,259	3.85	89,475	17,773	31.9

	Overall Financial analysis for Priority-1 rollout						
	CAPEX (US$)	OPEX/ yr US$	OPEX Saving/ yr (US $)	Payback Period (yr)	ROI	NPV (US $)	CO_2 Emission reduction (Ton/Yr)
Total Average	410,880	18,854	113,338	3.6	28%	501,902	207
	68,480	3,142	18,890			83,650	34.5

Cash flow for Priority 1 sites is as follows:



Priority Results Summary Table

A financial analysis was undertaken considering CAPEX and OPEX savings for each priority group. A summary table of financial results of all priority groups is as follows:

Financial Results of all Priority Groups

Priority	Number of Sites	Total CAPEX (US $)	Yearly OPEX (US $)	OPEX Saving/Yr (US $)	Payback Period (yr)	ROI	NPV	CO_2 Emission Reduction (ton)
1	6	410,880	18,854	113,338	3.6	28%	501,902	207
2	23	1,571,880	69,227	412,669	3.8	26.3%	1,906,088	790
3	141	9,623,760	389,588	2,567,884	3.7	27%	11,492,399	4912
4	32	2,304,480	138,393	532,017	4.3	23.25%	2,981,944	1026
5	139	10,032,120	608,016	2,304,312	4.35	23%	13,009,243	4451
6	21	1,459,080	84,414	378,258	3.85	26%	1,873,764	681

Energy Efficiency Recommendations

For overall energy optimisation, GPM came up with a list of recommendations which could help Banglalink reduce their energy requirement at every site. Examples of these include:

- Not to use any Aircon for off-grid sites
- Use Free Cooling Units (FCU)/DC Aircon for Shelter/BTS-room environment control
- Not to use Aircon only for on-grid sites. Use FCU + Aircon if low power outage tendency
- For high power outage on-grid site, use only FCU for Shelter/BTS-room environment control
- Not to keep anything other than telecom equipment in BTS-room
- Purchase outdoor BTS for upcoming deployments
- Use a battery cooler for all both on-grid and off-grid sites. It will increase battery life by 50%
- Use VDT/intelligent controller to manage battery and DG operation
- Use energy saving light for all GF/GFRT sites

There are a number of off-grid sites which were not recommended to have a renewable energy solution, due to the site characteristics and poor business case. GPM provided some specific recommendations for those sites to help Banglalink reduce its energy OPEX. Examples of these include:

- Dismantle all existing Aircon and use FCU instead
- Use battery coolers
- Turn off unused/less used TRX
- Use energy savings light

GPM also found a large number of on-grid sites have inconsistent power availability which forces network operator to use DGs during these power gaps. To get rid of this, GPM came-up with some specific recommendations:

- If any sites have more than 6 hours of power outage tendencies:
    - Dismantle all Aircon and use FCU instead.
    - Upgrade existing battery bank to 2000Ah
    - Install battery cooler for each battery bank

GPM found that by implementing these recommendations, Banglalink could save 21,600 litres of diesel every day.

Summary Results for Full Feasibility Study

After an eight week Green Power Feasibility Study, GPM concluded that:

Suggesting green power solution implementation at:	362 off grid sites
Not suggesting green power solution implementation at:	468 off grid sites
Deep battery cycling at:	On Grid Sites having more than 6hrs power outage tendency
A list of generic recommendations those can save up to 40% of energy OPEX.	

GSMA also provided the operator with financial figures for entire green power rollout.

Total CAPEX requirement for Green solution implementation	$25.4 million
Current total energy OPEX for off grid sites	$7.6 million/year
Total energy OPEX for Off grid sites after implementing Green solution	$1.3 million/year
Total energy OPEX can be saved at off grid sites by implementing Green Solution	$6.3 million/year
Average Pay back period	4 years
Payback period less than 4 yrs	188 sites
Average NPV	$ 87,750
Average ROI	25%

GSMA Green Power for Mobile

In September 2008, the GSMA Development Fund launched its Green Power for Mobile programme (GPM) to 'extend mobile beyond the grid' with two primary objectives:

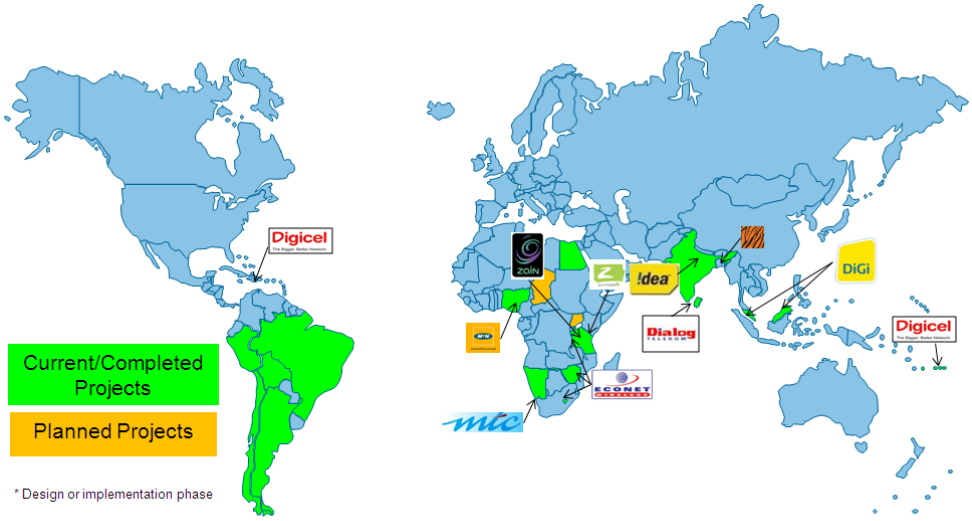
- To systematically reduce diesel consumption by mobile operators through the promotion of renewable energy technologies and energy efficient base stations
- To remove the barriers to handset charging in off-grid regions

The GPM programme aims to advance the use of renewable energy sources by the mobile industry to power 118,000 new and existing off-grid base stations in developing countries by 2012. Achieving this target will save up to 2.5 billion litres of diesel consumption and cut annual carbon emissions by up to 6.8 million tons.

The programme has partnered with the International Finance Corporation (IFC). The IFC are providing both financial support for the programme's activities and seeking to assist operators with financing for green base station rollouts.

Green Power for Mobile is now offering a Feasibility Study service for operators. This service analyses an operator's entire country network of base stations, identifies those that are most suitable for green power solutions, dimensions the equipment required and forecasts CAPEX and ROI. Our primary goal is to maximise the Return on Investment for operators and to provide training on the Green Power for Mobile Methodology. The service also assists operators with RFP design and interpretation of responses from vendors specific to the use of alternative energy.

Project Locations and Operator Partners



About the GSMA Association

The GSMA represents the interests of mobile operators worldwide. Spanning 220 countries, the GSMA unites nearly 800 of the world's mobile operators, as well as more than 200 companies in the broader mobile ecosystem, including handset makers, software companies, equipment providers, Internet companies, and media and entertainment organisations. The GSMA also produces industry-leading events such as the Mobile World Congress and Mobile Asia Congress.

About the Development Fund Serving the underserved through mobile

The GSMA Development Fund brings together our mobile operator members, the wider mobile industry and the development community to drive commercial mobile services for underserved people in emerging markets. We identify opportunities for social, economic impact and stimulate the development of scalable, life-enhancing mobile services.

For more information on the GSMA's Green Power for Mobile, please email greenpower@gsm.org

Development Fund