IFC International Finance Corporation
World Bank Group

GSMA Green Power for Mobile

In partnership with the Netherlands

Extending The Grid: Bangladesh Market Analysis

(Sizing Potential for Green Power in Bangladesh)

January 2013

Contents

Glossary

Definition	
GSMA	GSM Association
GPM	Green Power for Mobile
DG	Diesel Generator
GDP	Gross Domestic Product
EA&CEI	Electrical Advisor and Chief Electrical Inspector
PGCB	Power Grid Company of Bangladesh
PSMP	Power System Master Plan
MW	Mega Watt
kWh	kilo Watt hour
EMRD	Energy and Mineral Resources Division
CDM	Clean Development Mechanism
SEDA	Sustainable Energy Development Agency
VAT	Value Added Tax
BERC	Bangladesh Energy Regulatory Commission
MNO	Mobile Network Operator
SIM	Subscriber Identity Module
GSM	Global System for Mobile Communication
CDMA	Code Division Multiple Access
CAPEX	Capital Expenditure
OPEX	Operating Expenditure
FCU	Fan Cooling Unit
BTS	Base Transmitter Station
CAGR	Cumulative Annual Growth Rate
ESCO	Energy Service Company
PPA	Power Purchase Agreement
ESA	Energy Saving Agreement
Off-grid site:	Telecom Base Station Site which is NOT connected to the commercial Grid power supply
On-grid site:	Telecom Base Station Site which is connected to the commercial Grid power supply
Tower Company:	A company that manages a part or the entire assets of a telecom tower

Figures and Tables

Objective

The aim of this Market Analysis report is to examine the possibility for green power deployments and its potential for the telecom industry in Bangladesh.

The objective for this report is to analyse the current state of energy and infrastructure regulations in Bangladesh, and the current approach in telecom infrastructure and power solutions being used. This report presents the reader with a market sizing as well as the future outlook for green power in the telecom sector and showcases the potential opportunity for the third party ESCO energy outsourcing model.

Approach

The approach for this report was to gather first hand data through stakeholder interactions and questionnaires. At the same time, this report utilises data from the market through various secondary resources.

Executive Summary

Bangladesh, located in South Asia, and one of commonwealth countries has a population of about 152.51 Million people and a land mass of 147,570 sq. km – making it one of the most densely populated countries in the world[1]. Energy has become a major problem in the country – over 50% of the population does not have access to electricity.

Telecom is recognised as one of the most important industries for socio-economic development, particularly in developing nations. Currently the mobile telecom industry of Bangladesh has 60.1 million unique subscribers with population coverage of around 95%[2]. The remaining population live in rural areas with unreliable or off-grid coverage.

Currently Bangladesh has a total of 25,858 telecom cell towers with approximately 14% of them lacking access to grid electricity. Around 282 telecom sites out of 3,622 off-grid telecom sites are powered by 24x7 fossil fuel based diesel generators (DG). The remaining sites are running with DG-battery hybrid solutions. The total number of telecom sites is expected to grow to 36,679 by 2015.

The GSMA estimates that the total energy consumption for powering the network for 25,858 sites is around 453 million kWh and it would reach 642 million kWh by 2015. Additionally, the total number off-grid and bad grid sites will increase from 3,622 sites to 6,660 sites by 2015. Currently the DG-battery hybrid setup is the most commonly deployed solution in the country with 81% for all off-grid sites.

The GSMA estimates a potential saving of implementing green technology solutions to around US$41 Million OPEX for 3,622 sites and could reach US$90 Million by 2015. With a total investment of up to US$100 Million required for 3,622 and US$184 Million by 2015.

A potential saving can also be made using the 3rd party ESCO model based on a power purchase agreement (PPA). Estimated savings on OPEX MNO side is around US$9.4 Million for 3,622 sites. GSMA estimates that the market potential for the ESCO model reaches US$42 Million in 2012 and it could reach US$77 Million by 2015.

1 Bangladesh Bureau of Statistic (BBS) - www.bbs.gov.bd
2 Wireless Intelligent

1. Bangladesh

Bangladesh is in South Asia – bordered by India and Burma (Myanmar), and faces the Bay of Bengal to its south. It is one of the largest deltas in the world with a total area of 147,570 sq. km. With a unique communal harmony, Bangladesh has a population of about 152.51 million, making it one of the most densely populated countries of the world. Over 98% of the people speak Bangla, and English is also widely spoken. The country is a network of rivers and canals forming a maze of interconnecting channels.

1.1 Geographical

Bangladesh is located between 20° 34′ and 26° 38′ North latitude and between 88° 01′ and 92° 41′ East longitudes with 3 main seasons: summer (March-May), rainy season (June-September) and winter (December-February). Dhaka is the capital of Bangladesh and the country has divided into 7 divisions: Dhaka, Chittagong, Khulna, Rajshahi, Sylhet, Barisal and Rangpur.

Bangladesh has several natural resources such as coal, natural gas, lime, white clay, glass sand and granite.

1.2 Economic

Bangladesh as part of SAARC (South Asia Association for Regional Cooperation) has a GDP of US$772 per capita as shown in table 1. Bangladesh has had positive growth and an increment of 38.10% in GDP over the past 5[3].

Table 1. Gross Domestic Product (GDP), at the current price (Dec 2012)

	2007-08	2008-09	2009-10	2010-11	2011-12(p)
GDP (Million TK)	5,458,224	6,147,952	6,943,243	7,967,040	9,147,842
Per capita GDP (in TK)	38,330	42,628	47,536	53,238	60,350
Per Capita GDP (in US$)	559	620	687	748	772

Note: p donates provisioning

Figure 1. Percentage of sector wise contribution to GDP

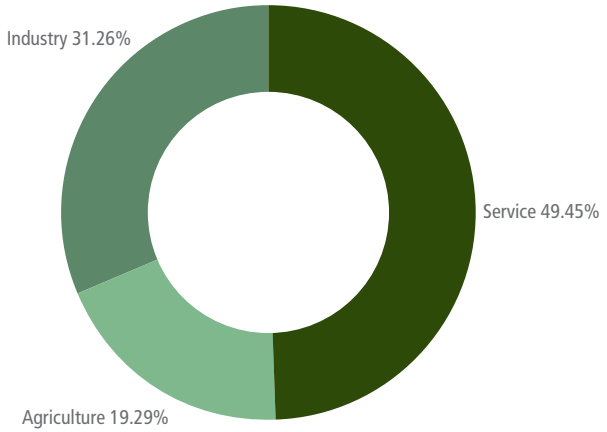


Figure 1 shows the GDP share across three sectors where services contributes almost 50% of the total GDP in Bangladesh – 3.4% out of 49.45% is from the telecommunication sector.

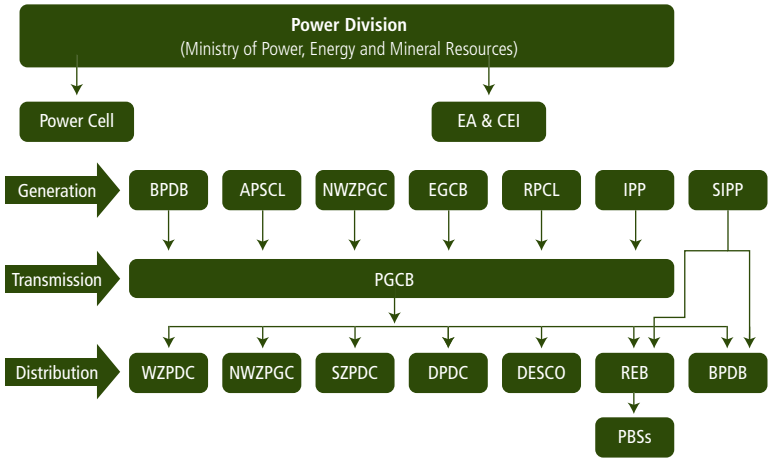
1.3 Power and Energy

Power and energy are critical indicators for economic growth measurement and enhanced standard of living. Currently, more than 50% of the total population has no access to electricity. This sector is managed by the Ministry of Power, Energy and Mineral Resource[4].

The structure of the Power Division at the Ministry of Power, Energy and Mineral Resources is shown in Figure 2. The Power Division is responsible for formulating policies relating to power as well as to supervise, control and monitor the developmental activities of the power sector of the country. The Power Division has two parts, the first is Power Cell which has the responsibility of planning, tariff strategy and to ensure the delivery of electricity to customer satisfactorily. The second part is as an Electrical Advisor and Chief Electrical Inspector (EA&CEI). This department focuses on thrift, simplicity and safety. EA&CEI also ensures proper control of longevity and property in the generation, transmission and distribution of electricity.

3 Bangladesh Bureau of Statistic (BBS) - www.bbs.gov.bd
4 Power Division - www.powerdivision.gov.bd

Figure 2. Power Division Structure in Bangladesh.



(Source: power division)

Power generation and distribution, is handled by multiple entities from the government – some of them are joint venture with private companies. For transmission, PGCB (Power Grid Company of Bangladesh) is responsible for distributing energy across the country. PGCB is a public company and the government has a majority share in it.

1.3.1 Electricity Infrastructure

For the past 5 years, Bangladesh has experienced a lack of electricity as shown on Table 2, where the average of deficit is around 30% from the demand.

The booming economic growth, rapid urbanisation, incremental industrialisation and development have increased energy demand within the country. To address this, the government of Bangladesh has a set Power System Master Plan (PSMP) in 2010. As per the PSMP, electricity generation in the country is supposed to be 5000 MW by the year 2011 and 7000 MW by 2013. The government aims to generate 15,000 MW electricity by 2016.

Table 2. Demand vs Capacity[5]

	2008	2009	2010	2011	2012
Demand Forecast (MW)	5,569	6,066	6,454	6,765	7,518
Max Generation (MW)	4,036	4,296	4,698	5,174	6,350

Bangladesh has a good stock of natural gas which is the main source of mass power generation. 23 gas fields have been discovered in Bangladesh, and currently 17 gas fields are producing around 2,000 million cubic feet per day.

Bangladesh imports around 1.3 million metric tonnes of crude oil and 2.7 million metric tonnes of refined petroleum products annually. A major consumer of liquid fuel is the transportation sector which is followed by agriculture and industry & commerce, though this is mostly met by imported liquid fuel.

Bangladesh has significant coal reserve of around 3.3 billion tonnes from five deposits; of these four deposits are extractable at present.

1.3.2 Energy Regulation in Bangladesh

Renewable energy in Bangladesh is managed by the Energy and Mineral Resources Division (EMRD) under the Ministry of Power, Energy and Mineral Resources. In a 2008 Act, EMRD introduced a renewable energy policy to increase the use of renewable energy deployments, encouraging both public and private sector investment and promoting clean energy for the Clean Development Mechanism (CDM) - all to achieve a goal of 5% of total power demand by 2015 and 10% by 2020.

The Sustainable Energy Development Agency (SEDA) is a focal point for sustainable energy development and promotion. The SEDA board is comprised of stakeholder representatives, including the business community, academic and/or Bangladesh Solar Energy society, financial institutions and implementing agencies.

To prompt renewable energy, all renewable energy equipment and related raw will be exempt from 15% Value Added Tax (VAT). In addition, a network of micro-credit systems have been established, particularly in rural and remote areas, to provide financial support for purchasing renewable energy equipment. Renewable energy project investors both in the public and private sectors will be exempted from corporate

income tax for a period of 5 years from the date of notification stated in the policy - it could be extended periodically following an impact assessment of tax exemption on renewable energy.

If an investor wants to build power generation for a renewable energy project with a capacity 5mW or more, a special license is required from the Bangladesh Energy Regulatory Commission (BERC). Additionally, the energy tariff will need to be approved by BERC[6].

1.4 Telecommunication

1.4.1 Subscriber and Penetration[7]

Bangladesh has 60.1 million unique subscribers, with an estimated growth of 15.15% in year 2012. The Telecom market in Bangladesh has reached almost 70% market penetration in Q32012 with a SIMs per subscriber ratio of 1.80. This makes the total number of connections over 108 million in Bangladesh.

Figure 3. Subscriber Growth

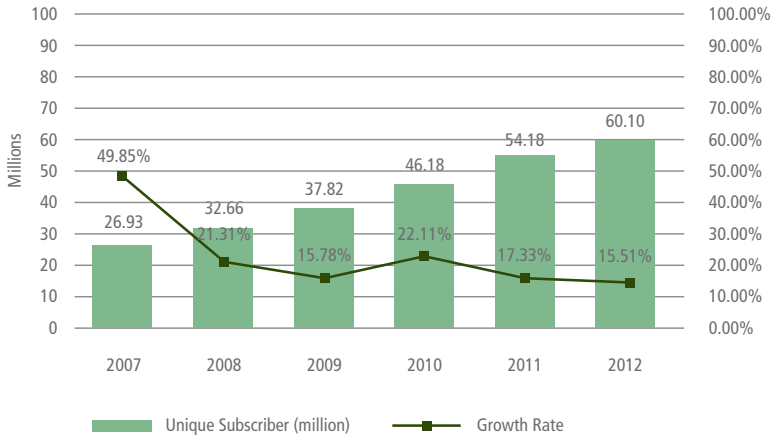
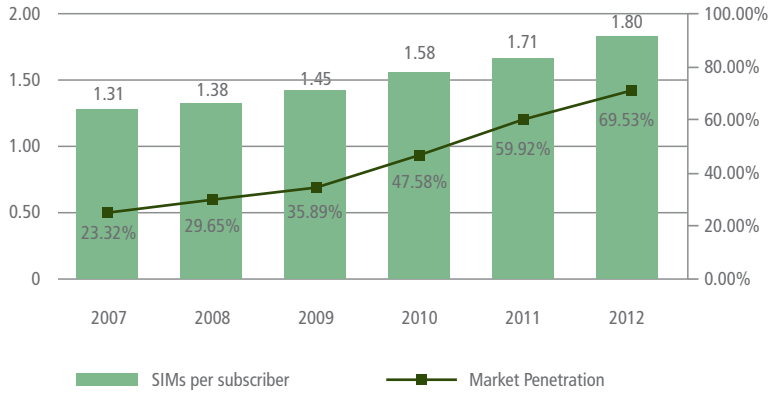


Figure 4. Market Penetration



1.4.2 Mobile Coverage

The mobile industry consists of 5 GSM operators (Grameenphone, Banglalink, Robi, Airtel and Teletalk) and 1 CDMA operator (Citycell). The GSM operators operate in 2G – 2.5G technology. 3G services were launched in October 2012 by Teletalk, a government owned operator; the government may open 3G licensing for private operators to launch 3G services soon.

The population with mobile coverage in Bangladesh is around 95%. The remaining population live in rural areas with unreliable or no grid connection.

6 Power Division – www.powerdivision.gov.bd
7 Wireless Intelligent

1.5 Eco-system and Regulation

1.5.1 Industry Structure

The telecom infrastructure in Bangladesh is usually owned by the Mobile Network Operators (MNO) themselves. Site sharing is an emerging trend, but at the time of writing this paper, Tower Companies were not yet in business.

Figure 3. Ownership Table

	MNO	Telecom Vendor	Power Vendor	Managed Service
Who owns the assets?	•		•	
Who provides Power equipment & solution?		•	•	
Who owns power?	•		•	
Who manages power?	•		•	•
Who manages site operations?	•			•

The telecom infrastructure industry is represented by MNOs who own the tower assets and telecom equipment vendors who supply the solutions. The site operation and maintenance is still led by MNOs and Managed Service providers with support from third party sub-contractor; if the MNO buys the power from a power outsourcing company then the maintenance falls to the power company itself.

1.5.2 Regulatory in Telecom Sector

The snapshot of infrastructure and power sector regulation is presented below.

Year	Infrastructure Regulations in Telecom	Power Sector Regulation
2008	Passive infrastructure sharing regulation with objectives to maximise land use and wide range service deployments throughout Bangladesh The operators will provide to its own infrastructure and to other operators on a non-discriminatory "first come, first serve" basis Tower owners can reserve no more than 25% of the space for their own purposes	5% of total power demand by 2015 is renewable energy 10% of total power demand by 2020 is renewable energy

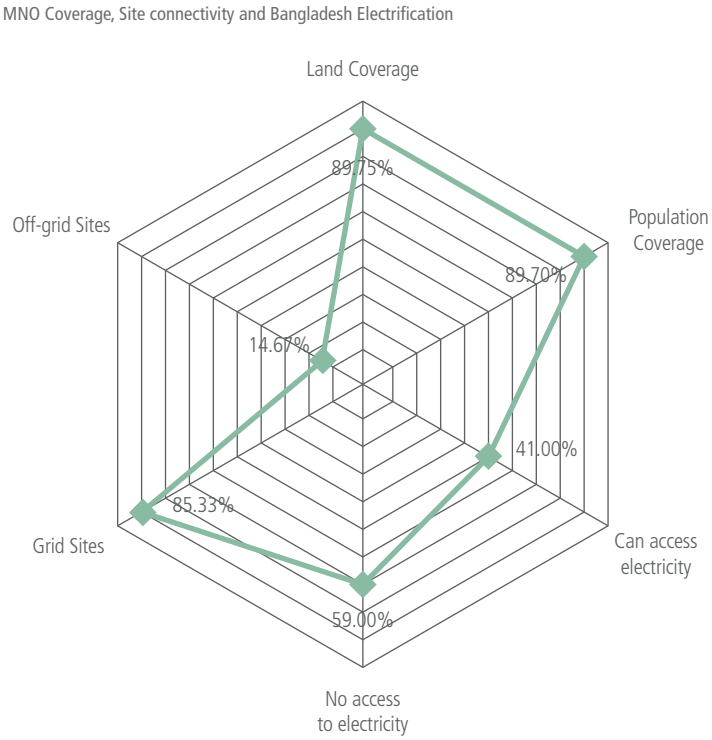
2. Powering Telecom: Current Approach

In the following section, GSMA analyses the current telecom network and coverage penetration, its impact on power within telecom, as well as the cost structure on powering the network.

2.1 Current State of Deployment[8]

Mobile Network Operators will always try to cover the most densely populated areas. The total number of base station sites in Bangladesh is around 25,858 which cover 89.7% of the land. The remaining population live in rural remote area without access to modern infrastructure.

Figure 5. Coverage, electrification and base station[9]



8 GPM has considered sites with power outage more than 12 hours per day to be unreliable-grid site

9 GSMA GPM Analysis and Research, Wireless Intelligent, Power Division – www.powerdivision.gov.bd

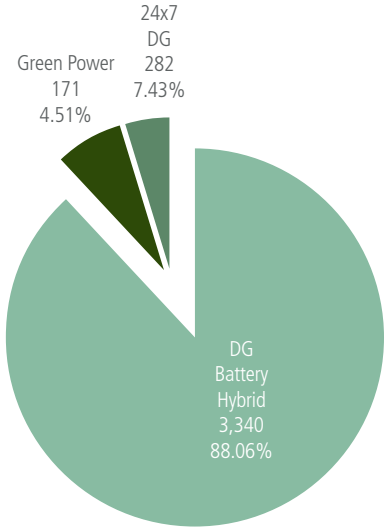
14.67% of the 25,858 base stations are off-grid (or unreliable grid) yet the electrification rate of the country is 41%[10]. In many cases the MNO extends the grid at their own costs, so one village may have access to electricity whereas a neighbouring one may not.

For off-grid sites, MNOs have no choice but to rely on diesel for power. The reliability of grid connection in the main city does not guarantee 24 hours availability and averages 2-4 hour outages every day.

The number of off-grid sites and their power source is shown on Figure 6. Of the 3,793 off-grid base station sites, 97.70%, use DG battery hybrid solutions by optimising batteries on site and 171 sites in Bangladesh[11] use renewable energy.

DG battery hybrids are common for areas with unreliable grid. The deployment of green power solutions has not yet scaled due to challenges of CAPEX. The majority of deployed sites are solar powered.

Figure 6. Off-grid sites by power solution



With this in mind, MNOs need to find solutions for powering their equipment across the country otherwise their dependency on fossil energy will soar over the next few years.

2.2 Costs of Powering Telecom

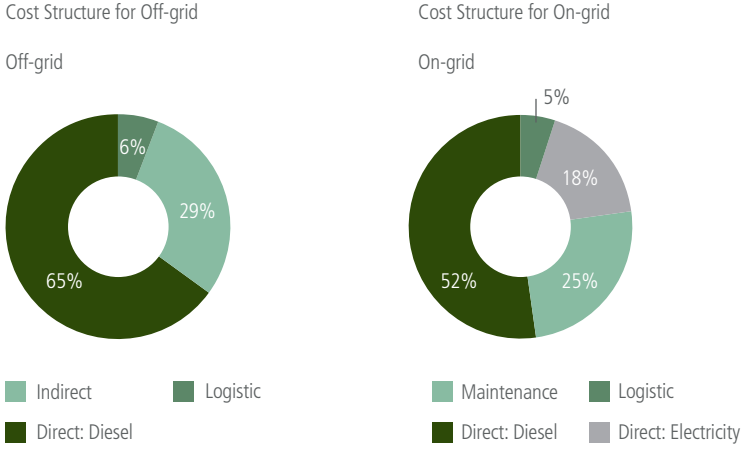
The limited grid connection and poor power infrastructure means MNOs rely on diesel generator to power off-grid and unreliable-grid sites. Fuel costs are increasing and will continue to do so over the next year.

The cost of powering telecom sites can be divided into direct and indirect as per below:

- **Direct cost**: cost of diesel and fuel
- **Indirect cost:** cost of maintenance for power equipment including diesel generator and other power system, and overheads

The GSMA has analysed the cost structure of powering off-grid and on-grid sites based on current deployments. The diesel cost has become a major consideration for powering telecom equipment as shown on figure 7.

Figure 7. Powering Cost Structure[12]



10 Power Division - www.powerdivision.gov.bd
11 GSMA GPM Market Analysis and Research
12 GSMA GPM Analysis (based on current power deployment)

The cost structure of powering the network varies for on-grid sites depending on reliability and availability of grid connection. Overall cost structure shows diesel cost is the major component for both scenarios. For an off-grid cost structure the diesel contributes 65% of the total cost and 52% for on-grid site[13].

The diesel cost for on-grid sites becomes a major component due to poor grid supply for most of the cities across the country.

3. Powering Telecom: Green Telecom and Market Sizing

This section discusses Green technology options in Bangladesh. It analyses the renewable energy choices that might fit and are acceptable in the Bangladesh market.

3.1 Green Technology Options

Bangladesh has enormous potential for renewable energy deployments. Solutions like solar PV are proven for this geography as the average daily solar radiation is around 4-6.5 kWh/m2. Solar solutions are gaining acceptance for providing electricity to households and small businesses in rural areas.

Bangladesh also has strong potential for biomass gasification based electricity as well. The most common biomass resources available in the country are rice husk, crop residue, wood, jute stick, animal waste, municipal waste, sugarcane bagasse etc. The potential for utilising biogas technology derives mainly from animal waste which may be one of the most promising green energy resources for Bangladesh.

The potential for using wind energy in Bangladesh is mainly on coastal areas and offshore islands. Research on wind speed in Bangladesh is yet to be done and the mapping of wind speed is in process.

Fuel cell technology was recently introduced to the local market. However it is a supply dependant solution and an established supply chain to support fuel cell deployments for telecom doesn't exist yet.

Pico hydro has limited potential in Bangladesh with the exception of Chittagong Hill Tracts. Hydropower assessments are required to identify the possible locations with the correct river velocity to run hydropower solutions. The table below describes the market availability for each choice and the potential for adoption of the particular green technology in the telecom industry.

Table 4. Green Power Choices in Bangladesh

	Solar	Biomass	Wind	Fuel Cell	Pico Hydro
Solution Availability	Very Good	Good	Poor	Poor	Poor
Reliability	Good	Good	Good	Good	Good
Market Acceptance	Good	Poor	Poor	Poor	Poor
Supply Chain Readiness	Good	Poor	Poor	Poor	Poor
Stage of Adoption	Commercial	N/A	Poor	N/A	N/A
Resource Potential	Moderate	Good	Low	Poor	Unidentified
Barriers to Adopt	- High CAPEX on initial stage - Space requirement	- Supply chain challenges - Unproven operational trial in telecom field - Business model offering	- Low scalability limited to coastal area - High initial CAPEX - No wind mapping data in the country	- High initial CAPEX - Supply chain hydrogen or methanol - Suitable only for unreliable sites	- Number of sites near the river flow location - High initial CAPEX - Operational challenges
Risks to Adopts	- Reliability issues due to distance from the nearest O&M based - Vandalism of battery and panel theft	- Biomass supply and sustainability - Scalability of solution for telecom load	- Operational risk due to wind speed availability - Unreliable power generation due to wind speed characteristic	- High replacement cost of fuel cell - Reliability of supply chain	- Operational risks associated with limited knowledge and readiness

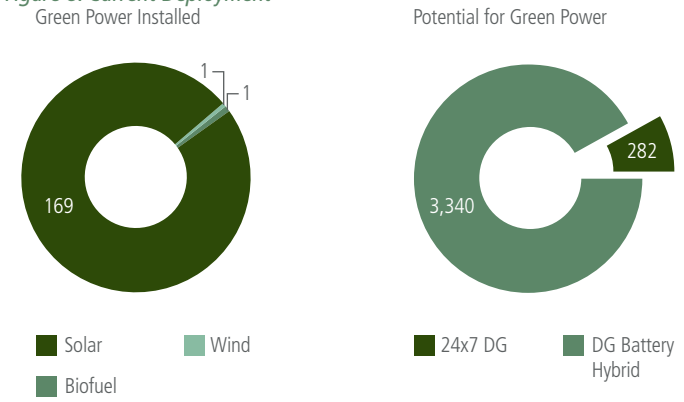
As shown in the table on the previous page, solar solutions have become a proven green technology option with commercial adoption in the market. The biomass and fuel cell solution also has the potential for adoption within the telecom sector but establishing an appropriate supply chain is essential.

3.2 Market Sizing

Green technology deployment in Bangladesh for powering telecom is yet to scale. Both CAPEX and OPEX models have been introduced to the market, but 90% of the existing renewable energy deployments use the CAPEX model[14].

GSMA has identified that from the 25,858 base stations in Bangladesh, 3,622 sites have the potential to be converted to green sites.

Figure 8. Current Deployment



3.3 Potential OPEX Saving

From the 3,622 off-grid and unreliable grid connected sites, there may be a significant saving by implementing green power sourcing. From our estimations, MNOs can save around US$41 million per year by going green. This would require a CAPEX of around US$27,000 per site. The total investment requirement is about US$100 million for the 3,622 potential sites[15].

4. Powering Telecom: The Way Forward

4.1 Short Term

Energy efficiency is the quickest way to save and reduce carbon footprint. On the other hand, converting a double DG power supply at off-grid sites will also have a huge impact. The efficiency can be achieved by BTS equipment modernisation, replacing the air conditioner with a fan cooling unit (FCU), replacing indoor type BTS's with outdoor type BTS, etc.

Based on the data, Bangladesh has 25,858 telecom towers with a total of 282 off-grid sites and 3,340 unreliable grid connected. The estimated annual energy requirement for the current mobile network is 453 million kWh.

GSMA estimates a 67% potential OPEX saving by converting 282 off-grid sites from 24x7 DG running systems to DG-battery hybrid solutions. The saving leverage can be increased by optimising DG and batteries configurations.

4.2 Long Term

In the long term, taking into account the land coverage and a 2% network blocking rate, the GSMA estimates base station growth in 3 years to be at 36,679 total sites and 6,660 for off-grid/bad grid sites. For off-grid and bad grid estimation, GSMA estimates the new sites will be placed on no grid connectivity or bad grid situation whereas the power availability below 12 hours a day.

14 GSMA GPM Market Research and Analysis
15 GSMA GPM Market Research and Analysis

Figure 9. Site growth[16]

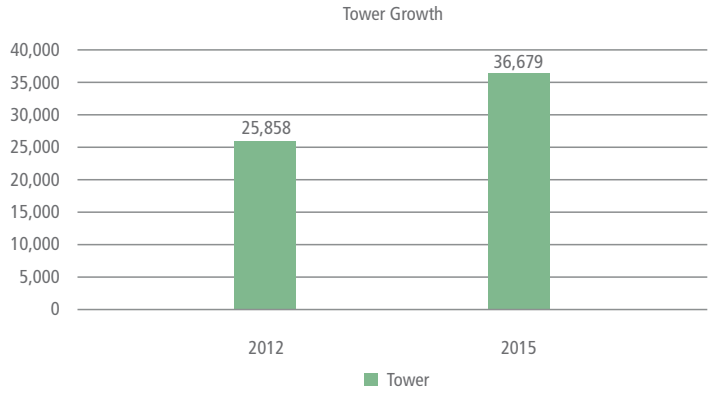
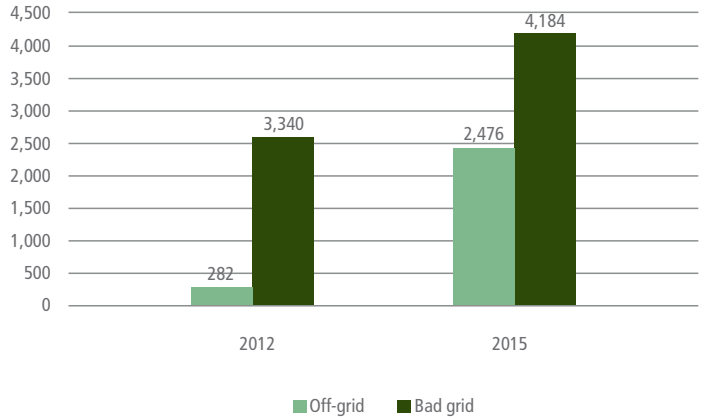


Figure 10. Off-grid and Bad Grid Site Growth



The long term strategy will be for green technology deployments to be best practice. It will be in line with energy OPEX reductions and energy optimisation programmes to measure the technology benefits and creating a positive environmental impact.

4.3 Tower Sharing by Tower Companies

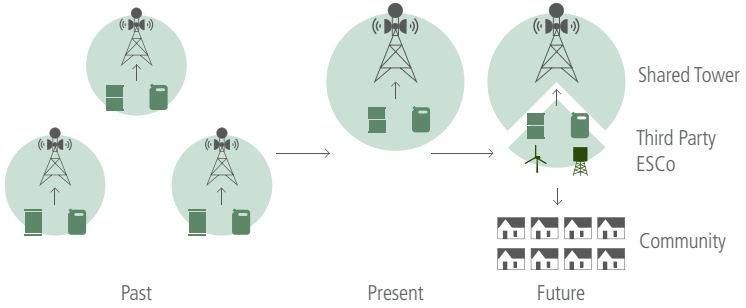
A tower company provides passive infrastructure support to mobile operators. In many cases, tower companies are also energy outsourcing company who provides energy source to their tenants. The tower company constructs their sites based on a specification provided by the MNO or alternatively, they will buy the tower infrastructure from MNO and lease it back to MNO.

At the time of publication, there are no established tower companies in Bangladesh.

4.4 Future Business Model

Trends have shifted the business model and ownership of infrastructure. Tower Companies will provide passive infrastructure to operator on lease. This means that MNOs can focus on their core business to maintain their market share and customer satisfaction.

Figure 11. Business Model Trends



The transformation has not yet finished - Energy Service Companies (ESCO) are yet to fully emerge to provide reliable power outsourcing to MNOs or tower companies when available. The ESCO can act as an energy provider to both tower companies and MNOs. An ESCO not only takes responsibility for financing the equipment, but also the full provision of power to the tower. The ESCO business and energy service models that are being considered, developed and tested in the market place include:

- *Power Purchase Agreement (PPA)*, the ESCO will install the renewable energy power system and sells power to the MNOs at an agreed per kWh rate.
- *Energy Saving Agreement (ESA)*, the ESCO will install the renewable energy power system on existing site and the MNOs fee is based on portion of verified energy cost 'savings'.
- *Fixed Fee Operating Lease*, the ESCO will install the renewable energy power system and sell monthly power to the MNO at a fixed cost. The main benefit from this scheme is that MNOs will not have any variable budget on their expenditure.

The potential saving from an ESCO model for 3,622 sites is about US$9.4 million for an MNO where the MNO doesn't need to spend the initial CAPEX to achieve the saving. The GSMA estimates that the market potential for the ESCO model can reach US$42 million in 2012 and US$ 77 million by 2015[17].

5. Conclusion

Green powered deployments in Bangladesh are still in the early stages of development. Multiple green solution technology needs to be introduced and trialled in the Bangladesh market. Pilots and trials are required to develop success cases of reliability and sustainability. On energy efficiency, MNOs has deployed DG-battery hybrid combination by optimizing batteries life cycles on sites.

On a policy level, the government has targeted 5% of telecom tower to be converted to renewable solutions by 2015. The business model for tower company and energy service provider has not yet been established in the country, which is required to give an investor the opportunity to enter the market with a concept. However to make a network greener, additional support is required from regulators and service providers for powering the telecom network to help reduce the MNO's OPEX.