IFC International Finance Corporation

GSMA Green Power for Mobile

In partnership with the Netherlands

Green Site Selection Best Practice: Pakistan and Afghanistan

March 2014

Contents

Glossary

MNO : Mobile Network Operator

DG : Diesel Generator

TowerCo : Tower Company

GSMA : GSM Association

OPEX : Operational Expenditure

CAPEX : Capital Expenditure

ESCO : Energy Service Company

BH : Busy Hour

O&M : Operation and Maintenance

kW : kilo Watt

ROI : Return on Investment

Pt : point

Pts : points

Figures

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Executive Summary

Pakistan and Afghanistan are located in South Asia with a total land mass area of 796,096 sq. km and 652,230 sq. km respectively. The countries share their borders with India in the East, Iran in the West and with Turkmenistan, Uzbekistan and Tajikistan in the North.

Mobile telecommunications is one of the key sectors and contributes to economic growth of both countries, by connecting the regions and catalysing their economic activity. However, Mobile Network Operators (MNOs) have been facing huge infrastructure challenges, limiting the expansion of their network. Electricity is another one of their challenges.

The electrification rate in Pakistan is about 67% and 30% in Afghanistan. These low electrification rates have forced MNOs to look for alternative energy sources to power their base stations. Currently, fossil fuel-based solutions are the common practice in both countries to address the challenges of limited grid power supply and infrastructure reach. Diesel Generator (DG) battery hybrid solutions are another one of the preferred OPEX options for MNOs in Pakistan and Afghanistan.

A renewable energy solution is an alternative for MNOs to eliminate their dependence on diesel power for powering their base stations. This document provides guidelines for MNOs to determine if a site is a suitable candidate to convert into a green site and provide a best practice process for MNOs.

Introduction

In emerging markets such as Pakistan and Afghanistan, the telecom sector has played an important role to connect the countries' regions to one another. As of 2012, the mobile penetration in Pakistan had reached 28.51% and 33.92% in Afghanistan. The GSMA identifies 63.2 million unique subscribers for both countries as of 2012.

In 2013, the total number of tower sites in Pakistan and Afghanistan amounted to 33,160 and 5,292 sites respectively, with a total of 2,989 off-grid sites and 7,812 unreliable grid sites in both countries. The numbers will grow as GSMA estimates that by 2016 there will be 8,135 off-grid sites and 16,262 unreliable grid sites.

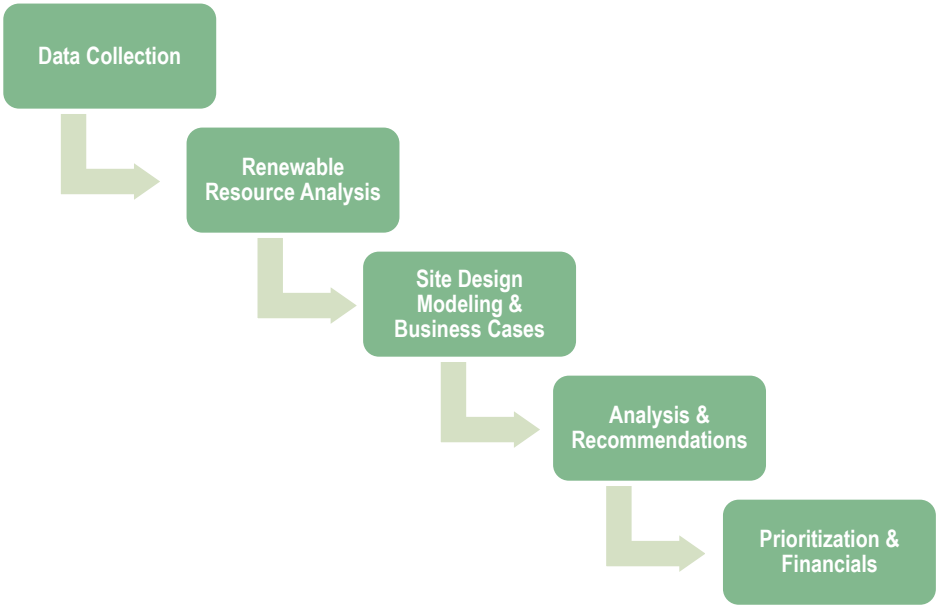
In this light, MNOs will experience heavy OPEX costs, especially maintenance and fuelling costs. To eliminate the issue, MNOs need to find an alternative solution that can minimize their OPEX and maintenance expenditure.

Converting to a green power source is an alternative solution for MNOs to minimize their costs. The process for determining and prioritising a site to be converted to a green site must align with MNO's financial capability and strategy. Today, MNOs can partner with Energy Service Companies (ESCOs) that will provide and manage the energy for their base stations in exchange for a fee.

Green Site Selection Process

Converting to a green site is not an easy process for MNOs. They need to go through a decision making process to determine if a site is a suitable candidate for conversion into a green site. Below is the process flow for the green site selection.

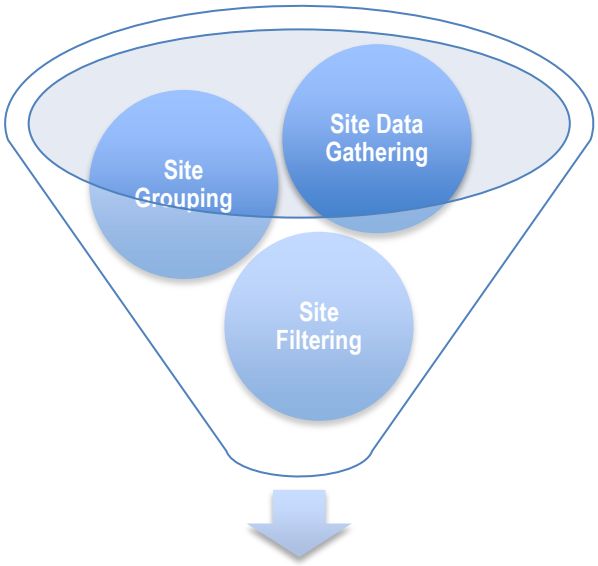
Figure 1 Green Site Selection Process



Data Collection

Data collection is the most important step of the green site selection process. The compilation and analysis of all existing data by regions, as well as the MNOs future expansion plans, needs to be done. A high level of detail is required and all relevant data should be included into the analysis. For example, traffic BH (Busy Hour) is an important data point as the cities of Islamabad and Karachi can have high capacity base stations that will cover the BH and this will impact the calculation of the power requirement. Other data points to consider during are the community issue and the physical access to the telecom site, because maintenance activities can be tricky in some parts of these countries. This is especially true for Afghanistan, where provinces such as Badakhshan present a geographical challenge as landslides happen during the winter season.

Figure 2 Data Collection Flow



Site Data Gathering

Site data gathering is key and multiple stakeholders need to participate to ensure the process is done thoroughly. Here are each department's responsibilities:

- **Roll Out Teams** need to provide site data related to the site on-air date, site location, site type and site infrastructure data in detail for every region.
- **Operation and Maintenance (O&M) Teams** need to provide historical power data for each site, power consumption, power configuration and battery autonomy.
- **Planning/Engineering Teams** need to provide installed equipment on site and future power consumption for each site. The expansion plan duration can be from 6 months to 1 year.

Site Grouping

After the data gathering has been completed, the next step is site grouping. The site grouping will help with the analysis and design modelling site-by-site, as the sites will be categorised based on similar loads and operational characteristics. The grouping is mainly based on base power configuration and location.

Site location grouping can be defined by province. In Pakistan site groupings will be divided into four regions: Punjab, Sindh, Balochistan and Khyber Pakhtunkhwa. In Afghanistan, which has 34 provinces, the location grouping will be based on the distance between each site.

The grouping outcome will be used for site filtering purposes and site modelling.

Site Filtering

Site filtering usually comes together with site grouping. The purpose of site filtering is to provide a summary of target sites for analysis. The site filtering criteria may vary from one MNO to another based on their priorities. Below are some criteria that can be considered while filtering a site:

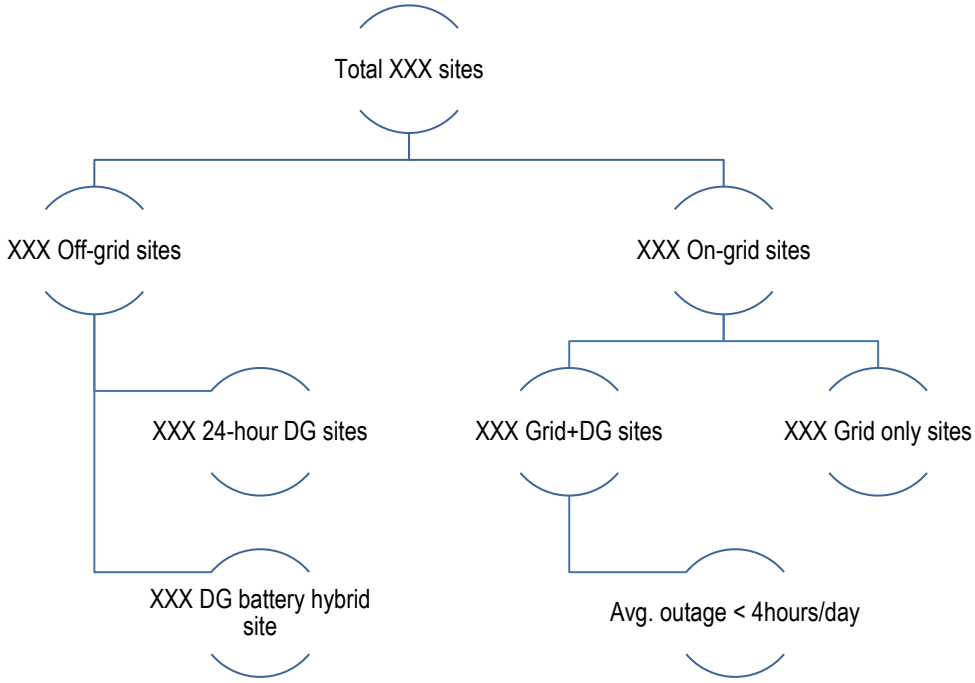
- Power configuration
- Site type or site category
- Power outage duration or site availability
- Traffic BH
- Community Issue
- Access Road

Overall Network Data Analysis

Once the site grouping and site filtering is completed, the final process is summarised for the overall network data. The outcome from the data analysis will be a total number of sites that will be considered to analyse the green power feasibility.

Below is a tree diagram of the data analysis outcome before calculating the green power financial feasibility.

Figure 3 Tree Diagram of Data Analysis



The figure above shows how many sites are on-grid and off-grid. Based on the data analysis, an MNO will be able to shortlist potential candidate sites to further the analysis of the green site feasibility.

Renewable Resource Analysis

Identifying renewable resources during the site selection process is needed for the site design and modelling. The renewable resources data can be provided by the local government authority or from other resources, such as NASA.

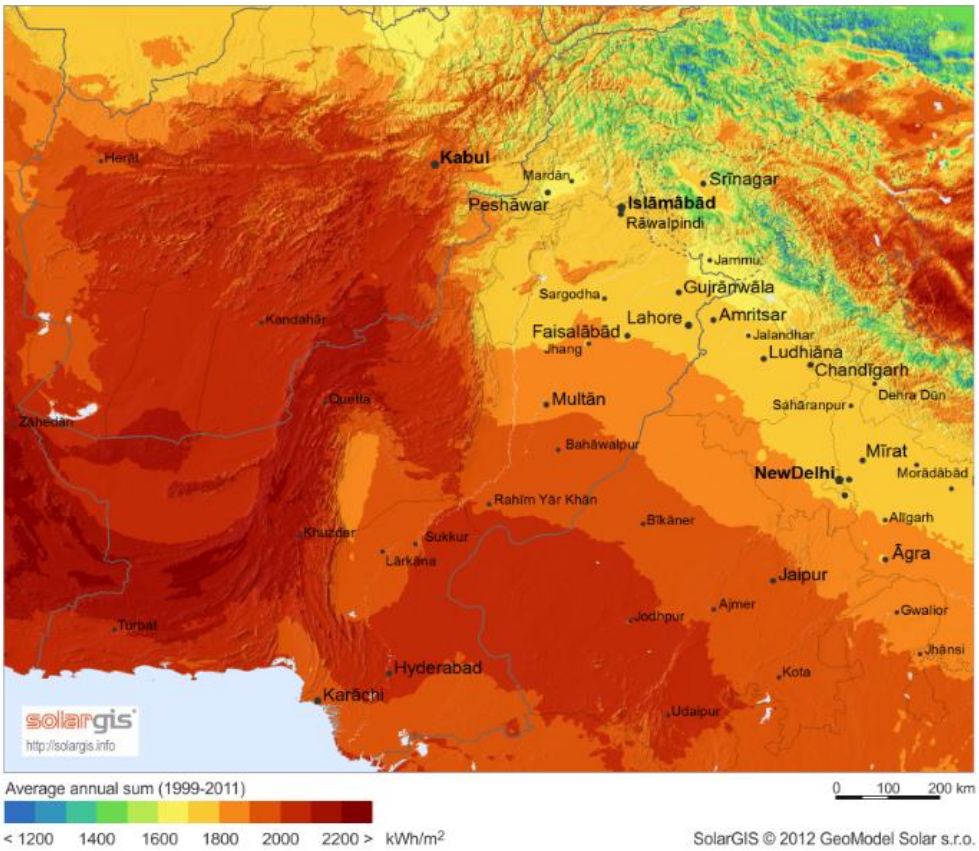
Solar and Wind

Data on solar radiation and wind speed can be downloaded from the following websites:

- 3tier http://www.3tier.com
- NASA : https://eosweb.larc.nasa.gov
- Solargis : http://solargis.info/imaps/

The most accurate data on solar radiation and wind speed data comes from the National Meteorology Department. Below is an example of the radiation data from Solargis.

Figure 4 Solar Radiation Map (Solargis)



Other Resources

Renewable energy is not only about solar panels and wind turbines, it can also include fuel cells or hydro solutions. Fuel cell solutions have a large dependency on the supply chain of hydrogen or methanol as well as

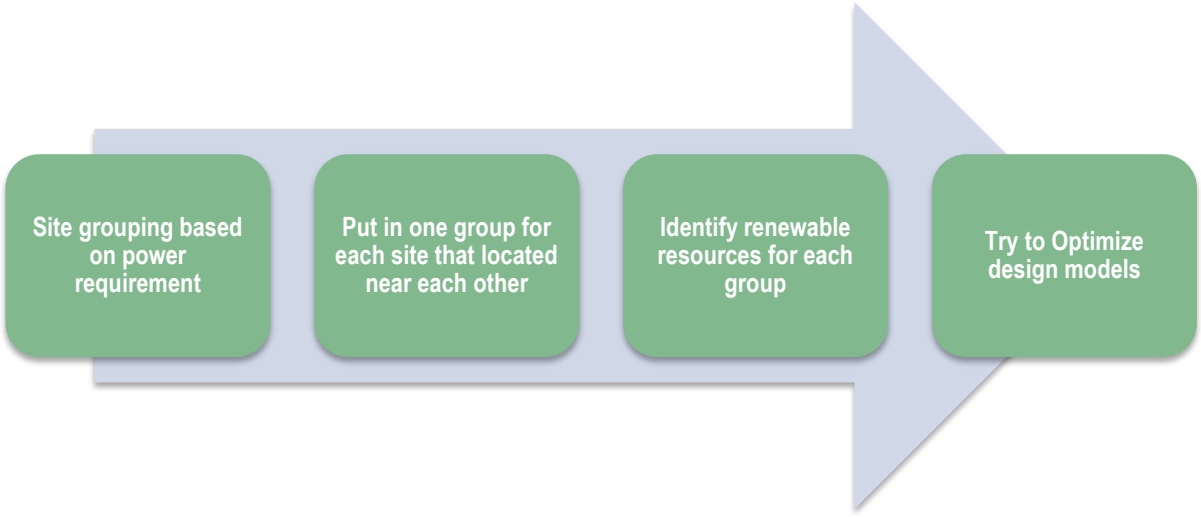
supplier and distributor availability in both Pakistan and Afghanistan. Before deciding on a fuel cell solution, an MNO needs to consider continuity in its supply chain.

On the other hand, the challenge with a hydro solution is that the MNO has to find a site that is located near a river or water stream so that the distance between a site and its hydropower source is not too far.

Site Design Modelling and Business Cases

The next process is site design modelling, resulting from site grouping and filtering. The figure below presents the decision making process for site modelling.

Figure 5 Site Design Modelling Flow



Each site must represent similar renewable resources and load characteristics of the modelled group of sites. Business cases are developed for each model to analyse the financial feasibility and returns.

The HOMER software from NREL provides technical and financial results for the design. If during the design and modelling process 10 models are needed, then 10 business cases will be generated for 10 models. This way, in the future, engineering teams will not need to create site modelling from the beginning again.

Analysis and Recommendation

Once site modelling is completed, the next step is analysis and recommendations for each model. A sample decision tree and analysis flow is illustrated below.

Figure 6 Site Analysis and Recommendations Tree

Model A: 0.8 kW off-grid sites allocated in region A

Model B: 1kW off-grid sites located in region B

Prioritization and Financials

Site prioritization and financial planning are the final key steps in the overall site selection process. In order to help MNOs in decision-making and investment planning, a sample prioritization criteria and process can be as follows:

Table 1 Site Prioritization

Site	ROI < 3yrs (First Priority)	Community Issue (Second Priority)	Traffic BH < 1,000 calls (Third Priority)
Site 1	L1	L1	L2
Site 2	L3	L2	L3
Site 3	L1	L2	L3
Site 4	L2	L3	L1
Site 5	L2	L1	L3
:	:	:	:
Site 34	L2	L3	L1

Note: L1: 3 pts. L2: 2 pts. L3: 1 pt.

Example:

- In the ROI column, any return of investment that less than 3 years needs to put as L1 and get the highest rank/priority.
- In the Community Issue column, the greater number of issues that an MNO is facing means the higher rank that needs to put in that column.
- And in the last column for traffic load during Busy Hour (BH), the highest value on traffic occupancy during BH the lowest level that we can put, such as L3, because sometimes an MNO wants uninterruptable services for that particular base station.

Based on site level on Table 1, the site that has collected the highest number of points will be the first priority and the rest will be line according to the point. After the prioritization has been done, the financial result will be presented based on that site prioritization. Here is the example of financial summary based on site priority.

Table 2 Financial Summary Based on Priority

Priority	No. of sites	CAPEX ($)	OPEX ($)	OPEX Saving ($/yr)	Payback period (Yrs)	ROI (%)	IRR (%)	NPV ($)
1	5	32,000	1,600	20,000	2.8	36%	31%	17,000
2	10	35,000	1,500	20,500	3.0	30%	29%	17,100
3	19	40,000	1,200	19,000	3.3	29%	26%	17,000
Total	34							

Based on financial summary result, the MNO will decide its strategy on converting the site to a green solution.

Conclusion

The site selection process is needed when a MNO is looking to green its network. For the overall process to be successfully undertaken, thorough data gathering is the key step before analysing the network. By doing a site selection, the MNO can validate and refine their strategy on deploying the green solution on their network.

The MNO will be able to prioritize their needs and to draw out a green deployment roadmap with impactful and long term financial results.

About the GSMA Association
The GSMA represents the interests of mobile operators worldwide. Spanning more than 220 countries, the GSMA unites nearly 800 of the world's mobile operators with 250 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and Internet companies, as well as organisations in industry sectors such as financial services, healthcare, media, transport and utilities. The GSMA also produces industry-leading events such as Mobile World Congress and Mobile Asia Expo.

For more information, please visit the GSMA corporate website at www.gsma.com. Follow the GSMA on Twitter: @GSMA.

About Mobile for Development - Serving the underserved through mobile
Mobile for Development 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 and economic impact and stimulate the development of scalable, life-enhancing mobile services.

For more information, please visit the Mobile for Development website at http://www.gsma.com/mobilefordevelopment/. Connect with us on Twitter @GSMAM4D

About the GSMA Green Power for Mobile Programme
Green Power for Mobile works to extend the coverage, reduce the cost and minimise the environmental impact of mobile networks by championing renewable energy.

Whilst it continues to serve mobile network operators globally, the programme will place key focus on a number of target markets in Africa and Asia including Indonesia, Bangladesh, Pakistan, Afghanistan, Nigeria, Ghana, Kenya, Tanzania, Uganda, Senegal and Cameroon. With Project Managers based in each of these regions, GPM is well positioned to engage with the industry and address the requirements of these markets.

For more information on the GSMA's Green Power for Mobile Programme, please contact us on greenpower@gsma.com

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