Green Power for Mobile

In partnership with the Netherlands

Best Practice Procurement Guide for Green Energy in India

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Glossary

Ah: Ampere Hour
CAPEX: Capital Expenditure
DG: Diesel Generator
ESCO: Energy Service Company
IP: Infrastructure Provider (or Tower Company)
IRR: Internal Return Rate
kVA: Kilo Volt Ampere
kW: Kilo Watt
kWh: Kilo Watt Hour
MNO: Mobile Network Operators
NOC: Network Operations Center
NPV: Net Present Value
O&M: Operation and Maintenance
OPEX: Operational Expenditure
PV: Photovoltaic
RFP: Request for Proposal
ROI: Return of Investment
SLA: Service Level Agreement
Wp: Watt Peak

Executive Summary

This is the revised version of our earlier published *Best Practise Procurement Guide for Green Energy in India*, to enhance market intelligence for the Indian mobile telecom industry, and is based on current intelligence of the Indian Market.

The GSMA Development Fund launched the Green Power for Mobile (GPM) Programme in September 2008 to 'extend mobile beyond the grid' through the promotion of renewable energy technologies and energy-efficient base stations. The programme is supported by the International Finance Corporation (IFC).

The telecom industry is an essential service sector. A lack of stable commercial power is the biggest threat to the telecom industry in emerging markets. Like any other service industry, telecom utilises power to provide communication services. Due to the shortage of commercial power availability, Mobile Network Operators (MNO) and Infrastructure Providers (IP) are forced to create their own power supply. As a diesel generator (DG) is easy to deploy, it has been widely used across the world as either a back-up power solution or a standalone power source for off-grid areas. However, due to environmental factors and the tendency for diesel prices to increase, DG is no longer the preferred standalone solution for the industry. Therefore, the industry has moved towards greener, renewable energy solutions.

This document aims to guide the reader in identifying the right approach for moving forward with renewable energy solutions. This guide can be equally useful for MNOs and IPs but with the latter holding the largest market share of 'last mile' passive infrastructure, we consider IPs the main beneficiary of this document. Please note that financial figures used in this document are purely indicative based on market intelligence.

Introduction

The lack of grid power availability, the increasing cost of diesel, and the commitment of reducing greenhouse gas emissions are key factors driving the industry towards alternative energy solutions. Renewable energy solutions have the potential to reduce energy OPEX which can increase scalability. Since an MNO's core business is to provide voice/data services, the investment for renewable energy solutions remains a low priority. On the other hand, the CAPEX requirements for renewable power sources can be quite high. To omit CAPEX-related challenges, OPEX models can be very useful. In various OPEX models, an ESCO (Energy Service Company) can take over the total responsibilities and risks to generate and provide power to the IP/MNO. The IP/MNO pays for the power it uses, leaving the ESCO to take over all commercial responsibilities and making it a profitable business model for themselves.

Different Procurement Models

There are two different procurement models that the industry currently uses for deploying renewable power solutions:

- In-house CAPEX Model
- Outsourcing OPEX Model

In-house CAPEX Model

The CAPEX model is the most widely used model in the telecoms industry where the capital investment for the renewable energy equipment is made by the IP/MNO. The ROI (Return on Investment) and OPEX saving is higher in a CAPEX model. Since the IP/MNO has to invest its entire CAPEX into this model, scalability heavily depends on the fund allocation from IP/MNOs to purchase renewable power equipment. Additionally, the MNO/IP has to be an expert on technology selection and utilisation.

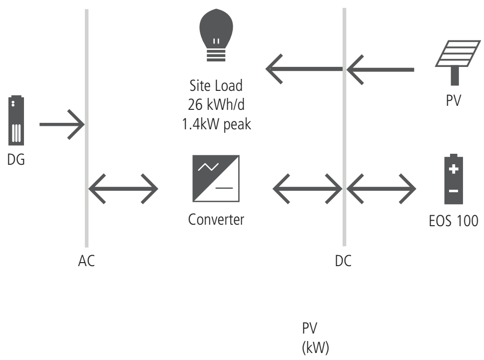
Sample CAPEX Model

An example of a Solar-hybrid solution with the CAPEX model:

- An existing site with a load of 1kW
- A site which has a 15kVA DG which runs for 16hrs every day

Assuming current fuel costs are US$1/litre, fuel consumption for a DG is 2lt/hr, a solar PV costs US$2/WP and 70% finance is available on CAPEX, a solar hybrid system can be dimensioned using HOMER (a software application for renewable solution dimensioning developed by National Renewable Energy Lab).

Figure 1.
Homer Design Model



	PV (kW)	DG (kW)	EOS 1000	Conv. (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren Frac.	Diesel (L)	DG (hrs)
	4.00	12	24	8	$28,008	2,243	$40,683	0.750	0.53	2,150	780

HOMER proposes 4kWp PV, 1 string 1000Ah OPzS series battery, an 8kW converter and a 120A controller as an optimised solution with an average DG run of 2hrs per day.

If we plot the design into a business case, an estimated year-by-year cash flow for such solution deployment would be as follows:

Figure 2.
CAPEX Model Investment Sample

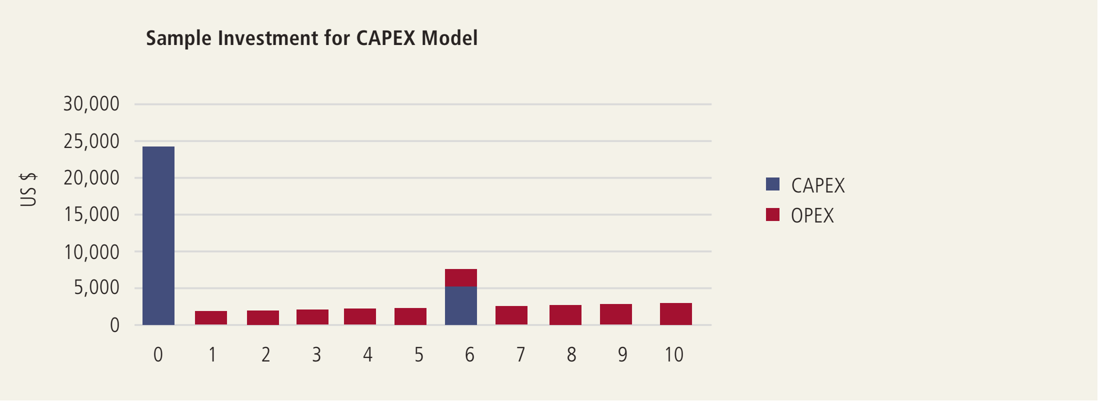
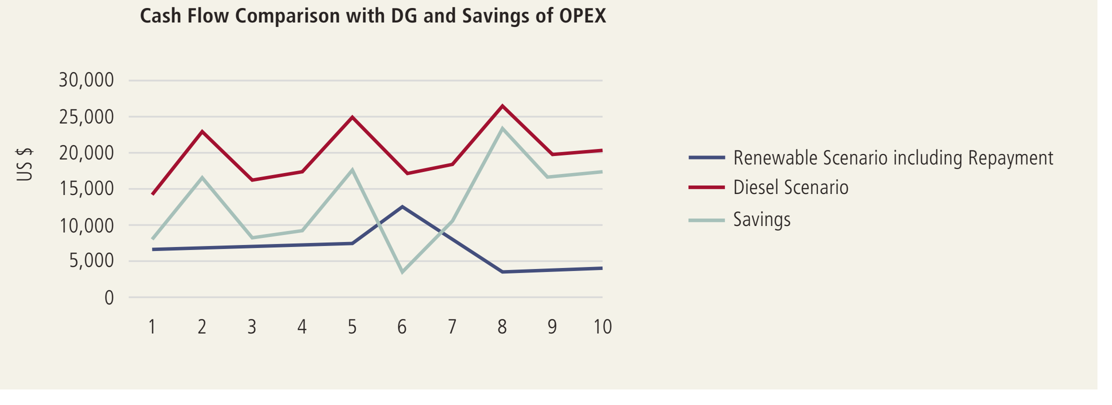


Figure 3.
Cash Flow Comparison and OPEX Saving



The financial summary would be:

PayBack	**1.91**
ROI	**45%**
IRR	**124.2%**
NPV	**$55.,234**
Discount Rate	**12%**

All figures above are indicative and in US$

Process Flow for In-house CAPEX Models

A step-by-step process has been described below for an IP/MNO to deploy a renewable power solution through a CAPEX model:

- Site survey and Technical Dimensioning
- RFP Circulation
- Vendor Selection for Equipment Supply
- Operation and Maintenance Partner Selection
- Agreement
- Implementation
- Operation
- Monitoring and Control

Site Survey and Technical Dimensioning

The IP/MNO has to conduct an explicit survey to their target sites to identify the site situation. Based on the survey, technical dimensioning should be prepared. The technical dimensioning should balance the CAPEX cost and the OPEX savings. In order to do that, the technical team should have enough experience dealing with such technologies. They also should be good at creating business models as this will allow them to examine all the potential possibilities before finding the right balance to suit the IP's requirement. A third party consultant can also be hired for this activity.

RFP Circulation

Once the survey and technical dimensioning are done, an RFP can be launched based on the technical specifications of the solution. The RFP should be outlined with:

- Technical expectation for individual equipment
- After sales support from a vendor

Vendor Selection for Equipment Supply

Before selecting a vendor the IP/MNO should do an extensive technical analysis of all the products being proposed by the various vendors. Proven products should ideally be chosen for renewable power deployments given the high demand on reliability of the telecom industry.

Operation and Maintenance Partner Selection

O&M is a crucial part for renewable energy deployment. An O&M partner should be selected at the beginning of the project. In many cases the equipment vendor becomes the O&M partner. While selecting an O&M partner, a number of key criteria should be considered, such as operation and maintenance experience of renewable equipment, industry knowledge, proven track record of reliability, local knowledge, ability to handle possible logistic issues, etc.

Agreement

For the CAPEX model, there may be two different agreements signed at the same time; one can be with an equipment vendor and another with O&M service provider. The agreement with the equipment vendor typically has two major focus areas: supply of equipment and an Annual Maintenance Contract (AMC) for the supplied equipment. The agreement with the O&M service provider will mainly focus on O&M processes and SLAs (Service Level Agreement). On many occasions the equipment vendor acts as the O&M service provider. The IP should consider imposing a penalty clause if the supplied equipment does not perform as committed, or if the O&M service does not meet the SLA.

Implementation

In most cases the equipment vendor will also be responsible for the implementation. However, it is important that the IP takes control over the project monitoring process and manages the progress. Some of the key things to be considered during implementation should be:

- Ensuring that the implementation is done in phases so that IP/MNO can efficiently utilise their available resources, overcome any weaknesses that they may have, and ensure proper control over the project
- A specific time-plan has to be agreed between parties for each phase of deployment
- An Acceptance Test has to be formalised

Operation

Operation is the most crucial part of CAPEX model deployment. Some of the operational field issues may prevent the project from being successful. Therefore, the IP / MNO has to be very careful while preparing the operational plan for renewable sites. Some of the key points to keep in mind are:

- An intelligent controller should be used at the site
- Set a minimum number of times the O&M partner should visit the site
- SLA for individual components (PV, Battery, DG, Controller, rectifier etc.) should be agreed. If any of these components are down or malfunctioning, the O&M partner should be responsible for that and penalised
- Site security should be the responsibility of the O&M partner
- The site security guard should live within the security fence 24hrs / day
- A security supervisor should be appointed for every cluster / area whose responsibility will be supervising individual security guards
- In the event of fuel theft / pilferage, the primary investigation should be done by the security supervisor. The security guard should be replaced immediately
- The security guard should not be provided with any keys other than the front gate
- The O&M partner should maintain a strict log-book of all their activities
- Diesel refuelling should be done by the O&M partner

It is essential that the IP / MNO sets a strict O&M process, otherwise the OPEX saving potential by implementing a renewable solution may not be achieved.

Monitoring and Control

The IP / MNO should set a specific process to monitor and control site activities. Some areas may require extra attentions, such as:

- A site performance data collection process has to be set
- Performance data collection should be automated where possible
- Site performance data should be collected at regular intervals
- Site performance data should be transmitted real time to the Network Operation Centre (NOC)
- Performance data collection mechanisms / automation tools should not be tampered
- Monitor energy contribution of individual equipment throughout the year
- Monitor diesel fuel level on a real-time basis
- Closely monitor DG usage and the reason for its usage
- Security supervisors should report 2-3 times a week on the performance of site guards
- A site performance analysis process needs to be set to identify operational challenges
- A mitigation plan should be made to overcome operational challenge for each site.

Besides the above, a NOC should be set to monitor the site performance in real time. The performance monitoring should be both for individual sites and the entire network.

Outsourcing OPEX Model

The Indian telecom industry is currently evolving models to outsource the power management for telecom sites. It helps the IP/MNO to reduce dependency on diesel generators without having to invest the capital for the renewable energy solution. Since power generation and maintenance is not the core competency of an IP/MNO, outsourcing power generation will help the IP/MNO eliminate the challenges associated with power management. The concept of an energy service company (ESCO) has been introduced to the telecoms industry to facilitate the outsourcing model.

Different Outsourcing Models

- Operating Lease or Monthly Flat Fee Model
- Power Purchase Agreement (PPA) model
- OPEX saving recovery or Energy Savings Agreement (ESA) model

In an operating lease or monthly flat fixed fee model, the ESCO would own, install, operate and maintain the renewable energy equipment and provide power to the operator's site for a fixed monthly cost. In addition to capital expense being the responsibility of the ESCO, it stabilises the IP's OPEX associated with power, therefore no longer a variable part of the budget.

In the PPA Model, the ESCO owns, installs and maintains the renewable energy power system and sells power to the IP/MNO at an agreed per kilowatt-hour rate. The main benefits of a PPA to the IP/MNO are that the payments for energy are an operating expense. The operator is only paying for the power they use and the investment of the power equipment is the responsibility of the ESCO. In this type of arrangement the IP must typically commit to a minimum consumption of power or otherwise assume the risks of energy load levels.

An OPEX saving recovery or ESA is where an ESCO installs the renewable energy system and operators pay based on a portion of verified energy cost "savings". The key component to the ESA is the operators payment formula which will determine how much of the saving will be passed through to the operator and how much will go to the ESCO to recover the capital cost of the equipment. This formula to split the saving will sometimes change at an agreed time during the term of the contract.

Operating Lease or Monthly Flat Fee Model

In an operating lease, the ESCO bears the financial risk of OPEX increases for any of the power sourcing components. For any given power requirements, the ESCO is required to provide uninterrupted power (99.95% power availability) for the entire duration of the contract. While calculating the monthly fee, the ESCO usually has an implied margin of 10% – 15% on its cost. In addition, the ESCO has to be careful while considering all possible operating costs as some can be unpredictable (i.e. diesel fuel cost etc.). As this model precisely triggers a specific power requirement of telecom equipment, the ESCO gets the monthly fee regardless of whether or not the telecom equipment consumes the power. For a similar sample site as before, with 1kW power requirement, the same technology and technical dimension of the CAPEX model, the year-by-year cash flow for the ESCO, considering site maintenance is a responsibility of ESCO, will be:

Figure 4.
Year-by-Year Investment for ESCO in Operating Lease Model

	0	1	2	3	4	5	6	7	8	9	10
Total Cost for ESCO	-7,500	-5,237	-5,346	-5,465	-5,586	-5,723	-11,857	-6,022	-6,188	-6,337	-6,528

For an operating lease, the estimated monthly flat fee for the ESCO will be:

Implied Margin	15%
Annual Fee	8,256
Monthly	688

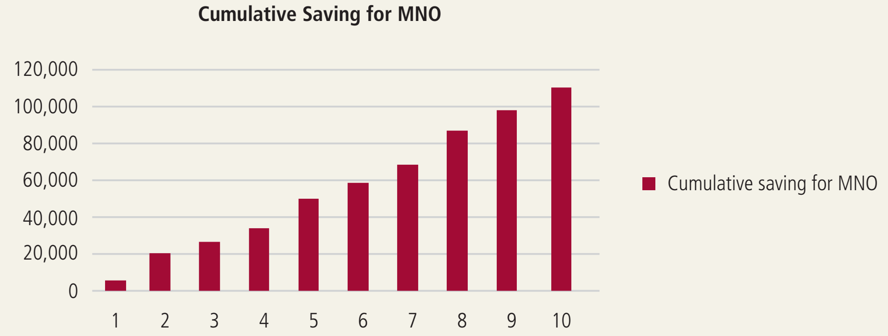
Figure 5.
Cash Flow of IP in Operating Lease Model

Therefore, cash flow for the IP in the operating lease or monthly fee model will be:

	1	2	3	4	5	6	7	8	9	10
MNO Cash Flow	8,256	8,256	8,256	8,256	8,256	8,256	8,256	8,256	8,256	8,256

Figure 6.
Cumulative Savings for IP/MNO in Operating Lease Model

However, the IP/MNO will still have a significant saving compared to the current diesel:



All figures above are indicative and in US$

Therefore, for operating lease or monthly flat fee model, the ESCO's financial summary will be:

PayBack to ESCO	2.59 yrs
ROI to ESCO	39%
IRR	27.5%
NPV	$11,404
Discount Rate	12%

Power Purchase Agreement (PPA) Model

The PPA is a more complicated model. In this model, the IP/MNO pays for power on a per kilowatt-hour (kWh) basis for the exact usage of energy. The rate for per kWh may become more difficult to calculate as the market scenario may change over the 10 years of the business case. The key to implementing this model successfully is aligning the per-kWh price-expectations of IP with the rate an ESCO is able to provide. It should be remembered that the per-kWh rate may not be as competitive as commercial power as it's a distributed renewable energy model. Also, due to the distributed nature, the O&M and last mile operation becomes quite costly to maintain the required uptime demanded by the telecoms industry.

Considering the same sample site again, with a 1kW load and the same technical solutions, the generic year-by-year cash flow for ESCOs would remain the same.

If the IP requires 10% of extra power on top of the current side load:

Power Requirement Per Annum (kWh)	9,636

From an investment perspective, 25% is a desired IRR value. To achieve that, an estimated price for energy would be: **US$0.85/kWh**

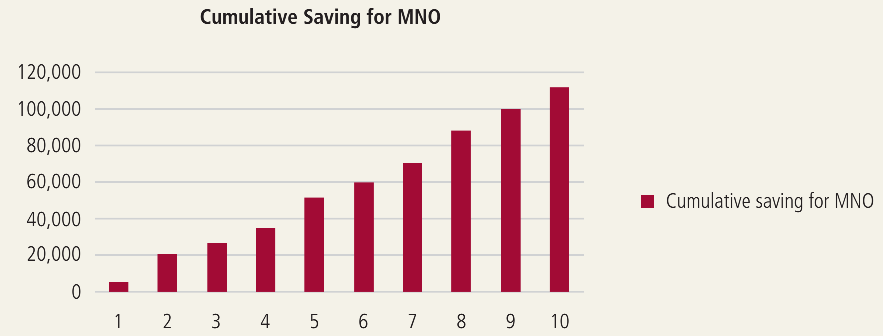
Figure 7.
Cash Flow for IP/MNO in PPA Model

The estimated cash flow for the IP/MNO will be:

	1	2	3	4	5	6	7	8	9	10
MNO Cash Flow	8,191	8,191	8,191	8,191	8,191	8,191	8,191	8,191	8,191	8,191

Figure 8.
Cumulative Savings for IP/MNO in PPA Model

The MNO will still be saving OPEX in comparison to the current diesel solution:



All figures are in US$

NB. The cash flow may be different if the site load increases. Additionally, the kWh rate may be different for different site loads and depending on the technology being used.

For a PPA model, the ESCO's financial summary will be as follows:

PayBack to ESCO	2.61 yrs
ROI to ESCO	38%
IRR	26.2%
NPV	$11,037
Discount Rate	12%

OPEX Saving Recovery or Energy Savings Agreement (ESA) Model

In this model, a 3rd Party ESCO invests CAPEX for renewable energy solution implementation. After the implementation, the ESCO measures how much energy OPEX has been reduced by introducing renewable energy. The difference between the earlier OPEX and current OPEX is calculated to determine the gross savings. The ESCO will receive a percentage of the OPEX savings value from IP/MNO.

Some of the difficulties of this model are:

- It is challenging to identify actual OPEX savings. In order to do this, an ESCO must observe the current diesel based OPEX, and then observe the OPEX for renewable
- Sometimes unavailability of the current energy OPEX can lead to delays in deployment as progression cannot be made until the ESCO has examined the current energy OPEX
- If the energy requirement at the site increases, it becomes very difficult for the ESCO to measure the OPEX saving

Figure 9.
Cash Flow Comparison with DG Solution and OPEX Saving

Taking the CAPEX model example again:

	1	2	3	4	5	6	7	8	9	10
Renewable Scenario Including Repayment	6,359	6,468	6,587	6,708	6,845	12,979	7,144	3,091	3,240	3,431
Diesel Scenario	14,090	22,674	15,287	15,931	24,607	17,317	18,062	26,845	19,667	20,530
Savings	7,731	16,206	8,701	9,223	17,763	4,338	10,919	23,754	16,427	17,099

From the figures above, we can see that there is an OPEX saving each year. In an ideal case, if the ESCO returned **50%** of the saved OPEX, the ESCO's net revenue would be:

Figure 10.
Revenue for ESCO on OPEX Saving Recovery Model

	1	2	3	4	5	6	7	8	9	10
ESCO Revenue	3,865	8,103	4,350	4,611	8,881	2,169	4,560	11,877	8,214	8,550

All figures are indicative and in US $

Process Flow for Outsourcing OPEX Model

From an overall industry point of view, below are the steps an IP should follow to outsource power:

- RFP Preparation
- ESCO Partner Selection
- Agreement
- Implementation
- Operation
- Control and Monitoring

RFP Preparation

For the ESCO outsourcing model, articulating an RFP is the first and most important step for an IP. The RFP should be outlined with:

- Objective of the project
- Technical expectation for the ESCO
- Financial expectation from the project
- Deployment sizing
- Expected operational process from the ESCO
- Control, monitoring and evaluation processes
- ESCO's previous track record and financial strength

Considering an ESCO prepares a proposal based on the RFP outline, it is important that the IP documents its complete requirements through the RFP; otherwise the ESCO may not be able to prepare a comprehensive proposal.

ESCO Partner Selection

Choosing the right ESCO for renewable power generation is the most important part in the outsourcing model. As telecom is an essential service industry, energy availability should be 99.95% to ensure all telecom network elements are providing a seamless service. In order to do that, the partner ESCO should have the capacity to provide an extensive service. Below are some of the key cross-check points for an IP before selecting an ESCO as their energy outsourcing partner:

- What are the benefits outlined by the ESCO for IP in the proposal
- Background and current activities of the ESCO
- Financial liability and strength of the ESCO
- Field outreach of the ESCO
- Methodology to identify proper solution and solution dimensioning
- Commitment for a strict SLA

Agreement

Apart from the standard legal clauses that usually come in an agreement, some of the areas that require special attention for an ESCO outsourcing contract include:

- Duration of Agreement
- Minimum Usage Definition Set for PPA
- Service Level Agreement
- Penalty Clause
- Penalty Relaxation Clause
- Exit Clause for the Renewable Outsourcing Model
- Asset Ownership

Duration of Agreement

Since the ESCO outsourcing model bears large financial risk by nature, an ESCO will always ask for a long term agreement. On the other hand, as the industry will be re-shaping in next few years, the IP/MNO may not be interested in restricting themselves to a long term agreement. From an overall industry prospective, 7-10 yrs can be a good duration for an ESCO outsourcing model. This will give an ESCO enough room to repay its debt and overcome all financial risks. Over the term of the agreement, regardless of whether or not the service costs remain the same, the model will need to be well judged to make sure it is sustainable.

Minimum Usage Definition Set for PPA

If the IP/MNO and the ESCO agree to a Power Purchase Agreement (PPA), there should be a definition for minimum power consumption at each site. Regardless of whether the IP/MNO consumes the power, it will be paid for. For example, at a site with 1kW load, a minimum energy requirement definition will be set for 24x1 kWh of power. If for any reason, the IP/MNO does not consume 24kWh power, the IP/MNO will still be obligated to pay the amount of 24kWh to the ESCO. Conversely if the IP/MNO consumes higher than 24kWh, a regular per kWh rate will be applicable. Since the ESCO will be bearing all the risk associated to CAPEX and OPEX, they should have a minimum guarantee of energy usage by the IP/MNO.

Service Level Agreement

The IP/MNO requires an extensive Service Level Agreement (SLA) from the ESCO to maintain maximum uptime of telecom network equipment. To agree on such an extensive SLA is a big challenge for ESCO, especially those who are new in the market place. Some of the identified areas that are more sensitive and require scrutiny are:

- 99.95% power availability
- Site security
- Damage and theft recovery
- Re-fuelling

Penalty Clause

An IP/MNO is usually under a penalty clause with the MNO. If the MNO's services are interrupted due to any reason associated to IP/MNO's scope, the IP/MNO has to pay penalty for revenue loss to the MNO. In most cases, the main reason for such service interruption is due to power unavailability and site security. Since both of these two activities will be outsourced to the ESCO, the penalty cause may be transferred to the ESCO. The agreement should clearly state how the penalty can be enforced. It is also important to select an ESCO that has strong financial records of being able to bear the potential penalty.

Penalty Relaxation Clause

While starting a new business model, both predictable and unpredictable difficulties may arise and the ESCO must be prepared for this. In some cases, it can become extremely difficult for the ESCO to provide the agreed service from day one as there will be a transition period. Any deviation from SLA may have a sizable penalty for the ESCO and such business model will not be attractive to the ESCO if the penalty clause is imposed from the outset. A specific duration of time can be allowed for the ESCO to fine-tune any of their shortcomings to provide the agreed SLA, and the ESCO should get a penalty free duration after the installation; from two weeks to two months. This will give the ESCO enough time to overcome any technical or non-technical difficulties they may be facing.

Exit Clause for the Renewable Outsourcing Model

The exit clause for any contract may become a crucial point in settling the ESCO outsourcing model. As there are a number of variables and uncertainties, creating an exit clause for a deal may become difficult as it may require for a number of various situations to have occurred. While preparing the agreement, both parties should have reasonable arguments. From the industries perspective, exit clauses may be applicable if:

- The ESCO fails to providing the service on time
- The ESCO is unable to meet the SLA repeatedly
- Commercial power becomes available at the site and is substantially cheaper than the ESCO outsourcing model price
- The IP/MNO repeatedly fails to pay energy bill on time etc.

NB. The exit clause may be applicable for individual site or for all the sites covered in the agreement.

Asset Ownership

Typically in the ESCO outsourcing model, assets on sites contributed by the IP/MNO or the ESCO remain on their respective balance sheets. At the time of exiting the agreement, the IP/MNO can take ownership of the ESCO's assets deployed on the site at the depreciated price, or the ESCO remove all of its installation. Usually it is stated in the agreement whether the IP has the right to purchase the existing ESCO equipment on site. For the duration of the contract, the passive assets owned by IP may be used by the ESCO either for free or at a predetermined leasing amount.

Implementation

Implementation is typically the responsibility of the ESCO. Having said this, planning for implementation is equally important for the IP/MNO as their will be several internal tasks that need to be completed before starting the power outsourced era. Some of the key implementation guidelines should include:

- Implementation should be done in phases rather than deploying large numbers of sites at one time
- A specific time-plan has to be agreed between parties for each deployment phase
- A site survey and selection should be done diligently
- A specific Acceptance Test process has to be formalised

During implementation the ESCO has to deal with a large number of challenges which include:

- The specific technical dimensioning for each site
- Verification of site information including the site survey
- Non-cooperation from the local community

Operation

Operation of the ESCOs OPEX model is the most challenging aspect. In this model, the IP/MNO has no responsibility of the site's operation. All responsibility and liability goes to the ESCO. For this reason, the ESCO has to be very careful while preparing the operation plan for the OPEX model. In order to manage the site's operations efficiently, these three areas should be looked at in depth:

- Site Automation
- Site Security
- Site Technical Maintenance

Site Automation

- Site should have an efficient automation system
- The automation should be applicable for site controlling and monitoring
- Automation should have an uptime of 99.95%
- The site technician will be responsible for making sure automation is working properly
- Any tampering of automation should result in immediate dismissal of the site technician

Site Security (Applicable for Areas Requiring Security)

- An independent but professional security guard should be appointed to each site
- Site security guard should be living within the security fence for 24/7
- Except for the entrance gate, the security guard should not be provided with any other keys
- A security supervisor has to be appointed for every cluster or area and will be responsible for supervising individual security guards
- Security guard will be responsible for any sort of theft or pilferage
- Primary investigation of every fuel theft/pilferage should be done by the security supervisor and should be immediately replaced after such incident
- Diesel re-fuelling should be done under close supervision

Site Technical Maintenance

- The ESCO should set a minimum number of times for its technician to visit the site
- A strict SLA for individual components (PV, Battery, DG, Controller, rectifier etc.) should be fixed. If any of these components are down or malfunctioning, the ESCOs operation team should be responsible and penalised
- The ESCO should maintain a strict log-book for all their activities

The ESCO outsourcing OPEX model will only be successful if it can maintain a strict and efficient operational process. Otherwise the model may not be successful.

Control and Monitoring

Control and monitoring is one of the key areas the ESCO should be very attentive to from the beginning. A specific data collection and data analysis process should be set. This will allow the ESCO to monitor its performance and trigger a mitigation process for underperforming areas. Some of the key suggestions include:

- A site performance data collection process
- Performance data collection should be automated
- Site performance data should be collected after every specific interval
- Monitoring of the energy contribution of individual equipment throughout the year
- Monitor diesel fuel level on real-time basis
- Closely monitor DG running and reason for the DG running
- A site performance analysis process has to be set to identify operational challenges
- A mitigation plan should be made for every site operation challenge

A remote monitoring facility should be in-built with controller and the controller should able to provide a visual output.

To monitor real-time site performance, ESCO should have a Network Operations Centre (NOC). The NOC should be monitoring individual sites. Below is a sample site monitoring platform's snapshot from Flexenclosure:

Figure 11.
Monitoring Platform Snapshot

Courtesy: http://www.heise.de

Conclusion

The Indian telecom market is large by nature. The number of off-grid and unreliable grid connected sites is comparatively high. Renewable energy will be scalable in the Indian telecom market only if a strong and flexible business model can be established. The CAPEX model may still lead the market unless the ESCO come up with a competitive business case (and pricing) and are able to demonstrate their reliability. Due to increasing fuel costs, operational challenges, government & social pressures, yet decreasing ARPU, MNOs have little choice but to force IP/MNOs to reduce the OPEX costs associated with power. One of the main ways an IP can do this is by outsourcing the energy part to a 3rd party who is specialised in energy management. Eventually this outsourcing may happen for a large percentage of off-grid and unreliable grid sites in future.

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