IFC International Finance Corporation World Bank Group

GSMA Green Power for Mobile

In partnership with the Netherlands

Best Procurement and Maintenance Practice: Indonesia

December 2013

Contents

Glossary

MNO	: Mobile Network Operator
CAPEX	: Capital Expenditure
OPEX	: Operational Expenditure
eTOM	: Enhanced Telecom Operations Map
ESCO	: Energy Service Company
GPM	: Green Power for Mobile
SLA	: Service Level Agreement
ROI	: Return on Investment
RFP	: Request for Proposal
DG	: Diesel Generator
KVA	: Kilo Volt Ampere
kW	: Kilo Watt
L	: Litre
PV	: Photovoltaics
Ah	: Ampere Hour
IRR	: Internal Rate of Return
NPV	: Net Present Value
SoW	: Scope of Work
PPA	: Power Purchase Agreement
ESA	: Energy Saving Agreement
O&M	: Operations and Maintenance
NOC	: Network Operations Centre
TT	: Trouble Ticketing
KPI	: Key Performance Indicator

Figures:

Tables:

Executive Summary

By Q2 2013, the number of unique subscribers in Indonesia had reached 93.4 million[1], putting pressure on Mobile Network Operators (MNOs) to expand and upgrade their network capacity to accommodate the traffic. The required network expansion has brought multiple challenges such as obtaining land permits, acquisition and community issues as well as grid availability in particular locations.

To solve the issue of grid availability, MNOs need to find alternative energy solutions to power their base stations and green technologies can provide that solution. To date, MNOs have optimized their power configuration through energy efficiency activities to reduce their expenditure in off-grid and unreliable grid locations by using DG battery hybrid solutions.

The DG battery hybrid solution is the preferred, and the fastest, solution to make cost savings. However, implementing green solutions can potentially generate more savings then the DG battery hybrid solution.

This document is a best practice guide for the Indonesian market, providing guidance on choosing and procuring green solutions as well as on operations and maintenance of green sites. The document also presents multiple CAPEX and OPEX business models with some explanations on the process flows and snap shots of the business cases for readers to understand the basic concept of green procurement.

With regards to issues of maintenance, the document will present some best practices seen in Indonesia, in line with the Enhanced Telecom Operations Map (eTOM) framework. It will give the reader an understanding of the scope and responsibilities maintenance entails. This document will serve as a guideline for MNOs, Vendors or Energy Service Companies (ESCOs) to choose suitable renewable energy business models, based on Green Power for Mobile's (GPM) latest research and analysis.

[1] Wireless Intelligence

Introduction

Indonesia is an archipelago country with more than 17,000 islands across the country. The electrification rate in the country varies from one island to the others, Java Island has the country's highest electrification rate, with above 90% electrification rate, while Papua Island has the worst, with 50%. This variety within Indonesia requires MNOs to adapt their strategy from one region to another.

By 2012, Indonesia had more than 90,000 telecom sites installed, with 5% of them located in off-grid locations. The number of sites will increase with time, as MNOs expand their networks to rural and remote areas and the incremental increase of diesel price will add another pressure on daily operation costs for MNOs.

GSMA has recorded that about 4,590 green sites have been deployed across the country. Solar has become a preferred renewable energy source, followed by fuel cell. GSMA has estimated that future investment in green solutions for off grid and unreliable grid sites could reach USD 151.5 million by 2015[2]. To tackle the CAPEX issue, MNOs could choose an OPEX based model to deploy the green technology solution in their network. MNOs would shift the responsibilities of commercial and daily operational activities to ESCOs in exchange for a recurring fee.

1. Green Procurement Guide

Procurement is an acquisition of goods or services from an external source. A sustainable procurement or green procurement is an acquisition taking into consideration the environmental, social and economic impacts. The principle of sustainable procurement aims at finding the most adequate green energy vendor/ESCO solution based on technical and financial requirements taking into account those three aspects.

Regarding technical requirements, some key elements to consider on selecting a vendor/ESCO can focus on following areas:

- Technical solutions for green technology
- Energy efficiency
- Content of hazardous substances from the solution
- Maintenance capability
- Service Level Agreement (SLA)
- Disposal process from the solution

And financial requirements consist of:

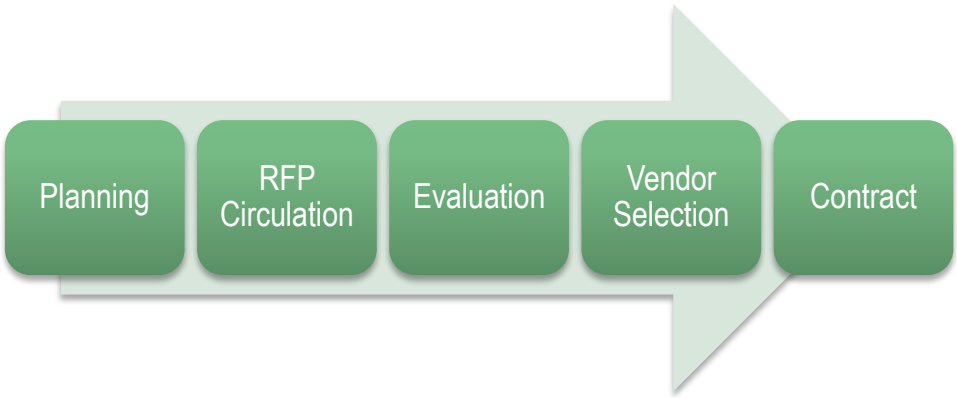
- Vendor/ESCO financial capability to support the project
- OPEX saving target by implementing the solution
- Return on Investment (ROI)
- Net Present Value for each capital that company spent for the solution in future

1.1 Sustainable Procurement Process

A basic sustainable process will not be so different from a traditional procurement process. The difference is only on environment and social consideration while procuring the solution. The below figure illustrates the procurement process flow activities.

2 GPM Market Analysis

Figure 1 Procurement Process



- 1st step – Planning. The planning includes the gathering of information on the user's demands and identifying the needs and requirements to acquire goods or services.
- 2nd step - Request for Proposal (RFP). This activity will begin after receiving an order request from the user. The RFP itself consists of technical requirements, warranty terms and post warranty support from vendor/supplier.
- 3rd step - Evaluation, this step will analyse each incoming proposal from vendors/ESCOs and build a comparison among the proposals.
- 4th step - Awarding the tender. After filtering and analysing each proposal, the procurement team needs to work together with the procurement committee to award the winner from the bidding. The procurement committee members can come from technical, finance, HR and legal teams.
- 5th step - Contract. This is the final stage of the procurement process. The contract will be given to the party that complies the most with the RFP requirements.

1.2 Different Procurement Models

In procuring green solutions, the MNO can choose two different business models based on a financing scheme. These two business models have been recognized in the telecom market as the **in-house /CAPEX model** and the **outsourcing / OPEX model**.

The in-house or CAPEX model requires a large investment from the MNO to acquire a green solution but will provide significant OPEX savings. On the other hand, Returns on Investment (ROI) will be one of the main points to consider before choosing the solution to secure the investment.

In the outsourcing or OPEX model, the MNO will shift the responsibility of investment and maintenance to an ESCO. The ESCO will bear the cost of acquiring the assets and in return the ESCO will receive a fee based on the services. The ESCO provides a Service Level Agreement (SLA) to the MNO to measure its services.

Table below shows the ownership of each activity in both the CAPEX and OPEX business models.

Table 1 CAPEX vs OPEX Ownership

Activity	CAPEX Model	OPEX Model
RFP preparation	MNO	MNO
Technical design	MNO	ESCO
Project management	MNO	ESCO
Procuring equipment	MNO	ESCO
Operation and maintenance	MNO	ESCO
Risk management	MNO	ESCO
Site monitoring	MNO	ESCO
Site security	MNO	ESCO

Fueling and DG maintenance	MNO	ESCO

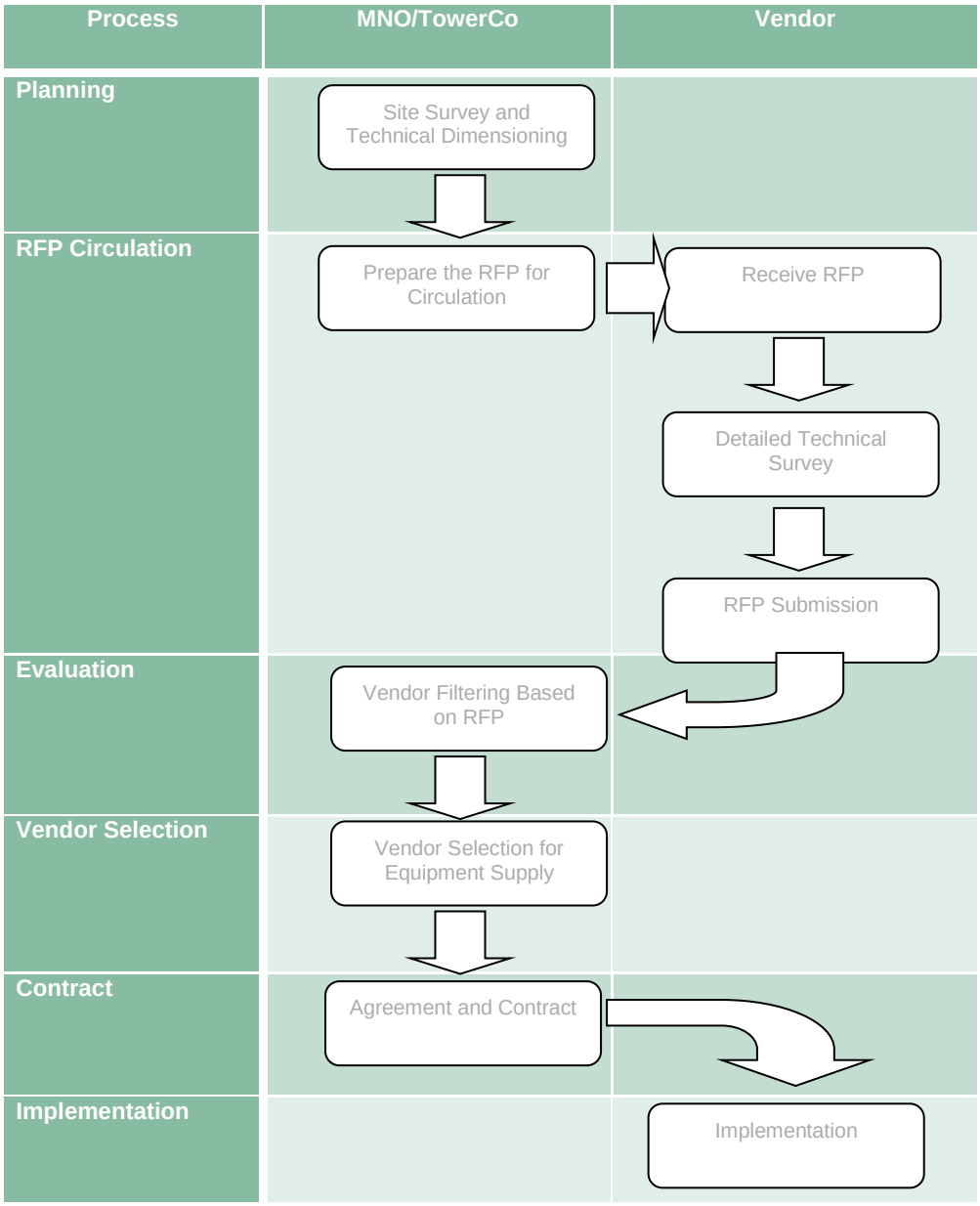
1.3 CAPEX Model

The CAPEX model is the most recognised option for procuring green solutions in Indonesia. MNOs and Tower Companies have flexibility on how to design and deploy green solutions, considering the OPEX saving targets they want to achieve.

1.3.1 Process Flow: CAPEX Model

The CAPEX model process flow is described below:

Figure 2 Process Flow: CAPEX Model



1.3.1.1 Planning

Before deciding to purchase a green solution, the MNO/TowerCo's needs and requirements should be defined in the RFP. Site survey and technical dimensioning are the

key points to build the RFP. A site survey will give the current status on the targeted sites for dimensioning a solution.

During the site survey, the MNO/TowerCo needs to consider the following aspects to assist realistic design and goals for green RFP preparation.

- Site power characteristics and possibility to optimize the site load
- Site layout and environment surrounding the site
- Site security and community situation on target site
- Analyse the sites for grid extension possibility and the costs associated
- Business case development and target OPEX saving that need to be achieved for each site
- Green site dimensioning and equipment to consider

And here is the sample of a CAPEX model design, with a business case development.

Sample CAPEX Model

An existing site, with a power configuration as follows:

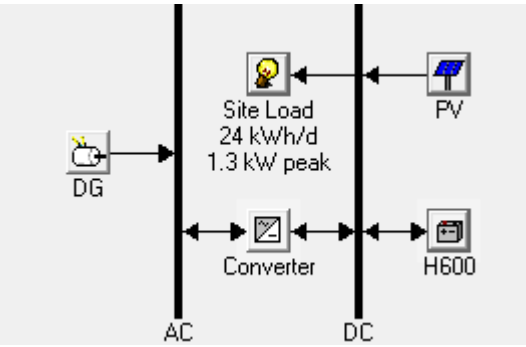
- 1 kW off-grid site load
- The site has 10 KVA DG with 16 hours running a day

Assuming,

- Diesel price is around USD 1.2/L (including transportation)
- 10 KVA fuel consumption: 2 L/hr
- PV Solar cost: USD 300 for 250W panel

Based all those assumed values, the HOMER design will look like as follow:

Figure 3 Homer Design Model



	PV (kW)	DG (kW)	H600	Conv. (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.	Diesel (L)	DG (hrs)
	5.00	10	24	8	$ 29,600	2,334	$ 42,788	0.868	0.75	979	420

As a result, HOMER provides the optimal green energy solution based on entries above. The HOMER suggests using a 5 kW solar solution with 8 rectifiers and 600 Ah batteries.

CAPEX and OPEX Estimation

Apart from technical results, the HOMER software also produces a financial report. Below is the investment schedule for the CAPEX model.

Figure 4 Investment Schedule: CAPEX Model

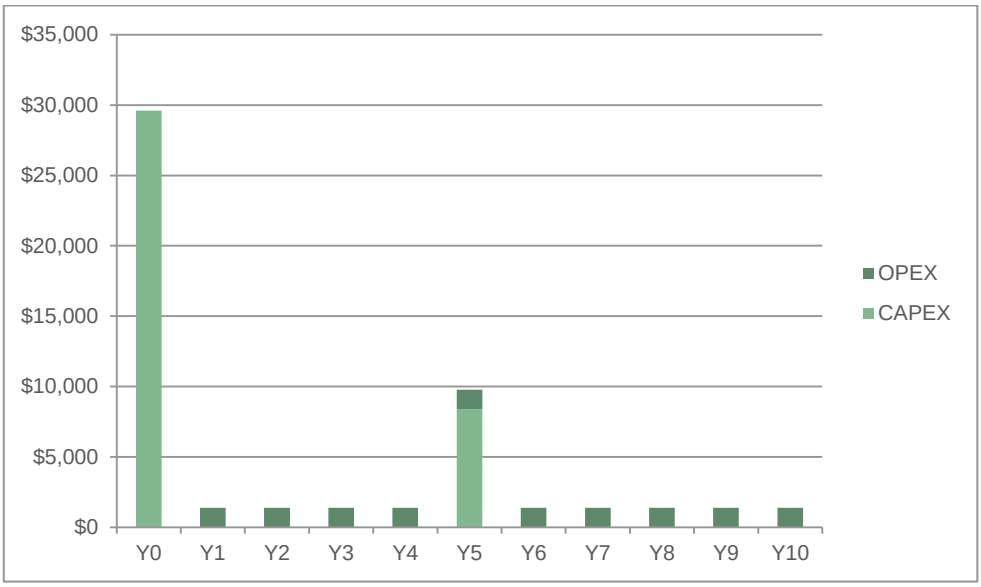
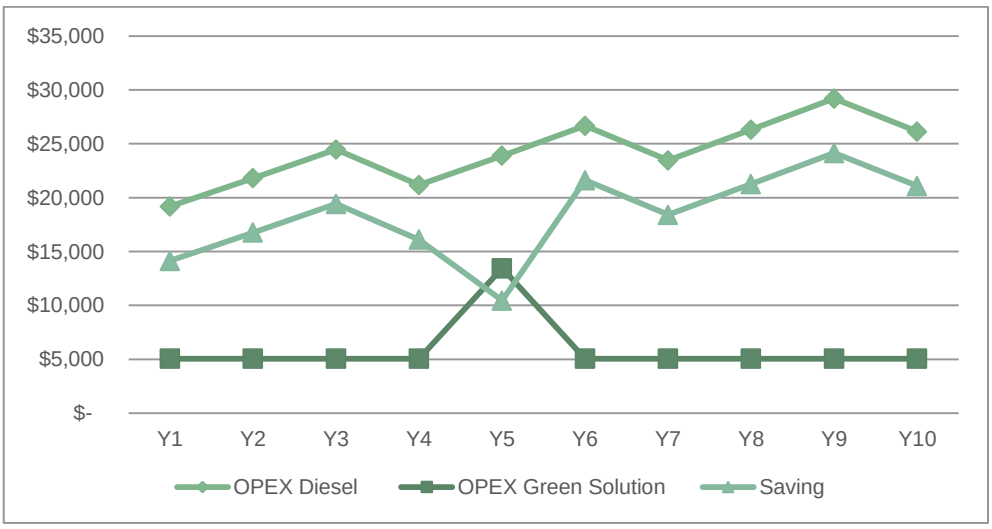


Figure 5 Cash Flow Comparison: CAPEX Model



Note: OPEX Green Solution includes load schedule payment

The CAPEX model cash flow shows the potential saving year-on-year against diesel based power solution. The increase in the OPEX of the green solution in year 6 is due to battery replacement. The financial summary is presented below.

Table 2 Financial Summary: CAPEX Model

PayBack (Year)	**1.58**
ROI	**63.2%**
IRR	**63.40%**
NPV	**$68,077**
Discount Rate	**12%**

1.3.1.2 RFP Circulation

Once the site survey and technical dimensioning has been done, the MNO/TowerCo can prepare technical specifications and requirements to a vendor. The request should be included in the RFP document. The RFP should cover the following areas:

- The Scope of Work (SoW) and procurement's timeline
- The technical requirement without giving any specific brand
- A clear responsibility matrix between each parties

Table 3 Sample of Responsibility Matrix

No	Activity	Purchaser	Supplier
1	RFP Distribution	R	
2	Technical Site Survey	S	R
3	RFP Submission		R
4	Supplier Selection	R	
5	Contract Finalization	R	S
6	Release Purchase Order	R	S
7	Installation	S	R
8	Test and Commissioning	S	R
9	Acceptance Test	A	R
10	Final Acceptance Certificate	A	R

Note: R: Responsible, S: Support and A: Approval

- A project schedule
- A compliance table including technical, legal and administrative compliance for vendors to confirm their capabilities

The RFP needs to be distributed to all vendors at the same time.

On the vendor's side, a few activities need to be prepared before responding to the RFP, such as:

- The detailed technical site survey: this site survey is a must-do activity before completing the RFP. With a technical site survey, the vendor will have an understanding of the target site for design, geographical situation and possibility to extend the grid. The survey needs to observe security situation surround the location
- The RFP submission will be completed after the detailed technical survey is done. The RFP response will be based on the vendor's technical capabilities and the site survey.

1.3.1.3 Evaluation and Vendor Selection

The final step of the procurement is awarding a winner. Once all RFPs are received from the vendors, it is time to filter and clarify. The filtering can be based on compliance tables for each particular category and the clarification should consider the following elements:

- Technical aspects: the durability is a main concern to be considered. The solution must be flexible for site load expansion and easy to maintain. The lead-time on implementation of the solution will need to be considered, including how spare part availability in or out of the country will be handled.
- Financial aspects: Capital availability is a key point to consider when choosing a vendor for the CAPEX model. An alternative to consider is an OPEX based model.

Some of the key elements to consider of an OPEX solution are: maintenance costs term of payment and performance bond for the solution provider.

- Post-project support: post-project support includes the customer service, warranty terms and technical support from the vendors.

1.3.1.4 Contract

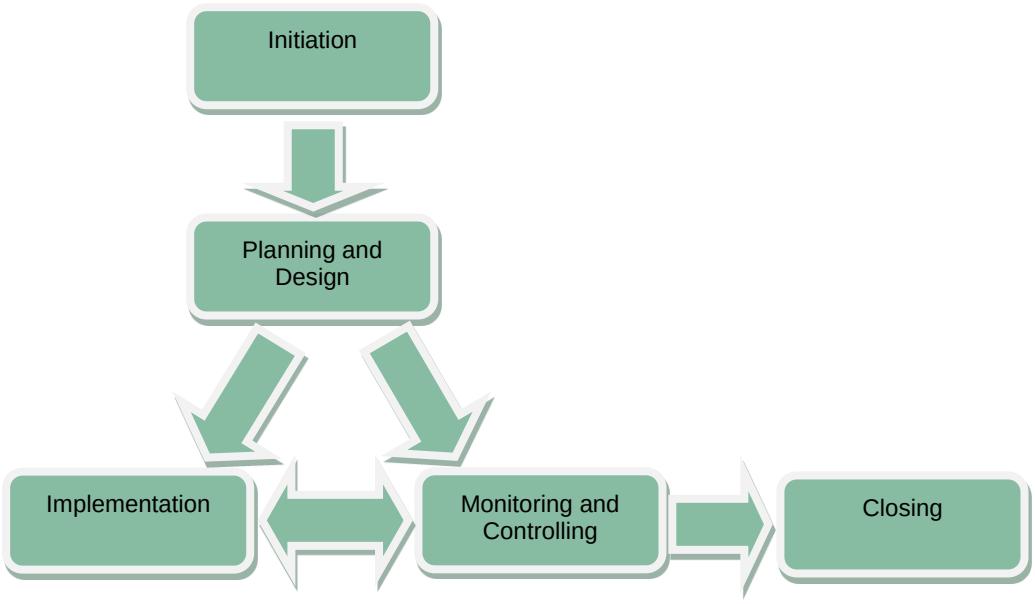
Once the vendor has been chosen, the process goes into the legal aspects of the contract. The contract has to cover the following elements:

- A detailed description of the scope of work
- A specific price and payment arrangement
- A clear mention of mutual obligation
- A project schedule with dates and deadlines
- A penalty clause if one of both parties cannot fulfil the contract requirements
- Force majeure term

1.3.1.5 Implementation

The implementation is one of the steps of the project management process. The figure below shows a standard project management process:

Figure 6 Project Management Stages



- Initiation or project kick-off, it is the process where both parties will agree on a project's timeline and deadline
- Planning and design, in this process the vendor will follow on approved design to be implemented during the project
- Implementation is the main activity for the execution of the project
- Monitoring and controlling, a regular meeting and site visit have to be conducted to track the progress
- Project closing

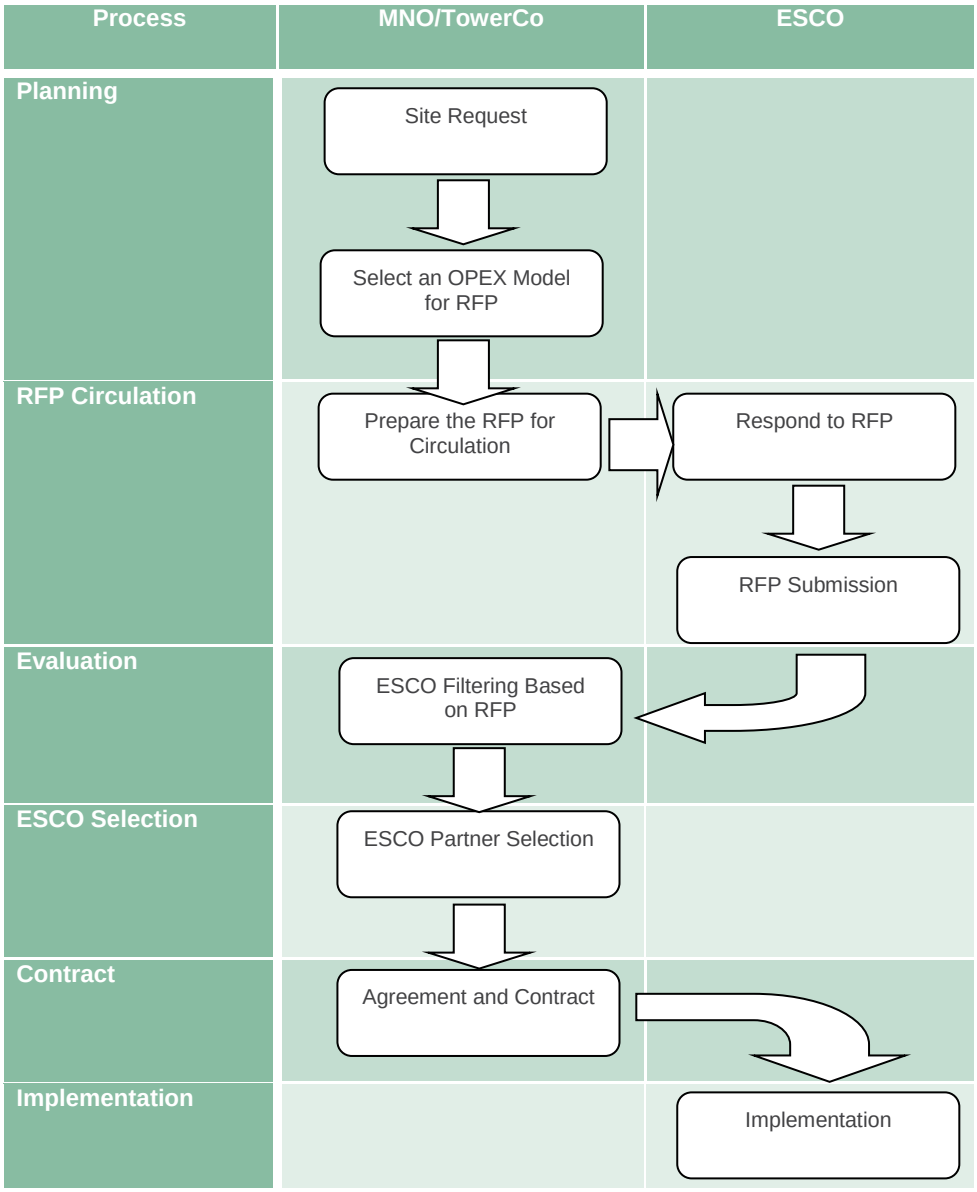
1.4 OPEX Model

The OPEX model or outsourcing model is another option for purchasing green solutions. By implementing the OPEX model, the cost of implementation and maintenance will be shifted from the MNO/TowerCo to the ESCO. The ESCO will do the end-to-end activity to provide a green solution for the MNO/TowerCo.

1.4.1 Process Flow: OPEX Model

Below is the procurement process flow for the OPEX model

Figure 7 Process Flow: OPEX Model



The procurement process flow is very different from the CAPEX model but some key elements need to be highlighted on OPEX model:

Table 4 Key Elements for OPEX Model

Process	MNO/TowerCo	ESCO
Planning	- The MNO/TowerCO needs to pick an outsourcing model before releasing the RFP - Clustering site locations for maintenance - Long term engagement target for OPEX model	
RFP Circulation	- Define clear scope of work inside the RFP - Define an outsourcing model and an expected price per kWh	- The ESCO needs to have operational experience to handle the maintenance - Hands on power management and site maintenance - The ESCO needs to have good human resources to support the project
ESCO Selection	- Choose the ESCO who has the strongest financial support Proven in field maintenance - Choose ESCO that can give competitive price per kWh	
Contract	- Create KPI and SLA for ESCO - Suitable contact tenure - Set penalty clause for any violence on KPI/SLA	- Set minimum usage for PPA model - Clear define commercial and operational terms in the contract

1.4.2 Energy Outsourcing Models

There are multiple types of energy outsourcing models, but here are three main ones used in the telecom industry:

- Monthly Flat Fee model
- Power Purchase Agreement (PPA) model
- Energy Saving Agreement (ESA) model

1.4.2.1 Monthly Flat Fee Model

The monthly flat fee model implies that the ESCO will install a green solution and provide power to the site. The MNO/TowerCo will pay a monthly fixed price to the ESCO. The ESCO's responsibility is not only to provide and power up the site, but also to maintain the power equipment and to ensure an agreed SLA will be met.

One of the challenges with this model is the diesel price fluctuation, because it will impact the Return on Investment (ROI) calculation and daily operational cost. The monthly flat fee model itself is a commitment-based agreement between the ESCO and the MNO/TowerCo. The MNO/TowerCo will give the load-window commitment to the ESCO and the ESCO will charge it on a monthly basis.

In the outsourcing model, the ESCO will define a maximum load for the MNO/TowerCo and any consumption that exceeds the load-window will be charged separately. In this case, the ESCO needs to install a power monitoring system to ensure all those commitments and at the same time monitor the power equipment in real time.

Here is an example of a Flat Fee Model cash flow based on the green design of 1 kW off-grid site from the CAPEX model illustration above. The solar green solution costs USD 29,600.

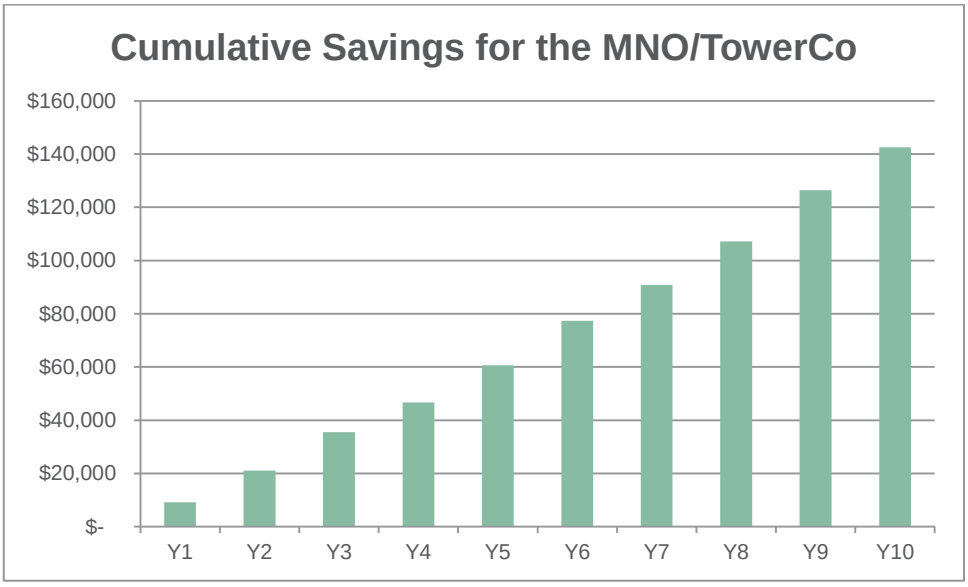
Table 5 Cash Flow: Monthly Flat Fee Model

	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
MNO Cash Flow		$9,974	$9,974	$9,974	$9,974	$9,974	$9,974	$9,974	$9,974	$9,974	$9,974
ESCO Cash Flow	-$8,880	-$6,642	-$6,701	-$6,762	-$6,827	-$6,895	-$6,966	-$7,041	-$7,120	-$7,203	-$7,290
ESCO Gross Profit	**-$8,880**	**$3,332**	**$3,273**	**$3,211**	**$3,147**	**$3,079**	**$3,007**	**$2,932**	**$2,854**	**$2,771**	**$2,684**

Note: Y0 is the ESCO investment 30% of total solar solution

The ESCO's ROI can be achieved in 2.5 years with an implied margin of 15%. The flat fee cost for the MNO is USD 831/ month. The cumulative savings for the MNO adopting this model compared with diesel scenario, is shown below:

Figure 8 Cumulative Savings for the MNO/TowerCo with a Flat Fee Model



1.4.2.2 Power Purchase Agreement (PPA) Model

The PPA model is the outsourcing model in which the MNO/TowerCo needs to pay on a usage basis. This model gives the flexibility for the MNO/TowerCo to expand its network, but it will be difficult for the ESCO to cater to their demand without proper planning and design.

The challenge of this model is to identify a fix rate per kWh over a 10 year-business plan. Note that the rate of the PPA may not be as competitive as a commercial power.

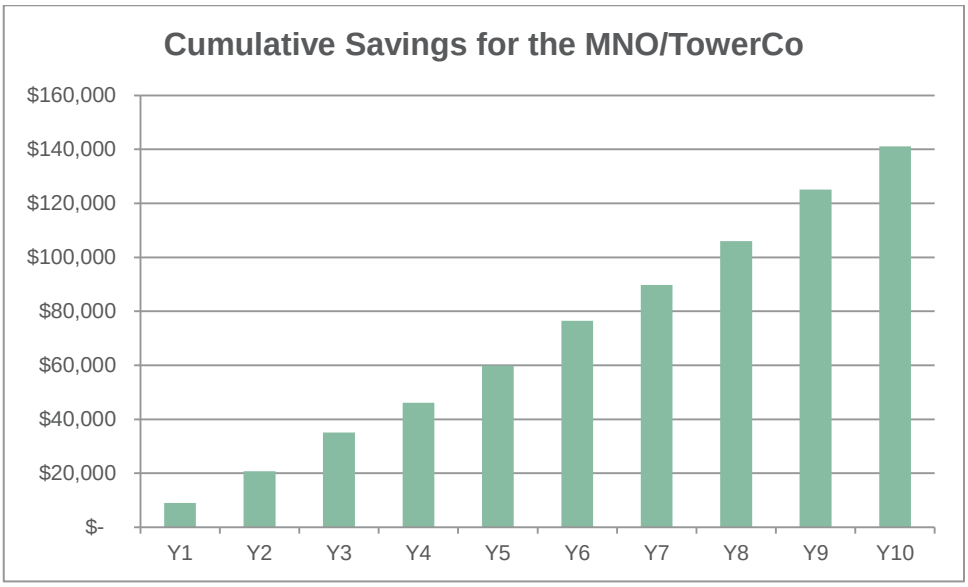
For example, for the PPA model with a 1 kWh site load requirement and a 10% buffer, the system cost is of about USD 29,600.

Table 6 Cash Flow: PPA

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Power Requirement	9,636	9,636	9,636	9,636	9,636	9,636	9,636	9,636	9,636	9,636
MNO Cash Flow	$10,118	$10,118	$10,118	$10,118	$10,118	$10,118	$10,118	$10,118	$10,118	$10,118

The calculation considers CAPEX and OPEX investments. The cumulative savings for the MNO/TowerCo is described below.

Figure 9 Cumulative Savings for the MNO/TowerCo from PPA Model



The detailed financial summary for the ESCO is as follows:

Payback to ESCO (Year)	**2.51**
IRR	**25.55%**
NPV	**$ 13,530**
Discount Rate	**12%**

1.4.2.3 Energy Saving Agreement (ESA) Model

The ESA model will require more efforts to implement, as the MNO/TowerCo and ESCO partner need to record the current OPEX consumption in each particular site before implementing a green solution. Without previous OPEX records, this model will be hard to realize. This model can create disagreements between the MNO/TowerCo and the ESCO if the savings calculation does not match among all parties. However a good power monitoring system will eliminate those issues.

This method might not be applicable for the Indonesia market where there are a lot of towers across the islands, representing a challenge to control and monitor.

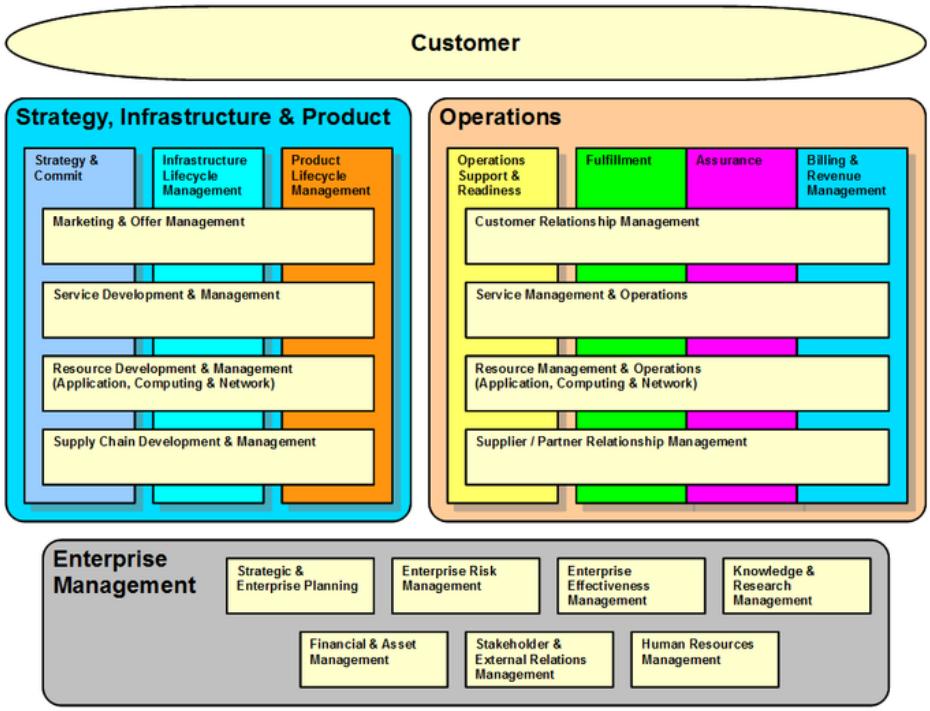
2. Operations and Maintenance Guide

Operations and maintenance (O&M) becomes a key-driving factor after the implementation to ensure the ROI for each green site. The telecom industry aims at reaching operational excellence by standardising its operations and maintenance process. The eTOM framework is the most common process that has been used worldwide in the telecom industry.

The eTOM is divided into three main focus areas:

1. Strategy, Infrastructure and Product covering planning and lifecycle management
2. Operations, covering the core of day-to-day operational management
3. Enterprise Management covering corporate and business support management

Figure 10 eTOM Framework[3]



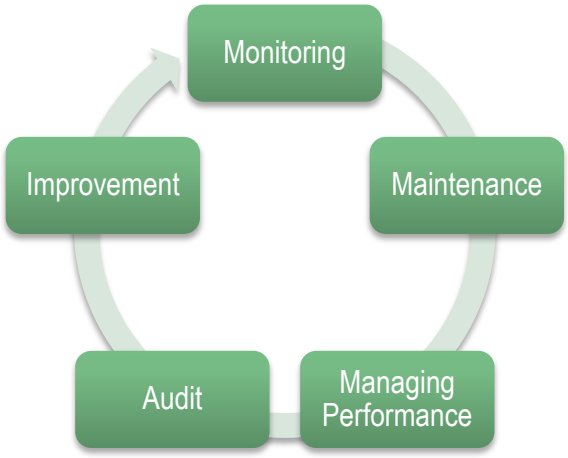
This section focuses on operations processes. A process is needed to give a guideline for the field operation team to act and react during maintenance and fault handling to achieve a network availability and OPEX efficiency.

The difference in the operations and maintenance process between the CAPEX and OPEX model are as follows:

- In the CAPEX model, the MNO/TowerCo can do the maintenance in-house or outsource it. In-house means the MNO/TowerCo needs to prepare all operational logistic, resources and strategy to maintain their power network equipment. To outsource the maintenance, the MNO/TowerCo will need to choose a third party to maintain their power equipment.
- In the OPEX model, the ESCO will maintain its own equipment and the MNO/TowerCo will help the ESCO monitor through their Network Operation Centre (NOC).

3 TMForum – www.tmforum.org

Figure 11 Operations and Maintenance Process



2.1 Monitoring

Monitoring is an essential element during the O&M process, to survey the status of the equipment and to alert any unusual activity in the network on a real time basis. The NOC or Network Operations Centre is responsible for the first level of monitoring.

The NOC should have the following capabilities:

- Real time monitoring: a 24/7 alarm monitoring should be established and integrated to the NOC to be able to monitor and control the sites in real time.
- Incident tracking system: a Trouble Ticketing (TT) system should be available to record any incident happened in the network.
- Power management: the NOC needs to be able to get a historical data on power usage in each particular site to analyse its performance and ensure the site's characteristics still follow the business case and guarantee the target ROI.
- Web based alarm: web based alarm is a good feature to have for the field maintenance team to access and report the current status for each alarm.

2.2 Maintenance

The Field maintenance team is the first line maintenance support on the ground. The maintenance can differ based on the kind of activity.

- Preventive Maintenance
- Predictive Maintenance
- Corrective Maintenance

2.2.1 Preventive Maintenance

Preventive maintenance is a regular maintenance schedule based on time or on machine run hours to detect, preclude or mitigate degradation of a system with the aim of sustaining or extending its useful life through controlling degradation to an acceptable level.

To achieve the aim, followings should be done:

- Maintenance schedule: a schedule should be created on a weekly, bi-weekly, monthly, quarterly or yearly basis along with maintenance check list. It depends on a nature of equipment and suggestion from the manufacturer.
- Clustering: putting a team in clusters will be beneficial for maintenance and responding to an alarm.

- Tools: a set of tool for each field maintenance team is needed, especially portable generator with sufficient capacity.
- Site security: a security guard has to be established to secure the assets in the site and in many occasions, the guard will help the field team on minor trouble shooting on the spot.
- Site logging: a logbook needs to be in place for each site, to record who has entered the site.

2.2.2 Predictive Maintenance

Basically, predictive maintenance differs from preventive maintenance by basing maintenance needs on the actual condition of the equipment while preventive maintenance is time-based. The predictive maintenance is a planned activity to prevent failures in the system.

2.2.3 Corrective Maintenance

Corrective maintenance can be defined as the maintenance, which is required when equipment has failed, with aims to bring it back to a normal condition. The corrective maintenance has the following objectives:

a. Eliminate breakdown
b. Bring the system to normal condition as soon as it can
c. Eliminate deviation
d. Eliminate unnecessary repair
e. Optimize all the critical planned activity

2.3 Managing Performance

A maintenance contract always comes with some Key Performance Indicator (KPI) and Service Level Agreement (SLA) targets. Managing alerts is a way to keep KPIs and SLAs from any degradation.

Below are some KPI examples for energy outsourcing.

Table 7 Sample of KPI

Key Performance	Variable or Equation	Target
Preventive Maintenance Completion Rate	$\% = \frac{Total\ maintenance\ completed}{Total\ maintenance\ scheduled}$	> 95%
Network Availability	$\% = 1 - \frac{Total\ hours\ downtime}{Total\ hours\ in\ service}$	> 97%
Maintenance Overtime Percentage	$\% = \frac{Total\ maintenance\ overtime\ during\ period}{Total\ regular\ maintenane\ hour\ during\ period}$	< 5%

Note: The target will depend on corporate strategy

Table 8 Sample of SLA

Severity	Target	Response Time	Resolution Time
Minor	> 99.00%	< 8 hours	< 24 hours
Major	> 98.50%	< 15 minutes	< 6 hours
Critical	> 99.00%	< 15 minutes	< 4 hours

Note: The definition of severity may vary

2.4 Audit

Auditing is a part of the control process, and aims at finding any weakness or leakage from daily operations. The outcome from the audit is to provide suggestions as to how to reach operational excellence.

A few things need to be analysed and checked during an audit activity:

- Operations: preventive maintenance activity check list against the schedule, the predictive maintenance against schedule maintenance outage, alarms log from NOC, site log book, site security log book, and refuelling record against DG run log hour.
- Financials: a business case against a real situation in the network, operational cash flow and third party maintenance payment.
- Resources: man-hour record against maintenance schedules, overtime record against alarm log in the network and attendee record against the man-hour record.

2.5 Improvement

Once the audit has been done, the improvement and finding report will be released as the outcome of the audit activity. A continuous improvement has been recognised as Act, Plan, Do and Check (APDC).

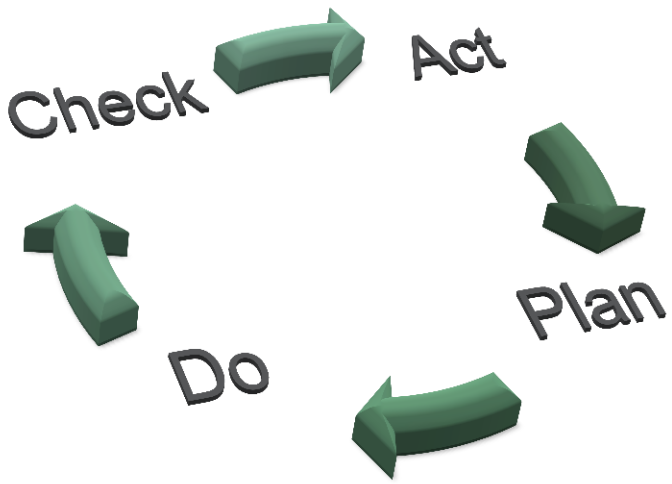


Figure 12 Continuous Improvement Plan

- Act: Act, based on audit report.
- Plan: Proper planning to improve the findings and ensure a better network availability and OPEX efficiency.
- Do: Execute the plan according to a timeline and audit report suggestions.
- Check: Monitor and control the execution plan.

3. Conclusion

Using the CAPEX model is common practice in Indonesia, but the paradigm is shifting to the OPEX model and integrating a third party ESCO player is needed for Indonesia's green OPEX solutions to break through in the telecom industry. The ESCO needs to get a deeper understanding of Indonesia's geography and a strong financial support for long-term contracting.

Best practise in maintenance is crucial for both CAPEX or OPEX business models as almost all MNOs have outsourced their operations to telecom equipment vendors or third party maintenance vendors. These practises provide good guidelines for MNO/TowerCos and the maintenance vendors. A managed service company from telecom equipment vendors usually has a well-established and tested maintenance process, which is different from a third party maintenance vendor that is run and owned by a local company and would rely and follow MNO/TowerCo's maintenance process as their internal process.