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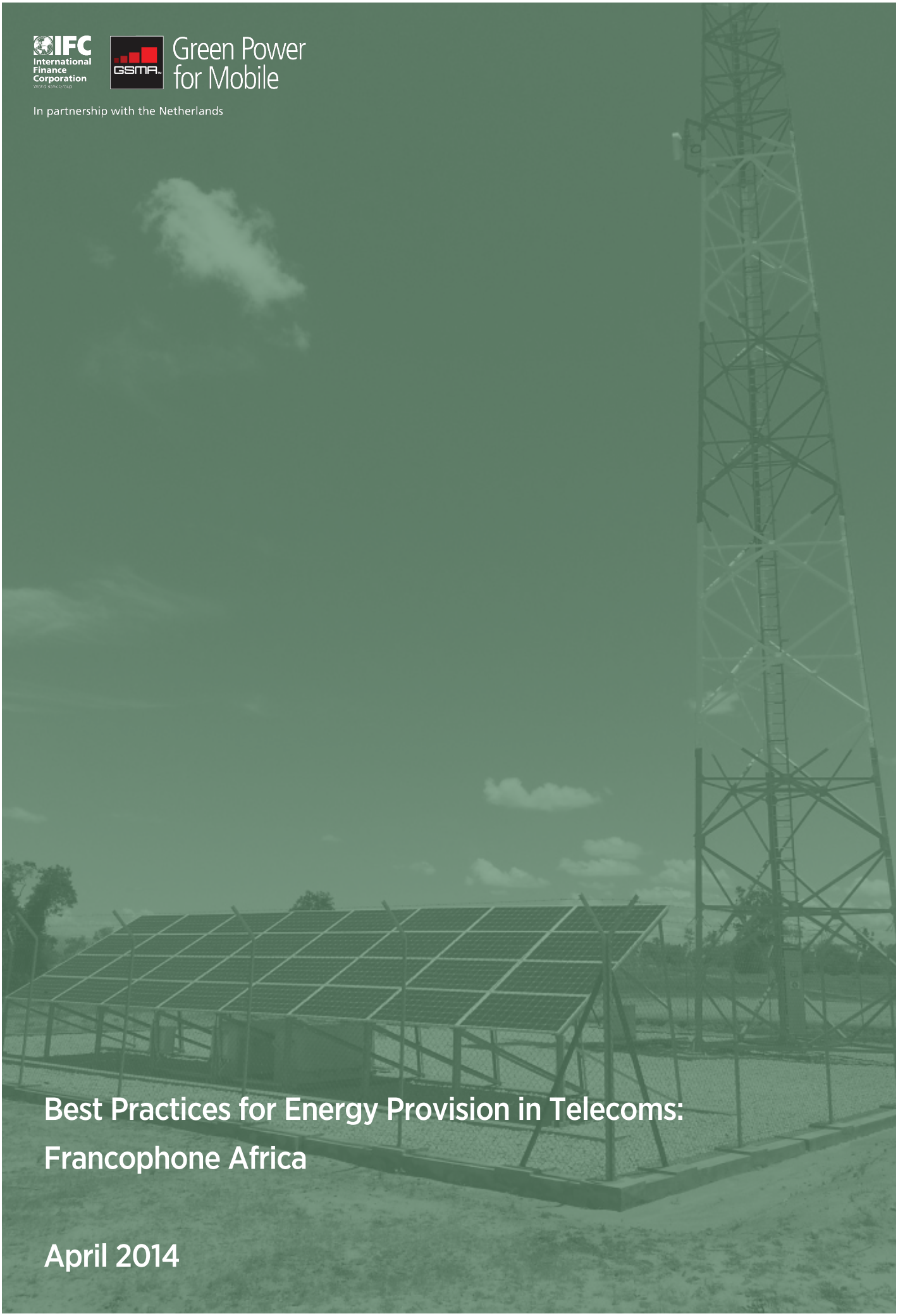


# Best Practices for Energy Provision in Telecoms: Francophone Africa

April 2014

# Contents

**Figures and Tables:**

**Glossary:**

TowerCo: Tower Company

MNO: Mobile Network Operators

MSP: Managed Services Partner/Provider

ESCO: Energy Service Company

O&M: Operation and Maintenance

OPEX: Operational Expenditure

CAPEX: Capital Expenditure

PV: Photovoltaic

DG: Diesel Generator

NOC: Network Operations Center

SLA: Service Level Agreement

Network Availability: Uptime of Mobile Network Services

OPEX efficiency: Provision Effective Services at Optimum OPEX

# Introduction

The mobile industry in Francophone Africa, specifically Senegal and Cameroon, has grown significantly over the years, even reaching a majority of the rural population who otherwise could not have access to telecommunication services. Mobile Network Operators (MNOs) in Senegal and Cameroon have made significant investments in expanding mobile network coverage by investing in key network equipment as well as passive infrastructure such as telecom tower assets, power equipment and systems for powering the network.

Power provision has been an essential element of network operations and is a critical part of mobile network infrastructure providing 24x7 network uptime. The availability and reliability of power supply as well as the source of power supply has great implications on operations and associated costs impacting the overall OPEX performance of the network.

Unfortunately, the mobile industry in Francophone Africa faces many challenges due to lack of reliable supporting infrastructure such as power grid and roads which tremendously impact mobile network operations. The limited reach of power infrastructure and poor accessibility to widely dispersed network of telecom sites has enormously impacted the operations and costs of running the network across the region.

MNOs in Senegal and Cameroon have long been dependent on diesel generators to power their network in the context of unreliable grid power supply and limited reach of grid power infrastructure. This has driven up the cost of powering the network and has resulted in energy provision costs constituting a significant share of the overall network OPEX for the MNOs. Besides the huge energy OPEX, the diesel based powering approach has negative environmental impacts increasing the carbon footprint of the mobile networks.

As part of their OPEX saving strategy, MNOs in Francophone Africa have considered various green alternatives including powering from renewable energy technologies as well as hybrid power systems in order to reduce diesel consumption and dependence on diesel power thereby saving energy OPEX. However, the adoption of green power alternatives has not reached its potential scale due to various factors including high initial CAPEX, feasibility of technology and availability or local presence of technology providers as well as technical expertise within MNOs' internal resources and eco-system.

This document focuses on the best practices for energy provision in the mobile industry and looks at various alternatives available for sustainable energy provision in a commercially viable approach. The scope of the document limits to the 'approach' rather than the technical solutions or technology details.

In this document, while looking at the best practices in energy provision, we take reference to Senegal and Cameroon in the Francophone African region and the current practices in energy provision to the mobile networks as well as opportunities present for various green power alternatives in Francophone Africa along with best practice approaches in energy provision.

# Energy Provision: The context of Francophone Africa

Senegal and Cameroon are two leading markets of the Francophone region in terms of adopting various alternative models in energy provision to the telecom networks. The mobile telecommunications industry in Senegal and Cameroon has reached a subscriber base of 10.9 and 13.5 million recording a penetration level of 85.3% and 67.3% respectively. Currently, 85% of the Cameroonians and 87% of the Senegalese are covered by mobile network signals.

The total number of telecom towers stands at 4,990 sites providing mobile network coverage to around 85% of the current population in both the countries. Senegal and Cameroon have a base of 2,900 and 2,090 total sites respectively. Nearly 28% of the total 4,990 sites are off-grid, located in places without access to grid power supply. The number of off-grid sites stands at 850 and 533 sites in Senegal and Cameroon respectively. The remaining sites are on-grid sites and have grid power supply with variable quality and reliability.

Approximate 29% of the existing off-grid sites are deployed with green power while nearly 52% of off-grid sites are powered by diesel generators running on 24x7. The remaining off-grid sites are deployed with battery hybrid solutions. Most of the on-grid sites have diesel generator as backup power source.

In the following sections we look at the current practices adopted in providing energy to the networks in Senegal and Cameroon.

## Current Context of Energy Provision

The deteriorating quality and reduced availability of grid power supply to telecom sites has led to more reliance on diesel power for running the on-grid network. Grid extension has been a big challenge due to expensive grid extension costs, regular maintenance costs and high meant time to repair of grid faults.

Senegal and Cameroon have deployed green power solutions to a considerable number of off-grid sites thereby reducing the diesel OPEX at those sites. The operators have focused on implementing battery hybrid solutions at both off-grid and on-grid networks to further optimize the energy OPEX of running the network. However, the operators have been facing various operational challenges including lack of local vendor support, unavailability of spare parts for green power deployments.

Both the major operators in Cameroon, namely MTN and Orange have been driving the deployment of solar power systems as part of their OPEX reduction strategy and hence reducing the dependence on diesel for powering up their off-grid network of sites. 182 off-grid sites in Cameroon are deployed with solar power systems accounting for approx. 34% of its total off-grid network of 533 sites. 2 sites in the on-grid network are deployed with grid-solar-DG hybrid power solution.

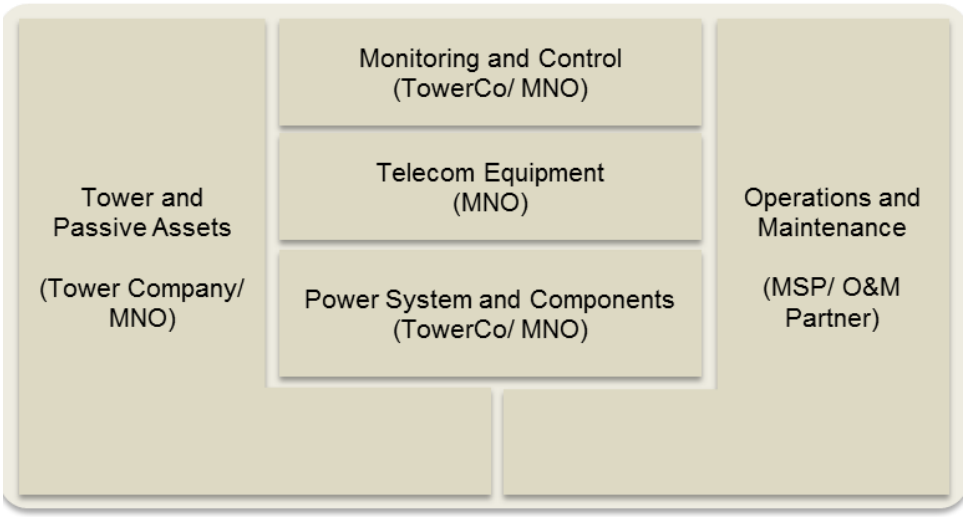
Currently, over 4.6 million people in Senegal and Cameroon are yet to be covered by mobile network and majority of them are living in rural and remote off-grid areas. Further deployment of green power in off-grid areas would require considerable investment in order to reduce diesel usage for powering the off-grid network.

## Industry dynamics and impact on Energy Provision

Cameroon is in the forefront adapting the tower outsourcing model with the recent entry of Africa focused Tower Company, IHS Towers Africa. IHS Towers now owns and manages the tower assets of MTN and Orange, the two major MNOs in Cameroon. Tower sharing is expected to pick up in the near future with an expected expansion of network capacities and also, with the expected entry of Cameroon's third GSM operator. Senegal, on the other hand, has all its towers owned and managed by the respective MNOs. The mobile industry is yet to see the entry of any major Africa focused tower companies.

The industry structure affects operational dynamics in energy provision to the mobile networks. The below diagram illustrates the operational structure in Cameroon and Senegal and how it impacts the energy operations in these countries.

**Figure 1: Industry Structure by Ownership and Scope – Power and Operations**



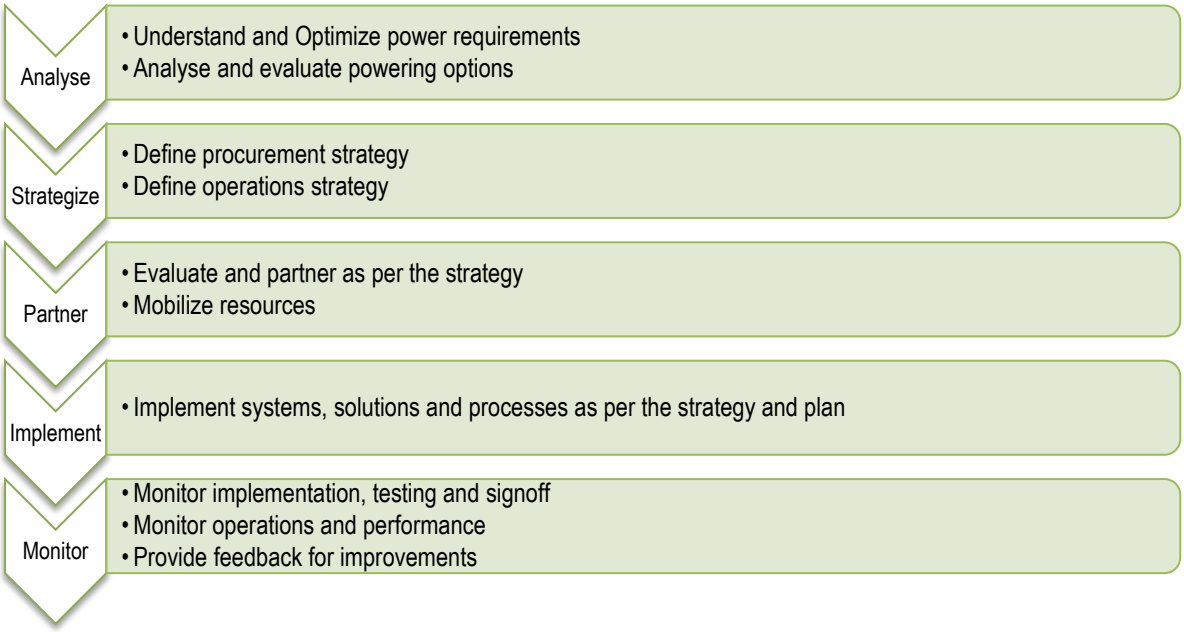

In Cameroon, the Tower Company manages the power assets and operations with support from operational partners at the field level. The Tower Company owns the responsibility of power provision and the SLAs with the MNOs for providing reliable power supply with 99.95% uptime. The approach of power provision and the underlying technology and solutions is completely under the responsibility of the Tower Company. However, in many cases, the Tower Company does not have clear visibility on the power requirements of the MNO and it is challenging to understand and forecast future power requirements. This hugely impacts the planning and design of power systems.

In Senegal, on the other hand, the power assets and operations are owned and managed by the MNOs with support field level operations and maintenance partners. The MNO has a better visibility towards the power requirements and hence more control over power systems planning and design.

# Energy Provision: Best Practices

In the context set above, energy provision to mobile networks is a crucial and challenging activity for mobile operators and requires a systematic approach with clear planning. The following illustration presents the key steps and approach followed by mobile operators for powering up their networks.

**Figure 2: Energy Provision Approach**




## Understanding the Power Requirements and Solution Options

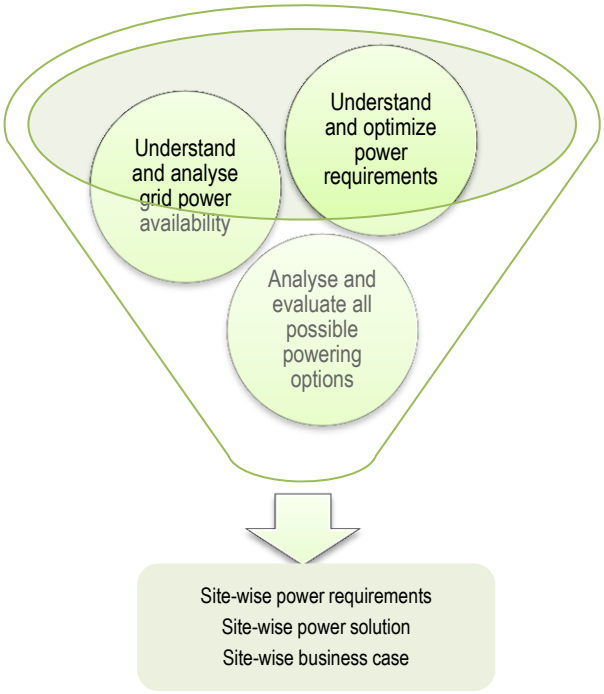
The first step in power provision for mobile networks is to understand the power requirements of the network through a comprehensive analysis of existing network, equipment deployed and the future requirements from planned upgrades or capacity additions to the existing sites. In addition, the tower companies need to understand their tenancy growth and plan for the future power requirements.

The next step is to optimize the power requirement in order to remove any inefficiency in power requirements and hence reduce the costs of power provision to the network. This is very critical for reducing the power requirements and hence reducing the energy OPEX for MNOs.

Given the understanding of the power requirements, the MNO/Tower Company has to consider and evaluate various available options for supplying power. Amongst the various options, the grid power connection comes as the first priority for operators depending on the availability and reliability of the grid power as well as the associated costs of grid connection to the sites.

The MNO/Tower Company should analyse other alternative options for both off-grid and on-grid network of sites and come up with a comparative analysis of all the possible options in order to choose the most feasible powering option in terms of technical and financial feasibility. This should be supported by a relevant business case and financial analysis.

**Figure 3: Understanding Power Requirements and Powering Options**




A sample case for power optimization and energy efficiency is demonstrated below in the context of Senegal.

**Sample case: Energy Optimization & Efficiency**

In Senegal and Cameroon, the MNOs have clearly focused on optimizing site power requirements as part of their energy efficiency strategy to reduce OPEX. The energy efficiency strategy of MNOs in Senegal is positioned around two aspects.

1. Network modernization for Energy Efficient Equipment

The network modernization has focused on reducing the power requirements of telecom equipment and reduction in the footprint of equipment. A typical site with old BTS equipment consumes around 36kWh of power per day. Modernization of equipment to energy efficient BTS will reduce the daily power consumption by nearly 20% and hence reducing the energy bill.

2. Migration from Indoor Shelter to Energy Efficient Outdoor Cabinets

The MNOs have realized that indoor shelter sites will require additional passive power consumption in the form of air-conditioner load which is almost a third of the total power consumption of a typical site. The MNOs have taken initiatives to remove shelters and hence the air-conditioner load to save on energy bills.

Consider a typical indoor existing site with telecom load of 1.6kW with air-conditioner with input power requirement of 1800W.

One option is to reduce the air-conditioner power requirement by replacing the AC Air-Conditioners with DC Air-Conditioners which consume less power for the same cooling capacity. Another option is to consider moving from indoor to outdoor with energy efficient outdoor cabinets. The above could save mobile operators up to 22 -35% energy OPEX.

The below is an illustration of a business case for the energy efficiency initiatives.

**Table 1: Energy Efficiency Business Case**

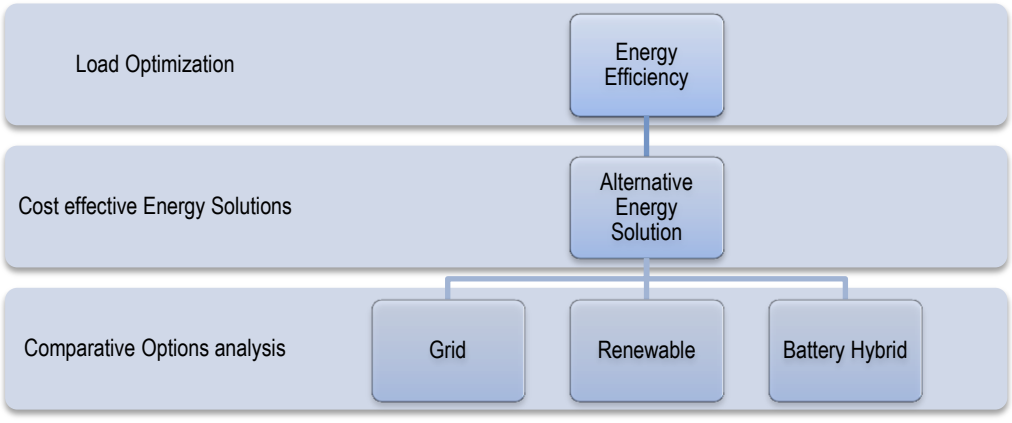
| Energy Efficiency Business Case | | |
|---|---|---|
| | Existing Scenario | Energy Efficiency |
| **Load Assumptions** | | |
| Telecom Load (W) | 1600 | 1300 |
| Aircon Load (W) | 1800 | 300 |
| Other misc. load (W) | 300 | 300 |
| Total Load (W) | 3700 | 1900 |
| Total energy requirement (kWh/day) | 88.8 | 45.6 |
| **Battery Assumptions** | | |
| Battery Autonomy (@300Ah) | 3 | 6 |
| No. of Cycles per day | 3 | 2 |
| Replacement period (years) | 1.10 | 1.64 |
| Amortized annual replacement cost ($) | 3285 | 2190 |
| **Cost Assumptions** | | |
| Grid Electricity rate ($/kWh) | 0.21 | |
| Diesel cost ($/L) | 1.3 | |
| Additional CAPEX for Energy Efficiency ($) | 7,500 | |
| | | |
| **Case 1) Off-grid Scenario (DG-Battery hybrid power system)** | | |
| DG Run hours per day | 15 | 12 |
| CAPEX ($) | 0 | 7,500 |
| OPEX | | |
| Diesel cost per year ($) | 21,353 | 17,082 |
| DG maintenance cost per year ($) | 3,833 | 3,066 |
| Battery Replacement Cost per year ($) | 3,285 | 2,190 |
| ***Total Energy OPEX ($)*** | ***28,470*** | ***22,338*** |
| ***OPEX Savings ($)*** | **6,132** | |
| ***% of OPEX savings*** | **22%** | |
| ***Payback (years)*** | **1.22** | |

| | | |
|---|---|---|
| **Case 2) On-grid Scenario (Grid-DG-Battery hybrid power system)** | | |
| **Grid availability (hours per day)** | 6 | 6 |
| DG Run hours per day | 9 | 6 |
| CAPEX ($) | 0 | 7,500 |
| OPEX (annual) | | |
| Electricity cost ($) | 1,702 | 874 |
| Diesel consumption ($) | 12,812 | 8,541 |
| DG maintenance ($) | 2,300 | 1,533 |
| Battery Replacement ($) | 3,285 | 2,190 |
| ***Total Energy OPEX ($)*** | ***20,098*** | ***13,138*** |
| ***OPEX Savings ($)*** | **6,960** | |
| ***% of OPEX savings*** | **35%** | |
| ***Payback(years)*** | **1.08** | |

Energy efficiency initiatives will drive and provide clear next steps in terms of analysing and designing of cost effective alternative energy solutions for energy provision. The MNO needs to analyse all available energy alternatives to compare and evaluate their technical feasibility as well as the business case for long term economic feasibility and OPEX savings.

A sample options evaluation approach is illustrated below.

**Figure 4: Energy Solution Options Evaluation**



## Defining the strategy for Energy Provision and Operations

Procurement and operations are the two key elements of overall energy provision strategy. The energy provision strategy of the MNO/Tower Company depends on the kind of business model adopted for procurement and operations. The decision on adopting a particular model for procurement or operations depends on the availability of in-house technical resources, availability of credible technical and operational partners, as well as the availability of financial resources and the ability to mobilize funding at a reasonable cost of capital.

Currently, the MNO/Tower Company in Senegal and Cameroon has a strong preference for the in-house lead model where the asset ownership lies with either the MNO or Tower Company with key partners for technology and operations.

There are three types of energy procurement models prevalent in the mobile industry depending on the ownership of energy assets and the overall scope of responsibility amongst the supply chain stakeholders. The three procurement models, looking from an MNO perspective, are listed below.

- In-house, MNO-lead energy procurement model
- Partially outsourced, MNO-lead energy procurement model
- Fully outsourced, TowerCo or 3rd party lead energy procurement model

In the in-house model, the MNO owns the energy assets as well as the overall operations responsibility and power provision to the networks. The MNO works in partnership with field level O&M and logistics partners for regular site logistics, operations and maintenance activities. The majority of the operators in Senegal currently adopt this model of energy provision to their network.

In the partially outsourced model, the MNO owns the energy assets, but the overall energy provision and operations responsibility is outsourced to either the Tower Company or managed services partner with strong performance SLAs. This model is currently being adopted in some parts of the Francophone region including Cote d'Ivoire, Cameroon where a Tower Company manages the energy assets and operations, providing reliable power supply to MNO's network assets.

The fully outsourced model is majorly led by tower companies with the recent emergence of tower outsourcing model in Cameroon, Cote d'Ivoire and other markets in the Francophone region. In this model, the tower as well as power assets are owned and managed by a Tower Company with strong SLAs for energy provision to the MNO's network. In this model, the CAPEX as well as OPEX for energy is under the control of Tower Company and depending on the contractual agreements and terms, the MNO pays for the consumables and energy supplied to the network.

The outcome of this step is a clear procurement and operations strategy with sustainable business model.

## Partnerships in Energy Provision

It is very critical for MNOs to form strong partnerships with credible stakeholders in order to ensure smooth management of energy supply and operations to meet performance requirements of the network. Key partnerships are a must for all aspects of energy provision including technology, project implementation, logistics and operations, security, and performance monitoring. The level of partnerships will depend on both the procurement as well as operations model adopted by the MNO.

Partners in the energy provision value chain and key elements to consider while selecting the right partners are presented below.

**Table 2: Key elements of Partnerships in Energy Provision**

| Partner | Key parameters to consider |
|---|---|
| **Technical** | • Reliable technology<br>• Deployment experience<br>• Proven results<br>• Local presence and technical support |
| **Operational** | • Credibility<br>• Operational expertise<br>• Effective operational resources<br>• Technical expertise |
| **Financial** | • Long term financing<br>• Low cost of capital |

## Implementation and Monitoring

Implementation of the strategy and monitoring of performance play a very important role in the overall process of deployment of assets and energy operations for effective energy provision to the mobile networks.

The key steps in implementation of the solutions are detailed below.

**Table 3: Implementation and Monitoring Steps**

| Steps | Remarks | Outcome |
|---|---|---|
| **Project planning** | • A detailed project plan with resource requirements need to be prepared<br>• Select an implementation partner | Project plan<br><br>Resource allocation<br><br>Partner selection |
| **Implementation planning** | • Prepare a detailed implementation plan with timelines | Implementation plan with timelines |

| | | |
|---|---|---|
| **Project Execution and Monitoring** | • Design, construct and deploy power system<br>• Monitor the execution of the project by regular status check and review of progress<br>• Test and sign-off project execution as per the agreement and contract | Power system deployed as per strategy |

Post implementation of the energy provision strategy and solutions, the MNO/Tower Company has to put in place robust monitoring systems and processes for reliable operations and performance control. The key elements of the monitoring are presented below.

- The MNO needs to set strict monitoring and control practices to regularly monitor the performance of the site and to assist in preventive and corrective maintenance of the site operations
- Implement site performance monitoring framework and system and integrate the monitoring system with the central monitoring systems such as NOC
- Monitor equipment level performance information to identify and address any discrepancies and mitigate operational risks
- Implement a central monitoring and control system for site access providing multilevel access based on operational requirements

## Summary

The summary energy provision steps and their outcome is presented below.

**Table 4: Energy Provision Steps - Summary**

| Step | Details | Outcome |
|---|---|---|
| **Analyse** | ➢ Understand power requirements<br>➢ Optimize power requirements<br>➢ Analyse available powering options<br>➢ Evaluate powering options | ➢ Site wise power requirements<br>➢ Site wise power solution |
| **Strategize** | ➢ Procurement model and strategy<br>Operations model and strategy | ➢ Site wise business case<br>➢ Procurement and operations model |
| **Partner** | ➢ Credible partnerships<br>Financial and technical resources | ➢ Credible technical, operations and financial partners |
| **Implement, Operate and Monitor** | ➢ Implementation of energy systems and solutions<br>➢ Operations framework<br>➢ Operational resource mobilization<br>➢ Monitoring framework | ➢ Successful deployment of energy solutions and operational frameworks in line with procurement and operations strategy<br>➢ Performance monitoring and feedback |

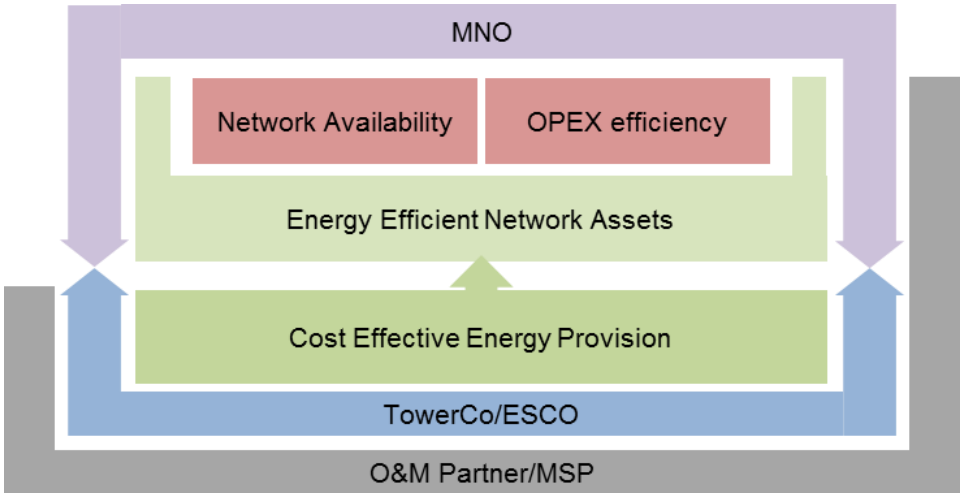
# Energy Provision: Framework

The primary goal for mobile operators is to reduce the energy OPEX without sacrificing on the reliability and availability of the network for the end users. The reliability and availability of network relies on the availability of critical supporting power infrastructure and the reliability of power supply. Power being a non-core activity of mobile operators, it is very essential for the mobile operators to build a strong supporting value chain for power provision with efficient OPEX and reliable operational performance.

With increasing competitive pressures and declining ARPUs, the mobile operators also need to be cost effective and enhance their cost competitiveness to be able to offer cost effective services to the end users. Energy is a major part of the network OPEX for the mobile operators and therefore energy efficiency becomes a critical element of cost effective service offerings.

Given the above context, the strong energy provision framework is an essential requirement for MNOs to build efficiency in network operations and develop cost competitiveness. The illustration below presents a framework with essential elements of network operations and energy provision.

**Figure 5: Energy Provision Framework for MNOs**




In the above framework of energy provision, the key operational goals of network availability and OPEX efficiency lay at the center of the framework as the prime focus elements for an MNO. The efficiency of network assets in terms of energy requirements is under the management scope of an MNO in collaboration with the network equipment supplier along with a Managed Service Partnership. This enables the MNO to deploy efficient network assets with optimized energy requirements.

The availability of the network for end users if strongly dependent on the supply of energy to power up the network equipment which is either under the scope of an MNO (in an in-house energy provision model) or owned and managed by a TowerCo or ESCO (3rd party Energy Service Company) within an outsources energy provision model.

In both scenarios, a key supporting role is provided by a reliable O&M (Operations & Maintenance) partner to enable smooth operational support for energy provision. In some cases the Managed Service Partner also manages the scope of energy operations and maintenance activities with support from the O&M service provider.

Therefore, as illustrated in the above framework, the three aspects including energy efficient network assets, cost effective energy supply and enabling O&M support, are essential for reliable energy provision to the network in order to achieve the key operational goals of network availability and OPEX efficiency for an MNO.

The MNO benefits by implementing the energy provision framework and best practices are twofold. The first benefit to MNO being the operational effectiveness achieved by defining clear partnerships and scope of responsibility amongst the key value chain stakeholders. The second benefit is that MNO will achieve energy efficiency in network operations as well as OPEX efficiency by deploying cost effective power solutions.

# Conclusion

The MNOs and tower companies in Senegal and Cameroon need to adopt a systematic approach to energy provision for achieving OPEX efficiency and network availability and performance. The energy provision should be driven by a clear understanding of the power requirements and the operating context.

Given the context of low grid power penetration and increasing diesel OPEX, it is essential for MNO/tower companies in Senegal and Cameroon to focus on deploying energy efficient networks and cost effective energy solutions for powering up these networks. Energy efficiency should be a key first step in the process to optimizing the energy needs and bringing OPEX efficiency.

Strong partnerships including technical, operational and financial partnerships are also essential as part of overall energy provision strategy for sustainable procurement and operations.

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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

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