Green Power for Mobile

Supported by

International Finance Corporation
World Bank Group

TeliaSonera

TeliaSonera – Feasibility Study

In March 2011, Swedish telecom major TeliaSonera Eurasia signed an agreement with the GSMA for a Feasibility Study to be conducted by the Green Power for Mobile (GPM) team. The study encompassed technical and financial feasibility analyses on a large number of base stations in TeliaSonera's existing and planned networks in Nepal, Tajikistan and Azerbaijan, and identified those that are most suitable for green power solutions.

Introduction

A Field Implementation Manager from GSMA's GPM Team was mobilised to each of the above operations where he stayed with each operation for about one month undergoing the information collection and analysis required to study their feasibility for renewable energy on both technical and financial grounds.

The entire project's duration spanned about 70 days, and the primary objective was to ensure that TeliaSonera maximised Return on Investment (ROI). Additional project objectives were:

- Provide recommendations on alternative energy technology, equipment sizes, new technologies, equipment trial possibilities, forecast CAPEX, forecast ROI & forecast NPV for base stations
- To support establishment of a centre of excellence within TeliaSonera through the provision of training materials and a training curriculum from GSMA's Green Power for Mobile
- To assist with vendor identification and RFP (Request for Proposal) interpretations
- To provide a monitoring and evaluation framework (Key Performance Indicators) for assessing the technical and financial performance of the sites
- To provide TeliaSonera with a global platform from which to publicise its environmental

initiatives, through the GSMA's publicity materials and communication channels

- Introduce TeliaSonera to development banks, including the International Finance Corporation (IFC – member of World Bank Group) to investigate financing options to support green power networks

In each of the three operations, a kick-off and close-out presentation was delivered to the technical team and senior management outlining the results of the analysis done. Moreover, an in-depth training on the technical simulation and financial analysis for renewable energy systems was delivered to multiple personnel within each operation.

At each of the operations, the following was explored in detail to come up with a sound feasibility analysis for renewable implementation:

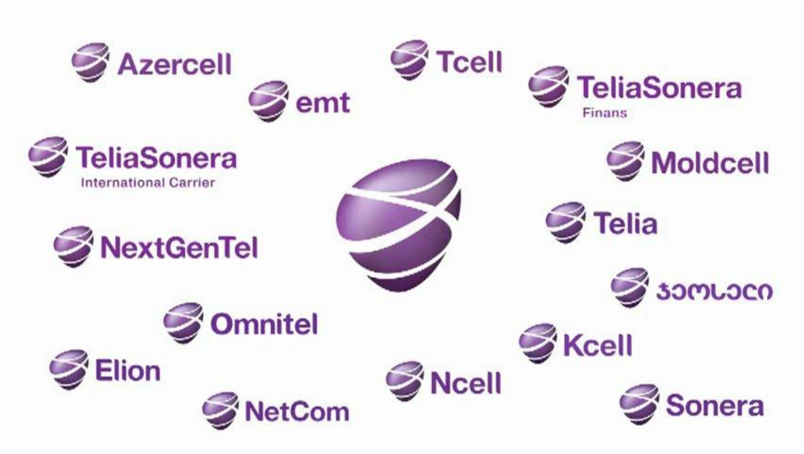
- Site technical information:
    - Power consumption, power plant, expansion plans
    - Outages, traffic volumes, operational pattern
    - Site layouts, connectivity
    - Equipment specifications and feedback on performance
- Equipment and service costing of existing service providers and system integrators
- Financial modelling information:
    - Interest rates, custom duties, insurance and transpo, etc.
    - Traffic patterns and call tariffs
- Logistical costs
- Meteorology office visit, NASA info, 3tier.com, GPM database

TeliaSonera – In Brief

Founded in the 1850s, TeliaSonera are pioneers in the telecom industry and are of the most reputable groups of GSM operators worldwide. Starting from local operators, they developed to be the fifth largest telecom operator in Europe – in less than 20 years.

From Norway to Nepal, TeliaSonera operates in Azerbaijan, Belarus, Denmark, Estonia, Finland, Georgia, Kazakhstan, Latvia, Lithuania, Moldova, Nepal, Norway, Russia, Spain, Sweden, Tajikistan, Turkey, Ukraine, and Uzbekistan. Their subscriber base exceeds 159 million and with EBITDA of SEK 36,897 million (about $ 5.86 billion).[1]

In May 2011 TeliaSonera united their operations under one common symbol and identity:



Ncell Network – In Brief

Ncell Pvt. Ltd, previously known as Spice Nepal Private Limited, was established in 2004 as Nepal's first private operator of mobile communication services in the GSM standard. The services were commercially launched under the Mero Mobile brand on September 17, 2005. As of 2010, it has been operating under the Ncell brand with the N standing for Nepal. Ncell has been part of TeliaSonera since October 2008, with TeliaSonera controlling

[1] http://www.teliasonera.com/

80% of Ncell.

Tcell Network – In Brief

“Tcell” in Tajikistan is represented by two legal companies: CJSC “Indigo Tajikistan”, operating in RRS, Khatlon and GBAO regions; and CJSC JV “Somoncom”, operating in Sugd region. Both companies share the same values, offer the same products and are owned by the same shareholders. While using services customers of each company feel like they are customers of the same company (regarding services, prices and network coverage perspective).

Tcell is the common brand of CJSC “Indigo Tajikistan” and CJSC JV “Somoncom” as of March 2010. Before this, they were working under the common brand “Indigo”. CJSC “Indigo Tajikistan” (South Tajikistan) was established in November 2001. Indigo Tajikistan obtained a GSM-900 license in November’2001 and started commercial operation in July’2002. In 2003, the North and South networks were united through a direct national roaming interconnection and continued working under the common brand “Indigo”. During 2005-2006, the companies launched automatic international roaming, channel and data transfer (including IP, GSM-900/1800 and telematic service), 3G-UMTS and WAP/GPRS/MMS services.

In July 2007, TeliaSonera acquired controlling interest in “Indigo Tajikistan” and “Somoncom”, and its ownership in Tcell is 60%.

Azercell Network – In Brief

LLC “Azercell Telecom” was established in 1996. Founders were Turkcell İletişim Hizmetleri A. S. and the Ministry of Communications of Azerbaijan Republic. Azercell has a strong leading position in Azerbaijan and is the second largest operation within business area Eurasia. Azercell is operated through Fintur Holdings, with TeliaSonera owning 51.3%.

Fintur Holdings B.V. — is a partnership of Turkcell (42%) and TeliaSonera (58%). Fintur Holdings B.V. is one of the leading providers of mobile telecommunications services in the Eurasian emerging markets through its operations in Azerbaijan (Azercell), Kazakhstan (K-cell), Georgia (Geocell), Moldova (Moldcell) and Ukraine (Astelit).

Approach to Financial Analysis & Site Modelling

The financial analysis or business case for renewable energy deployments in operational telecommunication networks aims at comparing existing CAPEX & OPEX vs. Renewable CAPEX & OPEX. Additionally, if a network experiences severe site outages due to grid power unavailability, the mobile network suffers losses in all the following:

- Revenue: outgoing calls & SMS
- Revenue: incoming calls & SMS interconnection charges
- Revenue: VAS services
- Revenue: subscriber churn
- Brand Image: subscriber dissatisfaction

This lost revenue from severe site outages would not be incurred if correctly dimensioned renewable energy systems were deployed on these sites. For networks with severe site outages – primarily due to power unavailability – the business cases for renewable deployment have to include a value for the lost revenue (i.e. comparing Existing CAPEX & OPEX & Lost Revenue vs. Renewable CAPEX + OPEX). Since the primary source of revenue for most mobile networks comes from outgoing calls and SMS, only this will be taken into account while calculating revenue losses for a mobile network.

In order to come up with a value for the lost revenue, a dollar value for a minute of outgoing voice traffic and SMS on that network needs to be computed. For that purpose, the following was explored:

- Actual outage time of sites
- Actual traffic volumes of sites
- Calling charging rates
- Estimate revenue model for sites throughout project life

Ultimately, this value was calculated for Ncell and Tcell operations (due to the presence of network outages, Azercell network outages are very minimal and hence this was not needed), and a project lifetime of 15 years was considered for renewable energy projects. Furthermore, the discount rate considered for this project in Nepal and Tajikistan was taken as 12% (provided by the finance team at each operation), and the average running hours per diesel generator was considered for OPEX calculation.

Whilst doing the dimensioning of renewable systems, the following was taken into account:

- A Free Cooling Unit (FCU) OR DC Fan should be used for each indoor site to compensate the need for an air conditioning. Therefore an additional loading of about 300 W was considered whilst modelling indoor sites, and the price for the unit was considered in the business cases.
- A battery cooler should be used in indoor sites to maintain the batteries in good condition (extending / doubling its lifetime) and reduce heat dissipation in the room/shelter
- Additional New Batteries were included as CAPEX for all sites
- Additional New Rectifier or expansion of existing rectifiers were included as CAPEX for all sites
- Average Transportation & Warehousing Costs were considered in all business cases (Airport to W/H + W/H to reachable site)

Site Analysis Performed

More than 4000 sites among Ncell, Tcell, and Azercell were analysed in the scope of this feasibility study. The sites that could not have renewable power systems implemented for them – either due to space limitations or co-existence in government / official locations – were excluded at the start of the analysis.

The remaining sites were analysed in terms of average annual (and hence daily) grid power outages and current OPEX. The sites connected to a stable or fairly stable grid were then also excluded from the analysis.

The remaining off-grid sites and sites with highly unstable grid power were first optimised in terms of the systems consuming power on-site, and recommendations as well as assumptions were made to reduce the requirement of power. Then the sites were grouped into models based on the following criteria: 1) Grid power outage 2) DG availability on site and DG type 3) Average Power Consumption of the site.

Upon grouping the sites, a technical design / simulation was done for each model of sites to come up with a design for the renewable system that would provide for the power requirement of the site.

Finally, a business case was done for each of the models that included current OPEX and CAPEX incurred by the mobile operators, as well as the OPEX and CAPEX that will be incurred if the operator chooses to go for renewable energy and green systems. The business cases also outline the financial measures needed to set guidelines on whether the investment was worth it or not –that included payback period, ROI, NPV, IRR, and Capital Expenditure.

Priority Assignment and Financial Analysis

The decision to implement renewable energy as a means of reducing OPEX by a mobile network is best done by prioritising which sites the operator wishes to start with. Same as in rolling out a network, the operator may choose to expand coverage in rural areas, or focus on increasing capacity in highly urbanised cities.

An operator may choose to prioritise their renewable rollout based on one or more variables. GSMA was keen on presenting different variables to TeliaSonera's management, based on which they can ultimately come up with an informed decision on the way forward for renewable implementation.

The base station sites were hence analysed and prioritised based on the following factors:

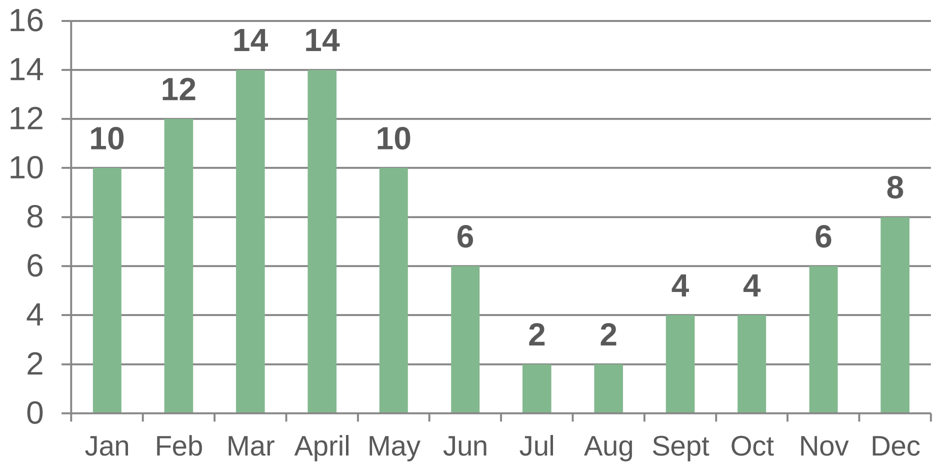
- Sites with transmission priority significance: Based on the number of sites linked to each site via microwave transmission, a priority has been assigned.
- Sites with traffic / availability / data significance: Based on a combination of the following 4 factors, a priority level was assigned to each of the sites:
    - A) Average voice traffic in peak busy hour (in Erlangs)
    - B) Average total voice traffic per day (in Erlangs)
    - C) Average site availability (% of time the site is up and running)
    - D) Weather or not the site has 3G (and hence is significant for its data)
- Sites that are problematic in terms of field maintenance: In certain cases, field maintenance teams suffer to maintain some sites in their network due to the difficulty of accessing these sites either during some months of the year (bad weather conditions) or that there is no road access to the site (which implies maintenance personnel have to walk for long distances or even use a helicopter). If these sites could be implemented with renewable energy, this could significantly reduce the burden on the operations team in maintaining these sites ultimately enhancing overall network KPI's.
- Sites with certain ROI ranges: Another categorisation which mobile operators may chose in prioritising the sites in their network for renewable implementation is purely financial – meaning the sites which yield higher ROI (less payback) could be considered a higher priority (investment-wise) than other sites with lower ROI (higher payback).

Summary of Results

Grid Power Situation

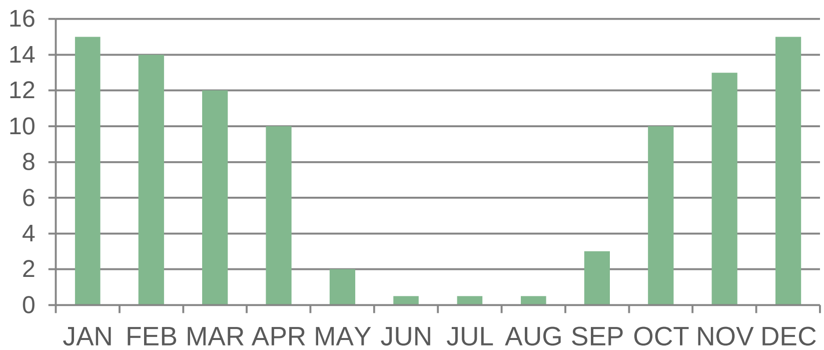
In terms of grid power reliability, all 3 countries suffer from bad grid reliability if not throughout the entire country, then at least outside the major cities. Nepal having the worst grid power outages, followed by Tajikistan, and then Azerbaijan. However, what can be observed in all countries is that the grid availability is seasonal and sinusoidal in nature as the primary source of power comes from hydro-plants nationwide triggered by the monsoon and the melting of ice on mountain-tops during the summer time. The average daily power outage (in hours, for most parts of the country) is shown in the tables below (top for Nepal, bottom for Tajikistan).

Nepal's Load Shedding Pattern (Average hrs. of Grid Blackout per day)



Tajikistan's Regions have an Average 8 hrs. of Grid Blackout per day

HOMER Simulation Grid Blackout (outage hrs.)											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
15	14	12	10	2	0.5	0.5	0.5	3	10	13	15



Severe Outage	High Grid Outage	Low Grid Outage	Stable Grid

Renewable Sources

In Nepal, solar radiation intensities are quite high year-round and therefore it is the best choice for renewable energy for Ncell. This was already experienced practically by Ncell as they have 17 sites some running 100% on solar power and some are hybrid between solar and grid / Diesel Generator.

In Tajikistan and Azerbaijan, solar intensity is seasonal, and during the winter months when the grid power is at its worst, the solar radiation intensity is also at its worst levels and may not be sufficient to power up the site unless a large-scale solar system was put in place. That would of course mean a larger investment, and ultimately a higher payback period and lower ROI.

Solar

- Solar patterns do not vary much within a few square kilometres
- Solar Insulation is low during the months where Grid power is unreliable Oct-Mar
- Solar Insulation is high during Apr-Sept *(excellent for sites not connected to Grid)*

Monthly Averaged Insulation Incident on a Horizontal Surface ($kWh/m^2/day$)												
Lat 40.209 Lon 69.666	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22-year average	1.98	2.85	3.90	5.26	6.64	7.78	7.76	6.90	5.49	3.86	2.40	1.73

Wind power in many parts of these countries may pose as a better source of renewable energy. Wind speeds in some areas are extremely good throughout the year, and a renewable design of only wind energy could in many cases be the best option, and in other cases a hybrid design between solar and wind was found to be the most reliable and cost-efficient.

Wind

- Wind patterns do vary incredibly within a few metres – especially due to the mountainous and hilly terrain that is 93% of the land
- Wind speeds must be measured &/or surveyed prior to deploying Wind turbines for any site – as it may either be 100% beneficial or 100% loss if the location of the set-up was mistakenly chosen
- My recommendation is to go for wind turbine manufacturers that offer 5 year warranty to avoid risk

Monthly Averaged Wind Speed at 50, 100, 150 and 300 m Above Earth's Surface (m/s)													
Vegetation Type: Rough glacial snow/ice													
Lat 37.23 Lon 71.484	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
50m	7.86	7.43	7.50	7.21	6.67	6.02	6.33	6.50	6.72	7.48	7.77	7.54	7.08

Business Case Results

From the business cases, one can deduce that renewable systems can be retrofitted in existing sites at Ncell and Tcell operations and would yield good financial returns and payback periods less than 7 years.

As for Azercell's operations, the current OPEX being incurred on the operational sites is very low due to the mature managed services model they are operating, and hence renewable energy systems would only be cost beneficial to be implemented in new site deployments in off-grid locations.

Next Step for TeliaSonera

Nepal - Ncell

	Financial Analysis				
	CAPEX ($)	OPEX ($)/yr	Payback Period (yr)	ROI	NPV ($)
0 yrs < Payback < 2 yrs (300 sites)	19,848,665	807,177	1.30	79%	94,387,481
Average per site	66,163	2,690			314,625
2 yrs < Payback < 4 yrs (485 sites)	30,981,450	2,345,743	3.06	34%	45,690,915
Average per site	63,879	4,837			94,208
4 yrs < Payback < 7 yrs (303 sites)	20,205,746	1,437,050	5.74	18%	5,736,745
Average per site	66,685	4,743			18,933

Total CAPEX for Green solution implementation	$65.3 M

Tajikistan - Tcell

	Financial Analysis		
	CAPEX ($)	Payback Period (yr)	ROI
0 yrs < Payback < 2 yrs (123 sites)	4,639,800	1.19	84%
Average per site	37,722		
2 yrs < Payback < 4 yrs (200 sites)	9,313,400	3.00	35%
Average per site	46,567		
4 yrs < Payback < 7 yrs (62 sites)	3,651,300	5.51	19%
Average per site	58,892		

Total CAPEX for Green solution implementation	$17.64 M