



Green Power for Mobile



Telefónica – South America – Feasibility Studies

The GSMA conducted a six country study for Telefónica in South America. The countries covered by this study were Argentina, Chile, Colombia, Mexico, Nicaragua, and Venezuela.

Country Profiles

Argentina

Argentina has a population of 40 million¹ and an area of 1.1 million square miles. The GNI per Capita is US\$6050². Argentina has a vast energy transmission network, which covers most of the country. The price of electricity (US\$0.06) and diesel (US\$0.8) is heavily subsidised by the state for political reasons. Many sites located in the southern part of the country have dedicated power transmission lines, and it is not unusual that upon a power cut the electricity company gives preference to repairing the lines which serve a significant number of users, leaving cell sites unattended for weeks, particularly during the winter period.

Mountainous landscape in the south is accompanied by constant strong winds, whereas due to the Antarctic summer/winter periods, sun radiation is reasonably high for six months and very low for the other six months.

The northern part of the country is mostly plains, meaning that winds are low and unstable, but solar radiation levels are increased.

Chile

Chile has a population of 17 million³ and an area of 757,000 square kilometres. The GNI per capita is US\$10,084⁴. Geographically Chile shares the southern part of South America with Argentina; therefore most of the information already mentioned in the Argentina summary partially applies to Chile. Chile has a modern energy transmission network which

¹ www.worldbank.org

² www.worldbank.org

³ www.worldbank.org

⁴ www.worldbank.org

covers most of the country. Many sites located in the southern part of the country have dedicated power transmission lines, and it is not unusual that upon a power cut the electricity company gives preference to repairing lines which serve a significant number of users, leaving cell sites unattended for weeks.

In many cases the cost of construction of a dedicated power transmission line (usually done at the cost of the operator) makes the sites commercially unviable, but still has to be constructed due to the government coverage requirements.

Chile differs from Argentina in the fact that the Chilean electricity industry is wholly in private hands, with the government present only in a regulatory, monitoring and indicative planning capacity. To provide further motivation in the search for alternative energy sources, the Chilean Government has initiated a funding scheme that provides grants for renewable energy feasibility studies.

In June 2010, Chile's government unveiled various projects under evaluation as part of the Unconventional Renewable Energy Law (ERNC). These initiatives are designed to mitigate Chile's dependence on non-renewable energy. Twenty-three wind farms with a total capacity of 135mW were studied for feasibility. Current renewable energy output totals 2mW in the whole country, which due to its unique location between the mountains and ocean, has steady wind supplies throughout the whole country. Current energy price are US\$ 0.16 per kWh and diesel fuel US\$2.0 delivered to the site.

Colombia

Colombia has a population of 45 million⁵ and an area of 441,000 square miles. The GNI per capita is US\$4950⁶. Colombia has a vast energy transmission network, which covers most of the country. Hydro-electric power plants account for 65% of the generating capacity, while thermal power plants account for approximately 35%.

Despite the fact that energy generation, transmission and distribution are unbundled, there is no provision for private parties to resell the excess energy to distribution companies. In order to do so, a company has to be registered as an energy generating company, which is a complex procedure and is not viable for a company whose core business lies in another field.

Commercial electricity price is relatively low – around 400 Colombian pesos (€0.24 as of 27.07.2010). A law was adopted in 2001 to promote the use of renewable energies; however it lacks incentives such as tax breaks or other benefits for those who use it. Credits for CO₂ emissions are calculated but not used and diesel fuel costs US\$2.0 delivered to the site.

Nicaragua

Nicaragua has a population of 5.7 million⁷ and an area of 46,430 square miles. The GNI per capita is US\$1080⁸. Nicaragua is the largest country in Central America, but one of the least densely populated. It has the sub region's lowest GDP per capita and about 62% of the population lives below the poverty line. Like its economic indicators, Nicaragua's mobile penetration is also the lowest in Central America. Energy generation and transmission systems of the Central American countries are combined into a single network. Energy price (US\$ 0.20 per kWh) might seem low in absolute numbers, but considering the fact that 62% of the population lives below the poverty line, proportionally it makes a substantial impact on any commercial operation. Price of diesel fuel is US\$ 1.6 delivered to the site.

Venezuela

Venezuela has a population of 28 million⁹ and an area of 352,143 square miles. The GNI per capita is US\$7320¹⁰. Venezuela is a country undergoing profound economic changes. Many of the production and services companies have been nationalised, and grouped together to form state-owned corporations. Energy transmission and generation companies are not an exception. Electricity prices are heavily subsidised (0.0014 US\$ per kW/H) which leads to the highest per capita electricity usage in Latin America. 75% of the country's electricity comes from the Guri hydro-electric power plant. Droughts in recent

⁵ www.worldbank.org

⁶ www.worldbank.org

⁷ www.worldbank.org

⁸ www.worldbank.org

⁹ www.worldbank.org

¹⁰ www.worldbank.org

years, the lack of investment into energy supply and transmission networks and matching the usage increase led to the overall instability of the country electricity supply. Between 2008 and 2010 there were several major electricity failures, some lasting up to 15-17 hours.

Mexico

Mexico has a population of 112 million¹¹ and an area of 758,449 square miles. The GNI per capita is US\$8960¹². The energy sector in Mexico has certain limitations in terms of private participation and foreign companies are allowed to operate in the country only through specific service contracts. As required by the Constitution, the electricity sector is federally owned, with the Federal Electricity Commission essentially controlling the whole sector. Attempts to reform the sector have traditionally faced strong political and social resistance in Mexico, where subsidies for residential consumers absorb substantial fiscal resources. Energy prices are 0.115 US\$ per kW/H and the diesel price is US\$1.17/l delivered to the site.

¹¹ www.worldbank.org

¹² www.worldbank.org

Challenges of Feasibility Study

In Argentina, Mexico and Venezuela, the availability and low price of commercial power made it very difficult to construct a viable business plan for renewable energy. Additionally, Argentina subsidises the price of diesel making a viable business plan very challenging.

Approach of Feasibility study

Due to time and logistical constraints, each country was asked to provide a list of suitable sites from their network for the GSMA’s Implementation Consultant to study. These could then be used as a template for any future rollout of new sites. The consultant visited most of the countries in the study and worked with the local teams on providing suitable solutions for their particular network and country. Individual studies were provided to each country and a group presentation was provided to Telefónica.

Renewable energy results and recommendations

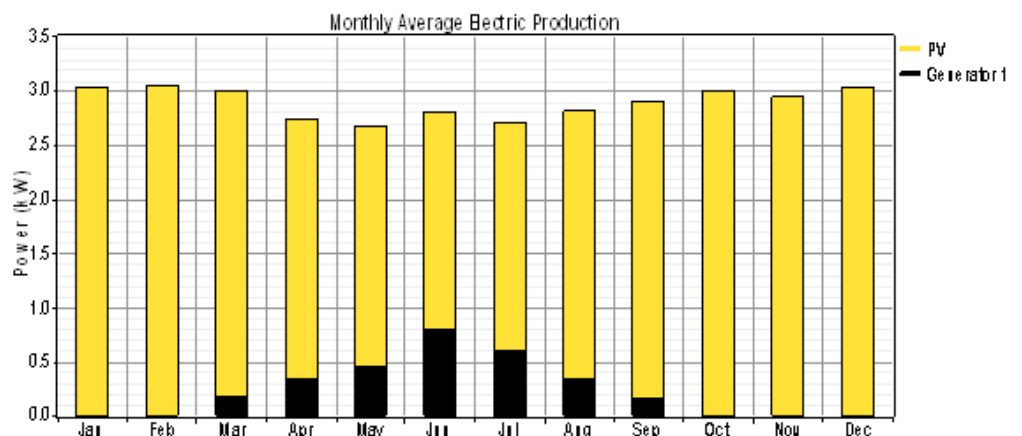
Argentina

Movistar Argentina provided the GSMA team with data on 22 of their sites. All the sites provided for analysis from Movistar Argentina have commercial power available and have no diesel generators on site. Although all sites are grid connected, the supply can be disrupted for long periods especially during the winter.

Due to the poor access to these sites and the unknown amount of potential outage time, the GSMA provided two designs for renewable solutions. These showed the cost of providing a solution for these sites to be run wholly on renewable hybrid solutions. The CAPEX cost for hybrid solutions range from US\$66,000 to US\$80,000 depending on location and design, with an annual OPEX of under US\$5,000. However, it was not possible to provide a viable business case, as figures for loss of potential income from a site being down for an unknown period was very hard to ascertain. A list of generic recommendations was created for energy optimisation and given to Movistar Argentina.

Hybrid Solution Design Example:

CAPEX	Yearly OPEX	Solar Array Size	Battery	Contribution to Energy
US\$80,000	US\$4,312	14KW – 56 X 250W	3000 Ah	Solar 92% Generator 8%



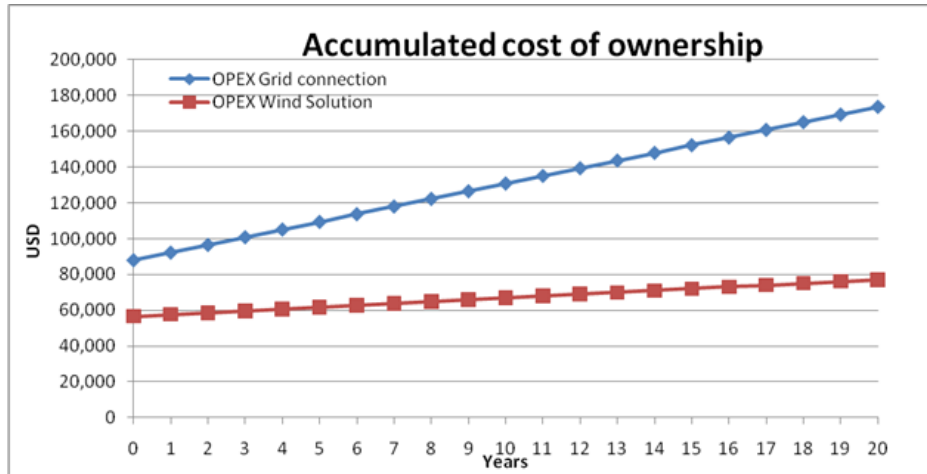
Chile

Movistar Chile provided the GSMA team with data on a total of 12 sites. All the sites provided for analysis from Movistar Chile were grid connected and have no diesel generators on site. Although all the sites were grid connected, the supply could be disrupted for long periods, especially during the winter. There is no financially viable renewable energy solution for the existing sites that are already connected to the grid. A renewable solution has been provided to show the cost benefits for any new remote sites, which have cost for initial grid connection. A business case has been produced to show the

cost comparison between a new renewable energy solution and the initial cost to connect to the grid. A figure of US\$80,000 has been quoted for a site 5km from the existing grid. A list of generic recommendations were created for energy optimisation and given to Movistar Chile.

Wind Solution Design Example:

CAPEX	Yearly OPEX	Wind Turbine	Battery	Contribution to Energy
US\$56,000	US\$3,500	7.5kW	3000 Ah	Wind 100%



This design compares favourably with a remote site requiring connection to the grid. The OPEX for a wind solution is less than running a site connected to commercial power.

Colombia

Movistar Colombia provided the GSMA team with data on a total of 18 sites. These sites were categorised into three types; Type-A, Type-B & Type-C.

Type-A: Four solar-hybrid design models were created for Type-A and the renewable energy solution business case showed good potential for a financial feasible design with a pay back on investment within one year.

Type-B: Two Solar-Hybrid design models were created for Type-B, again giving payback within one year

Type-C: These sites were not recommended for renewable solutions, but a list of technical recommendations has been created for implementation to save energy and OPEX.

Financial Analysis Summary

Priority	Number of Sites	Total CAPEX	Yearly OPEX	OPEX Saving/Yr	Payback Period (yr)	ROI	NPV	CO2 Emission Reduction (ton)
Type-A Model-1	1	\$80,480	\$2,848	\$130,666	0.62	161%	\$103,663	166.6
Type-A Model-2	3	\$241,440	\$8,544	\$391,998	0.62	161%	\$310,992	500
Type-A Model-3	1	\$82,980	\$3,018	\$130,476	0.64	156%	\$107,744	166.6
Type-A Model-4	1	\$82,980	\$5,547	\$127,947	0.65	153%	\$128,777	163
Type-B Model-1	1	\$80,480	\$2,828	\$112,082	0.72	138%	\$103,664	140.2
Type-B Model-2	4	\$331,920	\$13,032	\$355,088	0.93	107%	\$438,996	418.8
Type-C	7	\$129,080	\$700	\$23,353	5.53	18.1%	\$134,904	NA

Implementation of all hybrid solutions would require a total of approximately US\$1 million in CAPEX.

Due to the high cost of diesel and the current use of very large generators on the existing sites, some very large savings can be achieved as generators consume an average of 9l/h. The proposed solutions identified a total of approximately US\$1.2 million in potential OPEX savings by implementing renewable energy solutions.

Nicaragua

Movistar Nicaragua provided the GSMA team with data on a total of 15 sites. No sites were found with a potential for renewable energy solutions due to site power loads and the availability of commercial power.

A list of specific recommendations was created in order to reduce energy OPEX by US\$8965 per year per site, including:

- Dismantling existing air conditioners and replacing them with a Fan Coil Unit (FCU) will reduce grid power usage by 40% to 50%
- Dismantling existing auxiliary loads and using only energy efficient lights will reduce the consumption of grid power
- Dismantling existing battery coolers and batteries and replacing with energy efficient battery coolers and 1500 Ah OPzS series batteries will save battery replacing OPEX by US\$30,000, as well as grid power usage by up to 10%.
- Replacing existing legacy DG by 12kVA DG will save up to 60% of diesel usage.

Venezuela

Movistar Venezuela provided the GSMA team with data on a total of 31 sites. To reduce grid power and diesel generator usage, GSMA provided Movistar with specific recommendations for using wind-hybrid solutions in two scenarios.

No financially viable business case was found for implementing hybrid renewable energy solutions, but the designs will reduce grid power usage by six hours per day, as well as reducing the use of the diesel generator--a current objective for Movistar Venezuela. All the sites are on-grid and have a minimum number of TRX average power outage of less than 3hrs per day with the average site load being 2.5KW.

The following actions were suggested to Movistar Venezuela:

- Dismantle all existing air conditioner, battery cooler, lights, fans and batteries
- Disconnect all auxiliary power connections from load, other than base station equipment
- Install FCU for indoor sites
- Install energy efficient low watt bulbs
- Dismantle diesel generator, except for higher power sites, and implement wind generated power solutions

Equipment to be considered included: 10 KW wind turbine, 2500Ah OPzS batteries as well

as battery coolers & FCU for indoor sites. A 10kW wind turbine will be installed to charge the battery bank which will not be grid connected. Every day from 12am till 6am, the base station will be forced to disconnect from grid power. For these six hours, the base station will be supported by the battery bank. If the grid power fails during any other hours, the base station will be supplied by the battery bank. Sites that are consuming high power will also have a backup diesel generator. If the battery charge level falls below 60%, the diesel generator will start supporting the site and charging the batteries.

Mexico

Movistar Mexico provided the GSMA team with data on a total of 29 sites and of these, 12 sites were selected for further analysis due to their lower power consumption - > 2.8KW. The analysis was done remotely, due to time and logistical constraints. Business cases encompassing the selected 12 sites were created and a list of generic recommendations was created for energy optimisation.

Total OPEX savings per year for 12 sites was US\$1.5 million with all sites being off-grid. The OPEX per site would be reduced by US\$127,947 per year.

Financial Details for Hybrid Design

Number of Sites	CAPEX	Yearly OPEX	OPEX Saving/Yr.	Payback Period (yr.)	ROI	NPV	CO2 Emission Reduction (ton)
2	\$995760	\$34176	\$1567992	0.62	161%	\$103663	166.6

Site Load	Solar	Grid Status	Battery	Contribution to Energy
2.8 KW	\$995760	\$34176	\$1567992	0.62

Summary of results for full feasibility study

Analysed operator's data from 6 countries: Colombia, Venezuela, Nicaragua, Chile, Argentina and Mexico.

- Site data for 127 sites was provided for detailed analysis
- A list of generic recommendation was created for energy optimisation for each country
- Renewable energy solutions with specific business cases were recommended only for Colombia and Mexico. No potential business cases were found for renewable energy solution implementation in Nicaragua, Chile, Argentina and Venezuela
- Some specific energy optimisation recommendations were created for Nicaragua which could save up to 50% of energy OPEX
- The study found that if US\$1.9 million CAPEX could be invested in Colombia and Mexico for renewable energy deployment, energy OPEX of US\$2.7 million could be saved per year

Operator Name	Diesel Saving Per Year (L)	GHG Saving Per Year (Tons)	Comments
Telefónica Argentina	326,000	848	Result based on 22 site analyses. 20% - 40% energy cost can be saved strictly following the list of recommendations on energy efficiency.
Telefónica Venezuela	27,125	71	Result based on 31 analysed sites whereas all sites are grid connected. 60% energy cost can be saved by following the energy efficiency recommendations.
Telefónica Chile	0	0	All analysed sites are powered by main grid. DG is not available at any of the sites. A list of specific and generic recommendations on energy efficiency was created for this operator. 20% - 40% of energy cost can be saved by implementing the recommendations.
Telefónica Colombia	600,000	1,555	Result based on 18 site analyses. \$1.2 million energy OPEX can be saved per year by implementing renewable solution and energy efficiency recommendations.
Telefónica Mexico	64,000	166	Result based on 12 site analyses. \$1.5 million energy OPEX can be saved per year by implementing renewable solution and energy efficiency recommendations.
Telefónica Nicaragua	26,250	68	Result based on 15 site analyses. 50% energy cost can be saved by following the list of energy efficiency recommendations.

About the GSM Association

The GSMA represents the interests of mobile operators worldwide. Spanning 220 countries, the GSMA unites nearly 800 of the world's mobile operators, as well as more than 200 companies in the broader mobile ecosystem, including handset makers, software companies, equipment providers, Internet companies, and media and entertainment organisations. The GSMA also produces industry-leading events such as the Mobile World Congress and Mobile Asia Congress.

About the Development Fund Serving the underserved through mobile

The GSMA Development Fund brings together our mobile operator members, the wider mobile industry and the development community to drive commercial mobile services for underserved people in emerging markets. We identify opportunities for social, economic impact and stimulate the development of scalable, life-enhancing mobile services.

For more information on the GSMA's Green Power for Mobile, please email greenpower@gsm.org