

**BACKUP POWER FOR MOBILE TELECOMMUNICATIONS:
MARKET ANALYSIS FOR ALTERNATIVELY FUELLED GENERATORS IN
BRAZIL, ARGENTINA AND MEXICO**

by

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Abstract

The opportunity in the markets of Brazil, Argentina and Mexico for high-efficiency, low power (2.5kW and 5kW), alternatively fuelled, extended-run backup power generator products for the mobile telecommunications industry is assessed. Although mobile penetration is very high and mobile data use is growing rapidly, there are few drivers for extended-run back-up power system adoption in these markets. Grid power is reliable in each country. Regulatory attention is focussed elsewhere besides back-up power availability in Brazil and Mexico, and installation of extended-run back-up in Brazil and Mexico is infrequent, limiting the opportunity for alternatively fuelled generator products. Despite its poor macroeconomic climate, Argentina appears to be the most attractive market, driven by government regulation requiring extended-run back-up power at all mobile network sites. Due to its dominance in Mexico, unique strategy in Brazil and major presence in Argentina, América Móvil is the recommended target customer.

Keywords: Extended-run backup power generator; power generation; mobile telecommunications infrastructure; Brazil; Argentina; Mexico.

Executive Summary

Unceasing growth in the use of mobile telecommunications world-wide for both voice and data has created a significant market for dedicated backup power systems to keep networks functioning during grid power outages. Batteries are used to provide one or more hours of back-up power for most mobile telco base station radios, and in areas with reliable power grids, this battery back-up is normally eight hours or less. For extended-run capability, diesel gensets are commonly used, however they generally have disadvantages of low efficiency, noise, pollution, high weight and vibration, high maintenance requirements and poor reliability. Low power, high efficiency, extended-run backup power generator products that run on methanol or hydrogen are an alternative that enjoy growing acceptance in the US, European and Asian markets. At the request of a generator manufacturer, the market opportunity for these products in the largest economies of Latin America – Brazil, Mexico and Argentina – was assessed.

Favourable drivers for adoption of telco back-up power systems in these markets include:

- high mobile penetration, nearing or exceeding 100% in each market;
- increasing use of mobile networks for voice and data communications, and growing economic and social reliance these communications;
- Growing importance of telecommunications as a proportion of overall economic output;
- Reliance on mobile telco as the dominant form of internet access;
- Growing demand for telco infrastructure, as data volume increases and becomes an ever-larger portion of carrier revenues

Present or likely future limitations in the size of the market, and barriers to growth for low-power extended-run backup power generator products include the following:

- High grid power availability and reliability, and low average duration of outages in all three markets – resulting in part from the low prevalence of natural disasters;
- Very low adoption of extended-run back-up, including diesel, in Brazil and Mexico;
- An industry trend to “coopetition” in use of passive infrastructure, including sharing of tower infrastructure through the use of third party “tower companies” in Brazil and Mexico and likely in the future, in Argentina.

- In Brazil, competition extends to shared-use of diesel gensets, and this trend may occur or take hold in Mexico and Argentina;
- Growth in telco system capacities and power demand at individual sites to levels beyond that which can be served by small generators;
- Lack of regulatory attention to back-up power availability in Brazil and Mexico;
- A desire for quick payback, typically two years or less, on project investments by telco industry decision makers, hampering addition of systems with higher initial costs even when lifecycle costs and return on investment are superior to existing technologies;
- Weakening economic conditions in Brazil and poor conditions in Argentina.

Despite its very poor macroeconomic environment, Argentina appears to be the most attractive market of the three - driven by government regulation requiring extended-run back-up power at all mobile network sites. The market also appears to have very low use of shared infrastructure and a resulting higher prevalence of low-power, unshared sites. In contrast, Mexico and Brazil do not have strong drivers for adoption, and the opportunity is limited to very low sales volumes. Because available information regarding the Argentinean market was limited, further investigation is required, and limited sales should be expected in the near term. Furthermore, because the opportunities appear small in Brazil and Mexico, the best channel to market in each market is to go “direct to market”, as volumes are likely to be too low to support intermediaries or capture the interest of distributors in the near term. Where demand for extended back-up products proves real, use of a local distributor is recommended, and if sufficient sales if traction is gained, a local sales employee or sales agent who best understands the local market and who can best represent the interests of the manufacturer is further recommended.

The most desirable customer is América Móvil, due to its near-monopoly position in Mexico, unique strategy in Brazil, and strong presence in Argentina. In Brazil and Mexico, the Tower companies, particularly American Tower, are an important factor in the business environment. Factors for back-up power system manufacturers to monitor in the future include:

- Passing of laws forcing more competition in Mexico,
- Simplification and standardization of tower laws in Brazil,
- The unstable macroeconomic climate and Argentina.
- Increasing importance of small roof-top sites, for which small efficient generators are better suited. As this segment grows, companies other than Móvil, particularly Telefonica which is active in all three countries, should be targeted.

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Glossary

Base Transceiver Station (BTS)	Two-way radio equipment that facilitates wireless communication between user equipment, such as mobile phones, and a telecommunications network
Cell site	A location where antennas and electronic communications equipment telephone including BTS are located, usually with one or more radio antennas on a radio mast, tower or other high place, to create one or more cells in cellular networks.
Operator / Carrier / Service Provider / Mobile Network Operator (MNO)	A mobile network operator, or “operator” herein, also known as a wireless service provider, wireless carrier, cellular company, or mobile network carrier, is a provider of wireless telecommunications and data communications services.
Passive Infrastructure	Equipment that does not handle voice and data communications. Includes the cell phone tower, cell phone tower site real estate, and back-up power systems (where used).
SAIDI	System Average Interruption Duration Index - a common measure of Grid Power system reliability; the average outage duration for each customer served (hours/year)
SAIFI	System Average Interruption Frequency Index - a common measure of Grid Power system reliability; the average number of interruptions that a customer experiences (events per year).
Telco	Mobile telecommunications (cellular phones and cellular data) service provider (also known as “operator”).
Tower	Often used interchangeably with the term “cell site” or “base station”, tower is more properly used to refer to a radio antenna tower for base transceiver station antennas for mobile telecommunications; a.k.a. “cell phone tower”. Colloquially, tower is often used to describe a cell site, regardless of whether a tower is actually used, or of the antenna is actually mounted on the side of a building or on a similar non-tower structure. Most base transceiver station antennas are mounted on towers, either large freestanding towers or small rooftop towers.
Tower Company	A company that specializes in ownership of passive infrastructure for the mobile telco industry, and in particular owns or manages towers and sites at which telcos rent space for their radio network equipment.
Wireless Penetration	Mobile subscribers as a percentage of country population. Can exceed 100% where subscribers have more than 1 device or more than one SIM card.

List of Key Telco Industry Companies in Latin America

American Tower	The largest <i>tower company</i> in Mexico and Brazil; smaller competitors in Brazil include SBA Communications and BR Towers
América Móvil	Mexico-based multinational telco carrier América Móvil, S.A.B. de C.V. Parent of <i>Claro</i> and <i>Telcel</i> .
Claro, Claro Americas	Subsidiary <i>América Móvil</i> , operating in many Latin American countries including Brazil and in Argentina.
Telcel	Subsidiary of <i>América Móvil</i> , operating in Mexico.
Telefónica S.A	Spanish-based multinational telco carrier, operating in Spain and many Latin American countries. Parent of <i>Movistar</i> and <i>Vivo</i> .
Movistar	A major mobile phone telco owned by Spanish-based Telefónica, operating in Spain and many Latin American countries, including Mexico and Argentina.
Vivo	Legally known as Telefônica Brasil, Vivo is the consumer trade name of the Brazilian subsidiary of Telefónica

1: Introduction and Project Objective

Unceasing growth in, and societal and economic dependence on the use of mobile telecommunications for both voice and data has created a significant market for dedicated backup power systems which keep networks functioning during grid power outages. While batteries are typically used to provide one or more hours of back-up power for most mobile telco base transceiver stations, in areas with fairly reliable power grids, this battery back-up is normally limited to less than eight hours, often much less. For extended run capability, 10kW to 40 kW diesel gensets are commonly used, however they have disadvantages of low efficiency, noise, diesel exhaust pollution, high weight and vibration when operating. Furthermore, the diesel fuel, diesel gensets, and even the batteries and copper interconnection wires and bus bars are prone to theft in many markets. Low power, high efficiency, extended-run backup power generator products that run on methanol or hydrogen are an alternative that enjoy growing acceptance in the US, European and Asian markets. At the request of a generator manufacturer, the market opportunity for these products in the largest economies of Latin America, Brazil, Mexico and Argentina was assessed. This report provides a partial summary of key findings of that assessment.

The objective of the capstone project was to perform a market analysis of the opportunity for high-efficiency Methanol and Hydrogen fuelled power generator products designed for extended-run backup in Mexico, Argentina and Brazil. This includes an assessment of the size and value of the opportunity along with the directional information regarding the cost and timeline necessary to access it in each of the countries. A secondary objective was to provide recommendations on preferred channel access and efficient product delivery systems. Factors for consideration include the competitive conditions, tax situation, enablers and barriers to entering the markets and feasibility of entering the markets.

2: Industry Analysis

2.1 Mobile Telco Operator Infrastructure

Telco operators own or rent space at tower or rooftop sites where mobile network base transceiver stations are located. In Latin America, the telco operator may own the entire site and all of the equipment, or may rent space at a site managed or owned by a tower company. Figure 1 illustrates an example of a tower site managed by a tower company. Most of the equipment besides the tower itself is the responsibility of the tenant telco operators.

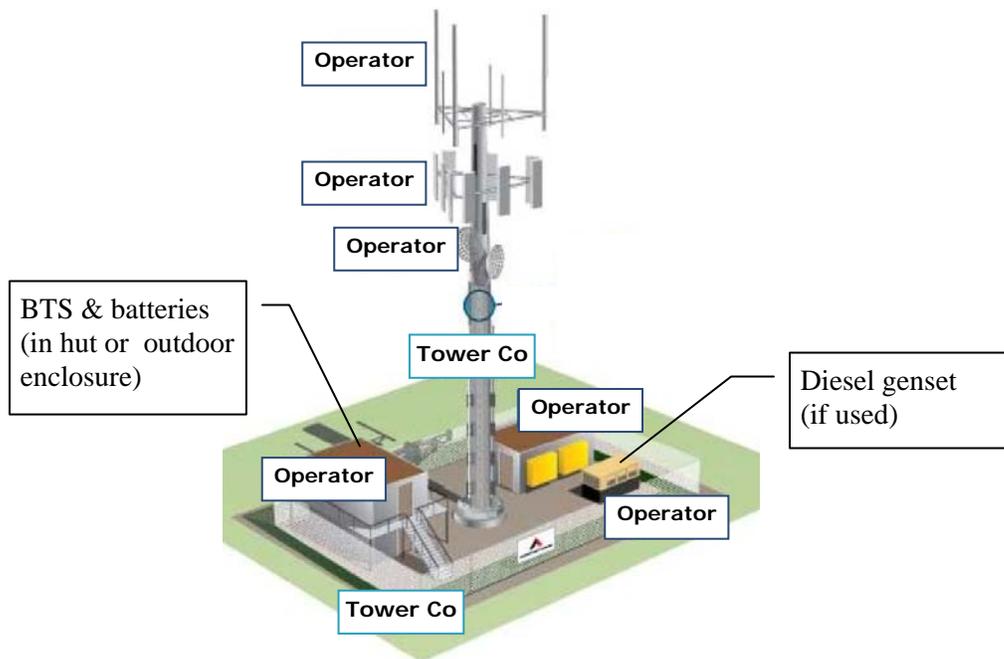


Figure 1, Sample Outsourced Tower Site

(Adapted from American Tower, 2013a)

Sites managed by towercos often host competing tenant operators, allowing the tenants to reduce costs by engaging in “coopetition”. A large tower will typically be constructed with capacity for four or more tenants. Tenant operators will provide their own Antenna equipment, including microwave equipment, cables, and backup power. In Latin America, tenants may use shelters containing indoor base-station equipment, battery back-up equipment, and HVAC, which the tenants themselves own, operate and maintain. When used for back-up power, diesel gensets are installed, owned and operated by tenants in the Latin American business model.

2.2 Rooftop vs Tower Sites

The number of tower sites in each market is known well. However, it is difficult to estimate the number of rooftop sites. Worldwide, there are likely more rooftop sites than towers, but in many less developed markets, tower sites dominate. In developed urban areas of Latin America, the numbers are estimated to be similar, but this estimate is provided with low confidence.

2.3 Evolving Mobile Telco Operator Business Model

Key activities in the telco operator business include:

- provisioning and network development
- network management
- operations
- marketing and product development
- sales
- service delivery
- customer care
- billing and collection.

Telcos were traditionally highly integrated and some have remained so, while others have outsource many of these activities – often the network development, network management, and operations cost drivers, as well as billing and collection – in recent years. The highly-outsourced companies can focus on competencies visible to the customer, and which tend to be variable-cost revenue drivers. A recent trend in outsourcing, including in Mexico and Brazil, is the divestiture of tower infrastructure. Out of approximately 100,000 towers in Brazil, Argentina and Mexico (author’s estimate), in 2011, approximately 7,287 towers were sold, in Brazil, Mexico. In

particular, Telefonica actively divested its portfolios across the region in continuation from the previous year. In 2012, 6,378 towers were divested, with 5,420 of them in Brazil. In 2013, the trend continued: in Brazil 12,369 towers were sold and 1,666 in Mexico. (Tower Xchange, 2014a).

The divestiture of sites frees up capital for spending on the higher-return areas of network development. - network upgrades to 3G and 4G. The divested sites became available as “third party shared sites” where more than one operator could become a tenant. Sharing at 3rd party sites offers lower transaction costs than attempting to do business with a direct competitor at a carrier owned and managed site – thus the participating operators used divestiture of sites to engaging in cooperation to share and reduce fixed costs.

In contrast to many regions in the world, the shared site model does not extend to outsourcing of the power supply or the back-up power. In Latin America, each carrier provides their own back-up equipment (Tower Xchange, 2014c). In Mexico, the competing carriers except for dominant player Telcel/America Móvil, generally rely on shared sites, but they provide their own back-up, and use of diesel for back-up is very rare. In Brazil, the carriers that use shared sites (Vivo/Telefonica, Tim, Oic - each major carrier except Claro/America Móvil) provide their own battery back-up, but also informally share access to diesel gensets in the rare instances in which one of them installs such equipment. It appears that deregulation in Argentina has not yet lead to widespread sharing divestiture and of tower sites, and that necessarily, each operator provides their own back-up – if back-up is installed.

Shared site infrastructure (including back-up power) , in addition to shared towers, is a model being adopted in other regions of the world, and may offer as much as 150% of the savings offered by only sharing towers (Madden, J. and Kaul, A., 2010); this will be an important trend to watch for in the future in Latin American markets. Carriers in some markets are realizing even more substantial savings by sharing backhaul and sharing network capacity – it is likely that carriers in Latin America will not ignore these opportunities in the future.

2.4 Use of Back-up Power and Relevance of the Shared Site Model

Carriers typically may opt to install one or more hours of battery back-up, but seldom more than eight hours in areas where the power grid is reliable. To address the very occasional longer outages, some carriers may elect to install back-up generators, but usually at only very high-revenue sites – sites with extremely high call density, or a high level of high-revenue service, such as international calling at tourist sites, or sites with very high data usage.

At sites that are not shared, there is often only one BTS installed, and a small 5kW or 2.5kW generator may provide an attractive alternative to:

- not installing extended-back-up capability – which may lead to loss of revenue or, in areas where regulation mandates back-up capability, penalties if the power is lost
- installing more than 8 hrs worth of batteries – which is expensive relative to the cost of stand-by diesel, and which exposes a very high value battery installation value to battery theft
- installing a diesel back-up generator – which will run inefficiently at the idle loads (a genset is typically 10-40 kW and will run inefficiently and poorly at loads of 5kw or less). The diesel is prone to theft (both administrative theft and opportunistic theft) and the diesel genset itself is prone to theft in many markets. In the case of small roof-top installations, gensets may be particularly unsuitable due to the weight, noise and vibrations.

At shared sites, if the operators are prone to sharing back-up generators, the overall load would exceed 5kW, and a small 2.5kW or 5kW generator would be unsuitable.

2.5 Competitiveness of Small Extended-Run Back-Up Power Generators

2.5.1 Total Economic Value - Cost and Revenue Drivers vs. Pure Battery Back-Up

The power grid is reliable enough, and the revenues low enough that there is little economic justification for *any* extended (>8hrs) back-up capability at most sites in the target markets. We do not have access to carrier revenue histograms by site; but we may reasonably estimate the fraction of sites that have high enough revenues to justify installation of extended-run back back-up by counting those sites that already do have extended-back-up systems (diesel-plus-battery) installed. An exception is the Argentinean market, where regulation may incentives back-up of most of the market.

2.5.2 Total Economic Value - Cost and Revenue Drivers vs. Diesel-Plus-Battery Back-Up

The small (5kw and 2.5kW) extended-run back-up power generators offer the following impacts in cost and revenue drivers, as compared to the use of Diesel back-up plus batteries.

Cost Drivers

- Comparable initial capital cost
- Reduction in battery replacement cost (reduced re-curing capital cost)

- Reduction in Operation & Maintenance (reduced operating costs for parts)
- Reduction in Operation & Maintenance (reduced operating costs for labour)
- Reduced Fuel Cost
- Reduction in Genset and Diesel Fuel theft, reduced battery theft (reduced operating costs, consumables and labour)

Revenue Driver

- Increased usage of network (downtime reduction; higher revenues)

2.5.3 Value / Breakeven Analysis: Small Generator vs. Diesel-Plus-Battery back-up.

While the initial price of the small generator solution is comparable to a Diesel GenSet-and-Battery system, and the recurring costs are lower, the price point needs to be more competitive to break substitution barrier. Latin American Telcos will likely continue to use technology with which they are familiar, until “up front” costs are demonstrably lower, or payback times are significantly lower than two years.

3: Evaluation of Market Size and Attractiveness

3.1 Market Evaluation Criteria

The following criteria were used to evaluate the attractiveness of the market in each country:

3.1.1 Country Economic Attractiveness

- What are the country specific macro and micro economic conditions, and do they incent or discourage the need for extended back up power?
- What are the telco service providers economic decision criteria for purchasing extended back-up power?

3.1.2 Regulatory Environment

- Are the regulations for telco carriers that impact provision of back-up power?
- What are the regulations for tower operators?
- Do the regulations incent or discourage need for extended low-power extended-run back up power systems?
- If relevant, are the regulations enforced?

3.1.3 Opportunity

- What is the grid reliability and prevalence of natural disasters (e.g., hurricanes) that impact grid reliability?
- What is the country social and economic dependency on mobile communications?
- What is the current number of sites – or Total Addressable Market (TAM) - in each country?

- What is the Served Available Market (SAM) in each country: what is the current number of suitable sites – sites with extended backup power needs in the power range and type suitable for small 5kW and 2.5kW generators?
- Who is the Target Market – who are the most likely buyers?
- What is the forecasted growth in mobile usage, and sites. What is the forecasted type of growth in sites (e.g. large multi-tenant towers vs. small rooftops installations)?

3.2 Country Overview – Brazil

Table 1, Brazil Economic and Telco Industry Overview

Economic Outlook:	Weak, and falling	<i>Rising inflation, gov't debt, falling productivity</i>
Telco Net Revenue:	\$73 billion	
Wireless Subscriptions:	>270 million	2007-2013 CAGR: 16%
Wireless Penetration:	136%	2007-2013 CAGR: 15%
Data as a Fraction of Revenue	27%	2013Q3
Industry Attributes	<p>Over-saturated networks, poor service quality.</p> <p>There is little competition for internet access, TV, or voice communications (mobile dominates over other electronic communications media).</p> <p>Carriers have high difficulty setting up new sites; many or most sites are illegally installed. Back-up and theft are tertiary concerns.</p>	
Regulation	<p>New "Law of Towers" may streamline permitting.</p> <p>No regulation requiring back-up capability.</p> <p>No import duty for methanol or hydrogen fuelled generators.</p>	
Carriers	Subscriber Market Share	Business Model
Claro (America Móvil)	25% ^{1,3}	Integrated, not sharing
Vivo (Telefonica)	28% ^{1,3}	Shared infrastructure
TIM (Telecom Italia)	27% ^{1,3}	Shared infrastructure
Oi	18% ^{1,3}	Shared infrastructure
Grid Power Reliability ²	High: Saidi 18 hrs/year; SAIFI 11 outages/year	
Prevalence of Natural Disasters	Low	
Sites	75,000 tower sites, likely smaller number of rooftop sites	
High revenue sites	< 90% (urban markets) ⁴	
Penetration of Extended Back-up in high revenue markets	1% (estimated) ⁵ : < 1000 sites	
Suitable desirable sites:	<< 1000 sites (estimate) ⁶	

Notes / Sources:

1. American Tower, 2013
2. World Bank, 2005.
3. Teleco, 2014b.
4. Tower Xchange, 2014b.
5. Estimate – source withheld; low confidence.
6. Estimate, based on figures above. Desirable sites excludes sites with multiple voltage needs or high inrush loads (as caused by a/c).

3.3 Country Overview – Mexico

Table 2, Mexico Economic and Telco Industry Overview

Economic Outlook:	Good: Steady growth; low Inflation	
Telco Net Revenue:	\$27 billion ¹	
Wireless Subscriptions:	>103 million ²	2007 – 2Q13 CAGR: 8% ²
Wireless Penetration:	>90% ²	2007 – 2Q13 CAGR: 6% ² <i>Additional room for growth</i>
Data as a Fraction of Revenue	37% ²	2013Q3 ²
Industry Attributes	<p>Most customers are prepaid; revenue is collected regardless of service level provided.</p> <p>Low competition for internet access, TV, or voice communications (mobile dominates over other media).</p> <p>Telcel is a monopolistic carrier; competitors have high barriers to entry, difficulty setting up cell sites</p> <p>Theft of copper and batteries³ and of diesel fuel and gensets, are substantial problems.</p>	
Industry Regulation:	Focussed on opening up completion, not back-up.	
Carriers	Subscriber Market Share	Business Model
Telcel (America Móvil)	70% ²	Integrated, not sharing ³
Movistar (Telefonica)	19% ²	Shared infrastructure ³
USACELL	7% ²	Shared infrastructure ³
Nextel	4% ²	Shared infrastructure ³
Grid Power Reliability	High: SAIDI 2-4 hrs/year; SAIFI 2-3 outages/year ⁴	
Prevalence of Natural Disasters	Low	
Sites	25,000 Towers and a much smaller no. of rooftop	
High revenue sites	Unknown	
Penetration of Extended Back-up in high revenue markets	1% (estimated) ⁵ : ~ 250-500 sites	
Suitable desirable sites:	<< 500 sites (estimate)	

Notes / Sources:

1. Teleco, 2013b.
2. American Tower, 2013.
3. Tower Xchange, 2013.
4. Tower Xchange, 2014d.
5. “Indicators CFE and LFC; Mexico Department of Energy”, 2009.
6. Estimate – no data to corroborate, may be *very low*.

3.4 Country Overview – Argentina

Table 3, Argentina Economic and Telco Industry Overview

Economic Outlook:	Poor: very high inflation ¹	
Telco Net Revenue:	\$17 billion	
Wireless Subscriptions:	61 million	1 Yr. Growth – 5%
Wireless Penetration:	150%	
Industry Attributes	<p>Most customers are prepaid; revenue is collected regardless of service level provided.</p> <p>Argentina’s smartphone market is expected to outperform all other markets in the region.</p> <p>[Diesel] “fuel theft is a major problem” ²</p>	
Industry Regulation:	<p>Regulation requires 24hrs availability of back-at at all sites. ³</p> <p>Compliance is unknown.</p> <p>Regulation promotes use of Hydrogen as energy fuel. ⁴</p>	
Carriers	Subscriber Market Share	Business Model
Claro (America Móvil)	35% ⁵	Integrated, not sharing ⁶
TIM (Telecom Italia)	31% ⁵	Integrated, not sharing ⁶
Movistar (Telefonica)	31% ⁵	Integrated, not sharing ⁶
Nextel	3% ⁵	Unknown
Grid Power Reliability	High: SAIDI 5.25 hrs/year; SAIFI 5.15 outages/year ⁷	
Prevalence of Natural Disasters	Low	
Sites	15,000 – 30,000 ⁸	
High revenue sites	Unknown	
Penetration of Extended Back-up	As high as 100% ⁹	
Suitable desirable sites:	< 15,000 sites (estimate)	

Notes / Sources:

1. The Economist, 2014
2. Tower Xchange, 2013.
3. “Secretaría de Comunicaciones – Telecomunicaciones - Resolución 1/2013”
4. Barreiro, M.J., 2010.
5. Teleco, 2014.
6. Author’s inference – no evidence of site sharing found.
7. World Bank, 2005.
8. Author’s estimate based on population and cellular penetration data, and regional saturation rates.
9. Assumes compliance with government regulation requiring back-up.

3.5 Country Analysis – Brazil

Refer to Table 1, Brazil Economic and Telco Industry Overview.

3.5.1 Country Economic Attractiveness

Penetration rates exceed 100% and growth of the “mobile economy” and the “digital economy” continues. Social and economic dependence on mobile networks is high. Dependence on mobile for internet access is substantial. Despite the declining macroeconomic conditions, industry growth renders Brazil a favourable telecommunications market in general.

3.5.2 Regulatory:

Brazilian carriers offer notoriously poor service, with extremely high dropped call rates. Network infrastructure is insufficient to meet call demand. An unworkable regulatory environment that makes permitting new tower sites nearly impossible. The market expansion for small roof-top sites – which would favour use of small back-up power systems over gensets or large battery banks – should be investigated further.

Regulatory attention is focussed on penalizing the carriers for poor call quality and dropped calls, as well as streamlining the tower approval process; a new “Law of Towers” is due for approval in 2014. Regulators are not focussed on back-up power availability at sites, as service outages (power outages that exceed the typical battery back-up capability) are rare.

Import duties for methanol and hydrogen-fuelled generators are very low.

3.5.3 Opportunity:

The TAM is approximately 75,000 sites. However, grid power is reliable in Brazil, and as few as 1% of urban sites are backed up with diesel gensets, despite this being one of the most over-subscribed (high subscribers and call volumes per site) markets. Prepaid plans dominate, so outages do affect revenues much. Carriers typically install only 2-4 hrs of batteries. The major carriers, except Claro, share sites, and, where extended-back-up (diesel gensets) is used, the carriers tend to share the equipment. This renders only Claro likely to have tower sites where the total load may be back-ed up by small (5kW or less) generators. Insufficient data is available to assess the prevalence and possible trend towards expansion by small rooftop installations.

Rural sites, approximately ten percent of the market (<10,000 sites) generally lack the population density and revenue density needed to justify back-up power on economic terms.

3.6 Country Analysis – Mexico

Refer to Table 2, Mexico Economic and Telco Industry Overview.

3.6.1 Country Economic Attractiveness

Mexico has a positive economic outlook, due to its continued economic growth, competitive labour, and integration with the Canada-USA Economy.

3.6.2 Regulatory:

Because of Telcel's near monopoly and the barriers faced by Telcel's competitors, subscriber rates (prices) uncompetitive. Regulatory attention is focussed on opening up the market, and potentially forcing Telcel to share access to its passive and even active infrastructure. As the regulations have not yet been passed, uncertainty in the market is causing carriers to delay near term infrastructure upgrades (Tower Xchange, 2014d).

3.6.3 Opportunity:

There is substantial opportunity for continued growth and increasingly vigorous competition in the mobile sector. Grid power is reliable in Mexico. Research suggest that as few as 1% of sites are backed up with diesel gensets, although conflicting anecdotal evidence suggests that the actual use of extended-run back-up may be far higher. Prepaid plans dominate, so outages do not affect revenues much. Only the dominant carrier, Telcel, installs substantial battery back-up at sites, and this is typically limited to 8 hrs. Therefore, the market for extended back-up is extremely small - the total number of target sites is likely in the hundreds.

The major carriers, except Telcel, face substantial barriers to entry in populated regions, in that they lack real-estate for new tower sites – so they are economically and strategically inclined to share sites. This renders only Telcel likely to have tower sites where the total load may be back-ed up by small (5kW or less) generators. Insufficient data is available to assess the prevalence and possible trend towards shared back-up at the shared sites, but this is a possible negative trend to watch in future, as the total loads at shared sites would exceed the capacity of small 5kW or 2.5kW generators.

Given the barriers to expansion by traditional towers, expansion by small rooftop sites may become an emerging trend. The potential growth of small roof-top sites – which favours use of small back-up power systems over gensets or large battery banks – should be investigated .

3.7 Country Analysis – Argentina

Refer to Table 3, Argentina Economic and Telco Industry Overview

3.7.1 Economic Attractiveness

Argentina has a very poor economic outlook. Inflation is extremely high and the government continues to pursue anti-competitive measures.

3.7.2 Regulatory:

Argentina has aggressive laws requiring the availability of 24hrs of back-up at every cell site, and issues cursing penalties for companies that have service outages. This may prove the strongest incentive for adoption of extended-run back-up power in all of Latin America. However, it is not clear if the regulations are enforced and if they have an actual effect on the market. Further investigation is required.

Argentina also has regulations favouring the use of hydrogen as an energy fuel.

3.7.3 Opportunity:

Grid power is very reliable in Argentina. Despite extremely high penetration rates and very high usage of mobile data, without regulation, there is little economic incentive to provide back-up power at many sites, except that provided by regulatory pressure.

The total addressable market is estimated to be in the order of 15,000 tower sites and a smaller number of rooftop sites, based on comparison of mobile market size with Brazil and Mexico. Despite a wealth of data regarding 3rd-party tower infrastructure and carrier divestiture of tower in Latin America, no evidence that the carriers share passive infrastructure in Argentina was found. This suggests that the carriers are still as integrated operations, and that there may be a great many unshared sites with single BTS installations, which would more likely than in other markets to favour the use of small generators over diesel, where extended-run back-up is used. Thus, to the extent that extended-run back-up is used, Argentina is a particularly attractive market for small generators relative to diesel gensets. [Diesel] fuel theft is reported to be a “major problem” (Tower Xchange, 2013), which anecdotally corroborates the suggestion that there is a significant population of sites backed up with diesel in this market.

If the regulatory pressure for backup has a strong effect – if it drives adoption of extended-run back-up power generators, the target market may number in the many thousands.

Claro (Móvil) is a major player in Argentina, and given that the Móvil companies are the preferred target customer in Brazil and Mexico, it makes to pursue Claro in Argentina first as well, to the extent that supplier decisions are influenced or determined at the corporate level.

3.8 Country Market Assessment Summary Table

Table 4, Summary of Market Assessment, by Country

	Brazil	Mexico	Argentina
High-volume sites	> 75,000	>25,000	> 15,000
High Revenue Sites	Many	Many	Many
Economic drivers for extended-run back-up? (Already use Extended-run back-up?)	~1%	~ 1%	?
Favourable Type (power, load type) and Location (unshared site)	Many	Many	Many
Unreliable Grid	No	No	No
Favourable risk posed by natural disasters	Low	Low	Low
Favourable Telco Regulation	No	No	YES
Regulation Enforced?	N/A	N/A	?
Target Market (number of target sites)	Hundreds	Hundreds	<i>Thousands</i> ?
Other Favourable Regulation?	yes (low import duty)	yes (low import duty)	yes (H ₂ fuel incentives)
Favourable macroeconomic climate	~	yes	no
Likely near-term opportunity	Very Small	Very Small	Investigate

3.9 The Future - Parameters to Monitor

3.9.1 Brazil

With the status quo in Brazil, Claro (Móvil) is the best target customer; it has a large market share and is the only carrier that strategically avoids sharing sites – thus it has the highest likelihood of possessing many small sites with loads compatible with small 5kW generators. The forthcoming *Law of Towers* is due to be enacted in 2014, and its release may spark a wave of growth (a release of pent-up demand) in the industry, but the outcome of the regulations could drive growth in large shared tower sites (unfavourable for small generators) or it might drive growth in small rooftop sites (favourable for small generators). In the long term, general

industrial growth in Brazil may outstrip improvements in the power supply, reducing power availability and increasing demand for back-up power, making the backup equipment market more favourable than it is now.

3.9.2 Mexico

The estimate of the rate of existing adoption of extended-run back-up at carrier sites, provided earlier in this report, power intuitively seems extremely very low. Use of back-up in Mexico should be investigated further, as the market may well be larger than is estimated herein. With the status quo in Mexico, Telcel is the best target customer, as it has the largest market share and is least likely to share sites. However, if a trend for other carriers to adopt more small roof-top installations exists or forms (as it has in other regions), then Movistar (Telefonica), the second-place player, would likely become the preferable target customer in Mexico.

Market uncertainty will continue until the new competition regulations are revealed and enacted in law, and till any resulting shake-up takes hold. These regulations may re-shape the market, and may also decrease the market for small generators, since the laws are likely to drive industry growth through shared usage of Telcel's sites, and expansion through additions piggybacking on Telcel's infrastructure rather than new small sites.

At present carriers do not outsource back-up to towercos in Latin America. But this trend is taking off in other regions, and should be monitored. It would negatively affect the portion of the shared-site market that does or could use small un-shared generators (where carriers might each have a small generator at a shared site, but could move to using a single large diesel generator operated by the towerco, if the telcos outsourced power back-up).

3.9.3 Argentina

Generator manufacturers should verify that in Argentina the regulations requiring back-up power are enforced, and if there is actually a resulting market for back-up power generators. If so, Argentina should be considered the primary target market, even though the economic outlook is grim. A trend to watch moving forward would be towards shared site usage models, as is happening in many other markets, which would decrease the attractiveness of this market for small generators.

4: Channel Analysis

While the near-term markets in Brazil and Mexico appear very small, Argentina may have the potential for significant volumes. As such, the preferred channel for accessing the markets by an American or Canadian manufacturer may vary from distributors to channels that require much higher equity stakes or direct operating costs which must be born by the manufacturer.

4.1 Comparison of Distribution Channel Models

Table 5, Distribution Model Comparison

	Direct Sales	Dealer / Reseller	Agent / Distributor	Joint Venture	Subsidiary
Model	Company employee sales person	Locally owned entity	Local, fee or commission based	Joint ownership local entity	Self-owned operation
Implications	High Alignment between Channel and manufacturer. Suits very low volumes or very high volumes. Customers wary of lack of local operations presence.	Typical Industry Practice. Able to balance retail management and distribution channel expansion. Distributor's local knowledge valuable. High mark-up and volumes needed to attract & retain interest of good dealer.	Advance product purchase unnecessary. Commission-based sales. Agent's local knowledge valuable. Interests more aligned than dealer.	More control of distribution. More flexibility to tackle inventory issues. Ease of Entry.	Stronger sales performance. Large investments. Preferred strategy of global brands. Suitable for high volume.

Local distributors can help market the generators. Distributors are better positioned to allow telco operators to rent or lease units to try before purchase units that will involve higher CAPEX. They may be in a better position to offer local technical service staff to provide on going support and services, and they are better positioned to allow creative supply arrangements, e.g. demo, rent, lease; easing CAPEX concerns and needs for quick payback targets (< 2 years with Latin American telcos). Distributors and local agents are more likely to have a better

understanding of local markets, and should be able to provide local technical support & training on short notice.

For lower volumes, many Latin American customers prefer dealing with local distributors; there is often a perception of market power over the distributors or dealers and believe they can negotiate harder than by dealing with a remotely based American or Canadian. Local distributors may be able to offer better payment terms and credit limits to customers than an American or Canadian entity is likely to grant.

A local sales person or agent can best help with: Sales specifications for the telcos, identifying preferable distributors to work with; provide training for distributors; handle claims in a way more comforting to the clients; locally monitor distributor performance; identify customers who fit a profile likely to buy directly from the manufacturer; better understand the local economical situation and regulations; work with local trade associations and governments entities, and to develop prospects and opportunities in other segments that the manufacturer may be active in.

Given the very low business opportunity anticipated in Brazil and Mexico, a minimalist approach to the sales channel – a local sales agent and/or an American-based sales person is recommended for all three markets. For Argentina, if the regulatory driver proves real and significant sales volumes materialize, then the manufacturer should consider dealing with a local distributor – preferably a distributor who is familiar with the local telco industry or familiar with alternate fuels, or both.

4.2 Market CAGE Distance from an American or Canadian Firm

Ghemawat's CAGE Distance Framework is used to identify Cultural, Administrative, Geographic and Economic differences between countries, and may be used when developing strategies for international business. Table 6 summarizes an assessment of the CAGE distance between a USA or Canadian based generator supplier and the markets of Brazil, Mexico and Argentina.

Table 6, CAGE Distance between USA/Canada and Brazil, Mexico and Argentina

	Overall Cage Score	Cultural Distance	Administrative Distance	Geographic Distance	Economic Distance
Brazil	Medium	Medium	Medium	High	Medium
Mexico	Medium-low	Medium-low	Medium-low	Low	Medium
Argentina	Medium-high	Medium	Medium	High	High

Key differences between the home market of USA/Canada and the targets of Brazil, Mexico and Argentina are Geographic, are Economic, and Administrative (in the case of Brazil and Argentina). In addressing the question of distribution channels, the administrative and cultural differences are likely to be important, including the cultural aspect described by Hall (Hall, 1976) in his theory of *high context* (Brazil, Mexico and Argentina) vs. *low context* cultures. The higher cultural distance between the home location (in USA or Canada) and Brazil and Argentina (in particular) and CAGE distance in general suggests that a firm should form a relationship with a local entity or develop a local agent or distributor sooner (i.e. with lower sales volumes) than would be the case for business expansion into "closer" similar markets, for example, Northern European countries.

5: Conclusion

5.1 Key Findings and Recommendations

Despite its poor macroeconomic environment, Argentina appears to be the most attractive market of the three countries - driven by government regulation requiring extended-run back-up power at all mobile network sites. This market also appears to have very low use of shared infrastructure, which would result in a higher population of low-power, unshared sites. Because available information regarding the Argentinean market was limited, further investigation is required, and limited sales should be expected in the near term.

In contrast to Argentina, Mexico and Brazil do not have strong drivers for adoption, and the opportunity is limited to very low sales volumes. Because the opportunity in Brazil and Mexico is small, and the best channel (to market) in each market is to go “direct to market”, as volumes are likely to be too low to support intermediaries or capture the interest of distributors in the near term. Where demand for extended back-up products proves real, use of a local distributor is recommended, and if sufficient sales if traction is gained, a local sales employee or sales agent who best understands the local market and who can best represents the interests of the manufacturer, and who can best manage “high-context relationships” is further recommended.

The preferred target customer América Móvil, due to its near-monopoly position in Mexico, unique strategy in Brazil and Mexico which increases the likelihood of Móvil having many small sites, and its strong presence in Argentina. In Brazil and Mexico, the Tower companies, particularly American Tower, are an important factor in the business environment. Factors for back-up power system manufacturers to monitor in the future include:

- Passing of laws forcing more competition in Mexico;
- Simplification and standardization of tower laws in Brazil;
- The unstable macroeconomic climate and Argentina, and a potential shift towards more shared infrastructure;
- Increasing importance of small roof-top sites, for which small efficient generators are better suited. As this segment grows, companies other than Móvil, - and particularly Telefónica which is active in all three countries, should be targeted.

- The trend in the global industry to outsourcing power back-up, especially at shared sites. This trend favours generators larger than 5kW; makers of small generators should consider pivoting or increase scope of their products to include models with larger power ratings.

5.2 Addressing Challenges Encountered During the Investigation

The research investigation and analysis supporting this paper was conducted as part of a team project. Several challenges were encountered by the consulting team, key amongst them:

- Working as a consulting group across both physical gaps (time zones, and geographic distances) as well as social gaps (national, cultural, demographic, and personal and stylistic differences) was a challenge.
- Difficulties conducting research remotely, in foreign languages and foreign countries.
- Lack of detailed knowledge regarding the value proposition(s) for the potential customers
- Lack of “voice of the customer”
- Difficulty obtaining market information
- Limited access to the client, and inefficiency of the “fresh eyes” approach.
- Working with widely varying estimates for information where data was not available.

The challenges encountered in attempting to work as a synergistic team while reaching across the many barriers and gaps between team members were significant. For the most part, these challenges were overcome by having each team member focus on areas of strength and interest, by taking stock of progress regularly, by regularly rebalancing work loads, and by collectively remaining flexible regarding the inevitable unanticipated constraints that need to be accommodated.

The most significant technical challenge that the team faced was starting the investigation in a “green” state - with little specific knowledge of the market, and no knowledge and little understanding of the “voice of the customer”, and little knowledge regarding the specific attributes of the client’s products that were actually driving sales in different markets. This challenge was increased by the client’s desire to have the consulting team approach the problem with “fresh eyes” rather than to capture the information and judgements were might have been available within the client organization and to assess the path forward from that point. The team was also unable to approach certain potential customers, and was unsuccessful at approaching experts or decision makers within potential customer organizations. Furthermore, it was found to

be difficult to get relevant specific types of information about the potential customer telco companies through internet and industry database searches.

To overcome this technical challenge, the team met with surrogates for the target customers – individuals active in organizations that were different (non customer) market players, and individuals from different but similar businesses, but who's area of knowledge overlapped with the specific market of interest – that for telco back-up power. Similarly, while certain types of information about the potential customers proved very difficult to obtain, related information was often much easier to obtain, and still proved useful. For example, information regarding use of rooftop sites by telcos is limited, but much is written about the tower business, so accessing this parallel knowledge channel helped move the investigation forward dramatically.

Appendices

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