Introduction

Mobile telecom operators in remote regions are beginning to shift from an expensive reliance on diesel fuel in favor of hybrid renewable energy systems that require higher CAPEX but afford lower OPEX. Deeply rooted structural changes in the telecom industry, rising diesel costs and declining solar and battery costs have catalyzed the shift. Long payback periods, split incentives among stakeholders and a lack of 'boots on the ground' to operate and maintain renewable energy systems in far-flung corners of the world has held back the opportunity to date. Most renewable energy service companies "RESCOs" in the telecom space are caught in the catch-22 of requiring scale to gain contracts, but unable to gain enough contracts to scale. However each of these issues are being addressed, and viable investment opportunities are emerging.

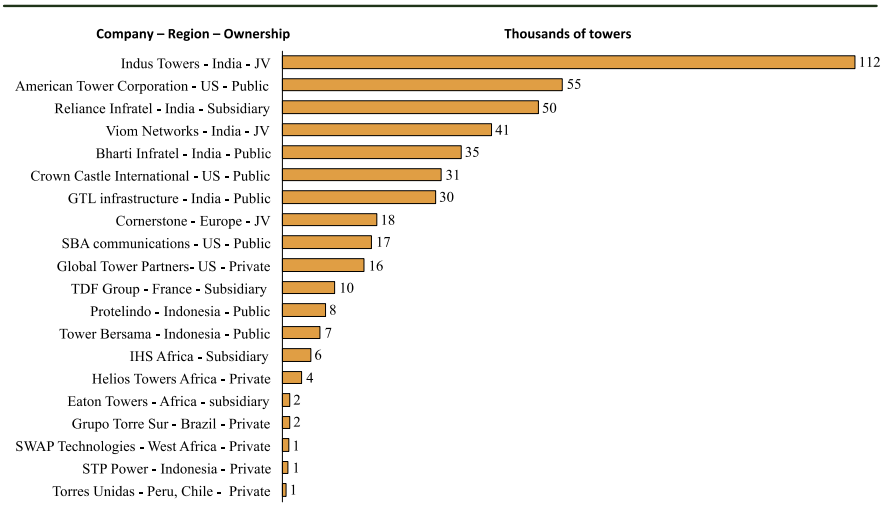
This report will explore the rapid rise of third-party telecom tower ownership, and the implications that this structural shift may have for emerging RESCOs. Our contention is that tower companies "TowerCos," as opposed to telecom operators, are better suited to accept the value-proposition of RESCOs and that the same industry dynamics that caused operators to sell their tower infrastructure to third parties will ultimately lead to further infrastructure outsourcing in the form of RESCOs.

Tower Power

Green telecom towers comprise just 1 percent of total towers worldwide.

Solar panels found their first commercial markets in the 1970's in space stations and satellites, and then progressed onto niche applications on earth, such as mobile telecom towers. It may then be surprising that, according to the Groupe Speciale Mobile Association (GSMA), 'green' telecom towers comprise just 1 percent of total towers worldwide. With an estimated 5 million towers worldwide, 3 million of which are in developing countries, 1-1.5 million of which are tied to unreliable grids and 640,000 of which are completely off-grid, only 55,000 towers are serviced with a hybrid mix of "green" energy technology *and* diesel generation sets. China Mobile Communications has installed nearly half of these green telecom towers. In terms of addressable market size, telecom towers consume the energy-equivalent of 1 percent of the world's electricity, costing up to $136bn per annum (MIT Technology Review). The industry's growth markets are largely in developing countries, where three out of every four new base stations will be deployed over the next decade[1], a significant portion of which will be constructed by TowerCos in off-grid locations – which is ideal for hybrid renewable energy systems.

Figure 1: International telecom tower companies "TowerCos"



Source: Saviva Research, tower company websites, Wireless Estimator, TowerXchange

[1] Analysys Mason, a telecommunications research firm.

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Industry dynamics

The two biggest operators in most mobile markets earn all of the profit.

The global telecom industry reinvests 15 percent of annual revenues in CAPEX – just 0.02 percent less than the electric utility industry, which is the most capital-intensive segment of the economy (GSMA). Network upgrades, coverage build-out, spectrum purchases, O&M, R&D and a brick-and-mortar sales approach all require tremendous cash investments. As a result of the efficiencies of scale implied by such capital intensity, the two biggest operators in most mobile markets earn almost all of the profit. In Europe the biggest companies, including UK-based Vodafone Group, Spain's Telefonica, Deutsche Telekom and France Telecom dominate, while a long list of smaller operators struggle to stay afloat. A similar dynamic exists in the U.S. Research from Sanford and Bernstein estimates that AT&T and Verizon have collectively invested $89bn upgrading their networks and $20bn buying spectrum over the past four years, which is close to five times that of their two closest competitors, T-Mobile and Sprint, combined. Much to the chagrin of regulators, the telecom industry is economically structured to favor the largest operators in each market.

These dynamics have resulted in unprecedented M&A activity in the global telecom markets. In the U.S. alone, Dealogic reports that there has already been $49bn in wireless M&A deals announced in 2013, on top of $53bn of transactions for the whole of 2012. In an effort to free-up cash for re-investment in higher margin activities, telecom-operating companies have begun to sell their tower infrastructure assets. Within the past five years, specialized infrastructure companies known as 'TowerCos' have emerged around the world to buy tower infrastructure from operators and then lease back their services. Large private equity firms have backed a number of independent TowerCos that are pursuing multi-hundred million-dollar tower portfolio sale-leaseback deals. The availability of low-cost debt over the past five years has supported this wave of asset acquisitions.

TowerCos own 10 to 15 percent of the towers in the world, and are on track to own a much larger share over the coming years.

All told, an estimated 10 to15 percent of the towers in the world are now owned and operated by third-party TowerCos. In India, telecom towers have gone from entirely operator owned to 90 percent third-party owned in the last five years. In the U.S., the penetration has reached 50-60 percent over a longer timeframe. The European market has been slow to accept independent TowerCos; instead operators have chosen to form joint ventures. The 54 nations that comprise the African telecom market have just begun to transition towards TowerCos, with third-party ownership estimated to be between 10 percent and 15 percent of the total market. Some industry experts expect the Africa TowerCo market to follow a trajectory similar to that of India, i.e. a rapid transition to third party ownership. The Indonesian market is now 40-50 percent owned by TowerCos, driven by government regulations mandating tower sharing in urban environments, along with the need to team up to cover the cost of 3G rollouts in rural regions. Telecoms in Brazil, Peru and Chile have begun to outsource their infrastructure as well, with small 1,000-2,000 tower deals beginning to be completed.

The emergence of TowerCos

The liberalization of the telecom sector is a relatively new phenomenon. Only a decade ago, the outsourcing of strategic infrastructure including towers, network management and call-centers would have been unthinkable to operators, most of which were vertically integrated. The change has been driven by two megatrends:

1) The explosive growth of data-enabled services has forced operators to free up cash to upgrade network equipment from 2G to 3G to 4G at shorter intervals between generations.

2) Average revenues per user (ARPU) have steadily declined around the world – compressing margins in the process.

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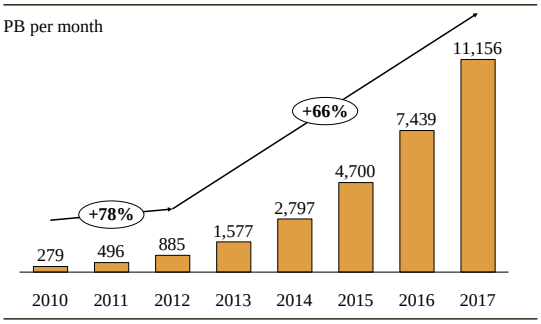
Declining ARPUs and explosive data growth have forced telecom operators to sell assets to generate cash.

Table 1: Average revenue per user (USD)

Region	2008	2009	2010	2011	2012	CAGR
Africa	12.2	10.6	10.8	8.8	7.9	-10%
CIS	9.8	8.1	8.6	8.7	8.8	-2%
Asia Pacific	11.8	11.1	9.7	9.3	9.1	-6%
Latin America	13.7	12	11.9	11.5	11.4	-5%
Middle East	16.3	16.9	16.2	16	15.7	-1%
Europe	31.7	29.4	27.1	27	23.2	-7%
North America	52.8	51.3	49.9	49.9	49.8	-1%
Others	20.4	14.4	13	12.1	10.6	-15%

Source: GSMA

Figure 2: Global Mobile Data Traffic



Source: GSMA, Cisco, VNL 2013, A.T Kearney

Developing regions with the lowest ARPUs were the first to embrace tower outsourcing as a means for telecom operators to generate cash to expand networks and capture market share. India led the way when Bharti Airtel, Vodafone and Idea created Indus Towers through a privately held joint venture in 2008. Although privately held, Indus remains the largest TowerCo in the world (Figure 1). The joint venture model worked well early on in the outsourcing wave – particularly in less economically developed geographies where new operators needed to quickly roll out new networks and were distrustful of untested third-party TowerCos.

Table 2: Telecom tower infrastructure

Active components	Passive components
Spectrum	Steel tower
Microwave radio equipment	Shelters
Switches	Electrical supply
Antennas	Batteries
Transceivers	Air-conditioners

In more developed economies, early forms of telecom infrastructure sharing began over a decade ago with government-mandated network roaming schemes. Dual-site sharing, i.e. placing two towers in a plot of land, soon followed suit in urban environments as a response to expensive easement rights. Cutting back to one tower by sharing passive infrastructure such as steel masts, energy equipment and land was the natural next step in this outsourcing process. Some believe that active infrastructure sharing, which includes antennae, spectrum and licensed radio communication electronics (i.e. 3G or 4G) will become the industry norm in rural regions as well as highly populous regions. In Spain, Orange and Vodaphone have taken this approach to decrease the cost of 3G deployments in more remote areas.

Operators can save 30 to 40 percent of their network costs by teaming up to share their infrastructure.

The business case for operators to share passive infrastructure is simple: By teaming up with competitors through a joint venture, operators can save 30-40 percent of the expense of building, running and maintaining networks.[2] For a typical large telecom company with $50bn in annual revenue, this would equate to $1-2bn in annual savings.[3] Alternatively, by executing a sale-leaseback agreement with a third party TowerCo, operators can often be paid cash 1-2x the book value of their passive infrastructure (Table 3). Additionally, network CAPEX is transformed into an operating lease, improving their balance sheets and effectively accessing more efficient financing of those assets through TowerCos.

Tenancy ratio is viewed as the key metric determining TowerCo profitability.

For TowerCos the business model is essentially one of asset leasing. The goal is to acquire geographically strategic towers and to then lease their usage back to as many operating companies as possible. The value creation lies in the tenancy ratio multiplier. For example, American Tower Corporation, which is the

Table 3: Illustrative tower valuations and tenancy ratios

Region	$/tower valuations	Avg. tenancy ratios
U.S.	$250,000	2.6
Latin America	$175,000	1.5
India	$55,000	1.7
Africa	$195,000	1.4

Source: ATC annual SEC filing 10-K, CEO Q&A.

[2] Booz and Co. "Sharing mobile networks: Why the Pros Outweigh the Cons".
[3] Booz and Co. "Sharing mobile networks: Why the Pros Outweigh the Cons".

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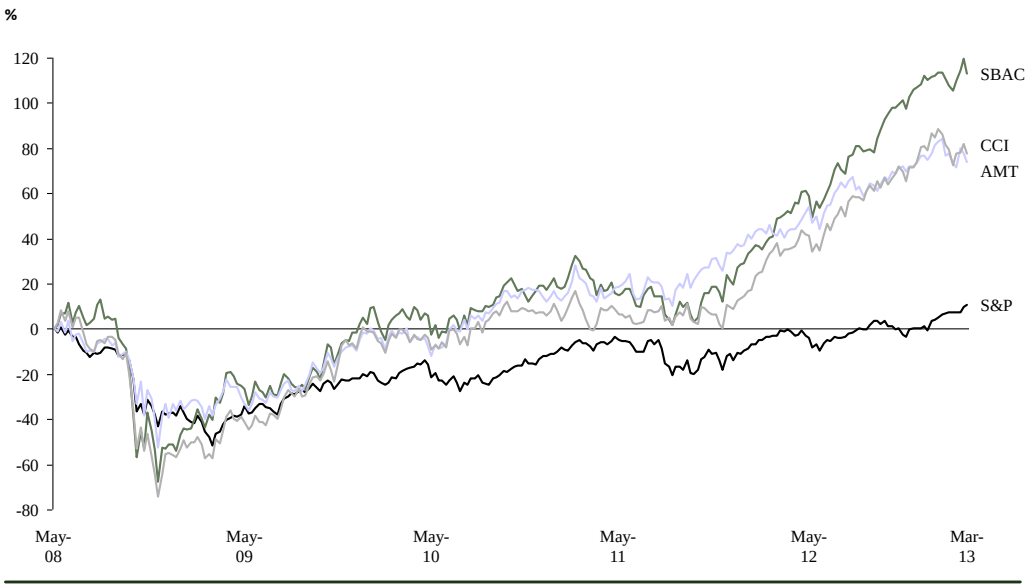
only truly international TowerCo, earns a 4 percent annual return with a single tower tenant, a 13 to 14 percent return with two tenants, and a 20 percent return with three tenants in the U.S.[4] Table 3 details American Tower Corporation's average tower portfolio valuations and tenancy ratios in major markets. Anecdotally, some towers in urban areas in Africa and parts of Southeast Asia are reported to have up to six or seven tenants.

Tower portfolio valuations vary widely based upon land value, expected tenancy ratios, regional ARPUs and equipment costs. With single tower CAPEX ranging from $40,000 to $100,000, and deal development fees ranging from $20,000 to $30,000 per tower,[5] the value unlocked through infrastructure sharing is implicit within such high tower portfolio valuations.

For investors, the attractiveness of TowerCos lies in the predictability of cash flows through long-term leases with creditworthy counterparties. Many TowerCos are privately held. However, a few have gone public and achieved significant success on the stock market (Figure 3). The three publically listed pure-play TowerCos in the U.S. have each outperformed the S&P by 70 to 90 percent over the past 5 years.

U.S. public TowerCos have outperformed the S&P 500 by 70 to 90 percent over the past five years.

Figure 3: The success of public TowerCos in the US



Source: Yahoo Finance

Split incentives

There are two primary TowerCo models: Joint ventures among telecom operators and sale-leaseback transactions between telecom operators and third-party TowerCos. The joint venture model was preferable for many operators in developing regions early on in the outsourcing movement, but is now generally considered to be inefficient. The complexities of aligning operator objectives, each with their own internal strategies, financing needs, and organizational processes, makes it too difficult to further monetize passive infrastructure through new operator leases outside of the joint venture structure. Additionally, pursuing OPEX reductions through equipment upgrades and renewable energy systems is frequently stalled because of the large number of decision makers. There are simply too many cooks in the kitchen.

[4] The Economic Times interview with James Taiclet, the CEO of American Tower Corporation. http://articles.economictimes.indiatimes.com/2012-12-21/news/35953433_1_telecom-tower-telecom-business-real-estate

[5] Booz and Co. "Sharing mobile networks: Why the Pros Outweigh the Cons".

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The passive infrastructure sale-leaseback model is a more efficient model and represents a more attractive opportunity for RESCOs. TowerCos are more motivated than operators to upgrade equipment and to decrease network OPEX, as it is the largest line item on the profit and loss statement (Figure 5). Additionally, TowerCos represent a single decision making entity with whom RESCOs can contract. However split incentives arise when operators either:

(a) Retain ownership of the energy equipment or,
(b) Sign a power pass-through agreement with TowerCos.

Scenario (a) is referred to as a 'managed energy services' contract whereby TowerCos provide O&M services with varying levels of passive infrastructure ownership. Contracts of this nature are typically an initial step, and a lower margin step, in a services relationship with operators. Under such an arrangement, TowerCos have little incentive to deliver OPEX reductions unless contractually stipulated. However, enforcing such stipulations, which take the form of target fuel consumption per hour metrics, is difficult and time-intensive for operators and is typically counterproductive due to lengthy audits and the prospect of animosity between counterparties.

Power pass-through agreements described in scenario (b) have become common in the industry, particularly in India. Under such contracts, energy costs are passed on to the operators, subject to agreed maximum limits. TowerCos have historically negotiated for power pass-through contracts in order to eliminate their exposure to fuel price volatility. However, as an unintended consequence, TowerCos have been left with virtually no incentive to reduce OPEX or to mitigate diesel theft under such contracts. The incentive structure works against telecom operators, and these contracts are beginning to change.

Increasingly, operators are pushing for fixed power and fuel cost arrangements, rather than traditional cost pass-through. Industry insiders have stated in phone interviews that there is an estimated $3bn rupees ($55m USD) in disputed bill settlement between TowerCos and operators in India at any given time. Additionally, rampant diesel theft has pushed fuel costs 20 to 25 percent higher than "should-be" costs.[6] As both a time and a cost saving measure, operators are beginning to favor paying TowerCos a 5 to 10 percent premium for long-term power purchase agreements "PPA" that are adjusted for price inflation in diesel and electricity costs.

TowerCos have come around to the PPA model as well, for different reasons in different geographies. In mature TowerCo markets with declining ARPUs, such as India, the focus of executives has begun to shift from top-line revenue growth through network expansions to improving bottom-line profitability through cost-savings measures. Once a PPA has been signed with an operator, TowerCos can directly realize the cost savings associated with reduced generation costs. In regions with low tenancy ratios, such as Africa and parts of Latin America, TowerCos have come to view fuel use reduction as a metric of similar importance as tenancy ratios. In much of the developed world where ARPUs remain high and diesel costs are comparably low, OPEX reduction through 'green' telecom towers is mostly driven by public relations motivations.

The change from fuel pass through contracts to specified PPAs is occurring in India, and has already become the standard in Africa.

The change to a PPA contract with a specified pricing structure will likely be swift. In India there are an estimated 400,000 towers managed by TowerCos, with only 20,000-25,000 towers under specified PPAs. The rest simply pass through fuel costs. Industry experts have stated in phone interviews that they expect nearly all contracts in India to shift to fixed PPAs within 1-2 years. This shift will create tremendous opportunity for RESCOs. The African markets, which have had the benefit of learning from India's mistakes, are almost exclusively using the PPA model.

[6] AT Kearney. "The Rise of the Tower Business" 2012

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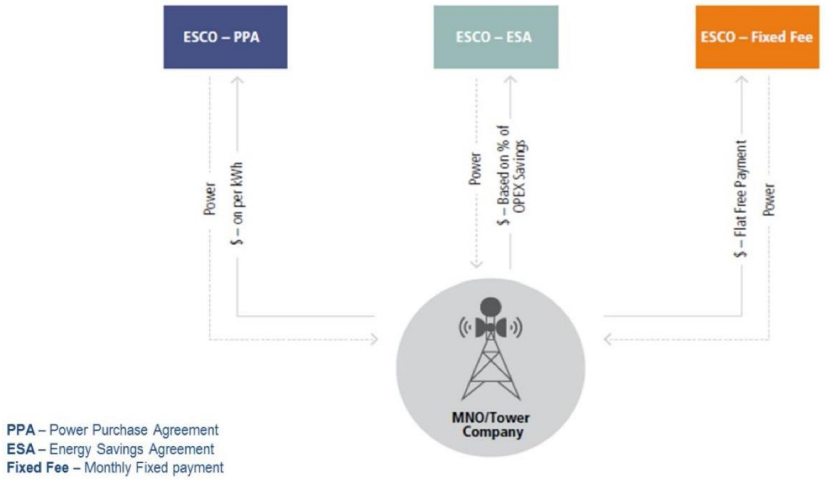
Our investigations reveal TowerCos are increasingly willing to sign fixed PPA agreements with operators, thereby absorbing the risk of fuel price volatility, so long as they can then transfer this risk to RESCOs through separate fixed PPA agreements. TowerCos would thus bookend both PPA arrangements.

The next wave of outsourcing: RESCOs?

A trend of TowerCo consolidation should continue in the coming years. Ultimately, the most successful TowerCos should be those that minimize OPEX without compromising power quality or reliability. Towards this end, TowerCos can directly finance and manage energy efficiency upgrades and renewable energy systems, or they can sign long term energy-as-a-service contracts with RESCOs. We expect TowerCos to prefer the energy service model given a lack of internal technology competency and the potential asset finance efficiency it offers.

From the perspective of an emerging RESCO, the most profitable contract would be an energy savings agreement (ESA); however, attempting to negotiate a baseline, audit energy savings, and measure financial impacts is usually prohibitively complex. Therefore long-term power purchase agreements negotiated at a slight premium to historical energy costs, and rising with inflation, are the preferred industry RESCO model.

Figure 4: RESCO business models



Source: GSMA

The entry of TowerCos into any geographical market will likely consolidate supplier contracts with operators. Where operators' legacy contracts might see multiple partners engaged in security, maintenance and fuel delivery, TowerCos are often inclined to bundle these into fewer, longer term contracts. Additionally, operators tend to defer non-essential maintenance and equipment upgrades on towers that they know they are going to sell. The completion of transactions often releases pent up investment that is typically directed towards energy equipment and remote monitoring software.

Energy costs are the largest line item on a TowerCo's profit and loss statement but are less visible for operators engaged in a wider range of activities.

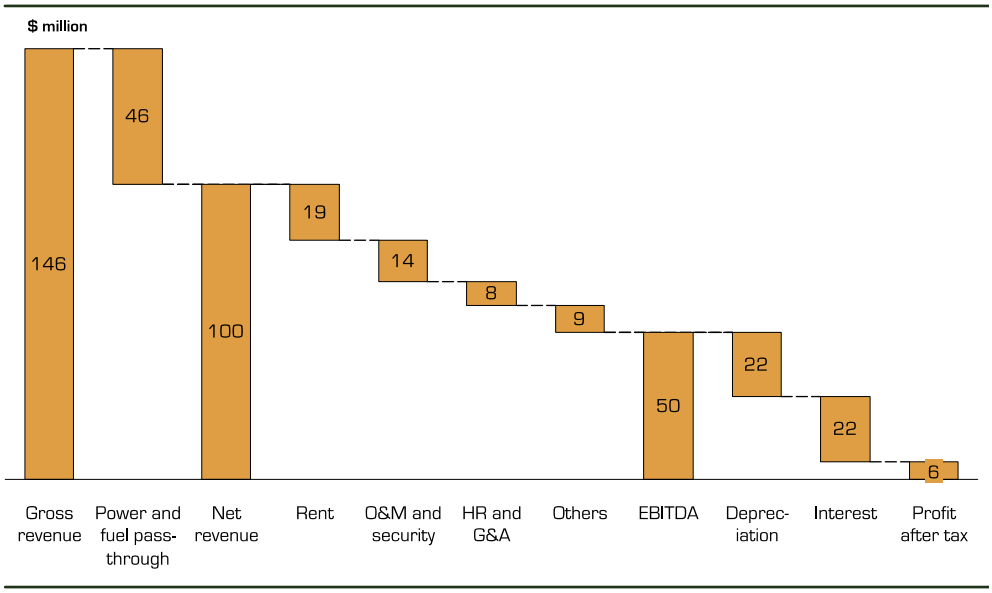
Energy costs tend to be the largest line item on a TowerCo's profit and loss statement (Figure 5). Numerous industry sources contacted for this report estimate power and fuel costs between 30 to 40 percent of total network costs. According to the IEEE, diesel costs frequently exceed 50 percent of network costs on islands and in remote rural regions. There is ample opportunity to engineer cost

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savings. It is worth noting that the same line item is less important for telecom operators, who are generally engaged in a wider range of activities, and for whom energy costs are a less visible line item.

Energy costs are typically 30-40% of net revenue, but can exceed 50% in remote regions.

Figure 5: Illustrative TowerCo profit and loss statement



Source: A.T Kearney analysis, "The Rise of the Tower Business"

Engineering and economics

To ensure site-level reliability and enable growth in tenancy ratios, TowerCos tend to install oversized generators and air conditioners, both of which consumer power inefficiently at low loads. Additionally, telecom operators usually place their active infrastructure components in separate air-conditioned units, as opposed to sharing cabins and using one air conditioning unit. These inefficient systems are further oversized to meet peak load demand, which can be 40 percent more than daily average load.

There are a bevy of quick-win engineering solutions to reduce OPEX that are cheaper and easier to implement than hybrid renewable energy systems.

A simple and efficient cost reduction measure for TowerCos is to implement deep cycle discharge batteries designed for peak load condition. Also, TowerCos can downsize the generator and combine the air conditioning loads. Adding thermostats and switches to use open-air cooling at night can significantly reduce OPEX. Another simple measure is the installation of diesel fuel tank remote monitoring systems (RMS) in regions with high suspected theft. Basic RMS systems typically cost $3,500 to $7,000 per site. Power conditioning units that adjust the power factor of low quality grid electricity by injecting reactive power also typically project short paybacks.

Solar, wind, micro-hydro or biopower systems are typically the highest CAPEX and longest payback energy cost reduction options for TowerCos. Complete hybrid energy generation solutions inclusive of remote monitoring and control technology can cost up to $70,000 to $200,000 per site, which can exceed the initial cost of the entire tower and radio communication equipment. At the equator, the capacity of solar installations often needs to be increased by 50 to 100 percent because the tower itself casts a shadow over the panels for half of the day. Shadows significantly reduce the output of solar panels. Often times additional land is leased a significant distance away from the tower to circumvent the shadow problem, a practice that adds numerous expenses.

In general, green solutions tend to only be deployed at key off-grid sites with high tenancy ratios that can justify the expense. However new greenfield sites in most markets are reportedly being built to be 'hybrid ready' with appropriate equipment housing and power conditioning equipment pre-installed.

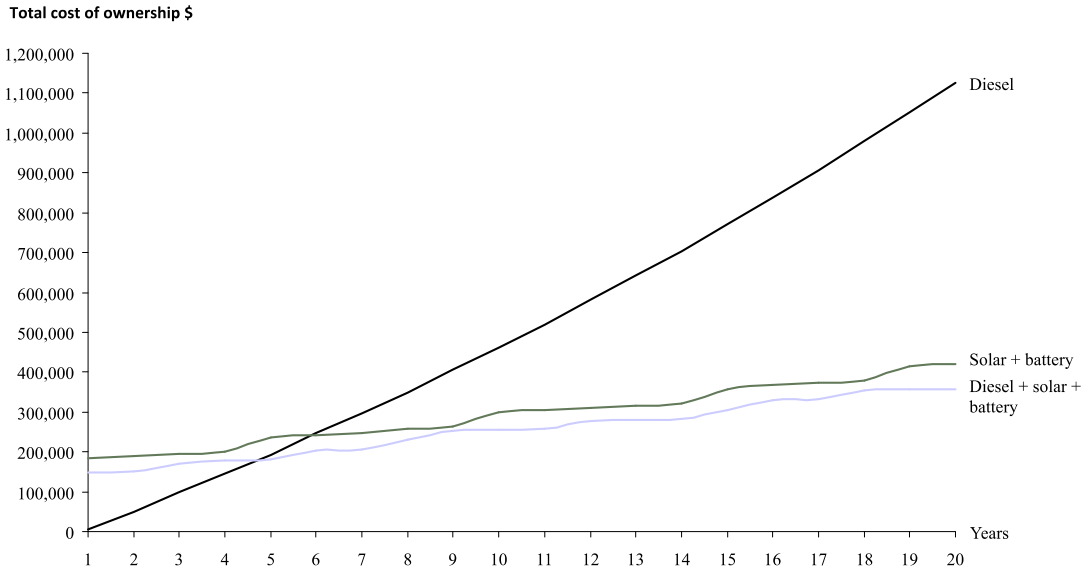
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Figures 6 and 7 illustrate the economics of green power systems for an 8 kW base station. Our modeling includes cyclical replacement costs for battery, power controller and diesel components, which account for the idiosyncrasies of the total cost of ownership for the renewable systems.

Critically, these systems still hold payback periods of four to six years while numerous industry sources interviewed for this report have stated that the telecom industry operates in a 2-year payback regime for cost saving measures.

Hybrid systems that include diesel generators are the most economic on a total cost of ownership basis.

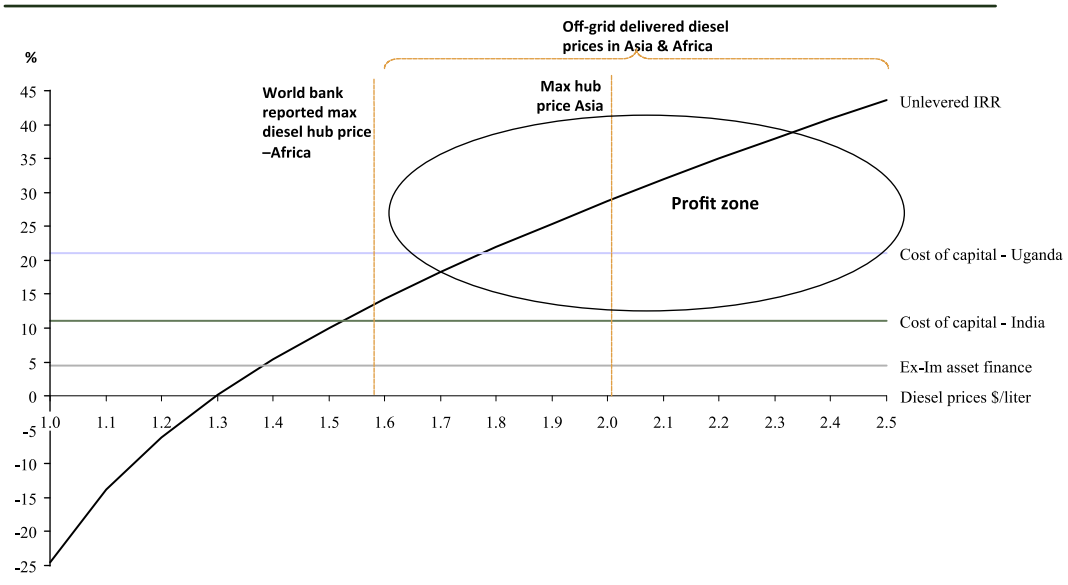
Figure 6: Illustrative solar hybrid system economics



Source: Saviva Research. Note: Assumes 8 KW off-grid load with 1400 KWh/kW/year insolation and 3% diesel fuel price inflation per year.

Green base station retrofits in remote regions with high diesel prices can generate returns north of 30%. However a high cost of capital in emerging economies creates a challenging hurdle rate.

Figure 7: Illustrative solar hybrid system ten-year unlevered IRR



Source: Saviva Research. Note: Assumes 8 KW off-grid load with 1400 KWh/kW/year insolation

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The declining power consumption of base stations is quickly lowering the payback period for high CAPEX renewable energy hybrid systems.

The power consumption of base stations and diesel fuel prices are the two most important drivers of the return profile for renewable energy base stations. Reducing the energy requirement of active infrastructure equipment can be just as important as the energy generation solution. The active infrastructure of new top-of-the-line base stations typically consumes 2-3 kW of power. Huawei claims to have developed equipment that consumes just 1 kW of power. Solid-state radiofrequency ("RF") power amplifiers may explain part of the jump. For instance, a start-up spun-out of MIT named Eta Devices, which does not appear to be affiliated with Huawei, has developed RF amplifiers that they claim can reduce energy input by 50 percent. In general, active infrastructure continues to decline in price and power consumption. Passive infrastructure, on the other hand, continues to increase in price. At the moment energy consumption of most towers is split roughly 50/50 between active and passive components. The primary power draw of the passive infrastructure components is air conditioning equipment, especially in the developing world near the equator.

Table 4: World Bank diesel pump prices in 2012

Select regions	Avg pump price
Turkey	$2.33/liter
South Sudan	$1.97/liter
Malawi	$1.90/liter
Uruguay	$1.88/liter
Euro area	$1.85/liter
Rwanda	$1.73/liter
Central Africa Republic	$1.69/liter
Korea Republic	$1.63/liter
Japan	$1.61/liter
Australia	$1.57/liter
Dominican Republic	$1.35/liter
Uganda	$1.35/liter
China	$1.28/liter
Sub-Saharan Africa	$1.27/liter
Latin America	$1.18/liter
United States	$1.05/liter
Saudi Arabia	$0.07/liter
Venezuela	$0.01/liter

The World Bank reports average diesel prices in each region (Table 4). However these prices are reported pump prices in accessible city centers. Transportation to remote locations can add a substantial premium. A 10-hour drive can increase the price by one third.[7] Graft also takes its toll, increasing costs by 20 to 25 percent in many markets.[8] The more remote the location, the higher the diesel price and the more attractive diesel becomes as a means of exchange. It is not uncommon for delivered diesel prices in remote impoverished regions to be north of $2 per liter.

In general, cell tower OPEX can increase 50 to 100 percent[9] as one moves off-grid from well-connected areas to rural areas without decent roads. The logistics of getting diesel and O&M services to the site makes up most of the increase. Additionally, engineering skills are scarce. Remote off-grid telecom towers are therefore strong candidates for renewable hybrid systems. One major challenge is equipment replacement, repair, and maintenance in these remote locations in order to guarantee reliability. Cellular service plans are usually pay per minute in developing regions, so operators are unable to make money during service interruptions.

Innovative remote monitoring systems may allow RESCOs to circumvent the cache-22 of needing scale to gain contracts, but unable to gain contracts without sufficient boots on the ground.

Remote monitoring software (RMS) can help limit this need by streamlining O&M visits on an as-needed basis. Inala Technologies, a leading RMS provider in Africa, charges $20,000 to $40,000 for their most robust renewable hybrid monitoring and control software. Currently, off-grid sites run 24/7 on diesel generators that require 250-hour maintenance intervals. So, a technician visits each tower every 10-11 days to maintain and refuel the diesel generators. Displacing these local service industries with RMS software and higher wage engineers may cause friction and resistance in local communities. The infamous 'diesel mafias,' which may include a network of local stakeholders and in many cases the very security guards hired to protect supply, often extract economic rent from diesel storage tanks and at various point in the supply chain. For these reasons, renewable hybrid sites have to factor in a higher probability of theft and vandalism, and may pay more for site security.

Price volatility is also amplified at the end of long supply chains. Islands are particularly susceptible. It is possible that the passing of Hugo Chavez may lead to an increase diesel prices in the Caribbean. This is

[7] Bloomberg New Energy Finance, "Power to the People".
[8] AT Kearney. "The Rise of the Tower Business" 2012
[9] Industry Interviews, TowerXchange Volumes 2 & 3., GSMA reports.

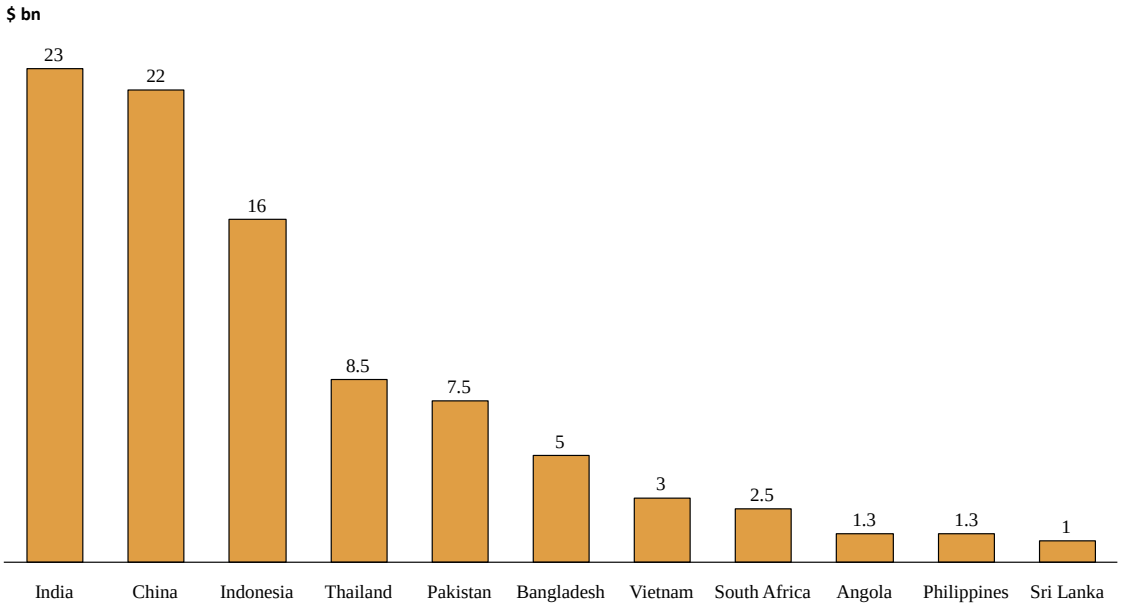
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because Venezuela's new leadership may modify or terminate the Petrocaribe agreement, which subsidizes the cost of fuel for 17 Central American and Caribbean countries and costs Venezuela an estimated $5bn per annum. Wikileaks cables have revealed correspondence between U.S. ambassadors and oil company executives who view Chavez's passing as a catalyst for an end to the Petrocaribe agreement.

Beyond the Caribbean, diesel fuel subsidies limit the opportunity for off-grid renewable energy hybrid solutions in most developing countries – particularly in Southeast Asia and Oceania.

Diesel subsidies substantially weaken the value proposition of renewable hybrid energy systems in many countries.

Figure 8: Diesel subsidies in selected countries, 2010



Source: World Energy outlook, IEA

Key markets

Nearly all of the towers in developed markets are on-grid, and as such renewable energy technologies will not be competitive in these markets for some time. Additionally, high ARPUs of $40 to $50 per person in the developed world orient TowerCos and operators around top-line impacts to profitability, while in the developing world, with ARPU's of $8 to $10 per person; bottom line savings have a bigger impact on profitability. Green telecom tower initiatives in developed economies, such as Verizon's recent $100m announcement to retrofit 19 base stations with fuel cells and solar panels,[10] are usually driven by public relations and corporate social responsibility (CSR) goals as opposed to cost-saving measures driven by CFOs. Thus the market opportunity in the near-term, particularly for private investors, is in developing countries, most notably within India and Africa.

India

With over 400,000 towers, the Indian market is considered oversupplied in urban areas.[11] Growth has tapered off, which can be seen in the teledensity trends displayed in Figure 9, and recent regulations

[10] http://www.greentechmedia.com/articles/read/verizons-100m-fuel-cell-and-solar-power-play
[11] AT Kearney. "The Rise of the Tower Business" 2012.

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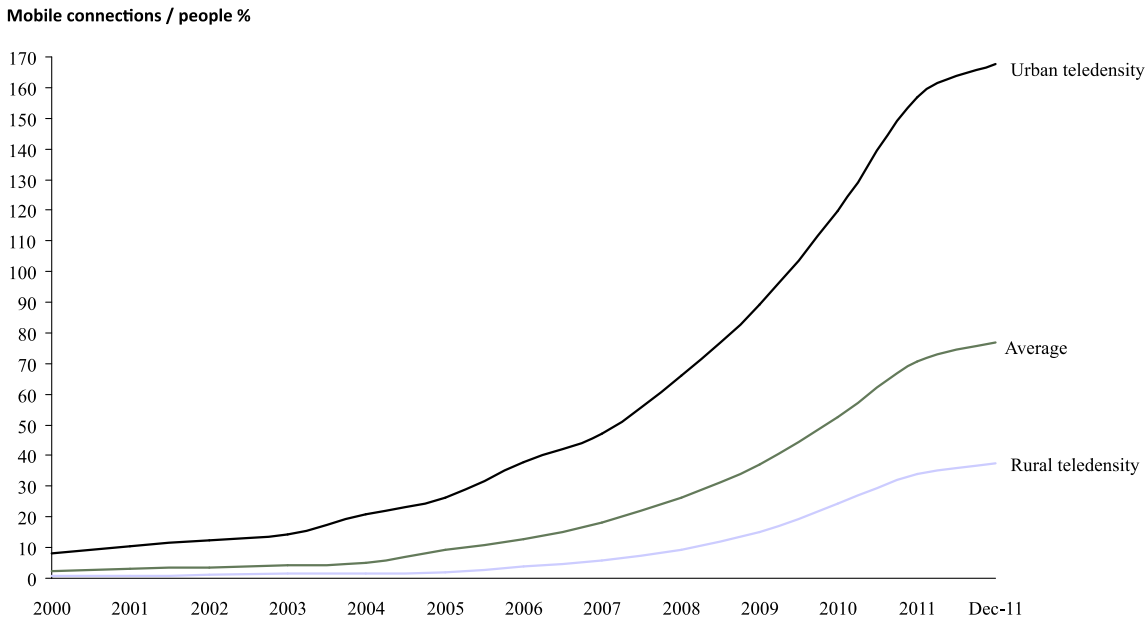
have limited the number of operators in the market, which in turn has reduced TowerCo tenancy ratios. As a result numerous TowerCos are on the brink of bankruptcy. Since going public, Bharti Infratel and GTL Infrastructure, which are the only two publically traded Indian TowerCos, have underperformed the S&P by 19 percent and 34 percent, respectively. This difficult environment is forcing Indian tower companies to aggressively pursue operational efficiencies in order to survive.

In addition, outside lobbying and balance-of-trade concerns are beginning to shape the regulatory environment in India in favor of hybrid renewable tower power. The telecom regulatory authority of India (TRAI) mandated last year that 50 percent of the towers in rural areas and 20 percent in urban areas be supplied by renewable hybrid generation sources and grid power by 2015. Following that announcement, the Reserve Bank of India made an announcement supporting the deregulation of diesel prices to contain trade deficits, which are now around $160bn per annum.[12]

These dynamics have created an immense opportunity and a competitive RESCO landscape. Industry sources state that the number of RESCOs in India has grown from a handful to over two hundred within only a few years. The GSMA reported that over 20 RESCOs won contracts with Indian TowerCos in 2011, accounting for 15,000 base stations. Applied Solar Technologies and OMC Power have earned the limelight to date with high profile venture capital funding. Both are viewed favorably by the economic development community and have been provided considerable financial support.

As shown in Figure 9, urban teledensity growth started to plateau at the end of last year. Although official data for 2012 has not yet been reconciled by TRAI, industry executives have stated that growth has stalled. Having focused on the lucrative urban areas thus far, rural off-grid areas may be the next frontier. Then again, the revenue potential in such areas may be too limited to justify continued rollouts.

Figure 9: Teledensity trends in India



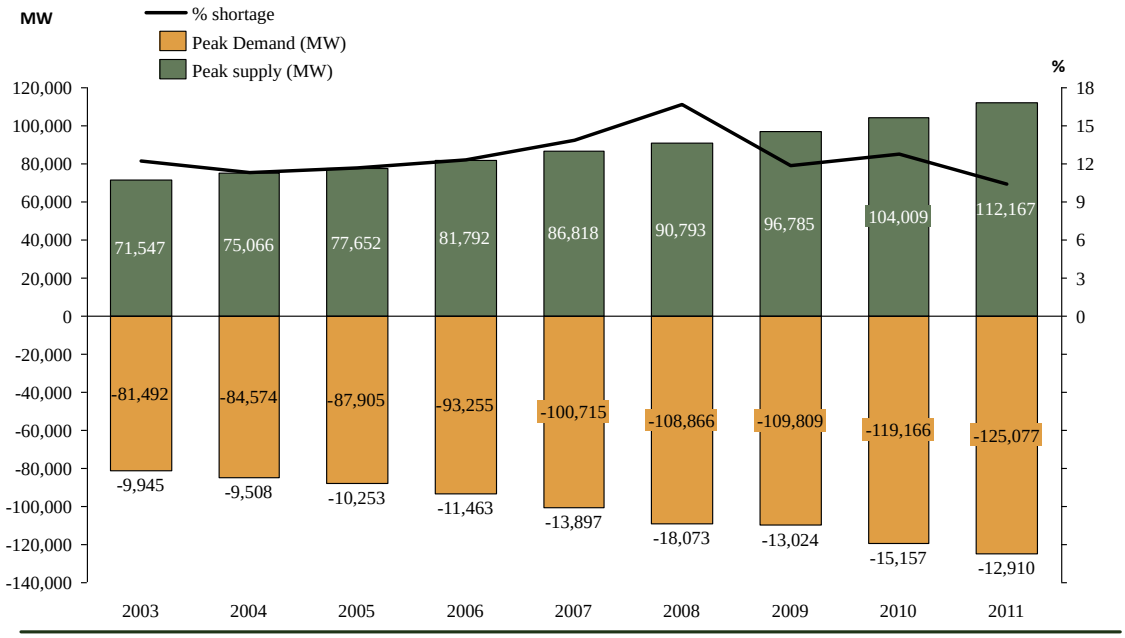
Source: TRAI

[12] http://articles.timesofindia.indiatimes.com/2012-01-24/india-business/30658350_1_fiscal-deficit-diesel-prices-petrol-prices

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Grid reliability and power quality remain pressing issues for the telecom sector in India (Figure 10). Around 70 percent of the towers in India remain cut off from grid power for more than 12 hours a day. With diesel generation costing more than 3-4 times the price of electricity from the grid, the economics of renewable solar hybrid solutions is competitive (Figure 7).

Figure 10: Power quality in India, getting better, still a ways to go



Source: government of India, Ministry of Power, Jan 2012, Report of Working group for power, 12th plan

Africa

With a population of one billion, a median age of eighteen and wireless data & internet penetration less than 10 percent, Africa is clearly a major market opportunity for telecoms. There are approximately 170,000 telecom towers in Africa today, with estimates that up to 300,000 towers will be needed to meet growing demand for capacity and coverage over the next 5-10 years.[13] However, most operators are currently losing money due to low ARPU's and hefty infrastructure costs. Rural telecom towers can cost up to $150,000 to $300,000. Interestingly, while margins are low due to small amounts of data usage and lower ARPUs, TowerCo EBITDA can be higher than other developing markets due inexpensive land rents.

Many African countries with populations of 10 to 25 million people have five or more operators, which suggests consolidation in the future. For instance, Tanzania and Nigeria have eight and nine competing operators, respectively.

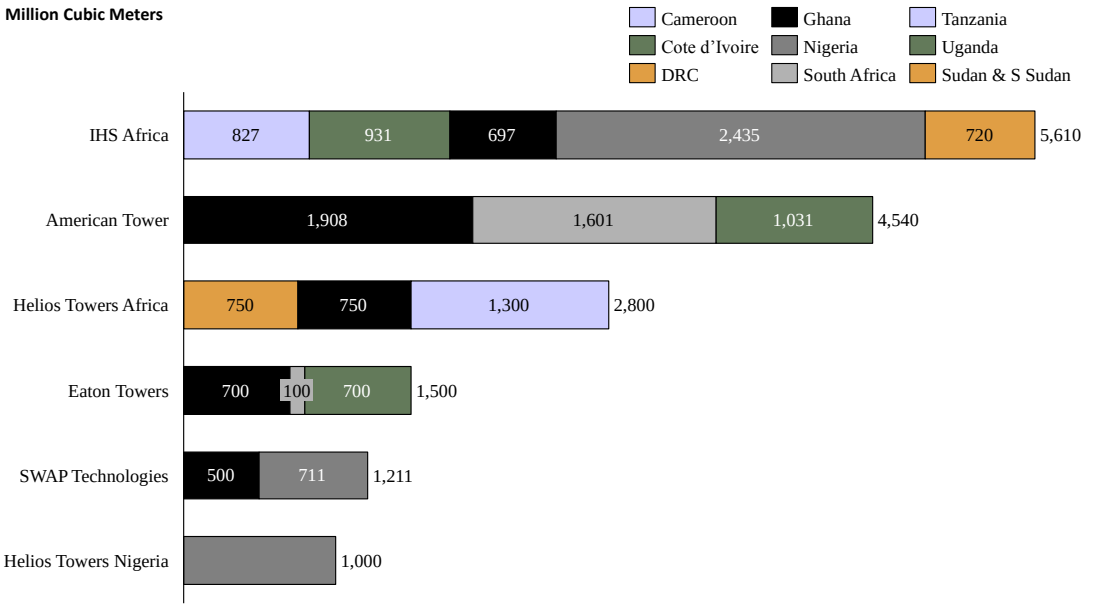
Infrastructure sharing is underway in Ghana, Tanzania, and Uganda and has just begun to take place in Cameroon and Cote d'Ivoire. Ghana has led the infrastructure sharing market due to high fuel and security costs, representing up to 60 percent of total OPEX for *operators*. An estimated 5 to 10 percent of the telecom towers in Africa have been outsourced to third-party TowerCos. Many believe that the African market will follow a similar trajectory to the market in India, and that the vast majority of towers will be third-party owned within the next five years.

[13] TowerXchange Volume 2 & Volume 3

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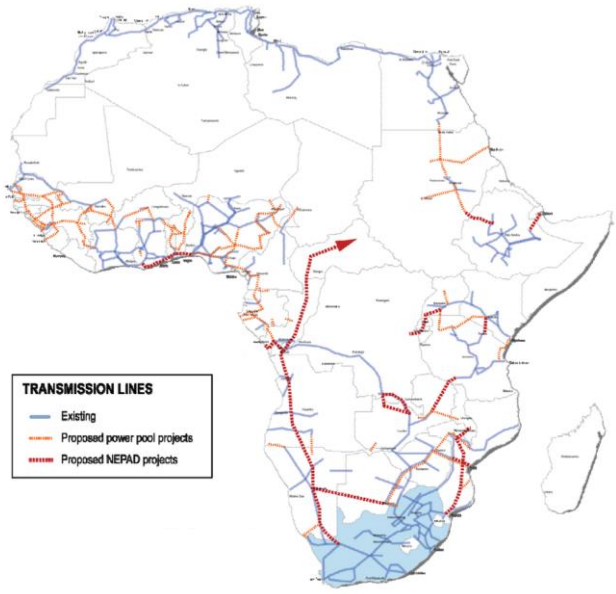
Cellphone and smartphone usage throughout Africa continues to rise at meteoric rates. Analysys Mason projects that handsets in Sub-Saharan Africa will increase from 500 million with 5% smartphone penetration in 2012 to 700 million with 15% smartphone penetration by 2017. Increased smartphone usage will likely increase ARPUs and be a boon to operators as well as TowerCos.

Figure 11: TowerCo ownership in Africa



Source: TowerXchange

Figure 12: Transmission lines in Africa



Source: Global energy networks institute

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Grid penetration throughout Africa remains sparse. Even in locations with grid connections, the reliability of the grid is significantly strained. Urbanization rates exceed new generation capacity and grid infrastructure installations. Planned rolling blackouts are common throughout major cities in Africa. Due to expensive fuel costs, hybrid renewable energy generation systems are both more reliable, and cheaper on a total cost of ownership basis than traditional diesel generation. In terms of the levelized cost of energy (LCOE), diesel generation in Africa typically ranges from $0.30 per kWh all the way up to $1.00 per kWh while renewable hybrid systems deliver a range between $0.20 per kWh to $0.50 per kWh.[14] Our modeling, along with industry interviews, suggests that single project internal rates of return are typically in the 30 to 40 percent range by year ten.

Conclusion

The TowerCo business model has been a disruptive force for rapid change in the telecom industry. The infrastructure-outsourcing trend should continue to energy equipment, led by RESCOs. Hundreds of RESCOs have emerged over the past few years in key markets around the world to take advantage of this opportunity. Commoditization of the RESCO equipment offering will soon follow, squeezing margins in the process. However, the market is just now beginning to take shape and the market opportunity is vast. First mover advantage, and deep operating data to demonstrate the efficacy of the systems, will be critical in the race to secure large contracts. However, a technology-agnostic equipment offering, combined with access to low-cost debt, will be of equal or greater importance. Such companies can avail themselves of commoditization and falling costs in system components, and finance large volume sales through low-cost debt, thus creating a platform for large-scale deployment. Accordingly, there is a two-front battle currently being waged by RESCOs: one for cheap capital and one for TowerCo clients as long-term, large-volume customers. Clearly, this dynamic sector is one for investors to watch in the near-term.

[14] IRENA, World Bank, Industry Interviews.

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