Regional Profiles

Renewable Energy in Latin America and the Caribbean

ACORE
American Council On Renewable Energy

REGIONAL PROFILES: RENEWABLE ENERGY IN LATIN AMERICA AND THE CARIBBEAN

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AMERICAN COUNCIL ON RENEWABLE ENERGY (ACORE)

ACORE, a 501(c)(3) non-profit membership organization, is dedicated to building a secure and prosperous America with clean, renewable energy. ACORE seeks to advance renewable energy through finance, policy, technology, and market development and is concentrating its member focus in 2014 on National Defense & Security, Power Generation & Infrastructure, and Transportation. Additional information is available at: www.acore.org

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INTRODUCTION

The American Council On Renewable Energy (ACORE) is pleased to present *Regional Profiles: Renewable Energy in Latin America and the Caribbean*, which offers key market insights about Latin America and the Caribbean (LAC) through a number of case studies and assessments on renewable energy in countries throughout the region.

As you will read in the following articles, common characteristics of the LAC energy market make it a natural area of focus for ACORE. Present energy issues in the region include high electricity prices, outdated or burgeoning infrastructure, and water and energy access concerns. Renewable energy has the potential to address these problems.

ACORE invites our members to play an active role in creating the financial, policy, and market solutions needed to facilitate renewable energy growth in the LAC region. We thank the authors for the articles they have contributed on these critically important topics and look forward to your engagement in this dialogue.

CHILE: RENEWABLE ENERGY GROWTH: SUCCESSES AND CHALLENGES

James Meffen and Dairo Isomura
Overseas Private Investment Corporation (OPIC)

At a time when the world's population is growing rapidly and resources are increasingly scarce, renewable energy is ever more critical to sustainable long-term development. While numerous regions of the world have natural resources and ambient conditions favorable to renewable energy, Chile is able to offer an attractive investment climate as well, and as a result, is demonstrating particularly strong domestic renewable energy adoption. As of October 2014, Chile's installed renewable energy capacity was 1.8 GW, with 855 MW more under construction.[1]

As the first South American country to join the OECD, Chile offers stable economic growth, several incentives designed to foster expansion of the renewable energy sector, and present high power prices, which in some locales can exceed $200 per megawatt-hour (MWh).[2] Such conditions enabled the advent of bankable utility-scale merchant renewables. The rise of the merchant plant is one reason installed capacity of these technologies (primarily wind) in the Sistema Interconectado Central (SIC), Chile's main power grid, grew from roughly 190 MW in 2011 to over 800 MW either installed or under construction in 2014.[3] The growth in installed capacity of wind and solar power has the potential to reshape Chilean power markets, but questions remain.

Financiers and developers operating in today's highly favorable climate should consider whether or not such conditions may continue to allow for plants to operate without long-term power purchase agreements (PPAs). Given expansion success by the renewable energy sector in Chile, prudence dictates highlighting potential risks associated with over-expansion.

THE PRICE IS RIGHT

Given the policy-effected market uncertainty in the traditional renewables markets of Europe and the United States, developers are seeking alternative markets with attractive investment climates and high rates of return. Chile is a good fit in almost every respect. As the producer of roughly one-third of the world's copper[4], Chile's economy is benefiting from robust global commodities demand. The country posted more than 4% annual GDP growth, and Chile's 6% unemployment rate is comparatively low in Latin America.[5] Coupling such positive economic data with a country that manages its debt and prides itself on maintaining free-market principles, the result is an investment-grade country (Aa3/AA-, Moody's/S&P) ripe for international investment.

Free-market principles are the foundation of the Chilean power market and a large reason why international investors are comfortable with the

[1] Reporte CER Octubre 2014, Centro de Energias Renovables (CER) – Ministry of Energy
[2] "Costo Marginal Ver RSS." *Costo Marginal*. 1 Mar. 2013. Web. 13 Nov. 2014. <http://www.cdec-sic.cl/informes-y-documentos/fichas/costo-marginal/>.
[3] Synex. "Market Study and Revenue Projection", Internal Report (2014).
[4] Brininstool, Mark. *U.S. Geological Survey, Mineral Commodity Summaries*. U.S. Geological Survey, Feb. 2014. Web. <http://minerals.usgs.gov/minerals/pubs/commodity/copper/mcs-2014-coppe.pdf>.
[5] "GDP Growth (annual %)." *World Bank Development Indicators*. The World Bank Group, 1 Jan. 2014. Web. 14 Nov. 2014. <http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>.

sector. The Chilean power sector began the liberalization process in the 1980s when state-owned assets were privatized. The liberalization continued into the early 1990s when the final government-owned generators were privatized. The result is a system where the government's primary role is to regulate the sector and maintain a stable operational investment environment. Today the system operates in a transparent manner where generators are dispatched according to merit order determined by lowest variable cost inclusive of fuel. The last unit dispatched determines the market price for power, which means that run-of-river hydro and renewable power plants such as wind and solar are the first to be dispatched.

Generators either can enter into financial contracts for a specified price and quantity of power or can choose to earn the spot price that is calculated on an hourly basis by the system operator, the Centro de Despacho Económico de Carga (CDEC). Regardless of the type of contract, the generating plant's variable cost determines if it is called on to produce power. If a generator supplies less power to the system than it has contracted, it must purchase the deficit in the spot market. Likewise, if it produces more power that it has contracted, it would receive spot market prices for any excess over the contracted amount. At the end of each month, the CDEC issues invoices for balances due, and payments are settled among the generator pool.

Against this reformed system, Chile finds itself with some of the highest power costs of any OECD country. This is primarily due to the fact that the system was initially constructed on the backbone of cheap Argentinean natural gas. From the early 1990s to mid-2000s, the country added over 2,000 MW of natural gas power capacity.[6] However, in 2004, natural gas from Argentina was curtailed. Since then, the system has been playing catch-up with its generation mix against the backdrop of increased demand and lower than average hydro conditions, which have left the price of power over $200 per MWh in some instances. This price is significantly higher than the installed cost of traditional renewable energy technologies such wind and solar.

In April 2008, Chile passed a law to support the development of non-conventional renewable energy (NCRE) such as small hydro (under 20 MW), solar, biomass, wind, and geothermal. The law applies to generating companies with over 200 MW of capacity and requires that all energy supply contracts signed after August 2007 commit to supplying 5% of the energy demanded via such renewable sources, starting in 2010. Non-compliance brings a penalty. In October 2013, Chile doubled its renewable energy target by modifying the NCRE Law to require generating companies to source 20% of their energy contracted from NCRE by 2025 (Law 20/25). This law resulted in the creation of a green certificate market that renewable energy projects may access as an additional source or revenue.

HEADWINDS?

The combination of these market dynamics has attracted large investments from international players, creating a renewable energy boom in Chile. This boom is resulting in major utility-scale, non-conventional renewable energy projects being announced and financed, with the first 100+ MW utility-scale solar plant recently starting operations with more on the way. According to the Ministry of Energy, approximately 14.3 GW of renewable projects have environmental permits approved, with another 5 GW under review[7]. Law 20/25 creates between 6 GW and 6.5 GW of clean energy needs over the next 10 years.[8] Even if a majority of this pipeline were to fall through, the potential for supply-demand mismatch is acute. The continued success of the system's renewable expansion leaves

[6] Synex. "Market Study and Revenue Projection", Internal Report (2014).
[7] Reporte CER Octubre 2014, Centro de Energias Renovables (CER) – Ministry of Energy

[8] Renewable Energy - An Update on the Chilean Experience, Ministerio del Medio Ambiente, Government of Chile

questions about whether Chile is expanding too quickly and what effect over-expansion may have.

Clearly, the primary driver of investment in the sector is the continued ability to finance projects with revenue projections of US $100 or more per MWh. But it is unclear as to whether the pricing trends seen to date can continue. Of many issues, developers and generators need to consider:

- **Copper price trends.** The Chilean economy benefits significantly from strong copper demand. What will be the stresses due to a drop in copper prices? The last several years of slower Chilean GDP growth, fears of economic slowdown in China (the world's top copper consumer), and resulting drop in copper pricing call into question energy demand projections and, as a result, energy price projections.
- **Increased supply of hydropower.** This has been one of the first non-drought years in Chile over the past several – a reminder that Chile is a country of vast hydrological resources. This base load holds potential to displace more expensive plants and drive down market prices. Over expansion of NCRE, such as wind and solar projects, may affect market prices; as these prices fall, NCRE becomes less competitive from a financial returns perspective.
- **Competition from imported natural gas.** In the coming years, the United States may develop a clearer policy on the export of U.S. natural gas resources. Chile could potentially become a prime market, although it remains unclear what the availability of this resource might do to Chile's spot prices. Although many doubt this as a possibility, the prospect of Argentinian gas returning also is a consideration.
- **Transmission line capacity constraints**. Wind and solar resources in Chile are oftentimes located in the same regions and share the same transmission lines. In Chile, this has the potential to limit transmission. How CDEC and CNE may respond to rapid NCRE growth is unclear because system expansion planning does not presently take into account the short construction timelines of NCRE projects. Without such adaptation, transmission bottlenecks may affect prices and lead to potential curtailment.

CONCLUSION

Chile's burgeoning renewable energy sector is a bright spot in the industry, and there are compelling reasons for Chile's success to continue. To foster continued growth, the Chilean government must properly plan for these new assets. Equally, investors must properly assess the risks associated with outsized success. The result of such planning and assessment can be that Chile reduces its dependence on thermal generation and concurrently achieves its goal of lowering power costs. If so, by meaningfully reducing its cost of power, Chile can provide their people with continued stable economic growth by making its economically dominant raw material sector even more globally competitive.

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OPIC is the U.S. Government's development finance institution. It mobilizes private capital to help solve critical development challenges and, in doing so, advances U.S. foreign policy. OPIC achieves its mission by providing investors with financing, guarantees, political risk insurance, and support for private equity investment funds.

BRAZIL: THE SUN STARTS SHINING FOR PV PROJECTS IN BRAZIL

Camila Ramos
CELA – Clean Energy Latin America

Solar PV is a mature and fast-growing technology, with over 150 GW of installed global capacity. In 2013 alone, roughly US $115 billion was invested in the sector, and over 38 GW of new PV projects were installed worldwide.[9]

Brazil is a sunny country, with a mean daily horizontal global solar irradiation of around 1,500-1,650 kWh/m^2 throughout its territory[10], much greater than that of the majority of European countries. Brazil is also Latin America's largest country, with a population of 195 million. Its installed capacity represents 41% of the electricity online in Latin America. Moreover, power demand is growing at 5% per year,[11] faster than GDP growth, due to a growing population, an even faster growing middle class with increasing access to credit, and social policies that grant universal energy access to Brazilians by 2030, when power demand is predicted by Brazil's Ministry of Mines and Energy to be twice as large as today. Meeting such demand requires US $140 billion of investment in power generation assets and the addition of 6,000 MW of new capacity per year,[12] presenting great opportunity for the renewable energy industry.

High power prices also present a major opportunity for the addition of more renewable energy in Brazil. Prices are steep for most power consumers: over US $150/MWh for industrial consumers and over US $170/MWh for residential consumers.[13] Additionally, wholesale prices are increasing as droughts stress the country's power supply, new hydro plants become harder and more expensive to develop, and expensive fossil fuel thermoelectric plants are increasingly dispatched.

Yet, out of Brazil's 137 GW power matrix, only 18 MW come from PV projects, largely because PV has not been included in Brazil's energy planning and regulatory framework in the past. However, this situation is about to change with Brazil's first federal PV auction.

Three-fourths of Brazil's power is negotiated in the regulated market,[14] via government-organized auctions, where the Ministry of Mines and Energy defines which technologies can participate. Other forms of renewable energy (e.g. biomass, wind, and small hydro) have been allowed to compete in these auctions for over seven years, but solar has not been allowed to participate, as it was viewed as too expensive. These auctions are vital to the development of renewable energy technologies. Since wind's introduction in the Brazilian auctions a few years ago, the sector has grown from 248 MW of installed capacity in 2008 to 11 GW in 2013,[15] and from the world's most expensive wind energy to among the world's cheapest.

The Brazilian PV industry is finally taking shape, going through a phase very similar to that of the

[9] European Photovoltaic Industry Association
[10] Brazil's Solar Atlas
[11] Economic Commission for Latin America and the Caribbean (ECLAC)
[12] Brazil Ministry of Mines and Energy
[13] On average, source: ANEEL - Brazilian Electricity Regulatory Agency
[14] CCEE Brazil Energy Commercialization Chamber
[15] ANEEL and ABEEólica

then-nascent Brazilian wind industry in 2008. Solar will become an important source of energy in the next few years, as PV costs continue to fall, economies of scale take hold, and the government creates the legislative infrastructure to integrate solar into the Brazilian energy mix.

Net-metering legislation was put in in place in April 2012, allowing for small solar energy producers to connect their own PV modules to the grid and export the excess energy produced. This begins to open up a major regional solar market, as small-scale PV power production presents great opportunity in Brazil, where solar irradiation levels can be as high as 2,000 kWh/m^2/year.[16] Nonetheless, difficulties remain. Very few net-metered solar projects are actually installed in Brazil. High costs for small consumers seeking to purchase solar PV systems result not only from actual system costs, but also from double taxing on the existing net-metering legislation, as well as bureaucratic difficulties such as getting systems connected to the grid, certifying grid-connected equipment, and securing financing.

ANEEL (Agência Nacional de Energia Elétrica), the Brazilian Electricity Regulatory Agency, started showing additional signs that they were seeking to include utility-scale solar in the national power system. In 2011, the agency issued a request for proposals for grid-connected PV pilot projects and approved 24.5 MW of potential capacity were approved to build and connect plants to the national grid by 2014.[17] For the first time, the Brazilian government through its energy planning body, EPE, began to include solar in its energy expansion plans. Then, in late 2013 solar was allowed to participate in two federal power auctions, for the first time. No solar PPAs were signed in the federal auctions in 2013, however, as solar projects competed with cheaper hydro, biomass and wind projects.

In a pioneering move, the state of Pernambuco conducted a solar-only state auction in December 2013 where 120 MW of PV projects were contracted[18]. In April 2014, ANEEL and EPE announced that solar would be allowed to participate in the November 2014 A-5 federal auction, competing against other technologies, and in June 2014, the Brazilian Ministry of Energy announced the first federal solar PV-specific auction in Brazil. The official documentation for the October 2014 Reserve Auction was published on the first of that month, with a ceiling price of BRL 264/MWh (US $104 /MWh) specifically for PV projects, competing only against other PV projects[19] – a breakthrough for the sector. As a result, 890 MW of PV projects signed 20-year PPAs in Brazil's first federal solar auction, at an average price of BRL 215.12/MWh.[20]

Finally, in August 2014, the BNDES (Brazilian Development Bank), Brazil's main financier of infrastructure and renewable energy projects, which has funded over $20 billion in local clean energy projects, announced the financing conditions and local content rules for solar PV projects that want to access its credit lines for the first time. Under the new rules, PV projects will now be able to get access to the most competitive financing lines available for projects in Brazil, which have only been available to other renewable energy sources in the past.

The announcement of the first and successful solar-inclusive auction and BNDES financing rules for solar PV projects mark the beginnings of solar PV industry growth in Brazil. As a result, developers are lining up to deploy utility-scale solar projects in the country. Following in the footsteps of the country's now-mature wind industry, 400 PV projects totaling 10.8 GW of installed capacity registered to compete in the recent federal tender, revealing developers' appetites for this technology in Brazil's sunny regions. Finally, 890 MW were successful in the bid.

[16] Brazil Solar Atlas
[17] Brazil Ministry of Mines and Energy
[18] Secretary of Energy of the state of Pernambuco
[19] Brazil Ministry of Mines and Energy
[20] CCEE and Ministry of Mines and Energy

Nonetheless, bottlenecks are still in place and must be overcome. Margins for PV projects still seem somewhat low, because no local suppliers have manufacturing capacity in Brazil, which is a requirement for BNDES financing. Additionally, costs throughout the nascent supply chain are still comparatively high, because no large-scale utility projects have yet been built. Uncertainty in the face of a first-ever auction – e.g. worries of low auction prices, or final prices lower than the announced ceiling price – and uncertainty over the frequency of solar-only auctions in the future still must be addressed.

As events in the sector unfold,[21] the situation appears to be an optimistic one, with the first 890 MW of projects contracted, and similar trends and challenges as those experienced by the wind industry in 2008 – now the fastest-growing energy source in the country. Even the Ministry of Mines and Energy's recently published *National Energy Plan 2050*, a publication not known for being bullish about non-hydro renewables, already shows 118 GW of new PV capacity installed in the country over this period. PV can play a very important role in Brazil's energy matrix in years to come, and its development is taking shape right now.

ABOUT THE AUTHOR

CELA – Clean Energy Latin America is a São Paulo-based financial advisory firm supporting renewable energy companies and investors in Latin America. CELA supports its clients with equity fundraising, project finance, mergers & acquisitions, financial analysis during energy auctions, and development of greenfield investment projects and strategy. For more information, access www.celaexperts.com.

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[21] This article was written in early October of 2014, before Brazil's federal auction

MEXICO: LATIN AMERICA'S RENEWABLE ENERGY CROWN JEWEL

Dino Barajas
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In contrast to unpredictable renewable energy policies in the United States and the European Union, Mexico has emerged as a lightning rod for renewable energy investment. As renewable energy investors assess changing global opportunities, Mexico continues to offer numerous stable investment prospects. Mexico's investment-grade credit rating provides potential investors one of the few high-grade investment environments in Latin America. Additionally, the sharp reduction in contracted large-scale renewable energy opportunities in the U.S. and Europe has catalyzed recent interest in Mexico.

THE OPPORTUNITY

The Mexican economy has been bolstered by strong international demand for its commodities and a competitive labor force favored by numerous U.S. industries following a reevaluation of a low-cost production chain previously outsourced to China. As a result, continued economic growth has reenergized interest from foreign investors into Mexico's power generation and transmission systems. Because the long-term relative stability of Mexico's economy provides investors with safe, profitable power sector development opportunities, savvy political technocrats in the country are using the investment window to attract additional foreign investors and are taking advantage of downturns in other international renewable energy markets to thrust the Mexican renewable energy sector to the forefront of the global market.

Given President Enrique Peña Nieto's favorable energy policies and a push by the federal government to further modernize the country's power sector, Mexico's renewable energy sector will continue to provide opportunities for private equity investors, development companies, construction companies, and lending institutions. However, one of the challenges for investors is to understand the inherent risks of investing and operating in Mexico.

During the 1980s and 1990s, Mexico was a darling of the investment community looking to capitalize on attractive returns and diverse opportunities across infrastructure sectors. Many region-specific private equity funds emerged during this period. Infrastructure development companies formed dedicated Latin American teams. But as competition for infrastructure development grew and profit margins declined, investors and developers soon turned to other markets – such as Eastern Europe, Russia, the Middle East, and Asia – that were experiencing their own infrastructure development booms and offering more profitable investment opportunities. Investors and developers also began looking to the U.S. and Europe, which were also experiencing economic prosperity and aggressive energy sector build-outs. With this shift in regional focus, many private equity players and developers deemphasized their capital deployment efforts in Latin America and disbanded their "LatAm" teams.

The demise of these region-focused teams meant a loss of institutional knowledge for these firms and an opportunity for smaller regional developers to gain a foothold in Mexico. As new energy investors now move into uncharted waters, they would do well to study the lessons learned from past investors in the Mexican power sector during the last 20 years. Edmund Burke's statement that "those who don't know history are destined to repeat it" holds true for

the new generation of investors looking to make their fortunes in the bonanza that is the newly reinvigorated Mexican energy sector. Successful investors must retain external advisers with a deep knowledge of the Mexican energy market in order to properly judge market opportunities and investment risks.

THE MEXICAN ELECTRICITY SECTOR

In the early 1990s, the Mexican government embarked on a massive infrastructure build-out program in its electricity sector. Mexico developed a well-defined legal framework to permit private investors to participate in the development and ownership of power generation facilities to supply the national electric utility, *Comisión Federal de Electricidad* (CFE), as well as large industrial and corporate customers. The CFE independent power project (IPP) program has become an extremely effective international power plant development program; the speed of power plant deployment and the low costs associated with the long-term energy pricing of the power plants demonstrate the competitive and transparent bidding environment CFE has been able to foster. CFE's IPP program allowed the government to refocus its own capital investments into the national transmission grid.

To promote renewable energy development and diversify the country's power generation portfolio, CFE adopted attractive policies regarding wheeling to benefit renewable energy projects. CFE's preexisting wheeling structure failed to account for renewable energy's intermittent nature and penalized projects for failing to produce a stable constant electricity supply. In order to account for wind and solar power's intermittent nature, CFE created a system where a renewable energy project can bank excess energy production during periods when an off-taker does not require energy from the project and allow the user to access the banked energy during periods when the power project does not produce sufficient energy to meet its needs. Additionally, the government also enacted postage-stamp wheeling charges earmarked solely for renewable energy to benefit renewable energy production. As a result, buyers of renewable energy see power rates that directly compete with fossil fuel-generated energy.

The Mexican government provided for a sea change in renewable energy development in 2014 by enacting sweeping reforms to the entire electricity sector. Renewable energy projects that had begun their interconnection process with CFE before the government passed the reforms have been grandfathered into the renewable energy policies in place prior to the enactment of the reforms. One drastic change enacted by the government is that renewable energy offtakers are no longer required to be shareholders of the project company developing the renewable energy project. By lifting the "self-supply" requirement, offtakers can be solely short or long-term customers of renewable energy projects. The new electricity reforms define "available customers," with whom energy producers can contract, because they have an aggregate load demand of at least 3 MW. After one year, the threshold will be reduced to 2 MW, and after two years it will be further lowered to 1 MW of aggregate load demand.

The new market structure portends to allow greater flexibility in aggregating customers with varied energy demands and contracting strategies. In some cases, developers may look to secure long-term anchor customers with attractive pricing with the majority of the available capacity of a project, which supports long-term nonrecourse financing. Once a developer secures its core customers, the developer then can contract out the remaining available capacity with shorter-term and higher-priced off-takers to increase project profitability.

The wildcard in renewable energy development for Mexico is whether the government policymakers suspend postage-stamp wheeling and energy banking for new renewable energy project developments. Removing postage-stamp wheeling may slow down future wind and solar developments by forcing developers to site their projects closer to off-takers, thus losing the ability to aggregate loads on a nation-wide basis and failing to optimally use

Mexico's renewable energy sources. Any dismantling of the energy banking system can also delay renewable energy development by forcing developers to install expensive storage alternatives to compensate for the intermittent nature of solar and wind power generation or purchase replacement energy from the proposed wholesale energy market, which the government has yet to develop. The reforms also provide for a system of clean energy credits, which the government must still develop, regulate, and implement.

READILY AVAILABLE FINANCING

The true test of whether the projects in a market are viable is determining if third-party, non-recourse financing is available. In Mexico, Japanese, U.S., and European commercial lending institutions are actively looking for lending opportunities to well-structured renewable energy projects. Multilateral lending institutions, such as the International Finance Corporation, the Inter-American Development Bank, and North American Development Bank are also working in the Mexican market with creative financing structures. In addition to multilateral financing institutions and commercial lenders, international development banks have supported infrastructure projects that promote certain economic, environmental or social objectives. Some international development banks have even prioritized the Mexican market as a target lending environment to spur specific project development, such as renewable energy power plants. Understanding the present requirements of potential lenders and the structures of past financings is essential for developers trying to secure nonrecourse project financing. The most successful projects will be those that incorporate this knowledge early on in the development phase of a project. Failure to anticipate these requirements creates an Achilles heel for uninformed market participants.

CONCLUSION

The Mexican energy market is poised to attract the majority of new renewable energy investment in the Americas if Mexican policymakers continue to view renewable energy as a critical part of the country's overall power generation portfolio and enact policies to promote increased wind, solar, and geothermal development. Mexico's natural renewable resources and its thriving economy have provided it with an opportunity to become a world leader in renewable energy development at a time when developers the world over are searching for investment opportunities.

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MEXICO: THE IMPACT OF ENERGY REFORM ON RENEWABLE OPPORTUNITIES

Bryan Fennell
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The energy reform legislation enacted in Mexico in August 2014 has the potential to create a dynamic growth market for renewable energy development going forward in the country. The legislation is just not a function of reform related to the electric generation market, but a broader change considering the effect of renewable energy growth as influenced by the reforms introduced to the oil and gas industry in 2014, as well as the 35% renewable energy target the country wants to reach by 2024, and ultimately, 50% by 2050. While these are extremely ambitious goals, and only time will tell whether they can be achieved, Mexico will be hard pressed to achieve them without the introduction of market forces. This article explores the linkage between the country's two pieces of energy reform legislation this year and how they are likely to effect the overall Mexican economy. Coupling the reform with the country's near- and long-term targets for renewable energy, there is an opportunity for tremendous growth in Mexico's renewable energy sector.

A driving force behind Mexico's energy reform is the oil and gas sector. A look back over the last ten years shows oil production declining from a peak of 3.8 million barrels per day (BPD) in 2004 to 2.9 million BPD in 2013. This represents a decline in annual production of 8% and lost gross domestic product of $32.9 billion, at an assumed long term oil price of $100 per barrel. Coupled with Mexico's domestic consumption, including its relatively high dependency on oil for electricity generation, net oil exports are forecast to be in the range of 800,000 to 900,000 BPD for 2014. This net export amount is down considerably from its peak of approximately 1.9 million barrels in 2004 and represents a significant negative effect on the country's economic health. As a result, in order to help drive the economy forward, Mexico needs to both increase oil production through the introduction of outside capital and competition, as well as reduce the country's domestic consumption of petroleum products, the lowest-hanging fruit being electricity generation.

If the introduction of private capital into oil and natural gas exploration is able to return production to even 2007 levels of 3.5 billion BPD, then the Mexican economy can conceivably grow by approximately $22 billion per year, or an incremental 1.7% above the present 3% growth rate. This is before taking into account the introduction of new renewable generation assets.

Utility reform must go hand-in-hand with petroleum sector reform. The ability to instill competition in the sector serves to help move the country's generation mix further away from oil and more toward natural gas and renewables. Presently, 20% of the country's installed capacity is fired by either heavy oil or diesel fuel. This amount has been declining over the years and should approach zero as the system incorporates additional combined-cycle natural gas turbines (CCGT) and renewable generating assets. The primary system additions since 2000 have been CCGT, fueled primarily with natural gas imported from the U.S. However, with a target of 35% of electricity supply coming from renewable energy sources by 2024 and an increased economic growth rate, renewables such as wind, hydro, solar, and geothermal will have to capture a larger and larger share of the market.

By the end of 2014, estimates suggest 11,000 MW of large hydro and 3,900 MW of other renewables, including 1,800 MW of wind generation and 100 MW of solar, out of a total installed capacity of approximately 65,000 MW.

Projecting present trends out to 2024, and assuming a growth rate of 3%, total installed capacity needs to be approximately 87,000 MW in order to meet system demand. Assuming that system capacity is 50% for all generation, total energy generation must be 381,000 GWh. This translates into about 133,900 GWh coming from renewable sources to meet the renewable generation requirement. Finally, assuming the overall renewable portfolio operates at a capacity factor of 35%, then the system requires a total of approximately 31,000 MW of installed renewable capacity, or an increase of 28,800 MW. Assuming an average installed cost of $2,000/kW across the entire addition, these projects equate to an incremental capital investment of at least $57.6 billion.

Taking this exercise one step further and assuming that the increased investment in the oil and gas industry results in an incremental increase in economic growth, which we use as a proxy for growth in electric consumption, from 3% to 4.5%, then using the rationale above, the system requires approximately 154,000 GWh of energy derived from renewable sources. This suggests a total of 50,500 MW of total installed renewable capacity, including 35,600 MW of incremental capacity that equates to an incremental capital investment of approximately $71.8 billion. Examining a downside case where growth is only 2% over the period, the system still requires an incremental 24,700 MW, which equates to $49.4 billion in incremental investment.

To date, the bulk of the country's renewable energy installations developed by the private sector have been under the self-supply scheme whereby power is sold to large commercial and industrial customers from renewable energy facilities in which the customer has some ownership interest (in many cases, a de minimus interest).. The results have been somewhat modest, because there is a limited number of potential off-takers that have adequate credit, sufficient load, and willingness to accept the long-term obligation of a power purchase agreement, all of which are required to support the financing and construction of a renewable energy project.

However, achieving the numbers shown above will require a departure from the self-supply approach, as well as the proper economic incentives to attract the developers and capital-providers who can successfully bring projects to completion. It will also require market rules that will be viewed as fair and transparent by all participants. Fortunately, the Mexican government has eased certain investment requirements by indicating that offtakers no longer need to be shareholders of the companies developing renewable energy projects, increasing flexibility in how projects are developed.

Although specific market rules are still being developed, the framework being put into place appears to pave the way for a well-functioning market. The transfer of control, transmission, and distribution of electricity from the Comisión Federal de Electricidad (CFE) to the National Center of Energy Control (CENACE), providing for increased competition, greater transparency, and improved access to the transmission system, is probably the most significant step being taken. CENACE's roles will include operating the national power system, guaranteeing open, non-discriminatory access to the transmission and distribution grids, and operation of the electric power market.

In addition, there are a number of market issues to be addressed and are still being discussed, including the absence of a functioning wholesale market, ancillary service provisions, rules related to how the transmission system will be accessed, whether or not there will be dedicated competitive renewable energy zones, and the treatment of renewable energy credits. These issues are expected to be resolved over the course of the next several months, but both the speed and dedication of the present government in addressing the issues to date are

encouraging and suggest that it will deal with these secondary issues in the same manner.

The numbers related to the potential growth of renewable energy investment we have shown here are for illustrative purposes only and to provide a view to the potential size and scope of the market. We have used an amalgamation of data available through various public sources, as well as having made some very broad assumptions to reach the conclusions stated above. Regardless of those assumptions, it remains fairly obvious that the amount of incremental investment is significant. In the event that growth assumptions are exceeded due to a better than expected economic environment spurred on by the oil and gas sector, the opportunities could increase dramatically.

ABOUT THE AUTHOR

Bryan Fennell joined Marathon Capital as a Managing Director in April 2013. Prior to that he was vice president, development of NextEra Energy Resources, LLC a competitive energy supplier with a presence in 26 states and Canada. He was appointed to the position in June 2007 and was responsible for mergers, acquisitions and divestitures for the company.

Mr. Fennell joined NextEra Energy Resources in April 2003 as vice president, business management responsible for the wind business and then as vice president, business management for the west region. Prior to joining NextEra Energy Resources, he was an investment banker at Dresdner Kleinwort Wasserstein and New Harbor, Inc. where he led a number of utility and independent power transactions. He began his career as project developer for Enserch Development Corporation and later, PSEG Global.

Mr. Fennell holds a BS in engineering from the United States Merchant Marine Academy and a MBA from Fordham University. Mr. Fennell holds his Series 79 and 63 license.

JAMAICA, THE DOMINICAN REPUBLIC, AND PUERTO RICO: ISLAND INNOVATION: ENERGY INDEPENDENCE IN THE CARIBBEAN

Jatin Sharma
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As island territories in the Caribbean look to reduce their traditional reliance on expensive diesel imports, renewable energy presents a great opportunity to foster the benefits of energy independence.

However, to do so, island communities must continue to address the inherent logistical and regulatory challenges of building a local supply chain. Equally, they must evaluate the technological demands and risks of complex wind regimes and energy storage mechanisms.

This article assesses the progress to date of renewable energy projects in Jamaica, the Dominican Republic, and Puerto Rico.

Island communities, by their very nature, require stable, secure, and cost-effective energy supplies. Today, most rely on energy imports because land availability historically excluded large generating facilities. These imports tend largely to be made up of fossil fuels – either oil/diesel or liquefied natural gas.

Fossil fuel imports are rarely stable. Oil and gas prices fluctuate relative to geopolitical change. Importing fossil fuels also requires significant infrastructural spending in an associated distribution and storage network. With many island communities in the Caribbean working hard to develop their economies, relying on these fossil fuels continues to drive high electricity prices and drain resources that could otherwise be spent on improving the lives of the communities.

The growth of renewable energy and the proliferation of projects worldwide demonstrates that renewable energy technology is becoming an increasingly available option for economically challenged countries and regions. This option presents an attractive opportunity for Caribbean island communities to take advantage of rich onshore and offshore wind, solar, geothermal, and even ocean thermal energy resources, and, by doing so, to make positive steps toward energy independence and carbon reduction.

The journey to a clean energy future is not one that will be quickly completed. While there is no shortage of ambition across the Caribbean region, Caribbean markets continue to face a number of hurdles. Establishing a solid regulatory framework is arguably the first of these. Addressing the wider financial and infrastructural challenges of building large-scale projects may take many years.

As far as governmental support is concerned, the region's progress is well-illustrated by the fact that three of the largest Caribbean Island markets – the Dominican Republic, Jamaica, and Puerto Rico – have solid renewable energy targets in place. Jamaica seems prepared to easily surpass a target to achieve a 20% renewables share by 2030, while Puerto Rico hopes to achieve the same by 2035, and the Dominican Republic, which already boasts a good hydroelectric resource, is targeting a 25% share for clean energy sources by 2025. These targets have been supported by financial incentives such as feed-in tariffs and tax benefits.

However, while each of these nations have enshrined policies and targets that support and incentivize renewable energy development, the pace of new project development is slow. To date, initial activities are frequently followed by periods of inertia while the market responds to the infrastructural challenges of bringing clean, renewable energy online, and developers seek to finance the next round of construction. For example, in Puerto Rico, following the financial crisis in 2008/9, land that previously was designated for hotel development became available for new wind energy projects, because capital ready to be deployed for tourism shifted elsewhere.

But this is unlikely to be a long-term trend. In a similar vein, while a number of early installations have put Jamaica and the Dominican Republic on the path toward achieving their targets, reaching a level of supply chain development that allows the establishment of a major industry is another matter and will require greater collaboration among islands in the Caribbean.

Attracting the necessary international investment to encourage consistent growth will depend on fostering a diversity and scale of new technologies and construction across the entire region.

In this regard, the value of bodies such as The Caribbean Renewable Energy Development Programme (CREDP) – a German-funded initiative of the Caribbean Community (CARICOM) – cannot be understated. CREDP works to remove political, legal, and regulatory barriers to the development of renewable energy in the region and contributes to energy reforms and goals across the Caribbean.

This work ultimately should pave the way for greater communication and cooperation among the islands and communities involved. Once utilities in the region begin to collaborate, Caribbean island communities can start to realize vital cost reductions and economies of scale that, in turn, can draw the attention of the global developer and investment communities, as has occurred in other markets such as South Africa and Brazil.

Collaboration also is essential when it comes to addressing some of the common infrastructural and technological challenges that come hand-in-hand with the island locations and complex topographies of Caribbean communities.

Given their long history of diesel generation, aged and inefficient local grids in Jamaica, Puerto Rico, and the Dominican Republic are in need of an overhaul before they can support large-scale renewable generation. Problems relating to grid connectivity created significant power export curtailments in markets including Brazil and China, where wind projects in particular were constructed faster than the grid was able or was adapted to accommodate them. Start-up delays and the inability to export power inevitably lead to substantial losses for project owners, and, in light of prior experience, international developers watching the Caribbean are particularly keen to see that the grid is in a suitable condition for connectivity before entering the market.

Given the costs associated with constructing interconnection cables between islands, the adoption of individual and centralized battery storage systems to enhance the stability of the grid is perhaps a more immediate solution. These systems are of particular use for wind farm operators – capable of storing energy for use at times of peak demand, mitigating negative effects on the quality of power exported to the grid, and capturing excess energy to release during off-peak times.

Today, large-scale commercial battery storage is at an early stage of development and poses a substantial technological risk for project owners. GCube's single largest loss resulted from a fire at a battery storage facility in Hawaii. The employment of proactive risk mitigation strategies will be highly important when this technology is adopted at a large scale across the Caribbean.

Wind energy resources in Jamaica, Puerto Rico, and the Dominican Republic are strong,, but the inherent volatility of wind speed affects how battery storage

systems cycle between charging and discharging. Random fluctuations across a wind farm are capable of putting significant stress on these systems and potentially causing dangerous overheating. From an insurance perspective, it is therefore crucial that battery storage installations are designed and constructed with best fire protection practices in mind.

As the industry expands, project developers also will need to employ best practice risk mitigation strategies to safeguard themselves against a range of logistical risks originating from the remote nature of these sites. The construction and ongoing operations and maintenance of a wind or solar farm requires access to critical resources ranging from key parts and equipment, such as cranes and transformers, to skilled labor approved by contract to carry out complex tasks. In the absence of local manufacturing hubs, such access depends heavily on a diligent spare parts strategy, pre-agreed lead replacement times for critical components or cranes, and site access constraints.

Damage or delays to crucial equipment in transit can put projects on hold for months, especially because replacements may need to be shipped from the U.S., South America, or potentially as far as Europe and Asia. The quality of both ports and road networks is therefore paramount, and it is likely that significant supporting infrastructure investment will be required before a fully-fledged renewables industry can be realized. Common equipment losses in the Caribbean region have resulted from poor packing of technological resources in transit by sea or by land, road traffic accidents, vibration damage, and dropped equipment during loading and unloading.

Maintenance demands of renewables in the Caribbean are further elevated by the very strength of the available resource. As mentioned above, wind regimes in the region are highly volatile, putting turbines and supporting infrastructure under additional loads and strain that may affect the performance of sites and equipment over time.

Furthermore, the Caribbean market is particularly exposed to natural catastrophe. Hurricanes are a common occurrence, and GCube has previously paid claims for damage caused to operational wind farms in the Caribbean following category 3 storms. Storm surges are capable of damaging equipment in storage, toppling stacked resources, and even washing away access roads. In the U.S., property damage to solar assets following Superstorm Sandy in 2012 also generated large claims, and given the elevated hurricane risk in the Caribbean, there are certainly lessons to be shared about how this kind of damage can be prevented.

In this climate, it is not only vital that governments seek to support the growth of renewable energy in the region, but also that the developers, manufacturers, and operators looking to build the first projects in the island markets of the Caribbean have an appreciation of the inherent complexities of the territory.

Ultimately, the largest obstacle to the success of the industry in Jamaica, the Dominican Republic, and Puerto Rico is a financial one. While a combination of geographical, technological, and logistical hurdles may slow the progress of construction in the area, the main and most damaging effect is to deter investors from entering the market.

In order to counter this obstacle, it is highly important that greater collaboration continues to be fostered not only among nations, but also between the utilities and developers working in the region, and their insurers. The Caribbean market is unique in its geography, but not to the extent that lessons cannot be learned from the experience of the industry in other, similar markets around the globe.

The Caribbean renewables sector can demonstrate to the global investment community that it is addressing its specific risks and challenges. By cooperating with one another, the various governments and utilities driving the growth of renewables in the region can start to bring about the regulatory reform that will turn a small number of projects into a major industry. Likewise, by taking

proactive steps to mitigate logistical and technological risks, developers can show the international community that Caribbean renewables are a viable investment proposition.

In doing so, they will set themselves on the path towards ending an intergenerational reliance on fossil fuels and fulfilling the long-term ambition of achieving energy independence.

ABOUT THE AUTHOR

As Business Development Leader at GCube Underwriting Ltd., Jatin Sharma has specialized in underwriting offshore wind, wave and tidal projects since he joined the firm in 2010 and has expanded the company's visibility and reach in emerging markets around the globe.

Prior to joining GCube, Jatin was Divisional Director at Willis, responsible for risk consultancy, contract risk management, account management and the procurement of all classes of insurance for onshore and offshore renewable energy projects on behalf of leading power and utility companies in Europe.

Jatin started his career in renewable energy as an intern specializing in the Production Tax Credit (PTC) at the United States Congress and holds an MSc in Climate Change Management from the University of London. Jatin's MSc thesis was on the challenges of delivering greater UK content in offshore wind. Jatin has also completed the Lloyd's Leadership Programme at London Business School.