Latin American Energy Markets

Investment Opportunities in Nonconventional Renewables

LATIN AMERICA IS VERY RICH FROM THE POINT OF VIEW OF ITS varied energy resources, with an abundance of hydroelectric generation and large reserves of fossil fuels. At present, although there is a general awareness of climate change issues associated with fossil fuel use, the facts show that economic needs over the short and medium terms are the engine of technology change.

It is logical that Latin American countries with low fossil fuel resources—Chile, Uruguay, Brazil, Honduras, and Panama, among others—have become pioneers in implementing nonconventional renewable energy sources (NCRES). Additionally, the sustained low costs of such NCRES make it strategically reasonable for these countries to adopt wind and photovoltaic generation as fundamental elements of their energy solutions.

Over the last three decades, Latin America has seen major changes in the electrical industry, from both the regulatory and energy matrix perspectives. In the 1980s, for example, Chile was the first to institute electricity market deregulation, followed by Argentina in the 1990s.

While relative differences exist among the various Latin American countries in their introduction of new-generation technologies, over the last two years changes have begun to take place very rapidly: unquestionably, wind and solar energy are becoming a reality and will experience significant growth over the next five years. Today, the penetration level is very high in some countries, and their projections are

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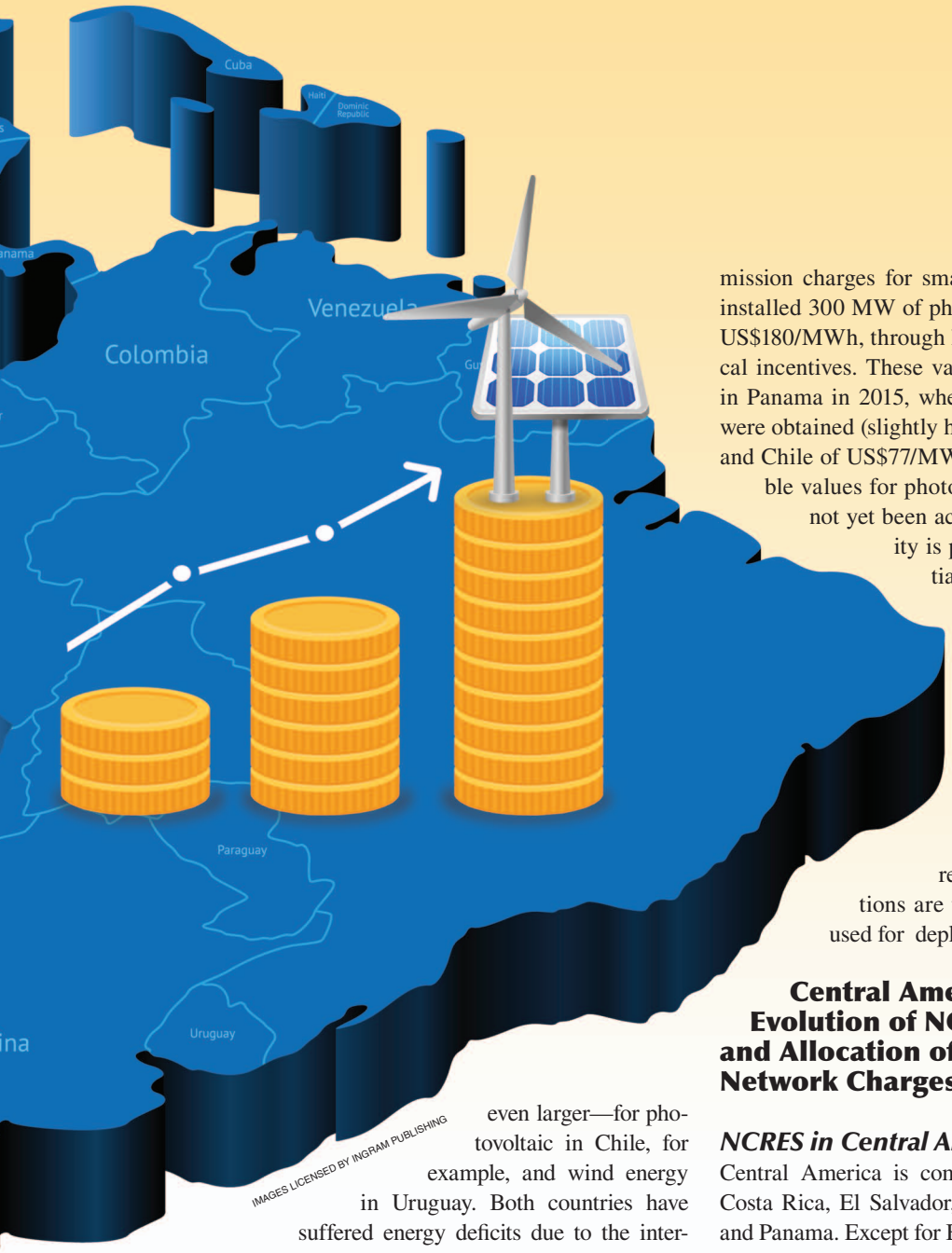


even larger—for photovoltaic in Chile, for example, and wind energy in Uruguay. Both countries have suffered energy deficits due to the interruption of natural gas (NG) supplies to Chile and the power supply to Uruguay from Argentina. Additionally, Argentina has suffered an important deficit in its energy matrix since 2007.

Another example is Brazil, the largest country in Latin America. Brazil opted for an auction mechanism, where it is possible to buy power and/or energy through long-term contracts. By means of this mechanism, today Brazil has installed more than 7,000 MW of wind energy, representing 5% of its energy matrix. Using similar auction mechanisms, Chile established a mandatory percentage for energy distribution companies and, as a result, has more than 2,500 MW of photovoltaic and wind energy, covering 10% of its energy matrix in 2015.

In the case of Central America, Panama and El Salvador encouraged the incorporation of wind farms and photovoltaic due to high fuel prices and a hydro generation deficit. These generation types are sold on the spot market in Panama, with fiscal and tax incentives and the exemption of transmission charges for small generation units. Honduras has installed 300 MW of photovoltaic farms, with rates around US$180/MWh, through long-term contracts and tax and fiscal incentives. These values are well above the last tender in Panama in 2015, where values of US$80–US$90/MWh were obtained (slightly higher than those achieved in Brazil and Chile of US$77/MWh). These examples show that stable values for photovoltaic and wind technology have not yet been achieved in the region. This instability is producing some demand to renegotiate contracts signed with Honduras in 2014.

The incorporation of NCRES is growing rapidly under the farms scheme, connected to transmission and subtransmission networks and, to a lesser extent, to distribution networks of medium voltage. Most of the countries analyzed in this article have experience in renewable energy auctions. Such auctions are the primary regulatory instrument used for deploying NCRES in Latin America.

Central America and Panama: Evolution of NCRES Regulation and Allocation of Transmission Network Charges

NCRES in Central America

Central America is composed of seven countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. Except for Belize, which is an English-speaking country, all are linked by language, history, and culture. In addition, they share an agreement creating a regional electricity market (MER, as its acronym is written in Spanish). Currently, just two countries (Costa Rica and Honduras) still remain vertically integrated in their electricity markets. However, after enactment of its General Electricity Industry Act of 2013, Honduras is undertaking a restructuring of its electricity sector.

In 2015, MER's maximum power demand was 7,481 MW. Energy demand was 46,377 GWh, led by Guatemala (9,398 GWh) and followed by Panama (9,358 GWh), Costa Rica (8,901 GWh), Honduras (8,368 GWh), and El Salvador (6,291 GWh); Nicaragua had the lowest consumption (4,061 GWh).

MER is a seventh autonomous market, based on the standards of regional level; these standards are mandatory rules approved through a regulatory agency called the Regional Commission Electric Interconnection (CRIE).

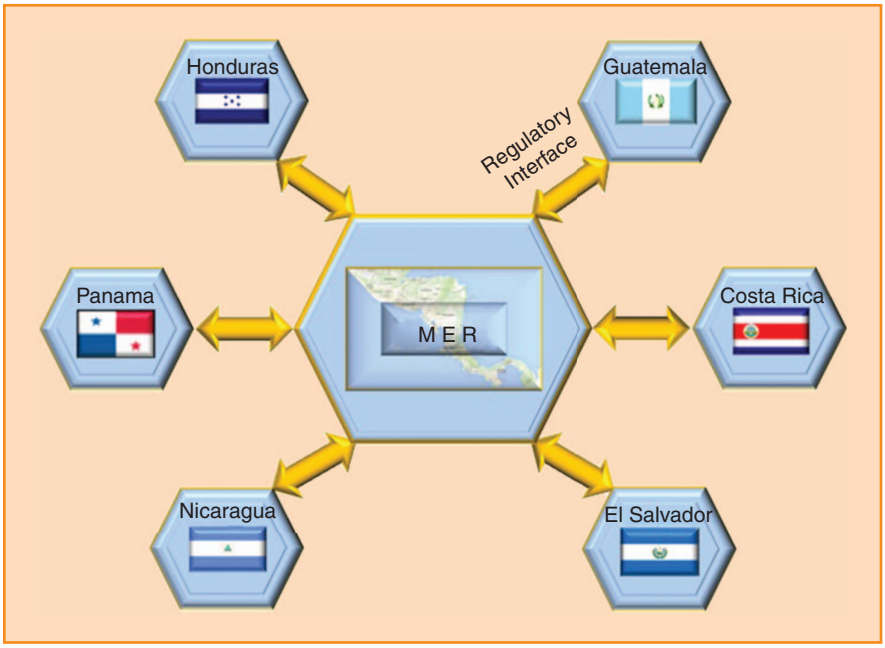


figure 1. The interaction between MER and national energy markets in Central America.

The regional operator entity is responsible for the operation of the regional electricity system, and the Council Director of the Regional Electricity Market (a political body that ensures compliance with electrical integration) works harmoniously with the CRIE for the development of MER. National markets interact with MER through regulatory interfaces harmonizing national regulations with regional ones (Figure 1).

Implemented through MER was an electrical line joining six counties, the Electric Interconnection System for Central American Countries (SIEPAC). This line, in conjunction with existing bilateral interconnection lines and each individual country's national electrical networks, can take advantage of surplus energy within the country and support and implement future-generation projects at the regional level.

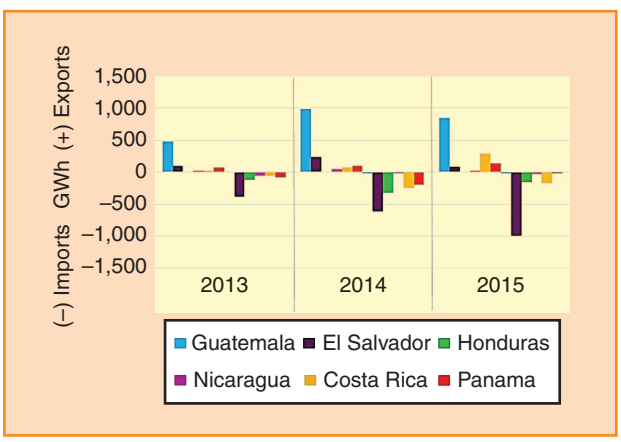


figure 2. Energy transactions within MER, 2013–2015.

Energy prices in the wholesale markets in the countries of Central America are highly dependent on petroleum fuels prices; in 2015, these prices were as follows (in US$/MWh): Guatemala, 68; El Salvador, 105; Nicaragua, 89; Costa Rica, 53; Honduras, 109; and Panama, 100—for an average of US$88/MWh. Figure 2 shows energy transactions within MER for the years 2013–2015.

As Figure 2 suggests, in recent years Guatemala has been a main exporting country, while El Salvador has been a main importing country. However, it is noteworthy that none of the countries of Central America has installed generation plants with a regional perspective in mind.

Among the main obstacles to the development of generation projects in MER, three stand out. The first is the uncertainty in transmission charges, mainly because current regional regulation allows transmission rights to be obtained for only up to one year. The second relates to each country's protectionism of its own supply, which leads to each country selling only surplus generation. The third is the use of MER lines to solve national energy problems without adequate expansion of national transmission among different countries. All of these issues are currently under review by MER.

MER does not yet provide a specific regulation for intermittent renewable generation sources. However, these kinds of projects require the authorization of the regional CRIE to connect to the regional transmission grid. In this way, regional standards must be modified for the new requirements of this technology.

Regarding renewable generation, all countries in Central America encourage the development of such technologies, usually based on tax and hiring incentives through specific, long-term contracts establishing a unit price for the electricity produced. Specifically regarding the development of NCRES, some countries with competitive generation markets—such as El Salvador, Guatemala, and Panama—have power purchase agreements that have resulted in prices for energy from wind sources ranging between US$95 and US$132/MWh and prices for power from photovoltaic generation ranging between US$80 and US$138/MWh.

Panama: A Context for NCRES

In Panama, whose energy matrix is approximately 65% based on renewable energy, specified incentives are established by law that benefit renewable generation. The incentives are exemptions from any payment associated with

transmission and/or distribution charges for plants up to 10 MW; plants up to 20 MW are exempt from the payment of fees for the first 10 MW over up to ten years.

Additionally, in Panama, new transmission charges (described in Figure 3) explicitly recognize that both wind and photovoltaic generation plants, due to their intermittency, do not have a firm capacity. Therefore, these plants have to pay charges only for electrical tracing, which offers another way to incentivize the development of generation from renewable sources.

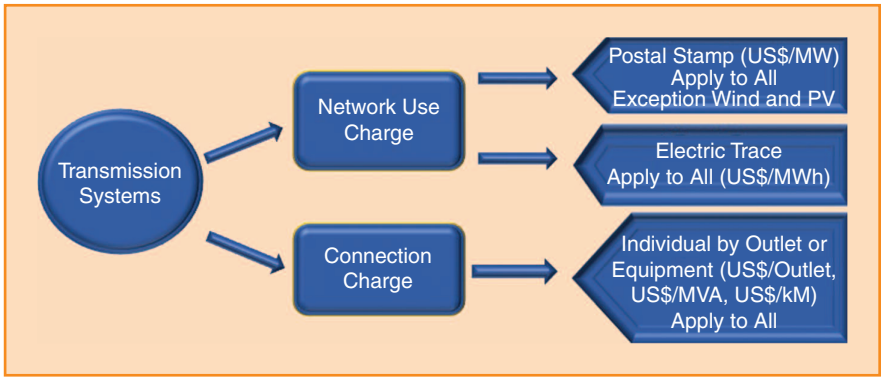


figure 3. New transmission charges in Panama.

Progress in the Implementation of Distributed Generation and Smart Distribution Grids

With regard to renewable distributed generation, which is connected directly to the distribution network, Guatemala and Panama (with 98 MW and 83.6 MW, respectively) are the most representative cases in Central America. Development of distributed generation that connects directly to the customer has, in recent years, been given an important regulatory impulse and has achieved installed capacity in Costa Rica, Panama, and Guatemala of 2.5 MW, 4.1 MW, and 10.7 MW, respectively.

Chile: Leading the Way in Deregulation and Implementing Nonconventional Clean Energy

Chile led the modernization of the electricity sector in Latin America by promoting unbundling and privatization. According to the December 2015 report of the National Energy Commission of Chile, thermal generation dominated the electricity matrix, with a share of approximately 57% compared to 33% for hydroelectric energy. However, nonconventional renewable energy shows significant and increasing penetration, with wind and photovoltaic solar energies representing 4.6% and 2.8%, respectively.

The process of privatizing the electricity sector attracted huge investment, with offers relatively adapted to the growth of the country's economy. Because of its lack of fossil fuels, Chile is heavily dependent on oil and NG imports. This situation impacts energy rates, which are among the highest in Latin America. For example, in 2011 the average residential rate in Chile per MWh was US$211 compared to US$215 in January 2016, a very significant increase caused by exchange rate variation over the period, which reached 40%.

Evolution of Renewable Generation: Past, Present, and Future

Chile was one of the first countries in Latin America to set a goal regarding the percentage of renewables on the energy matrix. According to this goal, 20% of the country's electricity generation shall be provided by renewable sources by 2025. Therefore, the government adopted auctions as a policy tool for renewable energy deployment. These have proven to be very efficient, resulting in an increased numbers of wind and photovoltaic farm projects under development. Most of the photovoltaic projects are located in the north of the country. For instance, in the first half of 2015, solar power plants accounted for 500 MW of installed capacity.

An important tool to stimulate competitiveness in renewable energy has been the definition of three time periods for electricity supply: 11:00 p.m. to 8:00 a.m, 8:00 a.m. to 6:00 p.m, and 6:00 p.m. to 11:00 p.m. Another very efficient strategy were incentives offering full exemption from payment of transmission charges for renewable energy projects between 9 and 20 MW.

The trend for prices obtained in auctions of NCRES has surprised the market. In the auction held in October 2015, the energy was sold at an average price of US$79.3/MWh, 40% less than in the 2013 auction. A total of 1,000 GWh/year were auctioned to supply power for 20 years beginning in 2017. Some market players are skeptical and prefer to see the response of the sector in the upcoming auction, to be held later in 2016, when 13,000 GWh/year for 20 years will be auctioned. In turn, the competitive trend of photovoltaic solar energy is obtained from the projects in progress in Chile. Currently, 1,150-MWp and 939-MWp photovoltaic generators are being installed there.

Challenges for Future Renewable Energy in Chile

The synergy of the current legal framework and its buoyant energy market make Chile a promising country to attract investment to exploit renewable energy. The targets set by the government encourage investors to increase the installation of new wind and photovoltaic farms. Nevertheless, several obstacles will likely arise in the implementation of new renewable energy projects, mainly because of their geographic location in relation to existing power substations. Photovoltaic plants located at distant places will face more difficulties, both

technical and economic. Another problem is related to the existence of large areas under the control of mining companies. These areas cannot be assigned for use by third parties.

From a technical view, revision and reinforcement of the transmission system are essential, particularly considering technological upgrades, such as an automatic generation disconnection scheme for successful renewable energy integration.

Brazil: NCRES Regulation and Incentives Versus the Mismatch of the Transmission Network

The modernization of the Brazilian electricity sector began with the state's decision to launch a privatization program. The program included the breakdown of the supply chain into separate activities, namely generation, transmission, distribution, and commercialization. In 1995, new public guidelines were established regarding the auctioning of new energy generation projects, the definition of independent power producers, free access to transmission and distribution systems, and granting consumers the freedom to choose their own their energy suppliers. In 2004, the model of the Brazilian electricity sector was revised, with the adoption of some important improvements to make it less vulnerable to market uncertainties.

According to the Brazilian Energy Planning Company, in December 2014 the national grid had an installed capacity of 134 GW, with 62% hydro, 15% thermal, 2% nuclear, 5% energy import, and 16% shared participation of biomass plants, mini-hydro, wind, and solar plants. In terms of tariffs, electricity supply services in Brazil are well positioned relative to Latin American and Organization for Economic Cooperation and Development (OECD) countries; the country's residential end-user rates were about US$178/MWh in 2014, as shown in Figure 4.

Development of Renewable Generation: Past, Present, and Future

In recent years, wind energy has been successfully introduced in the energy matrix through auctioning. In late 2015, Brazil had 281 wind farms distributed over 11 states. In August 2015, the installed capacity was about 7,000 MW, with a projection of a 5% stake in Brazil's total energy matrix at the end of that year.

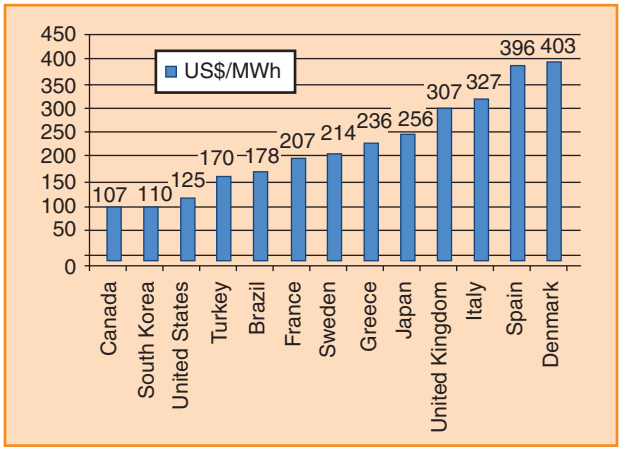


figure 4. Residential electricity rates in Brazil compared to OECD countries (2014).

Until recently, photovoltaic generation in Brazil was restricted to a few farms in the northeast. The crisis caused by a deficit of water resources, especially in the southeastern region of the country, led to the transfer of a large amount of thermal power plants operating on the basis of reserve contracts, which has significantly increased energy prices. This critical stage has greatly contributed to the development of renewable sources, and several photovoltaic and wind energy auctions were implemented. In 2014, the first Brazilian auction specifically targeted to photovoltaic energy took place. In this contest, 31 projects with a total capacity of around 1,000 MW were chosen.

In November 2015, a second auction of reserve for that year was held, with photovoltaic and wind farms participating. This auction chose 20 wind power generation projects and 33 photovoltaic power generation projects and contracted for 548.2 MW in wind energy projects and 1,115 MWp in photovoltaic energy projects. The price of photovoltaic closed at an average value of US$77.60/MWh, while wind power reached a final price of US$53.10/MWh.

Regarding micro-renewable generation, the national regulatory agency regulates micro- and mini-generation systems connected to the distribution network. The new regulations include important improvements, such as

- ✔ establishing agreements for self-consumption and remote-shared generation
- ✔ providing the possibility of sharing energy credits among the headquarters and subsidiaries of business groups
- ✔ allowing generation distributed to condominial systems (individuals and companies)
- ✔ increasing the maximum power for mini-generation from 1 MW to 5 MW.

Future Challenges for Renewable Energy in Brazil

The highest potential for wind energy is in the northeast of the country, where many wind farms are concentrated. Conversely, the highest demand for energy is in the southeast, which faces difficulties in transporting the energy due to the lack of transmission line capacity, causing significant problems for wind farm developers. According to the Brazilian Association of Wind Energy, the largest gap between transmission lines and wind farms occurred in 2012. Delays resulted in approximately US$900 million in expenses to indemnify wind farms that were ready but unable to sell power due to poor transmission capacity. Thus, the government had to accelerate the planning of new transmission lines to incorporate new wind farms and other power plants going into operation.

A recent government study indicates that investment of around US$1.7 billion is needed to transport power generated from the northeast of Brazil to southeast and regional

interconnections. If these obstacles are overcome, the prospects for renewable energy in Brazil are positive, with a growing market and competitive costs.

Uruguay: Opportunities for Investment in a Mature, Vertically Integrated Market

Features of the Uruguayan Electricity Market

The Uruguayan electricity market is vertically integrated and controlled by the National Administration of Power Generation and Transmission (UTE), a state-owned company that regulates the liberalization of power generation, involving private stakeholders, as well as free trade among other regional countries. The UTE manages the participation of independent generators through bids for each technology, with purchase commitments usually lasting 20 years. Moreover, the rules allow the UTE to associate with other private companies. This Uruguayan model of public–private association has been very successful for investment promotion, allowing for the autonomy of bordering countries.

The maximum demand load in Uruguay is about 1,900 MW, and the installed power capacity is slightly over 4,000 MW, of which approximately 38% is from controllable hydropower (from dams), 30% is from conventional thermal, 21% is from wind generation, 10% is from biomass, and 1% is from solar photovoltaic.

By the end of 2015, Uruguay had 24 wind farms in operation, with an installed capacity of 856 MW, and ten projects then under construction will supply additional power of 657 MW in the short term. By the end of 2016, it is expected that 25% of electricity demand will be met by wind resources. Concurrently, in terms of solar photovoltaic farms, as of January 2016 three farms were in operation, with a power capacity of 58 MW, and other 15 were under construction, which will supply additional power of 170 MW. These were all developed from bids through the UTE.

Uruguay constitutes an interconnected system, having two international interconnections with Brazil and Argentina (with Montevideo serving as their load center). Although a power-generation market exists, the state is the main buyer. The electricity spot price during 2015 was on average US$60/MWh, with very low prices in several months (close to zero). In turn, end users' electricity costs (including taxes) are around US$210–US$300/MWh for residential users, US$160–US$250/MWh for commercial users, and US$130–US$220/MWh for industrial users.

NCRES Incentives

The 2005–2030 State Energy Plan emphasizes the diversification of Uruguay's energy matrix, mainly by promoting the use of conventional sources and NCRES. The encouragement and protection of investments made by both national and international investors, including the granting of important tax exemptions, is in the public interest, according to the NCRES investment promotion policy. In this sense, for instance, an attractive policy grants to NCRES investors exemptions from taxation of income investment (from 20% to 100%, depending on the type of project). In this context, the prospects for wind power generation are outstanding, particularly taking into account Uruguay's great natural wind resources, with capacity factors close to 40%. Moreover, reduction in capital costs of wind generators over the last several years has allowed wind power to become a very economical option, with competitive electricity prices near US$65/MWh (based on values established during the most recent auctions).

Another factor that encourages wind power is its complementarity with hydropower generation. Hydrological phenomena occur less frequently than do wind phenomena (which is why wind power is recommended). For instance, evaluating hydroelectric power would take 30 years of measurement; by contrast, evaluating wind power takes only one year. Likewise, hydroelectric plants are very reliable in the short term thanks to dams, but they are not so predictive in the medium and long term due to their hydrological randomness. On the other hand, wind farms are very reliable in the medium and long term, but not so predictive in the short term. These characteristics make wind and hydro intrinsically complementary.

Toward Smart Distribution Grids

At the distribution level, Uruguay is taking several steps toward encouraging energy efficiency based on the new paradigm of smart distribution grids. Some regulations are being introduced to allow customers connected to a low-voltage network to install their own generation based on renewable energy, with the main requirement being that it not exceed 10 kW (16 A). In this sense, the UTE is committed to buying all the energy a prosumer injects into the network for a period of ten years, at least under a typical tariff scheme for "net balance."

Finally, it is worth mentioning that the UTE has recently implemented a "smart plan" and mobile app services. The former establishes a tariff scheme so that a day is divided into two separate periods having different electricity prices; during the peak load, the price is higher. Based on this plan, between 2009 and 2014 more than 14 MW were shifted from the peak load time. Mobile apps now allow customers to make several free arrangements, e.g., to make a claim for loss of electric service or request a debt report or invoice.

Colombia: An Investment Opportunity for Clean Energy Stakeholders

Electrical Industry Evolution and Current Issues

The evolution of the electrical industry in Colombia since the 1980s has been marked by the following milestones:

- ✔ transition from a generation matrix based on fossil fuels (during the 1980s) to a current matrix based on hydropower (68%) and thermal (28%)
- ✔ evolution of the electricity market from a vertically integrated model held by the state to a liberalized model based on bids

- ✔ significantly increased system reliability and power quality associated with technological changes
- ✔ increased demand, with an average annual growth rate of 3.6% over the last ten years.

Colombia has an approximate installed capacity of 16,000 MW, of which around 71% comes from renewable resources (mainly energy generated by hydroelectric plants). In 2015, demand for electricity was approximately 65,300 GWh, with a peak demand of 10,000 MW. To meet such demand, the participation of NCRES is close to 3%, plus 4% from hydroelectric power generation, the capacity of which is lower than 20 MW; the total participation, approximately 7%, is very low in relation to the country's potential. For instance, winds in Colombia are considered a renewable energy source with high potential; however, less than 0.4% of their theoretical potential is exploited.

The current generation matrix marks the country as having a high rate of vulnerability within the electricity sector due to several factors. For instance, hydroelectric generation in the country decreased by 25% in 2015 due to the El Niño phenomenon; this decline is being overcome by thermal generation, but it is expensive for its variable costs in some cases. Before El Niño, the cost of 1 MWh was approximately US$90; during the phenomenon, it spiked to almost US$140 due to the decrease in hydroelectric generation.

Moreover, the Colombian electricity sector has not been fully incorporated into certain parts of the country. In Colombia, about 50% of the national territory corresponds to noninterconnected zones (ZNIs) outside the national interconnected system. Despite limited economic resources, ZNIs in the country have great potential for generating electricity with NCRES.

The high degree of uncertainty in hydroelectric generation and its vulnerability to the effects of El Niño represent a major weakness in the current structure of the Colombian generation matrix and, therefore, in system reliability regarding electricity supply. Nevertheless, this scenario is a very good business opportunity for different actors wanting to invest in distributed generation, smart grids, microgrids, and nonconventional renewable generation technologies (Figure 5).

To make Colombia's electricity distribution system more resilient to those issues, the actors involved (the utilities, state, and users) agree that investment should be made, given the low costs of these new technologies. The findings reported here are based on interviews with several advisors, academicians, and experts in the field, as well as representatives of the Colombian Association of Electricity Distributors, which brings together the 23 main electricity distribution companies in the country and provides services to 98% of users, with a presence in 96% of Columbia's municipalities.

The State's Strategic Vision, Planning, and Regulatory Agencies

The state, aware of the potential of NCRES, smart grids, and microgrids, has established a national energy plan for the period 2015–2029 to address the challenges mentioned earlier. This plan proposes several strategies and objectives with the aim of using nonconventional generation resources, with particular emphasis on rural communities and isolated areas of the interconnected system. This interest encourages the implementation of microgrids in to meet the particular needs of different ZNIs.

The state emphasizes that laws related to renewable energy provide the basis for pioneer projects and, therefore, encourage research on smart grids and microgrids, for a total capacity of 461 MW. According to state plans, it is expected that, for instance, 8% of demand will be met through nonconventional renewable generation by 2020 and 15% by 2030.

The Need for Active Participation of the Demand Side

According to the Colombian Association of Electricity Utilities, which gathers together large energy consumers, the country needs to incorporate 2,000 MW of firm power into low-cost generation. This assessment results from price increases due to the El Niño phenomenon. A solution to the deficit in low-cost installed capacity is investment in nonconventional renewable generation and microgrids; the demand side can participate by investing and operating as self-generators. To promote self-generation, certain regulations in Colombia establish both energy policy guidelines regarding delivery of surplus self-generation and maximum limits for small-scale self-generation power.

Moreover, other Colombian regulations aim to encourage demand response based on a scheme for voluntary demand disconnection. However, the demand side neither knows about these regulations nor applies them. The use of this tool could entail that the demand side reduce its consumption in response to price signals of the wholesale electricity market. Incentives to demand will be stipulated in bilateral contracts with marketers, with savings on energy bills seen due mainly to reduction of consumption during peak hours.

Argentina: Back on Track and Developing NCRES

Features of the Argentinian Power Market

The power sector in Argentina is based on a competitive market, liberalized for the power generation agents and monopolized in the transmission and distribution networks. The Argentinian interconnected system is developed on an extensive infrastructure of transmission networks of 500 and 220 kV, and it is interconnected with four border countries: Uruguay, Brazil, Paraguay, and Chile.

Currently, the installed power generation capacity is 32.5 GW, where about 60% is thermal based on fossil-fuel, 34% is hydropower, 5.4% is nuclear, 0.58% is wind energy, and just 0.02% is solar photovotaic. Electric energy consumption is about 144,000 GWh/year, with an annual per capita

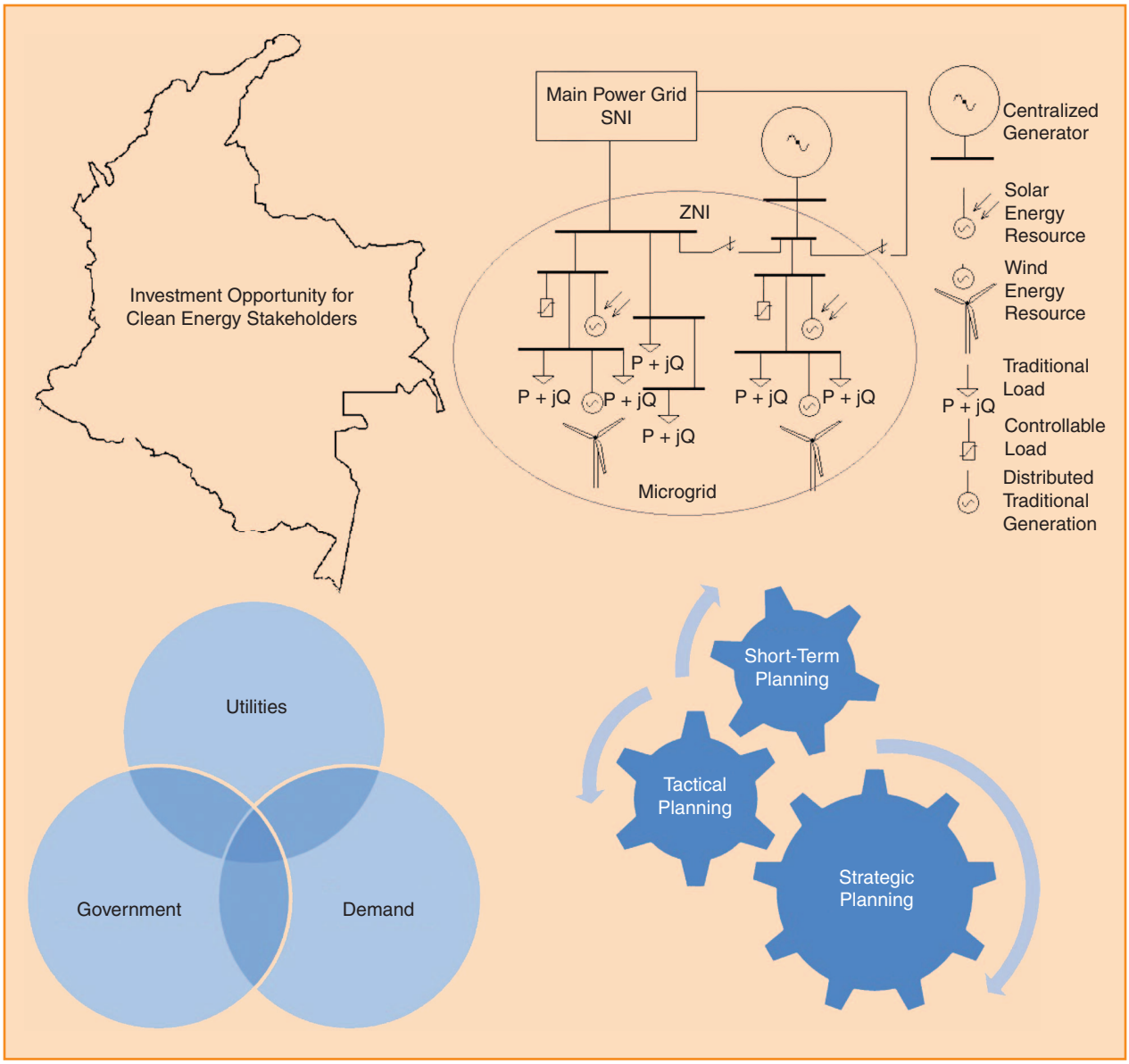


figure 5. The investment opportunity for clean energy stakeholders in Colombia. SNI: interconnected national system.

consumption rate of around 3 kWh per habitant, where 64.6% is from fossil-fuel energy (of which 70% is based on NG), 29.8% is from hydropower, 5.1% is from nuclear, and 0.5% is based on NCRES. The electricity price on the wholesale market is around US$70/MWh, and the maximum demand load is about 24 GW.

History and Evolution of the Power Market (1990–2015)

Even though Argentina was the second Latin American country to liberalize its power industry (in 1992, after Chile), at that time it was the more successful, making bigger contributions mainly to the generation and distribution sectors. This success resulted, in part, from the introduction of thermal generation based on combined-cycle gas turbines, which produced a reduction of wholesale electricity prices of up to US$25/MWh with higher power reserve levels; also, prices were lower than those estimated by electricity agreements by around US$40/MWh at that time. Furthermore, Argentina was the first Latin American country where power quality and reliability were successfully regulated, settled, and controlled mainly by utilities systems.

However, the success of the Argentinian power market lasted only a few years, due to an ideological change in energy politics introduced at the beginning of the current century. This caused a reduction in generation investment, the abandonment of exploration for new resources of oil and NG, and indirect intervention on private companies by the state through the freezing of tariffs with a high level of subsidies (in some cases, up to 90% of the tariff prices).

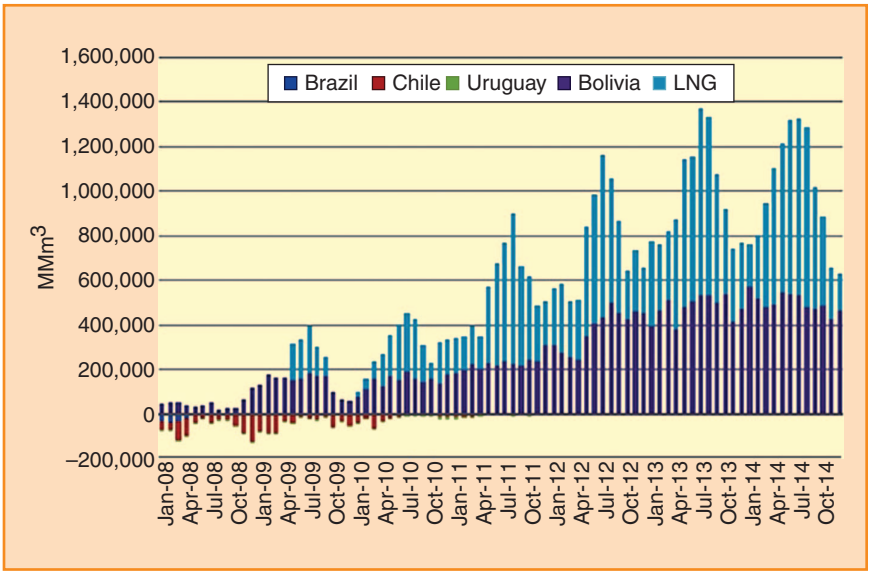
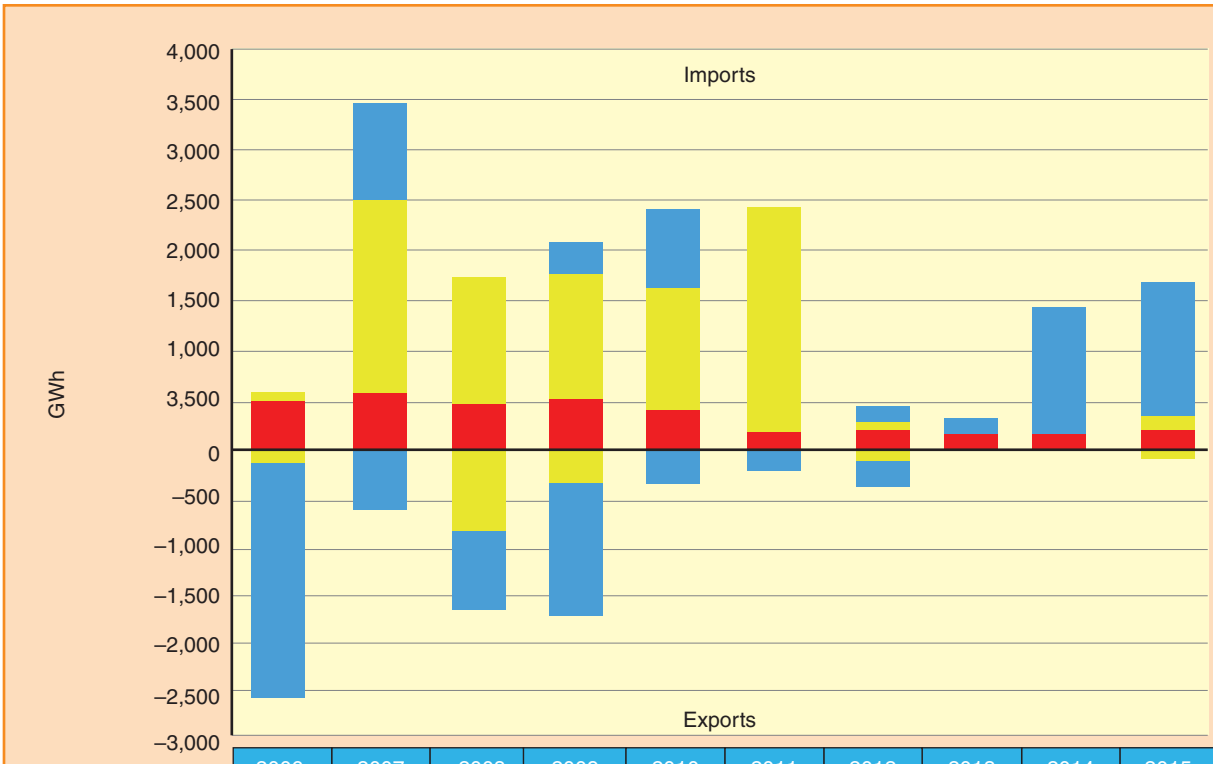


figure 6. The evolution of Argentina's NG exchanges with border countries, including the importation of LNG. (Source: AGUEERA.)

During the period 2001–2015, as a result of the reduction in private investment, there was a pronounced deterioration of power quality, with a gradual energy deficit and a loss of power "market" conditions, impoverishing the electricity companies, which were reduced to mere observers of the process controlled by the state. This crisis forced Argentina—which had been exporting NG to Chile and Uruguay—to begin importing NG from Bolivia and Brazil and even to buy liquefied NG (LNG), as shown in Figure 6. Similarly, the electricity sector changed from being purely an exporter of electricity between 2001 and 2006 (mainly to Uruguay and Brazil) to becoming a net importer between 2010 and 2015, as shown in Figure 7.



		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Export	Uruguay	–2.530.71	–573.225	–833.543	–1.357.49	–338.812	–264.649	–278.333	—	—	–0.4
	Brazil	–76.420	–4.483	–778.812	–329.024	14.860	–107	–73.445	–0.211	–0.6	–41.0
	Paraguay	—	—	—	—	—	—	—	—	—	—
	Chile	—	—	—	—	—	—	—	—	–3.9	–0.1
Import	Uruguay	6.814	971.183	15.651	241.030	752.012	18.994	193.240	206.409	1.266.8	1.312.9
	Brazil	27.419	1.971.936	1.277.525	1.278.300	1.202.64	2.257.503	78.477	0.424	0.7	228.5
	Paraguay	524.649	515.800	480.993	520.830	437.427	135.749	150.997	135.205	115.9	113.2

figure 7. The evolution of Argentina's electricity exchanges with border countries. (Source: CNEA.)

Current Challenges and Future Opportunities

Since the beginning of 2016, with a new government instituting radical changes in energy policy, the state has been implementing some norms to regularize commodity prices (fossil fuels and electricity) and to improve the regulation of renewable energies, including many incentives for private investors. One goal is for 8% of the energy matrix to be from NCRES by December 2017 and 20% by 2025, with requirements that big users (such as supermarkets and factories) meet those percentages or face financial penalties.

Within this new context, it is hoped that by normalizing electricity tariffs, utilities can make technological investment plans aimed at improving efficiency in their distribution networks; this would open a door to new control and smart-metering technologies, and even the inclusion of NCRES. To this end, some provinces have implemented regulations for connecting to NCRES, and others have given economic incentives in the form of tariff rates, which include a net-balance fee to remunerate the NCRES (such as solar phtovoltaic, wind power, biomass, and mini-hydropower).

Conclusions

Latin American should be viewed as very promising for penetration of NCRES, with 8% by 2020 and 20–25% by 2025 in most countries—and in countries like Uruguay and Chile, the percentage is higher.

Incentives for NCRES penetration are motivated primarily by the pressing overall energy deficit facing some countries and the uncertainty in hydroelectric generation, which is exacerbated by the El Niño phenomenon in the case of Chile, Brazil, Colombia, and Panama. Second, and crucially, there are economic factors, achieved through auctions, allowing very competitive costs for both wind power and photovoltaic. (As mentioned at the beginning of the article, environmental impact runs a distant third.) Regulatory incentives include guidelines imposed by state enforcement agencies, taxes, and, most importantly, the requirement that contractual demand for long-term energy should include minimum percentages of nonconventional renewable generation.

These conditions are conducive to significant business opportunities for NCRES in Latin America; indeed, this favorable business climate has existed for at least the last two years (currently affected somewhat by temporary declines in the price of oil and NG).

Steps for introducing renewable energy at early stages and for the short and medium term are being taken mainly through farms of photovoltaic and wind power because these can quickly incorporate massive generation, are competitive in terms of cost, are being promoted through financial offers by international organizations, and pose few major technical difficulties. For later stages and in the long term, as distribution networks and clients require subsidies, new governing rules for this type of generation and a new culture in the use of this type of energy will need to develop.

Latin America today poses challenges regarding transmission network planning and complementarity with other generation sources if high participation is to be achieved without compromising operational security and at the same time ensuring economic dispatch and reduction of the energy deficit caused by the randomness of renewable primary resources. In fact, the financing of new projects by international organizations is limited only by transmission capacity.

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For Further Reading

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