Review of Support Schemes for Renewable Energy Sources in South America

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Introduction

The South American region is among the most promising lands for the development of non-conventional renewable energy sources (RES, i.e., wind, small hydro, solar, tidal, geothermal and in some cases waste) or "green" energy. First, the region shows a huge "green fuel" potential: strong and persistent wind flows, rich country lands, availability of biomass, potential for small hydros and thousands of sunny hours a year. Second, in many cases, RES would be economic, not only from the carbon saving perspective but also due to the fact that the cost of energy in some of the regions is undergoing a significant increase. Third, there are many isolated areas for which distributed generation is truly the "great white hope". And finally, the high proportion of large-reservoir hydro plants that some of these systems present provides a suitable environment for the deployment of non-dispatchable RES.

Nowadays we count on a very significant number of experiences and literature that can help us assessing the efficiency of the different alternatives promoting RES. The problem is that many of the conclusions, particularly the ones extracted from the experiences in developed countries, cannot be exported to other systems, particularly the South American ones (different not only due to their topological nature but also the particular socio-economic environment).

This article reviews the current experiences undertaken to promote RES. We briefly describe first the particular characteristics of the territory which make it so appealing for RES deployment. Then we scour the continent examining the mechanisms implemented to date. We conclude by pointing out what should be expected in the years to come.

Renewable Potential in South America

South America has one of the cleanest energy matrices in the world, mainly due to its intensive use of hydro power for electricity generation and more recently the growing use of sugarcane ethanol for transportation in some countries.

The power sector of this region contributes very little to greenhouse gas emissions. The strong and persistent wind flows, rich country lands and thousands of sunny hours a year provide a significant potential for several types of RES. Some examples include cogeneration from sugarcane bagasse and small hydropower plants. In addition, in most cases hydro reservoirs can easily smooth out production fluctuations of intermittent (wind and solar) or seasonal energy sources (biomass), thus providing an operation flexibility that facilitates their technical and economic integration. In other words, hydro reservoirs play the role of "energy warehouses" that may "store", besides water, other types of energy such as wind, solar and biomass.

While the "conventional" RES (mainly large hydro plants) have a major share in the region, the penetration of non-conventional RES (wind, small hydro, solar, tidal, geothermal) has occurred mirroring the developed world but is still small. Despite the primary objective of increasing the population's access to electricity, budget constraints have not allowed South American countries to set a priority for renewables for the past decade. This situation is, however, changing and renewables have started this decade with a fast penetration in these countries due to the increasing awareness of the crucial role of clean energy supply, a need to diversify the generation mix and a pressure to conform to world efforts in this direction.

The downside of renewable energies in South America is first the higher economic cost as compared with standard generation options (although recent prices resulting from long-term auctions in Brazil or Peru might show that the gap is near to nil, see next section) as well as, in some cases, the weak state and instability of transmission networks.

However, energy power systems in the region present a number of particulars that if the costs keep on decreasing can turn RES into an interesting generation option:

- From the security-of-supply perspective, RES represents an opportunity to diversify the current generation mix, currently heavily based on hydro facilities, which leads the power systems to be critically vulnerable to the El Niño/La Niña-Southern Oscillation. Also, in contrast to the last five years for "regular" hydro, their construction time is short (around

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18 months). This allows flexibility in the entrance of new capacity; which is valuable as a hedge against the countries' load growth uncertainty[1]. RES are also the best solution to provide access to electricity to the large numbers who live in isolated areas of the continent.

- From the economic perspective, the new "regular" hydro plants expected to be built in the years to come, may in many cases be large scale projects (examples include the 11,233 MW Belo Monte plant in Brazil and the 2,400 MW Pescadero plant in Colombia – both under construction - and the large Peruvian hydro projects on the right-hand-side of the Andes, which can easily total over 6,000 MW[2]). Because of the large capital costs of this type of investment, the number of qualified investors expected to enter electricity markets in the region is limited. This in some cases reduces competition. In contrast, due to their smaller scale RES increases the range of potential investors. Also, the substitution for imported oil- or gas- or coal- fired generation by locally available RES could save expenses in foreign currency and foster the installation of local manufactures, which increases job creation and contributes to economic growth.

Renewable Support Schemes in South America

RES energy support mechanisms have been present in the South American region for the past 10 years under the form of some sort of fiscal or tax incentive for renewable development in a state or municipality. In the beginning of the last decade Brazil, Argentina and Ecuador implemented feed-in tariffs to foster renewables. However, due to various reasons, such incentives have not been successful (see below). The countries of South America also have never had binding renewable targets in their electricity matrices. Some isolated initiatives appeared at the beginning of the decade in some countries but were not binding.

With the implementation, beginning in 2004, of the second wave of sector reforms to attract new generation, (see Batlle et al. 2010), long-term auctions for energy contracts or capacity payments (e.g., Brazil and Colombia) gained momentum and started to be used in several countries as their main support scheme for RES. The auctions function as an indirect way for feed-in price discovery and manage to reach the right amount of investment and to reduce risk aversion with long-term contracting. This is the case of Brazil and Peru, where renewable auctions complement the regular auctions to attract conventional generation. Argentina and Uruguay have also implemented specific auction processes to attract RES. Chile has opted for a quota scheme placed on generators. All other countries do not have an explicit support mechanism besides soft loans, tax credits, fiscal incentives or specific funds to foster RES investment in isolated areas.

Following are reviews of the current situation of RES regulation in the largest countries in the region.

Brazil

The "Proinfa" program, launched in 2002 was the first scheme adopted in Brazil to foster RES. It was essentially a feed-in tariff designed to contract for 3,300 MW of wind, biomass and small hydro until 2006. Each RES had a different tariff and first priority for 1,100 MW. The energy produced by participating plants is purchased by Eletrobras (the holding company for power utilities owned by the Federal Government) through 20-year contracts, which then resells the energy to all consumers in proportion to actual consumption (formally a levy is paid). Consumers are then entitled to portions of Proinfa energy in their contract portfolios. The average price paid to Proinfa wind farms for 2010 is about 140 US$/MWh. Proinfa was responsible for jumpstarting the wind industry in Brazil but completion has been delayed (the original deadline of 2006 was extended several times and is now 2011) and its performance has been criticized on grounds of (the lack of) economic signals for efficiency and for technological improvement.

In 2007 a second support mechanism, now in the form of discounts on transmission and distribution tariffs for free consumers who purchase energy through contracts that are backed up by RES, was implemented. In practice, this is a cross subsidy on the 'wires' cost, paid by captive consumers and received by free consumers who purchase RES. Depending on the location of the consumer the benefit is significant and allows RES to sell high-priced energy contracts.

The revised power sector regulation implemented in 2004 allows the use of contract auctions as a backstop mechanism for the development of specific technologies driven by energy policy decisions or to increase the system's reserve margin ("reserve energy auctions"). These auctions are organized in a similar way to the long-term auctions to supply the distribution companies (which act as regulated retailers for small consumers), (see Barroso et al. 2006), with some implementation differences. In the case of RES, the government has the prerogative to call an auction to contract a government-selected volume of RES, even if it is not contemplated in the demand forecasts prepared by the distribution companies,

as well as to select the participant technologies. All consumers pay for this energy as a system charge. It works as a feed-in tariff scheme, but, as opposed to Proinfa, the consumers are not assigned a share of the contracted energy to their portfolio of contracts.

The auction-based approach has become the main tool in Brazil to foster RES. Its "technology-specific" approach allows the organization of auctions to specifically contract one or another RES. The first auction was carried out in August 2008 to contract new energy from the cogeneration of sugarcane bagasse for delivery in 2011 and 2012. Some 2,400 MW (gross capacity) were acquired in 15-year contracts for an average price of 80 US$/MWh. The net capacity available for the power sector is about 1,500 MW.

In December 2009 a similar auction to contract for wind power for delivery in 2012 was carried out. The product that was offered to potential investors, a 20 year energy contract with delivery starting in 2012, has a very specific accounting mechanism designed to provide investors with a fixed payment (for financing purposes) while managing the quantity-price risk and incentivizing/penalizing production above/below a given energy threshold (see Porrua et al 2010). 13,000 MW of wind projects registered for the auction, and some 1,800 MW of capacity were contracted for an average energy price of 77 US$/MWh (21% below the initial auction price). A diverse mix of investors (local and foreign private generators, manufactures and government-owned companies) won the contracts, and three new wind turbine factories are to be installed in the country. An impressive issue is the fact that the average capacity factor of winning projects hovers around 45%. Another RES auction was carried out in Brazil in August 2010, resulting in an additional capacity of 2,900 MW. This includes 70 wind farms, 12 sugarcane cogeneration plants, and seven small hydro plants. Wind energy totaled 2,050 MW at an average rate of US$75/MWh. Biomass came second with 713 MW of capacity at an average rate of US$82/MWh, and small hydro reached 132 MW at an average rate of US$81/MWh. Once more, the average capacity factor of winning projects of the 2010 auctions is high: it hovers around 45% with some projects having capacity factors over 50%.

Tax incentive programs have also been implemented and direct subsidies to pre-investment assessments. A reduction of 75% on the income tax during the first 10 years of operation and special financing conditions were given in some regions of the country.

Chile

Chile has followed a different path than its neighbors. Distribution companies hold long-term energy contract auctions to supply their regulated consumers in which no technology discrimination is applied. In 2009 a wind farm won a 275 GWh/year, 15-year energy contract for a price of 93 USD/MWh[3]. However, the electricity regulation was modified in 2008 and a quota system was introduced, which required that at least 10% of the energy traded by generators be produced by RES. The requirement starts with a 5% obligation in January 2010 until 2014, and from then on there will be an increase of 0.5% annually until reaching 10% in 2024. In case the requirement is not met, a fine of is established.

It is uncertain if the quota-mechanism will be successful due to the (currently) limited number of RES projects readily available to be developed. The remuneration of such projects is also an uncertainty (the spot market or firm energy contracts with production-delivery risk are the alternatives) and some developers have requested the implementation of feed-in tariffs or another RES support mechanism.

Argentina

The strong intervention in Argentina's electricity market after the 2001 political-economic crisis had several effects including the stalling of generation investments and freezing of commodity prices that have contributed to an aggressive energy demand growth. With the increase of regulatory uncertainty, the drivers for new investments in generation clearly shifted, from the private sector (previously to the crisis) to the National Government (after the crisis).

In May 2009, Enarsa (the State-owned energy company created in 2004) organized a specific auction to develop renewable technologies, basically wind power (the so-called GENREN program). The renewable auction offered a 15 year contract signed between the winning generator and Enarsa and a mirror contract signed between ENARSA and Cammesa. The total offer was about 45% greater than demand. The offers were broken down by technology: 1,155 MW for wind power; 155.4 MW biofuels; 54.1 MW biomass; 14 MW biogas; 22.5 MW photovoltaic solar energy; and 12.7 MW from small hydro projects. The auction awarded 895 MW of new capacity to be built in two years, of which 754 MW were wind power plants (the remaining 140 MW were distributed among biomass, geothermal, solar and plants burning biofuels). These wind offers were around 130 US$/MWh with capacity factors around 40% (the

adjudication process required projects with capacity factors higher than 35% and the weighted average price of all bids was fixed as auction cutting price, this was 136 US$/MWh).

Uruguay

UTE, the Uruguayan national vertical integrated electricity utility, ran two successful auctions for low-scale wind projects (total 50 MW awarded). Then in 2010 promoted an auction to acquire 150 MW of wind power, expected to come online by 2014, through 20 year contracts. UTE received 950 MW of proposals from 22 projects of 15 companies for a 150 MW tender. The clearing rules of the auction were pretty complicated (for instance, national-component levels were favored and a two-round auction system was implemented, in such a way that first participants bid without transmission costs and on the basis of the results they had to rebid with such costs after a reference network was planned by UTE).

At the time of this writing the UTE indicated its preference for the three cheapest bids at prices around 85 US$/MWh but rivals allege there are a number irregularities in some of the bids and threaten legal action (Sciaudone, 2011). A new tender has already been announced for April 2011 to contract an additional 150 MW.

Peru

Peru has also adopted technology-specific contract auctions for RES according to the targets established by means of an RES development plan approved by the government. Although this plan has not yet been released, in February and July of 2010 procurement auctions were applied to contract small hydro, photovoltaic, wind and biomass generation. Winning generators were awarded contracts for up to 20 years to deliver the annual amount of energy offered at its offered price for 3 years ahead. As in the Brazilian case, demand pays a fixed annual amount and collects the spot market revenue.

About 140 MW of wind power were competitively contracted at energy prices averaging 80 US$/MWh. Contracting of 160 MW of small hydro, 90 MW of solar plants, and 27 MW of biomass was observed with prices of about 60 US$/MWh, 220 US$/MWh and 63 US$/MWh, respectively. These energy prices had discounts of 50% (biomass), 27% (wind) and 18% (solar and small hydro) with respect to the auction price cap and winning investors are mostly foreign private companies.

Bolivia

Currently the Bolivian system is completeing a strong restructuring process. Nationalizations have occurred in generation and distribution (it is not yet clear if they are not going to affect the whole system) and most developments are driven by the recreated state-owned vertically integrated company (ENDE).

Currently, the tightness of the reserve margin is worrying and the planned new generation investments are basically gas-fired. In the five-year expansion plan made by the system operator (CNDC) no development of RES is foreseen. The only hints about RES initiatives are some news about the presumed interest of ENDE in developing geothermal sources in the south of the country.

Ecuador

In Ecuador, RES activities have been small and sporadic. A law passed in 2000 established a feed-in tariff for photovoltaic installations (520US$/MWh), but once implemented, it was never paid. Installations of some hundreds of isolated photovoltaic systems was done between 2003 and 2006 by means of a public fund (Marginal Rural and Urban Electrification Fund, Ferum) based on a 10% tax on the power consumption for commercial and industrial consumers. In any case, the current regulation passed by President Correa has allowed the State to re-take full control of the electric power system and bans private initiative to invest in generation facilities. This will definitely postpone any plans to foster RES developments.

Colombia

No explicit support mechanism for RES is in force in Colombia to date. Quite the contrary, a recent study published by the governmental UPME (Mining and Energy Planning Unit) clearly states that "at least during this decade, it is clear that reducing emissions is not a priority that determines (at least significant) investment goals". And even if this would be the case, large hydropower and also the rehabilitation of existing thermal plants are seen as the least-cost power options and also the best from the CO_2 emission reduction point of view. The only advantage the government sees in wind generation is, as is the case in Brazil, it being complementary to hydro energy resources. But at least for the moment, no explicit RES support mechanism is in place and the most likely way to hedge the system against scarcity appears to be the expansion of coal-based generation.

Venezuela

In Venezuela no RES support mechanism has been implemented to date. In 2007 the government created the National Registry of Renewable Energy. This registry is nothing but the first bureaucratic condition to supposedly be able to opt to join any potential (yet to come) program on RES promoted by the Ministry. However, the new law passed at the end of 2010 establishing the "socialist management model", declares the public utility of all goods related to the electric power service and centralizes all the electricity activities in a fully State-owned vertical utility. The law announces a Development Plan of the National Electric Power System, which, among other objectives, will eventually contain 'actions aimed at promoting the use of alternative sources of energy, renewable and environmentally sustainable'.

Paraguay

99% of the generation capacity in Paraguay is large-hydro-based (Itaipú). There are no plans to undertake any initiative to deploy any alternative RES.

Conclusion

Long-term auctions are the main tool to promote RES in South America. Auctions appear as an effective mechanism to stimulate competition between RES investors, to provide price disclosure while managing the right amount of investment and reducing risk aversion with long-term contracting. On the other hand, its main challenges include the definition of criteria to select the quotas for each RES, the design of a relevant set of guarantees (financial, technical and operational) and the attraction of competition in order to avoid the mixed experience with auctions promoting RES in other parts of the world.

Efforts were devoted in South America to both the design of the auction and the product. However, some of the auctions had shown excessive political interference: capacity factors for wind plants estimated from short historical records of wind measurements and aggressive bidding. The proof of the pudding will be in some years' to come, when the winning projects will have to start delivering energy.

Footnotes

[1] Additionally, the lack of a coherent policy for environmental licensing often leads to delays of such large plants, which might affect supply reliability. RES are usually spread out over several plants with smaller capacities, providing a sort of hedge against project delays.

[2] Eastern Peru has a large hydro potential, enough to supply the whole county, export energy to its neighbours and to use its reservoirs to regulate downstream run of the river plants located in Brazil. Brazil and Peru are currently discussing commercial and scheduling arrangements to allow Peru to develop such projects, being Inambari (2,200 MW) the first hydro plant in the pipeline.

[3] RES are entitled capacity payments in Chile. They amount about 9 US$/KW month and are paid in proportion to the project's expected capacity factor de-rated by a factor of 30%.

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