

Regulating Generation Investment in Latin America: Future Challenges

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Introduction

A key concern for South American countries is how to procure new generation resources to supply demand, optimising reliability levels and cost impacts on consumers. Historically, this procurement activity has been very challenging due to factors such as uncertainty in load growth rates, limited access to financing, lack of enforcement in the case of delays in construction, deficient legal and regulatory institutional arrangements etc. More recently, the problem complexity has been compounded by environmental concerns about land use, impacts on biodiversity, indigenous populations and greenhouse gas emissions and climate change.

Many different approaches to energy procurement have been applied in these countries over the past decades, ranging from direct government investment in the 50s and 60s, use of Power Purchase Agreements (PPA) between government agencies and energy producers in the 70s and early 80s and, with the worldwide power sector reforms starting in the mid-80s, reliance on private investment driven by economic signals from short-term energy markets and administratively set capacity payments. Although details and circumstances vary widely among countries, it can be said that none of these approaches has been very successful – as it may be inferred from the large number of countries who experienced severe supply difficulties at some point (Maurer, Pereira and Rosenblatt, 2005). As a consequence, there is great interest in innovative experiences on this topic.

Since 2004 some South American countries such as Brazil, Chile, Peru and Colombia have been relying on new auction-based schemes to incentivise the entrance of new generation capacity. This scheme reflects the regulator's willingness to ensure a certain amount of new generation capacity under competitive conditions and facilitates the introduction of new financial instruments that can help to complete the electricity market: it auctions long-term supply contracts or call options backed, in some cases, by firm energy resources.

During the past years, these arrangements have been getting increased attention from investors, governments and multilateral agencies. One of the reasons for this interest is the large amount of capacity that has been already contracted. Altogether Brazil, Chile, Peru and Colombia have contracted for over 62,000 MW of new generation capacity between 2005 to 2010, with delivery dates from 2008 to 2018. Other interesting results from the South American auctions include:

- Successful private investment in new large-scale hydroelectric plants: about 18,000 MW in Brazil, including Santo Antonio and Jirau hydro plants (3,500 MW each) and Belo Monte hydro plant (11,233 MW) at prices of about 45 USD/MWh. In addition, about 3,000 MW have been auctioned in Colombia;
- Successful auction of other renewables such as wind, biomass and small hydro: more than 6,000 MW have been contracted, in most cases at very competitive prices (about 80 USD/MWh). In fact, wind power prices have proved to be among the lowest in the world in the case of Peruvian and Brazilian auctions.
- Wide variety of auction arrangements: (i) all-against-all auctions in which hydro, natural gas, coal, oil, biomass etc compete directly with each other; (ii) renewable-only auctions in which small hydro, biomass and wind plants compete with each other; (iii) biomass- and wind-specific auctions; and (iv) project-specific auctions (applied to the very large Brazilian hydro plants).
- Joint auctions: with multiple buyers and sellers that have a tendency to be organised as centralised processes in order to obtain benefits from economies of scale.
- Diverse auction mechanisms: first price sealed-bid auctions; descending clock (dynamic) auctions with or without elastic demand curves; hybrid and combinatorial mechanisms.
- Different types of contracts: mid- and long-term forward contracts, call options and reliability options.
- Diversity of investors: ranging from large companies established in the country to new local and foreign investors and first-time-power-system investors.

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See footnotes at end of text.

- The first objective of this article is to briefly describe the evolution of market regulation for generation investment and the recent auction-based mechanism experience in South America. Focus will be given to countries where the auctions have been having a more active role, i.e., Brazil, Chile, Peru and Colombia. The ultimate aim is to identify key challenges that will need to be addressed in the near future.

Early generation investment incentives in South America

The early electricity market design in South America was fundamentally centred on system marginal pricing. Short-term energy electricity markets were created, trusting that spot prices¹ would promote the efficient use of existing generation resources and provide signals to foster the interest of investors in building new capacity if needed (Schweppe et al, 1988). An imbalance between supply and demand caused by demand growth, for instance, would result in spot price increases and thus would create incentives for the construction of new plants. Moreover, the optimal amount of capacity could recover total costs, i.e., expected spot market revenues would be enough to remunerate investment and cover operational costs. In addition, energy bilateral contracts were to be freely negotiated between generators and consumers, subject to a reference price that was determined by the regulator in order to stimulate efficient contracting by distribution companies.

Furthermore, capacity payments were established in some countries such as Bolivia, Chile, Colombia and Peru in order to complement generators' energy revenues and provide incentives for the entrance of new capacity. In the capacity payment approach, the capacity price (a value expressed in \$/kW.month) is determined administratively by the regulator. Except for Colombia – that has replaced the regulated capacity payment by a market-based reliability option – capacity payments are employed in Peru, Bolivia and Chile up until today.

On the other hand, Brazil adopted the firm supply concept – implemented as firm energy certificates assigned to generators – and complemented its energy-only market with an obligation of consumers to have at least 85% of their consumption in contracts backed by firm energy certificates.

The challenges of generation investment in Latin America: why did the early design fail?

This early design was initially very successful in allowing power systems to improve efficiency and security of supply with an increasing number of new agents. Under this era, energy trading started to be massively promoted by private entities between different countries, e.g., Chile-Argentina-Bolivia-Brazil; electrification was significantly enhanced, e.g., Brazil increased its demand coverage from 85% up to about 98% nowadays (World Bank, 2005); prices to end customers decreased and the security and quality of supply was significantly improved, e.g. Argentina extraordinarily decreased his unsupplied energy from about 16% a month in the late 80s to nearly zero in the late 90s.

Despite all these positives aspects, this basic design has presented a number of problems in most of the countries that later led to, in some cases, severe energy crisis. Electricity shortages – or severe risk of shortages – have been observed in the region (for example, Brazil (2001), Chile (1999 and 2004) and Peru (2006)). In addition, capacity payments did not suffice to stimulate the availability of generation and ultimately the early design failed to promote generation adequacy in the region.

The early market designed failed because of various reasons. Firstly, the economic signal provided by the energy spot market has proven to be too volatile and difficult to correctly indicate and stimulate the entrance of new capacity. This is especially true for countries with a high hydro share, where the occurrence of conjuncture favourable hydro conditions can drive the spot prices downwards even if there are structural problems with supply. The second reason is the combination of strong demand growth (over 5% yearly) and regional economic instability, creating uncertain conditions for trading energy between neighbouring countries and impacting on energy price expectations.

Furthermore, some Latin-American power systems are also affected by challenges related to the financing of new generation which is done under a project-finance mode and where lenders require a stable long-term project's revenue stream in order to concede affordable long-term financing rates.

All these factors makes generation activity very risky, inhibits the closing of financing for new projects and makes development of new generation more difficult on a constant basis. Capacity payments in Chile, Colombia and Peru only represent a small part of the overall generator income and its role is very limited by the uncertainty of the energy spot market.

It is worthwhile to mention at this point that bilateral contracts between generators and large consumers, with prices negotiated between the parties involved, may reduce risk and make them immune from unstable energy spot prices. They represented in the past, and do today, a way to assure investment from

interested parties like the mining industry in Chile. Nevertheless, these bilateral contracts only represent part of the portfolio contracted by a generator while many other contracts, particularly with small consumers, were still representing high risks to investors given their direct link to the evolution of the system marginal costs.

Beyond energy-only markets and capacity payments: long-term contract auctions and call options

The sequence of problems, crises and, in general, adverse events that dominated South America in the early 00's motivated a search for new mechanisms to ensure generation adequacy. Because the energy spot price does not provide adequate signals for new investments and given the difficulties in defining a regulated capacity payment, a convergence was observed to use auction mechanisms in which potential investors compete to obtain a long-term energy contract or a call option such as the one proposed in (Vazquez, River and Arriaga, 2002). Auctions encourage the participation of many participants, foster competition and allow for efficient price discovery.

The conceptual aspect of the new proposal is to carry out auctions of long-term energy contracts called ahead of time, so that winners can have enough time to develop their investment and a minimum revenue is guaranteed for a number of years. At the same time, investors have to cover their bids by using capacity certificates that ensure physical coverage and security of supply². In order to create a market for contracts, all consumers, both regulated and free (i.e. non-regulated large consumers), are forced to contract 100% of their consumption (demand growth, contract expiration with a decommissioning plant, etc.) in a long-term fashion through forward or call option contracts.

Whilst Chile and Peru have set very similar rules to auction contract renewals and new energy contracts, Brazil and Colombia have followed a completely different path. Implementation details can be seen in (Bezerra, Barroso and Pereira, 2011; Crampton and Stoft, 2007; Dutra and Menezes, 2005; Mocarquer et al 2009; Moreno et al, 2010a). Main auctions' characteristics can be found in Table 1:

Looking ahead: identifying challenges in the new framework

The new framework has been generally assessed as a positive reform and generation investment has been clearly boosted. Apart from the experiences and lessons (Moreno et al, 2010b), there are a number of challenges that need to be analysed in details if one wants to prove that this proposal is, in effect, efficient and robust in the long-term.

1. **Correct auction design:** auction design is critical to ensure that contracts for future supply are being allocated to the right investors at efficient prices. Flaws in incumbent auction design have been already identified in (Moreno et al, 2010b) and these involve issues such as future price indexation, network charges' uncertainty and price clearance mechanisms. For example, network charges uncertainty could lead to a significant bid price increase and ultimately to an inefficient contract allocation if this is not tackled properly in the auction design.
2. **Demand response and energy efficiency:** 100% demand coverage through fixed(indexed)-price long-term forward contracts such as in Brazil, Chile and Peru could lead to a situation in which demand becomes completely irresponsive to short-term price signals. Although capacity charges during peak demand hours can contribute in this respect, potential real-time price mechanisms would be difficult to implement in the future (e.g., when Smart Meters arrive). In this respect, call options can, in contrast, effectively allow real time demand response whilst spot prices are lower than the strike prices and, at the same time, incentivise generation investment through fixed revenue streams.
3. **Competition and market power:** competition is, in principle, ensured in investment through the auction mechanism and in operation through the wholesale electricity market. Auctions also make the market more contestable, ensuring a better behaviour of incumbent agents (Baumol, 1982). However, for an auction to work, it is important to attract bidders and to stimulate bidders to behave competitively. A condition that shadows competition analysis is the presence of State owned companies in several of the countries analysed, where opportunities for political price manipulation are a risk that needs to be observed carefully, particularly in a country like Brazil (e.g., governments may try to lower auction prices by bidding low values in the auction processes).
4. **Efficient pricing:** the separation in the competition between existing and new capacity indeed facilitates the entrance of new comers in Brazil. However, whilst in Colombia existing generators take the clearing price from the new capacity's auction, in Brazil existing generators compete in different auctions that clear at different prices. Hence, very diverse prices between existing and new energies arise which can be, in the case of the former, affected by the aforementioned pres-

	Brazil	Colombia	Chile	Peru
Capacity mix	Hydro 75%, thermal 125%	Hydro 65%, Thermal 33%	Hydro 40%, Thermal 60%	Hydro 60%, Thermal 40%
Load growth (per year)	5-6%	4-6%	4-6%	5-8%
Objectives of the procurement	Attract new capacity	Attract new capacity	Attract new capacity	Attract new capacity
Specificity of the electricity procured	Specific project; specific technology and "any energy"	All technologies and projects compete	All technologies and projects compete	All technologies and projects compete
Degree of centralisation	Joint auctions by distribution companies organised by the government	Joint auction to ensure reliability, closing gap between supply and demand organised by a government agency	Distribution companies organise and manage their auctions, possibility of joint auctions	Distribution companies organise and manage their auctions, possibility of joint auctions
Buyers	Regulated users	All consumers	Regulated users	Regulated users, but free consumers can be included
Sellers	Separate auctions for existing and new capacity	New energy	All existing and new generation (in the same auction)	All existing and new generation (in the same auction)
Load forecast responsibility	Distribution companies are required to inform their load forecasts in each regular auction to supply regulated market	Regulator and planner provide demand, auction bridges the total system gap	Done by distribution companies, auction supplies the regulated market	Done by distribution companies, auction supplies the regulated market
Grace period	1-3-5 years ahead for 1,5,15 year contracts tied to energy certificates	3 to 7 years ahead	3 years ahead for any period up to 15 years	3 years ahead for any period up to 15 years
Total to date	31	1	3	3
Volume (MW)	57,000 MW of new capacity	3,000 MW	4.2 average GW	3.0 average GW
Auction process	2-phase hybrid auction	Descending clock auction	Sealed-bid combinatorial auction with pay-as-bid rule	
Energy policy decisions	Specific auctions for technologies and projects	All technologies compete together	All technologies compete together	Separate auctions for renewables
How often are auctions organised?	There are regular auctions to contract new capacity, government can organise specific (additional) auctions whenever needed	At planner's discretion, whenever there is a gap between total system future demand and supply	Disco(s) decide	Disco(s) decide

Table 1: Main auctions' characteristics per country

ence of the State as a bidder.

5. Integration of renewables: energy auctions have been also used in South America to promote renewable generation. Peru and Brazil are the leaders, but Argentina and Uruguay have also been conducting auctions to procure wind plants. Although renewable generation can be fostered by the aforementioned auctions, it becomes a critical problem to decide how much capacity should be initially auctioned and to what extent these resources still need additional incentives to successfully enter the market.

6. Dealing with long-term uncertainty: demand, fuel cost and availability and a number of important variables to be considered for a long-term investment plan are uncertain. Therefore, mechanisms to supply electricity demand in the future should be flexible enough in order to deal with an array of future scenarios in an efficient and secure fashion. In this respect, the auction mechanism to commit investors at present needs further improvements in, for example, indexation formulas. Indeed, prices can change in time according to the indexation formulas specified in the contract, forcing the auctioneer – and, ultimately, consumers – to take a risk position when allocating contracts.

Final Remarks

Concerns over electricity supply adequacy indicate that investment in new generation capacity looks as a promising activity in the future not only because of the increasing level of development and electrification of Latin-American countries, but also because of the efforts of a number of Latin-American governments to change regulation as to incentivise new entrants. In this line, considerable improvements have been made in regulatory frameworks across the region resulting in significant new investments. However, a set of challenges at fundamental and practical levels have been implicitly left for future analysis and development. Failing to address them could result in another wave of regulatory changes in the future

Footnotes

¹ Excepting Colombia, most countries of the region did not implement a bid-based system for dispatch and price formation. Instead, the "spot price" was calculated as a marginal cost of a dispatch model for scheduling decisions in Peru, Chile and Brazil.

² The adequacy guarantee of a generator is a MWh or MW rating that reflects the generator's contribution to the overall system supply reliability. These can be calculated by the regulator following several methodologies such as the one in (Batlle and Vazquez, 2000).

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