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-- Contribution from Jose Luis Lima R. --

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# LATIN AMERICAN COMPETITION FORUM



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## Session II - Electricity Markets in Latin America: Regional Integration and Competition Issues

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### ANALYSIS OF LONG-TERM ELECTRICITY MARKETS IN A REGIONAL MARKET INTEGRATION CONTEXT

-- CONTRIBUTION FROM JOSE LUIS LIMA R.<sup>1</sup>--

#### 1. Introduction

1. The view of interconnection as a reliability source has evolved in Latin American (LA) countries to take full advantage of more integrated electricity markets, where wholesale transactions can take place beyond national borders. A full integration of national electricity markets ideally requires a single system operator, a common regulatory authority and a unified wholesale market with spot, forward and long-run transactions.

2. Long-term contracts are financial instruments commonly used in electricity markets that give a predictable cash flow to the seller (generation company or generator) and stable price and supply to the buyer. Long-term contracts reduce the spot market risks and incentivize the investment in new power plants, increasing the reliability of an electric system. Latin American countries have experienced different market mechanisms to allocate long-term contracts, from administrative set of prices (Ecuador), pure energy forward contracts (Peru, Chile, Brazil) and energy call option contracts (Brazil and Colombia). These differences in market regimes constitute a challenge for a full integration of electricity markets and raise the question of what regime would be the optimal one for an integrated regional market.

3. In this paper we analyze the characteristics of long-run contract markets in Colombia, Peru, Ecuador, Chile and Brazil, identifying some existing challenges for competition that can be relevant in an integrated energy market. This paper is organized as follows: in Chapter 2, we made a brief revision of some experiences in the interconnection and integration of national electricity markets in LA, and some of the difficulties to foster competition in integrated electricity markets observed in Europe. In Chapter 3, we analyze the observed differences in wholesale markets in some LA countries that offer a challenge for the

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full integration of national electricity markets. In Chapter 4, we analyze the long-run contract systems used in the same LA countries, to give incentives for investments in new power generation and increase the reliability of electric systems. In Chapter 5, we present some conclusions of the analysis.

## **2. Interconnection and integrated regional markets**

### **2.1 *Electricity grids interconnection between Latin American countries***

4. Many Latin American (LA) countries have connected their national electricity grids through cross-border links (interconnectors) in order to assist one another in case of temporary shortages, caused by unexpected high demand or generation outages, augmenting the reliability of their systems. For example, in Figure 1 we show some active and projected interconnectors between national grids in South America.

5. In most of these countries the power generation and transmission network is still operated at the national level by a system operator; therefore, international interconnectors are considered as an additional source/demand of power in the daily operation of the system. Spot, forward and long-run electricity transactions between non-governmental players mainly happen within national wholesale markets.

6. The view of interconnection as a reliability source has evolved to take full advantage of a more integrated regional market, where spot, forward and long-run transactions can take place beyond national borders. Following this view, Guatemala, Honduras, Costa Rica, El Salvador, Nicaragua and Panama have formed the Interconnected Electric System for Central American Countries (SIEPAC, for its acronym in Spanish), which has its own regional system operator and a regional regulator. However, SIEPAC respects the diversity of markets and regulations in all six countries and acts as a seventh alternative market with its own independent rules; therefore, the level of international transactions remains low in SIEPAC: less than 1% of total energy generation have been exported/imported between markets in recent years.<sup>2</sup>

7. As another example, the Andean Community (Colombia, Ecuador, Peru and Bolivia) has also been studying the creation of a sub-regional electricity market since 2002: the Interconnected Andean Electric System (SINEA, for its acronym in Spanish).<sup>3,4</sup> In 2003, Colombia and Ecuador physically interconnected their national grids with a 230 kVA double-circuit line and started international transactions (a second 230 kVA line was built in 2008).<sup>5</sup>

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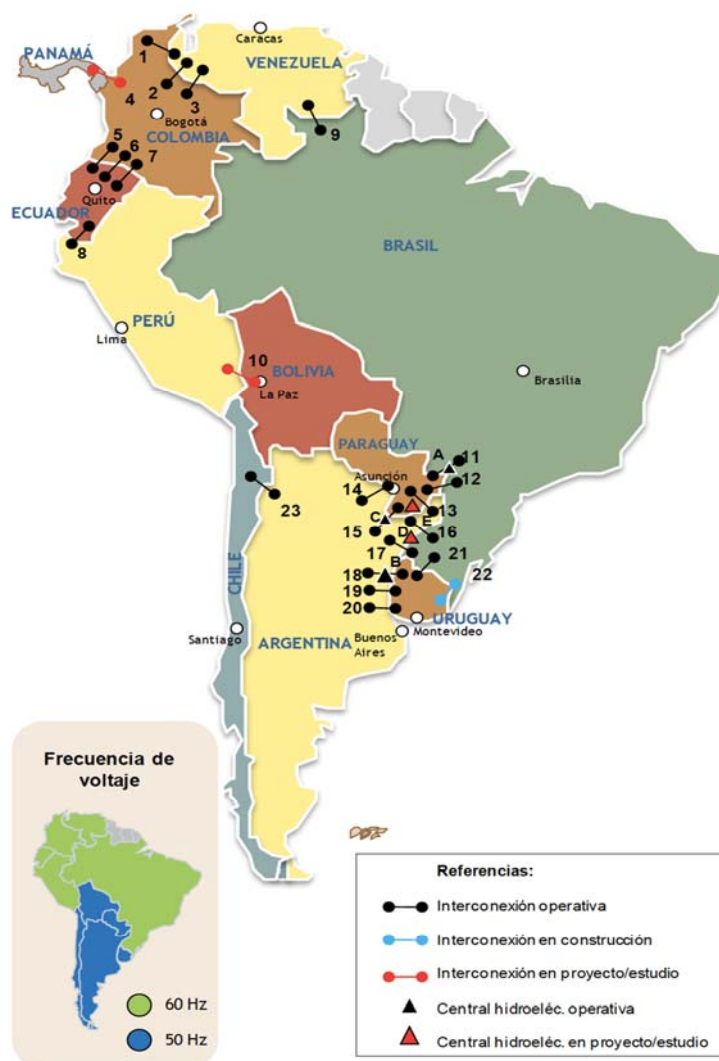
<sup>2</sup> CEPAL (2013). Only in 2000 the participation of exports in total generation reached a maximum of 5.4%.

<sup>3</sup> Andean Community mandatory agreements 536/2002, 720/2009 and 753/2011.

<sup>4</sup> In 2012, Chile has joined this initiative.

<sup>5</sup> Peru and Ecuador also interconnected their grids in 2004 but this interconnector is not active.

Figure 1: National Grids Interconnections in South America



Source: CIER, 2013

## 2.2 International interconnections and competition at wholesale markets

8. From a competition policy point of view, having interconnected grids and integrated electricity markets should make generators and suppliers on both sides of the border exposed to an additional source of competition. On the supply side, for example, the possibility of electricity exports should incentivize the construction of bigger and more efficient power plants in countries with more natural resources for power generation (natural gas, hydro-power); therefore, electricity imports should drive prices down to the level of the minimum required cost to serve the required electricity in those countries.<sup>6</sup> Moreover, imports should also play a role in eroding the market shares of major generation companies in wholesale electricity markets.<sup>7</sup>

<sup>6</sup> For example, Sauma, et al. (2010) showed that the electricity interconnection of the Andean Community and Chile can reduce marginal costs in the national spot markets.

<sup>7</sup> ECC (2007b).

9. However, as the European Union experience had recently showed,<sup>8</sup> the enhancement of competition in integrated markets can bear some difficulties, such as:

1. **Congestion on cross-border interconnectors.** The arbitrage process between national markets can shift the generation pattern in the integrated market towards lower cost production facilities. However, congestion on interconnectors can severely limit the effects of arbitrage: as a consequence of congestion, national electricity markets will be separated from each other with different price levels. Therefore, imports are limited and their ability to counter market concentration in local markets and exert competitive pressure on (dominant) generators is reduced and consumers pay more for their electricity than strictly necessary.
2. **Low incentives to increase capacity of interconnectors.** Congestion on interconnectors produces congestion revenues in the operation of the systems, which may not be used to increase the interconnectors' capacity, but may be used to subsidize national grid tariffs instead. Building new interconnectors can also be complicated for countries due to the fact that in many cases increasing the level of cross border capacity also requires substantial internal grid reinforcements.
3. **Congestion mechanisms to allocate existing interconnectors' capacity.** Non-market mechanisms, such as "First-come-first-served"<sup>9</sup> or pro-rata rationing<sup>10</sup>, will result in inefficient use of interconnectors' capacity, as they do not necessarily allocate capacity to participants with the highest value for it. "Grandfathered capacity rights",<sup>11</sup> could also result in inefficient allocation if secondary trade markets remain immature. These mechanisms can also be manipulated by incumbents to block access of more foreign energy to the grid.

Market based mechanisms, such as explicit or implicit auctions,<sup>12,13</sup> can be more efficient in the allocation of interconnectors' capacity to players with the highest value. However, as the European countries' experience indicates, explicit auctions may still result in economically inefficient outcomes if the deadline of interconnectors' capacity auctions ends before the energy markets clear in one or both sides of the line.<sup>14</sup> In this situation, market participants have to place auction bids based on expected and uncertain wholesale market prices, and can make a loss if the market price is different to that expected. On the other hand, in implicit auctions cross-border capacity and energy are traded together; therefore, implicit auctions are less likely to have inefficient use of interconnectors' capacity.

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<sup>8</sup> ECC (2007a) and ECC (2007b).

<sup>9</sup> Capacity is allocated according to the order in which the transmission requests have been received by the System Operator. Starting from the earliest request, all requested amounts of capacity are fully granted until the available capacity is used up.

<sup>10</sup> All requests received by the System Operator are partially accepted so that each applicant is granted a fixed share of his requested capacity amount, the share being equal to the amount of available capacity divided by the sum of all requested capacity amounts.

<sup>11</sup> Also called "retention". A proportion of the available capacity is granted in long-term contracts signed at open seasons that secured capital from interested players to build the line.

<sup>12</sup> In an explicit auction (first price or uniform price bid auction), along with the requested capacity amount, applicants have to declare how much they are willing to pay for this capacity. These bids are ordered by price and allocated starting from the highest one until the available capacity is used up.

<sup>13</sup> In an implicit auction, transmission capacity is managed implicitly by two or more neighbouring spot markets: network users submit purchase or sale bids for energy in the power exchange in the market they wish to generate or consume, and the market clearing procedure determines the most efficient amount and direction of physical power exchange between the market zones. Hence, separate allocation of transmission capacity is not required.

<sup>14</sup> ECC (2007a) and ECC(2007b).

4. **The need for harmonization of transaction and administrative rules underlying electricity markets.**<sup>15</sup> Different rules may increase the complexity for market players to trade across borders and may reduce the scope for competition. A complete harmonization of markets ideally requires a single system operator, a common regulatory authority, and a unified wholesale market. The European Regulators' Group for Electricity and Gas, for example, has made some practical proposals to eventually have harmonic and competitive integrated electricity markets in the EU.<sup>16</sup>

- Definition of Bidding Zones, where players can participate and bid in common spot, forward and long-run markets. A Bidding Zone is defined according to the congestion level observed in the lines that connect it with other Bidding Zones. This definition should be revised every two years.
- A single System Operator which simultaneously determines the volume and prices in all Bidding Zones. Prices will differ between zones only if congestion exists in the interconnector.
- Short and long-run markets for existing capacity in the interconnectors of Bidding Zones. However, these transactions should include a use-it-or-sell-it clause.

### 3. Differences in wholesale markets in some LA countries

10. In this section we'll analyze the differences between five national wholesale markets in LA: Colombia, Brazil, Chile, Peru and Ecuador. These differences offer a challenge for the full integration of national electricity markets.

#### 3.1 Colombian wholesale market

11. There are two types of buyers in the Colombian wholesale market: price-regulated (final users at distribution companies) and free buyers. According to Colombia's regulation, to be a free buyer a player has to consume more than 55 MWh/month of energy or more than 100 kW of capacity. Both distribution companies and free buyers cannot buy energy directly from the spot market but can sign contracts with electricity wholesale suppliers (electricity production and wholesale supply are separate activities). Wholesale suppliers can buy energy at the spot market and sign forward contracts with generation companies and buyers.

12. The spot market is organized with one-day-ahead energy auctions, where Generation Companies can offer prices that reflect their cost of dispatch and have to declare the operational availability of their power plants for the next day. Power plants are dispatched in economic merit order, using the price they offered the day before. The marginal cost of the system is set as the highest price offered by power plants that are dispatched to meet demand every hour. Generation companies can sign forward contracts with suppliers to avoid the spot price risk, with a contract length of one or two years. Contracts can be pay-as-contracted or pay-as-demanded.

13. The Colombian electricity market does not offer a direct payment for firm capacity to power plants (like Chile and Peru, for example);<sup>17</sup> all of the costs of power plants have to be recovered through the energy price instead. However, Colombia has started auctions of long-run contracts of firm-energy

<sup>15</sup> Such as: different imbalance settlement periods, differences in wholesale markets, etc.

<sup>16</sup> ERGEG (2011).

<sup>17</sup> Firm capacity is the amount of power available for production or transmission which can be guaranteed to be available at a given time.

obligations since 2006. In these contracts, the generation company accepts the obligation to supply a certain amount of energy at a shortage-price established in the contract, when the spot price is greater than the shortage-price.<sup>18</sup> In exchange, the generation company will receive a constant fee, called the “Reliability Charge”.<sup>19</sup>

### **3.2 *Ecuadorian wholesale market***

14. There are two types of buyers in the Ecuadorian wholesale market: price-regulated (final users at distribution companies) and free buyers. According to Ecuador’s regulation, to be a free buyer a player has to consume more than 4500 MWh/year of energy and more than 650 kW of capacity in the last six months. Free buyers can sign forward contracts with generation companies and/or import energy from Colombia. Generation companies, mostly owned by the State, have the obligation to sell to distribution companies, also in the hands of the State.

15. There is no wholesale market in Ecuador. Power plants are dispatched in economic merit order using declared variable costs. The production of energy of each power plant is valued at variable cost and one part is passed on regulated consumers as a variable charge. There is a fixed charge for regulated consumers too, which covers part of the declared fixed and investment costs of power plants. However, the system operator calculates a marginal cost of the system, which is used to value the international transactions with Colombia.

### **3.3 *Peruvian and Chilean wholesale markets***

16. Peru and Chile have very similar wholesale markets. In both countries there are two types of buyers: price-regulated and free buyers. To be a free-buyer in Chile, the player has to show more than 2000 kW of connected capacity to the system. In Peru, the requirement is 2.500 kW. Players with a connected capacity between 500 kW and the lower limit of a free-buyer can opt to be price-regulated or a free buyer.

17. Power plants are dispatched in economic merit order using declared variable costs and a marginal cost of the system is calculated. In both countries, generation companies are the only players in the spot market, *i.e.* they act both as producers and wholesale suppliers in the market. As producer, they sell energy and firm capacity at the marginal costs of the system. As wholesale suppliers of long-run contracts, they buy the energy and firm capacity demanded by their clients at the marginal costs of the system. They have the obligation to supply their clients even if their plants are not dispatched. As a counterpart, generation companies are free to sign long-run contracts with distribution companies and free buyers, and receive fixed prices for the energy and firm capacity supplied in those contracts.

18. In both countries, the administrative process that established the price of energy for long-run contracts between generation and distribution companies have been changed few years ago for a system of long-run contract auctions. In Chile, distribution companies have to auction off long-run contracts, with a length between three to fifteen years, to cover the projected demand of energy and firm capacity of their regulated clients. Generation companies compete between each other in the energy price they bid to win these contracts. The price of firm capacity is fixed at its marginal cost observed at the moment of the auction. Generation companies should start supply of these contracts in three years after the auction.

19. In Peru, the system to allocate contracts is very similar to Chile. The main difference is in the length and the start of supply period of the contracts that can be auctioned off. Three types of contracts are allowed in Peru: short-run contracts, with a length determined by the regulator and with start of supply

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<sup>18</sup> Oren (2000).

<sup>19</sup> See [http://www.creg.gov.co/cxc/english/que\\_es/que\\_es.htm](http://www.creg.gov.co/cxc/english/que_es/que_es.htm)

between one and three years after the auction; medium-run contracts, with a length of at most five years and with start of supply in at least three years after the auction; and, long-run contracts, with a length between five and ten years and with start of supply in at least three years after the auction.

### 3.4 *Brazilian wholesale market*

20. The definition of buyers is similar to those in Peru and Chile. To be a free-buyer in Brazil, the player has to be connected to the system with more than 3000 kW. Players with a connected capacity between 500 kW and the lower limit of a free-buyer can opt to be price-regulated or a free buyer. The dispatch of power plants and the spot market are also similar to Peru and Chile; the only difference is that Brazil doesn't have any payment for firm capacity.

21. In Brazil two different systems to allocate long-run contracts coexist:

1. **Pure energy contracts auction system.** In this system, long run contracts to supply all regulated clients at distribution companies are auctioned off by the authority. There are three types of contracts that can be sold:
  - One-year-ahead contracts, with a length between three and fifteen years, starting supply one year after the auction. This kind of contract is intended for existing power supply.
  - Three-year-ahead contracts, with a length between fifteen and thirteen years, starting supply three years after the auction. This kind of contract is intended to attract new thermoelectric projects to the system.
  - Five-year-ahead contracts, with a length between fifteen and thirteen years, starting supply five years after the auction. This kind of contract is intended to attract new hydro-electrical projects to the system.
2. **Energy call options.** An energy call option is a financial instrument that specifies quantity, delivery time, delivery location and a strike price for energy, and it gives its holder the right but not the obligation to obtain the specified energy at the specified strike price.<sup>20</sup> In order to insure deliverability, the call options must be backed by existing generation capacity, or by a commitment to invest in generation capacity that will be available by delivery time. In exchange, generators will receive a capacity payment in the form of a call option premium, and must refund to the customers any inframarginal profit resulting from spot prices that exceed the strike price. The Brazilian authority auctioned off long-run contracts (on behalf of distribution companies) similar to energy call options with physical cover and physical delivery. In those contracts, the consumer rents the plant from the investor, paying a monthly fixed amount (to allow investment and fixed cost recovery) for its availability, and reimbursing the plant's owner on its declared variable operating costs whenever the plant runs. Therefore, the distribution company is now responsible for any spot market transaction. Generation companies are allowed to offer both the premium of the contract and the strike price in the auction.<sup>21</sup>

22. The main difference between these two types of contracts is that in a pure energy contract generation companies take the spot market price/quantity risk, but in the energy call option contract of Brazil the spot market risk (up to a strike price) is borne by the client.

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<sup>20</sup> Oren (2005).

<sup>21</sup> Barrozo, et al. (2006).

#### 4. Competitive issues in long-run electricity markets

23. Long-term contracts are financial instruments commonly used in electricity markets that give a predictable cash flow to the seller (generation company or generator) and give stable price and supply to the buyer. Long-term contracts reduce the spot market risks and incentivize the investment in new power plants, increasing the reliability of an electric system. As it was noted in the previous chapter, many Latin American countries have experienced different types of long-term market mechanisms:

- Peru, Chile and Brazil have pure energy forward contract auctions.
- Colombia has auctions of contracts with firm capacity obligations and a “reliability charge” that replaces the fixed payment for firm capacity of power plants.
- Brazil has also auctions of energy call option contracts, which are more sophisticated variants of firm capacity obligation contracts in Colombia.<sup>22</sup>
- Ecuador doesn’t have a long-run market and the price of electricity is administratively set by the regulator to reflect short-run variable costs and long-run fixed costs of production.

24. These differences in long-run market regimes offer a particular challenge for the full integration of national electricity markets (especially for the Andean Community and Chile) and raises the question of what regime would be the optimal one for an integrated regional market. To give some light to the discussion of this question, which has to be taken at the highest technical level in LA countries, we present a brief analysis of the experience and existing challenges to foster competition in those regimes.

##### 4.1 *Pure energy forward contract auctions*

25. The recent experience in Chile with this kind of contract has shown a lot of difficulties to keep prices down. As seen in Figure 2, Chile has experienced a continuous growth in observed prices for successive auctions. Even more, some auctions (in 2008 and 2013) had to be declared void because no bids were received from generation companies.

26. On the contrary, the experience in Peru and Brazil with pure-energy contracts has not been bad. Prices in successive contract auctions have remained stable and new generation capacity has been built in recent years. However, some auctions in Peru had to be declared void because no bids were received from generation companies.<sup>23</sup>

27. From a competitive point of view, in order to have competitive pure-energy contract auctions it is crucial to have the participation of many generation companies and projects with important amounts of energy to contract in the auction.<sup>24</sup>

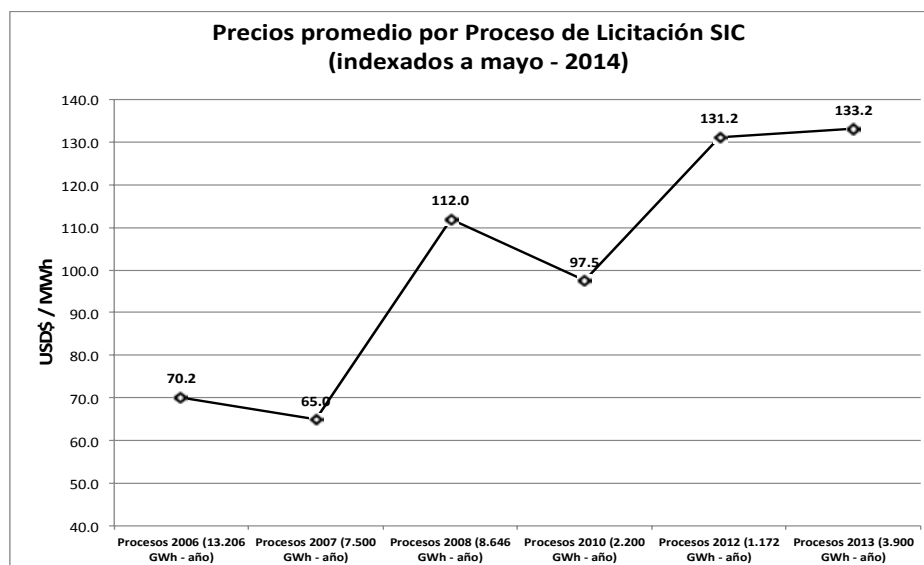
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<sup>22</sup> Barrozo, et al. (2006).

<sup>23</sup> OLADE (2013b).

<sup>24</sup> Fabra, et al. (2014), Lima (2014).

Figure 2: Mean Price of energy obtained in forward contract auctions



Source: National Energy Commission of Chile, 2014

28. From the experiences in Brazil, Chile and Peru, the major challenges to obtain more participation in this kind of auctions are:

- **Administrative and Political barriers to entry for new projects.** Administrative barriers are created when building permits (environmental, for example) for power plants suffer significant delays. Generation companies have shown reluctant to participate in auctions with projects that do not have the corresponding building permits for the plant and the line to connect it with the grid. Political barriers are also important. In Chile, for example, some local communities have successfully battled the construction of carbon thermoelectric power plants (Castilla, Barrancones) and hydroelectrical plants (HidroAysén) in their zone.
- **Not enough time to build a power plant.** Three years (or five years, in the case of hydroelectric plants), between the end of the auction and the start of supply, has shown to be not enough to build some thermoelectric power plant projects, because of unexpected problems at the construction stage and the international turbine market excess of demand. It's of high risk for generation companies to sign a long-run contract which starts supply before they can have their power plants ready for operation (they can even go out of business, as it happened to Central Campanario S.A. in Chile, 2011). Generation companies can be reluctant to participate in auctions if they foresee they will not be ready to generate before the supply of the contract begins. However, Peru and Brazil's experiences show that auctioning multiple types of contracts, with enough flexibility in the length of the contract and the period before the start of supply, can help the allocation of pure energy contracts.
- **Total demand divided in multiple auction processes.** An attractive auction for generation companies is one with large amounts of energy to buy. The initial experience in Peru shows that small distribution companies don't have enough energy demand to attract bids of generation companies. Distribution companies in Chile have made efforts to tender their energy requirements in a single process, in order to be more attractive to generation companies. On the other side, Brazil auctioned off the projected demand of all price-regulated consumers in tenders directly managed by the authority.

## 4.2 *Energy call option contracts*

29. Energy call option contracts are used in energy-only electricity markets without payments for firm capacity. From a competitive point of view, Oren and Sioshansi (2003) argue that markets with an explicit payment for firm capacity give generators incentives to understate their true generation costs in order to capture higher capacity rents. That is possible because the capacity payment guarantees a constant cash flow that helps existing generation companies to be more aggressive in the spot market. This aggressiveness can discourage entry of new companies and power plant projects in the market and the system can finally end with an oligopolistic structure. Therefore, Oren (2000, 2003) proposes the reformulation of existing electricity markets with an explicit capacity payment into energy only markets (like those in Colombia, Brazil, California, Nordpool, Australia, etc.) and introduces energy call option contracts to insure capacity payments to power plants according to demand.

30. As the Colombian experience shows, energy call options can coexist with pure energy forward contracts. In this case, energy call options and forward contracts pursue different objectives: energy call options are intended to allow generation companies to have a firm capacity payment according to demand, and forward contracts allow them to hedge against price/quantity risks in the spot market. On the other hand, the modified energy call option contract used in Brazil reaches both purposes: it allows generators to have a firm capacity payment and, at the same time, transfers the price/quantity risks of spot markets to consumers. Therefore, this particular contract can act as a substitute of more traditional pure-energy long-run contracts.

31. An important characteristic of these contracts is that they can be resold to other participants, before the supply of the contract begins, if the generation company foresees it will not be ready to supply them. Finally, the experience in both Colombia and Brazil does not show many problems using this kind of contracts (even though, some details can be improved): participation in auctions was high and observed prices have kept stable in successive auctions.<sup>25</sup>

## 4.3 *Administrative set of prices*

32. In the case of Ecuador, the price of electricity received by generation companies is administratively set by the regulator to reflect short-run variable costs and long-run fixed costs of production. However, before 2008 Ecuador experienced with spot and forward contracts markets, but serious problems such as a high lack of investment in cost-efficient power plants and high costs of production in existing gas-turbine plants motivate drastic changes in the regime. As the integration of electricity markets within the Andean Community goes deeper, it can be possible for Ecuador to change its current regime and allow for wholesale markets, without being subject to the same problems they had experienced before.

## 5. **Conclusions**

33. Differences in long-run (and short-run) market regimes offer a particular challenge for the full integration of national electricity markets in LA countries and raises the question of what regime would be the optimal one for an integrated regional market. To give some light to the discussion of that question this document made a brief analysis of the experience and existing challenges to foster competition in those regimes.

34. The analysis of some electricity markets in LA shows that one of the initial decisions to take in the integration process is about the explicit capacity payment for generators. Theoretical results show that

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<sup>25</sup> OLADE (2012a).

having an explicit payment for firm capacity may induce greater levels of concentration in electricity markets. Hence, it may be better to have an energy-only regional electricity market. Moreover, only in energy-only markets, it is reasonable to have energy call options contracts to give generators a competitive firm capacity payment.

35. It also seems important to have an integrated forward/long-run contract market to allow generators to hedge against the price/quantity risks in the spot market. They are also desirable because they can reduce market power in the spot market and induce an efficient trend of investments in power generation.<sup>26</sup> However, some important issues should be taken into account to have a competitive long-run contract market: a) administrative and political barriers to entry the market of power generation should be appropriately handled by each national authority; b) it is desirable to offer contracts with different lengths and different lag periods between the end of the auction and the start of supply; and, c) it is desirable to auction off a sufficiently high-level of energy demand, to attract more participants.

36. Another important issue has to do with transparency and enforceability of the obligations in long-run or energy call option contracts in an integrated market scenario. For example, it should be clear for all participants in the integrated market how local authorities will treat supply obligations in long-run contracts when an energy crisis occurs in their electric systems. A regional binding arbitration procedure for conflict resolution is also desirable, where private firms and even states can solve commercial conflicts with long run contracts.

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<sup>26</sup> Anderson and Hu (2008).

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