A REGULATORY INSTRUMENT TO ENHANCE SECURITY OF SUPPLY IN THE SPANISH WHOLESALE ELECTRICITY MARKET

Carlos Batlle*, Carlos Vázquez*, Michel Rivier* and Ignacio J. Pérez-Arriaga*

Ensuring that there is enough generation capacity to meet future demand has been a contentious issue in market design since the beginning of the deregulation process. Particularly in Spain, security of supply has been a matter of concern since the very start of the process of electricity liberalization. A capacity payment mechanism was designed and implemented, and since then, this methodology has been subject to deep debate. This paper describes the mechanism that the "White paper for the reform of the regulatory scheme of the power generation in Spain" (Pérez-Arriaga 2005) proposes to improve upon the current scheme. This proposed design introduces improvements aimed at guaranteeing at least a minimum capacity reserve margin, as well as at providing a strong incentive for each one of the generators in the system to do their best to be available when needed, namely, in situations in which supply is likely to be insufficient to meet the total demand.

1 INTRODUCTION

Designing a stable regulatory framework, so that electricity can be delivered efficiently and reliably now and in the long term, happens to be a major concern of regulation policies in electricity markets. Since the choice of a regulatory framework that is open to competition whenever possible is an accepted principle, the key issue now is how to introduce any necessary adjustments in the initial designs of the markets that have been implemented already, so that the identified shortcomings are eliminated and any necessary regulatory measures to be introduced interfere as least as possible with the functioning of the market, while ensuring the long-term sustainability of the model.

* {Carlos.Batlle, Carlos.Vazquez, Michel.Rivier, Ignacio}@iit.upcomillas.es

Instituto de Investigación Tecnológica, Universidad Pontificia Comillas, Sta. Cruz de Marcenado 26, 28015 Madrid, Spain.

Security of supply has been an issue of concern in Spain since the very start of the process of electricity liberalization. A capacity payment mechanism was designed and implemented, and since then, this methodology has been subject to much debate. Basically, the question under discussion has been whether a market-based regulation would be able to provide enough generation capacity in the system without any regulatory intervention and, also, if the mechanism that was put in place was properly accomplishing its purpose.

The objective of this paper is to describe the mechanism that the "White paper for the reform of the regulatory scheme of the power generation in Spain" proposes to improve the one originally implemented. This document (Pérez-Arriaga 2005) was elaborated by the co-authors of the present paper, under the direction of its first author. The proposed mechanism introduces improvements aimed at guaranteeing at least a minimum capacity reserve margin, as well as at providing a strong incentive for each one of the generators in the system to do their best to be available when needed, namely, in those situations in which supply is likely to be insufficient to meet the total demand. An additional (and very significant in the Spanish case) advantage of the implementation of this mechanism would be a reduction of the pressure on any required market power mitigation and supervision measures, since tight reserve margin episodes should be certainly rare with the proposed mechanism.

2 THE ORIGINAL CAPACITY PAYMENTS MECHANISM IN SPAIN

Capacity payments were first used in Chile in 1982 and later adopted in Argentina, Colombia, Peru and some other Latin American Countries, under various formats, and also in Spain. In essence the method consists in awarding to each generator a daily payment -only when it is available- which is computed by multiplying the firm capacity of each generator times a per unit capacity payment (€/MW) that may be uniform or may vary with the season. Each country has chosen a different approach to determine the firm capacity of the generators, but the basic idea is that the firm capacity is a measure of the contribution of each generator to the reliability of the power system. Frequent conflicts have arisen because of the rules of definition of firm capacity of hydro plants and also of different technologies and vintages of thermal plants.

2.1 Key weaknesses of the Spanish capacity payments mechanism

The current mechanism of capacity payments (“garantía de potencia” is how it is called in Spain) is expensive and has significant weaknesses that can be summarized in two: it does not provide generators with an incentive to make a special effort to be available and producing electricity when there is a real need for it and it does not guarantee that there will be a reasonable volume of installed capacity to meet demand at all times.

Absence of a well defined product

The mechanism implies that generators receive a payment in exchange for almost nothing. If a generator happens to be unavailable in a day when there is not enough supply to satisfy the system demand, it just losses the capacity payment corresponding to this particular day, what represents an extremely small proportion of the total amount to be earned for the whole year. It can be therefore stated that the mechanism does not represent a special incentive for generators to really provide reliability for the system. Only the energy prices, potentially high when the reserve margin is tight, provide an incentive to be available whenever the system is close to rationing.

Therefore, there is no product from the generators’ side, just a small incentive and no commitment to provide the assigned firm capacity when the system is close to scarcity. Besides, this scheme forces the regulator to supervise the availability status of each power plant very closely, since there is an economic incentive for the generator to declare as available a non-dispatched power plant, regardless whether it is available or not.

Moreover, the firm capacity to be taken into account for this payment is calculated following an extremely crude and arguable procedure: multiplying an average availability rate times a capacity value that, schematically, is the installed capacity for thermal units and the energy produced in an average year for hydro plants. A more sophisticated procedure would discriminate hydro plants with large reservoirs from those without, or even consider additional aspects such as environmental constraints of certain thermal plants (e. g. SO2 or NOx limitations) or the firmness of the fuel acquisition contracts. However, there is not yet a consensus in the literature about an adequate model to calculate the actual firm capacity of the different (and diverse) power generating plants technologies. At the present stage, it seems advisable to be wary about moving towards more sophisticated algorithms.

On the other hand, the current criteria that are followed to make sure that the plant is able to contribute to the reliability of the system are very questionable. In particular, the requirement to produce at least 480 hours per year to have the right to receive the payment interferes with the market functioning, forcing a set of expensive plants to generate when they are not needed.

The strategic fuel reserves condition can also be subject to conflict. The experience shows that the requirement to have at the generator's disposal an alternative fuel and a prescribed stored volume to prevent scarcities is difficult to supervise. In a broader sense, from the point of view of reliability, the way the gas procurement is managed in the case of combined cycle gas turbines can pose some problems. For example, a generator might decide not to operate so that it can sell the gas in the international Liquefied Natural Gas market or it might decide to tighten its reserve margin, in such a way that if for instance a boat is delayed (e. g. due to a storm) the generator would be subject to a energy limitation that might lead to a non reliability compliance if the critical scarcity period lasts more than a few hours.

No adequate reserve margin guarantee

The second regulatory flaw that has to be faced is that, although in a limited extent the capacity payment backs new investments by introducing an additional remuneration, it is not possible to ensure that it will be sufficiently appealing for the amount of them required to hold the desired capacity margin.

The security of supply mechanism in force in the Spanish market has been effective to prevent certain old installations from retiring. These plants were expected to be into operation very rarely, although their contribution to the system reliability in emergency periods was (and in certain moments has indeed been) crucial. Nevertheless, it does not look like that this mechanism has been behind the rather numerous new plants that have decided to get installed in these recent years. The regulatory uncertainty related to the capacity payments has reduced significantly the efficacy of the mechanism as an attractor for new investments[1]. Although the initial value was notably high, the perception that the Government ("the regulator" from this point on) can often and unexpectedly modify it has overshadowed the desired long-term investment signal.

As a result, if the regulator's purpose is to assure a certain level of investment margin, a new methodology has to be put in place.

3 THE PROPOSED CAPACITY PAYMENTS MECHANISM REFORM

3.1 Fundamental criteria

As mentioned above, relying on a healthy reserve margin is a key element for the correct development of a market. The credibility of the market price will be a critical factor in facilitating the entry of new investors and this, in turn, will help in maintaining this desired margin of the installed and available generation capacity over demand at all times. If this is the case, the situations where the margin is so tight that the price can be easily manipulated will be very rare, which is also helpful[2].

Most liberalized electricity systems -the Spanish one among them- have opted for implementing some kind of specific security of supply mechanism, although it does not yet exist a clear consensus on which is the more reasonable design.

The most appealing option for us, and the one that has being recently proposed for several markets, is the reliability options mechanism. This scheme was first sketched in Pérez-

---

[1] The total volume of the payments has evolved from an initial value of 7,8 € per each MWh of the system load in 1998, to 6,9 €/MWh a few years later and finally to 4,8 €/MWh from year 2000.

[2] Obviously, an active participation of the demand in the market will be a powerful factor of mitigation of market power. Unfortunately, the involvement of the demand has been scarce so far in actual electricity markets.

Arriaga (1999)[3], discussed in the context of a regulatory reform in Argentina late in 1999[4], then proposed by the authors of this paper –also later by others- for the Colombian market[5], fully described in Vázquez (2001), Vázquez (2002) and Vázquez (2003), as well as by Chao (2004) and Oren (2005) in the U.S. context.

The reliability options mechanism establishes an organized market where the regulator requires the Market or the System Operator to buy in a public auction a prescribed volume of contracts from generators on behalf of the demand. These contracts allow the consumers to obtain a price cap on the market price in exchange for a fixed remuneration for the generators. Additionally, the consumers obtain a satisfactory guarantee that there will be enough available generation capacity whenever it is needed. Otherwise the generators will be penalized. The generators are compensated economically for this service. Although the compensation per unit (MW) of firm capacity is uniform, the more reliable a generator is the higher is the economic margin that the generator obtains from the option contract.

In more precise terms, the commitment of a generator winning the auction is as follows: the generator sells, in exchange for a premium a call option for all the energy that its firm capacity can produce, at the strike price of the option, and it is subject to a prescribed penalty if the power is not delivered when required.

---

[3] In Pérez-Arriaga (1999) and Vázquez (2001) what we now call "reliability options" were named "price risk-hedging contracts" and "call options", respectively.

[4] Regulatory reform led by the Argentinean Secretary of State for Energy, with the support of local consultants Beatriz Arizu and Ramón Sanz and external consultants Larry Ruff, Alex Papalexopoulos and Ignacio J. Pérez-Arriaga.

5 Within the research project "Capacity charges in Colombia", (in Spanish) prepared for the Association of Electricity Generators of Colombia (ACOLGEN), May 2000. See also, C. Vazquez, M. Rivier, I. J. Perez-Arriaga and J. C. Enamorado, "A market approach to generation capacity payments", IIT Working Paper IIT-00-0078-A, November 2000.

Therefore, this mechanism determines both the common per unit capacity premium and the firm capacity that is committed by each power plant through a competitive auction.

However, when developing the actual implementation of the mechanism for the Spanish market, there are two basic elements that justify the use of a modified version of the reliability options that may be better suited to the particular structure of the market in Spain.

On the one hand, one should be aware of the convenience of developing a gradual reform, avoiding an abrupt change in the remuneration of the generating units that will affect what it is supposed to be a long-term economical signal. Therefore, our proposed reform of the reliability mechanism should try to maintain, for the equipment already existing by the time the reform is implemented, an investment cost remuneration equivalent to what they would had received under the old capacity payments. We shall modify the existing capacity payments, aiming at including some operational incentives for these plants, but we shall make a specific treatment of these existing generators in order to ensure as much as possible that their payments are not significantly modified.

On the other hand, the Achilles' heel of the reliability options scheme is the potential for market power that can appear in the capacity auction. As in any other market-driven mechanism, there are many advantages in letting players express their valuations and preferences, but there is also a risk for manipulation if the players are few. When buying the options this risk is particularly high, since probably all of the existing units will be required and also some new additional ones. The workability of the mechanism depends critically on the ability of the auction to attract several potential new entrants and on the role of the incumbents. Being the latter a concern for us -the Spanish market is still rather concentrated-, some specific modifications of the reliability options are proposed in order to mitigate this problem.

Summing up, we are devising a kind of intermediate solution between the existing capacity payments and the ideal reliability options, that can be seen as a rational transition towards a fully market-based methodology, as it could be the reliability options market. Compared with the present mechanism, the proposed scheme introduces specific improvements addressed to guarantee a minimum margin of installed firm generation capacity over peak demand, and also to provide a strong incentive for each generator to be available and ready to produce at any time where it is really needed to meet the demand. This has the double purpose of improving the security of supply of the system and also to maintain a healthy margin of generation over demand at all times, so that the potential of price manipulation is decreased.

In brief, the basic recommendation is to maintain the existing capacity payment format, consisting in a regulated remuneration to the generators according to their firm capacity (assigned administratively as well and agreed with the generator, which could initially ask for a reduction in case it might consider the pre-assigned value to be excessive, particularly in the case of hydro plants). However, we propose to add some new elements that can be summarized in two:

- The commitment of each generator to provide its assigned firm capacity whenever the system is close to rationing. A heavy penalty must apply to dissuade non compliance.
- In case the market -with the capacity payment- does not provide a prescribed minimum margin of installed generation capacity over demand, an auction should be run to attract the desired new capacity and to determine the value of the capacity payment that will be applied transitorily to any new entrants.

Next, these two new elements are discussed in more detail.

3.2 A commitment in exchange of the capacity payment

The basic scheme of what it is being proposed is described next:

- The regulator calculates a value of the firm capacity of each generator in the system.

  A generator may choose to reduce -but not to increase- its assigned firm capacity[6]. Anyway, to avoid potential manipulations (e. g. a hydro plant might desire to alter its firm capacity if a dry year is expected), these modifications should only be approved only when

---

[6] For instance, a 300 MW hydro generator with a very uncertain water inflow, which has been assigned 250 MW of firm capacity, may decide to accept only 200 MW of firm capacity, since it estimates that the risk of not meeting the commitment and incurring into a penalty is too large.

the firm capacity is assigned for the first time, or with much anticipation or when a significant change takes place in the power plant, e. g. a repowering or a derating.

Also, it is convenient to establish a minimum level under which it would not be possible to decrease the firm capacity value, since an excessive reduction of these values might leave the system into a weak condition from the point of view of security of supply, or even to prevent situations in which generators could be interested in forcing an auction for new entrants (see description in the next section).

- An administratively calculated payment is defined for each megawatt of firm capacity.

The regulated price of the firm capacity should be made up of two components: a high proportion of the investment cost (not the whole, e. g. 80%) of a single cycle gas turbine[7] and an estimation of the average amount the generator will have to pay back to the system demand as penalties due to unexpected unavailabilities that may happen at critical times for the system.

- It will be considered that the system is "near-rationing" (and therefore the generator will have to be generating at least[8] its firm capacity) whenever the energy price in the spot market is above a certain threshold, the strike price of the reliability option.

The chosen indicator, as in the pure reliability options mechanism, is the short-term energy price, since it is the only one that properly reveals that there is a problem (if it is well above the operation variable costs of the peaking units, it can be taken for granted that there is a lack of supply in the system). And, more precisely, this reference has to be the daily market price. Every plant is compelled to present its operating schedule to the System Operator[9] in such a way that they have to declare that they will be generating at least their

[7] The closer the strike price is to the operation cost of this technology, the higher this proportion has to be.

[8] A hydro plant might be producing more than the output initially committed if for instance the reservoir level is higher than expected at this point of time.

[9] They can fulfil their obligation either bidding in the spot market or declaring a bilateral contract.

full firm capacity in those hourly blocks in which the market price is above the predetermined strike price.

From that point on, the generators that have not been committed in the daily market do not have any further obligation to be available in secondary markets, what allows to avoid forcing *slow-start-up units* to be permanently ready. Also, every additional net purchase in any of the secondary markets (the intradaily or the ancillary services markets, for instance) after the spot price turns out above the threshold will have to be charged the penalty, in order to preclude fake arbitrages.

The strike price represents a regulatory frontier between the “normal functioning” and the “near rationing” market conditions. Thus, it should be at least at the level (plus a margin) of the marginal variable cost the regulator estimates as the most expensive in the system (the regulator may decide to preclude some generators from participating in the mechanism), for example the average operation cost of an efficient gas turbine, powered with natural gas, that should be in operation for four consecutive hours. Additionally, this price should be transparently indexed to the international natural gas and the CO2 prices.

- If the generator at this point in time is not actually producing the committed amount (its firm capacity according to which it is being paid), it shall pay a strong penalty for each megawatt not committed.

This explicit penalty is meant to discourage even more those bids that are not backed by reliable generation capacity. Besides, it has to be high enough to prevent an investment in a peaking unit with a reasonable failure rate from being also discouraged, taking into consideration that this value is linked to the capacity payment as well as the prescribed strike price.

- Under these critical circumstances, all the energy produced by the committed firm capacities will be remunerated at the regulated threshold price and not at the current spot price.

Following the same idea of the reliability options previously introduced, the commitment of a generator receiving a capacity payment for its assigned firm capacity is as follows: the generator sells, in exchange for a premium -which is the capacity payment- a call option for all the energy that its firm capacity can produce, at the threshold price, and it is subject to a prescribed penalty if the power is not delivered when required.

The first main element of the proposed mechanism, to assess to what extent is the firm capacity that is being remunerated really available when needed, is to complete the mechanism design by adding a commitment for each generator, in such a way that it will be heavily penalized in case of non compliance. On the other hand, if the committed firm capacity of the plant is unavailable at a time when the power system is not close to load shedding, -e. g. at 2 A.M. of a Saturday in May-, there is no reason to require the plant to be available or to penalize it for this cause.

This way, it is up to the agents to make the proper decisions to achieve the predetermined reliability objectives. For example, a hydro plant will have a clear incentive to manage its reserves cautiously to comply with its commitment. If for instance this plant decides to generate a significant amount of its stored energy in November, it increases the probability of being short of the required energy to fulfill its firm capacity commitment in January. Additionally, another advantage of this approach is that it is no longer necessary to assess the generators availability explicitly, what means that inefficient rules as the requirement to produce at least 480 hours a year (or any other of this nature, as for example periodic inspections) are no longer needed.

This approach is as well particularly useful for gas-powered plants. There are various reasons why a plant of this type might run out of fuel: failures in the gas network, lack of purchases, lack of an alternative fuel, *interruptible contracts*, etc. The penalty rule prevents the regulator from the hard task of supervising the gas procurement. This responsibility stays now with the generator, which in fact is the one that is best suited to do it and which will have to make sure to produce (or to be hedged against potential penalties) with at least the committed firm capacity during any critical episodes, and therefore it will have to negotiate contracts to convey the penalties to the supplier.

The regulatory process is thus significantly eased (and in fact liberalized), avoiding a micro-regulation of the intermediate decisions that a generator has to make to be available, such as requirements of minimum levels of fuel storage, since the generators will have a strong incentive to take care of this matter by themselves.

However, this does not mean that the regulator should not take into consideration any safeguard measure to avoid potential failures. For example, the regulator should not assign capacity payments to a plant that does not have an *Access to the Network contract* or that is affected by a local NOx emissions limit that does not permit it to generate whenever is needed. In principle, the penalty discourages this kind of behaviors, but it appears to be reasonable to impede any irresponsible conduct.

3.3 Guaranteeing an adequate reserve margin

The second flaw of the current capacity payments mechanism is that, although in a limited extent it backs new investments by introducing an additional remuneration, it does not guarantee that it will be sufficiently appealing for the amount of them required to hold the desired reserve margin. It is necessary to implement an additional mechanism to let the regulator be assured against underinvestment.

The Directive 2003/54/EC of The European Parliament and the Council of the European Union (2003), in its article 7.1 states that ‘The Member States shall ensure the possibility, in the interests of security of supply, of providing for new capacity or energy efficiency/demand-side management measures through a tendering procedure or any procedure equivalent in terms of transparency and non-discrimination, on the basis of published criteria. These procedures can, however, only be launched if on the basis of the authorization procedure the generating capacity being built or the energy efficiency/demand-side management measures being taken are not sufficient to ensure security of supply’. On the other hand, the Spanish Electric Power Act, CNE (2005), in its article 10 reads ‘The Government may, for a certain period of time, adopt the necessary measures to guarantee the supply of electric power whenever any of the following circumstances arise', among which it includes 'A definite risk for the provision of the supply of electric power'.

Generally, the solutions that are often considered under these circumstances imply very long-term contracting (of the traditional kind that is known as "power purchase agreement" or PPA contracts, involving the payment of fixed and variable costs) that interferes in the short-term energy market, as in California, EIA (2005), Brazil, Bezerra (2006) and Peru, Cámac (2006). Here we propose an indirect mechanism that is expected to interfere much less. The main idea consists in allowing the regulator to call an auction to determine the value of the capacity payment that will be applied transitorily to any new entrants. Otherwise, both the existing and the new entrants function in the energy market in the normal way.

This procedure is aimed at guaranteeing a predetermined reserve margin (available installed capacity related to the expected demand) in case the market -including the capacity payment- might not provide it by itself. The basic idea would lie in empowering the regulator to call an auction only when it might consider that there is not enough investment announced in the system for a prescribed time horizon (e.g., three years). Since the default value of the capacity payment appears not to be enough, this auction would determine the new value of the capacity payment that the potential investors require to enter the system.

The existing generators would continue receiving the standard capacity payment. The new generators that have won in the auction would receive the marginal value of the capacity payment resulting from the auction, but just for five years. Afterwards they would receive the same standard payment as anybody else.

One of the positive characteristics of this design is that the auction just affects a small number of generators, while the capacity remuneration of the majority remains regulated, and essentially, not involved in this new capacity market, thus reducing the potential market power interference, and therefore avoiding certain types of undesirable games that might appear.

Basic scheme

The basic scheme of the proposed mechanism is:

- The regulator, supported by the System Operator, supervises if there is enough investment announced in the system for a prescribed time horizon (the lag period, see below), taking into consideration the existing generators as well as the expected (and confirmed) new entrants and plant closures, and checks if the expected reserve margin for this term is suitable enough.

  To do so, the System Operator will calculate the difference between the expected maximum system load plus a security margin[10] and the firm capacities of the expected installed generators at this point in time in the future, considering the already installed units and those that the System Operator expects to get installed according to its best assessment.

- If there is not enough upcoming investment, the regulator runs an auction for the amount of needed capacity. The participants in this auction can be the potential new investors as well as those installed generators that are less than five years old (the binding period, see below) and that have not won any previous capacity auction.

- The auction winners assume analogous capacity obligations as the ones that already have the existing generators. This commitment is effective after a lag period -three years- and its maturity is no longer than five years -the binding period-. In exchange, these generators earn the marginal capacity price resulting from the auction during the time their obligation lasts.

The duration of the lag period is devised to allow for a new entrant to build his plant after he has won the auction. We recommend to use three years, since most gas generation units can get installed in that time[11]. Regarding the binding period, we propose to use five years, as it

---

[10] The expected production from non-manageable renewable energy plants as well as the elastic demand should be deducted from this amount.

[11] Of course, this means that the new entrant would have to start the administrative procedures (sitting, permissions, etc.) much before, but these are tasks that do not involve great investments and can be considered as a low entry cost.

is a time frame that should provide the potential investors a sufficient stability to justify building the plant.

- Once the five years binding period is over (or the five years minus the time since the generator got installed, for the case of the existing generators), the winners of the auction receive the regulated capacity payment like the rest of the already existing units.

Three types of generators

Except for the capacity payments, all plants operate normally in the wholesale market and receive the energy market price. *Ad hoc* additional rules are needed so that potential new investors do not find it advantageous to wait until the auction is called, therefore forcing any new investment to happen only via the auction. For instance, a new entrant receives the standard capacity payment but, if an auction is run within five years of its date of entry, it receives the capacity payment that results from the auction for the remaining time. According to this, we can distinguish three kinds of generators:

- The existing units, namely those installed before this mechanism is implemented or those that have already won any previous auction. These generators do not take part of the auction, so they do not provide any incentive for the utility to raise capacity auction prices to get higher profits.
- The generators already installed (and not older than five years old) that have not yet had the chance to play a part in any previous auction. For the time being they receive the standard capacity payment. These generators can still be considered as “new” and therefore they can take part in the auction, earning the marginal capacity price resulting from the auction until they are five years old. From this point of time on, they are paid the regulated default value.
- The new generators, that is, the ones that, at the moment that the auction is run. are not yet part of the system. These agents can participate in the auction, subject to the formerly described conditions.

The capacity auction price bounds

The auction clearing price (i. e. the new value of the capacity payment for the new entrants for five years) is bounded: a lower limit is determined by the standard regulated payment that the existing generators already receive and an upper limit represents the maximum payment the system is willing to pay, i. e. a price such that it is considered worth having less installed capacity than paying for it. The objective of setting this upper bound for the price is to avoid potential market power abuses in case the auction might not be liquid enough. If the lower limit –that is, the standard regulated capacity payment- is set to 80% of the reference investment cost, the maximum price could be set at 120% of this value[12].

The case of lack of auction contestants

An additional and critical aspect is what to do in case the firm capacity that is offered at lower prices than the upper bound (the strike price of the reliability options) is lower than required. It does not seem acceptable that the System Operator may decide to increase the upper bound for the bids in the auction or to buy capacity outside the auction at a higher price. To prevent this situation from taking place, we propose a two-step procedure, which is inspired in the British radio station auctions, Binmore (2002), and which has been a reference also for the Brazilian energy auctions we formerly referred to.

First, the agents are asked just for quantity bids, assuming that all of them will be willing to commit themselves to fulfill the reliability obligations at a price not higher than the predetermined upper limit. If the volume of total bids is satisfactory, the regulator proceeds to a second round in which the agents are asked for prices.

However, if the total volume is insufficient to guarantee a competitive auction outcome, then the original bids are frozen for a period of a few months, and a second round of the auction is widely announced, aiming at attracting new entrants. The idea behind this procedure is that

[12] In theory, this latter value should be enough to fully finance a peaking unit, even if it would never operate. Therefore, bids at higher prices would reflect either a wrong estimation of the regulator or market power abuse behavior.

most potential investors do not present bids in every market in the world, since it would be rather time consuming and their chances to win in each one of them appear to be quite slim. Whenever there is a lack of bids and therefore a high price can be expected, it is likely that some additional players will join the second round of the auction.

4 CONCLUSIONS

The proposed mechanism improves the capacity payments regulation since it provides, on the one hand, a valid incentive for generators to manage their plants wisely (particularly in the case of hydro plants and fuel procurement contracts) internalizing security of supply considerations and, on the other hand, a real insurance for consumers (and the regulator) to avoid scarcity or underinvestment scenarios, as well as price spikes.

The proposed mechanism takes as a starting point the prevailing state of the Spanish market structure (still a rather imperfect and concentrated generation market) and the current scheme to enhance security of supply (the traditional capacity payment). It can be seen as a rational transition towards a fully market-based methodology, when the market structure allows it, as it could be the reliability options market.

5 REFERENCES

Bezerra B., L. A. Barroso, S. Granville, A. Guimarães, A. Street and M. V. Pereira (2006).“Energy Call Options Auctions for Generation Adequacy in Brazil”, PES General Meeting, 18-22 June, Montreal, Quebec, Canada.

Binmore, K. and P. Klemperer (2002), “The biggest auction ever: The sale of the British 3G telecom licences”, Economic Journal, March 2002.

Cámac, D., V. Ormeño and L. Espinoza (2006). “Assuring the efficient development of electricity generation in Peru”, Panel Session: Market Mechanisms and Supply Adequacy in the Second Wave of Power Sector Reforms in Latin America, PES General Meeting, 18-22 June, Montreal, Quebec, Canada.

CNE (2005). Spanish Electric Power Act. Unofficial English translation, Comisión Nacional de la Energía, Volume 7, 3rd Edition, 2005.

Chao, H. and R. Wilson (2004). “Resource Adequacy and Market Power Mitigation via Option Contracts,” Electric Power Research Institute, Draft, March.

Energy Information Administration, EIA (2005). “Subsequent Events-California's Energy Crisis”, Status of the California Electricity Situation, available at www.eia.doe.gov.

Oren, S. (2005). “Generation Adequacy via Call Option Obligations: Safe Passage to the Promised Land”, Electricity Journal, November, 2005.

Pérez-Arriaga, J. I., C. Batlle, C. Vázquez and M. Rivier (2005). *White paper for the reform of the regulatory scheme of the power generation in Spain*, (in Spanish) for the Ministry of Industry, Tourism and Trade of Spain.

Pérez-Arriaga, J. I. (1999). “Reliability in the new market structure (part 1): Reliability and generation adequacy”, IEEE Power Engineering Review, December 1999.

The European Parliament and the Council of the European Union (2003), “Directive 2003/54/EC of the European Parliament and the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC”, Official Journal of the European Union, L 176/37.

Vázquez, C., M. Rivier and J. I. Pérez-Arriaga (2001). “If pay-as-bid auctions are not a solution for California, then why not a reliability market?”, Electricity Journal, Vol. 14, no. 4, pp. 41-48, May 2001.

Vázquez, C., M. Rivier and J. I. Pérez-Arriaga (2002). “A market approach to long-term security of supply”, IEEE Transactions on Power Systems, vol. 17, no. 2, May 2002.

Vázquez, C., C. Batlle, M. Rivier and J. I. Pérez-Arriaga (2003). *Security of supply in the Dutch electricity market: the role of reliability options*, for The Office for Energy Regulation (DTe) of The Netherlands. Presented at the workshop CEPR Competition & Coordination in the Electricity Industry, Toulouse, January 2004.