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Efficiency of reliability options and applicability in different market designs

Ignacio Pérez-Arriaga & Carlos Batlle

LARSEN WORKSHOP

Capacity mechanisms for long term supply security in liberalised electricity markets

Campus de Fontenay-aux-Roses, University Paris XI

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Santa Cruz de Marcenado 26 - E 28015 Madrid - Tel: +34 91 542 28 00 - Fax: +34 91 542 31 76 - http://www.iit.upco.es

Outline

- **The nature of the problem & the terminology**
- The reliability options approach
  - The original reliability options scheme
  - The proposed scheme in the Spanish White Paper
  - Implementation details in different market designs

The nature of the problem & the terminology (

- Diverse time scopes for consideration
  - Reliability: **security + firmness + adequacy**
  - Strategic energy policy
- **Security**: readiness of existing generation capacity to respond, when it is needed in operation, to meet the actual load (a short-term issue)
    - Security typically depends on the operating reserves that are prescribed by the ISO
- **Firmness**: short-term generation availability that partly resul from operation planning activities of the already installed capacity (a short to mid-term issue)
    - Firmness depends on short & medium term management of generator maintenance, fuel supply contracts, reservoir management, start-up schedules, etc.

The nature of the problem & the terminology (

- **Adequacy**: existence of enough available capacity, both installed &/or expected, to meet demand (a long-term issue)
  - Is the market remuneration enough to promote the entry of generation technologies that are well adapted to the future evolution of the demand in the long term?
- **Strategic energy policy**: concern for the long-term availabi of energy resources: physical existence, price, energy dependence of the country, reliability of the internal & extern energy resources, potential environmental constraints, etc. (long to very long term issue)

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The original reliability options scheme (1)

Motivation

- Somebody (regulatory authority) **acts on behalf of the demand** specifies the desired generation adequacy level
- **Consumers:** Obtain a well defined commercial product in return their money
  - adequate installed capacity
  - plant availability at the time it is needed
  - a reasonable price cap whenever shortages may occur
- **Generators:** Stabilize the most volatile fraction of their revenues
- A **market mechanism** is used to determine
  - The **price** to be paid to the committed capacity
  - Each generator's **committed capacity** (how much capacity bid is each generator' decision)

The original reliability options scheme (2)

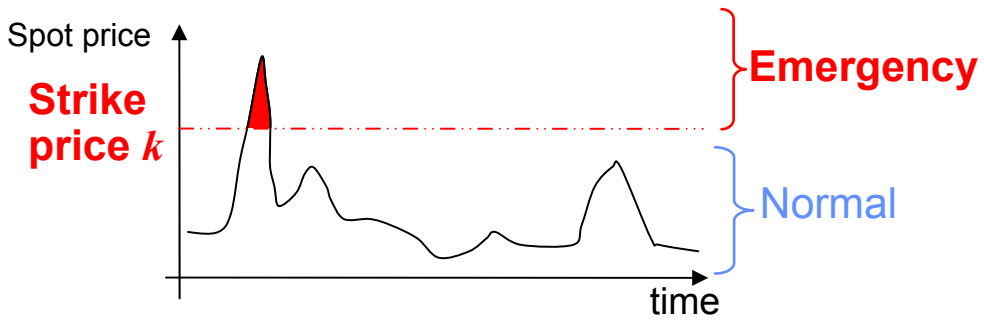
- **Implementation**
- The market authority buys through an auction
  - to the generators
  - on behalf of the entire demand
  - some predefined *reliability product*, a combination of
    - a financial call **option** …
      - It gives the **buyer** the **right**, but not the obligation, to buy the electricity at a certain predetermined strike price k, instea of the spot price s
      - The **seller** receives in exchange a **premium** fee c, the *call price*

    … **plus** a physical delivery **obligation**

      - The seller has to pay a penalty Π if $s > k$ and he is not generating the committed amount of capacity

The original reliability options scheme (3)

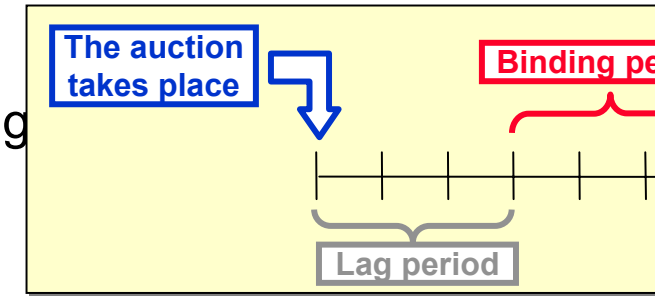
- **Procedure (i)**
- The regulator determines:
  - The strike price k
    - Frontier between normal energy prices and emergency prices
    - High enough to activate only when the system is in trouble
      - In general, above the operating costs of any generator
  - The penalty Π
  - The time horizon of the auction
  - The total amount of capacity to be bought
    - e.g. Peak demand + Reserve margin



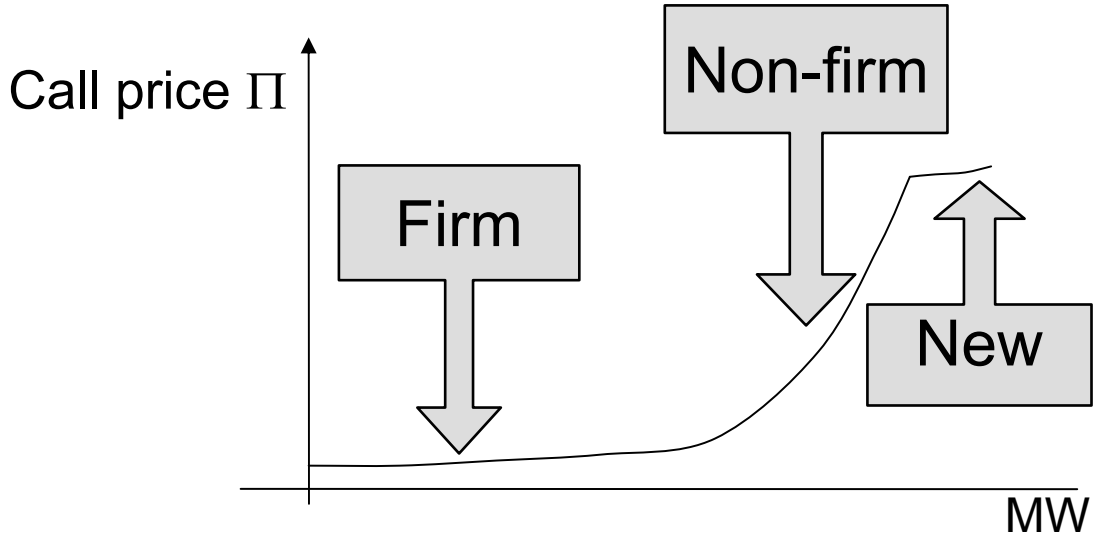
The original reliability options scheme (4)

- **Procedure (ii)**
  - Generators submit **bids**
    - **Price** (minimum premium fee required) …

    ... and **quantity** (capacity committed)
  - For a **generator**, selling a reliability contract means a **reduction** in his **risk** and a **strong incentive to be available** during critical periods
    - Since the premium fee results from an **auction**, any unit can ask the price it needs to get installed (or to stay in the system)
    - The duration of the contracts should be large enough to stabilize the income
      - The lag period facilitates the bidding process of new entrants
        - One or two years



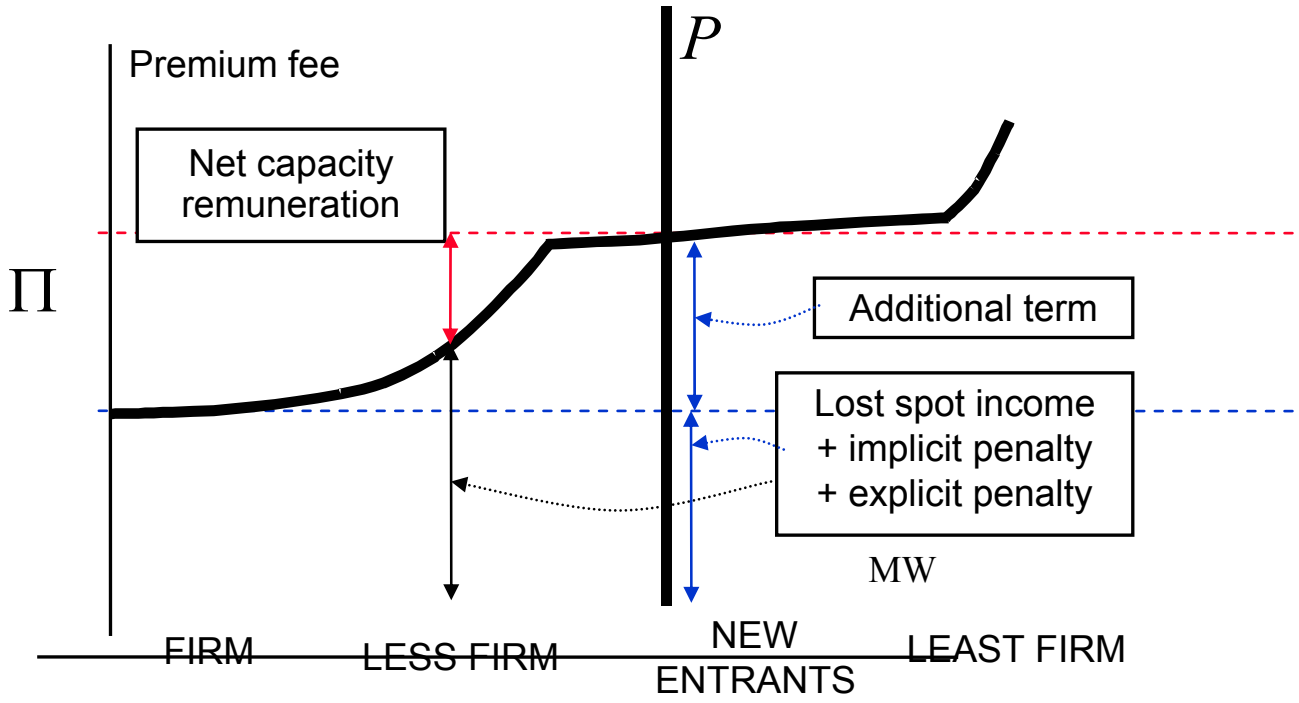
The original reliability options scheme (5)



- Competition among existing energy blocks (generators) is determined by the degree of firmness (reliability) of each blo and...
- ... it is not influenced at all by their operating costs

The original reliability options scheme (6)

- Net income of each generator is related with its firmness
  - Equivalent to a capacity payment
  - This corresponds with some previous theoretical results



The original reliability options scheme (5)

Strong points

- Compared to the energy-only market
  - Additional incentive for new investments, since they stabilize a fraction of their income
  - Clear commitment for generators to be available when needed
  - Consumers are protected from high spot prices & their guarantee of supp improves *(although they pay for it)*
- Compared to the traditional capacity payments mechanism
  - All the previous advantages, & besides:
  - Generation capacity adequacy is guaranteed
  - No need for regulated determination of the value of firm capacity
  - Capacity payments are determined by the market

The original reliability options scheme (6)

Potential weak points *(may require some positive regulatory action)*

- The premium fee may not be enough to attract new entrants, since they would like a larger duration of their fixed payments
- Not easy to fine tune the commitment for generators to be available when needed
  - Gaming opportunities
- Potential market power abuse in the auctions
  - As in any market, but this case is more critical due to the long-lasting effects
- All consumers are protected from very high spot prices
  - It does not promote an active demand response for s > k
- Capcity margin adopted by regulator & SO impacts on energy revenues for all generators

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(i)

- Keep the present system of “capacity payments” with two major improvements
  1. The “capacity payment” now implies a commitment *(it actually becomes a “reliability option”)*
     - To produce an output equal or greater than the committ capacity “when needed”, i.e. when the spot market price exceeds a threshold *(the “strike price”)*
       - and provide the power at this strike price
     - Otherwise there will be a strong penalty
     - The regulator assigns the value of the firm capacity, although the generator may ask for a lower value

(ii)

- *(continuation)*

1. A. Treatment for the presently **existing units**
   - No auction for existing units
   - **Price** is fixed administratively
     - Based on the former capacity payment plus the cost of the new obligation
       - Opportunity costs of the option (strike sets the maximum income)
       - Expected costs of the penalties to be paid due to unexpected failures
   - **Quantity** (committed capacity) defined by the regulator
     - Generators may ask for a lower value

(iii)

- *(continuation)*

1. B. Treatment for the **new units**
   - Auctions to determine the value of capacity payments of new entrants (for 5 years) **only** if the SO foresees margin below threshold
   - Every year the System Operator evaluates the expected reserve margin, looking three years ahead of time
   - The auction is open to new entrants & to new existing units *(le than 5 years old)* that have not yet won an auction
   - **Required total capacity** is defined by the regulator / SO, & participants decide the firm capacity they want to bid
   - **Price** *(capacity payment)* is determined by the auction

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designs

- Specific for the scheme proposed in the Spanish White Paper
  - Prevent gaming by potential new entrants if they expect an auction to happen soon
- Shared with other schemes
  - Determination of “firm capacity” in the presence of hydro thermal & intermittent generation

designs

- *(continuation)*
- Specific of reliability options in different versions
  - The definition of the “strike price”
  - The role of the “penalty” for not providing the assigned firm capacity when required
  - Determination of the values of the strike price, the penalty, the total required volume of firm capacity, th time horizon & the time lag
  - Preventing that unavailability of the required firm capacity might be hidden via successive markets
  - Implicit or explicit selection of new investment technologies via the implementation details

designs

- *(continuation)*
  - Interaction with long-term contracts
  - Choice of lag period with multi-year repetitive natura phenomena
  - Lack of price signals to consumers above the strike price
  - Firmness of commitments by generators located in other countries
  - Safeguard rules to prevent reckless behavior by generators

Preventing gaming while waiting for the auctions

- Ad hoc rules to prevent gaming with the date of the auctions
  - The generators already installed (and not older than five years old) that have not taken part in any previous auction
    - receive for the time being the standard capacity payment
    - can take part in the auction, earning the marginal capacity price resulting from the auction until they are five years old

The determination of firm capacity

- Strongly dependent on the system requirements ...
  - Demand behavior (seasonality, peaking)
  - Generating system characteristics
    - Key factor: share (and characteristics) of the limited energy plants
  - Firm supply = firm capacity? firm energy? a mix of both?
    - Firm supply “units” = MW, MWh or MWh*
      - e.g. PJM, Brazil or Guatemala (h*=4 peak hours in the dry season)
- ... & on the design of the regulated capacity scheme
  - May even distort the market behavior (Argentina, Colombia)
  - The higher the capacity incentive the larger the firm capacity th generators will try to make available
    - Which is the firm capacity of a hydro plant?

The strike price

- Theoretical definition: regulatory frontier between “normal functioning” and “near rationing” conditions of the market
  - In principle, the strike price at least should equal the highest short-term marginal cost of any unit in the system
- On the generation side
  - What happens when the variable cost of a significant fraction of the installed capacity is well above the estimated (or desired) price level of rationing?
    - e.g. Peru, Guatemala
    - How to prevent free riding?
- On the demand side
  - If demand can opt-out, there is also a free riding proble
    - e.g. The Netherlands

The lag period and the duration

- The unavoidable market intervention: implicit selection of technologies by the adopted implementation scheme
  - Observed undesirable results of implicit incentives
    - Peru and the former capacity payments
      - Regulatory uncertainty reduced the incentive to “efficient” ent
      - Just “ultra expensive” peaking units (minimum investment cos
    - PJM Reliability Pricing Model and Spain and average valuations
      - Lack of peaking units
  - Quasi-explicit technology selection via product definition
    - Brazil and the energy call options auctions
      - Fifteen year duration contracts
      - Long-term planning model to solve the auction (considering handicaps)
    - Guatemala and the regulated competitive bidding
      - Aimed at base-load generators (strike price defined accordin

Lack of price signals to consumers

- Demand
  - Mechanisms could be implemented to provide economic signals to demand during high-price periods
    - The total volume of call options P that the OS buys is broken dov into pieces Pi that are assigned to every consumer/retailer i
      - This is a minimum quantity (consumer may ask for more)
    - Whenever the spot price $s > k$, the consumer
      - pays a penalty Π for its consumption above Pi
      - receives a bonus Π if its consumption is under Pi
  - It is more difficult to implement as it requires individualized loa predictions for each consumer/retailer

Firmness of commitments from external systems

- Transmission
  - The penalty Π also applies if the committed generation does not have the required firm transmission rights to make its generation available when $s > k$...

  ... but transmission availability is the responsibility of the ISO
  - For external generators
    - The same requirement of provision of firm transmission rights
- Safeguard against foreign regulations
  - Committed foreign generation capacity should not be recalled to serve its national demand under emergency conditions
    - Need to harmonize European regulations
    - Meanwhile, place the burden on the foreign generator and make sure that the penalty Π can be applied

Safeguard rules to prevent excessive risks

- Safeguard rules
  - A number of safeguard rules can be implemented to avoid generators from taking excessive risks
  - Some of them are:
    - No portfolio bidding
    - No bids above nominal capacity are accepted from a generator
    - No secondary trading is allowed for the physical delivery obligation
    - Financial guarantees
      - Depending on a certain measure of risk exposure (for each generator) calculated by the regulator

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