Challenges, policies and the future of the electricity market: An economist's view

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The electricity market

- Complex market structure (generation, transmission, retailing, distribution, ancillary services)
- Many markets (e.g. Nord Pool Spot /Elbas, markets for primary, secondary, tertiary power, forward markets, futures markets, bilateral agreements; and some places: capacity markets)
- Time is important (dynamic sequences of markets)
- Uncertainty is important in both the short and thelong run (large investments up front with long pay back periods)
- Strongly linked to «environmental markets» (e.g. black, green and white certificate markets)
- Several kinds of «market failures» that call for regulation

Not many markets are equally rich in economically interesting features

Market failures

Electricity provision should not be left to market forces alone, but also be subject to regulation to deal with the market failures

Relevant kinds of market failures:

- Natural monopoly (a type of monopoly that exists as a result of the high fixed costs or startup costs of operating a business in a specific industry. Economically: large economies of scale and therefore "only room for one")
- Negative externality (the cost that affects a party who did not choose to incur that cost. Occurs when an individual or firm making a decision does not have to pay the full cost of the decision.)
- Public good (goods that one individual can consume without reducing its availability to another individual, and from which no one is excluded).
- Missing markets (sometimes markets cannot be created)

Competition and regulation

- Generation and wholesale market
  - Competition is possible and should be stimulated, («economies of scale» at low generation levels)
  - Market power exertion a possible problem due to existing large «national champions». May be diluted by cross border market enlargements
  - Environmental externalities may be present
- Transmission:
  - A natural monopoly
  - A need for regulation through a SO (third party access/ open access)
  - Environmental externalities may be present
- Retailing:
  - Competition is possible and should be stimulated
  - Consumers should be able to switch retailers at low cost

Competition and regulation

- Distribution:
  - local natural monopolies,
  - A need for regulation, (third party access/ open access)
  - Still «yardstick competition» is possible
  - Important to separate regulated distribution activities from retailing activities
- «Ancillary services» (to ensure the physical functioning of electricity supply)
  - Significant uncertainty of demand and supply both in the short and in the long run
  - A need for a System Operator (SO)
  - Practical with a sequence of markets to gather information as uncertainty is revealed along the way to real time deliveries and consumption
  - A particular task of the SO is to ensure a certain degree of the security of supply (possibly through a capacity market)

Challenges

- Measures and instruments applied in order to deal with market failures affect the electricity market
- Among these the policy of increasing the share of renewables in the electricity sector is of particular importance
- The erratic nature of wind and solar power generation poses a serious problem in terms of security of supply
- Security of supply may defined in terms of the probability of black and brown outs (hence security of supply is not an absolute, but rather a relative concept)
- Some consider security of supply to be a public good (while electricity as such is not a public good)
- Viewed from the demand side the security of supply problem may be seen as caused by a “congestion externality”. One end user’s (significant) increase of power consumption inflicts harm on others in terms of reduced security of supply for all

Energy only markets

- An electricity sector characterized by «energy only» markets implies that there is no direct regulation of the availability of power at the instant of delivery and demand
- Still there are some trade in power capacity as the SO typically contract with the supply and/or the demand side to secure sufficient balancing power in real time
- The generators of electricity thus get a payment from
  - Sale of electricity on the energy only markets
  - Sale of power for power regulation and system services (ancillary services)
- A larger share of intermittent power leads to
  - Longer and more frequent periods of low prices due to low short run marginal costs
  - More frequent periods of scarce power implying very high prices

The missing money problem

- The question then is whether existing “energy only” markets are able to deal with the security of supply problem caused by the increasing share of intermittent power or if new capacity markets need to be created
- If the security of supply level is to be secured at any time, then a sufficient capacity of conventional power must be installed so as to deliver when intermittent power generation fail
- These are periods of high electricity prices, that potentially may give a remuneration to even high cost marginal capacity
- However, sufficient capacity at all times implies on average low electricity prices, and only high prices occasionally during periods of e.g. wind stand still or demand spikes during sudden spells of extremely cold weather and unexpected black outs due to natural causes (stormy weather).
- Marginal conventional capacity would only make money and prove profitable during the periods of tight capacity utilization as prices rise to very high levels.
- Hence, if prices are not allowed to rise significantly due to price regulation or because very high prices are not politically acceptable and calls for intervention, then there is a so-called “missing money” problem (se e.g. Joskow, 2008)

Missing markets and demand side adaption

- Missing money in energy only markets may not be the only problem related to ensuring a sufficient level of security of supply.
- Missing markets may be another one (Newbery, 2015). Apart from capacity markets, there is also a need for liquid markets for financial price hedging.
- A possibility exists for the demand side to buy call options issued by producers with reserved capacity. By this the producer may get sufficient remuneration and the consumers may get the power when needed.
- Apart from this, mechanisms to reflect the demand side's willingness to accept reductions of the level of security of supply should also be investigated.
- Over the years it seems as if economists working in this field to a larger degree recognize the necessity of capacity mechanisms

Capacity mechanisms

<table>
<tr><td colspan="5">Capacity mechanisms</td></tr>
<tr><td colspan="4">Volume based</td><td>Price based</td></tr>
<tr><td>Targeted</td><td colspan="3">Market-wide</td><td></td></tr>
<tr><td>Strategic reserve</td><td>Capacity obligation</td><td>Capacity auction</td><td>Reliability option</td><td>Capacity payment</td></tr>
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Source: ACER, Bergman (2016)

Capacity mechanisms

- The purpose of any of these mechanisms is to ensure power capacity in addition to what would otherwise be available through energy only markets
- Price based mechanisms: The SO fixes a price to be paid per unit of reserved capacity (capacity payments). Quantity is uncertain.
- Volume based mechanisms: The SO determines the size of power capacity reserved for peak load situations. Price is uncertain.
  - Targeted (intended for more extreme situations, and considered strategic. May be offered to spot market if allowed by SO in non- tight periods)
  - Market-wide (no restriction on offers to the market. These are considered as the genuine capacity markets)

Capacity markets

- Capacity obligation: contracts that bind large consumers and large retailers to keep a margin between available energy/ power and deliveries/ use of electricity/power. May come in the form of a certificate market. Penalties apply in case of non-compliance
- Capacity auction: Similar to capacity obligation, but it is the SO that buys capacity, not the large consumers or retailers
- Reliability option: Like call options but quantity and strike price is not determined by the market but by a third party

Experiences in the USA

- The USA have had several capacity mechanisms that have been functioning since the 1990'ies. (NYSO, PJM, ISO-NE)
- In general, the markets seem to have been able to
  - maintain resource adequacy
  - stimulate competition in reserves
  - attract large quantities of low cost supplies in terms of demand response, energy efficiency, imports, generation upgrades, deferred retirements (Spees, Newell, Pfeifenberger, 2013)

Capacity mechanisms in use in Europe

- Strategic reserves: Sweden and Germany
- Capacity auctions: England
- Capacity obligations: France
- Reliability options: Italy
- Capacity payments: Ireland, Spain, Portugal, Greece

Capacity mechanisms in practise: Three questions

- How should one determine the quantity of power capacity to solicit? Should be related to a relevant security of supply target (reliability measures): VoLLxDuration=RCC (rental cost of reliable capacity)
  - VoLL is difficult to assess, and may vary with time of use
  - An exaggerated assessment of VoLL may lead to too much power capacity as seen from the point of view of society
  - Also difficult to assess Duration (degree of security of supply)
- To what extent should import possibilities (in the relevant market) be included? Included with caution (not possible to guarantee imports)
- To what extent can the consumer responses be involved in power capacity supply?
  - Mostly large consumers (industry) may be involved
  - Single households may have larger information and transaction costs, but the development of smart grids, "prosumer" activities and storage facilities may improve on this

Market influences of capacity markets

- Electricity prices
  - Presumably lower spikes and less frequent spikes
  - Presumably higher spot prices as some capacity lie idle in periods instead of being supplied into the market
- Cross-border trade
  - Improve efficiency if there are uniform capacity markets in countries involved in trade
  - But may be less effective if capacity markets are non existent or different for some of the trading countries
  - Uniform capacity mechanisms in regions (relevant markets) rather than national capacity markets may be efficiency improving if at the same time open access in interconnectors, free competition and free pricing mechanisms are stressed

Lessons for the future

- Policies on the development of renewable energy exacerbate the security of supply problem. Policies should be critically scrutinized (Is there an optimal share of intermittent power capacity?)
- Introduction of capacity markets involving the demand side in addition to energy only markets is in general a good idea
- Introduction of capacity markets may stimulate competition and attract large quantities of low cost supplies
- The risk of providing too much idle power capacity through regulation (involving a waste of resources) should be addressed
- Necessary to make the capacity markets in Europe uniform (otherwise market distortions may result)
- The idea behind the development of a European Energy Union is a good idea that can effectively secure energy (electricity) at the lowest cost possible (Gains of trade may be realized by the "Single European Market for Electricity")
- This necessitates integration through interconnectors and uniform market constellations: and abandoning the idea of self sufficiency
- For an excellent overview of the topics involved see, Bergman, L. "Mot en integrerad Europeisk Marknad för el?", Rapport 2016:263, EFORIS. Energiforsk

Extra slides

Energy Union

- Energy Union: affordable (competitive), secure, sustainable energy for every European
  - Solidarity clause (Lessen energy dependency within Europe, and reduce security of supply problems)
  - Energy flows, as if it were a Fifth freedom (free flow of energy involving energy unbundling, independence of regulators, redesigning electricity markets, removing environmentally harmful subsidies).
  - Energy efficiency first (promote competition)
  - Transition to a low-carbon society that is built to last (transition to non-fossil energy, promoting EU technological leadership)

EU target and instruments for promoting competition and security of supply

- Increase competition (promote affordability)
  - Enlarging and redesigning markets (e.g. unbundling), so as to promote competition and dilute market power exertion
  - Integrating the EU energy systems ("the electricity interconnection target" of 10% by 2020, not for natural gas)
  - Monitoring of energy prices
  - Reduction of subsidies to mature energy technologies
- Increase security of supply
  - Two meanings: reduce probability of "energy supply chocks" to the economy and reduce the risk of «black» and «brown» outs.
  - Reduce dependency on single energy supplier by spreading the energy mix in energy consumption
  - Purchase energy from friendly neighbors by way of interconnecting energy infrastructure

Effects on participating parties

- Producers:
  - Short run
    - Improve the profitability of conventional power plants
    - Reduce the risk of investment
- Consumers:
  - Spikes less frequent, so consumers with genuine spot contracts get a reduced risk
  - Otherwise, presumably no large effects
  - Contract forms and new technological “gadgets”
- The SO: Will naturally become the operator of the capacity market
- The regulatory authorities: Market power may reappear with a capacity market if a few large producers become dominant in the supply of power capacity