Resource Adequacy and Capacity Mechanisms

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1. Capacity mechanisms. What is it for?
2. Why the market is not enough?
   • Historic rationale for introducing CMs
   • A new security supply challenge
3. Types of Capacity Mechanisms
   • Strategic reserves
   • Market wide mechanisms
4. Design and implementation issues
   • Strategic reserves
   • Market wide mechanisms
Capacity mechanisms: a tool to keep the lights always on

- **Power system reliability:**
  - The power system have sufficient resources to respond to unexpected shut downs and fluctuation in demand.
  - Two main elements:
    - Resource adequacy: there are sufficient resources available to meet the needs of electricity consumers
    - Operating reliability: the ability of the system to respond to sudden shocks. More challenging as the share intermittent generation is growing rapidly

- **Can the market ensure power market reliability without CM?**
  - USA: 3/5 ISO has CM.
  - Europe: While the integrated electricity market target model is energy only, recently several countries opted for CM.

- **Two basic types of CMs:**
  - Strategic reserve: set aside some production capacities to be called in in case of scarcity
  - Market wide mechanism: investment incentive in the form of regular payment for the capacity made available
Why the „Energy-Only” market is not enough? The traditional rationale for CMs

It is not a fundamental design problem:
According to the energy only market concept, markets do provide sufficient incentives to invest: Wholesale electricity prices and the price for ancillary services will rise if market participants anticipate shortage and will invest accordingly.

BUT:
There are too demanding politicians:
  – Reliability standards are set at too conservative level which may not reflect the value of uninterruped supply

There is not enough market:
  – Price caps to keep electricity affordable
  – Bad ancillary services market design
  – Missing interconnectors/not efficient rules to trade

➢The „Missing Money Problem” is primarily caused by market distortions
No net fossil and nuclear capacity addition since 2010
The oversupply is part of the story, but but some elements are here to stay

Change in Installed Electricity Generation capacity in EU 28

- Other renewables + waste
- Solar PV
- Wind
- Hydro
- Fossil fuels
- Nuclear
How does energy transition influence the profitability of mid-merit generators?

Marginal costs covered

Fixed costs are covered

Renewables Nuclear Coal CCGT Peaker

Renewables Nuclear Coal CCGT Peaker
Lower capacity utilization and smaller price “spikes” deteriorate project economics for new CCGTs

Estimated levelized cost of electricity of CCGTs for new generation resources entering service in 2022

Source: https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf

Decrease in revenue for CCGTs (in €/MW/month)


Next few year: profitability expected to improve
- Nuclear closures (ageing + social preferences) + Coal closures (aging + climate policies)
- Negative: more renewables
- Increasing CO2 prices: coal gas/substitution
Power system reliability will require more flexibility and it will pay for it. If distortions are fixed, permanent missing money problem is not likely.
Remaining issues: Revenue uncertainty arising from the energy transition. Is it optimal to collect the revenues via price spikes?

- Project economics is based on forecasted revenues for the next 20 years. Lot of uncertainty around
  - Future supply stack: trends are clear (?), pace and magnitudes are less predictable.
  - Former mid merits has to change their operation mode: value creation is confined to spot markets
    - Instead of baseload production, focus on DAM + ID + BM
    - Limited experience, difficult to forecast demand, hours with positive clean spark spread
  - Emerging competition on the flexibility market: Storages + demand side response
    - Still on the learning curve: improving cost competitiveness
  - Revenue uncertainty increases funding costs:
    - monthly debt burden compared to worst case scenario

- **Even if teething problems:**
  - Long term bankability might require more predictable income streams than provided by price spikes!
  - Can the ancillary markets provide the stable part of the revenue?

- **If the system needs capacities and not production: pay for capacity!**
There are many types of capacity mechanisms

Capacity mechanisms

Quantity-based

Targeted mechanism

One-off tenders
FR

Strategic reserve
BE, DE, SW, FI

Market-wide mechanism

Capacity obligation
Decentralised
FR

Capacity auction
Centralised
UK, IT, IE

Price-based

Capacity payment

Not recommended: inefficiency and overcompensation

Competition issues
Strategic Reserve: last resort in case of system stress

- Typical driver in EU: high winter demand, due to electric heating (California: summer peak)
- Market failure: weak peak supply economics
- Ensure reserve adequacy with a special reserve set apart
- Quantity based tender, capacity fee determined by the market
- Duration: whole year or high season
- Participation:
  - Assets to be mothballed or decommissioned
  - Operating assets (for a season)
- Non-standard application:
  - Germany: facilitate high redispatching need due to delays in commissioning new interconnectors
Strategic Reserve: last resort in case of system stress

• Impact on market outcomes:
  - If otherwise non-active unit wins the tender: limited impact
  - If active assets give the reserves: higher domestic prices, incentivises imports and investments

• Main risk: frequent triggers
  - Dampens price peaks, deteriorates profitability of other producers
  - Bad trigger: DAM prices rearches a pre-set level
  - Good trigger: if DAM market is not able to settle physically

• Costs (ballpark) : 0,1€/MWh on consumption

• Strategic reserve: costs & benefits:
  - It tackles the reserve adequacy problem for the next few years
  - Gives indirect and limited investment incentive
  - Doesn’t address the operational reliability/flexibility issue
  - Cheap (compared to market wide CM)
  - Easy to dismantle
  - EU recommends it as a temporary fix for temporary structural problems. Prerequisite for implementation: commitments to remove market distortion
   a. Full insurance is more costly than the cost of interrupted supply
   b. Trade-offs are different: LOLE: UK 3h/y, IE, IT: 8h/y, Canada: 1h/y
2. Assessment of the reliability situation
3. TSO calculates how much capacities are needed to ensure that LOLE meets the reliability standard
4. Procurement:
   a. Centralized: TSO buys the necessary capacities at capacity auction
   b. Decentralized: obliged suppliers and large consumers contract the necessary capacity determined by TSO. Trading on different platforms and OTC
5. Responsibilities of the contract holder:
   a. UK capacity market: produce when called-in by TSO (H-4), other periods free
   b. IT, IE reliability option model: submit bids (DAM, ID, BM) all the time
   a. UK capacity market: capacity fee from TSO to contract holder, penalties from contract holder to TSO
   b. IT, IE reliability option model: „capacity fee“ depends on prices
7. Decision on the method of socialization of the costs
Reliability options vs capacity markets

- Capacity fee + financial option: similar to contract for difference.
- In case of prices>strike price, difference payment to TSO
- In high price periods producers are incentivised to produce to dampen prices.
- If prices are high, capacity payments are reduced.

- No advance trigger by TSO, availability requirements has to be met continuously.
  - It ensures long term capacity booking and gas supply contracts
  - Lower marginal cost, higher CSS, more production
- Key parameter: strike price: IT: 125 €/MWh
  - It must be higher than the marginal cost of marginal technology, to provide coverage for fixed costs
  - IT: cost of new entry (CONE) for OCGT
Step 1. Adequacy assessment
The traditional approach based on capacity margin calculation

- Deterministic methodology expresses the relation between peak demand in the electricity system and the reliably available supply.
- Spare capacity is that part of NGC which should be kept available to cover a 1% risk of shortfall on a power system. (operation in 99% of situations.
- EU target level: minimum 5%

Problems:
- Probability of coincidence of shocks (supply and demand)
- Export/import: based on capacities and not on actual flows

Source: Entso-E Sscenario analysis and adequacy forecasts 2015.
Step 1. Adequacy assessment
New approach: Model based stochastic simulation by Entso-E

Monte Carlo simulation: 20 years climatic conditions
- Load/wind/solar per country according to climatic conditions
- Correlated and consistent dataset, same probability for each year
- Different types of hydro years (Wet, Dry, Normal) for regions
- Forced outages (units, HVDC and HVAC)

Import/export: flow based on price differentials, constrained by available capacities

Problems:
- Ramping restrictions to be incorporated
- Investment/mothballing is not (yet) endogeneous, Best forecast of TSO

Step 1. Adequacy assessment. Example from ACER MAF 2017

What to do if LOLE is higher than adequacy standard?
- increase interconnection capacity
- storage, demand side response
- generation capacity

Loss Of Load Expectation (h/y)
LOLE is the number of hours in a given period (year) in which the available generation plus import cannot cover the load in an area

Step 2. Determine the necessary amount of capacities

Two key issues:

- Different bundles of technologies might win a contract
  - Simulations for potential bundles
  - Choose by least worst regret analysis (minimax)

- Deterministic or stochastic demand:
  - Deterministic: more exposed to market manipulation
  - Demand curve
  - Optimal capacities demanded when price is at net-CONE (cost of new entry – operating revenue)
  - No demand if capacities offered at a price level economically unjustifiable
  - No need for contract if capacity fee approaches to zero, supply is abundant.

[Diagram showing Price vs. Capacity with key points labeled VOLL, Net-CONE, and reduced operating reserves, with targeted volume of capacity capacity marked.]
Step 3. Qualify eligible capacities

**Types of capacities:**
- Producers, except those under other subsidy regimes E.g. renewables, nuclear with CfD.
- EU requirements: Technology neutral, but limit on emission.
- Storage
- Demand response
- Foreign producers:
  - Interconnectors directly: when capacities are scarce and not owned by TSO.
  - Revenue split between IP and foreign producers: Foreigners first bid for IP capacity tickets then for capacity contracts.

**What is the reliably offered capacity?**
- De-rating of capacities based on contribution to peak load
  - If renewables can participate (US): production profile
  - Probability of forced outages
  - Interconnector: forced outages + foreign price differential
Step 4. Auction

- Existing and new capacities is able to participate
  - Main auction T-4: for existing and new capacities
  - Additional auction T-1 to fine-tune volumes: primarily for existing and projects in-the-pipeline
  - Allow for secondary market

- Different capacity contracts are offered:
  - 1 year for existing
  - Longer for new developments and overhauls (3-15 years)

- Bidding obligation (?)

- Pricing constraints might apply on participants with significant market power
  - Minimum price to prevent disclosing newcomers?

- Pay as clear
Market outcomes. Capacity mechanism is not necessarily the most efficient way to boost flexibility (UK experience)

Simple capacity market favors technologies with low CAPEX (and high OPEX)

• Four rounds of T-4 auctions in UK:
  • Interconnectors, demand response, storage: competitive
  • Peakers are successful: many gas and diesel engines
  • No new CCGT, only one CCGT overhaul

• Consequences:
  • Supply stack: mid-merit squeezes
  • High price volatility: from zero to peaker marginal cost
  • Operational reliability is a concern:
    • who provides automatic frequency restoration reserves?

• Capacity mechanism is not necessarily the most efficient way to boost flexibility
  • Reliability options favors mid merit producers. Test it!
  • More targeted subsidy scheme is needed:
    • Balancing market? Can it provide longer term contracts
    • Tiered capacity market?
THANK YOU FOR YOUR ATTENTION!

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