

Capacity mechanisms

Policy instruments for influencing investment

27-6-2011

Goals

- To ensure a sufficient level of generation capacity
- To maximize reliability
 - mitigate incentives for capacity withholding
- To stabilize electricity prices (?)
- To reduce market power (?)

Two types of capacity mechanism:

- Provide financial incentive to build more capacity
- OR**
- Regulate capacity, create market-based compensation mechanism

Price-based mechanisms

- capacity payments
- strategic reserve
- operating reserves pricing

Fixed capacity payments (1)

Fixed payments to generators for installed or available generating capacity.

Subsidy in exchange for better security of supply.

Fixed capacity payments (2)

- + Easy to implement
- + Can be combined with a price cap to mitigate withholding, because the payments provide additional investment incentive
- Effect is uncertain: which level of payments leads to an optimal investment equilibrium? Do they prevent investment cycles?
- Examples: Spain, Argentina (until March 2000), Columbia, Chili

Dynamic capacity payments (1)

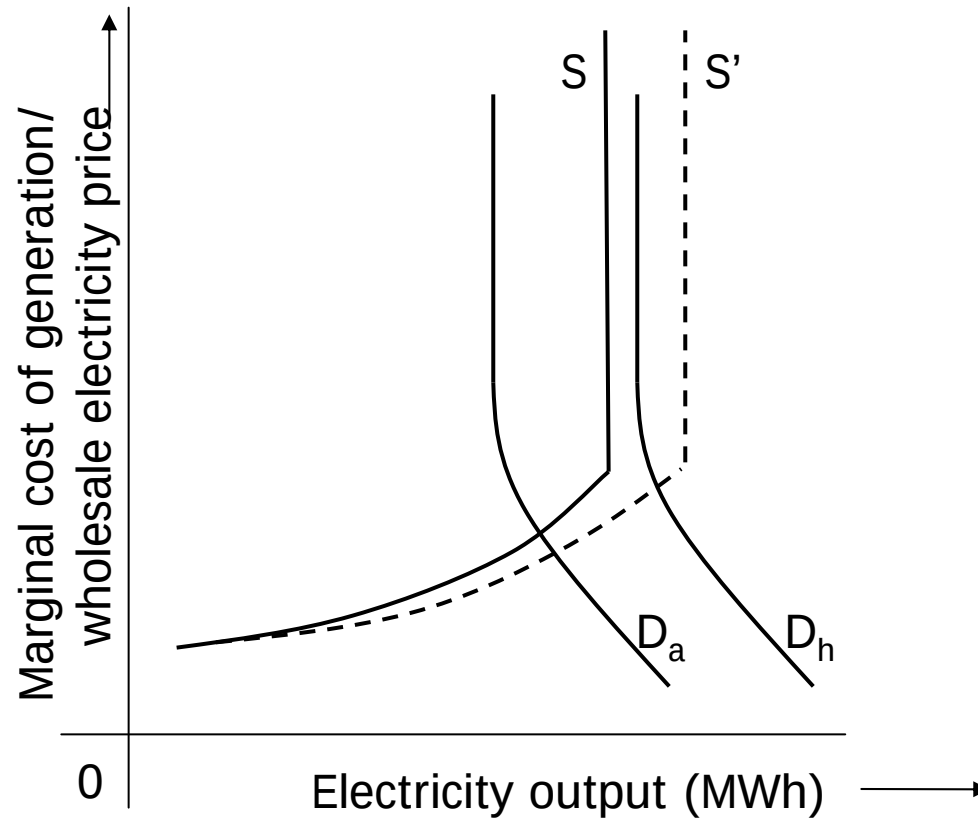
Payments depend upon the capacity margin (the need for reserves)

Subsidy in exchange for better security of supply.

Dynamic capacity payments(2)

- + Flexible incentive, increases with need for capacity
- Volatile short-term signal needs to provide long-term incentive
- Requires mandatory power pool
- This system was manipulated in the England and Wales Pool

Capacity payments



Strategic (mothball) reserve (1)

Centrally operated generating reserve.

- Essence: a public organisation takes the risk of providing reserve capacity.
- Consists of old units, purchased or leased when they were about to be decommissioned.
- But in case of a lack of such units: new construction?
- Dispatch only in 'emergencies'. But what are these?

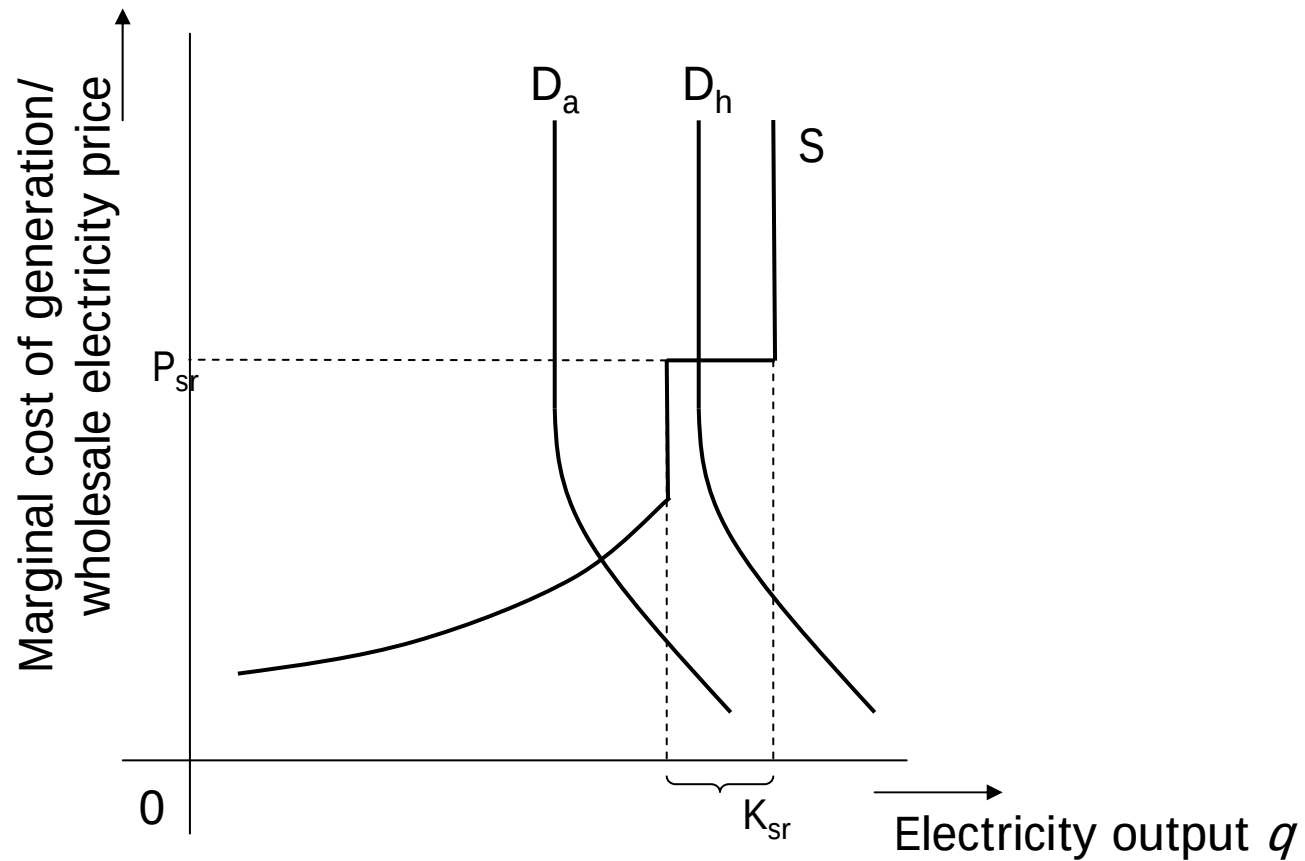
Strategic (mothball) reserve (2)

- Problem: dispatch price = maximum price electricity market.
- Economically efficient price = average VOLL:
 - difficult to determine
 - risk that government cannot tolerate such prices for very long
 - no mitigation of incentive to withhold
- May disturb merit order

Strategic (mothball) reserve (3)

- + Easy to implement.
- Incentive for price manipulation unmitigated.
- Risk of inefficient dispatch.
- TSO in wholesale market: conflicts with policy of unbundling.
- Examples: Sweden, New Zealand.

Strategic Reserve



Capacity-based mechanisms

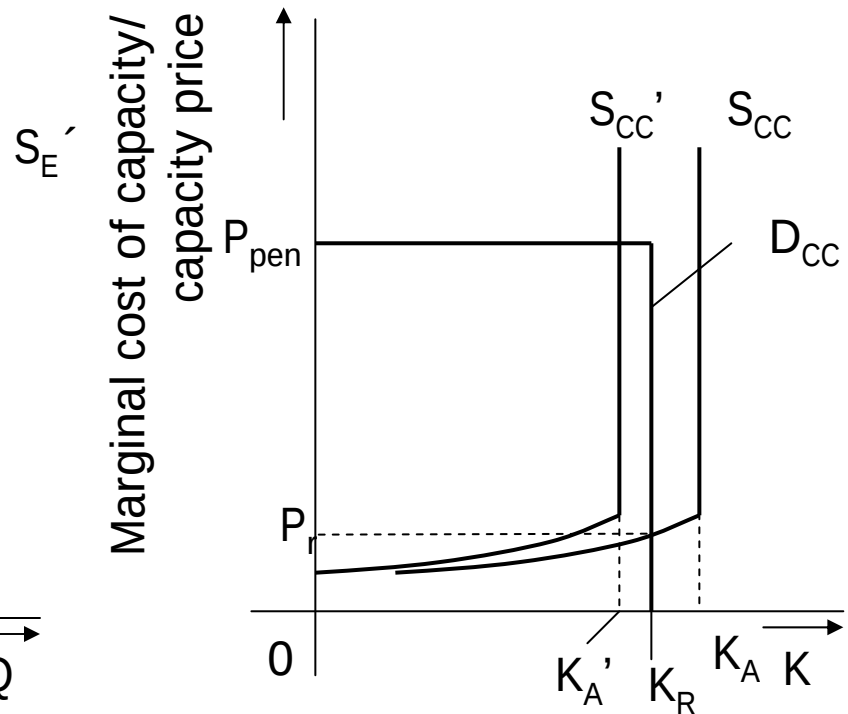
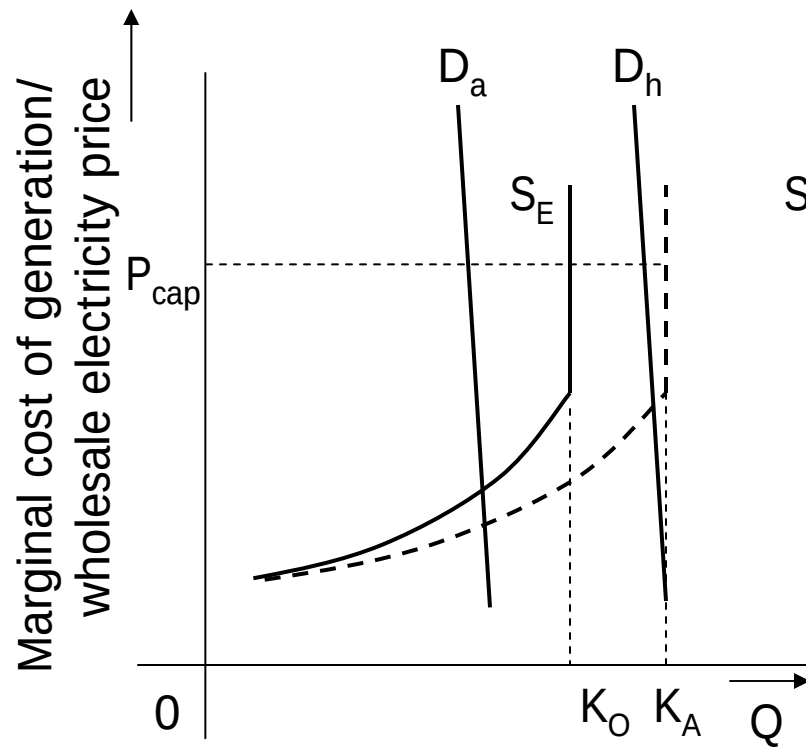
- capacity requirements (ICAP, USA)
- reliability contracts
 - 'call options'
- capacity subscriptions

Capacity requirements (PJM's ICAP)

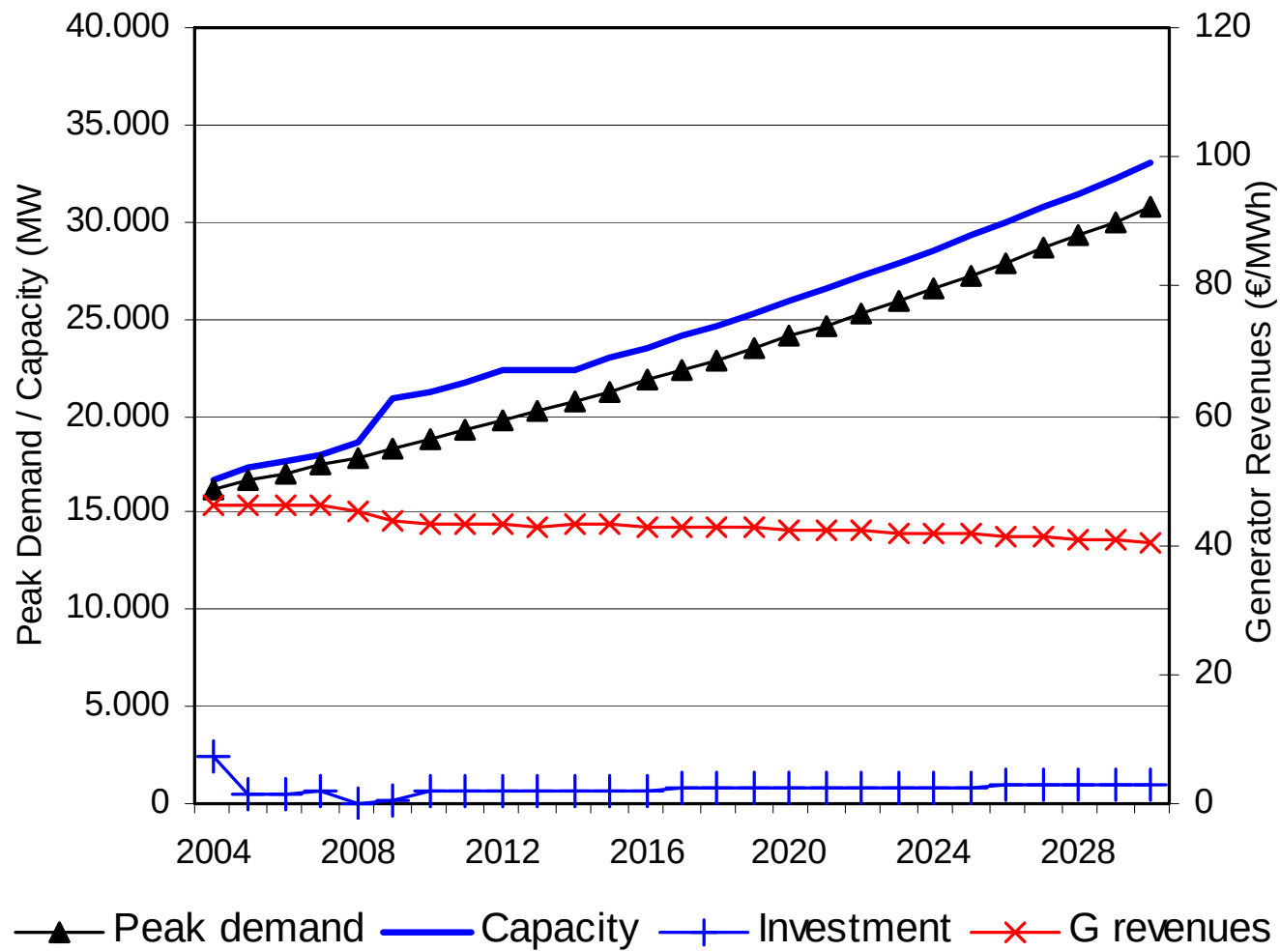
Load-serving entities required to purchase capacity credits:

- Capacity requirement equals peak consumption plus fixed % margin.
- Capacity requirement is determined by the regulator.
- Capacity credits can be traded.
- Capacity credits may consist of interruptible demand.
- Capacity market covers large part of fixed costs; price spikes not necessary.

Capacity requirements



Capacity requirements – dynamic



Capacity requirements - pros

- + Robust, effective
- + Stabilization of investment
- + Stabilization of prices
- + Incentives to involve demand

Capacity requirements - cons

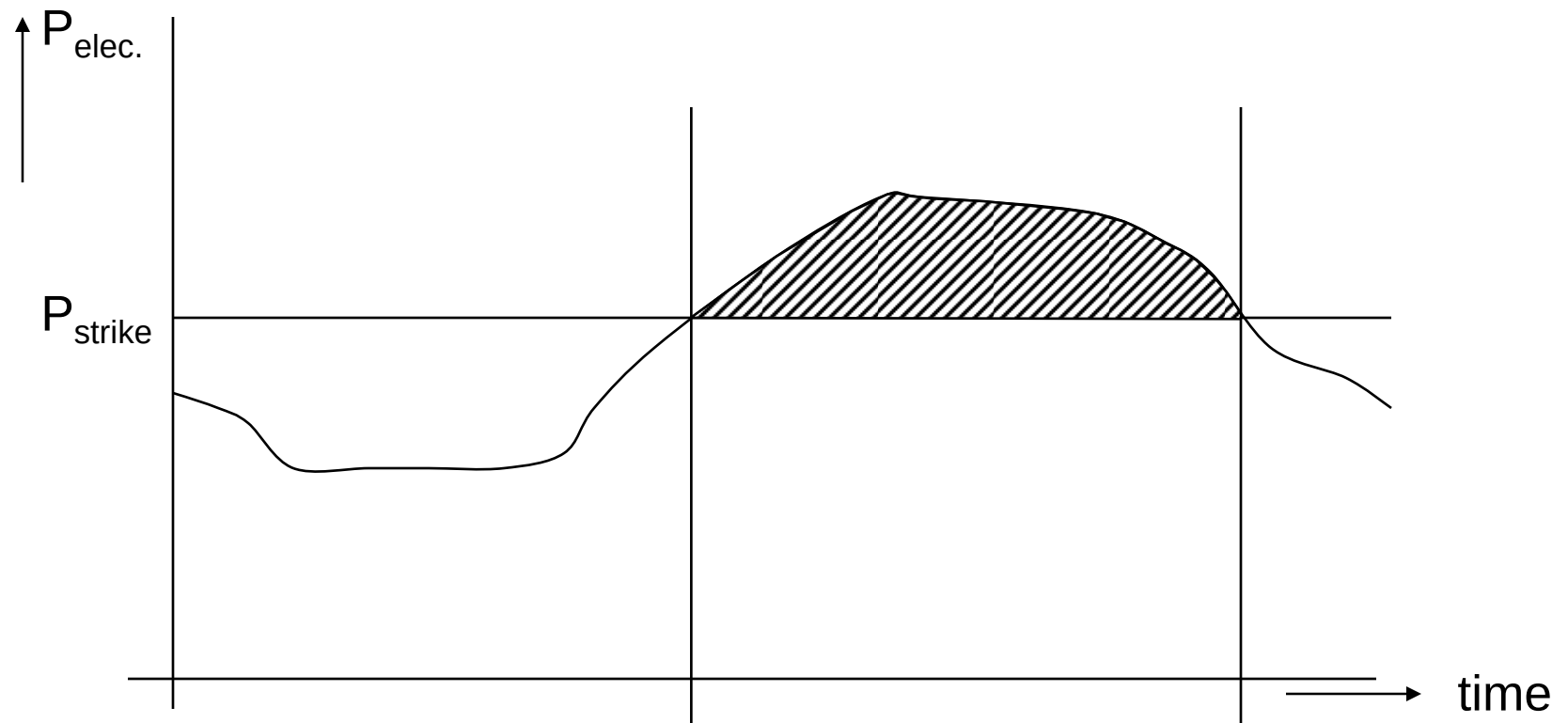
- Capacity market volatile.
- Feasibility in decentralized market ('recalling' exports)?

Examples: PJM, New York Power Pool, New England Power Pool

Reliability contracts

- The system operator purchases options from the producers.
- These give the SO the right to purchase electricity for a certain *strike price*.
- The volume of the options equals the expected demand plus a reserve margin.
- The options are purchased in auctions.

Reliability contracts

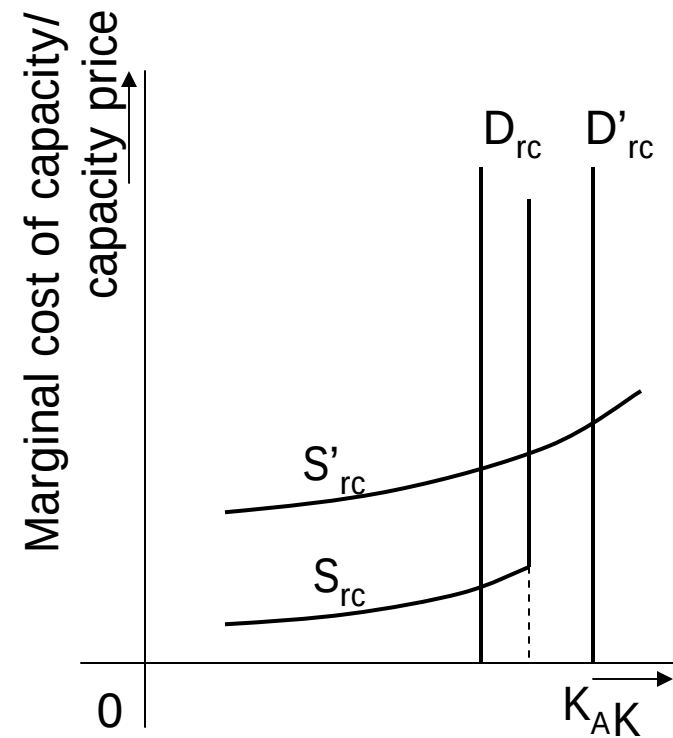
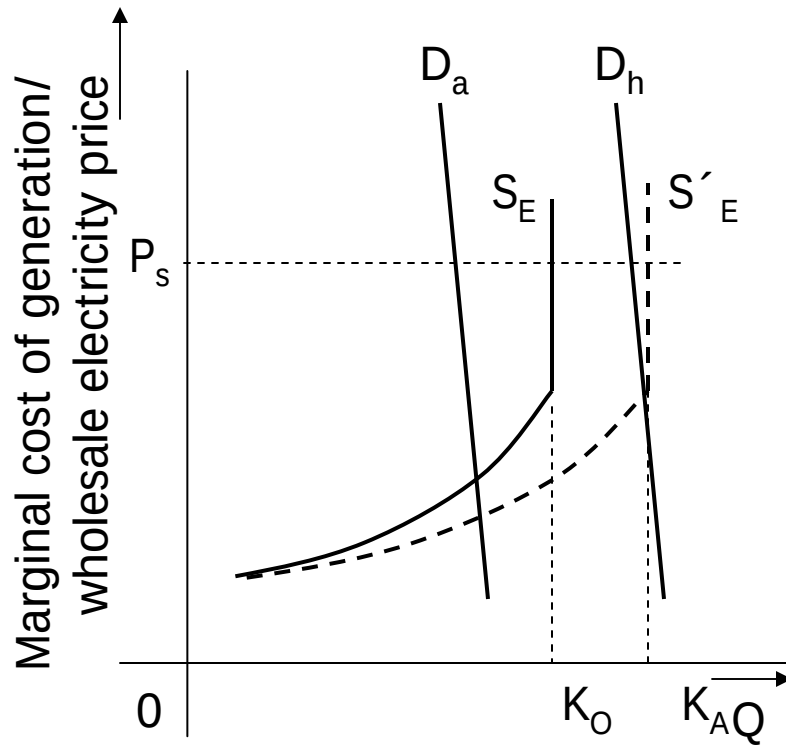


Generator revenues

- If $P_{\text{elec}} < P_{\text{strike}}$: options are not called, generators receive P_{elec} .
- If $P_{\text{elec}} > P_{\text{strike}}$: options are called, generators pay $(P_{\text{elec}} - P_{\text{strike}})$ to the system operator.

<i>Revenues generator</i>	generator has sold options	generator has not sold options
Plant runs	P_{strike}	P_{elec}
Plant does not run	$-(P_{\text{elec}} - P_{\text{strike}})$	0

Reliability contracts



Reliability contracts - pros

- + Price volatility is converted to stable payments to producers → risk reduction for both producers and consumers.
- + Good incentives for generators:
 - to maximize their output during shortages
 - to invest.

Reliability contracts - cons

? Incentives for demand price elasticity

- Auction of option contracts appears vulnerable to manipulation.
- Original design for mandatory pool, complex in decentralized market if there is a risk of 'leakage' to neighboring systems.
- No experience.

(Inventors: Pérez-Arriaga, Vázquez and Rivier)

Evaluation

- Implementation issues
- Pros and cons of capacity mechanisms
- Alternative solution
- Integrating renewables?

Implementation issues

- Effectiveness in the presence of international trade
- Feasibility
- Minimization of risk of regulatory failure (e.g. due to complexity and novelty of cap. mech.)
- Stimulation of demand elasticity
- Efficient choice of generation technology
- Efficient dispatch

Price-based mechanisms

Operating-reserves pricing most interesting:

- + easy to implement
- + can be combined with other measures
- + extension of existing operating reserves
- risk of 'leakage'
- need large reserves to protect against price manipulation and investment cycles

Capacity-based mechanisms

Reliability contracts most interesting in short term:

- + clear and timely investment signal
- + stabilizes generator income
- + protects consumers against price risk
- no experience
- complex, especially in a decentralized market with imports/exports

Capacity subscriptions best long-term solution?

Other benefits of capacity mechanisms

- Level of security of supply is explicitly chosen, either by the government or by the individual consumers themselves
- Long-term stabilization of market
 - reduction of investment risk for generators
 - reduction of price risk for consumers
- Improved transparency
- In some cases: improved incentive for demand-side management (demand elasticity)

Alternative solution...

Given the all the trouble and the lack of interest of consumers:

Reinstate the consumer franchise!

(But... political acceptability?)

More renewable energy...

- Renewable energy technologies have high fixed costs...
- And are more susceptible to policy risk.
- Renewable energy has low marginal cost → larger 'flat' area of supply curve
→ higher price volatility
- Need capacity mechanism for renewable energy?
- How to deal with intermittency?

Appendix

More capacity mechanisms...

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Operating reserves pricing (1)

System operator creates investment signal by contracting a volume of operating reserves.

Limited willingness to pay → effectively caps price.

Lower price spikes compensated by OpRes payments.

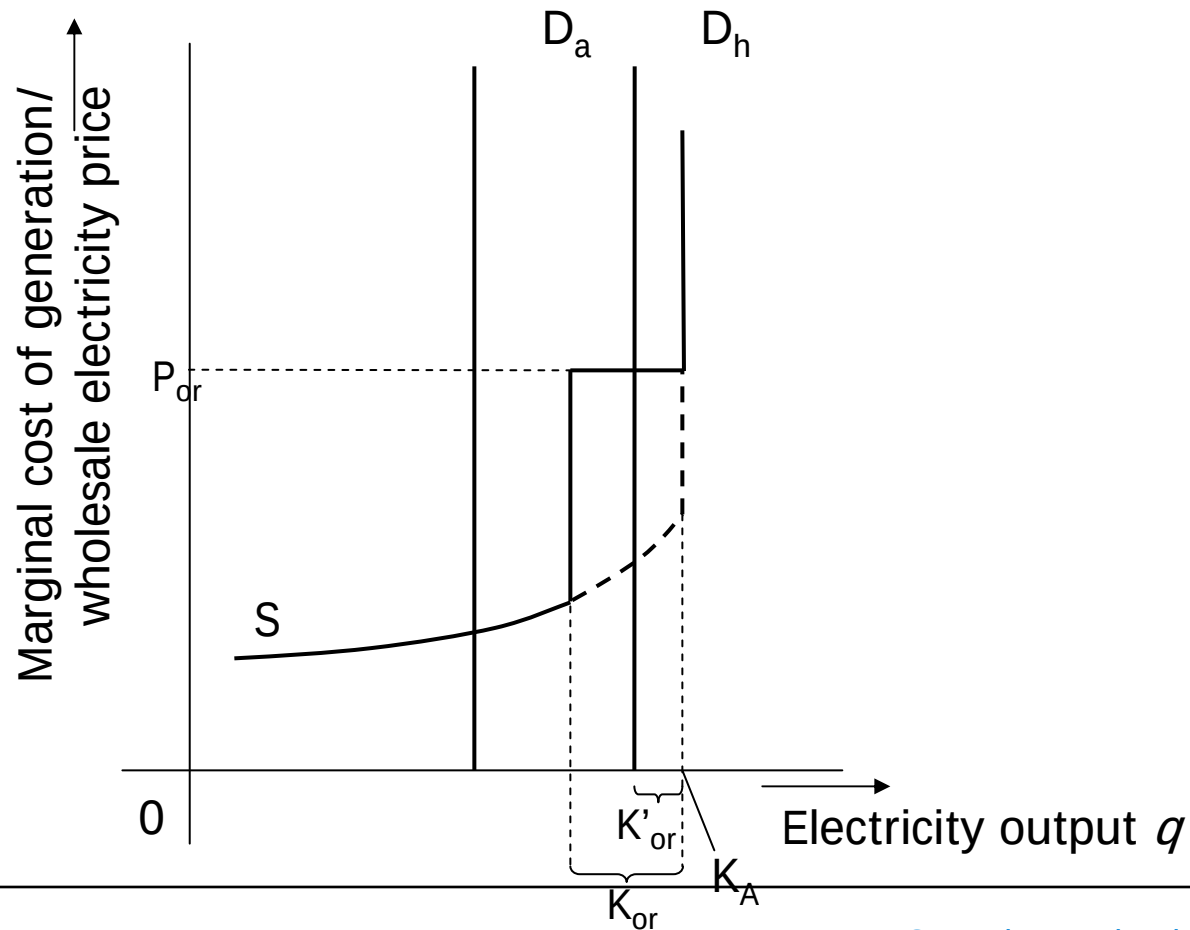
→ Larger operating reserves allow for lower price caps.

(Inventor: S. Stoft)

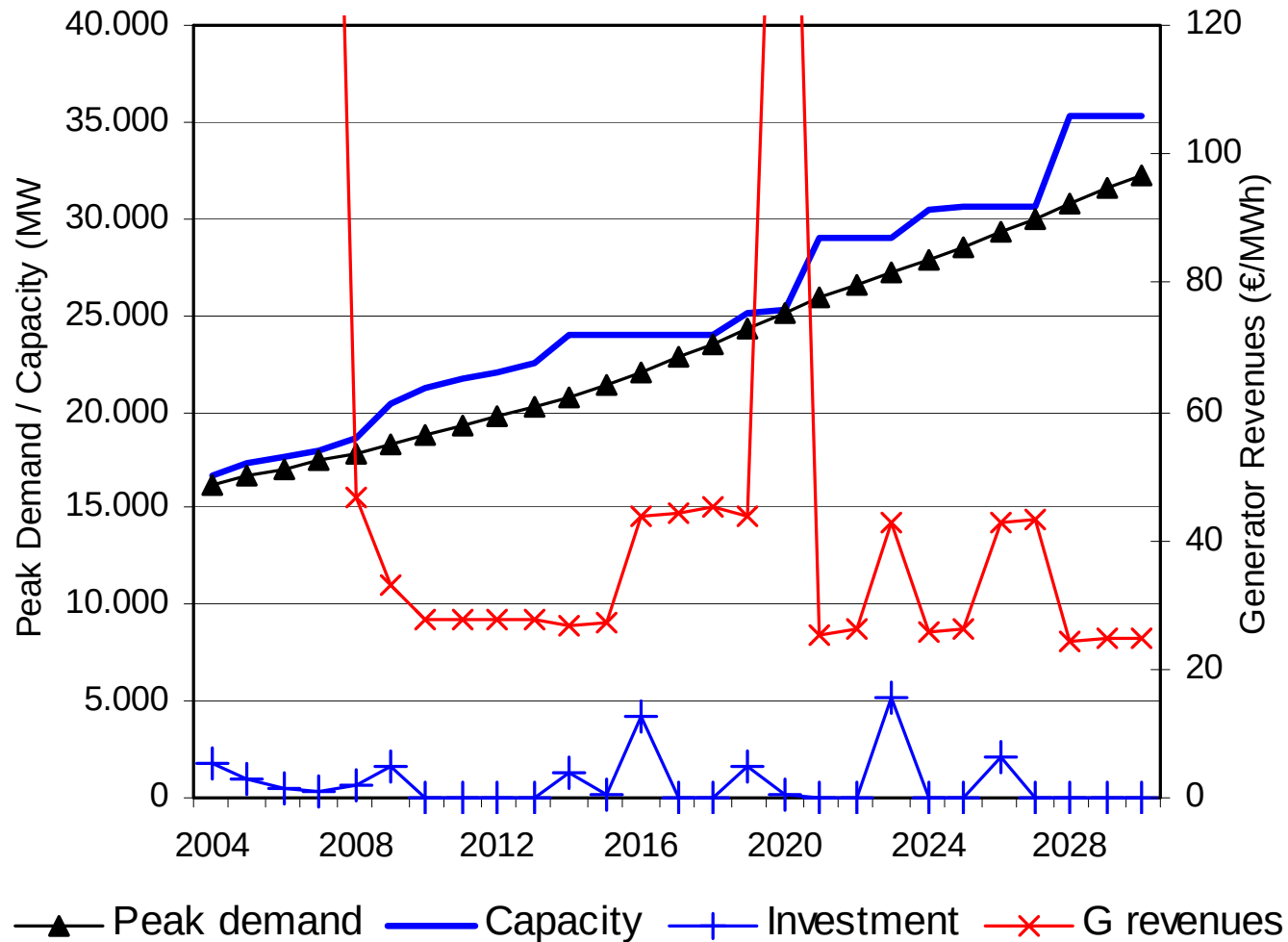
Operating reserves pricing (2)

- + Easy to implement.
- + Limits price volatility
 - reduction of investment risk
 - reduction of price risk consumers
 - reduction of incentive to manipulate prices.
- Reduced incentive for demand price elasticity.
- Causes of investment cycles and price manipulation are not removed, only limited.

Operating Reserves Pricing



OpResPricing – dynamic analysis



Capacity subscriptions

Install device that limits consumption. Consumers pay capacity price for their maximum consumption.

- + Internalization of public good characteristics
- + Optimal incentives to generators and consumers
- Not tried in practice
- Significant implementation requirements
- Still residual public good aspects?

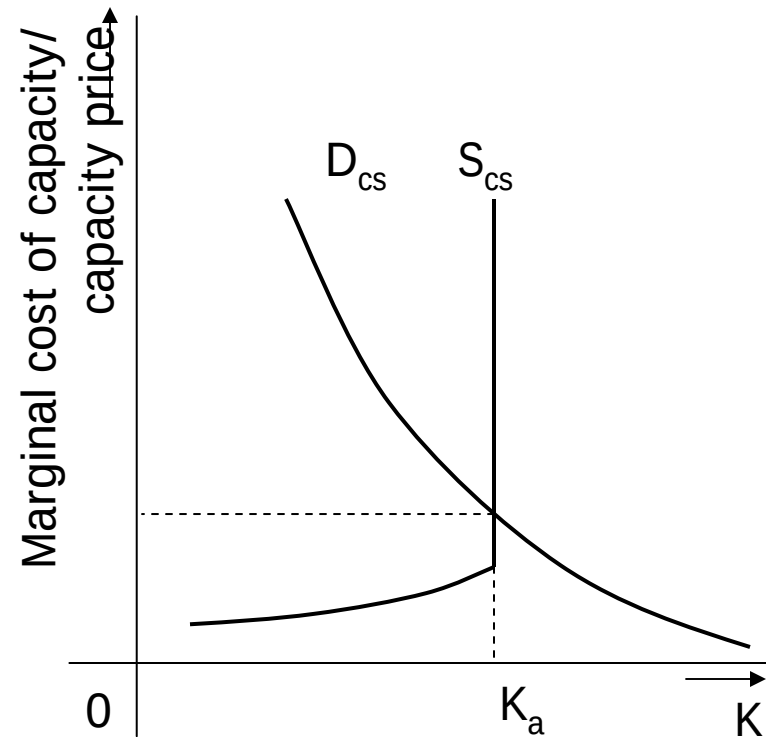
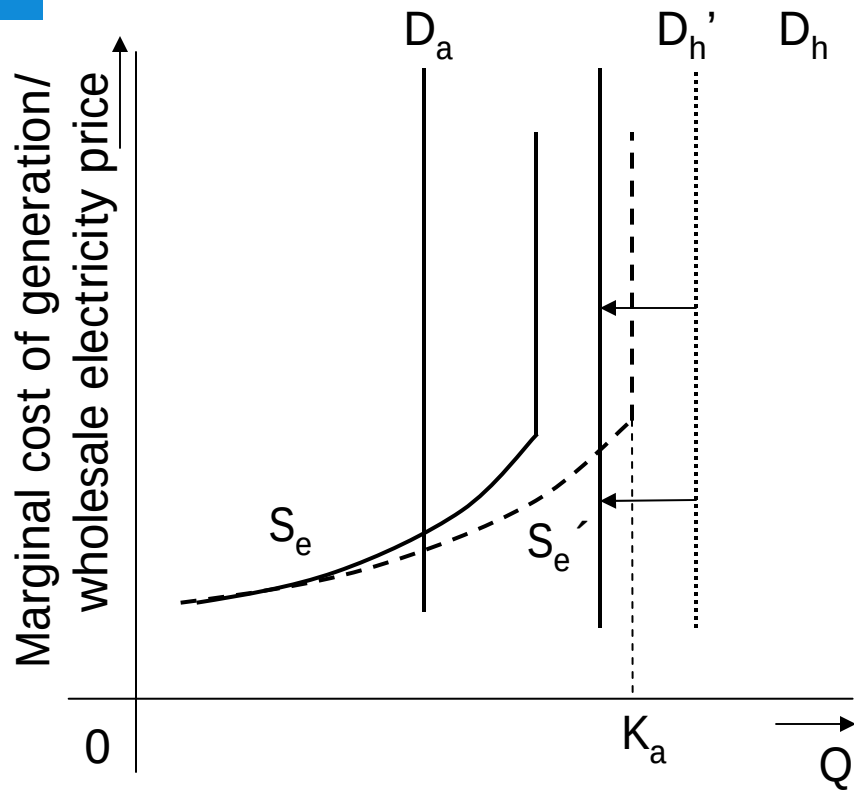
Capacity subscriptions (1)

- Original idea: 'electronic fuse' at every customer:
 - limits individual peak consumption if activated;
 - can be activated remotely during shortages by the system operator.
- The size of the fuse is negotiable.
- Only generators can provide fuses to the market; they need to register the volume they sell and need to back them with available generation capacity.

Capacity subscriptions (2)

- Price of fuse ~ fixed costs generators
- Price of electricity ~ variable costs generation
- Essence: fixed and variable costs of generation are transferred separately to consumers
→ consumers carry the risk of investment in generation capacity.
- In presence of real-time meters, a financial variant is conceivable.

Capacity subscriptions



Capacity subscriptions – pros & cons

- + Most market-based capacity mechanism.
- + Allows consumers to choose their level of reliability.
- Requires fuse or real-time meter at every consumer.
- In original version: ‘leakage’ to neighboring systems?
- Consumers may not want the fuss?
- Need to regulate generators
 - monitor available capacity of generators
 - penalties for generators who do not deliver the capacity they sold.