The visible hand: perspectives on capacity markets and mechanisms

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Optimal retail price and capacity – price responsive demand

On-peak price covers capital (and variable) costs

Off-peak price covers variable cost

Optimal capacity: expected marginal operating profit on-peak equals marginal capital cost

Source: Boiteux (1949)
Implementation of optimal pricing

On-peak marginal profit equal to marginal cost of capacity, around 53 000 €/MW-year. For example, price at 1 100 €/MWh for 53 hours per year on average.

Source: Boiteux (1949)
Optimal price and capacity -- inelastic demand

Administrative curtailment required to balance supply and demand
Value of Lost Load

- Value of Lost Load (VoLL) is consumers willingness to pay for 1 MWh when curtailed
- VoLL varies across states of the world, consumers classes, outage types and durations
- VoLL (for a given quantity) always higher than price
- Distribution of VoLL(s) is not known. SOs use administrative estimate, denoted v
Optimal pricing and capacity inelastic demand

At the (third-best) optimum, marginal value of capacity when curtailment occurs = (v-c)h is equal to marginal cost of capacity.
VoLL vs. Expected curtailment hours

Curtailment hours

Optimal capacity

VoLL times curtailment hours equals marginal capital cost: $v*\text{h}=r$

* Investment cost 95,000 $/year, variable cost 100 $/MWh, Stoft (2002), page 138
Optimal retail price and capacity – partially elastic demand, curtailment required

Administrative curtailment required: insufficient demand response
Resulting optimal pricing

At the (third-best) optimum, marginal value of capacity when curtailment occurs plus the on-peak marginal profit is equal to marginal cost of capacity.
Optimal retail price and capacity – partially elastic demand, no curtailment required

Sufficient demand response: 4.0% (or more) customers price responsive if price elasticity = 0.01, (14% or more if elasticity = 0.1)
No administrative curtailment required

Risk to energy-only markets: producers’ exercise of market power

Lower capacity (installed and/or available), higher prices, more curtailment hours
If you do not believe in market power ...
Policy response: capacity mechanism

Price cap limits market power but creates “missing money”

Capacity mechanism restores missing money hence optimal capacity
Perspective on capacity mechanisms

• Capacity mechanisms are capital subsidies to non-renewable power producers, as Feed in Tariffs are capital subsidies to renewable power producers

• Political economy: transfer from consumers to utilities to limit damage from renewables

• Main drawbacks:
  — Complex administrative mechanisms – back to regulation?
  — Probable inconsistencies between national capacity mechanisms: European Commission rightly skeptical
  — Detract attention from flexibility and demand response, which are key issues
Large users demand response curve

Willingness to pay for one MW for one hour

(In) Price
(€/MWh)

Capacity (MW)

Conceptual
Capital subsidies reduce demand response

Willingness to pay for one MW for one hour

(In) Price
(€/MWh)

10 000
1 000
100

Low wholesale price and volatility: investment costs recovered through subsidy

Capacity (MW)

Conceptual