



Lodz University of Technology
Institute of Electrical Power Engineering

A need for capacity markets

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- Energy Only Market
- taxonomy of capacity mechanisms
- centralized and decentralized approach
- application of fuzzy sets for evaluation
- conclusions





Energy Only Markets can operate in two cases:

- there is an excess of generating capacity left after monopoly era
- large price spikes are allowed in the market to cover fixed costs

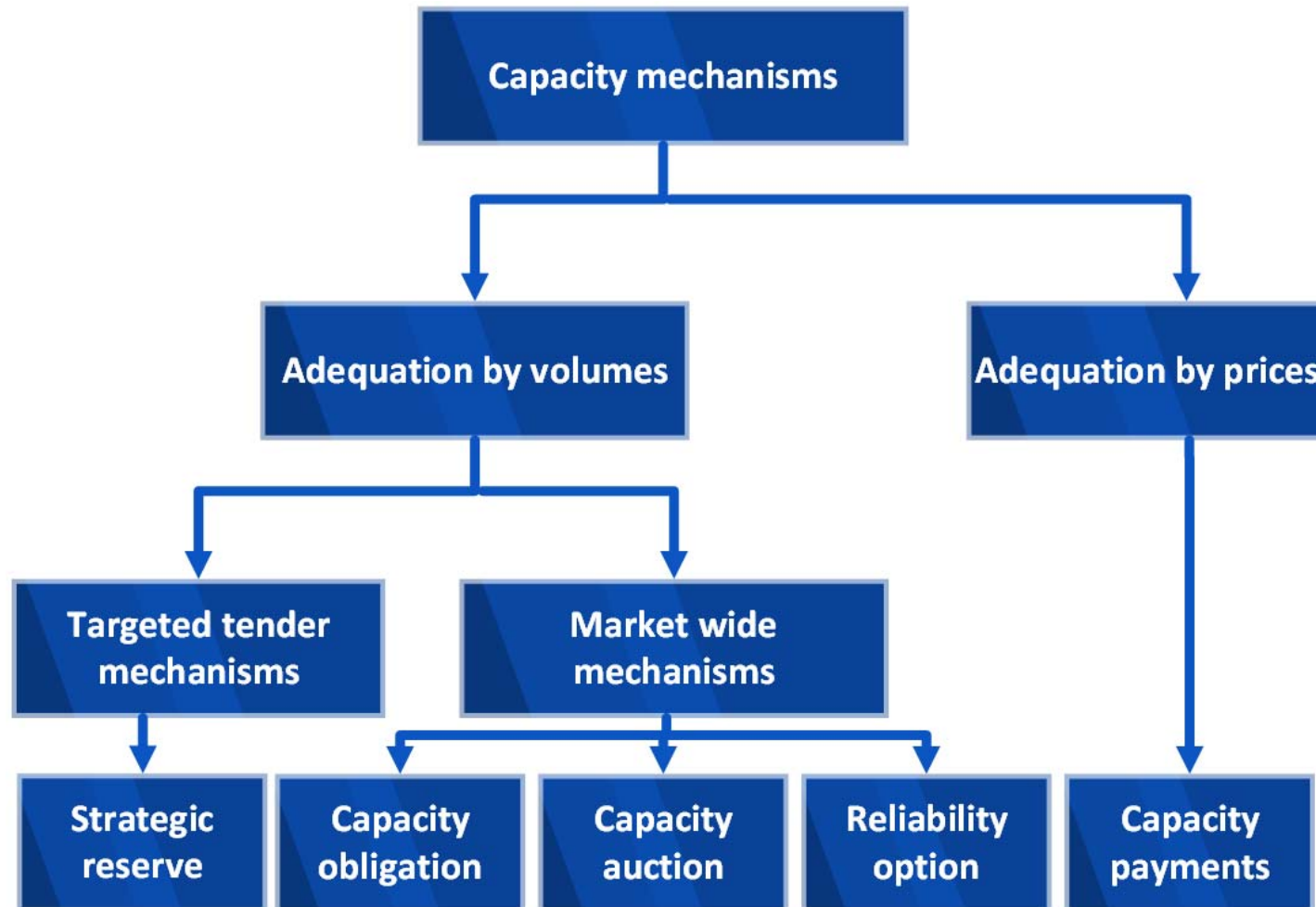
There are two problems that have to be addressed:

- "missing money"
- "missing capacity"



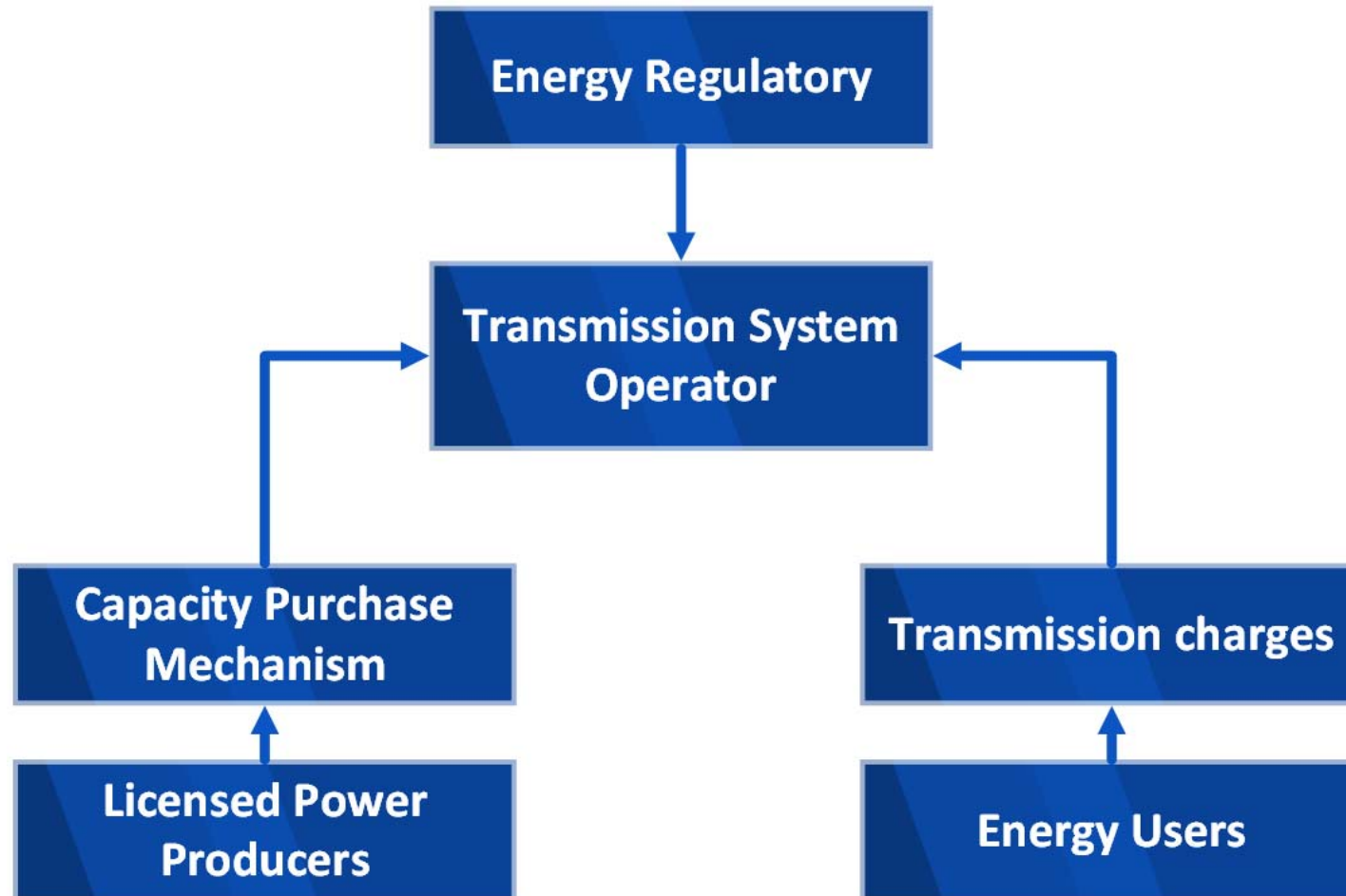


Taxonomy of capacity mechanisms



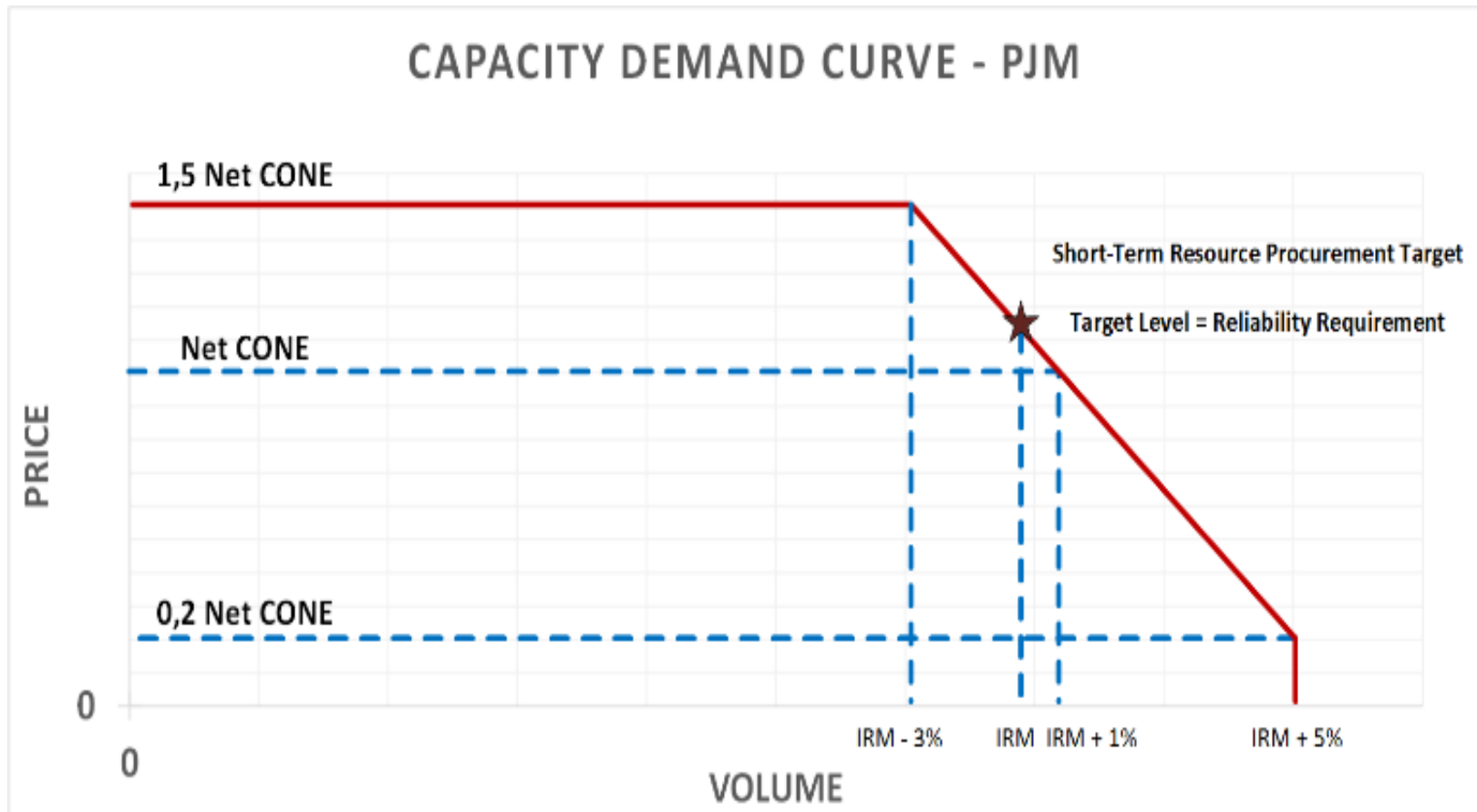


Capacity auctions – centralized approach





Determining demand and price for capacity

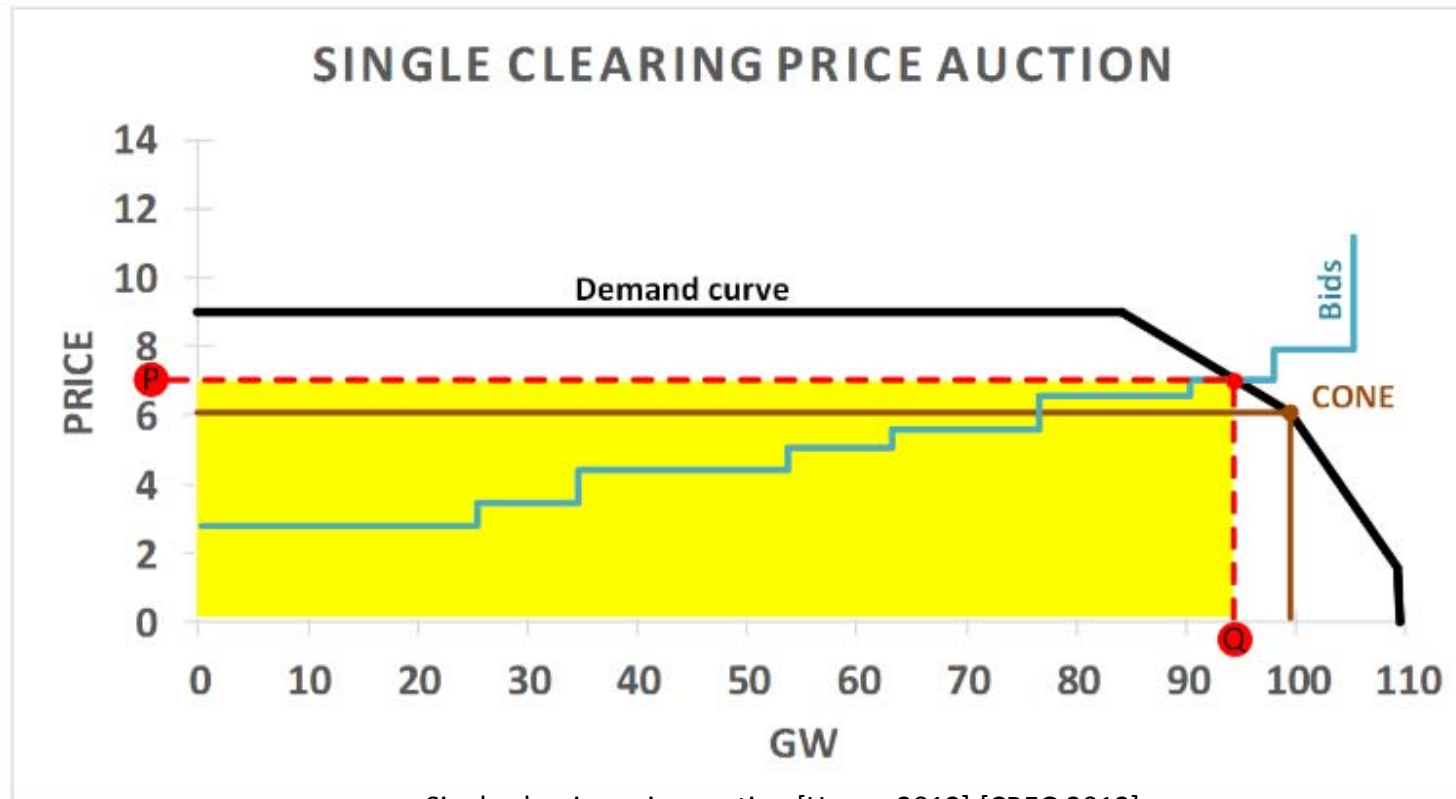


Capacity demand curve [Hogan 2012] [CREG 2012]





Single clearing price auction

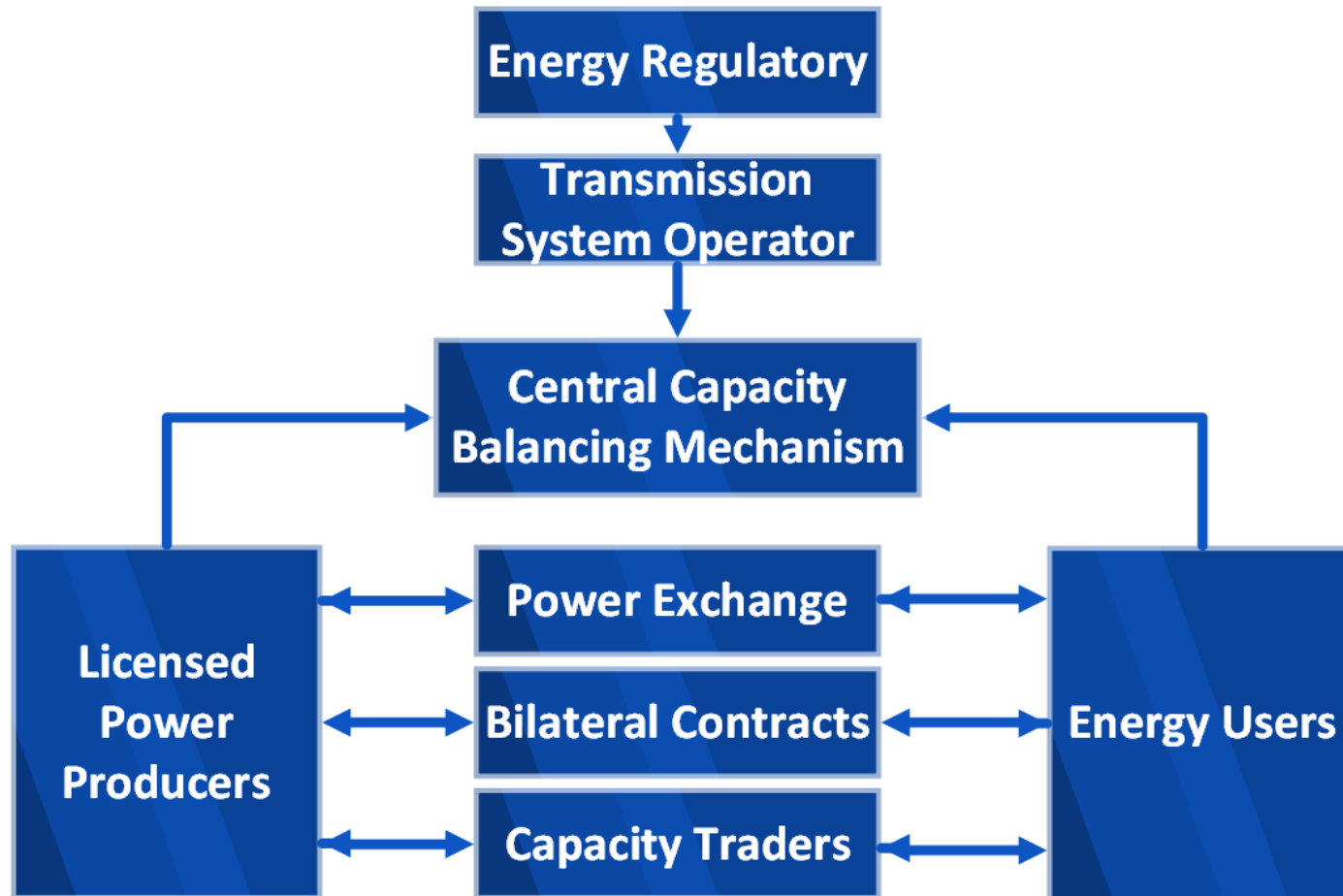


Single clearing price auction [Hogan 2012] [CREG 2012]





Capacity obligations – decentralized approach





Centralized vs decentralized approach

Centralized approach:

- entirely controlled by the TSO and/or energy regulatory
- passive positions of energy consumers

Decentralized approach:

- active positions of energy consumers
- impulse for development of Distributed Generation (DG) and Demand Side Response (DSR)





Criteria for capacity mechanisms

The European Commission published a Staff Working Document on the 5th of November 2013 determining a set of numerous criteria which any capacity market should fulfill.

The criteria are formulated into a checklist and they are divided into two main parts: ***justification of intervention***, which concerns a need for and the conditions of capacity mechanisms and ***choice of mechanism***, which presents a set of criteria for capacity mechanisms.

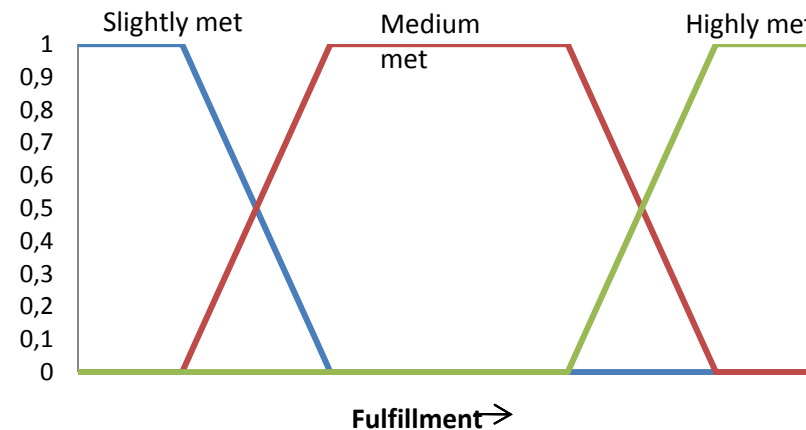




Application of fuzzy sets for evaluation

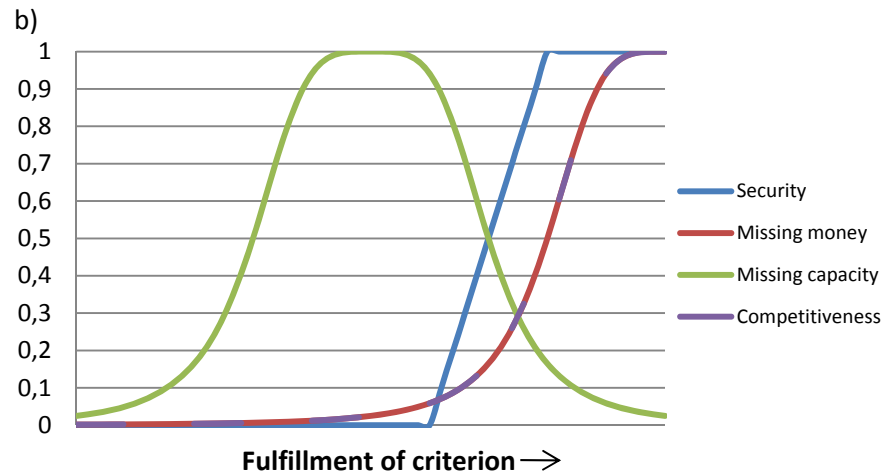
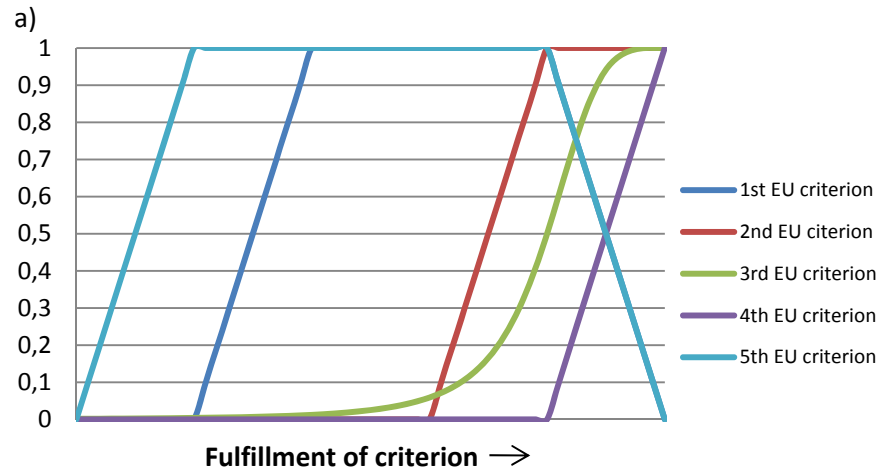
Procedure of continuous value evaluation:

- choice of capacity mechanisms for evaluation
- choice of criteria
- presentation the fulfillment of each criterion as membership function
- aggregation using specialised operators





Application of fuzzy sets for evaluation





Application of fuzzy sets for evaluation

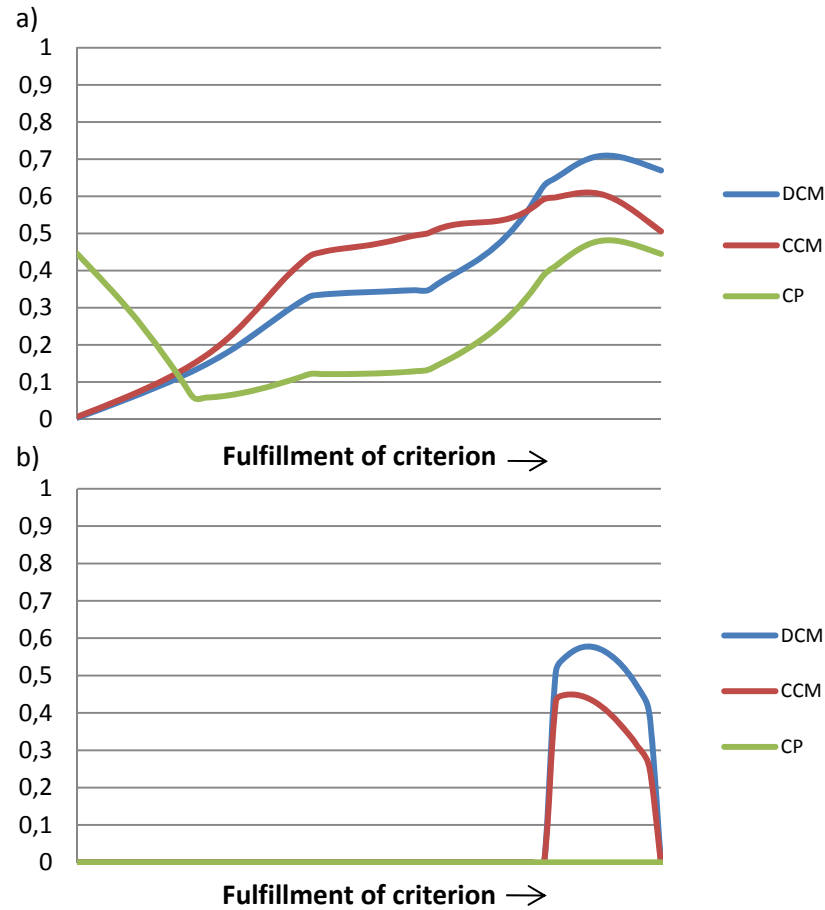
There are several types of fuzzy aggregation operators which can be used in a multi-criteria decision process. They can be divided into three main groups:

- fuzzy averaging
- fuzzy intersection
- fuzzy union





Arithmetic and geometric mean





Conclusions

- the two problems of Energy Only Markets are "missing money" and "missing capacity"
- centralized structures of capacity markets can be burden for energy users
- decentralized approach can stimulate customers response to power demand and development of distributed generation
- fuzzy sets are useful tools in capacity mechanisms evaluation





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Thank you for your attention



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