



## A VCG Auction for Electricity Storage

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**Thomas Greve and Michael G. Pollitt**

Energy storage is of great importance to the future of the electricity system. Storage units can give the flexibility needed, as they can be sources of load at times of excess supply, be sources of supply at times of excess demand, and provide other non-energy electricity products (such as fast voltage support or reactive power).

The key market design question around storage is how to appropriately involve storage units within energy and other electricity service auctions. Current market designs tend to run separate auctions for different energy products (where they run auctions at all). Future market designs could and should use auctions which simultaneously clear multi-product markets on the basis of bids from units capable of producing and demanding a range of electricity products.

The paper presents a design that meets the concerns and problems of today's markets. We present a double-sided Vickrey-Clarke-Groves mechanism (VCG mechanism) that would allow the participation of storage units capable of both buying and selling energy and providing reserve capacity.

The VCG mechanism is based on social welfare and delivers truth-telling about cost, individual rationality, i.e. a storage can choose whether or not to participate in the assignment procedure, and efficiency, i.e. the chosen allocation is the one that maximises total value across bidders. Further, we get results in simultaneous pricing

of the different products. With our design, storage can now be part of the energy market and/or be a reserve supplier or demander. The system operator (SO) is part of the design and therefore, it is given the opportunity to express preferences on offered contracts, based on its desire to balance the system in a context where flexibility needs to be properly priced. We show how the design can be extended to include coupled electricity markets.

Contact  
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[tg336@cam.ac.uk](mailto:tg336@cam.ac.uk)

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