

# A system operator's utility function for the frequency response market

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**Abstract** How can the electricity system operator determine the optimal quantity and quality of electricity ancillary services (such as frequency response) to procure in a market increasingly characterized by intermittent renewable electricity generation? The paper presents a system operator's utility function to calculate the exchange rates in monetary values between different frequency response products in the electricity system. We then use the utility function in a two-sided Vickrey-Clarke-Groves (VCG) mechanism combined of two frequency response products – enhanced and primary – in the context of the system in Great Britain. This mechanism would allow the market to reveal to the system operator the welfare optimal mix of speed of frequency response and quantity to procure. We show that this mechanism is the efficient way to support new faster sources of frequency response, such as could be provided by grid scale batteries.

**Keywords** Utility function, ancillary services, system operator, energy storage, VCG mechanism

**JEL Classification** D44, L94

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