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Reactive Power Procurement: Lessons from Three Leading Countries

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Reactive power is necessary to maintain the local electricity network voltage within the required limits to secure the proper operation of electrical equipment. Requirements for reactive power are driven by the nature of the supply and demand on the network. This means that reactive power sources (ideally in the same place where it is required) are required to support imbalances. The demand for reactive power may be expected to rise in the presence of an increasingly decentralised electricity system.

In contrast with other electricity ancillary services such as frequency regulation or capacity reserves where market based mechanisms are used for their acquisition, reactive power (measured in Mvar and related to voltage stability) is less subject to competitive procurement mechanisms. Among some of the reasons for this are the local nature of reactive power ("Vars do not travel well"), the limited number of potential providers and technological and modelling issues. The presence of distributed energy resources (DERs) – such as flexible demand, small scale generation and electrical storage - creates the potential for local market mechanisms for acquiring reactive power services by the system operator. This is a new way to deal with voltage stability issues. The increase of DERs and the use of their capabilities will be important to support both transmission and distribution system reliability.

This paper explores the international experience in the procurement of reactive power and related ancillary services. It involves system operators from different jurisdictions including Australia, the United States and Great Britain. The paper evaluates different procurement mechanisms and related compensation schemes. In addition, it also presents a novel approach (arising from the Power Potential initiative in the UK) for contracting reactive power services from DERs using a market-based mechanism. The conceptual auction design applicable to the procurement of reactive power is also discussed.

The study finds that there is a lack of competitive mechanisms in the procurement of reactive power at both the transmission and the distribution level, in comparison with the procurement of other ancillary services. Instead, reactive power tends to be compensated by administratively determined pricing methodologies (involving fixed rates or cost-recovery) for procuring reactive power. This means that reactive power suppliers are likely to be over or under compensated. The introduction of more market oriented mechanisms and resources (such as DERs) for acquiring reactive and active power services by the system operator opens new opportunities and new ways

to deal with voltage stability issues. This also imposes new challenges such as the implementation of new types of agreements (different from the traditional ones) between DERs/system operator/electricity distribution firm and the use of new platforms to manage reactive power.

Power Potential is a first of its kind in seeking to competitively procure reactive power from DERs. It offers the opportunity to trial not only the DER performance in the provision of reactive and active power but also an innovative procurement mechanism design. This paper provides key recommendations for such a design drawing on general lessons from auction theory and practice.

Our discussion of the principles of mechanism design would suggest that attention is given to the following. First, the frequency of the auction and its price determination mechanism offers significant scope for learning what sort of price resolution might be necessary/desirable or possible. Second, consideration of the use of pay-as-clear (rather than pay-as-bid) helps to reveal information about underlying costs and to experiment with a different (and arguably superior) payment rule. Third, more consideration of how to enhance the substitutability of products within the trail area should be given, particularly by integrating the procurement across a regional market that can be represented by a group of reactive power supply points (4 in the case of Power Potential).

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