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Designing an electricity wholesale market to accommodate significant renewables penetration: Lessons from Britain

EPRG Working Paper 1719

Cambridge Working Paper in Economics 1756

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The European Union has committed itself to a 27% share of renewable energy in total gross energy production by 2030. As it is much easier to adopt renewable energy sources in the electricity sector (RES-E), it is likely that its share of electricity will be 40%, or possibly more in hydro-rich countries like Norway and Spain. To be fit for purpose, the electricity market design should ensure that the right investments are made in generation, transmission and distribution, at the right time and at least cost, that due account is taken of the climate change benefits of low-carbon technologies, and that learning spill-overs from immature renewable energy in the electricity sector (RES-E) are properly included in determining the optimal investment portfolio. These last two considerations are problematic in a liberalized electricity market, as they both involve externalities that, unless properly addressed, will be under-supplied by the market. Further, if CO_2 is not adequately priced, the more carbon-intensive fossil generation (like coal) will be over-supplied and wholesale prices depressed below their efficient (carbon-inclusive) levels, further discouraging lower or zero carbon options.

The paper addresses the question of how best to deliver a secure, sustainable and affordable electricity supply system in the context of private ownership and a liberalized market, both at the individual Member State Level and for the EU when it comes to design its energy Directives, targets and mandates. It draws on lessons from the British Electricity Market Reform of 2013 and the EU 2016 *Clean Energy Package*, discussing capacity remuneration mechanisms, network tariff design, pricing carbon through a Carbon Price Support, and the lessons from the recent British renewables auctions. The second part of the paper discusses various improvements that this experience suggests are needed, to capacity remuneration, network pricing and renewables support.

Designing an electricity wholesale market to accommodate significant RES-E penetration requires other reforms to transmission pricing and the form of support if RES-E is to be delivered at least cost. The wholesale market redesign has to address two major market failures – the inadequacy and lack of credibility of current and future carbon prices in the EU Emissions Trading System, and the need to compensate developers for the learning spill-overs that wind and solar PV currently create. In addition, there are important markets that are missing, notably futures markets for energy and ancillary services. Future price expectations of both energy and ancillary services are critically important for guiding the right choice of suitably flexible generation (and demand response) to accommodate growing levels of intermittency and falling levels of system inertia.

Some flexibility services (notably very fast frequency response and rapid ramping) may lack price signals in many markets, although System Operators are increasingly recognising the need to create such markets or contract for these new services. Rapid developments in information and communications technologies, smarter grids and distribution networks, active network management and the emergence of aggregators may, however, alter the value and prices of these flexibility services quite rapidly, making current price signals an unreliable good guide to their future value.

Transmission and distribution networks will need to accommodate very different patterns of connection and flows, leading to the need to better coordinate investment in wires and generation. If tariffs are relied upon to give good price signals, they will need to ensure that the efficient price signals based on marginal costs are not distorted by the need to recover average costs. The difficulty of ensuring both efficiency and revenue adequacy may require a central planning body that designs network expansion and makes suitable RES-E sites with access to networks available for auction. If markets are preferred to planning, then nodal pricing looks increasingly attractive in giving better dispatch signals in the short run and potentially better location guidance in the longer run (when combined with longer term hedging contracts).

RES-E support is justified partly by the inadequate carbon price, for which an additional premium per MWh reflecting the value of carbon saved is appropriate, and partly by the learning spill-overs. A better EU-wide RES-E support system would collect funds from Member States and then auction off capacity supports (e.g. for a specified number of full hours operation) EU-wide, ensuring the RES-E connected where the value of the resource and the cost of delivery delivered least system cost. The funds could also be used to support EU-wide low carbon innovation.

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Publication December 2017
Financial Support Paper commissioned by *Papeles de Energy*, to appear in vol. 4