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Market design for a high-renewables European electricity system

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David Newbery, Michael Pollitt, Robert Ritz, Wadim Strielkowski

In 2014 the European Council confirmed the EU's 2030 targets for tackling climate change as a reduction of at least 40% against 1990 greenhouse gas emissions and increasing the share of energy from renewable sources to 27%. It is currently putting in place the legislation to deliver this.

Given the difficulty of decarbonizing transport and heating, the electricity sector will continue to bear a significant burden arising from economy-wide decarbonization. Fortunately, rapid technological progress in wind and solar energy, combined with increased use of interconnection, existing hydro resources and new battery technologies suggests that a high-RES electricity system is not only a necessary outcome of the 2030 policy targets but also a realistic future scenario.

The advent of intermittent renewables with high upfront capital costs but very low short-run costs has led to a reduced role for the market in guiding investment. Governments now dominate by setting the subsidy regimes and capacity payments that determine new generation investment. The share of renewables in EU-28 electricity production has increased remarkably to 28% in 2015. However, raising the renewables share to 50%+ by 2030 will be challenging without substantial modifications to the "1st generation" market design.

In this paper, we review the evolution of liberalized electricity markets and EU renewables and climate policy to date. We note the unintended problems which have arisen under the current market design. We then outline key elements of a "2nd generation" market design, which provides better price signals, incentives for RES investment and operation, and greater system flexibility.

We begin by advancing six principles of good electricity market design: correcting as closely as possible current market failures; allowing for cross-country variation in market design; using price signals and network tariffs to reflect the value of all electricity services; collecting network fixed costs in as efficient a way as possible; de-risking low-carbon investment; and retaining the flexibility to respond to new information on the attractiveness of different low-carbon technologies.

We then provide a more detailed analysis of the key elements of a new market design and present a number of policy recommendations. These can be summarized as follows:

1. There are still substantial short-term benefits of further European cross-border market integration (equal to around 2-3% of overall generation costs) and significant value in increased interconnection. A policy priority is to ensure proper remuneration of interconnector services so as to incentivize private investment.

2. The shorter-term potential of electric storage, including from electric vehicles (EVs), remains tiny compared to existing pumped and hydro storage. Battery storage looks like to play two main future roles: deferring upgrades in transmission and distribution systems by shaving peak use, and improving the management of power flows on the network by varying the charging rates of EVs. The business models to allow batteries to capture this value still need to be clarified.

3. We then examine possible improvements to the design of renewable support mechanisms, which yield better signals on where to locate renewables across Europe. We suggest a move from current output-based (per MWh) feed-in-tariffs to support more based on capacity, with procurement by auction.

4. Network charges for distributed generation (DG), such as rooftop solar PV, need to be made more efficient. We recommend that the apportionment of charges between fixed, off-peak and peak use of system charges needs to be changed to be more cost-reflective.

5. A system dominated by intermittent renewables enhances the need for more granular pricing of electricity. The scope for nodal pricing of electricity has increased in tandem, given recent improvements in computing power and smart metering. More granular electricity prices will improve location decisions for generation investment, and enhance the value of greater system decentralization.

6. We suggest less reliance on politically-backed long-term indexed price contracts to support renewables and nuclear investment. The preferred design of capacity auctions employs “reliability options” which retain efficient spot prices. Policy should support the deeper forward markets and employ long-term procurements contracts only where necessary to reduce risk and the cost of capital.

How to genuinely decentralize investment decisions on the quantity and type of generation remains a key problem for all decarbonizing electricity markets. A radically different future design may need to emerge via experimentation and new technologies. The ability and willingness of governments to let the private sector deliver such solutions will vary. The electricity sector of 2030 may exhibit wider variations in the degree of government control than was foreseen in the mid-2000s.

Contact Robert Ritz – rar36@cam.ac.uk
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