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Can wholesale electricity prices support "subsidy-free" generation investment in Europe?

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Europe has made significant progress in the creation of a single electricity market, since the first electricity directive of 1996. Subsequent directives have seen a shift from market-driven investment in fossil-fuel based power plants to significant investment in subsidised renewable electricity generation. By 2017, almost all new investment in electricity generation was in the form of subsidised renewables (IEA, 2018).

The European Union's (EU) climate targets for 2030 would imply a further step up in the share of renewables in electricity production (to ca. 50%), without binding targets at the national level. Intermittent renewables (VRE – variable renewable energy) impose well-known challenges for the rest of the electricity supply industry, such as efficient matching of supply and demand. At a Europe-wide level, network investments will be needed to support both supply and demand matching of the whole European power grid and could involve substantial increases in interconnection. In the light of these developments, our research objective is (i) to quantify the impact of VRE on merit order (merit order effect) and the trade-offs between merit order effect of VRE and fossil fuel and carbon prices effect, and (ii) to quantify the impact of higher VRE on *'investability'* in electricity generation under the current market design. As a proxy to the current market design, we take "wholesale energy-only prices" i.e., energy-only market design. *Will the wholesale power prices still be a reliable signal to guide investment decisions in the European power sector?*

Our results suggest that the so-called merit order effect of higher shares of VRE is very specific to local market context – for example, it is rather pronounced in France and Italy and less so in Britain and Germany, while in Italy higher fossil fuel prices will cancel out the merit order effect completely. That is, the interplay between fossil fuel prices and higher VRE depends on the existing generation mix.

Further, the results show that an increase in VRE capacity in line with the EU's 2030 policy objectives (e.g. to 32% of RES in final electricity demand by 2025) will result in a rather modest decrease in annual average power prices in key European power markets, while higher VRE penetration means higher volatility of these prices.

With higher VRE penetration the potential for overcapacity could be larger (although actual market data and our modelling results show that the 2015 capacity mix is already in a state of overcapacity, to some extent). The potential exit of conventional generation in response to the merit order effect, due to their missing money problem, means that power prices could be higher on average (in response to tighter capacity margins).

For example, in a high fossil fuel and carbon price market condition, CAPEX for offshore wind would need to decrease by just 35% (on 2017 levels) for the technology to break even using energy-only wholesale power prices alone. This is the background to recent zero subsidy offshore wind auction results in GB, Netherlands and Germany.

Our results also show the importance of further interconnection between markets in Europe – even though this could be very expensive and/or difficult to achieve. Further interconnection allows near complete convergence of power prices (both baseload and peak prices) and, more importantly, stabilises these prices (reducing volatility) and hence reduces potentially higher market risks due to more VRE. However, increased interconnection does not change the picture we paint on the '*financeability'* of subsidy-free VRE and fossil fuel investments via energy only markets by 2025.

Finally, the results suggest that higher fossil fuel and carbon prices seem to help stabilise the economics of existing conventional generation. Thus, a significant rise in carbon prices would improve the ability of a low carbon electricity system to be self-financing.

The available evidence and our own modelling show that if wind and solar are to be self-financing by 2025 under the current European electricity market design, they would need to be operating in circumstances which combine much lower capital cost and/or much higher fossil fuel/carbon prices. In the absence of these favourable conditions for VRE, long term subsidy mechanisms in the form of auctions would need to continue in order to meet European renewable electricity targets.

A move away from feed-in-tariffs for wind and solar to market prices will also expose generators to increased price volatility, which would raise their investors' target rates of return. The question of the need for a market redesign to let the market guide generation investments in both renewables and conventional generation would seem to remain.

Interventions to create capacity markets or sharpen ancillary services markets payments can help to address the problems of the current market design by creating the incentives for the optimal addition and retention of power plants in the system.

These mechanisms are problematic to design, and investments supported by them will likely have higher costs of capital given the volatile and difficult to predict income streams that they give rise to. This is because ancillary services markets are subject to fundamentally different governance arrangements relative to energy markets, making them expensive to rely on as a source of long-run funding for generation investment.

Our analysis suggests a trend continuation in current generation '*financeability'* problems, with only some partial mitigation should fossil fuel and carbon prices rise further, or there be substantial improvements in interconnector capacity across Europe.

However, a sharp further drop in renewable electricity capital (and O&M) costs, closure of unprofitable fossil fuel power plants and/or rise in carbon prices would certainly help to drive the arrival of subsidy-free renewables within the existing electricity market design.

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