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Electricity Market design for a decarbonised future:

An integrated approach

Executive Summary

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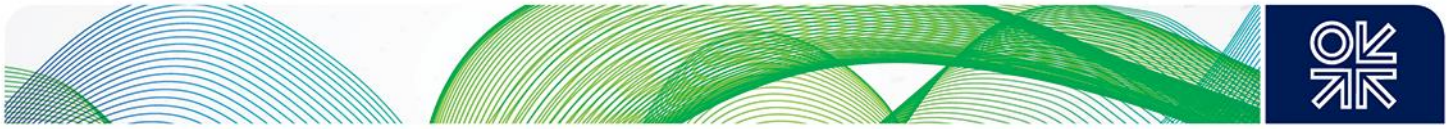
Countries around the world are seeking out opportunities to expand the contribution of renewable. The growing share of variable RES generation in the power system is introducing strains into the common design of European power markets. The European Commission, industry representatives, regulators, and observers all recognise the necessity of a new market design, but the debate over which new design to adopt is far from consensual: some focus on decreasing the cost of RES deployment through competition for long-term contracts, some extol the virtues of engaging historically passive demand for system balancing, and some call for a stronger regional approach to market design and policy making.

How should we think about such seemingly eclectic proposals? How should we approach the problem of electricity market design given the complexity of electricity markets and their interdependence with other government energy policies? We contend that the answer to these questions is to be found through holistic integrated thinking that seeks to understand and align both *horizontal* relationships among coordination modules of broadly defined market design (from wholesale market, retail market, market coupling, to network regulation), and *vertical* relationships among levels of coordination in the power sector (from macro-level policy making, to the micro-level design of policy instruments and markets)

In this paper, we propose a seven-step, condition-dependent evolutionary design, which integrates elements from many existing market design proposals. We arrive at our recommendations by combining the partial and non-mutually exclusive solutions that have already been voiced, assembling them into an integrated whole, so that they collectively address the market design misalignments that we have identified. Unlike proposals that champion revolutionary re-design of the power market, our recommendations, informed by system thinking, are based on evolutionary changes.

Our proposals reflect the gradual relocation of dispatch decisions closer to real time, the increasing use of long-term contracts as a risk-sharing mechanism between investors and consumers, and the provision of electricity services by an increasing range of market participants. The steps are sequenced such that earlier reforms may create the conditions required for later reforms.

1. Award RES subsidy and capacity payment as long-term contracts via competitive auctions, with payment based on capacity rather than on production;
2. Investigate the benefits of further spatial differentiation for energy markets (optional adoption);
3. Include more participants in the wholesale markets:
    a. Refine post-day-ahead energy markets to improve liquidity, partially by enabling cross-border, storage, and large demand-side participation;
    b. Place balancing responsibilities on RES generators, once short-term market liquidity is adequate so that RES generators can easily access and supply balancing services;
4. Graduate RES technology from capacity-based RES subsidy to the technology neutral capacity market, once the level of support needed for the said RES technology is of comparable level to conventional capacity;



5. Re-align retail tariffs with underlying costs:
    a. Implement innovation-oriented distribution network regulation to provide enabling monitoring and control infrastructure and refine special differentiation (if necessary);
    b. Recover network tariff and other capacity-based cost based on demand contribution to peak-coincident capacity;
6. Bridge wholesale and retail market by enabling distributed demand-end participation via aggregators or smart equipment;
7. Remove distributed RES support scheme.

In order to operationalise the integrated market design approach that we recommend, we prototype a 'module-and-level' framework to facilitate the discussion of market/non-market coordination modules at both national and EU level. We use this framework to systematically identify misalignments that exist between components of current market design and physical RES integration/financial RES support schemes. In parallel, we have identified five key trends which have implications for the future of coordination in the power sector (deployment of RES, electrification of other sectors, deployment of storage, smart grid, and supergrid) and have developed four explorative scenarios, each embodying a plausible combination of these forces (centralised, decentralised, early hybrid, and late hybrid). Our central design scenario is a hybrid future, where distributed energy resources coexist with centralised generation, while decentralised market participants trade with each other and with incumbents.

The debate on electricity market design in the EU, in addition to the fitness-for-purpose of existing market design, has also extended to the appropriateness of energy policy that underpins the existing market design, and on the process through which energy policy is coordinated with market design. Therefore, in addition to our market design recommendations, we clarify the dynamic relationship between energy policy objectives and present our understanding of the role of electricity market design as part of overall energy policy.

Energy policy objectives (decarbonisation, security, and affordability/competitiveness), while conflicting in the short term (given the lack of complementarity between low-carbon technologies and the pre-existing socio-technical regime of the power sector), have the potential to be synergistic if low-carbon technologies and the coordination mechanism in the power sector mutually adapt to each other.

The design of electricity market is one among a wide range of policy instruments that can be used to encourage innovation compatible with decarbonisation, a long-term vision for societal transformation. The market design process does not exist in isolation, it is embedded within macro-level policies and interacts with the design of other micro-level policy instruments. Therefore, we argue that participants in the market design process need to be aware of developments in the neighbouring niche-protected innovation processes, so that unjustified barriers do not prevent market participation by technologies emerging from niches. Also, the design of demand-pull policy instruments (like the strategic deployment of RES via support schemes intended to work in conjunction with market competition) needs to be considered within the scope of market design. It is necessary that they are proposed and evaluated alongside changes to other components of market design, instead of being designed in isolation.