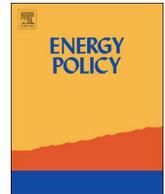


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Editorial

Special section: Towards hybrid market regimes in the power sector

The context and the policy objective guiding the liberalisation of the electricity industry have changed significantly over recent decades. Policy priorities in favour of decarbonisation and maintaining security of supply have taken centre stage on the policy agenda in many countries. The emergence of new decentralised and variable technologies and the change toward fixed cost technologies have profound implications for market dynamics.

Yet the design of liberalised electricity markets has largely failed to evolve and be reconciled with these changes as well as with policy objectives. As a result the initial “energy market” model is being questioned and a number of reforms have been implemented around the world.

The Chaire European Electricity Markets (CEEM) organised a conference at the Université Paris-Dauphine University in July 2015 in order to improve our understanding of the evolution required for electricity markets to satisfy the competing objectives of sustainability, security of supply and competitiveness, and to adapt to other changes including new technologies and change in the industry cost structure. For two days, leading scholars from Europe and the Americas discussed the issues raised by market failures and the short-comings of the initial “target model” market design.

One of the key issues that emerged from the discussion is the question of the ability of market price signals to generate sufficient and adequate (i.e. in the optimal generation mix) investment, given the series of market and regulatory imperfections that prevail in current electricity markets, and the many types of policy interventions. Despite a great variety of points of view on specific issues, a consensus emerged that adding ad hoc “patches” to energy-only markets to address some market or regulatory failures and/or support some technologies is not a sustainable option.

Reconciling public policy objectives and free price formation in electricity markets requires the theorisation and implementation of “hybrid market” regimes capable of reconciling public policy objectives and free price formation in a comprehensive and forward-looking fashion. The five articles in this special section all cover different aspects of these “hybrid market” regimes in order to respond to the issues raised by tensions between initial objectives of market liberalisation and the long-term policies goals of decarbonisation whilst maintaining security of supply.

Since the liberalisation of the electricity industry in the 1990s in OECD countries, the underlying policy objectives have changed. The objective of the initial reforms was to improve the efficiency of the electricity industry which was then organised around public- or private vertically integrated monopolies. The rise of information technology and combined cycle gas turbines (CCGT) enabled fragmentation of the value chain possible and the introduction of competition in retail and production activities. In the European Union, the liberalisation was also driven by the objective of creating an internal integrated market as the networks were sufficiently developed to facilitate competition between various producers on a large territorial scale. Investment was facilitated by the low capital-intensive profile of CCGT, and there was not much focus on security of supply as often most markets were in an overcapacity situation.

In this context, the main focus of the initial reforms was on the efficient functioning of energy markets and the extension of retail competition in industrialized countries with mature demand. The experience in some developing countries with significant growth of demand and need for new investment in the early 2000s casted some doubts on the ability of energy markets to provide timely and efficient investment incentives. This led a number of Latin American countries, for instance, to reform the initial market designs and adopt capacity remuneration mechanisms (CRM) and/or auctions for long term contracts to shift risks to consumers.

Since the mid-2000s, new long term policy priorities have emerged in Europe and the US, as well as in other OECD countries: the decarbonisation of the electricity industry and security of supply. This has profound implications for the functioning and optimal design of electricity markets. Priority is given to investing in RES and low-carbon technologies and in peaking units and back-up technologies, whose share of CAPEX per MWh in the cost structure is high, casting a new light on the relationship between market design and the need to allocate risks efficiently in order to minimize financing costs. The use of long term arrangements – feed in tariffs (FITs), fee-in-premium (FIPs), and contracts for difference (CfDs) – to promote variable RES has enabled large-scale deployment of RES production with low variable cost.

But as a result, the investment and coordination signals by market prices have been largely undermined, which raises a number of questions regarding the ability of the current market design to provide adequate operational and investment incentives. For this reason the market architectures of electricity markets must evolve and a number of countries have embarked on wide ranging reforms of their electricity markets. The energy, reserves and ancillary markets need to be improved to provide better scarcity signals in the short term, whilst mechanisms need to be introduced to facilitate risk transfers and provide long term signals to investors. Downstream, electricity demand must be made more price-responsive to facilitate hourly adjustments and physical supply-demand equilibrium. On the grid side, price signals are needed which better indicate supply constraints in order to provide locational signals to new resources, and changes in the regulation of network tariffs are needed to facilitate their transformation into smart grids.

In the conclusion of the workshop, the overarching question that remained was whether the different reforms point toward a common direction and reveal a structural mutation of the market regime of the power industry. Indeed we observe a great variety of reforms in response to regulatory

imperfections and market failures that characterize current market architectures. For the time being, it appears that a coherent consensus model of comprehensive market design for emerging and advanced economies is still outstanding.

1. The contributions in this special section

During the conference, a large spectrum of issues was covered. These included short term issues such as the effects of increasing shares of variable renewable energy (VRE) on energy markets and the need for operational flexibility, as well as long term issues such as investment and large scale deployment of low carbon technologies, the impact of VREs on security of supply, and the lack of appropriate locational signals to electricity markets investors and operators, as well as the increasingly important roles of demand response and distribution grids in the integration of decentralised production.

This Special Section gathers some of the key contributions to the Conference, which deal with the upstream issues of the electricity system. The papers cover the issues associated with risk allocation and coordination of electricity market participants through price signals for dispatching and investment in generation. The first three papers deal with changes in market designs (capacity mechanisms, long-term arrangements for risk transfer, and reform of support for variable renewables) intended to address some of the well documented market failures. The other two papers explain these changes in market design with an institutional approach and conceptualize the shift towards a hybrid market regime.

The issues related to the downstream of the electricity system are voluntarily left out of this special issue, as the research presented at the conference on these issues did not seem to be as mature and consensual as the research on the upstream part of the value chain. In future, a myriad of changes could coalesce into new business models and bring about new types of market players in different domains, in particular at the end of the value chain: aggregators of RES generation or demand response, decentralised storage, prosumer collectives, etc. For now, however, these changes remain at too early a stage to imply a “change of paradigm”. While there is a clear possibility, there is also no guarantee that this change will happen. At the present stage, the mutation of the market appears more mature upstream.

This special section presents two original features compared to recent special issues of *The Energy Journal* and *Energy Policy*, which deal with changes in electricity systems and markets resulting from the RES promotion policies.¹ First, it covers market and regulatory imperfections that arise independently from the introduction of renewables in electricity markets, even though the latter's impact is fully recognised. Second, it includes papers that adopt a comprehensive approach to the changes resulting from the attempt to amend the market design and the new policy priorities towards long term objectives such as decarbonisation and security of supply. In particular two papers attempt to conceptualize and explain the shift towards a new hybrid market regime that consciously integrates the contributions of decentralised market actors and centralised coordination in a coherently conceptualised notion of hybrid markets.

2. Overview of the contributions to the special issue

The first three papers deal with market and regulatory imperfections in the market and point toward some of the key elements characterizing the new hybrid market. The first paper studies the limitations of the long-term price signal in the presence of non-convexities. The second paper focuses on rationales for capacity remuneration mechanisms (CRMs) as indispensable complements to the energy market at the current stage of development. The third paper studies the conditions for social efficiency in the use of contracts for difference (CfD), reliability options and CRMs. These normative papers are followed by two institutional papers investigating the trajectory of the necessary evolution of electricity market regimes given the structural tension between the policy objectives of competitiveness, security of supply (reliability) and sustainability (decarbonisation). The first of these papers develops an institutional framework to conceptualize the different elements of hybrid market regimes, while the second provides a review of recent developments by drawing on the UK and Irish market reforms.

1. Miguel Vasquez, Michele Hallack and Carlos Vasquez² discuss the limitation of price signals for long term decisions, given the problem of electricity price definition which is raised in the presence of non-convexities, in particular binary start-up decisions. Short term electricity price setting rules and their long term implications are a highly topical issue, given the large and increasing impact of significant shares of variable renewables on price formation and the relevance of non-convexities due to the permanent adaptation of the conventional equipment that is required by the variability of VREs. Starting from possible pricing regimes that allow for side payments in a short-term setting, the paper then proposes various pricing schemes that contain additional criteria to define the right long term signals, including the opportunity costs for energy pricing. As the authors underline, there exist solutions such as the complex bidding offers on the former British pool or the PJM market in the US or capacity mechanisms that complement the revenues from energy markets to trigger investment decision in conventional technologies. Ultimately, the paper provides insights into the various pricing models considered in the specialised literature and thus promotes the debate over the methods and objectives that can be pursued by market designers and operators.

2. Jan-Horst Keppler's paper³ is a building block in the argument in favour of capacity remuneration mechanisms (CRM) versus scarcity pricing, a debate which has been particularly intensive in the European Union during the 2015–2016 discussion on the new Directive for the design of the power market. Challenging the belief in the efficiency of the energy market price signals with scarcity pricing (VOLL pricing) in order to guarantee reliability of supply, this paper provides some conceptual guidance on the rationale for adopting CRMs, which are eyed with suspicion by a profession wedded to the theoretical benchmark model. The profession tends to ignore the two market failures that make CRMs the practically appropriate and theoretically justified policy response to capacity issues. First, energy-only markets fail to internalise security-of-supply (SOS) externalities as involuntary curbs on demand under scarcity pricing generate social costs beyond the private non-consumption of electricity. Second, when demand is inelastic and the potential capacity additions are discretely sized, investors will underinvest at the margin rather than overinvest. These two explanations distinguish themselves from the usual explanations in terms of “missing money” resulting from regulatory imperfections such as price caps and imperfect or incomplete markets that would not allow consumers to express their *private* willingness to pay for security of supply. The paper concludes with some consideration regarding the design of CRM, which must include voluntary demand response programs as a way to internalise security of supply externalities and to align private and social preferences for security of supply..

¹ The special issue of *The Energy Journal*, co-edited by Bollino and Madlener (2016, Volume 37) entitled “High Shares of Renewable Energy Sources and Need for Electricity Market Reform”, with sixteen papers, and the special issue of *Energy Policy* entitled “European Union: Markets and Regulators” coordinated by Costa-Campi et al., 2016.

² Paper entitled “Price computation in electricity auctions with complex rules: An analysis of investment signals”.

³ Paper entitled “Rationales for capacity remuneration mechanisms: Security of supply externalities and asymmetric investment incentives”.

3. Andreas Ehrenmann, Gauthier de Maere d'Aertrycke and Yves Smeers⁴ consider the issue of investment decisions in market designs including capacity remuneration mechanisms by integrating the risk faced by decision-makers in a formalized approach that combines a long-term market equilibrium approach and investment modelling with techniques stemming from the finance literature. This yields a fresh perspective because the current literature on market failures regarding investment in liberalised markets is focused more on reduced investment incentives due to market power or price caps, and less on the high risks for investors in those markets. Long-term contracts and capacity remuneration mechanisms can indeed reduce those risks and accelerate capital cost recovery. The objective of the paper is to demonstrate that remedies to market failures such as long-term contracts, CfDs or reliability options as well as capacity remuneration mechanisms can be assessed by a framework combining stochastic equilibrium modelling with risk management criteria. The main result is that almost all of these instruments require liquidity levels that are unlikely to be met in current markets. If liquidity cannot be provided in each case, as is currently the case, the value of such long-contracts in terms of social welfare is strongly diminished. Capacity markets can serve as an alternative to long-term contracts, but also do not significantly improve welfare if liquidity is limited. The paper concludes by interpreting the respective results for the three mechanisms in terms of the hurdle rate implied by the different risk-management solutions.

4. Fabien Roques and Dominique Finon⁵ develop an institutionalist analysis of the ongoing mutation of the electricity market regime. The emergence of policy interventionism in electricity markets raises questions as to how market design can best be adapted to meeting the investment challenge associated with security of supply and decarbonisation objectives. The move from the market regime towards a hybrid regime, which relies on a combination of planning, long-term risk sharing arrangements and improved market signals for short-term coordination, appears to be unavoidable where economic growth necessitates significant development of generation capacities and/or where ambitious decarbonisation policies are adopted. The paper introduces a framework to analyse the role and interactions of the different “modules” or building blocks of the historical market regime. They then show that current reforms lead to the addition of new modules, required to achieve long-term policy objectives, which destabilise the functioning of the modules of the initial market design. The paper reviews a number of international experiences with reforms introducing such hybrid regimes. Whilst there is a wide range of approaches in different countries, the paper identifies some key recurrent elements which characterise a new hybrid regime of the electricity sector that structurally integrates security of supply and decarbonisation objectives. The key changes are the introduction of long term risk sharing and coordination mechanisms and improvements in short-term price signals through the reform of intra-day, real time and reserve markets.

5. David Newbery⁶ illustrates the current evolution of the electricity market regime towards a hybrid market regime to overcome the tensions between sustainability, security of supply and competitiveness, while at the same time maintaining market competition as the principal allocation mechanism. Focus is on the UK electricity market reform which explicitly strives to go beyond the EU energy-only target model for the electricity sector; it is considered impossible to deliver these three conflicting objectives through a short term market price signal alone. In the UK, capacity auctions with long-term contracts for new entrants are considered the least-cost solution compared to relying on expectations of future prices to deliver an adequate generation and demand side response. The UK combines these with feed-in tariffs (FITs) for small scale renewables, while the EU is pressing for feed-in premiums (FIPs). This paper also draws on the UK's experience to highlight the problems that have arisen between the diagnosis of the problem and the delivery of solutions. It sets out the theory and practice of delivering low carbon capacity, and security of supply via the auctioning of long term contracts both for large-sized low carbon and RES technology as well as through a capacity remuneration mechanism that allocates long term capacity contracts for new units. While the auctions provide sufficient incentives to reveal information on the anticipated costs of developing capacity, problems may appear with respect to monitoring the capacity auctioned by the regulator. Some reliability risk may be unavoidable in the present system. In Ireland, reforms illustrate the problem and possible answer of how best to deliver security of supply with high shares of intermittent renewables by transforming the system from capacity payments to reliability auctions. Moreover, the new market design also aims at remunerating system services and ancillary services (seven different system service products are indeed recognised) to help develop the supply of such services through auctions that would provide long-term contracts for new installations. Both cases are presented in contrast with the EU energy trilemma and highlight the difficulty of current EU energy policy to integrate long-term concerns adequately.

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⁵ Paper entitled “Adapting Electricity Markets to Security of Supply and Decarbonisation Objectives: toward a hybrid regime”.

⁶ Paper entitled “Tales of Two Islands: lessons for EU energy policy from electricity market reforms in Britain and Ireland”.