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LAW & ECONOMICS PERSPECTIVES ON ELECTRICITY REGULATION

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Abstract

This paper first reviews some of the main contributions of the new institutional economics to the analysis of the process of competitive transformation of network industries. It shows that neo-institutional analysis is complementary to the microeconomics of rational pricing, since it accounts for the decisive role of an institutional framework adapted to new transactions. It emphasizes the importance of the political reform process, which draws on the conditions of attractiveness and feasibility to define an initial reorganization of property rights in these industries. The paper then analyzes in this light some of the main challenges ahead for electricity regulation: the question of investment in generation capacities and the link to long term contracts, the regulation of wholesale market power, the support to Renewable Energy Sources for Electricity (RES-E) and the design of new regulatory authorities.

Keywords

Electricity Markets, New Institutional Economics, Law & Economics

I Introduction[*]

Until the late 1970s, the organization of electricity markets around the world was largely characterized by natural monopolies integrated both horizontally and vertically. This traditional organization was based on the full integration of generation and transport activities, in general completed by a monopoly in retail supply at the local or regional level with regulated prices. The shift of regulatory regimes towards market-based competition has been widely discussed (Armstrong, Cowan and Vickers, 1994; Crew and Kleindorfer, 1986) and largely implies, if not a retreat, at least a redefinition of the role of the state and its tools for action (Jamasb, 2006). The technological specificities of the electricity industry largely explained the recourse in the former period to both horizontal and vertical integration. The technical needs to coordinate each and every step of the value chain and the alleged natural monopoly characteristics of electricity transmission and distribution networks concurred to justify an organization of electricity activities within centralized firms holding an exclusive right to supply. Technology did not allow for the measurement and allocation of costs and benefits among different trading partners at reasonable costs, which *de facto* justified internalizing transactions within unified entities. This is thus the transactional complexity of electricity trade which for decades led to the organization of power transactions internally and to the centralization of decision making within integrated monopoly, administratively regulated by the state under sector-specific rules (Hunt, 2002).

This model had obvious strengths and weaknesses. On the one hand, it facilitated investment in high-fixed costs technologies and ensured security of supply, though at a hidden cost for society (Stern, 2004). Risk allocation for producers was facilitated by cost of service regulation which allowed utilities to pass on costs and risks to captive customers. The financing of projects was structured under debt financing, often with a state guarantee, which ensured low risk premiums. On the other hand, the model provided few incentives to improve production efficiency within the centralized entity and tended to slow down adaptation in phases of mature demand or rapid technological change (Joskow, 1991). Performances in terms of production costs were also highly heterogeneous (Joskow, 1989). The regulation of energy industries was in general largely determined by political or societal goals, easily financed under public ownership (Joskow, 2008). Several studies showed how governments in the name of the 'general interest' pursued political goals by targeting aids to specific groups of customers without any analytical background and showed that there was a general bias towards investing in the most capital intensive technologies (Finon and Perez, 2008). These weaknesses incrementally eroded the consensus around the political and economic justifications of the former industrial organization of power markets. In parallel, the general slowdown of demand growth in developed countries, by shifting the focus of regulation from investment to efficiency, constituted another driver of reform.

In parallel to the increasing awareness of the shortcomings of the monopolistic model, the academic community started to address the problem of the reform from a more theoretical perspective. From the early 1960s onwards, leading academics questioned the efficiency of administrative regulation and the alleged superiority of horizontally and vertically integrated firms in the provisions of electricity, telecommunications or airport services (Averch and Johnson, 1962; Demsetz, 1968). Ever since the early successes of liberalization in the last two sectors, the interest of the academic community in the deregulation of network industries, in particular for the electricity industry, has been vivid and a wide consensus around the introduction of market forces where possible has emerged. In retrospect, it appears however that some of the expectations have failed to realize and that the regulation of electricity markets remains a major challenge all over the world.

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This paper has therefore a dual ambition. It will first review the evolution of the economic theory of competitive reforms in network industries and in the electricity sector, focusing on the contribution of the new institutional economics. The new institutional economics are of interest for law & economics scholars as it brings key insights to the design of an appropriate institutional framework. The paper will then review in this light some of the key challenges ahead for electricity regulation.

II Complementarities between the New Institutional Economics and the Standard Microeconomic Analysis of Network

Since the middle of the nineteenth century, economic theory has had a particular interest in the problems specific to industries with network monopolies. However, while microeconomics has extended the rationale for, and the foundations of, rational price setting, neo-institutional economics has revealed the centrality of the design of an adapted institutional framework for managing the competitive functioning of network industries. We here present these initial neo-institutional analyses and emphasize their complementarities to the standard microeconomic theory of networks.

II.A Microeconomic Theory of Rational Price Setting

For over a century, economic analysis persisted in defining the principal economic feature of network industries as being a "natural monopoly" and devised a rational solution in the form of optimal pricing of network use. The first microeconomic foundations for this theory of rational pricing appeared in France in the nineteenth century in the works of engineers building bridges and railways (cf. Jules Dupuit and Alfred Picard). This work was subsequently taken up at Cambridge UK by Alfred Marshall and Arthur Pigou (1920), then in the United States. During the 1930s, a second wave of theoretical renewal of this rational price setting was founded on the general equilibrium systems of Leon Walras and Vilfredo Pareto. And, driven by the work of economists like Harold Hotelling (1938), Maurice Allais (1943) and Abba Lerner (1944), these theoretical developments culminated in the famous recommendation that prices be set at marginal cost ($p = mc$). Throughout the 1960s and 1970s, at least two generations of economists learned this from the textbooks of Paul Samuelson (1979). Finally, more recently a third generation has emerged, notably represented by Jean-Jacques Laffont and Jean Tirole (1993 and 2000), who have redefined the economic foundations of rational price setting on the basis of incentive theory. Concurrently, in the UK Stephen Littlechild (1983) introduced the concept of a price cap as an innovation applicable to the deregulation of telecoms. Shortly thereafter, he became the first regulator in the world to implement this innovation in the electricity industry.

Thus, for over one hundred years, from the middle of the nineteenth century until the 1970s, a broad theoretical consensus bound rational price setting in infrastructure monopolies to the very core of microeconomic analysis of the functioning of markets. This standard approach to regulating network industries was not subject to significant theoretical challenges.[1] At Cambridge UK, after introducing the notion of externality in 1920, Arthur Pigou could have pursued the matter of institutional innovation, but neglected to do so. All of the solutions he proposed (taxes, standards, public ownership) derive from the only institutional innovation he retained from the war effort of the First World War: the government is an alternative to the market in the "voluntary" administration of economic resources. In practice, externalities can be internalized in the price system by a tax, which later came to be called a "*Pigouvian tax*." Pigou did not devote any attention to alternative institutional forms, which could provide different solutions to various forms of market failure—of which he deemed natural monopoly and externalities to be the most significant. The "*Welfare Economics*" he

[1] That is, aside from those brought during two phases of internal renewal of the microeconomic theory of markets.

founded at the beginning of the twentieth century are thus nothing other than the economics of the "*Welfare State*."

However, starting in the 1930s and on several occasions over some forty years, a handful of economists (later designated "*institutionalists*") contested the conclusions and/or premises of the standard reasoning with respect to regulated network industries. To these "institutionalists," the rules of the game that intervene, or that should intervene, in the normal functioning of regulated network industries are much more varied than only rational price setting policy. Also, the economic nature of these rules of the game often differs from the simple promulgation of a price.

II.B Institutional Economics and the Reform of Network Industries

In 1937, the today most famous "institutional" and "Law and Economic" author, Ronald Coase, questioned that prices are freely delivered to economic agents and, instead, advanced the hypothesis that prices are generated from market activity. Thus, these prices themselves had a cost: the cost of producing and disseminating market prices. Moreover, these market prices can only play a limited role in the coordination of behaviour within a firm in which "fiat" authority - an alternative mode of coordination - prevails. Ten years later, when the most distinguished economists in the UK recommended nationalizing all monopolies, claiming they could easily manage them with marginal pricing, it is no surprise that Ronald Coase (1946) publicly expressed his dissent. In the language that came to be his trademark, we can say that Coase did not believe it possible to use "*blackboard economics*" to create an optimal pricing system allowing all nationalized firms to be managed efficiently while rendering useless any recourse to real markets for framing real transactions.

Approximately one decade later, Coase (1959) contributed another family of analytical tools to his deconstruction-reconstruction approach to the regulated market. It is not, he claimed on radio frequencies, the fact that they are by nature public goods that makes it so difficult to allocate them by an ordinary market for means of production. It was rather because the government regulation that was in effect did not seek to create the property rights required for the normal functioning of a normal market. In a similar vein, Coase (1960 and 1974) contested another pillar of the welfare microeconomics of Pigou and Samuelson. Granted, the existence of negative externalities in production or consumption gives rise to failure in the system of market prices. However, this does not necessarily imply that government intervention is preferable to private bargaining for managing externalities as the pigouvian's Nirvana Economics too simply assumes. In particular, in the absence of any private bargaining, how would the public authority be able to effectively compare the real economic value of various benefits and damages caused by externalities with the probable economic value of the various alternative remedies proposed?[2]

This contestation of the traditional institutional framework of government regulation reached a zenith toward the end of the 1960s, following in the wake of Coase (1960), with the proposal advanced by Harold Demsetz (1968) to eliminate the agencies regulating network industries and replace them with a competitive mechanism for attributing licences for operating network monopolies. The rationale is striking in its simplicity. The best alternative to competition "*in*" the market is competition "*for*" the market. If the core problem of network markets is truly the monopoly pricing of their services, then why rely on governmental bureaucracy to tackle this issue in a clumsy and suspect fashion? There exist dynamic competitive auction methods to identify the lowest responsible bidder and provide the service at the best possible price.

Then, the middle of the 1970s saw the arrival of a second wave of institutional analysis (notably Victor Goldberg, 1976 and Oliver Williamson, 1976), which both completed and shed some perspective on the first wave of institutional contestation. First, these two authors underlined that some

[2] For example, indemnification, buyback, unilateral protection, and technological innovation.

of the critical dimensions of the services rendered by network industries may go beyond price setting. Other useful characteristics may be as important as the price, such as the quality of service, the localization of the service, its temporal-seasonal profile, the range and scope of options and potential for individualization, reactions to unforeseen randomness, etc.

In these cases, *ex ante* price setting does not eliminate the need for complex contracting *ex ante* and providing for appropriate controls *ex post*. In many other non-monopolistic, industries the interplay of competition between producers and pressure from consumers provides the context in which transactions occur. However, in network industries, how could a periodic opening to competition, in the form of an *ex ante* competition on prices, substitute *ex post* for competition between producers and pressure from consumers? Outside of the mechanisms of competitive auctions, can consumers really contract *ex ante* with potential producers for non-price characteristics of future services, and then control and enforce compliance with these contractual service commitments *ex post*? We can well believe that some very large consumers may own both the means to contract *ex ante* and the control and reaction structures *ex post*. However, it is more realistic to assume that, for most consumers, this type of bilateral structure governing their transactions with network industries has little chance of spontaneously emerging from the free interplay of market forces. In this case, the rationale of transaction governance suggests a multilateral type of structure, in which large groups of consumers are represented by their "contracting agents." This amounts to creating collective contracting agencies for services rendered by network industries. We are led to the conclusion that the construction of a competitive mechanism *ex ante* is no substitute for the usefulness of an *ex post* regulatory structure with complex service contracts and in which the "*right to be served*" implies a real power to sanction *ex post*.

Finally, Douglass North (1990) developed a new branch of institutional analysis to characterize institutional environments. In the "Samuelsonian" post-Keynesian world, the real and precise characteristics of society's general institutions were overlooked in economic analysis. We would, after all, be inclined to believe that open and democratic societies will have developed institutions that are at least reasonably competent, if not nearly perfect, to guarantee the efficient functioning of public economics and markets. In North's universe, we should start from the other corner: institutions are what they are … nothing more. Also, there are not necessarily any "ready to use" solutions for creating a complete block of perfect institutions starting from the real world as we know it. Nor should we conclude that all existing public institutions have taken a solemn "public choice"-type oath to thwart all manifestations of economic efficiency in all markets. The institutions that actually exist must thus be rationally assessed for the effective capacity to efficiently guide the exact policies we expect.

However, in keeping with the work of North (1990), Aoki (2001), Barzel (2001), and Greif (2006), the characteristics that are truly important in the existing institutions are not easily renegotiable in the short or medium term. These real characteristics of existing institutions thus appear as true constraints on the agents when they need to make decisions, elaborate strategies, and interact. Thus, examining relationships between institutional environments such as they are, as we find in North and in Williamson's "institutions of economics" (1985: *Firms, Markets, Relational Contracting*) becomes a milestone of the analyses of network industry reforms.

III Institutional Dimensions of Competitive Reforms

Thus, the institutional analysis of the reforms in network industries is complementary to standard analysis. Clearly, institutional analysis recognizes that pricing and markets play a key role in these industries, whatever they may be. Combined with standard analysis, institutional analysis splits the study of network industry reform into five segments, which can be separated and then recombined.

1. If network industries were solely sources of monopoly rents, then the simplest policy for dismantling a monopoly should be favoured: directly open the markets wherever possible, set rational prices where that strategy is inadequate.
2. If, in fact, highly protective industrial structures (vertical, horizontal, or spatial) shield these industries and make them unresponsive to governance by the market, it becomes necessary to order divestiture, either prior to or after the reforms.
3. If these industries have become immune to market forces because of a poor initial configuration of agents' property rights, it becomes vital to create institutional market infrastructures by reconstituting these rights (definition, allocation, and protection). This is the central argument in the analysis developed by Barzel and North on the role of institutions and inter-individual agreements. Specifically, problems with measuring and enforcing property rights (Barzel, 1989; North, 1990; Libecap, 2002) are at the core of the analysis.
4. If network industries are highly unresponsive to governance by the market owing to the nature of their transactions, it becomes necessary to construe a governance structure that is adapted (bilateral, multilateral, or trilateral with a "third party") and / or a voluntary action for modifying the specificity of these transactions (like with network interconnection and interoperability policies; cf. Glachant, 2002).
5. Nonetheless, if governance by the market or governance by a third party is hampered by existing institutional environments, then competitive reforms are confronted with an entirely new problem: institutional change.

III.A The Problem of Private Interests

The abusive monopoly is a priori the simplest case for economic "blackboard" analysis, since it is sufficient to eliminate the monopolization of the rent to provide an incentive for market forces to flourish. The main practical problem in conducting this type of public intervention is that it requires the constitution of coalitions that actively support policies to dismantle the monopoly against those interest groups that have traditionally benefited from it (Stigler, 1971; Peltzman, 1976; World Bank, 1995). To the extent that public government intervention is inspired by interest group coalitions that are opposed to other coalitions of interest groups, the future, potentially competitive, market is not necessarily a major force in the political economy of the reforms, *a priori*. Thus, as a team of researchers from the World Bank (1995) observes "*The reform can cost a government a support base, because reforms almost invariably involve eliminating jobs and cutting long-established subsidies* (p. 10)."

Some of the interest groups benefiting from the status quo may have been traditional targets of government policy for a long time. The best known of these policies are the European "*public service*" policies, guaranteeing certain social, territorial, or usage groups access to services at a price comprising many transfers and cross-subsidies. Direct challenges to these perks by the government officers may prove very difficult, sometimes even impossible (Margaret Thatcher was unable to deregulate the Post Office). Gomez-Ibanez (2003) has shown that, in developing countries, a reform will only be sustainable if it allows for just treatment of the interests of investors and consumers. This practical difficulty is not trivial from an analytical perspective, and institutional analysis characterizes

it with the notion of "*attractiveness of the reforms*" (World Bank, 1995). If no robust coalition of interests is built, the reforming pressure may dissipate before materializing or, after it is launched, become bogged down in the tortuous meanders of practical application. If the pro-reform coalition is not sufficiently solid, it could become necessary to exempt a substantial proportion of the vested interests in order to facilitate the launch of the changes. Thus, according to Moravcsik (1993 and 1994), it is in the interest of European governments to leave the responsibility of public service reforms in the hands of the European Commission, to the extent that these industries are too entrenched on the domestic socio-political scene. Some national reform policies have thus remained incomplete - in the sense of traditional economic theory - and are quite different from one country to the next, or from one industry to the next, or from one period to the next, when they fared poorly on the attractiveness test.

III.B The Problem of Political Window of Opportunity

Network industries may be unresponsive to governance by the market because they have built protective industrial structures over time. These may take the form of vertical, horizontal, or spatial (over contiguous zones of operation, sometimes smaller than the national territory) concentrations. These cases of industrial structures that are unsuited to market interactions may only be a particular form of monopolization, with the same dimensions in terms of attractiveness of the reforms, coalitions "for" and "against," and compromises making it possible to begin even when the initial conditions are less than ideal. This process is described by Spiller and Tommasi (2003):

> "Public policies and their features are determined by the functioning of political institutions such as Congress, the bureaucracy, and interjuridictional relations. (…). The working of the political system (i.e. the rules of the policy making game) constitute here the equivalent of the 'institutional environment' in Williamson (1996). (…). Assume that the political game starts with a period in which players can make some agreements. This period captures the notion 'contracting moment,' a time when the parties reach an understanding about how they will restrict their action in the future."

According to these authors, the nature of public intervention will depend on the preliminary distribution of power across the various political and administrative institutions. This *ex ante* distribution of "rights to the reforms" is conceptualized as a game, the rules of which depend on the institutional environment (constitution, electoral rules, the effective functioning of the legislative and executive powers, etc.). At the beginning, the "contracting moment," political actors fix limits on their own actions in the following periods.

Therefore, we understand that direct action on industrial structures prior to the reforms poses a quandary for public policy. *A priori*, public authorities (government, legislators, regulators, competition authorities) have access to a much broader slate of tools for modifying legislation and regulation than for overturning the organization of the ownership of industrial and commercial assets. There are few political and legal levers for fundamentally restructuring an incumbent, often very capital-intensive, industry around a competitive paradigm that will disrupt the financial and asset value of its industrial and commercial base. The government itself is rarely able to fully achieve the competitive restructurings of its own asset base. Even the UK was unable to escape that principle, and privatized British Gas as a monopoly and electricity as a duopoly, etc.

In practice, therefore, the "industrial restructuring" phase of these reforms is the Achilles' heel of these policies. We saw this in the pioneering countries, the UK and the United States, but also throughout the European Union. In many cases, during the initial phase of the reforms, implementation of industrial restructuring is intentionally diluted to limit domestic opposition. Subsequently, after a market of some kind has begun to operate between the operators in the sector, it can be difficult to resume industrial restructuring at the expense of stockholders. Nonetheless, in practice many reforms strive to spread the magnitude of the desired changes over time and proceed in a progressive, sequential, and "modular" fashion. For example, European telecoms were initially

deregulated at the terminals, then in professional services, then in the long distance and cell phone service and their new infrastructures, and finally in the old infrastructure of the local loop.

Competitive reform policies can also be implemented over transition periods that may last as long as a decade or two. Thus, the first European Directive on the "internal energy market" was enacted in 1996. Its mission was to initiate the opening of the electricity and gas sectors. Seven years later, the second Directive of 2003 aimed at harmonizing the Member States' reforms. At last, the Third Directive entered into force in March 2011 with the objective to effectively create a competitive single market.

The voluntary segmentation of the reforms into successive modules presupposes, at least implicitly, that this will not significantly affect the trajectory of the reforms as a whole. However, this has not been proven, either theoretically or empirically. In network industries in which the infrastructures are not easy to duplicate (railways and aviation; gas and electricity),[3] the most basic form of reform modularity is the institutional separation ("*unbundling*") of the operation of the network infrastructures from production-final sales (which may be the transportation of merchandise or passengers, or the provision of energy). This separation of the two activity types protects against the spectre of "foreclosure" of infant markets. However, decisions regarding major investments and technology choices must be coordinated over long periods between infrastructure operators and competitive entrepreneurs.

Finally, the content of the initial industrial restructuring may be objectively difficult to define at the beginning of the reforms, owing to the ignorance of the general architecture or of critical details about the design characteristic of the "maturity" of the reform. An initial leap into the unknown may subsequently produce all sorts of collisions between the various modules of the industry, or between its sequential components (examples abound from electricity in the UK and California). We have also found surprising offshoots, such as after-the-fact pressure for vertical or horizontal reintegration (Codognet et al., 2003), and even some re-nationalizations of European railways and electricity (Lévèque, 2006; Barquin et al., 2006).

The modular and sequential nature of the "big" competitive reforms of network industries is thus a recurring problem in institutional analysis. Notably, it is a matter of establishing how structures that are built *ex ante*, at the launch of the reforms, might interact *ex post* with an institutional design that has either never, or only very shortly, been in existence.

III.C Liberalization and the Initial Allocation of Property Rights

When it is not a matter of rapidly freeing up a potential market that is already bogged down with the industrial structures and rents that come with monopoly, another institutional problem arises. It becomes necessary to lay the groundwork for a new market in a milieu that has always been a stranger to all types of market relationships. For instance, electricity networks were not built to promote competition but technical reliability and mutual help, thus promoting competition in the use of these networks requires defining totally new property rights and enforcing them in a competitive way. Here, market failure is first and foremost endogenous which is deeply entrenched. For a market to emerge, first the institutional foundations must be laid, like creation of property rights, creation of public independent third party and finally creation of efficient enforcement mechanisms in and thanks to the local institutional endowment. Thus, the reform policy must explicitly address the market design, and not limit itself to "de-monopolizing" the traditional industry.

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[3] On the contrary, when infrastructures can be duplicated by new operators they often remain integrated with the other activities of the incumbent operators (notably in telecoms, but also in postal services, and, sometimes in aviation where airports are hubs of interconnections between companies and airlines.

In case of a lack of appropriate definitions, allocations, and protections of the agents' new property rights, they will be unable to engage in market relationships. This type of reasoning has become common in radio and television, where the attribution of radio waves is performed through auctions. This is also the case for the frequencies of new telephone services, such as UMTS. We know that this was not at all the case in 1959 when Coase discussed the role of the FCC as communications regulator. Today, in the world of telecoms, the Internet, and the digital economy, as innovation in processes and services accelerates, the creation of new "appropriate" rights becomes essential for developing all the new markets (Brousseau and Glachant, 2002). Here we may think, for example, of the configuration of the market for downloading music, which remains fragile in the absence of a better definition of the usage rights of the users.

To internalize the negative externalities of pollution from CO_2 emissions, the European Union recently introduced a system for allocating pollution rights that has become an international point of reference for the recourse to market mechanisms in a field that has traditionally fallen under the sphere of "pure" government policy (Boemare and Quirion, 2002; Buchner, Carraro and Ellerman, 2006). Similarly, to manage short-term externalities in the flows on electrical transmission grids, it is now possible to compute the economic value of congestion effects (at each minute) on each of the thousands of nodes on a grid covering a territory much larger than France and Germany. These computational techniques can be introduced into the conduct of 5 minute auctions per node on a wholesale market for commodities, as is currently the case in the United States in the electrical zones PJM (Pennsylvania-New Jersey-Maryland) or MidWest ISO. Now market operators can even hedge against random movements in "nodal" electricity prices on a parallel market for financial rights to the revenues from electricity transmission (*Financial Transmission Rights*, as in Joskow and Tirole, 2000).

IV The Agenda Ahead for the Regulation of Electricity Markets

In this section the objective is to highlight some of the core issues energy regulators still have to tackle in electricity markets, with a particular focus on the European Union. We will review in turn the question of investment in generation capacities and the link to long-term contracts, the regulation of wholesale market power and the support of Renewable Energy Sources for Electricity (RES-E).

IV.A Regulation of Wholesale Market Power

Looking back at the twenty years or so of liberalization experience, monitoring and mitigating wholesale market power has been one of the most intricate issues for energy regulators (and competition authorities) in liberalized electricity markets (Joskow, 2008). Problems of the wholesale market power have been particularly acute in the most de-integrated systems, as for instance during the California crisis in 2000-2002 (Borenstein, 2002; Borenstein, Bushnell and Wolak, 2002; Joskow and Kahn, 2002). Electricity markets are indeed naturally prone to wholesale market power (Borenstein, 2002). Generally, wholesale market power arises from (i) transmission constraints limiting the size of the market, (ii) import and export monopoly protecting dominant generators, (iii) excessive reliance on short-term trading, (iv) non-storability of the commodity and (v) lack of demand elasticity (Borenstein, 2002; Borenstein and Bushnell, 1999; Joskow, 1997). In addition, the market power mitigation devices implemented by regulators often have perverse effects, for instance on investment incentives in generation (Joskow, 2006; Joskow and Tirole, 2007).

Country and industrial segment specific studies[4], however, tend to show that implementing competitive reforms in the wholesale market may yield substantial benefits (Markiewicz, Rose and Wolfram, 2004). In particular, there is ample evidence that it leads to better generation performance, both in terms of plant availability and operational costs (Bushnell and Wolfram, 2005; Newbery and Pollitt, 1997). The British experience is probably the closest to the 'textbook' model (Green and Newbery, 1992; Newbery, 2006) and it is usually considered the "*golden standard*" for competitive reform in the wholesale market (Joskow, 2009). Substantial performance improvement in the pool, as well as reduction in market power, appeared when concentration in generation decreased (following new entry and divestiture by incumbent suppliers) and new institutional arrangements were created (the New Electricity Trading Arrangement replaced the pool) (Evans and Green, 2005). Argentina (Dyner, Arango and Larsen, 2006), Texas (Adib and Zarnikau, 2006), New Zealand (Bertram, 2006), Australia (Moran, 2006) and Scandinavia (Amundsen, Bergman and von der Fehr, 2006) also experienced performance benefits, though some problems remained here and there (e.g. in Texas). On the contrary, in countries where institutional arrangements have substantially departed from the standard prescription, strong performance problems have been reported, for instance in Japan (Goto and Yajima, 2006), much of the US (Joskow, 2006) and Brazil (Lizardo and Araujo, 2006). Most importantly, consistency between the different components of wholesale market reform and comprehensiveness are key parameters of success (Joskow, 2008). It is for instance ineffective to grant a legal right to industrial customers to choose suppliers if access to physical and commercial infrastructures (e.g. transmission network and power exchanges) is not ensured (Glachant, 2000).

In theory, a firm exercises market power when it is able to charge a price above marginal cost, i.e. the price under competitive conditions (Stoft, 2002). This simple definition however yields more questions than answers when it has to be applied by a regulator. In short, how to differentiate between the exercise of market power and legitimate premium given by the market throw scarcity rents (Fraser, 2003)? How to define a 'reference' market model in terms of product, geography and market design to which to compare the actual prices observed? Should we use the "Nirvana Economy" as a reference, hence a reference to marginal cost, or should we use oligopolistic market models working under imperfect market conditions? These questions must be addressed by competition authorities, for instance when they have to define relevant markets. The definition of relevant markets in electricity mainly depends on transmission constraints and/or the capacity of interconnectors between regions. Within congested zones, the relevant market can be very small and thus highly concentrated. As congestions evolve over time and space, opportunities for market power abuse evolves accordingly.

We can depict three basic forms of market power in electricity markets: vertical, horizontal and local. Vertical market power is exercised when a firm manipulates market prices by using assets controlled on two or more segments of the supply chain. This usually takes the form of predatory behaviours, cross-subsidies, entry barriers, etc. Glachant and Pignon (2005) have for instance showed that transmission owners vertically integrated in production are able to use internal congestion management, losses procurement and ancillary services to manipulate wholesale prices. In industries that had been vertically de-integrated by government, we observe strategic re-integration by mergers and acquisitions, minority investment with control rights or long-term contracts aiming at using vertical market power (Newbery, 2000).

Horizontal market power is exercised by a firm which only controls one segment of the supply chain. This firm can act on prices or quantities. Price strategies entail an individual or collective manipulation of prices by strategic bidding (Borenstein, Bushnell and Wolak, 2002; Sheffring, 2002; Wolfram, 1999). Collective price strategies take the form of collusive bidding behaviours. Strategies based on quantities usually entail straightforward withholding of capacities. The extent of market

[4] There have been a few comprehensive studies of the costs and benefits of electricity market liberalization to the exception of Newbery and Pollitt (1997) who find that if the social gains from liberalization have been substantial in the UK, they have mostly been pre-empted by suppliers.

power then depends on the availability of substitutes. We can define three broad categories of strategies based on quantity: (i) withholding of capacity to artificially create a scarcity rent (Newbery, 2000); (ii) withholding of capacity to distort the incentive schemes of other bidders (Wolak and Patrick, 1997); (iii) arbitrage between wholesale and balancing markets (Stoft, 2002).[5]

Lastly, local market power covers strategic behaviours aiming to take advantage of network externalities and constraints such as congestions and black-outs to manipulate spot prices and extort rents from market players liable to pay for these externalities (Joskow, 2000). The exercise of local market power is typical of electricity markets as it relies on network and power flow constraints. Certain producers are able to define the geographical pricing zone on which they bid by artificially creating congestions and frontier effects (Glachant and Pignon, 2005; Twomey et al., 2005). It is also the most complicated to tackle as it requires a precise understanding of network functioning and the law of physics.

In theory, indices of market power should be able to provide a quantitative assessment reflecting the ability to exercise market power for a given product (e.g. spot or forward) on a given geographical market. Several sorts of structural and behavioural indices as well as various simulation approaches have been used but they all present strengths and weaknesses (Twomey et al., 2005). The main structural indices include the well-known Herfindahl-Hirschmann Index (HHI), the Pivotal Supplier Indicator and the Residual Supply Indicator. They try to detect the *potential* for market power, whereas behavioural indicators try to examine actual business conduct by analyzing bid-cost margins and withholding of capacities.

There is a wide range of theoretical solutions to market power. We can classify them in three areas: structural, regulatory and market rules solutions (Twomey et al., 2005). Structural solutions include ordering divestiture of generation capacities held by dominant operators or removing barriers to entry such as discriminatory licensing procedures. A natural structural mitigation device is to ensure the timely development of the transmission network. This is true not only because the development of electricity trade tends to create network congestion, which in turn may limit the gains from trade and create room for market power abuse, but also because it may create network reliability problems for Transmission System Operators (TSOs) (Joskow, 2008). Investment in national and cross-border transmission lines is thus a key aspect to tackle wholesale market power. On the demand side, increasing demand response, for instance by the wide implementation of 'smart meters', is also a promising solution (Twomey et al., 2005).[6] Regulatory solutions include imposing price-caps, forced capacity selling by dominant generators at regulated prices or under long-term contracts. Long-term contracts may indeed limit the incentives of dominant operators to abuse their market power on the spot as increases in prices would only be profitable on the un-contracted part of their supplies, hence long-term contracts tend to increase traded volumes, especially when supplier concentration is low (Bushnell, 2007; Green, 1999; Willem and de Corte, 2008). Lastly, market rules solutions cover all behavioural regulations imposed on market players' decisions such as bidding restrictions.

The institutional design of market power monitoring also remains a major issue. Various units, often within the TSO, collect data and use these indices to monitor markets and re-evaluate the market designs implemented (Twomey et al., 2005). It is generally considered that market monitoring procedures should follow the following phases (Glachant, 2004): (i) establishing surveillance rules and allocating monitoring powers, (ii) collecting data, (iii) screening data to define cases of possible abuse,

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[5] Balancing markets are dedicated to the adjustment between the difference of supply and demand revealed in the day-ahead market and what happens in real time.

[6] Meters are digital devices which provide information on the amount of electricity that has been used between two points in time. Standard meters however do not provide customers with information about their consumption at different times of the day, e.g. night or peak period, where production costs vary. However, the so-called 'smart' meters can provide consumers with prices that vary with production throughout the day, which thus allows them to optimise consumption patterns.

(iv) analyzing possible occurrences of market powers in-depth, (v) mitigating and sanctioning, (vi) fixing market design rules.[7] This last step shows that ideally the market monitoring process should be forward-looking with a strong regulator willing to fix market design deficiencies. At last, the international experience with market monitoring has shown that independence of the market monitoring entity from the market players, from the system operator itself and the political process is crucial for success (Wolak, 2004).

IV.B The Question of Investment in Generation Capacities and Long-term Contracts

The problems of long-term generation adequacy and of the definition of an optimal fuel mix have gained considerable importance in the public policy debate in recent years, and even more so in recent months. The current financial crisis will indeed only slow down the long-term trend of rising world electricity demand but might significantly hamper investment decisions in the short term and lead to a supply crunch once the economy recovers. Overall, USD 1 trillion a year of investment worldwide would be needed by 2030 to meet consumer needs (Sicilia, 2009). The timing of investment decisions is therefore a key aspect, reinforced by the ageing of base load capacities (essentially coal and nuclear). The fulfilment of climate policy commitments might also require a massive wave of investment in high-fixed cost technologies such as Carbon Capture and Storage or nuclear. Investment in the next decade will thus be critical to a low-carbon future in the longer term.

In the early years of liberalization, regulation tended to limit vertical integration and long-term (supply) contracting in order to achieve fully de-integrated markets. In the UK for instance, constraints on vertical integration into generation by retailers was imposed.[8] In the US as well, regulators imposed stringent restrictions in some states on longer-term contracts to force market players to trade on organized spot and forward markets, which is due to increase liquidity and hence facilitate new entry (Joskow, 2007). California for instance ordered divestiture of generation assets and did not allow the signing of long-term contracts (either physical or financial) for a transitional period of 5 years, until the crisis in the years 2001-2002. This crisis marked a u-turn in the way both practitioners and academics thought about the role of long-term supply contracts in a decentralized market setting. The California crisis showed that beyond stable and coherent market rules, market players may need long-term contracts before committing to invest, at least as a complement to spot trading, and that long-term contracts also *de facto* limit possibility of market power abuse. It also showed that excessive retail competition may lead to the failure of the pure supplier model.

The reform of the Californian power market was much influenced by the British experience and although parts of wholesale and retail market designs differed to some extent, most basic features were retained (Joskow, 2008). Interpretations which have been advanced to explain the collapse of the Californian system are complementary and run as follows: first, the poor wholesale market design which in particular precluded forward contracting (markets were hourly and day-ahead) provided few incentives for investment in generation and thus led to a generation shortage (Sweeney, 2006). It must be noted that in the first years of restructuring, generation investments was generally low in much of the US, essentially due to the uncertainties on the path of restructuring and the constant changes in the rules of the game. California was thus no exception (Joskow, 2001). Second, the California system was a peaking summer system and too many generation units were unable to produce when the system started to shrink during the winter 2000-2001. This yielded debates about possible anti-competitive withholding of capacities and thus market power abuse, not only by generators but also by traders such as ENRON. Economic research subsequently showed that if generation capacities had been tight at this period of the year in any way, wholesale market power would have indeed been exercised

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[7] The process of market monitoring in the electricity industry therefore has a lot in common with monitoring in financial securities market (Wolak, 2004).

[8] Retailers could not hold more than 15% of market shares of the generation market in their own supply area.

(Borenstein, Bushnell and Wolak, 2002; Joskow and Kahn, 2002). Third, no transitory arrangements had been organized to help utilities hedge their retail commitments and pass on to final customers rising wholesale prices. When the utilities started to default, generators became increasingly reluctant to supply by fear of not being paid, which ultimately led to the collapse of the whole system. As transitory solutions, Californian regulators imposed costly long-term supply contracts and procurement obligations, and froze retail competition (Joskow, 2008).

The California crisis gave practical evidence that competitive reform models could lead to insufficient generation investments, in this case peaking units. The problem of investment in generation at the onset of reform was essentially linked to over-investment in gas generation technologies, which could create an excessive specialization of the technology mix. Theoretical and practical considerations on generation investment then largely focussed on incentives for developing peak generating capacity and ensuring a reserve margin to guarantee reliability, i.e., short-term security of supply.[9] Abundant literature developed about this issue, in particular about the different ways of capacity payment (see for instance Oren, 2003, Cramton and Stoft, 2006). However, little attention was paid to the conditions for other investments in base load and semi-base load equipments, since untimely and non-optimal development of the technology mix does not present the same risks as inadequacy of total capacity and its impact on system reliability. As shown by Green (2006), if the mix of capacity is characterized by a lack of base-load equipment, the marginal price will be unduly high during a large part of the year relative to a situation with an optimal mix. This will be at the expense of the social surplus, the loss for the consumers being higher than the supplement of net profit for the producers. A positive effect of long-term contracting is thus not only that it facilitates investment and thus contributes to long-term generation adequacy, but it is also that it helps achieve optimal fuel mix diversity by facilitating investments in base load technologies such as nuclear or coal (Finon and Perez, 2008). Indeed, the greater the fixed costs are, the greater are price and quantity risks (Roques, Newbery and Nuttal, 2005; Finon and Roques, 2008). As a result, at least where full de-integration has been applied, long-term supply contracts are back on the agenda and the imposition of retail franchise or compulsory contracting has been proposed (Newbery, 2002; Roques, 2008).

There is still today a complicated regulatory trade-off between allowing long-term contracts and vertical integration to facilitate investment in the existing uncertain environment and encourage de-integration and shorter-term contracts to facilitate entry. In the context of decentralized electricity markets, two basic strategies are thus possible. The first strategy is to let market players bilaterally contract forward as long as organized spot and forward markets do not mature. This might however take very long or simply not happen. The second strategy is more radical and consists of forbidding all long-term supply contracts. In this case, liquidity would mechanically increase on spot and forward markets, asset specificity would decrease and the value of long-term contracting for market players would fall. However, there is no estimate of how long it would take for this effect to play in full and thus of how long this policy would be detrimental for investment. It could of course be argued that sustainably high wholesale and CO_2 prices would allow for high fixed cost generation investment to be sunk without long-term supply commitments in the transition period, but there is no certainty. Overall, long-term supply contracts thus appear both as a barrier to liberalization and as a cure for the shortcomings of restructuring for individual contracting parties.

[9] Hours of the day are usually classified as peak and off-peak (sometimes mid-peak) hours according to the volume of electricity consumed. Daytime (and week) hours are generally peak hours as the volume consumed is higher. During peak hours, units of production (usually gas, coal or even petrol power plants) with higher marginal costs must be called for to meet excess demand so prices are expected to rise. Peaking units thus are those units which are called for to produce during peak hours. They have normally relatively low capital costs and therefore can 'survive' producing only a fraction of hours during a year. As all the units are needed to meet demand, it is usually during peak hours that competition is the lowest and opportunity for market power abuse the highest.

IV.C The Support to Renewable Energy Sources for Electricity Generation

Since the end of the 1990s, different objectives have driven governments to develop renewable energy policies: preserving a set of collective goods, climate stability, local environment and energy security. Government support is necessary for Renewable Energy Sources in Electricity (RES-E) because, although desirable from a social welfare perspective, they are not competitive in power generation systems dominated by large fossil fuel generation plants. Three reasons create a bias against RES-E in a market environment: (i) environmental costs are not adequately internalized by conventional electricity generation technologies; (ii) the absence of scale effects on costs, due to the generally small size of the plants,[10] and (iii) the intermittent character of most sources of RES (wind power, mini-hydraulic), which creates negative externalities.

Following the unsuccessful attempts of using systems of voluntary purchase of green electricity by consumers, as well as direct investment subsidies, demand-side strategic deployment policies have emerged as the preferred instrument in most countries. By imposing obligations to purchase RES electricity or to meet a RES-E quota on a clearly specified type of agent, these policies are designed to allow demand-side forces to determine the allocation of RES-E production subsidies to pre-commercial and commercial RES-E technologies. There are three possible instruments: feed-in tariffs, bidding instruments for the assignment of long-term purchase contracts and exchangeable quotas.

Feed-in tariffs obliges electricity distributors or incumbent suppliers to purchase electricity from any new RES-E plant in their service area and pay a minimum guaranteed tariff per kWh fixed over a long period of time. Bidding instruments are selected through auction RES-E projects and oblige local electricity distributors or incumbent suppliers to buy electricity from the successful plants on the basis of a long-term contract. The price of this contract is generally the bid price in the reference design (or the marginal price in some countries). Exchangeable quotas introduce binding targets for electricity suppliers to buy either green electricity directly from the RES-E producers, or green certificates issued by RES-E producers. These targets are defined as a percentage of their electricity deliveries. A compensation mechanism for the opportunity cost incurred by purchasers is usually introduced.

Following Finon and Perez (2007), the outcome of these three support mechanisms can be differentiated in terms of investment incentives, adaptability, positive impact on technological progress and the ability to fit in a market-based regime. The table below summarizes their conclusions and shows that there is no best solution.

Comparison of Performances of the Three Instruments

	Feed-in tariffs		**Bidding**		**Exchangeable Quotas**	
Criteria	*Ex ante*	*Ex post*	*Ex ante*	*Ex post*	*Ex ante*	*Ex post*
Investment safeguards	++	-	-	++	+	+/-
Ex ante adaptability of the instrument	+		0		0	
Incentives intensity and cost control	+/0		+		++	
Technological progress	++		0 *(Best available per technology band)*		- *(The most mature technique)*	
Conformity with electricity market regime	0		0/+		++	

Source: Finon & Perez (2007)

[10] This character could be discussed for certain RES-E technologies, such as biomass, which could benefit in the future from scale economies in supply up to a certain size.

IV.D Institutional Constraints and the Making of the EU Single Market for Electricity: The Case of the Creation of ACER

The EU is an interesting example of how some the institutional and political impediments described in our theoretical section constrain the reform process but also may be partly overcome within the existing institutional structure for decision-making.

For a variety of reasons, EU Member States have had very different views on the advantages of the new market organization. The ten year negotiation process which led to the enactment of the first liberalization directive already evidenced the difficulties of getting a consensus (Hancher, 1997) and many of the problems which would impair the reform process in the next period, in particular the lack of a clear legal basis for energy in the old EC Treaty. This has for instance resulted in the absence of a true EU-wide regulator in charge of developing interconnectors. It also did not give to the European Commission the power to alter property rights in the different Member States and thus to carry an aggressive policy of horizontal de-integration which would probably deliver better and faster results (Green and Newbery, 1997; Newbery et al., 2003). As a result, some elements of market design were devised at the Community level, others at the Member States level and the restructuring of ownership and industrial structures as well as changes in the energy mix were pursued, or not, by Member States.

As reformers, Member States themselves faced constraints of different nature. First, their ability to reform has depended on the domestic legal framework, such as the ability to alter property rights of private and public parties. As a result, a re-definition of property rights has often been easier than a complete reallocation (Glachant and Finon, 2000). Second, the opposition of the potential losers from reform such as the labour unions has limited the space for reforms as much as purely political factors. Member States' national politics was thus a key aspect to explain the different patterns of restructuring (Glachant and finon, 2000; Finon, 2003). Competitive reforms may also have contradicted other policies, pursued at Member States or Community levels, such as environmental, employment, technology or regional development policies. Other factors such as a pro or anti-market ideology and institutional stability have also been pointed out (Finon, 2003). These constraints defined the extent of restructuring, corporatization and privatization at the Member State level, which has then defined the behaviour of the firms as well as their ability to lobby the state. Decisions of Member States have indeed first been influenced by different lobbies (e.g. environmentalists, trade unions, consumer interest groups) and then interacted with the business strategies of market players (e.g. mergers, acquisitions and joint-venture) (Lévêque and Monturus, 2008), themselves constrained by opportunities created by the evolving regulatory environment (Chabaud et al., 2005; Williamson, 1998). The political economy of each Member State has thus defined the outcome of restructuring. The temptation to create national champions to protect national interests and take the opportunity to control foreign companies in the liberalized environment has also seemed to play a role in the European Union (Thomas, 2003). In reaction, Member States who followed the 'textbook' model more closely have felt threatened by countries with 'national champions' who naturally 'championed' a better integration of markets. From fear of foreign domination, these countries have exhibited a tendency to limit market opening and oppose foreign takeovers (Correljé and de Vries, 2008). Interconnecting markets also meant making prices converge, which revealed winners and losers in the different price areas. This explains reluctances to develop interconnections, together with local lobby groups who often opposed projects due to the social and environmental externalities.

Overall, the political commitment for reform has been uneven at best among Member States. Therefore some of the key prescriptions of the 'textbook' model such as horizontal and vertical de-integration have not been implemented. This resulted, as predicted, in problems of market power in the wholesale market and an ineffective investment framework for cross-border interconnections, among others. The different technological and institutional parameters have resulted in concentrated market structures and a low development of interconnections. In view of the difficulties we face with the

absence of a robust cross-border regulatory framework, in particular the absence of a true EU-wide regulator, a recent development is worth investigating in the light of the institutional constraints described above: the creation of a new Agency for the Cooperation of Energy Regulators (ACER) in the context of the Third Legislative Package.

As laid down in the Third Legislative Package, ACER is "*to assist the regulatory authorities* […] *in exercising, at Community level, the regulatory tasks performed in the Member States and where necessary, to coordinate their action*". Its objectives are thus to provide a framework for the cooperation of NRAs, complement their actions at the EU level to address regulatory gaps on cross-border issues and provide greater regulatory certainty. ACER will primarily have an advisory role in relation to national TSOs, national regulators, the Commission, the Council and the European Parliament, as well as a monitoring role on behalf of the Commission. Its opinions and recommendations should contribute to ensuring more coordination among TSOs and among regulators of the different Member States, spread good practices and in particular contribute to the implementation of the new (non-binding) Community-wide ten-year network development plan, i.e. monitoring the work entrusted by the new legislation to the new European Network of Transmission System Operators (ENTSOs) for electricity and gas.

Overall, ACER will not dispose of any true decision or veto powers on the action of TSOs and NRAs. ACER is rather intended to create an institutionalized forum for cooperation on cross-border issues, and will be vested only with a limited degree of discretionary power which will essentially limit its action to 'sunshine' regulation (Henry, 1997; Henry et al., 2001). ACER may however gain significant influence (as distinct from formal powers), if the Commission generally complies with its opinions, which resorts to a sort of 'soft law' approach. Far from a regulatory revolution, ACER will thus in essence continue the current tasks of ERGEG, albeit with a formal basis in the European Directives and Regulations. How can we analyze these limitations?

In EU institutional terms, these limitations can be analyzed on the basis of the so-called *Meroni*[11] doctrine. The Commission cannot delegate to an agency powers it itself does not possess. The powers delegated can be neither greater nor different than those granted in the first place by primary or secondary EC law. Delegation thus cannot lead to the creation of new powers since this would upset the so-called 'institutional balance'. Only strictly defined executive powers can be delegated, but not political or decision making powers. This implies that the delegating entity must conserve the ultimate decision power and strictly monitor implementation by the agency. The problem then becomes differentiating between technical and truly political powers. The *Meroni* doctrine finally requires that a decision of such an agency can only be case-specific and must not have a more general value on which firms could rely in other contexts. From a legal point of view, the current powers of ACER reflect a strict application of the *Meroni* doctrine, as interpreted above. Its powers to define the terms and conditions for access and operational security of cross-border infrastructure are inherently technical and case specific and its few decision powers are subject to approval by the Commission and Member States themselves. A breach of the institutional balance could indeed probably be invoked only when ACER is not politically and legally accountable to the same extent as the delegating entity (Lavrijssen and Hancher, 2008).

However, the self-interest of the different actors involved seems to better explain the limitations of ACER. Drawing on the recommendations of the regulatory networks themselves, the Commission considered three possible options to strengthen regulatory convergence: to expand its own monitoring powers vis-à-vis the national authorities, to create an independent European Regulatory Agency and lastly, to strengthen the role and powers of the existing European regulatory networks (Zimmerman and Talus, 2008). The NRAs and the Member States took a sceptical stance on the first two options,

[11] Case 9/56, *Meroni &Co Industrie Metallurgiche SpA v High Authority of the European Coal and Steel Community*, [1958] ECR 11.

mainly because they would lose some of their powers to the Commission and/or to an EU independent agency. Similarly, Member States opposed any strengthening of NRAs' decision powers and independence. However, there was guarded support among the national authorities themselves for the further development of the role and powers of European regulatory networks, in the form of a 'European network plus' which would give them more independence and a way to share responsibility (Lavrijssen and Hancher, 2008).

Even with the full implementation of the Third Legislative Package, Europe still remains deprived of a unified energy regulator at the Union level. ACER will in fact enjoy very limited decision rights and will mostly follow the role that ERGEG has played so far, at least in the coming few years. We should however welcome the creation of a well-structured *network* of regulators able over time to go beyond the role of mere adviser to the European Commission, even though some uncertainties remain. The process of unification of *ex ante* regulatory powers at the Union level found its limits in the EU institutional frame as much as in the vested interests of existing players. However, regulatory convergence and the creation of the single market are still going forward, and sometimes in some unexpected ways.

V Conclusion

While standard microeconomic theory delves into the logical underpinnings of rational price setting in networks, neo-institutional economics focuses on the design of an appropriate institutional framework. A first key institutional dimension is the management of private interests. A second dimension is the institutional feasibility of competitive reforms. This is particularly relevant when these reforms require radical changes to the industry ownership structure as well as widespread and recurring redefinitions of property rights throughout the expansion of the reform process.

On the practical side, we have seen that some major challenges remain for electricity regulation. At the forefront is investment all across the energy mix, including the need for a massive deployment of renewables to tackle climate issues. This will require adapted contractual structures and support mechanisms which at times might endanger the liberalization process. Abuse of market power also remains a major issue and solutions are likely to come from better institutional structures for market monitoring. However, as we have seen with the creation of ACER in the EU, the wider institutional frame and existing decision rights might constitute powerful constraints to institutional innovations.

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