

Are Deregulated Electricity Market and Climate Policy compatible? Lessons from overseas, from Europe to Japan

Bianka Shoai-Tehrani,

Systems Analysis Group, Research Institute of Innovative Technology for the Earth (RITE), 9-2 Kizugawadai, Kizugawa-shi, Kyoto, 619-0292 JAPAN, +81-774-75-2304, shoai@rite.or.jp

Pascal Da Costa,

Laboratoire Genie Industriel, CentraleSupélec, Université Paris-Saclay, Grande Voie des Vignes 92290 Chatenay-Malabry, France., pascal.da-costa@centralesupelec.fr

Keigo Akimoto,

Systems Analysis Group, Research Institute of Innovative Technology for the Earth (RITE), 9-2 Kizugawadai, Kizugawa-shi, Kyoto, 619-0292 JAPAN, +81-774-75-2304, aki@rite.or.jp

Yasuhide Nakagami,

Systems Analysis Group, Research Institute of Innovative Technology for the Earth (RITE), 9-2 Kizugawadai, Kizugawa-shi, Kyoto, 619-0292 JAPAN, +81-774-75-2304, nakagami@rite.or.jp

Acknowledgements

The authors would like to address special thanks to the interviewed experts for their time and precious insights: Christophe Bonnery, Dominique Finon, Laurent Joudon, Francois Lévêque, Jean-Eudes Moncomble, Jacques Percebois, Didier Sire, Thomas Veyrenc.

Introduction

Electricity market liberalization processes were pioneered in particular by the United Kingdom, which was a model or at least an example for the European Union to create a single liberalized European electricity market in 1996. In the meantime, the European Union has committed to high GHG emissions reductions through common initiatives such as the EU-ETS in 2005, the first Climate and Energy Package in 2008, and more recently the NDC submitted to COP21, and national initiatives, e.g. the definition of a carbon price in UK or the Energy Transition Law in France. The case of Europe is particularly interesting in that it is tightly bound to US shale gas revolution. While the US have no carbon market or carbon pricing system at federal level, they have achieved emissions reductions thanks to shale gas replacing coal power generation: CO₂ emissions from coal power decreased by 12% between 2010 and 2013 (IEA 2015; IEA 2012). On the other hand, in Europe, where the EU-ETS was meant to be a leading example for climate action worldwide, power companies imported cheap coal from the US and coal power generation rose by 5% during the same period, as well as the associated CO₂ emissions (IEA 2015; IEA 2012). This underlines a paradox between stated objectives and actual achievements within EU.

At the same time, in Japan, the Electricity Market Reform has taken new steps by recently opening the residential sector to retail competition in April 2016. Japan is also bound, after the Paris agreement in 2015 at the COP21, to implement an ambitious GHG emissions reduction plan containing major energy savings (e.g. a 17% reduction of electricity demand) and low-carbon energy objectives, in particular a new electricity mix target for 2030 with at least 44% low carbon electricity (renewables and nuclear). Against this background, there are concerns regarding the compatibility between market liberalization objectives and national emissions targets, as the Japanese Electricity Market Reform aims at establishing cheaper electricity prices and a market-driven electricity sector.

In this paper, we aim at analysing the articulation of electricity market liberalization and climate policy in the European experience and extract lessons for Japanese case. To do so, we conducted a review of the literature and a series of semi-directive interviews with 8 experts from academia and electricity industry. The paper is organized as follows: Section 1 explains the principles and goals of the electricity market liberalization and climate policy in Europe, first as separate policies and then as a combined policy package. Section 2 assesses the current results of policies implemented so far within the EU and identifies major issues linked with the interaction of liberalization and climate policy. Section 3 presents the main recommendations from literature and experts; last, Section 4 extracts lessons learned for the Japanese case.

1 Principles and Goals of electricity market reform and climate policy

This section presents the principles and goals of the two policies under study in this paper: the EU electricity market liberalization process on the one hand, and the EU climate policy on the other hand, as they emerged as completely separate policies, with no reflection on how to articulate with one another.

The first two subsections presents the roots of each policy and first implementations, while the third one presents the recently adopted combined policy package aiming at reconciling them.

1.1 *Theoretical movement for liberalization and first policies for EU electricity market*

The ex-ante electricity sector in Europe consists of mainly monopolies or very integrated sectors. Such a structure was inherited from the massive nationalization and integration movement in the post-Second World War period. In France, nationalization of power company is voted in 1946, which leads to the creation of Electricité de France (EDF) (Beltran and Bungener 1987). In the United Kingdom, nationalization is also decided according to the Electricity Act voted in 1947. The British Energy Authority is created in 1948 and becomes the Central Electricity Generating Board (CEGB) in 1957 (Grand and Veyrenc 2011). Italy also chooses to nationalize the electricity sector in the Constitution in 1946, but national operator Enel is created only in 1962 (Grand and Veyrenc, 2011) due to industrial reluctance in the sector: nationalization indeed means that Enel has to absorb the 1270 historical power operators. The process will be completed in 1995 (Enel website). In these three countries, the electricity sector has thus become a state monopoly. Governments have direct control over pricing and technology choices. The situation in Germany and Spain is different: they do not create state monopolies nor centralized planning (Grand and Veyrenc 2011; Ibeas Cubillo 2011). Their electricity industry corresponds to an integrated model. The German electricity sector keeps its structure including local and regional companies, due to the particular structure of federal German state itself – being divided in powerful Länder. Yet the sector is very integrated on both vertical and horizontal scales through numerous exclusivity contracts between power generators and grids, generators and distributors, but also from generator to generator. In the end the electricity sector in Germany is not submitted to competition and prices are controlled indirectly by the 1935 Energy Act. Technology choices are adopted at a federal level. In Spain, where regions are powerful although it is not a federal state, electricity sector integration happens through the coordination of private companies by themselves (Ibeas Cubillo 2011). In 1944, 18 electricity companies create the Asociación Española de l'Industria Electrica (UNESA), in order to promote a real national electricity grid by developing more interconnections to ensure better supply (Asociacion espanola de la industria Electrica 2013). Like in Germany, the Spanish government controls prices indirectly through the unified limited rates system established in 1951 that sets maximum prices and regular tariff harmonization in the different areas of the country.

European states thus take control of the power industry either through a monopoly called “natural monopoly” by economic theory, either through an integrated model where potential entrants and prices are influenced by the state. However, the efficiency of such a model starts to be questioned in economic literature around the 1960s, as studies empirically identify their negative effects. Such effects are, among others: a tendency to overcapitalize (Averch and Johnson 1962), a lack of efficiency (Leibenstein 1966), a risk of regulatory capture (Buchanan 1975; Peltzman 1976; Stiglitz 1976). The concept of ‘natural monopoly’ is questioned in grid sectors like the electricity sector or the telecommunication sector; it is argued that, except from purely grid-management related activities, competition should be introduced for the benefit of the consumer (Baumol 1977; Kahn and Eads 1971; Sharkey and Reid 1983). As a result, the United Kingdom is the first country in Europe to reform their electricity market in the 1980s (Glachant 2000).

In parallel, as a follow-up of the political construction of EU initiated in the 1950s, several European Communities for trade and economy are created, which leads to the adoption of the Single European Act in 1986. In 1996, the EU decides upon the creation of a single European electricity market with the EU Directive on common rules for the internal market in electricity (European Commission 1996).

The creation of such a market has two goals: lower electricity prices thanks to competition and improve system optimization by broadening the perimeter for resources (Grand and Veyrenc 2011). According to a study by consulting firm Booz and Pr Newbery, EU net economic benefits from completion of the internal market were assessed to be in the range of 16-40 billion € per year (D. Newbery et al. 2013). Regarding the implementation, each member state can choose whatever measures they see fit to meet the objectives, since, according to the Lisbon Treaty, the European Commission has no authority on their national energy policies. They can choose whether to open the market to new entrants, or stop controlling prices, or create an independent regulator for every activity open to competition, etc. (D. Newbery 2002; Perrot 2002). While the past British model defines the ideal case for a smooth liberalization process: a unitary state dismantling a national monopoly (Glachant 2000), it is far from being a standard model within Europe both from an institutional and industrial point of view. Before the reform, European countries with different characteristics (federal or regional states, monopolies or oligopolies) are to implement the reform within the common framework build by the European Commission. Given the heterogeneity of institutions, markets and industries in different European countries and given also the flexibility of European Commission Directives, results end up being very unequal. In reaction to this issue, a mention of energy issues was added to the Lisbon Treaty in 2009, stating that that EU's members state countries should aim to behave in a solidary way with EU energy market objectives (Delbeke and Vis 2015).

1.2 EU Climate Policy

The EU Climate Policy started as a part of environmental policy, within the Single European Act of 1986. The EU environmental policy grew more and more detailed over the years to become a set of EU legislation on environmental protection of air quality, water, waste, biodiversity (Delbeke and Vis 2015). There are two reasons for environmental questions to be treated at EU level: they often involve cross-border related issues, such as river pollution or air pollution; moreover, as EU internal trade was intensifying over the 1980s and 1990s, short-terms distortions were identified as a result of differences between national environmental policies, which called for harmonization. As greenhouse gas emissions issues started to rise in the early 1990s, there was a proposal for a carbon and energy tax in 1992 that was eventually abandoned after a decade of negotiations. Instead, the EU agreed upon choosing an overall limit of emissions: a 'cap', for a cap-and-trade system of carbon pricing. The EU-15 agreed upon 19% reduction over 1990-2012 period under the Kyoto Protocol, and the European Union Emissions Trading Scheme (EU-ETS) was created in 2005. Another reason for the success of the trading scheme over the tax scheme is that within EU negotiations, trading could be agreed through a qualified majority, whereas a carbon tax required unanimity (IPCC 2014). Three phases have occurred so far : Phase I from 2005 to 2007, Phase II from 2008 to 2012, and Phase III starting in 2013 to end in 2020, each phase evolving based on the previous' phase experience regarding targets, allowances and auctions volumes. The EU released the First Climate and Energy Package in 2009, with targets for 2020: 20% GHG emissions reduction, 20% renewable energy share in primary energy mix, 20% energy efficiency improvement. The Second Climate and Energy Package with 2030 targets released in 2014 comprised the objectives submitted to the COP21 in 2015: 40% GHG emissions reductions (compared to 1990 levels), 27% renewable energy share in primary energy mix, 27% energy efficiency improvement (European Commission 2015b; UNFCC 2015).

1.3 Towards a combined policy package

It is only very recently that the European objectives have started to evolve towards a combined policy package regrouping European Commission directives on internal electricity market, EU-ETS, climate energy packages in order to ensure compatibility and complementarity. The 2014 EC Internal Market Progress Report mentions that market integration will serve variable renewable integration. From February 2015, there is now, as an objective for 2019, the creation of an 'Energy Union' (European Commission 2015a; M. Newbery 2015). It aims at a new governance for the energy sector, acknowledging that climate action and energy sector governance are directly linked. In particular, there is an urgent need to reconcile the contradiction between the energy market liberalization policy that focuses on competition and promotes less intervention from the states,

and increasing government interventionism for climate policy purposes (Keay and Buchan 2016). The ‘Energy Union’ includes general geopolitical objectives, climate objectives and market integration objectives. Geopolitical objectives aim at diversifying energy sources, and reducing import dependency of EU. Climate objectives consist in binding gas reduction target: -40% in 2030 compared to 1990 levels as in the Second Energy Package released in 2014 and as in the NDCs submitted to the UNFCCC for the COP21 (UNFCCC 2015; European Commission 2015b). It also includes the same EU-wide binding renewable energy target (27%), objectives to improve energy efficiency, and to reform the EU-ETS. In order to promote market integration and competition within the market, but also to improve security of supply and reduce CO₂ emissions, the plan for the ‘Energy Union’ also plans to invest 647 million € in ‘Projects of Common interest’ that are mainly energy infrastructure; the target being that 70% should be completed in 2020 (European Commission 2014b).

2 Assessment of situation in Europe considering those objectives

The current situation shows that liberalization did not bring cheaper electricity supply for retail customers while causing significant losses to major power companies, and that although 2020 targets are about to be met, climate policies seem to have a limited impact, given that EU-ETS failed to prevent gas to coal switch in Europe after shale gas revolution in the US.

2.1 Current state of policy implementation and targets achievements

2.1.1 Market liberalization

Market integration

Regarding market integration, the EC identifies positive trends in current single market progress (European Commission 2014b), such as the creation of the Agency for the Cooperation of Energy Regulators (ACER) and European Networks of Transmission Systems Operators (ENTSOs), or the fact that market coupling progresses: in February 2014, 14 Member States had established day ahead market coupling, and in May 2014, the South West market was coupled with North West. The unbundling of transmission system operators (TSOs) from vertically integrated energy groups can be considered globally a success, as 96 of about 100 transmission systems in European are now compliant with EU legislation. Connection was achieved between Estonia and Finland, UK and Ireland; electricity interconnector between Sweden and Lithuania is under construction. However, the unbundling did not trigger the hoped for increase in cross-border infrastructure, as current interconnections are assessed to be insufficient. The EC has now set a target of a minimum of 15% of installed electricity capacity, arguing that interconnections will help market integration as well as emissions reductions and energy efficiency. Priorities are set on North-South electricity interconnections in Western Europe, such as improving the connection of Ireland, UK or the Iberian Peninsula with the continent, North-South electricity interconnections in Central Eastern and South Eastern Europe, the Baltic region, and to build offshore grid in the North Sea for offshore and onshore renewable integration. In total, 132 ‘Projects of Common Interest’ (PCIs) in electricity are being funded, but currently, only one project has already been completed, while seven projects have entered the construction phase (European Commission 2014b).

Market structure

Regarding market structure, we observe that the current oligopoly stands from historical monopolies mentioned in Section 1 with few new entrants. Since the first directive of electricity market reform, there were two types of new entrants:

- The first type are the new entrants around 2005, mostly based on CCGT technology, as it was the most profitable investment given wholesale prices at the time. These new entrants really are the result of liberalization.

- The second type are the new entrants based on renewable technologies and driven by FiT and other support schemes. These new entrants are out-of-market new entrants.

However, if we observe companies' movements between concentration and actor multiplication, we can see that new entrants of medium and small sizes mostly tend to be bought by historical majors, and in particular, cross-border new entrants tend to return to their historical market: French operator EDF had bought a share of EnBW in Germany but ended up selling it to the Baden-Wurtemberg; Italian operator Enel had entered the Romanian market but finally left it, as French company Engie did in Slovakia. The main exception is the UK where the major companies, the 'big six', include French, Spanish and German operators. As a result, the EU market is still concentrated around historical operators.

Prices

According to recent EC reports (European Commission 2014a; European Commission 2014b): 'in the EU on average, household electricity prices have risen 4% a year for the last five years (2008-2012). In most Member States, this is an increase above inflation [...] For industry, retail electricity prices rose by approximately 3.5% a year in the same period – above inflation in half of Member States'. But 'in contrast to these retail developments, in the period 2008-2012 wholesale electricity prices declined by between 35% and 45% on the major European wholesale electricity benchmarks (with huge disparities among countries and sectors) [...]

While the EC interprets these trends as a result of competition, but also of 'increasing renewable sources able to produce at zero marginal costs as well as the economic downturn', most of the literature assesses that the role of competition was actually negligible (IPCC 2014).

As the following graph from EC quarterly report on electricity markets shows, average European wholesale prices are plunging from levels between 45 and 85 €/MWh in 2008 to levels between 20 and 45 €/MWh in 2016. In particular, in the first quarter of 2016, France, Germany, Benelux all reach prices under 30 €/MWh (European Commission 2016).

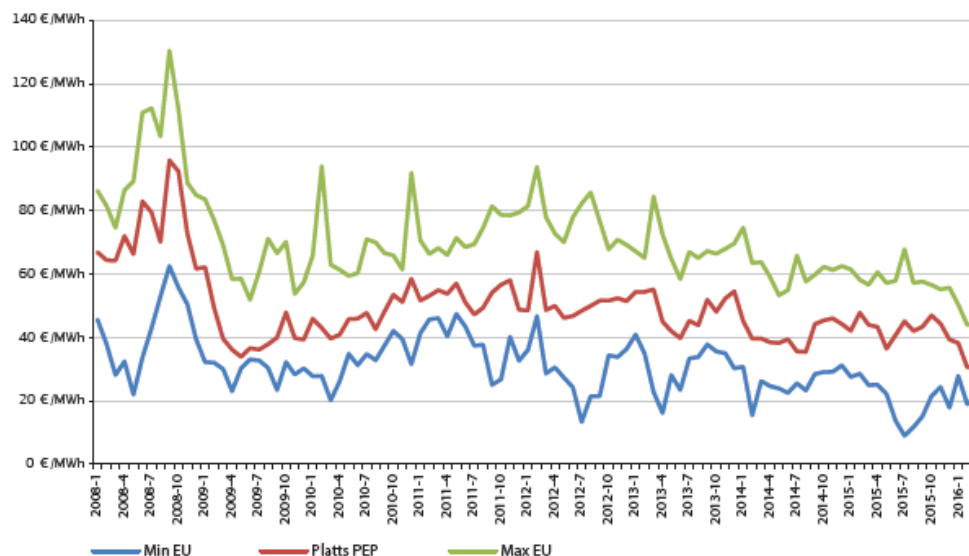


Figure 1: The evolution of the lowest and the highest regional wholesale electricity prices in the EU and the Platts Pan-European Power (PEP) Index ¹

Source: EC Quarterly report on electricity market, 2016 (European Commission 2016; Platts 2016)

¹The Platts Pan-European Power (PEP) is a demand-weighted day-ahead baseload indice indicating price trends for Europe's free electricity markets as a whole. The indice uses the mid-points of Platts assessments for the European power markets, giving each country a weighting according to demand. As spot trade has developed at a different pace in each European market, Platts has used demand weighting to replace traditional trade volume weightings to give a more representative price for the pan-European market (Platts 2016).

On the other hand, as the Figure 1 extracted from Eurelectric report ‘Power statistics and trends’ shows, retail prices are rising steadily, mainly because of rising taxes due to renewable support (Eurelectric 2015).

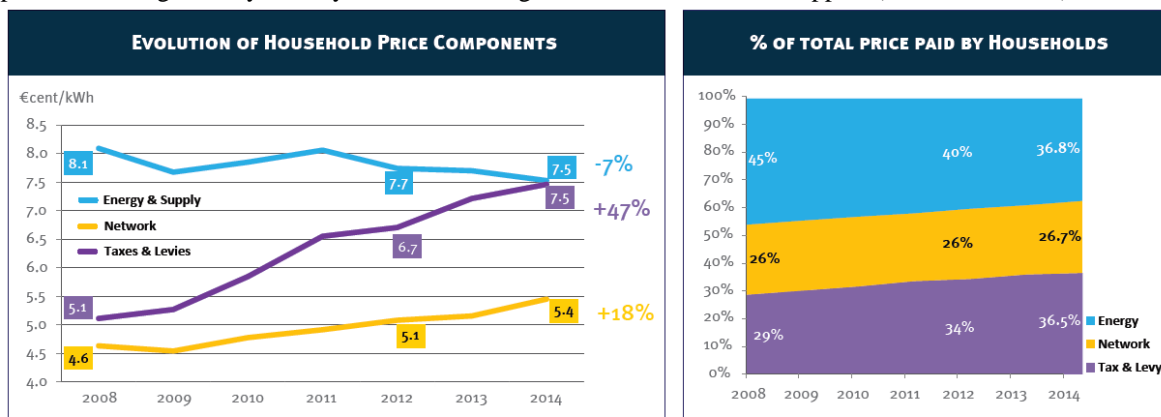


Figure 2: Evolution of household price components and household price breakdown from 2008 to 2014, average EU figures

Source: Eurelectric 2015, Power Statistics and Trends.

Besides, the graph on electricity prices allows to quantify the real potential of liberalization in terms of gain for the final consumer: since the reform brought competition in the electricity generation and distribution sector, reductions are only to be expected on this component of the price, which accounts for about one third. The remaining two thirds of the electricity price in Europe consist in taxes (that are rising) and transmission and distribution fees – transmission and distribution sectors still being regulated monopolies.

2.1.2 Climate policy

2020 targets

A global overview of climate policy achievements shows that regarding the 2020 targets (Keay and Buchan 2016):

- EU is over-achieving on emission reductions: emissions reductions are expected to be 24% lower in 2020 compared to 1990 levels (European Commission 2015d); however this is mainly due to economic recession;
- EU is expected to at least achieve the renewable energy deployment target (European Commission 2015c), although with high costs in support schemes;
- EU is under-achieving in energy efficiency : with current trends, energy efficiency achievements in 2020 would correspond to 18-19% instead of 20% (European Commission 2015e).

In this section, the current state of the implementation of the reform in EU was evaluated through the evolution of market structures and prices in the electricity sector. Interpretations from literature reviews and interviews of experts are then discussed.

Issues in the EU-ETS

For the European Commission, the EU-ETS is the ‘flagship’ policy, the key instrument for decarbonization. It works well in theory as it is ‘market-friendly, technology-neutral, EU-wide’ (Keay and Buchan 2016). However it has ‘little impact in practice’; indeed, prices are low, and no significant effect on energy mix, low carbon investments or behaviors of energy users has been observed. As mentioned earlier, it failed to prevent power companies from importing cheap coal from the US when the shale gas revolution occurred. Coal power generation consequently rose by 5% between 2010 and 2013, as well as the associated CO₂ emissions (IEA 2015; IEA 2012). Although allowances prices reached unexpectedly high levels around 30€/tCO₂ during the 2005-2007 pilot phase, they fell from two thirds between 2008 and 2012 and the second phase ended up with a surplus of allowances (IPCC 2014).

It is assessed that the carbon price should reach at least 100 €/tonCO₂ to trigger the desired effects, but such levels would be unacceptable for several countries, e.g. Poland and their 83% coal (Keay and Buchan 2016). There are several reasons for such little impact (Robinson 2015). First, governments introduced multiple mechanisms that undermined the EU-ETS, such as FiT and support schemes, mandatory targets for renewable share, policies for energy efficiency, or the additional carbon floor price in the UK. All these mechanisms reduced the demand for emission allowances and lowered carbon price. Moreover, the EU allocated too many permits at the beginning of the phase, which is linked with the fact that the EU-ETS was not designed to deal with the economic recession that unexpectedly lowered emissions and thus demand for allocation permits.

2.2 The root of the ‘missing money’: the combined effect of renewable support and liberalization

Major power companies have dangerous financial difficulties as the low level of wholesale prices do not allow them to recover variable and even fixed costs, which causes them to suffer from stranded costs and impairments. About 70 GW of coal and gas power plants were shut down between 2010 and 2014, with important acceleration over time: 3 GW per year in 2010 and 2011, 10 GW in 2012, almost 30 GW per year in 2013 and 2014 (Robinson 2015).

There are several roots of this missing money problem that were identified and discussed through literature review and experts interviews.

Falling demand

The literature notes that electricity demand is stagnating and even falling as a result of several factors: situational factors (economic crisis) but also structural factors: more efficient in energy use, decoupling of economic growth and electricity consumption, mature economies moving away from energy-intensive industries to services, demand saturation, consumers have consumed as much as they want (Robinson 2015).

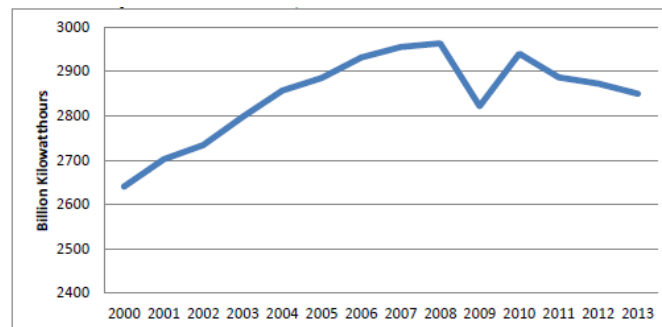


Figure 3: Electricity demand in the EU-27, from 2000 to 2013

Source: Eurelectric, Power Statistics and Trends (various years) (Robinson 2015)

The combined effect of renewable support and liberalization: overcapacity and low marginal cost

According to both literature review and interviews of experts, the root of the missing money problem mainly resides in the combined effects of renewable support and liberalization in Europe (Keay 2016; Keay and Buchan 2016; Robinson 2015; M. Newbery 2015; Finon and Roques 2013). As mentioned earlier, liberalization and climate policy were initially separate packages in EU policy and thus unharmonized until the latest packages, which means that the EU was creating a liberalized internal market while taking out about 20 to 30% of generation out of market with FiTs and other support schemes at the same time – renewable generation represented 26% of power generation in 2015 (European Commission 2015c). Support schemes encouraged important investments in renewables ending up in overcapacity given the falling demand, while liberalization induced marginal cost pricing on wholesale markets. Since renewables are fossil energies and have priority access to the network, massive renewable production with very low marginal cost brought wholesale prices down under 30 €/MWh in early 2016, ‘to a point where no unsubsidized generator can earn a living’

(Keay and Buchan 2016), a feeling largely shared by interviewed experts. Renewables reduce power companies' revenues while increasing some of their costs: in addition to lower average wholesale price, peak prices are lower – yet peak sales are usually a source of profit for baseload and semi-baseload power plants. The overcapacity in Europe resulted in less demand for conventional thermal plants, increasing their average costs. Intermittency causes new system costs, as investments are needed in network for off-shore wind, in local distribution for distributed solar: network tariffs rose by 18% between 2008 and 2014 for residential consumers (Eurelectric 2015). As a consequence, energy-only markets are assessed to be unable to remunerate the fixed costs of power stations; moreover, it induces that there is no exit plan for support schemes. Moreover there are additional problems linked with massive renewable investment and 'missing money' problem for thermal power plants. There is a phenomenon of cannibalism for renewable investment and especially PV investment: for such investment, the additional capacity will produce more electricity at the same peak period (at noon for PV for instance). There is thus less and less value to invest in such additional capacity, as it tends to increase the burden of intermittency-related issues and thus system costs.

The role of autoconsumption and curtailment

According to (Robinson 2015), in addition to the issues identified above, rising retail prices due to renewable support lower the demand as it encourages savings, efficiency, auto-consumption - a trend that only EV development would change, although high retail prices discourage EV deployment and thus compromises the decarbonization of transportation. However, such an interpretation is questionable as it supposes that electricity demand is price-elastic. The price elasticity of electricity demand cannot really be measured in Europe since electricity prices are capped to a level of 3000 €/MWh. However, experts tend to say that there is little elasticity for electricity demand, and high retail prices do not affect electricity consumption on the short-term. On the long term though, there could be observable effects such as fuel switch for heating for instance. Besides, this interpretation also supposes that autoconsumption is getting more and more attractive. Indeed, the literature analyses the potential for autoconsumption causing the death spiral of utilities (Sioshansi 2014), and there were mentions that rooftop PV had reached grid parity in several countries (such as Italy). But concretely, it actually is an artificial grid parity, as it means that the cost for auto-consumption is equal to market electricity prices including high taxes, which in no way means that generation costs are equal. Autoconsumption is still assessed to be far from competitive worldwide, even in areas with the highest electricity prices (Khalilpour and Vassallo 2015). It develops unequally within Europe, meeting little success in France or UK, but developing in Scandinavian countries and Germany. For such countries, this aspect could thus potentially become an issue in the future.

In the end, major utilities are facing a critical "missing money" problem, trapped in a vicious circle that does not allow them to pay fixed costs; the system is thus unable to phase out of support schemes and shift to clean energy investments only, and retail customers do not benefit from low wholesale market, as summarized on Figure 4 below.

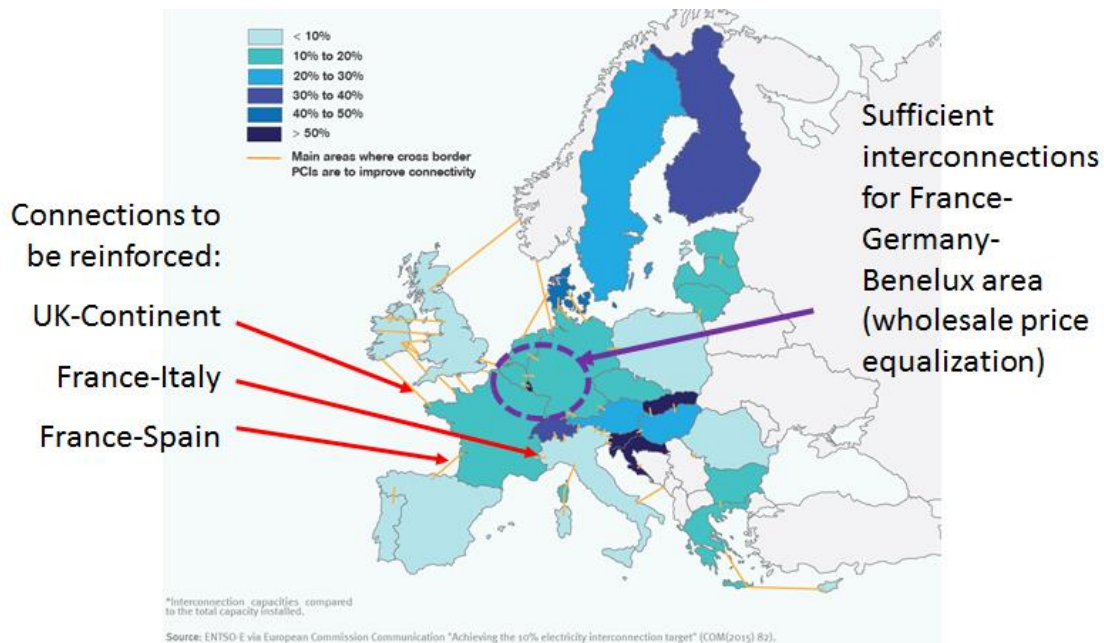


Figure 5: Interconnections levels in 2014 and areas where the interconnectivity is expected to be improved due to the PCIs , with comment on most important priorities

Source: ENTSO-E 2015

3 Policy recommendations

The study allows to map out current issues in Europe. In response to these issues, solutions tend to already appear on the market itself, through a general movement towards re-regulation. Several recommendations are identified for EU from literature review (Keay 2016; FTI Intelligence 2015; RTE 2014; Finon and Roques 2013) and interviews of experts.

3.1 Electricity market regulation: towards re-regulation

First, it is commonly accepted that **capacity mechanisms** are necessary to remunerate the guarantee of generation necessary for peak load investment (FTI Intelligence 2015; Finon and Roques 2013).

Second, it is essential to transfer the price signal of wholesale market to retail consumers (industrial, residential), which can be done via **smart home system and demand response**. It would mean to re-think the **interface between wholesale and retail**, for instance to replace it by a single buyer.

Third, **centralized planning** of capacity by the government is one of them, for example through tenders – which would allow competition for the choice of the company for the particular investment – so that the electricity mix is a state decision rather than the result of market price signals.

Last, **long term arrangements** are mostly banned by competition regulation, but allowing them in some form would allow revenue guarantee for companies as well as a hedge against price volatility for consumers. There are currently a few financial schemes that are close to such arrangements, such as the Exeltium consortium in France, a group of electro-intensive industrials who benefit from a long-term agreement (24 years) for cheap power supply (Exeltium 2016).

3.2 Climate policy instruments: carbon floor price and market-friendly support schemes

In response to the fact the EU-ETS offered too many emissions allowances in previous phases, which was identified as one of the causes for low carbon prices, a **stability reserve** will be implemented from 2019, allowing to freeze a certain proportion of allowance if needed (European Commission 2015d).

A **carbon floor price** around 30 €/tCO₂ would allow to shift from coal to gas by changing the merit order as a first step towards a steadily rising carbon price to direct low-carbon investments. It would cut emissions by 15% a year, while increasing the gas share to 40% in European power generation. On the longer term, a 100 €/tCO₂ price would allow 30% emissions cuts per year (RTE and ADEME 2016). In practice, the UK has already adopted a carbon floor price starting at a level of 18€/tCO₂ and planning to reach 30€/tCO₂ in 2020 (Government of UK 2014). However adopting such a policy at a national level without guarantee of harmonization within the EU represents a risk in terms of competitiveness. Several countries are considering a carbon floor price; among them, France has recently given serious considerations to the implementation of a carbon floor price from year 2017, which would be relatively easy as it would have little effect on the country's economy given the low share of fossil fuels in the mix. Moreover, according to the latest declarations, such a carbon floor price would be implemented only for coal-fired plants which would limit even more its effect as France has only four coal power plants, two of them belonging to German operator E.ON (Barroux 2016; Le Monde 2016).

Last, **market-friendly renewable support such as Contract for Difference or Feed-in-Premium** instead of Feed-in-Tariffs would allow to expose producers to market prices in order to prevent overcapacity, while still protecting them from important variations. The figure below explains the functioning of these three renewable support schemes.

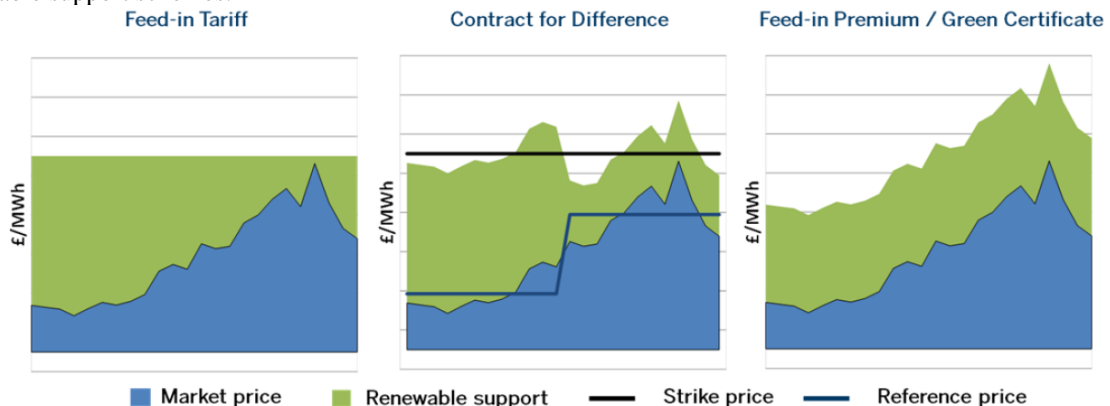


Figure 6: Functioning of different renewable support schemes

(FTI Intelligence 2015)

While Feed-in Tariff provides constant revenue, Feed-in Premium add a premium to the producer's revenue, which thus follows market variations. Contract for Difference are an alternative between Feed-in Tariff and Feed-in Premium. The revenue of the producer is compensated according to two prices: the reference price and the strike price. The reference price correspond to the average market price on a given period (annual average price, seasonal average price or even hourly price according to cases) and is thus follows market though usually with less volatility. When reference price is below a negotiated 'strike price', the revenue of the producer is compensated to reach the level of the strike price. On the other hand, when the reference price is superior to the strike price, the difference is paid back by the generator. A more detailed figure for CfD is shown below.

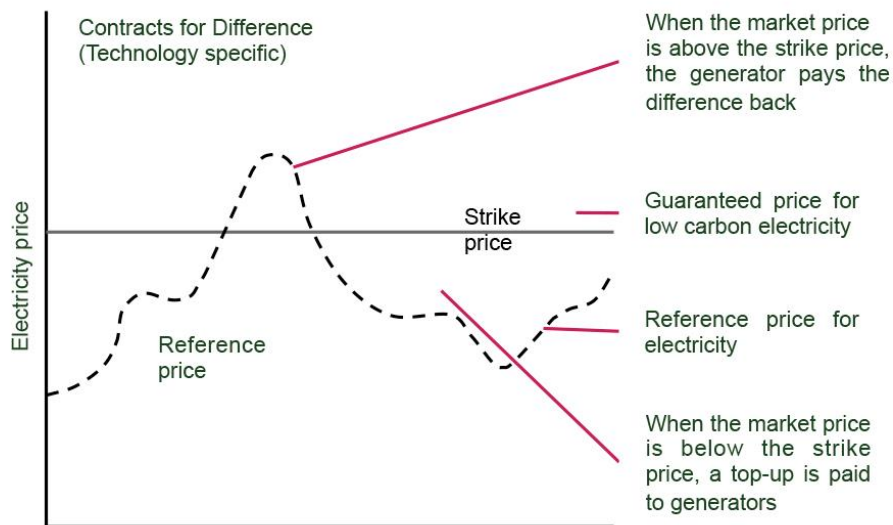


Figure 7: Functioning of Contract for Difference, detailed graph
(Government of UK 2015)

A simplified version of CfD consists in taking the market price as the reference price.

Although these support schemes are market-friendlier than FiT, they may still at some point be ineffective to prevent overcapacity as they protect the producer anyway.

3.3 Tackling upcoming issues: investment and pricing for transport and distribution systems

Transmission and distribution management, in terms of both investment and pricing, are foreseen to be the next essential issues (Jamme 2016; Creti 2016; Roques and Verhaeghe 2016; Meeus 2016; Galland 2016; Thouvenin 2016; Schwarz 2016). Both market liberalization and renewable integration require reinforcement of the grid, in transmission as well as distribution, as they will require more and more flexibility. Large-scale wind and upcoming nation-wide capacity mechanisms call for more transportation capacity, while recent massive PV and small renewable investments demand new infrastructure for distribution grid. While the network used to be conceived and designed from power plants to end-use consumers, that is to say from transmission to distribution, from Extra-High Voltage towards Low Voltage, the opposite need appeared: from residential customers to main grid. For such 'prosumers' (consumers and producers at the same time), since only net subtracted electricity is billed, fixed costs of the distribution and transmission network are not rightly remunerated. A benchmark of current pricing practices for distribution shows that fixed costs are not properly remunerated in most European countries, which is problematic for investments – except for the Netherlands, Spain and Sweden, where fixed costs account for over 75% of the tariff (Roques and Verhaeghe 2016). There is thus a need to reconsider pricing (Galland 2016), but also to design incentives such as storage premium so that prosumers can contribute to grid support. Beyond investment and pricing, alternative regulations should be considered to adapt the system to customers' new needs: for instance to design small-scale capacity mechanisms at city levels or neighborhood levels, managed by distribution operators rather than nation-wide capacity mechanisms managed by transportation operators (Meeus 2016; Creti 2016).

4 Lessons learned for the case of Japan

4.1 Japanese liberalization context compared with EU context

Throughout its history, the Japanese electricity sectors has already known concentration and de-concentration movements. It starts to be concentrated early as 50% of electricity generation concentrated in the hands of 5 major companies in 1929 already. A state-owned monopoly regrouping power generation and transmission, Nihon Hatsusoden Co, is established in 1939, while nine distribution companies are created in 1942, one for each region of Japan: Hokkaido, Tohoku, Hokuriku, Kanto, Chubu, Kansai, Chugoku, Shikoku, and Kyushu. After World War II, contrary to Europe, there is a movement of de-concentration of the economy, with the establishment of the Commission for the democratization of electricity business in 1948, which leads to the division of the electricity monopoly into nine private electricity companies that are regional monopolies in 1951. The Okinawa power company is created in 1972, resulting in the current electricity sector with 10 regional monopolies. One technical particularity of the electricity system of Japan is the presence of two grids with difference frequencies: western Japan built a 60Hz grid based on the American system while eastern Japan built a 50 Hz based on the German system (Asano and Goto 2013).

The principles and goals of the Japanese Electricity Market Reform are explicated by the Ministry of Economy, Trade and Industry (METI) as the following ones (METI, Agency for Natural Resources and Energy 2015):

- Given the lack of system of transmit electricity beyond regions, it aims at ensuring stable supply by expanding scope of supply (whole country instead of region)
- Given the current state of little competition and strong price control, it aims at cheap electricity prices through competition
- Given the inertia of the system, it aims at stimulating changes in the energy mix especially regarding renewables deployment
- It aims at expanding choices for consumers and business opportunities

Concretely, the liberalization process had started in 1995; it has recently regained importance after the Fukushima disaster, as it made it necessary to reconsider electricity policy to deal with issues of energy mix choices and high energy prices (Asano and Goto 2013).

In terms of implementing the reform, Japan is a unitary state, very centralized (similar to France or UK rather than Spain or Germany); although the electricity sector is divided in 10 regional monopolies, the regions corresponding to each monopoly have no political power (the country is divided in prefectures). Local power is sometimes represented in power companies' shareholding structure through the main cities of regions: for instance, about 10% of Kansai EPCO is detained by Osaka City, about 50% of TEPCO by a Tokyo Municipal Entity created after the Fukushima accident. On the companies' side, the ten Japanese EPCOs have formed the Federation of Electric Power Companies (FEPC) to negotiate with the government and have three representative firms as their opinion leader, that are located in Tokyo, Osaka and Nagoya, the three cities with largest population and electricity demand. In this regard, and adding to the fact that this oligopoly was historically a monopoly, the electricity sector is more centralized than it seems. Moreover, since Japanese trade corporations located in Tokyo purchase most of fuels for the electric power companies, there is practically no difference in fuel cost among firms. Last, operation and cost structure are always monitored by Japanese government so labour and capital structures are the same among companies: in the end, there are thus little regional differences (Goto, Inoue, and Sueyoshi 2013). Despite being a regional oligopoly, the institutional framework and historical heritage makes the electricity sector of Japan very homogenous compared to the EU or even to federal European countries such as Germany or Spain, whose electricity sector seems to have a similar structure to the Japanese one at first glance.

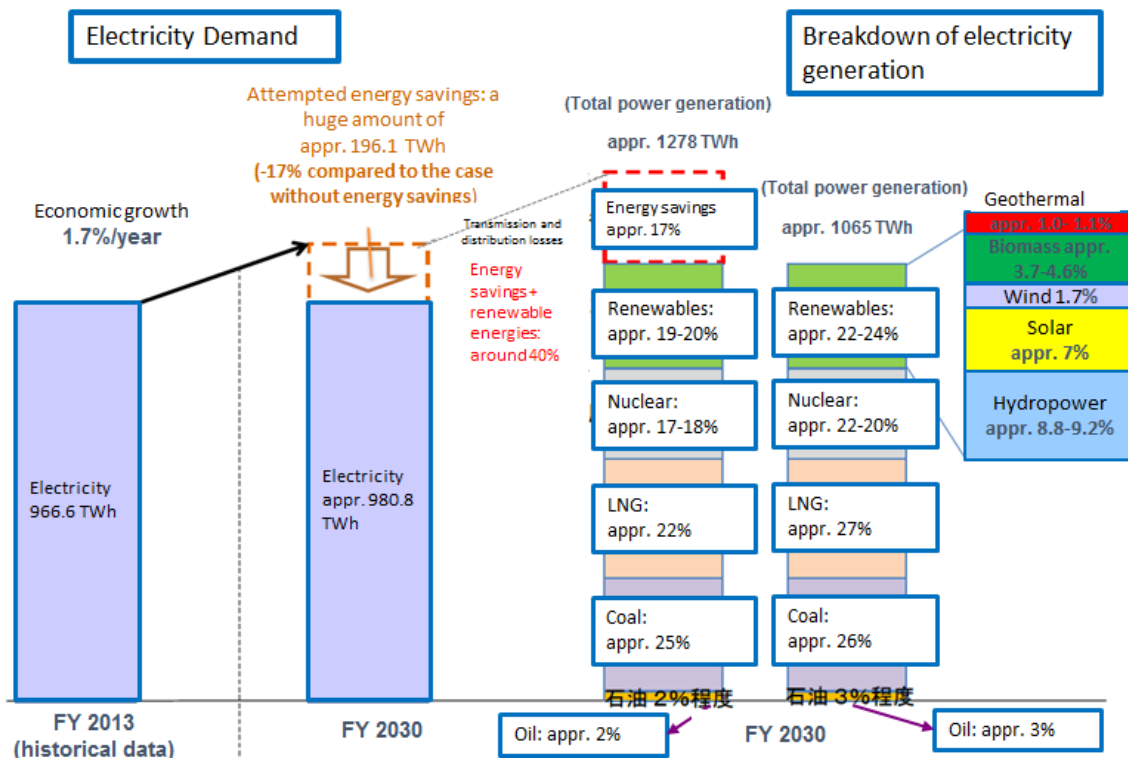
4.2 Climate Policy in Japan

In Japan, the latest climate policy and energy policy packages were carefully designed to be consistent with each other in view of the submission of the Nationally Determined Contribution (NDC) for the COP21.

First, the Strategic Energy Plan was elaborated in April 2014, based on the '3E+S' principles: energy security, economic efficiency, environment, and safety, with the following targets (METI/ANRI 2015):

- The self-energy sufficiency ratio should be higher than prior to the Great East Japan Earthquake (around 25% in primary energy)
- The electricity cost should be reduced compared to the current level.
- Greenhouse gas emissions should be reduced as to make Japan a leading example for the rest of the world and with levels at least equivalent to those of the EU and the U.S.

The electricity mix is shown respectively in Figure 8. In the estimation, the government assumed the GDP growth of 1.7% per year between 2013 and 2030. A significant improvement of energy efficiency is expected in the energy mix: a cut of 17% in electricity consumption compared to baseline (196.1 TWh).



- Figure 8: Electricity mix in 2030 (METI/ANRI 2015)

The NDC was then determined in accordance with the energy mix: a 26% emission reduction by 2030 compared to 2013 levels which corresponds to a 25.4% reduction compared to 2005 (the emissions target in 2030 is 1.042 GtCO₂eq.). In order to ensure the achievability of the NDC, the government elaborated the breakdown targets by bottom-up calculation based on the energy mix with concrete policies, measures and individual technologies, as shown in Table 1 below.

Table 1: Expected energy-related CO₂ emissions by sector for achieving the INDC (METI/ANRI 2015)

	2005	2013	2030
Industry	457	429	401
Commercial and other	239	279	168
Residential	180	201	122

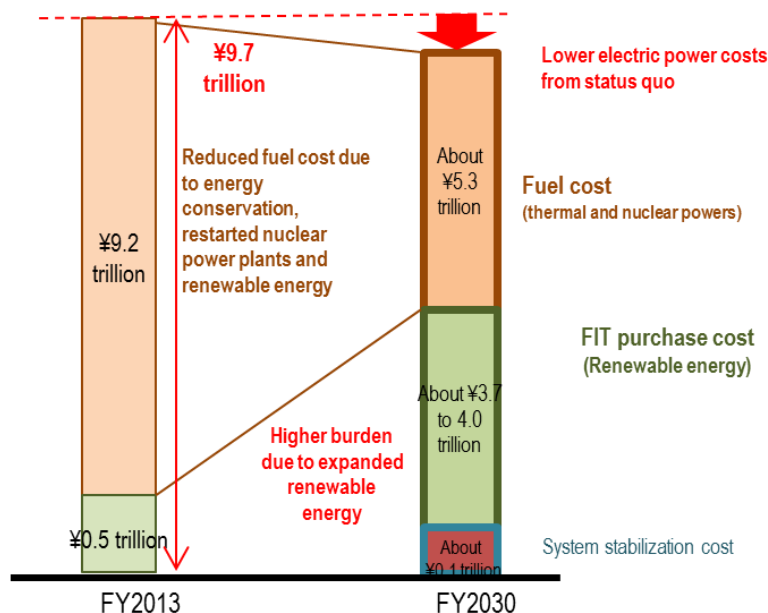
Transport	240	225	163
Energy conversion	104	101	73
Energy-related CO2 Total	1219	1235	927

[Value: million t-CO₂]

Note: Emissions by sector include indirect emissions (e.g., electricity consumptions). Emissions from energy conversion is those of own use and losses in energy conversion.

The government intends to promote renewable energies via FiT and energy efficiency of fossil fuel power in order to achieve both a reduction in CO₂ emissions and electricity costs, as shown on Figure 9.

<Transition of electric power costs (image)>



(Note) Renewable energy introduction costs budget purchase cost. This includes escapable cost, but fuel cost is reduced for that.

[Source] Power generation fuel cost is estimated based on the power generation fuel input (private power generation included) in the comprehensive energy statistics and the fuel import prices in the trade statistics.

Figure 9: Structure of national expenses for electricity in 2013 and 2030 (METI/ANRI 2015)

4.3 Applicable recommendations for Japan

Japan can be compared to the EU as whole, since in both cases, the reform aims at integrating separate markets; comparisons with each member countries are also relevant when it comes to national policy implementation. As it is one country, Japan avoids European complexity and its particular institutional framework. From this point of view, the reform implementation is expected to be much easier. As mentioned in Subsection 4.1, despite an oligopolistic structure, the situation of Japan's electricity sector is more similar to the one of the UK or France that are centralized countries. Theoretically, this could favour a smooth implementation of the reform (Glachant 2000). In practice, it could actually have the opposite effect, like in the case of France, where the historical monopoly remains in the dominant position and competition is quasi non-existent. The monopolistic aspect of the 10 utilities and the strong cooperation through the Federation may induce a risk of similar inertia.

On the other hand, the presence of two transmission systems with different frequencies is a major technical hurdle to market integration, and to the development of trading activities between regions to improve economic efficiency of Japanese grid and regional interconnection.

As the description of market reform policy and energy climate policy shows, the re-regulation movement is pre-existing in Japan, the energy mix being decided by the government (though without stating the way of achieving it), making the centralized planning recommendation less relevant for Japan than Europe.

On the other hand, since high FiTs for renewables have been implemented up to now, the risk for overcapacity and related vicious circle resulting from renewable support and liberalization exists. Besides, such risks on revenue are the main fears of power companies regarding electricity market reform (JEPIC 2016). Anticipating protection of power companies, that is to say designing guarantee mechanisms for remuneration for fixed costs for producers and TSOs such as capacity mechanisms, rationalizing renewable support to avoid overcapacity are thus a relevant recommendations.

Conclusion

In a nutshell, through the comparison between EU and Japan regarding their ongoing electricity market reforms as they take place within very different environments, this paper discusses the level of government intervention that is desirable in a post-reform electricity sector and sorts out existing policy instruments to reconcile requirements for a liberalized market and an effective climate policy. The main lesson for Japan is that they have a chance to implement from the beginning the so-far identified solutions for smooth articulation between climate objectives and efficient liberalization: existing planning and control is likely to limit free market ups and downs and protect national electricity sector more than in the EU; however recommendations for fixed costs remuneration are thus an issue to tackle through capacity mechanisms of other solutions.

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