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WORKING PAPER
N°12/14 SEPTEMBER 2014 | CIMATE

Getting out of the perfect storm: towards coherence between electricity market policies and EU climate and energy goals

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ADAPTING THE DESIGN OF THE EU ELECTRICITY MARKET TO A NECESSARY DECARBONISATION

In recent years, the EU power market has been hit by a "perfect storm", combining multiple interacting factors: revision of demand expectations, growth of both conventional and renewable capacities, a drastic shift from gas to coal power plants and a lack of visibility on future evolutions. Some of these factors are related to the climate agenda, but mostly, they show the inherent and structural difficulties of the current design of the EU power market itself. Within the debate on EU's 2030 framework for climate and energy policies, this situation raises the question: how can the EU's policies address current difficulties of the power market while simultaneously achieving the structural targets of security, affordability and sustainability of supply in the context of decarbonisation?

COMBINING ELECTRICITY MARKET AND CLIMATE POLICIES

Hitherto, the two agendas of internal electricity market policy and climate policy have been largely considered in isolation or even as conflicting agendas. However, a secure low-carbon transition will require significant policy intervention in the electricity sector, including in electricity market design. And, vice versa, an ambitious and coherent package on climate and energy policy can help restore an efficient and competitive electricity market, by strengthening investment signals, improving coordination among member states and providing a sound market framework to improve the technical and economic integration of new low-carbon technologies. Against this background, future challenges for the European policy framework should be considered along two lines: the balance between market forces and regulatory intervention, and the interplay between national and regional approaches.

REINFORCING EU LEVEL GOVERNANCE AND COOPERATION

A reinforced EU ETS will have an important role to play, but will not be sufficient on its own to guide both dispatching and investment decisions. Complementary policies will be needed, to provide visibility on the retirement of old carbon intensive plants as well as enhanced coordination and development of flexibility and adequacy measures across borders. Furthermore, the increasing mutual dependence and interactions between Member States implies reinforced governance mechanisms to provide more visibility on national choices and their implications on neighboring countries and the EU market in order to assess how European policies can support the implementation of decarbonisation strategies. Furthermore, it appears crucial to shift the focus of future adequacy and flexibility measures towards the regional market and EU level, rather than national level to strengthen coordination.

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Citation: Rüdinger, A., Spencer, T., Sartor, O., Mathieu, M., Colombier, M., Ribera, T. (2014). *Getting out of the perfect storm: towards coherence between electricity market policies and EU climate and energy goals*, Working Papers n°12/14, IDDRI, Paris, France, 20 p.

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This article is based on research that has received a financial support from the French government in the framework of the programme « Investissements d'avenir », managed by ANR (French national agency for research) under the reference ANR-10-LABX-14-01.

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ISSN 2258-7071

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An internal electricity market for Europe is not an end in itself. It is urgently needed to achieve the objectives of the Union policy on energy. Those include: secure and competitively priced supplies; renewables and climate change targets of 2020 and beyond; and a significant increase in energy efficiency across the whole economy. That market should be based on fair and open competition. To achieve those public policy objectives, it is widely accepted that there is a need for some public intervention in electricity markets.

EC Communication C(2013) 7243 final: "Delivering the internal electricity market and making the most of public intervention"

1. INTRODUCTION

Europe has begun the debate on its 2030 climate and energy framework, with the 2014 proposal by the Commission and the response by the 2014 March European Council. A political decision on the main pillars of this framework is expected in October 2014. This policy agenda will have important implications for energy markets in Europe in the decades to come.

At the same time, there is a hot debate running on the potential need to adapt the design of electricity markets in order to ensure security, affordability and sustainability of supply in the context of decarbonisation. At European level, the overarching framework is the Third Internal Energy Market Package, which sets out to increase competition and interconnection within the European electricity sector. Several Member States have also started important policy reforms responding to their needs to secure investments for security of supply and decarbonisation. The UK Electricity Market Reform is perhaps the most prominent example. The debate around the recently adopted Commission proposal on State Aid for Energy also underscores the spillovers of these national policy interventions for the European electricity sector and *vice versa*.

Europe therefore has two overarching policy frameworks for the electricity sector:

- *Internal electricity market integration*: based on the principles of liberalisation and integration;
- The *transformation to a low-carbon economy*: with an almost zero emissions electricity sector.

Hitherto, the two agendas of internal electricity market policy and climate policy have been largely considered in isolation. When they have been considered together, supposedly antagonistic interactions have often been at the forefront of discussions. This is the case, for example, in much of the debate around renewables and the functioning of the electricity market. However, it is necessary to consider these two agendas together: a secure low-carbon transition will require significant policy intervention in the electricity sector, including in electricity market design. At the same time, a functioning internal market and the right use of market forces is essential to make the transition sustainable and cost-effective. *Vice versa*, an ambitious and coherent package on climate and energy policy can help restore an efficient and competitive electricity market. This requires that the potential of synergies and frictions between both agendas have to be addressed and managed.

Against this background, it seems necessary to consider future challenges for the European policy framework along two lines: the balance between market forces and regulatory intervention, and the interplay between national and regional approaches.

In this context, this paper has two objectives:

1. Offer a diagnosis of the current situation in European electricity markets, as well as a perspective on the long-term trends and structural changes implied by the shift to a low-carbon electricity sector.

2. Provide a first framework to consider the interactions between electricity market policy and decarbonisation policy at Member State, regional, and EU levels in order to inform the 2030 energy and climate framework, as well as EU and Member State energy and climate policies.

The debate around the future electricity market framework in the EU is clearly still at an early stage.[1] By contrast, the debate on the 2030 climate and energy framework is more advanced. In this context, this paper aims to 'set the agenda' for considering these two important policy pillars together, and to provide a framework for thinking through their interactions.

This paper highlights three defining issues around which it is proposed to structure further discussion on the nexus between electricity market and climate policy in the context of the 2030 package:

- Reconsider the different roles of price signals as coordination mechanisms in an increasingly complex system: e.g. internalizing long-term marginal costs into market signals for new investment and enhance coherency between price signals to optimize system operation and costs.
- Foster regulatory and incentive measures to optimize the existing fleet with regards to short- and long-term objectives, including the possibility to retire plants at the end of their economic lifetime.
- Optimizing the response to challenges of system balancing and adequacy, including through a stronger consideration of cross-border spillovers.

In each of these areas, there are potentially important interactions between decarbonisation and electricity market goals which are best addressed by combining the two perspectives. Section 4 of the paper discusses some of these interactions in detail.

The paper is structured as follows:

- Section 2 provides a diagnosis of the current situation in EU electricity markets, and assesses why this situation has arisen.
- Section 3 gives an outlook on the structural trends and changes in EU electricity markets in coming decades.
- Section 4 develops a framework for thinking through the interactions between the agendas of internal electricity market integration and the transformation to a low-carbon economy.
- Section 5 concludes with some key principles and questions for considering the interaction between the decarbonisation and climate policy agendas.

2. CURRENT TRENDS IN EU POWER MARKETS: DIAGNOSIS AND ASSESSMENT

2.1. Current trends in European power markets

The objective of this section is to briefly survey some of the symptoms of current challenges in EU electricity markets. To some extent, these are examples of long-term structural trends in electricity markets, as the goals of secure, affordable and sustainable supply are pursued. They also give a concrete introduction to some of the potential interactions between the climate and electricity markets. Current challenges include:

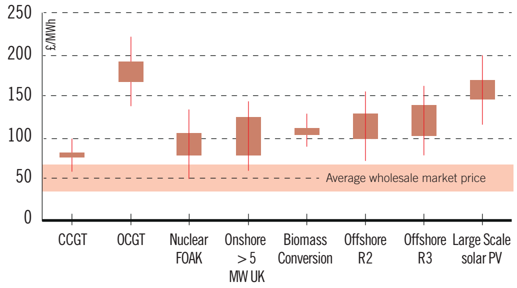
- **A decline in gross market prices:** wholesale baseload electricity prices have fallen in several market areas compared to pre-crisis levels, and particularly since 2012.[2] This evolution is most visible on the Central-Western market, where monthly average baseload prices in June 2013 fell below 30€/MWh for the first time since March 2007 (DG Energy 2013). On the German market, future baseload prices have fallen from an average 56€/MWh in 2007 to 40€/MWh in 2013, whereas peak prices have fallen from 79€/MWh to 51€/MWh.[3] It is difficult to define a "correct" price level on an open market. However, it clearly appears that current levels are not sufficient to make new investments in low-carbon assets viable and provide timely replacement for the significant share of infrastructure that will reach the end of its lifecycle in the next decade (see section 3). Even in the UK, where wholesale market prices are relatively high (due to the carbon price floor and limited interconnections with continental Europe), wholesale prices are not sufficient to ensure financial viability of new capacity investments, regardless of the technology.

1. A "4th internal market package" has not yet been officially announced. But recognizing the structural mid- and long-term challenges, the agency for the cooperation of energy regulators (ACER) has already launched a consultation on the "Bridge to 2025".

2. European Commission, "Electricity Market Report", Q2 2013.

3. BDEW 2013, "Kraftwerksplanungen und aktuelle ökonomische Rahmenbedingungen für Kraftwerke in Deutschland", Berlin, August 2013.

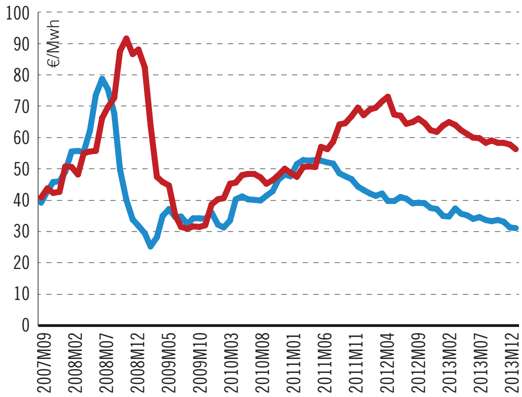
Figure 1. Wholesale prices *versus* levelized cost estimates for projects starting in 2013 in the UK (10% discount rate)[4]



Source: DECC 2013, IDDRI

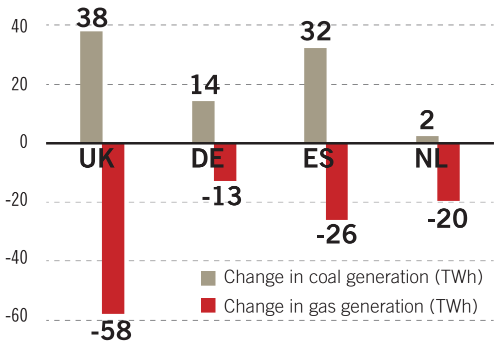
- **A shift from gas to coal:** due to significant changes in commodity prices for gas and coal and the low-carbon price signal, coal-fired generation is increasingly replacing gas in the merit order.[5] Starting from very similar short-term marginal costs in 2009, the increase of margin spreads between gas and coal raises the question of the financial viability of recent gas investments (Figure 2) and the capacity of the EU ETS price to support a coal-gas switch (see section 4).[6] Along with increased renewable generation and stagnating demand, this resulted in a sharp decline of full load hours and power generation from gas power plants and a switch to coal-fired generation across Europe (Figure 3). This raises the issue of the role of recent gas investments in securing supply and flexibility in the transition to a low-carbon electricity sector, as well as possible lock-in effects due to possible new investments into coal-fired power plants according to current market fundamentals (see section 3).

Figure 2. Short run marginal cost of electricity from coal and gas 2008-2013



Source: IDDRI

Figure 3. Change in electricity generation from gas and coal between 2010 and 2012 (TWh)



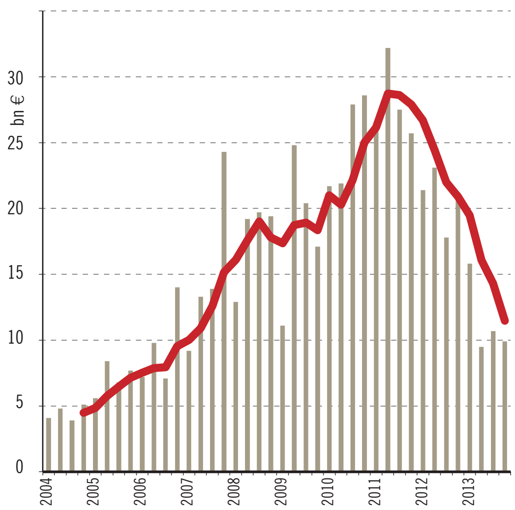
Source: IDDRI based on data from DECC, AGEB, RTE, Red eléctrica, CBS

- **Financial pressure on European utilities:** due to the current situation of supply-demand imbalances and low price levels, utilities are increasingly being put under financial stress, which in turn explains current reluctance to replace assets that reached the end of their life cycle and limits their capacity to undertake new investments. According to Euroelectric's analysis (2013), utilities' stock market performance significantly underperformed the total market index in 2012, due to high debt, regulatory risk and a decline in operational margins. There has been a significant loss of value in the sector, confirmed by recent reports on last year's financial performance.[7]
- **A decline in renewable energy investments:** Investments into renewable energies in Europe declined strongly in recent years. According to

4. This figure only provides an illustration of the tension between average market prices and generation costs for new plants based on existing analysis for the UK. Generation costs (for renewables in particular) and market prices can be very different among Member States, depending on geographical potential and financing costs. Additionally, the figure does not take into account the possibility to reimburse flexible plants based on peak load prices. However due to overcapacities and merit order effects, a tightening of peak and base-load prices can be observed in most European countries.
5. Import prices for natural gas have doubled between 2005 and 2012, whereas coal import prices almost halved between 2011 and 2013, passing from 123€/ton to 74€/ton (IEA 2013: Coal Medium-term Market report 2013).
6. Under current circumstances and depending on the national context, the EU ETS allowance price should reach between 30€/ton CO_2 and up to 60€/ton to restore the competitiveness of gas-fired generation compared to coal.
7. *The Economist* (12th Oct. 2013) indicated that European utilities had lost more than half of their stock value between their peak in 2008 and the second half of 2013. French utility GDF-Suez announced a net loss of €9.3 Bn after a €15 Bn write-down of assets. German utility RWE posted a net loss of €2.8 Bn after significant write-downs.

Bloomberg New Energy Finance data, new investments in clean energy fell by 60% between 2011 and 2013. Part of this can be explained by price effects (e.g. decreasing technology costs, for solar in particular). However, investment volumes (i.e. capacity installed) have also declined in several countries since 2011, due to uncertainty or a scaling back of policy support. Some of this has been in response to evident inefficiencies in policy frameworks and the current situation of overcapacities in the market. However, further investments are still needed in order to achieve 2020 renewables goals, long-term decarbonisation objectives, and replace aging capacities (see section 3).

Figure 4. Clean energy investments in Europe



Source: Bloomberg New Energy Finance, 2014

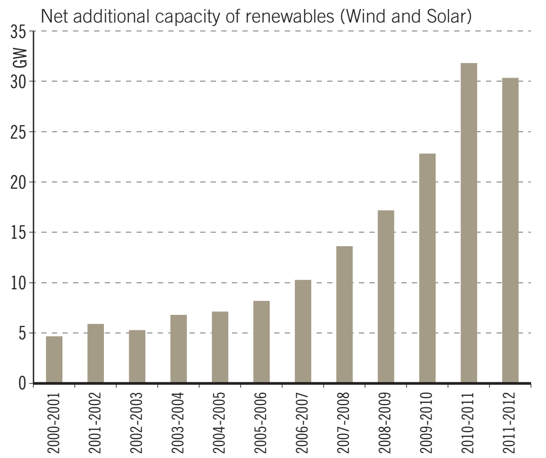
2.2. Analysis of current trends

The objective of this section is to provide an assessment of the reasons behind the current situation in EU electricity markets. This allows the identification of areas where policy may need to be improved, including through the consideration of interactions between climate policy and electricity market policy. The current situation can be explained *via* a number of factors:

Anticipations on the evolution of electricity demand

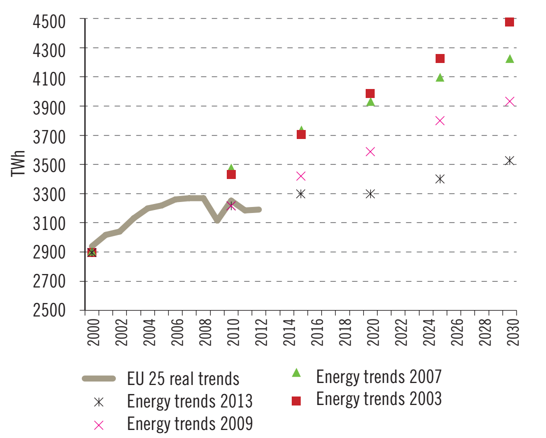
While market actors might have anticipated growing demand based on historical trends, actual consumption data shows a different picture. Due to the economic crisis, electricity demand (in particular in industry) declined sharply, and recovery has been slow. Energy efficiency improvements have also contributed to a decrease in projected growth rates. Figure 5 compares the evolving projections for electricity demand in Europe, and shows the extent to which these have been sharply revised downward post crisis. The difference in electricity demand projections for the EU25 in 2030 reaches 1,000 TWh between the Energy Trends 2003 and 2013. Figure 6 shows the three year moving average in electricity demand at EU level, and in Germany, France and the UK from 2000 to 2012. As can be seen, the economic crisis represents a massive bifurcation in electricity demand compared to previous trends.

Figure 5. Net additional capacity of renewables (Wind and Solar) in Europe



Source: Eurostat

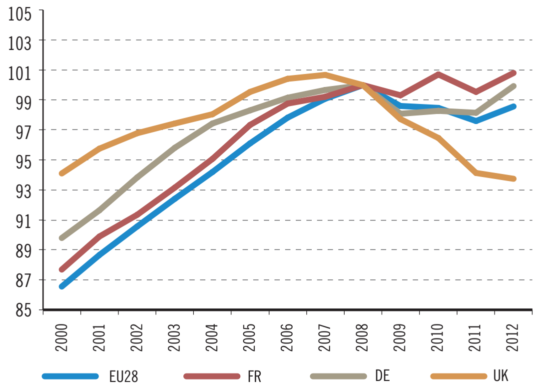
Figure 6. Evolutions of projections for electricity demand over time EU25[8]



Source: IDDRI, based on Eurostat, EC (Energy trends 2003, 2007, 2009 and 2013)

8. Although more recent projections include new Member States, the data has been scaled down to the EU-25 to allow for better comparison on a constant perimeter.

Figure 7. Final electricity demand, 3 year moving average, 2000-12



Source: Eurostat

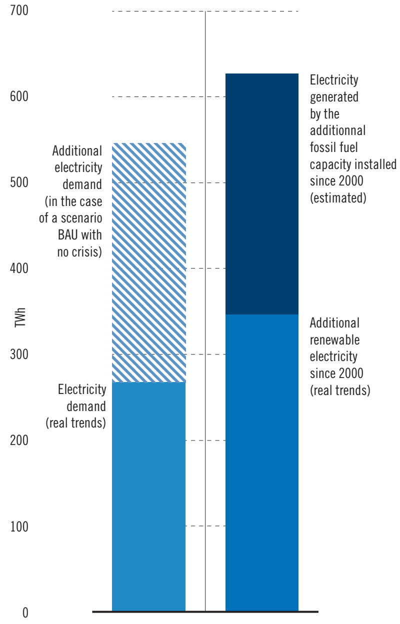
Strong growth of renewables generation and conventional generation capacities

Three factors must be taken into account when attempting to explain the current situation of overcapacities: the evolution of electricity demand and impact of the economic crisis; the evolution of fossil-fuel generation capacities; and the development of renewable capacities according to policy objectives adopted at European and national levels:

- As shown above, the economic crisis is the single most important factor when explaining current overcapacities in the European market. Between 2000 and 2012, final demand increased by 267 TWh. If electricity demand had followed the pre-crisis trend (2000-2008) up to 2012, the total increase between 2000 and 2012 might have reached up to 550 TWh.[9]
- At the European level, renewable capacities developed according to the trajectory defined through policy objectives, with additional generation of 350 TWh between 2000 and 2012.
- In parallel to the development of renewable generation, net fossil-fueled generation capacities increased by 80 GW between 2000 and 2012. Normalized according to a conservative anticipated load factor of 40%, this represents a production potential of around 280 TWh.

These observations are summarized in Figure 8, which shows actual incremental demand growth 2000-12, as well as counter-factual demand growth under a fictional "no-crisis" scenario. It then compares this with increased renewable electricity generation, and the productive potential of new net fossil capacities assuming a conservative anticipated load factor of 40%. In this way, it shows that the current situation of overcapacities is due to the combination of the factors above (effect of the crisis, growth of conventional capacities and of RES capacities) and cannot be ascribed to the growth of renewables, which is in line with the achievement of the 2020 objectives.

Figure 8. Incremental electricity demand 2000-2012, with and without crisis, versus incremental renewable and fossil* electricity



Source : IDDRI based on data from Eurostat

* N.B. calculated from incremental net fossil capacity 2000-2012, adjusted for an average load factor (40%). This therefore represents estimated production potential of this capacity under an expected load factor.

Fragmentation of policies and reliance on national policy to regain investment and operational signals

As seen in section 2.1, the current gross market prices are not sufficient to ensure the economic viability of new investments, in particular but not only investments in low-carbon technologies. This has led to the development of national support schemes to incentivize investments in low-carbon technologies and flexible capacities. The diversity of existing and new support schemes to encourage new investments into low-carbon, renewable and other generation capacities induces a risk of increasing policy fragmentation and further weakening of the internal electricity market. Figure 9 illustrates the variety of national measures planned or implemented to maintain generation adequacy

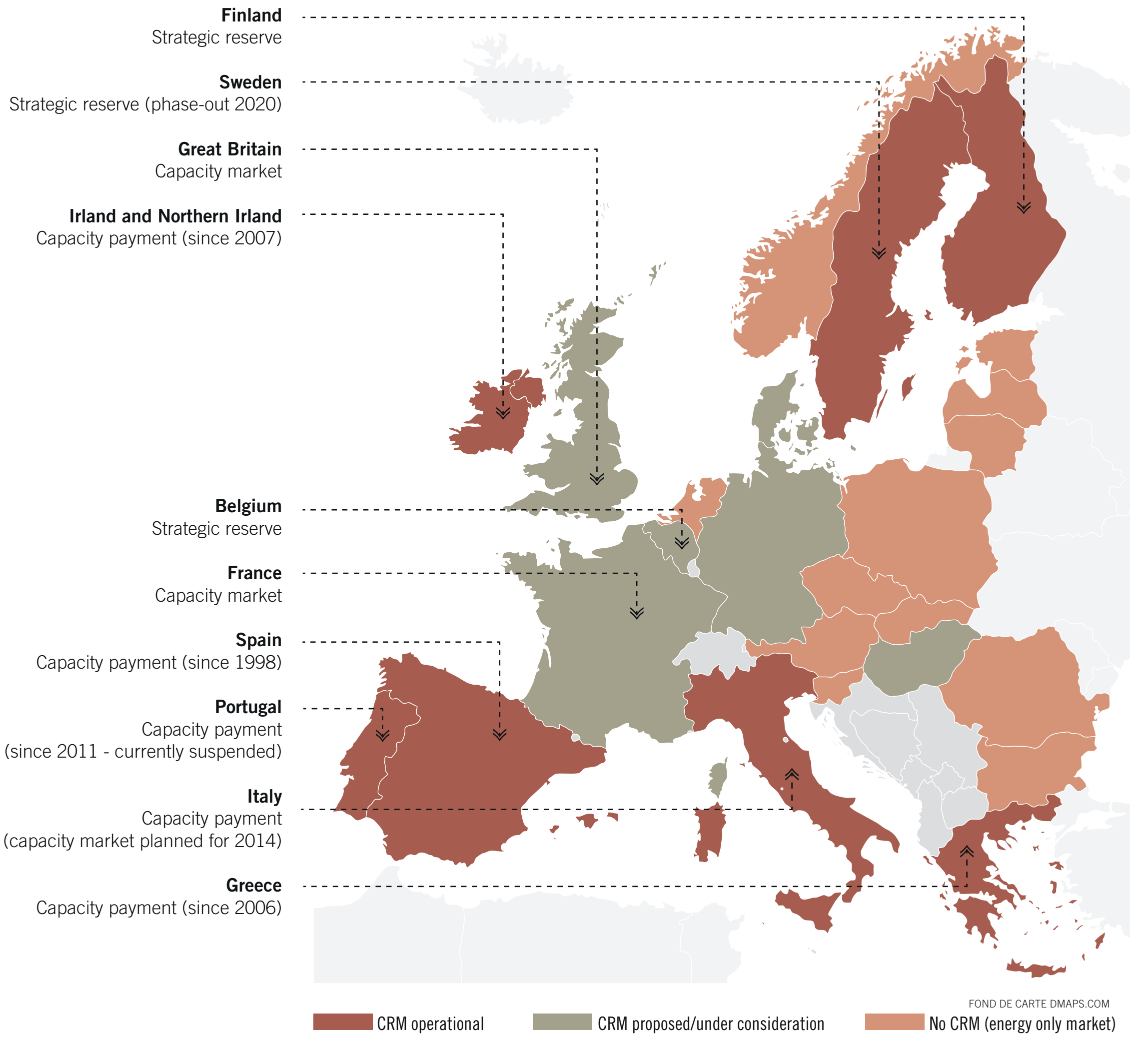
9. The annual increase in final electricity demand reached +1.8% between 2000 and 2008. Extending this trend up to 2012 would have resulted in a demand increase of 550 TWh, or 283 TWh more than actual demand in 2012.

on a national basis. Considering the complexity of such schemes and long implementation delays, there is a real risk that the adoption of differentiated national schemes produces a lock-in effect, preventing further integration or adaptation of the European market design in the mid term, as well as a progressive merger of national schemes into regional mechanisms.

2.3. Conclusion

In the short term, European power markets are facing two broad types of challenges. On the one hand, there have been a series of cyclical and market driven effects that have contributed to a situation of overcapacity, of unprofitable new gas plants, and of weak and falling wholesale prices. These effects are not the fault of policy but rather the result of largely market-based developments which were not anticipated by actors, and which have been further reinforced by policy-driven measures. On the other hand, the EU and national governments have chosen to pursue a number of specific policies in response to the need to transform and decarbonise the EU energy system. While certain parts of these policies have not performed as well as they could have (e.g. the weakness of the EU ETS, unresponsive RES schemes), pursuing these objectives implies a certain degree of disruptive change. In the following sections, we turn to such long-term structural changes implied by a shift to a low-carbon electricity sector.

Figure 9. National measures to preserve capacity adequacy



Source: National Regulatory Authorities (2013), in *Capacity Remuneration Mechanisùs and the Internal Market for Electricity* (Agency for the Cooperation of Energy Regulators, 2013).

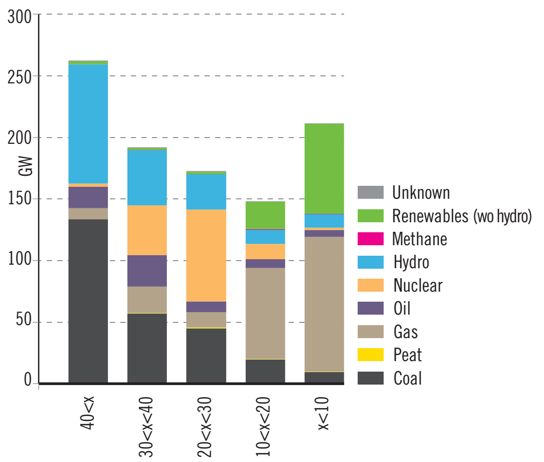
3. ELECTRICITY MARKET PERSPECTIVES TO 2030 AND BEYOND

The objective of this section is to build on the analysis above, and present long-term structural trends in the EU electricity sector. This allows the identification of the long-term challenges which climate policy and electricity market policy will need to address. The outlook to 2030 suggests that the European power markets will have to deal with at least five major developments.

3.1. A new investment cycle as existing power plants are retired

The first major challenge facing power markets is managing the next investment cycle over the coming two decades. Though mentioning the challenge of a new investment cycle might appear paradoxical in the current context of overcapacities, this need appears for two reasons.

Figure 10. Average age of all kind of power plants in commercial operation in 2012 (EU27)

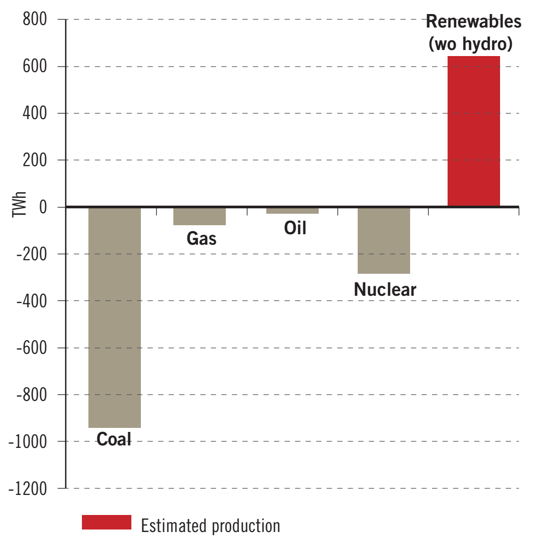


Source: Platts data

Firstly, the current situation of overcapacities might quickly reverse in the coming decade if aging plants are retired over time. Between now and 2030, and assuming an average plant life of 45-50 years, between 130-170 GW of Europe's coal power fleet, which today provides around one quarter share of European power production, would reach the end of its productive life (see Figure 10). Furthermore, a significant share of old coal power plants might be forced to close by 2015 under the Large Combustion Plant Directive (around 35 GW), with an additional 25 GW of shut-downs expected by 2023 under the Industrial Emissions Directive (Figure 11).[10]

Over the same timeframe, decisions will also begin to be taken about the existing nuclear fleet, which currently accounts for an estimated 17% installed capacity, and some other peaking plants such as oil generators (Figure 11). The capacity provided by these plants will need to be replaced in order to meet future peak capacity needs, which JRC (2012) has estimated at around 775 GW in 2030.

Figure 11. Estimated production from power plants aged over 40 years in 2020 and estimated incremental production from renewables by 2020 to meet RES targets



Source: IDDRI analysis based on Platts data, and EC 2013

Secondly, the need for new investments is directly linked to the achievement of EU's long term objective to develop a low-carbon economy with two implications. On the one hand, this means that investments into new low-carbon assets cannot be delayed. On the other hand, this implies that additional policy measures might be necessary to phase-out the less efficient and carbon-intensive plants in the meantime to provide space for new entrants. Under current circumstances, carbon pricing alone will be insufficient to provide an economic signal, and other regulatory measures (in line with the IED for example) might be necessary to manage the retirement of old CO_2 intensive capacities.

This process might also be facilitated by a redistribution of functionalities of different plant for the power system. Indeed, some of this thermal capacity may need to stay online in order to provide backup capacity to variable renewables,

10. Figures based on IFRI (2012): *The European Coal Market: Will Coal survive the EC's Energy and Climate Policies?,* and Pöyry (2013): *Outlook for new coal-fired power stations in Germany, the Netherlands and Spain*, DECC, April 2013.

rather than providing baseload generation. To provide a point of comparison, Figure 11 shows the incremental renewables production needed to reach 2020 targets, and the power generation linked to the oldest power plants in Europe: indeed the generation of thermal power plants exceeding 40 years of age by 2020 (i.e. which might shut down in the following decade) represents the double of additional renewable generation expected by 2020, indicating that there will be a major need for new investments in the 2020 decade.

3.2. A shift from operating costs to capital costs

The current design of the electricity market reflects the dominant preoccupation at the time the market was first designed, in the 1990s: to optimize the dispatch of a power fleet that was dominantly fossil-fueled and mostly amortized, thus explaining the focus on short-term marginal costs. However, the efficiency of this design is challenged today by the rapidly evolving nature of the generation mix and the cost structure of low-carbon generation technologies such as renewables, nuclear, and even CCS, which have high capital costs and relatively low operating costs.

This raises the question of how to design the electricity market in such a way that the capital costs of these technologies can be recovered during their operating lifetime, and how financial instruments and policy frameworks can minimize the risk premium and financing cost of such upfront capital intensive technologies. Under the current design, the shift to low op-ex technologies will also have an impact on electricity markets by pushing higher op-ex technologies out of the merit order (merit order effect).

In theory, plants operating at reduced hours should still be able to recover costs during peak hours. However, as the share of low op-ex technologies increases, this would increase risks for generation plants by focusing a high share of their revenues into very short periods during the entire year. Secondly, due to the increasing variability of generation, both the volume and timing of peaking hours will be uncertain, which might significantly increase financial risk premiums and thus overall generation costs. Such concerns are already leading to a focus on capacity markets and payments, in particular, as a way of ensuring capacity adequacy during the transition and provide one way of remunerating capital costs (IEA, 2012).

3.3. A strong increase in the share of electricity produced from intermittent renewable technologies

In the short to medium terms, European and national decarbonisation objectives will need to be met, to a significant extent, by continuing to increase the share of electricity production from intermittent renewable energy sources, particularly wind and solar. To give a sense of scale, the European Commission's Impact Assessment accompanying the EU's 2030 Climate and Energy Framework in January 2014, found that the "cost-effective pathway" to the EU's 2050 climate mitigation goals implies increasing the share of electricity produced from renewables from 23.5% in 2012 to 36% in 2020 and between 47% and 66% by 2030. Table 1 provides figures for the estimated incremental growth of renewables between 2020 and 2030 in a number of major Member States and the EU as a whole.

Table 1. Projected renewable electricity in the EU and in national scenarios in FR, UK, PL and DE in 2020 and 2030

Country	2020 RES-E (TWh)	2030 RES-E (TWh)	2020-2030 RES growth (%)	2030 RES Share
FR[a]	112 - 148	194 - 242	73 - 114%	41 - 42%
DE[b]	235 - 237	351 - 364	49 - 54%	50%
UK[c]	107 - 120	187 - 258	84 - 116%	41 - 55%
PL[d]	19	32	67%	17%
EU27 (decarb. scenarios)[e]	1238	1660 - 2164	34% - 75%	47% - 66%

a. FR figures taken from the report of the working group 2 of the French Energy transition debate (DNTE): "Quelle trajectoire pour atteindre le mix énergétique en 2025 ? Quels types de scénarios possibles à horizons 2030 et 2050, dans le respect des engagements climatiques de la France ?". Figures indicate the average value of the two central scenarios (DIV/EFF) as well as (for the upper limit) the objective stemming from the National Action Plan for Renewable Energies.

b. DE figures taken from the Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global, BMU, 2012, scenario variations A, B and C.

c. UK figures taken from the Climate Change Committee Review of the Fourth Carbon Budget, 2013, underlying data for figures 2.7 and 2.9.

d. PL figures taken from Agencja Rynku Energii (2011), "Aktualizacja Prognozy zapotrzebowaniana paliwa i energię do roku 2030", Polish Ministry of Economy. [Updated energy projections to 2030]

e. The 2020 value is taken from the Reference Scenario 2013 (DG Energy). 2030 values reflect the lower and upper bound of decarbonisation scenarios in the Impact Assessment: A policy framework for climate and energy in the period from 2020 up to 2030 (SWD(2014)final).

This evolution raises a number of issues. Firstly, there will need to be adequate incentives and regulatory clarity for investors in renewables to be willing to invest. Secondly, the variability of renewables creates challenges for power markets in terms of supply *adequacy*, as additional standby capacity in one form or another (either as physical capacity, interconnections, demand response and/or storage) becomes necessary to ensure that peak demand can be met when renewable output is low. Thirdly, higher renewable penetration requires greater *flexibility* to respond to rapid changes in demand and renewable output. This requires adapting market designs to minimize the cost of providing these services, including through the consideration of cross-border adequacy and flexibility solutions. This would not only require increased interconnection capacities, but also a higher level of coordination among Member states on the evolution of respective generation portfolios, shared analysis of security of supply, flexibility needs, planned support, and capacity mechanisms. Some options will also require an evolution of the market design to minimize costs for system services, e.g. providing more liquid intra-day markets and possibly new "products" linked to balancing requirements.

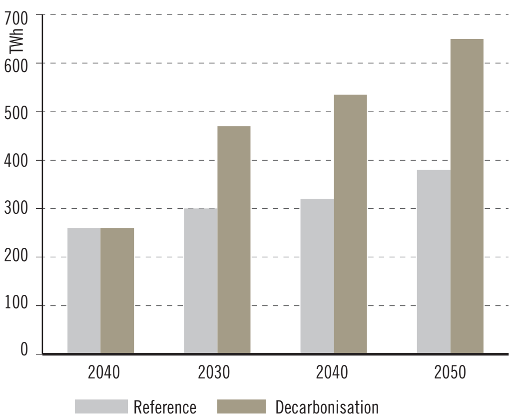
3.4. An increasing integration of power markets across borders

A fourth, related challenge concerns the increasing integration of European power markets *via* interconnections and policies seeking to promote cross-border balancing and competition.[11] Most studies agree that a more interconnected, integrated European power market offers significant savings on the cost of increasing the share of intermittent renewable energies in power markets. As noted in the impact assessment for the 2030 framework:

> *"[…] deep decarbonisation […] requires that crucial infrastructure elements such as those on transmission lines are put in place in time. Good anticipation of future climate change mitigation commitments is of crucial importance for all actors to make decisions enabling deep structural changes and for the coordination of these decisions".*[12]

However, integration also entails additional governance challenges and needs for coordination. As markets become more integrated, the design features of markets with cross-border trade will increasingly have spillover effects on either side of the border. Figure 12 shows the estimated increase in cross border trade between a decarbonisation and a reference scenario. Although different scenarios will show differing degrees of power market integration, the general trend in decarbonisation scenarios is for increased integration relative to current levels.

Figure 12. Electricity trade in the decarbonisation versus reference scenario



Source: Eurelectric, 2013

3.5. Changes in the nature and profile of electricity demand during the transition

The fifth and final long-term challenge for power markets concerns the fact that a European energy transition will not only affect the supply side of the market, but also the demand side. A range of policies, including energy efficiency policies, growing electrification of final demand sectors, as well as climate change itself are likely to have implications for the demands consumers place on the operation of power markets and the value of specific goods (e.g. volume of electricity *vs.* flexibility and ancillary services). Indeed, current market prospects (Energy Trends 2013) indicate that the market will witness a slow growth in terms of volume; however, new business models are already emerging in relation to energy services and system integration.[13] This requires a more integrated approach on the evolution of business models in the power sector and the policy signals and support measures that can foster the emergence of innovative approaches, such as Energy Service

11. While the degree of interconnection remains currently quite low in EU markets, there is nevertheless a steady trend towards interconnectedness in the internal market. The EU's 3rd Energy Package set a modest target of interconnections equivalent to 10% of EU capacity, while work continues on harmonizing network codes and establishing cross-border balancing markets (ACER, 2014).

12. p. 151

13. Groot 2013: *European power utilities under pressure?* CIEP Paper 03/2013.

Companies, system integrators (specialised on network management and flexibility services) and aggregators (combining and commercializing different renewable portfolios to reduce transaction costs and increase flexibility).

3.6. Conclusion

Alongside the current cyclical situation, electricity markets are thus facing a number of profound structural changes, as the goal of a sustainable, secure and affordable supply is pursued. These include:

- Internalizing long-term marginal costs into market signals for new investment to better reflect the financial structure of the increasing share of low-carbon assets, while maintaining a price signal to optimize daily dispatch on the short and medium term.
- Integrate the technical aspects into the economic equation. This requires a reflection on the best options to translate technical requirements (adequacy of supply, flexibility) into efficient price signals.
- Recovering incentives and regulatory signals to optimize the existing fleet and provide timely signals for new investments that are coherent with the need to retire aging carbon-intensive plants and to drive the structural transformation towards a low-carbon power mix
- Optimizing the response to challenges of system balancing and adequacy, including through a stronger consideration of cross-border spillovers.

The need to manage these changes is leading to a proliferation of policy frameworks within Member States and at EU level. Given the evident policy and physical spillovers within the electricity sector, it is necessary to reflect on the risks such fragmentation poses for the market integration process and long-term decarbonisation strategies and possible solutions linked to an enhanced governance framework. This is the objective of the following section.

4. A FRAMEWORK FOR CONSIDERING ELECTRICITY MARKET POLICY AND CLIMATE POLICY INTERACTIONS: WHAT ORIENTATIONS ARE NEEDED?

The above sections outlined the current trends and future structural changes in European power market. As mentioned, these evolutions are soliciting policy responses from Member States, as they try to provide an appropriate framework for secure and sustainable supply. However, the spillovers at European level also need to be considered, both in terms of synergies and potential antagonisms between the agendas of electricity market integration and the transformation to a low-carbon economy. This is the objective of the following sections: to tease out the interactions, using a combination of scenario thinking and empirical analysis. It is structured according to challenges to be addressed, rather than policy instruments.

4.1. Getting incentives right for new investment in low-carbon and conventional technologies

Marginal price signals emerging from traditional electricity energy-only markets do not currently reflect the long-term costs of building new capacity, neither for conventional nor low-carbon technologies (see Figure 1). This has created concern that markets may fail to deliver enough new investment in time to ensure supply adequacy. Lower wholesale prices also make low-carbon technologies uncompetitive at market prices, and thus increase the premium needed to support them. This can exacerbate the challenge policy makers face because it increases the apparent cost of support for low-carbon generation, even though a significant part of these costs simply reflect the cost of reinvesting in new generation capacity that will be needed for the next decades.

The inconsistency between wholesale power prices and the cost of providing generation reflects four broader challenges facing electricity markets:

- Overcapacity in the short run, which is leading to below marginal cost pricing as amortized assets compete with new generation capacity. But there are risks of a possible non-marginal "step-change" to under capacity in the long run, due to the phase out of coal fired plants due to the industrial emissions directive, nuclear phase outs and the ageing of the existing fleet. This evolution towards a lack of capacity might not affect all Member States to the same extent, but poses a significant threat to the European market as a whole.
- The lack of long-term price signals in existing power markets. Such longer term signals would allow generators to include the cost of capital in their bid prices, would reflect long-term scarcity of supply, and would help investors to lower financing costs by hedging price risk. However, such liquid long-term markets do not exist in current energy-only markets and fixing a convenient time horizon for long-term contracts (2, 5, 10 years or more) is not an easy task and

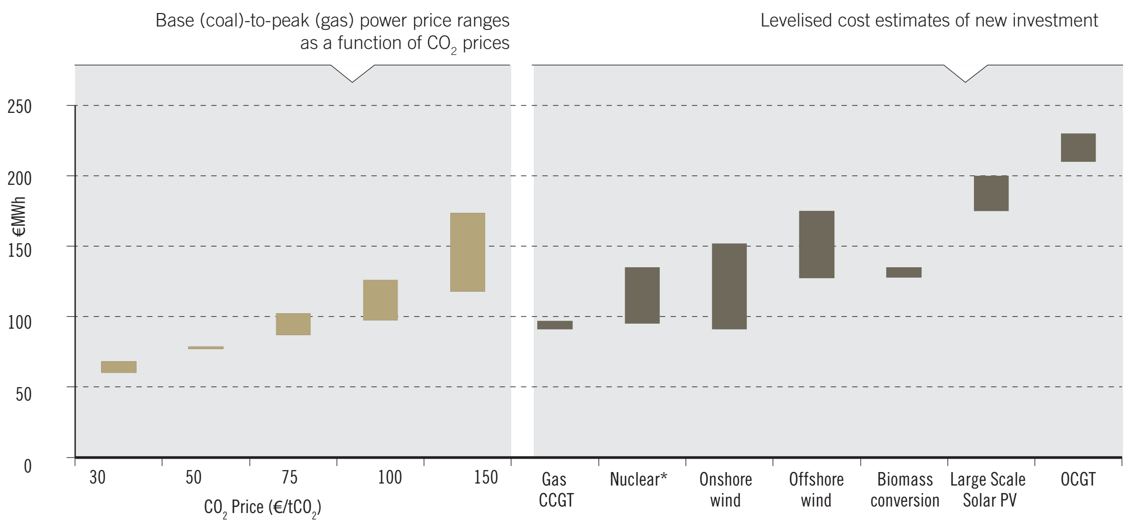
largely technology-dependent. This presents a particular challenge for low-carbon generation, which typically has high capital expenditures but low operating costs, and therefore requires greater visibility than conventional generation over longer term prices to reduce investment risk.
- The weakness of the EU ETS carbon price due to an overhang of surplus allowances. This reduces wholesale power prices, since marginal generation is typically coal or gas fired power in most EU markets.
- The need for traditional actors to adapt their business models. The variability of renewables generation means that average loads and revenue streams for conventional generation technologies are changing. This requires a larger share of existing traditional generation capacity to shift from base-load to peak-load and flexibility business models, which will increase price volatility. It is not yet clear that power market actors as a whole are adapting their business models and pricing behaviour to reflect this challenge.

For these reasons, it is increasingly clear that energy-only markets based on marginal pricing will be unable to deliver low-carbon investment and also run a risk of market failure in delivering generation adequacy and flexibility. The optimal architecture of power markets to ensure that these services are provided remains a subject of ongoing debate amongst experts. In this context, Member States have begun to pursue a mix of measures to circumvent real and feared market failures to provide longer term price signals, e.g. national capacity or strategic reserve markets or payments, long-term contractual arrangements such as contracts for difference and feed-in tariffs, and national carbon price floors.

However, while the optimal long run synthesis of different approaches remains somewhat uncertain, it is clear that stronger European and regional policy and governance frameworks can help to reduce the need for purely nationally focused measures, and reduce the associated risks of policy fragmentation. For example, taking a more regionally focused approach to capacity adequacy and flexibility concerns can help to simplify national debates on the need for new policy instruments by exploiting existing capacity and flexibility services at a larger scale. On the other hand, where there are needs for integrating longer term signals into power markets—such as in the provision of investment certainty to renewables or low-carbon investors, or providing capacity payments on a targeted basis—coordination and greater harmonisation of these investment signals offer obvious benefits. However, they will require new regional governance mechanisms and technical solutions to be achievable. For example, conducting prospective security of supply analysis on a regional (rather than national) basis taking into account interconnections might be a first step to a common assessment of adequacy and flexibility needs and options.

Another way in which European post-2020 climate policy settings will be important for getting incentives right for new investments is *via* the EU ETS. It should be clear from the outset that the EU ETS is not intended to drive investment *per se*, since it merely prices the scarcity of carbon in the

Figure 13. Wholesale prices, carbon prices, and levelized generation costs (UK 2012)



Source: Levelised technology costs (DECC, 2013). Note: assumes fuel costs of 56€MWh and 31€MWh for CCGT gas and coal-fired plants respectively.

carbon market. However, by setting a continually declining cap on CO_2 emissions, the ETS, together with a functioning energy-only market, could effectively ensure that the business case for certain kinds of carbon intensive investments can no longer be made over time since they will not be able to dispatch power competitively. Thus the ETS could be conceived as a tool gradually pushing certain options *out*, rather than pulling other options—like renewables—*into* the market. In practice, however, a significantly more rapid tightening of the ETS cap would be necessary compared to what is currently proposed to deliver this result in the timeframe which would optimise the carbon intensity of the generation of existing assets (see below).

Secondly, as a key input into present power production, the carbon price could also be seen as a way to help to close the gap between short-term marginal power prices and longer term scarcity prices. While not necessarily driving investment, the EU ETS would nevertheless be a way to reduce the need for "non-market" premium and public underwriting for new low-carbon investments. Such an approach is sometimes seen as unpalatable since it would imply higher carbon prices than have to date been seen as politically acceptable. For example, Figure 13 shows that, at least for the UK, carbon prices would have needed to be high relative to current levels to make marginal power prices attractive enough to support new low-carbon investments. However, it should be noted that implicit carbon prices in renewable feed-in-tariffs, market premia, contracts for difference, etc., are just as high if not higher in some cases and will come down as prices of low-carbon technologies, such as solar PV and onshore wind continue to fall.

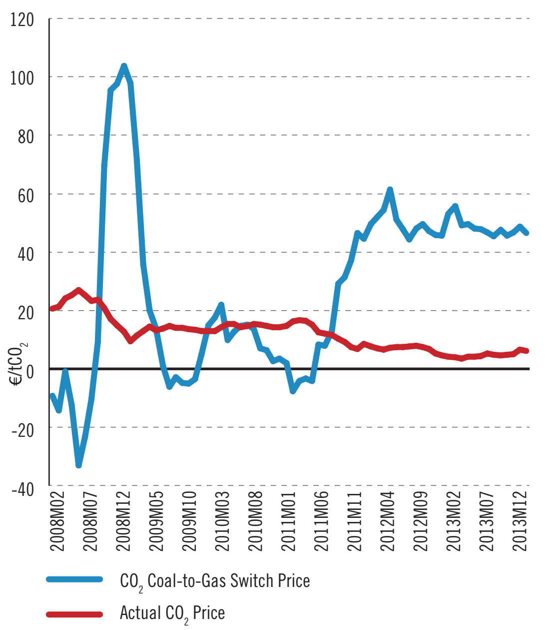
Nevertheless, for the reasons outlined above, carbon pricing alone will be insufficient. Complementary mechanisms which can help to restore greater visibility over longer term prices[14] for power sector investments will also be necessary.

Moreover, since many businesses will be required to change their business models as the share of intermittent renewable in power grids increases, investors will demand clarity on the trajectory that power markets will follow in order to plan and undertake investments. The content of national plans to decarbonise will therefore be an important component in the 2030 package, as will the consistency of policies at European level which impact investors (e.g. the relationship between interconnection goals in the 4th Energy package and decarbonisation goals in the 2030 Climate and Energy Package).

4.2. Recovering incentives to optimize the existing fleet

Another important goal of an effective electricity market policy framework should be to optimize the use of the existing fleet. As noted above, changes in the relative prices of coal and gas, changes in demand projections, and overinvestment have led to a large share of new, relatively low-carbon, and flexible gas-fired capacity not being used. An effective climate policy and electricity market framework should help to create a space for a more productive use of these assets. The optimization of the existing fleet, and the timely retirement of plants at the end of their lifetime (largely coal), is also required in order to regain long-term scarcity signals. Doing so is also important to reassure investors that policy makers will make sure that investments taken on the basis of policy expectations, as was the case with many gas investments, will be profitable in the long term.

Figure 14. CO_2 Coal-to-Gas Switching Price vs. Actual CO_2 Price (2008-2014)



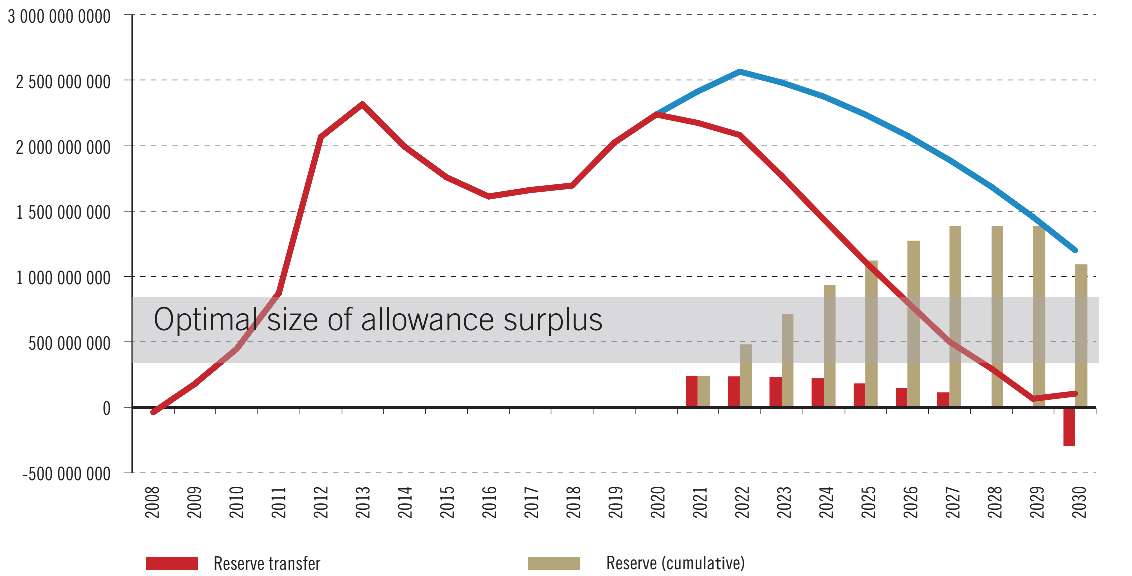
Source: Data from ICE ECX Day Ahead EUA Futures, IMF Commodity Prices, Eurostat.

Note: CO_2 intensities of coal and gas fired plant are 0.95 and 0.41 respectively. These intensities reflect the existing stock of plant (coal and lignite) and CCGT gas, but are likely to be lower for new builds.

Optimizing the existing fleet of power plants will require, as a minimum, changing the relative costs of generation from different technologies. In principle, this is a task well suited to carbon pricing. As

14. In addition to clarity over price levels, clarity over price volatility will also be important. As price volatility is linked to the generation mix, visibility over the generation mix during the transition in specific electricity markets may also be important for investors.

Figure 15. Evolution of EU ETS surplus of allowances in reference case and under existing stability reserve proposal



Source: Authors, based on data from EUTL and DG Clima

Note that this figure excludes aviation emissions from the estimate of the ETS cap, emissions and surplus. It includes the impact of back-loading and of spreading the return to market of the back-loaded allowances over 2021 and 2022 due to proposed rules for "end of phase" auctions.

Figure 14 shows, at ETS carbon prices of 45-60€/ tCO_2, coal would begin to be replaced by gas as a base-load power source. (Although below these prices, switching from lignite to hardcoal would also become economical.) Of course, these figures are only indicative: there is a distribution of different costs and efficiencies for plants of different vintages and so there is no one unique switching price. Moreover, the fact that operating costs for coal become higher than those for gas does not automatically mean that all coal-fired power plants would be retired.

However, in practice there is a significant risk that carbon pricing may fail to do the task. This is because, on current policy settings, ETS reform would take effect too slowly to provide a strong enough price signal to force coal-fired power plants out of the grid in favour of gas before the mid-2020s. For example, the present design of the ETS Market Stability Reserve would see the surplus returned to an optimal size only by the mid-2020s and only then begin to return scarcity signals to the market (see Figure 15). Although, in practice, if the mechanism is perceived to be a credible commitment on the part of policy makers to tighten the ETS cap, then it may deter further investment in new coal.

Regardless of whether they take the form of capacity mechanisms, national portfolio policies, or greater reliance on carbon pricing, a discussion is needed on the instruments that will be used for incentivizing the optimisation of existing capacity and the associated retirements of amortized, unprofitable plant. Given the potential for interactions between instruments, greater discussion may help to provide clarity on the way in which they are intended to fit together as a package.

4.3. Optimizing the response to the balancing and adequacy challenge

Taking into account the respective national strategies on the evolution of generation portfolios, current trends indicate that the ability to meet flexibility and capacity adequacy challenges will be a key issue for the European market. In this regard, increasing interactions between national strategies and the European market will need to be addressed:

- Visibility on national portfolio strategies: implicitly or explicitly, Member States are pursuing portfolio strategies to adapt their electricity mix. Granting maximum visibility on the respective strategies should be a first step to assess the additional flexibility and balancing needs for the European power market and identify the extent to which European measures can provide efficient and complementary solutions. In parallel, this reviewing process should help verifying consistency between national and European decarbonisation strategies on the mid and long terms.
- Optimizing market frameworks to support flexibility in the short term: developed under

different historical conditions and with a specific set of objectives, the current market design does integrate some flexibility options, but has not been optimized in this regard. Thus, integrating the need for increased flexibility into the target model of the market integration process might offer efficient opportunities to maximize flexibility options in the short term, for example through shorter gate closure delays and increased liquidity on balancing markets.

- Developing a reference framework for the implementation of national mechanisms: the implementation of new national mechanisms to ensure flexibility and/or capacity adequacy might lead to increasing policy fragmentation and higher costs in the absence of a common framework and eventually, threaten the European market itself. In parallel, the interactions between national capacity mechanisms and European instruments such as the EU ETS should be addressed explicitly to avoid contradictory economic signals, reinforcing the need for a European framework. Without interfering too much into national or regional initiatives, such a common framework should set out the minimum criteria required to minimize negative spillovers on the common market and enable the regional integration of national schemes in the mid term.
- Introducing a value of flexibility in the market: adding new flexibility measures into the market might require a common understanding of the system value of additional flexibility measures (demand or supply side), before designing market mechanisms. Furthermore, it has to be clarified who should bear the responsibility of additional flexibility requirements (independent market actors or system operators).
- Integrate the process of planning, implementation and financing of interconnection capacities into the broader logic of the EU decarbonisation strategy. This might imply specific cross-border capacity targets or the identification of additional projects based on a common analysis of the evolution of respective generation portfolios.
- Supporting the technical and economic integration of renewables: the impact of intermittency can be lowered if certain provisions are made to enhance system integration and system service contribution. Thus, the reflection on financial support to RES should also integrate the technical dimension and consider how support mechanisms could support the development of these additional services.[15]

5. CONCLUSIONS AND ORIENTATIONS

A 'perfect storm' of factors is responsible for the current situation in EU electricity markets

It is crucial to take into account the various factors at play and the interactions among them when establishing the diagnosis of the current situation of the electricity market: dramatic revision of demand expectation, high growth of conventional and renewable generation, a change in coal-gas competitiveness, and the absence of incentives for the retirement of plants at the end of their economic life. Taking into account all of these factors and their interactions is crucial to develop adapted policy responses. Rather than causing the current fragility of the power market, climate and energy policy has interacted with these other factors. It is important to ensure that appropriate signals are sent to allow market actors to anticipate policy.

There is a strong need to consider interactions and maximize coordination between the climate policy and electricity market agenda

Strong synergies can be found in the measures needed to restore a well-functioning electricity market and to achieve climate objectives. This includes a strengthened ETS to provide an investment signal for highly efficient capacities and low-carbon generation. Enhanced coordination and development of flexibility and adequacy measures through cross-border interconnections also represents a mutually reinforcing measure. Clear policy signals supporting the progressive phase-out of old and carbon-intensive infrastructures might as well help to decrease current overcapacities and reduce uncertainty over the economic viability of new efficient and low-carbon capacities.

Eventually, on the mid term, it appears necessary to adjust the historic price-fixing mechanisms of the power market to better reflect the evolution of both policy objectives (security of supply, efficiency and decarbonisation) and generation technologies (from OPEX to CAPEX).

Conversely, there is a real risk of contradictory signals between the electricity market policy and the climate policy agendas if both agendas are not taken into account. A good example is the ETS and capacity markets. A strong ETS signal could be important to optimize the use of existing capacity,

15. For example, cutting the peak output of PV installations by 30% can significantly reduce intermittency and grid reinforcements, whereas the annual generation loss is limited (<10%). Introducing such a system integration approach for support schemes rather than a "volume-only" approach aimed at maximizing generation might facilitate the integration of high levels of variable RES. See also: IEA (2014): *The power of transformation. Wind, Sun and the Economics of Flexible Power Systems.*

and also help drive new investments. At the same time, the ETS price signal could be distorted by capacity markets if designed independently of European instruments and create counterproductive effects regarding the evolution of the generation mix. There is thus a need to consider in detail and explicitly the interactions between these agendas.

Mutual dependence and interactions between Member States, and between Member States and the EU level, requires further cooperation, in particular at the regional level

There are clearly numerous spillovers between Member States and between Member States and the EU level, in terms of the policy choices, the content of their transition (energy mix, etc.) as well as the policy instruments they implement. The challenge of securing sustainable, secure and competitive electricity supplies will need to be addressed *via* enhanced cooperation and coordination (see below). The last two decades have seen increasing regional integration of European electricity markets. It also makes sense that the challenges of adequacy and flexibility posed by decarbonisation—and which today are largely the focus of national debates—should receive greater focus at the regional and European level.

The urgent need to recover investment signals, including through dedicated complementary policies

Despite the current situation of overcapacity, new investments are needed in order to ensure security of supply in the coming decades and to achieve long-term decarbonisation targets. This requires a perspective on timely retirement of plants at the end of their economic life; greater integration of long-term marginal costs of supply into wholesale prices; as well as dedicated investment instruments such as market premia or contracts for difference to bridge the remaining gap between the wholesale price and the long-run marginal cost of new low-carbon investment.

The EU ETS is important but not sufficient

The EU ETS will have a key role in two regards. Firstly, to integrate the long-run marginal cost of supply more strongly into wholesale prices, and secondly to optimize the existing fleet. The second point is important to ensure long-term scarcity signals through the retirement of plants, and the use of new, flexible, efficient plants to meet the long-term balancing and adequacy challenge. In both cases, however, it seems unlikely that the EU ETS will be enough, particularly under the current reform proposal. There is thus a need for an open discussion about the role of the ETS, what is needed to achieve this role in terms of structural reform, and what complementary policies may be needed in addition.

Need for consideration of coordination between Member States in multiple areas; including 'portfolio policies' at Member State level

The high spillovers in the electricity sector, and the inadequacy of a single instrument (the ETS) to address the challenges of decarbonising the electricity sector, underscore the need for coordination around Member State strategies and policies. This covers multiple areas. At the same time, it needs to be recognized that Member States will pursue different strategies and policy approaches. A detailed assessment is therefore needed of where the strongest spillovers and risks exist, and what the appropriate coordination instruments could be. Member States are already putting in place 'portfolio policies', broadly aiming at developing particular technology mixes in the longer term. A key element of the cooperation framework in a more bottom-up EU framework would be to ensure the understanding, visibility and implementation of these national strategies. A key question for future governance mechanisms concerns the issue whether such coordination mechanisms should emerge based on a regional approach (covering different market zones) or directly at the European level.

Getting out of the perfect storm: towards coherence between electricity market policies and EU climate and energy goals

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