The Rise of Capacity Mechanisms: Are They Inevitable in the European Union?

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EXECUTIVE SUMMARY

Many EU Member States have established Capacity Remuneration Mechanisms (CRMs) in their electricity markets. These mechanisms aim to ensure that the electricity system has sufficient capacity available to meet the electricity demand at all times. They are not a new topic but until recently such mechanisms remained limited to a very small number of Member States.

Their current proliferation is due to the growing doubts in many Member States about the ability of their liberalised electricity markets to meet the electricity demand in 2020 and beyond. These doubts are based on different factors that negatively affect the investment climate for generation capacity. This situation obviously increases the risk of the occurrence of blackouts, rare in our industrialised societies and economically very costly. To improve the prospects of adequate generation capacity and prevent the risk of blackouts, many Member States have thus undertaken to remunerate firms for the provision of generation capacity, and thus compensate the deficiencies of what is called the 'energy-only' electricity market model.

CRMs have provoked many debates, comments and criticisms. They have proponents and opponents. Different questions need to be considered though. First, has the market become more unstable to the extent that it requires new stabilisation instruments? Second, if the answer to the first question is positive, are there options other than CRMs and are they better? Third, if there are no alternative options, how can CRMs be designed to reduce costs and not hurt competition or free trade?

One should not underestimate the huge changes undergone by the electricity system in Europe during the last ten years. The introduction and quick development of renewables has made the electricity system much more complex, since it relies now on a greater number of primary energy sources, quite different in technical and financial aspects. Additionally, the capital needs of producers are extremely diverse. Some have very high fixed costs. Others have much higher variable ones. In any case, the arrival of many new renewable electricity producers with very high fixed costs requires more previsibility in a changed context that generally provides less of it. The electricity production system has also been made more irregular with the rapid development of renewables such as solar and wind. As a result, the reliability challenges of the electricity system have changed and have increased. Furthermore, the development of the energy single market has introduced an additional layer of complexity. It is not difficult to understand why such a situation has provoked a growing thirst for more security, and also rising calls for public intervention.

It is thus difficult to deny that, in the present context of decarbonisation, there is a need to take measures to compensate the growing insecurity of electricity provisioning. Capacity mechanisms participate in that logic and aim to provide that compensation. However, if there were a real threat to the security of the electricity system, this does not automatically mean that capacity mechanisms offer an adequate response. In fact, the growing instability is provoked by numerous and various factors, and not only by the growth of renewables. Any strategy aiming to reduce electricity insecurity thus needs to deal with many instruments.

As there is limited practical experience of most CRMs in the EU and as some have been frequently modified since their introduction, it is too soon to provide a valid assessment of their efficiency and impact. Clearly, however, they can have repercussions on free competition, on the single market principles and on further integration. It is in fact paradoxical to define the guarantees of security at the national level, without taking into consideration the impact for the EU market, while Member States frequently invite all parties involved to complete the internal market, through, in particular, increased cooperation. As a minimum, the need for a viable and strong EU framework clearly exists, to avert (or at least minimise) the potential damage that could prevent a further integration of national markets. Fortunately, the Commission has taken initiatives in that direction.

INTRODUCTION

In recent years, the EU has seen the proliferation of Capacity Remuneration Mechanisms in many Member States. These mechanisms are employed to ensure that the electricity system has sufficient capacity[1] available to meet the electricity demand at all times in the national markets. They depend on medium- to long-term projections of peak demand and the long-term projection of supply.[2]

Capacity Remuneration Mechanisms (hereafter CRMs) are a complex but not a new topic. They already exist in other regions of the world (e.g., the United States or South America) and even in Europe (e.g., Russia). In the EU, however, they have remained limited until recently to a very small number of Member States.

The cause of the current proliferation of CRMs in the EU lies, as surprising as it may seem, in the fact that an increasing number of Member States entertain growing doubts about the ability of their liberalised and restructured markets to meet the electricity demand by 2020 and beyond.[3] Their doubts are based on a combination of factors that negatively impact the investment climate for generation capacity. In other words, until now, there has been no clear answer to the question of whether operators would invest sufficiently in new generation capacity in time to meet electricity demand in the future. This uncertainty obviously increases the risk of the occurrence of blackouts, which are rare in our industrialised societies and economically very costly. To improve the prospects of adequate generation capacity and prevent this risk, many Member States have thus undertaken to remunerate firms for the provision of generation capacity, and thus compensate for the deficiencies of what is called the 'energy-only' electricity market model.

Under this 'energy only' model (EOM), electricity generators are not paid for the generating capacity provided, but for the energy they sell. The (expected) energy price is presumed to reflect operating conditions and to provide the right incentive for investment in generating capacity. In other words, the price of the energy gener-

1 Capacity includes both generation and equivalent solutions such as storage or demand response, but for convenience we will in this introductory paper often refer simply to generation. ACER's Framework guidelines on electricity balancing of 18 September 2012 (p. 8) define Demand Response as 'changes in electric usage by end-use consumers from their normal load patterns in response to changes in electricity prices and/or incentive payments designed to adjust electricity usage, or in response to the acceptance of the consumer's bid, including through aggregation'. Other definitions exist, however. See, for instance, Directive 2012/27/EU (Recitals 44 and 45) as well as the March 2015 Eurelectric paper entitled 'Designing fair and equitable market rules for demand response aggregation' (p. 7).

2 L. Meulman and N. Méray, *Capacity Mechanisms in Northwest Europe. Between a rock and a hard place*, Clingendael International Energy Programme, Nederlands Institut voor Internationale Betrekkingen, November 2012, p. 9.

3 ENTSO-E in its latest scenario outlook and adequacy forecasts of 2015 foresees a 0.8% annual increase in electricity demand from 2016-2025 due to electrification of heating and transport and the economic recovery. These results are based on the transmission system operators' highest forecast for electricity demand growth.

ated is the key driver for investment decisions in capacity. Under the current conditions, this model fails to send the economic signals necessary to ensure investment in capacity.

With the introduction of CRMs, Member States want to give a value to generating capacity in order to protect their security of electricity supply (security of electricity supply means different things in different contexts. In this introductory paper, security of supply refers to generation capacity adequacy and the need for real-time generation flexibility). They have decided to recognise via CRMs that the creation and maintenance of generating capacity, and not just output, need to be rewarded.

CRMs have provoked many debates and comments. There are proponents and opponents. It goes without saying that utilities, in particular those affected by stranded generation assets,[4] have been largely supportive of the implementation of CRMs. However, other questions need to be considered. First, has the market become unstable to the extent that it requires new stabilisation instruments? Second, if the answer to the first question is positive, are there options other than CRMs and are they better? Third, if there are no alternative options, how can CRMs be designed to reduce costs and not hurt competition or free trade?

This introductory paper concentrates only on the electricity sector and aims to provide basic answers to these three questions. To this end, it will describe (I) the main elements driving the implementation of CRMs; (II) the various forms of CRMs, with examples of Member States which have already introduced them; (III) criticisms of CRMs; (IV) the Commission's initiatives and (V) some Member States' collective initiatives, and finally, the question of their inevitability and potential alternatives (VI).[5]

Tania Zgajewski[6]

4 Generation assets become uneconomical to operate when their marginal cost of generation exceeds the price for electricity over an extended period of time, meaning that they cannot generate profits through the sale of electricity. See B. Caldecott and J. McDaniels' *Stranded generation assets: implications for European capacity mechanisms, energy markets and climate policy*, Working Paper, Smith School of Enterprise and the Environment and the University of Oxford, January 2014, p. 5.

5 Research for this introductory paper stopped mid-June 2015.

6 Tania Zgajewski is a Senior Research Fellow at Egmont.

I. THE DEVELOPMENTS UNDERMINING THE ENERGY-ONLY ELECTRICITY MARKET MODEL THAT POINT IN FAVOUR OF CRMS

The Member States' general distrust of markets stems from different developments that appeared in the wake of the growth of electricity generation from renewable energy sources (RES) that benefitted from support mechanisms (subsidization[7] and priority dispatch); the stagnation of electricity demand (due to the economic crisis and the implementation of energy efficiency policies); and last but not least the insufficiently flexible power plant fleet. They reveal why market actors have not been inclined to invest in generation capacity while remedies or solutions have not been brought forward.

The first development is linked to electricity trading on power exchanges. The latter produce reference prices and cooperate in order to intensify cross-border electricity trade between Member States. They have operated a process of market coupling for several years. Market coupling allows the optimisation of the available production resources and the electricity needs by matching supply and demand on the energy exchanges of the different coupled markets. This system increases the liquidity of the energy system across a larger geographical area. However, it faces a major physical obstacle: it has to take into account the insufficient availability and capacity of cross-border interconnectors.

But Member States are currently alarmed by what is taking place in the prices produced in the context of these power exchanges.

Electric power is provided by generating facilities that serve a large number of customers. They entail fixed and variable costs. Fixed costs are essentially capital costs to build the plant and land. They do not vary with the level of output (i.e., how much electricity the plant produces). Variable costs are complex and compound fuel costs,[8] pollution costs,[9] and variable operational and maintenance costs. They fluctuate with the level of output and the power generation technologies used.

The variability of demand for power (with its daily, weekly and seasonal patterns) and the limited ability to store electricity (although improvements are being made in this area) require that every power system uses various generation facilities. Base-load plants satisfy the minimum demand around the clock and throughout the year.

[7] For instance, through feed-in tariffs, which guarantee a fixed price per unit of renewable electricity generated.

[8] It should be noted that fuel costs are driven not only by the cost of the fuel that is being converted to electricity, but also by the efficiency of the conversion process.

[9] For instance, costs of airborne pollutants [i.e., sulphur and nitrogen oxides (respectively SO2 and NOx), carbon dioxide (CO2), particulate matters (PM2.5)] generated during electricity production.

They are typically inflexible because it takes time to bring them up to full power and shut them down again. They bear low variable costs but high capital costs (e.g., nuclear and coal-fired plants). Intermediate plants can also operate for extended periods at a time, but generally do not run all the time. They are typically combined cycle combustion turbines (CCT) fuelled by natural gas with fuel oil as a back-up. Peaking plants generally run only when there is high demand for power. This means that they step in on request during peak hours. For this reason, they are very flexible and can commence and change output very quickly. Typically they are simple cycle combustion turbines (CT), with low capital costs but high variable costs because they tend to have relatively low-fuel efficiency and relatively high air emissions per KWh of energy generated. Many of them are fuelled by natural gas with oil as a back-up.

The cost of producing each MWh (equivalent to 1,000 kWh) is called the ‘marginal cost’.

The generator is remunerated only through selling energy (remuneration per MWh). So the price signal sent by the market will be extremely important because the profitability of power plants depends on the level of electricity prices. It is this level which will allow them to make a profit and recover their fixed and variable costs.

However, a well-functioning and competitive power market produces electricity at the lowest possible price. To achieve this, the merit-order (employment sequence of generation facilities) is applied. Generation facilities with the lowest marginal costs will thus be the first in line to meet electricity demand, and the number of generation plants involved will increase up to the point where electricity demand is fully satisfied. The final price is thus equal to the marginal costs of the most expensive power plant in use.

In theory, for base-load and intermediate plants, fixed costs are recovered by the difference between the market price and the variable costs of the power plant (this difference is called the ‘infra-marginal rent’). By contrast, peak plants, which produce only occasionally when demand is high (peaking), earn no infra-marginal rent. They rely on their ability to increase their offer price to generate what is called a ‘scarcity rent’. As a result, the electricity system experiences very high prices which are considered justifiable because peak plants operate in standby mode, and because the prices allow them to recover their fixed costs. The increased occurrence of such price spikes signals to investors that new investment in peak units would be profitable.

The penetration of RES (in particular, wind and solar) simultaneously with the liberalisation of the European electricity markets has upset this operating mode. Their continuously increasing share[10] has become a source of distortion for the wholesale electricity markets. On the one hand, this distortion has contributed to containing or

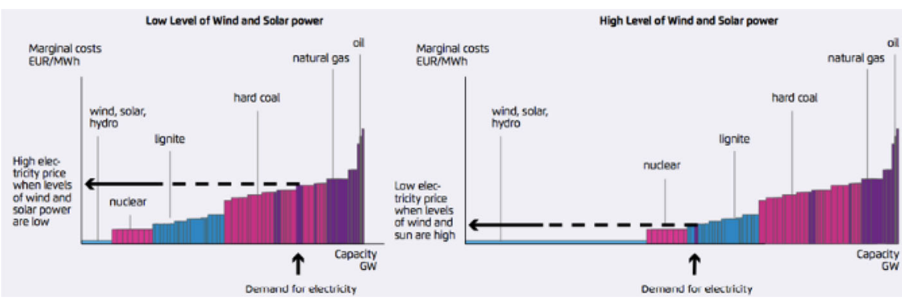
[10] In the 2015 edition of the *Scenario Outlook & Adequacy Forecast*, ENTSO-E indicates that 22 countries will have a RES capacity penetration level higher than 50% in their systems. In eight countries (Germany, Denmark, Great Britain, Greece, Ireland, Northern Ireland, Netherlands and Portugal), demand could at times be totally covered by renewable generation.

lowering electricity prices in many wholesale markets by causing a shift in the merit order.[11] Indeed, green electricity generation is characterised by low or near zero marginal costs since it has zero fuel costs (see Figure I).

On the other hand, it has also contributed to producing zero or even what is called ‘negative prices’. Negative prices are not new but their occurrence has strongly increased on the European energy exchanges since 2008. They are prices that fall below zero. They indicate that consumers are getting paid by electricity producers for consuming electricity. They are due to the simultaneous presence of two elements: an abundant green electricity generation characterised by zero-fuel costs (thus upsetting the merit order) and a low electricity demand. They are also the consequence of opportunity costs for certain types of generators – i.e., it is less costly to operate the plant at even negative prices for a very limited period of time than to reduce the plant’s output. Many power exchanges (within and outside the EU) do not allow negative prices, however.

It should be noted that if their more frequent occurrence (especially in certain Member States), is worrying, negative prices can be useful. They are an indicator of tense situations in the power system and convey information for market participants. In the short term, negative prices talk to energy consumers. They create an economic incentive for consumers to shift their consumption patterns in order to capture the opportunity of being paid, instead of paying, to receive energy. In the long term, however, negative prices talk to energy producers, not to energy consumers. Their emergence shows that the generating fleet encompasses too little ‘flexible’ capacity, or that grid interconnections are insufficient to properly exploit the spare, flexible capacity available within a market area.[12]

Figure I: Electricty Prices and the *Merit-Order* Curve



(Source: https://www.google.be/search?q=merit+order&rlz=1C1CAFA_enBE627BE627&espv=2&biw=1258&bih=859&tbm=isch&tbo=u&source=univ&sa=X&ved=0CCYQsARqFQoTCM-2-efLxscCFcNZFAodxVoMoQ)

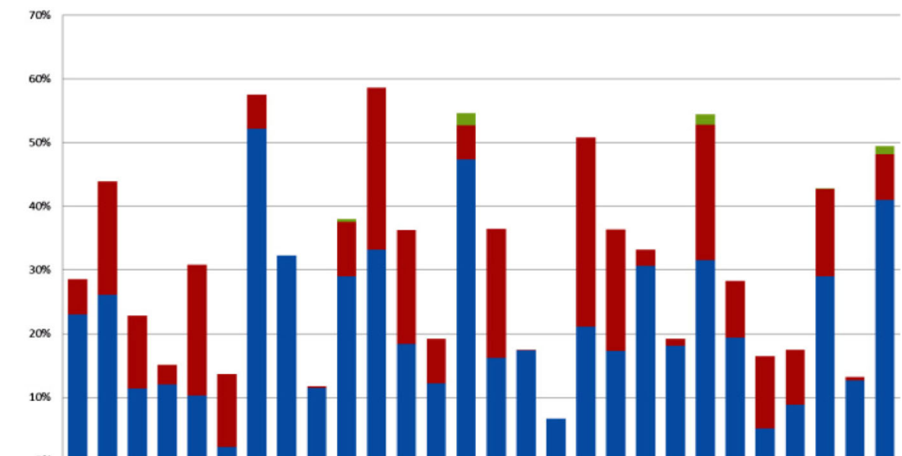
[11] For more information on this issue, see P. Deane (UCC) et al., ‘Quantifying the merit-order effect in European electricity markets, the INSIGHT_E project’, *Rapid Response Energy Brief*, February 2015.

[12] See the article by Simona and Carlo Stagnaro published in the *Energy Post* on 27 May 2014 and entitled ‘The case for allowing negative electricity prices’ (http://www.energypost.eu/case-allowing-allowing-negative-electricity-prices/).

The impact of this first development is compounded by another. The increase of solar and wind capacities coupled with the stagnation of electricity demand (due to the economic crisis and the implementation of energy efficiency policies) has engendered a reduced demand for conventional electricity production. This situation has led to overcapacity in the electricity system for conventional power plants, because they are under-utilized. Gas-fired power plants are the most affected as their situation has been compounded by changes in coal-gas fuel price spreads and by a weak carbon price signal within the EU ETS, reducing the penalties for burning coal.

Needless to say, these two trends are damaging the revenues that should contribute to the recovery of conventional generators' costs. As a result, they are discouraged from investing in conventional power plants, which might suffer from low utilisation, or may not even be used once built. Meanwhile, the increased need for flexible back-up units to cover the continuously growing irregular generation from RES (see Figures II and III) and peak demands remains, as well as the need to replace old, inefficient and polluting power plants or nuclear plants when nuclear phase-out has already been envisaged. Therefore, the current overcapacity of conventional power plants could well become undercapacity in the next few years or in the long run. This undercapacity, if it occurs, could become more problematic with the growing intermittency due to the continuous development of RES capacity, since this intermittency could lead to tensions in the electricity system, even during off-peak periods.

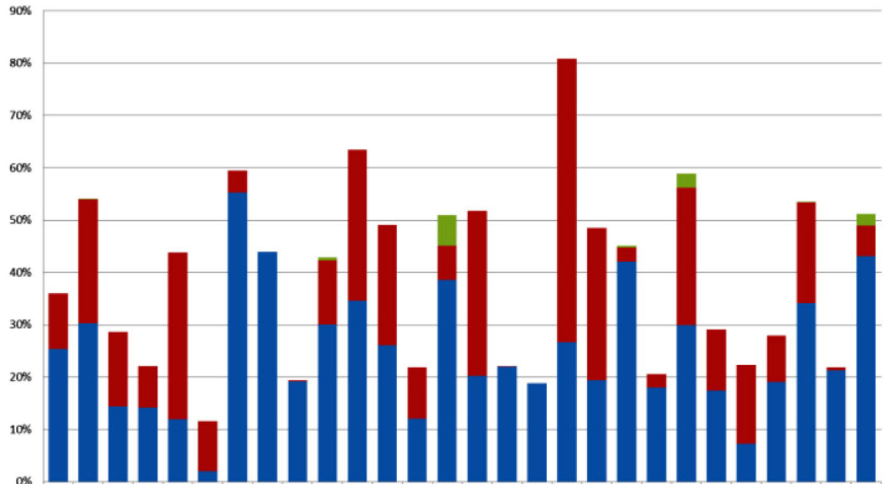
Figure II



	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE	UK
%Other	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	1%
%Solar	6%	18%	11%	3%	21%	11%	5%	0%	0%	9%	25%	18%	7%	5%	20%	0%	0%	30%	19%	3%	1%	21%	9%	11%	9%	14%	1%	7%
%Wind	23%	26%	11%	12%	10%	2%	52%	32%	11%	29%	33%	18%	12%	47%	16%	17%	7%	21%	17%	31%	18%	32%	19%	5%	9%	29%	13%	41%

Source: Insight_e project study, 'Quantifying the merit order effect in European electricity markets', *Rapid Response Brief*, February 2015, p. 9.

Figure III



	AT	BE	BG	HR	CY	CZ	DK	EE	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE	UK
%Other	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	6%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	2%
%Solar	11%	24%	14%	8%	32%	10%	4%	0%	0%	12%	29%	23%	10%	6%	32%	0%	0%	54%	29%	3%	3%	26%	12%	15%	9%	19%	1%	6%
%Wind	25%	30%	14%	14%	12%	2%	55%	44%	19%	30%	35%	26%	12%	39%	20%	22%	19%	27%	19%	42%	18%	30%	17%	7%	19%	34%	21%	43%

Source: Insight_e project study, 'Quantifying the merit order effect in European electricity markets', *Rapid Response Brief*, February 2015, p. 9.

The third development is related to the 'missing money' problem. The missing money problem concerns unsuitable price dynamics in peak load hours due to regulatory actions such as price cap measures. Price caps limit the highest prices. They are problematic for peaking plants. By preventing prices from reaching high levels during scarcity situations, these price caps reduce the payments that could be applied to cover their fixed costs, to the point that some assets prematurely close or are mothballed across the EU as profits are further eroded. Therefore, the resulting missing money also reduces the incentives to maintain plants or build new generation facilities. The above-mentioned current capacity oversupply situation across much of Europe may provide a temporary buffer, but ultimately plant closure will undermine security of supply.

If authorities are encouraged to adopt price cap measures, it is because they consider very high prices politically unacceptable. But the primary reason for capping energy prices is to mitigate generator market power in scarcity situations. This possibility of exercising market power during scarcity situations comes from a lack of short-term demand response.[13] However, as the electricity market is not fully competitive, it is difficult for these authorities to distinguish between peak prices which occur in real

[13] See R. Meyer et al., 'Analysis of capacity remunerative mechanisms (CRMs) in Europe from the internal electricity market point of view', *Elforsk rapport* 14:22, March 2014, pp. 1-2.

scarcity situations, and market power abuses. The definition of the appropriate level of a price cap is consequently always a delicate task.

In summary, the missing money, which has become more topical with the growing penetration of RES, goes hand-in-hand with ‘missing incentives’, and alternative approaches thus appear necessary to complement the EOM.

The combination of these three developments has prompted Member States to intervene by introducing CRMs as the best option to ensure adequate investment signals, generation adequacy, and flexibility, as the electricity market seems to have currently lost the ability to do this for itself.

Some Member States have already put these mechanisms in place. Others are planning or considering doing so. However, there is neither a standard design for capacity mechanisms nor a common trading platform for capacity as a product in Europe.[14]

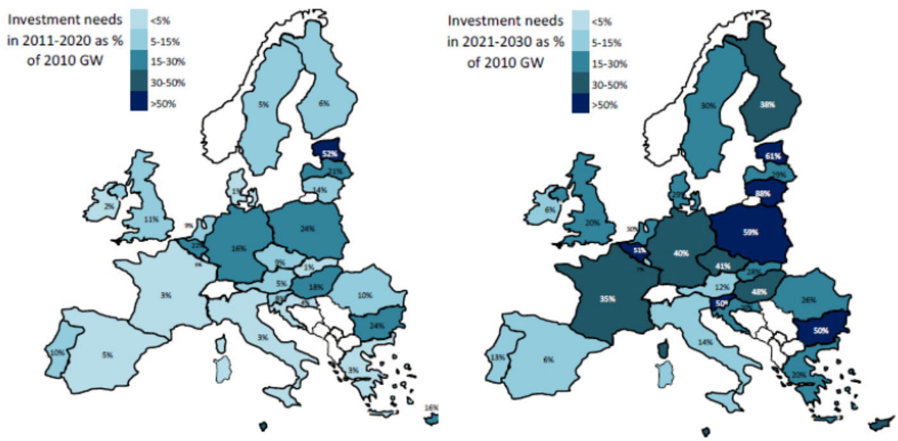
So the EU is thus in a peculiar situation, due to the accumulation of several developments. The electricity system has become more diverse. New electricity sources (such as wind and solar) have an intermittent nature and are variable in output. Security of electricity supply is therefore – in the absence of appropriate and affordable storage solutions – linked to an energy back-up system. The rapid and continuous growth of RES and their entry at zero marginal cost in the power generation mix have also substantially disrupted the modus operandi put in place, and have created huge challenges to conventional generation operators, even bringing into question their business model. The situation is critical in particular because of the current overcapacity induced by the economic slowdown in recent years. Furthermore, all this is happening in a strategic period. A lot of old and polluting capacities have to be decommissioned and gradual nuclear phase-out foreseen. Finally, as electricity is a key vector in a low carbon economy, it will play an increasingly central role in the energy mix in the future, while renewable generation will continue to progress and to increase the challenge to system flexibility. There is thus a strong need for a long-term vision for a new electricity system, since this is indispensable for offering the proper investment incentives. (See Figure IV).

As emphasized by the International Energy Agency (IEA), the mounting role of renewables in the electricity system engenders mounting problems with investments in peak power plants.

> ‘The variability of electricity demand and the need to meet peak demand has always been a concern for system operators. During a few hours of peak demand, efficient electricity wholesale hourly prices are volatile and much

[14] J. Grigorjeva, *Capacity Mechanisms in the EU: Nationalizing energy security*, Jacques Delors Institut Berlin, Policy Paper 134, 21 May 2015, p. 12.

Figure IV: Requirements in new dispatchable plants according to an extrapolation of decommissioning



Source: COWI/THEMA Study, Capacity mechanisms in individual markets within the IEM, June 2013, p. 65.

> higher than the yearly average wholesale price: efficient peak prices reflect the costs of the plants needed to meet peak demand. With high shares of wind and solar power, new investment in capacity, including generation plants, demand response, storage capacity will be needed. However, attracting sufficient and timely investment in peak capacity and incentivizing demand response has proven to be a problem for several OECD electricity markets.'[15]

Clearly, given the increasing need for decarbonisation, even well-designed and regulated energy markets do not suffice to offer the proper incentives for investment.

15 M. Baritaud, *Securing power during the transition*, IEA, 2012, p. 11.

II. The patchwork of capacity remuneration mechanisms in the EU

The CRMs put in place, planned or considered by Member States vary strongly. These variations often result from the specific context of the country concerned (energy mix, political sensitivity, power generation industry). Given the different characteristics of Member States' energy markets, there is thus no single fix to the problem that CRMs are intended to address.[16] Consequently, their classification is difficult. According to the Agency for the Cooperation of Energy Regulators (ACER), there are broadly three major categories of CRMs: Capacity Payments, Strategic Reserves and Capacity Markets (i.e., the 'capacity auction' model regarded as a centralised mechanism, or the 'capacity obligation' model seen as a decentralized mechanism or 'reliability option' rarely used in the EU).[17] The first two categories are complementary tools in the framework of the EOM. The third category creates a new and separate market alongside the EOM.[18] The first category includes price-based mechanisms, while the last two categories include quantity-based mechanisms (also called volume-based mechanisms). Within these three categories, there can be many differences in structure and in implementation.

Capacity Payments. The principle is to give a direct payment to the available capacity. In other words, each MW installed receives ex-ante determined payment for its availability. The payment is estimated by the competent authority and may differ according to technology or the definition of availability. The costs are borne by consumers in the form of taxes or capacity surcharges. Such mechanisms are not, however, as simple as they appear to be. They require a detailed knowledge of the market. An erroneous estimate of the structure of the incentive can easily cause undesired under- or overinvestment in capacity.

Greece and Ireland introduced Capacity Payments in 2006 and 2007 respectively. Spain introduced them in 1998 but is discussing further reforms. Portugal introduced the same Capacity Payments system as Spain in 2011.

Strategic Reserves. These are reserves triggered by extreme market or system security circumstances. The Strategic Reserve is limited to bridging the gap identified by the competent body (transmission system operator or TSO, and/or grid regulator).

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16 L. Meulman and N. Méray, *Capacity Mechanisms in Northwest Europe. Between a rock and a hard place*, Clingendael International Energy Programme, Nederlands Institut voor Internationale Betrekkingen, November 2012, p. 11.

17 For more information, see ACER's paper, *Capacity remuneration mechanisms and the internal market for electricity*, 30 July 2013, pp. 4-8.

18 J. Grigorjeva, *Capacity Mechanisms in the EU: Nationalizing energy security*, Jacques Delors Institut Berlin, Policy Paper 134, 21 May 2015, p. 12.

Centrally and competitively procured, it can include old power plants as well as newly built units. But there is increasing disquiet within the industry concerning the lack of transparency around remunerating capacity this way. Union rules on public procurement[19] must be respected and help ensure that there is no overcompensation.

Belgium, for instance, introduced a Strategic Reserve in 2014 (in the wake of the 'Plan Wathelet') to ensure a sufficient level of security of electricity supply during the winter periods (from November to March). It is activated during such periods in situations where total Belgian consumption cannot be covered by the available production capacity in Belgium and imports from other countries. The design, procurement and operation of this mechanism has been assigned to the Belgian electricity transmission system operator, ELIA, under the supervision of the CREG (the federal regulatory authority for the energy sector), which also validates the rules of operation.

Thanks to this mechanism, ELIA is able to activate generation units that would otherwise be unavailable, or to instruct consumers willing to participate in this mechanism to reduce their load.

Finland, Poland and Sweden also have a Strategic Reserve mechanism, while the Netherlands developed a Strategic Reserve model in 2003 but has not yet activated it.

(Forward) Capacity Markets. By comparison with Capacity Payments and Strategic Reserves, Capacity Markets imply the creation of new and separate markets in addition to the existing EOM. Capacity is traded as a product on these new markets, which are complex.

Italy, for instance, introduced Capacity Payments in 2004 to ensure capacity, but has now chosen a market-based mechanism (auction model), with the first auction to be held during the last quarter of 2015. The auction model was prepared by the Italian grid operator, TERNA, on the basis of criteria developed by the Italian Regulatory Authority for electricity (AEGW). It was approved in June 2014 by the Italian Ministry of Economic Development with the endorsement of AEGW. The auction will take place a few years ahead of the delivery year in which capacity is required to be made available. According to this model, procurement of capacity is performed by competitive tenders where TERNA is the central counterparty that also determines the level of capacity to be made available. Participation of power producers is made on a voluntary basis. Specific characteristics must, however, be met by the participants (e.g., in addition, the participating power plants – planned, under construction or existing – must have a pre-defined capacity and be located on Italian territory,

[19] Relevant legislation includes Directive 2004/17/EC coordinating the procurement procedures of entities operating in the water, energy, transport and postal service sectors (OJEU, L 134/1, 30.04.2004).

although criteria for the participation of 'beyond the borders' plants are expected). Participants cannot be intermittent power producers. The product negotiated into each tender is the reliability option contract. Within this model, two types of auction will be implemented (a main auction and an adjustment auction). These two auctions also include a geographical element because they are organized by zone. In addition, a 'secondary market' will provide a higher degree of flexibility, allowing power producers to trade between them the contracts they have entered during the auctions mentioned above.[20]

France has also decided to implement a market-based mechanism (obligation model).[21] The market will kick off on 1 January 2017. Here, the obligation to acquire enough capacity to meet the expected consumption of their customers during peak periods is carried by electricity suppliers. To meet its obligation, the supplier will have to acquire capacity certificates. Generating capacity operators that commit to making their capacities available during consumption peaks are granted compensation certificates that they will be able to sell to suppliers. Capacity certificates will be traded on the EPEX power market. It is RTE, the national grid operator, owned by state-controlled utility EDF, which has designed this obligation model, and which will operate the market. The mechanism is technology-neutral (e.g., nuclear, gas, wind, etc).

The United Kingdom also implements a Capacity Market mechanism (auction model). Here the National Grid (the United Kingdom's TSO) provides a forecast of future peak demand and ministers decide the total amount of capacity needed to ensure security of supply. Successful participants in the auctions run by National Grid will enter into 'capacity agreements'. Auctions will take place a few years ahead of the delivery year in which capacity is required to be made available. The first auction was held in December 2014 for capacity in 2018/2019. The government wanted commitments above 49 GW of power generation, which corresponds to the forecast maximum demand in the United Kingdom in 2018/2019. The auction results, which were highly criticized,[22] showed an over-subscription, with 65 GW bringing into question the need for a capacity auction at this point in time and a clearing price considerably below market consensus expectations,. This failed to attract new-build generation and demand-response. The winners were the nuclear fleet and pumped storage reservoirs. On the other hand, the auction outcome was considered a success by the government.[23]

[20] For more information, see 'Capacity Payment in Italy and the German case', Clifford Chance, April 2015 <http://www.cliffordchance.com/briefings/2015/04/capacity_paymentinitalyandthegermancase.html>.

[21] See T. Veyrenc (RTE), 'A capacity market in France – status of discussions and future steps', WEC European Energy Forum, 24 April 2014. See also, *French Capacity Market*, Report accompanying draft rules, RTE.

[22] See the article written by C. Goodall, 'The UK capacity auction made power companies merry this Christmas', in the *Guardian*, 24 December 2014 and the article written by M. Parr, 'UK's "capacity market" is not a market – it's state aid (£1 billion/year)', EnergyPost.eu, 26 January 2015. See also the paper written by Phil Baker, E. Bayer and J. Rączka, *Capacity market arrangements in Great Britain*, Forum for Energy Analysis, January 2015.

Romania has also had a Capacity Market since 2007.[24] Other European countries are discussing the topic. This is the case of Germany, where discussions are particularly strong. It hesitates a choice between two options: an optimized EOM (Electricity Market 2.0 option) that investors can rely on, or the introduction of a Capacity Market mechanism. Each option has its proponents and opponents. In the meantime, several German operators have announced that they will shut down their peaking plants by April 2016 because according to them they can no longer supply power to the market at profitable terms. They have even threatened to consider legal action if the government prohibits the shutdown of plants. This situation should not be underestimated because it could happen elsewhere in the EU.

Other types of classification are also proposed. As mentioned in Point IV of this introductory paper, the Commission has adopted Guidelines on State aid for environmental protection and energy 2014-2020 (EEAG).[25] They contain for the first time rules to assess capacity mechanisms (Section 3.9). As this is a relatively new field in state aid policy, the Commission has also created a Working Group with the Member States to help them implement the relevant provisions in the Guidelines and to share experience in the design of CRMs. Thematic papers are then issued by the European Commission. In this context, the Commission has issued a discussion paper presenting a dual description of CRMs, based on the essential distinction between targeted and market-wide models.[26] This dual description is also the one proposed in its recent capacity mechanism state aid probe, launched in April 2015[27] (see Figure V, p. 19).

23 GOV.UK's press release published on 2 January 2015 <https://www.gov.uk/government/news/the-first-ever-capacity-market-auction-official-results-have-been-released-today>

24 Romania country profile, p. 79 [http://www.ebrd.com/downloads/legal/irc/countries/romania.pdf,

25 OJEU, C200/1, 28.06.2014.

26 Capacity Mechanisms Working Group, 30 June 2015 – High-level comparison of capacity mechanism models and compatibility with state aid guidelines.

27 State Aid: sector inquiry into capacity mechanisms – frequently asked questions (MEMO/15/4892 of 29 April, 2015.

Figure Va: Taxonomy of capacity mechanism models

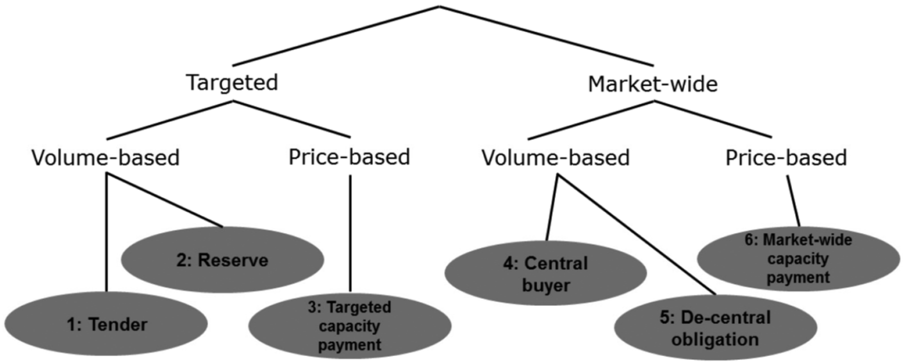
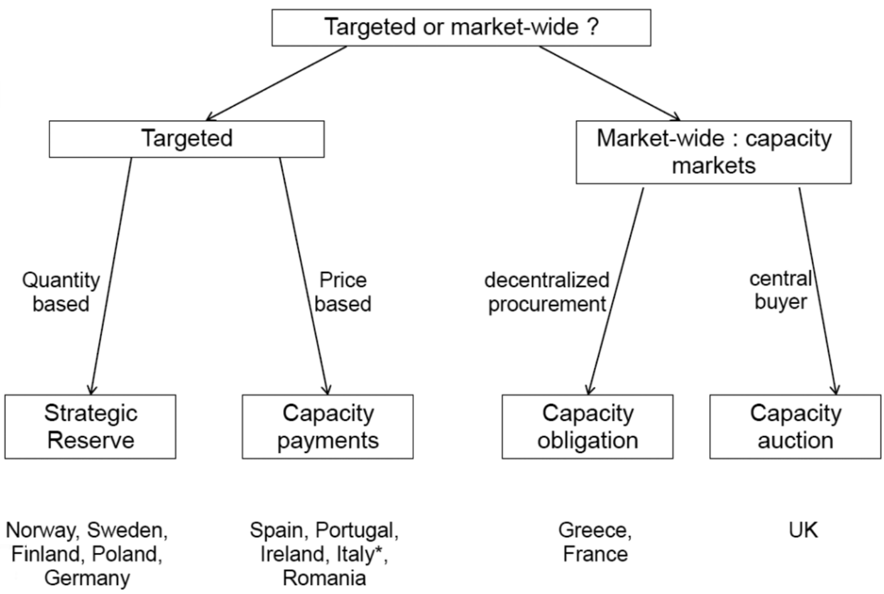


Figure Vb: Different types of capacity mechanismes



III. TEN CRITICISMS OF CRMS

Many criticisms are made of CRMs. The following ten counterarguments are presented without distinguishing between the three categories of CRMs introduced.

First, capacity is encouraged on the basis of uncertain forecasts for various conditions made several years in advance.[28] Deviation between forecasts and the electricity demand – and therefore the capacity requirements – can result in distortions of the electricity price formation. More crucial in the development of the single energy market, generation adequacy is increasingly difficult to ensure on a purely national basis.[29] Yet Member States have so far continued their own national forecast.

Second, the cost of CRMs can be very high. Expensive CRMs could thus increase the energy bills paid by energy consumers without facilitating improved supply security.[30] International experience shows that CRMs can cost up to 10% to 20% of wholesale electricity (i.e., energy only) prices.[31]

Third, CRMs can over-reward generation that is financially viable.[32] They can also be designed in a way that benefits certain operators or technologies (even if they are uneconomical and unsustainable) and this can discourage other types of investment. They can also impede the development of alternative solutions such as storage or Demand Side Response (DSR), for example.[33] This is an important point considering

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28 For instance, see the CREG Study entitled « Les mesures à prendre afin de disposer du volume adéquat de moyens de production conventionnels pour assurer la sécurité d'approvisionnement en électricité de la Belgique », 4 June 2015, p. 6.

29 SWD(2013) 438, p. 3.

30 According to the Booz *2013 Study on the benefits of an integrated European energy market,* the fact that Member States tend to ensure security of supply on a national basis costs them between €3-7 billion extra per year.
See also A. Pototschnig and M. Godfried, *Capacity mechanisms and the EU internal electricity market. The regulators' view*: *ACER's report on capacity mechanisms*, 2013, p. 1. See also B. Caldecott and J. McDaniels, Stranded generation assets: implications for European capacity mechanisms, energy markets and climate policy, Working Paper, January 2014, pp. ix and 11. <http://www.acer.europa.eu/The_agency/Organisation/Administrative_Board/Meetings/16th%20AB%20Meeting%20%20Background%20Documents/21-AB-16-14_Pototschnig%20Godfried%20Chapter.pdf >

31 SWD(2013) 438, p. 32.

32 For more information on the topic, see SWD(2013) 438, pp. 24-25.

33 According to the Capacity Mechanisms Working Group, Demand Response or DSR refers to 'the ability of electricity consumers to supply electricity by reducing their demand at times of system scarcity.' <http://ec.europa.eu/competition/sectors/energy/capacity_mechanisms_working_group_4.pdf > The DSR concept refers to various solutions sponsored by the power grid, the most common of which involves paying companies or end-users to be on call to reduce electricity usage when the grid is stressed to capacity. The concept is, however, broader. In fact, it can be either incentive-based, where consumers are offered payments to reduce their power consumption at times of peak demand or when the system is under stress, or it can operate on a time-price principle. In either case, it requires consumers to either actively respond to signals from the operator or, hopefully with the development of ICT, to make use of automated solutions to enter into contracts with service providers. This implies that customers voluntarily accept to deviate from normal consumption behaviour in order to obtain lower electricity prices and to support security of supply. Consequently, Demand Response flattens the load profile and avoids more expensive investments in new power plants. This presents the additional advantage of reducing CO_2 emissions.

the comparative benefits of adapting demand rather than increasing supply. As indicated by the Commission, DSR can offer benefits to all parties involved:

> 'Demand response is an asset for both the retail and the wholesale market. In wholesale markets, equal market-entry opportunities for demand side resources (e.g., industrial loads) alongside generation should be pursued in line with the EU energy policy. The value of demand response for the wholesale and balancing markets, at various time scales (i.e., including the day-ahead, intraday and forward markets) is far from being tapped. EU industries and businesses of all sizes need to have access to these markets and be adequately compensated. As a consumer-driven and market-based mechanism successfully implemented in many other economic sectors, demand response is also an integral part of a consumer-centric retail market vision in the energy sector'.[34]

However, a strong nexus exists between DSR and the development of smart grids, which are presently behind schedule in Europe.[35]

Additionally, few countries allow DSR to participate. A frequent explanation is that it makes the implementation of the CRM more difficult. The experience of the United States has, however, shown that a capacity mechanism that allows for adequate participation by DSR can enable it to take off.[36] This said, one of the drivers for the United Kingdom and France to adopt a CRM was the ambition to increase opportunities for DSR.

Fourth, a capacity market can only prove an effective solution to security of supply problems if the capacity market itself can provide credible signals for investment. For instance, the British mechanism with its first auction has proved unable to generate the signals mentioned in this paper.

Fifth, various Member States have reconsidered all or part of the CRM since their introduction.[37] This constant change in regulation can disrupt investment planning and fundraising. It also causes difficulties in managing relationships with investors.

Sixth, many CRMs involve state aid.[38] Yet some countries submit their CRM for state aid clearance to the European Commission (e.g., the United Kingdom), while others

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34 SWD [2013] 442, p. 4.

35 See T. Zgajewski, *Smart Grids: a very slow deployment in the EU*, Egmont Paper n° 74, February 2015.

36 See the North European Power Perspectives's paper, *Capacity mechanisms: Revived interest in capacity mechanisms throughout Europe in the face of high volumes of intermittent generation*, September 2011.

37 L. Meulman and N. Méray, *Capacity Mechanisms in Northwest Europe. Between a rock and a hard place*, Clingendael International Energy Programme, Nederlands Institut voor Internationale Betrekkingen, November 2012, p. 11.

38 L. Meulman and N. Méray, *Capacity Mechanisms in Northwest Europe. Between a rock and a hard place*, Clingendael International Energy Programme, Nederlands Institut voor Internationale Betrekkingen, November 2012, p. 12.

do not because they consider that their CRM do not involve state aid (e.g., France). This constitutes an additional source of (legal) uncertainty.

Seventh, when designing CRMs, the cross-border contribution to security of supply through market coupling and TSOs' cooperation is often overlooked.[39] Market coupling, through an algorithm, directs electricity to flow away from low-price regions and towards high-price ones. TSOs' cooperation could also play an important role by establishing cross-border electricity balancing markets. Electricity balancing refers to the situation after markets have closed (gate closure) in which a TSO acts to ensure that electricity generation equals demand in and near real time. That is essential as it reduces the need for back-up generation and ensures security of supply at lower costs for consumers. The approach to procuring 'ancillary services' is an important aspect of balancing. The latter refer to a range of functions that TSOs contract so that they can guarantee system security.[40] The rationale for developing cross-border balancing markets is thus strong. The revised version of the network code on electricity balancing, prepared by ENTSO-E and recommended on 24 July 2015 by ACER for adoption by the European Commission, is considered to be an important step towards facilitating these cross-border balancing markets.

Eighth, the uncoordinated and unilateral introduction of a CRM in one Member State can create cross-border distortions.[41]

For instance, CRMs may have welfare redistribution effects between interconnected markets due to 'spill-over effects'. A March 2015 study made by DNV GL for Agora Energiewende shows that the envisaged Capacity Market in France could benefit German consumers by limiting the rise in power prices when electricity demand is high in both countries, while the cost of capacity certificates falls on French consumers, whose electricity bills rise. German power plant operators, meanwhile, could lose out on profits from peak power prices.[42]

Other examples of how design choices of CRMs can lead to cross-border distortionary effects are given by ACER.[43]

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39 See the article by S. Farrington published in *Energy Risk* on 16 March 2015 entitled 'Power capacity mechanisms worry EU electricity traders'.

40 Some experts consider, however, that trading an ancillary service on a capacity market creates distortions. For more information, see the article by L. Harrison entitled 'The trouble with capacity markets' in *Wind Power Monthly* of 1 November 2013 <http://windpowermonthly.com/article/1218191/trouble-capacity-markets>.

41 L. Meulman and N. Méray, *Capacity Mechanisms in Northwest Europe. Between a rock and a hard place*, Clingendael International Energy Programme, Nederlands Institut voor Internationale Betrekkingen, November 2012, p. 10.

42 'Potential interactions between capacity mechanisms in France and Germany', DNV GL, March 2015. See also the previous study made by R. Meyer et al, 'Analysis of capacity remunerative mechanisms (CRMs) in Europe from the internal electricity market point of view', *Elforsk rapport* 14:22, March 2014.

43 See the previously mentioned ACER paper, *Capacity remuneration mechanisms and the internal market for electricity*, 30 July 2013, p. 10.

Ninth, CRMs might contradict the objective of phasing out environmentally harmful subsidies, including those for fossil fuels.[44]

Tenth, in the literature, several simulation results show that once a CRM is implemented it becomes the main driver (as opposed to energy prices) for investments in new electricity generation capacity.[45] So remunerating generators for their capacity may not solve problems and could even entail opportunistic speculation.

[44] Communication from the European Commission on launching the public consultation process on a new energy market design – COM(2015) 340, p. 14;

[45] See the previously mentioned ACER paper, *Capacity remuneration mechanisms and the internal market for electricity*, 30 July 2013, p. 12.

IV. The European Commission's initiatives

Communication on generation adequacy in the internal electricity market

A few years ago, the Commission was clearly considering that the single market was the pillar of electricity security of supply (including generation adequacy). Consequently, Directive 2009/72/EC[46] on the internal market in electricity affirms that 'the security of energy supply is an essential element of public security and is therefore inherently connected to the efficient functioning of the internal market in electricity and the integration of the isolated electricity markets of Member States' (Recital 25). For that reason, according to Article 3.2 of the same Directive, 'Member States may impose on undertakings operating in the electricity sector, in the general economic interest, public service obligations which may relate to security, including security of supply,' but such obligations have to be 'clearly defined, transparent, non-discriminatory, verifiable and guarantee equality of access for electricity undertakings.' They also have to be notified to the European Commission as indicated in Article 3.15 of the same Directive.

Reality has proved more complex, however. In a 2010 judgment, the Court of Justice of the European Union stated that Member States have to be able to show that public service obligations are necessary, proportionate and transitional in nature.[47]

In November 2013, the Commission also issued a Communication 'Delivering the internal electricity market and making the most of public intervention,'[48] accompanied by a Staff Working Document entitled 'Generation adequacy in the internal electricity market – guidance on public interventions'.[49] In this document, the Commission recalls that CRMs must not only comply with competition and state aid rules, but should also be in line with the objectives and requirements of EU energy policy.[50] It also acknowledges that 'if remaining market failures are identified as precisely as possible, public intervention should be designed in a cost-effective manner so as to ensure effectiveness and proportionality.'[51]

46 OJEU 2009, L 211/55, 14.08.2009.
47 C-265/08 Federutility and Others v Autorità per l' energia elettrica e il gas. The judgment of the Court sets out 'First, such an intervention must be limited in duration to what is strictly necessary in order to achieve its objective… Secondly, the method of intervention used must not go beyond what is necessary to achieve the objective which is being pursued in the general economic interest. Thirdly, the requirement of proportionality must also be assessed with regard to the scope ratione personae of the measure, and, more particularly, its beneficiaries.
48 C(2013) 7243 final.
49 SWD(2013) 438.
50 For more information, see Kai Uwe Pritzsche, 'Capacity mechanisms: the rules on State aid in Capacity mechanisms. Reigniting Europe's energy markets', Linklaters, 2014, p. 13.
51 Generation adequacy in the internal electricity market, SWD (2013) 438, p. 13.

Member States can thus intervene to fill a generation adequacy gap, and this public intervention may entail public service obligations imposed on generators, suppliers and/or TSOs, provided a number of conditions are respected. First, as required by Article 7 of Directive 2005/89/EC (Electricity Security of Supply Directive),[52] public authorities must regularly undertake an assessment of the generation adequacy situation in their Member State, also fully taking account of development at regional and EU level. Article 4 of Directive 2009/72/EC also points in this direction:

> 'Member States shall ensure the monitoring of security of supply issues ... they may delegate that task to the regulatory authorities. ... Such monitoring shall, in particular, cover the balance of supply and demand on the national market, the level of expected future demand and envisaged additional capacity being planned or under construction, and the quality and level of maintenance of the networks, as well as measures to cover peak demand and to deal with shortfalls of one or more suppliers. The competent authorities shall publish every two years, by 31 July, a report outlining the findings resulting from the monitoring of those issues, as well as any measures taken or envisaged to address them and shall forward that report to the Commission forthwith.'

Second, as already noted, the public service obligations must be cost-effective, proportionate and transitional in nature. Third, 'the intervention must be transparent and non-discriminatory. Intervention cannot undermine the effective functioning of the internal electricity market and in particular must not prevent access to national markets by electricity undertakings established elsewhere in the internal electricity market.'[53]

Interestingly, in spite of the mounting preoccupations regarding the security of electricity supply, the Commission has not endeavoured to elaborate some kind of integrated security mechanism. It is somewhat paradoxical for the Member States to involve themselves in the creation of a continental market, while at the same time elaborating security mechanisms at the national level.[54]

EU state aid rules

Many CRMs could involve state aid and have an impact on competition in the internal electricity market. For that reason, they are subject to EU state aid rules, in particular to the guidelines on State aid for environmental protection and energy 2014-2020,[55] which contain rules to assess CRMs (Section 3.9).

52 OJEU 2006, L 33/22, 04.02.2006.

53 SWD(2013) 438, p. 21.

54 See for example M. Baritaud and D. Volk, *Seamless power markets – Regional integration of electricity markets in IEA Member Countries*, 2014, p. 70.

55 Communication from the Commission (2014/C 200/01), OJEU C 200/01 of 28.06.2014.

In these 2014 guidelines, the Commission invites Member States to establish clearly the need for state intervention:

> "The nature and causes of the generation adequacy problem, and therefore of the need for State aid to ensure generation adequacy, should be properly analysed and quantified, for example, in terms of lack of peak-load or seasonal capacity or peak demand in case of failure of the short-term wholesale market to match demand and supply. The unit of measure for quantification should be described and its method of calculation should be provided.
>
> (223) The Member States should clearly demonstrate the reasons why the market cannot be expected to deliver adequate capacity in the absence of intervention, by taking account of on-going market and technology developments (96).
>
> (224) In its assessment, the Commission will take account, among others and when applicable, of the following elements to be provided by the Member State:
>
> (a) assessment of the impact of variable generation, including that originating from neighbouring systems;
>
> (b) assessment of the impact of demand-side participation, including a description of measures to encourage demand side management (97);
>
> (c) assessment of the actual or potential existence of interconnectors, including a description of projects under construction and planned;
>
> (d) assessment of any other element which might cause or exacerbate the generation adequacy problem, such as regulatory or market failures, including for example caps on wholesale prices.
>
> The Member States must also establish the appropriateness and proportionality of the contemplated measures, and also the avoidance of undue negative effects on competition and trade.
>
> (225) The aid should remunerate solely the service of pure availability provided by the generator, that is to say, the commitment of being available to deliver electricity and the corresponding compensation for it, for example, in terms of remuneration per MW of capacity being made available. The aid should not include any remuneration for the sale of electricity, that is to say, remuneration per MWh sold.
>
> (226) The measure should be open and provide adequate incentives to both existing and future generators and to operators using substitutable technologies, such as demand-side response or storage solutions. The aid should therefore be delivered through a mechanism which allows for potentially different lead times, corresponding to the time needed

to realise new investments by new generators using different technologies. The measure should also take into account to what extent interconnection capacity could remedy any possible problem of generation adequacy.

(228) The calculation of the overall amount of aid should result in beneficiaries earning a rate of return, which can be considered reasonable.

(229) A competitive bidding process on the basis of clear, transparent and non-discriminatory criteria, effectively targeting the defined objective, will be considered as leading to reasonable rates of return under normal circumstances.

(230) The measure should have built-in mechanisms to ensure that windfall profits cannot arise.

(231) The measure should be constructed so as to ensure that the price paid for availability automatically tends to zero when the level of capacity supplied is expected to be adequate to meet the level of capacity demanded."

In this framework, the Commission has recently launched an inquiry and has started individual assessments of 11 Member States that either already have CRMs in place or are considering them. The countries covered are: Belgium, Croatia, Denmark, France, Germany, Ireland, Italy, Poland, Portugal, Spain and Sweden.[56] The United Kingdom is excluded for now because its capacity market was cleared by DG COMP in July 2014.[57] The inquiry's aim is to seek information in order to check that each respective CRM does not favour particular producers or technologies, or create obstacles to trade across national borders. Final results of the initial phase of the inquiry should be published mid-2016. This inquiry should not be underestimated as it may provide the basis for future state aid actions and policy decisions of the European Commission (which may also include repayment of unlawful state aid).

Commission's communication on the Energy Union

It should be noted that the EU's approach has never been supportive of capacity markets as drivers of security of power supply. The Commission's communication on the Energy Union published in February 2015 clearly stated that a functioning internal market does not need CRMs. The EU approach instead encourages schemes of regional integration such as market coupling.[58]

56 See European Commission's press release IP/15/4891 of 29 April 2015.
57 See European Commission's press release IP/14/865 of 23 July 2014.
58 For more information, see Marco Giuli, 'Capacity mechanisms – A credibility test for the Energy Union', *Policy Brief*, 11 June 2015.

JRC

JRC, the European Commission's in-house science service, has been commissioned to assess the appropriateness of existing and proposed generation adequacy assessments at national and European level, and make recommendations on improving them.

V. Recent Member States' collective initiatives

European countries have taken another step towards enhancing EU energy security via regional cooperation.

On 8 June 2015, 12 European countries (Austria, Belgium, the Czech Republic, Denmark, France, Germany, Luxembourg, the Netherlands, Norway, Poland, Sweden and Switzerland) signed a 'Declaration for regional cooperation on security of electricity supply in the framework of the internal energy market'. The signatories want to start considering energy security as a European issue rather than a purely national one, commented Sigmar Gabriel, the German Energy Minister. The declaration sets out an initial series of joint steps to be taken as part of the cooperation.

The key points of the declaration are the following:

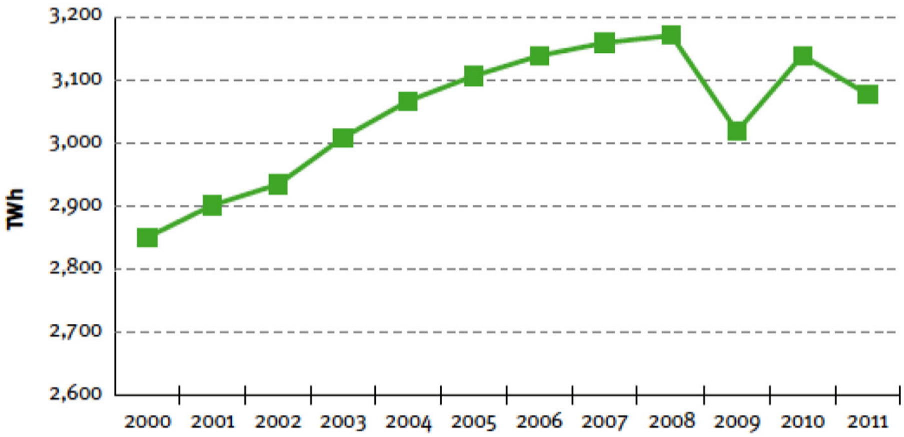
- Place greater focus on making supply and demand more flexible by making use of strong market signals and by using price peaks, as well as eliminating barriers that stand in the way of greater flexibility and refraining from introducing legal price caps.
- Reinforce the grids and avoid restricting cross-border electricity exchange, even in times of electricity scarcity.
- In future, place greater focus on assessing generation adequacy as a regional group and develop a common approach to this end.

In addition to this first political declaration, a 'second political declaration of the Pentalateral Energy Forum' was signed by seven European countries (Austria, Belgium, France, Germany, Luxembourg, the Netherlands and Switzerland). In this forum, representatives of the Member States and TSOs work together on the coupling of their electricity markets and their power exchanges.

VI. IS THE MULTIPLICATION OF CRMS THE BEST STRATEGY?

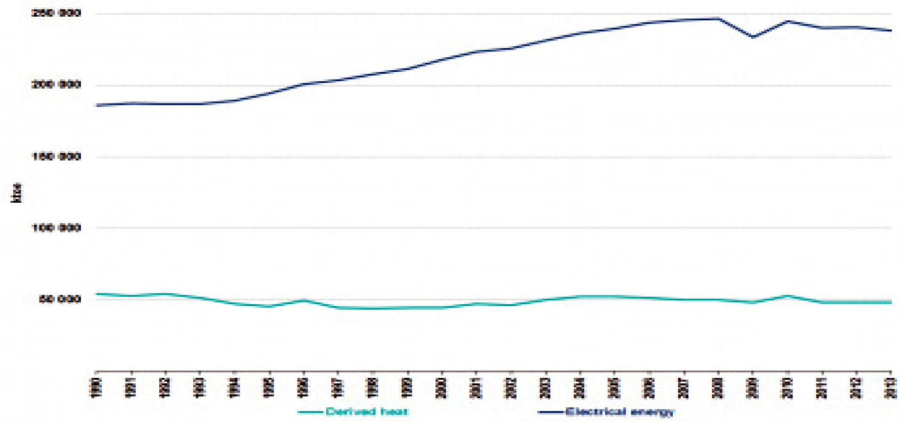
Currently, as we have seen, electricity prices are low on the wholesale market in Europe for many reasons. The deep economic recession after 2008, and the reduction of potential growth, have played an important role (See Figures VI, VII and VIII). Meteorology has also led to a lower level of consumption. Furthermore, the electricity intensity of growth has also diminished, notably because energy efficiency has progressed. Additionally, the huge subsidies offered to wind and solar during the last decade have brought a lot of new near-zero marginal cost capacity onto the market. Overall, there is currently too much capacity, coinciding with economic stagnation. Incentives for investment remain weak, and incentives for mothballing power plants, especially gas ones, substantial.

Figure VI: EU-27 Electricity Demand



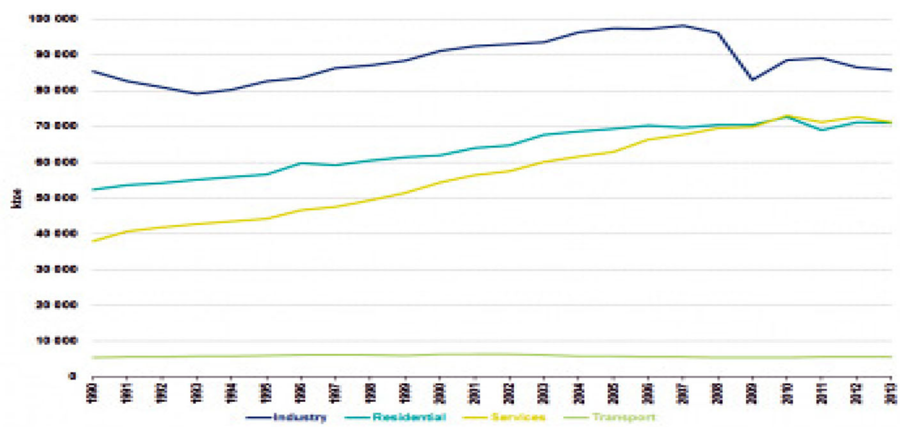
Source: A. Baker, Investing in electricity, 2014, p. 6

Figures VII: Final consumption of electricity and derived heat, ktoe, EU-28, 1990-2013



Source: Eurostat (nrg_100a)

Figure VIII: Final consumption of electricity by sector, ktoe, EU-28, 1990-2013



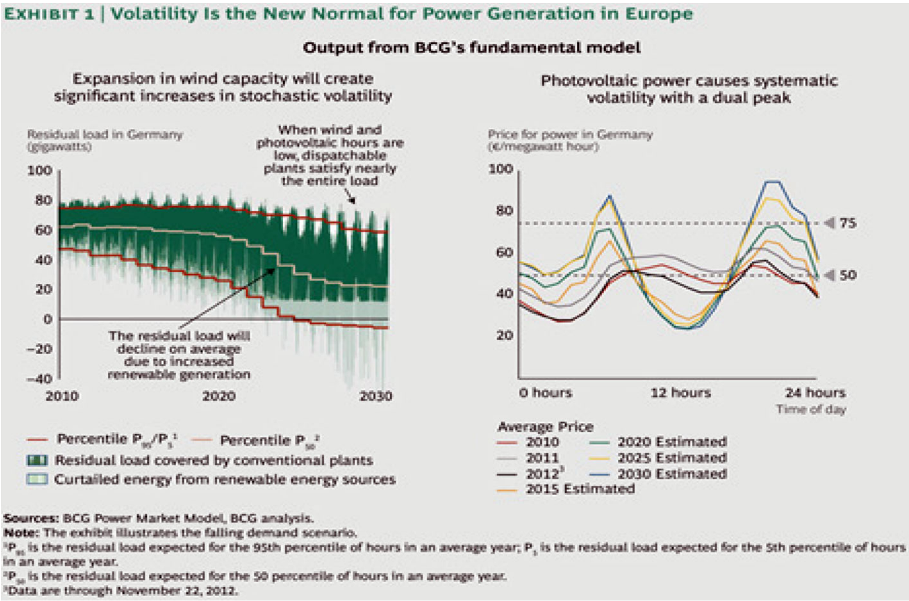
Source: Eurostat (nrg_100a)

Meanwhile, the projected continuous increase in RES (much of which is variable wind and solar), and its dominant part in new generation capacity additions over the forthcoming years,[59] put pressure on the electricity system's flexibility. The greater the market share of renewables becomes, the greater the need for flexibility in the traditional fossil fuel plants will be. 'The substantial growth of renewable energy is leading to a slowly declining and more volatile residual load – the power demand that is not met by fluctuating wind- and solar-electricity sources. This load needs to be followed increasingly by fossil fuel plants seeking to avoid the negative margins associated

59 See ENTSO-E's latest scenario outlook and adequacy forecasts 2015 ENTSO-E, p. 26.

with production costs that exceed the wholesale market price. More and more power plants can expect to be dispatched in large and relatively rapid shifts, depending on the respective availability of renewable sources.'[60] (See Figure IX)

Figure IX



Source: F. Klose and J. Prudlo, Flexibiliszation – The new paradigm in power generation, BCG perspectives, 2013

Something has thus to be done to better guarantee the security of electricity provisioning in the future. If demand is more or less stable, conventional capacities are slowly being retired due to the lack of economic incentives, and ENTSO-E believes this trend could be accentuated after 2016 (see Figure X). This is not sustainable in a long-term perspective. It is, however, difficult to define what needs to be done, for different reasons. In such a context, it is extremely difficult to anticipate the future. So far there is no proper method of assessment, especially for knowing how big the problem will be. Meanwhile, security of supply has been addressed exclusively as a national issue, with decisions taken exclusively on the basis of the country's own welfare, while neglecting to assess the potential negative impact on the neighbouring countries or the EU as a whole. Additionally, changing the organisation of generation and supply before a proper and comprehensive analysis carries risks of exacerbating some of the sector's ills.

60 F. Klose and J. Prudlo, 'Flexibilization – The new paradigm in power generation', *BGC Perspectives*, 2013, pp. 1-2.

Nevertheless, If CRMs are deemed necessary in the present context, it is also essential to carefully examine other possible alternative solutions, thus far underutilised. Here are a few. Obviously, the completion of the internal energy market and of the Ten-Year Network Development Plan 2014 may reduce the level of insecurity. A better use of existing capacity achievable thanks to stronger, smarter and more interconnected transmission networks (both domestic and cross-border) would also be useful. The development of market couplings as well as the introduction of cross-border and harmonised balancing markets and ancillary services may help as well. One essential solution should come from demand response (which also requires stronger and smarter networks). Demand response offers the possibility to have an electricity system where increasingly the 'demand follows generation' and not the reverse, in which 'generation follows demand'. This would reduce the need for expensive peaking plants to operate (since demand response can shift the electricity demand from peaking moments to off-peaking moments in time), and would have a positive impact on the merit order by decreasing the marginal price.[61] This said, the lowest fossil fuels' prices will never compete with the RES in the area of variable costs. Finally, of course, the improvement of electricity storage capabilities would be the ideal compensation for the mounting variability of renewables. A last option, which will probably have difficulty finding public acceptance, would be to allow peak prices so that available capacity is remunerated by the market and not by subsidies.

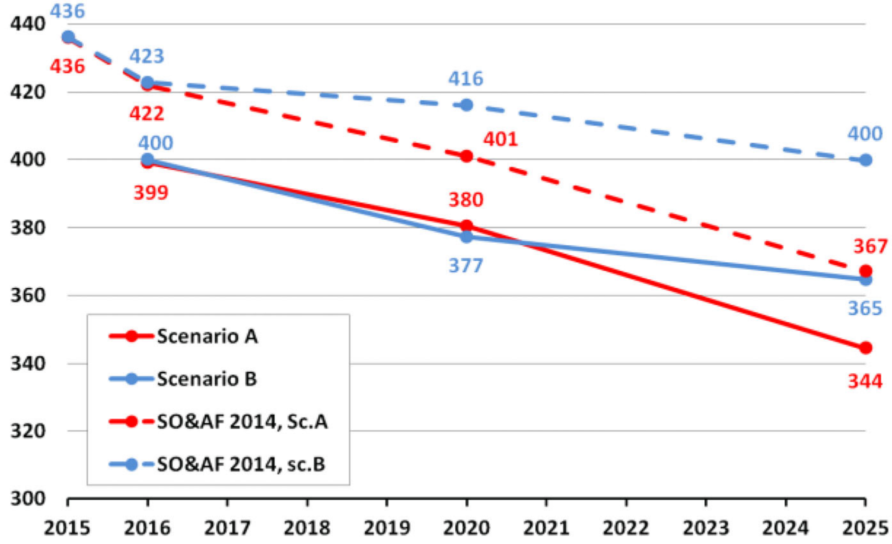
Taking into consideration these measures is fundamental because, as mentioned before, CRMs can present negative effects. In any case, CRMs need to be carefully designed and compatible with the internal energy market. Their implementation should not unduly increase system costs and costs to end users. Cross-border participation should be required and a clear exit strategy should be provided in case of adverse effects on cross-border trade.[62] Otherwise, the biggest danger of CRMs could be the reduction of the efficiency of the alternative solutions.

Meanwhile, CRMs have emerged in several countries with numerous associated problems associated, and they could be hard to remove if they deliver unexpected results.

[61] For more information, see the Insight_E study, *Quantifying the merit-order effect in European electricity markets*, February 2015, p. 4.

[62] For more information, see the study by Thema Consulting Group entitled *Capacity mechanisms in individual markets within the IEM*, June 2013.

Figure X: 1-ENTSO-E Fossil fuels generation capacity forecast in SO&AF 2014 and in SO&AF 2015; all scenarios; January 7 p.mù. [GW]



Source: ENTSO-E 2015 scenario outlook & adequacy forecast, 30 June 2015, p. 22

CONCLUSION

One should not underestimate the huge changes undergone by the electricity system in Europe during the last ten years. The introduction of renewables, especially solar and wind, has made the system much more complex, since it relies now on a greater number of primary energy sources, quite different in technical and financial aspects. Additionally, the capital needs of producers are extremely diverse. Some have very high fixed costs. Others have much higher variable ones. In any case, the arrival of many new renewable electricity producers with very high fixed costs requires more previsibility in a changed context that generally provides less of it. The electricity production system has also been made, of course, more irregular with the rapid development of renewables. As a result, the reliability challenges of the electric system have changed and have increased. Furthermore, the development of the energy single market has introduced an additional layer of complexity. It is not difficult to understand why such a situation has provoked a growing thirst for more security, and also rising calls for public intervention.

All this does not mean that there is an immediate risk of blackout. These dangers are clear, but they are not present yet. They concern more the middle term. Energy, however, is a very long-term sector for investments. Investment paralysis and the closure or mothballing of power plants will inevitably lead sooner or later to difficulties.

The importance of the problem is compounded by the rising importance of electricity in the energy system, due to the need for decarbonisation. Climate warming calls for more electricity, because it relies on renewable sources, which cannot be said about direct use of oil, gas or coal. It can also integrate a substantial amount of increased energy efficiency. The importance of the problem is also increased by other growing threats of energy instability in Europe. Renewables have been supported in Europe to fight not only climate warming, but also the EU's growing external energy dependence.

Consequently, it is difficult to deny that, in the present context of decarbonisation, there is a need to take measures to compensate for the growing insecurity of electricity provisioning. Capacity mechanisms participate in that logic and aim to provide that compensation. However, if there were a real threat to the security of the electricity system, this does not automatically mean that capacity mechanisms offer an adequate answer. In fact, the growing instability is provoked by numerous and various factors, and not only by the growth of renewables. For instance, the insufficiency of carbon pricing is another source of uncertainty for investment. The insufficiency of interconnectors with other markets at the borders is yet another source. Cross-border trade can reduce the overall cost of the electricity system by exploiting the complementarities between patterns of demand and differences of costs. Maximum electricity demand and production tend to happen at different times in neighbouring regions. A market of increased scope thus reduces proportionally the need for reserve capacity. The absence of flexibility of electricity demand is another source of instability. If there were more demand response, there would be less need for generation capacity. Any strategy aiming to reduce electricity insecurity thus needs to deal with many instruments.

Thus, compensating the growing insecurity of the electricity market requires a global strategy, using different instruments to limit market distortions. The use of different instruments is also required to minimize the negative repercussions of CRMs. They are difficult to manage, they increase the already great complexity of the market, they are costly, they can reduce the benefits of the single market, and last but not least, they can reduce the efficiency of other instruments. Furthermore, it is quite difficult to assess properly the electricity needs of an economy in a middle- and long-term perspective. In general, thus, too much attention has been concentrated on CRMs in the EU (which have certainly been promoted too quickly), and not enough on other potential solutions.

It is too soon to provide a valid assessment of the extent of CRMs' efficiency and impact as there is limited practical experience of most of them in the EU, and some have been frequently modified since their introduction. Clearly, however, they can have repercussions on free competition, on the single market principles and on further integration. It is in fact paradoxical to define the guarantees of security at the national level without taking into consideration the impact for the EU market, while Member States frequently invite all parties involved to complete the internal market, through, in particular, increased cooperation. As a minimum, the need for a viable and strong EU framework clearly exists, to avert (or at least minimise) the potential damages that could prevent a further integration of national markets. Fortunately, the Commission has taken initiatives in that direction.

This framework's definition, however, is fraught with difficulties. It is dependent on a fundamental (and preliminary) question: are capacity mechanisms a temporary component due to the apparition of provisional difficulties caused by RES, or a fundamental permanent component of the electricity system – also due to RES? Technically, the difference between the two analyses is essential. According to the first analysis, the present system's instability is something transitory, and the single energy market, once completed, will take care of it. There is thus no need for positive action, and the role of the EU is to limit the negative impact of capacity mechanisms in the transitory phase. According to the second analysis, the growth of renewables in the electricity system requires a new design. The single market will not deal with the challenge of increased instability. The EU must thus take positive action, and possibly define in the long term a new concept of electricity stability at its own level.

Most probably, as long as RES grow and variability grows with them, the EU will have to deal with this problem. Firstly, the internal energy market is far from completed. It requires more action, not only in regulation, but also in interconnections. Secondly, the persistent growth of renewables will inevitably increase the electricity system's fluctuations. This should continue – at least as long as very powerful means of electricity storage are not be available. Consequently, even if this proves difficult, in a long-term perspective a collective effort should be made by all parties involved to define as much as possible the parameters of a global capacity framework at the EU level.