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Pursuant to Article 11 of Regulation (EC) No 713/2009,

THE AGENCY FOR THE COOPERATION OF ENERGY REGULATORS reports on:

CAPACITY REMUNERATION MECHANISMS AND THE INTERNAL MARKET FOR ELECTRICITY

of 30 July 2013

1. Introduction

- 1) The aim of the on-going electricity market integration process in Europe is to ensure an efficient cross-border use of existing generation capacity, demand-side resources and transmission infrastructure, and to promote an efficient system development.
- 2) The Agency for the Cooperation of Energy Regulators (the “Agency”) acknowledges that the regional initiative process has already delivered significant progress towards achieving the Internal Electricity Market (“IEM”), leading to more competitive, liquid and transparent wholesale markets, to the benefit of end-consumers, while safeguarding security of electricity supply, especially in periods of high demand.
- 3) There is, however, a growing concern in several EU Member States (“MSs”) that electricity markets, with increasing shares of (intermittent) renewable electricity generation, will not be able to deliver sufficient capacity to meet electricity demand at all times¹ in the future. The political sensitivity to blackouts, as well as practical and theoretical uncertainties² as to if and when investors will build new generation capacity, has compelled a number of MSs to intervene by introducing Capacity Remuneration

¹ This objective has to be interpreted in probabilistic terms, i.e. as a given probability of meeting demand at all times, including at peak times.

² At the moment, there is considerable discussion, and different views, as to how generation adequacy should be addressed in the context of the IEM, taking into account the necessary transition to a low-carbon energy system.

Mechanisms (“CRMs”) in order to provide additional stimulus to investors and ensure that a sufficient amount of capacity will be available.

- 4) A CRM aims at providing market participants with a more effective stimulus than what is delivered by “energy-only” markets: it provides investors with a more certain stream of revenues, e.g. in the form of capacity remuneration. However, to the extent that these revenues, apart from being more stable, are also higher than what would be the case in an energy-only market, CRM may impose additional costs to energy consumers³.
- 5) Many national electricity wholesale markets are highly interconnected and adjacent electricity systems in regional(ised) electricity markets interact physically and economically. Due to this, CRMs may potentially distort cross-border trading or even act as a barrier to trade if they are designed without taking into account their cross-border impact or are implemented at national level without any coordination with neighbouring jurisdictions.
- 6) In view of both recent and future developments, the Agency has assessed the impact of different CRMs on the functioning of the IEM⁴. This report follows the Opinion on Capacity Markets provided by the Agency to the European Parliament’s Industry, Research and Energy (ITRE) Committee in February 2013⁵. The European Commission is expected soon to issue a communication on public intervention in the electricity sector, including capacity mechanisms. This report is therefore also offered as a contribution to the process for preparing such a communication.
- 7) The remainder of this document is structured as follows. First, some relevant considerations regarding the contribution of energy-only markets to adequacy are

³ The way in which any cost of the CRM are recovered depends on the specific form the CRM takes, but, typically, the bill ends up being paid by energy consumers.

⁴ This assessment started in December 2012, is based on presentations from NRAs (e.g. a workshop in Vienna on 11 December 2012), responses from NRAs to a questionnaire, an expert group meeting (Brussels, 25 January 2013) and a literature review and includes two cross-border CRM cases. Related documents on capacity markets include CEER’s reply to the consultation from the European Commission of 7 February 2013 (available at: http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_PUBLICATIONS/CEER_PAPERS/Electricity/Tab2/CEER_Response_CRM_and_IEM_7February2013.pdf).

⁵ Available at: http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Opinions/Opinions/ACER%20Opinion%20005-2013.pdf.

provided in Section 2. Then a taxonomy of CRMs and the current developments in the EU are presented in Sections 3 and 4, respectively. Section 5 explores the potential distortionary impact of different types of CRMs on the market integration process. Conclusions and recommendations are provided in Section 6.

2. The contribution of energy-only markets to capacity adequacy

- 8) In a pure energy-only market, in theory and in the absence of market failures⁶, the operating (e.g. fuel, start-up costs) and capital costs of a plant should be recovered exclusively through market prices for electricity and for the associated ancillary services. In energy-only markets, there are no payments for capacity and no distortions to the functioning of the IEM, because generators on both sides of a border are exposed to the similar price signals.
- 9) In most hours of the year and under most circumstances, there will be more available generating capacity than needed to meet demand. During these hours, assuming workably competitive market conditions, the energy market price, if allowed to vary unhindered, will tend to reflect the marginal operating cost of the most expensive unit dispatched or the opportunity cost of any energy-limited hydro resources when at the margin. In these hours, base-load and intermediate-load generators with operating costs lower than the market price can recover their variable operating costs and obtain an “infra-marginal rent” (i.e. the difference between the market price and the variable cost of the plant) which can be used towards covering fixed costs.
- 10) In some hours, however, the margin between available capacity and (peak) demand may tighten and electricity prices will rise above marginal operating costs to include a “scarcity premium”. During these (rare) occasions of capacity shortage, the system experiences extremely high prices, potentially up to the “value of lost load” (VoLL)⁷. During these hours, all plants in the merit-order (e.g. base-load, intermediate and peaking plants) receive a price which also contributes to recover their fixed costs.

⁶ For instance, the absence of smart metering or, more generally, the absence of mechanisms/tools to develop Demand Side Response.

⁷ VoLL is defined as the value attributed by consumers to unsupplied energy. Therefore, it represents the maximum price that consumers are willing to pay to be supplied with energy and at that price they are indifferent between, on the one hand, being supplied and paying the price and, on the other hand, not being supplied (and paying nothing). VoLL is typically quite high (e.g. several thousand euros per MWh).

- 11) In an energy-only market, scarcity prices should be sufficiently frequent to attract investment in new capacity and prevent existing capacity from leaving the market. In the absence of such price spikes and without any other revenues (e.g. from the provisions of ancillary services), existing peak plants might exit the market without being replaced. This would reduce the available generation capacity and increase the frequency of scarcity conditions and scarcity prices.
- 12) In any case, as long as demand is sufficiently price responsive, and falls to zero at VoLL⁸, an energy-only market will always deliver an equilibrium. The interaction between available capacity and demand determines the economically optimal level of installed capacity through the prices established in the market. The level of adequacy⁹ is therefore determined by the market.
- 13) The “political” acceptability of the adequacy provided by energy-only markets depends on the frequency with which prices reach very-high levels, possibly VoLL, and the “political” implications of such high prices.
- 14) It is the “political” unacceptability of extreme prices in energy-only markets which push MSs to intervene, e.g. by introducing CRMs, in order to reduce the frequency and level of price spikes.

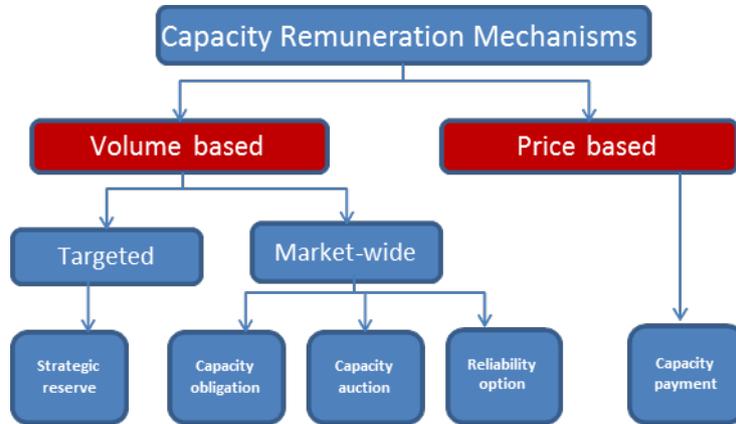
3. A taxonomy of CRMs

- 15) A variety of CRMs have been proposed. They can be classified according to whether they are volume-based or price-based. Volume-based CRMs can be further grouped in targeted and market-wide categories. As a result, five different types of CRMs can be defined, as presented in Figure 1.

⁸ Since, given the definition of VoLL, no consumer is willing to pay a price for energy higher than VoLL. However, it is worth mentioning that VoLL may be difficult to measure.

⁹ In fact, if demand is sufficiently price responsive, an energy-only market will deliver full adequacy, but at the cost of some demand “voluntarily” reducing consumption when prices reach the VoLL level. It is this way of achieving market equilibrium and adequacy which may not be political acceptable.

Figure 1: Taxonomy of CRMs



Note: Some price-based mechanisms can be targeted.

16) In what follows an outline of the different types of CRMs is provided. A more detailed description is presented in Annex A.

3.1. Strategic Reserve

17) In a Strategic Reserve scheme, some generation capacity is set aside to ensure security of supply in exceptional circumstances, which can be signalled by prices in the day-ahead, intra-day or balancing markets increasing above a certain threshold level. An independent body, for example the Transmission System Operator (“TSO”), determines the amount of capacity to be set aside to achieve the desired degree of adequacy and dispatches it whenever due. The capacity to be set-aside is procured and the payments to this capacity determined through a (typically year-ahead) tender and the costs are borne by the network users.

3.2. Capacity Obligations

18) A Capacity Obligation scheme is a decentralised scheme where obligations are imposed on large consumers and on load serving entities (“LSE”, further referred to as “suppliers”), to contract a certain level of capacity linked to their self-assessed future (e.g. three years ahead) consumption or supply obligations, respectively. The capacity to be contracted is typically higher, by a reserve margin determined by an independent body, than the level of expected future consumption or supply obligations. The obligated parties can fulfil their obligation through ownership of plants, contracting with

generators/consumers and/or buying tradable capacity certificates (issued to capacity providers). Contracted generators/consumers are required to make the contracted capacity available to the market in periods of shortages, defined administratively or by market prices rising above a threshold level. Failure to do so may result in penalties. A (secondary) market for capacity certificates may be established, to promote the efficient exchange of these certificates between generators/consumers providing capacity and the obligated parties or between obligated parties.

3.3. Capacity Auctions

19) A Capacity Auction scheme is a centralised scheme in which the total required capacity is set (several years) in advance of supply and procured through an auction by an independent body. The price is set by the forward auction and paid to all participants who are successful in the auction. The costs are charged to the suppliers who charge end consumers. Contracted capacity should be available according to the terms of the contract.

3.4. Reliability Options

20) Reliability Options (ROs) are instruments similar to call options¹⁰, whereby contracted capacity providers (typically generators) are required to pay the difference between the wholesale market price (e.g. the spot price) and a pre-set reference price (i.e. the “strike price”), whenever this difference is positive, i.e. the option is exercised. In exchange they receive a fixed fee, thus benefitting from a more stable and predictable income stream. Under a RO scheme, the incentive for the contracted generator to be available (at times of scarcity) arises from the high market price and from the fact that, if not available and therefore not dispatched, it will have to meet the payments under the RO without receiving any revenue from the market. The holders of ROs effectively cap their electricity purchase price at the level of the strike price, since whenever the market price increases above this level, the excess will be “reimbursed” through the payment made under the ROs. A scheme based on ROs usually rests on an obligation imposed on large consumers and on suppliers to acquire a certain amount of ROs, linked to their (self-

¹⁰ However, it is important to note that ROs are logically different from the options and other instruments for hedging price volatility which are available on the market, for two reasons: (i) the strike price of ROs is pre-set administratively (by an independent body) and not negotiated in the market; and (ii) the total quantity of ROs is determined by the required adequacy level, and not left for the market to decide (as it is the case with normal risk-hedging instruments).

assessed) future consumption or supply obligations, respectively. Different RO variants can be designed, depending on whether the scheme is purely financial¹¹ or also involves an obligation to have and make capacity available when the option is exercised (or otherwise face a penalty). In this latter case the RO scheme becomes similar to a scheme based on Capacity Obligations.

3.5. Capacity Payments

21) Capacity Payments represent a fixed price paid to generators/consumers for available capacity. The amount is determined by an independent body. The quantity supplied is then independently determined by the actions of market participants.

22) CRMs within any of these categories may be designed in many different variants, including with respect to:

- a) differentiation between different kinds of capacity, and demand side participation;
- b) how the eligibility to provide capacity is determined, especially in the case of load;
- c) how far in the future obligations are contracted;
- d) how the level of (adequate) capacity is determined;
- e) how availability is documented or certified;
- f) how, in the context of a Capacity Payments scheme, the payment is determined: whether prices are set administratively, according to auctions or in the market. Or, under a Capacity Obligation or a RO scheme, how the threshold/strike price is determined;
- g) how the costs are allocated; and

¹¹ In this case, the only obligation for the issuer of the option is to make the payment when the option is exercised.

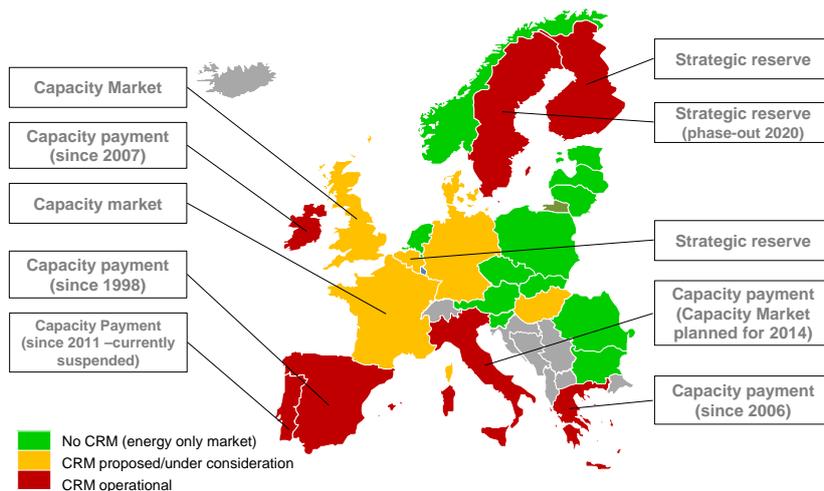
h) the rules for the operation and activation of the capacity, including participation in energy markets.

23) Apart from these design challenges, most CRMs interact with the energy-only markets and, if not properly designed, may add on the difficulty of creating a sound wholesale market producing reliable and efficient price signals. In any case, the objective of removing any barrier to the well-functioning of energy-only markets across Europe needs to remain a priority.

4. Current developments in the European Union

24) At present, a large number of MSs pursue a national generation adequacy policy. Figure 2 shows the current approach to generation capacity adequacy in Europe. It shows that Finland, Greece, Ireland and Northern Ireland, Italy, Portugal, Spain and Sweden have already implemented a CRM, with a number of other MSs including Belgium, Denmark, France, Germany and Great Britain considering doing so. Figure 2 also illustrates the diversity of approaches from one MS to another (Strategic Reserve, Capacity Payment and market wide schemes).

Figure 2: Status of capacity remuneration mechanisms in Europe – 2013



Source: National Regulatory Authorities (2013).

25) Table 1 shows that MSs pursue sometimes different and multiple policy targets with their CRMs. For example, CRMs may not only aim at addressing the problem of adequacy, but also the issue of flexibility and the reduction of risk and price volatility¹². In addition, MSs may also use CRMs to support demand-side response.

Table 1: General overview of considerations for CRMs (selection of EU MSs)

	Belgium	Finland	France	Germany	Greece	Great Britain	Hungary	Ireland	Italy	Portugal	Spain	Sweden
Adequacy	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Flexibility										☑	☑	
Reduced risk and price volatility								☑	☑	☑	☑	

Source: National Regulatory Authorities (2013). *Note:* In this table “Adequacy” refers to CRMs which aim at ensuring sufficient generation capacity in the electricity system to meet demand at all times, including at peak load periods; “Flexibility” (or reliability) refers to CRMs which aim at maintaining sufficient system flexibility to balance the electricity system notably in response to (sudden) demand variations or unexpected outages; and “Reduced risk and price volatility” refers to CRMs which aim at de-risking new investment and avoiding the price volatility associated with generators that run only periodically recovering their fixed costs over a short period of time.

26) Lastly, it should be emphasised that governments opting for different and mainly nationally oriented approaches are typically devoting limited attention to the impact of their CRMs on cross-border trade. For instance, the contribution from cross-border capacity to security of supply is often not taken into account sufficiently well when addressing national or local adequacy concerns. As a result the opportunities presented by the IEM and cross-border trade for delivering adequacy are often not fully appreciated and exploited, and enduring distortionary effects might be introduced without their consequences being assessed.

¹² It is clear however that these targets are not mutually independent. Adequacy may reduce price volatility, at least that part which stems from supply scarcity.

5. Impact of CRMs: design and distortions

- 27) The different types of CRMs interact differently with the energy-only markets and ancillary services mechanisms (balancing markets).
- 28) Few studies focus on the cross-border distortions¹³ of a unilateral introduction of a CRM in one MS, even though the effects may be considerable. Firstly, CRMs can impact prices in the short term and therefore alter production decisions (operation of power generating plants) and cross-border competition (section 5.1). Secondly, CRMs may influence investment decisions (investment in plants and their locations), with potential impacts in the long term (section 5.2). Thirdly, CRMs exhibit redistribution effects (section 5.3). Finally, as with all policies and measures, additional distortions may result from incorrect design or implementation of CRMs (see section 5.4).
- 29) It is worth mentioning that detecting these possible distortions is sometimes not straightforward, as the impact of CRMs may be interlinked with that of other (national) market design features. Moreover, most of the existing CRMs have been in place only for a relatively short period of time, thus not providing sufficiently long time series of data to draw firm conclusions as to what their mid- and long-term effects exactly are. However, these difficulties do not prevent a well-reasoned assessment.
- 30) As indicated in paragraph 22), the design of CRMs requires that choices are made with respect to several characteristics. The choices made may affect significantly the way in which CRMs impact on energy markets, both in the short- and the long-term. A case showing how specific design choices may lead to distortionary effects is presented in Annex B.
- 31) It is worth mentioning that the design of a CRM should take into account the existing market structure and its imperfections in order to avoid additional distortions to the functioning of the internal market.

¹³ Two types of efficiency distortions are distinguished: static short-term and dynamic distortions. The former are related to whether the production of electricity is at least cost effective and whether prices reflect the cost of production, with given capacities, while the latter are related to the efficiency of new investments and their location. In addition to efficiency distortions there are also redistribution effects such as “spill over effects”.

- 32) The design of a CRM is also influenced by the methodologies applied for assessing generation adequacy and security of supply levels¹⁴. Currently, these methodologies differ considerably between MSs which hampers the comparability of the assessment results. This poses an additional challenge when designing CRMs and their cross-border aspects.
- 33) In the Opinion on Capacity Markets issued by the Agency to the ITRE Committee of the European Parliament¹⁵, it is stated that *“It is however essential that any such [capacity remuneration] arrangement does not unduly interfere or distort the functioning of the energy market and does not delay the completion of the IEM. In fact, it would be most desirable if any arrangement aimed at promoting adequacy or flexibility were to exert its effect only when and to the extent that energy markets cannot provide sufficient stimulus for the required investments, while having as little influence as possible on the energy markets at other times”*. In this respect, one critical element in the design of many CRMs – including Strategic Reserve, Capacity Obligations and ROs-based schemes – which greatly affects the (possibly distortionary) impact on the energy market, is the level at which the threshold/strike price is set.
- 34) In principle, the level of the threshold/strike price should act as the discriminant between normal (albeit possibly tight) market conditions and situations of acute scarcity. It is therefore obvious that the threshold/strike price should be set below VoLL¹⁶. It is however also essential that the threshold/strike price is set well above any price level compatible with normal (albeit possibly tight) market conditions, and therefore (well) above the operating costs of the most expensive generating unit in the market. In fact the threshold /strike price should be set at a level which the market price would reach only in case of severe scarcity and when there are prospects of further increases towards VoLL. In the context of the considerations on the political acceptability of very high prices presented in paragraph 14), the threshold/strike price should be set at the level of the highest politically acceptable price spike.

¹⁴ Generation adequacy (criteria) refers to a long term targeted security of supply standard. This can be expressed in loss of load expectation (LoLE)) with for example a targeted standard of three hours LOLE per year. Further, security of supply level refers to the amount of (short term) reserves available relative to the demand.

¹⁵ Cfr. footnote 5.

¹⁶ A reference/strike price equal to or above VoLL would not serve much purpose, as in theory the market price should never exceed that level. In practice, the price may rise even higher, if consumers are not exposed to short-term prices and retailers have an obligation to serve their consumers.

35) It is worth noting that such a level for the threshold/strike price is typically much higher than the strike price of option contracts available in the market and used by market participants for risk-hedging purposes. Consequently, while being both option contracts by structure, ROs and market option contracts serve different purposes and should not be confused.

5.1. Short-term impact on cross-border competition

36) When a national CRM does not or insufficiently considers non-domestic generation capacity, this may impact cross-border competition at wholesale level and introduce short-term distortions. A case demonstrating short-term distortions from a CRM is presented in Annex C.

37) For instance, in the Strategic Reserve or Capacity Obligation¹⁷ schemes the threshold price acts effectively as a cap on the market price. Therefore, if it is set too low, it will prevent market prices to rise to signal scarcity.

38) In addition, the dampened price may be “exported” to jurisdictions with energy-only markets, thus leading to the average income of generators there being reduced as well.

39) Another rather straightforward example of a possible distortion is when generators in a CRM market receive (capacity) payments which are determined in a way that affects their electricity generation bids into the market, while in a neighbouring “energy-only” market generators do not. This may tilt the playing field for generators on either sides of a border.

5.2. Long-term impact

40) In literature¹⁸ 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.

¹⁷ In the case where the obligation is defined with respect to a threshold price.

¹⁸ See: Ozdemir, O., J. de Joode, P.R. Koutstaal, M. van Hout. Forthcoming. Financing Generation Capacity Investment in Electricity Markets with a High Share of Intermittent Renewables: The Impact of a German Capacity Market on Northwest Europe, ECN. Fortum, “Quantitative assessment for a European Capacity Market”, and:
http://srv128.bluerange.se/Documents/Market%20Design/seminars/CapacityMarkets/4_Fortum.pdf.

- 41) If market prices are effectively capped, as for example in the case of a Strategic Reserves or Capacity Obligation scheme, by a low threshold price, the average income of generators will be reduced, discouraging investment at market conditions and therefore increasing scarcity and the requirement for more reserves: a self-fulfilling prophecy situation.
- 42) The adverse impact on investment may spread to neighbouring markets with and without CRMs. In countries without CRMs investments in generation decline and plants are decommissioned earlier.
- 43) Furthermore, if a CRM does not take into account contributions from cross-border capacity when addressing adequacy concerns, it may lead to over-capacity and over-procurement of capacity in the country where the CRM is operational with a detrimental impact on consumers.
- 44) In fact, as highlighted in the Agency's Opinion to the ITRE Committee, "*[i]n the case of national mechanisms, greater efficiency can be achieved and the distortion of the IEM minimised by allowing participation of adequacy and system flexibility resource providers located in other Member States, taking into account available cross-border capacity*", as promoted by Directive 2005/89/EC. As indicated there, "*[t]his however requires that these resources will be allowed to contribute, directly or indirectly (through their TSOs) to adequacy and/or system flexibility in the Member States in whose mechanism they participate even at time of crisis also in the Member State in which they are located*".
- 45) Cross-border participation to CRMs does not necessarily require that cross-border capacity is set aside¹⁹. However, it requires a strong coordination of national security of supply policies and the fulfilment of additional conditions, namely that:
- a) the TSO, in whose jurisdiction the CRM²⁰ is implemented, is able, directly or through the adjacent TSO, to monitor the actual availability of the (capacity) resources committed by foreign provider over the contracted period and that

¹⁹ See footnote 11 in the Agency's Opinion on Capacity Markets to the ITRE Committee.

²⁰ ROs may be an exception to this.

- the foreign provider is able to provide the same level of commitment with respect to security of supply than a local provider;
- b) efficient cross-border allocation mechanisms are implemented on all timeframes, in particular in the day-ahead, intra-day and balancing timeframes;
 - c) MSs accept that their national resources (e.g. generation plants) are partly contracted to ensure the security of supply of a neighbouring MS and guarantee that providers will not be hindered in exporting at any moment in time, i.e. TSOs do not deviate from their routine in offering cross-border capacity²¹ in particular in stressed situation on both sides of the border²².

5.3. Redistribution

- 46) In addition to potential distortions, there is also a welfare redistribution effect between interconnected markets due to “spill-over effects”, i.e. positive externalities on neighbouring MSs which are not directly involved in an activity or decision taken at national level. For instance, the measures taken in one MS to ensure generation adequacy (e.g. implementation of a CRM) will likely benefit the generation adequacy of a neighbouring MS, in particular if the CRM induces much more generation capacity than what would be efficient for providing the required level of adequacy. As in this case the costs of the overcapacity supported by the CRM are borne by the consumers in the MS with the CRM, they will end up paying for capacity contributing to generation adequacy in the neighbouring MS.
- 47) The magnitude of “spill-over effects” depends on the size of the capacity remunerated by the national CRM and the degree of market integration. The more integrated the markets are - with overcapacities from CRMs - the higher the “spill-over effects” will be.
- 48) These welfare redistribution effects due to national CRMs in an integrated IEM will require MSs to be prudent when designing their CRM. Therefore, MSs should be encouraged to coordinate their national security of supply policies.

²¹ Without such a guarantee, the foreign provider would not be able to deliver the same level of commitment with respect to security of supply than a local provider.

²² In particular enforcement of Article 4(3) of Directive 2005/89/EC, concerning measures to safeguard security of electricity supply and infrastructure investment, should be ensured.

5.4. Risk of implementation errors

49) As for any other parts of the electricity market, there are many details in the design of CRMs which make them prone to implementation errors and which may lead to long-lasting distortionary effects on the functioning of the internal market for electricity, impacting the resource mix of electricity generation.

6. Conclusions and recommendations

50) In an integrated European energy market, security of supply (and other related issues) are no longer exclusively a national consideration, but should be addressed as a regional and pan-European issue. From this perspective, generation and, more widely, resource adequacy should be addressed and coordinated at regional and European level to maximise the benefit of the IEM and, moreover, to avoid adverse distortionary effects.

51) The Agency observes, however, that MSs currently have national and diverging approaches to security of supply with a lack of coordination among them, which might appear as paradoxical since, at the same time, MSs themselves urge all involved parties to complete the IEM through, in particular, increased cooperation. This lack of coordination has resulted in a patchwork of CRMs in the EU, which may be at the detriment of the market integration process.

52) The analysis of current CRMs does not provide sufficient evidence to generalise the existence of distortions due to CRMs, as it is - for instance - difficult to disentangle them from other market design inconsistencies. Nonetheless, there are risks of short- and long-term distortions to the functioning of the IEM. In the short-term, CRMs may lead to distortions if their design affects the natural price formation in the energy market (e.g. the bids for energy). In the long-term, CRMs may, if contributions from cross-border capacity are not appropriately taken into account, lead to over-procurement of capacity in CRM countries with a detrimental impact on consumers. These various aspects related to cross-border impacts (e.g. cross-border flows, competition, prices, investments, etc.) demand a careful impact assessment to be completed before implementing any mechanism, in particular since once a CRM is implemented it is usually not easy to remove it.

53) In addition, the implementation of a CRM should not delay the completion of the IEM, and the removal of barriers to the well-functioning of energy markets and to the formation of reliable and efficient price signals across Europe should remain a priority.

54) The Agency believes that the risk of potential distortions can be addressed by means of a better coordination of the security of supply measures. Further, where CRMs are considered for introduction, the potential cross-border distortions should be assessed based on a common set of criteria. Therefore, the Agency proposes the following recommendations:

- I. the harmonisation of generation adequacy criteria and security of supply levels should be undertaken where possible;
- II. a common (at least regional) and coordinated approach for a thorough security of supply assessment should be implemented;
- III. in the case of national CRMs, greater efficiency could be achieved and the distortion of the IEM minimised by assuring participation – to the extent possible – of adequacy and system flexibility resources provided by generators and load in other jurisdictions. The challenges to this are however significant²³. Further, harmonised or regional CRMs may reduce the need for foreign participation in national CRMs;
- IV. Concretely, where CRMs are introduced at a national level, they should be compatible with the IEM and their design should aim at the most effective and efficient solutions and prevent distortions to the functioning of the IEM, including cross-border trading. To this end and to improve the transparency regarding CRMs across the MSs, the introduction of national mechanisms should be accompanied by a sound and detailed impact assessment. This should be developed from an internal market perspective, including the following criteria:
 - the nature of the problem which the mechanism intends to address;
 - the necessity of a proposed mechanism;
 - the appropriateness of the proposed mechanism in terms of a well-targeted and durable mechanism²⁴;

²³ See paragraph 45).

²⁴ However, care should be taken that no expectation is formed among market participants and other stakeholders that these mechanisms will be maintained indefinitely.

- how cross-border capacity is taken into account;
- the possible short-term and long-term distortions introduced by the mechanism on the functioning of the IEM, including cross-border flows, competition, prices and investments, and how these distortions are tackled to be avoided or limited;
- the cost of the mechanism (including costs for implementation) and the (estimated) costs of capacity payments.

ANNEX A:

OUTLINE OF CAPACITY REMUNERATION MECHANISMS²⁵

This annex describes the five CRMs introduced in section 3 and - where possible - points to some design characteristics relevant to the functioning of the internal market. The remainder of this annex presents Strategic Reserves (section A.1), Capacity Obligations (section A.2), Capacity Auctions (section A.3), Reliability Options (section A.4) and Capacity Payments (section A.5).

The existing CRMs are to a large extent tailored to a specific market situation. As a result there is a large variation in the existing CRMs' design features. The experience with cross-border participation is virtually non-existing.

A.1. **Strategic Reserves**

Strategic or ring-fenced Reserves are essentially generating units that are kept exclusively available for emergencies (e.g. when the market is not able to cover demand) and are called upon by an independent body (e.g. the TSO).

The Strategic Reserve is intended to operate only when the market does not provide sufficient capacity and should therefore be dispatched at a price above a reference level signalling scarcity. In theory, the reserve should only be dispatched at a price close to VoLL in order not to interfere with the market even in tight conditions. In this case the natural price formation on the market is not affected and generators receive the same investment incentive as if there were no strategic reserve.

Capacity for Strategic Reserves is procured through a tendering procedure for a specified amount of capacity (in MW), for example on a year-to-year basis. The Strategic Reserve may

²⁵ This annex is based on: CREG, "Study on capacity remuneration mechanisms", 11 October 2012 (available at: <http://www.creg.info/pdf/Etudes/F1182EN.pdf>); Brunekreeft *et al*, "A Raw Model for a North European Capacity Market", June 2011 (available at: http://www.elforsk.se/Documents/Market%20Design/projects/CapacityMarkets/ER_11_30.pdf) and Tennbakk *et al*, "Capacity mechanisms in individual markets within the IEM", 1 March 2013 (*manuscript*).

consist of existing or - provided the auction takes place well in advance of when the contracted capacity should be available - new generation built for the purpose of reserve capacity and may include demand resources. The latter are normally obliged to reduce electricity consumption sufficiently fast to a specified level when called upon. The specification of the amount and type of capacity (e.g. peak units) or demand resources may be based on a so-called reliability study.

The compensation schemes for the providers of Strategic Reserves are specified in the tendering documents and may vary from case to case. These schemes may involve direct payments, payments in the form of an option or mixed forms. Strategic Reserve contracts contain also provisions for notification time, duration of activation, etc.

The costs of the Strategic Reserve schemes are typically covered through system charges included in the transmission tariff. Hence, they are passed on to consumers of electricity. In theory, the revenues, when dispatching the strategic reserves, should cover the costs.

Strategic Reserves and the IEM

The rules that determine when exactly Strategic Reserves are to be dispatched determine the impact on market prices. The activation of the reserve is linked to a predetermined threshold price. This acts effectively as a price cap on the market, shielding energy consumers from VoLL prices, if the threshold price lies below the VoLL. When the threshold price is set at a sufficiently high level, it will not distort the natural price formation in the wholesale market and will moreover not distort the functioning of the internal market (see paragraph 34)).

A.2. Capacity Obligation

A Capacity Obligation is a decentralised, bottom-up measure that places future reserve obligations on large consumers and suppliers. The Capacity Obligation creates ‘demand’ and ‘supply’ for capacity guarantees.

Large consumers and suppliers contract generation capacity corresponding to a certain margin above the volume of their expected²⁶ consumption or supply obligations, respectively. The margin is applied on top of the consumers' or suppliers' own assessment future consumption/supply obligations. An independent body may set some assessment rules and determines the (reliability) margin.

Large consumers and suppliers can meet their Capacity Obligations by owning generation capacity, by obtaining bilateral contracts with - for instance - generators and/or buying capacity certificates. These capacity certificates are essentially contracts that specify the required availability of an electricity generating plant or part of an electricity generating plant (duration, notification time, etc.). Generators may sell capacity contracts up to the volume of generation capacity that they have reliably available, which is determined by an independent body. Also, demand side resources may be included as interruptible load contracts.

Capacity certificates offer flexibility in the way that large consumers and suppliers comply with their capacity obligation and, if they are standardised, they can be traded on a bilateral basis or in an organised market/auction. In the latter case, the certificate price is determined by the supply and demand in the market/auction.

Capacity providers are paid for the capacity certificates (or bilateral contract) issued; the suppliers pass on the costs of these certificates to their consumers.

Capacity contracted under capacity obligations is expected to be offered into the wholesale market and, in particular, in scarcity situations. Failure to make capacity available results in a penalty.

A.3. **Capacity Auction**

Capacity Auctions are similar to a Capacity Obligation scheme, though the capacity procurement process is centralised and an independent body acts on behalf of total demand. It calculates how much generation (interruptible load) capacity consumers/suppliers require based on the expected total peak demand. The calculations require reliability assessments, i.e.

²⁶ Capacity Obligation schemes may apply to the present volume of load served or to load volumes expected to be served (or declared to be served) at some time in the future.

estimates of the total need for capacity including forecasts of peak demand and reserve margins.

Generators may sell capacity contracts up to the volume of generation capacity that they have reliably available, which is determined by an independent body. Capacity certificates can be traded. Suppliers include the cost of purchasing capacity credits in the price they charge to final consumers for electricity e.g. according to their off-take or off-take profile.

Capacity Auction schemes may allow generators and suppliers to procure capacity directly, as under a Capacity Obligation scheme, by means of owning generation, bilaterally contracting capacity. In this case they inform the independent body about their direct procurements outside the auction.

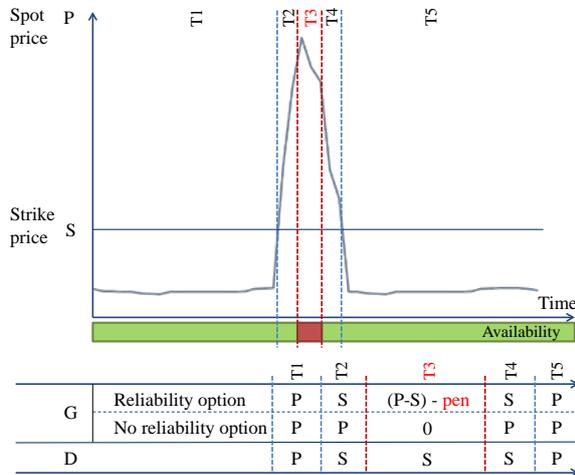
A.4. Reliability Options

The key idea of Reliability Options is to rely mainly on the financial incentives to ensure that capacity is bid into the market at times of scarcity.

In this mechanism, consumers (D) - or an independent body on their behalf - buy ROs. Contracted generators (G), who have issued ROs, pay to the holders of such options an amount, for each unit of energy covered by the option, equal to the difference between the market price (P) and a strike price (S), set administratively (e.g. by the independent body), whenever this difference is positive. In exchange they receive fixed revenues from the options issued and benefit from a more stable and predictable income. The mechanism may be purely financial, as just described, or a physical element may be included, by requiring contracted generators to make capacity available to the market when the market price exceeds the strike price. In this case a penalty (pen) may be payable, on top of the difference between the market price and the strike price, if the requirement is not met.

Consumers who hold ROs ‘implicitly insure’ themselves against future electricity extreme purchasing prices (above the strike price). In fact, whenever the wholesale market price (P) exceeds the strike price level (S), consumers effectively pay only the strike price, as the excess is compensated by the payment received from generators under the RO (see Figure A-1).

Figure A-1: Schematic illustration of reliability options



Source: http://www.hks.harvard.edu/hepg/Papers/Vazquez.Battle.Rivier.PerezArriaga_Secutiry_Supply_Dutch.pdf. Note: “G” stands for generators and “D” stands for demand.

The volume of the contracts, the strike price and the penalty, if applied, are typically determined by the independent body. The volume of ROs should be equal to the forecasted peak load plus a reserve margin, similar to the case of a Capacity Obligation mechanism. As indicated in the text (paragraph 34), the strike price should be set well above the highest operating (marginal) cost of all units (reflecting a “near rationing” level) in order not to discourage any generator from producing. The level of remuneration for the availability of capacity to generators is in fact the price of the ROs, which is determined on the market. Additionally, the time horizon (for example 7-10 years) needs to be set during which the seller may be required to make the committed capacity available when the market price exceeds the strike price.

Market-wide mechanisms and the IEM

The level of the strike price determines how much of the income that the generators receive will come from, respectively, the electricity market and the RO mechanism. For instance, a lower strike price should render a higher capacity option premium and *vice versa*, but only for generators participating in the national CRM. Generators located outside the CRM area, for instance in a neighbouring energy-only market, do not receive the premium if they cannot

participate in the CRM. The investment incentives between generators on both sides of the border are no longer the same, which impacts the resource mix of electricity generation.

A.5. Capacity Payments

The simplest type of capacity mechanism is to provide direct Capacity Payments. A direct Capacity Payment scheme encourages generators to invest in new or maintain old capacity by complementing the revenues that generators receive from the sale of electricity on the wholesale energy market.

The Capacity Payment is defined and controlled by an independent body. There are different methods of calculating the level of payments and how to target them. For example, the Capacity Payment may apply to all capacity or to existing generation plants only, to new plants, or to specific plant types. Alternatively, it can be differentiated between types of capacity, e.g. between base-load and peak capacity, existing and new capacity, etc.. Demand side resources are typically not eligible to capacity payments.

Generators who receive Capacity Payments for their plants sell their electricity on the wholesale market (i.e. electricity exchanges or bilateral contracts).

Capacity Payments may refer only to the present, but may also apply (exclusively) to new capacity. In the latter case, the payment is explicitly aimed at amplifying the investment incentives for new capacity.

The costs of Capacity Payments are covered by levies collected by suppliers. The fee is typically proportional to the amount of electricity supplied, usually in the form of an uplift charge on energy purchased.

Capacity Payments and the IEM

It is difficult to determine the right payment level and to determine the effect of the payments; the mechanism provides no guarantee against extreme spikes. This is probably why Capacity Payments are often combined with price caps in the wholesale markets in order to avoid extreme prices. An important drawback is that Capacity Payments are not well targeted; it is not clear what consumers pay for and what they get in return.

Depending on how Capacity Payments are designed, they may impact the investment incentives of generators on both sides of a border and ultimately impact the resource mix of electricity generation.

ANNEX B:

THE CROSS-BORDER IMPACT OF THE CRM IN SEM ON THE ENERGY MARKET IN GREAT BRITAIN

- B.1) An example of how specific design choices may lead to a CRM having a distortive effect on energy market is provided by the capacity payment scheme operating in Ireland and Northern Ireland. In this case, the distortions extend to the energy market in Great Britain.
- B.2) The Single Electricity Market (SEM) was established in Ireland and Northern Ireland in 2007. Market participants in the SEM regional market receive separate and distinct payments for capacity and energy. The CRM is an integral part of the SEM market design aiming to secure required new non-incumbent capacity and to reduce risk for new investments. The CRM is available to interconnectors, conventional generation, renewable generation and demand-side resources.
- B.3) The CRM in the SEM takes account of non-domestic generation by providing that importers into the SEM receive a capacity payment based on their volume of imports; exporters from the SEM pay a capacity payment to the SEM system based on their volume of exports. For 2013 a total amount of €30 million will be paid to generation and demand side in capacity payments, with a capacity requirement of 6.8 GW.
- B.4) The total amount available for capacity payments (i.e., €30 million in 2013) is divided into three components: an amount which is fixed at the beginning of the year (accounting for 30% of the €30 million); an amount which is fixed at the beginning of the month (accounting for 40% of the €30 million); and an amount which is determined ex post (accounting for 30% of the €30 million). Traders on the two interconnectors with Great Britain essentially trade on the basis of day-ahead electricity prices and a certain capacity payment that is equivalent to 70% of the total amount available for capacity payments in a specific half hour.

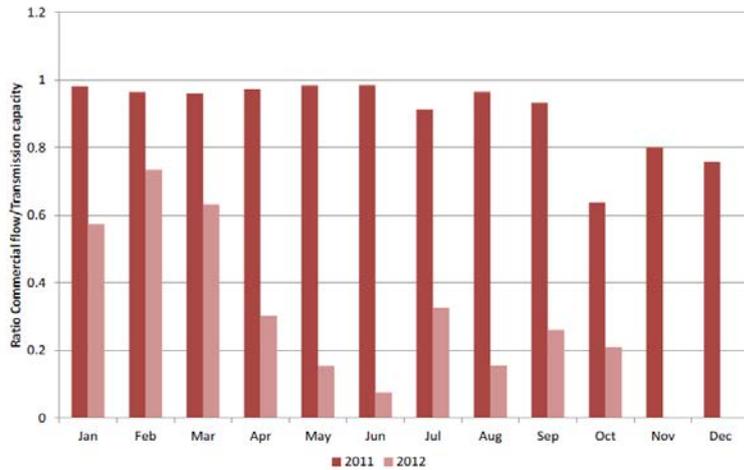
- B.5) The way the SEM CRM has been designed may raise two challenges. First, its compatibility with the day-ahead target model for cross-border trade (market coupling) to be implemented on the Ireland - Great Britain interconnector. Once market coupling is implemented it is no longer possible to distinguish which market participant exports and/or imports and therefore to distinguish who should receive or reimburse the capacity payment.
- B.6) Second, and maybe of lesser importance, the ex-post element of the capacity remuneration payment induces a risk for traders and therefore requires a higher price difference between the SEM and the Great Britain market to trigger exports, which can impact utilisation of the interconnectors and affect generation dispatch decisions.
- B.7) The compatibility of the SEM CRM with market coupling will be addressed by the SEM Regulatory Authorities who have recently published a decision setting out their plans to implement the European electricity target model.
- B.8) The annual review of the relative weightings of the capacity payments made by the SEM Regulatory Authorities (the next review will take place in summer 2013) may also lead to a reduction or the removal of the ex-post element of the capacity payment and therefore reduce its impact on cross-border trade.

ANNEX C:

THE IMPACT OF THE RUSSIAN CRM ON THE FINNISH ENERGY MARKET

- C.1) An example of a short term distortive effect of a CRM can be illustrated on the Finnish–Russian border. The Finnish and Russian electricity markets are linked via three 400 kV electricity lines (two DC, one AC) with an overall capacity of 1,400 MW. The Russian CRM creates a stable revenue stream to contribute to fixed costs of existing plants and new investments. The CRM was introduced when liberalisation of the market started in 2006 and was gradually implemented to become fully operational in 2011.
- C.2) The total monthly capacity payments in the North West of Russia correspond to approximately 4,000 €/MW (or 200 €/MW per day assuming twenty working days in a month) of peak demand. To recover these costs, a fee is added to all domestic demand and exports from North West of Russia during peak hours.
- C.3) For an exporter to Finland from Russia, the system of allocating capacity costs means that it is viable to export during Russian peak hours, only if the margin that can be achieved exceed 200 €/MW. When the price difference between the adjacent Russian electricity exchange and Nord Pool (Finnish zone) during Russian peak hours is less than the capacity charge, no electricity will be exported.
- C.4) Figure C-1 shows that in 2011 a stable cross-border flow close to the maximum cross-border capacity level from the Russian to the Finnish market was observed. After 2011, when the Russian capacity market rules for the treatment of exports and imports came into force, the cross-border electricity flow from Russia to Finland dropped to one-third during certain peak-time periods, which is shown in Figure C-2 for one day.

Figure C-1: Ratio of commercial flows to transmission capacity on the Finnish-Russian border, 2011 and 2012



Source: Fritz (2013), Available at: <http://www.iva.se/PageFiles/17441/Peter%20Fritz%20presentation.pdf>.

Figure C-2: Cross-border flow at the Finnish-Russian interconnectors on 22 February 2012



Source: Viljainen (2012), Available at: http://srv128.bluerange.se/Documents/Market%20Design/seminars/CapacityMarkets/8_L_apeenranta.pdf. Neuhoff and Siljainen, “What is the impact of the Russian CRM on trade flows?”, 15 February 2013 (Manuscript).

C.5) Indeed, other factors, such as energy market design in Russia, distort cross-border trade. Nevertheless, this example shows how a different treatment of energy imports and exports (e.g. energy flowing from Russia to Finland is surcharged with capacity payments and the

grid fee, whereas energy flowing from Finland to Russia would not be surcharged by an additional fee) can result in underutilisation of available cross-border capacity, even in the presence of an energy price differential between the two markets.



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