Capacity mechanisms and the EU internal electricity market
The regulators' view: ACER's report on capacity mechanisms

Alberto Pototschnig and Martin Godfried[1]

1. Introduction

The Third Energy Package has set rules for the integration of national markets into a single, internal market for electricity and gas. This should ensure, *inter alia*, an efficient use of existing generation capacity, demand-side resources and cross-border transmission infrastructure. The EU Council, in February 2011[2], set the target of completing the internal energy market by 2014, a goal reaffirmed in May 2013[3].

At the same time there is 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 times[4] in the future. The political sensitivity to blackouts, as well as practical and theoretical uncertainties[5] as to if and when investors will build new generation capacity, has compelled a number of MSs to intervene by introducing Capacity Remuneration Mechanisms ("CRMs") in order to ensure that a sufficient amount of capacity will be available.

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 and stable stream of revenues, e.g. in the form of capacity remuneration. However, to the extent that these revenues are also higher than what would be the case in an energy-only market, CRM may impose additional costs to energy consumers[6].

Many national electricity wholesale markets are highly interconnected and adjacent electricity systems in regional(ised) electricity markets interact physically and economically. Therefore, 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.

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[1] Alberto Pototschnig and Martin Godfried are, respectively, Director and Senior Market Monitoring Officer at the Agency for the Cooperation of Energy Regulators (the "Agency"). Corresponding address is alberto.pototschnig@acer.europa.eu. This Chapter reflects and is heavily based on the Agency's Report on Capacity remuneration mechanisms and the internal market for electricity of 30 July 2013. Therefore the authors acknowledge the contribution to this Report from Christophe Gence-Creux, Head of the Electricity Department in the Agency, and from colleagues in National Regulatory Authorities for energy, in particular members of the Capacity Mechanisms and Market Integration work stream. Any inaccuracies in this Chapter are however the sole responsibility of the authors.

[2] European Council, Conclusions on Energy, 4 February 2011, PCE 026/11, in particular point 4, available at: http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/ec/119141.pdf.

[3] European Council, Conclusions, 22 May 2013, EUCO 75/1/13, in particular point 2, available at: http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/137197.pdf.

[4] 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.

[5] 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.

[6] 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.

In view of both recent and future developments, the Agency has looked at the impact of different CRMs on the functioning of the IEM. Following its Opinion on Capacity Markets provided to the European Parliament's Industry, Research and Energy (ITRE) Committee in February 2013[7], in July 2013 the Agency issued a Report on Capacity remuneration mechanisms and the internal market for electricity[8]. The European Commission also recently intervened to provide guidance to MSs on how to design mechanisms to provide adequate generation capacity, in order to ensure the continuous supply of electricity without jeopardising the benefits offered by the EU-wide energy market[9]. In particular the Commission provided a checklist which allows MSs to verify the efficiency of their intervention and to improve it where necessary.

This Chapter illustrates the main conclusions presented in the Agency's Report of July 2013. The reader is referred to the Report for a more complete treatment of the impact of CRMs on the IEM.

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

In a pure energy-only market, in theory and in the absence of market failures[10], the operating (e.g. fuel, start-up costs) and capital costs of a plant would be recovered exclusively through market prices for electricity and for the associated ancillary services.

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"[11] which can be used towards covering fixed costs. 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)[12]. 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.

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[7] Available at: http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Opinions/Opinions/ACER%20Opinion%2005-2013.pdf.

[8] Available at: http://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/CRMs%20and%20the%20IEM%20Report%20130730.pdf.

[9] Communication "Delivering the internal electricity market and making the most of public intervention" of 5 November 2013, C(2013) 7243 final, available at: http://ec.europa.eu/energy/gas_electricity/doc/com_2013_public_intervention_en.pdf, and the accompanying Staff Working Document, "Generation Adequacy in the internal electricity market - guidance on public Interventions", of 5 November 2013, SWD(2013) 438 final, available at: http://ec.europa.eu/energy/gas_electricity/doc/com_2013_public_intervention_swd01_en.pdf.

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

[11] The difference between the market price and the operating (i.e. variable) cost of the plant.

[12] 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

In an energy-only market, scarcity prices may attract investment in new capacity and prevent existing capacity from leaving the market if they are sufficiently frequent and sufficiently high. 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.

In any case, as long as demand is sufficiently price responsive, and falls to zero at VoLL[13], 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 adequacy[14] is therefore determined endogenously by the market.

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. It is the "political" unacceptability of extreme prices in energy-only markets which pushes MSs to intervene, e.g. by introducing CRMs, in order to reduce the frequency and level of price spikes.

3. A taxonomy of CRMs

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. Five different types of CRMs can be defined and classified as presented in Figure 1:

a) Strategic Reserve schemes, in which some generation capacity, centrally and competitively procured, 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;

b) Capacity Obligation schemes, in which an obligation is imposed on large consumers and on load serving entities to contract a certain level of capacity linked to their self-assessed future (e.g. three years ahead) consumption or supply obligations, respectively. 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;

c) Capacity Auction schemes, in which the total required capacity is set (several years) in advance of supply and centrally procured through an auction by an independent body;

d) Reliability Option schemes, based on instruments similar to call options[15], in which contracted capacity providers (typically generators) are required to pay the difference

between, on the one hand, being supplied and paying the price and, on the other hand, not being supplied (and pay nothing). VoLL is typically quite high (e.g. several thousand euros per MWh).

[13] Since, given the definition of VoLL, no consumer is willing to pay a price for energy higher than VoLL. However, VoLL may be difficult to measure.

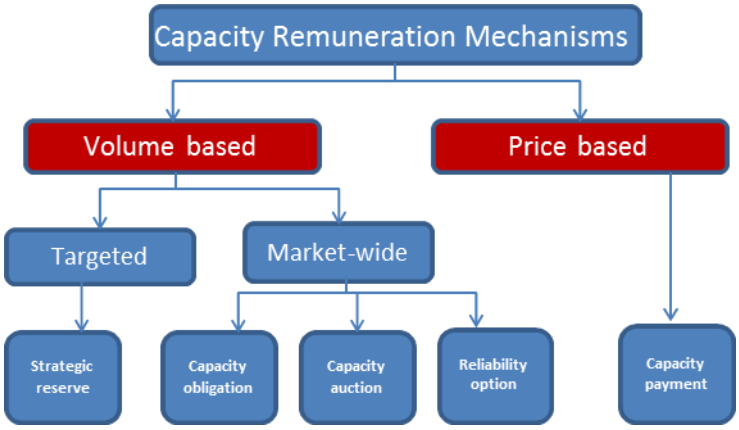
[14] In fact, if demand is sufficiently price responsive, an energy-only market will deliver full adequacy, but at the cost of some demand "voluntarily" reducing consumption when prices reach the VoLL level. It is this way of achieving market equilibrium and adequacy which may not be political acceptable.

[15] However, it is important to note that Reliability Options 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

between the wholesale market price (e.g. the spot price) and a pre-set reference price - 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;

e) Capacity Payment schemes, in which a fixed price is paid to generators/consumers for the available capacity.

Figure 1: Taxonomy of CRMs



Note: Some price-based mechanisms can be targeted.

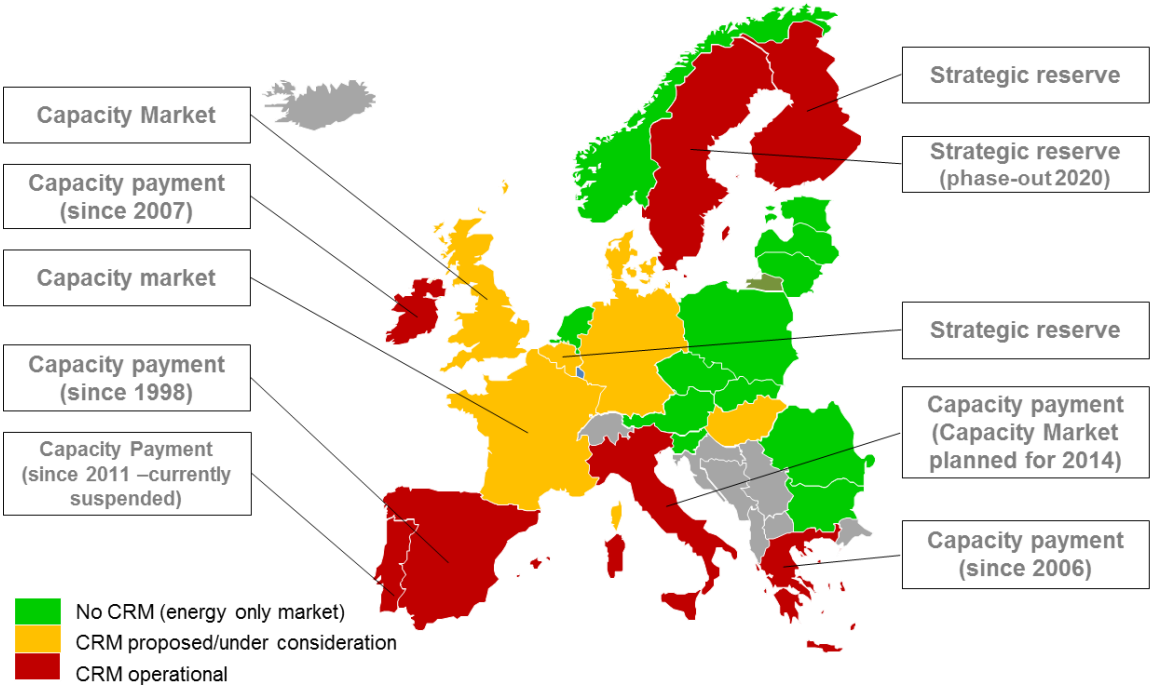
CRMs within any of these categories may be designed in many different variants. Most CRMs interact with the energy-only markets and, if not properly designed, may negatively impact the energy market, preventing it from producing reliable and efficient price signals. In any case, the objective of removing any barrier to the well-functioning of energy-only markets across Europe needs to remain a priority.

4. Current developments in the European Union

At present, a large number of MSs pursue a national generation adequacy policy. Figure 2 shows the approach to generation capacity adequacy in Europe in 2013.

Reliability Options is pre-set administratively (by an independent body) and not negotiated in the market; and (ii) the total quantity of Reliability Options 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).

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



Source: National Regulatory Authorities (2013).

It should be emphasised that, in designing CRMs, limited attention is typically devoted to their impact on the IEM and cross-border trade. As a result the opportunities presented by the IEM and cross-border trade for delivering adequacy are often overlooked and enduring distortionary effects might be introduced without their consequences being assessed.

5. Impact of CRMs: design and distortions

The different types of CRMs interact differently with the energy-only markets and ancillary services mechanisms (balancing markets).

Few studies focus on the cross-border distortions[16] which may result from a unilateral introduction of a CRM in one MS. 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 of the way in which CRMs may impose distortions on the IEM. These distortions may take different forms:

a) CRMs can impact prices in the short term and therefore alter production decisions (operation of power generating plants) and cross-border flows and competition. When a national CRM does not or insufficiently considers non-domestic generation capacity,

[16] 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".

it may impact cross-border competition at wholesale level and introduce short-term distortions. For instance, in the Strategic Reserve or Capacity Obligation[17] 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. 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. 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.

b) CRMs may influence investment decisions (investment in plants and their locations), with potential impacts in the long term. In literature[18] 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. In countries without CRMs investments in generation decline and plants are decommissioned earlier. 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. The benefits of and requirements for cross-border participation in CRMs are presented in Section 6.

c) CRMs may have welfare redistribution effects between interconnected markets. 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. The magnitude of this type of spill-over effect 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 effect will be.

Moreover, as with all policies and measures, additional distortions may result from incorrect design or implementation of CRMs. The design of any CRM requires that choices are made with respect to several characteristics[19]. The choices made may affect significantly the way in which CRMs impact on energy markets, both in the short- and the long-term.

[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.

[19] 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.

The design of a CRM is also influenced by the methodologies applied for assessing generation adequacy and security of supply levels[20]. Currently, these methodologies differ considerably between MSs, which hampers the comparability of their results. This poses an additional challenge when designing CRMs.

In its Opinion on Capacity Markets to the ITRE Committee of the European Parliament[21], the Agency 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 Reliability Option schemes – which greatly affects the (possibly distortionary) impact on the energy market, is the level at which the threshold/strike price is set.

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 VoLL[22]. 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, the threshold/strike price should be set at the highest politically acceptable level.

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, Reliability Options and market option contracts serve different purposes and should not be confused.

6. Cross-border participation in CRMs

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*".

[20] 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.
[21] *Cfr.* footnote 7.
[22] 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.

Cross-border participation to CRMs does not necessarily require that cross-border capacity is set aside[23]. 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 CRM[24] 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 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 capacity 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 capacity[25] in particular in stressed situation on both sides of the border[26].

7. Conclusions and recommendations

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 to avoid adverse distortionary effects.

In its Report, the Agency observed, however, that MSs currently have national, uncoordinated and often diverging approaches to security of supply, 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.

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, if the contribution from cross-border capacity is not appropriately taken into account, CRMs may 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 assessment to be completed before implementing any mechanism, in particular since once a CRM is implemented it is usually not easy to remove it.

[23] See footnote 11 in the Agency's Opinion on Capacity Markets to the ITRE Committee.
[24] Reliability Options may be an exception to this.
[25] 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.
[26] 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.

In addition, the implementation of a CRM should not delay the completion of the IEM: 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.

The Agency believes that the risk of potential distortions can be addressed by better coordinating 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 proposed the following recommendations:

a) the harmonisation of generation adequacy criteria and security of supply levels should be undertaken where possible;

b) a common (at least regional) and coordinated approach for a thorough security of supply assessment should be implemented;

c) 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 significant[27]. Further, harmonised or regional CRMs may reduce the need for foreign participation in national CRMs;

d) 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 and cover the following criteria:

    i. the nature of the problem which the mechanism intends to address;

    ii. the necessity of a proposed mechanism;

    iii. the appropriateness of the proposed mechanism;

    iv. how cross-border capacity is taken into account;

    v. 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;

    vi. the cost of the mechanism (including costs for implementation) and the (estimated) costs of capacity payments.

[27] See Section 6.