COMMENTS TO THE INTERIM REPORT OF THE SECTOR INQUIRY ON CAPACITY MECHANISMS

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1 SUMMARY

We acknowledge the publication of the Interim Report and the Annexed Staff Working Document as a huge contribution to enhance the design of Capacity Remuneration Mechanisms (CRMs) so as to minimise their "friction" with the Internal Energy Market (IEM). In order to fully seize the potential benefits of market integration, a minimum level of coordination in the security of supply dimension is necessary. Most of current CRM designs implemented or under proposal in the European Union are still based on an autarkic vision, according to which domestic resources must be capable of guaranteeing the security of electricity supply on their own. However, capacity remuneration mechanisms are going to critically condition the investments that will "shape" future European power sectors (indeed, this is why they are ultimately designed for). If cross-border resources are not allowed to fully participate in CRMs in a level playing field with domestic resources, each system will develop in isolation and the scope of the Internal Energy Market will be limited to a short-term market for "left-overs". The Interim Report and the Annexed Staff Working Document provide a much-needed assessment on the introduction of CRMs in the European Union, as well as a platform for discussion and creation of a common understanding of the main involved problems.

We share the assumptions on which the report is based and we agree with most of the tentative conclusions. Nevertheless, we have some comments, mainly regarding cross-border participation in CRMs, but touching also other issues, which we would like to share with the editors. Most of our inputs are related with eligibility and product design, according to the terminology used in the documents under consultation. Before entering into details, we briefly summarise hereunder our views on cross-border participation and other CRM-design issues.

1.1 Comments in a nutshell

1.1.1 Cross-border participation in capacity mechanisms

Implicit participation of cross-border resources has very limited value

Capacity remuneration mechanisms aim basically at guaranteeing, during scarcity conditions, that the demand is supplied or receives compensation. The so-called implicit participation of cross-border resources (e.g., the deduction of expected imports during scarcity conditions from the amount of capacity to be procured through the capacity mechanism) does not guarantee the security of supply (there is no such participation, but just an estimation of the expected contribution, which may not be finally delivered during actual scarcity conditions) and should not be considered as a possible solution. Explicit participation is the only way to guarantee the security of supply (or the equivalent compensation).

To allow for explicit cross-border participation on CRMs, further regulatory provisions have to be considered, including a novel sort of physical contract

Due to the implementation of price caps, the market coupling algorithm may not be able to properly assign available resources during regional scarcity conditions (i.e., stress events that affect more than one country). As a result, a novel type of physical contract would be needed for the counterparties of the cross-border reliability contract for the system launching the CRM to have a guarantee that in a scarcity event the committed energy will actually flow through the interconnection so the CRM contract fulfilled.

A "conditional nomination" rule should be introduced in the short-term market algorithm to ensure that, in this situation, available resources are assigned according to contracts signed in the framework of CRMs. This approach does not affect market efficiency; right the contrary, it deals with the inefficiency derived from the existence of a price cap. This issue, originally developed in Mastropietro et al. (2015a) is further discussed next in section 3.3 and largely analysed in the paper annexed at the end. It is important to remark at this stage that there is no distortion in the regulator of one country assigning a higher economic value to its electricity reliability, thus being willing to have a more "generous" capacity mechanism, as long as participation from other power systems is allowed.

Participation of interconnectors in the CRMs and conflict of interest

Explicit participation may consider as counterparties either interconnectors or cross-border resources. However, except those very rare instances of fully merchant lines, interconnectors are not market agents. In Europe, they are mostly part of regulated businesses which should

not take part in any market, since such participation would involve significant conflicts of interests. Only cross-border resources should be allowed to participate in national CRMs.

These discussion items on cross-border participation in CRMs, only outlined in this summary, are analysed in larger detail in the following sections.

1.1.2 Other CRM-design issues

Apart from this very central topic, we also have comments on side issues, of no lesser relevance, which we grouped together in the last section of this document and which are summarised hereunder:

- The Interim Report seems to acknowledge strategic reserves and tenders for new capacity at least as temporary or transitional measures. However, these measures end up being everything but transitional, as it is the case of tenders for new capacity that are supposed to involve long-term contracts. The risk with this kind of mechanisms is to enter in a "permanent transitional period", which results in market fragmentation and reduces the overall economic efficiency. As already well-known, these sort of tenders also lead to a market segmentation that also severely affects the efficiency of the market mechanism in the long term.
- The increased price volatility in the short term due to the installation of intermittent renewable technologies is not hampering investments as much as the uncertainty in the long term is doing. The key market failure is the inability of potential investors to hedge against this uncertainty in the long run (the so-called "missing market" problem, or market incompleteness). CRMs are supposed to provide investors with at least a partial long-term hedge they might require to enter the market.
- The larger demand-response potential comes from high-load commercial and industrial users, which already have smart meters with time differentiation. Thus DR deployment should not be postponed waiting for the roll-out of domestic smart meters.
- Non-performance penalties have a central role in well-functioning capacity mechanisms, but they need an extremely careful design, as demonstrated by empirical evidence from international experiences.

2 DETAILED COMMENTS ON CROSS-BORDER PARTICIPATION

2.1 Implicit vs. explicit participation

At page 136 of the Staff Working Document, it is said:

> *Implicit participation does not remunerate foreign capacity for the contribution it makes to security of supply in the capacity mechanism zone. If only domestic capacity receives capacity payments, there will be a greater incentive for domestic investment than investment in foreign capacity or interconnectors resulting in less than optimal investment in foreign capacity and in interconnector capacity.*

We agree with this point of view. The lack of remuneration to resources capable of contributing to the security of supply clearly distorts investment signals. Beyond this, we believe that implicit participation is not a solution at all, since it does not guarantee the security of supply, which is the ultimate goal of a capacity mechanism. Modern CRM designs provide a capacity remuneration and, in exchange, require committed resources to deliver during scarcity conditions, or to pay a compensation. If the contribution from cross-border resources is taken into account statistically, i.e., calculating the expected contribution at times of scarcity and deducting it from the capacity to be procured in the CRM, there is no way to guarantee that the contribution will actually be delivered. The majority of domestic demand would be covered through contracts with domestic capacity providers and, in scarcity conditions, it would be either supplied or compensated. However, there would be part of the demand, the equivalent of the amount deducted considering implicit participation, whose supply during shortages is only "likely" and cannot be guaranteed[1]. The hedge is not complete. Furthermore, there is a clear discrepancy between the treatment to domestic and cross-border resources.

A similar reasoning applies to the dichotomy in the product design between availability and delivery. In the Staff Working Document opinions in favour of both methods can be found. However, the availability method does not ensure demand supply. It is sometimes argued that the availability method is less distortive, but if a delivery method distorts market outcomes, the reason is likely to be found in a flawed design of the CRM. More explanations are provided in the following subsections, when talking about the critical period indicator.

2.2 CRM critical period indicator

The critical period indicator identifies the approach used to determine scarcity conditions (in the Staff Working Document it is referred to as "*period of obligation*"). Different approaches are

[1] Actually, we see the implicit participation as an indirect way to elude cross-border participation: if a Member State wants to maintain its autarkic vision on capacity expansion, it can just add the estimated contribution of cross-border resources to the desired capacity margin objective. Moreover, since this approach does not require any explicit commitment from cross-border resources, this "statistical" contribution has to be necessarily "undervalued".

possible and have been used in practice, but the most common are i) the price of a reference market: scarcity conditions are declared when such price exceeds a predetermined strike price; ii) grid parameters or emergency actions taken by the system operator (Mastropietro et al., 2015b).

In Batlle et al. (2015), we provide many arguments in favour of using a reference market price as critical period indicator. We believe that the short-term market price is the best "thermometer" of scarcity conditions in a market environment. This consideration should become increasingly valid in the future, with greater elasticity of demand. In fact, as long as the share of completely inelastic demand in the market (i.e., the demand that bids at the price cap) decreases, it will become increasingly difficult to define the demand which "must" be served and, consequently, to identify near-rationing conditions based only on the comparison of peak demand and available generation. Having the short-term price as the critical period indicator obviously assumes the presence of a liquid power exchange in the system, but this, in fact, is now considered as an essential feature of any efficient wholesale market. Therefore, in those systems where such a reference market is not yet in place, the implementation of a capacity mechanism of this sort could foster the development of a liquid short-term market (day-ahead or balancing).

A major advantage of using market prices to identify scarcity conditions can be found in regional markets. In fact, if markets are coupled, flows through the interconnections are fully determined by market price differentials. Therefore, very high prices in just one zone of the market coupling would trigger scarcity conditions in such zone, but at the same time they would result in flows through the interconnection towards such zone. This facilitates the participation of cross-border resources in CRMs.

2.3 Improving the firmness of cross-border participation in capacity remuneration mechanisms

Unfortunately, there are certain conditions in which the market is not able on its own to properly assign available resources and to allow the fulfilment of cross-border CRM contracts, even in those designs that identify scarcity conditions through market prices. During regional scarcity conditions, i.e., concurrent power shortages in more than one country, the market price is likely to reach the regional price cap, set at 3 000 €/MWh, and the market may not be

able to clear. According to RTE (2015)[2], in this case, the market coupling algorithm would assign available resources on a pro rata basis among those countries that share curtailments. Nonetheless, in such situations, available resources should be assigned to those consumers who paid for them in the "security of supply market", i.e., in capacity mechanisms. This concern was raised also by Member States, through their regulators or system operators, as can be read in DECC (2013)[3] or RTE (2014)[4]. According to us, this is one of the main barriers to explicit cross-border participation in capacity mechanisms.

The Staff Working Document seems to acknowledge this problem at page 150, when it states:

> *In the event of a scarcity event in two Member States at the same time that brings prices to in both markets to the market coupling price caps (currently EUR 3000 per MWh for the purposes of day ahead market coupling and below most estimations of the value of lost load) rules could be developed to enable electricity flows in proportion to cross-border capacity contracts held rather than the current default of equal sharing of curtailment.*

In a working paper made public in 2013, and published in a scientific journal later in 2015 (Mastropietro et al., 2015a), we proposed to include in the market coupling algorithm a "conditional nomination" rule, which ensures the fulfilment of CRM contracts during concurrent scarcity conditions on both sides of an interconnection. Such conditional nomination of a particular kind of physical contract enhances the firmness of cross-border reliability contracts and its inclusion is essential to increase the confidence in foreign reliability providers in the framework of CRMs. The conditional nomination does not interfere with market functioning during normal operation, but it allows to solve a tie situation when market prices, due to the activation of price caps, are not representative anymore of consumers' utilities. This does not affect economic efficiency and permits to make supply available to those consumers that paid for it in the "reliability market" represented by CRMs.

We deem that the inclusion in the market-coupling algorithm of the conditional nomination or of any other rule that guarantees the fulfilment of cross-border CRM contracts during regional

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[2] RTE, Réseau de Transport d'Électricité, 2015. Public consultation regarding the participation of interconnections and/or foreign capacities in the French capacity market. Consultation document released on 24 September 2015.

[3] DECC, Department of Energy & Climate Change, 2013. Electricity Market Reform: Capacity Market - Detailed Design Proposals. Working document released in June 2013.

[4] RTE, Réseau de Transport d'Électricité, 2014. French Capacity Market. Report accompanying the draft rules. Document released in April 2014.

scarcity conditions is of paramount importance and we believe that this should be reflected in the Final Report of the Sector Inquiry. For further details, please refer to the article Mastropietro et al. (2015a) and also to the paper that is annexed right after this document.

However, not all CRM designs rely on a reference market price to identify scarcity conditions. Actually, the majority of European CRMs, introduced or under study, are based on other critical period indicators. In these contexts, it is important to focus on the difference between physical and financial contracts (as for example the TSO estimation of the risk of scarcity). In the remainder of this subsection, we outline in a very summarised way the essential role of well-designed physical contracts for an efficient cross-border participation in CRMs. Details on this topic can be found in the Annex to this response.

Physical and financial energy contracts are not equivalent due to price caps

The use of physical electricity contracts instead of merely financial ones has always been a contentious issue. Today, especially due to the CRMs under design in the context of the EU Internal Electricity Market, the discussion around this topic needs to regain attention. In an ideal non-intervened and perfectly-competitive market, physical and financial contracts are equivalent. Financial contracts, however, are less valuable than physical contracts when, as it is the case in the European Union, the price is administratively capped. If the price cap is lower than the value that a certain agent assigns to its electricity consumption, then this agent would prefer a physical contract over a financial one.

On the other hand, physical contracts might be prone to generate inefficiencies in the short-term market clearing if no further provisions are considered. These inefficiencies can be avoided if the market operator allows to give "physical priority" to physical bilateral trades only when the price reaches the price cap, the so-called conditional nomination presented in Mastropietro et al. (2015a) and discussed above.

This discussion, involving the negative impact of price caps and the need for allowing for conditional nominations is equally valid when discussing the differences between physical and financial transmission rights (PTRs versus FTRs) in the network constrained world.

The need for physical commitments to allow for cross-border CRMs

CRMs are one of those contexts in which the aforementioned preference for physical contracts applies. The objective of a CRM should be to allow the contractor (e.g. the TSO on behalf of one Member State's demand) to be sure that, during scarcity conditions (e.g., when the price is

equal to the price cap), all contracted resources, either domestic or cross-border, are able to fulfil their capacity commitment "physically".

In meeting the CRM objective, it is both simpler and more efficient if scarcity conditions are properly identified by means of a regionally-determined price signal (e.g., the price resulting from the EUPHEMIA algorithm). As mentioned above, however, administratively-set price caps can lead to an inefficient regional allocation of available power resources during scarcity conditions. Thus, to solve this already existing inefficiency, it is essential to include some sort of conditional nomination that permits the execution of the cross-border CRM contract. Such nomination would not affect the short-term market efficiency, but rather would allow market agents to reflect their actual willingness to be supplied.

In case the CRM design does not fully rely on market signals, as it is the case in many of the proposed designs in the European Union (where scarcities are identified through emergency actions taken by the system operator), the application of the conditional nomination scheme can still be applied.

If, for some reason, the conditional nomination is not considered as an option, and there is still willingness to open CRMs to neighbours, the use of PTRs is the last resort solution to solve the regional adequacy problem. In this latter scenario, there will be a clear trade-off between the risk of affecting the efficiency of the short-term market with the PTRs and the enhanced efficiency of the long-term market represented by the regional participation in CRMs.

2.4 Coordinated management of regional scarcity conditions

Another major barrier to the development of cross-border CRM trades derives from the existence in many network codes of clauses that maintain that exports to other systems will be interrupted in case of domestic emergencies. This generates a lack of confidence in the firmness of the supply to be received from another system. If the system operator of a neighbouring country can curtail the flow through the interconnection, no matter of CRM contracts signed to properly assign the supply during regional scarcity conditions, then the only option to guarantee the security of supply is to pursue some sort of electricity autarky. However, this solution is highly inefficient and it must be avoided, as recognised also by the European Commission in the Security of Supply Directive (2005/89/EC), in its very-often-mentioned but rarely-applied article 4.3.

The Staff Working Document recognises this concern at page 143:

> *Common and transparent rules for Member State and TSO actions in scarcity and emergency situations are required to avoid the current lack of trust about the potential for imports at times of concurrent scarcity.*

Nonetheless, this is a very pivotal issue for success of CRM cross-border trades and we believe that this should be reflected in the Final Report of the Sector Inquiry. National and regional network codes must be modified, restricting *force majeure* conditions and preventing system operators from blocking exports when they are the result of an efficient market clearing (including both the energy and the capacity market).

In 2015, the European Commission issued Regulation 2015/1222, which establishes guidelines on capacity allocation and congestion management. As recognised by the already-mentioned RTE (2015), Regulation 2015/1222, in its article 72, tries to limit the scope for unilateral curtailments during concurrent scarcity conditions, authorising such curtailments only if the regional shortage is being faced in a coordinated manner among the involved system operators. Nonetheless, the possibility of export curtailments is still considered; thus there is a conflict between Directive 2005/89/EC, article 4.3, and Regulation 2015/1222, article 72, which is to be addressed.

3 FURTHER COMMENTS ON CRM DESIGN

3.1 Tenders for new capacity and strategic reserves

At pages 113, 114, and 115 of the Staff Working Document, it is said:

> *A tender for new capacity may be an appropriate temporary measure to incentivise investment (including potentially in a specific location) and offer a route to market for new entrants. (...) However, a tender does not effectively address longer term generation adequacy problems, and may exacerbate underlying market and regulatory failures unless complementary reforms are also made.*
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> *Strategic reserves may be appropriate transitional measures in situations where for example the completion of new capacity or transmission infrastructure or the implementation of market improvements are underway and expected to address underlying generation adequacy concerns. However, the reserve alone does not address underlying market or regulatory failures, and may exacerbate the problems preventing sufficient capacity investments in the market outside the reserve.*

We fully share the second part of both these sentences. Tenders for new capacity and strategic reserves (commonly targeting existing power units) are different mechanisms that result in the same undesired outcome, i.e., the segmentation of the market. Without acting on the real structural cause of the problem, these measures may be counterproductive.

However, we do not completely agree with the first parts of these sentences, which seem to justify the application of tenders for new capacity and strategic reserves as temporary or transitional mechanisms. We deem that both these measures affect market efficiency in the long term (even a single tender for new capacity may result in a certain amount of capacity

that will have a contract at a fixed price for several years). They may be the only feasible option under certain circumstances, but first it should be clearly demonstrated that there is no way to solve the problem resorting to demand response, and even also in these cases, they must be subject to specific limitations that make sure that the power sector develops in a "permanent-transition" environment. Such limitations may be represented by the prohibition to go back to market for those plants taking part in the strategic reserves or by prohibiting tenders for new capacity if they are not part of a process that finally results in a proper market-wide capacity mechanism.

3.2 Interconnector vs. cross-border participation

The clearest statement on this issue in the Staff Working Document can be found at page 88:

> *To ensure the right investment incentives, the revenues from the mechanism paid to the interconnector and/or the foreign capacity should reflect the relative contribution each makes to security of supply in the zone operating the capacity mechanism. Where interconnection is relatively scarce but there is ample foreign capacity in a neighbouring zone, the interconnectors should thus receive the majority of capacity remuneration.*

A similar reasoning can be found in Annex 2 (page 135).

In liberalised power sectors, transmission and system operation are regulated activities. Network expansion planning is monitored and approved by the regulator and transmission remuneration is calculated by the same entity[5]. In such context, the grid remuneration does not depend on any market revenue, even if it is the element that actually delivers electricity to consumers. Where nodal or zonal prices are calculated, congestion rents are typically used to cover part of the regulated remuneration of the network, but they shall never condition the profitability of network assets. These congestion rents convey a signal that should guide investments for grid expansion.

These same principles should hold in the context of capacity markets. Zonal capacity auctions can be used (as it is the case in the United States, e.g., in ISO New England) and, if different capacity prices arise, a capacity congestion rent can be collected, which, as the energy congestion rent, can be used to cover part of the regulated remuneration of the network while also help the regulator detect necessary grid reinforcements.

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[5] This is particularly true in the European Union, where merchant lines, if any, are anecdotal, and it applies to both national grids and cross-border interconnections.

Beyond this fundamental problem affecting power sector structure, if an interconnector is assigned capacity commitments, a problem arises regarding their fulfilment. In fact, interconnectors are clearly not able to generate electricity; therefore the interconnector operator could either i) do nothing and hope that during scarcity conditions the line actually delivers its expected contribution, or ii) try to sign firm contracts with cross-border resources to back up its commitment. In the first case, it would provide the same security of supply as in the implicit-participation approach. In the second case, a regulated activity would be active in a foreign market, which seems to be outside the scope of European system operators.

Finally, the interconnector approach may also lead to significant conflicts of interests. Cross-border interconnections in the European Union are usually owned and operated by consortia formed by the transmission system operators of the countries on the two sides of the line. At the same time, many CRMs are managed by the system operator of the country that introduces the capacity mechanism. In this framework, the system operator is in charge, among other activities, of de-rating resources, identifying scarcity conditions (only in certain designs), calculating the contribution of committed resources, and imposing penalties in case of underperformance. If the interconnector participates in the capacity mechanism, there is an evident conflict of interest. Continuous monitoring from an independent body can be applied, but it will not remove such perverse incentive (as highlighted by the discussion in the UK and Ireland).

Because of the reasons explained above, we believe that interconnectors should not actively participate in capacity mechanisms and that the explicit participation of cross-border resources is a more efficient solution. Obviously, this should not distort the efficiency of the energy market, as analysed in the following subsections.

3.3 Market volatility

At page 8 of the Interim Report, it is said:

> *The intermittent character of renewable sources of electricity creates uncertainty regarding the frequency of price spikes that help conventional technologies to recoup their investment costs.*

We deem that this statement needs to be qualified. The deployment of intermittent generation can indeed increase the short-term volatility of market prices. However, it is not such short-term uncertainty what hampers investments in conventional generation, but rather an increased uncertainty regarding the long-term development of the system which, besides the inherent uncertainty about the evolution of the learning curves of new technologies, is perceived as subject to hardly predictable regulatory interventions.

3.4 Demand-response potential

At page 9 of the Interim Report, it is said:

> *Demand participation requires that consumers have the equipment (e.g. smart meters), the real-time information and the contracts that allow them to react to price increases and to adapt their electricity consumption accordingly*

We share this recommendation. However, the experience from the United States suggests that the higher demand-response potential lays in the commercial and industrial sector more than in the domestic one. Therefore, the incomplete roll-out of smart meters should not be considered a plausible driver for the introduction of a capacity mechanism.

3.5 Reliability levels

At page 10 of the Interim Report, it is said:

> *A patchwork of mechanisms across the EU risks affecting cross border trade and distorting investment signals in favour of countries with more 'generous' capacity mechanisms*

We agree with the first part of the sentence, but the second one could be misleading. As we also mentioned in Mastropietro et al. (2015a), the final goal of CRMs is to guarantee a certain level of reliability of electricity supply. Regulators in different Member States can and should be allowed to require different levels of reliability, depending on the expected impact of a potential electricity curtailment in their system. This does not represent a distortion of the market efficiency, as long as cross-border contributions are properly taken into account. If cross-border resources are allowed to participate in a "generous" capacity mechanism, the investment signal is still the proper one.

3.6 Non-performance penalties

At page 16 of the Interim Report, it is said:

> *The inquiry found that, where obligations are limited and penalties for non-compliance are low, there is insufficient incentive for plants to be reliable.*

We fully agree on the pivotal role of non-performance penalties in achieving the final goal of capacity mechanisms, i.e., to guarantee the supply of electricity during scarcity conditions (Mastropietro et al., 2016). However, empirical evidence from international experiences with CRMs in the American continent suggests that the design of penalties needs to be very accurate for these regulatory tools to have the desired impact. We wrote an article on this topic (Mastropietro et al., 2015b), in which we identify the design elements of CRM penalty schemes and study how each one of them can alter the final outcome of the capacity mechanism.

IMPROVING THE FIRMNESS OF CROSS-BORDER PARTICIPATION IN CAPACITY REMUNERATION MECHANISMS

1 INTRODUCTION

The use of physical electricity contracts instead of merely financial ones has always been a contentious issue, and today, in the context of the EU Internal Electricity Market, the discussion around this topic has regained attention, particularly due to the potential role of these contracts in the context of the Capacity Remuneration Mechanisms (CRMs), and more specifically as tools to allow for cross-border participation.

The main opposition against physical contracts is that they are claimed to distort the optimal outcome of the short-term market, potentially generating inefficiencies. However, as we shall review here, physical contracts are justified precisely as an efficient safety valve to overcome some market imperfections that currently exist. Furthermore, a proper definition of the physical contract involving an active role of the market operator in its consideration and execution could avoid any inefficiency while still overcoming market imperfections.

In the following, we introduce the basic background. We first focus on the role of physical contracts on an ideal "copper-plate" context, characterized by the total absence of network constraints. Then we extend the reasoning to the network constrained reality of the EU regional Internal Energy Market. Finally, we apply the major conclusions in the CRM dimension.

2 BASIC BACKGROUND: FINANCIAL VERSUS PHYSICAL CONTRACTS IN A "COPPER-PLATE" CONTEXT

Summary of key points

Ideally, physical and financial contracts are equivalent

In an ideal electricity market, a physical and a financial contract are completely equivalent. The physical (open-to-renegotiation) contract and the financial one will lead to the same production and consumption decisions and therefore will not affect short-term efficiency.

Physical contracts amend the inefficiencies derived from price caps

The presence of administratively-set price caps as the ones currently in force in any existing power market, result in an indeterminacy during scarcity conditions and thus in a sub-optimal allocation of available resources. In such a context, physical contracts can act as a safety valve

allowing agents to express their willingness to pay a price higher than the cap for the electricity supply. If the price cap is lower than the value that a certain agent assigns to its electricity consumption, then this agent would prefer a physical contract over a financial one.

Physical contract nomination would only be necessary when the price reaches the cap

On the other hand, physical contracts are prone to generate inefficiencies in the short-term market clearing. These inefficiencies can be avoided if the market operator allows to give "physical priority" to physical bilateral trades whenever the price reaches the price cap. This could be seen as the market operator nominating the bilateral physical contracts only when there is a scarcity. Under normal conditions, the contract would never be nominated and therefore it would act as a mere financial hedge.

2.1 Introducing the physical and financial contracts

A physical contract is a physical electricity delivery commitment by a generator (and on a symmetric way, a withdrawal commitment by a demand) for a specific quantity of energy and at a specific price. This bilateral agreement can be nominated outside the short-term organised market, in such a way that the generator can produce without bidding and being committed in the power exchange, with the certainty that there will be a demand physically withdrawing that energy (and the other way around, the demand can consume without bidding and being committed in the market, with the certainty that there will be a physical generation counterpart). This physical contract should also be open to renegotiation, meaning that each part should be allowed to transfer its physical commitment to a third party. Otherwise an unnecessary source of inefficiencies is introduced.

On the other hand, a financial contract does not involve any physical delivery of the product. The generation and the demand signing the contract basically agree on a set of monetary flows which depend on the difference between the short-term market price and the contract price. This way, the generator or demand willing to physically produce or consume will have to first bid and then be committed in the market, for the financial contract does not entail any physical electricity delivery.

2.2 When are both types of contracts equivalent?

From an economic perspective, in an ideal electricity market, a physical and a financial contract are completely equivalent. An ideal market is characterised by perfectly informed and economically-rational offer and demand taking part into the market through bids which adequately reflect their costs and utilities. Furthermore, the price in an ideal market should be

determined by the equilibrium between offer and demand, without any intervention by the regulator trying to impose restrictions. In such a context, the physical (open-to-renegotiation) contract and the financial one will lead to the same production and consumption decisions and therefore will not affect short-term efficiency.

2.3 When are physical contracts superior to financial ones?

Unfortunately, real electricity markets are far from being ideal, and this is especially true during scarcity conditions. The short-term price is not always the result of the equilibrium between offer and demand. When the generation is not sufficient to cover the load[1], because this equilibrium would take place at a price that the regulator considers unsuitable, the price is commonly set administratively, through the application of a price cap (also known as scarcity price or non-served energy price). In this case, it is not possible to assign efficiently the scarce resource. The presence of an administratively-set price cap that limits the short-term price results in an indeterminacy during scarcity conditions leading to a sub-optimal allocation of available resources. In such a context, however, physical contracts can act as a safety valve.

If the price cap is lower than the value that a certain agent assigns to its electricity consumption, then this agent would prefer a physical contract over a financial one, because the delivery of the physical asset has a higher value than the corresponding financial compensation. In other contexts, this is what is usually known as convenience yield. The higher the difference between the price cap and the utility value of a certain demand, the higher the preference for a physical contract guaranteeing the delivery.

2.4 Well-designed physical contracts

One of the potential distortive effects of physical contracts is that generators may decide to honour the contract without accounting for the possibility of transferring its physical commitment to a third party (potentially selected through the market). When this is the case, short-term efficiency can be affected, since it could end up, for example, with a generating plant producing when the market price is below its variable cost.

Let us recall that whenever the price reaches the price cap, the demand being the counterpart of the physical contract will enforce the physical delivery[2]. But on the other hand the delivery

[1] More accurately, the portion of the load that is perfectly inelastic and that does not participate in the market revealing its willingness to pay for electricity.

[2] And if that fails to take place, the generator will pay a penalty.

can only be ensured if the generator nominates the contract and does not bid in the market, since short-term market design usually does not assign priority to any type of agents in case of scarcity conditions.

The solution to the previous problem is simple: the market operator should allow to make the contract "physical" whenever there is a scarcity. This could be achieved if whenever the price reaches the price cap, the market operator takes the bid aside of the market and nominates the physical contract, thus giving priority to the consumption having these contracts. In case the price does not reach the price cap, the contract would always be financial.

3 FINANCIAL VERSUS PHYSICAL CONTRACTS IN A NETWORK CONSTRAINED CONTEXT

Summary of key points

In the absence of price caps, physical and financial transmission rights are equivalent

When generation and demand are located in two different sides of a usually congested interconnection, the natural hedge disappears and a base price risk arises, because the price may vary differently for the two counterparties. This kind of base risk can be hedged through the procurement of transmission rights. Two different kinds of transmission rights are possible: PTRs (entitle the buyer to reserve part of the interconnection capacity for its cross-border trades) and FTRs (financial contracts over the price differential between two zones).

Physical Transmission Rights (PTRs) amend the inefficiencies derived from price caps

Again, the presence of an administratively-set price cap results in an indeterminacy during scarcity conditions and thus in a sub-optimal allocation of electricity. In this case, a demand which assigns a utility to its consumption higher than the administratively-set price cap active in the market will be willing to sign a contract with a cross-border agent to have priority for the physical delivery of the energy contract, since a financial contracts coupled to FTRs would not match its utility function.

PTR nomination would only be necessary when the price reaches the cap

On the other hand, PTRs contracts are prone to introduce short-term dispatch inefficiencies. These inefficiencies can be avoided if the market operator allows to nominate the PTR conditioned to scarcities in the country hosting the demand with the physical cross-border contract.

3.1 PTRs and FTRs

When generation and demand are located in two different sides of a usually congested interconnection, the natural hedge disappears and a base risk arises, because the price may vary in a different way for the two agents. This kind of base risk can be hedged through the procurement of transmission rights. Two different kinds of transmission rights are possible:

- Physical Transmission Rights (or PTRs), which entitle the buyer to reserve part of the interconnection capacity for its cross-border trades, thus providing access to a different zone than the one in which it is located, without being exposed to the price differential[3].
- Financial Transmission Rights (or FTRs), which are financial contracts over the price differential between two zones. Different kinds of FTRs are usually auctioned, allowing partial or complete and bi-directional hedge against the risk associated to trading electricity across an interconnection.

3.2 When is a PTR superior to a FTR?

The line of reasoning used in the previous section to analyse physical and financial energy contracts applies also to physical and financial transmission contracts[4]. Therefore, PTRs and FTRs are totally equivalent, unless scarcity conditions take place. In this case, a demand which assigns a utility to its consumption higher that the administratively-set price cap active in the market and signing a contract with a cross-border agent will have a preference for a physical energy contract backed by a PTR rather than a financial contract coupled to an FTR.

3.3 The non-distortive physical transmission right contract and the role of the market operator in its execution

Analogous inefficiencies as those reviewed in the copper-plate case can arise. Cross-border generators having signed physical contracts may decide to honour the contract under any circumstance and produce and nominate the PTR without accounting for the possibility of transferring its physical commitment.

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[3] In order to guarantee the maximum exploitation of the interconnection capacity (and to avoid gaming from agents eager to block cross-border trades by withholding capacity), PTRs usually include a Use-It-Or-Sell-It (or UIOSI) clause, which requires the buyer to nominate its capacity before the actual usage. Non-nominated capacity is then re-auctioned to a different agent.

[4] For a detailed dissertation about the differences between PTRs and FTRs, as well as for a summary of the nomenclature used in different contexts to refer to these instruments, the reader can refer to Batlle et al. (2014).

Again, the generator will need to anticipate potential scarcity conditions in the neighbouring country before bidding in the market. If scarcity conditions take place in the country where the demand with the physical contract is located, then the generator would better avoid bidding in the market and nominate the PTR, otherwise it will be exposed to the risk of having to pay the penalty if its counterpart is not supplied.

The solution is again, analogous. The market operator should allow to make the transmission right "physical" whenever there is a scarcity that affects the load having signed physical cross-border contracts. This could be achieved if, whenever the price reaches the price cap in the country, the market operator nominates the PTR and therefore withdraws it from the short-term market clearing. During normal operation, when the price does not reach the price cap, the PTR is not nominated and it acts as an FTR.

4 CROSS-BORDER PHYSICAL CONTRACTS IN THE CONTEXT OF CRMS

CRMs and the future of the European market

In order to fully seize the potential benefits of market integration, a minimum level of coordination in the security of supply dimension is necessary. Most of current CRM designs implemented or under proposal in the European Union are still based on an autarkic vision, according to which domestic resources must be capable of guaranteeing the security of electricity supply on their own. However, capacity remuneration mechanisms are going to critically condition the investments that will "shape" future European power sectors (indeed, this is why they are ultimately designed for). If cross-border resources are not allowed to fully participate in CRMs in a level playing field with domestic resources, each system will develop in isolation and the scope of the Internal Energy Market will be limited to a short-term market for "left-overs".

Unfortunately, there are certain conditions in which the market is not able on its own to properly assign available resources and to allow the fulfilment of cross-border CRM contracts, even in those designs that identify scarcity conditions through market prices. During regional scarcity conditions, i.e., concurrent power shortages in more than one country, the market price is likely to reach the regional price cap, set at 3 000 €/MWh, and the market may not be able to clear. According to RTE (2015)[5], in this case, the market coupling algorithm would

[5] RTE, Réseau de Transport d'Électricité, 2015. Public consultation regarding the participation of interconnections and/or foreign capacities in the French capacity market. Consultation document released on 24 September 2015.

assign available resources on a pro rata basis among those countries that share curtailments. Nonetheless, in such situations, available resources should be assigned to those consumers who paid for them in the "security of supply market", i.e., in capacity mechanisms. This concern was raised also by Member States, through their regulators or system operators, as can be read in DECC (2013)[6] or RTE (2014)[7]. According to us, this is one of the main barriers to explicit cross-border participation in capacity mechanisms.

The Staff Working Document seems to acknowledge this problem at page 150, when it states:

> *In the event of a scarcity event in two Member States at the same time that brings prices to in both markets to the market coupling price caps (currently EUR 3000 per MWh for the purposes of day ahead market coupling and below most estimations of the value of lost load) rules could be developed to enable electricity flows in proportion to cross-border capacity contracts held rather than the current default of equal sharing of curtailment.*

A cross-border contract signed in the framework of a CRM is a specific kind of contract for which the discussion presented so far on the firmness of bilateral contracts is particularly relevant.

The final objective of a CRM should be to allow the contractor to be sure that, during scarcity conditions (i.e. when the price is equal to the price cap), all contracted generation, either national or cross-border, is able to fulfil its capacity commitment "physically".

Summary of key points

The ideal CRM design identifies scarcities based on a short-term price signal

The regional integration of CRMs is simpler and more efficient if the scarcity conditions are properly identified by means of a regionally-determined price signal (e.g. the price resulting from the EUPHEMIA algorithm).

With this ideal CRM, a cross-border conditional nomination is the most efficient solution to solve the problem of cross-border participation

Again, even in this context, administratively-set price caps can lead to an inefficient regional

[6] DECC, Department of Energy & Climate Change, 2013. Electricity Market Reform: Capacity Market - Detailed Design Proposals. Working document released in June 2013.

[7] RTE, Réseau de Transport d'Électricité, 2014. French Capacity Market. Report accompanying the draft rules. Document released in April 2014.

allocation of available power resources during scarcity conditions. Thus, it is essential to include some sort of conditional nomination that permits the execution of the cross-border CRM contract. Such nomination would not affect the short-term market efficiency.

With not so-ideal CRMs, the conditional nomination can still be applied

In case the CRM design does not fully rely on market signals, as it is the case in the majority of proposed designs in the EU where scarcities are identified through emergency actions taken by the system operator, the application of the conditional nomination scheme can still be applied.

And PTRs would be the last resort solution, not the most efficient one, but probably better that not allowing any type of physical cross-border contract

4.1 The ideal CRM mechanism properties to facilitate regional integration

Since capacity mechanisms are based on contracts to be exercised during scarcity conditions in the system, the identification of these scarcities turns to be an essential element of its design. The regional integration of the mechanisms will be simpler if scarcities are identified by means of a regionally-determined price signal (today just the day-ahead spot price, through the so-called Price Coupling of Regions algorithm, known as EUPHEMIA, but in the not-so-far future it could also be an intraday or even a real-time regional price signal). The advantage of this setting is that in case there is a scarcity (or scarcity risk) in one country (and not across the borders), the price in that country will be much higher and the interconnections will be congested in the direction towards the region with scarcity conditions in place. On this basis, it is often argued that requiring availability to the cross-border agent is a good proxy of requiring physical delivery to the contractor. Availability is a good proxy, but it needs to be complemented to be perfectly efficient and overcome the reviewed inefficiencies that arise due to price caps[8].

Assuming that there is a harmonised price cap in the whole region (the expected scenario in the future), when both the CRM-system and a neighbour suffer scarcity conditions and therefore the price as determined by the PCR is equal in the two systems, the fulfilment of the

[8] If price cap setting criteria are not harmonised at the regional level, the inefficiencies are even larger, for the capability of the coordinated market to take the energy where most valued will be more severely affected. In this context physical contracts within the CRM context, turn to be more essential.

CRM contracts may not be naturally met, for there is a tie situation. In this scenario, physical CRM commitments can be used to solve this tie.

More generally, and following the same reasoning presented above, whenever the price reaches the price cap in the CRM-country, the contract should ensure the contribution of cross-border counterparties. In case scarcities are based on a regional price signal, one way to achieve the desired contribution in the most efficient manner is described in Matropietro et al. (2014) and can be summarised as follows:

"Both national and cross-border reliability providers must be allowed to express a conditional nomination that assigns their delivery to the CRM-system in case of scarcity. In the case of cross-border agents, this nomination will apply only as long as the interconnection is not already congested in the direction towards the CRM-system. Therefore the conditional nomination will have a slightly different scope for the two different groups:

- *For* ***national reliability providers****, the "conditional nomination" contract allows national providers to nominate energy within the CRM-system frontiers whenever the latter declares scarcity conditions.*
- *For* ***cross-border reliability providers****, the "conditional nomination" allows agents in the regional market to "nominate" cross-border contracts to be exercised whenever the following two conditions are simultaneously met:*
  - *The CRM-system declares a scarcity situation (as it is the case with the national providers).*
  - *There is free capacity in the interconnection (as determined by the PCR) in the direction towards the CRM-system. Note that if there is not cross-border capacity available, the CRM-system is already receiving all possible support to its reliability from the neighbouring system. This second condition is the key to avoid ex-ante capacity reservation, and leaves much more space to the PCR for it to efficiently assign transmission capacity in the regional market both during normal operation and stress events."*

4.2 When the CRM mechanism is not ideal

4.2.1 The conditional nomination can still be applied

If scarcities are not identified by means of on a regional price signal, but rather through emergency actions taken by the system operator, the efficient participation of cross-border resources is more complex, for we cannot rely any longer on the regional market to naturally solve most of the scarcity situations.

In this context, it is still possible to adapt the previous conditional nomination, in this case it should be activated through the scarcity indicator used in the CRM-system. Again, the conditional nomination will have a slightly different scope for the two different types of providers and the flow through the interconnector will play the same key role in determining whether or not execute the physical nomination.

4.2.2 The last resort approach

If the conditional nomination is deemed not implementable in the context of a CRM, then the only alternative to allow for an effective participation of cross-border resources in the mechanism is to resort to PTRs.

The crucial physical delivery condition in case a scarcity is declared can obviously be achieved through the existence of regular physical transmission rights. This has been traditionally considered as the only mean to ensure firm cross-border capacity trades. Although allowing PTRs is not in line with the guidelines expressed by ACER for the future development of the regional market[9], it is also worthwhile mentioning that, if no other solution is implemented, these tools might still be preferred with respect to not having any mean to ensure physical cross-border delivery during scarcity conditions. There would be, in this case, a clear trade-off between affecting the efficiency of the short-term market in order to enhance the efficiency of the long-term market represented by CRMs.

[9] Again, the major drawback of PTRs (even if they are of the use-it-or-lose-it type) is that if they are not properly managed, due to for example (among other potential reasons) information asymmetries, they could affect the short-term efficiency of cross-border exchanges (Batlle et al., 2014).