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Explanatory document

ENTSO-E proposed methodologies, common rules and terms of reference related to cross-border participation in capacity mechanisms

3 July 2020

Contents

Introduction

This paper accompanies the proposed draft methodologies, common rules and terms of operation related to cross-border participation in capacity mechanisms (CM) as requested to ENTSO-E by Article 26(10) of Regulation 2019/943. The aim of this paper is to further explain the options and main criteria considered by ENTSO-E when drafting this proposal.

Following up on the answers provided by stakeholders during the public consultation open from Friday 31st January to Friday 13th March included, ENTSO-E amended this document significantly in order:

- **to clarify the substance of the provisions proposed** when asked by stakeholders or when a misunderstanding was identified through some answers received;
- **to detail ENTSO-E's rationale**, specifically on issues on which ENTSO-E received technical questions. In this regard, ENTSO-E notably provides numerical examples on the calculation of Maximum Entry Capacity, on the sharing key proposed for revenue sharing and on the non-availability payment rules in case of single and multiple commitment situations;
- **to explain some changes of the Proposal** following up on the public consultation.

In particular, ENTSO-E would like to stress to the attention of the stakeholders the following modification in the Proposal:

- General provisions: the Implementation Period, mentioned in the draft proposed to the public consultation is now defined at Article 4 of the Proposal.
- Methodology for calculating the maximum entry capacity: The draft of this methodology was extensively completed so as to provide more transparency to market players. The methodology was also amended so as to isolate the contribution from non-neighbouring countries.

Methodology on for sharing the revenues: Among the two options proposed to the public consultation, ENTSO-E decided to retain option 2 as ENTSO-E believes that this options will enable to provide could incentives for investing in I/C assets while allowing to take binary decisions when the interconnection is consistently not scarce or scarce (based respectively on one fifth or four fifth of the situations).

- Common rules for carrying out availability checks and common rules for determining when a non-availability payment is due: In order to provide more visibility to market players while making sure that the methodology is not sensitive to the national framework for carrying out availability checks, ENTSO-E deciding to define a multiple commitment based on the possible overlap of delivery periods. The "derating" applied in case of multiple commitments can be modified at bilateral level as long as it benefits to the capacity providers.
- Terms of operation of the Registry and common rules for identifying capacity eligible: So as to being able to apply the methodology on non-availability payment in case of multiple

commitment, it is eplained that the composition in sites of an aggregated unit must be identical to being able to participate to several capacity mechanism with overlapping delivery periods.

Capacity mechanisms in the European Union

In the light of concerns about resource adequacy, some European Union (EU) Member States (MSs) have introduced capacity mechanisms, which aim at rewarding the availability to deliver energy in order to ensure that electricity supply can match peak load events, in the medium and long term. All existing mechanisms were notified, approved, or will be approved as State Aid instruments compatible with EU law, and therefore evaluated as proportionate means to ensure that the provision of capacities that are necessary to ensure security of supply in an economically viable manner.

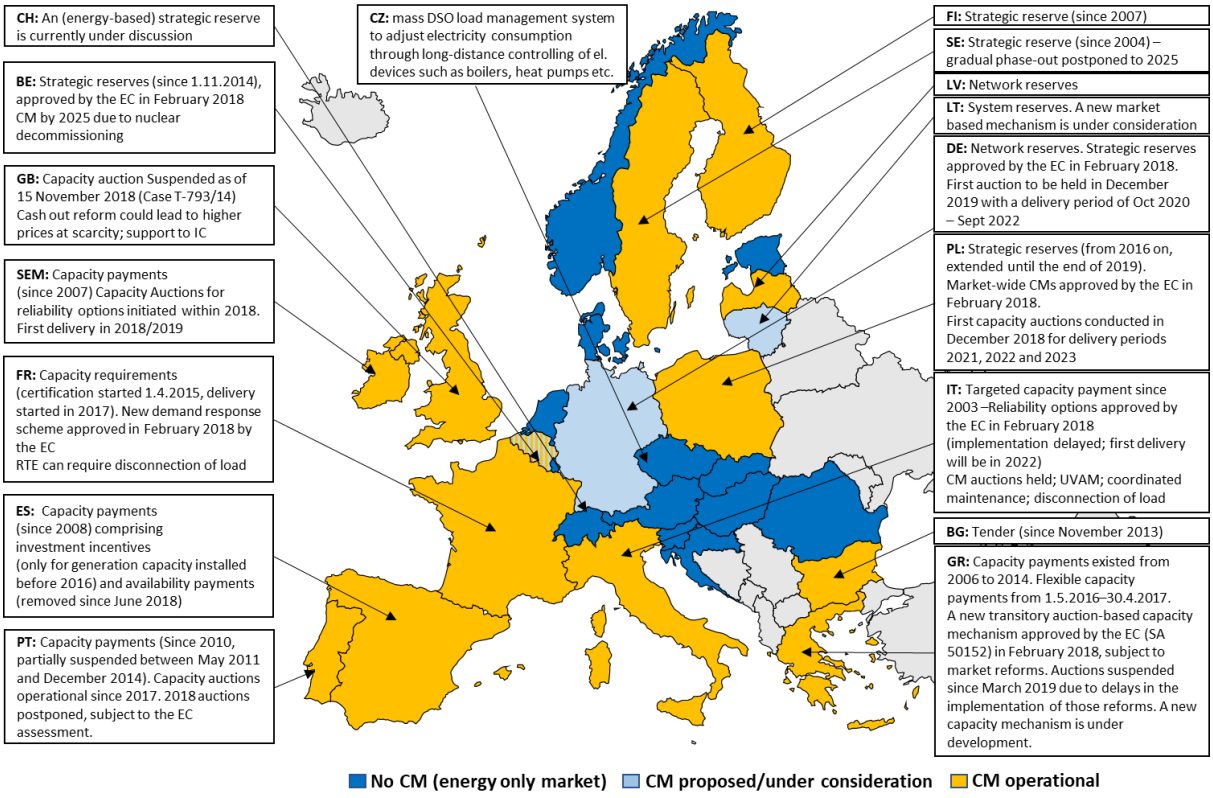


Figure 1: Map of Capacity Mechanisms in the EU (Source: ENTSO-E elaboration based on ACER market monitoring report]

The witnessed diversity of capacity mechanisms is representative of market designs aiming at addressing differentiated security of supply issues (e.g. load sensitivity to temperature variation, MSs relying significantly on imports, MSs with low import capacity, seasonal peak load, high share of

renewable energies) **in a proportionate manner,** which is ensured by all checks and balances foreseen by the State Aid Guidelines and by the Article 21 of the Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity, thereafter referred to as Internal Electricity Market (IEM) Regulation.

The IEM Regulation introduces at Article 26(1) an **obligation to enable direct cross-border participation of capacity providers located in Member States which are electrical neighbours**. Article 26(2) of the IEM Regulation indicates that, where foreign capacity is capable of providing equivalent technical performance to domestic capacities, direct cross-border participation must be implemented at the earlier date between:

- 4th July 2023;
- 2 years after the date of ACER's approval of the methodologies detailed in this document.

In this context, Article 26(11) of the IEM Regulation requires ENTSO-E to develop methodologies, common rules and terms of operation to facilitate the implementation of direct cross-border participation in capacity mechanisms, and to submit them to ACER for approval by 5th July 2020.
This Explanatory document details the content of ENTSO-E's draft common rules, methodologies and terms of operation, which are being publicly consulted until Friday 13th March 2020 included in a unique draft proposal.

This Explanatory document details the legal framework based upon which these rules and methodologies were drafted, explains the general provisions (Title 1 of the Proposal), and then follows the order of the Article 26 paragraph 11 of the IEM Regulation:

1. Legal Framework;
2. General provisions;
3. Methodology for calculating the maximum entry capacity for cross-border participation;
4. Methodology for sharing cross-border revenues in capacity mechanism;
5. Common rules for the carrying out of availability checks;
6. Common rules for determining when a non-availability payment is due;
7. Terms of the operation of the registry;
8. Common rules for identifying capacity eligible to participate in capacity mechanism.

A transition period, not detailed in this document, will be required to implement the set of rules, methodologies and terms of operation.

Key principles

The proposal relies on two key principles, which derive from the IEM Regulation:

- **The principle of non-discrimination:** In accordance with Article 22 of the IEM Regulation, which enumerates market design principles that capacity mechanisms must be compliant with, capacity mechanisms must *"select capacity providers by means of a transparent, non-discriminatory and competitive process"*. In this regard and in order to create a level playing field for every market participant, it is proposed to **ensure that eligibility examination and availability checks are carried out as equivalently as possible for market players participating to a given capacity mechanism, regardless of their location**. Therefore, the set of draft rules, methodologies and terms of operation does not intend to detail specific technical rules that will drive the processes of eligibility examination and availability checks, but rather aims at providing common definitions and processes to facilitating the necessary coordination between TSO and CM operators for implementing direct cross-border participation ;

- **Fostering the coordination between TSOs and CM operators:** Regarding the implementation of direct participation, the IEM Regulation foresees an operational role for the TSO where the capacity is located. Notably, Article 26 paragraph 10 states that the TSO where the foreign capacity is located must carry out the eligibility examination and the availability checks. Implementing direct cross-border participation therefore relies on both the TSO where the capacity provider is located and the CM Operator. The set of draft rules and methodologies aims at **defining clear roles for every stakeholder involved in the implementation of the cross-border participation while facilitating their coordination**. In this regard, Article 26 paragraph 15 of the IEM Regulation foresees that ENTSO-E shall set up and operate a registry where eligible capacity providers are registered. This registry must be created by 5th July 2021. In order to meet this ambitious deadline while targeting the binding provisions, notably specified at Article 26 paragraph 10.a), the European registry is yet considered as a coordination tool between TSOs and CM Operators, and thus complementary with existing national registries.

1. Legal Framework

Article 26 of the IEM Regulation constitutes the legal framework:

" […]

4. Cross-border participation in capacity mechanisms shall not change, alter or otherwise affect cross-zonal schedules or physical flows between Member States. Those schedules and flows shall be determined solely by the outcome of capacity allocation pursuant to Article 16.

5. Capacity providers shall be able to participate in more than one capacity mechanism. Where capacity providers participate in more than one capacity mechanism for the same delivery period, they shall participate up to the expected availability of interconnection and the likely concurrence of system stress between the system where the mechanism is applied and the system in which the foreign capacity is located, in accordance with the methodology referred to in point (a) of paragraph 11.

6. Capacity providers shall be required to make non-availability payments where their capacity is not available. Where capacity providers participate in more than one capacity mechanism for the same delivery period, they shall be required to make multiple non-availability payments where they are unable to fulfil multiple commitments.

7. For the purposes of providing a recommendation to transmission system operators, regional coordination centres established pursuant to Article 35 shall calculate on an annual basis the maximum entry capacity available for the participation of foreign capacity. That calculation shall take into account the expected availability of interconnection and the likely concurrence of system stress in the system where the mechanism is applied and the system in which the foreign capacity is located. Such a calculation shall be required for each bidding zone border. Transmission system operators shall set the maximum entry capacity available for the participation of foreign capacity based on the recommendation of the regional coordination centre on an annual basis.

8. Member States shall ensure that the entry capacity referred to in paragraph 7 is allocated to eligible capacity providers in a transparent, non-discriminatory and market-based manner.

9. Where capacity mechanisms allow for cross-border participation in two neighbouring Member States, any revenues arising through the allocation referred to in paragraph 8 shall

accrue to the transmission system operators concerned and shall be shared between them in accordance with the methodology referred in point (b) of paragraph 11 of this Article or in accordance with a common methodology approved by both relevant regulatory authorities. If the neighbouring Member State does not apply a capacity mechanism or applies a capacity mechanism which is not open to cross-border participation, the share of revenues shall be approved by the competent national authority of the Member State in which the capacity mechanism is implemented after having sought the opinion of the regulatory authorities of the neighbouring Member States. Transmission system operators shall use such revenues for the purposes set out in Article 19(2).

10. The transmission system operator where the foreign capacity is located shall: (a) establish whether interested capacity providers can provide the technical performance as required by the capacity mechanism in which the capacity provider intends to participate, and register that capacity provider as an eligible capacity provider in a registry set up for that purpose; (b) carry out availability checks; (c) notify the transmission system operator in the Member State applying the capacity mechanism of the information it acquires under points (a) and (b) of this subparagraph and the second subparagraph. The relevant capacity provider shall notify the transmission system operator of its participation in a foreign capacity mechanism without delay.

11. By 5 July 2020 the ENTSO for Electricity shall submit to ACER: (a) a methodology for calculating the maximum entry capacity for cross-border participation as referred to in paragraph 7; (b) a methodology for sharing the revenues referred to in paragraph 9; (c) common rules for the carrying out of availability checks referred to in point (b) of paragraph 10; (d) common rules for determining when a non-availability payment is due; (e) terms of the operation of the registry as referred to in point (a) of paragraph 10; (f) common rules for identifying capacity eligible to participate in the capacity mechanism as referred to in point (a) of paragraph 10. The proposal shall be subject to prior consultation and approval by ACER in accordance with Article 27.

12. The regulatory authorities concerned shall verify whether the capacities have been calculated in accordance with the methodology referred to in point (a) of paragraph 11.

13. Regulatory authorities shall ensure that cross-border participation in capacity mechanisms is organised in an effective and non-discriminatory manner. They shall in particular provide for adequate administrative arrangements for the enforcement of non-availability payments across borders.

14. The capacities allocated in accordance with paragraph 8 shall be transferable between eligible capacity providers. Eligible capacity providers shall notify the registry as referred to in point (a) of paragraph 10 of any such transfer.

15. By 5 July 2021 the ENTSO for Electricity shall set up and operate the registry referred to in point (a) of paragraph 10. The registry shall be open to all eligible capacity providers, the systems implementing capacity mechanisms and their transmission system operators."

2. General provisions

General provisions notably include all definitions used in the set of rules and methodologies. Key concepts are hereby introduced:

- Availability: As mentioned in the introduction, the capacity mechanism aims at providing remuneration for capacity provider available to deliver power when needed. It is defined as the possibility of Activation of the capacity contracted in the capacity mechanism and concerns:
    a) the availability in the energy and/or balancing market and/or ancillary services markets;
    b) for capacities contracted in the capacity mechanism but not participating to the market, the availability to deliver energy upon request of the TSO and/or in particular system conditions.
- Activation: Defined as a process in which the capacity contracted in the capacity mechanism delivers energy upon request by the transmission system operator and/or in particular system conditions during the Delivery period;
- CM Operator: a capacity mechanism is not necessarily operated by the TSO. Therefore, the entity signing capacity contracts with the capacity provider is referred to as CM Operator;
- Delivery Period: period set in the CM Contract during which the capacity obligation applies, i.e. during which availability checks can be carried out;
- Entry Capacity: it is the capacity expressed in MW that can be allocated to eligible foreign capacity for participation in a capacity mechanism and its total amount can never exceed the Maximum Entry Capacity;
- Reference Period: period during which the availability checks are carried out (e.g. PP2 hours in the French CM). It can coincide with the Delivery Period or be a subset of the Delivery Period.

So as to facilitating the implementation of direct cross-border participation, the General Provisions section also introduces a securing process to cover the operational and investment costs arising from the tasks listed at Article 26.10 of the IEM Regulation, among which examining eligibility and carrying out availability checks. These provisions aim at:

- neutralizing the cost impact for the TSO where the capacity is located;
- ensuring the proportionality of such costs through the cost approval by both National Regulatory Authorities involved;
- ensuring that these costs are covered, whenever possible, in the same system than for domestic capacities, through the decision of the NRA where the Capacity Mechanism applies.

3. Methodology for calculating the maximum entry capacity for cross-border participation

The methodology for calculating the maximum entry capacity for cross-border participation in capacity mechanisms shall "*calculate on an annual basis the maximum entry capacity available for the participation of foreign capacity. That calculation shall take into account the expected availability of interconnection and the likely concurrence of system stress in the system where the mechanism is applied and the system in which the foreign capacity is located"*, as stipulated in Article 26(7) of Regulation (EU) 2019/943.

3.1. Granularity and timing of the calculation

As stipulated in Article 26(7) of Regulation (EU) 2019/943, the maximum entry capacity shall be calculated *"on an annual basis"*, meaning that it should be a value valid for a delivery year of a capacity mechanism. Furthermore, as capacity mechanisms procure capacity well ahead of real time, the maximum entry capacity should be made available to TSOs several years in advance and should be based on hypotheses (on consumption, available capacity and interconnection capacity) on which stakeholders are consulted.

Usually, a maximum entry capacity computed based on a given ERAA publication will not be applicable for the following years but will have a certain lead time (usually 4 years) to be applied to the delivery years for which capacity auctions or exchanges have not yet taken place. Each annual ERAA publication, as well as the calculation of the maximum entry capacity performed by RCCs afterwards following Article 26(7) of Regulation (EU) 2019/943 and based on ERAA results, will provide relevant values up to a number of years ahead. How to use these results therefore remains a national choice, since different national capacity mechanisms have different delivery years and auction rules.

ENTSO-E expects the first calculation of the maximum entry capacity to take place in the year 2023, after the publication of the ERAA 2023 report.

ENTSO-E recommends that this calculation should be consistent with the methodology, assumptions and scenarios of the latest published ERAA pertinent to Article 23 of Regulation (EU) 2019/943.

3.2. Characteristics of the maximum entry capacity

The maximum entry capacity is expressed in MW and represents the maximally allowed foreign capacity considered between two Member States that can participate in a capacity mechanism during a certain delivery period.

This level of contribution is to be correctly calibrated, or otherwise it would be detrimental to the customers relying on the capacity mechanism for their security of supply.

- An overestimated value of the maximum entry capacity comes down to an overestimation of capacity available abroad for the security of supply of a given country. This would mean that local customers would incur higher costs through financial transfers to foreign capacity without benefiting from an enhanced security of supply.
- On the other hand, an underestimation of the maximum entry capacity would yield an over-procurement of local capacity. This local capacity could be procured at a higher price than the price at which foreign capacity is available, hence negatively affecting the local customers. Finally, it should be noted that the energy market rather than the capacity market determines the energy allocation.

The maximum entry capacity should therefore reflect the value that an interconnected system brings in terms of security of supply. An equivalent formulation is to measure the available power (MW) the considered bidding zone can be provided with by the interconnection of a system in times of system stress or scarcity. Scarcity situations are therefore of particular interest in calculating the maximum entry capacity for cross-border participation.

3.2.1. Importance of scarcity situations

Let's consider two countries in two hours without **no** 'scarcity' in the market (see Figure 1). In hour NH1 country B has positive margin larger than the transmission capacity and the cheapest available capacity. Therefore, following the market principles of welfare maximization, country B exports maximally to A 20MW. In this case the margin of country B was also larger than country A but this is of no importance in the market allocation of NH1.

In hour NH2 (see Figure 1) now is country A with positive margin larger than the transmission capacity and the cheapest available capacity. Therefore, following the market principles of welfare maximization, country A exports maximally to B 20MW. Notice that in this case the margin of country A (Margin = 25MW) is lower than of country B (Margin = 50MW). However, the margin of country B is more expensive capacity than the margin than can be exported by A. Therefore, in NH2, following the market principles of welfare maximization, country A exports to country B even if the margin od country A is smaller than of country B.

Notice in both NH1 and NH2 both the available production capacity (resource) and the available transmission capacity are enough to meet all demand and no country is in scarcity. Furthermore, country A and B could, both during NH1 and NH2 hours, meet their demand locally. They do not rely on imports to ensure its adequacy and the import & exports observe follow the market principles of welfare maximization.

These situations are therefore not relevant for the calculation of the maximum entry capacity as no market is in scarcity and the system is able to meet all demand satisfactorily.

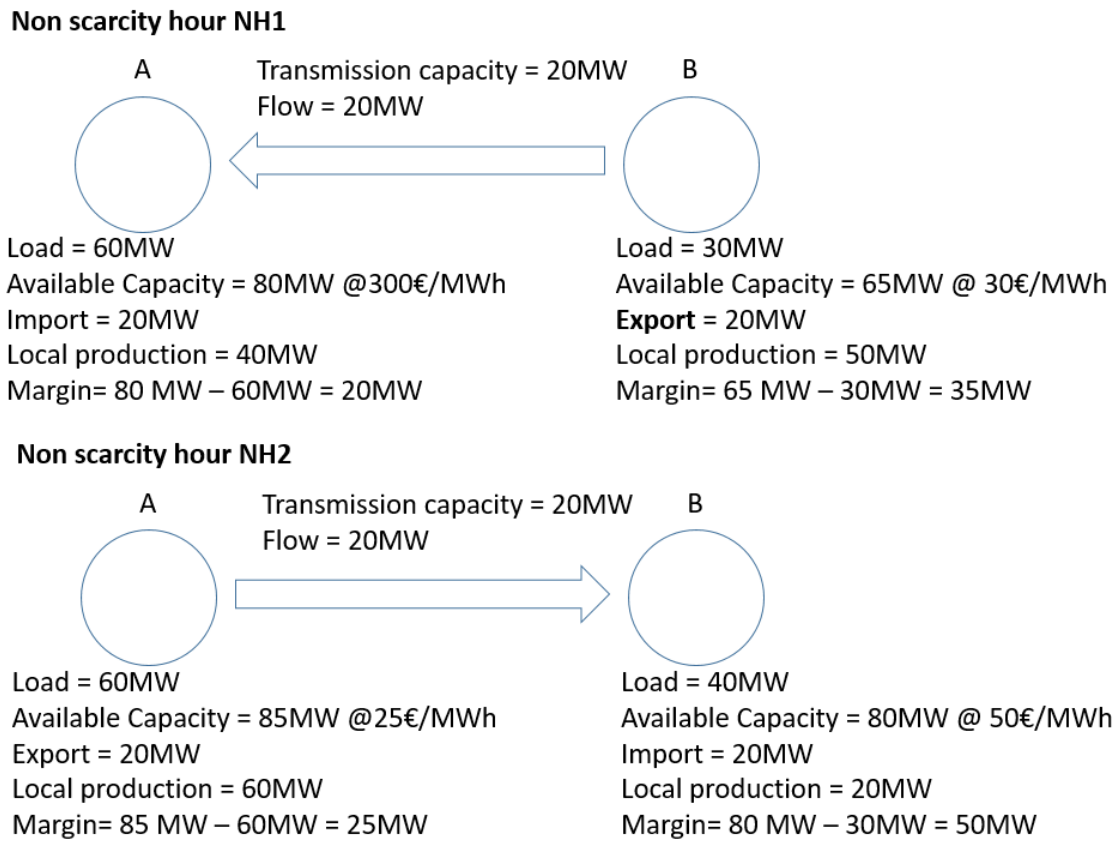


Figure 1: Example of power exchanges on an interconnector in a system of two neighbouring countries under normal market conditions and no scarcity

Let's now consider a situation in which one of the two countries is not able to meet their demand locally and hence relies on imports to ensure its adequacy (see **Error! Reference source not found.**).

- During hour NH3, country A relies on 15MW from country B to ensure its security of supply. Country B exports all its available margin to country A during this hour.
- During hour NH4, country B relies on 10MW from country A to ensure its security of supply. Country A contributes to country B's security of supply by exporting 10MW.

Without interconnected systems, country A would need an additional 15MW of installed capacity and country B an additional 10MW to avoid Energy Not Served (ENS).

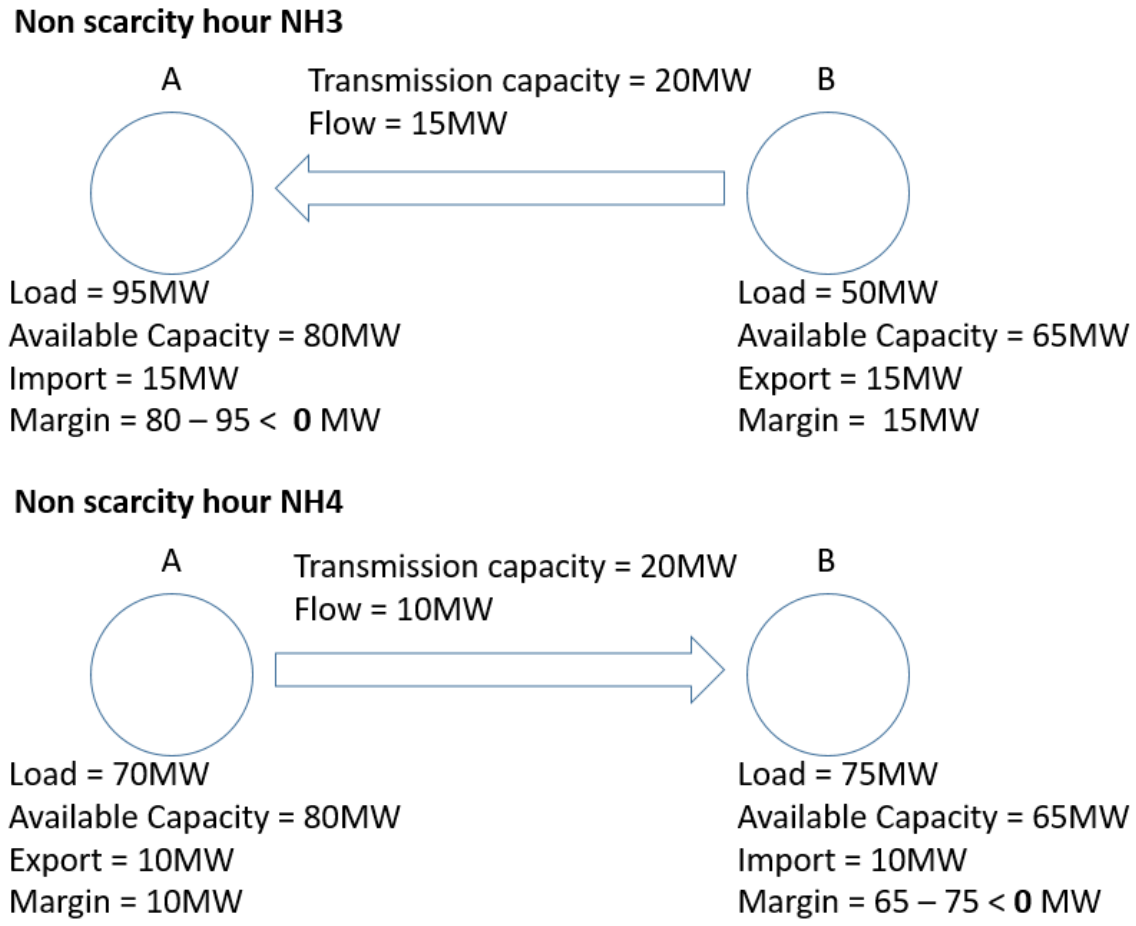


Figure 2: Example of the contribution of an interconnector to security of supply in a system of two neighbouring countries

The market follows the second principles of welfare maximization which is to minimize (avoid) the occurrence of Energy Non-Served (ENS) in the system. In the market, ENS is penalized with a 'penalty' much larger than the typical contribution to the welfare due to economic trade based on marginal costs (NH1 and NH2). This 'penalty' term therefore dominates the market behavior in situations in which ENS might occur in the market. The country relying on imports to ensure its adequacy is at the maximum price cap of the market, which is much higher than the typical marginal costs. The resulting flows in these cases are such that all imports are allocated maximally towards the country relying on imports to ensure its adequacy. In **Error! Reference source not found.**, during NH3 (NH4) imports are maximally allocated from B→A (A→B) with B (A) exporting all its margin, equal to the transmission capacity in this case, to A (B) respectively. Therefore the resulting flows observed in NH3 and NH4 can be quite different from the exchanges of energy that would be observed in a system under eg NH1 and NH2 since the objective of the market in NH3 and NH4 is to avoid ENS while in NH1 and NH2 there is no ENS and the objective is rather to maximize the economic welfare of the system.

However, in these hours NH3 and NH4 no stress/scarcity occurs and no ENS is observed in the final outcome (allocation) of the market. These situations are therefore also **not** relevant for the calculation

of the maximum entry capacity as no market is in scarcity after the allocation phase and the market is able to meet all demand satisfactorily. Since there is no scarcity in the market, it is no possible to say that there are 'scarce assets' in the market.

Finally, during hours of so-called 'scarcity', typically at least one country is in scarcity. Such country needs imports to ensure its adequacy, hence reaches the price cap of the market but despite the fact that imports will be maximally directed towards this country (and others in similar situation), these countries end up having Energy Non-Served (ENS) after the market allocation.

A **fundamental point** is presented here now:

A 'scarcity situation' is reached because the market, is as a whole, 'scarce'.

This means:

- The country relying on imports presents ENS (ENS ≠0 means the country is in 'scarcity') even after the market has allocated all the available energy.
- Transmission capacity and / or available production capacity (resource) of the exporting countries is 'scarce', *ie* it is not enough to avoid the occurrence of ENS in the system, despite the fact that the country (-ies) presenting ENS has (have) reached the maximum price (price cap) in the market**.**

It is important to notice that in these situations, a second 'exporting' country will be exporting to the first country 'in scarcity' irrespectively of its marginal costs, since these are lower than the price cap of the market. The second country will keep exporting until i) it has exported all its available margin, or ii) unless transmission capacity is reached before, and no more exports are therefore possible even if the available margin has not been exported.

If the second country exports all its available margin, the second country is said to be in 'near-scarcity' since it is close to its limit. Only if the second country exports all of its margin (available capacity), both countries would reach the same price, this price then being equal to the price cap of the market. 'Near – scarcity' therefore **only** refers to situations in which the exports of the second country are limited by its available margin and not by the available transmission capacity. In this case, it might be observed that the exports directed to the country in 'scarcity' are less than the available transmission capacity, since the maximum resource (available production) of the exporting country (-ies), is (are) lower than the available transmission capacity.

For all the above presented reasons, the relevant hours that the methodology should examine are hours for which at least one market is at a situation of scarcity. This means that one country has reached the price cap of the market in at least one given bidding zone and that after the market allocation, still ENS occurs, indicating that the market cannot guarantee adequacy in this situation. Only during these hours

of scarcity (ENS > 0MWh) in at least one given bidding zone, the results of the ERAA simulation would show the expected contribution of imports that a country or bidding zone can rely upon in moments of scarcity, (referred to '*system stress*' in Article 26.7 of the IEM Regulation), for adequacy, i.e. moments of 'scarcity' of resources and/or transmission capacity in the market.

The approach for calculating the maximum entry capacity is defined in the Article 6 of the Proposal. It is calculated as the average of imports during scarcity hours and shall be expressed in MW. The present explanatory note aims to highlight the Methodology with some examples on specific technical aspects.

3.2.2. Scarcity in the European Resource Adequacy Assessment

For each year assessed in one ERAA scenario, multiple occurrences are modelled to take into account different weather events (cold or heat waves, differences in hydropower availability), assumptions on availability of resources, etc. These occurrences may show more or less scarcity hours depending on the system conditions. The scarcity hours are the most interesting to assess the contribution of an interconnected system because, contrary to an hour of normal operation, all available market resources are dispatched in the model.

The ERAA market clearing simulation mimics the day-ahead market (DAM) coupling. The modelling considers as if all energy is offered and sold on an hourly basis using a 'perfect foresight' approach. This means that in the simulation, all the market actors know the exact value of generation forced outages, consumption and unit availability. Furthermore, the ERAA framework applies the DAM rules for cross-border capacity calculation as a best estimate since these rules are the most representative of the conditions described above and because the DAM is the most representative market for energy prices.

Regarding balancing markets and real-time markets, the ERAA applies derating on several power plants or, equivalently, applies an extra load so enough power is kept aside for balancing purposes, i.e. ensuring balancing reserves requirements. Hence the ERAA does not model the balancing market[1].

Therefore 'scarcity situations', as defined within the maximum entry capacity methodology, are the hours during which ENS ≠ 0 for at least one given bidding zone in the ERAA simulations, considering that ENS is calculated applying the conditions/assumptions mentioned above.

[1] ENTSO-E does not consider real-time reserves modelling (FCR, FRR and RR) and real-time grid operations in calculating the available capacity. Only scarcity due to adequacy is considered, not scarcity due to a lack of reserves to face balancing needs in real time. In fact, this is not possible/useful given the assumption of perfect foresight.

3.2.3. Interconnection capacity or available margin as the scarce asset

The methodology for calculating the maximum entry capacity for cross-border participation to capacity mechanism considers situations during which a country or bidding zone reaches scarcity. Scarcity occurs when all available market-based production and market-based demand reduction measures have been activated and imports are at their maximum level (if these conditions are not fulfilled, one can reduce ENS by increasing one of the aforementioned means). For imports two situations are possible:

- Transmission capacity is the scarce asset – The considered country or bidding zone cannot import more power from its electrical neighbours, even if these neighbouring countries/bidding zones still have available power which can be exported. In this case the maximum transmission capacity has been reached and it can be said that the transmission capacity is the scarce asset. The hourly contribution will be equal to the hourly transmission capacity, taking into account availability of the interconnection for this given hour.
- Resource capacity is the scarce asset – The considered country or bidding zone cannot import more power from its electrical neighbours, even if transmission capacity is still available for imports. In this case the exporting countries/bidding zones have reached their maximum possible export capabilities (the exporting country margin being 0MW and its ENS 0MWh), so all their available national means are used to cover their own demand and to provide maximal exports. In these cases, it can be said that the resource capacity of the considered country or bidding zone and its electrical neighbours is the scarce asset, since all these countries are maximally using the available resources and are maximally exporting. The hourly contribution will be what is transmitted on the interconnection, ranging anywhere between 0 and 100% of the transmission capacity.

Following the presented example (see **Error! Reference source not found.**), let's consider the contribution from country B to country A's security of supply. We will focus on two hours only:

During scarcity hour H1, country A's load is 105MW while its available capacity, meaning the market-based production and demand response, is only 70MW. On the contrary, Country B's load is only 50MW with an available capacity of 80MW meaning that it has a margin of 30MW. Flows of energy will consequently go from country B to country A. The hourly transmission capacity, after taking into account possible outages, equals 25MW. Although country B has a margin of 30MW, the resulting hourly contribution will only be 25MW as the transmission capacity is the scarce asset in this case.

During scarcity hour H2, country A's load is 100MW while its available capacity is only 80MW. On the contrary, Country B's load is 50MW with an available capacity of 65MW meaning that is has a

margin of 15MW. Flows of energy will consequently go from country B to country A. The hourly transmission capacity, after taking into account possible outages, equals 20MW. Although the available transmission capacity is 20MW, it will not be fully utilized as the available margin of country B is only 15MW. The resulting hourly contribution will only be 15MW as the available resource (margin) of country B is the scarce asset.

The maximum entry capacity will be computed as the average over the scarcity hours of country A, i.e. hours H1 and H2, and will then be equal to 20MW = (25MW+15MW)/2.

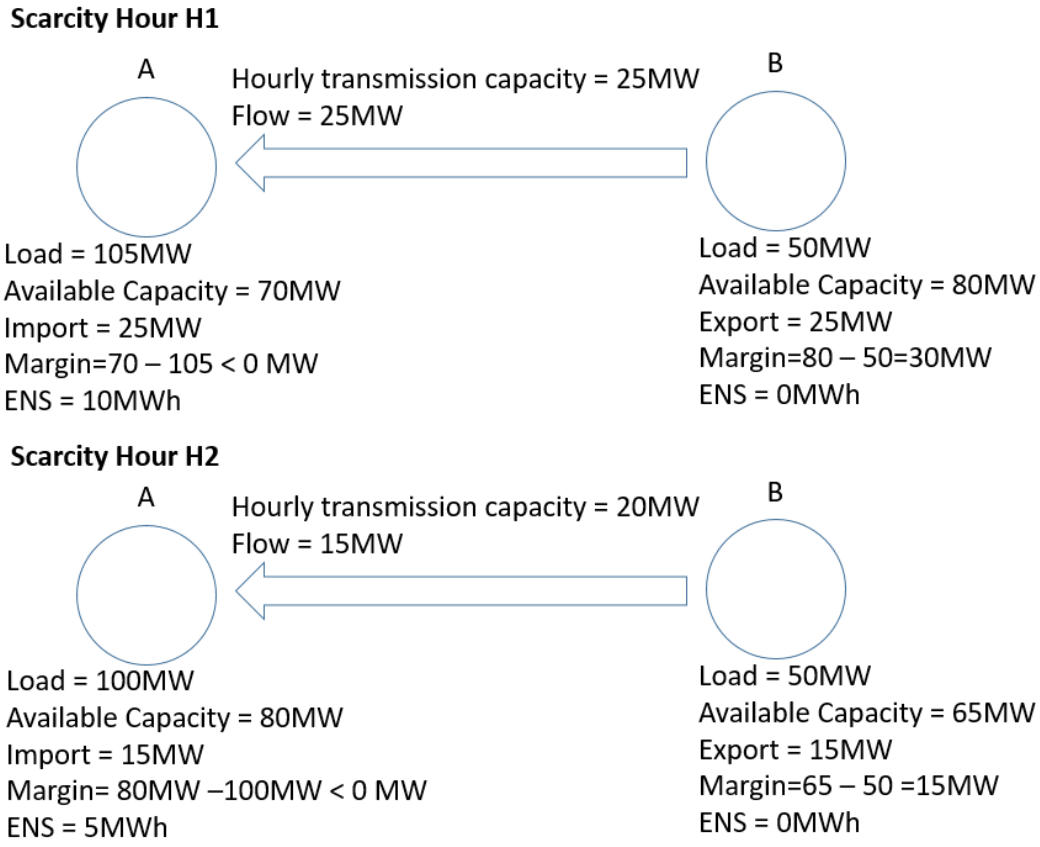


Figure 3: Example of power exchanges on an interconnector in a system of two neighbouring countries in a single scarcity situation

By averaging the imports on which a country/bidding zone can rely over all scarcity hours, the resulting maximum entry capacity captures the combined effect of scarce interconnection capacity and scarce available capacity.

3.3. Analytical expressions for the maximum entry capacity

The calculation of the maximum entry capacity requires a very complex modelling following the ERAA methodology. The ERAA simulation mimics the DAM coupling and applies the DAM rules for cross-border capacity calculation both for Net Transfer Capacity (NTC) and Flow-Based (FB) borders considering the whole Pan-EU perimeter and thus including regions with a highly AC meshed grid as

well as point-to-point High-Voltage Direct Current (HVDC) and High-Voltage Alternating Current (HVAC) interconnectors.

Due to the complexity of the modeling, the results of the maximum entry capacity calculation coming out of the ERAA simulation could be in some cases difficult to understand intuitively.

Therefore, a series of pedagogical analytical formulas are presented in the next sections with the purpose of increasing the transparency and the understanding of the methodology for calculating the maximum entry capacity for cross-border participation.

For the sake of clarity, we state very clearly here that i) the formulas in this next section are not to be understood as proposals complementing or extending the official proposal for the methodology for calculating the maximum entry capacity for cross-border participation (referred as the Proposal), but should rather be understood as analytical approximations which provide a proxy for the maximum entry capacity calculation in some specific cases and for specific assumptions, ii) these formulas are presented here only for pedagogical purposes and iii) these formulas shall in no case overrule the results of the methodology after an ERAA simulation.

3.3.1. The simplified case of point-to-point HVDC or radial HVAC interconnectors

As stated in Section 3.2.3 a very important concept in the calculation of the maximum entry capacity is the notion of the scarce asset, this being either the transmission capacity or the generation/resource capacity at either side of the interconnector.

Contributions from cross-border resources to a Capacity Mechanism are quite similar to national resources. However, one or multiple interconnectors will be involved that have a limited capacity as well as a certain probability of being unavailable. This probability is represented by an interconnector's Forced Outage Rate (FOR). In addition, there is a probability that the exporting system itself is in a scarcity situation when the capacity is needed and cannot deliver, either due to limited installed capacity, or unavailability of the resources due to e.g. forced outages for generating units, energy limitations or other constraints for storage, DSR, batteries, etc.

Power flows on HVDC interconnections are by nature fully manageable, while a radial HVAC transmission grid has no meshed structure for the power to fan out. Thus, in a pure HVDC network or in a radial HVAC transmission grid, both in NTC and/or FB, the scheduled exchanges correspond closely to the real physical flows of the power system.

However, in a meshed HVAC network, the situation is quite different and e.g. the FB approach is designed to manage the link between commercial exchanges between bidding zones in the market and the underlying real physical power flows occurring in the grid.

Below we present some simple analytical approximations only representative of point-to-point HVDC or radial HVAC interconnectors.

3.3.2. Single scarcity for point-to-point HVDC or radial HVAC interconnectors

In case of **single scarcity** for point-to-point HVDC or radial HVAC transmission grids, one can calculate the total unavailability for the interconnector based on its FOR. In case of single scarcity, i.e. in case a non-zero ENS (scarcity) occurs at only one of the end points of the point-to-point HVDC and/or radial HVAC, it can be expected that the maximum entry capacity (MEC) is well approximated by the following expression:

$$MEC \cong NTC * (1 - FOR)$$

The maximum entry capacity is hence approximated by the net transfer capacity of the interconnector, corrected for the probability of forced interconnector outages occurring.

3.3.3. Simultaneous scarcity for point-to-point HVDC or radial HVAC interconnectors

In case of **simultaneously scarcity**, i.e. in case a non-zero ENS (scarcity) simultaneously occurs at both end points of the point-to-point HVDC and/or radial HVAC interconnector, it seems tempting to proceed with a straightforward approximation extending the previous expression for single scarcity. One can calculate the probability for simultaneous scarcity for the two countries, and calculate a total unavailability for the interconnector based on FOR and then derive an approximate expression for the probability of unavailability of the interconnector for simultaneous scarcity situations as:

$$(1 - FOR^*) = (1 - FOR) \cdot (1 - P_{SimSc})$$

or

$$FOR^* = FOR + P_{SimSc} - FOR \cdot P_{SimSc}$$

where P_{SimSc} is the conditional probability for simultaneous scarcity[2] of the two end points of the interconnection and FOR is the Forced Outage Rate (FOR) of the interconnection. This defines an 'effective' forced outage rate FOR* which combines both effects:

$$MEC \cong NTC * (1 - FOR^*)$$

The validity of the expression above relies on the following assumptions:

- The FOR of the interconnector is independent of the scarcity in either ends of the interconnector and is only related to its technical availability.

[2] "conditional" meaning, "given that there is a scarcity event". E.g. if the simulations result in 100 scarcity events and 20 of them have simultaneous scarcity, then P_{SimSc} = 0.2.

- P_{SimSc} is independent of the FOR of the interconnector.
- P_{SimSc} refers only to the occurrence of simultaneous scarcity at the two end points of the interconnectors, hence it is not related to the occurrence of scarcity in any other parts of any AC meshed grids is the vicinity of the interconnectors but outside of the electrical distance around both end points of the interconnector.
- *NTC* refers here to the "maximum possible transmission capacity" that the market can utilize for the given border. For point-to-point interconnectors this should be equal to the physical capacity on the interconnectors. Furthermore, in general in AC meshed grid and especially within flow-based Capacity Calculation Regions (CCR) this value will deviate significantly from the physical capacity of the lines across the given border (see chapter 3.4.6 below for further details).

Now let's suppose that one of the end points of the HVDC interconnector is a CM country. From the ERAA simulations, it is possible to extract the total number of scarcity hours in the CM country, N_{CM_Sc} and the number of hours during which the exporting bidding zone, at the other end of the interconnector, also incurs scarcity. This number corresponds to the number of hours during which there is simultaneous scarcity for the point-to-point interconnector, N_{SimSc}. Note that N_{SimSc} is included in N_{CMSc} and clearly $N_{SimSc} \leq N_{CMSc}$. Then one can calculate simply:

$$P_{SimSc} = \frac{N_{SimSc}}{N_{CMSc}}$$

Although tempting, it would be dangerous to assume that all results from the ERAA shall comply with the formulas presented so far. There are several important limitations of this simple analytical derivations /formulas presented so far with respect the results that the ERAA methodology (Proposal) would provide namely:

- Although this is conceptually simple, the above expression does not consider the effect that the nearby AC meshed grid might have on the flows through such point-to-point interconnectors, e.g. in case these are handled in the market under 'Advanced Hybrid Coupling'.
- Also loop flows, transit flows from the AC meshed grids located 'behind' the two ends of the point-to-point interconnector might flow through the point-to-point interconnector in the market, since these devices might provide flexibility to alleviate congestions in the AC meshed grids behind the end points of the point-to-point interconnector. This is something that the ERAA methodology fully takes into account while it is beyond the assumptions made in the simple derivation here so far.
- Furthermore, the simple approach to derive the above formulas does not consider situations in which the exporting (non-CM) country is not in scarcity, but "almost" in scarcity (near-scarcity).

E.g. the NTC of the interconnector is 1000 MW, but during scarcity of the CM country only 200 MW is delivered through the interconnector because in the exporting area there is no more capacity (margin ~ 0). These situations can be referred to as scarcity – near-scarcity situations, with the CM country being in scarcity (margin = 0 and ENS > 0) and the exporting country being in near-scarcity (Margin ~ 0 and ENS = 0). They are not considered in the simple calculation above but are fully considered in the ERAA.

One way to improve the analytical simple formulation above for these scarcity (CM country) – near-scarcity (exporting country) situations is by calculating a "weighted probability of the occurrence of simultaneous scarcity" that also takes such situations into account. Mathematically this can be expressed as:

$$P_{SimSc} = \sum_{i=1}^{N_{CMSc}} P_{Sc,i} \frac{NTC - Flow_i}{NTC}$$

where $P_{SC,i}$ is the probability of scarcity event i in the simulations for the CM country and $P_{flow,i}$ is the corresponding flow from the exporting country to the CM country. Note that if near-scarcity events are not considered for the exporting country the previous expression is recovered since:

- $P_{flow,i}$ would always be equal to the NTC of the interconnector in 'single scarcity' for the CM country
- $P_{flow,i}$ equals 0 if a simultaneous scarcity occurs at both sides of the interconnector, i.e. if there is no flow across the interconnector for the isolated point-to-point case considered (by construction no loop flows, transit flows, etc... are assumed to flow through the interconnector in this simplified case).

In this case P_{SimSC} would be equal to the sum of the probabilities of the simultaneous scarcity situations. With uniform probabilities these are equal to $1/N_{CMSc}$ and with N_{SimSc} simultaneous scarcity situations, the result becomes the same as previously obtained.

Example:

Assume there are 100 scarcity events and all have the same probability. The NTC (given by the average flow in the single scarcity events) is 2000 MW. Of the scarcity events, 75 are single scarcity, 10 are (full) simultaneous scarcity, in 5 of them there is a flow of 400 MW to the CM country and in 10 of them there is a flow of 1900 MW. This would result in a weighted probability of the occurrence of simultaneous scarcity given by:

$$Pr_{SimSc} = 0.75 \cdot \frac{2000-2000}{2000} + 0.10 \cdot \frac{2000-0}{2000} + 0.05 \cdot \frac{2000-400}{2000} + 0.10 \cdot \frac{2000-1900}{2000}$$
$$= 0 + 0.10 + 0.04 + 0.005 = 0.145$$

The resulting entry capacity is $2000 \cdot (1-0.145) = 1710$ MW

In this case, the weighted Pr_{SimSc} is thus significantly higher than the "straight-forward" value, and the entry capacity correspondingly lower: 1710 instead of 1800 MW. On the other hand, if *all* near-simultaneous-scarcity situations were considered as (full) simultaneous scarcity, Pr_{SimSc} would be 0.25 and the resulting entry capacity 1500 MW.

3.4. Relation of the analytical expressions to the calculation of the maximum entry capacity

This section will show that, starting from the simple two-country case above and developing the expressions for the available contribution, one arrives at the result that the maximum entry capacity contribution is the average of the flows for all scarcity situations, as prescribed in the Proposal.

We now take another look at the expression for the weighted probability of the occurrence of simultaneous scarcity Pr_{Simsc}:

$$P_{SimSc} = \sum_{i=1}^{N_{CMSc}} P_{Sc,i} \frac{NTC - Flow_i}{NTC} = \sum_{i=1}^{N_{CMSc}} \frac{1}{N_{CMSc}} \left(1 - \frac{Flow_i}{NTC}\right)$$

$$= \frac{N_{CMSc}}{N_{CMSc}} - \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} \frac{Flow_i}{NTC} = 1 - \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} \frac{Flow_i}{NTC}$$

which uses the assumption that each event has the same probability and that the sum over all (conditional) scarcity probabilities equals 1.0[3].

We now use this to calculate the entry capacity according to the equation in Section 3.3.3, for simplicity assuming that *FOR*=0, in which case *FOR** becomes equal to Pr_{SimSc}:

$$MEC = NTC \cdot (1 - P_{SimSc}) = NTC \cdot \left(1 - 1 + \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} \frac{Flow_i}{NTC}\right)$$
$$= \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} Flow_i$$

where the last step uses the fact that *NTC* is constant and thus cancels out.

Now we can generalize the approach shown here for point-to-point interconnectors to other types of borders. Indeed, the general expression for the probability of simultaneous scarcity is:

$$P_{SimSc} = \frac{N^*}{N_{CMSc}}$$

where N^* is defined as:

$$N^* = N_{CMSc} - \sum_{i=1}^{N_{CMSc}} x_i$$

$$0 \leq x_i \leq 1$$

From this definition, it follows that N^* is zero in case of a single scarcity for the CM country, $ie\ x_i = 1$:

$$if\ x_i = 1\ \forall\ i\ \in\ N_{CMSc}: N^* = 0$$

Furthermore it also follows that $N^* = N_{CMSc}$ in case of all hours of scarcity in the CM country are hours of scarcity with other country, $ie\ x_i = 0$

$$if\ x_i = 0\ \forall\ i\ \in\ N_{CMSc}: N^* = N_{CMSc}$$

Finally

$$if\ 0 < x_i < 1\ \forall\ i\ \in N_{CMSc}: N^* \leq N_{CMSc}$$

N^* is defines the number of hours in which any other country within the relevant perimeter considered is <u>also</u> in scarcity together with the CM country.

$$P_{SimSc} = 1 - \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} x_i,$$

[3] This is no fundamental assumption, with different probabilities, the sum over all cases would still be 1.

The total probability of simultaneous scarcity is hence expressed in terms of the probabilities for each scarcity situation of the neighboring countries to the '*CM country*' expressed through the variable "x_i".

A proxy for "x_i" can be given in case $0 < x_i < 1$ as:

$$x_i^k = \frac{Import_i^k}{ENS_i^k}$$

Within $0 < x_i < 1$, "x_i" refers to the situation *i)* the country needs imports to ensure its adequacy *ii)* for all hours "*i*" *Imports* cannot avoid fully its *ENS* and hence the country is in **scarcity with non zero ENS.**

Furthermore a generalized analytical approximation for the maximum entry capacity through the bidding zone 'k − CM' border is presented for pedagogical purposes as:

$$\boldsymbol{MEC}_{k-CM} = \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} \boldsymbol{T}_i^{m,k-CM}$$

where in general, $\boldsymbol{T}_i^m$ provides the share of "exports" within the relevant area contributing to the global imports level observed for the "*CM country*" within hours *'i'* via the 'k − CM' border :

$$\boldsymbol{T}_i^{m,k-CM} = \frac{Export_i^{m,k-CM}}{\sum_{s=1}^{Exporting\ Countries} Export_i^s} * Import_i^{CMSc}$$

This expression shows that the maximum entry capacity can be calculated as the average flow "***T***" for all scarcity situations.

We now explore the above formulas for the different types of borders in the ERAA model.

3.4.1. Maximum entry capacity under single scarcity

We focus now on the case in which the exporting country 'm' is the same as the '*k*' country neighboring the "*CM country*" , *ie* m = k. Furthermore the country "*k*" is not in scarcity and hence will export to the "*CM country*" so the MEC expression becomes:

$$\boldsymbol{MEC}_{k-CM} = \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} \left[\frac{Export_i^k}{\sum_{s=1}^{Exporting\ Countries} Export_i^s} * Import_i^{CMSc}\right]$$

Note that in single scarcity for the "*CM country*", other countries than the "*CM country*" can also be importing but the "*CM country*" is the only country with non-zero ENS after allocation. Only if the "*CM country*" is also the only country importing, *i.e.* $\sum_{s=1}^{Exporting\ Countries} Export_i^s = Import_i^{CMSc}$ then:

$$\boldsymbol{MEC}_{k-CM} = \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} [Export_i^k]$$

3.4.2. Maximum entry capacity for a flow-based border within a flow-based CCR

We focus now on the case in which the exporting country 'm' is the same as the country neighboring the "*CM country*" , *ie* m = k . Further let's consider the '$k - CM$' border is a border between two countries within a flow-based CCR.

If the country 'k' in scarcity and hence $Export_i^{m=k} = 0$ and $Import_i^{m=k} \neq 0$ within the flow-based CCR and therefore:

$$Export_i^{m=k} = \mathbf{0} \rightarrow \boldsymbol{MEC}_{k-CM} = \mathbf{0}$$

If the country 'k' is not in scarcity within the flow-based CCR :

$$\boldsymbol{MEC}_{k-CM} = \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} \boldsymbol{T}_i^{m=k} = \frac{1}{N_{CMSc}} \sum_{i=1}^{N_{CMSc}} [\frac{Export_i^k}{\sum_{s=1}^{Exporting\ Countries} Export_i^s} * Import_i^{CMSc}]$$

3.4.3. Maximum entry capacity for a flow-based country and an external flow border

Let's assume that the neighbor "*k*" is <u>also</u> in scarcity. However, exports from another "exporting" country "$m \neq k$" can still flow through the 'k − CM' border. These situations are typically associated with so-called "loop flows" and "transit flows" within meshed AC grids. Therefore, in this case

$$\boldsymbol{T}_i^{m \neq k} = \frac{Export_i^m}{\sum_{s=1}^{Exporting\ Countries} Export_i^s} * Import_i^{CMSc}$$

Therefore during some scarcity hours '*i*', even if $Export_i^k = 0$, a part of the observed market flow between bidding zones $(k \rightarrow CM)_i$ can still be due to export of another bidding zone $m \neq k$:

$$(k \rightarrow CM)_i = \frac{Export_i^m}{\sum_{s=1}^{Exporting\ Countries} Export_i^s} * Import_i^{CMSc}$$

This equation captures the seemly "counter intuitive" situation in which country "k" <u>*seems*</u> to export to the "CM bidding zone (country)" through the "$k - CM$" border, even though country 'k" is in scarcity $x_i^k < 1$. It should be noted however that country "k" is a "transit" country and that exports come from another country/other countries "$m \neq k$".

3.4.4. Validity of the analytical expressions

The analytical equations shown above indicate that the entry capacity based on the initial assumption can be calculated as the average flow for all scarcity situations, and that the total probability of simultaneous scarcity is based on weighted probabilities for each scarcity situation.

For the point-to-point interconnector example case, the weights can be expressed as the respective differences between the feasible flows in single scarcity situation ("the maximally possible market flow" ≈ *NTC* of interconnector) and the actual flows in simultaneous scarcity situations $P_{flow,i}$..

In general, for the analytical approximations presented for FB-FB borders and FB-external flow borders, the weights "*x*" are equal to the level of "1-curtailment" of the neighboring country x_i^k and the feasible flows per border are given by $\boldsymbol{T}_i$, the share of "exports" within the relevant area under consideration 'multiplied' by the global import level observed for the "*CM country*" within each hours i.

$\boldsymbol{T}_i$ provides a "proxy" for the "maximally possible market flow" for the border the "$y_i - x_i^k$" . However it should be clearly stressed here that the expression for $\boldsymbol{T}_i$ **does not** represent any methodological definition for 'the Proposal', **does not** provide any official definition of "maximal cross-zonal capacities" and it should be understood only as part of the pedagogical analytical examples presented here for the purposes of explanatory note.

Although this approach is highly simplified compared with the full ERAA model, it illustrates why it is reasonable to use the average import during all flow situations as a reasonable estimate of the maximum entry capacity.

It should be noted that, although the equations above in some cases may result in the same entry capacity as the ERAA full model results, in most cases there might still be – sometimes considerable – deviations, among others due to the following:

- The properties of the flows in a meshed AC grid that cannot be easily replicated by simple calculations. The above formulas cannot be expected to properly describe all borders in the ERAA model, especially the ones embedded within the meshed AC grid, both for NTC and FB borders.
- "Hybrid coupling" needs to be considered to integrate point-to-point HVDC and radial HVAC interconnections in a model like the ERAA to assess the interplay of these interconnections with other borders embedded within the meshed AC grid. This is or will be the case in most CCRs in the future as Regulation EU 2015/1222 on Capacity Allocation and Congestion Management (CACM) sets the FB method as the target model for Europe.
- "Hybrid coupling" might be either Standard Hybrid Coupling (SHC) or Advanced Hybrid Coupling (AHC). In any case (SHC and AHC), when the power flows from a point-to-point HVDC or radial HVAC interconnection enter the meshed AC transmission grid, they will spread

further out within the AC transmission grid and use the scarce transmission capacity like all other power flows in the transmission grid.

- "Hybrid coupling" is properly accounted by the combination of NTC and FB borders in the modelling foreseen in the ERAA, and results in a more complex behavior of the power flows in large parts of the ERAA model than the behavior captured by point-to-point analytical formulas.

It should be noted that maximum entry capacity derived from the formulas in this chapter shall never be used to overrule the results from the ERAA/maximum entry capacity results (the Proposal) and that the results of the ERAA/maximum entry capacity simulation (the Proposal) are always the official results.

3.4.5. Example of the calculation of the maximum entry capacity for a flow-based CCR

The methodology is applicable for both NTC and flow-based approaches. While calculating the contribution under the NTC approach seems relatively straightforward, as defined in the Methodology Proposal and illustrated with some analytical formulas in chapter 3.3, the present paragraph focuses on a pedagogical fictive case under the flow-based approach.

Regarding the contribution of bidding zones to adequacy under flow-based, the following example is provided:

- Five countries/bidding zones are considered
- Countries/bidding zones "A", "B" and "C" are importing
- Countries/bidding zones "D" and "E" are exporting
- "A", "C", "D" and "E" are all neighbors to "B" within the same CCR
- The contribution per border into "B" for this given hour is as follows:
    - $A \rightarrow B = 0$
    - $C \rightarrow B = 0$
    - $D \rightarrow B = B_{import} * \frac{D_{export}}{D_{export}+E_{export}}$
    - $E \rightarrow B = B_{import} * \frac{E_{export}}{D+E_{export}}$

An explicit numerical example is provided:

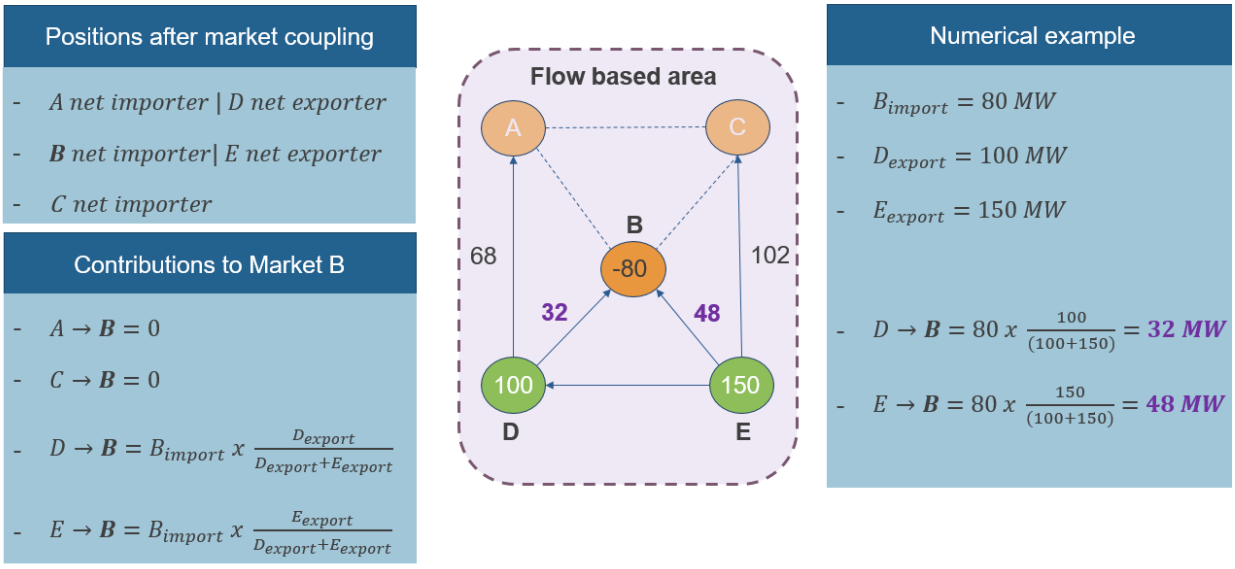


Figure 4: Example of contributions in a flow-based area consisting of five neighbouring countries

In the figure, B_{import} = 80, D_{export} = 100, and E_{export} = 150. We now have the contribution from D to B:

$$D \rightarrow B = B_{import} * D_{export}/(D_{export}+Ee_{xport}) = 80 \cdot 100/(100+150) = 32$$

and from E to B:

$$E \rightarrow B = B_{import} * E_{export}/(D_{export}+E_{export}) = 80 \cdot 150/(100+150) = 48$$

In this case, the contribution from E is higher, even if its direct export to B is lower.

3.4.6. Calculation of the maximum possible transmission capacity in the general case

As pointed out before, in the real grid the "maximum possible transmission capacity" might not be easy to determine analytically e.g. for flow-based borders. In any case, it should take into account the effect of the real possible flows and hence take into account loop flows, internal flows, unintended transit flows, security constraints, etc. These might all reduce the maximum capacity that can be offered and used by the market. For HVDC and HVAC point-to-point interconnectors and borders under Coordinated NTC calculations (CNTC) the maximum possible transmission capacity is typically equal to the *NTC*. For other borders, embedded within the AC meshed grid and following a flow-Based approach, a proxy for this maximum possible transmission capacity might be the average import to the CM country observed during *single scarcity* events in the ERAA, which reflects the physical maximal import possibility in the market for that country. It should be noted that e.g. for flow-based borders, the

definition of this “maximum possible transmission capacity” is not needed to calculate the maximum entry capacity following the procedure explained in chapter 3.4.5.

3.5. Simultaneous scarcity in day-head market clearing

During simultaneous scarcity periods, i.e. periods during which scarcity occurs simultaneously in two neighboring countries/bidding zones, the contribution is expected to be lower than the maximum possible transmission capacity. The flow between two countries or bidding zones in scarcity is defined by the "local_matching constraint" and the curtailment sharing principle within the market coupling algorithm of EUPHEMIA[4]. The “local_matching constraint” dictates that "whenever curtailment of price-taking orders can be avoided locally on an hourly basis, then it is also avoided in the final results". The aim of curtailment sharing is to equalize as much as possible the curtailment ratios between those bidding zones that are simultaneously in a curtailment situation, and that are configured to share curtailment. The curtailment sharing algorithm firstly maximizes social welfare. However, because of so-called flow factor competition in the flow-based market algorithm, it can occur that curtailed markets are not treated equally by the network. For example, when two curtailed markets are importing from a third one, the value of the PTDF coefficients can be such that one of the importing markets is favoured more and the flow to that market is maximized while the other market will be ignored and cannot have its curtailment mitigated in any way.

The curtailment sharing therefore solves a dedicated volume problem, where all network constraints are enforced, but only the acceptance of the price-taking volume is considered in the objective function. For more details, cf. the Euphemia public description, Section 6.8[3].

A low contribution, lower than the maximum possible transmission capacity, is indicative of an important contribution of simultaneous scarcity hours within all the scarcity hours considered. Note however that the maximum possible transmission capacity might be quite often less than the physical capacity for AC lines. An indicative value can be found by the flows during single scarcity events, which draw the maximum amount of power the market can provide to the scarce country, cf. Section 3.4.6. For HVDC point-to-point interconnectors, the maximum possible capacity is normally equal to the physical capacity of the interconnector.

3.6. Relevance of the scenario with capacity mechanisms and respect of the target LOLE

Let’s suppose that the result of the ERAA for the scenario with capacity mechanisms (CMs) shows that a country or bidding zone, having an existing or approved capacity mechanism, is significantly not respecting its national reliability standard target. The methodology then allows the National Resource

[4]EUPHEMIA Public Description. Single Price Coupling Algorithm. 10th April 2019

Adequacy Assessments (NRAA) to calibrate the pertinent scenario chosen for the purposes of setting the maximum entry capacity to respect the national reliability standard. This means that ex-ante the scenario will be set to respect the national reliability standard by adding or removing perfect capacity in the model, without assuming what are the technologies to add or remove from the system).

This calibration is important to ensure that the capacity mechanism meets its target. Two situations are possible:

- The result of the scenario yields that the calculated reliability standard LOLE in the ERAA is far above the national target (e.g. a LOLE of 10h compared to a target LOLE of 3h). If no calibration is undertaken the number of scarcity hours will be higher than the target, and more of these hours will correspond to single scarcity situations meaning that during more hours than normal the contribution will be equal to the physical available transmission capacity. In that case the contribution will likely be overestimated: the equilibrium of the capacity market will be skewed preventing development of needed local capacities.
- The result of the scenario yields that the calculated reliability standard LOLE in the ERAA is far below the national target (e.g. a LOLE of 0,5h compared to a target LOLE of 3h). If no calibration is undertaken fewer scarcity hours will occur compared to the target. Furthermore, these hours will mostly correspond to simultaneous scarcity situations meaning that during these hours the contribution will be close to 0. In that case the contribution will likely be underestimated: the equilibrium of the capacity market will also be skewed and will lead to over-procurement of local capacities.

Should any of two situations above presented occur in the ERAA results and hence on the RCC recommendation regarding the annual calculation of maximum entry capacity, a further calibration of the pertinent scenario chosen from ERAA for the purposes of setting the maximum entry capacity to respect the national reliability standard shall be performed by the relevant National Resource Adequacy Assessment (NRAA) or other relevant National study regarding the definition of the parameters for the relevant CM auction.

3.7. Numerical examples from a full market model using MAF2019 data and assumptions

Below the detailed results of a full market modelling simulation following the ERAA methodology and for a scenario in line with MAF2019 data for 2025 are presented.

3.7.1. Model & assumptions

Market Data and model: MAF2019 – Horizon 2025

Flow Based modelled area: CWE recently used in the PLEF GAA 2020 (Horizon 2025)

Area of Focus:

- Countries considered
  - [AT, BE, DE, FR, NL] = Modelled in flow-Based (considering 70%CEP)
  - [GB, ES, CH, ITN, PL, SI, NO] = Modelled in (CNTC)
- Focus borders considered
  - BE-FR = AC meshed grid border modelled in FB.
  - BE-DE = ALEGrO HVDC (AHC internal HVDC in FB)
  - BE-GB = NemoLink HVDC
  - FR-GB = IFA1+IFA2 HVDC
  - NL-GB = BRITNED HVDC
  - NO-GB = NORTH SEA LINKs (2 * 1400MW HVDC)
  - DE-PL = AC meshed grid border modelled as External Flow (NTC - SHC)

Curtailment sharing:

The model considers the effect of curtailment sharing following the principles of the EUPHEMIA DAM algorithm to calculate the ENS in line with the ERAA/maximum entry capacity methodology (the Proposal).

3.7.2. Results

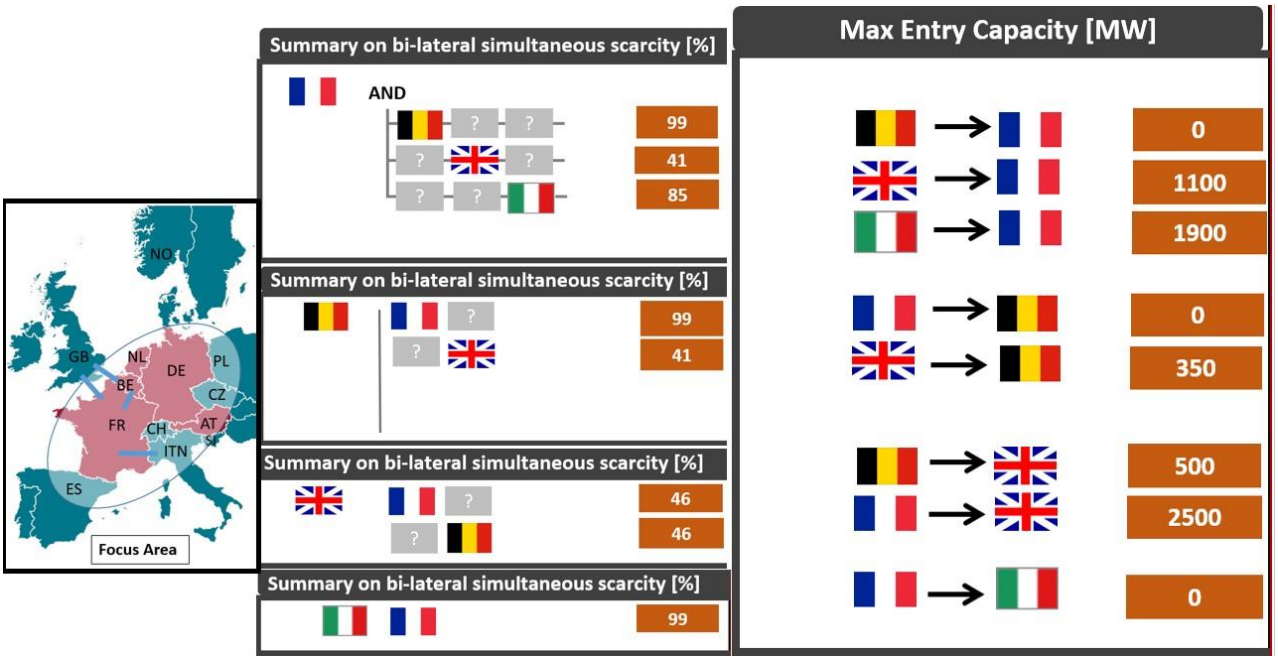


Figure 5: Example of the calculation of the maximum entry capacity (MW) for the interconnectors between France, Belgium, Great-Britain and Italy

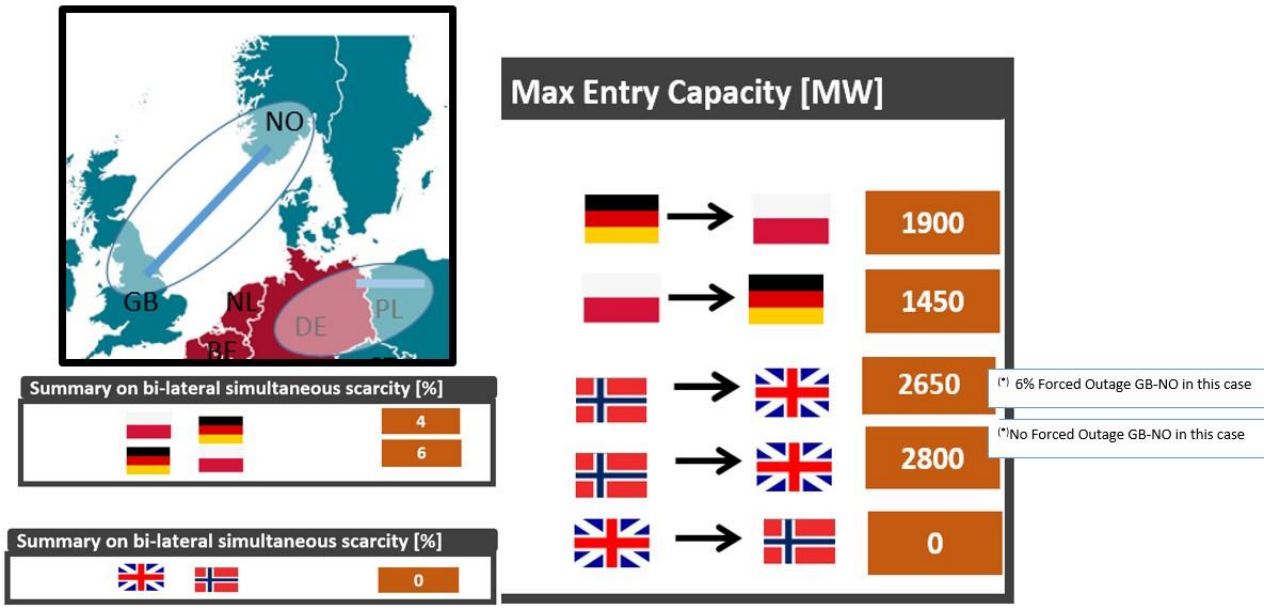


Figure 6: Example of the calculation of the maximum entry capacity (MW) for the point-to-point interconnectors between Poland and Germany and between Norway and Great-Britain

4. Methodology for sharing the revenues

4.1. Subject and scope

Article 26(1) of the IEM Regulation requires that *"capacity mechanisms other than strategic reserves and where technically feasible strategic reserves shall be open to direct cross-border participation of capacity providers located in another Member State"*. Article 26(2) defines that "*Member States shall ensure that foreign capacity capable of providing equivalent technical performance to domestic capacities has the opportunity to participate in the same competitive process as domestic capacities"*. Article 26(11) mandates ENTSO-E of developing several methodologies to allow efficient direct cross-border participation to capacity mechanism (including strategic reserves). In particular, Article 26(11) in point (b) mandates ENTSO-E to develop a methodology for the sharing of the revenues referred in paragraph 9 of the same article, hereafter the "Revenue Sharing Methodology.

Article 26(9) states: "*Where capacity mechanisms allow for cross-border participation in two neighboring Member States, any revenues arising through the allocation referred to in paragraph 8 shall accrue to the transmission system operators concerned and shall be shared between them in accordance with the methodology referred in point (b) of paragraph 11 of this Article or in accordance with a common methodology approved by both relevant regulatory authorities. If the neighboring Member State does not apply a capacity mechanism or applies a capacity mechanism, which is not open to cross-border participation, the share of revenues shall be approved by the competent national authority of the Member State in which the capacity mechanism is implemented after having sought the opinion of the regulatory authorities of the neighboring Member States. Transmission system operators shall use such revenues for the purposes set out in Article 19(2).*" In this respect Article 26(9) of the IEM Regulation provides the part of legal basis of this Revenue Sharing Methodology and clearly defines the context within which ENTSO-E should consider its proposal and in this way provides boundaries to the scope and philosophy that can be adopted by ENTSO-E for this Revenue Sharing Methodology. It is also to be noted that – as mentioned in the recitals of the proposed methodology – the ENTSO-E proposal focusses on the cases of two neighbouring Member States. This follows from article 26(9) which clearly describes the scope of the methodology as covering such cases. Other cases, e.g. sharing of revenues stemming from any participation from a non-neighbouring country (e.g. participation of Polish capacity in a French capacity mechanism) are not covered by this methodology. Notwithstanding that such non-neighboring participation is not excluded by the IEM Regulation, it does not provide further rules on the sharing of the revenues in such case. As far as ENTSO-E can tell, it may be in the spirit of the IEM Regulation that in such cases the relevant NRA(s) are the more natural actor(s)

to determine the sharing as in any case the IEM Regulation has provided the competence of approval to NRA(s).

Article 26(9) identifies in general terms the revenues considered by the Revenue Sharing Methodology as well as the decision process to be followed by the involved entities and where in this process this Revenue Sharing Methodology plays a role. On the latter aspect, Article 26(9) states explicitly that the Revenue Sharing Methodology can be applied for the sharing of the revenues where capacity mechanisms allow for direct cross-border participation by foreign capacity in two neighboring Member States over the same Delivery Period in accordance with Article 26 (9) of the IEM Regulation. It also indicates that this Revenue Sharing Methodology does not need to apply for the sharing of revenues if the neighboring Member State does not apply a capacity mechanism or applies a capacity mechanism, which is not open to direct cross-border participation by foreign capacity over the same Delivery Period. Art 26 (9) suggests thus to focus the application of this methodology to a specific case: XB CRM to XB CRM. Even in that case NRAs can jointly agree to apply a different revenue sharing methodology or sharing key.

Related to involvement of the NRAs, it is important to emphasize that – next to the obvious role of ACER (and hence implying NRAs) being to approve the revenue sharing methodology - concerned NRAs or the competent national authorities take anyway the last decision on the revenue sharing methodology to apply in a specific case and can adapt the methodology to suit local characteristics. If, however, the neighboring Member State does not apply a capacity mechanism or applies a capacity mechanism which is not open to direct cross-border participation by foreign capacity over the same Delivery Period, the competent national authority of the Member State applying the capacity mechanism approves the sharing key or another methodology after having sought the opinion of the neighboring NRA. This governance process – and the role of the NRA(s) - is important to bear in mind and provides an important guarantee to ensure that the applied sharing key should be acceptable (and can go beyond the methodology here proposed) and is not left to the discretion of one or more TSOs.

Art. 26(9) also indicates the revenue to be considered. Capacity mechanisms open for direct cross-border participation by foreign capacity require the allocation of the maximum entry capacity to eligible foreign capacity providers. To the extent this allocation process can result in a revenue, this Revenue Sharing Methodology aims at describing how this revenue could be shared among the concerned TSOs.

For the sake of clarity, the Revenue Sharing Methodology explicitly excludes the application of this Revenue Sharing Methodology in case of interconnectors directly participating in the capacity mechanism in the sense of Article 26(2) of the IEM Regulation. In such case the revenue meant by Article 26(9) for sharing by this Revenue Sharing Methodology is fully integrated in the capacity price

obtained by the interconnector in the capacity mechanism and can as such not be separated from the capacity price, neither does it appear necessary to foresee a further sharing rule in such case as any revenues to interconnectors are already covered by appropriate regulatory frameworks and as this direct participation rule is a temporary measures that is allowed only until at the earlier date between:

- 4th July 2023;
- 2 years after the date of ACER's approval of the methodologies detailed in this document.

Next, this Revenue Sharing Methodology relies on concepts determined in the methodology following Article 26(11) point (a) on the calculation of the maximum entry capacity for cross-border participation as defined in Article 26 (7): *"For the purposes of providing a recommendation to transmission system operators, regional coordination centers […] shall calculate on an annual basis the maximum entry capacity available for the participation of foreign capacity. That calculation shall take into account the expected availability of interconnection and the likely concurrence of system stress in the system where the mechanism is applied and the system in which the foreign capacity is located. Such a calculation shall be required for each bidding zone border. […]".*

Also, it is very important to position this Revenue Sharing Methodology correctly into the overall process related to the considered revenues. In particular, it should not be overlooked that the further use of the revenues resulting from the sharing following this Revenue Sharing Methodology is out of scope of this Revenue Sharing Methodology as also stipulated in Article 26 (9) with the explicit referral on this matter to article 19(2) of the IEM Regulation. Additionally, it should not be forgotten that any revenue shall be attributed to a TSO following Art. 26(9), taking into account the important role of the NRA(s) in this process (cf. supra). Hence, although the considered revenues originate from a specific context of cross-border capacity mechanisms, their use is not linked to these capacity mechanisms as such, neither should any of the revenues automatically go back to the capacity mechanism operator. Notwithstanding the latter is in several capacity mechanisms also a TSO, it is clear from Art. 26(9) that even though revenues are attributed to that TSO it is not in his role of capacity mechanism operator he receives them. The Revenue Sharing Methodology proposed by ENTSO-E fully respects this principle. Furthermore, note that for the sake of this Revenue Sharing Methodology following this ENTSO-E proposal also interconnectors which are not owned by TSOs could be understood as TSOs as has been the case for the treatment of congestion income in the past. This is deemed appropriate, as the use of the revenues resulting from cross-border capacity mechanisms and the use of classical congestion income are to be treated both following Art. 19.2.

Although beyond the scope of this Revenue Sharing Methodology, on the use of the revenues it is useful to remind Art. 19(2) of the IEM Regulation: *"The following objectives shall have priority with the respect to the allocation of any revenues resulting from the allocation of cross-zonal capacity:*
(a) guaranteeing the actual availability of the allocated capacity including firmness compensation; or
(b) maintaining or increasing cross-zonal capacities through optimisation of the usage of existing interconnectors by means of coordinated remedial actions, where applicable, or covering costs resulting from network investments that are relevant to reduce interconnector congestion." These rules are also applicable on how to use revenues resulting from cross-border capacity mechanisms. It is again clear from these rules that no revenues shall be used in relation to the capacity mechanism(s) from which they originate but shall generally be used to the advantage of ensuring that sufficient transmission capacity is available and can remain available or even increase through investments. Note, however, that the principles outlined in Art. 19.2 do not specifically link the use of the revenues to a specific border.

4.2. General principles

This section refers to Article 11 of the draft proposal.

The methodology for sharing cross-border revenues described in the remainder of the articles builds on the analysis of the relevant articles of the IEM Regulation as outlined in the previous section and is based on a number of principles:

- A border per border approach is followed in line with Article 26 (7) addressing the topic in a border per border manner. This approach is coupled with a direction per direction approach as, during adequacy relevant moments, the contribution of one Member State to a neighboring Member State is not necessarily symmetrical. Adequacy relevant moments might not happen at the same time and might occur differently in the neighboring states since there are differences in margins in available resources or underlying fundamentals (e.g. summer peak versus winter peak, different weather patterns). The way of sharing described further is therefore to be read as applying on one border, in one direction. It is important to keep this latter aspect in mind as the total revenue being attributed to a TSO in XB CRM – XB CRM case is clearly the sum of the application of the methodology for each direction and not for one direction only.

- The sharing of revenues resulting from a capacity mechanism should provide appropriate incentives for the development of transmission capacity. This implies on the one hand that when during adequacy-relevant moments more transmission capacity on the concerned border would

lead to more imports in the CM country and thereby increase resource adequacy, an incentive is to be provided to further develop this transmission capacity. On the other hand, it also means that when adding more transmission capacity on the concerned border would not result in a greater cross-border contribution on those adequacy-relevant moments, no such incentive should be provided as it would not be appropriate. The latter can for instance occur between two countries with high likelihoods of concurring system stress events, i.e. simultaneous scarcity. Although there may be ample transmission capacity available, the probability that the interconnection capacity will be the limiting factor when contributing to the adequacy of the Member State where the Capacity Mechanism apply will be small, since they will often be experiencing system stress at the same time. This is reflected in the max entry capacity, which considers among other things the "likely concurrence of system stress" according to article 26 (7).

- Differentiating towards revenue sharing between the different possible situations mentioned in the previous bullet requires a specific indicator. Although theoretical alternatives could be thought of, the indicator proposed for the assessment mentioned above of whether more transmission capacity will lead to a higher contribution during adequacy-relevant moments is the likelihood of simultaneous scarcity for the two concerned Member States. This indicator has been chosen, since it is an output that can be taken from the European Resource Adequacy Assessment that ENTSO-E has to carry out following Article 23 of the IEM Regulation. Moreover, it benefits from the robust modelling exercise undertaken that can represent the underlying subtleties required for its use. Therefore, it benefits from an integrated approach at European level and a strong governance process involving public consultation, ACER involvement and approval. This latter governance process is clearly described in Art. 23(7) of the IEM Regulation stating: *"The proposals under paragraphs 3 and 6 for the draft methodology, the scenarios, sensitivities and assumptions on which they are based, and the results of the European resource adequacy assessment under paragraph 4 shall be subject to the prior consultation of Member States, the Electricity Coordination Group and relevant stakeholders and approval by ACER under the procedure set out in Article 27."*

  In case the Maximum Entry Capacity is not fully allocated to eligible foreign capacity, this is a sign that the market does not demand more transmission capacity during those adequacy-relevant moments and therefore no incentive for further developing this transmission capacity for those moments is to be provided. If the max entry capacity is not fully allocated, it follows from the above principles that that it is to be attributed to the TSO of the Member State operating the XB CRM.

- The existing capacity markets in the EU are not homogeneous: various designs (e.g. strategic reserves, capacity mechanism), differentiated eligibility rules (e.g. some technologies could be excluded in one CM and allowed in the other) or ways to check availability (e.g. differentiated delivery periods).This leads to different bidding behaviors from market participants and prices that reflect both a “market access right” value and the “interconnector” value. The following methodology proposed try to differentiate both of these values to deliver relevant incentives. However, it is possible to conclude from a high market access value, that more capacity providers are willing to contribute i.e. that there may be demand for available interconnector capacity and that it could have a value. So, the way to calculate the maximum entry capacity is still the main way to determine the share of the available interconnector capacity that is allowed to participate.

- Functioning independently from the normal energy market functioning, the determination of the revenue to be considered for sharing and the sharing key itself take place after the allocation process of the Maximum Entry Capacity has taken place and should not await the actual delivery period, which may in several cases only be a number of years later. Such an approach enables to provide long-term visibility on TSOs’ revenues.

4.3. Determination of the total revenue considered for sharing

This section refers to Article 12 of the draft proposal.

For a delivery period, two neighboring Members States sell so-called "CM access tickets" or "tickets" to eligible foreign capacity that represent an access right to participate directly in a neighboring capacity mechanism. The amount of tickets proposed during the auction equals the Maximum Entry Capacity as determined following Article 26 (7) and the methodology foreseen by Article 26 paragraph 11 (a).

Such tickets are allocated to eligible foreign capacity by means of a non-discriminatory, market-based allocation mechanism. Typically, two kind of mechanisms can be distinguished (similarly to the allocation mechanisms of cross-border capacity in the energy market): implicit and explicit allocation. Whereas in the former both the capacity product and the ticket are sold together, in the latter a separate mechanism is used to only sell the ticket. The choice for implicit and explicit allocation depends on the choices made in the context of a specific capacity mechanism. Note that in practice an implicit allocation can happen in a two-step manner, i.e. by means of a pre-auction preceding a main auction, but still the ticket and the capacity product are priced together by the eligible foreign capacity.

In case of an implicit allocation of tickets, the total revenue considered – to the extent all tickets have been allocated, i.e. there was enough market demand – is calculated as the Maximum Entry Capacity multiplied by the price difference between the price offered in the capacity mechanism by the last contracted (based on the offered price) capacity and the last contracted (based on the offered price) foreign capacity. For instance, if the Maximum Entry Capacity is 200MW and that the highest offer selected in the CM auction is 30k€/MW and the highest offer from foreign capacity from the concerned Member State is 21k€/MW the total revenue considered 200*(30k€-21k€) = 1800k€.

Although in a pay-as-cleared setting the revenue is more obviously determined, it is to be noted that such approach can also be used in a pay-as-bid auction setting, albeit that the revenue is then more artificially determined.

In case of an explicit allocation of tickets, the total revenue considered for sharing equals the total revenue directly resulting from the auctioning of the tickets.

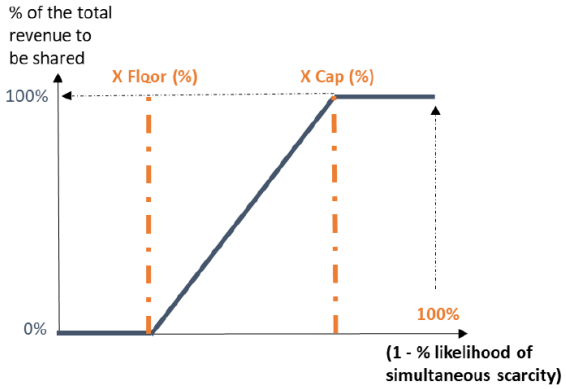
4.4. Determination of the sharing key

This section refers to Article 13 of draft proposal.

Having determined the total revenue considered for sharing following Article 12 of the draft proposal, two further steps are followed.

Firstly, following the above principles (cf. Article 11) and the stated need to provide appropriate incentives (and avoid distortive incentives) in cases where such additional incentive should be given, the relevant part of the revenue should go to those entities (i.e. TSOs) that develop the transmission capacity on that border.

The part of the total revenue to be shared between those that develop transmission capacity on that border is determined by looking at the probability of simultaneous scarcity between the considered neighboring Member States, i.e. '*1 minus the likelihood of simultaneous scarcity between the two concerned Member States*'. Taking into account a cap and floor (as described below), the total revenue considered for sharing as defined in Article 12 of the draft proposal is proportional to this probability of simultaneous scarcity. This is conceptually illustrated in the graph below. For values below the floor the total revenue considered for sharing is set at zero, while for values above the cap it is set at 100%. Between the cap and floor, a linear interpolation is applied. The example at the end of this explanatory document illustrates this further.



A cap and a floor related to the likelihood of simultaneous scarcity between the two concerned Member States is added. Such a cap and floor can be useful for, at least, two reasons:

- to further apply the underlying rationale of the methodology, i.e. whenever the transmission contribution during adequacy-relevant moments is deemed more significant (or not at all), a cap and floor reinforces this further by earlier giving (or limiting) a signal and attributing more revenues to the TSOs developing transmission capacity. This also allows for dampening any yearly variations that may occur following the use of ERAA modelling results.
- to reflect that towards the extremes of the spectrum, the more extreme results of the underlying modelling results that are driven the output, are likely to be more prone to uncertainties and inaccuracies. Therefore, it may be opportune to not let those determine the sharing key and cut-off earlier by means of a cap/floor mechanism.

In view of the above arguments, 20% for the floor and 80% for the cap are considered.

The '*1 minus the likelihood of simultaneous scarcity between the two concerned Member States*' resulting from the latest approved European Resource Adequacy Assessment is deemed an appropriate indicator for assessing when more transmission capacity could contribute to resource adequacy. Finally, being a 'continuous' parameter, it avoids overly arbitrary or binary allocation rules. Where the probability of contribution is high i.e. the simultaneous scarcity rates are low to non-existent, a large (or the total) revenue shall be attributed to those developing transmission capacity. Where transmission capacity is not (or less often) the scarce resource, a smaller share of revenue is attributed to those parties.

Secondly, once the part of the total considered revenue to be attributed to the TSOs developing the transmission capacity has been determined, this part is to be shared among the involved TSOs. Whereas for several borders a 50-50 rule is straightforward as TSOs also invest in a 50-50 manner in transmission capacity, the rules in the Revenue Sharing Methodology also allow for deviations from 50-50 in case more than two TSOs are involved and/or different investment shares have been applied in the past and/or

other entities have been investing in the past. This reasoning is similar to the application of the sharing of congestion rents as applied in the past in such cases.

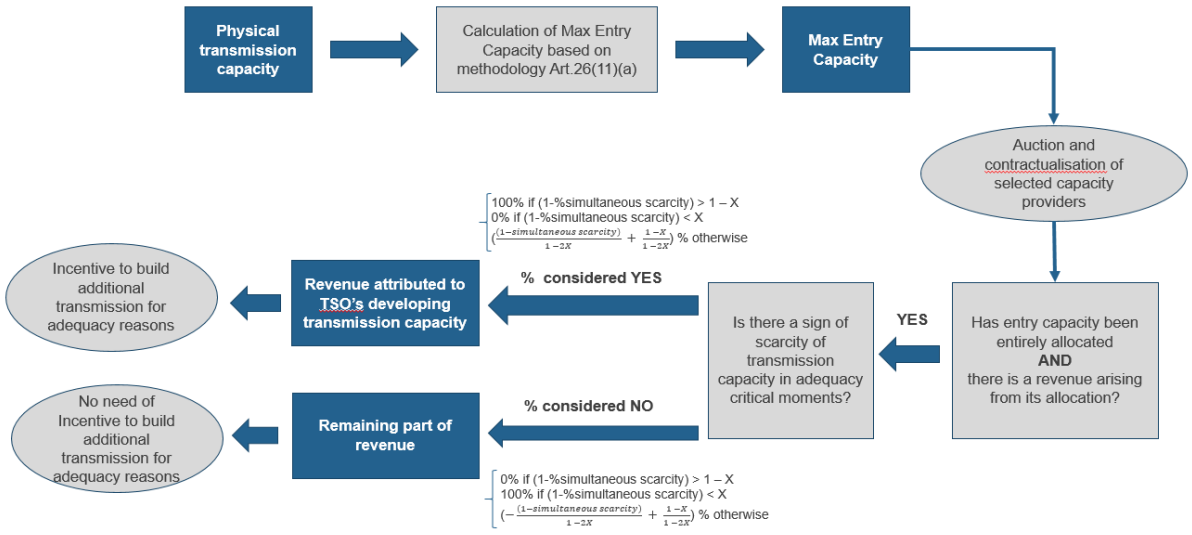
Finally, the part of the total considered that is *not* attributed to the TSOs developing transmission capacity remains with the TSO(s) of the Member State organizing the capacity mechanism. Remember that the above sharing key is determined per direction and that in the most likely cases of application of this Revenue Sharing Methodology, i.e. in case of capacity mechanisms that are open for cross-border participation in two neighboring Member States, the same approach is followed for the other direction and the concerned TSOs 'switch roles'. Also, keep in mind, as explained above, that even though revenue is attributed to the TSO(s) of the Member State organizing the capacity mechanism, the use of the revenue remains governed by the principles of Art. 19.2 and is therefore not linked to the capacity mechanism itself.

The sharing keys are to be determined each time entry capacity is being allocated to eligible foreign capacity. For instance, in case of allocations several years ahead a delivery period (e.g. in Y-4 as done in several capacity mechanisms), the sharing key is determined based on best available information at that moment. In relation to the above sharing key, this means using the latest approved European Resource Adequacy Assessment available at the moment of allocation of entry capacity. If at a later stage (e.g. in Y-1) additional entry capacity would be allocated, the sharing key at that moment is to be based on the best available information at that moment, which may differ from an earlier sharing key as the situation could have evolved meanwhile.

For the avoidance of doubt, for the use in the proposed sharing methodology it is foreseen that the likelihood of simultaneous scarcity between the two concerned Member States resulting from the latest approved European Resource Adequacy Assessment is rounded to the nearest whole percentage (e.g. 56%), rounding half up (e.g. 55,5% rounded to 56%). The percentages of revenues being shared are rounded to nearest first decimal (e.g. 23,8%), also rounding half up (23,75% rounded to 23,8%).

4.5. Illustrative example

All in all, the several steps applied to decide how cross-border revenues should be shared, per border and per direction, can be described with the flowchart below:



The concrete numerical examples used for MEC are continued, using also simultaneous scarcity factors estimated for the year 2025 for different circumstances & borders (CM-CM, CM- not CM) from the same simulations.

The examples in the table below focus on borders and directions between member states for which, based on today's information, the sharing methodology a priori applies following art. 26(9) of the IEM Regulation, i.e. borders between member states both hosting a capacity mechanism open for cross-border participation (cf. Supra).

The table below indicates the considered border and direction, the Maximum Entry Capacity as determined by its relevant methodology and as discussed in the examples on Maximum Entry Capacity, the relevant percentages and amounts in Euro of the total revenue assigned to each side of the border for the considered direction. For the calculation of the amounts a XB ticket value of 10 €/MW/h has been used. This number has been chosen arbitrarily for illustrative purposes only.

Table 1: Concrete examples on the functioning of the sharing methodology

Cap = 80% and Floor = 20%				
Border & Direction	Maximum Entry Capacity	Simultaneous Scarcity Probability	Percentage of revenues attributed to each side of the border	Yearly amount of revenues attributed to each side of the border (assuming ticket value of 10 €/MW/h)

GB → FR	1100 MW	41%	GB: 32,5%	FR: 67,5%	GB: 31.317 k€	FR: 65.043 k€
FR → GB	2500 MW	46%	FR: 28,3%	GB: 71,7%	FR: 62.050 k€	GB: 156.950 k€
BE → FR	0 MW	99%	BE: 0%	FR: 100%	BE: 0 k€	FR: 0 k€
FR → BE	0 MW	99%	FR: 0%	BE: 100%	FR: 0 k€	BE: 0 k€
GB → BE	350 MW	41%	GB: 32,5%	BE: 67,5%	GB: 9.964k€	BE: 20.695 k€
BE → GB	500 MW	46%	BE: 28,3%	GB: 71,7%	BE: 12.410 k€	GB: 31.390 k€
IT → FR	1900 MW	85%	IT: 0%	FR: 100%	IT: 0 k€	FR: 166.440 k€
FR → IT	0 MW	44%	FR: 30%	IT: 70%	FR: 0 k€	IT: 0 k€

To further illustrate the functioning of the proposed methodology, two examples from the above table are explained in more detail:

- France → Great Britain
    - Applying the MEC methodology on the considered data results in a Maximum Entry Capacity from France to Great Britain for the considered Delivery Period of 2500 MW. This means that there are 2500 tickets to be allocated to interested capacities in France for participation in the GB CRM.
    - The same simulation that resulted in the above MEC-value also resulted in a simultaneous scarcity probability of 46%. This means that in 46% of the cases that GB has scarcity, France is also in scarcity. Alternatively, in 1 - 46%, i.e. 54%, of the scarcity is observed in GB, there is no scarcity in France. In view of the principles underlying the proposed sharing methodology, during 54% of the moments with scarcity in GB, a larger contribution from France would have been helpful for adequacy and an incentive to develop transmission capacity for this purpose is deemed useful.
    - Following the above results:
        - As one minus the rate of simultaneous scarcity falls between the cap and the floor, the percentages of revenues is determined by the linear interpolated function between the cap and the floor levels.
        - In case of a cap at 80% and a floor at 20%, a rate of 1 – 46% = 54% results in 56,6% of the revenue being shared between the developers of the interconnection capacity on the border. Each side of the border is assigned half of this 56,6% of the total revenues, i.e. each 28,3%. The remaining 43,4% of the revenues is attributed to the TSO of the Member State organizing the CRM, in this case GB. Overall, this results in 0,5 x 56,6% = 28,3% being allocated to the French TSO and 0,5 x 56,6% + 43,4% = 71,7% being allocated to the GB TSO.

        - In monetary amounts, assuming that a ticket is worth 10 €/MW/h (arbitrarily chosen, for illustrational purposes only), this would result in a total revenue of 219.000 k€ being shared resulting in 62.050 k€ and 156.950 k€ being respectively attributed to the TSOs in France and GB.

    - From the table it can also be noted that when looking at the opposite direction for the same border (e.g. GB → FR), in general the amounts and percentages of the sharing are generally also in the opposite direction. However, it may not be perfectly mirrored as it also depends on the MEC value, i.e. the amount of tickets sold, the value attributed by the market to a ticket in a particular direction (e.g. linked to the design of the hosting capacity mechanism), etc.

- Belgium → France
    - Applying the MEC methodology on the considered data results in a Maximum Entry Capacity from Belgium to France for the considered Delivery Period of 0 MW. This means that there for that Delivery Period no tickets for cross-border participation from Belgium to France are available.
    - Obviously, as there are no tickets available, there will be no revenues from allocating them and no sharing can be applied.
    - Note that also the simultaneous scarcity percentage between those tickets is very high indicating that when France is in scarcity Belgium will almost always (99,5% of the cases) also be in scarcity.
    - It seems from these results that adding more transmission capacity on Belgium to France border would add little added value. Would there have been any tickets to allocate and a revenue would result from this, it would make little sense to provide with this revenue an additional incentive to develop such cross-border transmission capacity. The rate of simultaneous scarcity is such the (1 – the rate of simultaneous scarcity) would not exceed the floor level and the entire revenue would be allocated to France.
    - Note that in the opposite direction (FR → BE) a symmetric outcome applies.

Also, for the other borders and directions in the above table a similar reasoning can be made, illustrating the functioning of the sharing methodology and how it relates to its underlying principles.

6. Common rules for carrying out availability checks

6.1. Subject and Scope

Article 26(1) of the IEM Regulation requires that *"capacity mechanisms other than strategic reserves and where technically feasible strategic reserves shall be open to direct cross-border participation of capacity providers located in another Member State".* Article 26(2) defines that "*Member States shall ensure that foreign capacity capable of providing equivalent technical performance to domestic capacities has the opportunity to participate in the same competitive process as domestic capacities"*. Article 26(11) mandates ENTSO-E of developing several methodologies to allow efficient direct cross-border participation to capacity mechanism. In particular, article 26(11) in points (c) mandates ENTSO-E to develop common rules to carry out availability checks.

The aim of capacity mechanisms is to ensure that sufficient capacities are able to deliver energy in case of peak demand. Therefore, when verifying the performance of contracted capacity, the objective is generally to measure the energy that could be delivered in case of stress event, rather than the energy actually delivered. This is identified as "Availability", which means possibility of Activation of the capacity contracted in the capacity mechanism and concerns:

a) the availability in the energy and/or balancing market and/or ancillary services markets;

b) for capacities contracted in the capacity mechanism but not participating to the market (e.g. in case of strategic reserves), the availability to deliver energy upon request of the TSO and/or in particular system conditions;

In this regard, availability checks are needed in capacity mechanisms to establish if contracted capacity is made available during the delivery period at the amount of availability obligation entailed by the capacity contract[5]. The period, during which availability checks are actually led, is referred to as the "Reference period".

Based on these checks it can be derived the non-availability volume[6] and eventually non-availability payments, in the form foreseen by national CM rules, might be charged to the capacity provider.

[5] *Such an obligation can vary during the delivery period (e.g. load-following obligation)*

[6] *The non-availability volume represents the difference between the capacity subject to availability obligations and the capacity actually made available* by the capacity provider as resulting from availability checks

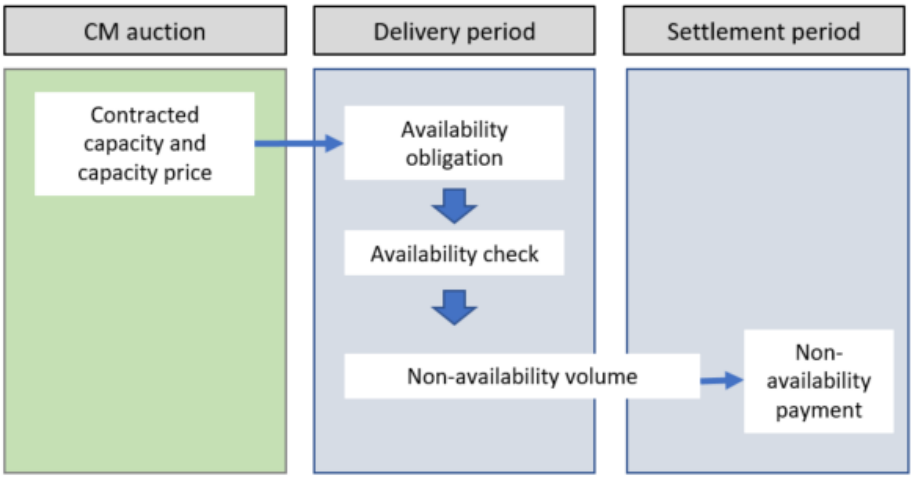


Figure 2: example for process for determining available capacity and penalties

It is key to notice that the product negotiated in different capacity mechanisms is not uniform, as it is the result of national design choices (e.g. centralized capacity auction, reliability options, decentralized obligations, …), tailored-made to efficiently address specific security of supply issues, all of which are detailed in national CM rules and rely on the electricity market architecture in the Member State applying the capacity mechanism. Therefore, each CM has specific characteristics in terms of availability obligations and consequently availability checks and non-availability payments methodologies. This aspect is of utmost importance when addressing the task of defining common rules to carry out availability checks and determine when non-availability payments are due for foreign capacity providers, since they are necessarily linked to the rules applied for domestic capacity providers to avoid any discrimination. In drafting the common rules for carrying out availability checks, this aspect was taken into account seeking a balance between the fundamental need of harmonization on common principles and the equally important need of not imposing a single design choice to all capacity mechanisms around Europe, while maintaining a level-playing field for every capacity provider participating to a given capacity mechanism.

ENTSO-E did not include specific provisions to carry-out availability checks on interconnectors since the scope of the proposed Methodologies under Article 26 of the IEM Regulation is limited to the direct participation of foreign capacity and not to the provisional direct interconnector participation currently adopted in some CMs (see also section **Error! Bookmark not defined.Error! Reference source not found.**). In the direct participation model interconnectors will not directly participate in CMs and will not undertake capacity contracts with related availability obligations.

The core principle inspiring the common rules for carrying out availability checks was the principle of non-discrimination meaning that participation of foreign capacity should be subject to the *as-equivalent-as-possible* conditions applied to domestic capacities in order to avoid positive or negative

discriminations. This principle derives from Article 22(1) letter (d) of the IEM Regulation *"select capacity providers by means of a transparent, non-discriminatory and competitive process"*.

6.2. Principle of non-discrimination

The section refers to Article 15 of the draft proposal.

The core principle of non-discrimination means that **foreign contracted capacity should be subject to availability checks carried as equivalently as possible as for domestic capacities**.

This equivalence means that foreign capacity providers should be subject to availability checks, if possible, with:

- the **same Delivery period**: the availability obligation can apply during the same hours;
- the **same Frequency**: if domestic capacity availability is checked every hour, or once a month, the same should apply to foreign capacity;
- the **same methodology**: it means that foreign capacity should be deemed available or not according to the same criteria used for domestic capacity.

In case it is not possible to achieve a perfect equivalence of calculation rules for carrying out availability checks due to different features of energy, ancillary services and balancing markets applying in the foreign country, availability checks for foreign contracted capacity should be carried out by adapting methodologies foreseen by the CM rules for domestic capacity, provided that the performance checked can be still considered technically equivalent.

In Table 2, three examples of methodologies and data used for Availability checks in three representative European CMs (France, Italy, and UK) are presented. As it can be noticed, there can be different contract obligations (e.g. obligation on offer vs on energy delivery) depending on different electricity markets architecture (e.g. unit bidding allows the TSO to know offers in the energy and balancing market for each unit, while where portfolio bidding is applied TSOs do not have access to these data), different security of supply issues (e.g. limited to specific periods of the year due to seasonality of peak load) and several other factors. As a result, different methodologies are currently applied throughout Europe to evaluate availability. The principle of non-discrimination entails that foreign capacity participating to a given CM should be subject to the same obligations and availability checks applying to domestic capacity.

6.3. Roles of involved TSOs and CM Operators

The section refers to Article 16 of the draft proposal.

Article 16 defines roles of involved TSOs (the CM Operator and the TSO of the system where foreign capacity is located).

Article 26(10) point (b) of the IEM Regulation states that **the task of carrying out availability checks** for foreign contracted capacity **lies upon the TSO of the system where foreign capacity is located**. The CM Operator, which signs a contract with every capacity provider participating to the CM, should act as a facilitator providing all information needed all over the processes:

a. **Delivery period and availability obligation** valid for the capacity mechanism (when availability checks have to be done);

b. **expected minimum frequency** of Availability checks (how often availability checks have to be done);

c. **timeframes** for carrying out Availability checks and communicating results;

d. Availability check **methodologies** (how availability checks have to be done);

e. format of data requested and **data exchange process**;

Article 16 promotes the use of **bilateral agreements** to detail abovementioned points (a-e) and execute the common rules for carrying out availability checks. These technical agreements should be used also for creating an operational information flow among TSOs (and CM operators whenever different from the TSO) related to Capacity Market Units (CMUs) contracted in multiple capacity mechanisms. The facilitation of cross-border participation is likely to require new processes, procedures, IT infrastructure, etc. Given that the aim of these new processes is to facilitate a contractual relationship and consequent remunerations between a foreign capacity and a CM Operator, they ought to be well arranged among TSOs. Therefore, bilateral agreements are useful and even necessary. Also, the organisation of the energy markets in the different Member States exhibit different practices, procedures and choices on data and energy market implementation (e.g. related to demand response or the checks on ancillary services). As capacity mechanisms should not impact the design of the energy market (and even more not the design of the market in a neighbouring Member State), detailing the operational specifics taking into account the necessary nuances in each Member State related to the execution of these common rules in a bilateral agreement among the involved TSOs contributes significantly to the implementation of Art. 26 of the IEM Regulation.

6.4. Application of Availability checks

The section refers to Article 17 of the draft proposal.

Article 17 aims at establishing **common principles and guidelines for Availability checks**, provided that specific rules and methodologies are defined at national level for each CM.

- Availability checks should not negatively affect system security nor increase the costs for maintaining the same level of system security (e.g. in case a TSO is requested to carry out

activation tests on a given CMU at a given time, it should be allowed to postpone the test where this endangers system security);

- Contracted capacity should be subject to availability checks with a non-zero probability during the delivery period, also a minimum frequency of availability checks should be applied (e.g. at least once a year);
- Generally, availability of contracted capacity can be checked through:
    - monitoring of availability in the market: (energy delivered, bids/commitments submitted, outage information, etc…); or
    - activation tests.
- Since activation tests are expensive, whenever monitoring of availability in the market already provides sufficient information, it should be prioritized for carrying out Availability checks;
- Availability checks are not applied during suspension of market activities;

All in all, these general principles allow a framework for enabling effective cross-border participation without limiting national design choices.

6.5. Reporting to the involved NRAs

The section refers to Article 18 of the draft proposal.

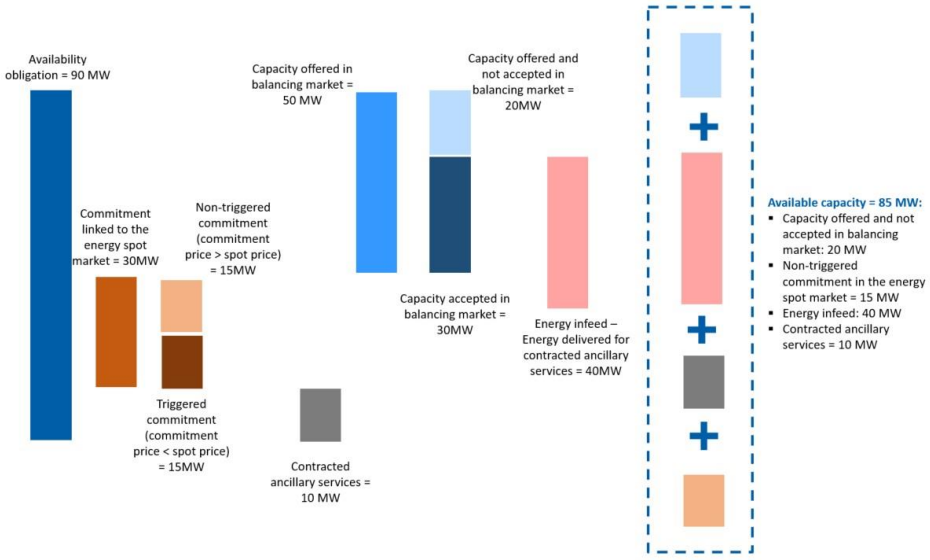
For the sake of transparency, it is foreseen that the CM operator shares with the involved NRAs after every delivery period, or at least once a year, a report with aggregated data on average availability of foreign contracted CMUs.

Table 2: examples of availability checks in different EU CMs

France:

Data used for availability checks:

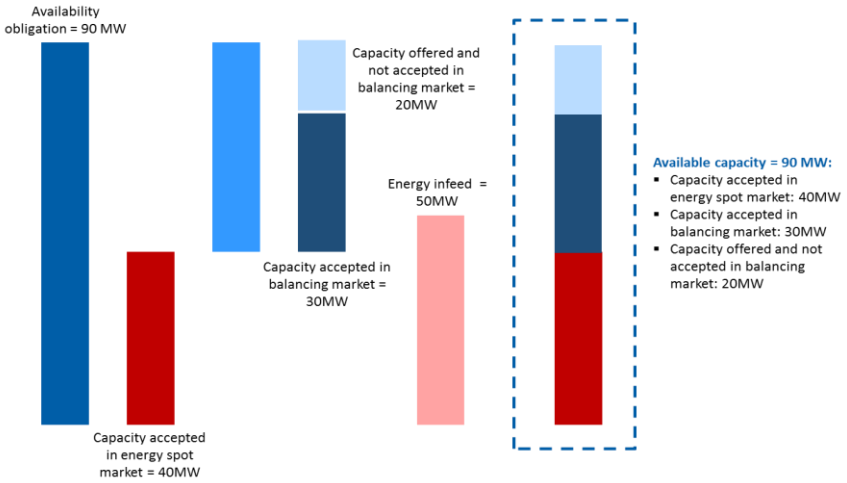
- energy infeed
- Commitments linked to the energy market
- Bids and accepted quantities in the balancing market
- Contracted ancillary services
- Activation tests (potential rebate applied)



Italy:

Data used for availability checks:

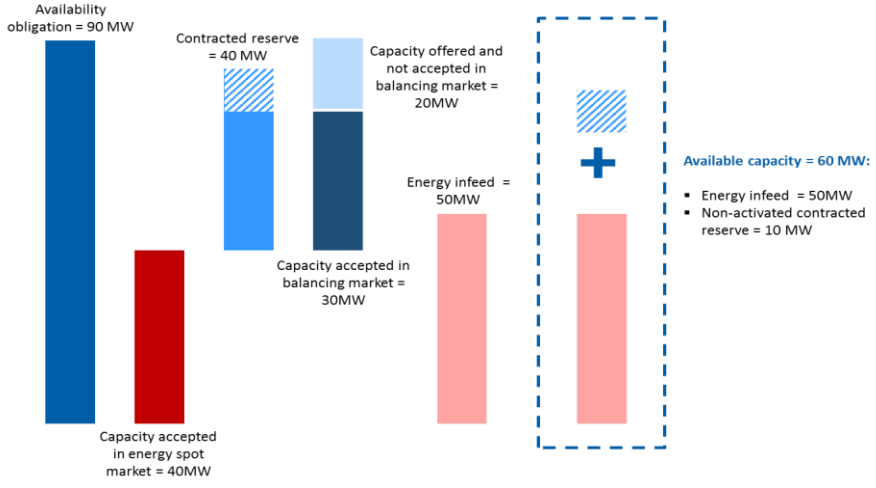
- bids and accepted quantities in the energy market
- bids and accepted quantities in the ancillary services and balancing market



UK:

Data used for availability checks:

- energy infeed
- contracted reserve volumes
- activation tests



7. Common rules for determining when a non-availability payment is due

7.1. Subject and scope

Article 26(1) of the IEM Regulation requires that *"capacity mechanisms other than strategic reserves and where technically feasible strategic reserves shall be open to direct cross-border participation of capacity providers located in another Member State".* Article 26(2) defines that "*Member States shall ensure that foreign capacity capable of providing equivalent technical performance to domestic capacities has the opportunity to participate in the same competitive process as domestic capacities"*. Article 26(11) mandates ENTSO-E of developing several methodologies to allow efficient direct cross-border participation to capacity mechanism. In particular,

Article 26(11) (d) mandates ENTSO-E to develop common rules to determine when a non-availability payment is due.

A non-availability payment is any kind of penalty that might be due when the capacity obligation is not completely fulfilled, depending on the capacity mechanism rules. Different rules apply in existing capacity mechanisms throughout Europe with a variety possibly higher than for availability obligations and availability checks.

For instance, some capacity mechanisms compute the average volume of non-availability over the entire delivery period, or a subset of it, and charge a non-availability payment based on the result (e.g. imbalance system in the French capacity mechanism). Some capacity mechanisms apply a differentiated penalty for each hour of non-availability, while others apply a threshold mechanism charging penalties if and only if the non-availability exceeds a certain amount (e.g. Italian capacity market). With reliability option mechanisms, non-availability payments are not necessarily charged at all since the difference payment entailed by the reliability option may be deemed a sufficient incentive to be available in times of system stress.

Also, several details related to the application of non-availability payments differ from one mechanism to another one. For instance, the implementation or not of stop-loss limit conditions, which aim at limiting the possible penalty (e.g. linking it to the remuneration received) or the escalation of penalties leading to contract termination in case of persistent unavailability. Finally, also several exemptions are foreseen in some national CM rules, for instance in case the unavailability is due to a planned maintenance approved by the TSO, or to restrictions imposed by authorities. All these features may vary significantly among capacity mechanisms.

As a general principle, non-availability payments as equivalent as possible between domestic and foreign capacity providers should be applied, as stated in the IEM Regulation, Article 26(6): "Capacity

providers shall be required to make non-availability payments where their capacity is not available" and article 22(1) letter (d) *"select capacity providers by means of a transparent, non-discriminatory and competitive process"*.

7.2. Principle of non-discrimination

The section refers to Article 20 of the draft proposal.

The core principle of non-discrimination means that **foreign contracted capacity should be subject to the same non-availability payments applied to domestic capacities,** to avoid distorting the functioning of the approved capacity mechanism and to respect market design principles stated in the IEM Regulation.

This equivalence means that foreign capacity providers should be subject to non-availability payments using the same (or as equivalent as possible):

a. amount of penalty imposed through the non-availability payment;

b. settlement timeframe;

c. non-availability payment methodology.

7.3. Roles of involved TSOs and NRAs

The section refers to Article 21 of the draft proposal.

Article 21 defines roles of involved actors:

- **Foreign TSO**: communicates results of Availability checks to the CM operator
- **CM operator**: computes the Non-availability volume and the associated Non-availability payment, if any, for each CMU and gives notice to the capacity provider
- **CM operator (or the contract counterpart)**: collects the payment from the capacity provider
- **NRAs**: monitor the enforcement of non-availability payments

7.4. Definition of Non-availability volume in case of multiple commitments

The section refers to Article 22 of the draft proposal.

When direct cross-border participation is allowed, cases where the same CMU is participating to multiple CMs ("multiple participation") may arise. The IEM Regulation prescribes that multiple participation should be allowed (Article 26(5): "*Capacity providers shall be able to participate in more than one capacity mechanism"*), subject to the condition that "*where capacity providers participate in more than one capacity mechanism for the same delivery period, they shall be required to make multiple non-availability payments where they are unable to fulfil multiple commitments"* (Article 26(6)).

As a capacity available at one place cannot help with adequacy issues in two Member States at the same time and in order to avoid windfall profits, a non-availability volume should be identified whenever the capacity made available is lower than the sum of simultaneous commitments (i.e. availability obligations valid for that timeframe) to provide the right incentive to capacity providers to commit only the capacity they expect to be able to make simultaneously available in case of overlapping Reference periods.

Secondly, a criterion should be identified to attribute the available capacity to every CM contract, considering that:

a) arbitrage between different penalties should be avoided;

b) the available capacity referred to the same CMU and timeframe might result in different values for each CM where the CMU is contracted due to different Availability check methodologies (cf. examples in Table 2);

c) The methodology proposed should be coherent with adequacy analysis – upon which rely the calculation of Maximum Entry Capacity – which enables a capacity provider to help with the security of supply of several Member States as long as there are no simultaneous scarcity situations.

The formula proposed in the common rules for non-availability payment to attribute the available capacity to different CM contracts relies on a simple pro-rata criterion:

$$available\ capacity_{h,CM_i} = Availability\ check\ result_{h,CM_i} \cdot \frac{capacity\ commitment_{h,CM_i}}{\sum_i capacity\ commitment_{h,CM_i}} \qquad \textbf{(eq.1)}$$

From (eq.1) it can be easily derived the Non-availability volume:

$$Non\ availability\ volume_{h,CM_i} = \max(0; capacity\ commitment_{h,CM_i} - available\ capacity_{h,CM_i}) \qquad \textbf{(eq.2)}$$

The capacity commitment for a given CM can be non-zero only during the delivery period of that CM and is equalized to zero during the rest of the time. This means that when delivery periods do not overlap there are no multiple commitments. Since during overlapping Delivery Periods, the contracted capacity could be needed in each CM, this approach enables multiple commitments while preserving security of supply and reducing uncertainty for capacity providers since Delivery Periods are well known ex-ante, (usually already when capacity contracts are signed).

ENTSO-E underlines that overlapping delivery periods in neighbouring CMs mean that both systems might experience simultaneous scarcity and need the activation of the contracted capacity at the same time. Therefore, it is important to avoid bidding strategies which would lead to a double counting of capacity with possible risks of adequacy and extra remuneration of the capacity provider. According to ENTSO-E proposal, the capacity provider is not prevented from selling the same MW in multiple CMs but would base its choice on the risk of incurring in penalties due to overlapping delivery periods and on the severity of such penalties. In this way, he would receive correct incentives to adopt a bidding strategy which doesn't increase adequacy risks for the system. ENTSO-E believes that, when dealing with multiple commitments, appropriate incentives for a correct behaviour of capacity providers in favour of system adequacy should be kept, also considering the different non-availability penalties frameworks across CMs which could raise arbitrage opportunities between penalties.

In case Delivery Periods do not fully reflect expected scarcity situations, CM operators can propose alternative approaches in national regulations or at bilateral level to better take into account the national specificities as long as they are to the benefits of cross-border capacity providers (e.g. consider overlapping commitments only when there is an overlapping of Reference Periods). **Example 1:**

- Country A and B with a CM
- CMU located in country B and participating to both CMs of country A and B

For hour h the availability obligations are the following:

- commitment CM A = 25 MW, commitment CM B = 75 MW

Availability checks results for the CMU in hour h are:

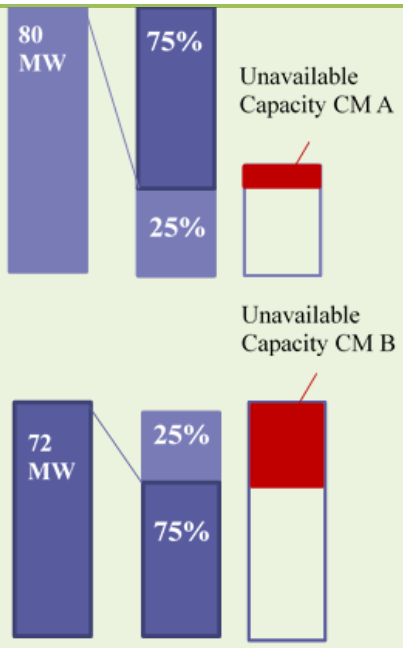
- Availability check result = **80 MW** (for CM A)
- Availability check result = **72 MW** (for CM B)

(according to availability checks performed by TSO of country B)

Assuming that the Reference Period is limited to the hour h:

Non-availability volume A = 25 - 80*25/100 = 25 – 20 = **5 MW**

Non-availability volume B = 75 - 72*75/100 = 75 – 54 = **21 MW**



Example 2:

This example shows a possible application of the methodology to a real case, showing availability checks and determination of non-availability volumes of a CMU located in Italy and participating to the French and Italian CM.

CASE 1: day 1 belonging to delivery period of IT CM only

1) Availability checks:

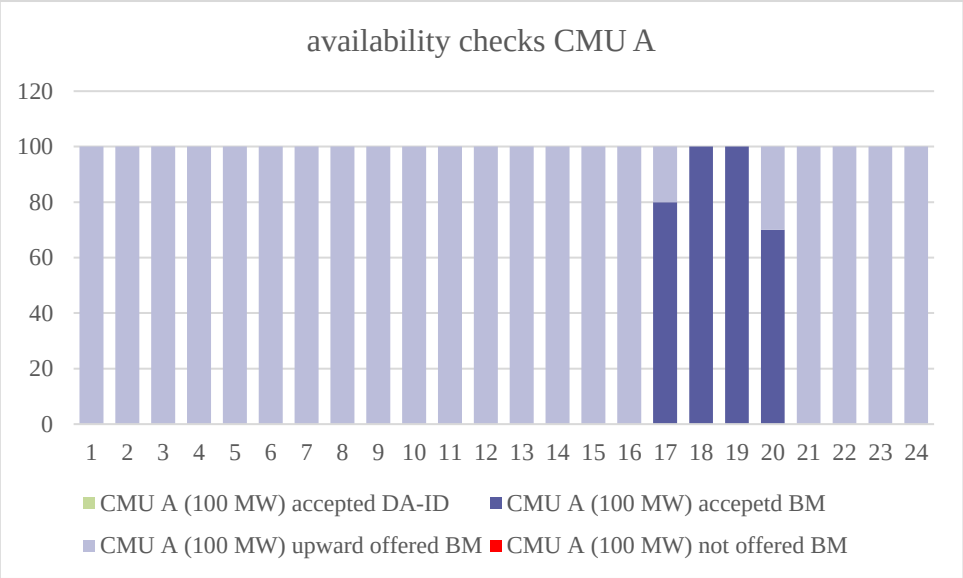


Figure 7: availability check CMU A IT CM (case 1)

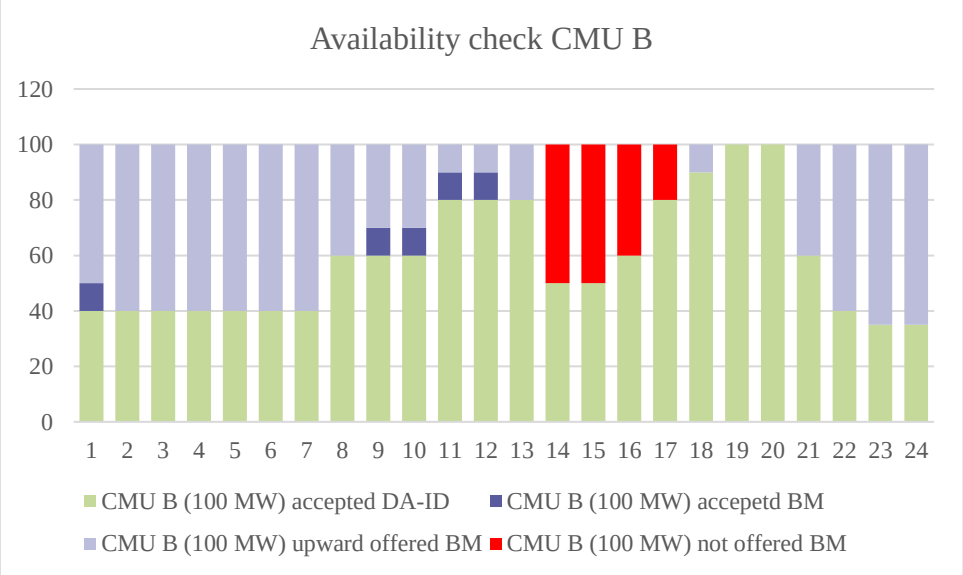


Figure 8: availability check CMU B IT CM (case 1)

The Italian TSO performs availability checks on the CMU A (peaker plant/DSR unit) and CMU B (baseload unit) according to rules of national CM. Accepted quantities in DA-ID markets, accepted quantities in AS and balancing markets plus offered and not accepted quantities in AS and balancing markets are considered as available capacity. Results of availability checks are reported in Figure 7 and Figure 8.

2) Non-Availability volume identification:

Considering an availability commitment equal to 80 MW for both CMU A and CMU B, it results that CMU A is always fulfilling its commitment while CMU B has non-availability volumes in hours 14-

16. The pro-rata rule is not applied since day 1 belongs only to the delivery period of the Italian CM and thus the commitment for the French CM is assumed equal to 0 MW.

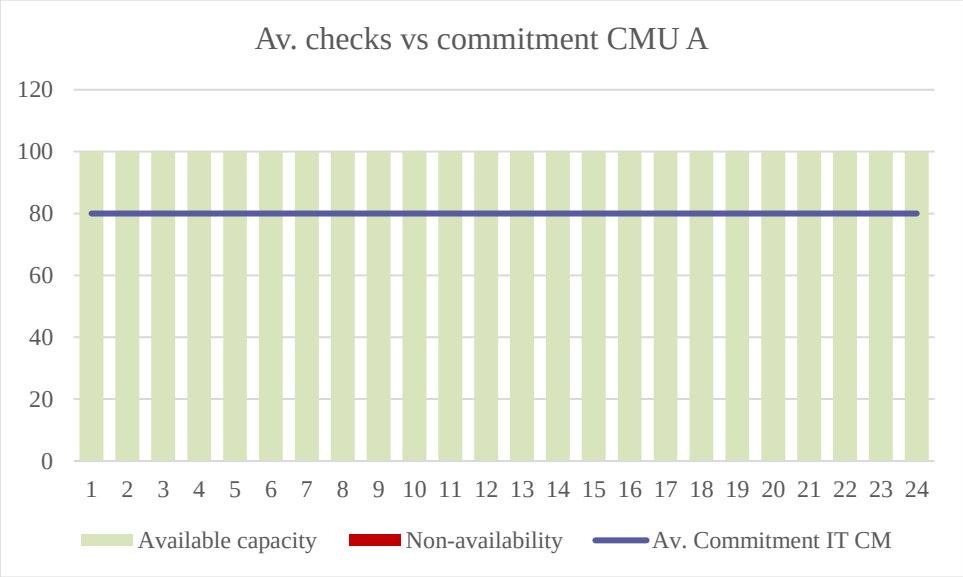


Figure 9: non-availability volumes CMU A (case 1)

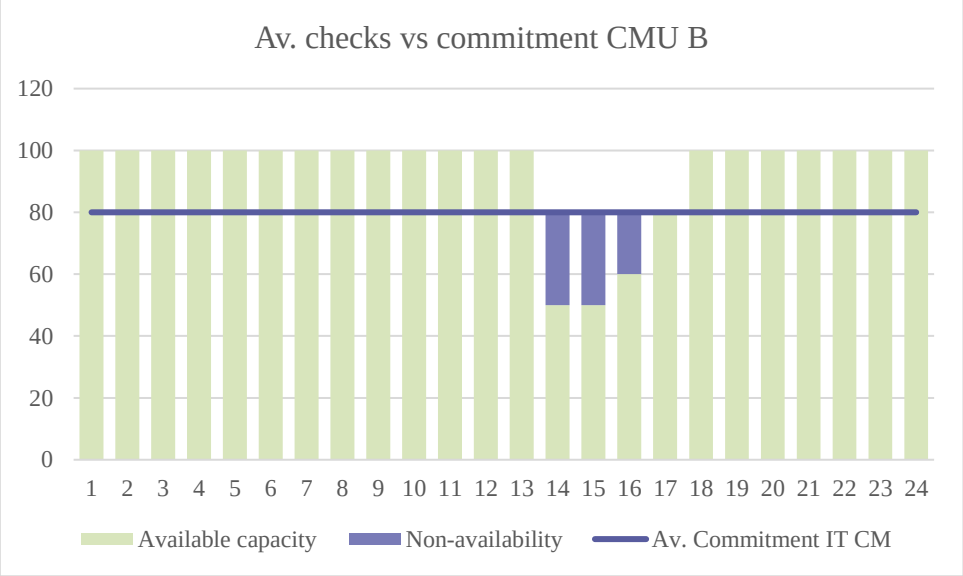


Figure 10: non-availability volumes CMU B (case 1)

CASE 2: day 2 belonging to delivery period of both IT and FR CM with PP2 hours

1) Availability checks:

The Italian TSO performs availability checks on CMU A and CMU B for both IT and FR CM since day 2 belongs to both delivery periods. Checks for the French CM are held only during PP2 hours (from hour 10 until 20 in this example). The availability checks methodology applied for the French CM will be in line to the one adopted for French domestic capacity as much as possible and will distinguish

between delivered energy, capacity offered and not activated in the AS and balancing market, and capacity not offered in the AS and balancing market. Results are shown in Figure 11 and Figure 12. Results of checks for the IT CM are the same shown in Figure 7 and Figure 8.

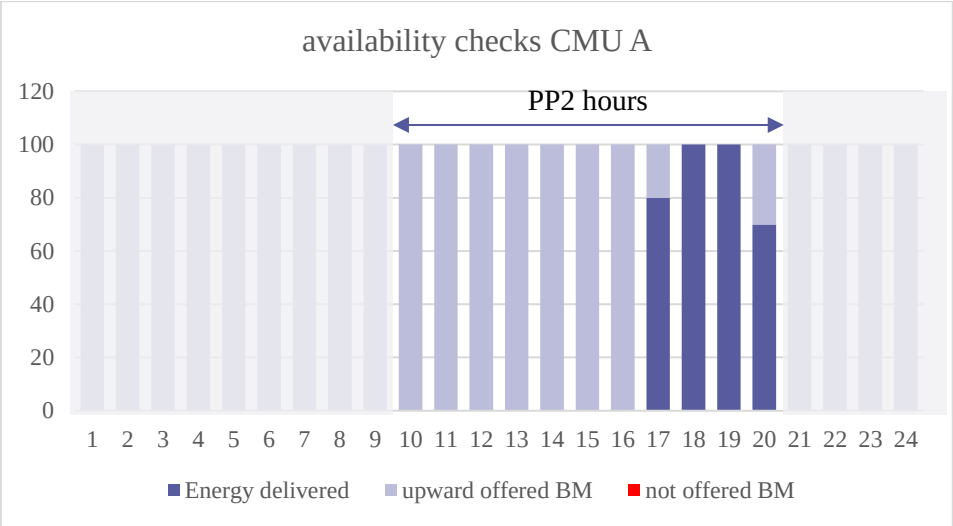


Figure 11: availability check CMU A FR CM (case 2)

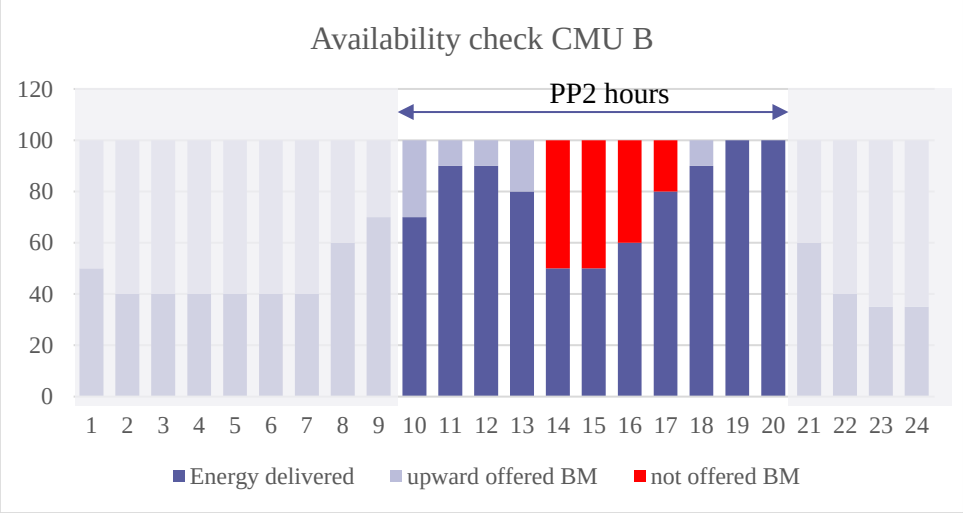


Figure 12: availability check CMU B FR CM (case 2)

2) Determining Non-Availability volumes

CMU A has an availability commitment equal to 80 MW for the IT CM and 40 MW for the FR CM, while CMU B has a commitment of 80 MW for the IT CM and 20 MW for the FR CM. The pro-rata rule is applied since day 1 belongs to the delivery period of both CMs and thus the commitment for the French CM is also considered.

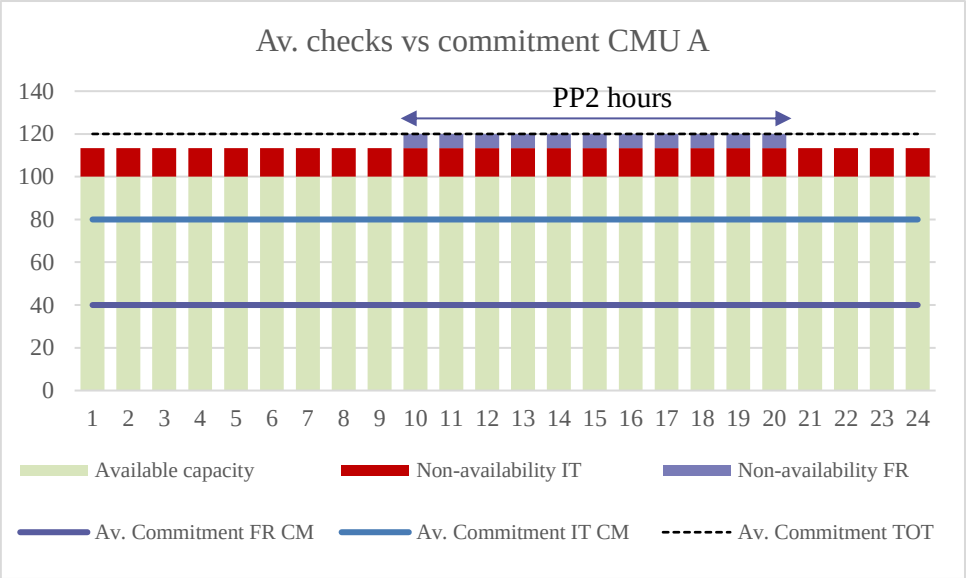


Figure 13: non-availability volumes CMU A (case 2)

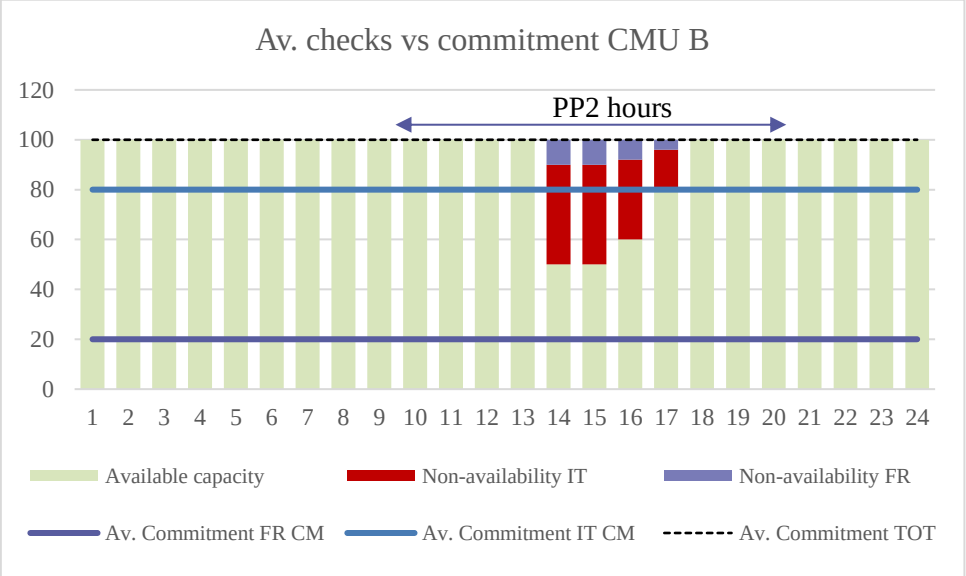


Figure 14: non-availability volumes CMU B (case 2)

CMU A faces non-availability volumes in all hours since the overall commitment undertaken is larger than its maximum capacity during overlapping delivery periods. Non-availability volumes for the French CM are only considered during PP2 hours (Reference Period) while the commitment is considered valid in all hours (Delivery Period). CMU B instead has proportionate commitments but faces a non-availability volume in hours 14-17, which is attributed to both CMs through the pro-rata rule. Penalties, if any, are then applied according to national CM rules.

Yearly results:

Assuming that the proposed methodology is applied for the whole year for CMU A, the impact of multiple commitments on non-availability are evaluated (no forced outage considered). Multiple

commitments impact on non-availability volumes only during winter months from November to March, when Delivery periods overlap, and the CMU has a total commitment exceeding its available capacity (see Figure 15). PP2 hours distribution was assumed in line with 2017 historical data.

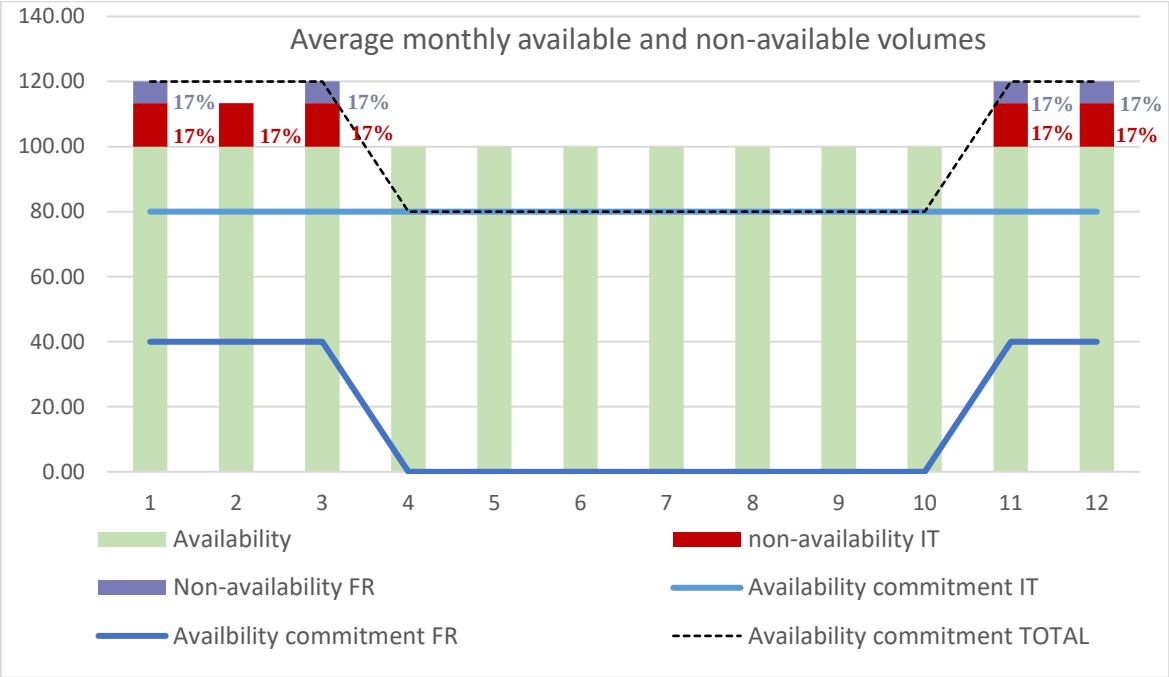


Figure 15: yearly results of availability checks for CMU A

In conclusion, the table below summarizes the yearly average availability of the CMU for both capacity contracts. The impact of overlapping delivery periods is stronger for the French mechanism since during its whole Reference period the pro-rata coefficient is applied.

Italy	France
93%	**83%**

7.5. Application of Non-availability payments

The section refers to article 23 of the draft proposal.

- Article 23 aims at establishing **common principles and guidelines for application of non-availability payments**, provided that specific rules and methodologies are defined in the national CM frameworks (approved by the European Commission). In case of **planned unavailability** of the CMU (e.g. maintenance), alternative penalties or exemptions may apply. The same applies to unavailability due to any measures taken by system operators or any other competent authority that prevent the market participation of the CMU (e.g. limitation to market activity for grid upgrade works, technical tests asked by the system operator, fuel rationing imposed by the authorities, etc…);

- **Stop loss limits** might be applied to non-availability payments;
- **Escalation of penalties** can be applied in case of persistent unavailability of contracted capacity;
- **Contract termination fees**, if any, should at least equal the payment due for Non-availability payment to prevent arbitration and should include the return of undue remuneration.

7.6. Reporting to the involved NRAs

The section refers to article 24 of the draft proposal.

For the sake of transparency, it is foreseen that after every delivery period, the CM operator shares with the relevant NRA, upon its request, a report with data on non-availability payments imposed on foreign contracted CMUs.

8. Terms of the operation of the registry

8.1. Subject and scope

The IEM Regulation requires TSO where the foreign capacity is located to establish whether interested capacity providers can provide the technical performance as required by a capacity mechanism in another Member States (i.e. technical eligibility). Eligible capacity providers should be registered in a common European registry. The terms for the operation of the registry detail the scope of the data it contains and specify the governance and transparency rules to provide reports on processes relevant for cross border participation in capacity mechanisms.

8.2. General Provisions

This section refers to article 25 of the draft proposal.

Supported processes

ENTSO-E needs to set up a functional registry by the 5th of July 2021, as foreseen in the Article 26(15) of the IEM Regulation. Therefore, these Terms of Operation focus on setting out the coordination processes as required by the IEM Regulation. This primarily concerns the registration of capacity providers as eligible, the required coordination between the involved stakeholders for this purpose, and the notification of transfers of allocated Entry Capacity between capacity providers.

Given the actual differences between applied and planned capacity mechanisms in various Member States as regards processes and systems, the registry should not replace procedures nor tools that are specific to such mechanisms and dependent on specific design choices (approved by the European Comission), **but should rather reinforce and facilitate the interaction and processes**. This among other things includes the key milestones of the functioning of a capacity market, such as auctions for capacity obligations and related secondary markets mechanisms.

The registry should serve cooperation between TSOs and CM Operators in order to facilitate cross border participation of foreign capacity providers. While, in a first stage it is the goal of ENTSO-E that the registry is set up properly with all the basic functions required by the IEM Regulation, at a later stage and based on experience, additional facilitating functions can be considered. The design assumptions of the ENTSO-E Registry include the interactions with existing national databases and registries.

The terms and conditions for the use of the registry will be prepared by the ENTSO-E. Those terms & conditions will among others include the data access, data privacy and data submission process.

Registry users

The registry serves to facilitate cooperation between the main stakeholders involved in the organisation of capacity mechanisms to facilitate cross-border participation of capacity providers. The IEM Regulation places registration obligations with TSOs where the capacity is located. To undertake such registration, TSOs should have access to the registry. In addition, TSOs can use the registry to notify the TSOs in the Member State applying the capacity mechanism of all information required with the eligibility checking process, as required by Article 26(10)(c) of the IEM Regulation.

The division of responsibilities for the allocation of cross-border contracts, including any subsequent transfers, is a Member State competence. Such tasks can be attributed to a TSO, but also to another party tasked with capacity mechanism responsibilities. This terms of operations refers to such party as a CM operator. In order to safeguard that notifications of transfers of cross-border contracts are based on valid transactions, the CM Operator also requires access to the registry.

While ENTSO-E has considered whether capacity providers require editor role in the registry, it was deemed less efficient to ensure this, at least at this first stage. Indeed, submission of data and subsequent changes would need to be verified in any case by the TSO where the capacity is located and any capacity in a Member State is already likely to interact with the TSO. Adding an additional counterparty to the process, only makes the process heavier for the capacity provider which is not in the interest of good market facilitation. The registered capacity providers have read only role.

Therefore and given its role in the process , it is up to the TSO where the capacity is located to define the processes to obtain correct data from the capacity providers located in its Member State (obviously building on any national processes already available) and adhere to its obligation to register their eligibility in the registry. The TSO where the capacity is located should establish rules of registration, data edition, annual verification and all related activities to enable effective cross-border participation in capacity mechanisms applied in other Member States. The NRA of MS where the capacity is located will be able to review such rules and conduct in accordance with national procedures. If the capacity provider questions action taken by TSO (e.g. wrong data submission, missing data, delayed operations) he should submit his complain to the NRA of MS where the capacity is located to the extent no concrete procedures for such matter are foreseen.

The relevant TSOs, CM Operators and ENTSO-E having access to the registry, NRAs and ACER can address these parties to request information concerning registration processes from TSOs with respect to their related duties. As explained under section 7.4 below, ENTSO-E does foresee to provide reports to ACER on the basis of the information included in the registry. The NRAs could address information requests to their TSO(s).

Information included in the registry

The methodology requires TSOs to submit information and data submitted by capacity providers for the purpose of the registration process to the registry. In some cases, data submitted to the registry will not

be sufficient for the capacity providers to participate in all CM processes. Thus, additional data might have to be submitted by the capacity provider in accordance with the procedures of the relevant capacity mechanism (see more in section 9.1).

The registry does not provide functionality to submit additional, specific data, but focusses on the common denominator in such data.

The Registry will be designed, operated and maintained by the ENTSO-E. Data security will be ensured using the highest quality product available on the market.

8.3. Scope of data

This section refers to Article 26 of the draft proposal.

Registration data

The data of the registered capacity providers that will be stored in the registry shall support process of the direct cross-border capacity participation in CM. ENTSO-E decided to limit the data to common information asked in most capacity mechanisms (based on the assumptions in section 8.3).

The registry will be a source of verified data that may allow to simplify initial verification of the capacity provider – the CM Operator has limited information about the foreign capacity providers (e.g. due to limited access to data, language). In this regard and in line with the provisions foreseen at Article 26 paragraph 10 of the IEM Regulation, the registration performed by the TSO where the capacity is located shall facilitate the process.

Participation status

The participation of capacity providers in multiple CMs is not forbidden, as explicitly mentioned in the IEM Regulation, Article 26.5. This has as a consequence that information about current capacity provider's participation and its status in CMs shall be known to the CM Operator where the capacity provider is willing to participate. This is required as it impacts the availability settlement for such capacity provider. Being active and having commitments in two (or more) CMs, requires each CM to ensure there is no double-counting, cf. section 6 related to the common rules for determining when a non-availability payment is due, where this is further addressed.

Allocated entry capacity

ENTSO-E has opted to include up-to-date information on allocated entry capacity per capacity provider in the registry to ensure compliance with the requirement of article 26(14) of the IEM Regulation that transfers of allocated entry capacity are notified to the registry. The obligation to update this information is put upon the CM Operator, as ENTSO-E expects this party to have a central role in the approval of any transfer between capacity providers. Up-to-date information on allocated entry capacity allows TSOs and CM operators to be informed of participation of a capacity provider in multiple capacity

mechanisms and ensure a proper availability monitoring. It ensures that the Maximum Entry Capacity is respected at all times.

8.4. Data access and reporting

This section refers to Article 27 of the draft proposal.

Read only data

The registered capacity providers can view data of their registered CMU's.

Editing data

All relevant registry users can view and edit the data that has been submitted to the registry. Capacity providers can request its TSO to edit their data. The TSO where the capacity is located may edit data when new information becomes relevant, The data related to a capacity provider stored in the registry can only be changed by the TSO where the capacity is located, in accordance with the rules and timelines referred to in Article 28(3) of the draft proposal. This solution allows to maintain data consistency and correctness. Moreover, it helps to limit the number of the registry users with edit rights and increases security of the data. It is the obligation of the capacity provider to inform his TSO on any changes in the data that are to be changed in the registry (e.g. CO_2 emission index). The methodology foresees an annual data verification process. The goal of this verification is to be sure that Registry stores most up to date data of the CMU, especially the CO_2 index that may determine the final eligibility status in the CM. The annual data verification shall be performed if there was no change of CMU's data from the beginning of the calendar year.

Data reports

The relevant TSOs, CM Operators and ENTSO-E having access to the registry, NRAs and ACER can address these parties to request information concerning registration processes from TSOs with respect to their related duties. ENTSO-E does foresee to provide reports ACER on the basis of the information included in the registry. NRAs could address information requests to their TSO.

Announcement of system stress

The registry will allow communication between the registry users. This functionality may be used to communicate to registry users e.g. the upcoming deadlines of the CMs.

Moreover, the CM Operator may send information to the capacity providers. It can be used, inter alia, to announce system stress events. As the capacity provider is not a registry user, this functionality of the registry shall not be treated as a primary source but as an auxiliary one.

ENTSO-E did not foresee to use the communication functionality of the registry to exchange the data related to the additional (beyond what is considered in the registration in the registry) eligibility check, availability checks and remuneration and non-availability payment.

9. Common rules for identifying capacity eligible to participate in the capacity mechanism

The IEM Regulation requires TSO where the foreign capacity is located to establish whether interested capacity providers can provide the technical performance (i.e. technical eligibility) as required by a capacity mechanism in another Member State. This part of the proposal contains common rules for TSOs to assess whether capacity providers meet a set of commonly defined requirements, further referred to as eligibility checks.

9.1. General provisions

This section refers to article 28 of the draft proposal.

The processes held with use of the registry's functionalities shall not replace any processes held by the CM Operator, unless the CM Operator decides otherwise. The fact that all capacity mechanisms are tailored for each individual situation of the Member State's system, results in numerous processes organized within those mechanisms, which are rarely alike between different Member States. Therefore, finding a common ground and establishing the spectrum of data required to be provided by the capacity providers to the registry seems to be implausible.

The list of data required for the eligibility check contains only the rudimental, universal information that shall be required by all CM Operators regardless of the CM's design. ENTSO-E has conducted a survey among all Member States that currently apply a CM or are advanced in the process of design of a CM. The high-level results of the review of the application of different eligibility criteria to existing and new/refurbished capacity providers are set in the table below. We note that, since some of the CMs studied (specifically Belgium and Greece) have yet to be implemented, some of the results need to be interpreted as provisional positions.

Eligibility requirements – Existing generation	GB	EI	FR	IT	PL	BE	GR
Corporate credentials	✓	✓	✓	✓	✓	✓	
Facility address	✓	✓	✓	✓	✓	✓	
Scale (MWs) and aggregation	✓	✓	✓	✓	✓	✓	✓
Grid connection	✓	✓	✓	✓	✓	✓	✓
Adequacy of metering equipment	✓	✓	✗	✓	✓	✓	✓
State aids received	✗	✗	✗	✓	✓	✓	✓
Availability / other aspects of technical performance	✓	✓	✗	✓	✓	✓	
Financial standing / capacity?	✓	✓	✗	✓	✗	✓	✗ ✓
CO2 emissions index	✗	✗	✗	✓	✓	✓	✓
Other requirements for existing plant?	✓	✓	✓	✗	✓	✗	✗

Eligibility requirements – New generation	GB	EI	FR	IT	PL	BE	GR
Corporate credentials	✓	✓	✓	✓	✓	✓	✓
Facility address	✓	✓	✓	✓	✓	✓	✓
Intention to build (e.g. FID)	✓	✓	✗	✓	✓	✗	
Grid connection offer	✓	✓	✗	✗	✓	✓	✓
Construction plan/dates	✓	✓	✗	✓	✓	✓	✓
Existing authorisations/ permits of proof of application	✓	✓	✗	✓	✓	✓	✓
Investment cost	✓	✓	✗	✓	✓	✓	✓
Financial commitment to proceed	✓	✓	✓	✓	✓	✓	✓
CO2 emissions index	✗	✗	✓	✓	✓	✓	
Other requirements for new or refurbishing plants	✓	✓	✓	✗	✓	✗	✓

Table 2: Non-comprehensive overview on the eligibility requirements in some CM [Source: Frontier Economics]

Table above shows high-level summary of the eligibility criteria in different MS CMs. The deep dive into designs of specific CMs shows complex designs and complies eligibility checks e.g., some of which were introduced to meet the DG COMP requirements in its approval of the CM as allowed State Aid:

- design of processes in the Polish CM foresees two stages of prequalification. The first one, so called general certification, is mandatory for all generation units with a capacity equal to or greater than 2 MW and all other types of units wishing to participate in further CM processes. The second stage, called main certification, is obligatory only for the CM participants. On that stage, the participants are required to state much more specific data that are not mandatory in case of any other country. For instance, the participants of Polish capacity market must state the sulphur oxides, nitrogen oxides and ashes emission, schedule of work for five upcoming years, financial costs of operations, different types of efficiencies (net design, net total, net at minimum load) etc… The aggregation of the units is allowed up to 50MWe, while single unit in this aggregate cannot be larger than 10MW.
- design of processes in the French CM foresees two stages for eligibility of cross-border capacity provider. Indeed, a light pre-qualification process is foreseen before the access ticket auction while the full eligibility is established only for capacity providers which were awarded access tickets so as to limit the administrative cost and burden for capacity providers. The aggregation scale ranges from 1 MW to 100 MW for domestic capacities, with an exemption for hydropower turbines that can exceed this ceiling if all sites are located on the same stream (notion of interdependency).

Out of all mentioned above (the ENTSOE survey and more detailed look) it is possible to draw a number of conclusions:

- Eligibility requirements vary according to whether it is existing or new / refurbishing capacity that is being considered;
- While there are some differences between jurisdictions, there is a reasonable degree of consistency as to the eligibility checks which are performed on capacity providers prior to CM participation. There would appear to be a "core" set of checks that are relatively common in today's CMs;
- Aggregation is typically required for smaller capacities – but in many cases this does not reduce the eligibility checking burden as individual sites are still subject to some eligibility checks;
- Eligibility checks on DSR may be undertaken under a longer period than for other capacity.

Based on this analysis ENTSO-E prepared list of common data needed for registration, that is further explained in the 9.3.

Rules and timelines

Thus, the registration in the registry shall be a process supporting the regular processes in a given CM, not one replacing them. The TSO where the capacity is located sets out the rules and timeline of the eligibility checking process (see also step 1 to 4 in figure 3). ENTSO-E will not define the guidelines nor common rules of such process. This decision is caused by the fact that majority of Member States have their own processes, solutions and tools for the eligibility checks and ENTSO-E is not willing to create new, other processes that may duplicate them.

Registration and further national requirements

In some cases, data submitted to the registry will not be sufficient for the capacity providers to participate in all CM processes. Additional data will have to be submitted by the capacity provider to the CM operator in accordance with the procedures of the relevant capacity mechanism. This could include formal and/or legal documents e.g. data related to financial performance, power of attorney, information related to declarations on not cumulating different support mechanisms, performance test results, etc. This information can vary for the different capacity mechanisms, but it is to be guaranteed that on foreign capacity providers as similar as possible requirements apply as on domestic capacity providers.

The correct provision of data to the registry, and its subsequent validation, will not entitle a capacity provider with an unconditional right for cross-border participation in a capacity, unless the CM operator decides otherwise.

The aggregated CMU's multiple commitments

As the level of response of a CMU participating as a part of an aggregation is unknown, the participation of a CMU have has to be unambiguous in order to being able to apply the *Common Rules for determining when a non-availability payment is due*, which aims at avoiding duplicity of commitments in different CMs for the same delivery period. In case of commitments in multiple CMs, the capacity provider offering a CMU aggregated of multiple resources shall not change its composition until the end of the last delivery period for which it has the obligations. Same applies when the Capacity provider would like to offer his CMU (as single resource), that has a capacity obligation in any CM, then it shall not participate in any other CM for the same delivery period as a part of any aggregated CMU.

9.2. Eligibility: registration process

This section refers to article 29 of the draft proposal.

The registration of the capacity provider to the registry starts on the request of the capacity provider (**step 1** in the graph below). The capacity provider shall submit data to the TSO where the capacity is located (**step 2**) and these data shall be verified by this TSO (**step 3**). Foreign TSO notifies the capacity provider about the verification result (**step 4**). In case of negative verification result, e.g. because of missing documents, the capacity provider may supplement them.

After collection of all required data and confirmation of its correctness, the Foreign TSO starts the registration by submitting it to the registry (**step 5**). The successful registration is notified to the CM Operator (**step 6**). At this stage negative registration may be caused e.g. by the wrong data format or missing data. There will be no data validity verification performed by ENTSO-E.

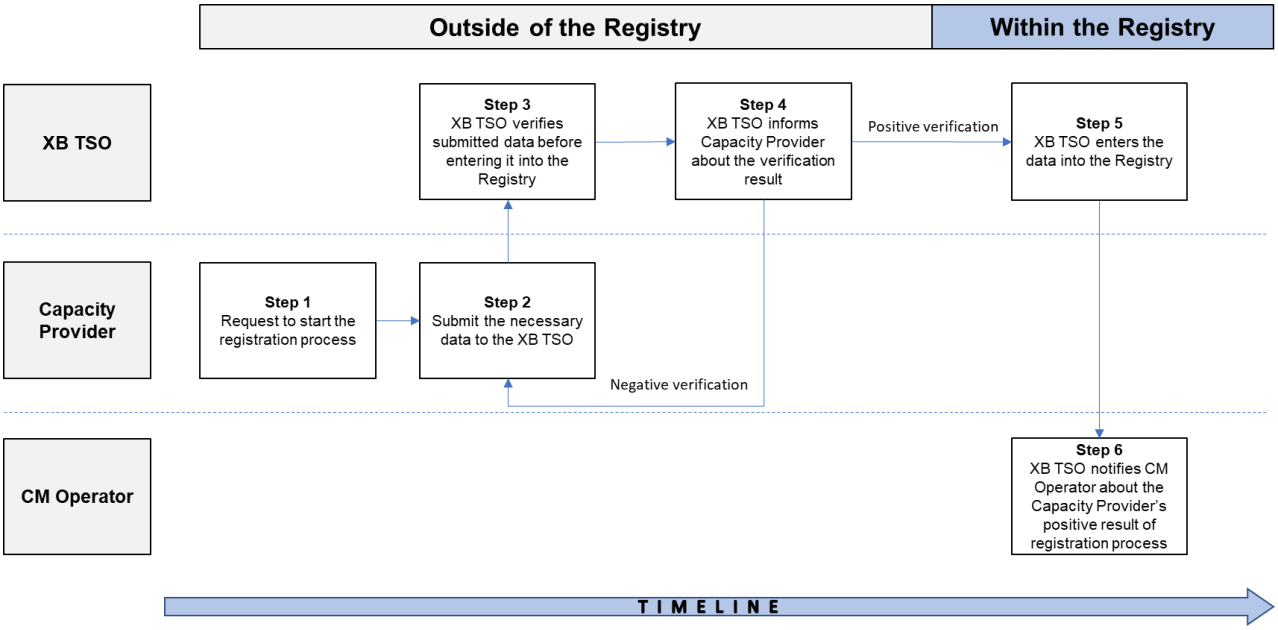


Figure 3: Graph on the registration of capacity provider in the Registry

After **step 6** the capacity provider is registered in the registry.

In case of a need of data change or/and update, the process should be carried out again completely from step 1 to 6.

9.3. Eligibility: eligibility check

This section refers to Article 30 of the draft proposal.

Required data

In order to get the confirmation of the status of the technical eligibility, the requested data must have been completed within the predefined times, confirmed by the TSO, where the CMO is located and submitted to the registry. Based on the analysis (described in 8.1) ENTSO-E prepared list of common data needed for registration: corporate credentials – proof of administrative details of the legal entity registering the resource;

- Energy Identification Code - this will facilitate the identification of units and possible connections with existing databases;
- facility address - proof of address and location of the resource;
- capacity, storage capacity and aggregation – general technical (capacity and storage possibility) information and if unit is aggregated;
- technology type and fuel - – general technical information e.g. needed to apply the derating factor;
- metering points - proof of grid connection and of technical sufficiency of site metering equipment;
- network operator - proof of grid connection and location;
- CO2 emission limits information as referred to the IEM Regulation Article 22(4) - proof of level of CO_2 emissions related to the resource calculated as referred to IEM Regulation.

The role of the capacity provider is to submit to his TSO the most up to date data.

Aggregation

Aggregation must be allowed under the conditions which the CM Operator had defined (as close as possible like for domestic capacity). As the data requested should be submitted by each unit, the TSO must verify the information coming from each unit separately.

Depending on its location, the units which would want to participate in an aggregated or separately form, may be connected on DSO level. In order to carry out information exchange between TSO and DSO, the solutions to be considered must be developed at national level.

All the units belonging to an aggregated unit must have fulfilled with the requested data, whether the units are connected to the transmission grid or to a distribution grid. Under the circumstances that one unit does not meet the conditions, the whole aggregated unit will not obtain the eligibility.

Annual verification

To maintain high data quality the registry shall be verified at least once a year. Then, all capacity mechanism's qualification processes, will be based on the CMU data updated at the correct time.

Negative result of registration process

The non-achievement, or loss of eligibility, will be the consequence of a negative result in the registry process, such as lack of data, out of date provision or update, do not meet the requirements, etc. The failure on eligibility must not affect the ongoing commitments. If an update of the capacity provider data impacts the result of the registration, the TSO where the capacity is located shall inform the CM operator.

Positive result of registration process

On the other hand, a positive result to the registration process do not grant full eligibility to the CM to which a capacity provider registered. Indeed, some further administrative exchanges can take place between the CM operator and the capacity provider so as to grant full eligibility thus verifying that the capacity provider meet the market rules requirements (e.g. environmental forms provided by third party, bank guarantee, information necessary to conclude the signature of the contract). These exchanges will also help to set a volume (in MW) of capacity up to which the capacity provider is eligible (e.g. application of possible derating factors per technology based on national rules). This can for instance also include a procedure to check the amount of energy that the capacity provider can actually deliver as a pre-condition to sign the CM contract (e.g. testing and auditing approach), as may be required for domestic capacity as well. In practice, all these details will be precised in the bilateral agreement foreseen between the CM Operator and the TSO located where the capacity provider is connected.