Explanatory note for the Public consultation on the scenarios, sensitivities and data for the CRM parameter calculation for the Y-4 Auction with Delivery Period 2026-2027

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Introduction

In order to support the public authorities in meeting their responsibility to ensure the security of supply for Belgium, Elia is provided with a number of tasks. In the framework of the Capacity Remuneration Mechanism (‘CRM’) these tasks are foreseen in the Electricity law (as amended from time to time) and in the proposed secondary legislation following this law. Recent instructions were in addition given by the authorities to prepare the first auction in this framework (see chapter 1).
As part of the intensive stakeholder involvement process initiated with the setting-up of a CRM, market parties are invited to be part of a public consultation on the data, scenario and sensitivities for the second CRM report on volume and parameter for Delivery Period 2026-27.
This explanatory document is provided to give stakeholders more context and guidance on the submitted consultation document, which is a vast Excel-file with above mentioned data. It foresees also some additional qualitative information, which is not quantified in the Excel. Should there be any remark on this document, this can obviously be provided as part of the consultation contribution. The slide deck presented during the task force of the 6th May, can also be considered as reference for the public consultation, taking into account that further amendments were made following CREG’s contribution on the matter.

1 Legal and regulatory framework

The federal electricity law of 29 April 1999 foresees in its article 7undecies §2 that the Transmission System Operator (Elia) elaborates on a yearly basis and after public consultation, the reports providing the calculation for the necessary volume and a proposal of auction parameters. The procedure is further defined in a Royal Decree laying down the parameters with which the volume of capacity to be provided is determined, including their calculation methods, and the other parameters necessary for the organization of auctions, as well as the method for and the conditions for granting an individual exemption from the application of the intermediate price ceiling(s) in the context of the capacity compensation mechanism (the Royal Decree) setting out the method for calculating the required volume of capacity and the parameters necessary for the organization of auctions under the capacity remuneration mechanism.

A first collaboration meeting was organized with FPS Economy, in presence of CREG on 23 February 2021.
A second collaboration meeting was organized with FPS Economy, in presence of CREG on 19 April 2021.
A task force was organized to provide market parties preliminary information, subject to further comments from CREG, on 06 May 2021.
On 07 May 2021, CREG sent its comments of CREG on Elia's proposal.
On 18 May 2021, Elia replied to CREG's comments.

2 Scenario and sensitivities

This chapter describes the data and assumptions related to the scenarios and sensitivities that have to be submitted to public consultation according to article 5 of the Royal Decree. The overall process should lead to the Minister to select a reference scenario that will be used as basis for the CRM calibration 2026-27, as mentioned in article 5, §2.
This chapter contains two main parts: the main data and assumptions regarding the scenario (Article 5, §2, 1°) and the sensitivities that could be integrated in the reference scenario (Article 5, §2, 2°).

Royal Decree Reference	
Art. 5. § 2. Au moins les sujets suivants sont soumis à une consultation publique : 1° la mise à jour des données et des hypothèses du scénario ou des scénarios, ainsi que des sensibilités, telles que visées à l'article 3, § 3 ; 2° la pertinence des sensibilités visées à l'article 3, §4, en ce compris les données et hypothèses à partir desquelles elles ont été établies ; (…)	**Art. 5.** § 2. De volgende onderwerpen worden ten minste aan openbaar onderzoek onderworpen: 1° de actualisatie van de gegevens en hypothesen van het scenario of de scenario's en de gevoeligheden zoals bedoeld in artikel 3, § 3; 2° de relevantie van de gevoeligheden bedoeld in artikel 3, § 4, inclusief de gegevens en hypothesen waaruit ze zijn opgebouwd; (…)

2.1 Data and assumptions for the scenario

This section presents all the data and assumptions included in the scenario. The data for all countries except Belgium is based on the Mid-term Adequacy Forecast 2020[1] from ENTSO-E which is the most recent European adequacy assessment, updated based on the most recent national/regional adequacy studies and will take into account the latest European methodologies approved in 2020. Belgium's data are all in line with the data

[1] https://www.entsoe.eu/outlooks/midterm/

consulted upon for the Adequacy and Flexibility study 2022-32 that will be published in June 2021. The sources of the updates are mentioned in each sub-section. The associated data are presented in the Excel file provided, 1° Data and assumptions for the scenario.

Royal Decree Reference	
Art. 3. § 2. A partir de l'évaluation européenne, visée à l'article 23 du Règlement (UE) 2019/943, et / ou de l'évaluation nationale visée à l'article 24 du Règlement (UE) 2019/943, les plus récemment disponibles au moment de la sélection, un ou plusieurs scénarios et sensibilités sont sélectionnés. Cette sélection comprend au moins le scénario de référence central européen visé à l'article 23, § 1er, 5, b) du Règlement (UE) 2019/943. Tant que lesdites évaluations ne sont pas encore disponibles, une sélection est effectuée à partir d'autres études disponibles. § 3. Les données et hypothèses à partir desquelles lesdits scénarios et sensibilités ont été établis, sont mises à jour sur la base des informations pertinentes les plus récentes.	**Art. 3.** § 2. Uit de op het ogenblik van de selectie meest recent beschikbare Europese beoordeling bedoeld in artikel 23 van Verordening (EU) 2019/943 en / of de nationale beoordeling bedoeld in artikel 24 van Verordening (EU) 2019/943, worden één of meerdere scenario's en gevoeligheden geselecteerd. Deze selectie omvat minstens het Europese centrale referentiescenario bedoeld in artikel 23, § 1, 5, b) van Verordening (EU) 2019/943. Tot zolang deze beoordelingen nog niet beschikbaar zijn, wordt een selectie gemaakt uit andere beschikbare studies § 3. De gegevens en hypothesen waaruit deze scenario's en gevoeligheden zijn opgebouwd worden geactualiseerd op basis van de meest recente relevante informatie.

2.1.1 Generation & Storage

First, the Belgian generation and storage capacities are presented. This sub-section also includes the forced outage rate based on historical data. The data is in line with the data consulted upon in the Adequacy and Flexibility study (2021), in line with article 3, §2 of the Royal Decree, and have been updated according to the most recent available information sources. Figure 1Table 1 presents graphically the main update implemented in the CRM calibration 26-27 compared to the previous calibration targeting the delivery year 25-26.

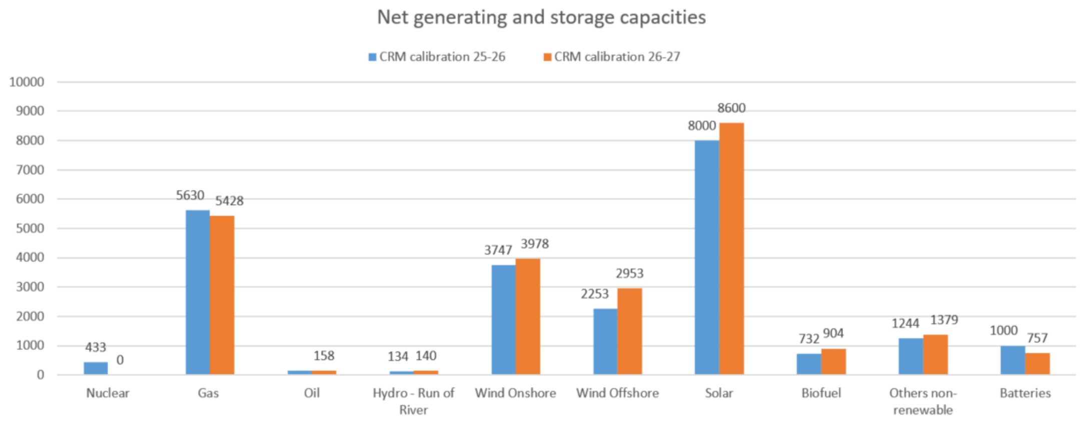

Figure 1: Installed capacity available to the market on Belgian market zone

2.1.1.1 Generation & Storage summary

A summary of the generation and storage installed capacity for the 2026-2027 delivery period is presented in the Excel file (section 1.1). Table 1 presents the installed capacities for each technology and already includes market response data presented in §2.1.2.2.

Regarding individually modelled non-renewable thermal generation, the numbers are in line with the data consulted upon for the Adequacy and Flexibility study (2021).

Note that new capacity will be added to the reference scenario based on the pre-selected capacity types to make the reference scenario selected by the Minister adequate for Belgium (see section 3.1), mentioned in article 5 §1.

Net Capacities	CRM calibration 25-26	CRM calibration 26-27	Sources and explanations
Nuclear	433	0	Doel 2 until 1st of December 2025
Gas	5630	5428	Capacity updates + Borealis Kallo 32MW – Vilvoorde GT
Oil	158	158	Assuming all existing TJ remain

Hydro - Run of River	134	140	Based on final NECP (WAM scenario)
Wind Onshore	3747	3978	Based on final NECP (WAM scenario)
Wind Offshore	2253	2953	Based on final NECP (WAM scenario)
Solar	8000	8600	Based on final NECP (WAM scenario)
Biofuel	732	904	Based on final NECP (WAM scenario) (sum of CIPU and non CIPU of waste and biomass categories)
Batteries	1000	757	See 2.1.1.3

Table 1: Update on generation & storage data

2.1.1.2 Individually modelled thermal generation

Section 1.2 of the Excel file details all individually modelled thermal generation facilities available for the 2026-2027 delivery period. The Excel document describes the name of the unit, the owner of the unit, its technology, its derating factor category its used fuel and the associated net generation capacity.

2.1.1.3 Storage

The storage installed capacity and reservoir volume for 2026-2027 delivery period is presented in the Excel (section 1.3).

Pumped-storage

The turbining capacity of Coo has been adjusted and adapted on ENGIE's website [2] bringing the overall pumped-storage installed capacity to 1224 MW and a storage capacity of 5300 MWh available for economical dispatch.

[2] https://corporate.engie.be/fr/press/release/augmentation-de-la-capacite-de-stockage-et-de-la-puissance-de-la-centrale-de-coo

Batteries

Large scale storage estimations are based on projects that are at least under study and known by Elia for short-term (up to 2023). Large scale storage are estimated to have a 2 hours storage capacity.

Small scale storage estimations are based on the assumption that each year 0.5% of the PV installations add a battery capacity of the size of the PV installation (with 3 hours of storage).

V2G are electric vehicles that allow bi-directional (dis)charging when connected to a bi-directional charger.

In order to estimate the amount of V2G capacity (the battery capacity that would be connected permanently to the grid and that would allow bi-directional charging), we assumed that:

- a certain amount of new EV registrations are capable of bi-directional (dis)charge and that are connected permanently to a bi-directional charger. We assume this to be 1% of new EV registrations in 2021 to 10% in 2030.
- In order to calculate the amount of storage (MWh) and capacity (kW), a charger of 7kW and 4 hours storage was assumed.

From this volume and capacity of storage, it was assumed that in 2021, 1% of the V2G amount is reacting to electricity prices. The other 99% is considered as 'out-of-market' (is therefore taken into account in the consumption profile following the ERAA methodology). The percentage of 'in-the-market' is assumed to evolve up to 50% in 2030.

The evolution of total capacity for other storage facilities is assumed to reach the 2030 target from Energy Pact.

2.1.1.4 Renewable and non-CIPU

Section 1.4 of the Excel file details the profiled thermal production as well as the renewable energy. The profiled thermal production takes into account the generation capacities for each category ('waste', 'biomass' and 'gas & other'). The figures are also based on the NECP as already performed in the Adequacy and Flexibility study (2021).

Biofuel

Both CIPU and non-CIPU capacity are presented together. As opposed to the previous study, no growth rate has been applied on the non-CIPU biofuel as the assumption was taken not to consider Rodenhuize in the market which reflects the decrease in biomass capacity. This results in a higher level of Biofuel compared to last year's assumptions.

2.1.1.5 Forced outage rates

The forced outage rates are presented in the Excel (section 1.5) and are based on the same methodology used in other adequacy studies performed by Elia.

For generation technologies, these numbers have been calculated from the last 10 years availability data (from 2011 up to and including 2020). These data are taken from the ENTSO-E transparency platform[3] (ETP) and from Elia's internal database.

Regarding HVDC link forced outage rates, note that 6% is proposed by ENTSO-E. Regarding the HVDC FO rate, this 6% is in line with the preceding calibration volume report.

2.1.2 Consumption & Demand-side response

Next sub-section is dedicated to the data related to the load which includes demand and demand-side response parameters. The data comes from the data consulted upon for the Adequacy and Flexibility study 2022-32. Table 2 presents the main updates implemented in the CRM calibration.

Data	CRM calibration 25-26	CRM calibration 26-27	Sources
Electricity total consumption	88.9 TWh	90.2 TWh	Final NECP (WAM scenario) + economic projections from Federal Planning Bureau (June 2020)
Demand-side response shedding	1565 MW	2044 MW	-The numbers are derived from a growth rate of 7% Until 2023 based on Ecube's study then an interpolation to the Energy pact forecast for 2030 is applied -This volume includes both volume dedicated to the electricity energy market and to the ancillary services.
Demand-Side response shifting	500MWh/day	700MWh/day	based on Energy Pact

Table 2 : Update on consumption data

2.1.2.1 Electricity total consumption

The total electricity demand is forecasted using the Total Demand forecasting tool

[3] https://transparency.entsoe.eu/

developed in collaboration with Climact. The tool uses as principal source the final NECP (WAM scenario for the 2026-27 horizon) concerning the electrification indicators. The impact of macro-economic trends on the total electricity demand this aspect is taken into account by considering the latest available projections of the Federal Planning Bureau from June 2020, accounting for the COVID crisis. More recent updates by the Federal Planning Bureau exists but do not contain the needed granularity to construct consumption forecasts. In addition the more recent forecasts show slightly better GDP growth for Belgium (compared to the one from June 2020) which can be considered as a "prudent" approach.

2.1.2.2 Demand-Side Response

Section 2.2 of the Excel file presents the data associated to demand-side response in Belgium. These data are in line with the Belgian Energy Pact and with the last Ecube study used in the Strategic Reserve (2020). The number are extrapolated until 2023 with a 7% growth rate then an interpolation is applied to the 2030 value based on the Energy Pact.

Demand-side response volumes can be considered as distributed capacity that can be activated when prices are above a certain level and for a limited time duration (depending on several constraints). These include shedding and shifting of consumption, storage and even small scale generators (not taken into account as generation units in the model such as for instance emergency generators). Note that in the CRM calibration, storage capacities are nevertheless considered in a separate category.

Demand-side response shedding are subdivided in 5 categories depending on their availability (1h, 2h, 4h, 8h or no limit), as it has been done in the 10-year Adequacy and Flexibility study 2020-30 (Elia, 2019). A volume is associated for each category. The total volume of demand-side response shedding is equal to 2044 MW. It includes both volume dedicated to the energy market and to the ancillary services.

Moreover, a demand shifting category is implemented as in the previous CRM calibration, the difference with previous categories is that in this case, the electricity is consumed during another moment of the day. This amounts to 700 MWh/day and this volume is based on the Energy Pact which was already used as source in the 10-year Adequacy and Flexibility study 2022-32 (Elia, 2021).

2.1.3 Balancing services

This subsection is dedicated to the required balancing services, i.e. reserve capacity, that need to be provided to deal with unexpected variations in demand and generation. The reserve capacity applied for the Y-4 auction of 2026-2027 delivery period is presented in the Excel file (section 3).

The reserve capacity impacts the volume to be procured in each CRM auction. This estimation is required by article 11, §2, 2° of the Royal Decree. The reserve capacity is added to the average load during simulated scarcity hours. This volume includes the capacity assumed to be procured by Belgian generation and storage units and by the

Belgian demand (see §2.1.2.2), as well as the volumes of cross-border reserve capacity, in order to make sure that full reserve capacity needs can be delivered, also during scarcity periods. .

The total reserve capacity needed is defined as the sum of the FCR[4] reserve capacity and the total FRR[5] reserve capacity for the delivery period 2026-2027.

- The FCR capacity is expected to decrease to 75 MW towards 2026-27. Currently, the capacity is determined based on the share of generation and demand of Elia's LFC[6] block compared to the total generation and demand in the synchronous zone of Continental Europe. This projection is therefore conducted based on the Belgian and European generation and demand profiles resulting from the MAF2020 2025 simulations.

- The upward FRR capacity (aFRR + mFRR) is expected to increase towards 1104 MW in 2026-27 in a reference case. Currently, the capacity is determined on day-ahead basis by means of Elia's dynamic dimensioning method taking into account prediction error risks and forced outage risks. Future reserve capacity needs therefore depend on system evolutions and performance of the market. In the framework of a study on the integration study of a 2nd wave of offshore wind power[7], projections were made and published until 2028.

Based on the above-mentioned assumptions, the total reserve capacity for 2026-27 delivery period is therefore assumed to be equal to 1179 MW.

Royal Decree Reference	
Art. 11. § 2. Ces deux volumes sont déterminés en cinq étapes : (…) 2° un volume correspondant au besoin en réserves d'équilibrage est ajouté à la charge visée au 1° ;	**Art. 11.** § 2. Deze twee volumes worden in vijf stappen bepaald: (…) 2° een volume dat overeenstemt met de vereiste reserves voor het bewaren van het evenwicht in het netwerk wordt toegevoegd aan het in 1° bedoelde verbruik;

Regarding the adequacy simulations conducted with Elia's simulation model, the total

[4] FCR: Frequency Containment Reserves
[5] FRR: Frequency Restoration Reserves
[6] LFC: Load Frequency Control
[7] https://www.elia.be/en/public-consultation/20201001-public-consultation-on-integration-of-additional-offshore-capacity---mitigation-measures

reserve capacity to be accounted can be split into two categories, the reserve capacity provided by Belgian demand-side response and the other capacity. An estimation based on Elia's projections assumes a total of 430 MW of balancing services to be provided by demand-side response in 2026-27. This capacity can be deducted from the total Belgian demand-side response.

2.1.4 Cross-border market capacities

This subsection presents the flow-based domain that will be implemented in the model. This domain will be complemented with the NTC values taken from the Mid-Term Adequacy Forecast (MAF 2020) of ENTSO-E for the borders which are not included in the flow-based region. The MAF 2020 only includes an NTC model in its base case but also integrates a flow-based modelization as Proof of Concept. The CRM calibration will use an up-to-date flow-based modelization as used in the Adequacy and Flexibility study (2021). The parameters are presented in the Excel file (section 4).

2.1.4.1 The 'mid-term flow-based' modelling framework used in the CRM calibration

Belgium's central location in Europe means that the country's import and export capabilities are defined following the principles of flow-based (FB) capacity calculation and capacity allocation within market coupling, as introduced by the European guideline on Capacity Allocation & Congestion Management (CACM), hereafter "FB CACM"[8]. In FB CACM, Belgium's net position is linked to the net position of the other countries in the CORE region and to the flow-based domain defining the possibilities for exchanges of energy between those countries. Only by replicating the functioning of the electricity market, adequacy and economic indicators can accurately be calculated. The flow-based method makes it possible to properly take into account interactions between market outcomes and the transmission grid. In the market simulations performed for this study, the commercial exchange capacities are modelled in three different ways:

- **For exchanges** between two countries **outside the CORE region** and**,** fixed bilateral exchange capacities (also called NTC – Net Transfer Capacities) as described in Section 2.1.4.2 are applied.
- **For exchanges between the CORE region and bidding zones external to CORE**, fixed bilateral exchange capacities are used. A flow-based modelling (also known as 'Advanced Hybrid Coupling'- AHC is applied as from year 2025. More information can be found in Section 2.1.4.3.
- **For exchanges** inside the **CORE region,** the flow-based methodology as described in Section 2.1.4.4 is applied;

[8] https://www.entsoe.eu/network_codes/cacm/

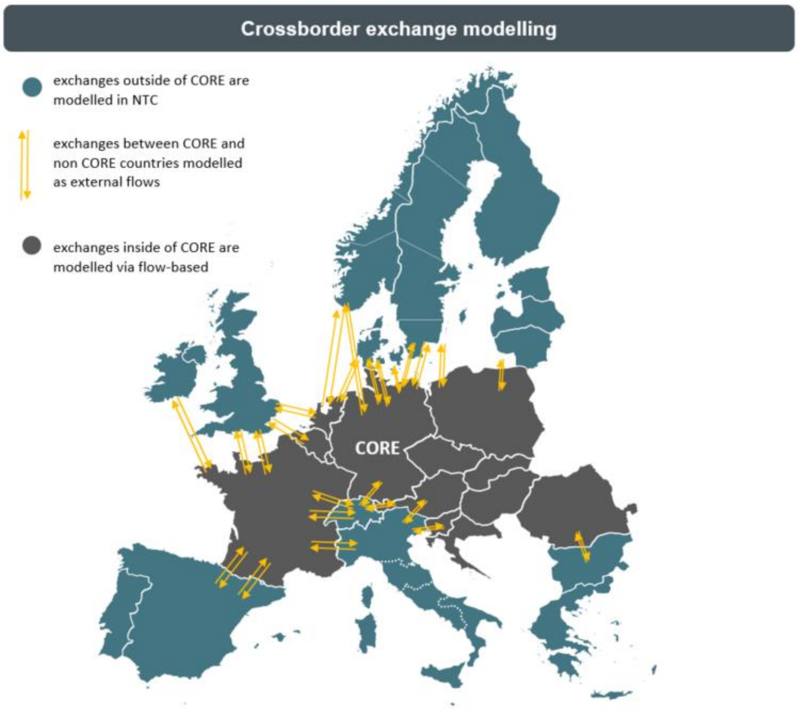

Figure 2

2.1.4.2 NTC modelling between two non-CORE countries

The commercial exchange capacities between non-CORE countries are modelled using 'Net Transfer Capacities' (NTC), corresponding to fixed maximal commercial exchange capacities between two bidding zones. The values are taken from the most recent dataset available at ENTSO-E and from bilateral and multilateral contacts with TSOs and are in line with those used for studies conducted within ENTSO-E (latest MAF study).

2.1.4.3 External flows: exchanges between CORE and non-CORE countries

External flows are flows in the CORE grid which are induced by exchanges through bidding zone borders that do not belong to the CORE region. Currently e.g. NEMOLink® is in this situation.

External flows can be linked to the flow-based region in one of two ways: standard hybrid coupling (SHC) or advanced hybrid coupling (AHC). In the former, a capacity margin is reserved on all CNEC's to accommodate for the external flows before flow-based market coupling. In the latter that will be used at the time horizon of the study, the external flow is part of the flow-based optimisation variables. On a high level, SHC grants priority access to these external flows into the meshed AC transmission grid of the CORE CCR by means of the above mentioned reserved capacity margin. In the AHC however these external power flows are threated in equal basis to the power flows created by to electricity commercial exchanges between CORE bidding zones. This results in a higher complexity of the flow-based domain calculation as any external border & link considered in AHC will add an extra dimension to the domains considered. AHC introduces a major conceptual and methodological change, which can be understood by its visual impact on the projected domains. A 2D flow-based domain projection will look larger in AHC compared its SHC counterpart, since in SHC the impact of the external exchanges as an external flow through each CNEC is reserved from the capacity margin of the CNEC (hence the RAM of the CNEC is reduced to account for this external flow) and hence not considered explicitly as part of the flow-based domain capacity.

2.1.4.4 Flow-based for CORE countries

Flow-based capacity calculation is a complex process involving many parameters. Multiple approaches are possible when building market models where market exchanges adhere to the rules depicted in a flow-based coupled market. For short-term forecasts and analyses, a framework using the flow-based domains calculated within the SPAIC process was developed[9]. However, this framework relies heavily on historical data, and becomes more complex and less accurate when multiple parameters and inputs are expected to change between the historical flow-based data preparation and the targeted time horizon. It is also not possible to take major evolutions into account (such as AHC, the extension of the capacity calculation region or the minRAM requirements) within this approach. Elia has therefore developed a flow-based framework which does not rely on historical domains, but instead aims to mimic the operational flow-based capacity calculation workflow, for which the required inputs are forecasted for the targeted time horizon. One of the key advantages of using such a method is that it enables modelling several planned evolutions such as AHC and the impact of minRAM requirements on the domains.

2.1.4.5 Flow-based parameters

Figure 3 provides an overview of the main parameters required to generate the flow-based domains on different targets years. For this study, in line with the foreseen market operations, CORE is modelled as a flow-based region. Flows outside CORE are subject to NTC constraints, and the interaction between the flow-based region and flows over external borders to countries beyond CORE are modelled using advanced hybrid coupling (AHC) as previously illustrated. For the 2026-27 delivery period the external constraint will no longer be applicable and only crossborder CNECs will be considered using the grid model from TYNDP 2020.

When creating flow-based domains for this study, the assumption is taken that no grid maintenance is planned throughout Europe in the winter period. In other words, while the impact of single contingencies is taken into account through the CNEC definition process, it is assumed that prior to a contingency, the European transmission grid is always fully available and operational. While for winter months, with a focus on the representation of scarcity events, this optimistic assumption is retained; for summer

[9] Framework of the Standard Process to Assess the Impact of significant Changes (SPAIC) within the CWE flow-based consultation group towards market parties.

months assuming the absence of any grid maintenance is deemed unrealistic. As a proxy for this reduced availability of the transmission grids, the domains generated for the summer months assume a fixed RAM of 70% applied to the fully available transmission grid.

The flow-based domain creation process will be described in the next section. Part of this process has the objective of determining initial loadings on all branches monitored in the flow-based market coupling. This approach assumes a decent approximation of the actual general market tendencies when determining such initial flows. In order to mitigate inaccuracies linked to flow reversals resulting from large approximation errors, the final RAMs will be capped to the technical transmission capacity of each CNEC.

Capacity calculation assumptions for the CORE zone (flow-based)	2026-27 delivery period
Minimum CNEC capacity given to market	MinRAM 70%
Treatment of external flows	Advanced Hybrid Coupling
CNEC selection	Only XB CNECs
BE external import constraint	no external constraints

Figure 3

2.1.4.6 Flow-based domain creation process

The flow-based framework developed for this study aims at mimicking the currently applied operational framework as well as integrating the future foreseen flow-based evolutions. This process is illustrated in Figure 4 and further detailed in the following paragraphs.

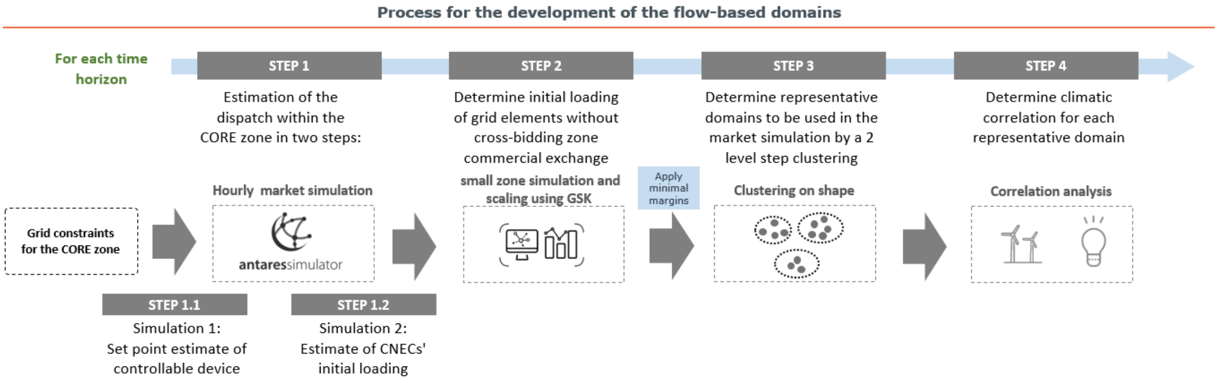

Figure 4

STEP 1: Estimation of the dispatch

The first simulation called 'flow estimation' aims to determine the set points of the different controllable devices, i.e. HVDCs and PSTs. This first run is crucial for the grid feasibility.

The second run or 'base case simulation' mimics the capacity allocation and congestion management (CACM) capacity calculation (CC) process and allows for a good estimation of the pre-loading on CNECs. Once fully set up, the flow-based framework performs an initial simulation to determine the initial loading of each CNEC. In this simulation, around 1/2 of the PST tap ranges in Belgium and about 1/3 for other countries can be used to optimize initial flows compared to their predefined set points in order to maximize the welfare of the system. The flows from this simulation determine the 'Reference Flows'.

STEP 2: Initial loading of grid elements

In a next step, combining geographical information on the location of load and generation within CORE with the hourly market dispatch from STEP 1, the loadings of grid elements associated with the hourly commercial exchanges resulting from the market simulation in STEP 1 can be determined for each hour. For determining the market domain, initial loadings of grid elements in the absence of commercial exchanges are required. Using the bidding-zone GSK, the net position of each of the bidding zones is scaled to zero. Hereby, commercial exchanges between bidding zones are cancelled, and the remaining flow on grid elements equals the initial loadings (loop flows and potentially some internal flows). The process used to scale the net positions of all bidding zones to zero is the same as the one used in flow-based operations today.

Such initial loadings could potentially pre-use a significant portion of the physical capacity of grid elements, and thereby restrict market operations. As from 1 January 2020, the 'Clean Energy Package' is applicable. In this regulation, specific requirements related to the availability of transmission capacity for market exchanges are introduced. To model the application of those rules for future time horizons, virtual minimal margins are applied to each grid element for determining the final hourly flow-based domains.

STEP 3

As the market simulation performed in STEP 1 creates an estimation of the dispatch and corresponding initial loadings within CORE for each hour of the simulated year, this would result in 8760 different flow-based domains. For the present study, it was chosen to limit the amount of flow-based domains for each time horizon in order to obtain feasible computation times by reducing the complexity of the simulations.

STEP 3.1: Smart slicing

Enumerating full-dimensional polytopes is impossible with the current domain dimensionality (12 CORE biding zones + ALEGrO + AHC dimensions). Nine dimensions (9D) are deemed most relevant to Belgian security of supply (CWE + ALEGrO + interconnectors BE-UK, NL-UK and FR-UK). The positions of the other dimensions are considered by the procedure of ‘smart slicing’ and thus fixed for each hour to the market simulation results obtained in STEP 2. Through 'smart slicing', the full dimensional polytope is then reduced to a 9D polytope describing the feasible net positions of these nine most relevant dimensions for Belgium. Vertices enumeration is hence perfomed by considering these nine-dimensional polytopes at each hour.

STEP 3.2: Clustering of domains

Applying a clustering algorithm requires a metric that can be used to assess the similarity of domains. The clustering of the 8,760 domains is based on their geometrical shape by means of comparing the Euclidian distance between vertices. A pre-cluster data split is applied to reduce cluster group size and hence computational complexity whilst respecting time-related trends. In this split summer and winter domains are separated, weekends and weekday are separated, and within the weekdays the peak & off peak hours are separated as well. This results in the creation of 6 groups to be clustered individually. Next, the number of centroids to retain must be defined. For weekends one centroid was calculated to represent the entire group, whereas for weekdays, per group, 2 clusters are created, each with its own centroid (see Figure 5). The clustering is performed by means of a k-medoid algorithm. Here the centroids are elements which are part of the initial domains, and therefore have physical meaning. This process is performed in two steps in order to be able to reduce the set and ultimately find the representative centroids.

The level 1 clustering gives a first set of medoids that will be further refined in the level 2 in order to reach the targeted number of clusters.

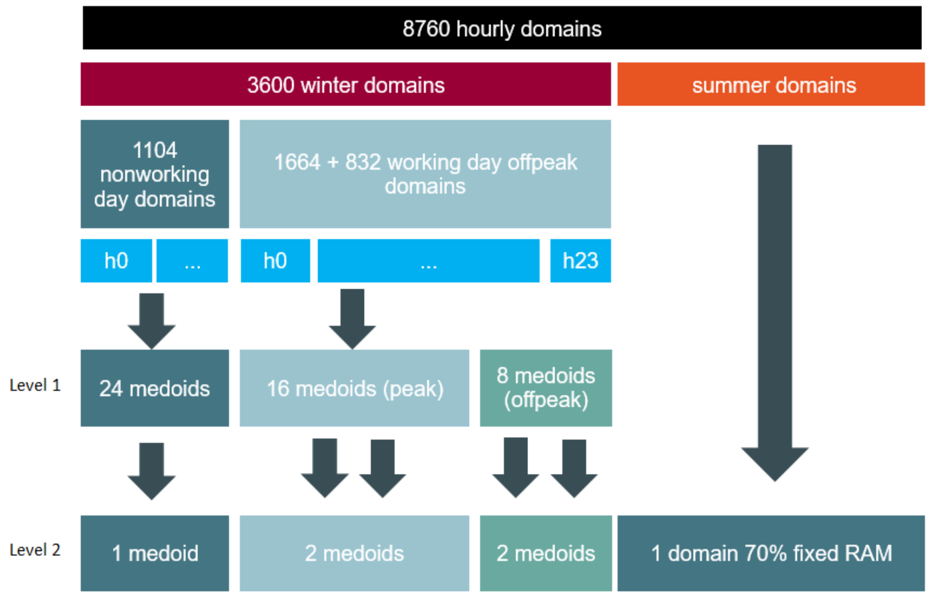

Figure 5

STEP 3.3: Resizing and approximating the domains for computational efficiency

The domains are subsequently restored back to their full dimensions of 12 CORE biding zones + ALEGrO + AHC dimensions prior to plugging them back into the ANTARES model. In general, the number of CNECs in the framework's domains is too large to be of practical use in market simulations.

A flow-based domain is defined by a certain number of inequality constraints representing the limits of critical network elements at a given time. Keeping the complexity at an acceptable level is key to successfully carry out the simulations. The chosen way forward is to use a simplification algorithm based on the Manhattan distance of two hyperplanes. This step allows to define the smallest set of CNECs that can be used to describe the entire domain, without any loss of quality or representativeness. Finally such smallest set is the one kept as the PTDF-RAM linear constraints to be set into the model.

STEP 4: Incorporating multiple flow-based domains into the adequacy assessment

The ‘Monte Carlo’ approach used in this study generates possible future states, called 'Monte Carlo' years. The method used for relating typical days to the climatic conditions as they occur in the Monte Carlo years was developed by the French TSO RTE (see reference documents[10] [11]), and is also implemented in RTE's adequacy study (*Bilan Prévisionnel* since 2017) as well as in the *Pentalateral Energy Forum - GAA 2020 Report* (PLEF 2020) and the latest MAF 2020 report.

This method can be understood as follows. The k-medoid algorithm not only selects the representative domains for each of the clusters, but also identifies for each day the cluster to which it belongs. Thus, for the climatic variables in scope, thresholds can be defined (typically at the 33rd and 66th percentiles) which lead to the creation of climatic groups. As such, it is possible to identify, for every day, the climatic group to which it belongs. By counting the amount of times a domain appears in a specific climatic group, it is possible to define a probability matrix. This matrix represents the probability of being in a given cluster of domains under certain climatic conditions. Using the climatic conditions encountered at a given hour in the model we can then map the clusters back to the hours in the model. It is this interpretation that is used when mapping the typical days onto the 'Monte Carlo' years.
This kind of systematic approach makes it possible to link specific combinations of climatic conditions expected in future target years, e.g. high/low wind infeed in CWE (Germany, France, etc..) high/low temperature and demand in France and Belgium, with the representative domains for these conditions.
For each time horizon, a correlation analysis between the domain clusters and several input parameters was applied in order to link a given market situation to the flow-based domain to be applied. This analysis resulted in the selection of German wind infeed and French consumption as the most relevant parameters in determining the selection of the domain. Therefore, in the final simulations the hourly choice of the applied domain is based on this correlation with said external parameters. The probability of finding a domain given a certain set of climatic conditions can be derived from the cluster process' results as explained above.

2.1.5 Other countries data

The same data as presented in §2.1.1 and §2.1.2 are also necessary for other countries. In the framework of the CRM calibration, the same perimeter as used for the 10-year Adequacy and Flexibility study 2022-32 (Elia, 2021) will be taken into account and is represented on Figure 6. New countries have been added in order to fully simulate the CORE region and to cover all countries of the European Union. Latvia, Estonia, Lithuania, Romania, Bulgaria and Greece were added to the model. Such approach is fully in-line with the 2019/943 Regulation which allows the NRAA to be carried out on a regional scope.

The perimeter of this study includes **twenty-eight countries**, as shown in Figure 6: EU

[10]https://antares-simulator.org/media/files/page/7NY5W-171024-Rte-Typical-Flow-Based-Days-Selection-1.pdf
[11] https://antares-simulator.org/media/files/page/ZHX0N-171024-Rte-Modelling-of-Flow-Based-Domains-in-Antares-for-Adequacy-Studies.pdf

simulation area namely:

- Austria (AT)
- Belgium (BE)
- Bulgaria (BG)
- Switzerland (CH)
- the Czech Republic (CZ)
- Germany (DE)
- Denmark (DK)
- Estonia (EE)
- Spain (ES)
- Finland (FI)
- France (FR)
- United Kingdom (GB and NI)
- Greece (GR)
- Croatia (HR)
- Hungary (HU)
- the Republic of Ireland (IE)
- Italy (IT)
- Lithuania (LT)
- Luxembourg (LU)
- Latvia (LV)
- the Netherlands (NL)
- Norway (NO)
- Poland (PL)
- Portugal (PT)
- Romania (RO)
- Sweden (SE)
- Slovenia (SI)
- Slovakia (SK)

Due to the specific market situation in Italy, Denmark, Norway and Sweden, these countries are modelled using multiple market nodes. This type of specific modelling is in line with the current market zones' definition, and is identical to the approach used in other studies, e.g. at ENTSO-E.

Figure 6: EU simulation area

The most recent European dataset available is the MAF2020 data. Unfortunately only the 2025 and 2030 time horizons were made publically available by ENTSO-E as they were the only 2 for which the input data was quality-checked and simulations were performed.

In addition, there is a disclaimer in the MAF2020 study stating that:

"However, the 2020 Mid-term Adequacy Forecast Report (hereinafter "the MAF 2020") and its findings should not be interpreted in light of the CEP for the following reasons:

- *The MAF 2020 is not an ERAA report;*
- *The collection of the input data and the scenarios used do not follow the CEP requirements;*
- *The methodology followed does not yet comply with the important elements of the CEP/ERAA framework which are notably, but not limited to, an economic viability assessment and the implementation of the flow-based methodology."*

Indeed, the first ERAA report will be published end of 2021 and an implementation plan is foreseen to take the recently adopted European methodologies gradually into account over the period until 2023-2025.

In the framework of the Adequacy & Flexibility study (2021) being conducted, and aimed for publication by the end of June this year, an updated 2026 base case scenario for the full simulated perimeter of European countries will be constructed. This scenario will use the MAF2020 data as initial dataset, will integrate updates based on the most recent public information available, and will apply the recently adopted European methodologies[12] [13]. The foreign dataset constructed as such will be used for the CRM calibration for target year 26-27.

2.1.6 Climatic years

As already presented in the Adequacy and Flexibility public consultation[14], the recently adopted ERAA methodology indicates that the future PECD should reflect evolutions of the climate conditions (Article 4 (f)). Elia aims to follow this evolution in order to better grasp this future requirement of the ERAA methodology, although the final implementation choice by ENTSO-E (as 3 options are left) will be only finalized in the coming years. ENTSO-E has indicated in its implementation plan that the target option is to use the first option (which is the one also chosen by Elia in this calibration report). It is also worth noting that the latest European adequacy study on which such calibration report should be based (the MAF2020) is still based on the previous PECD containing more than 30 historical climate years. The complete methodology is detailed on the webpage of the Adequacy and Flexibility public consultation[14].

12 ACER approved ERAA methodology october 2020

[13] Annex I – Technical specifications for cross-border participation in capacity mechanisms TITLE 2 Methodology for calculating the maximum entry capacity, december 2020

[14] https://www.elia.be/en/public-consultation/20201030_public-consultation-on-the-methodology-the-basis-data-and-scenarios-used

2.1.7 Economic parameters

The last point of this section is dedicated to data and assumptions for the scenario's economic parameters, necessary to calculate as precisely as possible the market revenues that are required to determine the missing money of technologies in order to calibrate the price parameters of the demand curve and to determine the intermediate price cap.

The parameters presented in section 6 of the Excel file comes from the World Energy Outlook 2020[15]. It includes the fuel cost for oil, gas and coal, expressed in €/MWh, and the CO_2 cost, expressed in €/tCO_2.

The update in comparison with the previous CRM calibration 25-26 is presented on Table 3.

Data	CRM calibration 25-26	CRM calibration 26-27	Sources
Oil Price [€/GJ]	11.7	10.5	World Energy Outlook (IEA) 2020
Gas Price [€/GJ]	6.4	5.8	World Energy Outlook (IEA) 2020
Coal Price [€/GJ]	2.6	2.0	World Energy Outlook (IEA) 2020
CO_2 Price [€/tCO_2]	27	31	World Energy Outlook (IEA) 2020

Table 3: Update on economic parameters

[15] https://www.iea.org/reports/world-energy-outlook-2020

2.2 Sensitivities that could be integrated in the reference scenario

This section presents the sensitivities that could be integrated in the reference scenario, according to article 3, §4. The purpose of the sensitivities is to take into account additional assumptions that can have an impact on the Belgian security of supply.

Royal Decree Reference	
Art. 3. § 4. En outre, d'autres sensibilités peuvent être définies, lesquelles peuvent avoir un impact sur la sécurité d'approvisionnement de la Belgique, notamment des évènements en dehors de la zone de réglage belge.	**Art. 3.** § 4. Daarnaast kunnen andere gevoeligheden gedefinieerd worden die een impact kunnen hebben op de bevoorradingszekerheid in België, met inbegrip van gebeurtenissen buiten de Belgische regelzone.

The sensitivities have been selected by Elia in collaboration with FPS and in concertation with the CREG. These sensitivities, the associated assumptions and data modification and their purpose are then submitted to public consultation. Elia provides then a public consultation report integrating the feedback from the stakeholders and provides recommendations. Based on this report, CREG will propose to the Minister a set of data and assumptions that constitutes a reference scenario on which FPS transmits an advice. Finally, the Minister decides which sensitivities should be applied in order to establish the reference scenario.

The sensitivities menu is presented in the Excel, section 7. This explanatory note explains further the purpose, the source and the impact of each proposed sensitivity.

Figure 7 presents the different sensitivities proposal for the Y-4 auction of 2026-2027 delivery period. 4 sensitivities have been proposed that concern the French nuclear availability, the uncertainties linked to the achievement of CEP rules regarding interconnections and the uncertainties on the Belgian thermal park. A fifth sensitivity on the Belgian demand is added after concertation with the CREG.

French nuclear availability 1	**Decreased French nuclear availability in continuity of last year's reference scenario** Lower availability by 2 units on average during winter
French nuclear availability 2	**Decreased French nuclear availability based on historical figures** Lower availability by 4 units on average during winter
FB CEP rules	**Non achievements of the CEP rules for 2026 to reflect the uncertainty on capacity calculation.** 50 % RAM instead of 70% minRAM
BE unit at risk	**Closure of turbojets due to aging and economics + Vilvoorde GT (officially closed in the meantime)** -158 MW
BE load stable	**In order to reflect a slower growth on the demand side, CREG proposes to integrate a sensitivity where the total demand is equal to the one considered in the 2025-26 calibration report** 88.9 TWh instead of 90.2 TWh

Figure 7: Sensitivities menu

2.2.1 French nuclear availability

1. A reduced availability by 2 units on average could be considered, this sensitivity was finally retained in the reference scenario for the CRM calibration report 2025-26. This sensitivity was also proposed in the GAA PLEF 2020.
2. The second option is in line with the 10-year Adequacy and Flexibility study 2020-30 (Elia, 2019, with the sensitivity proposal from the last CRM calibration report). It consists in reducing nuclear availability by either 4 units on average.

The reasoning behind this scenario is justified by recent observations on the unavailability of the French nuclear fleet:

- RTE (the French TSO) has confirmed that the observed maintenance is usually much higher than the one forecasted by the producer. RTE has made an historical analysis of the forecasted and realised length of the 'VD' on nuclear units in France. It showed that on average, the duration of realised 'VD' is on average 2 months longer than forecasted (but with sometimes much more longer delays)[16]. RTE has also commented that such uncertainties were not taken into account in the MAF 2020.[17]
- Moreover the units of 1300 MW will undergo their fourth VD starting in 2026.
- The last Swiss adequacy study published in June is also pointing out a significant level of uncertainties about the French nuclear park [18].
- **Figure 8 : Point 1**

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[16] https://www.rte-france.com/sites/default/files/bp2018_analyses_complementaires_vf.pdf
[17] https://eepublicdownloads.entsoe.eu/clean-documents/sdc-documents/MAF/2020/MAF_2020_Appendix_3_Country_views_on_the_MAF_2020.pdf
[18] Adéquation du système électrique en 2030 (ElCom System Adequacy 2030) - Étude sur la sécurité de l'approvisionnement en Suisse en 2030, juin 2020

- The last two winters have shown an under estimate of the planned unavailability see purple arrow showing at least 4 GW of difference for winter 19-20. Current value for winter 2021-22 already show a difference of 2 GW with the June 20 projections.
- **Figure 8 : Point 2**
- Winter 2023-24 still shows an expected unavailability above the value considered in MAF 2020.

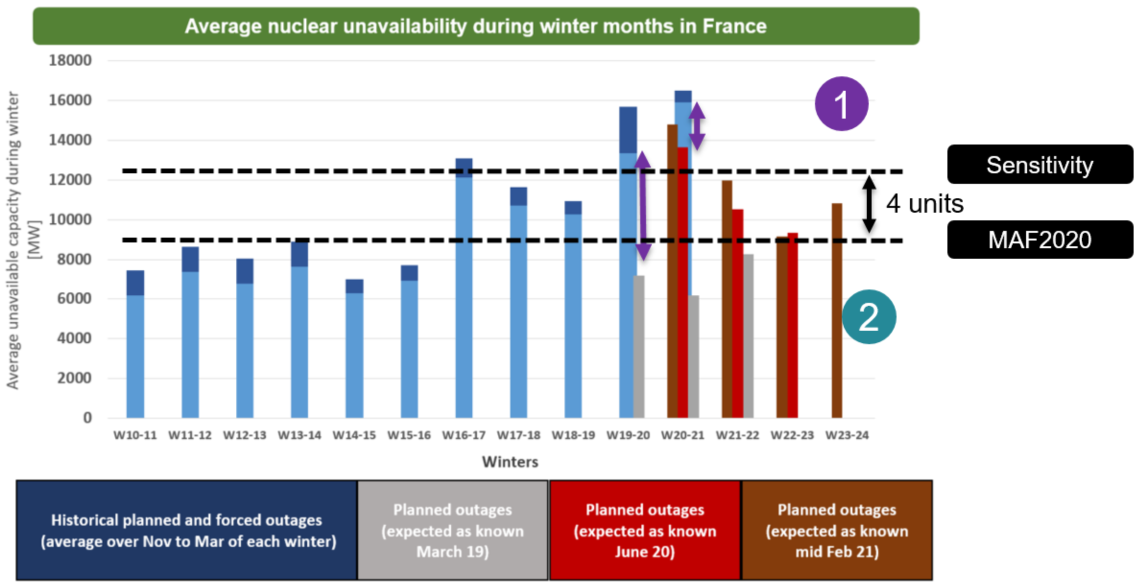

Figure 8: Average nuclear unavailability during winter months in France

Moreover, future events might also affect this unavailability. Indeed, inspection delays following the '4th Decennial inspections' starting from this year could have a significant impact. Given that it will be the first time that units are going to extend their lifetime above 40 years in France and that there is no framework yet in place for those, new requirements could be put in place by the French nuclear safety authority (ASN). This could lead to longer inspections and 'common mode failures' in the case of issues found which affect more than one nuclear unit.

It can be also stated that ageing can have an impact on the availability of the nuclear fleet. The historical data presented in Figure 8 seem to confirm this trend.

To take those uncertainties into account and reflect what happens in the past 4 winters, a lower nuclear availability for France of around 4 units (difference between the green and black dotted lines) will be applied.

2.2.2 Flow-based CEP rules

Several reasons can be put forward to justify the addition of sensitivity on the applied flow-based domains in the context of this study.

Firstly, in exceptional circumstances, the minRAM factor can be set below the targeted legal threshold by a TSO if required to maintain operational security (See CEP article 16.3 [19]). This type of events cannot be excluded and a minRAM 70% can therefore not be guaranteed at every hour and on every CNEC. The complexity and uncertainties linked to the forecasting of remedial actions (RA) are one of the main factors justifying that such operational security exceptions could occur during the period covered by this study. Such exceptional circumstances might arise during near scarcity periods. Recently, such a situation was observed during the cold wave that hit Central Europe in 2020, leading to a reduction in crossborder capacities by Tennet NL.

The need for sensitivity could be further justified in order to capture the potential delay in meeting the 70% minRAM target. Any country that would be facing unforeseen difficulties to meet the legal target, could still legally request a derogation after 2025.

Furthermore, the current legislation does not exclude the inclusion of grid elements internal to a bidding zone in the CNE list, if it is demonstrated with a Cost Benefit Analysis (CBA) that adding the internal grid element is a more economically efficient solution in comparison to – amongst others – a bidding zone reconfiguration. Given that the flow-based domains calculated in this study only consider cross-border CNECs, decreasing the available margin on those cross-border CNECs can be considered as a proxy to the inclusion of internal constraints into the market coupling.

If a country is facing systemic difficulties to meet the CEP requirements, a bidding zone split could constitute a solution forward. It can be expected that such a bidding zone split will neither be decided upon nor be applied overnight. As an example, the split of the German-Austrian bidding zone has taken about 2 years to implement, starting November 2016 when ACER issued a legally binding decision for the German-Austrian border, followed by the German and Austrian regulatory authorities (BNetzA and E-Control) agreement on May 2017 and finally with the split between Germany and Austria taking effect on 1 October 2018 [20]. The impact of such a bidding zone split would be difficult to estimate: while it might have a mitigating impact on initial flows affecting the flow-based domain, in general splitting bidding zones will lead to additional constraints to the market coupling, as former internal grid elements will become cross-border elements.

Finally, as mentioned earlier, in determining the flow-based domains for winter periods, the optimistic assumption is taken in this study that the transmission grid is always fully available. While covering the potential impact of any single contingency taking place, prior to such a contingency, a European transmission grid without planned outages and without forced outages that cannot be quickly repaired is assumed.

[19] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R0943&from=EN#d1e2713-54-1

[20] https://www.apg.at/en/Energiezukunft/Strompreiszone

The abovementioned arguments justify the consideration of a sensitivity fixed RAM 50%.

2.2.3 Uncertainties on Belgium's thermal units

During the last public consultation for the Adequacy and Flexibility study 2022-32, concerns about the availability of turbojets which is expected to gradually decrease over the years. Moreover the uncertainty around Vilvoorde GT that was initially considered in this sensitivity has been crystalized by the recent announcement of its closure. Therefore a sensitivity of 158 MW could be considered to the scenario taking into account a complete decommissioning of the existing turbojets.

2.2.4 BE load stable

In order to reflect a slower growth on the demand side, CREG proposes to integrate a sensitivity where the total demand is equal to the one considered in the 2025-26 calibration report: 88.9 TWh instead of 90.2 TWh.
"CREG propose to add a sensitivity relative to the total electricity demand. As estimated levels for electricity demand for 2025 are already quite high, CREG proposes to keep the same demand level for 2026 as for 2025."

3 Other parameters

This chapter describes the parameters that have to be submitted to public consultation according to article 5 of the Royal Decree, but that are not fixed by the Minister. This includes the sources of scenarios for periods after the delivery period in order to calculate the market revenues accordingly, the preselected capacity types to be added to the reference scenario in order to reach the security of supply criteria and the intermediate price cap parameters.

Royal Decree Reference	
Art. 5. § 2. Les sujets suivants au moins sont soumis à une consultation publique: (…) 3° le type de capacité supplémentaire visé à l'article 6, § 1er ; 4° les sources publiques des scénarios pour les années postérieures à l'année de livraison à partir desquelles les données d'entrée sont utilisées pour le calcul des rentes inframarginales visées à l'article 10, §6 ;	**Art. 5.** § 2. Ten minste de volgende onderwerpen worden openbaar geraadpleegd: (…) 3° het type bijkomende capaciteit bedoeld in artikel 6, § 1; 4° de publieke bronnen van de scenario's voor de jaren na het leveringsjaar waaruit de invoergegevens gebruikt worden voor de berekening van de inframarginale inkomsten, bedoeld in artikel 10, § 6;

5° la liste réduite des technologies existantes qui seront raisonnablement disponibles et qui sont éligibles pour la détermination du prix maximal intermédiaire visé à l'article 18, §1er.	5° de beperkte lijst van bestaande technologieën die redelijkerwijs beschikbaar zullen zijn, en die in aanmerking komen voor de bepaling van de intermediaire maximumprijs, bedoeld in artikel 18, §1.

3.1 Preselected capacity types

This section details the parameters included in the scope of this public consultation towards the preselected capacity types that shall apply in the Y-4 auction for delivery period 2026-2027.

Once the reference scenario is defined by the Minister, it does not mean that this scenario meets the legal security of supply criteria, as defined in article 7undecies, §3 of the electricity law. Indeed, the scenario choice takes into account data and assumptions from the latest European or National Resource and Adequacy Assessment updated with the most up-to-date available information and might take into account some sensitivities in or out of the Belgian market zone that can have an impact on the Belgian security of supply. The next step in the methodology is therefore to calibrate the scenario to the security of supply criteria in order to reach the right volume to be procured for the Y-4 auction of 2026-27 delivery period.

The proposed preselected capacity types are presented in the Excel file (section 8). Four categories are mentioned: semi-baseload, peakers 1, peakers 2 and demand-side response. Each category is associated with a typical technology available on the Belgian energy market.

- Volume
  For the first three categories, incremental capacity of the reference technology (new CCGT, new OCGT or new IC engine) is added step by step.
  For demand-side response, incremental capacity is added to each of the categories already defined for the Belgian market zone (see §2.1.2.2 proportionally to each demand-side response category size.
- Marginal Price
  For the first three categories, the marginal price will be calculated based on the parameters associated with a new entrant of each technology.
  For demand-side response, the marginal price is defined based on a weighted average of the existing demand-side response categories.

As long as the security of supply criteria are not reached, additional capacity from one of these categories is added step by step. The step size will be in line with the European Resource and Adequacy Assessment methodology and shall not exceed 100 MW. For each step, capacity will be iteratively added based on an economic optimization loop.

At the end of this process, the security of supply criteria are reached and a mix of capacities from the different categories will be selected based on the defined economical loop.

Royal Decree Reference	
Art. 6. §1er. Le gestionnaire du réseau s'assure que le scénario de référence tel que déterminé selon l'article 3, §7, répond aux critères pour la sécurité d'approvisionnement requis par l'article 7undecies, §3, de la loi du 29 avril 1999 en ajoutant, si nécessaire, une capacité supplémentaire à la zone de réglage belge : 1° provenant des types de capacité présélectionnés selon l'article 10 et proposés par le gestionnaire de réseau dans la consultation publique visée à l'article 5 et ensuite choisis par le gestionnaire de réseau en collaboration avec la Direction générale de l'Energie et en concertation avec la commission ; 2° d'une manière itérative sur la base d'une boucle d'optimisation économique avec l'incrément comme utilisé dans l'évaluation de l'adéquation des ressources à l'échelle européenne ou nationale visée aux articles 23 et 24 du Règlement (UE) 2019/943 et de maximum 100 MW.	**Art. 6**. §1. De netbeheerder verzekert zich ervan dat het referentiescenario zoals bepaald volgens artikel 3 §7 beantwoordt aan de criteria voor de bevoorradingszekerheid die worden geëist door artikel 7undecies, § 3, van de wet van 29 april 1999 door, indien nodig, aan de Belgische regelzone bijkomende capaciteit toe te voegen: 1° afkomstig van de volgens artikel 10 voorgeselecteerde types van capaciteit die voorgesteld worden door de netbeheerder ter openbare raadpleging bedoeld in artikel 5 en daarna door de netbeheerder in samenwerking met de Algemene Directie Energie en in overleg met de commissie gekozen worden; 2° op een iteratieve manier op basis van een economische optimalisatielus op basis van incrementele stappen zoals gebruikt in de Europese of nationale beoordeling van de toereikendheid van de elektriciteitsvoorziening, bedoeld in de artikelen 23 en 24 van Verordening (EU) 2019/943 en van maximaal 100 MW.

3.2 Scenario post-delivery period

This section details the parameters included in the scope of this public consultation towards the scenarios for the periods after the 2026-2027 delivery period used to calculate the market revenues for the technology with a lifetime longer than one year.

Indeed, point B of the demand curve is calibrated at the net-CONE, which is equal to the missing money of the technology with the lowest missing money. Three parameters are required to determinate it: the gross-CONE, the market revenues and the ancillary services revenues (defined in §3.3.3). Just as the gross-CONE takes into account the costs of the entire lifetime for the reference of each technology, market revenues must also be determined on this period. This requires more than the delivery period scenario to have a correct estimation. This is the reason why additional existing scenario from public available sources are taken into account. If a scenario is not available for one of the years of each reference technology lifetime, an interpolation is made between the values of the years for which a public scenario is available.

The proposed post-delivery period scenarios are presented in the Excel file (section 9). For 2028 and 2030, the proposal is to take the 10-year Adequacy and Flexibility study 2022-32 (Elia, 2021) as public source for the targeted year. For 2035 and 2040, it is also proposed to use the Adequacy and Flexibility study using the last year simulated 2032 as a proxy in order to keep consistency with the other time horizons and to use recent data. For each of these time horizons, a scenario as close as possible to the reference scenario of 2026-2027 delivery period defined by the Minister will be selected.

Royal Decree Reference	
Art. 10. §6. (…) Si le scénario de référence n'est pas disponible pour une année sur la durée de vie de la référence pour chaque technologie, une interpolation est réalisée entre les valeurs des années pour lesquelles le scénario de référence existe, éventuellement corrigé par des données disponibles complémentaires.	**Art. 10.** §6. (…) Indien het referentiescenario niet beschikbaar is voor een jaar uit de levensduur van de referentie voor elke technologie, wordt een interpolatie uitgevoerd tussen de waarden van de jaren waarvoor het referentiescenario bestaat, eventueel bijgestuurd door bijkomende beschikbare gegevens.

3.3 Intermediate Price Cap parameters

In this section, the parameters are described that are included in the scope of this public consultation towards the calibration of the intermediate price cap that shall apply in the Y-4 auction for delivery period 2026-2027.

3.3.1 Shortlist of technologies

In accordance with art. 5, §2, 5° of the Royal Decree on the volume methodology (cf. section 1), this public consultation includes a shortlist of existing technologies reasonably considered available during the delivery period 2026-2027, and deemed relevant for the calibration of the intermediate price cap. The shortlist is presented in the Excel file (section 10.1).

Based on the expert study delivered by Fichtner (2020)[21] followed by a peer review realized by AFRY (2020)[22] and Elia's assessment taking into account the remarks of the public consultation done by Elia on the same matter in view of delivery period 2025-2026, this shortlist of technologies is believed to represent a list of technologies likely to include the technology with the highest missing-money across the whole set of existing technologies reasonably expected to be available during the delivery period 2026-2027. Therefore, this shortlist serves as a basis towards the calibration of the intermediate price cap.

Building further on the above mentioned studies realized in 2020 and on the feedback received from market parties during the public consultation, Elia considers that the shortlist of technologies that was defined for the calibration of the IPC for the delivery period 2025-26 is still relevant and should apply for the calibration of the IPC for the Delivery Period 2026-27. Moreover, according to what is foreseen in the article 17 §1 of the proposal of Royal Decree Methodology, an update of these studies does not seem to be required by Elia: it is indeed stated that an update of the study from the independent expert is required at least every three years or in case of significant market evolutions. None of these criteria seems to be fulfilled and therefore to justify an update of the studies realized by Fichtner nor AFRY.

[21] Conform art. 17, §1 of the Royal Decree, ELIA has initiated a study – in concertation with the CREG – by an independent expert to determine the cost components associated to the technologies deemed relevant towards the calibration of the intermediate price cap. The resulting expert study by Fichtner titled "Cost of Capacity for Calibration of the Belgian Capacity Remuneration Mechanism (CRM)" is available at the following link : https://www.elia.be/-/media/project/elia/elia-site/users-group/crm-implementation/documents/20201214_fichtner-report-cost-of-capacity-crm_en.pdf.

[22] Several market parties pointed out in their reaction to the public consultation held by Elia between the 5th of May and 5th of June 2020 their willingness to see another expert perform a peer review of the study realized by Fichtner in 2020 on the 'Cost of Capacity for Calibration of the Belgian Capacity Remuneration Mechanism(CRM'. This peer review was realized by AFRY and presented in TF CRM on the 30th of October 2020. The study is available at the following link : https://www.elia.be/-/media/project/elia/elia-site/users-group/crm-implementation/documents/20201214_afry_peer-review-of-annual-fixed-costs-for-belgian-crm_en.pdf.

Royal Decree Reference	
Art. 18. §1er. Le gestionnaire du réseau détermine, sur la base de l'étude visée à l'article 17, après la consultation publique visée à l'article 5, une liste réduite de technologies existantes qui seront raisonnablement disponibles et qui seront considérées pour la détermination du prix maximal intermédiaire.	**Art. 18.** §1. De netbeheerder stelt op basis van de studie bedoeld in artikel 17, na de openbare raadpleging bedoeld in artikel 5, een beperkte lijst op van bestaande technologieën die redelijkerwijs beschikbaar zullen zijn en die in aanmerking genomen zullen worden voor de bepaling van de intermediaire maximumprijs.

3.3.2 Cost components

In addition to a shortlist of technologies and beyond the legal requirements regarding the scope of the public consultation for the calibration of the intermediate price cap (i.e. the above mentioned shortlist of technologies), like for the set of parameters for the Y-4 auction for the delivery period 2025-26, this public consultation also consults on various cost components relevant for the calibration of the intermediate price cap. In particular, yearly fixed operation and maintenance (O&M) costs and the activation cost for an availability test are consulted upon.

The yearly fixed operation and maintenance (O&M) costs (cf. art. 18, §2, 1° and 2° of the Royal Decree) have been assessed from the expert study realized by Fichtner (2020) followed by a peer review done by AFRY (2020). As mentioned above, Elia is of the opinion that the results coming from these studies are still robust and valid for the calibration of the IPC for the Y- 4 auction of the Delivery Period 2026-2027. Elia sees therefore no reason to update these costs which will be used for the calibration of the IPC for the delivery period 2026-2027. They are presented per technology included in the shortlist in the Excel file (section 10.1) and include the following components:

:

1. Fixed operating costs including personnel costs, administrative costs, electricity and gas transmission charges (where applicable);
2. The O&M insurance for general liability, machine breakdown and interruption of operation of the power plant;
3. Fixed maintenance costs including intrayear maintenance and a provision for major overhauls that do not necessarily take place on a yearly basis.

In accordance with the Royal Decree (art. 18, §2, 6°), the ***activation cost for an availability test*** is to be considered only for technologies with a high short-run marginal cost. Indeed because of the high short-run marginal cost these technologies are unlikely to be activated. As this makes it harder to monitor their availability in the market they are more likely candidates for availability tests. A CRM candidate offering such a CMU is therefore more likely to also include a provision for such an availability test in its bid. Among the technologies included in the shortlist, the activation cost is deemed relevant only for the *Market Response* technology, considered to be characterized by a high short-run marginal cost.

The activation cost – presented in the Excel file (section 10.2) – is therefore to be associated to the *Market response* technology and is derived from the historical data published on the Elia website regarding contracted volumes and prices for Strategic Demand Reserves (SDR).[23] Considering the average activation price for SDR for winter period 2015-2016[24] for a 4 hour activation (associated with a derating factor X, expressed in %), and assuming one availability test of 15 minutes per year, the activation cost is calculated as follows:

$$\frac{0{,}73673€}{kWh} * 0{,}25h * \frac{1}{X}.$$

3.3.3 Net revenues from the provision of balancing services

Finally, this public consultation also includes a reasoning regarding the consideration of net revenues from balancing services (cf. art. 19, §3 of the Royal Decree) towards the calibration of the intermediate price cap, which goes beyond the legally required scope regarding the public consultation for the calibration of the intermediate price cap. However, Elia considers it opportune to also consult on this specific aspect given that stakeholder feedback can only contribute to a better application of the principles put forward in the Royal Decree.

For the sake of clarity, no specific values are consulted upon in the Excel file (section 10.3), only a general approach regarding the consideration of net revenues from the provision of frequency-related balancing services for each of the technologies included in the shortlist is presented in this document.

The net revenues from the provision of frequency-related balancing services, in order to avoid double counting and to consider only net revenues, will be considered to the following extent:

- ***FCR***: No net revenues from the provision of FCR are deemed relevant for any of the technologies included in the shortlist. Battery storage – not included in the shortlist of technologies – is considered likely to become the dominant technology to provide FCR towards the relevant delivery period, i.e. by November 2026. Battery storage is not included in the shortlist of technologies, because, as mentioned in Fichtner (2020): "*Batteries are usually built for very specific system services, such as Frequency Containment Reserves (FCR), which cover their investment. They are therefore unlikely to have the highest amount of missing money as their remuneration depends on a structural need by a specific party (e.g. the TSO for FCR) rather than the instantaneous electricity price on the market".*

[23] https://www.elia.be/en/suppliers/supplier/energy-purchases/strategic-reserve-volume-and-prices
[24] Winter 2015-2016 is still the most recent winter period in which SDR was contracted.

- ***aFRR***: No net revenues from the provision of aFRR are deemed relevant for any of the technologies included in the short list. It is assumed that technologies that provide aFRR arbitrage between the provision of aFRR and selling energy. Indeed, by offering a price for an aFRR reserve contract, the party knows that the capacity can no longer be used for delivering energy in the energy market. Its price for participating in the aFRR auctions will therefore account for the potential missed revenues from selling energy instead. Therefore, aFRR reservation fees are assumed not to represent a net revenue on top of the inframarginal rents earned on the energy market. Besides, any relevant must run costs following the reservation to provide aFRR are considered included in the trade-off between providing aFRR and selling energy, meaning that such must-run costs do not represent any additional net cost.
- ***mFRR***: The perfect arbitrage principle presented above for technologies providing aFRR, seems not to apply for some technologies in the Belgian mFRR market. Indeed, the *Turbojet* and *Market response* technologies – both included in the shortlist of technologies – are believed to rely structurally on the mFRR reservation fees as primary source of income, seemingly unable to derive equivalent revenues from the energy market. According to the AFRY study, it can be assumed as well that *OCGTs*, included in the shortlist of technologies considered for the IPC calibration as well, may earn part of their revenues from the mFRR market: indeed, considering the current market conditions and taking into account the increasing quantities of renewable energy sources, it does not seem unreasonable to assume that OCGTs may derive a part of their revenues from the mFRR market. On the contrary, for other technologies that are capable to provide mFRR, the prospective incomes that can be derived from the mFRR market may not be sufficiently attractive, such that they do not replace the technologies that currently provide mFRR. Therefore, net revenues from the provision of mFRR are deemed relevant for the *OCGT, Turbojet* and *Market response* technologies included in the shortlist. For these technologies, the projected inframarginal rents from the energy market are weighed against a percentage of the weighted average mFRR reservation fee. Revenues shall be considered from the service, i.e. selling energy or providing mFRR, which leads to the highest value.